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I. Subareas 2 and 3

By W. Templeman

The Fisheries Research Board of Canada, Biological Station at St. John's has carried out in 1958 researches in Subareas 2 and 3 on cod, haddock, redfish, and American plaice. Hydrographic sections, also, have been taken over the area from southern Labrador to the southern Grand Bank during the period July 27 to August 26.

Cod, *Gadus callarias* L. Age determinations were made from otoliths of 800 cod taken in the Labrador area (ICNAF Subarea 2) in 1950 and 1951. About one quarter of the fish were from the inshore area and the remainder were taken offshore in depths of 100-200 fathoms. The age readings indicate that in the Labrador area best survival of cod from 1940 to 1947 probably occurred in 1942, 1945, and 1947. There was relatively moderate to good survival in 1944 and 1946. A fair number of old fish in the samples may be a reflection of low fishing intensity in the area at that time.

In 1958 the emphasis on better sampling of the inshore cod fishery was continued. Observations were continued throughout the fishery at Bonavista, which is one of the most important centres of the inshore fishery. With the inshore fishery in Newfoundland generally poor in 1958, only about 8,700,000 pounds of cod were landed at Bonavista, compared with 15,300,000 pounds in 1957. Of the 1958 total, 40% was landed from handlines, 26% from traps, 4% from linetrawls (longlines pulled by hand), and 30% from longlines. The 1957 landings were made up as follows: handlined, 50%; trapped, 24%; linetrawled, 2%; longlined, 24%.

To ensure a successful inshore fishery at Bonavista and on the east coast of Newfoundland, generally, it is apparently necessary for cod which come toward shore in the warmer, surface layer to be concentrated inshore and prevented, by cold water of the coastal portion of the Labrador Current, from descending too rapidly to depths beyond the range of the gears. This portion of the current exists in summer as a cold, intermediate layer below the warmer, surface water.

This cold layer, with temperatures below 0°C, was not as close to the surface in 1958 as in 1957. In addition, severe, early-summer storms mixed the inshore waters to such an extent that cod were able from early June to move much deeper than would be possible during a calm summer. The apparent lack of concentration of cod in depths within the fishable range of the usual inshore gears is reflected in the much lower catch per unit of effort of all gears generally throughout the season as compared with 1957. Also, the fishery with baited hooks was severely hampered by an extreme shortage of fresh bait.

In 1958 the landings from the longline fishery at Bonavista were 45% lower than in 1957. The longline catch per unit of effort, both offshore in the deep water and inshore in the shallower water, was much reduced as compared with 1957, and was lower than for any other year since the fishery began. It is apparent that unfavourably warm hydrographic conditions in 1958 had an adverse effect on the inshore longline fishery. In addition, the deep-water grounds are much more heavily exploited now. When the fishery began in 1952, the deep-water stocks of cod off Bonavista had not been fished previously, and until 1956 the Bonavista longliners were the only boats fishing the area. In 1956 a few large European trawlers began fishing in the area,

and in 1957 and 1958 a much greater concentration of effort by a larger number of trawlers occurred. In addition, a fleet of longliners from the Faroe Islands and from Norway fished off Bonavista and in neighbouring deep-water areas in 1957 and 1958.

Length measurements have been obtained from cod landed by longliners since 1952 from the deep water below 100 fathoms off Bonavista and comparisons made of the yearly length distributions in summer. In 1952, the first year of commercial longlining, 30% by number of the cod landed were 81 cm and larger, and the average length was 76.0 cm. Each year that followed, the proportion of these larger fish in the catch was reduced and by the end of July 1958, their contribution to the catch was only 6%. The average size of the longline cod has been reduced by about 10 cm in the 1952-58 interval and the fish landed in 1957 and 1958 were mainly between 50 and 80 cm in length, with greatest numbers at 62 cm. In 1958 it is apparent that even these fish were caught by the Bonavista longliners in smaller numbers than in 1957.

Observations were conducted at Isle aux Morts on cod from the fishery on the western part of the south coast of Newfoundland. Small motor boats, motor dories, and longliners all using the same type of longlines fished 3 to 5 miles from shore in depths ranging from 50-80 fathoms. Sizes of fish caught ranged from just over 30 cm to about 130 cm but during the fishery of March and April few cod larger than 80 cm were taken. By the middle of April there were indications of an increase in the numbers of large cod relative to the numbers of smaller ones as compared with early March, and in early July this change was obvious.

The age composition in March-April indicated a great range of ages from 4 to over 20 years of age, with fish from 5 to 11 years old making up the majority. In April the older age groups (beyond 8) were more abundant relative to the younger age groups than in March. It is apparent that in July the numbers of the older fish relative to the younger ones were even greater than in April.

The March-April samples were largely made up of fish of the stock which migrates into the Gulf in April-May, whereas the July sample would be composed of fish of the "resident" stock.

The change in size and age composition was reflected in a large decrease in the catch per unit of effort in the fishery beginning in May. The reduced catch per unit of effort throughout summer was apparently because the resident stock was far less abundant than the migratory stock which mingled with it during winter and on which the success of the winter fishery depends.

Haddock, *Melanogrammus aeglefinus* (L.). In May the yearly otter-trawling surveys for haddock were carried out by the Investigator II on the southern half of the Grand Bank and on St. Pierre Bank. The Grand Bank survey was made nearly a month earlier in 1958 than in 1957 and bottom temperatures were on an average higher in 1958. As in 1957 the haddock had already spread northeastward from their winter quarters in the deeper water of the southwest slope to occupy much of the southern half of the bank and hence were not very abundant at any of the stations. In the area as a whole, haddock were not quite as abundant as they were in 1957. Indications are that, due to the more favourable temperature conditions in 1958, haddock spread over the bank earlier than usual. This is also reflected in the commercial landings for 1958, which decreased rapidly about a month sooner than in 1957.

The St. Pierre Bank survey for haddock was made about five weeks earlier than in 1957 and bottom temperatures over the bank were favourable for haddock. However, as in 1957, no significant quantities of any year-classes were obtained, indicating that there has been no significant survival of young haddock on this bank since the extremely abundant 1949 year-class which maintained the commercial fishery there during 1954-56.

From the catch length-frequencies and the age analysis of the samples obtained from the Grand Bank haddock cruise in May, the most abundant group present in 1958 was the 1955 year-class with a mode at 30 cm, which will undoubtedly contribute significantly to the commercial fishery in 1959 and still more by 1960. This group accounted for more than 50% by number of the catches of the Investigator II. The once very abundant 1949 year-class has been relatively much reduced, accounting for less than 10% by number in the catches. The moderately abundant 1952 and 1953 year-classes with modes at 38 and 41 cm, which were important commercially in 1958, are on the decline and will be replaced in importance by the 1955 year-class. The 1956 year-class does not appear to have survived very well, and the same is true of the 1957 year-class.

