

Excerpts from

REPORT FOR 1951 OF THE
NEWFOUNDLAND FISHERIES RESEARCH STATION, ST. JOHN'S, NFLD.
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RESEARCH IN 1951

Groundfish

General Account Operations "Investigator II". During 1951 the "Investigator II" carried out two months' hydrographic work in the area between Hamilton Inlet Bank and the southern edges of the Newfoundland banks. Three exploratory cruises were made to investigate the sizes, abundance and hydrographic relationships of haddock. In four cruises rosefish size, abundance, depth and temperature relations were studied on St. Pierre Bank and on the south-west and eastern edges of the Grand Banks and on Flemish Cap. The Hamilton Inlet Bank area in Labrador and the deep area to the south were explored for cod, rosefish and plaice and in the autumn White Bay and the various deep arms of Notre Dame Bay were investigated.

Inshore Deep-Water Explorations in Newfoundland, 1946-1951. Near the Newfoundland coast and largely in or close to territorial waters there are many deep-water areas often with very interesting temperature and faunal conditions. Some of these inshore deep-water areas are connected with the deeper parts of the ocean by channels deep enough for the warmer saltier Atlantic water of over 3°C to flow in under the superficial layer of fresher below 0°C water produced by the Labrador Current and the local winter conditions. On the east coast, channels of over 150 fathoms are usually needed to provide this warm water and on the south and west coasts over 100 fathoms. In this deep warm water typical inhabitants brought near the coast are the rosefish and halibut, while cod exist in numbers, especially during the winter time, in the somewhat colder water about twenty to fifty fathoms above the rosefish. An area of this type is Hermitage Bay on the south coast of Newfoundland. Where, however, there are deep arms and bays particularly on the east and south-east coasts with ledges of shallow water across their mouths less than a hundred and fifty fathoms deep on the east coast and one hundred fathoms on the south and west coasts, they are likely to be filled to the bottom with cold water from the Labrador Current and from local chilling, and there is no access to the warm deep offshore Atlantic water. In such bays the typical inhabitants of the cold bottom waters are likely to be caplin, the Greenland halibut or turbot and the tiny Arctic cod, Boreogadus saida, but no quantities of warmer water fish such as rosefish and halibut are to be expected. Such a bay is White Bay on the north-east coast.

During the past few years, mostly during the autumn, almost all the deep inshore areas in Newfoundland have been

given at least a preliminary investigation hydrographically and by dragging. Dragging in the deep and below 100 fathom parts of Bay of Islands, Bonne Bay, White Bay, the arms of Notre Dame Bay, Trinity Bay, Conception Bay, Placentia Bay and Fortune Bay produced no commercial results. All of these deep water areas except Trinity Bay and Fortune Bay possessed cold Arctic water ledges at the mouth from the entrance of deep warm oceanic water. The inhabitants of the deep water were of the cold water type described above. Although dragging produced no commercial results, it was apparent that the Greenland halibut or turbot might be caught in moderate numbers by long-line in many of the areas. In Trinity Bay the bottom is rough in many parts and this bay in which deep water temperatures are moderately high, needs considerably more exploration. The Fortune Bay deep water is close to the Hermitage Bay deep water area and while, since it is surrounded by a ledge of much shallower bottom, really warm deep water cannot enter, the bottom temperatures are slightly above zero centigrade and some rosefish enter from the neighbouring area of abundance in Hermitage Bay. The witch flounder is also present in moderate numbers in this Fortune Bay area.

Hermitage Bay, the south coast deep-water area west of Hermitage Bay and the deep area near Port Saunders are connected with the ocean by deep channels and the deep water is warm with temperatures above 4°C. In agreement with this, rosefish of good commercial size were found to be very abundant in Hermitage Bay where a commercial development followed, fairly abundant along the remainder of the south coast west of Hermitage Bay and probably abundant enough for good commercial catches to be made near Port Saunders. In St. Mary's Bay, while the deep water is typically of the cold water type and Arctic cod are present, at certain times during the autumn the temperature in the centre of the bay rises slightly above 0°C and fair catches of cod were occasionally taken by otter trawl. In this bay also there were found large quantities of American plaice, mostly, however, below the present commercial size.

