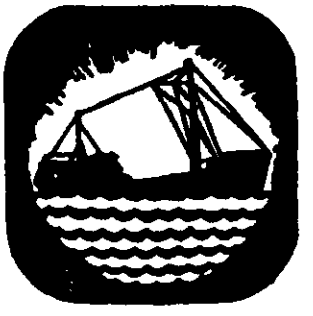
INTERNATIONAL COMMISSION

FOR THE

NORTHWEST ATLANTIC FISHERIES



REDBOOK 1966

PART II RESEARCH REPORT BY MEMBER COUNTRIES

Issued from the Headquarters of the Commission
Dartmouth, N. S., Canada

1966

INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1966 PART II

REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1965

(from Serial Numbers 1621, 1628, 1629, 1638, 1646, 1653, 1655, 1656, 1659, 1675, 1689, 1697)

Note

REDBOOK 1966 appears in 3 books. The first book contains Part I, Proceedings of the Standing Committee on Research and Statistics. The second book contains Part II, Reports on Researches in the ICNAF Area in 1965. The third book contains Part III, Selected Papers from the 1966 Annual Meeting.

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1965

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1965

I. Canadian Research Report, 1965

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

Canadian fisheries and oceanographic researches in Subareas 1, 2 and 3 were carried out by the Biological Station of the Fisheries Research Board of Canada at St. John's. The Arctic Biological Station of the Fisheries Research Board continued research on harp seals and did some hydrographic and plankton work and the Bedford Institute of Oceanography of the Department of Mines and Technical Surveys carried out oceanographic researches in the area. Canadian landings by subarea were not available at the time of writing this report and the figures used for Newfoundland landings are preliminary and not by subarea except where the fishery is largely confined to one subarea.

Subarea 1

A. Status of the Fisheries

Canada has no commercial fishery in this area.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. During the cruise of the *A.T.Cameron* to West Greenland 10 July-25 August, with the author as scientist-in-charge, temperature sections with a limited number of salinity determinations were taken between 28 July and 24 August at the fishing positions often widely separated from west of Disko Island to Dana Bank and southward across the Labrador Sea from off Cape Desolation to Hamilton Inlet Bank (Fig.1). These sections are dealt with in another document.

The Bedford Institute of Oceanography during September and October took temperature, salinity, dissolved oxygen and silicate measurements in the Northern Labrador Sea and Davis Strait. The cold component of the West Greenland Current was not sampled extensively but the warm Atlantic component showed unusually high temperatures including values of 5.5° to 5.9°C.

2. Plankton studies. Thirty-minute oblique hauls with the 2-m stramin net were taken at a number of the fishing locations. In 3 hauls at the mouth of the Labrador Sea in Div.1F but close to 2H (Fig.1 Station A) on 16-19 July, 47 redfish larvae were taken ranging in length from 10.7 to 24.5 mm and averaging 15.1 mm. Most of these larvae were rather large for certainty that the absence of ventral caudal chromatophores demonstrated their absence also at the time of larval extrusion. However, no ventral caudal melanophores, as found in western Atlantic *Sebastes mentella* and in some *S. marinus* larvae, were noted in the 15 larvae of 10.7-14.0 mm in some of

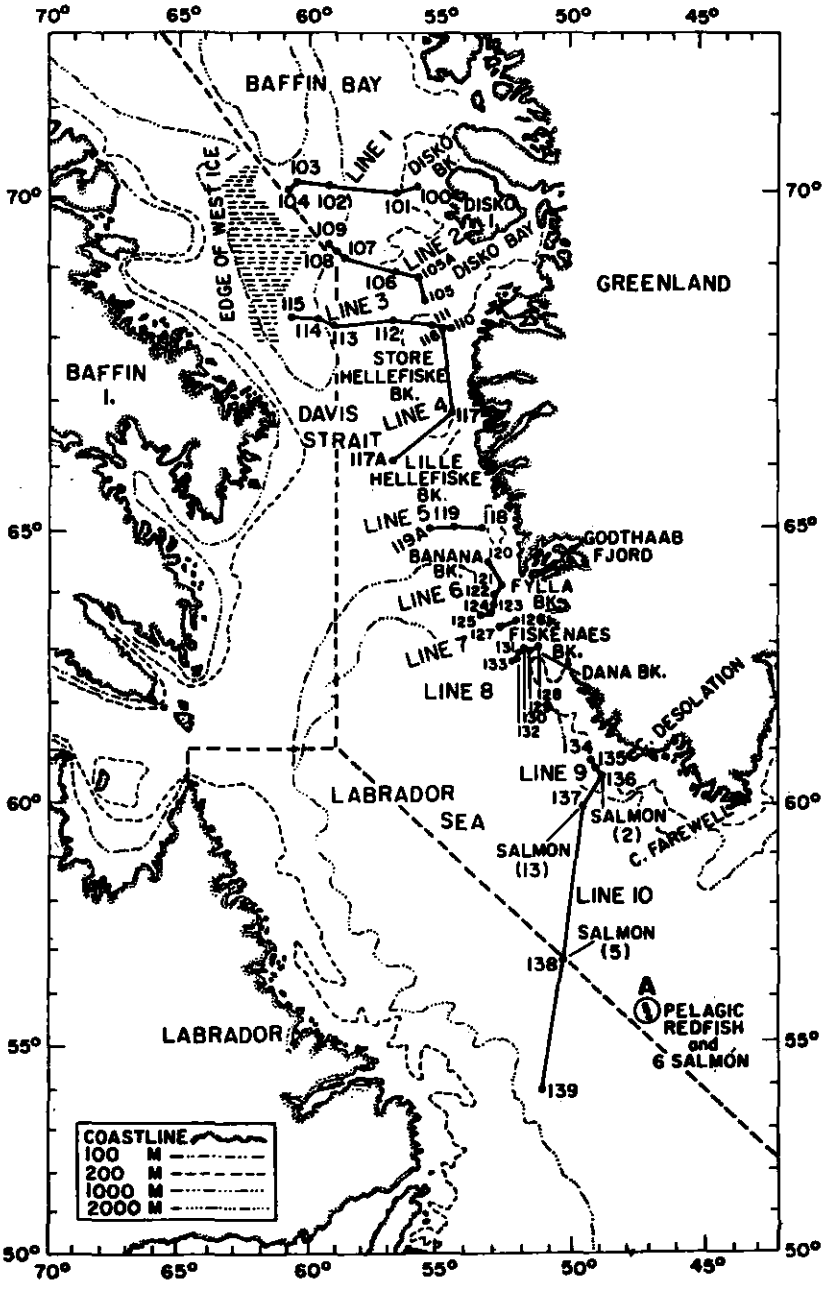


Fig. 1. Hydrographic stations and fishing localities, *A.T.Cameron*, West Greenland cruise, 10 July to 25 August 1965.

which they might have been expected to be visible if they were present. The pelagic redfish in the vicinity were *S. mentella* so these larvae were presumably predominantly *mentella* also.

II. Biological Studies

1. Cod, *Gadus morhua* L. Early in the *A.T.Cameron* cruise to the West Greenland banks, when the ship had reached no farther south than the northern part of Store Hellefiske Bank, the main winch failed so that the trawl could no longer be used. Samples of cod from the shallower areas of most of the West Greenland banks were collected for age, length, growth, maturity and food studies using Snella and rubber bait fishing.

2. Redfish, *Sebastes mentella* Travin and *Sebastes marinus* (L.). From 16 to 19 July while en route to West Greenland, the *A.T.Cameron* carried out experimental pelagic longline fishing for redfish between 180 and 460 m over oceanic depths in the central part of the mouth of the Labrador Sea in Div.1F but close to 2H (Fig.1 Station A) in the general vicinity of 55°29'N, 47°07'30"W. Squid, *Illex illecebrosus*, was used as bait. In all, 15 adult redfish, 33-41 cm in fork length, were caught. The 5 males and 10 females were all mature, the females being spent. These redfish were fairly heavily parasitized with *Sphyrion lumpi* and were all *S. mentella*. On the return voyage, 23 August, again over oceanic depths in the Labrador Sea (Fig.1 Station 138), about 120 nautical miles to the northwest of Station A, 2 adult *mentella* in good condition with the skin on, and recently taken by the shark, were obtained from the stomach of a porbeagle, *Lamna nasus*, caught in salmon nets at the surface. These *mentella* were also pelagic *mentella* similar to those fished in July.

On 23 July I had the privilege of accompanying Dr Paul M. Hansen on a shrimp and redfish fishing expedition in Godthaab Fjord. About 100 small redfish 7-30 cm in fork length (one 41 cm) caught at 200 m in Pisigsarfik Fjord were considered by the author to be similar to the small *mentella* of the Newfoundland area. Of 2 redfish taken by Snella at 25-50 m in Qorgut Fjord one of 45 cm in length was definitely *S. marinus* and the other of 37 cm had a definite short triangular chin beak and could have been either *marinus* or *mentella* but had a golden colour with greenish spots typical of *marinus*. In trawl hauls on the slopes west of Disko Bank, Disko Bay, and the northern part of Store Hellefiske Bank, 1,350 small redfish averaging 0.03 kg were caught in the trawl. The smaller redfish usually resembled small immature *mentella* from the western Atlantic but a few of the 30 to 40 cm fish were only doubtfully assigned to *mentella*. Twenty larger redfish averaging 2.9 kg caught in the same sets were definitely *marinus*. With small redfish below 20 or 30 cm, at West Greenland, it is at present not usually possible to be so definite in determination of *S. marinus* or *S. mentella* as with the more definitely characterized larger fish. The typical characters differentiating the two species apparently become more evident with size and maturity and the late maturity for males and the failure of females to mature in West Greenland extends the

difficulties of identification to larger sizes than in places like Flemish Cap where the species (especially the *mentella*) mature at relatively small sizes.

Farther south, fishing with longlines at 365 to 730 m but mainly to 475 m on the western slopes of Fylla Bank to Cape Desolation, 114 *marinus* averaging 4.4 kg and 2 definite *mentella* 40 and 45 cm long averaging 0.9 kg were taken (Fig. 2). The 2 *mentella* were taken off Fylla Bank. In line with investigations by other authors, all female redfish taken off West Greenland were immature. The larger males appeared to be maturing but with no milt in the vas deferens. Milt would be expected in the vas deferens in July-August.

Fig. 2. Above, *Sebastes marinus*, female immature, 60 cm total length to mid-fork, and below, *Sebastes mentella*, female immature, 40 cm total length to mid-fork, both caught by the *A.T.Cameron*, 14 August 1965, west of Fylla Bank on Line 6 (Fig. 1) at 455-485 m, 63°34'N, 53°00'W.

3. Cusk, *Brosme brosme* (Müller). Cusk were common (on bottom longline) west of Fylla, Fiskenaes and Dana Banks and west of the shelf off Cape Desolation. They were most plentiful west of Fylla Bank, where at 460 m, 5.4°C, 175 cusk (440 kg) were caught on 450 hooks, and west of the shelf off Cape Desolation at 400-475 m, 5.9°C, where 138 cusk (415 kg) were taken on 450 hooks.

4. Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum). Greenland halibut are fish of moderately cold water and none were caught south of Fylla Bank. In the north the best catches were west of Disko Bay, 31 July, 640 m, 0.9°C, 120 fish (130 kg) and west of the northern end of Store Hellefiske Bank, 68°04'N, 59°32'W, 3 August, 640 m, 1.0°C, 109 fish (190 kg), both in half-hour tows with a No.41 otter trawl. The only good catches farther south were on 7 August, west of Store Hellefiske Bank at 66°01'N, 650 m, 2.8°C, 20 fish (96 kg), and on 13 August, west of Fylla Bank at 1,460 m, 3.7°C, 17 fish (125 kg) both on 450 hooks.

5. Atlantic salmon, *Salmo salar* L. On the *A.T.Cameron* cruise in July-August, 39 Atlantic salmon were caught in drift nets set at night at the surface: 6 on 19-20 July over oceanic depths at the centre of the mouth of the Labrador Sea in the general fishing area (Fig.1 Station A) where the pelagic redfish were caught; 15 on or near the West Greenland coastal banks from the northern peak of Store Hellefiske Bank off Rifkol to off Cape Desolation, 5-20 August; 13 on 22 August over oceanic depths west of Cape Farewell (Fig.1, Station 137); and 5 on 23 August in the Labrador Sea (Fig.1, Station 138), about 120 nautical miles NW of the previous catches in this area. All but 2 of these fish (2+ sea years) had 1+ years of sea life. River life was mainly 2 years but salmon of 3 to 6 years river life were also present. Food was mainly squid with some paralepids in the Labrador Sea and mainly launce with some capelin on the West Greenland banks.

Subarea 2

A. Status of the Fisheries

I. Cod

Inshore cod landings increased to 26,000 tons in the inshore Labrador fishery from the low landings of about 16,000 tons in 1964. The inshore fishery was largely dependent on cod of the 1957 year-class (age 8). The 1959 year-class was also prominent as in 1964 in the trap catches in Div. 2J. Very few fish younger than age 6 occurred in the catches, and most of the fish caught by traps and jiggers were between 45 and 70 cm long, with the greatest numbers at 61 cm. Nylon gill nets were being used for the first time in some areas.

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

Canadians landed a total of 66,000 harp seals and 2,000 hood seals from Subareas 2 and 3.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. The section from Seal Islands across the southern part of Hamilton Inlet Bank was occupied on 2-3 August and is described in another document. Upper layer temperatures were above the average for recent years.

2. Plankton studies. The *Calanus*, en route to Frobisher Bay, occupied 15 stations during August within 60 nautical miles of the Labrador coast. Vertical and oblique plankton hauls and supporting hydrographic data were obtained.

II. Biological Studies

1. Cod. Cod of the Newfoundland inshore fishery along the Labrador coast were sampled for age and length studies.

Research information on Labrador cod is presented by Dr A.W.May in other documents at this meeting:

A. Otolith age validation in Labrador cod (Res.Doc.66/22).

B. The effect of the offshore fishery on the inshore Labrador cod fishery (Res.Doc.66/23). In recent years catch of cod per unit effort has markedly declined inshore, apparently as a result of the increased offshore landings. Recent estimates of various population parameters suggest that the present total fishing intensity in Subarea 2 may be at or beyond that giving maximum sustained yield.

C. Increase in growth of Labrador cod (Res.Doc.66/24). Growth of Subarea 2 cod is slower in the north than in the south. During the period 1959-64 there was a slight increase in average length at age in Div.2G and 2H and a much greater increase in Div.2J, but only for those ages taken in quantity by the commercial gears. The increase in growth has occurred over a period of greatly increased fishing.

D. Length-weight relation in Labrador cod (Res.Doc.66/25). Preliminary log-log plots showed that the length-weight relationship was described not by one but by two straight lines.

E. A note on natural mortality in Labrador cod (Res.Doc.66/26). Natural mortality appears to be about 0.2 (18% annually). Total mortality has increased from 0.3-0.5 (26-39% annually) in 1955-57 to 0.9-1.3 (59-73% annually) in 1963-64.

Subarea 3

A. Status of the Fisheries

I. Cod

Newfoundland landings from the inshore fishery were lower than in 1964. Newfoundland lands only a small quantity of cod from the offshore fishery of this area.

In the Newfoundland east and south coast areas, landings by inshore gears were generally low and there was a decrease in the sizes of cod caught. In cod-trap catches the smaller sizes were the result of the young 1961 year-class entering the fishery, but for the handline, longline and gill-net catches the decrease in sizes was the result of the relative scarcity of larger fish.

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

Newfoundland haddock landings from the Grand Bank and St. Pierre Bank, at 2,600 tons, continued to fall and were only about half those of 1964. The stock remains at a low level with no very large year-class appearing since that of 1955 with the smaller one of 1956. Catch per effort data on research survey cruises reveal no strong new year-class. The length composition of the catches indicates that 1- and 3-year old fish predominate but are not numerous. The present spawning stock is at a very low level and will require very favourable environmental conditions to produce a strong year-class.

III. Redfish

Newfoundland landings of redfish from the subarea increased to 20,000 tons from 15,000 in 1964.

IV. American plaice, *Hippoglossoides platessoides* (Fabricius)

Newfoundland landings of American plaice increased to 38,000 tons from 27,000 in 1964.

V. Witch flounder, *Glyptocephalus cynoglossus* (L.)

Newfoundland landings at 1,650 tons were approximately the same as in 1964. Catches of this species on the Grand Bank are usually taken on the southwestern slopes incidentally to the haddock fishery and they are likely to remain low until the haddock stocks and fishery increase.

VI. Yellowtail flounder, *Limanda ferruginea* (Storer)

Concentrations of yellowtail were found for the first time, in October-November, at about 40-75 m on the southeastern slope of the Southeast Shoal of the Grand Bank, and 2,030 tons were landed compared with only 56 tons in 1964.

VII. Greenland halibut

Greenland halibut landings, almost all from the deep east coast Newfoundland bays, increased greatly (with the development of new markets for the frozen product in Europe) to 8,120 tons from 890 tons in 1964. The increased landings were due to increased fishing effort by longline and gill net.

VIII. Atlantic salmon

Newfoundland commercial landings of Atlantic salmon (total for Subareas 2, 3, 4) were 1,160 tons compared with 1,265 tons in 1964.

IX. Herring, *Clupea harengus* L.

Newfoundland herring landings, mainly from Subareas 3 and 4 increased to 13,000 from 8,500 tons. Beginning in December 1964, a purse-seine winter-spring fishery for herring for fish meal has developed close to shore on the western part of the south coast of Newfoundland with supplementary catches from the west coast of Newfoundland in late autumn-early winter. This increased effort is presumably largely responsible for the increase in the landings.

X. Sea scallop, *Placopecten magellanicus* Gmelin

Canadian sea scallop landings from St. Pierre Bank (3P) amounted to only 13 tons of shucked meats (113 tons whole weight) compared with 32 tons of meats in 1964. This change in landings reflects the sporadic efforts by Canadian fishing vessels in this region.

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

Newfoundland squid landings, all taken in inshore waters, were 8,130 tons compared with 10,400 in 1964. The 1965 landings were the third highest during the 13 years since 1954 that statistics on squid landings have been collected.

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 23 July and 23 August and are described in another document. Temperatures at the surface were higher than in 1964 and temperatures over the bank and shelf areas usually varied from higher than to approximately the same as in 1964.

The Bedford Institute of Oceanography carried out during the summer a hydrographic survey for charting purposes in the Sir Charles Hamilton Sound area south of Fogo Island. In March and April, magnetometer, gravimeter and echosounder tracks were made eastward along 45°N and westward along 44°N while on passage to and from the Mid-Atlantic Ridge. These measurements add to our knowledge of the sub-bottom geology. On this cruise measurements of bacterial content of the deep water were made by Dalhousie University. In December, a temperature section was taken to a depth of 500 m for 75 nautical miles SW from the Grand Bank. An atlas of oceanographic sections observed from February 1962 to July 1964, including many stations in the Grand Bank and Gulf Stream regions, has been published.

II. Biological Studies

1. Cod. In experimental gill-net fishing in St. Mary's and Placentia Bays in April-May cod were caught close to or in spawning condition and males made up about 70% of the numbers caught. A similar result was obtained in a previous year. Presumably males are more active at the spawning season and are thus caught more readily by the gill nets.

On two survey cruises of the *A.T.Cameron* during April-May to the eastern slope and the southern half of the Grand Bank, cod were sampled and their distribution studied. On one of these cruises in late April large cod catches, up to 5 1/2 tons per half-hour tow, were obtained in depths of 100-185 m on the eastern slope of the Grand Bank. Over 60% of these cod were young fish of the 1961 year-class less than 45 cm in length and were feeding heavily on sand launce. All other sets were relatively unsuccessful, only one set reaching a ton per half hour.

Cod were tagged at the following places, depths, dates and numbers: western slope of Grand Bank off Cape Race, 70-155 m, May, 768; Point Lance, 37-60 m, September, 1,152; Mortier Bank off Burin, 15-80 m, September-October, 384; Fortune, 45-110 m, October-November, 384; Cape Spear, 37-145 m, November-December, 1,152.

2. Haddock. Haddock surveys of the southwestern Grand Bank and of St. Pierre Bank were conducted in May and June. Catches on the Grand Bank by the *A.T.Cameron* in June (with a No.41 net, 24.1 m headline) were invariably small. Of 69 successful half-hour drags, the best haddock catch was about 180 kg and only 5 others were over 45 kg. On St. Pierre Bank in June the largest catch taken by the *Investigator II* (with a No.36 net, 18.3 m headline) was 215 kg at 200 m. In the years 1960, 1962-65 the average numbers of haddock per half-hour drag in research vessel cruises on the southern half of the Grand Bank were 579, 79, 72, 32, and 29.

3. Redfish. For a week in February, the *A.T.Cameron* carried out a redfish survey in the Hermitage Channel area off the south coast of Newfoundland. In Hermitage Bay and the neighbouring parts of Hermitage Channel, where redfish are often plentiful in summer and autumn, catches were very small. However, outside the mouth of Hermitage Channel where it joins the main Laurentian Channel and also on the western side of Burgeo Bank, two half-hour catches of over 3 tons per half-hour of small redfish were obtained at 230 m.

4. Herring. Herring investigations began again in April after a lapse of several years. Almost all herring in samples from the west coast of Newfoundland taken off Port Saunders by otter trawl in 75-110 m and by drift net from Bonne Bay in early November were spent, apparently fall spawners, with little recovery. In samples from purse seine at Bonne Bay in late November, 40-50% had well developed gonads the remainder being mostly in the spent condition and apparently fall spawners.

A survey by the *Investigator II* in early December on the western part of the south coast of Newfoundland showed herring well spread out from the coast to 7 to 8 nautical miles offshore. Later in December the herring moved closer to the coast in this region, forming large concentrations in some of the bays and inlets and other coastal areas throughout the winter and spring. Purse-seine samples from these areas showed about one-third spring spawners with well developed gonads and two-thirds fall spawners with gonads in a spent condition.

Additional investigations by the St. Andrews Station carried out on the south coast herring near the beginning of the increased exploitation in 1965 showed that the mean length (33 cm) and the mean age (8.2 years) were smaller than those recorded from earlier investigations, but growth rates have not changed appreciably. Winter-caught herring of this area were of poor quality ranging in fat content between 2.3 and 7.7% of their wet weights.

5. Atlantic salmon. In an investigation of the Little Codroy River at the southwestern corner of Newfoundland in 1954-63 studies were conducted on smolt survival and utilization of adults. Each spring the seaward migrating smolts were distinctively finclipped; about 1 to 2% were estimated to have been taken as adults by the commercial fishery in Newfoundland and Labrador and about 1% survived to return as adults to the fence in the Little Codroy River.

Seaward-migrating spent salmon were tagged and about 5% of them were reported as recaptures in the commercial fishery. One was caught on the west coast of Greenland.

6. Short-finned squid. In 3 research cruises to the southwest slope of the Grand Bank and St. Pierre Bank in May and June only 29 small squid were taken. This contrasts with catches of up to 590 kg in an half-hour drag in this area in May-June 1964. On 10-15 July, however, 171 specimens were

taken in 8 hours' fishing. The large catches in 1964 were apparently the result of the trapping of quantities of squid below a low temperature barrier.

In both years, landings on the Newfoundland coast were high, 10 million kg in 1964 and 8 million in 1965. In experimental fishing for squid in Conception and Trinity Bays using Japanese multiple squid-jigger gear there was a failure to jig squid over deep water more than two miles from land and most successful sets were made less than a half mile from shore. About 400 squid were tagged in these bays but no returns were obtained.

B. Subareas 4 and 5
by J.L.Hart

Canadian researches in Subareas 4 and 5 were carried out by Fisheries Research Board of Canada stations at St. Andrews, Dartmouth, and Ste. Anne de Bellevue, by the Canadian Department of Mines and Technical Surveys at the Bedford Institute of Oceanography in Dartmouth, and by the Station de Biologie Marine of the Ministère de l'Industrie et du Commerce of the Province of Quebec. Many scientists were involved. Their names will appear in the list of ICNAF scientists.

Subarea 4

A. Status of the Fisheries

I. Cod

Preliminary statistics show that cod again led in Subarea 4 in total landings for a single groundfish species. Total mainland landings increased although the trend in Gulf of St. Lawrence (4T) landings continued to decrease as noted in 1964. There the groundfish fishery diverted effort more to redfish and flounders. Sizes of cod landed from Div.4T remained almost the same as in 1964 when most fish landed were 40 to 70 cm. However, sizes of fish accepted seemed to be lower, with about 5% of the fish recorded from commercial samples in the 34- and 37-cm length groups. The 1961 year-class dominated 1965 landings, and survey catches indicate that it will again dominate in 1966. Discards of cod in Div.4T remained low, about 1% by weight. No major changes in the 4V-W-X fishery were noted.

II. Haddock

Landings of haddock on the Canadian mainland decreased about 10% from 1964. Statistics for area of capture are not yet available. However, it seems likely that most catches in Subarea 4 came from Div.4X. Catches from Div.4V-W probably continued at a lower level. No particular changes in sizes of haddock landed were noted.

III. Flatfishes

Total mainland flatfish landings from all subareas increased by about 14%. Since preliminary Canadian statistics on flatfish are not separated by species or area, precise information about flatfish landings cannot be provided. However, tabulations of monthly landings reports provide general information about major species and stocks.

American plaice. Total mainland landings for this species seem higher than for 1964 with the stock in the Magdalen Shallows region (4T) and in part of 4Vn most important in Subarea 4. Increased effort in this region, diverted from cod fishing, seems to have accounted for much of the gain in landings. The Sable Island-Middle Banks region (4W) was an important American plaice fishing area as well. There were no apparent changes in size of fish landed, and discards of small American plaice in Div.4T remained at 70 to 80% by number.

Witch flounder (greysole). Landings appear to have remained about the same as in 1964; however, the Middle Bank region (4W) seems to have replaced the eastern Nova Scotia area (4Vn) as the most important region. Danish seining probably accounted for a greater proportion of the witch landings than in 1964. No changes in sizes landed were observed and, in general, discards of small witch were negligible.

Yellowtail. Landings for this species probably doubled to about 10,000 tons. Main stocks fished were from Middle Bank (4W) and Banquereau (4Vs).

Winter founder, *Pseudopleuronectes americanus* (Walbaum). This relatively inshore species has been steadily increasing in importance, particularly in the Chaleur Bay and Northumberland Strait regions of the Gulf of St. Lawrence (4T). It is believed that total landings of this species were about 4,000 tons.

IV. Pollock, *Pollachius virens* (L.)

Pollock landings by Canadian vessels were about 10% lower than in 1963 and 1964. Landings decreased most in the Bay of Fundy region of Div.4X.

V. Redfish

Total Canadian mainland landings increased about 65% over the average for 1963-64. Most of the increase apparently resulted from increased effort and good recruitment in the Gulf of St. Lawrence (4R-S-T).

VI. Other groundfish

Combined landings of species caught incidentally were lower by about 10%, to about 14,000 tons. Wolffish and cusk landings increased but hake (*Urophycis* sp.) landings were sharply lower.

VII. Herring

Herring landings in Subarea 4 amounted to 173,471 tons, an increase of 34,937 tons (25%) over the 1964 landings. Most of the increase occurred in Div.4X where for the second consecutive year record landings were made. Landings in Div.4R (2,756 tons) and 4W (1,365 tons) were somewhat lower than in 1964, while landings in Div.4T (42,998 tons) were higher. Landings in 4S (58 tons) and 4V (283 tons) were essentially the same as in 1964.

VIII. Swordfish, *Xiphias gladius* L.

Total Canadian landings of swordfish amounted to 5,328 tons (round weight), a decrease of 2,667 tons (33%) from the 1964 landings. Landings from Subarea 3 amounted to 1,051 tons, an increase of 69 tons (7%) over the 1964 landings. In Subarea 4, however, the catch amounted to 1,202 tons which is less than half the 1964 catch of 2,444 tons. There is no apparent reason for the decrease in landings from Subarea 4 in 1965. The fishing effort was somewhat less than in earlier years, particularly during July and August, and mean weights of swordfish have been decreasing steadily since the introduction of longlining in 1962. However, a combination of these two factors will not account for the decrease in landings during 1965.

IX. Mackerel, *Scomber scombrus* L.

Preliminary tabulations indicate that Canadian mackerel landings in Subarea 4 amounted to 11,076 tons, an increase of 1,050 tons (10%) over 1964. Landings in Div.4T (4,636 tons) were 471 tons lower than in 1964 while landings in 4X(4,057 tons) were 1,849 tons higher. Increased landings occurred mainly along the outer coast of Nova Scotia in Yarmouth, Lunenburg and Halifax Counties. Catches in other divisions of Subarea 4 were essentially the same as in 1964, except in 4S where there was virtually no catch in 1965.

X. Bluefin tuna, *Thunnus thynnus* (L.)

Total Canadian landings of tuna amounted to 651 tons. Of this amount, 475 tons were taken by purse-seiners and 45 tons by swordfish longliners to the south of Subarea 5. The catch in Subarea 4 amounted to 84 tons, most of which (75 tons) was taken by inshore fishermen in the St. Margaret's Bay region of 4X. Only bluefin are taken in the inshore fishery, whereas the offshore catch is a mixture of several species, but predominantly bluefin and bigeye.

XI. Porbeagle, *Lamna nasus* (Bonnaterre)

Small quantities of porbeagle are now being landed and sold by swordfish fishermen. Total landings amounted to 54 tons, of which 6 tons were caught in Subarea 3; 16 tons in Subarea 4; 8 tons in Subarea 5; and 24 tons south of the Convention Area.

XII. Scallop

Scallop landings by offshore vessels amounted to about 90 tons of shucked meats (757 tons whole weight), about 30% of the landings shown for 1964. In contrast to 1964 when most landings were from Browns Bank and the lower Bay of Fundy (4X), most of the offshore landings in 1965 were from Middle Bank (4W). This change in area of capture probably partly reflects differences in availability.

The inshore scallop fishery was confined to two regions, the Bay of Fundy region of Div.4X and the southern Gulf of St. Lawrence (4T). In the former, landings decreased about 20% to about 4,200 tons whole weight. In the Gulf of St. Lawrence region landings were at a record high of 330 tons of shucked meats (about 2,700 tons whole weight). Marketing of scallop adductor muscles with attached roes from the Gulf of St. Lawrence fishery was continued on an experimental basis in 1965.

XIII. Harp seal

The Canadian take was 73,000 by ships, aircraft and landsmen.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Coastal surface temperatures were monitored at several stations from the Gulf of St. Lawrence to the Bay of Fundy. Surface temperatures were below average in all areas. Negative anomalies were generally the largest along the western and southwestern coast of Nova Scotia (4XW) and the smallest around the Magdalen Islands (4T). A general decrease of temperature from 1964 to 1965 is indicated everywhere except around Magdalen Islands. Bottom temperatures in the Bay of Fundy (4X) followed the general cooling trend.

A survey of the temperature distribution in the surface layers of an area between 62°W and 65°W and south of 41°30'N (4WX) was carried out in April to increase knowledge of the interactions between the water masses in this region.

Three complete cruises were made in Chaleur Bay (4T) by the Station de Biologie Marine.

The *Calanus* occupied 9 stations in late July in the Strait of Belle Isle. Vertical and oblique plankton hauls and supporting physical data were obtained.

The monitoring section off Halifax (4W) was covered three times although the data from one cruise are of little value. Observations in Cabot Strait area (June and September) indicated gradual cooling of the deep layer as compared to previous years.

A study has been started of the time-series of observations along various standard sections off the Canadian coasts. A preliminary listing of all known observations on these sections has been prepared and some calculation of the correlations between the series of observations at different points has been carried out. One object is to evaluate the usefulness of long series of observations as quantitative predictors of future trends.

Circulation studies were intensified, mainly of the bottom drift over the Scotian Shelf (4VWX) and the surface and bottom drifts in the Gulf of St. Lawrence (4RT). The increased effort in the Gulf of St. Lawrence was directed toward the study of the environment pertaining to the distribution of groundfish eggs and larvae between May and September. A preliminary analysis of bottom non-tidal drift over the continental shelf area from the southwestern Gulf of St. Lawrence to the Bay of Fundy (4TVWX) was completed.

Non-tidal currents observed in the southwestern Gulf of St. Lawrence (4T) with parachute drogues and transponding drift buoys agreed well with calculations of geostrophic flow. Cyclonic gyres in the surface layers cause upwelling effects on the thermocline below and represent a potential mechanism for producing large fluctuations in bottom temperatures in inshore areas. Similar studies are demonstrating general movements of water layers throughout the southwestern Gulf of St. Lawrence. Another combined oceanographic and current survey was made across the St. Lawrence Estuary at Pointe au Père, Quebec (4T). Currents will be computed from the temperature and salinity data for comparison with the observed currents.

Measurements of tidal currents in the Bay of Fundy (4X) were made. Experimental current measurements were made in the deep water off the Scotian Shelf.

Work with a three dimensional electrical analog model to study wind-driven currents was continued.

2. Bottom topography. Hydrographic charting of the northern coast of Prince Edward Island was completed. Further surveying was carried out in Chaleur Bay and spot surveys at a number of other locations.

3. Bottom character. Bottom samples for geological studies were collected in Northumberland Strait and over a wide portion of the Scotian Shelf. From the Magdalen Shallows bottom samples were taken for determinations of granulometric, mineralogical, and chemical composition. Surveys with echosounders, sparkers, and sub-horizontal asdic have contributed valuable information on microtopography, sediment distribution, and thickness of sediment cover in the area. Ship-borne gravimeter and magnetometer tracks were taken in the Gulf of St. Lawrence and across the continental margin.

II. Biological studies

1. Cod. Surveys with small-mesh nets in the southern Gulf of St. Lawrence (4T) were continued in September. The length composition of catches

differed little from those in 1964; however, catch per tow had decreased about 45%. In 1964 the 1961 year-class was dominant. In 1965 it is still as strongly represented as the incoming 1962 year-class. The surveys suggest that the 1961 year-class will remain dominant in the commercial fishery in 4T during 1966.

The apparent lower availability of cod in Div.4T during 1965 is being reflected in greater landings of other demersal species from this area.

2. Egg and larval studies. The mechanism of recruitment for cod in the Gulf of St. Lawrence and its relation to drift of eggs and larvae and subsequent settling are unknown. Previous plankton surveys have yielded few cod larvae. Two cruises designed to sample eggs and larvae in the Gulf of St. Lawrence (4T-R) were carried out with the *A.T.Cameron*. Various types of plankton gear were compared to test their efficiency. The 1-metre net with #0 mesh consistently caught most gadoid eggs. A lined Isaac-Kidd trawl caught most pelagic larvae. In the May-June cruise, large catches of gadoid eggs (subsequently hatched and identified as cod) and American plaice eggs were made. Concentrations of gadoid eggs were found between Cape Breton and the Magdalen Islands, between the Magdalen Islands and Gaspé, and at the western end of Prince Edward Island (all in 4T).