In 1958 for the first half of the year the main fishery for haddock was concentrated in the southwestern Grand Bank area (ICNAF Subdivision 30). Most of the haddock landed from this fishery were from 33 to 50 cm in length, with a modal group at 40 cm, made up mainly of fish from the 1952 and 1953 year-classes.

In the second half of 1958 a limited fishery for haddock occurred in the southeastern Grand Bank area. Haddock landed were from 30 to 50 cm in length with modal groups at 33 to 34 cm and at 41 cm. The 33 to 34 cm modal group represents the larger fish of the 1955 year-class which were retained, and the 41 cm group represents fish of the 1952 and 1953 year-classes.

It is obvious that for the next two or three years fish of the 1955 year-class will be important in maintaining the Grand Bank haddock fishery.

Redfish, *Sebastes marinus mentella* Travin and *Sebastes marinus marinus* (L.). Researches in 1958 indicated that the marinus-type redfish could be more plentiful and have somewhat different habits than had previously been known for the area. The Investigator II in a half-hour drag east of Hamilton Inlet Bank on June 10 at 250-256 fathoms (460 m) caught 480 pounds of large marinus-type redfish per hour's dragging and only 80 pounds of the mentella-type. Almost all the marinus-type females had larvae ready or nearly ready for extrusion. This capture of significant numbers of marinus-type redfish at a depth where usually only mentella-type redfish exist is similar to that reported by Lundbeck in the German Research Report, 1957 (ICNAF Ann. Proc. Vol. 8, pp.39-42) of spawning concentrations of marinus-type redfish at 420-450 m off East Greenland.

In 1958 commercial redfish fishing began in Subarea 2 of ICNAF in an area off Hawke Harbour, Labrador, which was first fished by the Investigator II in September 1951. The part of this new commercial fishing area fished by Newfoundland trawlers is about 80 to 120 nautical miles south of the area east of Hamilton Inlet Bank which has been fished successfully for redfish by the Investigator II usually in August or September, from about 140 fathoms down to about 200 fathoms in each year from 1950 to 1953, and down to 300-400 fathoms in 1954, 1956, 1957, and 1958.

Redfish fishing in this new commercial area off Hawke Harbour has been very successful and has been participated in by Canadian, United States, Icelandic, German, Belgian, and Russian trawlers. The Newfoundland fishery occurred mainly between 150 and 180 fathoms (occasionally 125-200 fathoms) in late August 1958, and produced a catch of between 2 and 3 million pounds of redfish. These catches were all from ICNAF Subdivision 2J, mainly between Lat. 52°45' and 53°00'N and Long. 52°10' and 52°40'W, and with good catches also about 40 nautical miles north of this area. The northern part of the Newfoundland fishing area was on the southeastern part of the Hamilton Inlet Bank area and the more southern fishery which was much greater was on the fringes of Hawke Channel, the below-200-fathom indentation in the continental shelf leading toward Hawke Bay.

Sampling of some of the commercial catches from the area has shown that fair numbers of marinus-type fish occurred in the catches and between August 25 and September 25, 1958, when 1% of a total catch of one and a half million pounds was examined, 11% by number were found to be marinus-type fish. Since specimens of marinus were on the average more than twice as heavy as an average specimen of mentella, the marinus-type was considerably more important by weight than by relative number.

The data from this sampling would indicate that marinus-type fish are, in this area, relatively more abundant than we had formerly supposed and that on occasional trips, a very high percentage of a trawler's catch may be marinus-type.

In a cruise of the research vessel "Marinus" from May 5-22, 1958, just east of Hermitage Bay, at the northern entrance to Connaigre Bay on the south coast of Newfoundland at 112-116 fathoms, 146 marinus-type redfish were found in an hour's towing during which 4,500 pounds of redfish were caught. The remaining approximately 4,000 redfish were of the usual mentella-type.

Also on the east side of Connaigre Bay just below the edge of the 100-fathom contour and at the same time of the year one dragger caught 7,000 pounds of redfish in a 2-hour drag and the captain said that over half of these (probably by weight) were of the marinus-type. Another dragger also fishing in the same area reported over half its catch to be marinus-type. These marinus-type fish which are typically golden yellow in colour in this area, are on the average considerably larger than the mentella-type, and are readily recognized by the trawler skippers.

Flemish Cap has continued to receive our attention since 1950, when large catches of redfish were obtained there by the Investigator II. The area has, as yet, been little exploited by Canadian vessels, although vessels of the USSR have caught many millions of pounds there since 1956.

During the fishing trials of the new research vessel of the Fisheries Research Board, the A.T. Cameron, the opportunity was taken to examine again the general pattern of redfish distribution at various depths in the area on the north and northeast slope of Flemish Cap. A total of 15 sets was made in the area at depths between 112 and 410 fathoms. The A.T. Cameron appeared to fish well at all depths and good catches of redfish occurred to 300 fathoms. In greater depths, e.g., 400 fathoms, although redfish were scarce, the catches of other fish indicated that the trawl was still fishing efficiently.

As in previous trips to this area, marinus-type redfish were abundant in the shallower water of 150 fathoms and in the two daytime sets when large catches were obtained, 78% and 66% (by number) of the redfish were marinus-type. In two sets at 200 fathoms the combined data show only 1.6% of the catch to be marinus-type fish and at 250 fathoms the number was further reduced to only 0.3%. At depths greater than 250 fathoms no marinus-type fish were found.

In separating the marinus and mentella forms of redfish, only those which could be separated with complete confidence were typed and those in which any doubt existed were classed as "indefinite" or "doubtful" types. The indefinite-type fish occurred only in the shallow water (150 fathoms or less). This is mainly due to the fact that greater numbers of small fish occurred at these depths although the occasional larger fish which showed intermediate characters also occurred.

The largest catches occurred during the mid-day period in 150 fathoms where catches of 6,200 and 7,300 pounds per hour's dragging were obtained. These catches consisted mainly of large marinus-type fish and this is reflected in the average weight per fish, which is, for these sets, approximately 2 pounds. At 200-300 fathoms, where very few or no

marinus-type fish were present, the catches declined to between 3,000 and 5,000 pounds per hour's dragging but greater numbers of the smaller, deep-water, mentella-type fish were taken. Below 300 fathoms, with the exception of a set which extended from 350-280 fathoms, catches declined and at 400 fathoms only 7 redfish were taken in a 40-minute drag.

