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Report on a Biological Study of Fishery Statistics of the Atlantic Coast of Canada

By A. W. H. Needler

University of Toronto.

General Outline

This is the second report on a biological study of fishery statistics of the Atlantic coast of Canada started in the summer of 1924 and continued in 1925-26. The work was carried out under the Biological Board of Canada, and with the invaluable advice and assistance of Dr. A. G. Huntsman, Director of the Atlantic Biological Station at St. Andrews. In this report repetition of matter in the first is avoided as much as possible, but a brief resume is given where necessary to show the significance of results.

The statistics.

The statistics studied, and on which all results are based, have been collected by fishery officers along the coast since 1867 and published annually by the Department of Marine and Fisheries. The number of districts for which the figures for the catch have been given, and the quantities reported have varied widely. Not until 1917 the fishery overseers were required to give only an annual report of the fishery statistics of their district. Since 1918 a monthly report has been rendered, resulting in more valuable information and greater accuracy.

In some instances, for example from weir owners, the statistics are collected directly from the fishermen who keep a record of their catch. In most cases, however, notably in the case of

line fishing in small boats, this is impossible and the figures are collected from the men who buy the fisherman's catch when landed.

The question of the accuracy of the statistics is all important, as it determines to a large extent the value of the results of their study. Many persons have been critical in this matter although themselves unable to offer constructive information. Much, of course, depends on the fishery officers, and it must be remembered that the collection of the statistics is not a simple matter. Although certain instances of distinctly unreliable figures are present, the author is inclined to believe that the statistics represent the catch fairly accurately - say within ten or fifteen percent, in most cases. Evidence of accuracy is shown by the consistency of annual and seasonal variations of the catch shown in these reports. The nature of the conclusions does not demand an extremely high grade of accuracy, and the inaccuracy in the collection of the statistics is probably not the greatest obstacle to determining reliable information about the fish from these statistical reports.

Preparation of charts showing the distribution of the catch

The study of these statistics fell largely into three divisions: study of the distribution of the catch, study of the variations of the catch from year to year, and study of seasonal variations in the catch. The first path led to the preparation of charts showing the distribution of the catch in the inshore fisheries. The method of preparation of the charts, with means of eliminating inaccuracies, is treated in detail in the author's 1924 report.

Before the preparation of the latter, charts had been made showing, in the southern half of the coast, the distribution of the catch of albacore, alewives, cod, haddock, hake (and cusk), halibut, herring, lobsters, mackerel, pollack, salmon, sardines (young herring), smelts, and swordfish. Of these only the cod and lobster charts had been submitted to criticism by the fishery officers. In the present report local information regarding the fishing grounds has been incorporated in charts showing the distribution of the catch of haddock, hake, halibut, herring, mackerel, pollock, salmon, and smelts. This has been kindly supplied by the fishery overseers.

Charts showing the distribution of the catch in the northern part of the coast have been prepared for cod, capelin, halibut, herring, mackerel, salmon and smelts. In all of these but the last statistics given for the years 1880 to 1885 were used. In the case of the cod the figures were averaged for 1880 to 1892. These earlier statistics are not as accurate, but they were chosen because of the greater detail supplied. The figures are probably most accurate for the catch of cod which is the staple fishery of the north shore of the Gulf of St. Lawrence. The cod and capelin particularly gave regularity of results, which argues the reliability

of the figures. For the other species, of which relatively small catches are made, the charts have less quantitative value. In the case of the smelts the reports from 1911 to 1919 were used as no catch was recorded previously. The figures are more accurate but not detailed, being given for only about twenty-five districts.

In order to check the distributions shown by all previous charts, others showing the whole coast but giving less detail have been prepared from the reports for the years 1918 to 1923. In these years only seventy districts were given for the whole coast but the offshore catch was listed separately, and the statistics are more accurate following an improvement in the collection, including monthly returns and changes in the staff.

Annual variations

Some further work was done on the study of the annual variations of the catch as described in the first report. The nature of the results appears later.

Monthly variations

Statistics of the monthly catches of 1924, 1925, and the first part of 1926 were available through the kindness of the Department of Marine and Fisheries, Fisheries Branch, in supplying copies of the monthly statistical returns of the fishery overseers. From these the seasonal variations of the catch have been studied, and information on the seasonal migrations of the various species of fish determined. All the results for each species are given below.

ALBACORE. Thunnus thynnus Linnaeus.

