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Introduction

In carrying out this investigation, as complete a picture of the fishery, as possible, is of utmost importance in the beginning. The information necessary to formulate such a picture has been obtained in many ways, such as by talking with the fishermen and dealers throughout the area, as well as the fishery officers, by carrying on scientific investigations and by looking into the published records of the fishery in the past. These sources of information, as well as others as yet untouched, are far from exhausted.

When such a picture has been formed it is possible then to make comparisons between this fishery and others in different districts, and to determine what characters, if any, are peculiar to the region as a whole or any part of it. The next step, of course, is to determine the reasons underlying these peculiarities as well as the relationship of the fish responsible for this fishery to those in neighbouring regions. In this last respect it seems of importance to determine the relation, if any, existing between the inshore cod and the offshore or bank cod, since the two fisheries are carried on independently and, generally speaking, with decidedly different gear.

For this investigation the Halifax area has been defined as that region of the coast lying between Lunenburg and Ship Harbour on the outer or Atlantic coast of Nova Scotia. This region may be sub-divided into districts which are known as Mahone bay, St. Margaret bay and the Sambro peninsula. These three districts occupy most of the coast between Lunenburg and Halifax in the order named.

Halifax itself is situated in about the middle of the area which extends some forty miles on each side of it. East of Halifax the coast-line is fairly uniform and straight with no large bays or peninsulas.

During the past year (June, July, August, September and October, 1932) it was found impossible to cover the whole coast-line of the area. West of Halifax all the more important ports were visited as far as Blandford i.e. roughly speaking, Mahone bay and the immediate vicinity of Lunenburg was not visited. Going east from Halifax the whole coast was covered as far as West Jeddore. Thus it may be said that the extreme south west portion of the area and the extreme north east part were not visited. However, in dealing with the statistics it was necessary to include somewhat more ground, both to the westward and the eastward (due to the large statistical districts), taking into consideration the whole of Lunenburg and Halifax counties.

Economic Importance

The cod (Gadus callarias) is one of Canada's most important fishes. A brief survey of the last five years of published statistics reveals the fact that it stands second in point of quantity caught during that period and second in value in the caught and landed state. Herring rank first in quantity landed and salmon are first from the value standpoint.

This fishery is confined to the Atlantic sea-baord and Nova Scotia records by far the most landings, - between two and three times the amount landed in Quebec, New Brunswick only produces about one-eighth as much and Prince Edward Island about one-thirtieth.

In Nova Scotia itself there is a great difference in the amount of cod landed in the various counties. If the counties of New Brunswick are also included it is found that in 1931 there were some three hundred and forty-six thousand hundredweight landed in Lunenburg county, which county stands far ahead of all the rest in total quantity landed. Gloucester county N. B., comes second with about a hundred and sixty thousand hundredweight, while Halifax county comes third with about one hundred and fourteen thousand hundredweight. All the other counties show considerably lower landings.

Thus it is seen that the Halifax area is located in, and includes most of, two of the most important counties on the Atlantic coast of Canada insofar as the cod fishery is concerned. However, when the landings of these two counties are examined, it is found that as a rule, the inshore cod fishery in Halifax county is ahead of that in Lunenburg county. The condition in the offshore fishery, is just the reverse. This relation only holds true back to 1923, previous to which time the Lunenburg inshore landings exceeded the Halifax ones for four years. Previous to 1918 the landings were not divided into inshore and offshore. In figure 1 the above is seen graphically and also the tremendous difference between the Lunenburg offshore cod fishery and any of the three others which are all very much smaller and not greatly different among themselves.

In the Halifax area itself the cod fishery ranks first, with the haddock and lobster fisheries coming next in the order named, generally speaking. In 1930 this fishery for the two counties was valued at about one million, three hundred and fifty thousand dollars (fish caught and landed). The marketed value of these fish went up to about one million five hundred thousand dollars. In 1931 the

value of this fishery dropped to just a little better than one-half of what it was the previous year.

Fluctuations in the Cod Fishery of the Past.

Just as in 1930 and '31, the value of the landed and marketed product as well as the quantity of fish caught and landed has varied or fluctuated from year to year in the past. The value of the product, as well as the size of the landings, depend on many factors working either separately or combined in some manner.

Considering, for a moment only, the trend of the cod fishery as a whole along the Atlantic coast of Canada, it is seen in Mr. O. E. Sette's graph in his 1926 paper on the "Statistics of the Catch of Cod of the East Coast of North America", that the Canadian cod landings have been going down slowly and irregularly during the period 1880 to 1926. In this same paper and graph he also shows that the United States landings of cod fish from waters bordering the east coast of North America have also been going down slowly, but somewhat more regularly than the Canadian landings, while the landings in France and Newfoundland from the same region and during the same period have been very irregular but on the whole increasing slightly. Thus the whole cod fishery from about 1895 to 1926 has been very irregular but, generally speaking, it appears to have held the same average level over long periods.

In sub-dividing the Canadian catch it has been possible to obtain access to G. W. Jeffer's report on the cod fishery of the bay of Fundy, 1931. His statistics go back to 1872 and it is seen that the cod landings in this region increased from some three hundred thousand hundredweight in 1872 to almost double this amount by about 1887 when the peak of the bay of Fundy cod fishery was reached.

However, by 1890 the landings had dropped to slightly less than they were in 1872. From 1890 to 1930 they continued to decrease very irregularly to about one hundred thousand hundredweight by the latter date.

Generally speaking, this latter fishery has followed the trend of the Canadian cod fishery as a whole from 1887 onward, except that the fishery as a whole displayed certain periods of recovery which are not shown in the bay of Fundy fishery.

Now, considering the trend of the cod fishery in the Halifax area, as shown graphically in figure 2, a much different picture is found.

The fishery in this region appears to have increased from some two hundred thousand hundredweight in 1869 to ten hundred thousand (one million) hundredweight in 1900. From that time to 1906 most of the figures are lacking but in 1906 there were only about four hundred thousand hundredweight reported. However, a very rapid increase occurred after this and the peak of the whole fishery occurred in 1910 when almost one million eight hundred thousand hundredweight were reported landed. By 1914 the level had dropped again almost as low as in 1906, but from then till 1922 the landings increased, with a little over a million hundredweight being recorded in 1922. In 1923 and '24 a decrease occurred only to have the landings increase again to about a one million three hundred thousand level in 1926. However, from then until 1931 a rapid decline existed carrying the level of the curve back down to about that of 1906 and 1914.

Comparing this with Jeffer's graph of the bay of Fundy fishery, it is seen that about the only similarity between the two, is that both fisheries increased from 1870 to 1888, and that both are at a low level at the present time.

Using Sette's graph of the whole Canadian catch a greater degree of similarity is found. Both graphs indicate a high level from 1880 to 1888 with a somewhat lower level from that date to 1898. The increase about 1900 in both fisheries put the landings in the Halifax area ahead of any previous year, but in the Canadian fishery as a whole the increase did not bring the landings up to the level of the '80's. Both curves fall off from then to 1906 and increase to a decided peak in 1910 (maximum in the Halifax area, but still below the level of 1880 in the Canadian cod fishery curve). Again both curves drop off to a lower level by 1914, increase to 1922, drop during 1923 and '24 and rise to a peak again in 1926.

Now considering the Halifax area as two counties, it is seen that there is a tremendous difference. The Lunenburg landings closely parallel the total, while the Halifax landings only seem to be in the same class from 1869 till 1875. After that they are so far below as to be almost out of the picture. However, a close inspection reveals the fact that small peaks and hollows in the Halifax curve do agree with the large ones in the Lunenburg curve up to about 1906. After that the Halifax landings continued very steady until 1924 to 1926 when a small increase and peak occurred as in the Lunenburg county landings curve. From then to 1931 the landings in Halifax county remained slightly irregular, but at about the same high level, whereas the Lunenburg landings dropped off tremendously. Thus the drop in the inshore Halifax area cod fishery during the last five years shown can be attributed to the Lunenburg fishery only, for the Halifax county fishery shows no such great drop.

In an attempt to explain some of these fluctuations one must investigate the conditions surrounding the fishery year by year.

In some of the earlier reports of the Department of Fisheries, many details, extremely useful in this respect - of the fishery at various points were submitted in the inspectors' reports and published, but of late years, these reports have come more and more to the stage where the statistics are published, with a minimum of accompanying details.

From 1926 to 1931 the drop in the Lunenburg county landings can be blamed on the poor prices and small demand for dried cod, due to the general economic situation as well as the fact that Canadian cod has been meeting with stern competition on the world markets. Because of this many of the famous Lunenburg fleet of schooners have been unable to operate profitably and have stopped fishing. This decrease in the number of boats operating is shown admirably in the published reports which indicate the following number of schooners operating between 1926 and 1931 inclusive, - eighty-nine, eighty-two, seventy-five, and sixty-five. However, a change in the number of boats operating does not always result in a change in the landings as for example in 1914, '15, and '16 when there were from one hundred and fifteen to one hundred and thirty schooners operating in Lunenburg county and yet the landings were away below those in 1926 when there were some forty schooners less.

That this same decrease did not occur in the landings of cod in Halifax county may be attributed to the fact that, whereas by far the greater proportion of the cod are dried in the former county, a much smaller amount is dried in Halifax county, - possibly one-quarter or one-third. In this latter county, by far the greater proportion is marketed in a perishable condition on Canadian markets where it does not compete with foreign cod products and where the conditions of trade existing in this perishable fish market are not the same as those existing in the great dried fish markets. In

Halifax county most of the cod is sold as "fresh" fish, smoked fillets or "fresh" fillets. These products are consumed by an entirely different group of people from that, that uses the dried cod. Incidentally very little dried cod is consumed now-a-days in Canada.

However, along with the poor markets and prices, there is also the odd report that during the last three or four years the cod have been becoming scarcer, both on the inshore grounds and the offshore banks. Because of this some vessels have gone to Greenland waters and had a fairly profitable season, for cod seem to be plentiful in the more northern waters recently.

In respect to the poor years of 1923 and '24, nothing very definite can be found to account for the decrease, although much bad weather and reduced fleets, due to high operating costs are mentioned in this connection. There must, nevertheless, be something of greater significance than these to account for these two very low years during a period when the landings were on the increase 1914-'26, but what, is not known.

The poor years at the beginning of this long rise seem to be connected with the scarcity of food and bait, for during these three years 1912, '13, and '14 such statements as, "great scarcity of bait", "regular bait grounds were almost barren" are very commonly met with in the reports.

In 1910, nothing nearly so phenomenal in fishing conditions was reported, as the quantity of cod landed. The only remarks are to the effect that cod seemed to be plentiful all about Nova Scotia, both inshore and offshore during both the spring and summer. Along with this was reported a good supply of bait and very few dogfish.

Since herring and mackerel may play a part in the life habits of the cod, the statistics of the landings of these two species

for both a few years previous and a few years after 1910 have been investigated. While these statistics have not been gone into thoroughly owing to the work involved in converting everything to common denominators, still one reaches the conclusion that the landings of herring seemed to increase up to 1910 and drop off somewhat afterwards, while the mackerel landings seemed to display very little similarity to the cod landings. Thus there seems to be some indication that herring were plentiful at this period and may have had something to do with the great increase in the landings of cod in 1910.

With respect to the rather poor landings in 1906 nothing is mentioned in the reports. During the period 1890 to 1905, the reports accompanying the statistics for the odd years plotted, seem to indicate that the landings in the years, for which we have no statistics, were higher than for those shown. However, the only enlightening remark is that the fish were not so plentiful and they thought that they were staying on the outer banks.

Thus considering the figure as a whole it may be concluded that at the present time the fishery of this area is not at any lower ebb than it was say in 1906, 1907, 1913 and 1914 and that following these former periods of poor landings, very high peaks were reached in 1910, 1922 and 1926. Besides the hope of recovery from the present low level of the landings, extended by the fact that recovery from similar low levels in the past did occur, it may be added that at the present time the general report is that these fish are not scarce, but that the market conditions are responsible for the low level of the fishery, since there is no stimulus towards its prosecution and in many instances it is being carried on at a loss.

Besides the information on the trend of the fishery found in published reports and statistics, there are also the many opinions and ideas of the fishermen throughout the area.

One of the big changes within the last twenty-five years has been the change from fishing vessels to smaller gas boats. This change has occurred chiefly about the Sambro peninsula, where the first gas boats appeared about 1906. These small, powered boats gradually replaced the vessels and by 1915 the greater part of the change had been made.

In respect to the fishing at present numerous opinions were expressed. From Petpeswick to the eastern limits of the area they claimed that the fishing had been going down for quite a number of years, but that this year (1932) they had experienced the best fishing within the last eight to twenty years, depending on the fishermen and the locality. However, from this region to Halifax they claim the cod are still scarce and cite catches of two thousand pounds against five hundred now-a-days under the same conditions of time and gear.

About Halifax harbour and Sambro ledges they seem to think that there are a fair number of fish present and that the market situation is in more need of investigation than the fishery itself. Some special information was forthcoming at certain points, such as the fact that in 1889 the fishing vessels were laid up because the fish were scarce and there was no bait. If one looks back at figure 2 it is seen that a noticeable drop in the landings occurred that year. Another point is the fact that there was good cod fishing all winter long in Halifax harbour during 1928 and '29, something rather unusual. At the same time the reports from Terrence Bay indicate that they had exceptionally good fishing during these same two years and they credited this good fishing to the fact that the squid were very plentiful during that time and that they have been very scarce ever since. This good cod fishery of 1929 was also reported from

places well up into St. Margaret bay where cod are usually not very plentiful. The trend of these inshore fisheries is shown graphically from 1918-1931 inclusive in figure 1 and the reported good years of 1928 and '29 are seen to correspond with peak landings during these years in this figure.

A fair amount of correspondence is seen to have occurred during the above mentioned period between the Halifax and Lunenburg inshore fisheries. From 1918 to 1925 the curves are somewhat similar, but from then until about 1927 the Lunenburg fishery went through a great decline and succeeding recovery while the Halifax fishery maintained the same fairly high but irregular level. In 1927 a decline began in the Lunenburg inshore fishery which lasted till 1930 with a slight recovery in 1931. The Halifax inshore fishery went through the same sort of decline but began in 1928 instead of 1927. Thus it seems that there is a fair degree of correspondence between the inshore fisheries of these two counties and it is probable that the stocks of fish throughout the area responsible for the fishery are very closely related if not one and the same. However, there are several points of seemingly minor importance opposed to this view.

Horizontal Distribution

In a discussion of this topic practically all knowledge of the distribution of the fish is based on fish caught and these in turn depend upon the gear used and the circumstances surrounding the fishery in each particular locality. Thus it is seen that for various reasons the number of fish caught from year to year may not be truly representative of the fish present at certain or all times of year in that locality. However, it is possibly a good plan to assume that one does obtain a representative idea of the abundance of the fish, unless reasons contrary to this idea are put forth.

The landings represented in chart I are the average of the years 1928 and '29. These two and only these two have been used because the statistical sub-divisions are smaller than since then or for many years previous. They are also about average years as seen in figure 2. Unfortunately, the statistics of these sub-divisions are not divided into offshore and inshore, so that the landings shown represent the total cod landings. Because of this it is difficult to arrive at an idea of what proportions were caught off and inshore. However, from Halifax to Ship Harbour there are no vessels, schooners or trawlers. Thus only inshore fishing can be done due to their using small boats. About Sambro peninsula there are a few small schooners, but these too only operate on the inshore grounds. However, they do fish farther off than the small boats as a rule, but still generally not off on what are considered the offshore banks. The same applies for St. Margaret and the greater part of Mahone bay. However, there are many large schooners and one or two trawlers operated out of the Lunenburg region as well as about the same number per place of smaller craft that there is about the outer shore of Sambro peninsula. Out of Halifax and its immediate vicinity there are fewer small boats than at most any of the small fishing villages about the Sambro peninsula and only about one or two large schooners. However, there are about six trawlers on the average.

Thus it is seen that the only offshore fishing carried on, is done by vessels operating out of Halifax or Lunenburg and its surrounding district. Thus it may be assumed that the large landings recorded for Halifax were made from offshore grounds and, that nearly all or by far the greater part, of the large landings in the Lunenburg district, were also made from offshore grounds. To date little is known of the Lunenburg district fishery. However, deducting the

known inshore landings in Lunenburg county east, i.e. from Martin point to the Halifax county line, from the total inshore landings in Lunenburg county it is found that about seven thousand hundred weight are left to allocate along the western part of Lunenburg county. Dividing this in proportion to the number of gas boats, it is calculated that about six thousand of this belongs in the Lunenburg district and has been shown in chart I as round black spots in this district. From this it may be concluded that the landings represented by the round black spots in chart I were all from fishing carried on inshore and in general the spots have been placed along the coast where the fishing was done.

From this and chart I it is seen that more fish are landed on Sambro peninsula from inshore grounds than anywhere else in the Halifax area. This proves that there are more fish caught in this region (Sambro ledges) than elsewhere but it does not prove that there are not just as many cod present per grounds east of Halifax as there are on these Sambro ledges. Thus, before assuming from a hasty glance at the chart, that there are more cod about the Sambro region than in the Halifax, Ship Harbour region, it may be well to look into the matter a little more thoroughly, even though it may be said that if the fish were present in large numbers they'd be caught in large numbers. By this is meant the idea that where there are lots of fish, a fishery of corresponding size will be developed.

In chart II the average landings for 1928 and '29 have been divided by the average number of fishermen and the resulting weight of cod landed per man for the various sub-divisions is shown on the chart. For reasons mentioned previously, the two high figures at Lunenburg and the one at Halifax should not be brought into the comparison. Discarding these and considering only the figures based on known inshore landings, a different picture is found. The St.

Margaret and Mahone bay cod fishery per man is seen to be just as small comparatively as it is in chart I. However, the amount of fish caught per man about the outer part of the Aspotogan peninsula (the peninsula between St. Margaret and Mahone bay), Sambro peninsula and the shore east of Halifax does not vary nearly so much as the total landings are seen to do in chart I. Nevertheless, the catch per man about the outer part of the two peninsulas is the highest, but that in the Ship Harbour region is not far behind. The two sections just east of Halifax compare favourably with the south western part of the Sambro peninsula and the islands in the outer part of Mahone bay.

Thus it is seen that per fishing unit there is not such a great difference in the fishery of the outer part of the two peninsulas and the shore east of Halifax as one might expect from chart I. However, there are definite differences from place to place along the shore. In dealing with these differences let us first go back to chart one and determine how great these differences in the amount of the landings from place to place really are.

The following divisions of the coast-line of the area have been made because they seem to occur naturally. The landings of fish from the inshore grounds in each of these divisions have been apportioned to the best of our knowledge at the present time. The following percentages are of the inshore cod landings from approximately the La Have river district to Ship Harbour, excluding any amount (of necessity it would be very small) that may have been landed at Halifax city.

It is easily seen that the Sambro peninsula (Herring Cove to Indian Harbour) fishermen land half of the inshore caught cod, although this district only makes up about one-fifth of the total coast line.

Lunenburg district-Queens county line - 9 St. Margaret bay - 2
Mahone bay - 1 Aspotogan peninsula and adjacent islands - 13
Sambro peninsula - 50 Halifax (excluded) to Ship Harbour (incl.) - 25

Attempted explanations of these differences may be divided into the following sub-headings.

a. Fishing Effort.

Since the fishing effort is intimately connected with the number of fishermen, at least in the case of inshore fishermen whose gear consists chiefly of trawl lines and hand lines, let us look into the number of fishermen in the various sections of the coast. In this instance again, the inshore fishermen in Lunenburg west have been determined to the best of our knowledge and the following percentages calculated from the total number of fishermen in the area.

Lunenburg west - 11 St. Margaret Bay - 11

Mahone bay - 5 Aspotogan pen. and adjac. islands - 12

Sambro peninsula - 38 Halifax (excl.) to Ship Harbour inclus. - 23

Thus it is seen that, roughly, the same relation with respect to the number of fishermen exists in the various districts, that exists in the amount of cod landed. However, there is a greater percentage of the men found in Mahone bay and St. Margaret bay than there are landings of cod. Thus it may be concluded that either there are fewer cod frequenting these bays than the outer shores or that the fishermen do not fish them so intensively as they do along the outer shores. It is believed that both factors play a role in reducing the landings in these regions.