Haddock

Size and Survival. Head-on gutted and gilled haddock from the Grand Bank area are approximately 1½ pounds at 43 cm. (17 in.) and 2½ pounds at 53 cm. (21 in.) in length. In the years since the "Investigator II" began operation in 1946, the average size of haddock caught in research cruises has decreased from 48.4 cm. (19 in.) total length in 1946, to 43.0 cm. in 1950, with a quick drop to 35.7 cm. (14 in.) in 1951. Part of this large apparent decrease in size was due to the relative absence of small fish of new year-classes in 1946 and 1948. A good indication that the size decrease is a real one, however, is shown by the commercial landings at St. John's where haddock size decreased from average length of 53.4 cm. (21 in.) in 1948 to 50.8 cm. in 1950, with a quick drop to 45.2 cm. (18 in.) in 1951. Haddock of 45 cm. (18 in.) and below, formed 3% by number of the landings in

1948, 17% in 1949, 8% in 1950 and 55% in 1951. The numbers of haddock available depend on favourable survival of the young and the sizes depend on the age and growth of the fish. Haddock on the Grand Bank are slow growing and there is great variability in the survival of the young. The commercial haddock fishery on the Grand Bank in recent years, 1947 to 1950, has depended to an increasing amount on the 1942 year-class which survived in large numbers. By 1951 this year-class, now 9 years old, was very much reduced in numbers. The survival of haddock hatched in 1943, 1944 and 1945 was so low that these year-classes have formed no significant part of the commercial fishery. In 1949 a new year-class hatched in 1946 was found to be numerous. In 1951 this 1946 year-class as five year old fish formed by far the most numerous group in the commercial landings. This large group of small fish together with the lack of large sizes was responsible for the sharp reduction in size of commercial Grand Bank haddock in 1951. Most of the 1946 year-class will still be of scrod size for the next three years but will increase in length at the rate of 2 or 3 cm. or an inch each year.

In addition to the 1946 year-class, there is at present a very numerous group of two or three year old haddock on both the Grand Bank and the St. Pierre Bank. It will be two or three more years before these fish enter the commercial fishery in numbers as small scrod haddock.

Concentration of Haddock in Spring. Exploratory dragging in late March and early April, 1951, on the south-west edge of the Grand Bank, indicated the concentrating of haddock in a narrow band near the 55 fathom contour of the bank, close to the point where lower temperatures of 2.0, 1.7, and 3.9°C respectively, quickly changed to higher temperatures of 5.7, 5.2 and 7.2°C. Haddock were more plentiful at the higher than at the lower temperatures.

Haddock Concentrations and Caplin Spawning. During July and up to the middle of August, 1950, there was a very successful Newfoundland and European trawler fishery for haddock and cod, concentrated on the south-east Shoal of the Grand Bank because of the caplin spawning in that area. The Haddock were feeding heavily on caplin eggs attached to sand grains, while the cod were feeding on the adult caplin. In July, 1951, caplin spawn was again present on the south-east Shoal but only one good, one moderate, and two poor trips of haddock were brought from the area by the large otter trawlers from St. John's. Haddock present on the caplin spawning ground were very much smaller than in 1950.

Possible Causes of Reduction of Haddock Size and of Newfoundland Landings from the Grand Bank. Not only was the size of haddock greatly reduced in 1951 but the landed quantities were reduced also. Newfoundland's January to June haddock exports in 1951 were reported to be 1,300,000 pounds compared with about 5,700,000 pounds in the same period for 1950. Newfoundland trawlers, however, finding haddock scarce

and small, did not make the same fishing efforts for haddock in 1951 as in 1950, but turned their attention to the catching of rosefish, plaice and cod. The following factors have doubtless also contributed to the great reduction in size and numbers of haddock landed in Newfoundland in 1951. (a) Until recently the haddock on the Grand Bank were relatively undisturbed. The number of trawlers, however, both Newfoundland and European has been increasing rapidly since the war. (b) Newfoundland druggers have been discarding as too small for commercial use about fifty per cent by number of the haddock caught. (c) The failure of the 1943, 1944, 1945 broods of haddock to survive is now producing a scarcity of larger fish to replace the drain of the commercial fishery in the 1942 and earlier year-classes.