Distribution

The albacore, tunny, tuna, or horse-mackerel is a summer visitor to our coast. It is not known where the fish summering with us spend the winter. Probably they retire to deep water wether off our coast or elsewhere. Nothing definite is known of their breeding. The smaller fish - less than 20 pounds in weight - do not appear in our waters.

In a previous report the distribution on the Canadian coast was studied and a detailed chart of the distribution of the catch from 1910 to 1916 was given. In chart I of this report the catch from 1918 to 1925 is shown. It shows the catch accurately in fairly large districts -two to a county - and not in detail. Most of the catch shown between Halifax and Lunenburg is made in St. Margaret's bay. This chart varies from the previous one in the

smaller catch, particularly in Shelburne, Yarmouth, and Digby counties. The principal features of the distribution are the same in the two charts.

Annual variations

A study of the annual variations of the catch shows that it is very variable. This is true both of the catches in the individual districts and of the total catch for the coast. The variations in the different districts appear to be quite independent of one another. On Graph 1 are plotted the annual catches in the following districts:-

A. Halifax county
B. Lunenburg county
C. Shelburne county
D. Yarmouth county
E. Digby county

The annual variations of the catch show no correlation with the price obtained for the fish; nor can they be explained by the weather reports. Allowance must however be made for the small number of fish caught. Supposing an average weight of 200 pounds, the average number caught on the Canadian coast from 1918 to 1925 was about 1,800 annually.

Monthly variations

The monthly catches in 1924 and 1925 are plotted on Graph 2. Considering the total for the coast we see that there is no catch in June. The catch is largest in July and is fairly large in August. A small catch is made in September and in 1925 in Halifax county a small catch was made in October.

There appears to be little regularity in the order of appearance of the catch in the different districts except in the case of the Bay of Fundy. Here no catch was made until August in the southern part of Digby county (District of Clare) and none until September in the northern part. It seems that the albacore reach the open coast - Halifax to Yarmouth - in July, visiting the different parts in irregularly varying abundance. They do not enter the colder waters of the Bay of Fundy until August and September.

ALEWIFE *Pomolobus pseudoharengus*, Wilson
Pomolobus aestivalis, Mitchill

Distribution

Alewives spawn in fresh water. They ascend a great number and variety of streams. Apparently any stream unobstructed by

dams or waterfalls and leading to a lake or pond is suitable for their use. They are caught with weirs, trapnets and seines near the mouths of rivers and with seines and dipnets well up from the sea. Thus in studying the size of the catch of alewives we are considering the spawning migrations and not necessarily the abundance in the sea.

The distribution of the catch of alewives is treated in a previous report in which a chart of the distribution of the catch from 1910 to 1916 was given. On a chart (Chart 2) accompanying this report the distribution of the catch is shown for the years 1918 to 1925. It shows no detail and varies in no important manner from the other.

There are five districts of large catch on the Canadian coast. These are, in order of importance, - St. John harbour, N. B., from Cumberland county to Gloucester county, Queens county to Yarmouth county, N.S., Cobequid and Minas basins, and Inverness county, Cape Breton, in the vicinity of the Margaree river. These districts are shown on Chart 2.

Annual variations

A study of the annual variations of the catch shows that these districts are independent. Within the districts there are roughly similar variations in different parts. The annual catches in the following counties are plotted on Graphs 3 and 4.

Graph 3.
- A. Colchester county - Bay of Fundy coast.
- B. Hants county.
- C. Kings county.
- D. Yarmouth county.
- E. Shelburne county.
- F. Queens county.
- G. Halifax county.
- H. St. John county.

A, B, and C cover the district of Cobequid and Minas basins; D, E, F, and G cover the large catch from the south of Nova Scotia; H, St. John county, includes the district of largest catch.

Graph 4.
- A. Inverness county.
- B. Cumberland county.
- C. Westmorland county.
- D. Kent county.
- E. Northumberland county.
- F. Gloucester county.

A is a district in itself; B, C, D, E and F constitute the district of second importance.

1. St. John county. The variations of the catch are quite independent of those in any other district. (H, Graph 3).

2. Cobequid and Minas basins. (A, B, C, Graph 3). The annual

variations are roughly similar in the three counties shown.

3. Southern end of Nova Scotia. (See Graph 3). D (Yarmouth county) show quite similar annual variations in the catch. E (Shelburne county) differs from them only in having a relatively low catch in 1922. Halifax county (G) is separate. Here the fishery has suddenly grown in 1924 and 1925.