Since this region is noted for the large quantities of mackerel, herring and tuna that frequent it and since these fishes are captured chiefly by means of traps, it is to be expected that the fishermen here devote most of their time to these other fisheries whose prosecution is less arduous than line fishing. Hence a great reduction in the cod fishing effort in this region, not only in the number of men that do any cod fishing at all, but also in the amount of time that these men devote to this fishery, for almost all of them

have greater or less interest in trap fishing. Thus the catch per man in this region is much lower than it should be because the fish that are caught by a few fishermen have been divided up between them all in calculating the catch per man, since unfortunately the number of cod fishermen is not known. Because of this neither chart I or II gives a correct idea of the abundance of cod in this region. The correct comparison would be the actual catch per man per day, per season etc., from place to place.

What little information in this respect that is at hand seems to indicate that at the peak of the cod fishing season in both areas, the landings per man in the Sambro region are about twice as great as those in the bay, after all the factors of gear etc. have been reduced to as nearly the same terms as possible. Thus we are of the opinion that cod are not as abundant in this bay region as they are along the outer shore-line of the area, although it is t thought that they are present in greater numbers than would seem to be indicated either in chart I or II.

Now considering the Aspotogan and Sambro peninsulas as well as that part of the area east of Halifax it is found that there are considerable differences portrayed in chart I. However, when the total landings in these regions are compared with the number of fishermen in each, it is found that there is a much closer agreement.

	% of total no. of men	% of total landings
1. - Outer Aspotogan peninsula and adjacent islands	12	13
2. - The Sambro peninsula, outer part	38	50
3. - Halifax (excl.) to Spry Bay (excl.)	23	25

Thus it seems that to a great extent the difference in the total landings in these districts is caused by there being more men in one district than another, for there is very good agreement in

two of the three districts noted above. However, this does not hold throughout, for the men in the bay region catch less than their equal share for the number of fishermen in each. The calculated average year's catch per inshore fisherman in the Halifax area works out to about thirty-four hundredweight, while the average catch per man in the above three districts is (order as above), -

1. - 37 cwt.

2. - 44 cwt.

3. - 37 cwt.

Thus it is that the Sambro region is a better cod fishing district than the other two, in fact the best in the Halifax area, but still not as much better as chart I would seem to indicate.

This consideration of number of men in the various districts versus the total landings in each district has tended greatly towards equalizing the apparent abundance of the cod along the outer shore-line of the area, for along this outer shore there is no other fishery that is so much more attractive (as in the St. Margaret bay region) that it lessens the effort exerted in the cod fishery, very much. Thus, in season, one would expect that the cod fishery would be prosecuted about equally all along this outer coast. However, there are two more points that may tend to increase the effort in the Sambro region or lessen it slightly in the other two, and that is, a certain amount of farming, and means of disposing of the catch.

In respect to the first point a glance at chart III will reveal the fact that farming in the granitic Sambro region is out of the question and consequently the only occupation is fishing. However, the country east of Halifax is much more suited to farming and a great number of the fishermen divide their time. For example, it is a regular thing for the Three Fathom Harbour men to leave their island fishing headquarters for several weeks in August in order to

make hay. The outer south-west portion of the Aspotogan peninsula and the Tancook islands are also more suited to farming than Sambro. Thus if the fishermen of these two districts were to become full time fishermen as the Sambro men are it is quite possible that the catch per man would be still nearer equal to that of the Sambro men.

The second point, i.e. marketing, may be of practically no importance in this connection, for generally speaking cod are marketed dried or pickled. However, in the vicinity of Halifax a large percentage are sold "fresh", i.e. in a perishable condition. At certain times of year some of the Sambro landings are trucked into Halifax for there is no railroad in this district as seen in chart III. East of Halifax the railroad does run fairly close to the shore but only as far as Musquodoboit. Even in this district the ~~sch~~ schedule provides only four trains a week and at a time too early for the fishermen to be in off the grounds. However, west of Halifax there is a morning and afternoon train running into Halifax which can be utilized in marketing fish "fresh". On the whole, however, the marketing facilities affect the cod fishery very little in this area since drying is the chief form for marketing, outside of Halifax.

Now having shown that yearly landings per fisherman along the outer coast-line of the area do not vary nearly so widely as the total landings per district do, owing to the greater number of fishermen at the centres of greatest landings it might be well to briefly discuss the average individual catch from district to district and also the greater fishing population one place with another.

The difference in individual landings between the Tancook islands etc. and the Blandford, Aspotogan section may be due to some extent to the alternative occupation in the former district.

The south-western portion of Sambro peninsula is somewhat separated from the more easterly sections by having its main road running northwards along St. Margaret bay to join the Lunenburg Halifax highway at the head of the bay. Because of this it shares in the sporting and scenic possibilities of St. Margaret bay district. Thus the time of the fishermen, some of them anyway, is divided between tourist, guiding and commercial fishing, interests. This no doubt does not account for the total difference between the western and the two eastern districts of the Sambro region, but it is a factor that comes in here very much more than in the other part of the peninsula, where, in spite of its proximity to Halifax, fishing is a more intensive occupation.

This may sound to be a somewhat far-fetched explanation, but there are yearly landing records before the St. Margaret bay district had developed into the tourist centre that it is of recent years, which show greater landings in this western section of the peninsula than in the others.

East of Halifax the farming possibilities and activities decrease somewhat, as you proceed towards Ship Harbour, but whether enough to account for the change in the average individual catch is not known. However it is not thought so.

In respect to the varying size of the fishing population from place to place, little may be said. However, it may be pointed out that the large fishery possibilities (which have now be developed) off the outer coast of the Sambro peninsula are not necessarily responsible for the large number of fishermen living along the adjacent shore nor does this large fishery necessarily need a large fishing population in close proximity. These points are clearly brought out in the case of the Lunenburg district. Here, there are a large number of fishermen, but their chief fishing grounds are hundreds

of miles away and much closer to the eastern section of Nova Scotia and Newfoundland. Nevertheless this large fishing population has gathered here and not at the nearest point to the grounds.

In the Sambro region owing to the nature of the country, practically the total population of the region is distributed along the shore where there is practically nothing else to do but fish. However, in the other parts of the Halifax area there seems to be alternative occupations and because of the nature of the country the population is not all concentrated along the shore. Thus, in the Sambro region, St. Margaret bay district excluded, there is a much h higher percentage of the total population, fishermen, than in any of the other districts, except possibly Lunenburg, but here little information is at hand. Because of this it necessarily follows that there are more fishermen per unit area in the Sambro region than in the district east of Halifax, for instance.

Nevertheless, it is true that without the fishing possibilities, the Sambro region could not support such a large population, and it is also true that while the eastern section of the area shows a slightly lower catch per individual fisherman we do not know whether these eastern fishing grounds could support as large a total fishing population, as well as the Sambro ledges do. It is believed for reasons given later, that they could not, in spite of the fact that under the present fishing intensity they do provide a fairly comparable catch of cod per man.

b. Suitability of Conditions for Cod.

In order that cod may live in this Halifax area, the conditions in this area must be suitable for them. Thus, since they are there, there must be suitable food, the temperature and salinity must be favourable and the sea bottom must be of a suitable character. This last feature is intimately connected with the food since cod are

bottom feeders to a certain extent and because of this they are as a rule found only on certain types of bottom, but whether they frequent these types of bottom in order to procure certain foods or whether they prefer these types and just eat what food is there, is not definitely known.

(1) Food.

Many people are of the opinion that cod eat anything and everything and after listening to a recital of the numerous queer things that fishermen have found in cod stomachs one almost believes the above opinion. However, the analyses of numerous cod stomachs from a scientific standpoint does reveal the fact that cod do select their food to some extent at least. Besides this, the nature and amount of food eaten varies from place to place.

This last fact is being made use of in investigating the cod races about Newfoundland. Here they have found that certain foods form the chief articles in the diet during certain seasons over certain areas. Caplin formed for a period in the summer the principal diet of the inshore cod in the northerly regions. This was found in the stomachs progressively later in the season towards the north. Herring were found to be a spasmodic part of the diet in the western and southern regions while the Sand launce was the chief species eaten on the bank fishing grounds especially near the outer slopes. These forms, the launce and caplin more especially, are considered to be the great growth promoters while numerous other articles form a general background being more widely distributed. Among these general forms should be listed shrimps, crabs, squid and sand dabs. Other more occasional forms and of more local distribution were hake, rosefish, alligator fish, starfish and ascidians. Clams formed a large part of the diet in one section for the fall season only.

These different types and quantities of foods promote different rates of growth which thus provide identifying characteristics for the fish from different regions.

For contrast the following brief summary of the food of the cod in the Gulf of Maine is also given. Here, according to Dr. Bigelow, these fish exhibit different characteristics, for in contrast to the above, they are "ground feeders chiefly" consuming invertebrates in great variety and amounts. Mulluses collectively are probably the largest item in the cod's diet in this region, although crabs, prawns, Brittle stars, Sea urchins and cucumbers are also regularly eaten. Besides these they pursue and gorge themselves at every opportunity upon squid, herring, launce, shad, mackerel, menhaden, and in fact any fish small enough to swallow.

In the Halifax area, what analyses have been carried out so far, tend to show still different diet combinations. The collecting was carried on during June to October inclusive (the period of the year during which growth is generally conceded to be at its height and when the fish will no doubt be feeding heartily) and to date some Sixty stomachs have been investigated from cod of all sizes procurable by hooks of various sizes.

Oddly enough, even at this time of year, about twenty-three percent of these have been found to be empty.

The collections were made in different places, in fact one might say there were three more or less different localities. Bedford basin is the first locality and is an almost enclosed body of salt water, inland from the head of Halifax harbour. Halifax harbour itself (the outer parts, clear of the city) is the second and is fairly typical of bays and inlets all along the coast. The third collecting district was along the open, exposed shore. However,

these last collections were confined to the Sambro ledges and just a few miles on either side of them.

In the examination of this stomach contents, the preservative was drained off as much as possible and the contents then sorted out and the different materials weighed, moist. The food percentages have been calculated on the basis of these weights.

Considering the whole area it has been found that fish are the leading item in the diet. In Bedford basin it made up about thirty percent and increased as you proceed out Halifax harbour to the open ocean where it varied from fifty to sixty percent. This is unlike the Gulf of Maine, but is similar to the Newfoundland district. However, it differs in that instead of capelin, sand launce and herring being the chief species, the rosefish (Sebastes marinus L.) was the chief contributor in this fish diet, while sculpins and several odd unidentifiable species made up the remaining small percentage. The rosefish has been indicated, to be only a very small item in the diets, by both Thompson and Bigelow. The next most important articles of food for the cod of this area during the seasons mentioned previously are crabs and shrimps. The former comes second in Halifax harbour and along the open coast, making up about twenty-five to thirty-five percent while in Bedford basin it is third making up some fifteen percent. Shrimps in the outer waters are third but they make up only from five to ten percent of the food, while they are second in Bedford basin making up about twenty to twenty-five percent of the diet. In the harbour and ledge region all the other articles of food found made up five percent or less individually. However, in the basin fourteen percent of the stomach contents was stones and about twelve percent eggs, however in this last instance only one stomach, a large one, contained eggs and these

were considered to be herring eggs tentatively. On almost every stone was the evidence of there having been some form of sea cucumber attached to it. Thus the stones were possibly eaten because some form of food was attached to them. This maybe accounts for the stones in cod stomachs reported by the Halifax paper last year. The percentages of all the other items individually were less than five percent.

One point that stands out is the fact that in Bedford basin, the cod diet was much more varied than in either the harbour or the ledge region, for in the former case there were about a dozen weighable things in the diet while in the latter only about half a dozen, with the result that the percentage of each in the diet was higher than in the former case.

In summing up the information on the food of the cod reported by the fishermen a certain amount of correspondence is found with the above and one great difference. Almost invariably the fishermen claim that herring form a large part in the cod diet, which is contrary to the findings reported on just previously. However, their reports do agree with the preceding, in that crabs and shrimp are consumed abundantly. Their list of occasional items is much longer than our findings to-date, but it is drawn from a much longer experience.

All the fish collected for stomach analyses were taken over hard bottoms for the fishermen claim from experience, and the small amount of experimental fishing has shown, that few cod are caught over a soft bottom. Thus it is to be expected that the bottom organisms and certain others, found in the food, should be associated with hard bottoms, for after all, the cod's mouth is not adapted for rooting along the bottom in soft places like some other fishes. Hence this fish seems to frequent areas where its food may be obtained

by catching free swimming organisms or by picking such animals as crabs and brittle stars off hard surfaces. The chief fish in the diet, the rosefish is generally found over a hard bottom and the crabs also frequent this type of bottom more than mud. The rosefish according to its acknowledged range from about the deep water off New Jersey north to Labrador, should be found all along the open coast of the Halifax area. However, this species of fish is not essential since herring, caplin, sand launce and others replace it in other districts. Thus it seems that cod prefer the hard bottom regions and live off whatever organisms happen to be there.

Dredging on a number of recognized good fishing grounds in the general vicinity of Sambro ledges has yielded very little in the line of food organisms, for only the odd starfish, brittle star and whelk has been brought up. However, it has definitely established the fact that these cod grounds are very hard in character and are made up of rocks, ledges etc., for quite a number of times the dredge caught and either broke some of the lines or "brought the boat up all standing". Besides this, having line trawls fast on these grounds, and sounding with hand-lines when fishing thus and finding sudden changes in depth within a few yards of each other, goes to show that these good cod bottoms are in general quite rocky.

(2) Bottom.

From the preceding brief remarks it may be concluded that in the Halifax area the cod is found over hard bottoms and usually these bottoms consist of rocks of varying sizes and ledges.

In the Gulf of Maine Bigelow also says that they are caught on "rocky and pebbly ground, on gravel, sand, and on a particularly gritty type of clay with broken shells - seldom on soft mud". In the bay of Fundy there are several known regions where a hard stretch of bottom gives place abruptly to mud and it is characteristic of the

catches made on trawls set from one bottom to the other that the cod will all be on the hard bottom end. Certain fishing stations (experimental) in Passamaquoddy bay and the lower part of the St. Croix river, located over soft or semi soft bottom, characteristically give only the occasional cod in trawl or drag trawl catches while haddock and hake are common. While haddock themselves are supposed to prefer a hard bottom, the cod seems to like a harder bottom still.

Briefly summarizing the fishermen's reports on the type of bottom preferred by cod it is found that they are almost unanimous in their opinions that cod like hard bottoms best, preferably rocks in cliffs and ledge formation though some say that hard flat bottoms are also good cod fishing grounds. Quite a number claim that the edge of the shoals where the stones and gravel blend in with the surrounding softer bottom is the best cod fishing region. The odd opinion that a mud bottom or mud mixed with small stones is a good god bottom does exist. Besides this some of the fishermen at the head of St. Margarets bay claim that during recent years they seem to have been obtaining better and better catches of cod on soft bottoms. Thus this information also indicates that cod prefer hard rocky bottoms which are in the form of cliffs and ledges, and the slopes of shoals of this character seem to be the more favoured parts.

Now, that some idea of the kind of bottom that is preferred by the cod, has been set forth, let us take a survey of the character of the sea-bottom of the inshore waters of the Halifax area. Chart III gives some indication of the character of the sea-bottom as well as the adjacent shore. The granitic character of the land extends from inland central Nova Scotia in a southeast direction into about the centre of the Halifax area. It touches the northeast shore of Mahone bay and makes up the greater part of the Aspotogan peninsula

(except the southwest tip). The whole of St. Margaret bay is surrounded by this formation (Devonian granite) which extends still farther in the southeast direction forming the Sambro peninsula. The eastern limit of this formation, extends inland in a northwest direction from the North West Arm Halifax city. East of this and west of about Chester, Mahone bay, the shore formation is of a softer character (Precambrian slate and quartzite).

The sea-bottom samplings show somewhat the same distribution of hard and soft materials. The Lunenburg and Mahone bay district shows a large number of mud, stones, sand and gravel soundings with only a few rock soundings. Even St. Margaret bay, surrounded by the granite formation shows mostly soundings of a softer character, sand, gravel, and mud, with only a little rock about the mouth of the bay where the water shoals considerably both from inside and outside of the bay. Extending this southeast and northwest boundary line between the granite and softer formation to the westward, out to sea, it is seen that it runs from quite close inshore at Peggy Cove (the southwest point of the Sambro peninsula) gradually farther and farther offshore as you go eastward, until at cape Sambro the rock soundings extend out a number of miles and the depth soundings, as indicated in chart I by the contour lines (the fifty fathom line (not on this chart) shows this fact best), show that this rocky peninsula extends out under the sea a considerable distance forming what is known as Sambro ledges. East of this region the depth contour lines come sharply in towards shore again, for some distance, then parallel the shoreline to the eastward.

Going offshore from the central part (or westward) of the Sambro peninsula, a softer bottom is soon found, for gravel, mud and sand soundings are fairly common.

East of Halifax the soundings indicate rock, sand and gravel with the rock seeming to predominate. However, the bottom is generally fairly flat as far east as about Jeddore.

Thus, generally speaking the bottom is of a softer character west of the Sambro peninsula, including St. Margaret bay, than it is to the eastward where the rocky Sambro ledges extend out from the eastern part of the peninsula. This rocky character extends still farther to the east, but the bottom is generally much flatter than in the Sambro ledge region where there are numerous ledges and cliffs as the name implies.

From the survey of the area it was learned that the above mentioned information in respect to the sea-bottom checked very well with the actual fishing.

In the eastern part of the Halifax area, that is from Shut-in island, chart III, to Owl Head, the bottom is hard out to the twenty-five fathom line or about six or seven miles. From there out to about the ten mile limit they claim the bottom is muddy. Outside of this there is a hard ridge with shoaler water extending more or less in an east and west direction, about parallel to the shore.

The inshore fishing in this part of the area is done mostly inside the muddy bottom mentioned above or within about seven or eight miles from shore, for except right in the best seasons, as far as the weather goes, this is as far as these small boats care to venture offshore. Formerly there were schooners in this district but the owners have not been able to keep them in commission during the recent reign of poor prices and now-a-days there are only small boats in this region.

While this inshore fishing ground is fairly hard still there are more shoals towards the eastern limit. This is not only

shown on detailed charts but at Jeddore for instance, where there are about as many boats as at any one port in the region, most of their fishing is done inside of the muddy grounds and between a SSW and a SSE direction. Comparing this with the Three Fathom Harbour boats, where most of their fishing is done on the inshore hard bottom and between a SW and a SE direction, it is found that the latter boats range over a wider area than the former, - that is eight points of the compass compared to four - in order to be able to carry on. Thus, itis concluded that the fish are not so concentrated since the shoals and fishing grounds are reported to be fewer and farther apart. Besides this, the fishermen claim the good fishing grounds extend farther offshore in the eastern part of their range than they do in the western part.

Thus it is found that the boats near the eastern limit of the area fish over a narrower range than those nearer to Halifax or say at Three Fathom Harbour and the farther west and nearer to the last mentioned place one gets, the more easterly seems to be the average direction to the general grounds of each port.

However from Shut-in island to Devil island there is little cod fishing or in fact any hook and line fishing done at all. This is probably due to two reasons which arise from the same source. The shore in this district is chiefly gravel and earth etc. which makes good farming land and at the same time provides a fairly level, semi-hard sea-bottom with few hard shoals such as seem to be desired by cod. Besides this, this type of actual shore-line is easily eroded producing rounded headlands, exposed bays and a gradually shelving beach which slopes off into deeper water very slowly. Thus protected harbours and deep water entrances to harbours are scarce, with the result that all the boats must be small and of shallow draught so that they may be beached easily. This makes fishing on

the good grounds which are some distance away a tedious occupation compared to farming in a small way.

The above change in character of the fishing and character of the sea-bottom may be traced on chart III to the fact that the granitic belt cropping out some miles inland from the shore at the Halifax end of the region, gradually approaches closer to the shore as you go eastward until at Musquodoboit, Jeddore and Ship Harbour it touches the head of the long inlets and no doubt makes its influence felt under the softer surface layer some distance offshore in the sea-bottom. Thus, the reduced landings just east of Halifax and the gradual increase as one goes eastward to Ship Harbour, may be traced to the character of the country and sea-bottom which provides an easier alternative occupation in the western end of the region than in the eastern section. This seems to be readily taken advantage of because of difficulties in the way of easy fishing and fewer and possibly poor fishing grounds.