Haddock Otolith Weight. Older haddock of the same length as younger haddock and from the same area have been shown to have heavier otoliths than the younger fish. This observation provides the explanation for the differences found in the otolith weights of St. Pierre Bank and Grand Bank haddock of the same size, the St. Pierre Bank haddock having the faster growth and the lighter otoliths.

Cod

Age, Growth and Survival of Year-Classes. Ages of about four thousand cod, in samples obtained from all the main divisions of the Newfoundland area, have been read from the otoliths. The extremes in growth are Labrador, an area of very slow growth, in which cod take 14 years to reach 63 cm. in size as compared with a little over 6 years on the southern and south-western parts of the Grand Bank - the fastest growing area. Excellent but somewhat slower growth than on southern Grand Bank is also found on St. Pierre, Grand Bank north and east, and the south coast of Newfoundland, while the west and east coasts of Newfoundland have slower growth but still considerably higher than that of Labrador cod. In cod, while there is some variation between the survival of year-classes, there is not the wide variation found in haddock, and as a rule in any one area many year-classes aid in supporting the fishery. Thus, in most of the Newfoundland area while cod may fluctuate in a particular locality from lack of availability, they are not so likely to be actually scarce at any time over the whole area as are the haddock.

Measurements of Same Fish at Sea and on Shore. Measurements of 814 round cod at sea, and, on the average, 4 days later on shore, with the fish in the meantime preserved in ice, showed an average shrinkage in the shore measurement of only 0.06 cm. Similar measurements of 503 haddock at sea showed 4½ days later a shrinkage of 0.12 cm. in the shore measurement.

Cod Tagging. Of the 2,779 cod tagged at St. John's and 1,936 at Fogo in 1950, about ten per cent were recaptured

during 1951. About half of these recaptures were made within twenty or thirty miles from the point of liberation, while the remaining recaptures were widely spread but were mostly from inshore areas. From the St. John's tagging, only one cod was recaptured as far west along the south coast as Placentia Bay, while cod moved much more freely to the northern inshore areas, 18 being recaptured in and near Notre Dame Bay, 2 reaching White Bay, and 3 farther north, while one was recaptured in southern Labrador. A considerable number of offshore recaptures were made by European trawlers, 19 from the western and north-western edges of the Grand Bank, almost all in the spring, one from the eastern edge of the Grand Bank, one south of Whale Deep and one from Banquereau. Inshore dispersal from the Fogo area was about equally balanced north and south, although more fish were recaptured southward, presumably because of the greater amount of fishing to the south. The two recaptures farthest north were in the Strait of Belle Isle, while to the south 6 cod were recaptured on the outer coast of the Avalon Peninsula and one in St. Mary's Bay. Five cod tagged at Fogo were recaptured on the Grand Bank, four on the north-western edge of the bank and one on the south-western side near Whale Deep.

Between April 13 and 17, 1951, cod were tagged from the "Investigator II" in three areas of the Avalon Channel and of the Grand Bank, respectively 30, 60, and 120 nautical miles from the Avalon Peninsula. From tagging of 299 cod in the area 30 miles offshore, 6 tagged cod have been recaptured, 3 by European trawlers offshore, and 3 inshore on the Avalon Peninsula. From the tagging of 300 cod 60 miles offshore, there have been 8 returns, 2 by European trawlers offshore, and 6 inshore. Of 80 cod tagged 120 miles offshore, there has been only one recapture and that was from the inshore area. The cod in the 30 and 60 mile areas at least were feeding heavily on caplin. The cod in all three areas were spawning at the time of tagging and 5 of the inshore captures were in late June and early July at the time when the caplin enter inshore waters in large numbers to spawn. It is evident from these results and from the results of the St. John's tagging that European trawlers on the western and north-western edges of the bank during the spring and early June are catching many cod which have retreated from the shore for the winter to feed and spawn. Many of these cod apparently would have returned to the shore again with the caplin in the latter part of June.