The September survey was carried out in the same area (4T) but was extended into St. George's Bay on the west coast of Newfoundland (4R). Numerous flatfish larvae were captured but few cod larvae were taken. However, a subsequent cruise with the *Harengus* about one week later obtained better catches of cod larvae in Chaleur Bay. More regular survey cruises are planned for 1966 in an attempt to follow concentrations of gadoid eggs as they drift, hatch, and settle.

3. Haddock. A cruise in March and early April with the *A.T.Cameron* to the Emerald Bank region of Div.4W was conducted to survey pre-recruit haddock stocks. Moderately good but sporadic catches of commercial sizes of haddock were obtained, especially in the area south of Emerald Bank.

Previous predictions of year-class strength were confirmed. None of the year-classes from 1958 to 1962 have been outstanding. Current Canadian landings from this region rely mainly on the 1959 year-class of haddock. Year-classes of 1958 and 1960, which should also be influencing the fishery, are particularly weak.

Results of the 1965 survey suggest that the 1963 haddock year-class is relatively strong. If so, it fits with assessments for banks to the westward where this year-class is outstanding among pre-recruit sizes of haddock on Browns Bank.

4. Witch (greysole). Most effort was spent in validating age-determination methods by fishing for and capturing small witch, by back-calculation of otoliths, and by continued examination of otolith edges.

Small witch have been difficult to obtain but, in April 1965, 955 greysole were taken by shrimp trawl in one area east of Middle Bank. Of these, 173 fish were below 30 cm in length, and in this sample length modes occurred at 8, 14, 19, and 22 cm. Otoliths of these fish were aged as 1, 2, 3, and 4 years respectively. Back-calculation from a different sample of greysole otoliths showed mean length at the same ages to be almost exactly the same as the estimates of mean length at age from length distributions.

Tagging of about 2,600 witch between October 1963 and April 1965 yielded disappointingly low recaptures (about 3%). It is believed that immediate post-tagging mortality and tag shedding were the important contributing factors. Such recaptures as have been obtained show only local movements of witch, less than 20 or 30 nautical miles. This tentative result would agree with results of research-vessel survey catches, which indicate limited seasonal movements to and from deep water in winter and mid-summer, respectively.

5. Yellowtail. Preliminary analysis of data of commercial catches and from previous research-vessel cruises was begun to outline general distribution of this species. Although some yellowtails are caught in Div.4T, V, W, X, largest numbers occur in the Sable Island Bank (4W) and Banquereau (4V) region. Largest commercial catches are taken from spring to fall. Most research-vessel survey activity in the above regions has been in winter when catches of yellowtail have been relatively low. Beginning in 1966, spring and summer research cruises are planned to examine details of distribution, abundance, and general biological attributes of yellowtail.

6. Argentines, *Argentina silus* Ascanius. Two research-vessel cruises (July-August) were carried out between Sable Island and Browns Banks (4W, 4X) to study distribution of this species and of silver hake. In addition, part of a winter cruise of the *A.T.Cameron* to the central Nova Scotian Shelf was devoted to the same purpose. Results have been partially analysed and show that argentines were found in many localities along the edge of the continental shelf in the area surveyed. Best catches were made between 180 and 365 m. Argentines were also found in the deep-water basins of the Scotian Shelf. With the bottom trawl and small-mesh liners used, catches were not of commercial quantities.

Along the edge of the Scotian Shelf argentines were mainly 2 to 7 years of age and 20 to 25 cm long. In the deep-water basins on top of the shelf they were about 6 to 11 years of age and 30 to 38 cm long. Argentines appear to be slow growing and late maturing, and it seems likely that intensive fishing could rapidly reduce stocks.

7. Silver hake (whiting), *Merluccius bilinearis* (Mitchill). Studies on this species were conducted in the manner outlined for argentines. From the Scotian Shelf (4W-X) silver hake were taken only sporadically. Generally catches were not large enough to be considered of commercial interest. However, somewhat larger catches (average 320 kg per hour's tow) were taken near

the western end of Sable Island in early August. Best catches there were from depths of 35 m and silver hake taken were mainly from 25 to 46 cm long. Material collected for age determination, maturity stages, etc., has not yet been analysed.

8. Cusk. Studies on cusk life-history were begun in the summer of 1963 and continued as a term project in 1964 and 1965. Most of the study has relied on commercial landings since few cusk are taken in normal research-vessel otter trawl hauls.

Fisheries statistics show that almost all cusk landings from Subarea 4 come from Div.4W and 4X. In these regions cusk are found at depths from 75 to 365 m. Those from the shallower regions on top of the Scotian Shelf ranged from 40 to 70 cm in length. Along the edge of the Shelf, in deeper water, cusk caught were generally from 60 to 90 cm in length. Smaller cusk are not taken by commercial gear and only rarely in research-vessel hauls. Age determinations from otoliths show that most male cusk landed were between 5 and 9 years and females between 6 and 11 years. At 5 years of age, mean length of cusk was about 46 cm. By age 9, mean length was around 63 cm, with females slightly smaller than males.

Off western Nova Scotia (4X) the peak spawning period occurred in late June. About 50% of males were mature around 44 cm and 50% of females around 50 cm. A collection of gonad material is being studied to establish estimates of fecundity for different sizes of females.

9. Herring. "Sardine" herring samples from the Passamaquoddy region of 4X showed mean lengths from 9.7 to 27.4 cm and mean ages from 1.1 to 4.4 years. Individual lengths ranged from 7.5 to 38.0 cm and age-classes I to VI were represented in the samples. Three percent of the otoliths examined had opaque nuclei (spring-spawned type). However, disregarding spawning season, age-class II contributed 78% of the numerical yield for 1965. Age-class I entered the fishery in November, appearing first in a purse-seine catch from Grand Manan.

In the southwest Nova Scotia region of 4X, herring ranging in total length from 8.0 to 39.5 cm were taken by purse seine, weir and gill-net operations. Approximately 4% of the otoliths examined were of the spring-spawned type. Of the total number of fish examined for age, the 1961 year-class (age-class IV) was dominant, representing 49% of the numerical yield. Age-classes II to IX occurred in the samples. Mean ages ranged from 2.0 to 5.9 years.

Fatness determinations by an ether extraction technique were made on samples of herring from the southwest Nova Scotia pre-spawning and spawning stocks. Values ranged from 9.7 to 17.3% of the wet weight of the whole fish. A continuation of this study is planned which will incorporate a complete range of herring sizes, fishing localities, and seasons.

During the latter part of July 2,086 herring were tagged with yellow spaghetti tags. This was a preliminary attempt to tag herring in their third year of life or older on the New Brunswick side of the Bay of Fundy. The object of the experiment was to determine the origin of these fish by tag recoveries on the spawning grounds. Eighty-six (4.1%) recoveries were made between the first date of release (July 20 and November 30). None had travelled more than a few miles from the tagging sites and none were recovered on known spawning areas.

10. Mackerel. Mackerel investigations were extended this year to study the biology of the species in Div.4X, 4W, 4V, and 4T. A decrease in size composition of fish caught on the Atlantic coast of Nova Scotia as the season progressed was observed once more. Samples obtained in the last week of May from Yarmouth to Lunenburg had a mean length of 364 mm. Mean lengths decreased to 350 mm (1 to 15 June); 346 mm (15 to 30 June); 311 mm (1 to 15 July); and 270 mm (15 to 30 July). This change in size composition was due to a migration up the coast and into the Gulf of St. Lawrence with the larger fish leading the way. The 1961 year-class was dominant in the catches. Mackerel were immature or maturing between 26 May and 30 July on the Atlantic coast of Nova Scotia. Samples from the Gulf of St. Lawrence obtained between 12 July and 20 July contained 24% ripe fish and 72% spent fish. All mackerel sampled at Caraquet in the Bay of Chaleur on 10 August were spent.

11. Scallop. Continued sampling of inshore beds in the southern Gulf of St. Lawrence (4T) by research-vessel tows produced good catches of large scallops in the eastern end of Northumberland Strait and around the Magdalen Islands. In a number of regions, good catches of small scallops suggest subsequent good recruitment to the commercial fishery.

12. Harp seal. Monitoring of age-class survival and reproductive rate is being continued.

Subarea 5

A. Status of the Fisheries

I. Cod

Canadian landings of cod from Subarea 5 increased from about 2,500 tons in 1962 to about 7,000 tons in each of 1963 and 1964. Statistics for 1965 showing area of capture are not yet available, but it is believed that cod landings by Canadian vessels from Subarea 5 were about the same as in 1964.

II. Haddock

Canadian landings of haddock from Subarea 5 increased from about 3,500 tons in 1962 to about 11,500 tons in 1964. It is believed that haddock landings in 1965 were around the same level or slightly lower. Estimates of

discards obtained from log records indicate that at times large numbers of small haddock were discarded.

Haddock landings from Subarea 5 were sampled for lengths, and otoliths collected for age determination. This material was passed along to the US Bureau of Commercial Fisheries at Woods Hole for analysis.

III. Herring

There was no Canadian herring fishery in Subarea 5. There is Canadian interest in this area, but herring were particularly abundant in the adjacent inshore area (4X) and no attempts were made to fish for herring on Georges Bank as had been announced previously.

IV. Swordfish

Swordfish landings from Div.5Z and the region southward to Cape Hatteras amounted to 3,073 tons. This is 1,496 tons less than the quantity taken in 1964. The decrease occurred mainly in 5Z where the catch was less than 60% of the previous year's catch. The distribution of swordfish catches in 1965 is shown in Fig. 3.

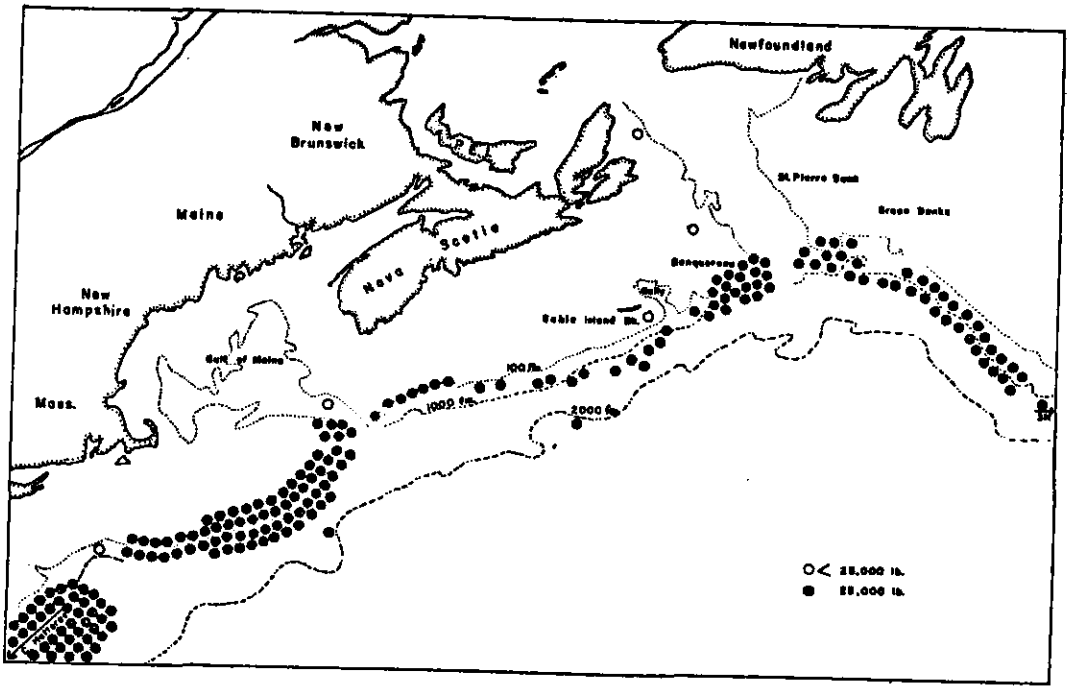


Fig. 3. Distribution of swordfish catches, 1965.

V. Bluefin tuna and skipjack

Landings of tuna from Subarea 5 by swordfish longliners amounted to 47 tons. In addition these vessels landed 45 tons from the area between Georges Bank and Cape Hatteras. All the purse-seined catch of 475 tons (including 13 tons of skipjack) was taken south of Subarea 5.

VI. Scallop

In 1965 Canadian effort on Georges Bank (5Z) was considerably reduced and landings amounted to about 4,600 tons of shucked meats (adductor muscles) or 38,000 tons of whole scallops. This was a reduction in landings of about 22% from the 1964 level. Fleet size increased to about 50 vessels compared to 40 in 1964. However, a significant part of their effort was spent south of the ICNAF Area in 1965 and landings from this region were about 3,200 tons of shucked meats (26,500 tons of whole scallops).

B. Special Research Studies

I. Environmental Studies

Nothing of significance to report.

II. Biological Studies

1. Exploratory fishing. Two exploratory fishing cruises to Subarea 5 were carried out in July-August. For demersal fish particular attention was paid to catches of argentines and silver hake along the eastern edge of Georges Bank.

Argentines. In the above region best catches of argentines were taken in depths around 180 m and temperatures of 8° to 9°C. Five tows at this depth averaged about 1 ton with individual catches up to 2 tons at two localities near Corsair Canyon. Most argentines caught were between 32 and 38 cm and about 70% were found to have gonads in the early ripening phase. Age material collected has not yet been analysed.

Silver hake. Small numbers of silver hake were caught at most stations fished from 35 to 365 m. Most fish caught were between 28 and 32 cm and examination of gonads suggests that spawning was taking place in August. Other biological observations and material collected have not as yet been analysed.

2. Herring. Herring samples containing a total of 1,297 fish were obtained during September and October by Dutch herring trawl on the northern edge of Georges Bank. Total lengths ranged from 19.6 to 35.4 cm. Three percent (3%) of the otoliths used for age determination were of the spring-spawned type. Of the autumn-spawned fish, the 1961 year-class represented 66% of the fish sampled.

3. Swordfish. Food studies were continued with an examination of 413 swordfish stomachs. In most instances food types reflect the area of capture with bottom forms in catches over the continental shelf and bathypelagic forms elsewhere. Twenty-three swordfish were tagged and released, but so far there have been no recoveries. Studies of the distribution of post-larval swordfish resulted in the capture of 47 specimens ranging in length from 1.8 to 11.1 cm. These were taken in three general regions of the western north Atlantic: off Cape Hatteras, in Florida Straits, and in the northeast part of the Caribbean Sea. Shore sampling of swordfish for size studies showed an average weight of 66 kg. Size composition of swordfish has been decreasing by approximately 9% annually since the introduction of longlining in 1962.

4. Tuna. Tuna were sampled from purse-seine and longline landings onshore. The former fishery started a month later than in the previous year, opening in mid-July (off Delaware), the various size groups entering and leaving the fishery in the same sequence whilst maintaining the delay. The catches were initially bluefin of age-class III (74-84 cm fork length), with age-classes VI-VII (130-158 cm) predominating in August. Skipjack schools also appeared late, in August. Skipjack were less abundant than in 1964 and the smaller individuals were not observed. Skipjack formed only 3%, instead of 42%, of the purse-seine catches.

The longlined tuna, mainly bluefin and bigeye, are taken incidentally by the swordfish fleet. The average weight of 412 fish at 68 kg (dressed) was similar to that of 1964 (67 kg), but analysis of size frequencies shows the 18-36 kg class, prominent in May of that year, to have been missing. This may be related with the late appearance of tuna in the seine fishery as longliners had moved further north after swordfish by that time.

II. Danish Research Report, 1965

by Erik Smidt

Subarea 1

A. Status of the Fisheries

I. Cod

1. The fisheries. There has been an increase in the landings from 21,980 tons round, fresh fish in 1964 to 33,987 tons in 1965, which is partly due to two new rich year-classes, 1960 and 1961, but also to increased effort.

As in previous years, the main part of the Greenlanders' fishery has been carried out in inshore waters. There has been an especially good pound net fishery in May-July in Holsteinsborg, Sukkertoppen and Godthaab districts (Div.1B-1D). In Holsteinsborg, where all fish were filleted, the total lengths of fish from that gear ranged from 40-60 cm, but in Sukkertoppen and Godthaab big quantities of very small fish, which are not included in the above given figure, were landed as industrial fish. In order to save these undersized fish, Greenland Fisheries Investigations has proposed a minimum size of 40 cm for cod landed in Greenland. Besides a rather important fishery was carried out in the open sea from 4 new cutters (100-200 BRT in size).

2. Forecast for the cod fisheries. In the northern districts (Div. 1B-1C) the only important year-classes in 1966 are expected to be the rich 1960 and 1961 year-classes as in 1965, and because of their growth the fishery is expected to be somewhat better in 1966 than it was in 1965. In the southern districts (Div.1D-1F) the year-classes 1960 and 1961 are still important, and, in addition, the 1958 year-class seems to be important in coastal waters. Also in the southern districts the fishery is expected to increase, and presumably there will be a greater variation in size there than in the northern districts.

II. Salmon

While the cod fishery has increased, there has been a big decline in the salmon fishery from 1,539 tons round, fresh fish in 1964 to 824 tons in 1965. Most likely this decline was due to lower prices in 1965 than in 1964, so that many fishermen became more interested in the cod fishery, which was also stimulated by a richer cod stock in 1965. The most important salmon fishery was carried out in the northern districts (Div.1B-1D), while it almost failed in the southernmost districts. The Greenlanders' salmon fishery is only carried out in inshore waters, and the only gear used is gill net.

III. Other commercial fish species

The fisheries for wolffish and Greenland halibut increased in 1965. In 1965, 3,257 tons round, fresh wolffish were landed (2,063 in 1964), and 3,042 tons round, fresh Greenland halibut were landed (1,928 in 1964).

IV. Deep sea prawn

The prawn fishery increased from 3,770 tons landed in 1964 to 5,051 tons in 1965 due to an improved labour situation in the plants at Disko Bay. This is the biggest Greenland prawn fishery hitherto.

B. Special Research Studies

I. Environmental Studies

Annual observations have been made from M/C *Adolf Jensen* and M/C *Tornaq* near Godthaab, but, as a planned cruise to Greenland waters by R/V *Dana* had to be given up because of major repairs to the vessel, the hydrographic observations and plankton collections in Davis Strait are only sparse.

1. Hydrography. A few temperature observations were made from *Adolf Jensen* in June and July over Fylla Bank, Lille Hellefiske Bank and Store Hellefiske Bank.

The material was treated by Mr Frede Hermann, who stated that temperatures over the shallow part of Fylla Bank (depth 40-50 m) were a little above normal (2°C at bottom). In July the bottom temperature on the same locality was almost the same as in June, which may indicate a current with colder water masses from the south. West of Fylla Bank the temperatures were unusally high in the deeper water layers (5.4°C in 400 m depth) in July, while they were about normal in the upper water layers (1.7°C in 50 m depth). Over Lille Hellefiske Bank the temperatures in July were high in the upper water layers and about normal in the deeper water layers.

2. Other environmental studies. Some plankton collections and measurements of the primary production by means of Carbon 14 were made on fixed stations near Godthaab.

II. Biological studies of fish by species

1. Cod

a. Larvae. Nothing can be said this year about the occurrence of larvae from stramin net samples, but as the water temperatures were relatively high over the shallow part of Fylla Bank in June, there is a possibility that the year-class 1965 will be rather good, as high temperatures on that locality in June are normally followed by rich cod year-classes. If the coming

years confirm that year-class 1965 is a relatively rich one, it will dominate the fishery in 1970 and in the following years.

b. Occurrence of small cod (age-groups I, II and III). Only scarce quantities of small cod were observed along the coast in the summer 1965, so that the year-classes 1962, 1963 and 1964 seem to be relatively poor. An exception was the Godthaab Fjord, where considerable quantities of small cod were observed.

c. Age and size of cod in commercial stock. Length measurements and otolith collections were made on the banks from *Adolf Jensen* and from the Faroese trawler *Skalaberg*. From inshore waters material was collected by *Adolf Jensen* and *Tornaq*, and moreover considerable material was obtained from the Greenlanders' catches. The distribution of the otolith samples was as follows:

	Offshore banks		Inshore waters	
Div.	No. samples	No. specimens	No. samples	No. specimens
1A	-	-	3	684
1B	4	1,448	3	561
1C	1	452	-	-
1D	4	704	4	751
1E	2	597	1	92
1F	-	-	3	494
Total	11	3,201	14	2,582

The age and length composition (in 3-cm groups) are shown in Fig. 1-3, Fig. 1 and 2 showing the bank stocks and Fig. 3 the stocks in inshore waters.

On the northern banks (Div.1B-1C and partly 1D) the year-class 1960 was by far the most numerous, followed in frequency by year-class 1961, while the previously dominating year-class 1957 has lost its importance. On the southern banks (Div.1E and partly 1D), the year-classes 1960 and 1961 were also numerous, but moreover older year-classes were important, especially the 1957 year-class.

In the inshore waters the year-class 1960 was dominating in the northern districts (Div.1A-1D), but also year-class 1961 was numerous, and in accordance with experience from previous years some very old year-classes were still frequent in Disko Bay (Div.1A). In the southern inshore waters (Div.1E-1F) the year-class 1961 was numerous like on the southern banks, but also in the inshore waters older year-classes, especially the 1958 year-class, were frequent. The year-class 1956, which was dominating in the southern inshore waters in 1964, was of less importance here in 1965.

The best explanation for the above facts must be that the year-class 1960 (like year-class 1957) is mainly of West Greenland origin,

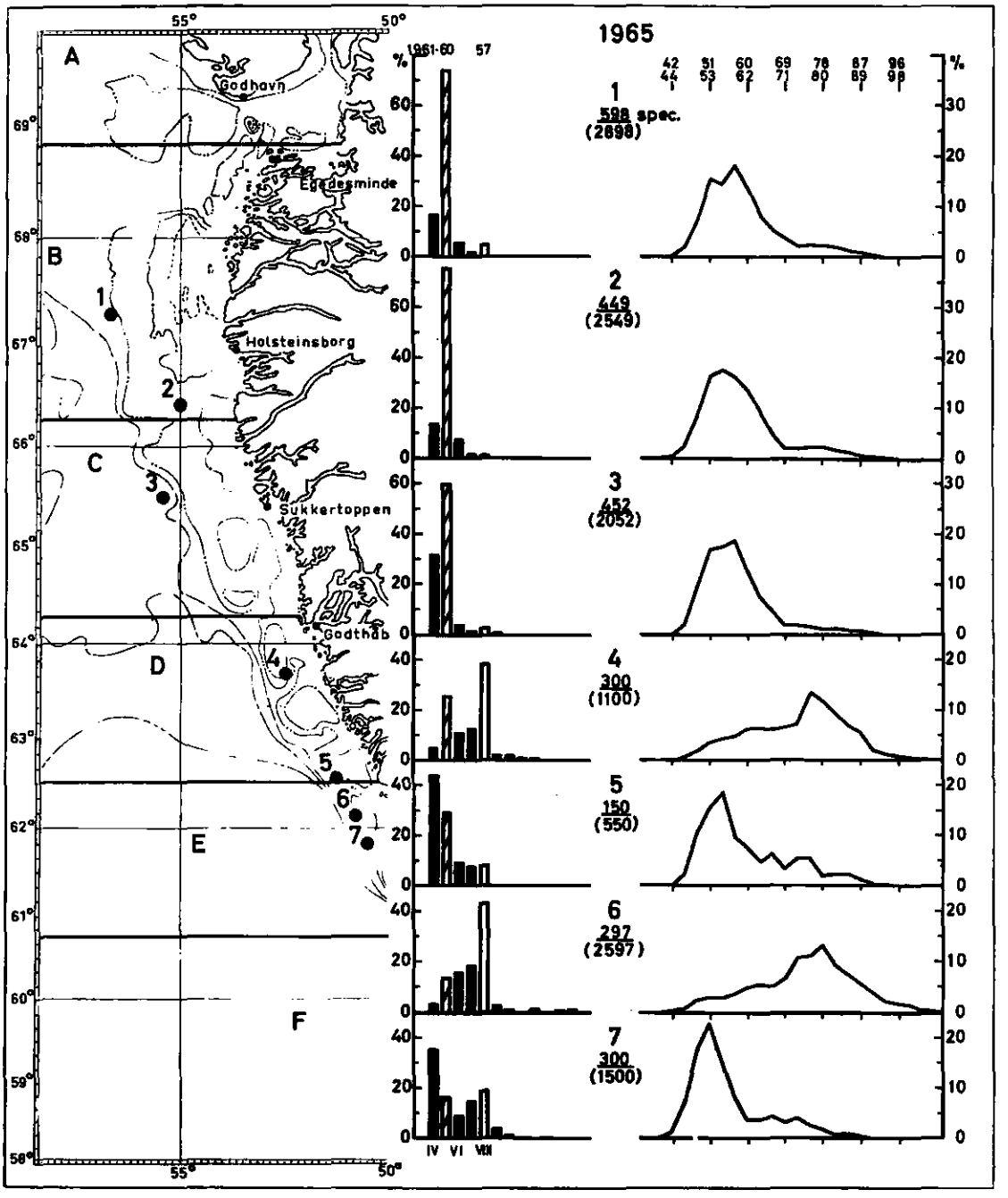


Fig. 1. Age and length composition of cod taken on the banks by the Faroese trawler *Skalaberg* from the beginning of May to the beginning of July. The upper numbers of specimens indicate otolith samples and the lower numbers (in brackets) indicate length measurements.

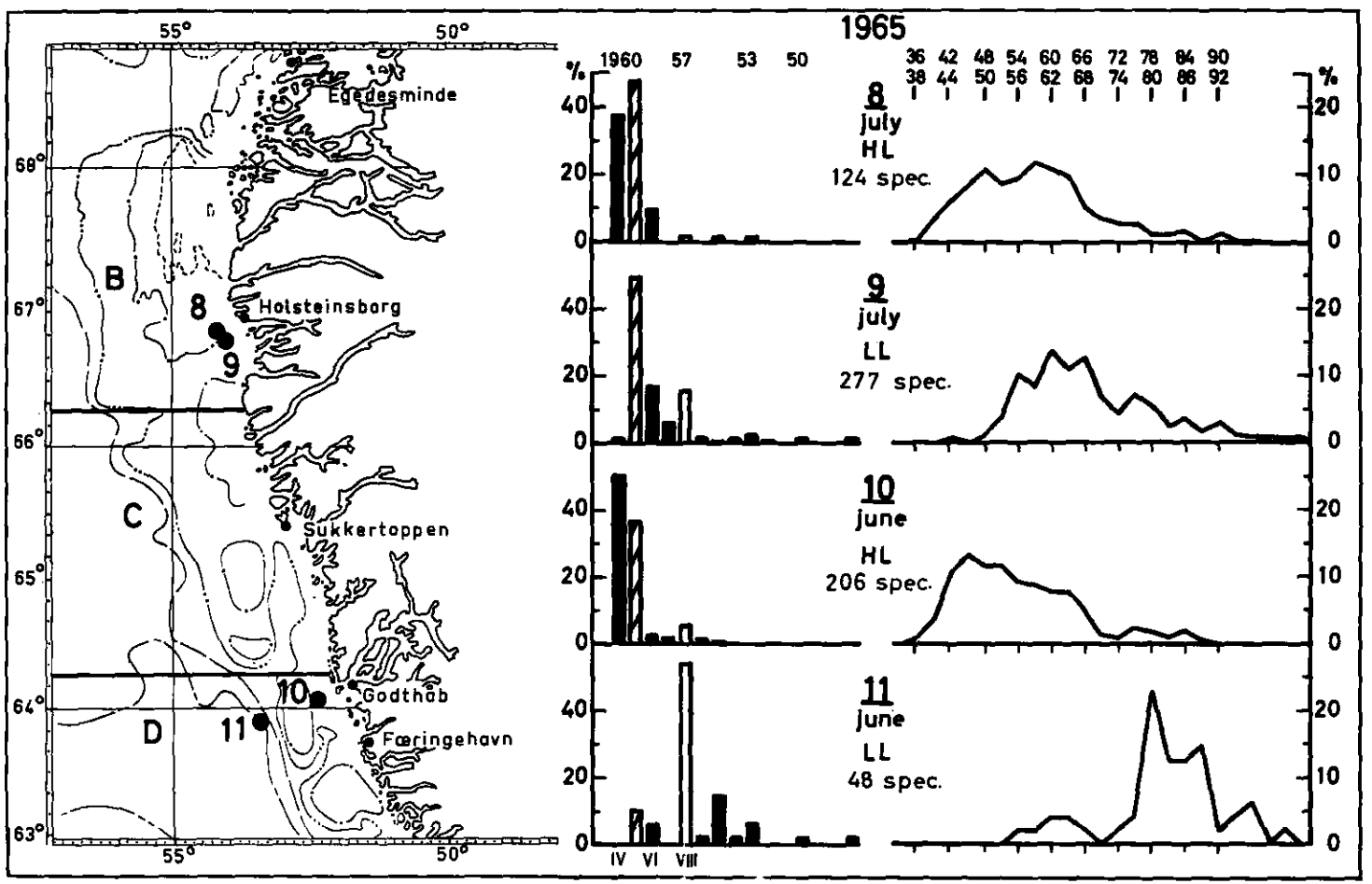


Fig. 2. Age and length composition of cod taken with longlines (LL) and handlines (HL) on the banks in June-July by M/C *Adolf Jensen*. Numbers of investigated specimens indicated.

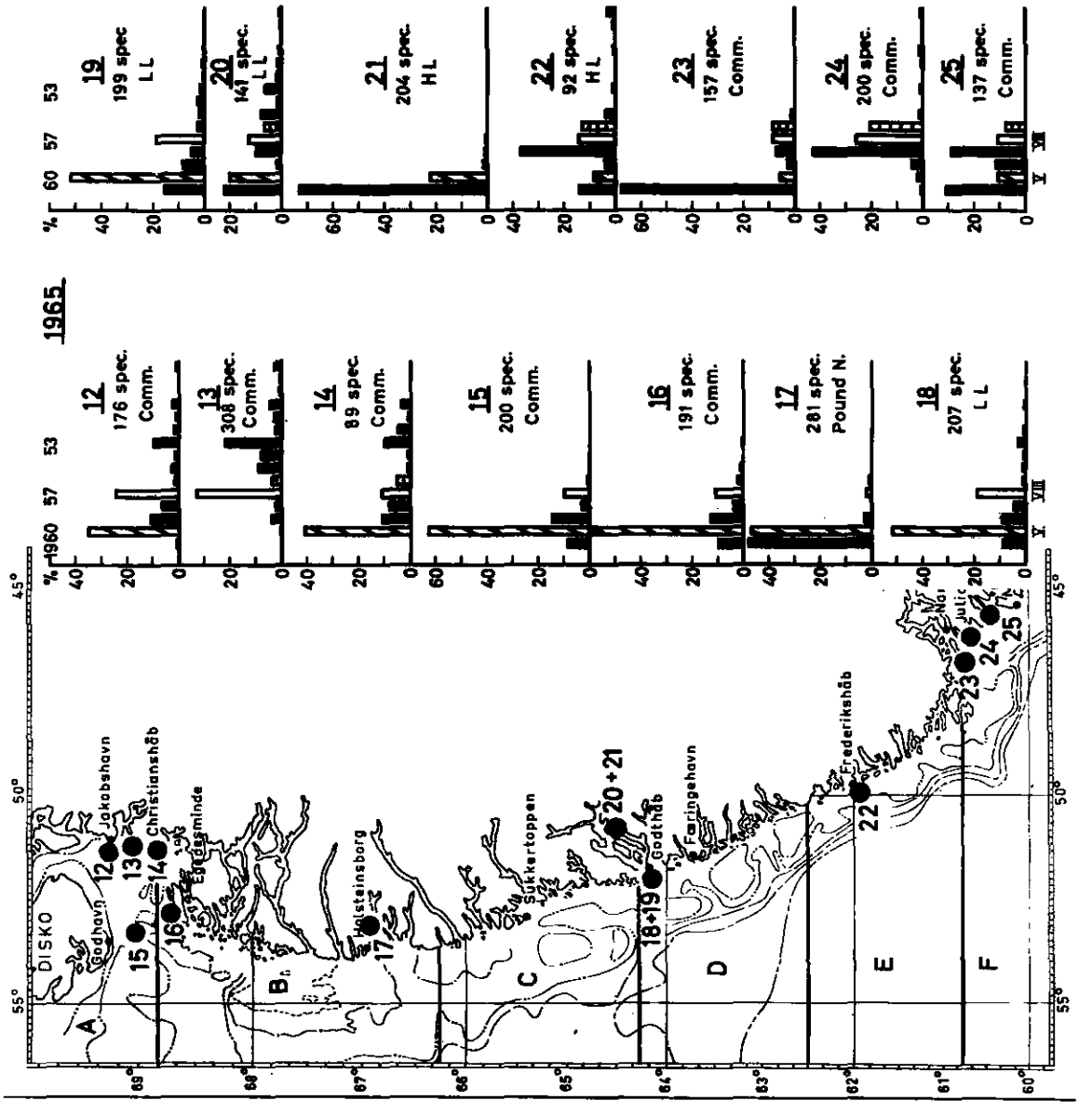


Fig. 3. Age and length composition of cod from inshore waters. Material obtained from the Greenlanders' catches (Comm. and Pound N.) and from the research cutters (longlines (LL) and handlines (HL)). Numbers of investigated specimens indicated. The samples were collected from January-October.

while year-class 1961, which was especially frequent in the southern areas, presumably has its origin partly from the Southeast Greenland spawning places (like year-class 1956), from where the fry has then been transported by the Irminger Current. Also year-class 1958, which was dominant in the southern inshore waters, is regarded as being of Southeast Greenland origin.

d. Tagging experiments. In 1965 a total of 2,393 cod were tagged. Taggings by divisions are given below (numbers in brackets are cod less than 50 cm when tagged).

Div.	Offshore banks	Inshore waters	
1B	358	-	(174)
1C	86	-	-
1D	250	180	(831)
1E	-	169	(64)
1F	-	198	(83)
Total	694	547	(1,152)

2. Salmon. In August electro-fishing experiments were carried out in rivers in Julianehaab district (Div.1F), where Norwegian salmon eggs had been planted in 1958 and 1959. In the Ilua River near Narssaq, 7 specimens were taken, and as they were determined to be 3-year-old parr and smolts, they must be regarded as belonging to second generation from eggs planted in 1958.

A specially important investigation was carried out in Godthaab district from the middle of September to the middle of October in collaboration with Scottish biologists; 223 salmon were tagged, and considerable biological material (measurements, scales, stomach content, parasites etc.) was collected from samples.

3. Other fish species. Previous years' tagging experiments on redfish from pound nets in the Godthaab Fjord were continued; 342 specimens were tagged. Moreover observations were made on other different fish species (wolffish, Atlantic halibut, Greenland halibut etc.).

4. Crustaceans. In addition to continuous prawn (*Pandalus borealis*) trawling experiments, some experiments with a special crab trawl were started in order to find out if a commercial fishery on deep sea crabs *(Chionoecetes opilio)* was possible.