The Halifax harbour fishermen, i.e. those from Devil island, Eastern Passage, Herring Cove, Portuguese Cove and Duncans Cove principally are located just along the eastern edge of the granitic Sambro peninsula district with the result that there are quite a number of good hard, rocky shoals about the mouth of the harbour where cod fishing is usually carried on successfully even though the fishing ranges of all these ports overlap to quite an extent. Besides this the individual ranges are decidedly smaller than those immediately to the eastward. Since there are only small boats here (there was formerly a fleet of schooners at Herring Cove) they do not venture far out past the harbour mouth which is about eight or nine miles out towards the sea from Halifax city. In fact they do not seem to go as far off as the boats to the eastward in spite of the number of boats and the limited fishing area. Thus

the apparently better and more numerous grounds in this region support more cod than are to be found immediately to the eastward.

In general the hard bottom off the outer coast of the Sambro peninsula is enclosed by the broken lines shown in chart III. This more or less pointed area extending in a somewhat southeast direction gradually peters out but continues as a deep sand and gravel ridge right on out to Sambro bank some fifty miles offshore. The hard bottom off Sambro consists of innumerable shoals, ledges and cliffs whose names almost cover detailed charts of the region. These seem to be concentrated right "broad off" Sambro itself.

From the standpoint of grounds fished, the fishing range and general direction of the operations of the boats from each of the ports along this outer section of the coast-line, it has been found that the broken lines in chart III outline the area of operations fairly well. The Sambro and vicinity boats operate almost directly off the shore and about as much to the eastward as the westward. From Pennant point to Peggy Cove the general direction of the operations tends to be more and more easterly. Because of the good grounds extending continuously offshore for a considerable distance, bigger boats are necessary and there are a number of schooners that operate to a considerable extent well out along the tip of this hard bottom area, which grounds are known as the Eastern and Western edges and are located in about seventy-five fathoms of water and some twelve to twenty miles from shore. The Western edge, in the correct depth, gives better catches, apparently, but the bottom is so irregular and "clifty" that much gear is lost with the result that more fishing is done on the Eastern edge and top of the ridge where fewer (somewhat) fish are caught but less gear is destroyed. Thus, this Sambro ledge region with its innumerable shoals seems to be the best cod fishing district in the

whole Halifax area, supporting large numbers of cod and a big fishery which drops off somewhat towards the western part or Peggy Cove vicinity as might be expected from the diminished hard bottom area in that region. This narrow hard bottom region with the softer bottom outside of it (mud outside of it in a number of directions) is fairly similar to the Shut-in island to Ship Harbour or Jeddore region and supports a fishery of about the same magnitude per man.

St. Margaret bay supports only a small cod fishery and as mentioned before the fishermen are engaged in other types of fishing generally. However, now it is seen that their interest in other types of fishing may have been caused not only by the abundance and easy of capture of these other fishes but by the scarcity of cod for the bottom certainly does not seem to conform to the usual standards for good cod bottom. Shoals are scarce and except along the outer western shore there are few if any rock soundings recorded.

Mahone bay also shows mud and sand soundings predominating. However, there seems to be a line of hard bottom, rock, sand and gravel extending both in a southerly direction and also in a southwest by west direction from the tip of the Aspotogan peninsula. These two lines of harder bottom, more especially the southerly one, make up the fishing grounds of the fishermen of the outer Aspotogan peninsula region. These grounds are fairly good since individual landings in this region compare favourably with the western section of Sambro peninsula and the Jeddore, Ship Harbour region.

Thus it is seen that the good cod fishing grounds conform to the pattern of the hard, rock and gravel bottom, and the better grounds even in these regions seem to be where the bottom is not flat, but is thrown up into many ledges, cliffs and shoals. In view

of this the good fishery off Sambro is made possible and the somewhat poorer one to the eastward and westward may be accounted for in some measure. This character of the bottom not only has its effect on the size of the fishery, but also on the type of gear and methods used, as will be gone into hereafter.

(3) Hydrography.

In general the optimum temperature range for cod is considered to be from about 2° - 8°C. or about 34° - 46°F., and the range in salinity is very wide. Some investigators change the temperature limits somewhat but since cod live at both higher and lower temperatures it is impossible to make or set a fixed optimum range.

In the Newfoundland investigations they have found that cod are generally inside of the fifty metre line since that is the lower limit for obtaining suitable temperatures. Where the bottom temperatures were less than 1°C. they found no fish, but in one case where ten metres off the bottom the temperature was 3.4°C. they cound lots of cod in that stratum and caught them with a jigger. Generally speaking cod are claimed to be plentiful in 3°C. water in this Labrador region;

This means that there is only a more or less narrow band of suitable water along the coast which probably explains Dr. Wakeham's 1892 report in which he claimed that the cod were so thick in a certain bay that his gig ran aground in them. Other men too, familiar with the region, say that the cod stay in large numbers in near shore and they are fished in water so shallow and clear that the fishermen can see the fish on the bottom.

In the Halifax area the cod do not congregate and stay in such large numbers near shore.

Records of quite a number of catches made in the Halifax area during the last few years on good fishing bottoms show that "good catches" (the significance of these terms vary with the different persons reporting) have been made in water with the temperature ranging from -.5°C. (about 31°F.) to 7.0°C. (44.6°F.). On the whole, however, it is believed that only "fair catches" are made in water from -.5° to 2.0°C. and from 7.0° to 9.5°C. while in the 2.0° to 7.0°C. water the catches are good. Some have been caught in water as warm as 13.5°C. (56.3°F.) according to the records, but from 9.5°C. up, cod are usually scarce. While the opinion has just been expressed that in water of temperature -.5° to about 2.0°C. only "fair catches" are made, still, irregular records from Halifax harbour made by Claude Darrach of the Fishery Experimental Station, Halifax, show that during some years there is "good" cod fishing in water of temperature -.5 to 2.0°C., while other years in water 1.00°C. the cod are scarce. This same irregularity of "good" catches continues in water up to about 7.0°C., but above that no "good" catches have been recorded.

The experimental trawling done this past summer by Capt. A. E. Calder was confined to water varying in temperature from .5°C. to 7.5°C. "Poor" catches were made in water above 4.0°C., "good" between 3.0° and 4.0°C., "poor" between .75°C. and 3.0°C. However, one setting of trawl was made in water of .55°C. and the maximum catch of cod during the whole season, was made.

When these records are compared with the work done by the French on the banks off Newfoundland, some slight differences seem to occur since they report that "cod are very scarce from -2° to 1.5°, sporadic from 1.5° to 3°, very abundant from 3° to 5°, less numerous from 5° to 7° and disappear at temperatures above 8° to 9°, except for a few particular cases, very near the coasts". Assuming

that their definition of "scarce", "sporadic", and "abundant" compares with our "scarce", "fair catches" and "good catches" favourably, it is believed that the cod in the Halifax area possibly frequent water with a slightly greater range in temperature and seem to be more abundant in water at the colder end of the range than do the cod about Newfoundland. This seems to be borne out by comparison not only with these French records, but also with those of the Bay Bulls Laboratory, Newfoundland.

At this point it might be interesting to point out some information obtained by holding cod in salt water tanks. While this does not bear directly on fishing operations since the following information was obtained from fish ranging from twenty-two to thirty-one centimetres in length (too small to be taken commercially in quantity) still it is of use. A number of fish of this size were kept in tanks during the past summer with the water temperature ranging from thirteen to twenty degrees Centigrade and at no time did they seem uncomfortable. The twenty degree temperature lasted only for about a day, but a temperature of eighteen degrees was a common occurrence. Not only did they live in this warm water, but they ate clams heartily throughout the whole period. However, one larger cod, about sixty centimetres long, lived throughout the whole time, but ate nothing. Thus there seems to be a great difference between the conditions suitable for adult, and young cod.

Another interesting feature in this respect, occurring during the period of investigation of this area last year, is brought out in figures 3 and 4. In figure 3 the monthly inshore landings of cod in Halifax county are plotted out for 1932. During the cold months of the year, January, February, March and April, the landings were small, but this does not necessarily contradict the records of good cod fishing in Halifax harbour at the cold seasons of the year,

because,for one reason or another, almost all of the inshore cod fishing except about Halifax harbour, ceases during these months, so that of necessity the total landings in the county must be greatly reduced. May, June, July and August were good months with July and August the best. However, September was very poor, while the remaining three months of the year were considerably better. Now, the question arises, why the very poor landings in September. From graphs explained later in this report, it is known that on the average September and October are not as good as July and August or quite as good possibly as November, but there is usually no tremendous drop as in 1932.

Now, looking at figure 4 the bottom temperatures at progressively deeper and deeper points are seen to take a big jump up about the first week in September out to about one hundred metres in depth. At one hundred fifty metres a drop occurred. This line of stations running offshore at this point is in about the centre of the Halifax area and may be assumed to indicate fairly well the conditions along the shore of the area, with reservations.

Thus the big storm and gales of wind from offshore, lasting for a number of days about the end of the first week in September, drove the warmer surface water onshore and mixed up the shore water pretty thoroughly out to about the hundred metre line, producing water varying in temperature from about 10°C. to 16°C. from bottom to top. Outside of this the bottom temperature dropped to about 2°C. with only about five to ten metres increase in depth. This condition of affairs lasted for some weeks, gradually coming back to the previous state of affairs by about the middle of October.

Just as soon as the gales were over the fishermen resumed operations but caught no cod on the grounds inshore where they had been, before the storm. For example, on Sept. 14/32 in sixty-eight

metres of water, bottom temperature 12.35°C. a commercial fisherman caught one cod on six hundred hooks baited with three kinds of bait. Thus it is seen that the storms drove the cod offshore by producing water too warm for them along the shore. As this warm water was gradually dissapated the cod worked back towards shore. Temperature was no doubt responsible for this long move offshore for it is doubtful if the physical effects of the storm would be felt at the bottom in water seventy metres deep.

From the temperature records in figure 4 and also unplotted other records made along the shore of the area it is thought that the temperatures usually existing along the shore of this area during most of the year come within the cod temperature range. Even in Mahone and St. Margaret bay, both of which are shallow and as a result might become too warm for cod, it has been found that in 1922 (records by Capt. A. E. Calder and also by Dr. A. W. H. Needler) the bottom temperatures in the deeper parts of St. Margaret bay did not go above 4.5°C. or above 5.88°C. in Mahone bay which is the shallower. Thus it appears that it is not any extremely unfavourable temperature that causes the poor landings of cod from these two bays.

From the above consideration of these two bays and the previous consideration of figure 4 it is believed that, as far as bottom temperatures go in the inshore Halifax area, cod can live at any time of year. However, there appears to be the possibility that certain regions become possibly less suitable than others at certain times of year, with the result that the cod may move from these less suitable surroundings to ones that are more suitable and in which they are not fished commercially to any extent. This possible movement will be considered later.

Considering the salinity of the inshore Halifax area waters during the period of last summer's investigations, it may be said, judging from the samples recorded from the line of stations running off Halifax, that these inshore waters did not go below about twenty-nine point five parts per thousand or above approximately thirty-four point five. This line of stations began in the outer part of Halifax harbour in water thirty metres deep and ran offshore about twenty-five miles to a depth of one hundred fifty metres.

Generally speaking the salinity increased from top to bottom, except the first few metres from the surface, and from shallow water to deep water. The latter statement is more especially true of the bottom water. This range of salinity compares favourably with that of the "cod water" on the banks off Newfoundland.

Capture

In the capture of cod various kinds of gear and methods may be used, depending on the circumstances. In the bay of Fundy conditions on the whole seem suitable and trawls are used more extensively than hand-lines. However, previous to about 1860 trawls were unknown on the Atlantic coast of Canada. The above mentioned two methods of cod fishing are the only two important ones in inshore waters.

However, in the Halifax area the hand-line predominates among the inshore fishermen. Many of them have trawl and after setting it hand-line while waiting. Among the schooner fishermen that operate either along the outer part of the inshore small boat fishermen's grounds or farther off, trawl predominates.

This condition of affairs is due to the circumstances under which the fishery is carried on. As mentioned before, the inshore

fishing grounds consist in general of small shoals of rock as a rule. Generally speaking, these shoals are that small that about one tub of gear (three to four hundred fathoms) will more than extend from edge to edge of the shoal with the result that the gear which extends out onto the softer bottom about the shoal does not catch many cod. Thus so little trawl (two or three tubs compared to six to ten in the bay of Fundy per boat) can be set per shoal, and so few fish caught that it doesn't pay to fish this way. Hence hand-lining is done more extensively in this region since the upkeep and initial cost is very much less and a fisherman may concentrate his efforts on one small shoal or part of a shoal with much more success than if he just set a line of trawl across it. Besides this the boats are too small to carry much trawl.

Those inshore small boat men that do set trawl usually set it on as hard bottom as can be found between the shoals, because they make better total catches of fish and run less likelihood of fouling with hand-lines or the cliffs and ledges in the shoals.

The small schooner fishermen operating somewhat farther offshore use several more tubs of gear as a rule for the grounds are somewhat more extensive as a rule and not so apt to foul the gear. These fishermen usually hand-line also, while waiting.

In both types of gear there is much uniformity throughout the area, which is to be expected in a way because there are no great changes in the conditions over the whole area.

Generally speaking the hand-lines a single or double line of steam-tarred three to five pound cotton line on a wooden reel. There is great diversity in shapes and types of lead weights since they are usually hand made, but they vary from about two to three and a half pounds in weight, the heavier weights being used in the deeper water. As a rule each man has two lines but in shallow

water these lines have one snood and one hook while in deep water they have two snoods with one hook each suspended from just below the weight. These snoods vary from three to six feet in length and when there are two on a line the one is from six to twelve inches shorter than the other. The snoods are the same weight or slightly lighter than the reel line. As a rule a fairly large hook, James or Mustad number twelve to fifteen is used. These hooks are usually white, curved and have a flat eye.

The trawls usually have about a twelve to fourteen pound, steam-tarred cotton "back" or "ground" line in shallow water and an eighteen to twenty-four pound line for deep water. The snoods of three to four pound line are cut about thirty-two inches long and spaced from five to six feet apart. James or Mustad number fifteen, sixteen or seventeen hooks are used, usually, white and with a long shank.

Unlike the fishermen of the bay of Fundy, these fishermen do not have to contend with strong tidal currents which govern the time of fishing. However, there are currents which do not seem at least at the present stage in the investigation, to correspond to any particular phase of the tide. Speaking generally, the currents are reported as going more to the westward than the eastward. They may run steadily in one direction for days at a time then turn the opposite way either during and after a storm or for no apparent reason. Then too these currents may go one direction at the surface and another below, sometimes opposite.

In the eastern part of the area the fishermen from east of Three Fathom Harbour to Ship Harbour claim that in July and August the current towards the westward, i.e. six to fifteen miles off shore, reaches its maximum and at that time is so strong that it makes trawling difficult and hand-lining impossible in many cases, so they move in closer to shore where the current is not so strong.

Over the Sambro ledge region these currents run almost any and every way within short distances both horizontally and vertically, and may change direction within half an hour.

In this area most of the fishing begins at dawn and continues until ten or eleven. Then the fish seem to stop biting and the fishermen, the small boats, usually go in. Sometimes a "spurt" will occur in the early afternoon and then again just about dusk. However, very few fish these last two mentioned periods, although some fish continuously from dawn till dusk if they can obtain bait. There are also a few reports that say that the evening fishing is is better in the late summer and fall, August and September, than at other times of year.

According to the fishermen it must always be remembered that different sizes of fish are caught at different locations on the shoals. It is generally believed that the smaller cod are caught up on the shoaler parts of the shoals. The larger fish are caught usually around the edges of the shoals or on the "slopes" as they say.

Probably the most important part of the two main methods of fishing is the bait question, for if there is no bait, there's no fishing. A certain small amount of winter and early spring fishing is carried on at various centres. Some little is done at West Jeddore and clams are used until herring arrive in April and May. Between here Halifax harbour little is done. In the harbour there is almost always someone out on fine days. Here mussels, obtained usually from pier number two, Halifax harbour commission, form the chief source of bait along with some frozen herring, mackerel and squid. A number of schooners from about the Sambro peninsula also come and operate out of Halifax under about the same conditions, though they do not go so far offshore as in the summer. Very little winter cod fishing is done west of Halifax harbour but some is carried on by using clams

at Terrence Bay, and, clams and mussels for the odd few days of cod fishing up towards the head of St. Margaret bay. At places like Indian Harbour and West Dover some frozen baits are sometimes obtained from Lunenburg. The odd little bit of salted herring is used occasionally by the odd fisherman.

Almost universally throughout the area cod fishing begins in earnest when the herring arrive in April and May. This form of bait is used until it begins to fail after a month or six weeks and mackerel and squid are used to supplement the herring. This state of affairs exists generally until most of the cod fishing ceases in the late fall. However in some districts the herring increase again in the fall so that there is lots of bait. About the mouth of St. Margaret bay these are spawning and spent herring. Another variation east of Halifax is the change from herring to clams in the summer just as soon as the dogfish become numerous. This change is made because dogfish do not take clam bait nearly so readily as herring or mackerel. Some change to squid when they "strike in" for dogfish do not apparently like this form of bait either very well.

This change that occurs in the kind of baits used, proves commercially that the experiments of Dr. Huntsman (1919) and Dr. Knight (published 1906-10) were correct. Their results go to show that clams, mussels and whelks are not only good forms of bait for cod and haddock, but that they are not taken readily by dogfish even when they are very numerous. This is one way to combat the evil of dogfish, which is one of the sore points with the fishermen. At the same time this change does away with the necessity of setting nettings for herring and mackerel and having them ruined by dogfish. However, this change is more easily made east of Halifax than west for owing to the nature of the country as mentioned before, there are many suitable places for clams east of Halifax but very few in the rocky outer Sambro peninsula.

Another rather interesting point is the fact that many fishermen trawl in the spring, but change to hand-lining, in the summer, because they claim that the fish don't bitesso readily and a moving bait is the best way to entice them into taking the hook. This idea of the fish biting better in the winter than summer was actually reported to be the case by a number of fishermen who did not say anything about moving versus still baits. These men just claimed that the "cod bite quickest in the winter". They also claim that mussels are the only bait that's any good, for they have tried out all the **frozen** baits (slow freezing) and found them inferior to the **mussels.**

East of Halifax when herring and mackerel fail, they can usually obtain clams fairly readily if they want to, so the lack of bait problem is a much less poignant subject than about Sambro where clams and mussels are reported to be scarce. However, at some place or other in the cod fishing countries of the world almost every shell fish of a fair size is used by somebody, and they are seen to be rather distasteful to dogfish. Thus, there is no reason why any shell fish found in the Sambro region and other places where bait becomes scarce may not be tried out. In some regions of the world each fisherman has a piece of iron set into the rail of the vessel and a hammer with which to break up the shells (in this instance chiefly cockle) and pound the meat into a pulp before putting it on the hook. Another bait used to a great extent has been lampreys by the Dutch. The English fishermen in 1907 sold thousands of dollars worth of lampreys to the Dutch fishermen to be used as bait. Scallop rims are also used successfully at certain points about Nova Scotia now.

Another way of getting around the scarcity of bait in certain regions (and this bait problem is a serious one some years

in some regions, witness the government bait intelligence service) is to change the type of gear used to one that does not need bait. For instance about Newfoundland, Labrador and Greenland jigging cod is done regularly. Even in the Halifax area this method is used occasionally, and successfully too, it is reported. Such reports were heard from Halifax harbour and the outer parts of St. Margaret bay. Another change that is more expensive is to use nets. These have been tried out to a small extent by some men. At West Jeddore they were tried out twelve to fourteen years ago, but they didn't make enough to pay for the gear. However, they are used to some extent to take spawning cod and haddock in and about St. Margaret bay for fish in such condition do not take a hook as a rule very well. Such gill nets usually have a six or seven inch mesh and of course are set on the bottom, however they do not necessarily have to be set on the bottom for they may be buoyed or "canned" to stay at any desired depth. This type of gear has been used in Norway for over two hundred years and they claim it is indispensible when bait is scarce or the cod won't bite. Mesh as large as ten inch is used there. In 1878, fifty-eight percent of the Norwegian gear was nets, thirty-two percent lines and ten percent deep bait. Some netting has been done off the American coast, but in most cases where failure was reported, the gear was frail and it is believed that netting has not been given a thorough try-out on this side of the Atlantic.