In the above mentioned cod tagging at St. John's and Fogo, the following tags were used: a small pink 13/16-inch plastic tag designed for salmon smolts and attached by nickel wire to the flesh at the base of the anterior end of the first dorsal fin or around the left maxilla or around the left pre-opercular bone; a 2-inch red plastic tag used attached to the pre-opercular or as an internal tag, and 2-, 3-, 4-, and 5-inch orange plastic tags used as internal tags; and a tag of the bachelor button type inserted through the opercular bone. In the few months of 1950 after tagging occurred, the smolt tags gave by far the best return, with the

opercular button and all sizes of internal tags giving approximately equal returns. In the inshore tagging the returns during the first year do not as a rule demonstrate important migrations, consequently the returns after the first year are of most importance. In the recaptures of the second year the smolt dorsal fin back tag, the 2-inch red pre-opercular tag and the 5-inch internal tag gave by far the best and the opercular bachelor button tag the poorest results.

Dogfish Tagging

In the years 1942-1950, about 450 spiny dogfish, Squalus acanthias, have been tagged. Only one tagging, that of 1942 has given significant returns. From this tagging of 281 dogfish off St. John's on July 9-23 there has been a total of 14 recaptures; four in 1942, 5 in 1943, and one in each of the years from 1944 to 1949 with the exception of 1946. Of these returns 5 have been made in Newfoundland on the north-east coast, 3 in Newfoundland on the south coast, one at Shippegan Island at the mouth of Bay Chaleur, one at Cheticamp in western Cape Breton, one in the Strait of Canso, 2 in Gloucester, Mass., one of these being caught four months after the tagging and one was caught by otter trawl 50 miles east by south from Cape Henry in Virginia in February 1947, four and a half years after being tagged.

American Plaice (Hippoglossoides)

Variations in Sexual Maturity and Size. The American plaice has been found to mature sexually at a small size in Newfoundland inshore waters and in the offshore area north of the Strait of Belle Isle, while sexual maturity was on the average at a considerably larger size on the southern, eastern and northern parts of the Grand Bank. In the former area the smallest mature female was 34 cm. in length weighing 0.7 lb. as compared with 39 cm. weighing 1.1 lb. in the offshore Grand Bank area. Comparable sizes of the smallest mature male were 16 cm., 0.1 lb. and 24 cm., 0.3 lb. Between 34-35 cm. and 42-43 cm., allowing the percentage mature at each size group equal weight, 45 per cent of the females were mature in the inshore and northern offshore area and only 10 per cent in the offshore Grand Bank area. Coincident with the larger size at first sexual maturity, plaice grow to a larger final size and are commercially fished on the eastern edge of the Grand Bank, while inshore, as in St. Mary's Bay where plaice are plentiful and where sexual maturity is attained at a smaller size, only a small percentage reaches the local commercial size of 40 cm.

Plaice from Bradelle Bank in the Gulf of St. Lawrence belong to the early maturing type and from St. Pierre Bank and Banquereau to the late maturing type.

Fast and Slow Dragging. A number of paired fast and slow drags of equal duration have been taken for plaice, each pair was in the same locality and depth, as close together in time as possible, and taken in a commercial fishing area for larger plaice. The fast drags were about 3.5 to 3.8 knots per hour and the slow drags about 2 knots. In all cases, in spite of only about half the ground being covered by a slow drag, greater catches of plaice, sometimes two, three or four times as high were taken by the slow drag. These results from a lightly weighted net will not necessarily hold true for the well-powered commercial trawler using a net with a heavily weighted foot-rope.