III. French Research Report, 1965

by R.H.Letaconnoux

Subarea 2

Gear Studies

Pelagic fishing trials for cod were carried out in March from the *Ville de Fécamp* off Labrador around 54°20'N and 52°56'N (Hamilton Bank and Russe Bank).

The trials were carried out with pelagic trawls of rectangular opening (36.3 m x 31.7 m) rigged, in one case, with a fork 25 m long ending in a single sweep-line 60 to 80 m long and, in the other case, with double sweep-line 60 m long.

Yields increased to as much as 11,200 kg of cod in a 2 hr 20 min haul. The average hourly catch by 21 hauls was 2,554 kg.

These results are 20% better than yields per hour obtained on the same fishing locations with bottom trawl of 25.5 m headline (2,068 kg).

New trials are planned in 1966.

IV. German Research Report, 1965

A. Subarea 1 and East Greenland
by Arno Meyer

A. Status of the Fisheries

I. General

Fishing off West Greenland was again carried out throughout the whole year and showed the expected further decrease in total catch and in catch per fishing day (Table 1). This decrease occurred in spite of the further increase in fishing power and freezing capacity of the larger built factory stern trawlers. Nominal catches in Subarea 1 have decreased 40% since 1962; the catches off East Greenland dropped to the 1960-1963 level. Catch per fishing day has fallen consistently over the past years and is at present off both West and East Greenland only 68% of the 1962 value. The decrease in the catch per fishing day during the last 7 years off West Greenland is shown in Fig. 1. However, the real decrease is far bigger. Up to 1961 the German fleet was composed mainly of side trawlers. These have far less fishing hours per day than the stern trawlers which can haul and shoot the net quicker and can fish the often few hours of daylight with good catching possibilities (off Greenland mostly the hours at noon) more effectively.

Table 1. German nominal catches (in tons) (without industrial fish) off Greenland, 1962-1965. Average annual catch per fishing day in brackets.

		Cod	Redfish	Total
West Greenland (Subarea 1)	1962	126,640 (19.2)	54,900 (8.3)	185,386 (28.2)
	1963	139,283 (19.4)	42,292 (5.9)	185,492 (25.9)
	1964	99,614 (17.7)	20,662 (3.7)	122,754 (21.8)
	1965	92,826 (15.8)	16,573 (2.8)	112,167 (19.1)
East Greenland	1962	14,246 (8.6)	24,720 (14.9)	40,495 (24.4)
	1963	13,614 (6.2)	30,916 (14.2)	46,646 (21.4)
	1964	29,352 (8.9)	37,294 (11.3)	69,575 (21.2)
	1965	11,681 (4.3)	31,992 (11.7)	45,790 (16.7)
Total Greenland	1962	140,886 (17,1)	79,619 (9.7)	225,881 (27.4)
	1963	152,898 (16.3)	73,203 (7.8)	232,146 (24.8)
	1964	128,966 (14.4)	57,956 (6.5)	192,329 (21.5)
	1965	104,507 (12.1)	48,565 (5.6)	157,957 (18.3)

As a result of the poorer catches off Greenland in 1965, there was increased fishing off Labrador, in spite of the poorer quality of the Labrador cod.

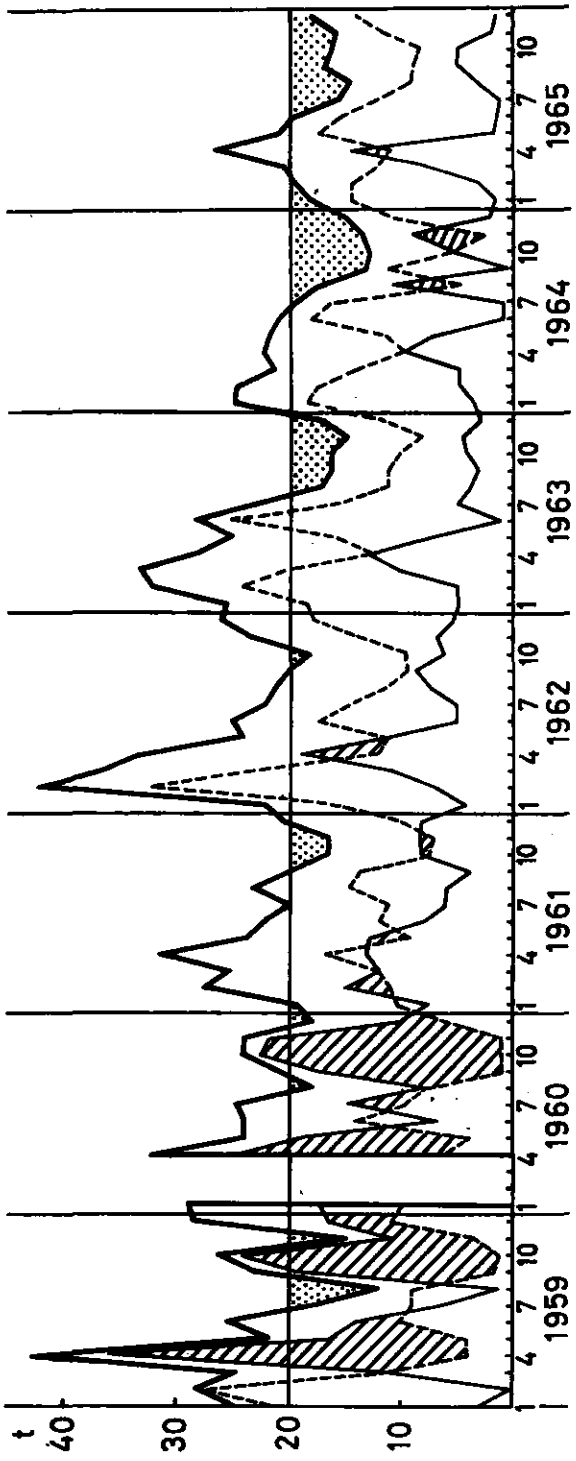


Fig. 1. Average monthly catch (in tons) per fishing day of German trawlers in Subarea 1 from 1959 to 1965. Thick solid line = total catch; broken line = cod; thin solid line = redfish; hatched section = redfish catches exceeding cod catches; dotted area = monthly catch per fishing day less than 20 tons.

II. Cod

Before 1961 nearly all cod were fresh fished by the German fleet in the southern part of West Greenland in Div.1D to 1F (1961: 91.5%). But in the last few years with increased freezing at sea, the northern Div.1C and 1B were fished more, especially from November to February. In 1965, 51% of all cod came from Div.1C and 1B. Cod fishing has never been so intensive on both sides of the Holsteinsborg Deep, nor has there been so little cod fishing in Div.1E and 1F (17%) as in 1965.

After the record catches of spawners in 1964, the cod catches off Southeast and East Greenland were poor in 1965 - the lowest during the past 6 years. Best fishing for spawners in 1965 was on the Heimland Ridge.

III. Redfish

Catches of redfish decreased further, as expected, especially off West Greenland, but also off East Greenland. The proportion of redfish - in the fifties the most important Greenlandic fish for the German fishery - decreased from 57.5% in 1959 to 30.7% in 1965. Since redfish do not breed off West Greenland and they immigrate from the Irminger Sea, the decrease in catches was much more pronounced in Subarea 1 (1959: 53.2%; 1965: 14.8%). Today it is only possible to fish for redfish off Southwest Greenland (close to the Irminger Sea area). The redfish concentrations which were present in the more northern Div.1D and 1C, in former years, have almost all disappeared. The output from these two divisions gradually decreased from 24,000 tons in 1962 to 4,400 tons in 1965, while in Div.1E and 1F the catches decreased during the same period only from 26,000 tons to 11,000 tons. The average daily catch for the whole West Greenlandic waters decreased from 12.5 tons in 1959 to 2.8 tons in 1965. Off East Greenland with its lower effort and proximity to the redfish breeding area, the decrease was less pronounced. Since 1962, when the last possible redfish grounds off Cape Discord and Cape Walloe were found, the average catch has dropped from 14.9 tons to 11.7 tons in 1965.

IV. State of Fisheries in the first 4 months of 1966 and forecast for the remainder of 1966

From February to the middle of April, when most of the trawlers left Greenland for better fishing off Labrador, the 1960 and 1961 year-classes were heavily fished and with good results on Banana and Fyllas Bank, but the percentage of industrial cod and discards was very high. From the middle of March to the middle of April, large concentrations of spawners were again found and fished far west of Banana Bank (as in 1961) in very deep water (700-750 m), but on very rough grounds. In the winter of 1965/1966 there was almost no fishing off Southeast Greenland. Heavy storms and the unusually large drift of ice, caused by further intensified atmospheric circulation over Greenland with high atmospheric pressure anomalies (plus over Greenland, minus over the Atlantic), made fishing more or less impossible. The strong northern

storms off East Greenland transported big quantities of ice southward to South and Southwest Greenland. It will be interesting to examine whether and to what extent this increased atmospheric circulation influenced the strength of the new 1966 year-class.

During the 1966 feeding season the 1961 and 1960 year-classes of cod will grow from 60 to 68 cm and 66 to 74 cm respectively. These two year-classes - the only year-classes which will have commercial importance in 1966 - with their now increased weight (2-2 3/4 kg and 2 1/2-3 1/2 kg respectively) will give relatively good fishing results. The proportion of redfish in the catches will continue to decrease more off South and Southwest than off East Greenland.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Owing to net selection studies, the *Walther Herwig* could only work 3 sections off West Greenland in the second half of November (Fig. 2). In late fall temperatures were not quite as high as in the very warm preceding year, but were considerably warmer than in 1963. Temperatures of more than 6°C in the Irminger Current were again found extending northward to the southern part of the Great Halibut Bank. But the core of warm water lay far deeper on the slope and did not reach the shallow bank areas. Only on Nanortalik Bank was water of more than 4°C found. The cold water of the East Greenland Current was only found over Nanortalik Bank and stretching far to the southwest.

In July, a section across Davis Strait from Cape Chidley (North Labrador) to Fiskenaes Bank was worked by *Anton Dohrn* (Fig. 3). Cold water of the Arctic component of the West Greenland Current, in the centre of which temperatures were less than 1°C, extended far to the west. The warm Atlantic water with temperatures to 5.5°C and salinity to 35‰ lay on the slope in 350 to 800 m. On the Labrador side the same warm water (left branch of the West Greenland Current) here coooled to 4.8°-4.0°C was found in 200-500 m and on the Labrador slope in 300 to 750 m. Cold Arctic water of the Baffinland Current covered the shelf of North Labrador with temperatures below 0°C.

In August another section was worked across Davis Strait, but further to the north from Hudson Strait and South Baffinland to the Great Halibut Bank (Fig. 4). This section shows clearly the large layer of Arctic water of the Baffinland Current extending downward to 200 m and stretching far eastward. This water with temperatures lower than -1°C is covered by a thin surface layer of warmer water heated by the sun. The warm Atlantic water of the West Greenland Current covers the West Greenland shelf with temperatures of more than 4°C. The most northern part of the left branch of this current on its way to Labrador is cut at stations 77-75 and 71. On the slope of the Baffinland shelf we find this water of more than 4°C in 350 to 400 m.

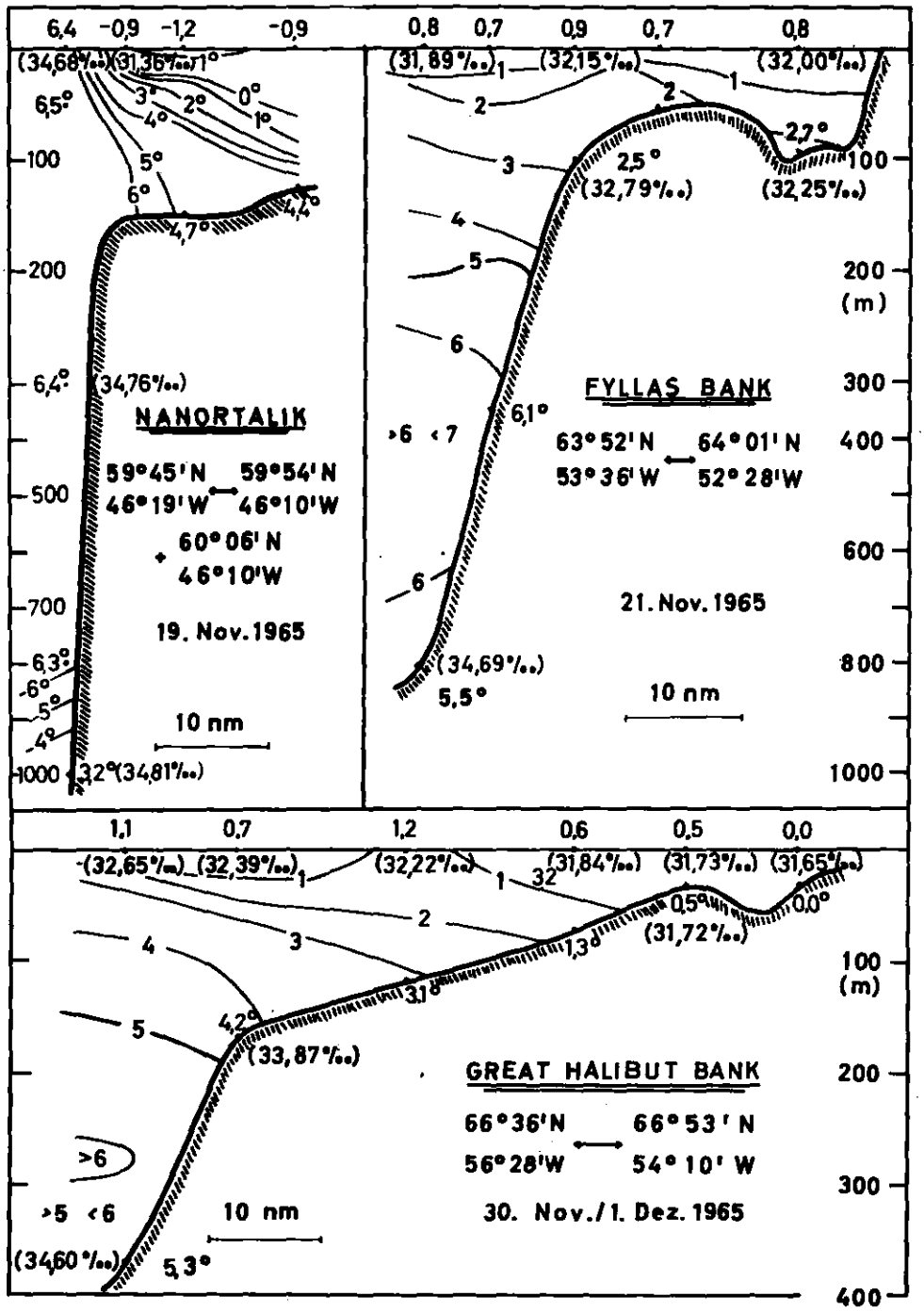


Fig. 2. Hydrographic sections off West Greenland, November-December 1965.

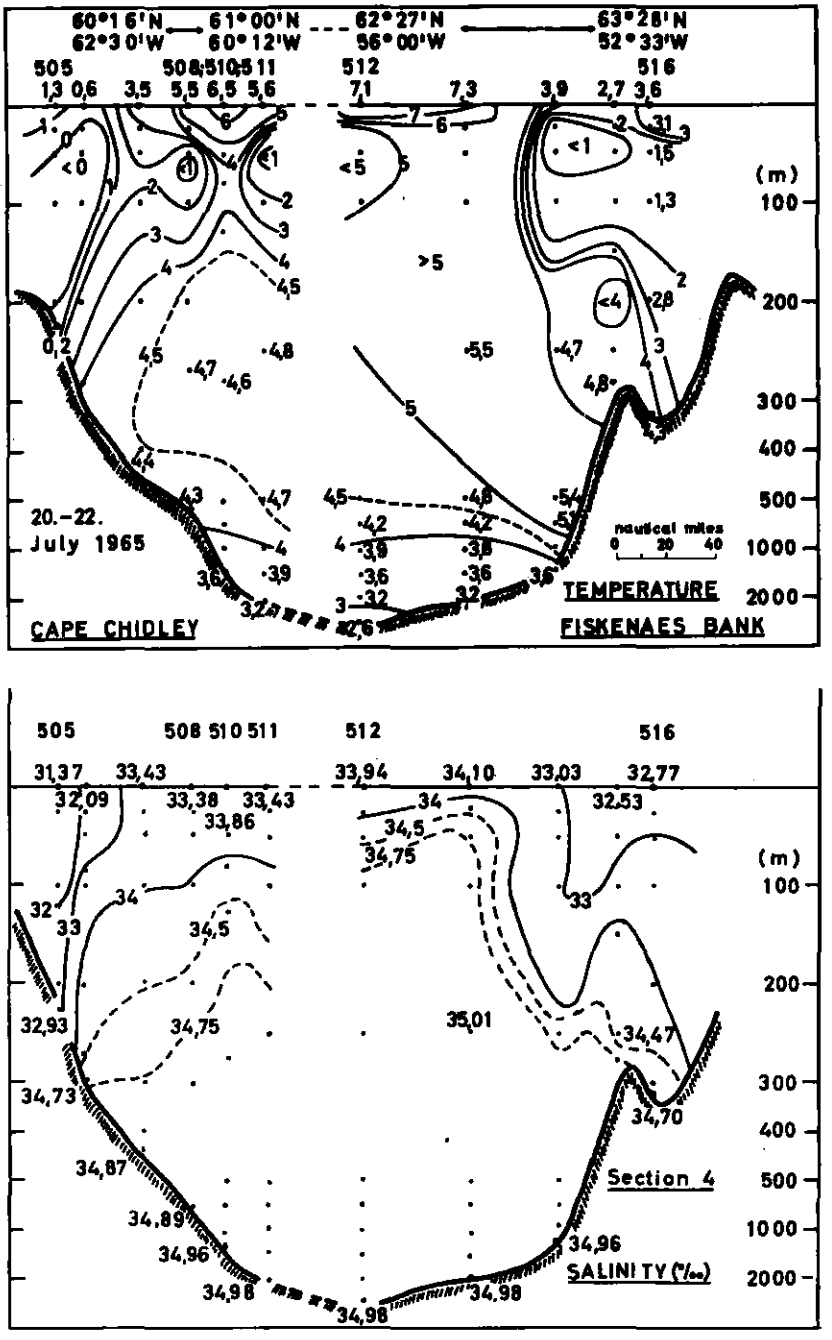


Fig. 3. Hydrographic section across Davis Strait from Cape Chidley (North Labrador) to Fiskenaes Bank, 20-22 July 1965. Salinity figures near the surface line refer to a depth of 25 m.

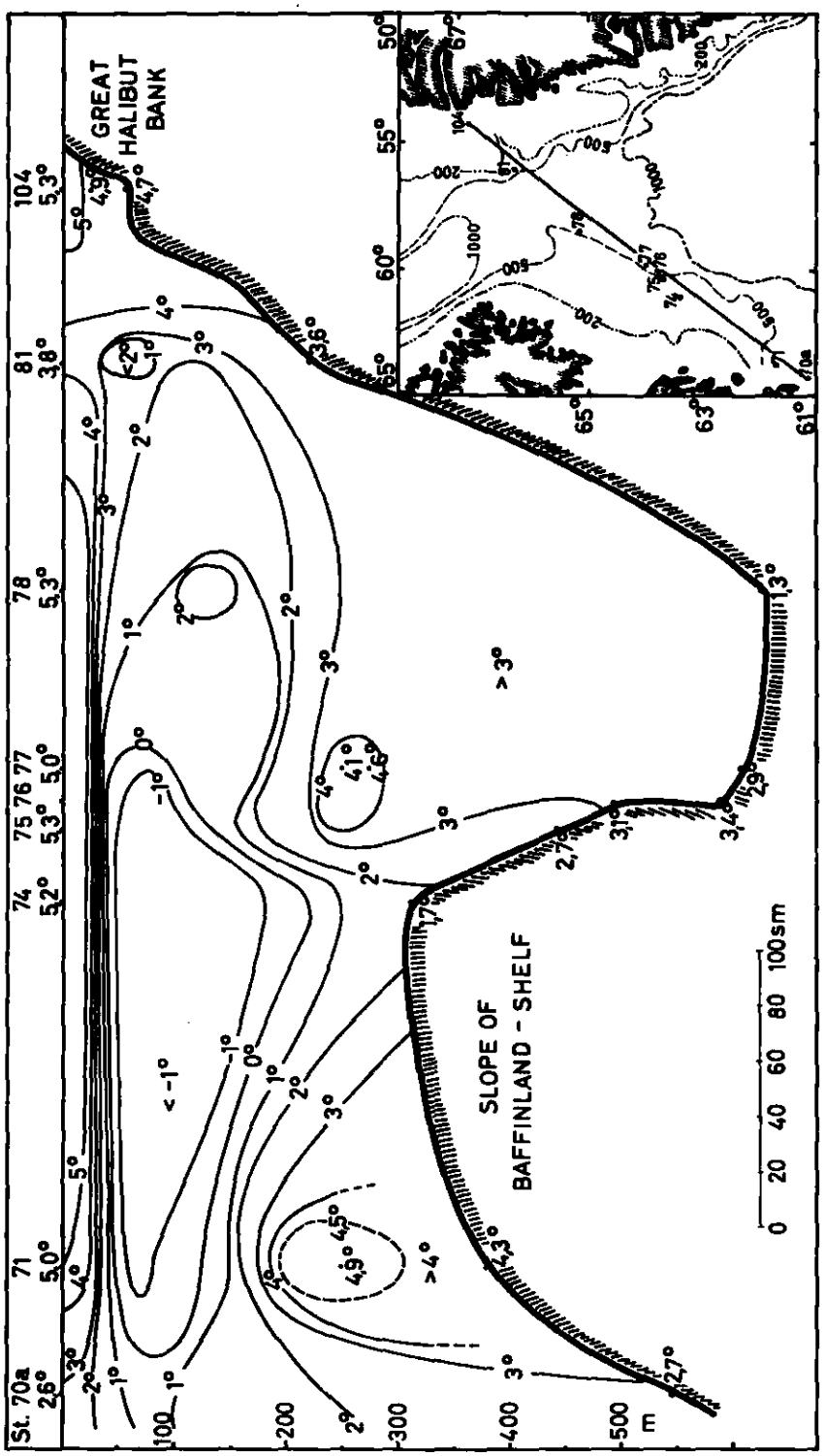


Fig. 4. Hydrographic section across Davis Strait from South Baffinland to Great Halibut Bank, 24-26 August 1965.

During early April some hydrographic work was done by *Walther Herwig* off East Greenland. The sections off Southeast Greenland (Fig. 5) show that Cape Tordenskjold Bank and Bille Bank are covered by the warm water of the Irminger Current. Compared with 1960 - there are no other early spring data - the temperatures in 1965 were about 1°C higher.

The two sections across Dohrn Bank (Fig. 6) show eddies and intensive mixing of Atlantic and Arctic water, typical for this region.

II. Biological Studies

1. Cod

a. Age and size of cod in commercial stock. The results of the age determinations of cod from samples of commercial landings, from samples taken on board factory ships and the *Anton Dohrn* and *Walther Herwig* (Fig. 7-9) provide information on the stock of cod and the special fishery conditions in 1965. They reveal that off West Greenland the very young year-classes of 1960 and 1961 (5- and 4-year-old fish) provided the major part of the fishery in 1965. Only during the short period in late winter and spring when concentrations of pre-spawners, spawners and post-spawners were fished, were the older rich year-classes of 1956 and 1957 of some commercial importance. However, these older year-classes, which in 1964 were still of the greatest commercial importance, must have become rather weak and gave such poor catches that most trawlers left Greenland waters during this period to fish off Labrador.

The strong 1960 year-class entered the fishery during the second half of 1964 and the strong 1961 year-class in 1965. Since June 1965 these 4-year-old cod (only 45 cm long at the beginning of the summer) were more heavily fished than the 1960 year-class. This is an alarming development on Greenlandic fishing grounds and shows the effects of the increased fishing intensity during the past years and the increasing trend of the fleet of factory ships to work the concentrations of young immature cod due to the present scarcity of the bigger and older fish.

In reality, the percentage of cod 4 years old and younger is higher than shown in Fig. 7. This is because the commercial catches do not include the large quantities of cod either discarded or turned into fish meal. According to reports of the captains in 1965, in Subarea 1 1,567 tons of small cod were discarded and a further 14,301 tons turned into fish meal. These figures are not included in Table 1. The gross catch thus amounts to 108,694 tons. Discards and industrial cod make up only 14.6% by weight, but these small cod are 43.4% by numbers! Of the 64 million cod caught by the German fleet in 1965 in Subarea 1, only 36 million could be used for human consumption! If the 28 million small cod (average length 40 cm), which grossed as fish meal 2.1 millions DM, could have been caught 1 year later (then 51 cm long and counted in a natural mortality of 20%), the trawler companies would have earned 13.5 millions DM or more than 6 times more. This is yet another

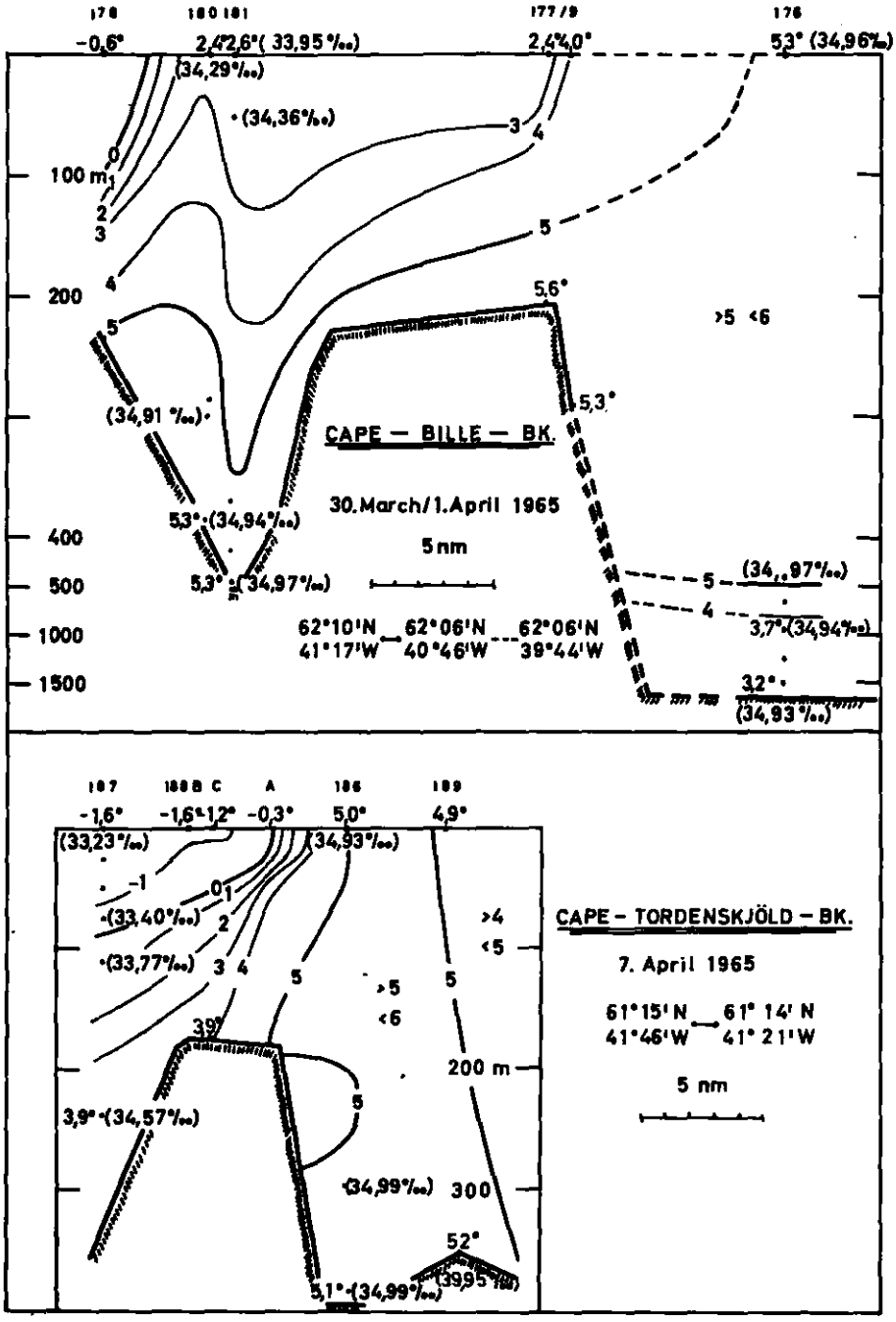


Fig. 5. Hydrographic sections off Southeast Greenland, March-April 1965.

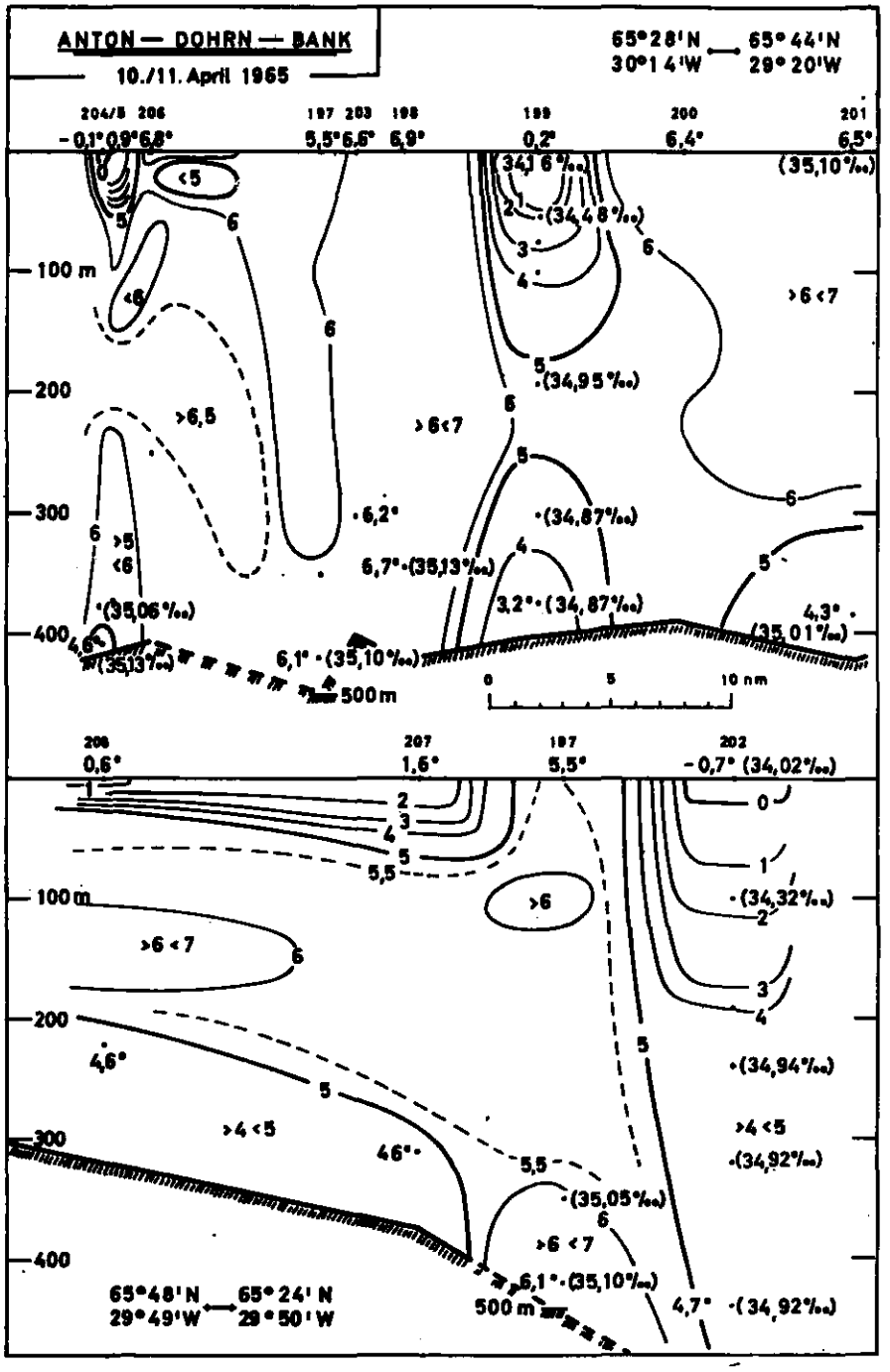


Fig. 6. Hydrographic sections across Anton Dohrn Bank, April 1965.

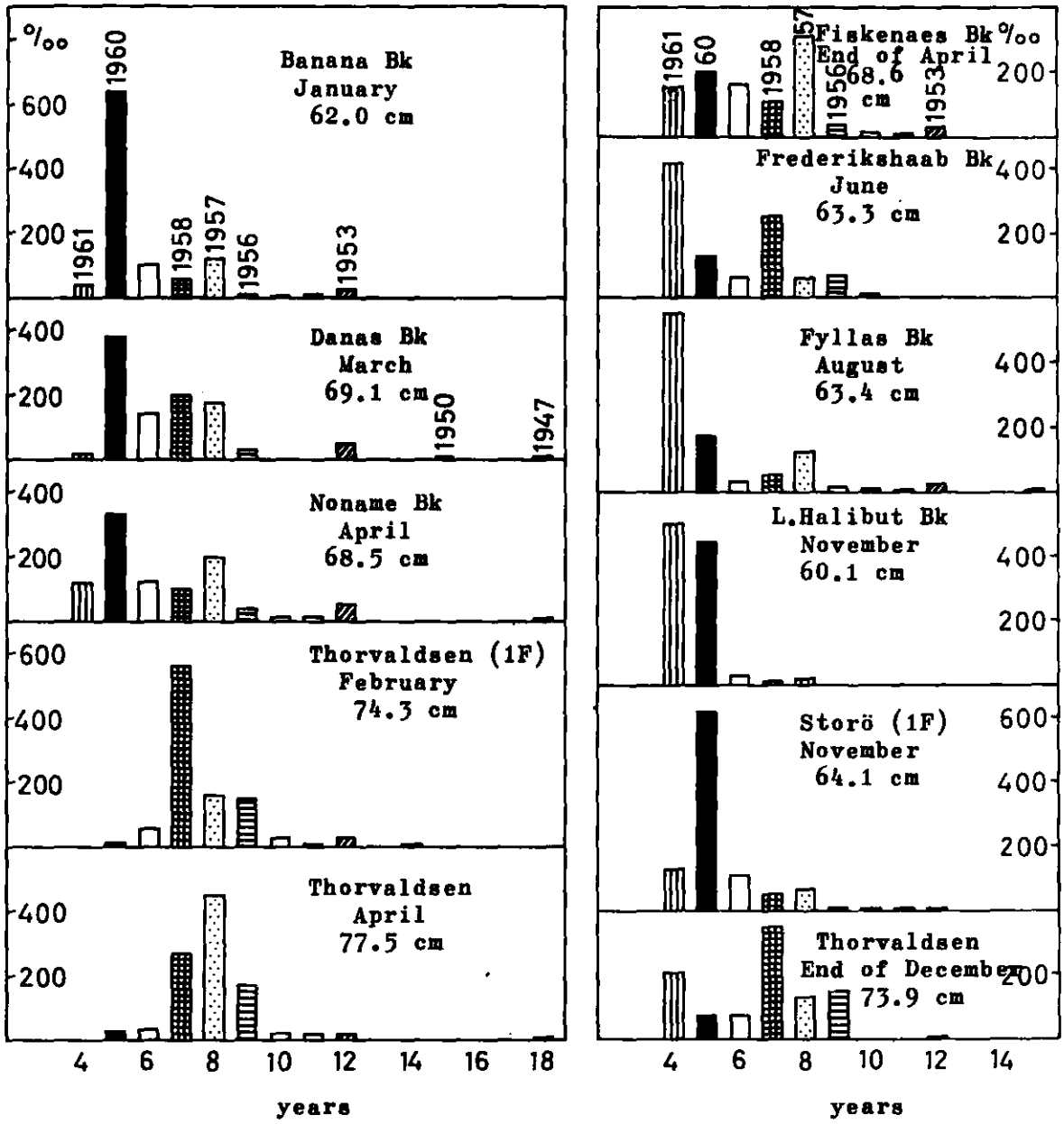


Fig. 7. Cod, Subarea 1; age composition of commercial catches in 1965.