4. Inverness county. (A, Graph 4) is a separate district.

5. Cumberland county, N.S., to Gloucester county, N.B. (See Graph 5). Of these Cumberland county (B), Northumberland county (E) and Gloucester county (F) have catches varying in the same manner from year to year. Kent county (H) and Westmorland county (N) have low catches in 1920 instead of high.

Thus it is evident that within each of these five districts the variations of the catch from year to year are roughly similar in the different parts, and that the five districts of large catch act independently. I believe we may disregard economic conditions as an important factor in determining the variations. The latter are too large and appear to be independent of the price obtained for the catch.

The significance of the similar variations in the different parts of each district offers possibilities of two kinds. On the one hand the similarity might be caused by the intermingling in the sea of the alewives of the whole district. The catches all over the district would express the abundance of this common stock. This view is in direct opposition to thé "parent stream" theory. This theory supposes that alewives spawned in a certain body of fresh water return to the same place when sexually mature. Bigelow and Welsh (1924, Fishes of the Gulf of Maine. Bull. U.S.Bur. Fisheries, Vol. XL, Pt. 1, p. 110) point out the success of re-stocking operations in bringing adult alewives to the stream three years after the planting of the fry, and not before, in support of the theory. If it is correct, we must consider the similarity in the annual variations of the catch as due entirely to more or less local similarity in the conditions of temperature and other physical factors with their result on the abundance of food, the development of the young alewives, etc. The incompleteness of the similarity would seem to favour the latter view.

Monthly variations

The figures for the monthly catches were available only for 1924 and 1925. They were given for about sixty overseers' districts on the Canadian coast south of Gaspé. On account of the extremely small catches in many of the districts they were combined for representation here. On Graphs 5 and 6 the monthly catches are plotted for ten districts covering the entire catch.

A study of the monthly variations shows that the catch is not made at the same time all over the coast. The alewives appear in a more or less definite order in different districts. In 1925, owing to a more open spring than in 1924, the catch was made earlier particularly in the southern part of the coast. But this did not

disturb the order of the appearance in different districts.

The earliest catch is made at St. John. Here in 1924 the catch was made in April, May and June with the maximum in May. In 1925 a small catch was made in March; the maximum catch in April and smaller catches in May and June.

Next to St. John the earliest catch is made in the south end of Nova Scotia from Digby to Lunenburg counties. Here in 1924 catches were made in May, June and July, in 1925 in April, May and June. In both years the maximum catch was made in May.

Minas and Cobequid basins come next with large catches in both May and June. Small catches were made in July, 1924, and April, 1925.

In the southern part of the Gulf of St. Lawrence in both 1924 and 1925 small catches were made in May, and a large catch in June. In Westmorland and Kent counties, N.B., and in Prince Edward island no catch was made in May.

Lastly from Paspebiac to Point Marquereau on the north shore of the Bay of Chaleur small catches were made in July only.

Nowhere were large catches made in July, or any catch at all in August.

A catch of alewives is recorded in the Miramichi river in September 1924 and October 1925.

CAPELIN. Mallotus villosus Müller.

Distribution

The capelin is a subarctic form circumpolar in distribution. On the Atlantic coast of America its extreme southern range is the coast of Maine. South of the Gulf of St. Lawrence, however, it is only of irregular occurrence. Here it occurs at long intervals in considerable numbers in limited areas as, for example, the southeastern corner of Cape Breton and the Bay of Fundy. It is endemic about Newfoundland and is abundant in parts of the Gulf of St. Lawrence north of the Bay of Chaleur and Cape Breton. It ascends the St. Lawrence in considerable numbers as far as Godbout and Rimouski county; its limit here is not known. The northern limits of the distribution of the capelin are not definitely determined. It is present on the southern parts of the coasts of Labrador, Greenland and Hudson bay.

The commercial catch of capelin on the Canadian coast is shown on Charts 3 and 4. On Chart 3 is plotted the catch as given by the reports of the Department of Marine and Fisheries for the years 1880, 1881, 1883, 1884 and 1885. In most of the earlier years the figures are rendered useless by listing catches as fish

for bait or manure without specifying the species. In the above years the kinds and quantities of fish used for bait and manure were specified for all parts of the coast except the St. Lawrence river, i.e., west of the Saguenay river and Rimouski county. Luckily no commercial catch of capelin appears to be made west of these places. A separate figure was also listed as capelin. The chart shows for each district the sum of these two figures listed independently as capelin and capelin for bait or manure. The latter was generally much the larger amount. Considerable detail was given, the catch being published for about 110 districts.