In connection with this bait problem some hints as to the feeding habits of cod have been obtained from holding cod in salt water tanks. As mentioned before young cod seem to feed heartily at a much higher temperature than older cod. The same seems to be true of quite low temperatures. Not only this, but in water between 2° and 3°C., what little data are at hand up to the present, seem

to show that the small cod feed more frequently than the larger ones. Up to the present only fresh clams and rapidly forzen "sardines" (kept in cold storage for some months) have been used as food. It seems to be true that the smaller fish prefer the sardines to clams at this low temperature while the larger fish will eat both heartily one time, only clams some days and only the small herring others. Then too, the larger fish do not evince any dislike for certain parts of the clams and herring while the small cod, when they do eat clams, seem to prefer the softer parts and in general they do not like the heads, tails, fins or cuts of herring with any of the entrails dangling from them. One other point is common to all sizes and that is that they seem to prefer to take their food while it is up in the water rather than off the bottom, even when there are many pieces close together on the bottom within easy reach and quite plainly seen. Then too, in well lighted tanks, the cod feed almost entirely by sight.

Seasonal Movements

Since cod are not landed in equal quantities all year around in this inshore Halifax area there must be some change in the direction or intensity of the fishing effort or in the quantity of cod on the grounds. That the effort changes is well known, but even at that the abundance of the cod on the grounds also seems to change, at least this is considered to be the case when the number caught per man or boat or day or month varies.

One of the best and quickest ways of obtaining an idea of the best cod fishing seasons is to look at figure 5. In this figure the average monthly landings for the period 1925-'31 inclusive have been plotted out for Lunenburg county west, and east and Halifax west and east. It is seen that a few fish are landed in March,

April and May in Lunenburg west. June, July, August and September are the big months, with the peak occurring in July. October, November and December show the landings declining still further towards the zero landings months of January and February. This section of the area thus shows a fishery having one maximum and that in the summer. In the eastern section of this same county the curve of the landings shows one peak also, but here the fishery begins about May, increases slowly, to the July, August and September levels which are all about equally high, (peak in September if anything) and then falls off slowly to a very small landing in December with none in January, February and March. Halifax county west is the only section that shows landings the whole year around. February and March are the poorest months. During April and May the landings increase to reach the yearly maximum in June. In July and August they fall off rapidly to about one-half of what they were in June and remain at this level or increase a bit towards the last of the period September and October. In November there is usually a decided increase, but it falls off decidedly in December and later in January. Thus this is the only section that definitely shows two peaks in the fishery, for, in Halifax east the cod fishery begins slowly in May, increasing rapidly in June and July to a peak in August only to fall off more rapidly still to a very low level in October and November with no landings from December to April inclusive.

Briefly, the Lunenburg county fishery is a one summer peak only, fishery, beginning in the west section in March, a month ahead of the eastern section, reaching its peak in July in the west and then falling off rapidly and steadily to its December low level as opposed to a slow increase to three high level months (July, August and September) and then a slow decline to December, in the eastern section. Halifax east is very much like Lunenburg west but

begins two months later, reaching its peak in August and ceasing in November. The Halifax west fishery is the odd one, for its minimum is reached in February and March and by June it has reached its maximum. During the rest of the summer it seems to drop off only to increase again decidedly in October and more especially in November. December shows considerably reduced landings compared to the rest of the summer and fall.

Since Lunenburg county west was not visited let us first consider Lunenburg east. Most of the cod landing in this section are caught by the fishermen of the Aspotogan peninsula (excluding that part directly on Mahone bay) and the islands off its tip. The April caught fish are taken chiefly by schooners or larger boats fishing from the outer part of the peninsula (off along the line of hard bottom extending about south of the peninsula). The peak reported for this fishery is along in May and June for it peters out along the last of July. Then they fish closer home.

The St. Margaret bay fishery begins about April and May, but reaches its peak along the latter part of June out towards the mouth and the latter part of July or early August up towards the head of the bay in spite of the fact that there are quite a number of reports to the effect that cod may be caught in the deeper parts (eighteen fathoms and deeper) all winter. However, there seems to be another run of fish come into this bay and these with what stayed in the bay all winter make the summer fishery, for besides the reports that they remain all winter and can be taken any fine day, there are other reports that say that when they begin fishing in the spring the run of cod sometimes has not arrived, but that it usually begins about June and reaches its peak along in August. From then until about October fifteenth it remains at a lower level but from then into November there is cod fishing about equal to that in the spring and early summer. This fall "spurt" is reported not to occur

every year and it is also said that some fish at least come into the bay from outside, for the fishermen about the mouth of the bay say that they have a few nights good cod fishing in the fall, just previous to the "spurt" of good fishing that occurs well up in the bay. Lack of bait usually determines the end of this fishery in the fall as well as its beginning in the spring for most of the fishermen wait for herring in the spring and quit when they leave in the fall. However, the landings have actually fallen off as a rule before they stop fishing.

The cod fishery of the outer coast of the Sambro peninsula seems to be considerably more complicated than that just discussed. Here, there are at least a few boats, usually small schooners with a greater fishing range than the small shore boats, which fish more or less all year around. During March and April most of these boats fish fairly well inshore, that is up to six or seven miles offshore. About the end of this period they begin to fish farther and farther offshore because they claim that the fish begin to move offshore in April and May. However the inshore small boats begin to fish along the latter part of April since they claim there's no fish inshore (and they mean within five miles or so) before this. Thus the fish that the inner schooners were fishing may begin to move about that time as they say they do but some at least apparently go inshore. During the whole time however some schooners have been fishing out on the outer edges of the Sambro ledges. Up until April these fishermen claim that the Western edge is the better, but after that due to the fish moving eastward they too have to go over to the Eastern edge or even farther east in order to keep up with the fish. In the fall and winter these men say that they have to do just the opposite in order to obtain good catches. Thus from about May on through June and into July the schooners are almost all operating

over the outer part of the Sambro ledges in water about seventy-five fathoms deep. However, about the end of this period quite a number of them come in and operate much closer to shore because they say that they can no longer obtain bait by setting nets away offshore over their fishing grounds. The others, obtaining bait from closer inshore, begin to work in closer towards the shore because they claim that these fish, which they've been fishing offshore up till July, begin to work inshore and by late August and September both small boats and schooners are fishing within easy reach of the shore in water about thirty to forty fathoms or less. Here they continue fishing until well on in November, during which month the landings seem to reach a slight peak. Most of the fishing ceases about then owing to bad weather and the majority of the boats are laid up from about the middle of December until the first of March. When it is said that the schooners move inshore in August and September it does not mean that some of them do not continue to fish in the deep water until forced inshore by bad weather, for they do and there is cod fishing out on the edges of Sambro ledges all year around.

In Halifax harbour the reports tended to indicate the same general movements. In February and March they claimed that if there were "worms" present (possibly some form of nereis from the vague descriptions) then there was good cod fishing. This irregularity of good cod fishing here is checked by reports from the Fishery Experimental Station which show that some years good catches of cod are made in February, March and April while other years there are practically no cod caught. Along in May there seem to be somewhat fewer fish inshore and for the rest of the summer the best fishing in this section is out about the outer automatic buoy and the Sambro lightship. Along in October and November good catches are again made closer in to shore.

East of Halifax there is very little cod fishing done before well on in May for a number of reasons chief among which are lack of bait (herring and mackerel) before that and the fact that the lobster season lasts late. Thus when they do finish lobster fishing and there is plenty of bait the landings go up with a rush as seen in figure 5. Considering all the reports it is found that in general the fishing is carried on farther offshore and in deeper water in the spring and early summer than later. However, some fishermen seemingly do the opposite. Anyway, generally speaking there is good fishing two or three miles off as well as on the outer inshore grounds in the summer. In this respect it is like the Sambro region and also in that the larger boats, which fish on the outer grounds, move inshore closer in August because of shortage of bait off there as well as the fact that they say the westward set to the current is so strong that they can not get their lines down to bottom. This condition seems to obtain most towards the eastern limits of the area. In the fall the fish are reported to work offshore again to some extent, although they say that cod may be caught all winter long if you go twelve or fifteen miles offshore. During the fall fishery there is a "spurt" of extra good fishing which occurs sometime in September or October and lasts for a number of weeks. However, most of the boats are put up along about the beginning of November because of bad weather among other things. As a rule when fishing ceases in the fall they have not worked offshore as far as they were in the spring.

In almost every place visited the fishermen in this eastern section were quite emphatic about another point and that is that they're sure the cod move eastward in the spring and back westward in the fall. This seems to be the opinion throughout the area.

However, they nearly all agree in that this movement is found on the outer inshore grounds.

It is rather hard to obtain a clear idea of what seems to be going on in the area as a whole, but at present there appears to be several movements that are fairly clear. About Halifax harbour and the Sambro ledges where some fishermen operate all year long there seems to be good fishing, but irregular, inshore during.February, March and April. These fish may be any distance offshore up to five to eight miles. About May they seem to begin to move and these schooner fishermen think they go offshore and in any case they operate farther and farther offshore. However along about May the inshore small boat fishermen begin to take cod fish, those regions that project farthest out into the ocean seeming to obtain larger catches first. Along in August the fishermen on the outer inshore grounds, at least about the Sambro ledges begin to work in saying that their fish are moving in. East of Halifax these fishermen come inshore then but for other reasons they claim. Thus, towards the last of the summer nearly everyone is fishing fairly well inshore. However from then on there is a slight slow movement offshore. Along about October there occurs the fall "spurt" of better fishing and directly after it a good many of the boats are laid up. Any that do carry on, move still farther off shore and continue fishing twelve miles or so offshore in the eastern section, about the eastern and western edges, or on the ridges off Aspotogan, during the winter.

Besides the above mentioned movements there is also the apparent eastward movement of the fish on the outer inshore grounds in the spring and westward in the fall and on into January. Besides the shift of the schooners from the western edge to the eastern edge in the spring and vice versa in the fall (mentioned before) there is

also a trek eastward of quite a lot of small schooners from about the mouth of St. Margaret and some from about the outer shore of Sambro peninsula in the fore part of the summer. Generally speaking those that intend to fish for cod go as far as the Egg island, Jeddore region where they claim there is better late spring and summer fishing than about Sambro. These boats go east about the latter part of June and early July, remaining for several months or so. This idea seems to be also borne out by the fact that in figure 5 the monthly landings of Halifax east are decidedly better than those of Halifax west during July, August and September. Lunenburg east also has its peak cod fishery late on in the season, but it is located chiefly in a large indentation in the shore-line and so might be expected to show the effect of a movement of fish into or past it later than regions located in line with or projecting farther out than, the general shore-line.

Up to the present time what material has been collected and worked up goes to show that the larger fish on the average are farther offshore, while those cod that are close inshore are, on the average smaller at least during the summer. Catches made within a few days of each other about the end of July, show that, east of Sambro ledges along a line of three stations extending offshore from Halifax harbour, the cod in twenty-five metres of water were about fifty-nine centimetres (twenty-four inches) in length, in seventy-five metres of water sixty-five centimetres (twenty-six inches) and seventy-one centimetres (twenty-eight inches) in length in a hundred forty metres of water. This corresponds to the general fishermen's report that the bigger fish are caught in deeper water. However, what little information is at hand concerning the fish immediately west of Sambro ledges shows practically no difference in length between the fish caught in forty-five and one hundred metres of water.

Now considering Halifax harbour only for which there are irregular catch records back a number of years, it is found that the average size of the fish caught seems to decrease as the season advances from late spring to early fall. Of the winter and early spring little is known, but in the late fall the average size increases greatly with the taking of nearly mature and mature cod. This checks with a number of reports from along the area outside of Halifax harbour which say that the fall "spurt" of cod is "eighty percent large", "same size as spring but fatter", "gaffers", and "large fall spawners". Besides this they speak of the cod caught inshore in the summer as "the small rock cod", or "natives", while in the spring many of them call the larger fish "the school fish".

Again considering only Halifax harbour 1932 another point has come up, that possibly bears on this same thing. While there are not an equal number of records for each month nor in fact are there at least some in every month, still there seems to be some interesting data.

During the winter there were no blank sets for cod, i.e. no sets made where other fish were caught and no cod. Comparatively speaking, the number of cod caught per hundred hooks was large and the fish were a fair size. In the spring, there were also no blank sets, but the number of cod per hundred hooks had decreased. However, in July there was the highest percent of cod per number of hooks, - when cod were caught at all - but in twenty-five percent of the sets there were no cod caught. In August the percentage of cod had dropped off by a half and fifty percent of the sets were blank so far as cod were concerned. In September no cod were taken, a fair number in October and very fair in November, but not with baited hooks, only jiggs were successful.

Thus it is seen that in the late fall and winter fair catches were made with no blank sets, a little poorer in the spring and still no blanks, while in July good catches were made with a number of blank sets and from then on the catches decreased and the blank sets increased till October. From this one might conclude that the cod were scattered all over in the first six months of the year but in July they gathered in schools in certain places and had apparently left almost altogether by September, that is, from sets made during the first week as well as later.

Thus this too, seems to indicate the idea reported previously, that there is a movement offshore in the late spring (possibly only the larger fish while the smaller ones stay and more of them come into shallower water at least for a time) and then back again in the fall, apparently for spawning purposes ultimately. Now this offshore movement in the spring is reported almost entirely by the few schooners that are large enough not only to operate to some extent almost all winter and early spring but good distances offshore in the summer. These men as a rule seem to look with more or less contempt on the small quantities and small sized fish caught by the small inshore boats. Thus, when they speak of a movement of fish offshore in the spring they mean the large good sized cod that they are interested in, not the small mixed lot that seems to go inshore and comprise the late spring and summer small boat fishery. Then again when these schooner men claim their fish begin to move in in August, September and October they mean the large fish which apparently form the inshore "spurt" of spawning fish in the fall, late.

Another means of attempting to determine the various movements and migrations of fish is tagging. Some of this was done in the summer (July 25 - Sept. 10 inclusive) of 1925. Capt. A. E.

Calder of the Atlantic Biological Station tagged two hundred and seventy-three cod about the outer parts of Halifax harbour and the inner shoals of the Sambro ledges. To date twenty-five tags have been returned or nine percent. Of these two were turned in in 1925 after the fish were tagged, twenty-one in 1926, one in 1927 and one has been returned with no information.

Of the fish tagged in July, three have been recaptured, and all in 1926. The first was recaptured in July, the second in August and the third in September. Of the August tagging two were recaptured in August 1925, one well up in Halifax harbour and the other off Pearl island, mouth of Mahone bay. The other eight were taken in 1926 during June, July, August, September and October. One of the August ones this year was also recaptured to the westward close in to Cape La Have, the others about Sambro ledges and vicinity. Of the September tagging none were recaptured in 1925, ten in 1926 and one in 1927, during the months of January, June, July, August and September. The one October recapture was found aboard a steam trawler and presumably was taken on the offshore banks somewhere. This is the only recapture made out of inshore, Halifax area, waters.

Thus it may be said that of the fish tagged, few moved very far. However, it must be remembered that this tagging was done the last of July, August and the first of September which period is the summer slack cod fishing season of this area as seen in figure 5 and during this time the fishery seems to be made up of what the fishermen call rock cod and "natives". By these terms they mean cod that stay around all year fairly near to shore as opposed to the "school" cod which are thought to move up and down the shore to some extent as well as possibly off and on in the spring and fall.

Now looking over the recaptures month by month, it is concluded that, during June July and August on the whole, these cod remained in close to shore, but that in September they seemed to be in a little deeper water, while in January the one recapture was taken in about the deepest water of any except the one presumably caught on the offshore banks in October. However this January recapture was made only out as far as the Sambro lightship, which indicates that at that time of winter the fish was still fairly close in to shore.

During this past summer considerable hydrographic data was collected and has been worked up by Mr. H. B. Hachey, copies of some of whose charts will be submitted here.

Unfortunately these records were begun late in June, thus no knowledge of the conditions existing before the June maximum in the cod fishery of Halifax county west is on hand. Chart IV shows that in the outer part of Halifax harbour (thirty metres, or about twenty-two fathoms) the bottom water was at a temperature just about 1°C. Going offshore it is seen that the temperature in fifty metres of water was .6°C., in a hundred metres, .8°C. and in one hundred fifty metres, 5.6°C. When some of the isotherms are drawn in with respect to the temperatures in the intermediate depths it is seen that the temperature drops from about 9.5°C. at the surface, to 1°C. somewhere about forty metres. From forty down to about eighty the temperature ranged from about .2° to 1°C. Below this depth, as seen at station number fifty-nine, the temperature increased until it was 5.6°C. in one hundred fifty metres.

Thus it is seen that there is a layer of cold water at an intermediate depth with warmer water above and below it. This cold layer spreads out somewhat, where it is in contact with the bottom as it slopes up towards shore, extending from about a depth of thirty

metres down to a hundred metres. As it goes offshore the layer becomes a little thinner.

Monthly records show that this cold layer (considerably warmer farther offshore, but still colder than the water above or below it) extended at least right out to Sambro bank, some fifty miles offshore, and east and west to the limits of the Halifax area. This state of affairs in general continued throughout the summer, with a slow rise in all the temperatures, however. The greatest changes occurred along shore and are indicated in the weekly charts.

As the summer progressed this cold layer gradually warmed. In chart V it is seen that the upper layer had warmed so that the temperature was then 4.1°C. on the bottom at station number sixty-two as opposed to 1.1°C. on June 27/32. At the same time the cold layer had warmed up so that the 1°C. isotherm as drawn in no longer touched the bottom as it did between stations sixty and sixty-two the last of June. Even the 2°C. isotherms enclosed a layer of water that did not spread over the bottom as much as the 1°C. layer did previously.

In chart VI, September 6/32, the layer of water below 2°C. was still further diminished while the warm surface layer was extended farther out along the bottom to greater depths and the warm deep layer had worked up the slopes into shallow water so that the cold intermediate layer was being pinched up off the bottom inshore and pushed back offshore.

Now; as mentioned previously the cod of this area seem to prefer water with a temperature of about 4°C. (more or less) or lower. Bearing in mind, along with this, the fact that the greater part of the inshore cod fishing is done in water under about fifty metres deep that is, the depth at station number sixty-one, it is seen that up until the end of June apparently all the bottom inshore

water from perhaps a few metres in depth (the ten metre level at station sixty-two showed a temperature of 3.5°C.) out to approximately one hundred and thirty metres or thereabouts, was at a temperature of 4°C. or lower. Besides this, only the water out to thirty metres in depth was above 1°C., except of course the deep warm layer. Thus, if the cod prefer shallow water, between 1° and 4° - 5°C. in temperature in the spring, they must be right in along the shore and out only as far as twenty-five to thirty metres in depth, that is, right in the inshore small gas boat fishing area. This corresponds with the average peak month in this Halifax west fishing season.

However, from then on until September this so-called cold layer of "cod water" retreated offshore and diminished in extent, for, while the 4°C. isotherm of the surface warm layer retreated into deeper water, that in the deep warm layer remained in about the same position. By the first week in September the "cod water" had retreated offshore so that no water below 4° - 5°C. was found inside of about the forty-five to fifty metre contour line. Thus during the summer the suitable cod water was being pushed farther and farther offshore out of the inshore fishing area and no doubt a great many of the cod moveddwith it. However, during July the " "cod water" extended from about the twenty-five metre depth out to about the fifty metre level. During August it extended from about the above levels out to from about forty to the hundred and forty metre line since the water below 1°C. in the intermediate layer had warmed up. Thus, during July and August this year the "cod water" remained over the inshore grounds until well on in August, which may correspond to the large landings.