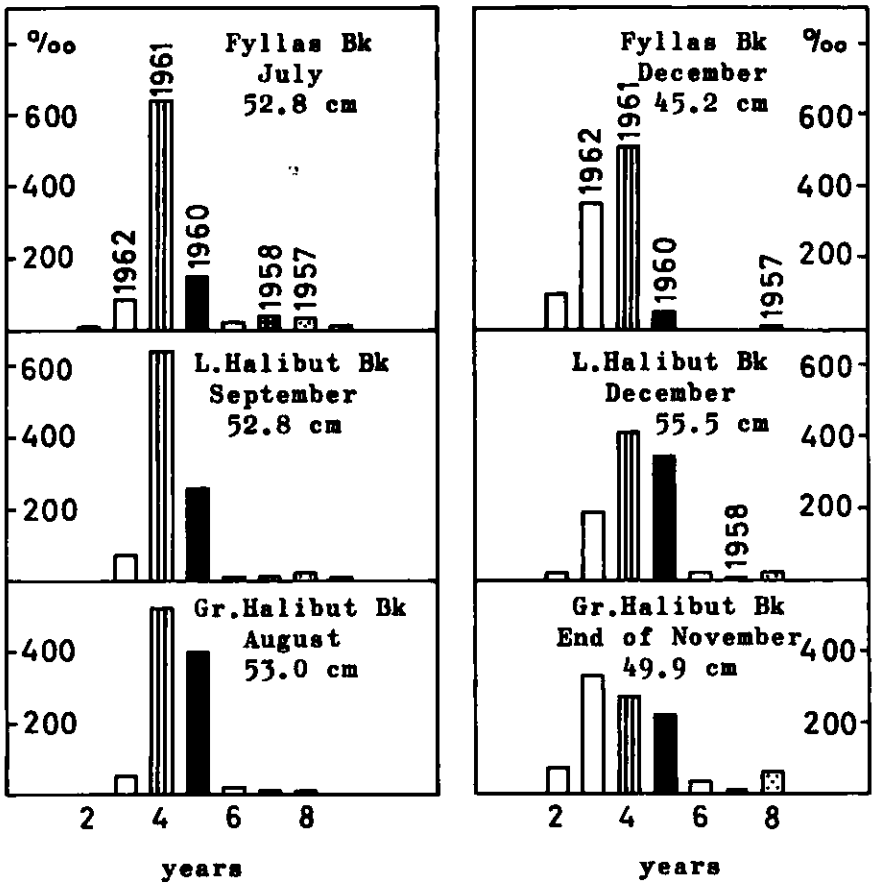


Fig. 8. Cod, Subarea 1; age composition of research catches in 1965, 110 mm mesh size, Fyllas Bank (December) and Great Halibut Bank (end of November) with covered codend.

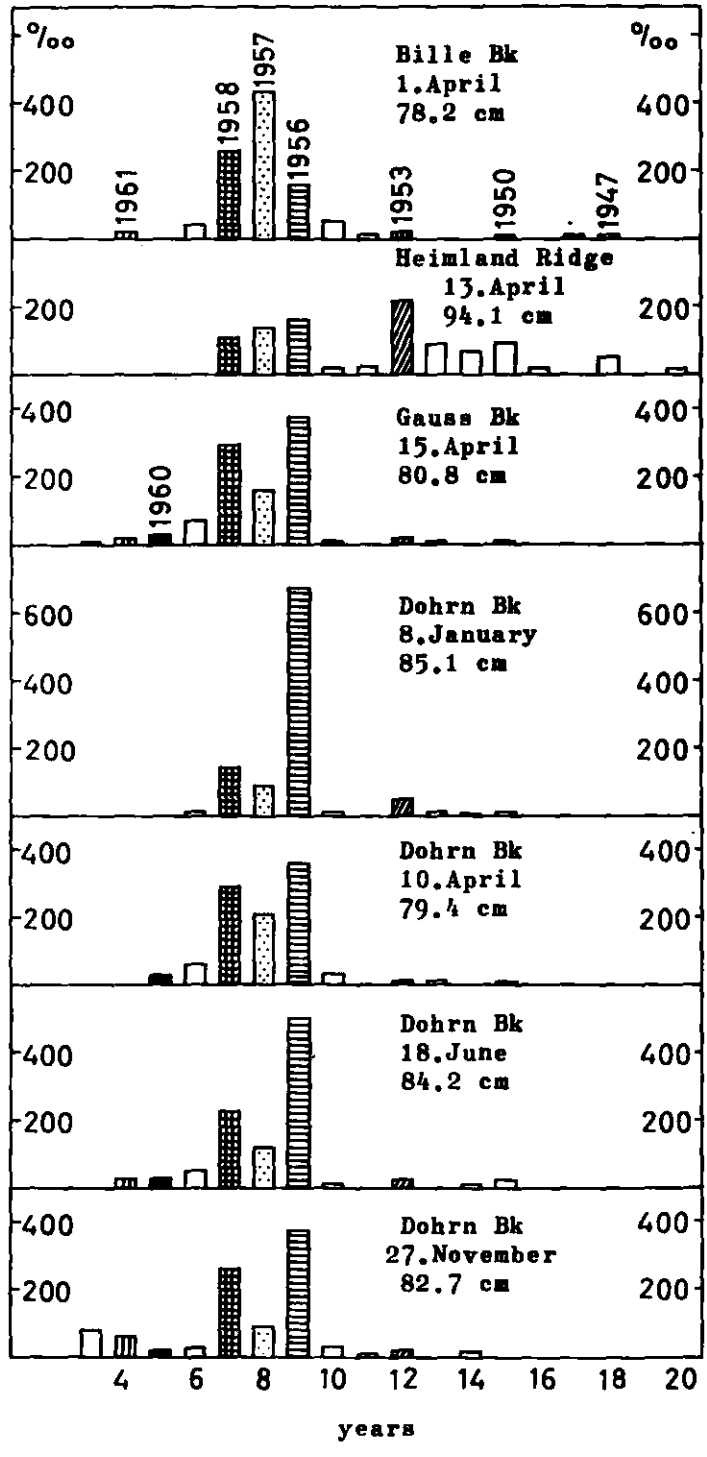


Fig. 9. Cod, East Greenland; age composition of commercial and research catches in 1965.

example to show the present uneconomic way of exploiting the Greenlandic stock of cod.

The high percentage of the younger year-classes is also shown by the research samples (Fig. 8). Especially informative are the catches with covered codend for mesh selection studies on Fyllas Bank (December) and Great Halibut Bank (end of November) which show a surprisingly high proportion of cod of the 1962 year-class. As far as is known, this year-class is only a medium or poor one. The average age of all cod caught with covered codend was 3.5 years on Fyllas Bank and 4.1 years on Great Halibut Bank!

Bigger and older cod were found in 1965 almost only off South and Southeast Greenland and only in rather small quantities. Again, the 1956, 1957, and 1958 year-classes were the most important. Compared with 1964 the percentage of the 1958 year-class increased and that of 1956 decreased (Fig. 9).

Again the spawning migration from Subarea 1 to East Greenland could be traced. The East Greenland 1956 and 1958 year-classes moved northeastward up to Dohrn Bank to spawn. The 1957 year-class, as in 1964, spawned mainly off Southeast Greenland but further northeastward. For the first time, commercial concentrations of spawners were found on Heimland Ridge (temperatures 4.5°C). The fish were rather old and large (Fig. 9). This is the same area where the biggest and probably oldest redfish (giants) are found most frequently.

b. Increased growth rate of West Greenland Cod. Now after 14 years of German fishery off Greenland, a study of the growth of cod caught in Div.1B, 1C, and 1D, was undertaken. The average lengths of the age-groups 2 to 10 at the end of the feeding season (end of December) show a striking difference in the two periods 1953-1960 and 1961-1965 (Table 2). The faster growth in the latter period means an average increase in weight (gutted weight) of 32% for each age-group.

Table 2. Average length and average gutted weight of West Greenlandic cod at the end of December in Div.1B, 1C, and 1D in 1953-60 and 1961-65.

Age-group	1953-1960 Length (cm)	1953-1960 Weight (g)	1961-1965 Length (cm)	1961-1965 Weight (g)	Increase in weight (%)
2 (end of 3rd feeding season)	?	-	32	250	-
3 (" " 4th " ")	40	510	44	670	31
4 (" " 5th " ")	49	915	54	1,260	38
5 (" " 6th " ")	58	1,555	64.5	2,035	31
6 (" " 7th " ")	67	2,250	71.5	2,705	20
7 (" " 8th " ")	70	2,540	76.5	3,290	30
8 (" " 9th " ")	73.5	2,930	80.5	3,820	30
9 (" " 10th " ")	75	3,100	84	4,360	41
10 (" " 11th " ")	77	3,475	85.5	4,600	32
					av. 32

The calculated average length of the younger year-classes is influenced by the selectivity of the net and by discarding. In the figures given in Table 2 errors of this kind were excluded.

2. Redfish. No special research for Greenlandic redfish was carried out. During the commercial fishery in Subarea 1, 32 tons were discarded and 1,903 tons processed into fish meal (mostly on salting trips). On a scouting trip in August across Davis Strait from South Baffinland to Holsteinsborg Deep, few small redfish (0.7-2.5 baskets per hour) were found in 430 to 600 m at bottom temperatures of 3.4° to 4.3°C. Their average length was 27.4 to 32.1 cm.

3. Other fish. On the August trip in Davis Strait, only small quantities of Greenland halibut were found (up to 8 baskets per hour in 430 to 690 m, temperatures 1.3° to 4.3°C). The average length was 59.8 cm. Macrurids (*Coryphaenoides rupestris*) were the only fish caught in greater quantities (up to 47 baskets per hour, 600 m, 1.3°C bottom temperature).

4. Tagging experiments. In 1965, a further 268 cod were tagged off West Greenland, 93 off East Greenland. Of 3,300 cod tagged off Greenland to the present, 8% were recovered off Greenland and Iceland.

B. Subareas 2-5
by J. Messtorff

Subarea 2

A. Status of the Fisheries

Landings and catch per fishing day of German trawlers are given in Tables 1a and 1b. Due to the decreasing catches off Greenland there was a remarkable increase of fishing off Labrador in 1965. In comparison to the preceding year (8,086 tons in 1964) the total landings from the subarea amounted to over four times as much. Fishing took place throughout the year but 95% of the catches were landed during the first half of the year with the peak of 66% in March/April. Whereas the landings from Labrador amounted to only 7% of those from West Greenland (Subarea 1) in 1964 they reached 33% in 1965. The average annual catch per fishing day rose from 16.3 (1964) to 27.6 tons.

I. Cod

As a matter of fact the increased German fishing activity in the subarea was purely on cod. Only 8% of the total landings (round fresh weight) consisted of other species including redfish. In the previous year, cod made up only 30% of the landings. In comparable months (April, July-December) during which fishery was carried out in both 1964 and 1965 the mean catch of cod per fishing day increased from 7.2 to 23.2 tons (round fresh weight). In the months (January-March, May, June) during which fishing took place only in 1965

Table 1a: Subarea 2, landings in metric tons, 1965

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year landing weight	roundfresh weight	Convers. factor
Subarea 2															
Cod	34	3494	11505	7723	3209	931	967	346	27	31	72	702	29041	36011	1.24
Redfish	4	352	1182	517	158	59	193	97	11	13	47	36	2669	2856	1.07
Catfish		29	33	0	0		1	1	1	2	1	o	68	85	1.25
Witchflounder		23	3	27									53	59	1.11
Halibut		5	18	5	2	2	7					3	42	47	1.11
Greenland Halibut		8	78	4	3	1					1		95	105	1.11
Other fish	0	13	52	35	12	2	43			1	0		158	164	1.04
Fishmeal	5	288	1456	1335	370	148	137	88	6	10	27	110	3980		
Products		84	158	88	7	2	3	10	2	0	6	6	366		
Total	43	4296	14485	9734	3761	1145	1351	542	47	57	154	857	36472	39327	
Div. 2G															
Cod				1043	1566	317							2926	3628	
Redfish				70	77	20							167	179	
Other fish*				202	192	53							447	43	
Total				1315	1835	390							3540	3850	
Div. 2H															
Cod				1672	826	227				14		702	3441	4267	
Redfish				112	41	14				6		36	209	224	
Other fish*				323	101	38				6		119	587	56	
Total	-	-	-	2107	968	279	-	-	-	26	-	857	4237	4547	
Div. 2J															
Cod	34	3494	11505	5008	817	387	967	346	27	17	72		22674	28116	
Redfish	4	352	1182	335	40	25	193	97	11	7	47		2293	2454	
Other fish *	5	450	1798	969	101	64	191	99	9	7	35		3728	360	
Total	43	4296	14485	6312	958	476	1351	542	47	31	154	-	28695	30930	

* including landing weights of fishmeal and products (liver/oil etc.), which are not contained in the corresponding roundfresh weights. See Table 4.

Table 2a: Subarea 3, landings in metric tons, 1965

Month:	I	III	IV	VII	VIII	X	XI	year landing weight	roundfresh weight	Convers. factor
Subarea 3										
Cod	42	119	22	3134	2979	39	30	6365	7893	1.24
Haddock		10			27			37	44	1.20
Pollock		3			2			5	6	1.24
Redfish	5	100	6	89	723	5	19	947	1013	1.07
Catfish		4		3	6	1		14	18	1.25
Witchflounder				3	1		2	6	7	1.11
Halibut		2		4	21			27	30	1.11
Greenland Halibut		4			2			6	7	1.11
Other fish		4	6	122	437	8	0	577	600	1.04
Fish meal	5	4	4	426	725	15	11	1190	-	
Products		5	0	69	35	1	2	112	-	
Total	52	255	38	3850	4958	69	64	9286	9618	
Div.3K										
Cod	21		22		108			151	187	
Redfish	2		6		139			147	157	
Other fish*	3		10		85			98	34	
Total	26		38		332			396	378	
Div.3L										
Cod	4	39		2727	1290	39		4099	5083	
Haddock					6			6	7	
Redfish	1	96		77	342	5		521	557	
Other fish*	0	10		546	262	25		843	290	
Total	5	145		3350	1900	69		5469	5937	
Div.3M										
Cod	17						30	47	58	
Redfish	2						19	21	22	
Other fish*	2						15	17	6	
Total	21						64	85	86	
Div.3N										
Cod				407	1581			1988	2465	
Haddock					21			21	25	
Pollock					2			2	2	
Redfish				12	242			254	272	
Other fish*				81	882			963	330	
Total				500	2728			3228	3094	
Div.3P										
Cod		80						80	99	
Haddock		10						10	12	
Pollock		3						3	4	
Redfish		4						4	4	
Other fish*		13						13	4	
Total		110						110	123	

a mean catch per fishing day of 29.8 tons was recorded and the average annual catch per fishing day amounted to 27.2 tons in 1965.

Most catches (78%) were taken from Div.2J followed by 2H (12%) and 2G (10%).

II. Redfish

Contrary to the intensified fishing activity and the increased total landings, catches of redfish decreased considerably from 4,546 tons in 1964 to only 2,856 tons in 1965. The proportion of redfish in the 1965 catches was only 7% against 52% in 1964. The average annual catch per fishing day dropped from 11 (1963) and 9.2 (1964) to 2.2 tons in 1965. This very pronounced decrease seemed not only to be connected with the favoured exploitation of the available cod concentrations but also exploratory fishing surveys along the slope of the Labrador shelf in June, July and August 1965 either failed in detecting worthwhile redfish concentrations or found a strong infestation of parasites (*Sphyrion lumpi* as well as nematodes in the muscle tissue). The proportion of infested redfish was too high (up to 30%) for profitable processing by refrigerated trawlers.

B. Special Research Studies

I. Environmental Studies

During three research exploratory cruises, hydrographic observations were carried out by the *Walther Herwig* in June, the *Anton Dohrn* in July and the specially equipped stern trawler *Kap Farvel* in August.

Temperature - and partly salinity - sections across the Labrador Current, especially within the frontal area of the cold and warm components, were made off Hamilton Inlet in June and July, off Cape Mugford in June, and off Cape Chidley in June and July. In addition vertical temperature distributions at scattered fishing stations along the Labrador shelf were ascertained by bathythermograph from surface to 275 m and, where necessary, by reversing thermometers at deeper levels and at bottom.

Hydrographic observations were extended over the northern border of Subarea 2 to Baffin Island by two sections off Resolution Island and off the southeast coast of Baffin Island in June and scattered observations in August.

Further observations in Subarea 2 were obtained by the *Walther Herwig* in January 1966.

Separate publication of the results obtained is in progress.

II. Biological Studies

1. Cod. As most landings were processed and refrigerated at sea only a few market samples could be taken. But during field investigations of the *Walther Herwig* and the *Anton Dohrn* and the *Kap Farvel* in June, July and August 1965 and of *Walther Herwig* in January 1966, a more extensive sampling of the exploited stock could be carried out and will provide research information on size and age distribution and gonad and feeding conditions of the offshore stock of Labrador cod.

In fishing trials off Baffin Island only a few age-group I cod (7-10 cm) were caught. These young fish may have crossed the Davis Strait by drifting westward with the West Greenland Current.

2. Redfish. On the research cruises mentioned above, samples for size, age, sex and depth distribution were taken along the edge of the shelf. North of Hudson Strait redfish became very rare.

3. Other fish. Beyond the shelf edge in depths exceeding 600 m relatively great quantities of macrurids (up to 3.5 tons per hour) were caught. Off Baffin Island, only Greenland halibut were caught regularly in small quantities (maximum catch 0.5 tons per hour in 600 m).

4. Tagging. In January 1966, 15 cod were tagged off Hamilton Inlet (2J).

Subarea 3

A. Status of the Fisheries

Landings and catch per fishing day of German trawlers are given in Tables 2a and 2b. Fishing activity of German trawlers increased somewhat and the landings were nearly doubled in comparison to the preceding year although the mean catch per fishing day decreased from 18.4 (1964) to 13.3 tons (1965). The total annual catch, however, was less than 10,000 tons and reached only 25% of the Labrador landings. About 95% of the landings as well as the fishing days were recorded in June/August. Preferred fishing region was Div.3L (62% of landings), followed by 3N (32%).

1. Cod. The cod fishery yielded 82% of the total catch from the subarea against 39% in 1964. Although the cod landings increased by 71% against 1964 there was only a slight increase of the mean catch per fishing day from 8.7 (1964) to 10.9 tons (1965). Most catches were taken from Div.3L followed by 3N (together 95%) but cod predominated also in the landings from Div.3K, 3M and 3P.

2. Redfish. Only 10% of the landings consisted of redfish. The mean catch per fishing day decreased considerably from 8.6 (1964) to 1.4 tons (1965) and the total catch reached only 40% of the 1964 landings.

Table 1b: Subarea 2, catch per fishing day in metric tons

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	landing weight	roundfresh weight
Subarea 2														
total	10,8	34.1	29.7	26.3	29.6	22.9	19.3	13.9	3.9	11.4	25.7	34.3	27.6	29.7
Cod	8,5	27,7	23.6	20.9	25.3	18.6	13.8	8.9	2.3	6.2	12.0	28.1	22.0	27.2
Redfish	1.0	2.8	2.4	1.4	1.2	1.2	2.8	2.5	0.9	2.6	7.8	1.4	2.0	2.2
trips	-	10	21	11	4	3	2	1	1	-	1	1	55	
fishing days	4	126	488	371	127	50	70	39	12	5	6	25	1323	
Div.2G														
total				26.3.	37.4	24.4							30.8	33.5
Cod				20.9	32.0	19.8							25.4	31.5
Redfish				1.4	1.6	1.3							1.5	1.6
trips				1	2	1							4	
fishing days				50	49	16							115	
Div.2H														
total				20.7	27.7	19.9				13.0		34.3	23.8	25.5
Cod				16.4	23.6	16.2				7.0		28.1	19.3	24.0
Redfish				1.1	1.2	1.0				3.0		1.4	1.2	1.3
trips				3	1	1				-		1	6	
fishing days				102	35	14				2		25	178	
Div.2J														
total	10.8	34.1	29.7	28.8	22.3	23.8	19.3	13.9	3.9	10.3	25.7		27.9	30.0
Cod	8.5	27.7	23.6	22.9	19.0	19.3	13.8	8.9	2.3	5.7	12.0		22.0	27.3
Redfish	1.0	2.8	2.4	1.5	0.9	1.3	2.8	2.5	0.9	2.3	7.8		2.2	2.4
trips	-	10	21	7	1	1	2	1	1	-	1		45	
fishing days	4	126	488	219	43	20	70	39	12	3	6		1030	

Table 2b: Subarea 3, catch per fishing day in metric tons, 1965

Month:	I	III	IV	VII	VIII	X	XI	year landing weight	roundfresh weight
Subarea 3									
Total	6.5	15.0	19.0	11.7	13.9	9.9	12.8	12.8	13.3
Cod	5.3	7.0	11.0	9.5	8.4	5.6	6.0	8.8	10.9
Redfish	0.6	5.9	3.0	0.3	2.0	0.7	3.8	1.3	1.4
trips	-	1	-	6	6	-	0		13
fishing days	8	17	2	329	356	7	5		724
Div.3K									
Total	8.7		19.0		15.8			15.2	14.5
Cod	7.0		11.0		5.1			5.8	7.2
Redfish	0.7		3.0		6.6			5.7	6.0
trips	-		-		1				1
fishing days	3		2		21				26
Div.3L									
Total	5.0	29.0		11.4	9.2	9.9		10.6	11.6
Cod	4.0	7.8		9.2	6.3	5.6		8.0	9.9
Haddock					0.0			0.0	0
Redfish	1.0	19.2		0.3	1.7	0.7		1.0	1.1
trips	-	0		5	3	-			8
fishing days	1	5		295	206	7			514
Div.3M									
Total	5.3						12.8	9.4	9.6
Cod	4.3						6.0	5.2	6.4
Redfish	0.5						3.8	2.3	2.4
trips	-						0		0
fishing days	4						5		9
Div.3N									
Total				14.7	21.1			19.8	19.0
Cod				12.0	12.2			12.2	15.1
Haddock					0.2			0.1	0.2
Pollock					0			0	0
Redfish				0.4	1.9			1.6	1.7
trips				1	2				3
fishing days				34	129				163
Div.3P									
Total		9.2						9.2	10.3
Cod		6.7						6.7	8.3
Haddock		0.8						0.8	1.0
Pollock		0.3						0.3	0.3
Redfish		0.3						0.3	0.3
trips		1							1
fishing days		12							12

3. Other fish. The remaining 8% of the landings (712 tons) consisted of small quantities of haddock, halibut, witch flounder, pollock and other fish mainly from Div.3N and 3P

B. Special Research Studies

I. Environmental Studies

Hydrographic observations were obtained by the *Walther Herwig* during three research cruises in January, February and May/June 1965 and in January 1966 and by the *Anton Dohrn* in July 1965 and the *Kap Farvel* in August 1965.

The Canadian standard section Grand Bank-Flemish Cap was occupied (at least partly) by the *Walther Herwig* in February and May 1965 and January 1966. Further more or less scattered observations of temperature distribution were made at fishing locations off northern Newfoundland (3K), on the Grand Bank and along the southwest slope (3K, N, O), on Flemish Cap (3M) and on the banks off the south coast of Newfoundland (3P).

Separate publication of the results is in progress.

II. Biological Studies

1. Cod. Market sampling could not be carried out because the entire commercial catch was processed at sea. But, on the research trips mentioned above, cod samples, providing information on size and age distribution, have been taken from all divisions of the subarea. The material could not be analysed completely in time for the meeting but will be published at the earliest convenience.

2. Redfish. Research vessel samples providing information on size, sex, depth and type distribution and occurrence of parasites have been taken in all divisions of the subarea.

3. Other fish. Research vessel samples of haddock and pollock (size and age distribution) and white hake (length frequency) have been taken in Div.3O and 3P. In January 1966, a few large haddock (mean length 68.3 cm, n = 21) were caught at Flemish Cap. Canadian plaice *(Hippoglossoides platessoides)* were sampled for length frequency in Div.3L.

4. Tagging. In January 1966, 16 cod and 1 haddock were tagged at Flemish Cap (3M) and 75 cod off the south coast of Newfoundland (3Ps).

Subarea 4 and 5

A. Status of the Fisheries

Landings and catch per fishing day are given in Table 3. Only two factory ships and one smaller side trawler operated for a short period in

Table 3: Subarea 4 and 5, Landings and catch per fishing day in metric tons, March 1965

Division:	4 V		4 W		Total		5 Z	
	land.wt.	rd.fr.wt.	land.wt.	rd.fr.wt.	land.wt.	rd.fr.wt.	land.wt.	rd.fr.wt.
Cod	10	12	147	182	157	195	10	12
Haddock	26	31	54	65	80	96	37	44
Pollock	97	120	6	7	103	128	119	148
Redfish	-	-	9	10	9	10	-	-
Catfish	-	-	6	8	6	8	-	-
Halibut	1	1	3	3	4	4	1	1
Other fish	2	2	6	6	8	8	1	1
Fish meal	27		8		35		16	
Products	-		6		6		-	
Total	163	166	245	281	408	449		
	catch per fishing day							
Total	20.4	20.8	14.4	16.5	16.3	18.0	23.0	25.8
Cod	1.3	1.5	8.6	10.7	6.3	7.8	1.3	1.5
Haddock	3.3	3.9	3.2	3.8	3.2	3.8	4.6	5.5
Pollock	12.1	15.0	0.4	0.4	4.1	5.1	14.9	18.5
Redfish	-	-	0.5	0.6	0.4	0.4	-	-
Catfish	-	-	0.4	0.5	0.2	0.3	-	-
Halibut	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1
trips	-		1		1		1	
fish. days	8		17		25		8	

Table 4: "Discards and Industrial fish" in metric tons (roundfresh weight), 1965

	Over board				Converted to fish meal			
	Cod	Redfish	Other fish	Total	Cod	Redfish	Other fish	Total
Subarea 2	2288	13	55	2356	5545	35	691	6271
" 3	22	-	26	48	254	44	758	1056
" 4 + 5	30	-	-	30	90	-	10	100

January/February 1965 in both subareas (landings were recorded in March!). Their total catches reached only 18% of the 1964 landings but a direct comparison with the fishing operations of the preceding year is not possible on account of different times and locations of fishing. In 1965 pollock catches predominated with 42% (1964 - 11%) followed by 35% cod (1964 - 24%) and 21% haddock (1964 - 52%). Catches were made only in Div.4V (25%) and 4W (43%) and 5Z (32%). During this short period the average total catch per fishing day of 25.8 tons was rather high. This was due to the temporary good fishing conditions for pollock which yielded a mean catch per fishing day of 18.5 tons.

B. Special Research Studies

I. Environmental Studies

Hydrographic observations were obtained by the *Walther Herwig* in February 1965 in Subareas 4 and 5 and in January 1966 only in Subarea 4. Regular hydrographic sections could only be taken on a few occasions. Most observations followed the pattern of the fishing operations and were scattered over the Nova Scotian Shelf and Georges Bank. Nevertheless the available data provide some information on the hydrographic conditions at the time and in the area of investigation.

II. Biological Studies

Market sampling was not carried out because the entire commercial catch was processed at sea.

1. Cod. Dense cod concentrations which yielded catches of over 5 tons per hour were located by the *Walther Herwig* in January/February 1965 and 1966 in the western part of the Banquereau Gully and along the western slope of Cabot Strait (4Vn + s). Samples from these areas were collected on both cruises for age, length, growth and maturity studies.

2. Haddock. Samples for length, age and growth studies from different locations distributed over the Nova Scotian Shelf and Georges Bank were collected by the *Walther Herwig* in January/February 1965 and 1966.

3. Pollock. Only a few small samples could be obtained.

4. Other fish. Dense concentrations of large Canadian plaice were located by the *Walther Herwig* on Artimon Bank in February 1966. One catch/hour amounted to 7.5 tons! Length frequency data were obtained.

5. Tagging. In January/February 1966, 99 cod were tagged in Div.4Vn and 44 in 4Vs.

V. Icelandic Research Report, 1965

by Jón Jónsson

Subareas 1, 2 and 3

A. Status of the Fisheries

In 1965 Icelandic trawlers fished mainly in Div.1D, 1E, 3K, 3L and 3M. In the whole area, fishing effort was rather similar to that of the year before; there was a decrease in fishing effort in Subarea 1, but an increase in Subarea 3.

Table 1. Fishing effort and landings of redfish and cod by Icelandic trawlers in the ICNAF Area in 1964 and 1965.

Subareas	1		2		3		Total	
Years	1964	1965	1964	1965	1964	1965	1964	1965
Hours fished	2314	1918	111	368	1709	2117	4580	4403
Redfish (tons)	1954	1253	379		1999	1942	4341	3195
Redfish tons/100 hours	84	65	341		117	92	95	73
Cod (tons)	3091	3376	114	598	887	1235	4274	5209
Cod tons/100 hours	134	176	103	163	52	58	93	118

Cod and redfish constituted 97% of the total landings. As shown in Table 1 there was a substantial decrease in catch per unit effort of redfish in Subareas 1 and 3 compared to 1964. For the whole area the decrease in catch per unit effort of redfish was about 25%.

As for cod there was an increase of 31% in catch per unit effort in Subarea 1, but the total landings from this subarea were rather similar to those of the previous year. In the whole area the increase in catch per unit effort of this species was 27%.

B. Special Research Studies

1. Cod. Three samples for length and age were taken from commercial cod landings from West Greenland. The first one taken from the Lille Hellefiskebank in the beginning of April showed a marked dominance of the 1960 year-class (53%) and the 1959 year-class (22%). The second sample was from Fiskenaes Bank in the beginning of May, but in this sample the 1961 year-class was the most abundant (39%), followed by the 1960 year-class (22%). The third sample covers Fiskenaes, Noname and Danas Banks at the end of May. Here there was a clear dominance of the 1957 year-class (38%), but the 1960 year-class was second with 18%.

Three samples are available from the Angmagssalik area in April and they will show a very similar age distribution.

The 1956 year-class was dominant with 26%, then came the 1953 year-class (16.3%), followed by the 1957 year-class (14.3%) and the 1958 year-class (12.3%). This age distribution is rather like that of the Icelandic spawning stock of cod at the same time, except for the lack of the 1953 year-class in the samples from Iceland.

VI. Norwegian Research Report, 1965

by Erling Bratberg

Subarea 1

A. Status of the Fisheries

In 1965 the total output of the Norwegian cod fisheries in the ICNAF Area amounted to 39,728 tons. As in previous years the Norwegian fishing fleet operated mainly in Subarea 1, where the total catch of cod was 33,349 tons, while the catch in the other areas (mainly Subarea 3) was 6,379 tons. Compared to 1964, the landings from the ICNAF area decreased by about 4%. This decrease in total catch was probably partly due to some decrease in fishing effort as fewer long liners participated in the cod fisheries in 1965 as compared to 1964.

B. Special Research Studies

Research was carried out off West Greenland by the *Johan Hjort* from 7 April to 13 May. During this period 4 hydrographical sections were worked, 15 stations were fished for cod with bottom longline and 25 hauls with trawl were made in connection with mesh selection and cod tagging experiments. An instrument for continuous measurement of the transparency of sea water at 2 m depth was in operation during the whole cruise. Temperature was measured on all the fishing stations and both the hydrographical and the fishing stations were sampled for cod eggs and larvae. The material sampled is unfortunately not worked up in detail but some preliminary results are given below.

I. Environmental Studies

1. Hydrography. Several hydrographical stations had to be omitted as heavy drift ice concentrations covered the southern bank areas between Cape Farewell and the southern part of the Frederikshaab Bank. In the north, ice covered the bank areas north of the northwestern part of Lille Hellefiske Bank and Holsteinsborg.

In spite of the heavy drift ice conditions, the surface temperatures in the investigated area were higher than in 1963 and 1964. On the western slopes of the banks, water with temperatures below 2°C penetrated down to 130-160 m, while the thermocline was found in 20-50 m west of the banks. The Atlantic component of the West Greenland Current seemed to be warmer than normal and the amount of water with temperatures about 5°C was greater than usual.

II. Biological Studies

1. Length and age composition of the cod stock. The mean length of the cod in the bottom longline catches varied greatly in the different catches,

from 62.3 cm to 68.2 cm. In Div.1C the mean length was 66.5 cm, in 1D 66.4 cm and in 1F 64.5 cm. The overall mean length in the bottom longline catches was 65.8 cm, a considerable decrease from 1964.

Of special interest were two bottom longline catches taken in deep water, 450-600 m, west of Banan Bank. The mean length of the cod in these two catches was about 88 and 90 cm. These fish seem to live in the deep water throughout the year and do not seem to mix with the ordinary West Greenland cod population. These two catches were not taken into account in making the calculations of the mean lengths mentioned above.

The mean length of the cod in the trawl catches in Div.1C was 55.0 cm and in 1D 64.4 cm. Compared to 1964 the overall mean length in the trawl catches decreased from 63.6 cm to 60.0 cm.

The decrease in mean length was probably due to the dominance of the 1960 year-class. In bottom longline catches, this year-class constituted in 1C 52%, in 1D 51% and in 1F 24%. In the trawl catches the 1960 year-class constituted in 1C 61% and in 1D 46%. Other important year-classes in the longline catches were in 1C the 1959 and 1957 year-classes, in 1D the 1959 year-class and in 1F the 1961 and 1959 year-classes. In the trawl catches also the 1961 and 1959 year-classes were of importance in 1C and the 1961, 1959 and 1958 year-classes in 1F.