On Chart 4 is shown the catch during recent years - from 1911 to 1924 excluding 1916. During these years the catches were given for about 25 districts on the coast of Quebec and about 60 on the coasts of New Brunswick, Nova Scotia and Prince Edward island. Small commercial catches are shown by vertical crosses. In addition diagonal crosses mark the positions of the more important records of the occurrence of capelin in considerable numbers. These represent the areas of periodical occurrence south of the Gulf of St. Lawrence.

The distributions of the commercial catch shown by the two charts differ in no important particulars. They corroborate each other very well. The catches appear to be less concentrated in Chart 4 than in Chart 3. This is because the former was plotted from figures given for larger districts than in the case of the latter. It must be kept in mind that the charts show only along what part of the coast the catch is made, and not how far offshore. The entire catch of capelin is made right at the shore. In the earlier years no catch was recorded outside the province of Quebec. From 1911 to 1924 the following were recorded:-

1914 - Victoria county, N.S.	Neil's har. and New Haven,	23	cwt.
	White pt., Dingwall,		
	Sugar Loaf,	36	"
	Meat cove and vicinity,	4	"
1920 - Gloucester county, N.B.,	Inderman to Glen Anglin,	30	"
1921 - Kings county, P.E.I.,		26	"
1922 - Kings county, P.E.I.		40	"

Thus it is seen that only isolated small catches are made in the southern part of the Gulf of St. Lawrence.

There are five principal districts in which large catches of capelin are made. They are as follows:-

1. North side of Bay of Chaleur from Miguacha to Barachois.

2. Near the boundary of Gaspé and Matane counties.

3. The west part of Mingan island east to Betchewan.

4. The vicinity of Natashquan.

5. Chicatica to Blanc Sablon.

Of these districts the first, third and fifth are the most important.

It is worthy of note that along the coast of Saguenay county the districts where large catches of capelin are made show also large catches of cod. This coincidence extends to considerable detail. Capelin are used chiefly for bait in the cod fishery; they are also used for manure. Along the north shore of the Gulf of St. Lawrence the cod fishery is the principal means of subsistence. These facts suggest that the catch of capelin along the coast is determined by the presence of a cod fishery with the consequent demand for bait, and existence of a fishing population. This being the case we must not give too much negative significance to the distribution shown by the charts. Capelin are abundant where large catches are shown but they may also be abundant at other points along the coast of Saguenay county.

In the Bay of Chaleur large quantities are caught along the north shore and none on the south shore. This may be due to the colder water on the north shore. The colder water enters the bay along the north shore and the water is warmer along the south shore.

The catch from Chicatica to Blanc Sablon shows a considerable decrease from 1885 to 1910. This decrease is also shown on the north shore of Anticosti island and at the Magdalen islands where no catch was recorded from 1910 to 1924.

Small catches appear along the entire coast of Quebec east of Matane county and Pointe-des-Monts.

Annual variations.

In the study of the annual variations of the catch of capelin a lack of data is noticeable. The variations were studied from 1911 to 1919. During these years only eleven districts showed catches of capelin.

Little or no correlation could be shown between the annual variations of the catches except slight similarities in adjacent districts. What slight similarity was shown occurred within the districts delineated on Chart 4 by broken lines. The similarity is so slight, however, that little significance can be attached to it.

The catch of capelin is particularly variable. The average percentage deviation of the catch each year from the mean annual catch is given below for eleven districts from 1911 to 1919.

District	Average annual catch (bbls.)	Average % deviation from mean
Maguacha to Paspebiac	4,940	105
Paspebiac to Pt. Macquereau	2,860	127
Fame pt. to Cape Chat	1,894	180
Jambons to Pigons	132	134
Pigons to St. Charles	4,409	106
St. Charles to Natashquan	1,365	123
Natashquan to Cape Whittle	365	104
Cape Whittle to Chicatica	375	105
Chicatica to Blanc Sablon	514	60
Anticosti island	4	200
Rimouski county	672	124

This variability is erratic. Very large catches appear preceded and followed by very small catches. These large catches are not often synchronous over any large area. This erratic abundance is interesting in view of the occurrence of the capelin at intervals in large numbers in limited areas far south of its ordinary range of abundance.