Rosefish (Sebastes)

Investigations in the Gulf of St. Lawrence. During the past few years, mostly in the late autumn, the deep channels of the Gulf of St. Lawrence in depths between 100 and 200 fathoms have been explored for rosefish by the "Investigator II". These investigations extended along the west coast of Newfoundland and the north shore of the Gulf of St. Lawrence in the deep channel running north from Cabot Strait to Port Saunders, also in the channel north of Anticosti and in the southern channel north of the Magdalen Islands and north of Orphan Bank just east of Gaspé. Over the whole deep water area of the Gulf some rosefish were found and catches of over a thousand pounds to two thousand per hour's dragging were common. The best catches - up to 6,000 pounds per hour's dragging and indicating commercial prospects - were obtained in the northern 30 miles of the deep channel ending near the Newfoundland coast off Port Saunders. The rosefish caught in the Gulf were generally of good commercial size and the bottom in the deep water areas was usually smooth enough for dragging

Increase in Size of Rosefish with Depth. In early May 1951, half-hour otter-trawl drags were taken on a series of lines of stations on the south-western slope of the Grand Bank, from depths of 80 to 120 fathoms down to about 200 fathoms. At all stations in depths down to 160 fathoms, the small non-commercial sizes of rosefish were obtained while at greater depths between 170 and 180 fathoms, larger rosefish were caught. At the 200 fathom level all down the south-western edge of the bank, where now there is no commercial rosefish fishery, almost all the rosefish were of fair commercial size. The bottom in the area is relatively smooth and catches were generally high: 6,000, 15,000, 20,000 and 1,800 pounds in four half-hour drags with a small net of 60-foot head-rope and 80-foot foot-rope in four widely separated areas from north to south near the 200 fathom level. In the rosefish mature males are on the average considerably smaller than mature females. At the shallower depths there were slightly more males than females and many of the females at these depths were immature, while at the two hundred fathom level and also, but to a lesser degree at the 170-180 fathom level, the large mature females greatly outnumbered the males

and were chiefly responsible for the considerable increase in average size at these depths. In early May, when these drags were made, almost all mature female rosefish were still carrying their young within the ovary and oviducts. The males apparently transfer sperm to the females in the late autumn. Consequently, in the spring the mature females may quite well be more or less separated from the main body of males. In a similar trip to St. Pierre Bank in the last week of June 1951, when about forty per cent of the mature females were recently spent and the others had not yet released their larvae, several series of drags between 100 and 200 fathoms were taken and again the larger fish, the females, were in deep water. Later, in a similar trip along the whole eastern edge of the Grand Bank in the second week of July, when 67 per cent of the females were spent, results were variable, some drags at greater depths producing larger fish than at shallower depths and some not showing this change. Here the rosefish are much larger and only a few large catches were made. From these results, we think it possible that, in the spring and in June and possibly in late winter, when female rosefish are carrying fertilized eggs and larvae, the females will be deeper than the males and consequently rosefish at greater depths will be larger. By fishing deeply at this time, rosefish of moderate commercial size may be secured in numbers on smooth bottom on the south-western edge of the Grand Bank where now no fishery exists for rosefish. This problem will be further investigated in 1952.

Groundfish Population Studies

In addition to the work described above a large amount of research is being carried out on the life histories of cod, haddock, rosefish and American plaice. This includes measurements to follow size changes in the population because of exploitation or new year-classes. In 1951 up to the end of September, 11,000 cod, 16,000 plaice, 25,000 rosefish and 13,000 American plaice have been measured. Studies are being made on these and other groundfishes of size at maturity; time and place of spawning; age and growth; food of cod, and the relation of sizes and numbers of fish to temperature and depth. Vertebral counts and other racial characteristics are being taken as an aid in the investigation of the amount of separation or mixing in fish populations.

Caplin

In 1950, we obtained the first definite evidence of caplin spawning on the banks. This spawning occurred, beginning before July 19, in water 24-25 fathoms deep, on the south-east Shoal of the Grand Bank about two hundred and fifty miles from St. John's. From the area covered and the large numbers of haddock and cod attracted by the spawn and the caplin themselves, it was evident that a very great amount of caplin spawning had occurred. In July and

