



ANNUAL MEETING - JUNE 1966

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-metre stramin net were taken at a number of the fishing locations. In 3 hauls at the mouth of the Labrador Sea in Division 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 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 enroute 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 Division 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.

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 lance with some capelin on the West Greenland banks.

SUBAREA 2

A. Status of the Fisheries

I. Cod

Inshore cod landings increased to 26 thousand tons in the inshore Labrador fishery from the low landings of about 16 thousand 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 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, enroute 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 Mr 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 Divisions 2G and 2H and a much greater increase in Division 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 2,500 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 37,000 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 8,220 tons from 1,960 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 1,250 tons compared with 1,265 tons in 1964.

IX. Herring, Clupea harengus L.

Newfoundland herring landings, mainly from Subareas 3 and 4 increased to 12,500 from 8,400 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-tailed 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, magneto-meter, 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 5½ 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 lance. 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 conditions 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 Division 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 Division 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 Division 4X. Catches from Divisions 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 Division 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 flounder, 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 Division 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 Division 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 Division 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 predominately 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 Division 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, air-craft, and landmen.

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 towards 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 Pere, 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 echo sounders, sparkers, and sub-horizontal asdic have contributed valuable information on micro-topography, 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 Division 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 M. V. 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 Division 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 Divisions 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 Divisions 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 areas 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 U.S. Fish and Wildlife Service 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 Division 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.

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 determinations 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.