A study was undertaken during 1958 of the differences between late-stage pre-extrusion larvae of marinus- and mentella-type female redfish obtained from selected areas around Newfoundland. The study has revealed a very interesting difference between the two types in so much as larvae from mentella-type nearly always possessed one or more caudal melanophores, situated ventral to the vertebral column, posterior to and separated from the ventral row of body melanophores, whereas in larvae from marinus-type parents these caudal melanophores were usually absent or if present, were in fewer numbers. The difference is a quantitative one and is useful for distinguishing populations of marinus- and mentella-type redfish and probably for deciding whether the so-called intermediate-type redfish are actually of marinus or of mentella-type, or whether early stage larvae captured at sea are predominantly mentella or marinus-type. It cannot, however, generally be used as an absolute diagnostic character in the type-identification of single redfish larvae.

American plaice, Hippoglossoides platessoides (Fabr.). Monthly sampling of American plaice from St. Mary's Bay has been continued. The same dominant year-classes were found as in 1957 and it appears that there is a strong survival of larvae in alternate years. Age determinations of commercial plaice from ICNAF Subdivisions 3L and 3N show that plaice from the latter subdivision reaches a larger size at a comparable age. From 3N the bulk of the commercial catch is of male fish aged 7 to 18 years and females of 7 to 25 years. From 3L the catch is of male fish aged 10 to 18 years and females of 10 to 24 years.

Hydrography. The customary six hydrographic sections were taken as usual in July and August. These sections extended from southern Labrador to the southern slope of the Grand Bank and across the banks and Labrador Current seaward to a depth of 500 metres at the seaward slope of the continental shelf. Once or twice each month temperatures and salinities were taken at a station 2 miles off Cape Spear, near St. John's, in 176 metres.

The hydrographic section off Seal Islands, Labrador, (Fig. 1) was taken from August 4-5, 1958, and revealed that the unusually high temperatures (3.9 to 4.7°C) which were present in the deep water in 1957 had disappeared and that the temperatures of the deep water had reverted to a more normal 3.3 to 3.7°C. The inshore upper layer of water with temperatures higher than 0°C was very much deeper in 1958 than in 1957. The salinity of the deeper water was slightly lower in 1958 than in 1957.

In the section off Bonavista, also, as in the Labrador section, temperatures in the deep water were more normal; almost a degree lower than in 1957. As in the Labrador section, the upper, surface, cold (below 0°C) layer extended deeper than usual in 1958 whereas it was shallower than usual in 1957. This coincided with a relative failure of the inshore cod fishery on the east coast of Newfoundland in 1958 compared with the much more successful fishery of 1957. A core of water with temperatures below -1.5°C was present in 1958 but not in 1957.

In the St. John's-Grand Bank-Flemish Cap section, (Fig. 2), mainly along the 47° Latitude line, the bottom temperatures of the shallower parts of the Grand Bank were slightly above 0°C in 1958 whereas in 1957 they were below 0°C. There was also considerably less water below -1°C on the shoreward portion of this section in 1958 than in 1957.

Seasonal cruises to the south and east of Newfoundland were carried out by the Atlantic Oceanographic Group, St. Andrews, N.B., in February and March and in October and November. These surveys covered a large area including the Laurentian Channel, the deep waters to the west, south, and the east of the Grand Banks, the Grand Banks, and the continental shelf east of Newfoundland as far north as the Bonavista section.

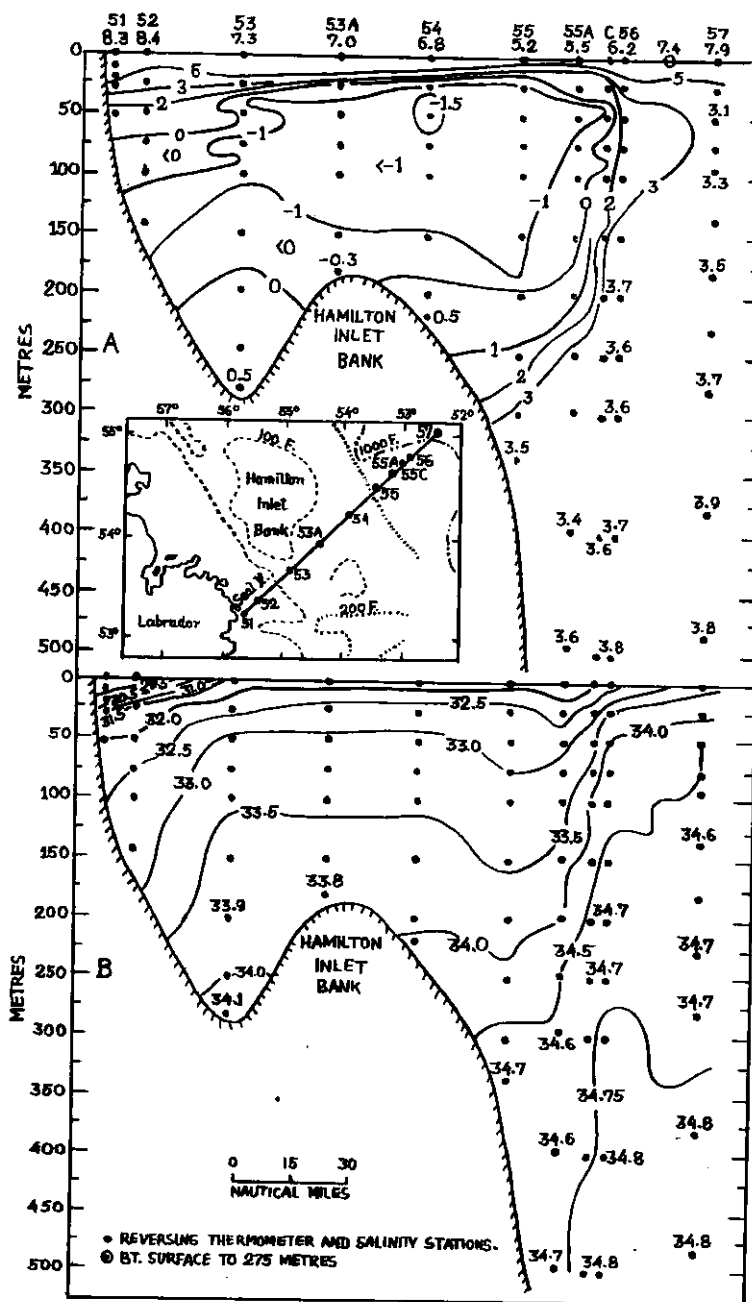


Figure 1. Hydrographic section off Seal Islands, across Hamilton Inlet Bank, Labrador, August 4-5, 1958.
A - Temperature °C; B - Salinity ‰.