After the first week of September, gales occurred, lasting for a number of days. These broke in on the slow changes taking place previously. After they were over, investigation revealed the picture shown in chart VII and figure 4. Briefly it may be said that the water, out to between ninety and one hundred metres in depth, was almost thoroughly mixed and of a uniformly high temperature ranging from about 10°C. on the bottom in the extreme depth to 14°C. on the bottom in thirty metres and 15.7°C. along the surface. Along with this, experimental and commercial fishing revealed the fact that there were no cod on the inshore fishing grounds. A commercial set of six hundred hooks in sixty-eight metres of water using a variety of baits only resulted in the taking of one cod. Figure 3 shows the tremendous drop in commercial landings in September.

By October 10/32, chart VIII, the "cod water" and its intermediate real cold layer had worked back closer inshore so that the 2°C. layer touched the bottom about one hundred metres depth and the 5°C. upper isotherm touched bottom in about forty-five metres. Corresponding with this the October landings of cod, figure 3, showed an increase, with the November ones a still greater one. However, we have no temperature data at hand after October 10/32.

Thus it appears that the suitable "cod water" covered the inshore grounds up until well on in August this year. Then it retreated offshore slowly, until assisted by onshore gales as in September, at which time all the cod left the inshore grounds. Later in the fall this layer of apparently suitable water again advanced on shore and good cod fishing was again experienced.

Corresponding to this, the cod landings, figure 3, remained at a very high level during July and August in 1932 as opposed to the average peaks level for the six years previous, which is seen in

figure 5 to have occurred in June. Since we have no hydrographic data to correspond to the above mentioned six year average, we can but suggest what might have occurred during most of these years. During this past summer it was amply demonstrated that warm water on the bottom inshore drove the cod back offshore into deeper water than that fished by the majority of the inshore small gas boats. This year there were no big storms during the summer to pile warm mixed water inshore until about the end of the first week in September. However, even without the storm, the suitable water was gradually being pushed offshore anyway and its effect would no doubt have been seen. Thus during the previous six years this ordinary warming process might have gone on faster or sufficiently large storms may have brought about this year's September state of affairs at a much earlier date, causing the cod to move offshore a month or so earlier, bringing the peak of the fishery in June instead of July and August as this year.

In view of the above hypothesis it will be very interesting to watch the picture develop this coming summer.

Reproduction

In order to assist still further in explaining the various points about the cod fishery of the Halifax area, all the information possible has been secured on the above phase of the life of the cod in this region, and up to the present this has been very meagre indeed.

One reason for this has been the fact that since cod are supposed to spawn in the colder part of the year, few of the fishermen are able to report anything concerning the cod at this time. As seen in figure 5 very few cod are landed in November (Halifax west, excepted) and scarcely any in December (none in Halifax east).

From then on through January and February there are no landings, only a few in (five point seven hundredweight on the average) in March in Lunenburg west, slightly more in April with both sections of Lunenburg county reporting, and in May all the regions show some landings but, with the exception of Halifax west, they are small. It might be thought that these months with zero or very poor landings were so as a result of no cod being present, but it may be said that the two main reasons for it are the bad weather preventing the operation of a large number of the boats and a change of occupation on the part of a great number of the fishermen.

However, some fishing is done and a little information has been forthcoming.

East of Halifax harbour there was only an odd report of anyone having seen a cod with running spawn and these have no doubt been exceptions, for they have been seen during the summer. However, this is a somewhat curious fact about the cod, for a great many fishermen have been heard to say that no matter when or where you make a large haul of cod, there'll always be one or more with "large spawn" in the catch.

About half the fishermen spoken to about Halifax harbour, had never seen cod with running spawn. Others reported cod taken in June and July (large females) with well developed spawn. Some said they had seen the odd cod in March with running "milk". Besides these, a few reported having seen not only cod with spawn almost ripe (so ripe in fact that when touched the extended ovary would burst open) but cod with running spawn in the fall, October and November.

Along the outer coast of Sambro peninsula the only points where any running spawn had ever been seen were at the two extremes,

Ketch Harbour and Peggy Cove. At the former place they reported "cod with very large spawn in October and November, but ripest and running in December, after this only odd fish with spawn and in general the fish are poor, watery and "slinky"! At Peggy Cove they were quite positive that the fall "spurt" of cod spawned in St. Margaret bay, for not only could the spawn be pressed out of them, but those cod caught early in the spring were nothing but skin and bones. However, the last might be the case anyway if they don't feed all winter.

At almost every point about St. Margaret bay the same sort of report was heard. At Boutilier Cove "lots of spawn fish, from October first on, spawn runs under pressure and the middle ground gives the best catches". One of the French Village men said he had never seen spawn running while another said the cod not only had running spawn about October twentieth, but that the May run also had running spawn. And so the reports went about this bay.

In connection with the capture of these fall cod, it should be mentioned that baited hooks are in general not very successful. A report from Halifax harbour said that commercial hand-lining during the middle of November using mussels, fresh herring and mackerel, failed, but that jiggs were very successful. In St. Margaret bay they said that hand-lining on the shoals gave only a few fish and not many of these had spawn anywhere nearly ripe in them. However, gill nets, and trawl (chiefly the former) set in deeper water along the edge of the shoals and off onto the soft surrounding bottom of sand or gravelly mud gave good catches of spawning cod.

Comparing this information with that from other districts and countries, reveals some correspondence and some differences. In respect to the type of bottom preferred for spawning, it has been

found that Ipswich bay, gulf of Maine, composed almost entirely of sand with only odd spots of clay is a great spawning ground and a spawning ground only, for it contains little feed. The feeding grounds in the vicinity of the above mentioned bay are reported to be made up of rocky shoals, sunken ledges and rocky channels.

Now returning to the Halifax area it is found that the two regions where spawning cod were reported, - Halifax harbour and St. Margaret bay - have in general, see chart III, a somewhat similar type of bottom to that noted above. St. Margaret bay has a lot of sand, mud and gravel bottom and the middle ground, mentioned previously in connection with spawning extends in almost a north and south direction near the head of the bay. It varies from seven to twenty fathoms in depth, is rocky along the centre ridge sandy along the slopes and surrounded by mud. In Halifax harbour there are several large islands about the centre and great ridges and shoals of a sandy, gravelly, stony character extend in all directions. In general these are confined to the central and eastern half of the harbour for as seen on chart III, the western side is rocky and fairly precipitous.

Considering the whole area one would think that there should be other suitable spawning grounds. East of Halifax there are many sandy and mud bays, but nothing is known about them since there is apparently no fishing at the right time of year. There are also sand, gravel, mud areas off Halifax harbour in deep water, off the tip of the Sambro ledges, along the series of ridges extending SxE from the Aspotogan peninsula and Mahone bay itself seems worth enquiring about, but as yet either these regions have not been visited or nothing has been found out about them.

Neither has anything been found out in respect to spawning temperatures and salinities up to the present. However, reports from Europe indicate that the cod spawn at a much later date, April to June, in their northern waters and in water with a very low temperature, that is, below 2°C. onthe bottom. Even in the bay of Fundy present knowledge seems to indicate little spawning before March.

A little definite data collected from Halifax harbour shows that almost throughout the year the female cod are slightly in advance of the males in respect to sexual maturity. Besides this, it appears that there's a little evidence which indicates that the males become sexually mature at a younger age than the females. In the fall of 1932 a reliable observer reported that during the whole of November spawn and milt ran from the cod caught commercially in the outer part of Halifax harbour.

Now while St. Margaret bay and Halifax harbour may be good spawning grounds and the nearby Sambro ledges certainly seem to be good feeding grounds, still this does not necessarily mean that there will be lots of young cod raised here from the eggs laid in the area. Since cod eggs float in the upper layers of the water, they may be carried most anywhere by currents. Up to the present Mr. Hachey hasn't all the various currents of the area worked out, but enough has been done to show that there are quite a number and they do not go in the same direction continuously. Besides this, there are the fishermen's reports of a pronounced westward "set" to the currents a few miles offshore, of many currents over Sambro ledges and of a very definite current sometimes going out of Halifax harbour. Nothing is known of St. Margaret bay.

Thus it seems that it would be quite possible for the eggs laid in Halifax harbour to be carried out and then to the westward

a considerable distance before the young fish become large enough to resist the current. Whether the same thing might occur in St. Margaret bay is not known, for no reports have been received mentioning any pronounced outward current.

One way of obtaining some light along this line is to find out the abundance and distribution of young cod. From Halifax eastward, according to the reports, the small cod increase in abundance until at West Jeddore they reported that "in the spring (June) sometimes there are lots of two to five inch cod both in and offshore while in July and August lots of eight to ten inch cod are caught". About Ketch Harbour they reported that there were lots of three to four inch cod about the wharves in June and still greater numbers of them out around the sand bars at the mouth of the harbour among the eel grass and shrimps. Jumping, as before, to Peggy Cove they said that there were lots of four inch cod around in the cove in May and June. Taking St. Margaret bay as a whole, the reports seemed to indicate that young cod were to be found almost all over the bay, except out near the mouth on the west side, in small numbers, never in schools or in quantities which the fishermen thought to be at all comparable to the amount of spawning occurring in the fall.

Thus it seems that some cod are raised in the eastern section of the area, but whether from spawning there or still farther eastward is not known. Those at Ketch Harbour might possibly be from the Halifax harbour spawning, since no young cod were reported about the harbour. Taking the St. Margaret bay reports as is one would think that either there is not as much spawning there as they believe there is or that the hatching and survival percentage is very low or that the eggs are carried out of the bay.

Thus, from the above and previous chapters it may be concluded that there are sufficient cod raised in the area to account for at least some of the fishery and that the large cod comprising the fishery belong inshore, - at least to the extent of the numbers raised inshore - and do not move very far away from this particular inshore area.

Summary

The Halifax area has been defined as that part of the outer coast of Nova Scotia lying between Lunenburg and Ship Harbour. Halifax is situated about the centre of it. To the westward there are two large bays and a large peninsula extending out beyond the regular line of the coast all within the distance of about forty miles between Halifax and Lunenburg. Between Halifax and Ship Harbour to the eastward about the same distance the coast line is fairly straight and broken by numerous small inlets only.

Economically this is Canada's second most important fishery. Halifax and Lunenburg counties, - the two bordering this area - are two of the three by far the most important districts for the landing of cod on the whole Atlantic coast of Canada. However, at the present time only the inshore fishery is under investigation and this only makes up a small part of the total, for the inshore fishery of the two counties, together with the offshore fishery of Halifax county (these three are all about equal) is only equal to about one-quarter to one-third of the Lunenburg county offshore fishery. In the Halifax area this fishery ranks first.

Considering the whole cod fishery of the Atlantic coast of America it appears that generally speaking it has held about the same average level over long periods, while the Canadian cod catch has been going down irregularly and slowly over the period 1880 to

1926. In the bay of Fundy the landings increased greatly from 1872 to 1887 (the peak of this fishery), dropped to their 1872 level by 1890 and from then to 1930 they too, decreased irregularly to about one-third of the 1872 landings by 1930. The landings in the Halifax area have not followed the trend of the bay of Fundy at all closely, but their graph shows a great deal of similarity to that for Canada as a whole.

The Lunenburg county landings parallel the total very closely while the Halifax county landings only do so up to 1875. From then until 1906 they were very very low, but their small irregularities do check with the other curve to some extent. Between 1906 and 1931 they remained fairly regular until about 1923 from which date on they increased irregularly as compared to the great drop in the Lunenburg landings between 1926 and 1931. This drop can be blamed on market conditions, although during the last few years there has been some reports to the effect that cod are becoming scarcer. However, whether due to market conditions or scarcity of fish, the fishery is not at any lower level than it has been at some other times and it always recovered afterwards.

Considering the distribution of the landings in the Halifax area it is found that there are more landings about the outer part of the Sambro peninsula than any other district in the area. East of Halifax the landings are fairly well distributed, being slightly less, nearer Halifax, and distinctly less than about Sambro peninsula. West of this peninsula the landings drop off, most of the fish inshore being caught about the mouth of St. Margaret bay and the outer tip of the Aspotogan peninsula. At the head of St. Margaret bay, in Mahone bay and Lunenburg county west, the landings are the least in about the whole area.

When the inshore landings of 1928 and 1929 (averaged) are divided by the average number of fishermen per statistical division it is found that the outer part of the Aspotogan peninsula, the two easterly divisions of the Sambro peninsula and the eastern extremity of the area compare very well in respect to this catch per man per year. The second group of districts, having one-half to three-fifths as large a catch per man as the first group, comprises the islands about the outer Aspotogan peninsula, the south western section of the Sambro peninsula and the Halifax to Jeddore region. As before Mahone and St. Margaret bay show poor landings. Thus the varying amounts of total landings in the different districts of the area correspond fairly well with the number of fishermen in each district, except in Mahone and St. Margaret bay where the fishermen are otherwise occupied than in cod fishing during part of their time at least and some of them never fish for cod. This condition may be said to rarely occur anywhere else in the Halifax area.

As to why there are more fishermen in certain parts than others it may be said that east of Halifax many of the total pupulation within a number of miles of the coast are occupied otherwise than in fishing, while along the outer part of Sambro peninsula all the population is located along the shore since the country is too rocky to do anything else but fish. Not only is the above true but many of the eastern section fishermen are not full time fishermen while those about Sambro are. If their time was not divided no doubt their cod landings would increase. The same may apply to the south west section of Sambro as well as the Tancook island district. That the Sambro area can and does support more fishermen than any other district may be due to having more, bigger and better grounds or to incomplete development of the fishery resources in the other districts.

About Newfoundland the food of the cod consists in the main of fish. Caplin, Sand launce and herring being thought to be the great growth promoters. Of course other things are eaten and in certain small districts at certain seasons things other than the above make up the chief articles of the diet. In contrast to this the cod of the gulf of Maine consume great varieties and quantities of invertebrates with molluscs being probably the largest item. As in Newfoundland many other things are eaten, and many things are common to both localities. In the Halifax area twenty-three percent of the cod stomachs were empty during this summer season. In the others fish (Sebastes marinus L. almost exclusively) formed the biggest single item, varying from fifty to sixty percent by wet weight along the open coast to thirty percent in deep, sheltered basins. Crabs are next most important in the open waters making up about thirty percent with shrimps third, five to ten percent. As you proceed inshore and up into the secluded basins shrimps stand second,- twenty-five percent of the diet. The remainder is made up of small amounts of many items. In this respect it was found that there were about twice as many items in the diet of the cod in this latter district as compared to the diet of the cod in open waters. In contrast to the above findings the fishermen claim that the herring is a big item in the food of the cod.

From fishermen's reports of various regions, experimental fishing data and published reports it appears that cod frequent hard bottoms mostly and if anything they prefer a still harder bottom than haddock. In the Halifax area experimental fishing together with the fishermen's reports indicate that here too, the cod are caught chiefly on hard bottoms, consisting of rock and stones, in the main, in the formation of shoals, cliffs and ledges. Thus, considering

this together with their food here, it appears that cod seek hard bottom areas and live on what they find there, not the opposite.

Upon considering the geology of the shore, the bottom sampling and the fishermen's reports on the number, distribution and character of their fishing grounds, it is found that the greatest landings per man are made where the bottom is rocky and in the form of shoals, cliffs and ledges. Along with this, it has been found that where such grounds are most abundant, there, the greatest total landings are made.

Thus, the Devonian granite formation extending southeast from the interior comprises the whole Sambro peninsula and extending out to sea in this same direction, but in a tapering fashion, forms the Sambro ledges, which region is the best and biggest collection of fishing grounds in the Halifax area. East of this the bottom is fairly hard but in general flat until near the eastern extremity of the area. The cod landings vary with this change. The two large bays in the western half of the area have in general soft bottoms and the poorest cod fishing.

In respect to the temperature of the water the reports of experimental fishing in the Halifax area during the last few years show that fair catches are made in water of -.5°C. to 2.0°C. along with some good catches. The same may be said of the 5.0°C. to 9.0°C. range with the odd good catches chiefly near the lower limit and poor if any catches at the upper limit. In both the above ranges of temperature blank catches, so far as cod go, are frequently made. However, between 2° and 5°C. good and fairly regular catches of cod are obtained with 3° - 4°C. seeming to be the best temperatures. About Labrador they find no cod below 1°C. and obtain good catches about 3.0°C. On the banks off Newfoundland, the French report that

cod are scarce from -2° to 1.5°C., sporadic from 1.5° to 3°C., very abundant from 3° to 5°C., less numerous 5° to 7°C., and disappear above 8° to 9°C. generally. In the inshore Halifax area our data seem to show a tending toward slightly lower temperatures at certain times and higher at other times than either of the above mentioned regions. Young cod of the Halifax area can live, eat heartily and thrive at 18° - 20°C. However, the flooding of inshore grounds out to about a hundred metres in depth with water of temperature 10° - 16°C. in September caused all the commercial cod to retreat beyond this depth. This warm water was gradually disappearing by the middle of October and the cod were returning slowly.

Generally speaking the inshore waters seem suitable for cod in respect to temperature up until summer. From then on, the warmer surface layer works down deeper towards the deep warm layer. Storms speed this up with the result that the inshore waters border on being too warm and sometimes are decidedly too warm for cod. The 1922 records from Mahone and St. Margaret bays indicate that at least during that summer the deeper parts of these bays did not become too warm for cod.

While trawling decidedly out-numbers hand-lining in the bay of Fundy, it is the reverse in the Halifax area, inshore. Besides that, those that do trawl only use two to four tubs of gear as compared to six to twelve in Fundy. Both these differences are due to the small size of the shoals and fishing grounds in this area, for a hand-liner can concentrate his efforts on one small area while more than several tubs of trawl will extend out onto the soft bottom around the shoal which is poor bottom for cod.

The general westward set to the currents a few miles offshore does not as a rule hinder fishing except late in the summer when the currents become too strong to allow the hooks to reach bottom in some districts.

Irrespective of tidal phase fishing usually begins about dawn and continues until well on in the morning. The afternoon (early) and evening "spurts" of good fishing are not taken advantage of to any extent.

To a great extent the beginning of the cod fishing season in the spring is dependent upon the arrival of herring for bait. Winter and early spring fishing is carried on by using clams, mussels and some frozen baits. To some extent clams are used in the summer to counteract the dogfish nuisance. Mackerel, squid, clams and mussels are used as alternatives during the summer and fall if herring become scarce. Scarcity of bait might be overcome by trying all available kinds of shellfish, and lampreys, as well as changing their type of gear and trying out jiggs more extensively or gill nets. Holding cod in salt water tanks is throwing some light on their feeding habits.

Averaging the monthly landings for a recent period of seven years shows that Halifax county west is the only section with two peaks in a year, i.e. June and November, while all the other four sections show only a pronounced summer peak. Halifax west is also the only one that does not show a period of no landings at all during the late fall and winter season. The fall peak in Halifax west is produced by a run of big fish onto the Sambro peninsula including St. Margaret bay and Halifax harbour. The progression of the peaks in the fishery in the various sections together with the fishermen's reports indicate a westward movement in the fall and an eastward movement in the spring some few miles offshore chiefly, together with an onshore movement in the spring and off in the fall and winter. However, they may also move off in the summer and on again in the fall. The above mentioned on and off movements are carried out by the so-called rock cod or "natives" chiefly, while there seems to be a movement from fairly close inshore, off, in the early spring of large

fish which make up the fishery for the small schooners. These seem to move in again late in the summer or early fall and together with possibly the few big fish in the "natives", make up the "spurt" in the late fall about November. They seem to back off again somewhat and remain more or less close inshore all winter. The above seems to be borne out by the fact that the size of the cod caught close inshore during the summer decreases until the fall "spurt", at which time the average sizes takes a big jump upwards.

Hydrographic data collected and worked up by Mr. H. B. Hachey throws some light on the causes of some of the off and on-shore movements. A colder intermediate body of water was found at about fifty metres depth, touching the bottom inshore at about this depth and extending offshore above a warm deeper layer. During the summer this upper, surface layer gradually warmed to a deeper and deeper level while the cold intermediate layer diminished and re-treated back offshore. This cool and cold intermediate layer touching bottom in along shore produces suitable temperatures for cod. As it moves, they seem to also, for, when it was suddenly pushed back offshore to a hundred metres depth in September the cod went too. Up until that time there had been good fishing, July and August being the peak months in 1932 as opposed to June on the average. However looking back over the individual years in the average, much irregularity in the location of the yearly peak is found, seeming to indicate greatly varying conditions from year to year.