VII. Polish Research Report, 1965

by F. Chrzan

Subareas 1-5

A. Status of the Fisheries

I. General

In 1965, 13 Polish factory trawlers fished mainly for redfish and a little less for cod in Subareas 2 and 3. They made 26 trips to the ICNAF Area compared with 21 trips made by 10 factory trawlers in 1964. In addition, 1 stern freezer trawler (1 trip) and 4 side freezer trawlers (7 trips) were operated in Subarea 5, mainly for herring. Total catches amounted to 56,630 metric tons, an increase from 37,843 tons taken in 1964.

Catches by major species in 1964 and 1965 are shown in Table 1.

Table 1. Catches by Polish vessels in the ICNAF Area in 1964 and 1965.

	1965		1964	
	metric tons	%	metric tons	%
Redfish	24,708	43.6	21,413	56.6
Cod	21,720	38.4	10,866	28.7
Flatfish	7,374	13.0	4,888	12.9
Other fish	1,381	2.4	641	1.7
Herring	1,447	2.6	35	0.1
Total	56,629	100.0	37,843	100.0

The above percentage data show a relative decrease in landings of redfish and increase of cod, other fish and herring. The greatest increase, both in tonnage and in percentage, has been for cod. The tonnage of flatfish caught was greater in 1965 but the percentage caught was nearly the same as in 1964.

The catch distribution and total fishing effort in 1965 is shown in Table 2.

There was one trip only to Subarea 1. With regard to the very low fishing yield, the trawler left these grounds for fishing grounds in Subarea 2. Table 2 indicates that fishing was carried out mainly in Div.2J and 3K, where the catches were good in winter and spring. The yield per day and fishing unit in these two divisions throughout the 1965 fishing period was 28.5 and 24.5 tons respectively. In comparison with data given for the year 1964, the yield per fishing unit in 1965 was greater in Div.2J and smaller in Div. 3K. In other divisions fished, the yield per day of the factory trawlers ranged from 16.1 (3N) to 37.7 (2H) tons.

Table 2. Catch and effort by Polish fishing fleet in ICNAF Divisions, 1965.

ICNAF Div.	Catch (m. tons)	No. hours fishing	No. hauls	No. days fished
Factory trawlers				
1B	17	30	19	2
1C	11	16	13	2
1F	16	17	12	2
2H	2,789	743	634	74
2J	19,046	7,554	4,717	679
3K	18,417	8,796	5,575	751
3L	3,313	2,827	1,501	199
3M	7,107	4,573	2,395	320
3N	290	269	128	18
4W	71	55	38	5
5Z	3,912	1,958	1,050	142
Freezer trawlers				
2J	1,009	1,187	619	101
5Z	630	885	412	71

The yield per one hour fished of the factory trawlers for the years 1962, 1963, 1964 and 1965 was 1.65, 2.15, 1.86 and 2.11 tons respectively. From the figures given above in 1965, both the increase in catch and yield per unit effort are obvious.

Table 3 shows the particular fishing grounds for redfish, cod and flatfish.

Table 3. Total catch (m. tons) of most important species in 1965

ICNAF Div.	Redfish	Cod	Flatfish
1B	-	15	1
1C	3	7	2
1F	-	16	-
2H	171	2,585	33
2J	8,162	9,398	2,270
3K	13,344	1,718	3,351
3L	1,109	910	1,294
3M	1,805	5,073	228
3N	89	77	117
4W	-	69	2
5Z	25	1,851	75
Total	24,708	21,719	7,373

II. Redfish

Fishing for redfish was carried out mostly in April and May in Div. 3K and in July and August in Div.2J. Catches were good in the spring, when in April and May the catch per 100 hours trawling for this species was 216.6 and 155.0 tons. In July and August the yield was less, giving 144.1 and 133.1 tons per 100 hours trawling respectively.

III. Cod

In January and February, Polish factory trawlers fished for cod mainly in Div.2J, where the catch per 100 hours trawling was 406.4 and 322.7 tons respectively. Ice hampered fishing. In May, in Div.3K, catches were generally poor, giving 31.9 tons of cod per 100 hours fishing. In the autumn the trawlers operated on Flemish Cap Bank, where the catches of cod per 100 hours in October, November, December amounted to 168.6, 105.5 and 104.5 tons respectively. On other fishing grounds and during other months of 1965 the catch of cod was quite poor.

IV. Flatfish

The fishery for flatfish was conducted mostly in March in Div.2J and April in Div.3K. The greatest abundance of flatfish, unfortunately for a short period, was found in Div.2J, where the average catch per 100 hours trawling was 311.2 tons. In Div.3K, this yield was 91.8 tons. In 1965, total catches of flatfish amounted to 7,373 metric tons of which there were 83 tons of Atlantic halibut and 956 tons of Greenland halibut.

V. Herring

The Polish herring fishery on Georges Bank in 1965 might be regarded as a pilot reconnaissance. In September the freezer trawlers had an average yield per 100 hours trawling of 87 tons of herring.

B. Special Research Studies

I. Hydrography

During two cruises of the *Wieczno* in April-May and August-October, the hydrographic studies were carried out from the Great Bank of Newfoundland to Georges Bank. The results of temperature measurements are given in Tables 4 and 5.

The surface salinities measured on fishing grounds oscillated from 32.18‰ on Banquereau Bank to 32.88‰ on the east slope of the Great Newfoundland Bank. At 50 m, the salinity was more constant (32.43 to 32.61‰).

Table 4. Water temperatures on fishing grounds in Subareas 3 and 4 in April-May 1965.

Date 1965	Fishing Ground	Position	Temperature in °C Depth in m							
			0	10	25	50	60	65	80	100
20 Apr	East of Great Nfld. Bank	46°11'N;48°32'W	0.75	0.37	-	-	-	-	-	0.10
2 May	Banquereau Bank	44°34'N;57°22'W	1.75	-	1.10	-	0.47	-	-	-
13 "	" "	44°21'N;58°01'W	1.87	-	1.68	1.12	-	1.11	-	-
16 "	" "	44°35'N;57°27'W	2.00	-	-	1.00	0.94	-	-	-
17 "	Artimon Bank	45°11'N;58°23'W	1.00	-	-	0.06	-	-	0.35	-

Table 5 shows that changes in surface temperatures on Georges Bank from August to October were rather small. In deeper layers, these changes were greater.

II. Plankton

Plankton samples were collected from the research vessel in April and May on slopes of Great Bank of Newfoundland and Banquereau Bank. Additional samples were taken in August and September on the fishing grounds of Georges Bank. Sampling of plankton was made from the bottom to the surface.

III. Biological Studies

1. Sampling. Between 16 April and 7 June 1965, catches made by the *Wieczno* were sampled in Div.3L, 3M, 3N, 3O, 3P, 4V, 4W. The total number of samples taken on this trip are shown in Table 6.

Table 6. Samples of fish taken from 16 April-7 June 1965.

Species	No. measured	No. of pairs of otoliths
Cod	35,050	4,732
Redfish *(mentella)*	12,719	1,467
Redfish *(marinus)*	414	303
American plaice	12,259	1,180
Witch flounder	840	275
Yellowtail flounder	4,072	446
Halibut	52	52
Greenland halibut	32	32
Haddock	7,502	275
Silver hake	472	102
Argentine	587	72

Table 5. Water temperature on fishing grounds in Subareas 3, 4 and 5 in August-October 1965.

Date 1965	Fishing ground	Position	Temperature in °C, Depth in m							
			0	20	40	60	80	100	140	150+
6 Aug.	SW slopes of Gr.Nfld. Bank	44°09'N 51°18'W	16,2	-	-	9,5	-	-	-	-
7 "	" "	44°25'N 53°09'W	15,9	-	-	1,8	-	-	5,7	-
8 "	" "	44°30'N 53°23'W	16,5	10,3	5,6	4,3	5,9	5,8	4,2	-
10 "	Banquereau	44°29'N 59°25'W	15,8	4,0	3,7	3,3	-	-	-	-
11 "	"	44°27'N 60°01'W	15,7	6,8	2,3	2,2	2,4	-	-	-
12 "	"	43°55'N 59°19'W	14,9	-	10,4	-	-	-	-	-
13 "	Sable Island Bank	43°36'N 60°09'W	14,7	13,5	2,2	1,5	-	-	-	-
14 "	" "	43°57'N 60°50'W	15,9	11,0	3,7	-	-	-	-	-
15 "	" "	43°44'N 60°34'W	15,5	11,9	4,9	-	-	-	-	-
19 "	Emerald Bank	43°21'N 62°12'W	18,5	11,3	5,7	3,3	2,7	3,5	-	-
19 "	" "	43°21'N 62°22'W	18,0	-	5,7	-	-	-	-	-
21 "	" "	43°09'N 64°02'W	16,5	11,6	1,6	1,3	1,2	-	-	-
22 "	La Have	43°32'N 64°21'W	9,1	4,0	2,5	0,8	1,4	2,4	-	5,3
31 "	Georges Bank N	42°04'N 67°36'W	15,4	13,3	11,4	-	4,9	4,6	-	-

Table 5. (cont'd)

Date 1965	Fishing ground	Position	Temperature in °C, Depth in m							
			0	20	40	60	80	100	140	150+
1 Sept.	" "	42°01'N 67°42'W	14,4	12,9	9,8	7,8	-	-	-	-
2 "	" "	42°05'N 67°36'W	15,5	13,5	13,2	-	-	-	-	-
3 "	" "	41°28'N 68°30'W	13,8	13,3	13,2	6,0	4,9	4,4	-	-
4 "	" " W	41° 69°20'N 32'W	14,8	13,6	13,0	11,6	-	-	-	-
6 "	" " S	40°36'N 68°10'W	16,0	16,8	10,3	7,2	6,9	-	-	-
8 "	" "	40° 67°34'N 24'W	17,2	13,7	6,4	5,9	6,1	6,1	-	-
9 "	" "	41°00'N 67°03'W	14,7	13,4	10,3	7,4	-	-	-	-
11 "	" " N	42° 67°10'N 12'W	13,6	11,4	10,1	8,0	-	-	-	-
12 "	" "	42°12'N 67°32'W	14,2	13,0	10,0	8,5	4,3	3,8	4,7	-
15 "	Brown Bank	42°34'N 66°10'W	12,7	7,7	4,3	4,4	4,1	3,5	-	3,9
17 "	Georges Bank N	42°02'N 67°41'W	13,7	13,6	9,8	8,4	-	-	-	-
18 "	" " W	41°30'N 66°34'W	14,5	11,9	10,8	7,3	5,8	-	-	-
20 "	" "	41°07'N 68°47'W	14,3	-	-	-	9,6	-	-	-
22 "	" " S	40°48'N 68°06'W	16,4	15,5	10,1	9,5	-	-	-	-
24 "	" "	40°33'N 67°52'W	16,4	12,4	9,1	6,4	-	6,7	-	-
25 "	" " N	41°56'N 67°08'W	14,6	12,4	-	-	-	-	-	-
1 Oct.	" "	42°00'N 67°27'W	13,8	13,4	-	-	-	-	-	-
2 "	" " S	40°05'N 69°12'W	14,2	13,8	12,6	13,7	6,8	12,1	-	-

During the second trip of *Wieczno* between 6 August and 2 October, the sampling was carried out in Div.4V, 4W, 4X and 5Z. The samples collected are shown in Table 7.

Table 7. Samples of fish taken from 6 August-20 October 1965.

Species	No. measured	No. of pairs of otoliths
Haddock	29,637	1,355
Herring	24,077	1,770
Silver hake	4,264	320
Mackerel	2,176	488
Redfish *(mentella)*	4,225	-
Red hake	658	90
Argentine	4,739	426
Alewife	811	259
Blueback	394	60
Butterfish	944	80
Pollock	9	9
Cod	1,271	22
Ocean pout	54	54
American plaice	1,757	107
Yellowtail flounder	1,006	105
Witch flounder	76	21
Halibut	37	37

The results of these measurements will be presented in the *Sampling Yearbook* for 1965.

2. Cod. Throughout the 1965 fishing season on the different grounds of Subareas 3 and 4, the length composition of cod in the catches ranged from 25 to 80 cm. In the Newfoundland area the fish were considerably older and longer than on the fishing grounds of Nova Scotia. Mean length of Newfoundland cod was 57.9 cm and of Nova Scotia cod 47.5 cm. The fish were 3 to 7 years old (1962 to 1958 year-classes).

In Div.3M the 1958 year-class (mean length 52.8 cm) was very abundant, while in Div.3L different year-classes - 1962 to 1958 (mean length 49.9 cm) - were observed. In the northern part of Div.3O the year-classes 1959 and 1958 (mean length 66.0 cm) were dominant, while in the same Div.3O but on the Green Bank the year-classes 1962 and 1961 were dominant. In Div.3P the year-classes 1962 to 1958 were represented in the catches (mean length 54.1 cm).

On the Nova Scotia fishing grounds (Div.4V and 4W) the 1963 to 1961 year-classes (mean length 37.1-57.6 cm) were mainly caught.

The investigation of racial characteristics show that average number of dorsal fin rays of cod on Scatari Bank and on Flemish Cap Bank was 19.73

and 21.08 respectively. The average number of vertebrae from cod on the east slopes of Great Bank of Newfoundland was 53.49; on St. Pierre Bank, 53.43 and Banquereau Bank, 53.20.

3. Redfish. The catches of redfish in 1965 were made at depths of more than 200 m. Of the two types of redfish, the *mentella*-type made up 90-100% of the total weight of both types. On the fishing grounds of Newfoundland and Flemish Cap (Div.3K, 3P, 3M) the mean length of redfish was 25.9 cm, whereas on the fishing grounds of Nova Scotia (Div.4V and 4W) the mean length was 28.1 cm.

The largest *mentella*-type redfish were 35.0 cm mean length and were captured on Flemish Cap.

The mean length of *marinus*-type redfish from Flemish Cap was 43.1 cm, however north of Burgeo Bank (Div.3P) - 46.3 cm.

Observations on the stage of sexual maturity carried out from the second half of April till the first week of June have shown that on the fishing grounds of Newfoundland the greater number of redfish have gonads in the resting stage, while in May on the fishing grounds of Nova Scotia a large proportion of redfish (up to 8.4%) have larvae developing in the gonads and have quite mature eggs.

4. Flatfish. Length measurements of American plaice were taken during fishing operations on the fishing grounds of both Newfoundland and Nova Scotia. The mean length of these fish were from 27.6 to 45.2 cm respectively. The most abundant among them were the length classes 30 to 40 cm.

Individual weights ranged from 250 to 2,150 grams (mean 979 grams).

In the samples there were found to be present fish from 2 to 28 years old (year-classes 1963-1936). In the catches fish 6, 7, 8 and 9 years old (year-classes 1959, 1958, 1957 and 1956) predominated.

Witch occurred only on the fishing ground of St. Pierre Bank and over the southern slopes of the Great Newfoundland Bank. Mean lengths in catches ranged from 32.0 to 42.0 cm.

Yellowtail was found in Div.3L, 3O, 3P, 4V and 4W. Length composition included fish of mean length 32.0 to 42.0 cm.

5. Haddock. In August large concentrations of haddock were encountered over the western slopes of Georges Bank. The best catch was 3,500 kg per hour, with 92% haddock. According to samples the catch consisted mainly of fish 3 years old (26.5%), 4 years old (30.4%) and 5 years old (38.3%), making in total 95.2%. Most abundant in the catch were fish of 38 to 42 cm length. On other fishing grounds, haddock occurred in considerably smaller number dispersed over various feeding grounds.

6. Silver hake. In August abundant concentrations of this species were found only over the northern and western slopes of Georges Bank. In trawl catches made on these fishing grounds silver hake was only 4 to 17% of the landed mass and was taken at a rate of 150 to 185 kg per hour. Fish of 27-29 cm length were most abundant in these catches. In the region of Sable Island Bank, where silver hake was scarce and was a by-catch of 1.4%, the individuals were mostly large fish, reaching the length of 33 to 38 cm. In the samples fish were 3 to 8 years old, though the most abundant were 5 and 6 years old and amounted to 44.7% in relation to total mass of silver hake landed.

7. Argentine. In August and September over the northwestern slopes of Sable Island Bank, up to 3,500 kg per hour of argentine were taken in some hauls. On Sambro Bank the catch of argentine alone reached 2,400 to 4,000 kg per hour. Slightly smaller yields were obtained from Browns Bank. Fish 22-26 cm long were most abundant in the catches.

During the spring months two size-groups of argentine occurred on the fishing grounds of Sambro Bank. Here, the mean length of the smaller fish was 17-19 cm and, of the larger fish, 27-28 cm.

From the samples it was found that the catches consisted mainly of fish 4, 5, 6 and 7 years old (total 53.5%). The life span of the fish aged was in general large; some individuals were 30 years old and about 50 cm long.

8. Herring. Samples were taken from the herring catches made on Georges Bank. Age compositions revealed that, in the period August-October, herring belonging to the year-classes 1960 and 1961 made up 68.8% of the catches. These fish were 24.0 to 36.9 cm long. Herring of the length 28.0 to 31.9 cm made up 85% of catches. Mean length of particular age groups of herring were as follows: II (year-class 1962) - 26.0 cm; III (1961) - 27.6 cm; IV (1960) - 29.0 cm; V (1959) - 30.5 cm; VI (1958) - 31.7 cm; VII (1957) - 32.8 cm and VIII (1956) - 33.5 cm.

9. Other species. The data relating to other species is presented in Res.Doc.66/42, B. Draganik and Cz. Zukowski - The rate of growth of butterfish *(Poronotus triacanthus)* (Peck) and ocean pout *(Macrozoarces americanus* Block and Schneider*)* from the region of Georges Bank.

IV. Studies on Selectivity

In order to eliminate double codends used by stern trawlers, investigations were made on codends which were enforced in one case with netting having meshes double the size of the meshes of the primary netting of the codend itself; in another case with netting having meshes four times larger than the primary netting. After such kind of chafing gear was applied, the selectivity was investigated and found to be sufficiently good. The investigations included the following species: cod, haddock, redfish, American plaice and yellowtail. The results, in detail, are presented in Res.Doc.66/21, W. Strzyzewski - The effect of the use of chafing gear on the selection factor.

Some further investigations also dealing with selectivity are given in another Res.Doc.66/28, B. Draganik and Cz. Zukowski - Investigations on the selectivity of bottom trawl codend, type BS-2, in relation to haddock.

V. Economical Study

Fishery economists were present on board the factory trawler *Andromeda* on her second trip (19 August-18 December 1965) to the ICNAF fishing grounds, collecting data and studying problems of vessel operation and catch disposal (production of fillets, headed fish meal, oils).

As regards fish stock conservation, the crew aboard the vessel reported that in consideration of economic aspects, they were as a rule in search of sizes of fish (cod and redfish) which would be best suited for the processing line requirements, i.e. they avoid catches of small, young fish.

VIII. Portuguese Research Report, 1965

by Manuel Lima Dias

During 1965 the Portuguese catch of cod in the ICNAF Area amounted to 197,157 metric tons as indicated below:

Subareas:	1	2	3	4	Total
Otter Trawl	2,737	72,836	34,649	14,665	124,887
Line Trawl (Dory Vessel)	57,946	-	14,324	-	72,270
Total	60,683	72,836	48,973	14,665	197,157

The otter trawlers operated in four subareas and the catches are almost double those made by the line fishery, which was carried out mainly in Subarea 1.

A decrease in total catch of about 13,100 tons from 1964 is due to the very low catches made by both otter trawlers and dory vessels in Subarea 3, that the increased catches in Subareas 1 and 2 could not quite make up for.

This report presents the status of the fisheries in the four subareas where the Portuguese fleet fished and includes observations made from commercial trawlers in Subareas 2 and 3. From these, there are data on lengths, ages, stage of maturity and probable age at first maturity. Samples were taken at random before discarding the undersized fish; for the age/length keys the same procedure is followed as in our previous reports. Detailed information on the samples will be included in the *Sampling Yearbook* for 1965.

Subarea 1

A. Status of the Fisheries

I. Cod

In this subarea the otter trawl fishery has been of minor importance. Best results came from Div.1B (1,461 tons) and 1D (1,218 tons) between May and September. Fishing in Div.1C, 1E and 1F, at the same time, gave only 58 tons.

The dory vessels were active in Div.1B, 1C and 1D with very good results in Div.1B where the landings were 29,848 tons, almost 50% of the total landed in the subarea. In 1D and 1C, 17,490 tons and 10,608 tons respectively were caught. Best catches in Subarea 1 were made in June and July.

Subarea 2

A. Status of the Fisheries

I. Cod

As in the previous year, only otter trawlers were fished in this subarea. The total catch (72,836 tons) represents an important increase of 31,689 tons from 1964. Catches in Div.2J, 2H and 2G were 57,992, 14,382 and 462 tons respectively. The highest production has been obtained during the second and fourth quarters of the year.

Samples for biological study were obtained in Div.2G, 2H and 2J from 19 March to 31 August as follows:

Sample Group	Sample numbers	Date	Depth (m)	No. lengths	No. aged
Div.2G					
A	9	28 Mar	370	400	0
Div.2H					
B	4-8	19-27 Mar.	240-400	625	225
Div.2J					
C	1-3	15-17 Mar.	290-420	175	100
D	10-24	4-25 Apr.	250-370	2,425	102
E	(25-30 (32,34,35 (37-43	1-31 May	170-400	2,900	126
F	44-49	1-15 June	195-290	1,300	37
G	50-56	24-31 Aug.	170-250	875	218

a. Lengths (Fig. 1). Lengths ranged from 25 to 97 cm classes. Mean lengths were A - 55.5, B - 50.3, C - 50.6, D - 52.8, E - 52.1, F - 51.2 and G - 51.9.

b. Ages (Fig. 1). In March the most important age-groups were the VI, VII and VIII in Div.2H and VI and VII in Div.2J.

From April onward in Div.2J the most important age-groups are VI, VII, VIII and IX (1959, 1958, 1957 and 1956 year-classes). Age-group III (1962 year-class) appeared for the first time in April with age-groups up to XXIII. However, in March the number of fish aged was comparatively small. In August age-groups IV-IX are still strong but the older ones are diminishing.

Mean ages are as follows: B - 7.5; C - 6.6; D - 8.1; E - 7.9; F - 7.7 and G - 6.6 years.

c. Growth is shown in the following table of average lengths (figures in brackets are numbers of fish):

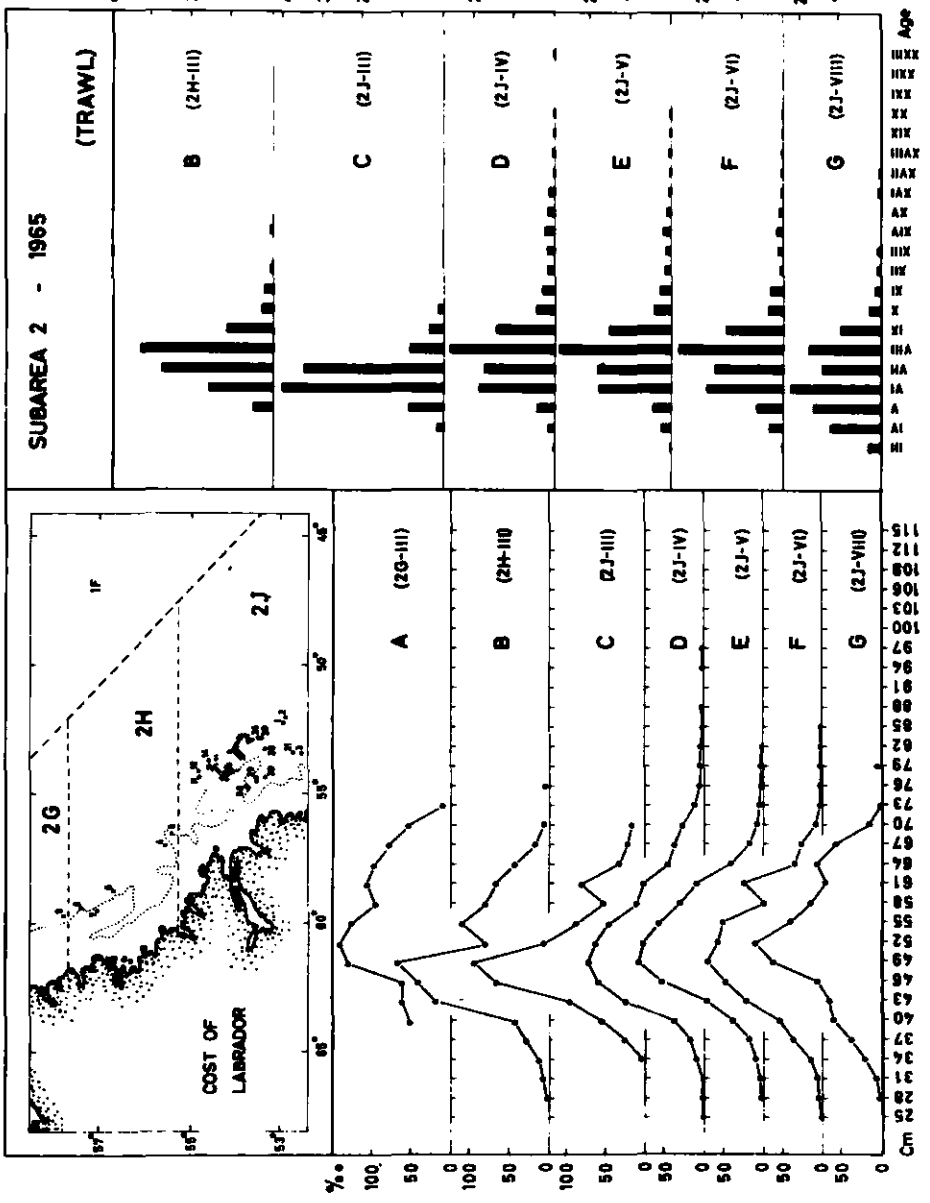


Fig. 1. Cod. Subarea 2. Length and age composition, March-August 1965.

Div.2H

Year-class	Age-group	1st Quarter
1960	V	38.9 (5)
1959	VI	45.6 (24)
1958	VII	47.2 (53)
1957	VIII	53.2 (90)
1956	IX	57.9 (35)
1955	X	60.1 (9)
1954	XI	65.8 (6)
1953	XII	58.0 (1)
1952	XIII	- -
1951	XIV	55.0 (2)

Div.2J

Year-class	Age-group	1st Quarter	2nd Quarter			3rd Quarter
		Mar.	Apr.	May	June	Aug.
1962	III	-	28.4	29.1	28.9 (4)	34.7 (9)
1961	IV	38.8 (2)	36.2	35.2	35.0 (26)	39.1 (31)
1960	V	42.4 (11)	39.4	39.0	38.8 (18)	46.6 (33)
1959	VI	47.7 (40)	46.1	46.3	45.8 (34)	50.6 (42)
1958	VII	52.0 (34)	49.0	49.5	48.9 (29)	55.8 (29)
1957	VIII	62.0 (8)	53.4	53.6	53.6 (47)	58.3 (37)
1956	IX	56.0 (4)	56.9	56.1	56.4 (31)	59.2 (22)
1955	X	64.0 (1)	62.6	60.6	60.9 (14)	63.8 (6)
1954	XI	-	62.5	61.1	61.0 (10)	68.7 (3)
1953	XII	-	66.7	63.3	63.1 (8)	59.4 (2)
1952	XIII	-	67.8	65.0	64.2 (8)	68.6 (2)
1951	XIV	-	63.8	62.3	61.5 (9)	-
1950	XV	-	69.2	66.7	66.7 (7)	-
1949	XVI	-	70.8	67.5	68.4 (8)	70.0 (1)
1948	XVII	-	79.7	78.6	79.6 (4)	79.0 (1)
1947	XVIII	-	69.7	69.4	68.2 (3)	-
1946	XIX	-	91.8	80.2	83.4 (3)	-
1945	XX	-	82.0	82.0	82.0 (1)	-
1944	XXI	-	-	-	-	-
1943	XXII	-	-	-	-	-
1942	XXIII	-	88.0	-	- (1)	-

d. Stage of maturity (Fig. 2). In Div.2H in March about 75% of the males and 40% of the females were in the spawning stage. About 50% of the females were still in the developing stage.

In Div.2J the males were spawning between March and June, while the females spawned principally from March to May.

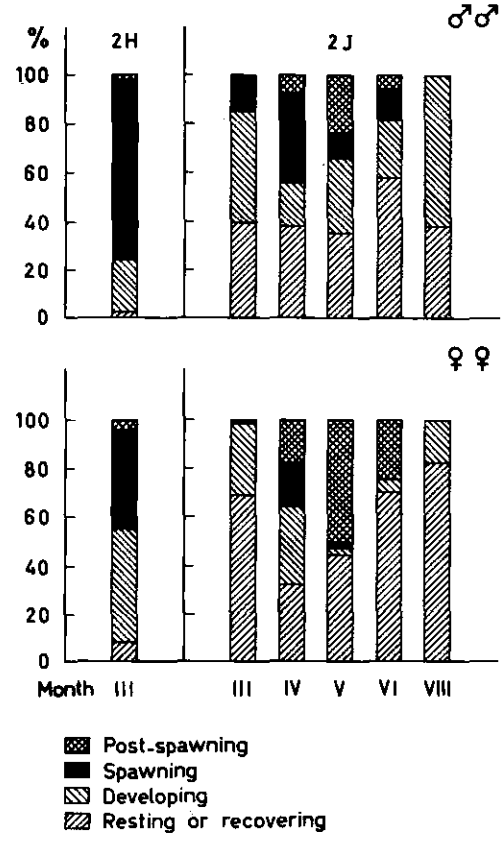


Fig. 2. Cod. Subarea 2. Stages of maturity, 1965.

e. Age at first maturity.

Div.2H

Age-group \ 1st spawn.	♂♂ VI	VII	VIII	IX	θ	?	Total	♀♀ VI	VII	VIII	θ	?	Total
V	–	–	–	–	3	–	3	–	–	–	2	–	2
VI	–	–	–	–	20	–	20	–	–	–	4	–	4
VII	4	3	–	–	31	1	39	1	2	–	11	–	14
VIII	2	10	2	–	43	2	59	1	9	3	18	–	31
IX	–	2	6	1	8	1	18	–	4	1	10	2	17
X	–	1	2	–	2	–	5	–	1	–	1	2	4
XI	–	–	1	1	–	–	2	–	–	1	2	1	4
XII	–	–	–	–	–	–	–	–	1	–	–	–	1
XIII	–	–	–	–	–	–	–	–	–	–	–	–	–
XIV	–	1	–	–	1	–	2	–	–	–	–	–	–
No. observed	6	17	11	2	108	4	148	2	17	5	48	5	77

Div.2J

Age-group \ 1st spawn.	♂♂ VI	VII	VIII	IX	X	θ	?	Total	♀♀ VI	VII	VIII	IX	X	XI	θ	?	Total
III	-	-	-	-	-	9	-	9	-	-	-	-	-	-	4	-	4
IV	-	-	-	-	-	28	-	28	-	-	-	-	-	-	31	-	31
V	-	-	-	-	-	12	13	25	-	-	-	-	-	-	37	-	37
VI	-	-	-	-	-	58	-	58	3	-	-	-	-	-	53	1	57
VII	-	-	-	-	-	40	-	40	2	3	-	-	-	-	47	-	52
VIII	1	4	3	-	-	30	5	43	2	11	1	-	-	-	31	4	49
IX	1	3	8	-	-	15	3	30	-	2	5	-	-	-	18	2	27
X	-	-	1	1	-	2	1	5	1	2	4	1	-	-	5	3	16
XI	-	-	2	-	-	4	-	6	-	1	-	-	-	-	5	1	7
XII	-	-	-	-	-	1	-	1	-	1	2	1	1	-	2	2	9
XIII	-	-	-	1	-	2	-	3	-	-	2	3	-	-	1	1	7
XIV	-	-	-	-	1	-	-	1	-	-	1	3	2	-	2	-	8
XV	-	-	-	1	-	2	-	3	-	-	1	2	-	-	1	-	4
XVI	-	1	-	-	-	2	1	4	-	-	1	1	-	-	3	-	5
XVII	-	-	1	-	-	1	-	2	-	-	-	-	-	1	1	1	3
XVIII	-	-	-	-	-	1	-	1	-	-	-	1	-	-	-	1	2
XIX	-	-	-	-	-	1	-	1	-	-	2	-	-	-	-	-	2
XX	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
XXIII	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
No. observed	2	8	15	3	1	208	23	260	8	20	19	12	5	1	241	16	322

Subarea 3

A. Status of the Fisheries

I. Cod

As mentioned, the catch in this subarea during 1965 was much less than in 1964. The differentials for the otter trawl catch was 38,251 tons and for the line trawl catch 15,376 tons.

The otter trawlers operated mainly in Div.3K and 3L with success from April to October. Otter trawl catches totalling 2,592 tons were also made in Div.3M, 3N, 3O and 3Pn. The dory vessels fished in Div.3L, 3N, 3O and 3P with catches in 3L amounting to 12,735 tons.

Samples for biological study were obtained in Div.3K, 3L and 3N from 6 June to 4 September as follows:

Sample Group	Sample Nos.	Date	Depth (m)	No. Lengths	No. Aged
Div.3K					
A	36-39	28-31 July	185-275	675	72
B	46-57	1-28 Aug.	160-290	2,400	255
Div.3L					
C	2-9 12; 13	6-30 June	150-230	1,050	485
D	14-19 21-35	1-26 July	170-340	3,350	365
E	58	4 Sept.	150	100	22
Div.3N					
F	10-11	26-27 June	150-280	250	122

a. Lengths (Fig. 3). Lengths ranged from 19 to 133 cm classes. Mean lengths were A - 58.7, B - 52.4, C - 66.0, D - 55.0, E - 62.2 and F - 53.8.

b. Ages (Fig. 3). In Div.3K ages range from 2 to 16 years with a marked dominance of the V, VI, VII and VIII age-groups (1960, 1959, 1958 and 1957 year-classes).

In Div.3L the difference in age composition of the September sample is probably due to the small number of age readings available.

For June and July age-groups IV, V, VI, VII and VIII (1961, 1960, 1959, 1958 and 1957 year-classes) were abundant.

In Div.3N in June age-groups IV, V, VI and VII (1961, 1960, 1959, and 1958 year-classes) were abundant.

Mean ages were as follows: A - 7.1; B - 6.0; C - 8.2; D - 6.2; (E - 7.1); F - 5.8 years.