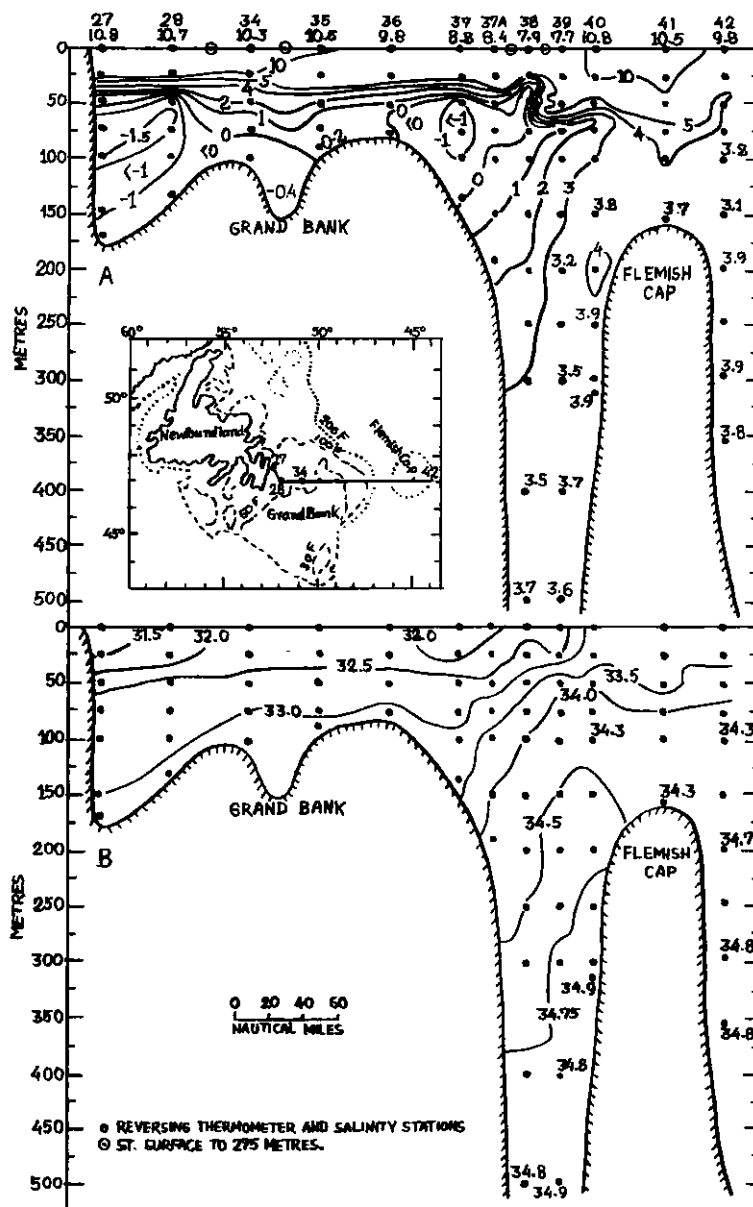


Figure 2. Hydrographic section St. John's - Grand Bank - Flemish Cap, July 27-30, 1958. A - Temperature °C; B - Salinity ‰.

II. Subareas 4 and 5

By W.R. Martin

Canadian research in Subarea 4 during 1958 was carried out by the Fisheries Research Board of Canada and the Quebec Department of Fisheries. The offshore species studied were haddock, Melanogrammus aeglefinus (L.), cod, Gadus callarias L., plaice, Hippoglossoides platessoides (Fabr.), redfish, Sebastes marinus (L.), and scallop, Placopecten magellanicus (Gmelin). The research is described by species of groundfish under the following headings: tagging, surveys, statistics and sampling, discards at sea, and gear selection. Scallop observations in Subarea 5, and hydrographic research which is pertinent to ICNAF, are briefly summarized.

Tagging. The Biological Station, St. Andrews, N.B., continued its tagging program to obtain information on populations, growth, and mortalities.

Sixteen per cent of the 1,085 haddock tagged at the mouth of the Bay of Fundy in November-December 1957 were recovered by the end of 1958. Winter recaptures of Passamaquoddy Bay haddock were taken in large numbers from the Jeffrey's Ledge and South Channel regions of Subarea 5, and in small numbers from the Digby Neck and Browns areas of Subarea 4. Summer recaptures were mainly from the tagging area in Subarea 4. Although few haddock appear to cross the deep-water Fundian Channel separating Browns and Georges Banks, haddock do move seasonally from the northern Bay of Fundy area of Subdivision 4X to the New England shore of Subdivision 5Y.

In 1957 and 1958 cod were tagged at the Magdalen Islands in order to study the relation of these cod to other populations in Subarea 4. Earlier cod taggings in the northern part of Subdivision 4T have shown few recaptures from the Magdalen Islands cod fishery. The distribution of recaptures is shown in Figure 1. Cod tagged in mid-summer 1957 were recaptured in the tagging area during the remainder of that summer, and outside the Gulf of St. Lawrence, along the 100-fathom contour, from January to April. In the spring recaptures were reported from the Magdalens area, and in summer months these cod had spread throughout Subdivision 4T with concentrations on the northern grounds off Bonaventure and Miscou Islands. Magdalens cod move northwest during spring months and southeast in the autumn. As noted in earlier taggings of cod and haddock in Subdivision 4T, few recaptures are reported from the other side of the deep-water Laurentian Channel, but they do move seasonally between Subdivisions 4T and 4V. In 1958 about one quarter of the winter returns were from French, Portuguese, and Spanish fishermen. All other returns were reported by Canadian fishermen.

Plaice were tagged in the northern part of Subdivision 4T in June and October 1958. A high percentage (27) of the 320 plaice tagged southeast of Shippegan Gully in June were recovered by the end of 1958. Most recaptures were taken from the tagging area, but some plaice moved offshore during the summer. Two fish, recaptured in September, had moved about 100 miles north, one to the Bay of Chaleur and the other to Bonaventure Island.

Surveys. In August 1958 the Sable Island-Emerald Bank area of Subdivision 4W was surveyed with the 84-foot Harengus, and in May to November the northern part of Subdivision 4T was surveyed with the 65-foot J.J. Cowie by the Biological Station, St. Andrews, N.B. The Marine Biological Station, Grand River, P.Q., extended the latter survey into the Bay of Chaleur in May to October. The survey programs are concerned with the seasonal distribution of haddock, cod, and plaice, and prediction of changes in the fishery.

The dominant species in the Subdivision 4W survey was haddock. In shoal water (10-20 fathoms) near Sable Island, large numbers of small haddock (mode 20 cm) were taken. In 20-45 fathoms the haddock were larger (mode 30 cm). At the edge of the bank, in 50-80 fathoms, still larger haddock (mode 50 cm) were taken along with small haddock (mode 20 cm). These larger haddock (mode 50 cm) were more abundant on Emerald Bank (40-44 fathoms). A continuation of this program in winter and summer months will lead to prediction of the relative importance of new year-classes before they enter the fishery.