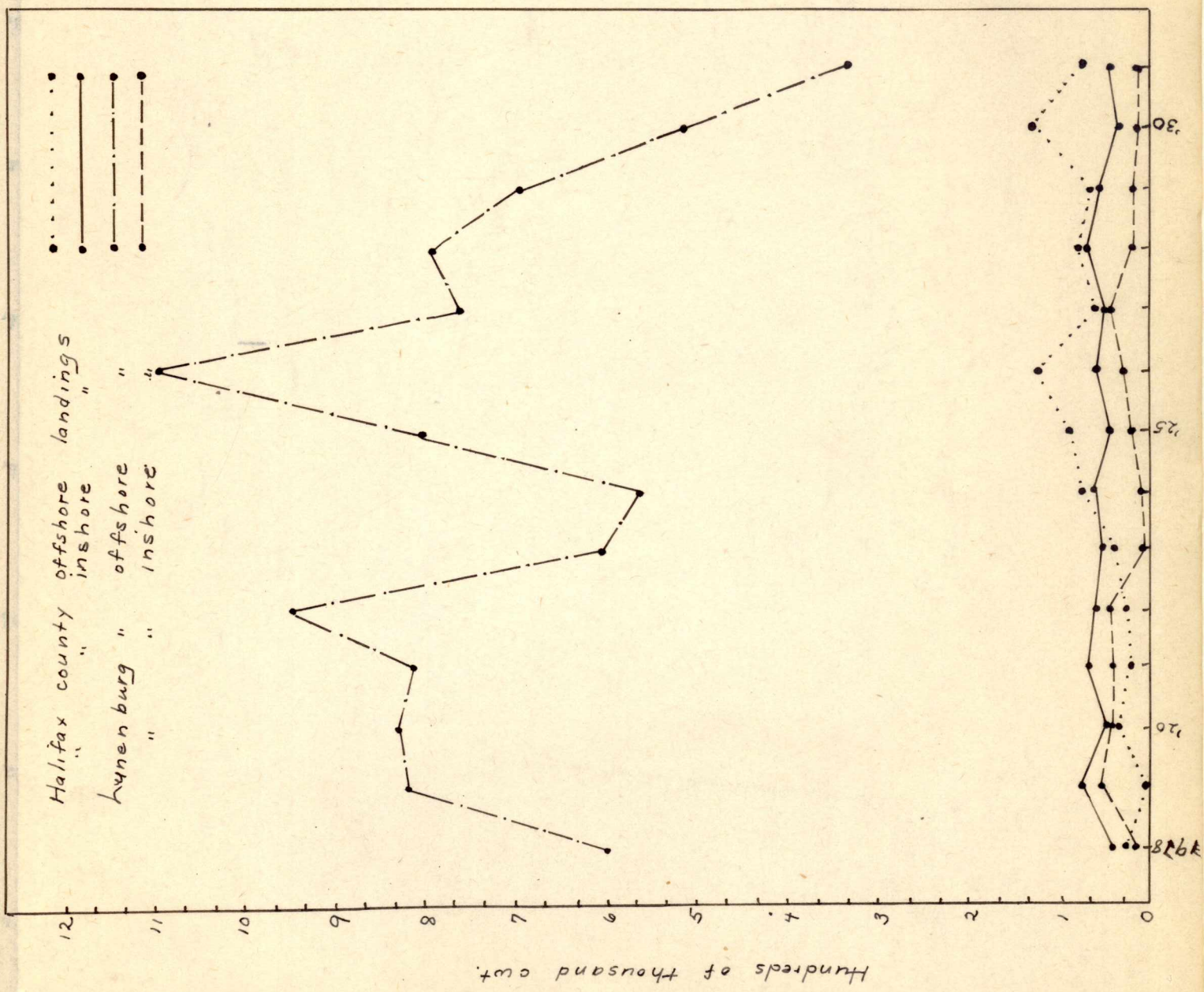
East of Halifax they fish little if any after the beginning of November so they do not know and could report little about cod spawning. However, fish with running spawn were reported to be in and about Halifax harbour as well as St. Margaret bay in late October and November. These fish are caught with jiggs and gill nets

as successfully or more so than with baited hooks. Some slight information seems to indicate that while the males become sexually mature at a younger age, the females throughout the year seem to be slightly in advance in respect to the yearly maturing of the reproductive products. Some cod seem to be reared in the eastern extremity of the region, some about the outer western limits of Halifax harbour and a few about St. Margaret bay with the greatest numbers being seen about the mouth of the bay.

Thus some cod are reared in the area but whether enough to maintain the fishery or not, is not known. The small amount of tagging indicates that there is little inter-mingling between the cod on the offshore banks and the inshore waters.

April 7/33. R. A. McKenzie.

Fig. 1. - Cod landings during the period 1918-'31 inclusive.



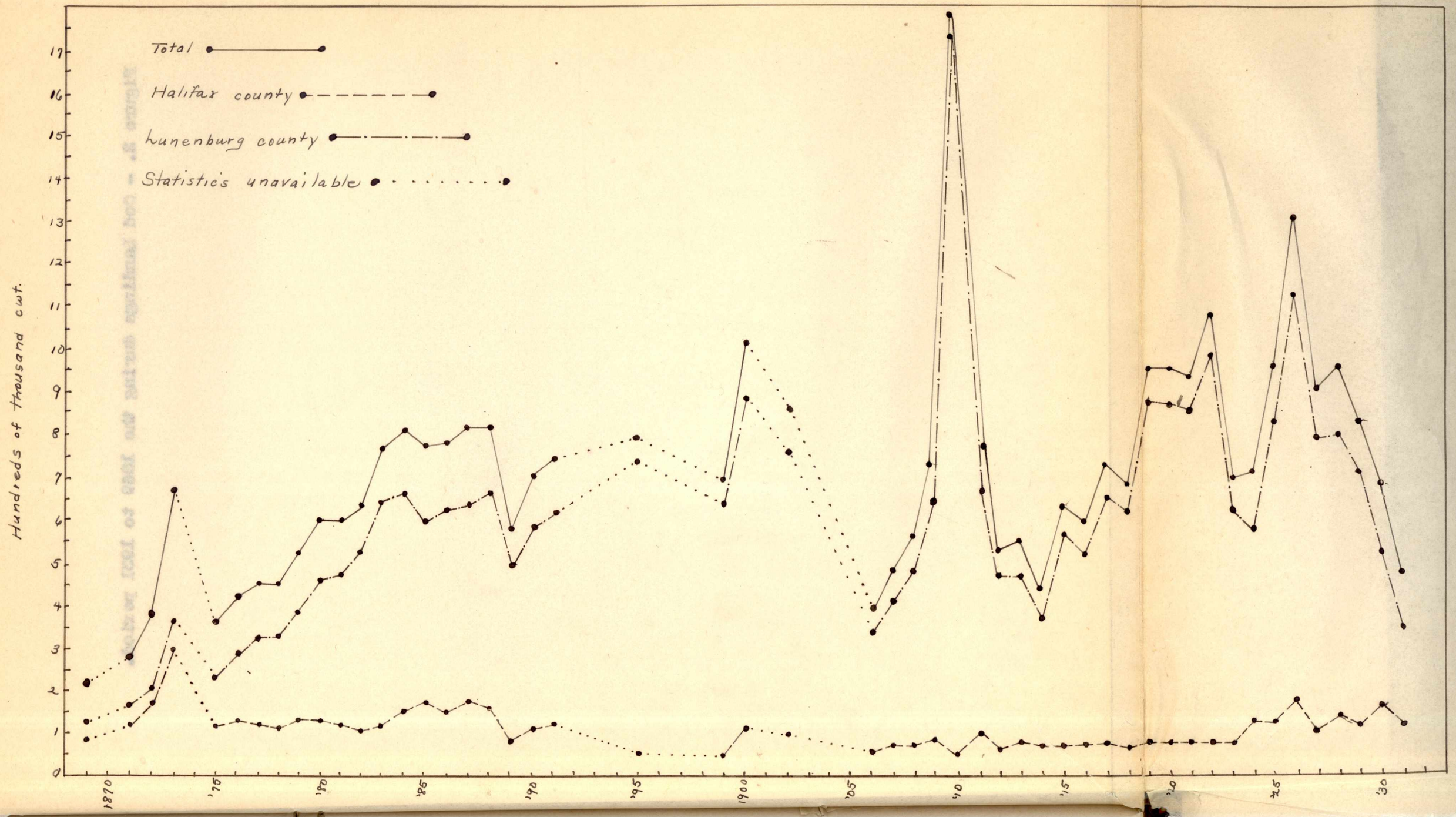

Total
Halifax county
Lunenburg county
Statistics unavailable
Hundreds of thousand cwt.
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
1870
'75
'80
'85
'90
'95
1900
'05
'10
'15
'20
'25
'30

Figure 3. - Monthly inshore cod landings in Halifax county during 1932.

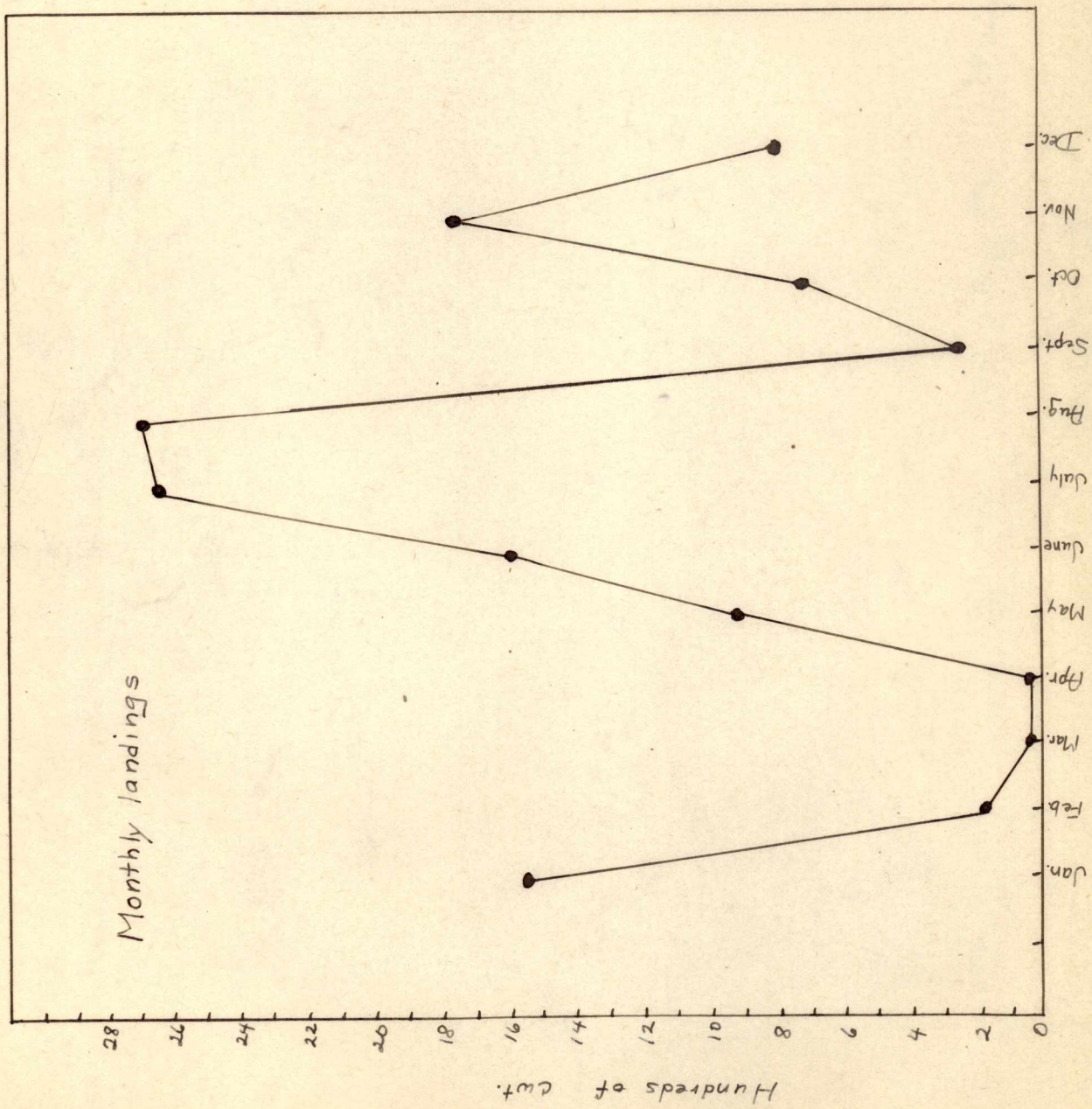


Figure 4. - Shows the bottom temperatures, during the 1932 summers investigations, of a line of stations extending off Halifax harbour about twenty-five miles.

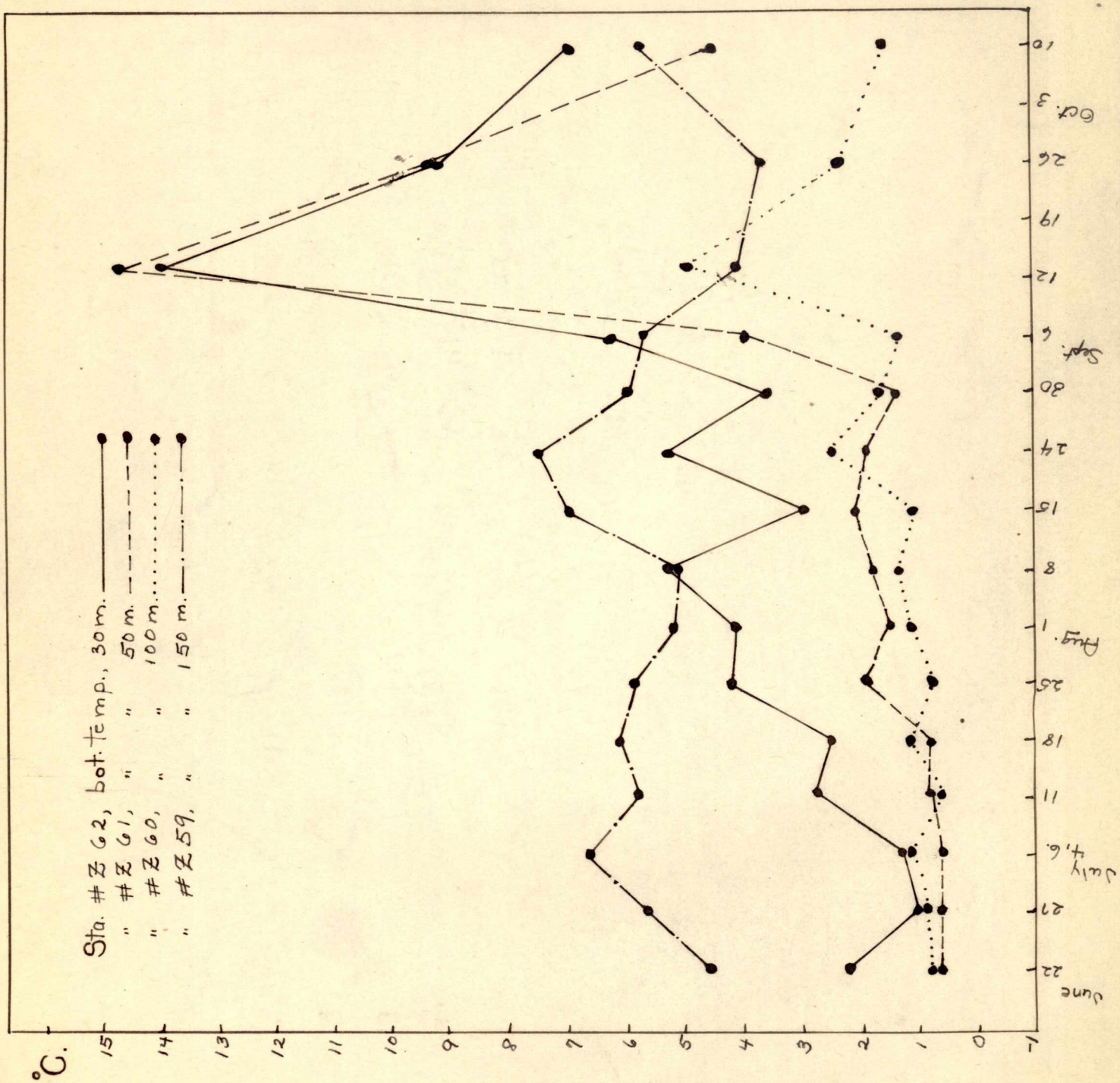
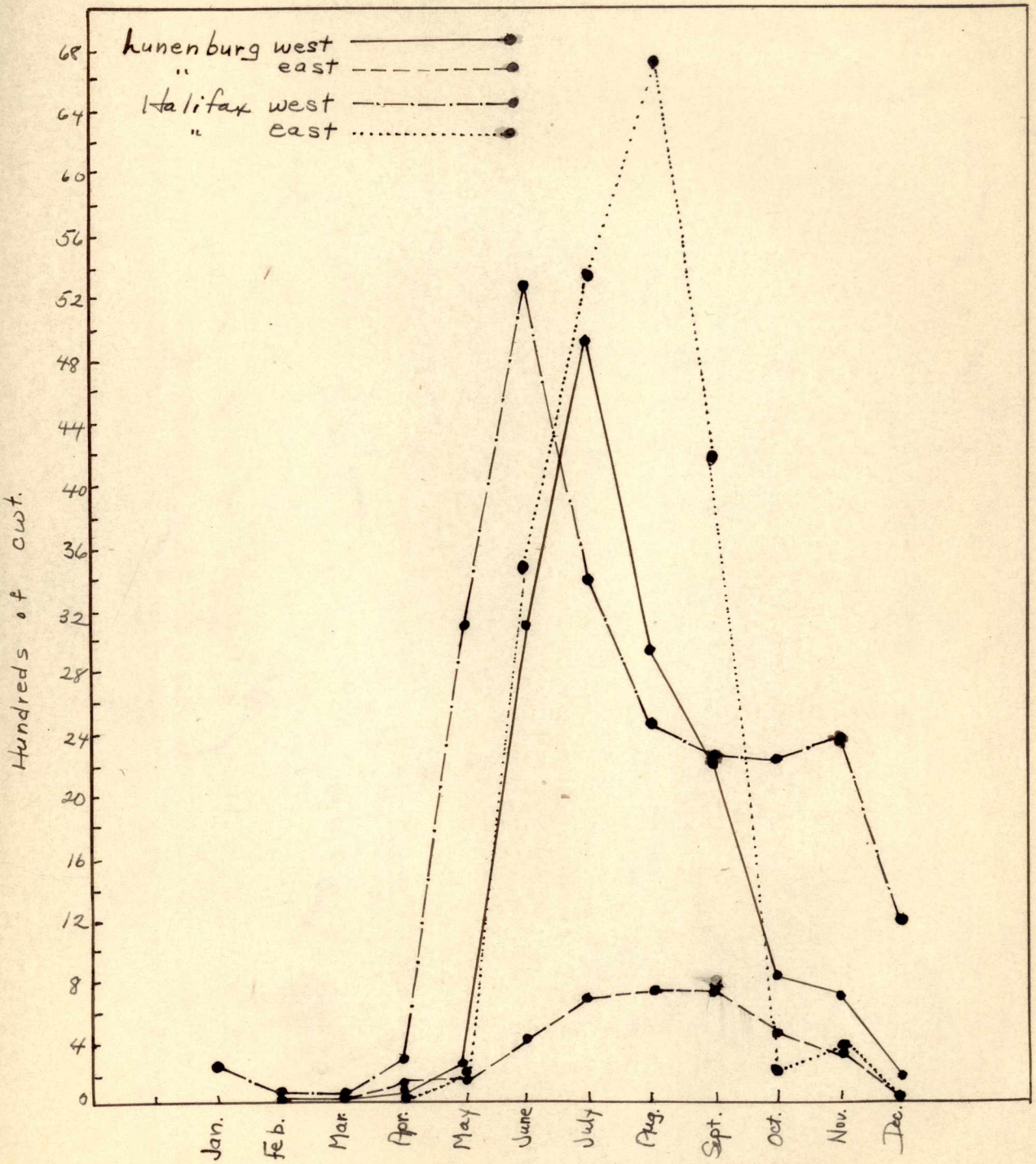


Figure 5. - Average inshore monthly landings for 1925-31 (inclus.) in Halifax and Lunenburg counties.