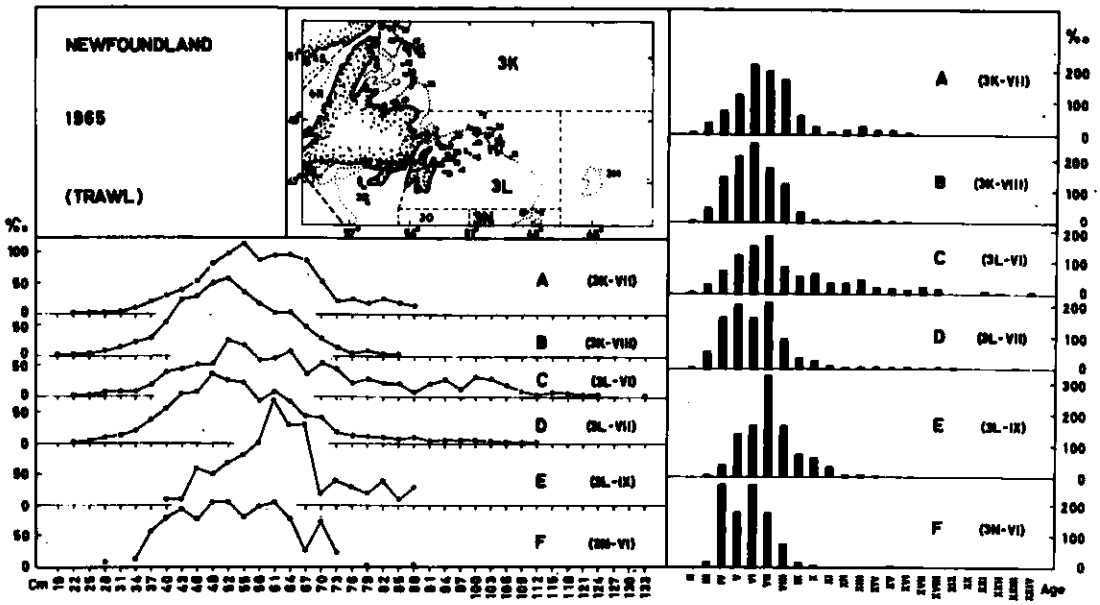


Fig. 3. Cod. Subarea 3. Length and age composition, June-September 1965.

c. Growth is shown in the following table of average lengths (figures in brackets are numbers of fish):

Div. 3K			
Year-class	Age-group	3rd Quarter July	August
1963	II	29.2	26.1 (7)
1962	III	35.4	34.0 (33)
1961	IV	40.7	40.6 (59)
1960	V	44.0	47.0 (45)
1959	VI	54.0	52.9 (48)
1958	VII	60.3	59.1 (44)
1957	VIII	64.8	63.8 (47)
1956	IX	68.9	68.0 (19)
1955	X	75.5	72.5 (9)
1954	XI	73.0	73.0 (2)
1953	XII	75.3	70.9 (3)
1952	XIII	82.7	80.6 (4)
1951	XIV	79.4	91.6 (4)
1950	XV	86.0	79.0 (2)
1949	XVI	73.0	73.0 (1)

Div. 3L

Year-class	Age-group	2nd Quarter June (cm)	3rd Quarter July (cm)	3rd Quarter September (cm)
1963	II	33.9 (4)	25.3	- (8)
1962	III	34.6 (21)	33.9	41.0 (41)
1961	IV	42.3 (48)	41.8	44.6 (55)
1960	V	47.6 (70)	49.2	51.4 (45)
1959	VI	54.3 (70)	54.5	57.6 (38)
1958	VII	61.5 (89)	60.7	62.1 (68)
1957	VIII	65.1 (45)	63.0	64.4 (35)
1956	IX	72.2 (29)	68.6	70.6 (22)
1955	X	80.5 (33)	79.7	79.4 (27)
1954	XI	87.5 (15)	84.1	83.3 (14)
1953	XII	85.3 (15)	92.7	88.0 (2)
1952	XIII	95.3 (16)	91.2	83.6 (10)
1951	XIV	101.0 (7)	96.2	82.0 (8)
1950	XV	92.0 (7)	98.8	- (3)
1949	XVI	105.8 (4)	102.0	- (3)
1948	XVII	103.1 (4)	105.4	- (3)
1947	XVIII	100.0 (4)	108.6	- (2)
1946	XIX	-	103.0	- (1)
1945	XX	-	-	-
1944	XXI	114.8 (2)	-	-
1943	XXII	124.0 (1)	-	-
1942	XXIII	-	103.0	- (1)
1941	XXIV	106.0 (1)	-	-

Div. 3N

Year-class	Age-group	2nd Quarter June (cm)
1962	III	33.9 (4)
1961	IV	42.8 (32)
1960	V	48.5 (19)
1959	VI	57.6 (31)
1958	VII	63.5 (22)
1957	VIII	66.0 (9)
1956	IX	65.1 (2)
1955	X	83.5 (2)
↓		
1940	XV	109.0 (1)

d. Stage of maturity (Fig. 4). In Div.3K in July and August about 50% of the males were in resting or recovering and 50% in developing stages, while in July about 50% of the females were in the resting or recovering stages and 50% in the post-spawning stage and in August 80% were in the resting or recovering stage and 20% in the post-spawning stage.

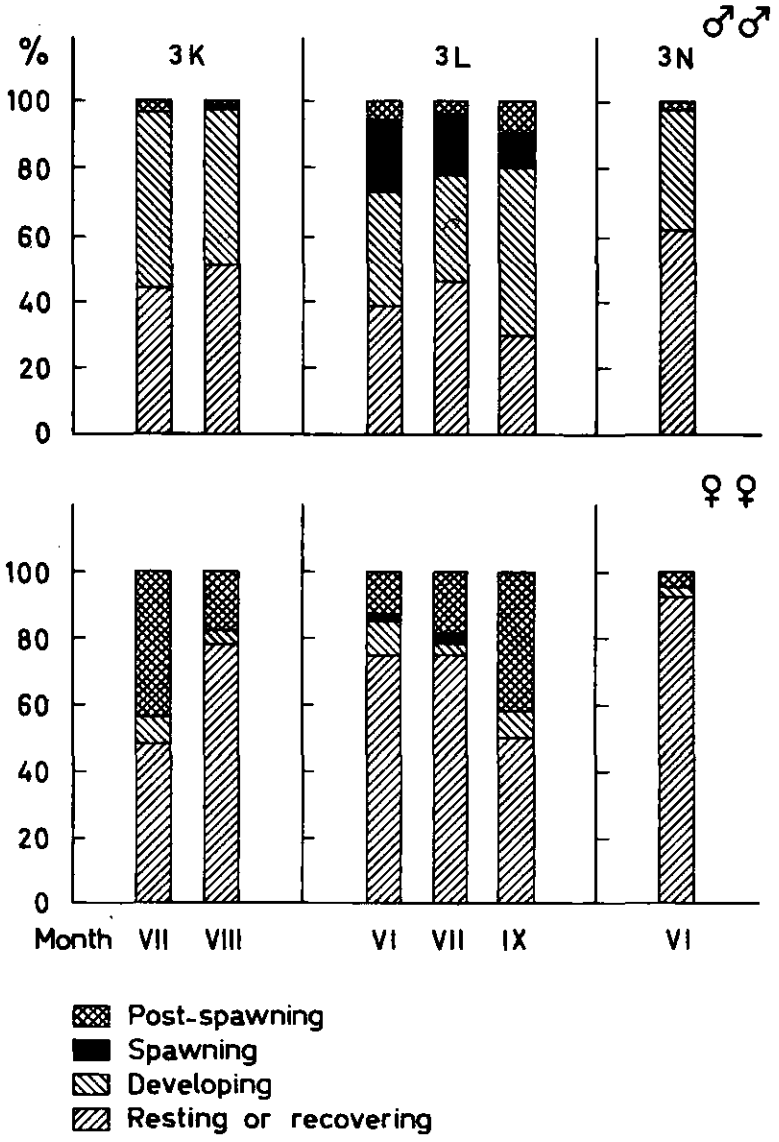


Fig. 4. Cod. Subarea 3. Stages of maturity, 1965.

In Div.3L in June, July and September 10-20% of the males were still spawning, while very few of the females are spawning in June and July and none in September.

In Div.3N in June about 60% of the males are in the resting or recovering stage and over 90% of the females are in the resting and recovering stage.

e. Age at First Maturity.

Div. 3K

Age-group \ 1st spawn.	♂♂ VI	VII	VIII	θ	?	Total	♀♀ VI	VII	VIII	IX	θ	?	Total
II	-	-	-	6	-	6	-	-	-	-	1	-	1
III	-	-	-	14	-	14	-	-	-	-	19	-	19
IV	-	-	-	32	-	32	-	-	-	-	27	-	27
V	-	-	-	22	-	22	-	-	-	-	23	-	23
VI	-	-	-	22	-	22	-	-	-	-	26	-	26
VII	-	1	-	14	-	15	-	5	-	-	24	-	29
VIII	1	2	-	5	-	8	-	10	4	-	22	2	38
IX	-	1	1	1	-	3	1	4	5	-	4	2	16
X	-	1	2	1	-	4	-	2	-	-	2	1	5
XI	-	-	-	-	-	-	-	1	1	-	-	-	2
XII	-	-	-	-	1	1	-	-	2	-	-	-	2
XIII	-	-	1	-	-	1	-	2	-	1	-	-	3
XIV	-	-	1	-	-	1	-	-	-	2	-	1	3
XV	-	-	-	-	-	-	-	-	-	1	-	1	2
XVI	-	-	-	-	-	-	-	-	1	-	-	-	1
No. observed	1	5	5	117	1	129	1	24	13	4	148	7	197

Div. 3L

Age-group \ 1st spawn.	♂♂ VI	VII	VIII	IX	X	θ	?	Total	♀♀ VI	VII	VIII	IX	X	θ	?	Total
II	-	-	-	-	-	10	-	10	-	-	-	-	-	2	-	2
III	-	-	-	-	-	36	-	36	-	-	-	-	-	26	-	26
IV	-	-	-	-	-	58	-	58	-	-	-	-	-	45	-	45
V	-	-	-	-	-	50	-	50	-	-	-	-	-	65	-	65
VI	-	-	-	-	-	53	-	53	4	-	-	-	-	51	-	55
VII	2	4	-	-	-	62	1	69	-	14	-	-	-	72	2	88
VIII	1	3	2	-	-	25	1	32	-	17	5	-	-	23	3	48
IX	-	10	7	1	-	9	1	28	-	5	3	1	-	13	1	23
X	1	6	13	1	-	11	2	34	-	6	7	1	1	6	5	26
XI	-	-	3	2	-	11	2	18	-	-	2	1	-	7	1	11
XII	-	2	3	2	1	4	-	12	-	-	2	-	-	3	-	5
XIII	-	2	1	4	-	5	-	12	-	2	3	-	-	9	-	14
XIV	-	1	1	2	-	5	1	10	-	-	-	1	-	3	1	5
XV	-	-	1	-	-	7	-	8	-	1	-	1	-	-	-	2
XVI	-	-	-	1	-	1	-	2	-	1	1	1	1	1	-	5
XVII	-	-	-	-	-	2	-	2	-	-	1	2	-	1	1	5
XVIII	-	-	-	1	-	1	-	2	-	-	2	1	1	-	-	4
XIX	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
XXI	-	-	-	1	-	-	-	1	-	-	1	-	-	-	-	1
XXII	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	2
XXIII	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
XXIV	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
No. observed	4	28	31	16	1	350	8	438	4	46	28	10	4	328	14	434

Div.3N

1st spawn. / Age-group	♂♂ VI	VII	VIII	IX	θ	?	Total	♀♀ VI	VII	VIII	IX	θ	Total
III	-	-	-	-	3	-	3	-	-	-	-	1	1
IV	-	-	-	-	22	-	22	-	-	-	-	10	10
V	-	-	-	-	7	-	7	-	-	-	-	12	12
VI	-	-	-	-	13	-	13	1	-	-	-	17	18
VII	1	3	-	-	7	-	11	-	3	-	-	8	11
VIII	-	3	-	-	-	-	3	-	3	2	-	1	6
IX	-	-	-	-	-	1	1	-	1	-	-	-	1
X	-	-	1	1	-	-	2	-	-	-	-	-	-
XV	-	-	-	-	-	-	-	-	-	-	1	-	1
No. observed	1	6	1	1	52	1	62	1	7	2	1	49	60

Subarea 4

A. Status of the Fisheries

I. Cod

In 1965 only the otter trawlers operated in Subarea 4 and caught 14,665 tons, which is about the same catch as made in 1964.

In Div.4R 11,714 tons was taken mainly in February and March, in 4Vn 1,790 tons from January to July, in 4S 1,006 tons in February and March, in 4Vs 88 tons from March to July and in 4T 67 tons in March.

IX. Spanish Research Report, 1965

by O. Rodriguez Martin

Subareas 1-5

A. Status of the Fisheries

Twenty-four otter trawlers and 94 pair trawlers (these vessels represent only 47 gears) have operated in the ICNAF Area during the year 1965. These vessels have a total weight of 63,000 tons, approximately a half for each type, and have a crew about 3,500 fishermen. Total catch was 232,000 tons, of which 97% was cod, 2% haddock, and 1% other species (white hake and pollock) (Table 1).

Table 1. Catches by Spanish otter trawlers and pair trawlers in the ICNAF Area in 1965. (Catches in metric tons)

by Divisions:

Division	Otter Trawler	Pair Trawler	Total
1B	622	-	622
1C	29	-	29
Total Subarea 1	651	-	651
2G	832	-	832
2H	6,827	-	6,827
2J	51,822	-	51,822
Total Subarea 2	59,481	-	59,481
3K	9,950	-	9,950
3L	11,014	21,076	32,090
3M	1,538	-	1,538
3N	2,111	28,495	30,606
3O	337	35,646	35,983
3P	2,366	13,496	15,862
Total Subarea 3	27,316	98,713	126,029
4R	219	-	219
4T	24	19	43
4V	1,899	32,579	34,478
4W	-	12,891	12,891
4X	-	148	148
Total Subarea 4	2,142	45,637	47,779
5Z	-	69	69
Total Subarea 5	-	69	69
Total General	89,590	144,419	234,009

Table 1. (cont'd)

by Species:

Species	Otter Trawler	Pair Trawler	Total
Cod	89,164	136,075	225,239
Haddock	318	6,286	6,604
White hake	51	299	360
Pollock	57	1,759	1,816
Total	89,590	144,419	234,019

If we compared the catches made by the otter trawlers and the pair trawlers, in successive years (Fig. 1), we see a consistent and converging increase until 1964 when the catch of the pair trawlers equals that of trawlers. In 1965 pair trawlers increased their catch well beyond that of the otter trawlers.

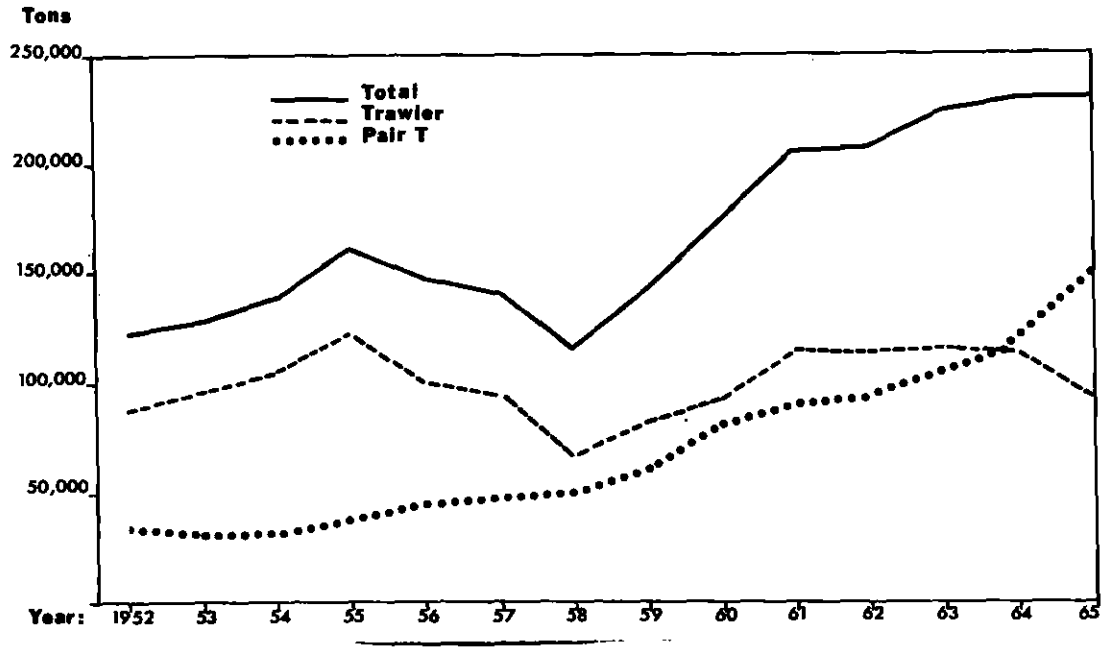


Fig. 1. Catch of the Spanish fleet in the Northwest Atlantic.

The Spanish cod fleet, dedicated only to salt and dry cod, requires better and better quality of species and sizes of fish. For this reason, cod is the only species sought, other fish (haddock, pollock, white hake, etc.) being ignored.

I. Discard

Information about discards for 1965 has been provided by the masters of the trawlers and presented to the Secretariat. Careful study of the data from each vessel shows striking disagreements, which must be due only to the different points of view of the masters. That is why we have only taken down the available information, but we think that a sampling system could be more efficient, using only a few ships whose captains could be more trustful. We feel it could be better to have observers on board certain vessels and to make general estimation from their data.

II. Recaptured Tags

During the present year, we have received information about 184 tags recaptured by Spanish fishermen. Most of the tags come from Canadian and Soviet taggings. All these tags were returned to their countries of origin and reward of 50-Pts. was paid to the fishermen who delivered them.

III. Scientific Cooperation

During October and November Mr O. Cendrero carried out some observations from a Spanish trawler in the Newfoundland and Labrador area on length and age frequencies, sex ratio, and the total length/head length relationship. Results are given in Res.Doc.66/27.

Similarly Mr Figueras has studied the length, age and growth of cod in Subareas 1-3, using material collected by observers at sea. Results of the study appear in Res.Doc.66/70.

X. USSR Research Report, 1965

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

The total catch obtained by the USSR fleet in the ICNAF Area in 1965 was 853,097 metric tons (Table 1) which was 235,784 tons higher than in 1964.

The increase in catches may be attributed to an increase both in the total fishing effort and the efficiency of fishing.

The catches of silver hake were, as previously, dominant in catches (39.3% in 1964 and 38.8% in 1965).

The catches of red hake, haddock, redfish and flounders increased, whereas catches of herring declined. The catches of cod and argentine remained approximately on the same level.

The share of other fish species was insignificant in the total catch.

Table 1. Species composition of USSR catches in the Convention Area, 1965.

Species	Tons	Percentage
Herring	42,295	5.0
Argentine	15,064	1.8
Cod	149,021	17.5
Haddock	128,756	15.0
Pollock (saithe)	3,071	0.4
Silver hake	331,418	38.8
Red hake	67,971	8.0
Redfish	63,318	7.4
Wolffish	2,288	0.3
Mackerel	2,862	0.3
Flounders	25,285	3.0
Halibut	1,191	0.1
Other and unidentified species	20,557	2.4
Total	853,097	100.0

Subarea 1

A. Status of the Fisheries

In January, one Soviet trawler fished in Subarea 1, mainly in Div.1C. Also, some research and scouting vessels operated in Subarea 1.

The total catch of groundfish was 1,456 tons including 1,251 tons of cod.

B. Special Research Studies

I. Environmental Studies

1. Oceanography. In Subarea 1 research vessels conducted investigations in June, July, August and December (see table below). Along with standard sections, the *Sevastopol* completed hydrological observations at different places, mainly before the trawling operations started.

Vessel	Month	Number of standard sections	Section code numbers	Object of investigation
Topseda	June	5	8-A, 14-A 13-A, 11-A 10-A	t, S, O_2, P
Topseda	July	4	8-A, 14-A 13-A	t, S, O_2, P
Sevastopol	August	-	-	t, S, O_2, P
Sevastopol	December	2	11-A, 10-A	t, S, O_2, P

In May-June 1965, cold Arctic air penetrated Subarea 1 from the Canadian coast; thus negative anomalies of air temperature reached 1-2°C. In other months an active cyclonic activity was typical for Subarea 1; warm air masses from the South Atlantic were driven in. This process was especially intensive in January, February and March, when a positive anomaly of air temperature was 8-11°C (in December up to 6°C).

An intensive influx of warm Atlantic waters started in November 1964 and water temperature in layers from 0 to 50, 0 to 200 and 200 to 500 m became 1-1.5°C higher than in previous years. Heat advection and intensive solar radiation gave rise to an early warming of the surface layer of the sea in the first half of 1965. In May water temperature in the layer 0-50 m in the area between Lille and Store Hellefiske Banks was 0.3°-0.5°C higher than in May 1960 and 1964, but it was 0.7°C lower than in a very warm year 1961. For the years mentioned, similar differences, even more distinct, were observed in the layer of 0-200 m.

In May 1965, the water temperature in the layer of 200-500 m was the same as in May 1960, but it was 0.2-0.8°C higher than in May 1961 and 1964. In June 1965, the water temperature of an Atlantic component of the West Greenland Current in the layer of 200-500 m was 4.3-4.8°C, i.e. 0.3-0.9°C higher as compared with 1961-1962.

In July 1965, a very intensive warming of water layer of 0-50 m was observed to the north of Lille Hellefiske Bank; the temperature of water became 1.5-2.0°C higher than in June.

In some areas, the surface water temperature rose up to 5.5°C. The water temperature below 1°C was no more observed within the shallow area of the bank.

In the second half of the year, a very rapid decrease in temperature was observed within the surface water layers. In December 1965, the water temperature in the layer of 0-50 m along the section to the north of Lille Hellefiske Bank was 0.8°C below that in December 1964, and 0.3°C higher, than in the cold year, 1963. But, in December 1965 the water temperature in the layer of 200-500 m remained 0.2°C higher than in December 1964 and 0.5°C higher than in December 1963.

II. Biological Studies

1. Cod. In January and early in February fishing and fish-finding operations were carried out on Banan and Fyllas Banks, where cod occurred throughout a large area at depths from 100 to 280 m.

The most dense concentrations were found on the western and south-western slopes of Banan Bank. Cod of 55-65 cm in length prevailed.

Cod 40-55 cm long was usually observed in great numbers at lesser depths (100-150 m).

Individual catches of the Soviet large stern trawler was 8-10 tons, but ordinary hauls usually gave 2-5 tons. Continuous local displacements of cod were observed within that area and fish did not stay on a fishing ground more than two or three days. Vertical migrations of cod (of diurnal nature too) were very pronounced. The catches with bottom trawl were most efficient from 5 p.m. to 10 a.m. The finding devices recorded cod concentrations within the layer from 20 to 25 m off the bottom with the thickness of schools being about 50 m. Sand launce was a basic food component for cod.

In August dense concentrations of cod were not discovered. Catches taken with trawl from the *Sevastopol* on the northern and southern banks gave not more than 300-500 kg mainly (45-65 cm long).

In December scarce concentrations of cod, mainly 48-58 cm long, were discovered by the *Sevastopol* near Cape Farewell; the catches were 500 kg per haul. Somewhat northward, on Banan Bank, the catches amounted to one ton per haul. Cod occurred through a large area and formed the most dense concentrations along the slopes of the bank, at depths of 180-280 m.

As a whole, 4- and 5-year-olds were dominant in the catches obtained in 1965, i.e. it was cod of 1961 and 1960 year-classes. In the beginning of 1965, the bulk of catches consisted of five-year-old fish 55.5 cm in length, and in the second half of the year there were mostly 4 years old, 56-61 cm long.

It should be noted that at the end of 1965 the 4-year-old cod on Lille Hellefiske and Banan Banks were larger in size (58-61 cm) than cod of the same age on Danas Bank (56 cm). It gives reason to believe that in summer 1965 the feeding conditions in the northern areas were more favourable.

2. Tagging. In 1965, 29 specimens of cod tagged by Soviet ichthyologists in 1962-1964 were captured by fishermen of Iceland, England, Denmark, Norway, Federal Republic of Germany and France. Polyethylene hydrostatic tags of ampoule type were applied. It is interesting to note that 7 specimens of tagged cod were recaptured near the shore of Iceland. All these fish were over 80 cm in length and obviously approached the Icelandic coasts for spawning. Nineteen specimens were caught on different banks off West Greenland; the position of recapture of one specimen remains unknown. The route of migration of another two specimens is of great interest.

Tagged					Recaptured		
Date	Latitude N	Longitude W	Length (cm) of cod	Tag Code number	Date	Area	Length (cm) of cod
17 December 1963	63°30'	52°20'	48	37072	July 1965	Grand Newfoundland Bank	63
10 July 1963	62°36'	51°50'	75	27115	February 1965	Labrador	78

The positions of recapture of these two specimens are not quite precise; and the quoted length of the latter specimen is obviously less than its real length at the moment of recapture. But, it cannot detract from the possibility that some cod specimens could make migrations from Greenland to the North American continent.

Subareas 2 and 3

A. Status of the Fisheries

A total of 210,993 tons of fish (mainly cod) was taken in Subareas 2 and 3. The main fishing areas were Div.2J in January-May, 3L in July-August, 3M in June and November-December, and 2H in December.

B. Special Research Studies

I. Environmental Studies

1. Oceanography. In the winter of 1964-1965, the water temperature near Labrador and Newfoundland remained below the average level recorded for

many years. In January 1965 the off-bottom waters with negative temperature penetrated together with the coastal branch of the Labrador Current to the south, up to 45°N, whereas, in January of a very cold 1963 this penetration reached 45°30'N.

In January 1965, cold waters penetrated with the main branch of the Labrador Current to the southeast, up to 48°W, while in January 1963, up to 49°W only.

However in summer and autumn 1965 a Polar Canadian and Labrador Currents became weaker.

The process mentioned as well as an intense solar heating led to considerable warming of water masses in Subareas 2 and 3. Thus, for example, at a series of stations along Section 7A the water temperature in a layer of 0-75 m in September 1965 was higher than in September 1964. In deeper waters, in the layer of 150 m, the temperature in 1965 remained below that in 1964 (see table below)

Water Temperatures (°C)

Depth (m)	47°00'N 49°30'W		47°20'N 48°55'W		47°36'N 48°30'W	
	1964	1965	1964	1965	1964	1965
0	9.38	11.84	7.14	8.65	7.58	8.31
10	9.21	-	7.02	-	7.03	-
20	9.13	11.65	6.46	8.56	6.48	2.62
30	8.98	11.76	5.40	8.02	2.33	1.50
50	0.43	2.06	-1.28	5.45	-0.92	-0.30
75	-0.14	0.50	-1.01	0.73	-1.00	-0.84
100	-	-	-0.86	-0.18	-0.34	-0.89
150	-	-	0.02	-0.10	0.38	-0.10

However, in December 1965-January 1966 the water temperature in the deeper layers was higher than in previous years. Thus, for instance, on 12 January 1966 a series of 13 stations was made in Div.3K (between points 50°40'N, 55°00'W and 52°00'N, 50°15'W. In the 200-500 m layer, an average water temperature appeared to be 0.78°C higher than on 12 January 1962.

In the winter of 1965-1966 on the southwestern and southern slopes of the Grand Bank the water temperature of all layers was 1°-2°C higher than in the moderate winter of 1961-1962.

It could be suggested that the North Atlantic Current usually moving to south of the Grand Bank, in 1965 was not so strong. As a result Coriolis force which caused the deviation of the current to the right has become weaker; warm waters moved in more left direction and reached the slopes of the Grand Bank.

Further, the inflow of warm waters to the north of Europe has decreased, particulary, to the Barents Sea (where winter was extremely severe),

and consequently there was observed some decrease in the compensatory outflow of Arctic waters in the East Greenland and Canadian Polar Currents. This fact caused, in its turn, higher water temperatures near Labrador, and some shifting of the ice fringe further to the north, as well as to some changes in the pattern of distribution of fishes.

2. Plankton. Plankton samplings were taken almost everywhere in Subareas 2 and 3, but they are not yet completely treated. Nevertheless one can come to some conclusions regarding plankton distributed off the Flemish Cap Bank. There it was possible to observe the second generation of *Copepoda*. In the middle of July a great number of eggs and nauplii were found in plankton samples. In the beginning of August, the specimens at third to fifth stages of development predominated in the population of *Copepoda* and earlier stages practically were not found.

Since the end of February, the abundance of larvae of *Ophiopluteus ramosus* was characteristic of the plankton of Flemish Cap Bank. The observations conducted showed that their mass settling took place in the second half of July.

3. Assessment of young cod. During the last five years the assessment of young cod is carried out in winter time. Trawling of one hour duration were performed by conventional bottom trawl with a fine-meshed screen inserted into the codend. Data obtained in the winter of 1965-66 together with evidence collected earlier are set out in Table 2. One can conclude that there was no possibility of making the assessment of young cod every winter in Subarea 2 (sometimes heavy ice conditions hampered this process).

Table 2. Average catch of young cod (up to 35 cm long) per hour of trawling in Subareas 2 and 3.

Years \ Divisions	2A	2H	2J	3K	3L	3M	3N	3O	3P
1961/62	-	-	60	38	26	15	13	2	15
1962/63	7	29	108	31	25	49	7	12	85
1963/64	-	-	-	34	44	7	13	4	17
1964/65	-	-	-	41	61	25	68	29	56
1965/66	20	96	168	65	72	15	173	15	46

The last cruise, from December 1965 through February 1966, was made in extremely favourable ice conditions, and assessment of young cod was completed for all divisions of Subareas 2 and 3. The estimation of young cod stocks of the Labrador population is of particular interest.

The catches of 2 to 3-year-old cod in Div.3K were always rather big (egg and larvae are brought in with the Labrador Current from the spawning grounds located in Subarea 2).

Table 2 shows a feeble fluctuation in the average catch of the young per hour of trawling in Div.3K by separate years. The highest catch was obtained only in the winter of 1965/66, because for the first time it was possible to investigate a coastal area of Div.3K which was previously covered with ice during the winter period. In the winter of 1965-66 the average catch will consist of 43 specimens (provided that only the young caught outside the coastal area are taken into account).

It can be suggested that the recruitment of the Labrador population is going on at a permanent level every year.

This conclusion is also confirmed by data set forth in Table 3, where the number of young cod of different ages is shown for four years.

Table 3. The average catch of young cod of different year-classes per hour of trawling in Div.3K.

	Year-classes						
Age	1958	1959	1960	1961	1962	1963	1964
0+				1	1	1	1
1+			5	3	2	1	
2+		21	11	21	15		
3+	10	15	11	24			

As seen from the table, the number of counted fingerlings did not rise over 1 for the four-year period; the number of specimens at the age of 1+ varied from 1 to 5, at the age of 2+ from 11 to 21, at the age of 3+ from 10 to 24. It can be stated for comparison that the fluctuations in the number of the young cod in the southern part of the Barents Sea during the same period are greater; being at 0+ from 3 to 74; at 1+ from 3 to 10; at 2+ from 2 to 18; at 3+ from 1 to 19. Thus, fluctuations of the Labrador cod are not so noticeable as in the case of Barents Sea cod.

The following regularity is easily traced in Div.2G, 2H, 2J, 3K: larger specimens of the young cod are found in the northern part of the area and smaller ones in the southern area (Table 4).

This fact can be explained by a gradual movement of the young cod to the north, following its growth rate and development.

Table 4 shows also that the larger specimens of young cod inhabit deeper layers.

In the southern part of Subarea 3 (Div.3N, 3O, 3P) the number of young cod of different year-classes fluctuated very pronouncedly.

Thus, in the winter of 1964/65, specimens at the age of 0+ (1964 year-class) dominated in Div.3N, and almost none of individuals at the age of

1+ were found; after the year elapsed, the individuals at the age of 0+ were, for practical purposes, not observed in the winter of 1965/66 and the bulk of the catch was made up of individuals at the age of 1+.

Table 4. The catch of young cod per hour of trawling and average length of fish at different depths.

Depth (m)	Div.2G		Div.2H		Div.2J		Div.3K	
	Catch per hour of trawling	Length (cm)	Catch per hour of trawling	Length (cm)	Catch per hour of trawling	Length (cm)	Catch per hour of trawling	Length (cm)
101-150	-	-	4	23.4	-	-	-	-
151-200	-	-	-	-	188	28.5	280	25.7
201-250	3	28.3	144	30.4	290	29.5	102	27.5
251-300	28	31.1	276	31.2	81	29.1	68	27.6
301-350	73	33.0	-	-	81	29.1	40	28.6
351-400	-	-	-	-	18	31.5	15	28.3
At all depths	20	31.6	96	31.0	168	29.4	65	27.4

4. Tagging. In 1965, 8,651 specimens of bottom fish, mostly cod, were tagged in Subareas 2 and 3. The greatest number of fishes (5,302 specimens) was tagged in Div.2J, close to the oceanic slope, where the concentrations of cod at pre-spawning, spawning and post-spawning stages were fished.

The particulars of recaptures of fish tagged and released in 1961-1965, are tabulated below.

Year of tagging	Recaptured in 1965										
	USSR	Canada	England	Spain	German Dem. Republic	Federal Rep. of Germany	Portugal	Norway	Poland	France	Total
1961	2	1	-	-	-	-	-	-	-	-	3
1962	-	2	-	-	-	-	-	-	-	-	2
1963	3	9	2	4	3	2	1	-	-	-	24
1964	7	50	8	7	12	6	2	3	1	1	97
1965	13	69	8	5	-	1	1	-	1	-	98
Total	25	131	18	16	15	9	4	3	2	1	224

Cod bearing the Soviet tags were caught as a rule by Canadian fishermen, fishing in summer off Newfoundland and Labrador.

It is interesting to analyze the route covered by one tagged cod, which was released at 58°31'1N and 59°39'9W on April 5, and caught at 54°13'N and 54°25'W on May 25. The fish covered about 300 miles in the course of 50 days journey mainly within the stream of course.

In 1965, 559 specimens of cod were tagged in Div.3M. Data on movements of some specimens are shown in the table below.

Marked				Caught		
Date	Latitude N	Longitude W	Length of fish (cm)	Date	Latitude N	Longitude W
27 Feb	46°38'8	46°06'8	53	5 May	46°50'	45°45'
28	46°34'3	45°47'4	72	10 June	46°41'	45°33'
28	46°34'3	45°47'4	75	5 August	46°30'	45°15'
28	46°34'3	45°47'4	56	2 June	46°50'	45°45'
27	46°39'8	46°13'9	60	30 May	47°58'	45°05'
28	46°34'3	45°47'4	55	1 June	46°50'	46°15'

These data as well as the results of tagging of previous years confirm the fact of the isolation of the cod population on Flemish Cap Bank. Cod never cross the path of icebergs, from Flemish Cap Bank to the Grand Bank and back.