Young cod of the 1953 year-class were dominant in 1958 commercial landings from Subdivision 4T. As a result, the average size of cod in dragger landings dropped to 60 cm, the smallest mean size since 1947. Surveys in 1957 and 1958 have shown modal size groups at 22-25, 31-37, and 40-46 cm, representing 2, 3, and 4-year-old fish. The 1954 year-class appears to be above average abundance, and it is expected that it will replace that of 1953 as the dominant year-class in 1959 landings. As a result, no appreciable change from the small average size of cod landed in 1958 is anticipated as in 1959.

The abundance of cod in the Bay of Chaleur increased from June to August with migration into the Bay, and decreased in October with the beginning of offshore migration. Mid-water line fishing in 1958 showed that some mature cod move off bottom in July and August. Euphausiacea appear to be more accessible to cod where they are concentrated at the thermocline.

Statistics and Sampling. Landings, abundance, and sizes of groundfish are reported elsewhere.

Canadian landings from Subarea 4 have increased substantially during post-war years with the adoption of more efficient fishing methods. Otter trawlers now take half the groundfish landings, including most of the redfish, flounders, and haddock, about half the cod, and a small fraction of the halibut and pollock. Cod landings continue at a high level, but with the increased landings of small-mouth species the cod catch is only about half the total groundfish catch.

With more intensive fishing, catch per unit effort and average size of most groundfish have decreased. Young, immature fish dominated haddock and cod landings in 1958. The 1952 year-class of haddock was dominant in Subdivision 4W. Various year-classes of cod, 1949 to 1955, were dominant in the landings from different populations of Subarea 4. In the Nova Scotia area, 1949 and 1952 year-classes dominated the spring catches of mature cod. Immature cod of the 1954 and 1955 year-classes were dominant for the remainder of the year. In the Gulf of St. Lawrence, the 1953 year-class replaced that of 1950 as the dominant year-class in cod landings.

Discards. The sizes and quantities of groundfish caught and discarded at sea vary with the sizes of fish available to the gear, the selective properties of the gear, and the sizes of fish acceptable for landing. During 1958, 16 trips on commercial otter trawlers were carried out by the Biological Station, St. Andrews, N.B., to assess discards of haddock and cod.

In 1951-52 on Nova Scotia Banks there were large numbers of haddock of about 30 cm in length; the codend mesh size was $2\frac{7}{8}$ inches; and the commercial cull for gutted haddock was between 40 and 45 cm. Under such conditions, 40 to 60% by weight of the haddock caught by otter trawlers were discarded at sea.

In 1958 small haddock were still numerous; the codend mesh size had increased to more than $4\frac{1}{2}$ inches as a result of ICNAF mesh regulation; and the commercial cull was lower, 40 cm for gutted and 38 cm landed round. It was observed, on 6 commercial trawler trips, that only 3 to 7% of haddock were discarded, by weight, on 3 gutted-haddock trips. On trips where most haddock were landed as round fish,

discards were only 2 to 4% by weight. For the small portion of these trips where haddock were gutted for landing, 33 to 37% by weight were discarded at sea. It appears that the large-mesh nets are releasing virtually all haddock below commercial size, and meshes larger than $4\frac{1}{2}$ inches, manila, or the equivalent with other twines, would release some marketable haddock. The advantage of a larger mesh size would depend on growth and survival of released haddock.

Ten summer trips on commercial draggers in Subdivision 4T provided data on discards of cod. Four trips were made on draggers using small-mesh ($3\frac{1}{2}$ inches) and 5 trips were on draggers using large-mesh ($4\frac{1}{2}$ inches) manila codends. These draggers fished mainly on Bonaventure Island grounds. A tenth trip was made in Chaleur Bay. The average discards on the small-mesh trips were 23% by number and 9% by weight. On the large-mesh trips average discards were 12% by number and 5% by weight. These results confirm those of 1957 in showing that $4\frac{1}{2}$ -inch mesh codends reduce discards by about half.

Although it is believed that a still larger mesh size would be advantageous for Subarea 4 cod, initial losses might be too high to warrant premature action by ICNAF. Fishermen's cull appears to vary with the sizes of cod available to the fishery. In 1957 New Brunswick draggers culled cod at about 50 cm; but with smaller fish in 1958 catches, the 50% cull point dropped to about 46 cm. Selection factors for manila codends have been found to be variable for cod. In some experiments the selection factor has been 3.7, and in others (see below) only 3.3. Large-mesh nets are probably more efficient, but the amount is not adequately known. Finally, the growth and survival of released cod are poorly understood. All of these variables are being investigated.

Gear Selection. Various gear-selection studies were carried out in Subarea 4 during 1958. The Biological Station, St. Andrews, N.B., investigated the selectivity of a $5\frac{1}{2}$ -inch mesh manila codend for cod, a 5- to $5\frac{1}{8}$ -inch manila codend for haddock, a $4\frac{5}{16}$ -inch mesh nylon codend for haddock, and the effect of chafing gear, as prescribed by ICNAF, on escapement of haddock. The Quebec Experimental Fishing Station, LaTabatière, P.Q., studied the selectivity of cotton and manila codend meshes for redfish, and the selectivity of 5-inch cotton meshes in traps for cod. The Marine Biological Station at Grand River, P.Q., studied selectivity of No. 14 and No. 17 Mustad hooks in line fishing for cod.

A selection factor of 3.3 was observed for a 5- to $5\frac{1}{8}$ -inch mesh codend made of double, 75-yard, 4-ply manila twine, and fished for haddock.

A piece of chafing gear, 18 meshes long, attached 4 meshes ahead of the splitting strap and along the laceage to 3 meshes from the codline mesh, of $4\frac{1}{2}$ -inch manila, and $1\frac{1}{2}$ times the width of the codend, did not have a measurable effect on the escapement of haddock from the same codend.

A higher selection factor, 3.9, was found for a $4\frac{5}{16}$ -inch mesh codend made of double-strand, 85-yard, braided nylon twine, and fished for haddock. The experiment indicates that a 4-inch double nylon mesh is equivalent in selection to a $4\frac{1}{2}$ -inch double manila mesh.

In all three experiments, a No. 36 Yankee manila trawl was towed by the M.V. Harengus on Sable Island and Emerald Banks in August and September 1958. A cover of $1\frac{1}{2}$ -inch stretched-mesh Nyak was used to catch the fish which escaped through the codend meshes.

Another covered codend experiment was carried out in the summer of 1958 while fishing the M.V. J.J. Cowie for cod in the northern part of Subdivision 4T with a $\frac{1}{2}$ No. 35 Yankee cotton trawl. A selection factor of 3.3 was observed for a $5\frac{1}{2}$ -inch mesh codend made of 75-yard, 4-ply manila twine. Higher selection factors had been observed earlier in double-mania, smaller-mesh experiments for cod.