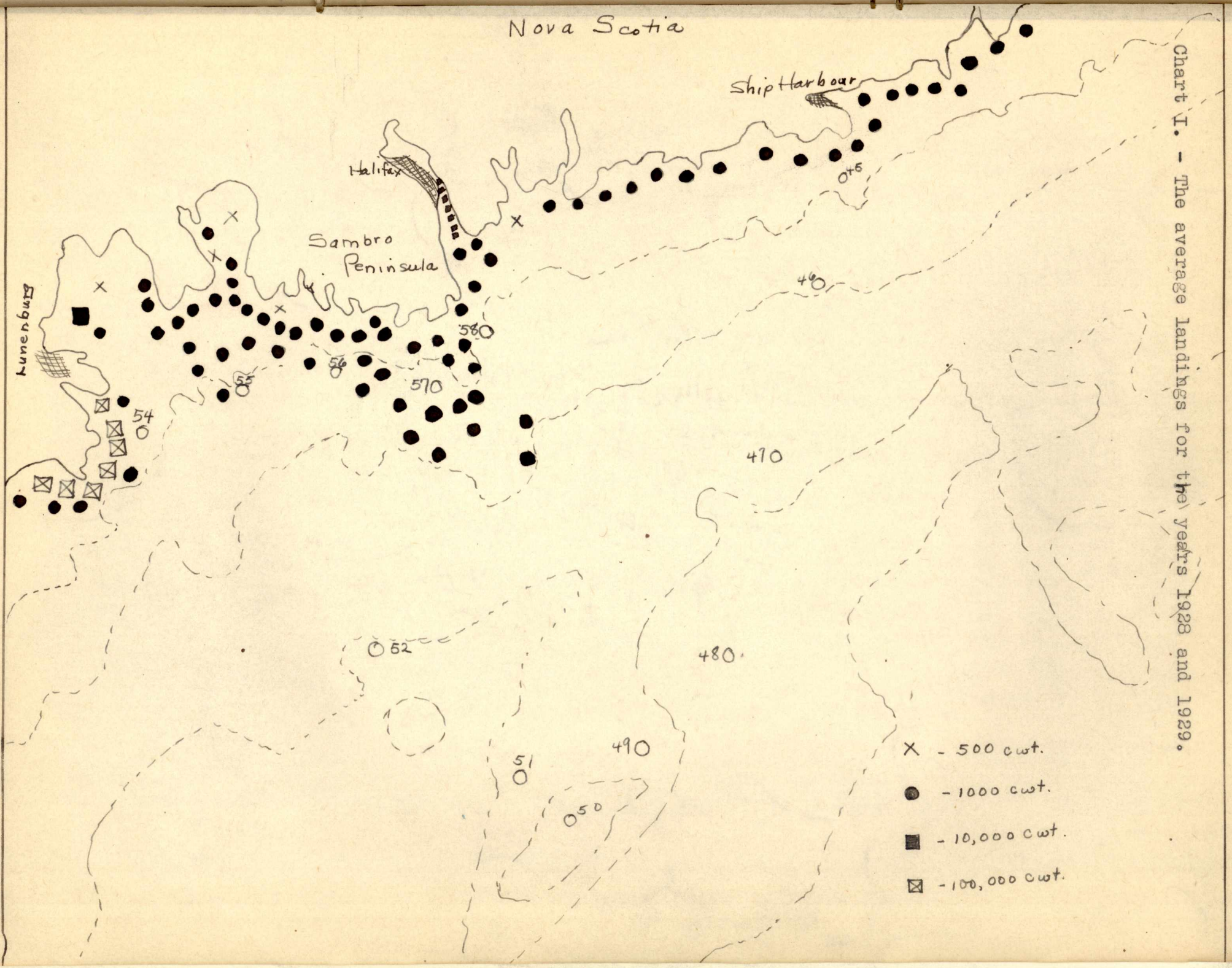
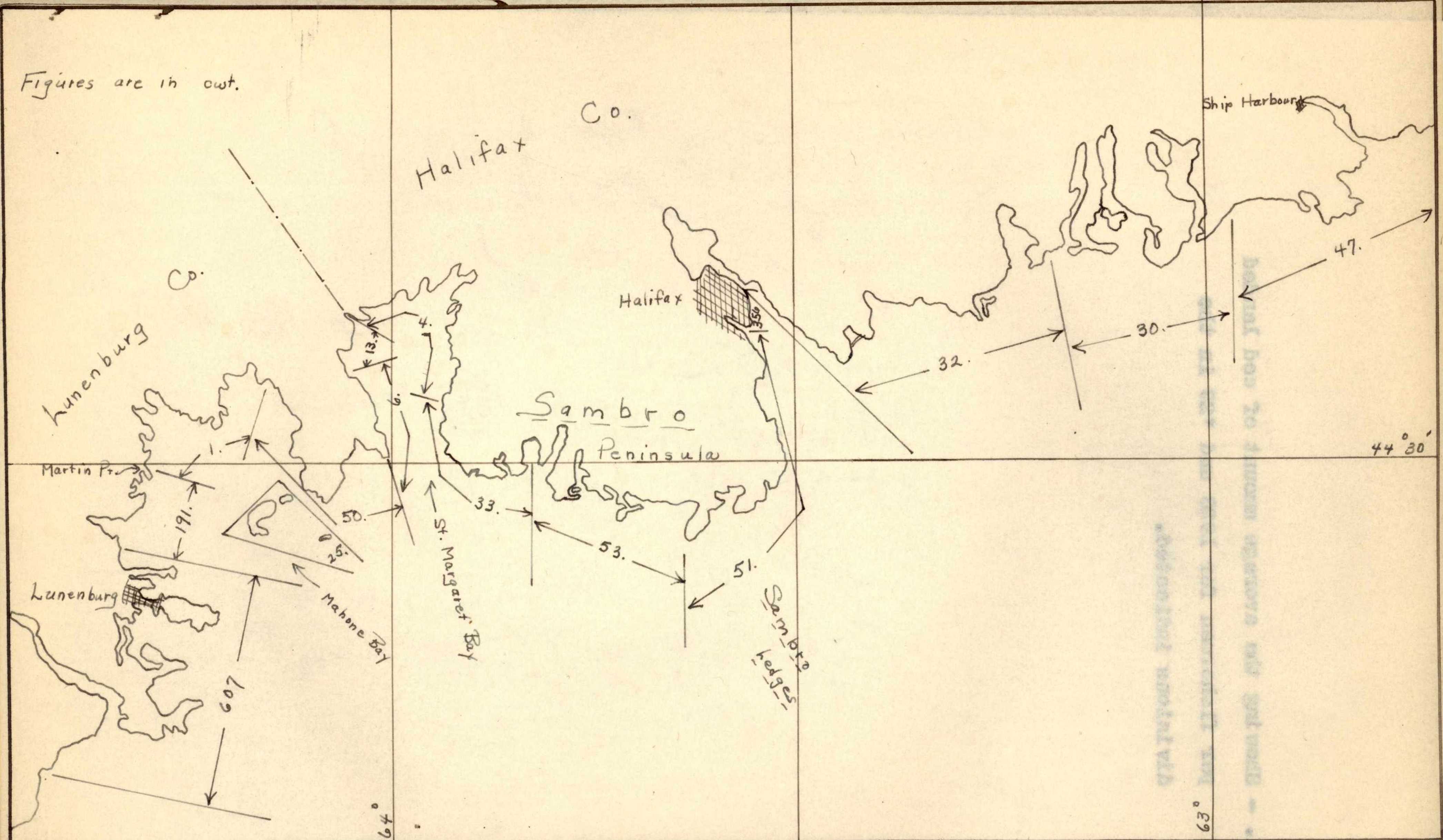
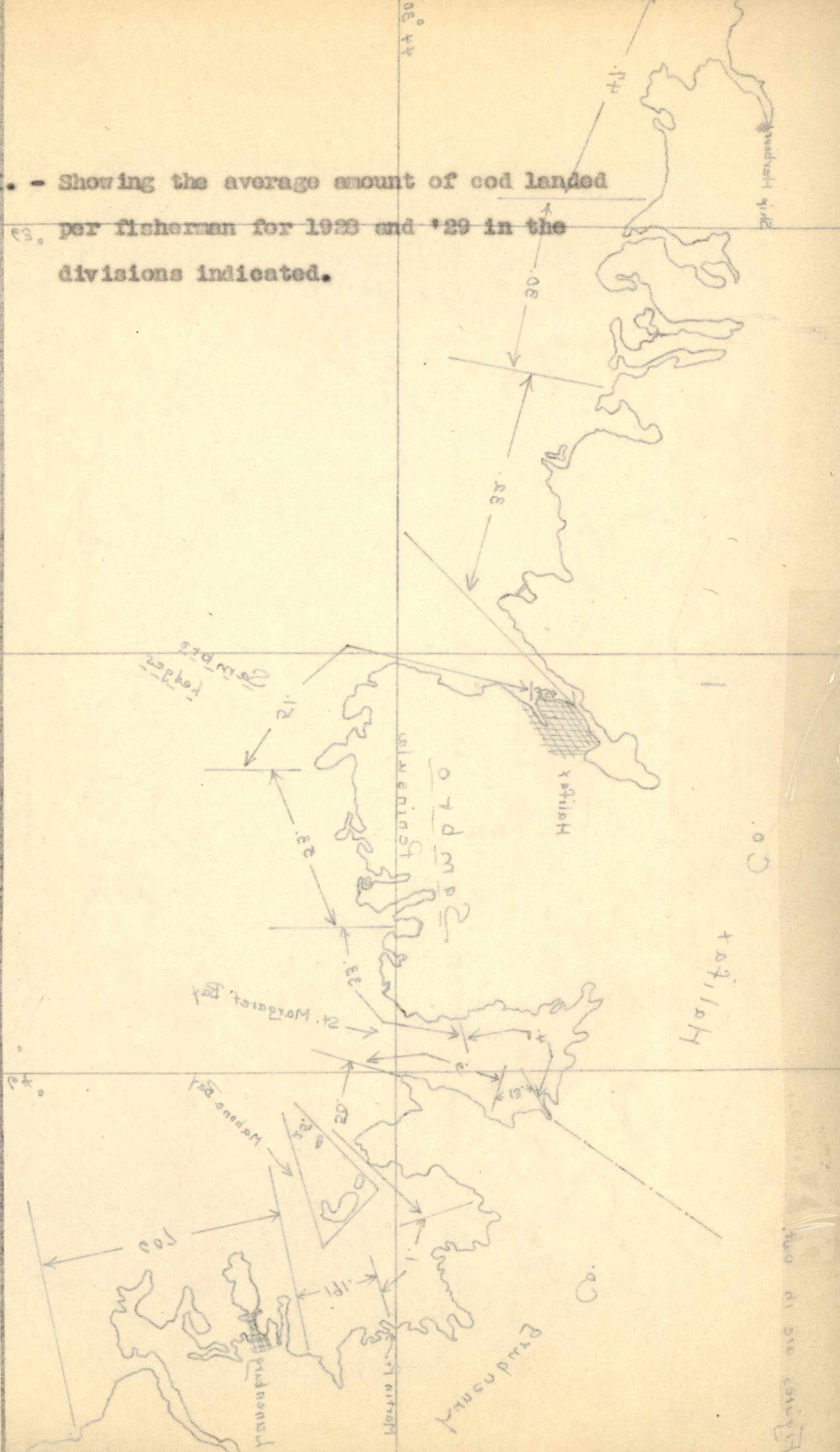


Chart I. - The average landings for the years 1928 and 1929.



Figures are in cwt.
Halifax
Co.
Lunenburg
Co.
Ship Harbour
Halifax
Sambro
Peninsula
Martin Pt.
Lunenburg
Mahone Bay
St. Margaret's Bay
Sambro Ledges
44°30'
64°
63°
4.
13.
6.
1.
191.
25.
50.
33.
53.
51.
32.
30.
47.
607

Chart II. - Showing the average amount of cod landed per fisherman for 1928 and '29 in the divisions indicated.



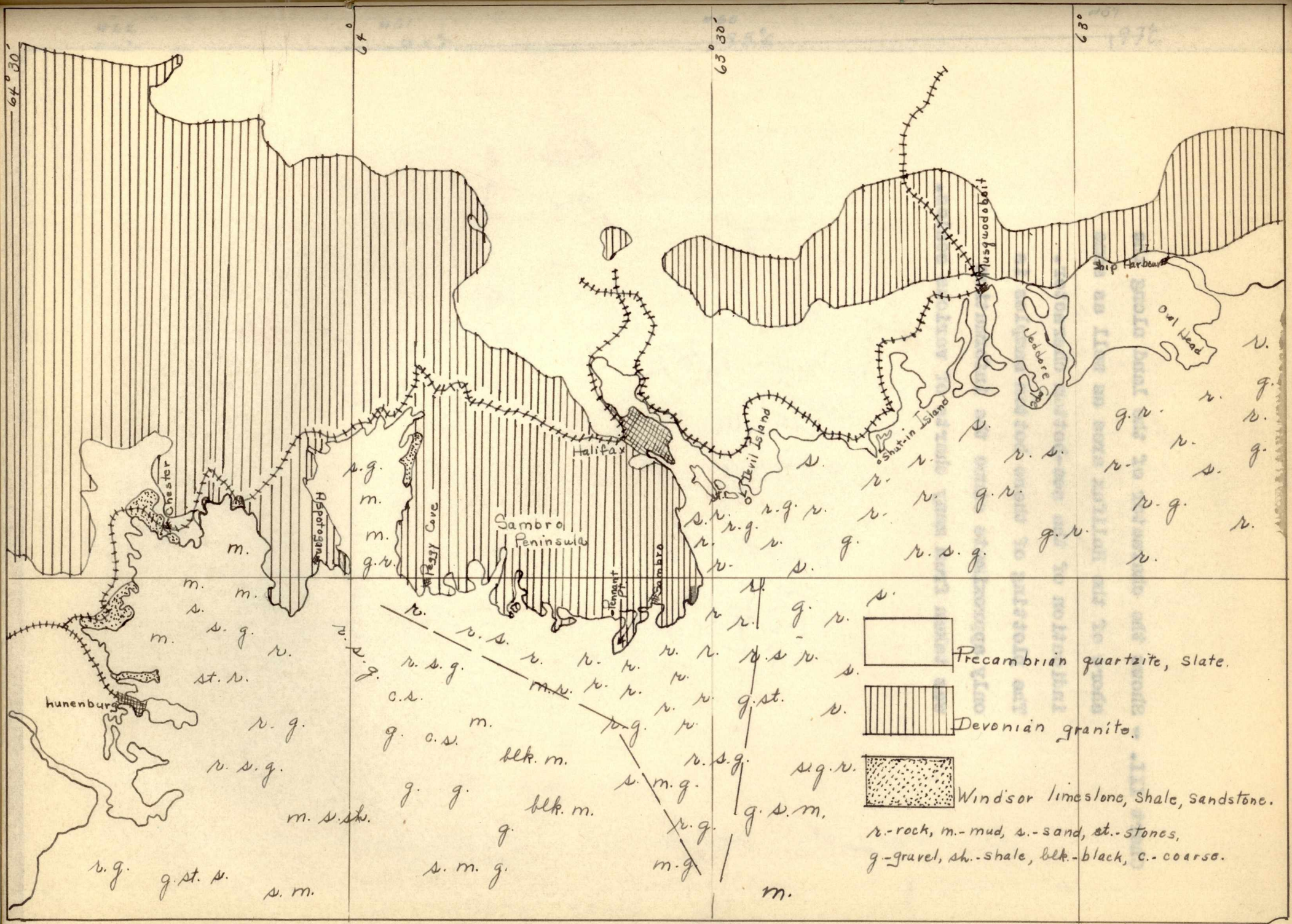

64° 30'
64°
63° 30'
63°
Chester
Aspotogan
Peggy Cove
Halifax
Sambro Peninsula
Sambro
Devil Island
Shut-in Island
Musquodoboit
Ship Harbour
Owl Head
Jeddore
hunenburg
Precambrian quartzite, slate.
Devonian granite.
Windsor limestone, shale, sandstone.
r.-rock, m.-mud, s.-sand, st.-stones,
g.-gravel, sh.-shale, blk.-black, c.-coarse.

Chart III. - Shows the character of the land along the shore of the Halifax area as well as some indication of the sea-bottom character. The plotting of these bottom samples is only approximate since the information was taken from many charts of various scales.