In 1965, in Subareas 2 and 3, the Soviet fishing vessels caught 12 cod specimens bearing Canadian tags and 4 specimens with Danish tags.

5. Haddock. Throughout the year, no dense concentrations of haddock were found in Div.3N and 3O.

The individuals of the 1961 and 1962 year-classes were dominant in catches of research vessels. The 1963 year-class according to assessment data was very poor.

The otolith structure and vertebral count and some other factors provide grounds for believing that haddock of the Saint Pierre Bank population prevailed in Div.3O and 3N.

Thus, haddock can migrate in great numbers from Saint Pierre Bank farther to the east, up to the boundaries of the southeastern slope of the Grand Bank, crossing on their way the coastal branch of the Labrador Current.

Subarea 4

A. Status of the Fisheries

I. Silver hake

In 1965 a further decrease in USSR catches of silver hake was observed in Subarea 4. The catches dropped from 123,000 tons in 1963 and 81,100 tons in 1964, to 50,000 tons in 1965.

The reduction in silver hake catches can be explained by a decline in the availability and, partially, by unfavourable hydrological conditions which hampered the formation of sustained commercial concentrations.

From the beginning of 1965 to May, silver hake concentrations were of no commercial importance.

A fishable concentration of silver hake was discovered only in May, on the slopes of the shelf, to the southwest of Sable Island, where an inflow of warm water (having off-bottom temperature of about 8.5°C) was observed. BMRT catches per hour of trawling gave rather good results for this period (3.3 tons at an average).

Toward the end of May the intensity of inflow of warm water fell off and the hake concentrations dispersed.

Again in June the concentrations of silver hake were not found. In July, individual BMRT catches of silver hake were up to 2-2.5 tons per hour of trawling in the shallow waters of Sable Island at depths of 25 to 60 m. However, silver hake was taken as by-catch in fishing for haddock, cod and flounder.

The catches by BMRT (in tons) per hour of trawling for the period from May through August 1963, 1964 and 1965 are tabulated below.

Years	May	June	July	August
1963	3.41	4.18	3.72	3.42
1964	3.38	2.74	3.70	3.75
1965	3.29	2.18	2.00	2.00

These data show that in 1965, the catches by BMRT per hour of trawling decreased which is an evidence of decline in silver hake stocks off Nova Scotia. But the general abundance of silver hake decreased much more than the catches per hour of trawling, because judging from distribution of fishing fleets one can see that area of silver hake concentrations became several times less. Apparently, further decline in stocks and catches of silver hake may be expected in the near future.

II. Haddock

The USSR catches of haddock in Subarea 4 rose from 5,500 tons in 1964 to 45,500 tons in 1965. The increase in haddock catches in 1965 can be attributed to the considerable increase in density and magnitude of haddock stocks, on the one hand, and to the decline in silver hake stocks on the other hand. So, vessels switched over to haddock fishery, which was carried out in the second half of the year, when silver hake was no longer fished on Georges Bank.

The catches of haddock were taken mainly in the shallow waters of Sable Island at depths from 30 to 60 m. Cod and flounder were taken together with haddock.

An incidental fishery for argentine, silver hake, pollock and redfish was conducted throughout the whole slope of the shelf, especially on the southern slopes of Browns and LaHave Banks.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. In 1965 hydrological investigations were continued in the area of the Nova Scotian Shelf and Georges Bank. Six research and exploratory vessels took part in oceanographic work; they made observations along the standard sections once during a season. The locations of stations on standard sections in Div.5Z, 4X and 4W are shown in Fig. 1.

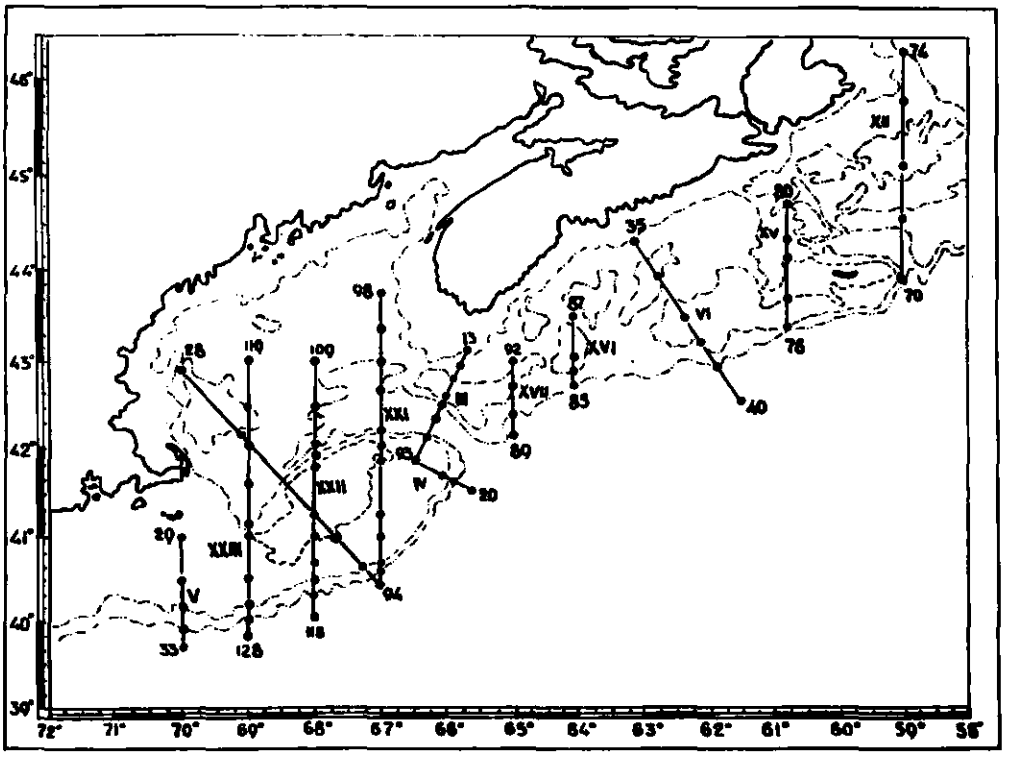


Fig. 1. Location of standard hydrological sections in Div.4W, 4X, 5Z.

The results of observations of the water temperature in Div.4X and 4W showed that cooling which began in 1963 continued in 1965.

Slow rise in temperature was observed from the beginning of 1965 till spring and a drop in temperature (almost to the 1964 level) was observed in summer and autumn.

The volume of warm water became somewhat greater in the course of 1965, although it was less than in 1962 and 1963.

As in 1964, the minimum temperature of the intermediate cold layer was 0.5°C. Temperature conditions of the Nova Scotian Shelf (Fig. 2-4) are represented by three sections.

In August the temperature fluctuated from 14°C in the surface layer up to 6°C in the off-bottom layer on a section between Georges and Browns Banks (Fig. 2).

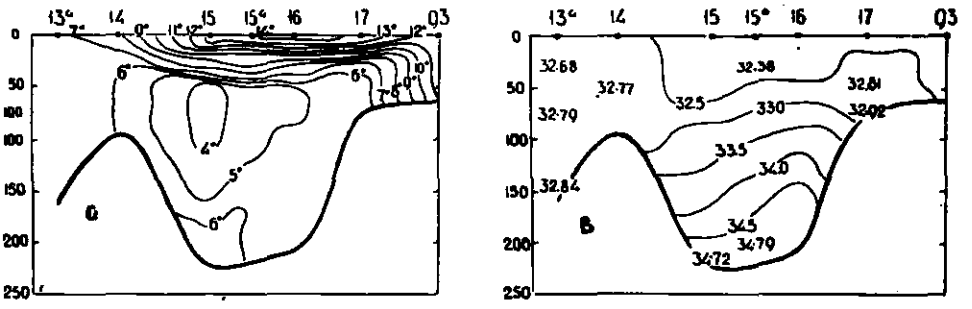
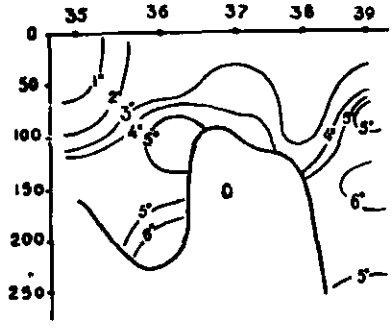
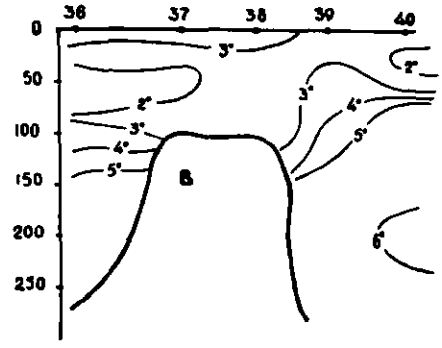


Fig. 2. Water temperature (°C) and salinity (‰) along Section III on 3 August 1965.

Along the Halifax section in January, the temperature observed was 2.3°C in the surface layer and 6°C in the off-bottom layer; in May the temperature varied from 3°C on the surface to 5°C on the sea bed and in August from 17°C to 5.8°C respectively (Fig. 3).

In May along the section 60°15'W the water temperature was 2°C on the surface and 0.1-0.2°C in the off-bottom layer, and in August it was 15°C on the surface and 2°C in the off-bottom layer (Fig. 4).





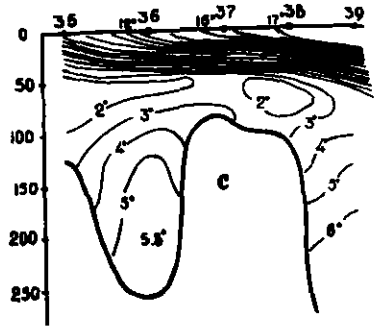
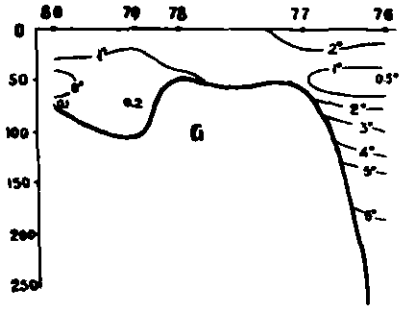
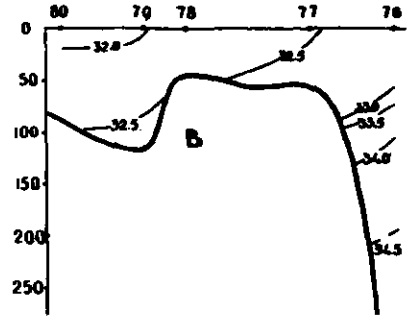
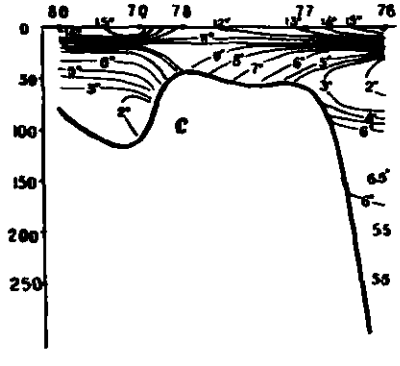


Fig. 3. Water temperature (°C) on Section VI.
a. 20 January 1965;
b. 7 May 1965;
c. 25 August 1965.







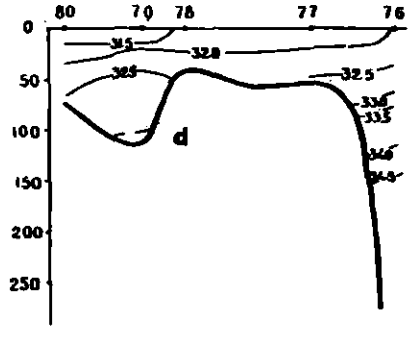


Fig. 4. Water temperature (°C) and salinity (‰) along Section XV. a. temperature, 5 May 1965; b. salinity, 5 May 1965; c. temperature, 3 August 1965; d. salinity, 3 August 1965.

II. Ichthyological Investigations

1. Silver hake. In 1965 observations on the length and age composition of commercial and experimental silver hake catches were continued in Div. 4W. A further increase in the average length of silver hake from 30.4 cm in 1963, 31.3 cm in 1964 to 32.2 cm in 1965 was observed in catches taken in 1965. Simultaneously, the percentage of four-year-old individuals increased in catches from 31.1% in 1963 to 57.7% in 1965, and the percentage of three-year-old specimens dropped from 56.4% in 1963 to 26.3% in 1965.

Such fluctuations in size and age composition of silver hake, as well as decrease in catch per effort and decline in fishing intensity, points to a considerable decrease in recruitment of silver hake stocks by year-classes, appeared after 1960. At the same time, the value of recruitment appears to be gradually reduced by years.

Subarea 5

A. Status of the Fisheries

I. Silver hake

The catches of silver hake in the area of Georges Bank increased from 107,400 tons in 1963 and 167,300 tons in 1964 to 281,000 tons in 1965.

The increase in catches was due to the growth of commercial efforts. The silver hake fishery was conducted as in 1964, mainly on the southwestern and southern slopes of Georges Bank as well as further to the southwestern part of the Georges Bank outside the ICNAF Area in the vicinity of Hudson Canyon. In 1965, 15,600 tons of silver hake were caught outside the ICNAF Area. The intensive silver hake fishery started in the second half of March, when stable concentrations were discovered in the area of Hudson Canyon.

Silver hake concentrations were observed in the area of warm water inflow with off-bottom temperature ranging from 6.0 to 9.5°C at depths of 150-280 m. In April, silver hake concentrations began to move gradually toward the south and southwestern slopes of Georges Bank.

In June, silver hake concentrations were less dense and unstable as compared with the period covering the end of March, April and May.

In July, silver hake concentrations decreased with the termination of spawning which resulted in significant decline in catches. Over a further period, the silver hake fishery in the area of Georges Bank was not regular.

II. Red hake *(Urophycis chuss)*

Up to 1964 red hake was not the object of a special fishery. Since December 1964, Soviet vessels of the BMRT type began to fish on the concentrations of red hake along the southwestern slopes of Georges Bank. Concentrations of red hake were observed even in May along the southwestern slopes of the bank, at depths of 140 to 300 m where the off-bottom temperature was 7.0°-8.6°C. The concentrations were dense and usually found in the off-bottom layer.

From January to April, the BMRT catches per hour of trawling were 4-6 tons, and RT catches per hour of trawling were 1.0-1.2 tons. In summer, red hake migrated to the southeastern slopes of Georges Bank. During that period, its concentrations were less dense.

III. Haddock

In 1965 on Georges Bank, haddock catches increased up to 81,800 tons. The haddock fishery was mainly carried out in the second half of the year. Haddock schools occurred throughout almost the whole area of the bank, but they were more stable on the southeastern and northern slopes.

IV. Herring

In 1965 the USSR herring catches dropped sharply from 130,100 tons in 1964 to 42,300 tons in 1965. The decrease in herring catches was due to reduction of that fishery because of decline in consumer demand for Georges Bank herring.

The stock of herring is in a good state and much larger catches could be taken. Throughout the year some vessels took herring as by-catch. Catches by large refrigerated trawlers (BMRT) per hour of trawling varied in different periods from 2 to 10 tons.

Herring catches by vessels of BMRT type per hour of trawling and day of fishing in June, September and October 1965.

Months	No. of days fishing	No. of trawling hours	Catch (in tons)	Catch per day of fishing	Catch per hour of trawling
June	34	482	977.4	28.8	2.0
September	31	173	1,803.1	58.2	10.4
October	31	382	949.6	30.6	2.5

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Observations of the hydrological regime in Div.5Z are partially represented in Fig. 4 and 5.

Anomalies on Georges Bank were observed only on its northern slopes in contrast to the Nova Scotian Shelf, where they were traced everywhere in the course of 1965.

A constant influence on temperature conditions on southern slopes was exerted by inflows of warm oceanic waters.

In the summer of 1965, cold water of Labrador Current origin penetrated to the bottom in the areas adjacent to the northwestern slopes of Georges Bank; the volume of that water was greater but the temperature was 0.5°-1°C in comparison with the summer period of 1964. In August the temperature in the north, along 67°W, was 17°C in the surface layer and 6.3°C near the bottom and in the south it ranged from 21°C in the surface layer to 8°C in the off-bottom layer (Fig. 5).

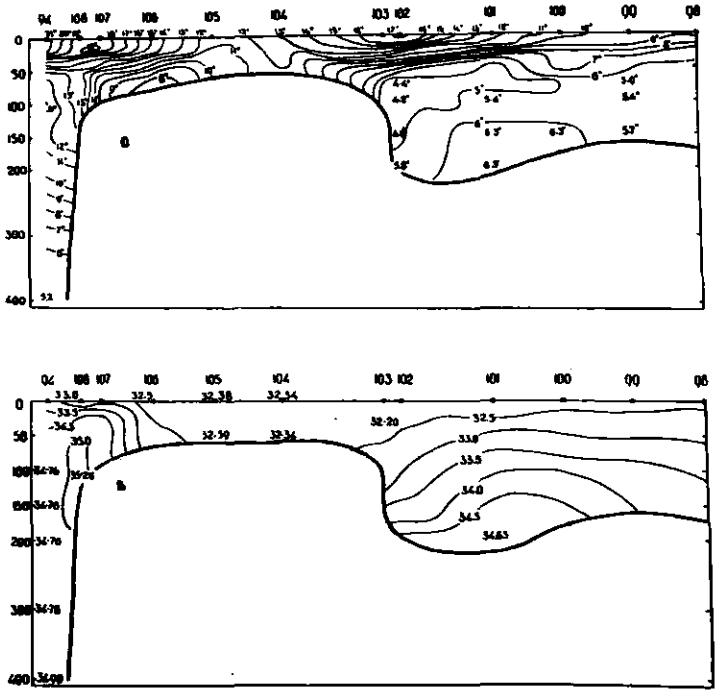


Fig. 5. Water temperature (°C) and salinity (‰) on Section XXI, 5 August 1965. a. temperature; b. salinity.

2. Zooplankton. In 1965, seven plankton surveys were completed from April through November. Three of them were performed at 55 stations and four only in the areas of ichthyoplankton sampling on the southern and northern slopes of the bank. At present samples are being analysed in the laboratory.

3. Ichthyoplankton. In 1965 the collection of ichthyoplankton with a net having a mouth of 80 cm in diameter was carried out on the hake spawning grounds. Six surveys were completed from June to October. Silver hake eggs were found in large numbers only on the southern and southwestern slopes. Solitary eggs and larvae of silver hake were observed on the northern slopes of the bank. Samples collected in the areas of herring spawning are not yet analysed.

II. Ichthyological investigations

1. Silver hake. In 1965 observations on the size and age composition of silver hake catches were continued. Investigations into age composition showed that, in catches made in 1965, 2-year-old fish made up an average of 6.9%, 3-year-old fish - 52.1%, 4-year-old fish - 33.4% and 5-year-old fish - 5.9%.

Thus, the catches as in previous years were mainly composed of 3- and 4-year-old fish. But in 1962-1963 the 4-year-old fish were more abundant than the 3-year-old fish, whereas in 1964-1965 the number of 3-year-olds increased.

The mean length of silver hake diminished from 31.7 cm in 1962, 30.4 cm in 1963 and 30.5 cm in 1964 to 28.3 cm in 1965 due to an increase in the number of 3-year-old fish in the catches. Probably the decrease in average length and the increase in the percentage of 3-year-old fish was due to the considerable increase in catches of silver hake during the recent years.

2. Herring. The analysis of age samples has shown that in 1965 the 1960 year-class constituted the bulk of the catches (57.0% in May and 49.5% in September); the 1959 year-class ranked second in its significance (23.0% in May and 15.3% in September); the 1961 year-class made up 20.0% in May and 11.4% in September.

In 1966 the bulk of herring catches on Georges Bank was also composed of the 1960 year-class, i.e. 6-year-olds. It should be taken into consideration that the numerical strength of that year-class would considerably lessen due to natural mortality. Since the 1961 and 1962 year-classes have proved to be comparatively poor, the herring stocks in 1966 will decrease as compared to 1963 and 1964. This fact, however, will not affect the magnitude of catches, because the state of herring stocks will allow the taking of considerably higher catches than have been obtained so far. Such a conclusion is confirmed by the assessment data relating to the abundance of the spawning population which had been obtained on the basis of eggs count on the spawning grounds.

Investigations carried out on herring spawning grounds have shown that the mass spawning in 1965 took place in two areas within the northern part of the bank: one of them was about 2 square miles where spawning lasted from 11 to 13 September; the second one was 6 square miles where spawning took place from 20 to 25 September. In 1965 herring eggs were deposited in a layer of 5-7 cm thick. The water temperature was about 5-6°C at a spawning time, and 8-10°C during the period of egg development.

3. Red hake. In 1965, observations of age and size composition were conducted.

In comparative haulings red hake was represented by individuals from 25 to 50 cm in length, the bulk of catches was composed of fish 27-39 cm in length and 150-250 grams by weight.

On the basis of age determinations by otolith, one can say that red hake is, like silver hake, a fish with a short life cycle. The bulk of red hake catches in March consisted of 2- to 4-year-old fish. Thus, the 2-year-old specimens made up 24.6%, the 3-year-olds 35.0%, the 4-year-olds 32.0%, the 5-year-olds 5.9% and the 6-year-olds 2.5%. A similar composition was observed in the samples taken from catches in other months.

4. Haddock. The analysis of haddock composition based on experimental catches taken by herring trawl (with mesh size in codend of 40 mm) was made from research and exploratory vessels in 1965. It was found out that the bulk of catches was composed of fish from 30 to 42 cm in length. The dominance of fish of these sizes in the catches confirms the results of the US investigations pointing to the appearance of a rich 1963 year-class. The collected samples of otoliths will permit (after the appropriate treatment) an evaluation of the importance of individual year-classes in the experimental catches of 1965.

5. Tagging. In August 1965, 1,706 specimens of silver hake and 2,047 specimens of herring were tagged with hydrostatic tags on the western, northern and eastern slopes of Georges Bank.

6. Serological investigations. The collection of samples of blood serum from different parts of the Nova Scotian Shelf and Georges Bank was performed on board BMRT *Atlant* in order to study the location of silver hake stocks and the genetic relationship of different local groups in the autumn and winter. A total of 256 samples was collected.

At present, the treatment of serum samples is partially by the electrophoresis method. Further investigations of silver hake blood serum is to be carried out using the immunity-electrophoresis method.

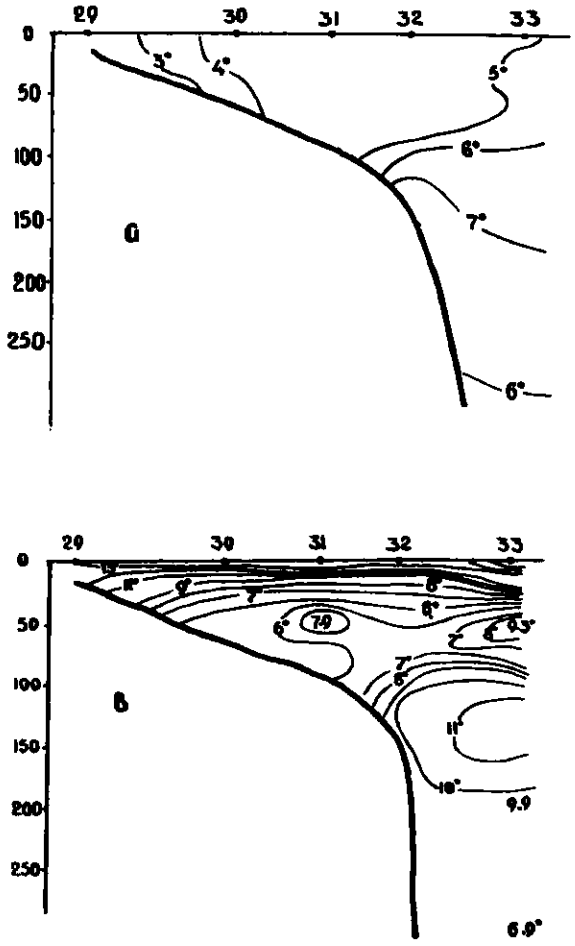


Fig. 6. Water temperature (°C) on Section V.
a. January
b. 26 June 1965

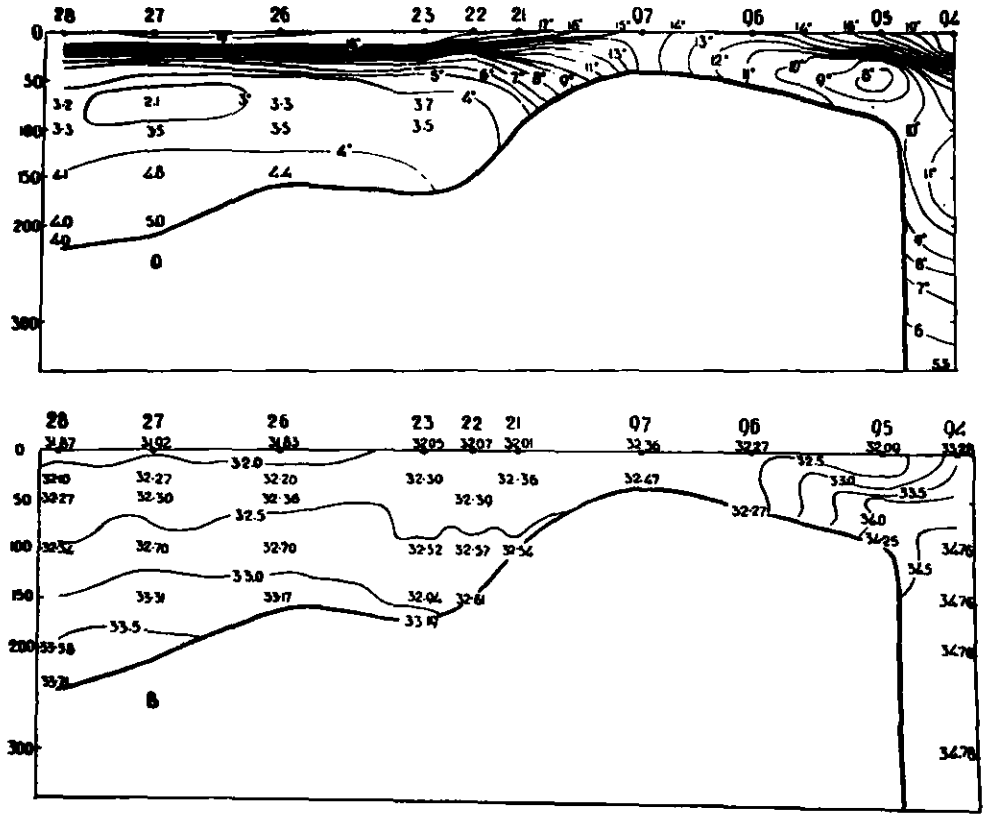


Fig. 7. Water temperature (°C) and salinity (‰) along the section between Sta. 28-94.
a. vertical distribution of temperatures
b. vertical distribution of salinities

XI. United States Research Report, 1965

by Herbert W. Graham

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

Subarea 3

A. Status of the Fisheries

I. Redfish

US landings from Subarea 3 were mostly from Div.3N and 3P in 1965, and decreased substantially over that of 1964 as did the effort. The catch per day increased somewhat, but because of the small amount of effort, this figure cannot be considered as a valid measure of abundance trends in 1965.

Table 1. US redfish statistics, Subarea 3, 1965 (metric tons, round fresh).

Year	Landings	Days fished	Landings/day fished
1961	16,706	1,057	15.8
1962	14,257	932	15.3
1963	12,089	882	13.7
1964	4,692	369	12.7
1965	772	54	14.4

B. Special Research Studies

I. Environmental Studies

In 1965 the US Coast Guard Oceanographic Vessel *Evergreen* conducted three cruises in the vicinity of the Grand Banks from March to June in support of the International Ice Patrol. Each cruise included an oceanographic survey to determine current conditions along the slopes of the Grand Banks and vicinity. A total of 173 oceanographic stations was occupied using Nansen bottle casts. An electronic BT was used as an aid to determine optimum sample levels. A PDP-5 computer was used very successfully aboard *Evergreen* for rapid data processing. Also included in the cruises were iceberg drift and deterioration studies and special studies of internal waves.

The *Evergreen* also conducted the 1965 post-ice season cruise in July and August. The main objective of this cruise, which was conducted in the Labrador Sea, Hudson Strait entrance and Davis Strait, was to study the source and formation of the Labrador Current. A total of 100 oceanographic stations was occupied including 69 core and grab samples.

During 1965 time-series observations were made on ocean station BRAVO by 7 Coast Guard cutters. The basic observational program on BRAVO consisted of Nansen bottle casts to a depth of 1,500 m on alternate days, with sampling extended to near bottom twice during each 3-week patrol.

Subarea 4

A. Status of the Fisheries

I. Haddock

Almost all the US effort for haddock in Subarea 4 was concentrated in Div.4X (primarily Browns Bank). Landings dropped sharply in 1965 due to decreased abundance and decreased effort (Table 2).

Table 2. US haddock statistics, Div.4X (metric tons, live weight).

Year	Landings	Days fished	Landings/day fished
1961	9,330	1,389	6.7
1962	6,388	875	7.3
1963	7,286	1,111	6.5
1964	8,541	1,132	7.5
1965	3,693	567	6.5

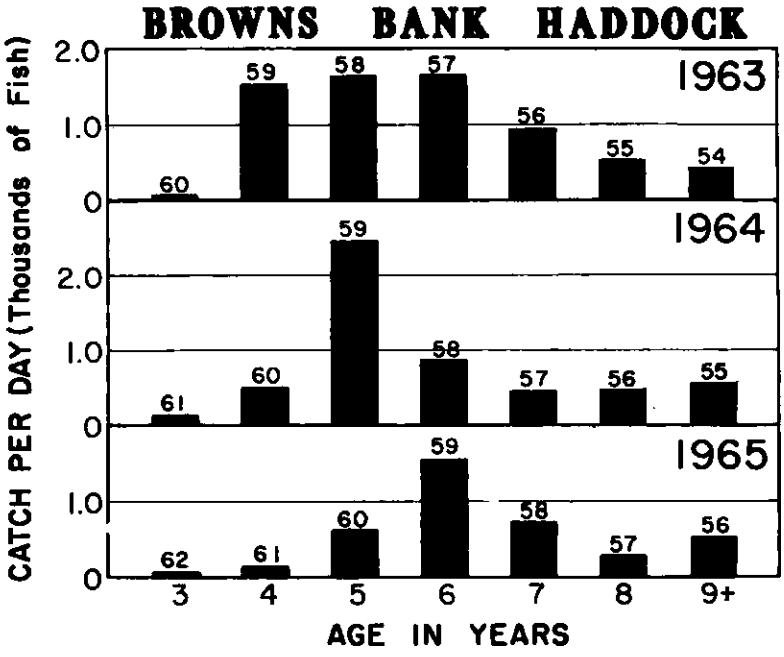


Fig. 1. Age composition of US landings of haddock from Div.4X (Browns Bank).

The age composition of landings from Browns Bank for 1965 (Fig. 1) indicates that the 1959 year-class (6-year-olds) provided the bulk of the catch as it did in the previous year. The strong 1956 year-class is passing out of the fishery; its members are now included under age "9+". The 1960 year-class is only of moderate strength and there is no strong year-class indicated for Browns Bank until 1963. However, the 1962 year-class appears strong in other areas of Subarea 4 and may contribute substantially in 1967. However, abundance of haddock on Browns Bank is expected to decline until the 1963 year-class begins to make substantial contributions in 1967.

II. Cod

US landings of cod from the subarea were less than 1,000 metric tons and represented a by-catch of the haddock fishery in Div.4X.

III. Redfish

Landings from Div.4R, S, T (Gulf of St. Lawrence) in 1965 increased over the 1964 figure which was, in turn, almost three times the amount landed in 1963 (Table 3). This appears to be the result of increasing abundance as indicated by the catch-per-day index.

Table 3. US redfish statistics, Div.4R, S and T (Gulf of St. Lawrence), (metric tons, round fresh).

Year	Landings	Days fished	Landings/day fished
1961	200	20	9.8
1962	67	8	8.7
1963	4,879	508	9.6
1964	12,278	735	16.7
1965	17,099	803	21.3

The catch from Nova Scotian Banks continued the downward trend started in 1963 in spite of an apparent increase in abundance as shown by the landings-per-day-fished index (Table 4).

Table 4. US redfish statistics, Div.4V, W and X (Nova Scotian Shelf), (metric tons, round fresh).

Year	Landings	Days fished	Landings/day fished
1961	28,960	3,016	9.6
1962	29,370	3,376	8.7
1963	23,282	3,104	7.5
1964	15,641	2,369	6.6
1965	13,082	1,246	10.5

B. Special Research Studies

I. Biological Studies

The studies of the haddock fishery in Div.4X have continued during the year. This included the exchange of statistics and samples between the USA and Canada.

The life history of the argentine *(Argentina silus)* was investigated on the basis of collections made on the seasonal groundfish survey cruises of the *Albatross IV*. The largest catches were made off Browns Bank (Div.4X) between 160 and 200 m. Most argentines were between 20 and 35 cm in length. Otoliths were used to determine age. Fish of 3 to 6 years of age made up the greatest portion of the catch, with 5-year-olds predominating. Otoliths of fish over 8 years of age are difficult to read. Spawning appears to take place during the winter and early spring. Samples obtained on the 1966 winter survey showed that argentines over 27 cm in length were ripe and ready to spawn. Examination of stomachs showed that crustacea were the major food item. Argentines in turn serve as food for such species as cod, skates, and several species of hakes.

II. Environmental Studies

The *Albatross IV* groundfish surveys, benthic studies and hydrographic surveys included a good part of Div.4X as well as Subarea 5 (see under Subarea 5).

Subarea 5

A. Status of the Fisheries

I. Haddock

The US landings of haddock from Georges Bank in 1965 were about 13% above those of 1964 (Table 5). The abundance index expressed as landings per day fished also showed an increase.

Table 5. US haddock statistics, Georges Bank (metric tons, round weight).

Year	Landings	Days fished	Landings/day fished
1961	46,350	7,131	6.5
1962	49,378	7,838	6.3
1963	44,126	10,029	4.4
1964	46,512	8,778	5.3
1965	52,823	9,407	5.6

The age composition of the catch (Fig. 2) shows that the abundant 1958 and 1959 year-classes which have supported this fishery in recent years (now 6- and 7-year-old fish) are contributing less to the fishery than the

incoming 1962 and 1963 year-classes.