August 1950, haddock were found to be again feeding in numbers in this area on caplin eggs attached to sand grains. The general location of caplin spawning on the shoal was similar to that of 1950. In 1950 a cold year on the south-east Shoal, with bottom temperatures in the caplin spawning area in July and early August of 2.5 to 2.9°C, caplin eggs from the shoal showed no sign of development on July 19 and only little development on August 9, when only one sample out of 55 had eye-pigment showing and this in its early stages. In 1951 a warmer year with bottom temperatures in July and early August about 1½ degrees higher than in 1950, all 37 samples of eggs taken on July 15 showed well developed caplin larvae with typically well developed eye-pigment. Larvae were approaching the hatching stage. From the stage of development of the eggs in 1950 it was estimated that most of the caplin hatching on the shoal would not take place before September, while from the stage of development of the eggs on July 15, 1951, it was to be expected that a good deal of the hatching would have occurred before the end of July. The 1951 spawning was probably in the latter part of June.

It had been expected that owing to the lower developmental temperatures of caplin eggs on the south-east Shoal, caplin vertebral counts in this area would be higher than those from the Newfoundland coastal areas. This did not prove to be the case and no significant difference was noted between caplin vertebral averages for the south-east Shoal, S. W. edge, the N. edge and the W. edge of the Grand Bank, nor could we be certain of a significant difference between vertebral averages from these areas and those of the coastal areas. The bank averages were as low, if not lower, than the coastal averages.

Squid (*Illex illecebrosus*)

Squid were captured offshore on the southern slope of the Grand Bank as early as May but these squid were small, averaging 12.8 cm. mantle length. As the season advanced squid captured were progressively larger and the largest were taken in late season catches both inshore and on the banks. In the inshore catches a comparatively small number of squid were larger in size than the usual run and the maturity of these was somewhat more advanced. Apparently not more than two size groups of squid, of which the smaller is predominant, are supporting the inshore late season fishery. Both size groups are maturing or mature in the late season. In the present year for the first time, the observation was made that the males were reaching full maturity by autumn with spermatophores ready for transferral extending from the penis. In the females the stage of maturity was considerably behind that of the males and the eggs were only beginning to develop by autumn. Consequently, while the spermatophores could have been transferred to the female at any time from about October or November onward, the eggs are apparently not released in

inshore Newfoundland waters since the squid, as a rule, leave the area before December.

The short-finned squid is of major importance to the Newfoundland line fishery for cod in August and the autumn months. This squid often begins to appear inshore in numbers by late July and generally, when numerous, is inshore by August and is the favourite bait for cod. The bait freezers operated by the Department of Fisheries are placed in a considerable dilemma by the sporadic appearance of the squid. If they stock up heavily on the herring in April and May or the caplin in June and July, and the squid appear, much of the caplin and herring will not be sold. If they do not stock up on caplin and herring and the squid are absent, the Bait Department will be blamed for not putting the bait freezers to their proper use as an insurance against a failure in the normal bait supply. We have compared the numbers of squid, caught in otter trawling mostly on the southern part of the Grand Bank by the "Investigator II" in May and June, with the quantities appearing inshore later in the year and found fairly good agreement considering the fact that no special efforts were made to capture squid on the Bank. Only 3 squid per 100 hours' dragging were obtained in 1948 when squid were scarce in the coastal area, and in 1949, when squid were so few on the coast as to be of little value to the autumn cod fishery, no squid were obtained in 31 hours' dragging on the Grand Bank. In 1951, a year of considerable abundance inshore, 5,683 squid were obtained per 100 hours' dragging in May on the Grand Bank. It is possible that a suitable otter trawling survey, taken yearly in May in deep water between 100 and 200 fathoms on the south-western edge of the Grand Bank, would give a high percentage of correct forecasts of the likelihood of the presence of squid inshore in numbers later in the year. Experience at present, however, is too limited to be certain that abundance on the banks will be followed by abundance inshore but in the past five years there has been some agreement between offshore abundance in spring and inshore abundance later in the year.