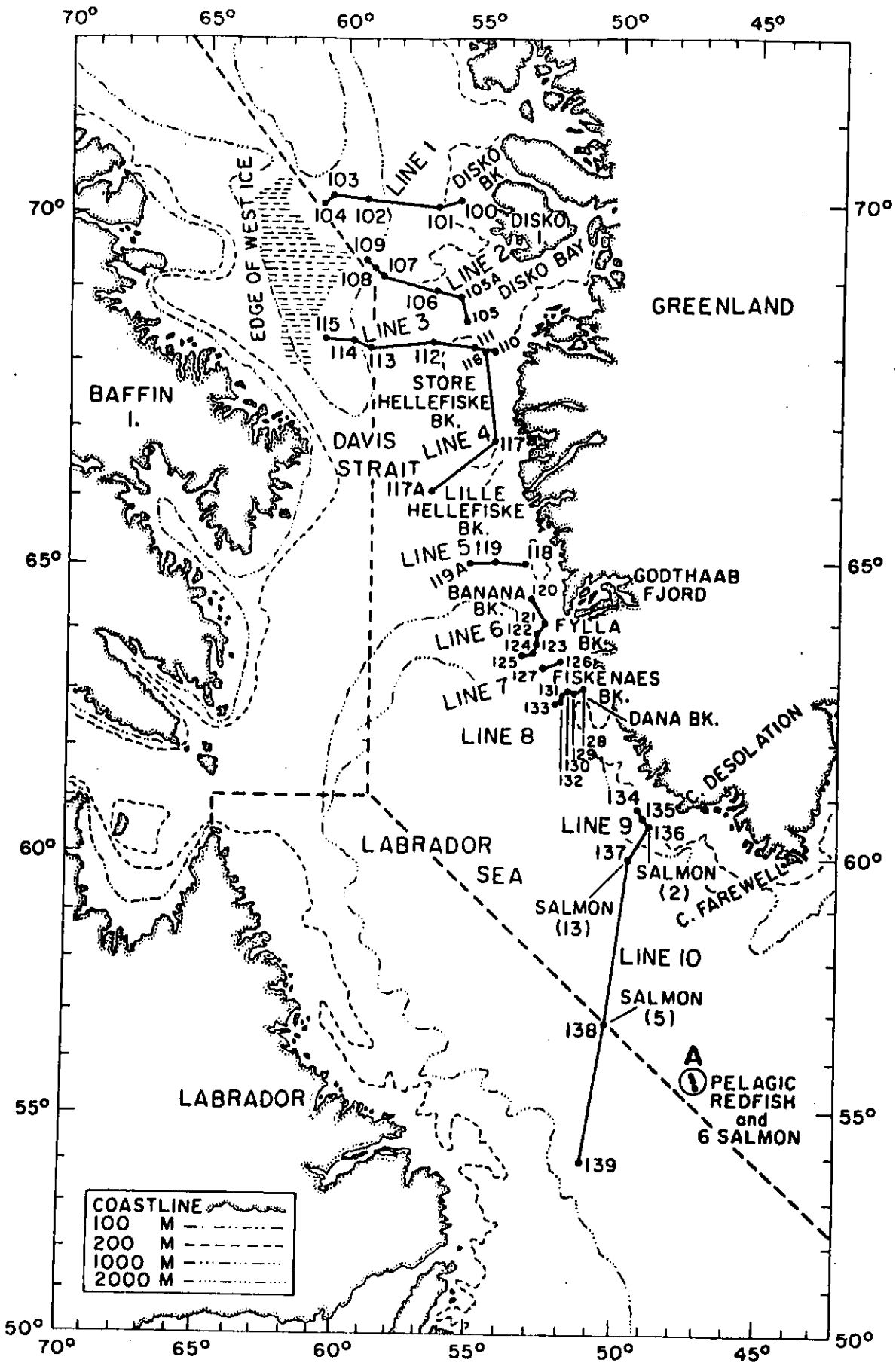


Fig. 1. Hydrographic stations and fishing localities A. T. Cameron, West Greenland cruise 10 July to 25 August, 1965.

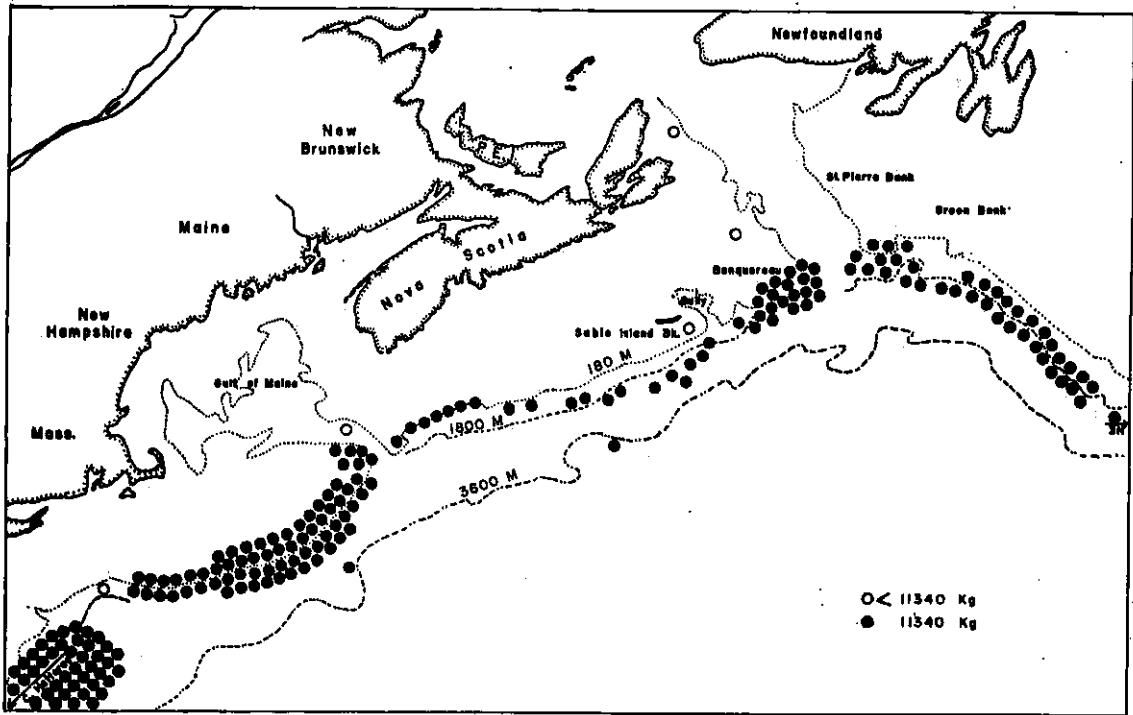


Fig. 3. Distribution of Swordfish Catches, 1965.



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.