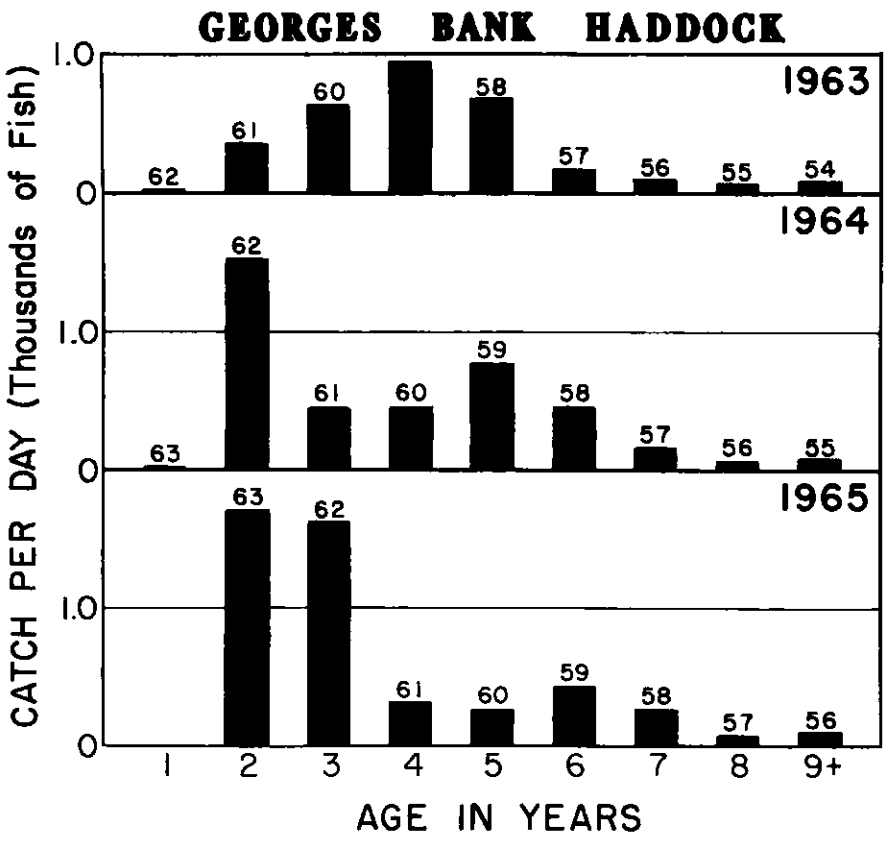


Fig. 2. Age composition of US landings of haddock from Georges Bank.

The *Albatross IV* groundfish surveys in 1963 suggested that the Georges Bank haddock year-class of that year was the largest for many years. This year-class appeared in the fishery on schedule in 1965 and provided the bulk of very heavy scrod landings, particularly later in the year.

Normally, one would forecast high abundance for Georges Bank haddock in the immediate years ahead based on the relative abundance of the 1962 and 1963 year-classes which are now in the scrod market category. However, there is evidence that fishing effort on the Georges Bank haddock stock was unusually heavy in 1965 and the effect of this effort on the large year-classes needs to be investigated when all the statistics for 1965 have been submitted.

Research vessel surveys indicate that the 1964 and 1965 year-classes are very small (Fig. 3).

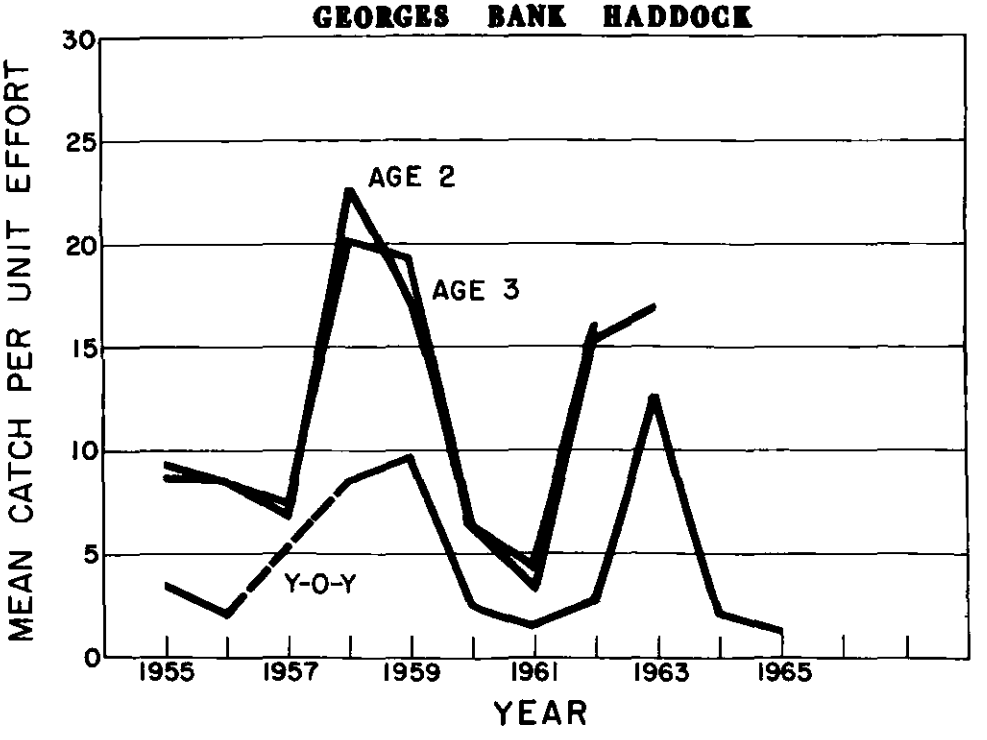


Fig. 3. Indices of abundance of year-classes. Young of the year research vessel index compared with indices of 2-year-olds and 3-year-olds in commercial landings.

II. Cod

The US landings of cod continued to decline in 1965 from the recent high in 1962. The landings per day fished dropped below the 1961 level, although it was still above the long term average (Table 6).

Table 6. US cod statistics, Subarea 5 (metric tons, round weight).

Year	Landings	Landings/day fished[1]
1961	17,669	1.0
1962	18,626	1.2
1963	16,734	1.8
1964	15,551	1.0
1965	15,007	0.9

[1]Calculated from the amount of cod caught incidentally by Boston haddock study fleet. Most cod landed in the USA from Subarea 5 is a by-catch of vessels engaged in other fisheries.

III. Silver Hake

The US landings of silver hake declined in 1965, both the portion landed for food and the portion landed for industrial purposes (Table 7).

Table 7. US silver hake statistics, Subarea 5 (metric tons, round weight)[1].

Year	Landings (Food)	Landings (Industrial)	Days fished	Landings/day fished (food only)
1962	44,271	5,333	2,393	18.5
1963	39,247	8,490	2,256	17.4
1964	39,479	13,666	2,615	15.1
1965	33,750	8,035	2,639	12.8

The index of food fish landings per day by US vessels continued to decline from the high attained in 1961.

In 1965, as in the years 1962-64, the US silver hake fleet did not fish much on Georges Bank, the area of intensive fishing by foreign fleets and an area previously important to the US fleet.

IV. Redfish

The US landings of redfish from the Gulf of Maine dropped about 10% in 1965 continuing the decline started in 1961. This occurred in the face of an increased abundance as indicated by landings per day fished (Table 8). The decline was due to a decreased fishing effort.

Table 8. US redfish statistics, Subarea 5 (Gulf of Maine) (metric tons, round weight).

Year	Landings	Days fished	Landings/day fished
1961	14,040	3,120	4.5
1962	12,541	3,135	4.0
1963	8,871	2,164	4.1
1964	7,812	1,817	4.3
1965	6,986	1,026	6.8

V. Yellowtail Flounder

The US landings of yellowtail flounder from Subarea 5 dropped about 5% in 1965 from the all-time high established in 1964. Recent heavy landings were made possible by an increased abundance of fish as shown by the index of landings per day fished which reached a peak in 1963 both in southern New England and on Georges Bank. This index dropped in 1964 and 1965 (Table 9).

[1]Amagansett, Long Island, industrial landings of silver hake included.

Table 9. US yellowtail statistics, Subarea 5 (metric tons, round weight).

	Southern New England			Georges Bank	
Year	Total landings	Days fished	Landings/ day fished	Days fished	Landings/ day fished
1961	16,626	4,686	2.5	1,816	2.4
1962	25,538	4,748	3.3	2,354	3.3
1963	35,220	5,244	4.1	2,317	4.6
1964	36,340	5,099	3.7	3,535	4.2
1965	37,178	6,010	3.1	4,486	3.2

Age compositions of the commercial landings for Subarea 5 are now available for 5 years (Fig. 4). The increase in landings, beginning in 1962, resulted from strong year-classes in 1959 and 1960. Fish from the 1959 year-class began making a large contribution to the catch in 1962. In 1963, when catch per day reached a peak, both the 1959 and 1960 year-classes were heavy contributors. In 1964 and 1965 catch per day declined since the strong year-classes were being diminished and the 1961 and 1962 year-classes following them were of only moderate strength. Landings have remained high in the 1964-65 period, despite a decrease in abundance, because there has been a substantial increase in effort.

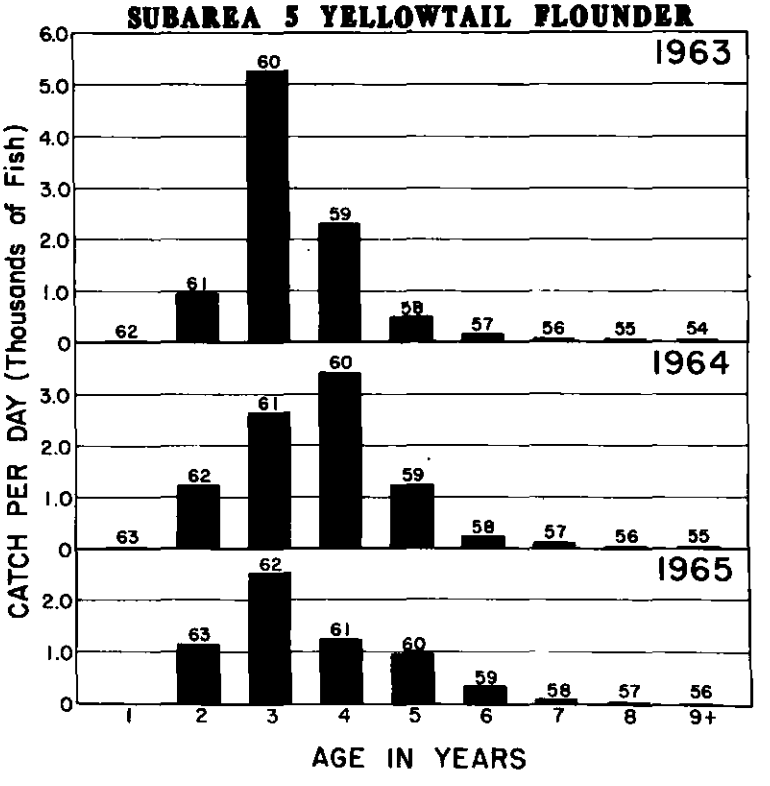


Fig. 4. Age composition of US landings of yellowtail flounder from Subarea 5.

VI. Industrial Fishery

Landings for industrial purposes increased 21% in 1965 over 1964, thus continuing the expansion of this fishery from its low point reached in 1960 (Table 10).

Table 10. New England landings for industrial purposes (metric tons, round weight)[1].

Year	Landings	Silver Hake %	Red Hake %	Other[2] %
1961	22,111	-	-	-
1962	26,666	-	-	-
1963	26,020	19.5	43.7	36.8
1964	27,899	20.0	42.6	37.4
1965	34,049	20.4	38.0	41.6

Silver hake and red hake comprise the major portion of these landings. The rest is composed of a large number of minor species.

VII. Herring

The US catch of herring in 1965 was 32,000 metric tons and was characterized by a poor catch in western Maine and a higher than usual catch in eastern Maine. The harvest was dominated by fish of the 1963 year-class, which contributed 90.2% of the total catch. The 1964 and 1962 year-classes contributed 2.6% and 6.1% respectively.

The two major types of gear, stop seines and weirs, have decreased in number along with the catches in recent years. The number of weirs has decreased steadily from 135 in 1960 to 63 in 1965, while the number of stop seines has decreased from 165 in 1960 to 104 in 1965. The total units of gear since 1959 have been: 1960 - 304; 1961 - 240; 1962 - 278; 1963 - 224; 1964 - 181; 1965 - 179. The yearly average catch from 1947 through 1960 was 60,000 tons as compared with 35,000 tons for the years 1961 through 1965. The 1965 catch was only a slight improvement over 1961 (25,000 tons) and 1964 (27,000 tons).

VIII. Sea Scallops

The US landings of sea scallops from Georges Bank in 1965 dropped drastically from the 1964 figure (Table 11). This was due to the diversion of effort to more southern grounds outside the Convention Area where good catches could be made more easily than on Georges Bank where abundance has been decreasing.

[1]Amagansett, Long Island, industrial landings not included
[2]Each component species less than 7%

Table 11. US sea scallop statistics, Subarea 5 (metric tons, meat weights).

Year	Landings	Days fished	Landings/ day fished	Research vessel index
1961	10,656	8,880	1.2	92.6
1962	9,687	8,806	1.1	99.1
1963	7,906	7,906	1.0	45.4
1964	6,296	6,296	1.0	40.0
1965	1,509	2,156	0.7	33.5

Research vessel abundance indices are now available for the last 5 years (Table 11). These indicate a continuous decrease since 1961. The landings per day fished, which is not considered a very reliable index because it sometimes depends upon the shucking rate rather than the catch rate, nevertheless shows a general downward trend during the same period.

B. Special Research Studies

I. Biological Studies

1. Haddock. Serological studies have continued in an attempt to differentiate stocks of haddock from various areas. Basic work on maximizing rate of antibody production in individual fish was conducted on blackback flounder. New rabbit anti-haddock sera were developed and will be tested on various haddock stocks.

2. Silver hake. Considerable work was done on validation of scale and otolith age determinations. There is little difficulty in determining the age of fish in the first and second years, but there appears to be a different pattern in fish from different areas. Additional work will be required before age reading can be put on a routine basis.

The exchange of otoliths among Canada, USSR, and the USA created problems which were alleviated by the exchange of photographs in addition to the otoliths themselves. Dr R. Blacker of Lowestoft, England, provided the photographs.

Silver hake data collected on the groundfish survey cruises of the *Albatross IV* indicate that it may be possible to obtain a valid index of abundance of young-of-the-year silver hake from such surveys.

3. Redfish. Tagged redfish remain plentiful in the stock at Eastport, Maine, where a tagging experiment was started in 1956. During a field trip in October 1965, only 54 redfish were caught, but 21% of these were tagged fish. Many more tagged redfish could be seen in the water around the docks, but the high abundance of small cod which were feeding voraciously on euphausiids at the surface made it very difficult to catch redfish on hook and line.

Most of the recaptured redfish carried plastic spaghetti tags, and their growth averaged about 15 mm per year, nearly the normal growth rate for untagged fish. Of three fish tagged with Petersen discs on the opercle, one had been tagged for more than 9 years, the longest survival of a tagged fish recorded at Eastport so far. It was the sixth recapture for this fish whose growth rate was about 3.6 mm per year, slow growth typical of redfish tagged with the Petersen opercular tag. The periodic measurements of this fish disclosed that its rate of growth had been remarkably steady during the 9-year period.

4. Herring

a. Age and Maturity. In 1965, 32 herring samples (2,048 fish) were obtained from Georges Bank and 71 herring samples (4,833 fish) from coastal Gulf of Maine. On Georges Bank, 48.8% of the fish were from the 1960 year-class, followed in percentage occurrence by the 1961, 1962, 1959, 1963, 1958, and 1957 year-classes. In coastal Gulf of Maine, 43.6% of the fish were from the 1960 year-class, followed in percentage occurrence by the 1962, 1961, 1959, 1958, 1963, and 1957 year-classes. In both areas the 1960 year-class was dominant in all months sampled except February (Georges Bank) and April (coastal Gulf of Maine). In these 2 months the 1962 year-class was dominant. Fish of the 1963 year-class were obtained during four of the nine sampling months, and were collected in the vicinity of Cultivator Shoals and the southwest part of Georges Bank.

Analysis of maturity stages indicated that in offshore and inshore areas the onset of fall spawning occurred during late August, the peak of spawning during October. On Georges Bank, recently spawned fish were obtained in February, while in the coastal Gulf of Maine, recently spawned fish were obtained in late March and early April. At the onset of fall spawning, the mean length of Georges Bank herring was 29.2 cm, the mean length of coastal Gulf of Maine herring was 28.8 cm. At the peak of spawning the mean length of Georges Bank herring was 28.4 cm, the mean length of coastal Gulf of Maine herring, 29.4 cm. There was no evidence of spring spawning on the banks, but a few spring spawners were obtained from samples collected in the coastal Gulf of Maine waters.

b. Racial Studies. Research on blood types and serum differences of herring has been continued. The phenomenon of unagglutinable cells, which occurs in some herring making them impossible to type, was further investigated. This phenomenon apparently is due to the presence of large numbers of immature red cells in the blood of herring because of temperature stress.

Blood samples were obtained from herring in the Gulf of St. Lawrence, Nova Scotia, Georges Bank, and coastal Gulf of Maine areas. These samples were typed with ten rainbow trout isoimmune sera. Significant differences in the frequency of individuals reacting with six of the ten sera were obtained. The data are being further analyzed to determine their possible genetic significance.

Fin ray counts (right pectoral and dorsal) of Maine sardines show that significant differences occur between sections of the Maine coast and between year-classes. Vertebral means show no significant section differences, but show significant differences between year-classes. Counts for the 1960 year-class were appreciably higher for all three meristic characters. This year-class was dominant in the inshore fishery during 1962 and 1963 and was dominant in the Georges Bank fishery during 1963, 1964, and 1965.

c. Behaviour Studies. Studies are being made of the behaviour of juvenile herring (sardines), in relation to their seasonal movements in coastal waters. Laboratory experiments to determine their responses to temperature and salinity gradients are providing information about the possible effects of hydrography on distribution and movements. The results of these experiments seem to indicate an aversion to temperature above 15°C. The possible effects of dissolved atmospheric gases on herring distribution are also being studied, since recent observations have shown that coastal waters are sometimes highly supersaturated with these gases in the spring when the young herring appear in shallow water.

5. Atlantic Salmon. Sport catches of Atlantic salmon were below average this year because of low water levels in the streams. Trap catches in the fall, when stream discharge increased, indicated that abundance of fish was average. Counts of upstream migrants continued on the Narraguagus and Machias Rivers. Two new Denil fishways on the St. Croix River were completed and operative in the spring.

A total of 165,000 smolts were marked with double fin clips and released during the spring, and 195 adult salmon were tagged with an adipose fin tag, the type previously recovered in West Greenland. Plans for 1966 include tagging of 100,000 smolts.

6. Plankton. A pictorial key to the identification of planktonic eggs and larvae of the common fishes of the Gulf of Maine is nearing completion. It will treat the 30 species most frequently encountered in plankton studies in the waters from Cape Sable, Nova Scotia, to Block Island, Rhode Island.

Overnight sets of buoyed and anchored tidal nets containing meters were made during the spring within the Sheepscot estuary of Maine to examine the relation of tidal excursions to catches of herring larvae. It was found that there was a statistically significant correlation between the length of the tidal excursion and the depth of herring larvae.

Monitoring of zooplankton seasonal abundance and composition in Gulf of Maine coastal waters continued. Mean seasonal volumes were significantly higher in 1965 than in the previous 2 years, due primarily to a marked increase in abundance of the copepod *Calanus finmarchicus*. Initial investigations of the inshore-offshore distributions of copepods indicated that occurrences were discontinuous for several species. The sharpest changes occurred within 5 km

of the coastal headlands, in the immediate vicinity of the 32‰ isohaline. *Calanus finmarchicus, Metridia lucens, Centropages typicus,* and *Acartia longiremis* were most numerous seaward of the 32‰ isohaline, and are grouped as outer-neritic forms. *Centropages hamatus, Acartia clausi, Tortanus discaudatus, Eurytemora herdmani,* and *Eurytemora affinis* occurred in greatest concentrations shoreward of 32‰ salinity, and are considered inner-neritic forms. Little variation was shown in the distributions of four common species - *Pseudocalanus minutus, Temora longicornis, Oithona spinirostris,* and *Oithona similis* - grouped as general-neritic.

7. Benthic Studies. The program of collecting, sorting, and analyzing quantitative samples of benthic invertebrates from the Continental Shelf and Slope off the US east coast was continued. A total of 2,000 samples have been collected and processed since 1957. Charts of Subarea 5 and vicinity are being prepared to show the density distribution of each of the 42 major taxonomic groups (phyla, classes, orders). Densities are illustrated in terms of (1) weight and (2) number of individuals per unit area of bottom.

8. Groundfish Surveys. Three groundfish surveys during the past year completed a 3-year series of seasonal surveys of the continental shelf between Hudson Canyon and the Bay of Fundy. On each survey about 180 stations were sampled according to a stratified random sampling plan employing 42 strata whose boundaries are based on hydrographic factors, primarily depth (Fig. 5). At each station length frequency and total weight of each species were recorded in addition to bottom temperature and bottom sediment type. Stomach contents of many species were also examined.

One of the major objectives of these surveys is to describe the seasonal distribution and relative abundance of all groundfish available to the trawl in order to get a more complete picture of the structure of the demersal community. These data may be of considerable importance in the long term as an ecological "benchmark" against which future changes in the composition of groundfish populations may be compared.

The use of a stratified random sample design easily provides abundance estimates (weighted according to area of each stratum) for any combination of strata, accompanied by appropriate measures of statistical precision (variance). However, the volume of data has permitted only preliminary analysis to date. Detailed analysis awaits completion of computer programs which will permit rapid computation of a variety of abundance indices and associated variances (e.g. for individual strata or groups of strata within a cruise, cruises within a year, individual species or groups of species, weight or numbers of each species in any size interval, etc.). Quantitative measures of species composition will also be computed.

Studies are in progress on the general problem of obtaining meaningful measures of statistical precision of abundance indices. Preliminary analysis of special sampling cruises has indicated that relative variance (on log scale

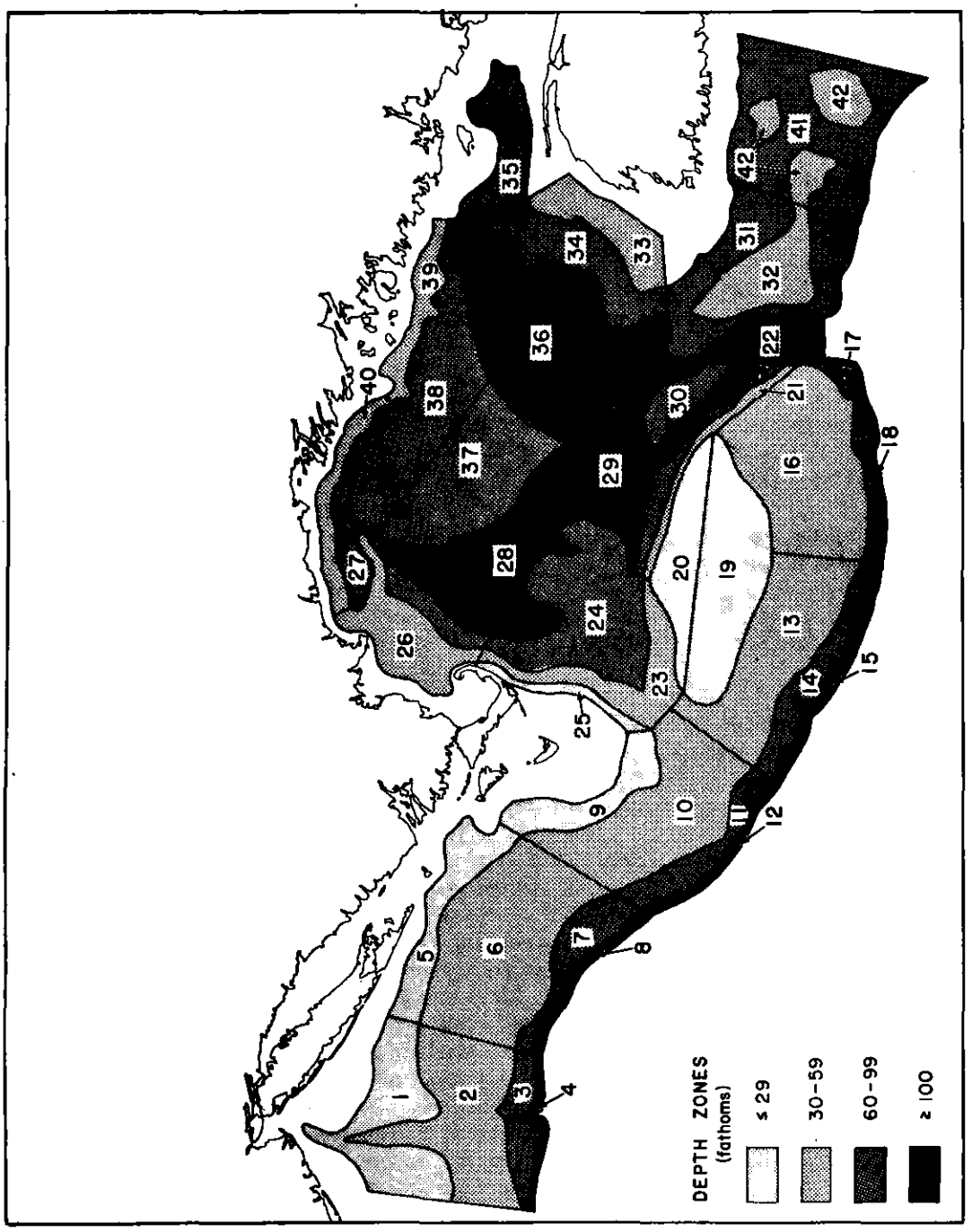


Fig. 5. Sampling strata of US groundfish surveys by *Albatross IV*.

because of contagious distribution of fish) tends to decline with increase in size of the sampling unit (either with longer tows or a larger net). Whether the increased cost per tow in terms of time (either towing time or time to process the catch) would offset the gain in precision has not yet been determined. It appears that a point of diminishing returns is rapidly reached in the relation between variance and sample size (number of tows) and therefore longer and fewer tows, for example, might result in a net gain in precision.

Another objective of the surveys is to monitor the strength of incoming year-classes. Young-of-the-year haddock (1965 year-class) were extremely scarce in all parts of the study area during the past year. The few fish caught on each survey were in the southern portion of the sampling area, mostly south of Block Island and Long Island westward to Hudson Canyon. The index of abundance for the 1965 haddock brood is the lowest index recorded since this sampling began. A report reviewing the problem of recruitment in New England haddock stocks is submitted as a separate meeting document.

Data from earlier groundfish surveys were published during 1965 in Folio 10 of the Marine Environmental Atlas of the American Geographical Society. It is entitled "Autumn Distribution of Groundfish Species in the Gulf of Maine and Adjacent Waters, 1955-1961".

9. Environmental Studies. The Gulf of Maine, Georges Bank and adjacent continental shelf waters between 64°30'W and 72°30'W were surveyed every 3 months during 1965 with the *Albatross IV* to measure seasonal and annual variations in temperature, salinity, dissolved oxygen, and chlorophyll. Between 75 and 90 stations were occupied during each cruise. A typical cruise track is shown in Fig. 6.

Results of each cruise are summarized in mimeographed reports that include the original station data and charts of the north-south transects for each variable measured. Further analysis of the data will be made when the 2-year series of surveys is completed in September 1966.

Distributions of temperature, salinity, water transparency, and currents within Gulf of Maine coastal water were analyzed from 21 stations located between Cape Ann, Massachusetts (44°41'N and 70°35'W) and Machias Bay, Maine (44°40'N and 67°20'W). During all seasons there was an eastward reduction in the vertical ranges of temperature and salinity, and the water column to the east was subject to greater mixing. This areal trend was especially marked in the spring and summer. In the western area isolines of temperature, salinity, Secchi disc reciprocals, and extinction coefficients showed departures from an alongshore contour pattern, and appeared related to river discharge along the coast. Surface drift bottles, seabed drifters, and calculations relative to the 30-m depth were used to study currents. Recoveries of drift bottles and seabed drifters indicated some of the major circulation features common to the Gulf of Maine, while contours of dynamic height anomalies (direction only) indicated portions of eddies or meanders in the western areas and an alongshore

westerly current in the eastern areas.

The Woods Hole Oceanographic Institution monitored temperature and salinity at lightships and towers in Subarea 5. Drift bottle and seabed drifter studies of residual drift in the Georges Bank/Gulf of Maine area were continued.

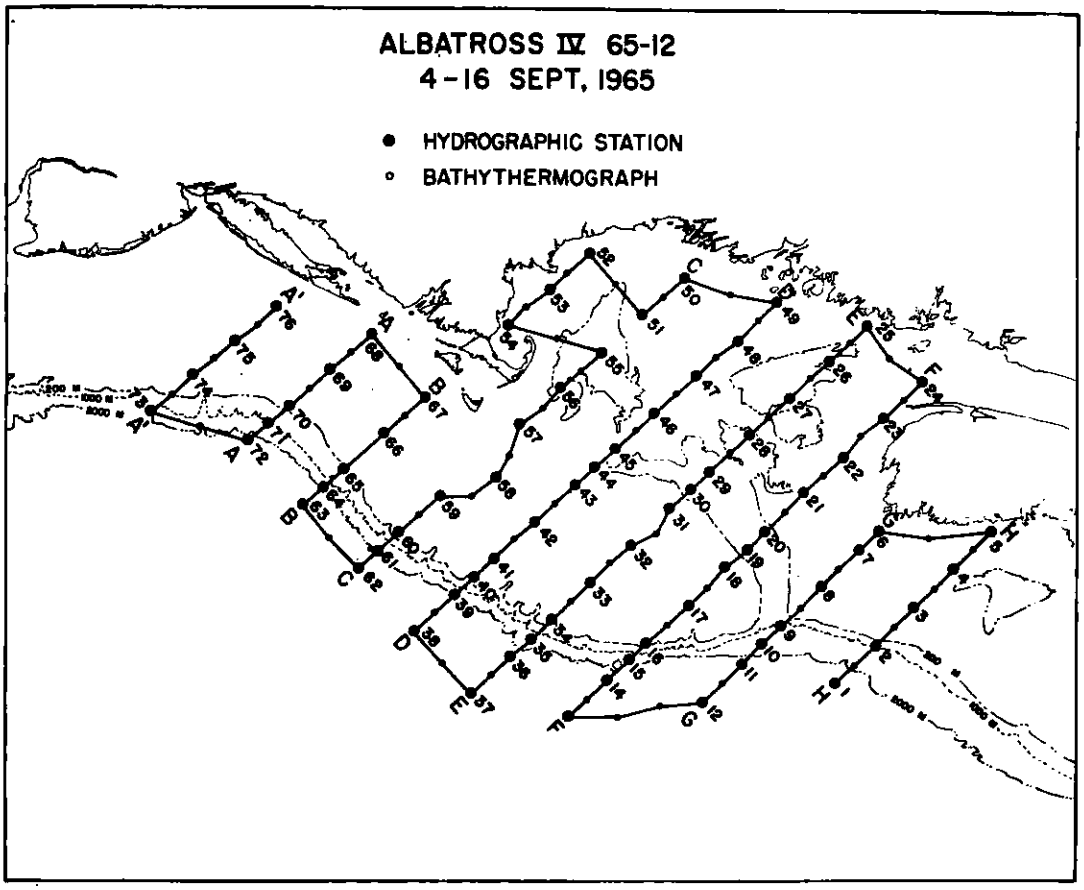


Fig. 6. Typical cruise track - *Albatross IV* hydrographic surveys.

XII. United Kingdom Research Report, 1965

by C.E.Lucas and J.A.Gulland

Subareas 1-5

A. Status of the Fisheries

The total UK landings from the ICNAF Area increased in 1965 by about 15% from 1964 to about 56,000 tons. Due partly to the increasing number of freezer trawlers coming into operation the amount of fishing (in total hours fishing) increased by about 20%, so that the increased landings are more than accounted for by the increased fishing.

Within the total there were big changes in the subareas fished. Both catch and effort in Subarea 1 fell to about half (total landings of ca. 15,000 tons), while landings from Subarea 2 increased by six times (to ca. 11,000 tons), and those from Subarea 3 doubled (to ca. 30,000 tons). Landings from Subareas 4 and 5 are still at a relatively low level.

In the two most important subareas the catch per hour fishing fell by about 10%, to 1.3 tons in Subarea 1 and 1.0 tons in Subarea 3.

B. Special Research Studies

I. Environmental Studies

UK research vessels did not work in the ICNAF Area in 1965, but a number of members of the Lowestoft, Aberdeen and Edinburgh laboratories have been actively engaged in writing the report on the NORWESTLANT surveys; this is now nearly complete. The Continuous Plankton Recorder survey has been maintained (see p.).

II. Biological Studies

Regular sampling for length and age continued on the fish markets (on landings of fresh fish), at processing works (on landings of whole frozen fish) and on factory ships. Altogether some 55,000 fish (cod, haddock, coalfish (pollock) and halibut) were measured. Some 2,000 otoliths were collected.

UK scientists have continued their studies of the state of the ICNAF stocks, being particularly concerned with the working group on Greenland cod.

Annex to
United Kingdom Research Report, 1965

by R.S.Glover

The Continuous Plankton Recorder Survey was continued in 1965, providing nearly 26,000 miles of sampling over nine standard routes in the ICNAF Area, as part of a survey of the North Atlantic Ocean and North Sea which yielded a total of almost 120,000 miles during the year. The program was supported by grants from the British Treasury and by Contract N62558-3612 between the Office of Naval Research, Department of the United States Navy, and the Scottish Marine Biological Association. The mileage sampled in 1965 is shown below for each of the ICNAF subareas in each month and for the whole year.

Subarea / Month	1	2	3	4	5	Total	No. of Records
	miles	miles	miles	miles	miles	miles	
Jan.	-	200	1,330	122	-	1,652	5
Feb.	-	-	590	246	-	836	3
Mar.	18	-	2,209	744	97	3,068	9
Apr.	-	248	2,077	235	207	2,767	8
May	364	300	1,678	485	123	2,950	9
June	413	252	1,102	60	-	1,827	4
July	235	560	1,280	455	110	2,640	7
Aug.	462	634	1,072	414	112	2,694	9
Sept.	243	412	1,908	417	-	2,980	8
Oct.	118	87	1,217	160	113	1,695	5
Nov.	230	320	463	10	-	1,023	3
Dec.	235	445	ca.838	253	-	1,771	6
Total	2,318	3,458	15,764	3,601	762	25,903	76

The material is being analyzed in the Edinburgh Oceanographic Laboratory and the results will be incorporated into a study of the distribution and abundance of the plankton with an emphasis on the analysis of variation in the plankton and the environment. The topics studied during 1965, and relating specifically to the ICNAF Area, included an analysis of collections made during the NORWESTLANT surveys, a comparative study of the food of larval cod and redfish, studies of larval and adult *Sebastes* in the open ocean, and detailed morphological and ecological analyses of intra-specific populations of *Calanus finmarchicus* and *Thysanoessa longicaudata*.