Redfish selection experiments in Subdivision 4R gave the following selection factors: 2.4 for 3 $\frac{1}{2}$ -inch mesh and 2.8 for 4 $\frac{3}{8}$ -inch mesh single cotton codends; 2.2 for 3 $\frac{1}{2}$ -inch mesh, and 2.5 for 5-inch mesh double-manila codends. These findings are consistent with earlier results for redfish.

The most frequent cotton mesh size in the back of codtraps is 4 inches. A preliminary experiment, using 3- and 5-inch meshes of single-cotton twine, gave a selection factor of 4.0. Further tests are needed.

There was little difference in the size composition of cod taken with No. 14 and No. 17 Mustad hooks on line trawl fished off Grand River, P.Q. Further work is required to compare the selectivity of these hooks with that of otter-trawl meshes.

Scallop. Two sea trips to Georges Bank were made by the Biological Station, St. Andrews, N.B., on commercial scallop draggers in August and October 1958 to observe quantities and sizes of scallops discarded at sea. There were remarkable differences in the density and size distribution of scallops from bed to bed. The shucking facilities were saturated most of the time, and high catches resulted in high discards. Discards by number varied from 55 to 86%. The mean selection size varied from 95 to 100 mm shell height. Landings per boat appeared to be a measure of shucking power and sizes of scallops saved, rather than of scallop abundance. The present 3-inch ring size in scallop drags has a mean selection size of about 72 mm. The advantages and disadvantages of a larger ring size are being considered.

Hydrography. In July and August 1958 the Atlantic Oceanographic Group, St. Andrews, N.B., took part in the IGY "Deep Water Circulation" Project by occupying stations along a section between Bermuda and Baffin Bay and also stations from various points off the Canadian east coast to the IGY line. A section between Greenland and the Strait of Belle Isle was also occupied. During this cruise observations were made in Subareas 1, 2, 3, and 4; they included temperatures, salinities, dissolved oxygen, phosphate, silicate, and nitrite. Biological observations were made for the full extent of the cruise.

A survey of the central sector of the Scotian Shelf was made four times in 1958. This phase of the work is a contribution to the IGY project "Polar Front Survey - North Atlantic". The temperature and salinity distributions in the section off Halifax are given in Figure 2 (A-D). In May, August, and October 1958 the intermediate temperature layer was less developed than during recent years. The bottom waters of the Scotian Gulf were colder than those observed in recent years in April, May and August. The bottom temperatures over Emerald Bank, between 6.0°C and 8.0°C were within the limits of observations of temperature generally observed in those seasons.

Analysis of volume transport through Cabot Strait for a series of 18 seasonal sections shows that, on the average, the maximum outflow occurs in the autumn, and that the maximum inflow occurs in the winter. The net transport through Cabot Strait in the deep layers, of temperature greater than 1°C, indicates that the resultant flow for all seasons is generally directed into the Gulf. The maximum net transport occurs in the autumn-winter half of the year. The maximum speed of the current within the deep layers was computed to be 10 cm per second along the Cape Breton coast and 20 cm per second along the Newfoundland coast.

Analysis of surface water temperatures along the coast shows that the main feature of temperature variations from 1957 to 1958 was an increase at all stations during the first 6 months of the year and a general decrease during the second half of the year.

As in earlier years, the Marine Biological Station, Grand River, P.Q., carried out hydrographic observations in Chaleur Bay.

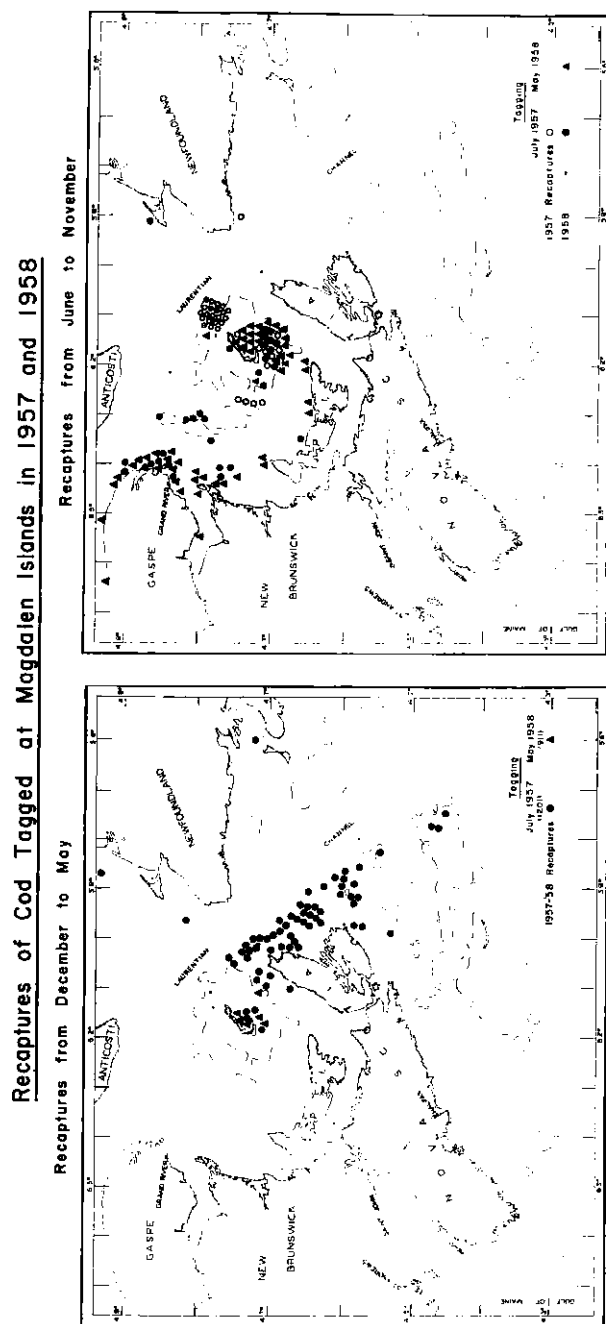


Figure 1. Recaptures during 1957 and 1958 of cod tagged at the Magdalen Island, in Subdivision 4T, in July 1957 and May 1958.