Hydrography and Fishing, 1951

In 1951 the "Investigator II" carried out, in March, a cruise over the southern Grand Bank and St. Pierre Bank areas. In July and August five sections were taken across the Labrador Current and bank areas from Domino in Labrador to the southern part of the Grand Bank, and most of the March stations were repeated. Monthly throughout the year temperatures and salinities were taken to 95 fathoms, 5 miles off Cape Spear near St. John's. Bottom temperatures were taken at all fishing stations. Temperatures in March were considerably higher in 1951 than in 1950 and in fact, higher temperatures were recorded in most areas than in any other year since these investigations began in 1947. In 1949 no March cruise was made. In March 1950, along a series

of 150-fathom stations running along the whole south-west slope of the Grand Bank between St. Pierre Bank and the south-east tip of the Grand Bank, there was in the south-east stations a great mass of below 0°C water, apparently derived from the eastern branch of the Labrador Current. The below 0°C layer occupied most of the volume from surface to bottom from Longitude 52° 46' W to the eastern tip of the bank. In March, 1951, on this same line of stations, there was only a narrow finger-like band of below 0°C water extending from the east, with a mere tip reaching as far west as Longitude 51° 05' W. In March 1950, a considerable mass of below 0°C water, extending from the surface to about 100 metres, was evident at the southern ends of the channels between St. Pierre Bank, Green Bank and the Grand Bank. In 1951, there was no trace of below 0°C water at these stations, most of the water temperatures down to 100 metres being between 3 and 4.6°C. In 1950, the Avalon Channel between the Avalon Peninsula and the western edge of the Grand Bank was completely full of water almost entirely below -1°C, with the greatest volume below -1.5°C and some temperatures as low as -1.68°C and -1.70°C. In 1951, only the inner coastal layer had about its volume of below -1°C water and the lowest temperature was -1.22°C.

In August, 1951, the southern Grand Bank and St. Pierre Bank hydrographic sections which are normally covered in March were repeated. Bottom temperatures had changed but little since March on the southern half of the Grand Bank, being increased about one degree in the most southern line of 40 fathom stations near the south-western slope. Surface temperatures were high, running in the vicinity of 17 to 20°C near the south-western edge of the Grand Bank and to 14 to 17.6°C further to the north-east toward the central section of the bank. Bottom temperatures on the shallower plateaus of St. Pierre Bank were high, over 6°C, and surface temperatures were between 15.5°C and 18.5°C.

During the latter third of July three lines of stations were taken across the Labrador Current, a northern section extending out from Domino, Labrador, an intermediate section off Cape Bonavista and a southern section along the 47° line of latitude from the coast across the Grand Bank and Flemish Cap. In the northern line of stations, from Domino out to water over 450 metres deep, the below 0°C water was found to have a width of about 80 nautical miles, its greatest depth near the coast running from 25 to 250 metres. In 1950, in early August, the below 0°C body of water extended further seaward (about 110 nautical miles) than in 1951; also in 1950 a small body of below -1.5°C water existed near the coast. In 1951 no temperatures as low as -1.5°C were present. In the intermediate line of stations off Cape Bonavista, the greatest depth of below 0°C water near the coast extended from about 40 to 250 metres, while in 1950, this below 0°C layer extended down to 350 metres. In 1950, a body of below -1.5°C water, varying in thickness from 125 to 25 metres and a width of about 55 nautical miles, was present near the coast, while in

1951, no temperatures as low as -1.5°C were found. On the third line of stations, across the central part of the Grand Bank, no strict comparison with 1950 is possible, since these stations were occupied in June 1950, and in July 1951. On this line of stations in June 1950, a cold layer of below -1°C covered the bottom and extended from the coast beyond the eastern edge of the Grand Bank to approximately $46^{\circ} 45' \text{ W}$ longitude. In July 1951, the body of below 0°C water, which near the coast extended from 50 metres to the bottom, gradually tapered away and disappeared entirely at the western edge of the Grand Bank at longitude $50^{\circ} 30' \text{ W}$. At $49^{\circ} 00' \text{ W}$ longitude, the below 0°C water reappeared in small volume, reached its maximum thickness at $48^{\circ} 00' \text{ W}$ longitude and ended at 47° W longitude. Thus in June 1951, the northern portion of the Grand Bank was covered with below -1°C water, while in July 1951, the bottom water in this area was above 0°C . The general picture from these three lines of stations is that the below 0°C layer of the Labrador Current was shallower and less extensive and did not contain as cold water in 1951 as in 1950.