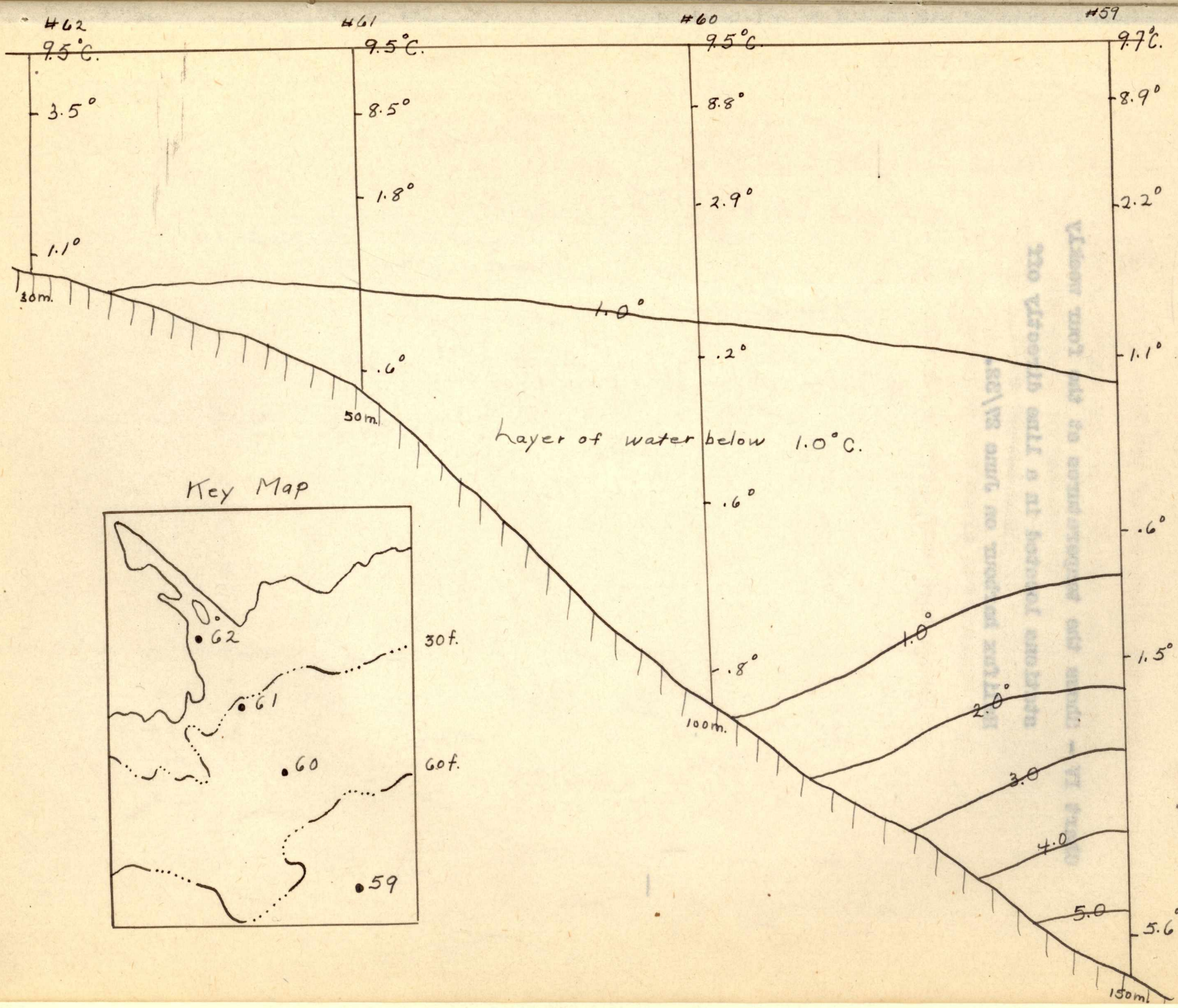
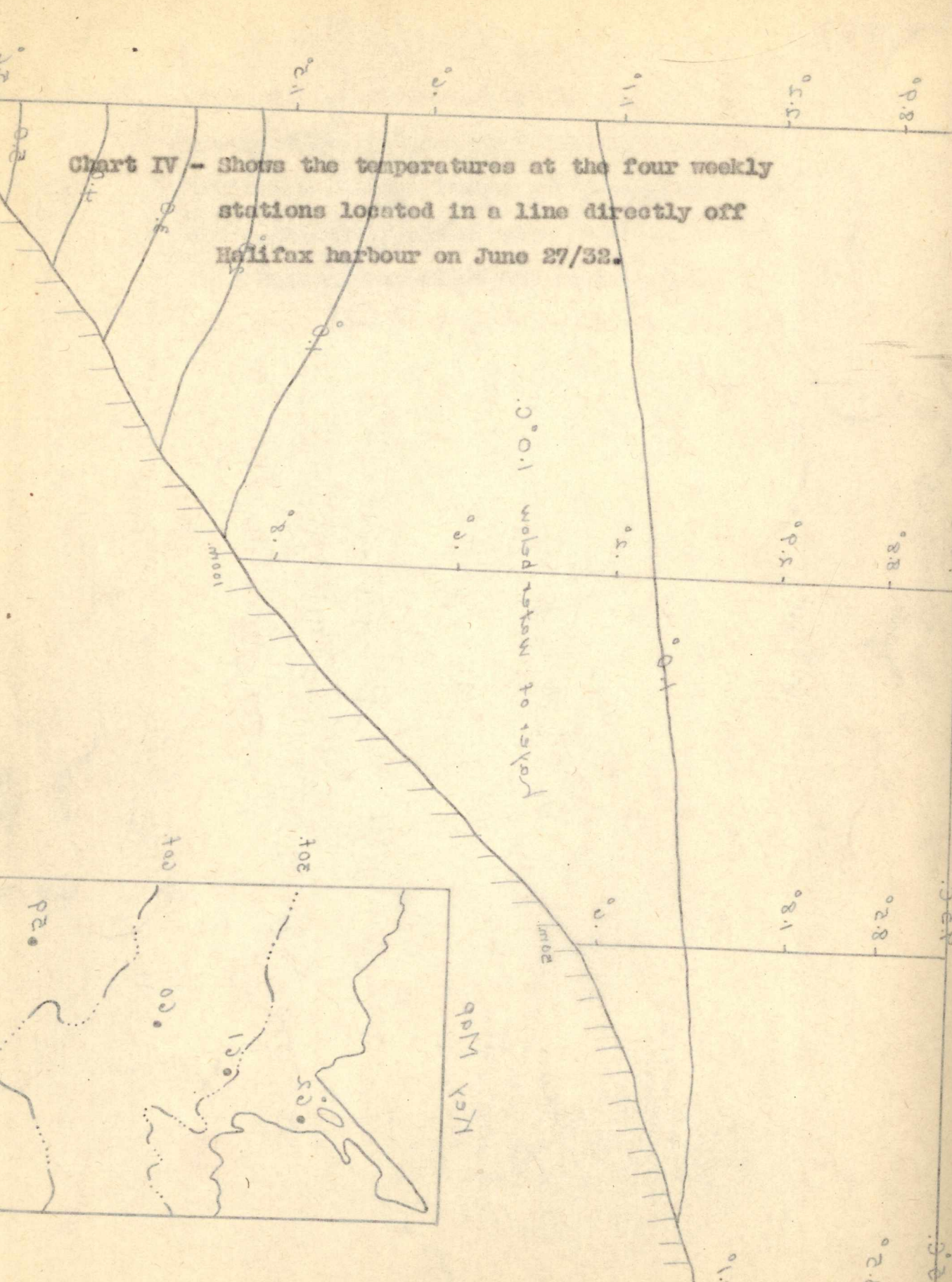

#62
9.5°C.
3.5°
1.1°
30m.
#61
9.5°C.
8.5°
1.8°
.6°
50m.
#60
9.5°C.
8.8°
2.9°
1.0°
.2°
.6°
.8°
100m.
#59
9.7°C.
8.9°
2.2°
1.1°
.6°
1.0°
2.0°
3.0°
4.0°
5.0°
1.5°
5.6°
150m.
layer of water below 1.0°C.
Key Map
62
61
60
59
30f.
60f.

Chart IV - Shows the temperatures at the four weekly stations located in a line directly off Halifax harbour on June 27/32.



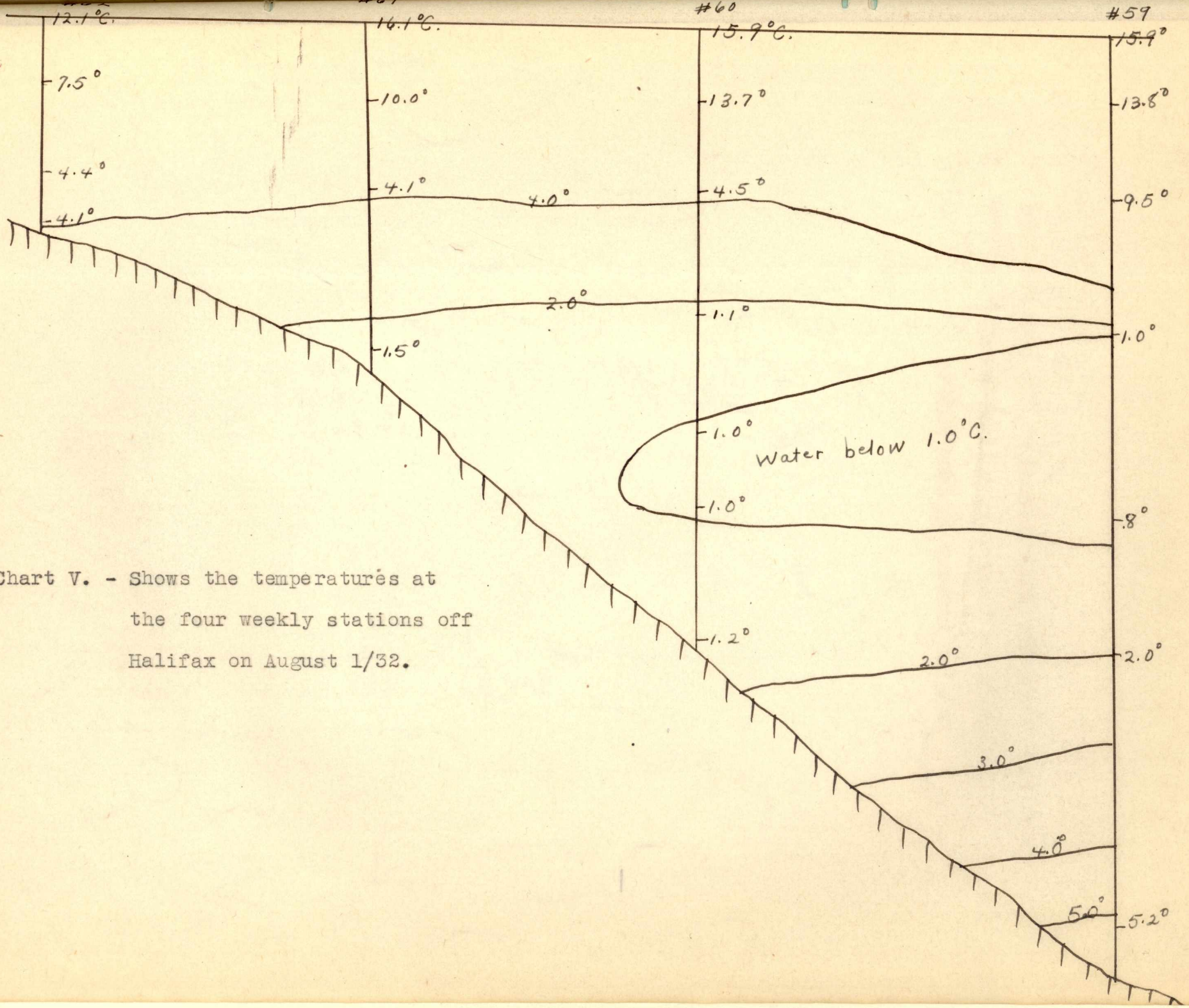


Chart V. - Shows the temperatures at the four weekly stations off Halifax on August 1/32.

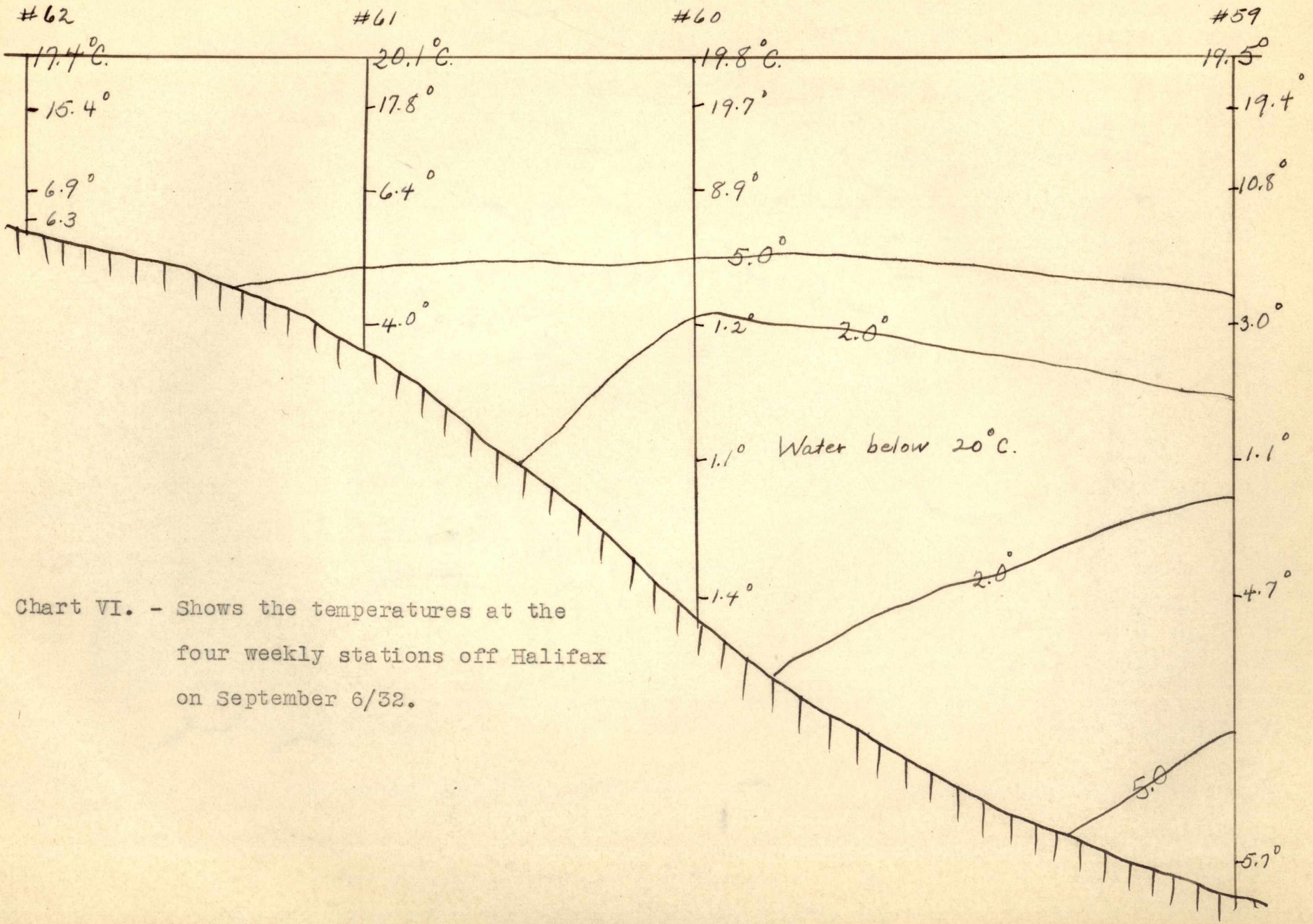


Chart VI. - Shows the temperatures at the four weekly stations off Halifax on September 6/32.

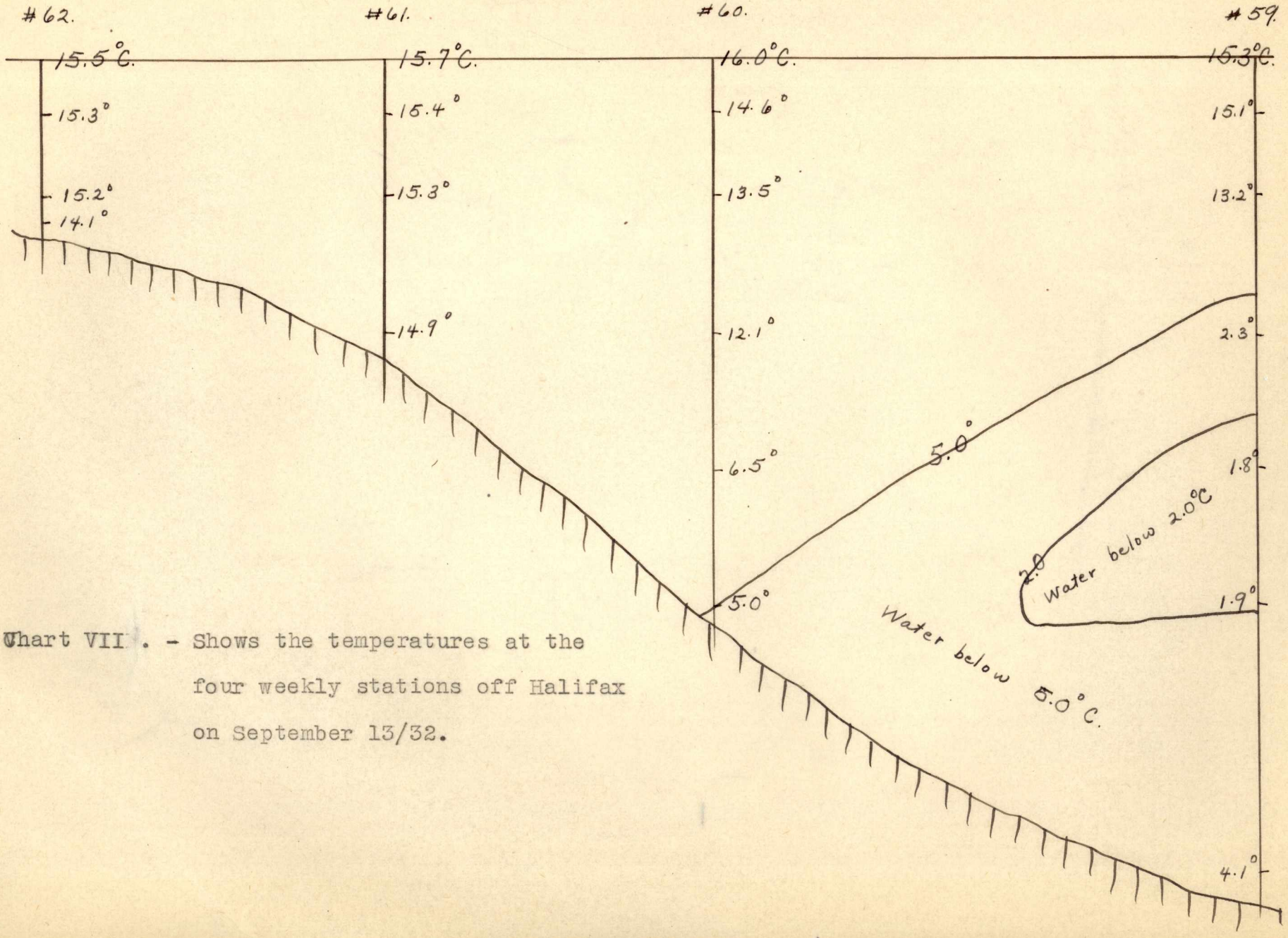


Chart VII. - Shows the temperatures at the four weekly stations off Halifax on September 13/32.

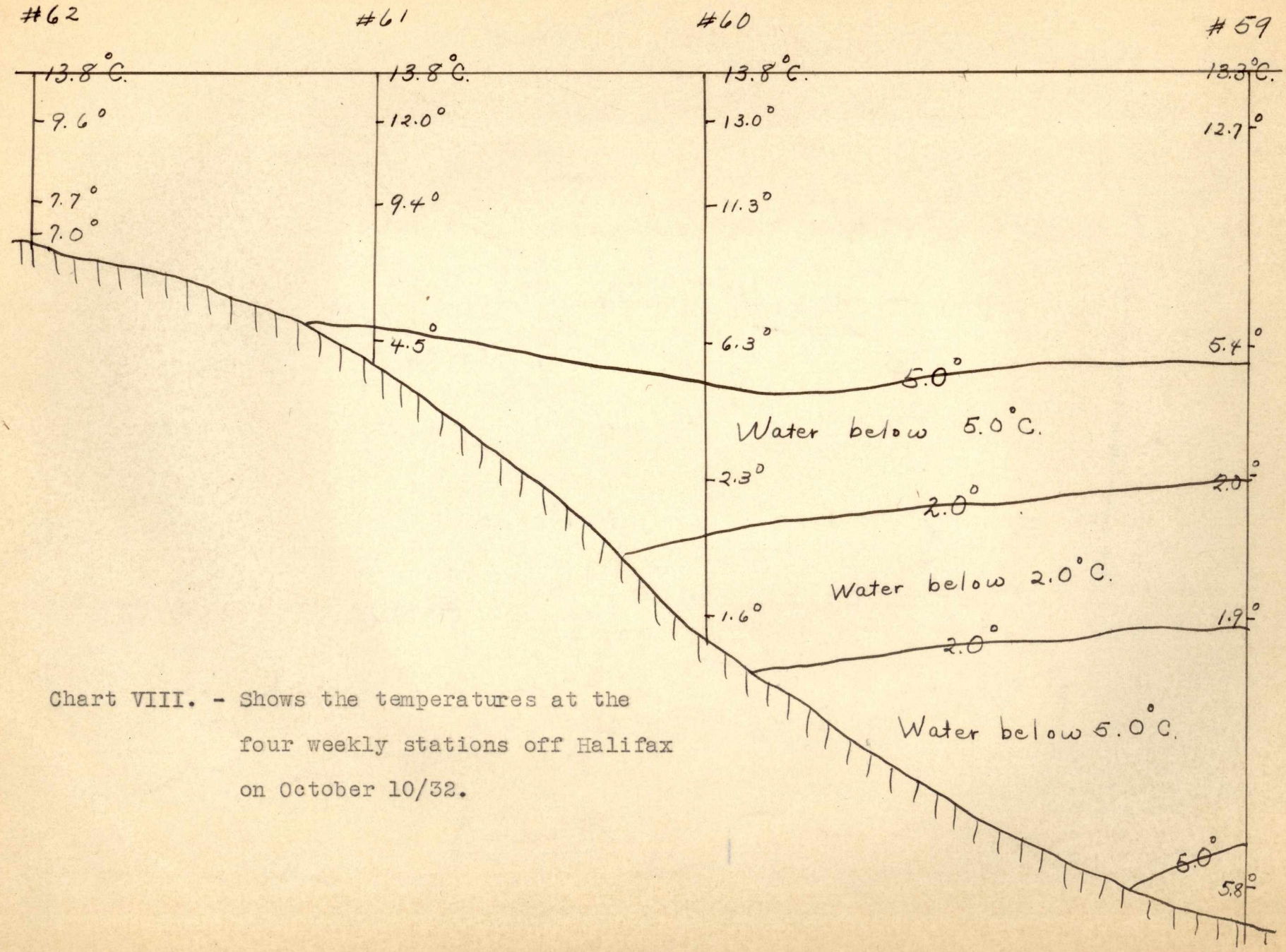


Chart VIII. - Shows the temperatures at the four weekly stations off Halifax on October 10/32.