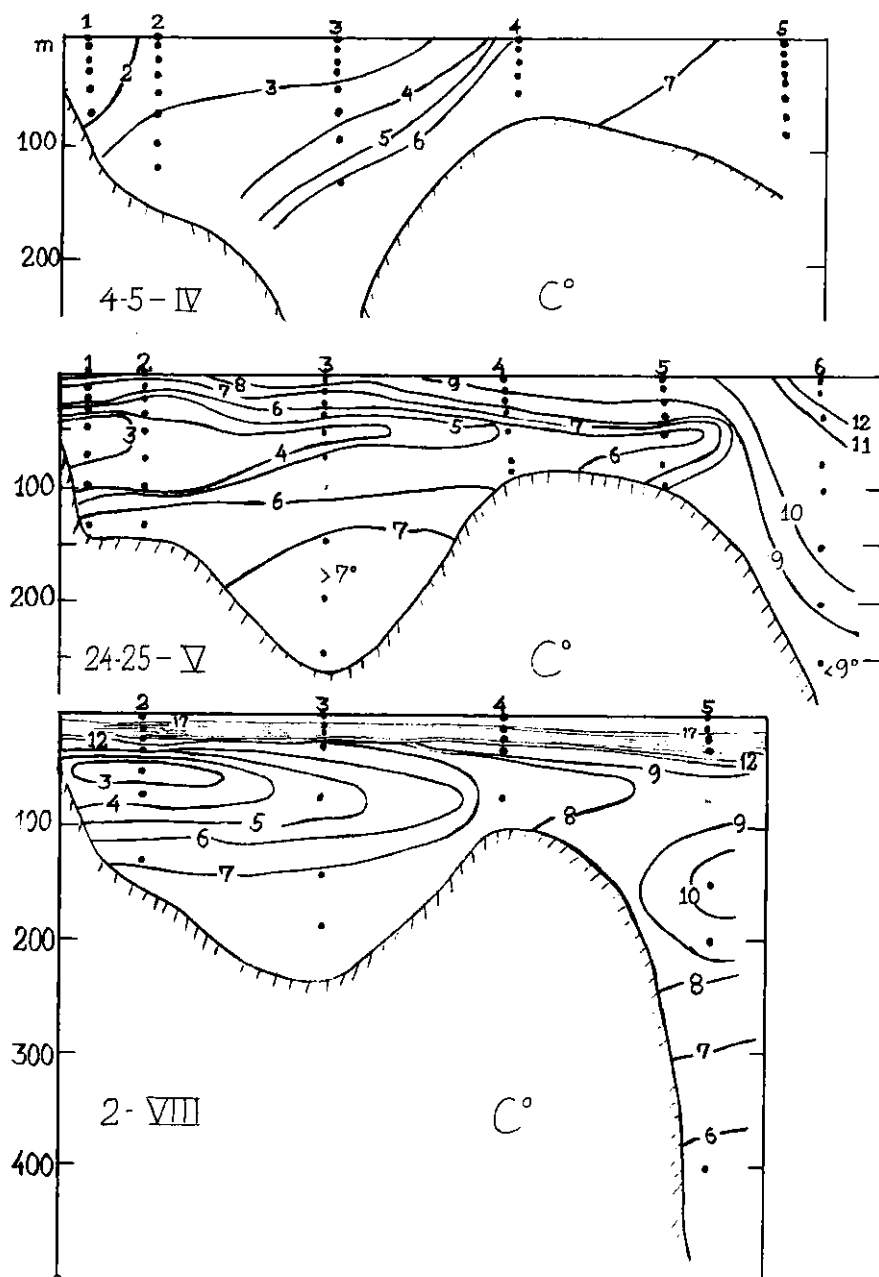


Figure 2 (A). Hydrographic sections off Halifax in 1958. Temperature. 4-5 April, 24-25 May and 2 August. Continued on Figure 2 (B).

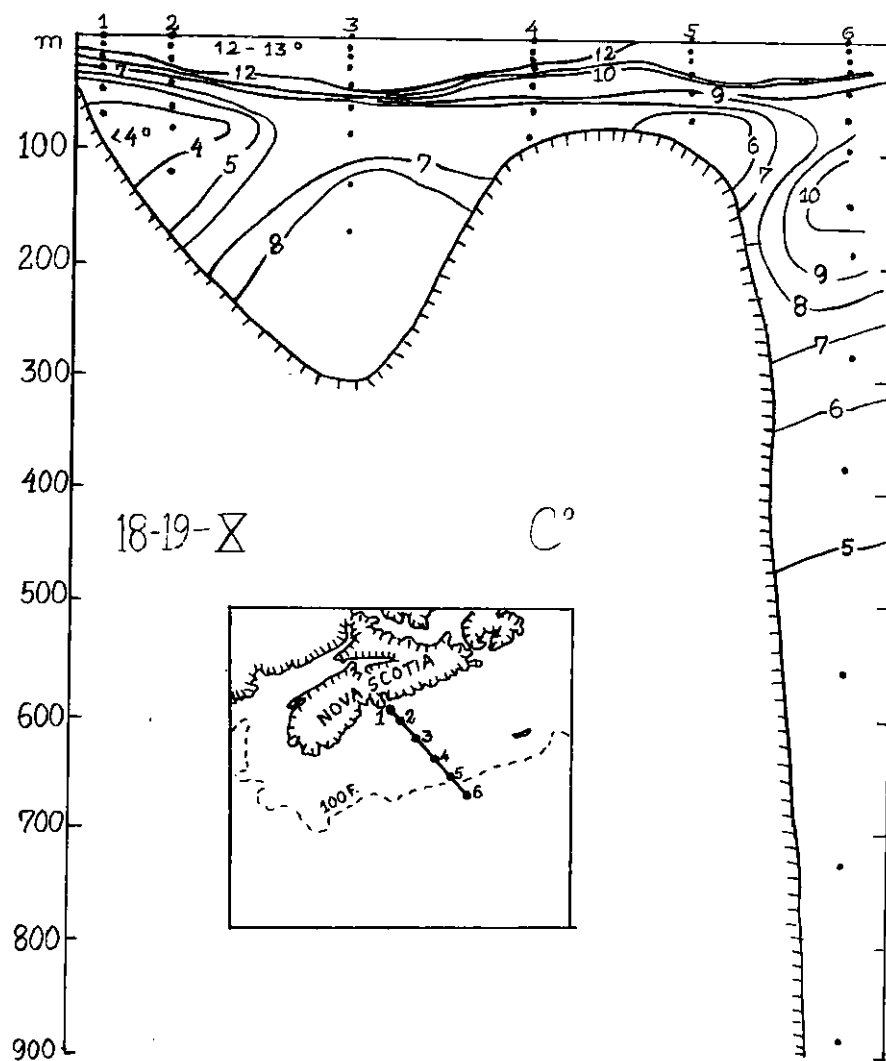


Figure 2 (B). Hydrographic section off Halifax in 1958. Temperature, 18-19 October. The inserted map shows the position of the sections shown on Figures 2 (A-D).