In the coastal station, 95 fathoms deep, 5 miles off Cape Spear, the bottom temperature in March to July, 1951, was between -0.43 and -0.80°C compared with -1.47 to -1.60°C during the same period of 1950. In 1950 at this station, water of -1.5°C or lower extended from surface to bottom in March and was present in the deeper layers from March to September, while in 1951 no below -1.5°C water was present at any time.

The year 1951, with a thinner layer of below 0°C water and, in this layer, very little water below -1.2°C as compared with a thick layer below -1.5°C in the previous year, was marked by a great and unusual abundance of cod in many inshore areas on the east coast of Newfoundland. Cod were also plentiful on the Labrador coast. The abundance on the east coast was especially evident during the trapping season, mostly in 10 to 20 fathoms in late June and July. Cod were also plentiful, but a little deeper, in August and in the autumn. On the banks, local trawling for adult haddock was poor, and the European otter trawlers obtained very poor catches of cod up to the latter part of June, when they left for Greenland. In east coast Newfoundland inshore waters, even in a year of relative lack of below 0°C water, there is still a great amount of this cold water present, and the slightly higher temperatures and the thinness of the cold water layer may not form as effective a barrier as in cold water years to the passage of cod to the surface, and from thence into the inshore area after the caplin. The success of the east coast fishery for cod largely depends on the results of trapping cod in water from 10 to 20, and mostly 10 to 15, fathoms before the layer of water warms up too greatly. In 1951, in spite of the comparative lack of below zero water, judging by our coastal station at St. John's the water at about 15 to 20 fathoms depth was slow in warming. Newfoundland otter trawlers and the European trawlers which are salting

their fish, both landing a low priced product, must obtain fish in very large quantities to make a profit. They will catch large quantities only when fish are concentrated. When fish are spread out off the bottom a considerable distance, as they very often are during and after spawning, line fishing may be more profitable. Haddock and cod appear to be concentrated best by water too cold on one side, and too warm, or too deep, or both on the other. Cod may also be plentiful where food such as caplin or launce are numerous but such feeding accumulations are often of temporary duration. In 1951 also, a much greater area of the shallower water at the northern tip of the Grand Bank, usually in the earlier part of the year too low in temperature, became suitable for cod, through lack of below zero water. In the summer of 1951, cod were present in moderate numbers in this area, where they are usually scarce. With a greater shallow water area at the northern part of the bank, of suitable temperature in 1951, the cod probably spread more widely than usual and were not so available for capture. The local squid, Illex illecebrosus, was extremely numerous both on the banks and in inshore Newfoundland waters in 1951. This squid, when on its visits to coastal waters beginning in late July or in August and usually ending in November, occupies the shallower waters of higher temperatures and only a few fathoms deep. Doubtless, therefore, there is a hydrographic relationship in its migrations. The great abundance in 1951 is given as a matter of record, as continuous observations of squid abundance and hydrographic relationships are necessary. With the lack of cold water, a number of fishes appeared to be more numerous than usual in the area. Billfish were reported very numerous in many Newfoundland areas, both inshore and on the banks. Many small great blue sharks and an occasional mackerel shark were caught in coastal waters. At least three captures of sunfish were made in the inshore Newfoundland area. At least three small 2- or 3-foot sturgeons were reported from the south and west coasts. The early salmon fishery was noted for an unusual abundance of large salmon about twenty pounds in weight. This was a year with little coastal ice in May to interfere with the east coast salmon fishery and it may be that an unusual number of the early run of large salmon, probably bound for the Gulf of St. Lawrence, ran nearer the coast than usual. There is also, of course, the possibility of a delayed maturity with considerable increase in size produced by the unusual amount and depth of very cold Labrador Current water in 1950. In a preliminary check, we have noted in scales from haddock caught in the spring that there was very little growth in 1951 in the young immature fish and usually little or none in the older mature fish. The year 1951 in older fish, as judged from the very dominant 1942 year-class, is present as only a tiny check in most scales and is probably absent in some scales, forming only a reinforcing of the winter band of the previous year.