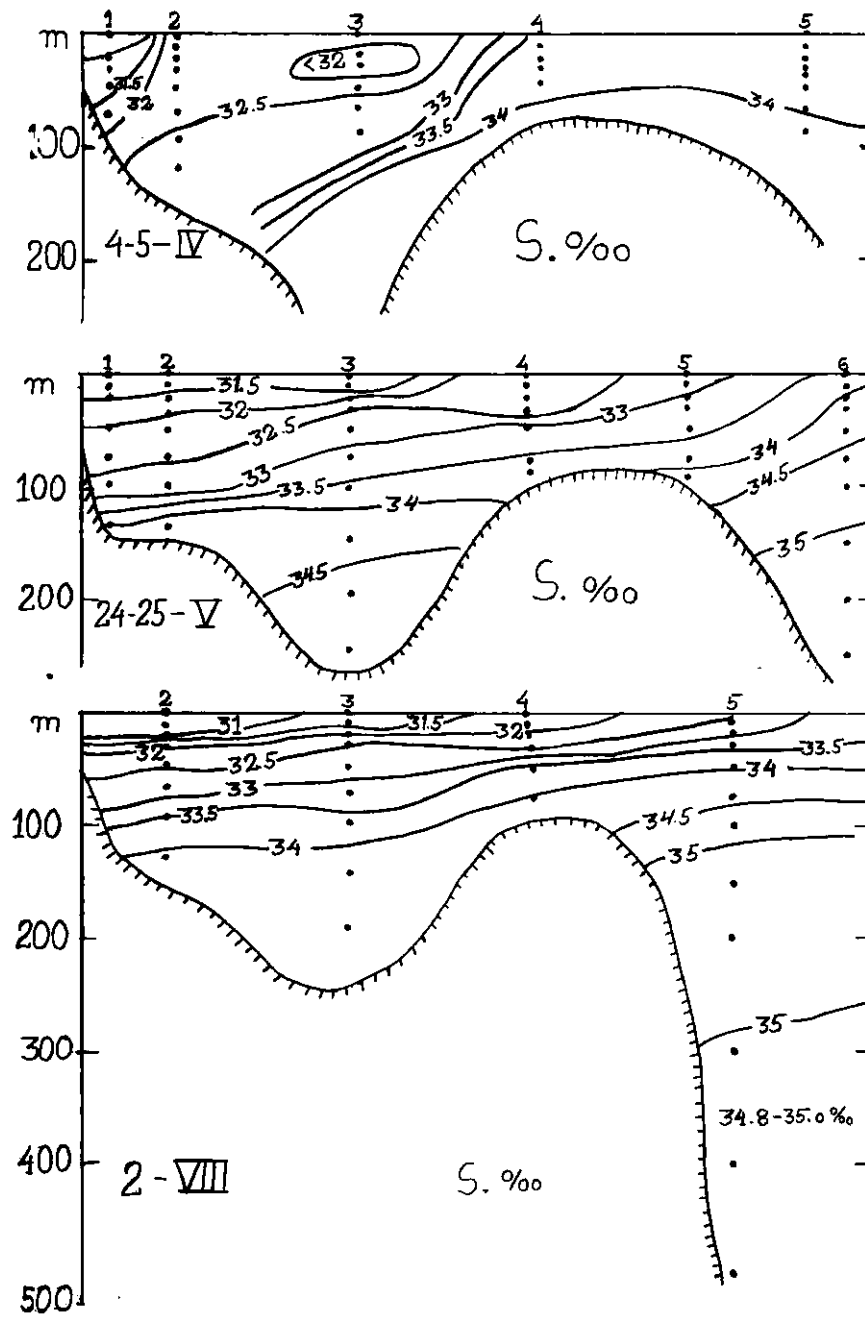


Figure 2 (C). Hydrographic sections off Halifax in 1958. Salinity. 4-5 April, 24-25 May and 2 August. Continued on Figure 2 (D).

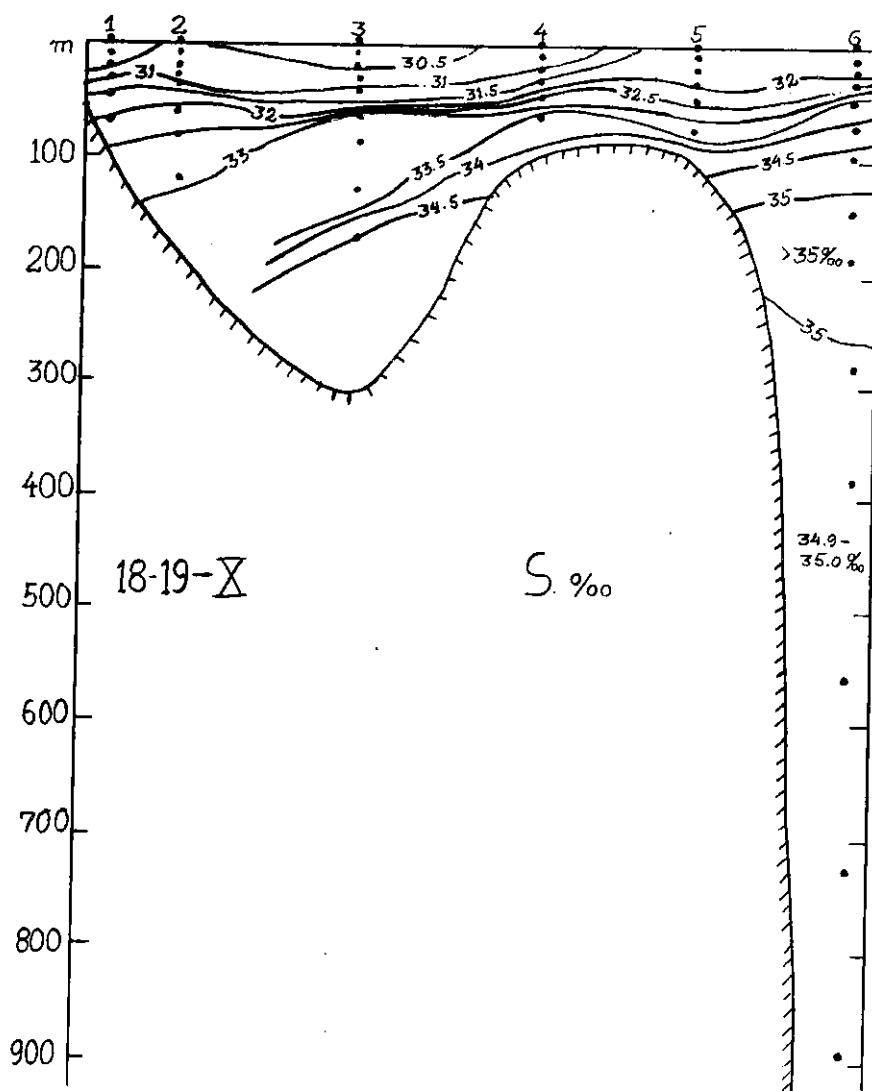


Figure 2 (D). Hydrographic section off Halifax in 1958. Salinity.
18-19 October.