Monthly variations

The monthly variations of the catch of capelin in 1924 and 1925 are shown on Graph 7. The entire catch is made during the months of June and July with the exception of a relatively small catch in August from Pigons to Mutton bay. The monthly catches for five districts, including the entire catch of capelin for those years, are plotted on Graph 7.

The north shore of the Bay of Chaleur and Matane county show catches in June only. From Godbout to Jambon the entire catch was made in June, 1924, and in July, 1925. Pigons to Mutton bay shows almost equally large catches in June and July and a smaller catch in August of both years. Mutton bay to Blanc Sablon shows catches in June and July, the latter month having the larger. Thus we see that the maximum catch and end of the season come earlier on the north shore of the Bay of Chaleur and in Matane county than on the north shore of the Gulf of St. Lawrence.

The seasonal distribution of the catch of capelin is not governed by the cod catch as may be the geographical distribution. It is determined by the time when the capelin come inshore to spawn. It is then that the catch is made. At other times the capelin keep in deeper water farther from shore.

COD. Gadus callarias Linnaeus.

Distribution

Cod are found on the Atlantic coast of America from Cape Hatteras to Arctic regions. In the southernmost part of their range they are winter visitors. On the Canadian coast the catch is smaller in the winter months. In the northern parts no catch is made from December to April both months included.

The distribution of the catch of the shore fisheries in the southern half of the Canadian coast is shown on a chart in a previous report where it is treated in detail. Small catches are made over the entire coast with the exception of Northumberland strait. The catch decreases towards the head of the Bay of Fundy. From the mouth of this bay to Inverness county, Cape Breton island, the catch is large. It is small in the Gulf of St. Lawrence south of the Miramichi river and the Magdalen islands.

On chart 5 of this report the distribution of the catch on the northern part of the coast is shown. The chart is plotted from figures averaged for the years 1880 to 1892 for about one hundred and ten districts. The figures for cod are more reliable in this case than those for other fish as the cod fishery is the chief support of the inhabitants of the north shore of the Gulf of St. Lawrence. Catches of other fish are relatively of no importance.

Cod are present in widely varying abundance over the entire northern half of the coast east of Godbout and Matane county on the St. Lawrence river. Particularly along the north shore of the Gulf large catches are limited to fairly definite areas between which only very small catches are made.

From the coast of Gloucester county, N.B., a large catch is made chiefly some distance east and southeast of Shippigan and Miscou islands. A shore catch is made in the Bay of Chaleur as far as Restigouche county. On the north shore of the bay a small catch is made as far west as Miguacha. It increases, eastward, to the largest shore fishery for cod on the Canadian coast - from Paspebiac point to Barachois. As we follow the north coast of Gaspé westward the catch decreases again. Although relatively small west of Fame point it extends to Matane county.

A considerable catch is made from the Magdalen islands - more particularly from the southern parts.

A small catch is made about Anticosti island almost entirely from the north side.

From Godbout east to Manitou point there is a small catch. From Manitou point to Long point the catch is large. There is a small catch about Betchewun. About Natashquan there is again a considerable catch. From Harrington harbour to HaHa bay there is a fair catch. The catch is large from Lydia cove, east of Chicatica, to Blanc Sablon except that it is small at Bradore. Between these districts only very small catches are made.

On chart 6 the catch of cod from 1917 to 1923 for the whole Canadian coast is plotted. The chart was made from figures for about 45 districts only. It is intended merely for comparison with the two former charts and is inaccurate in detail. It is more accurate, however, in that the offshore catch was listed separately and was omitted. It agrees in all essentials with the two other charts.

Annual variations

The catches in 33 districts of the coast were plotted for the years 1918 to 1923. Very little correlation of the variations was evident in the Gulf of St. Lawrence. The rest of the coast falls into two regions in which the annual variations are similar in different parts. They are as follows:

I. Charlotte county, N. B. to Yarmouth county, N. S. (see Graph 8)

A. Charlotte county
B. St. John county
C. Annapolis county
D. Digby county
E. Yarmouth county
F. Shelburne county
G. Queens county

The last two districts, Shelburne and Queens county, are intermediate between this group and the next.

II. Lunenburg county to Inverness county. (See Graph 9).

A. Lunenburg county
B. Halifax county
C. Guysboro county
D. Richmond county
E. Cape Breton county
F. Victoria county
G. Inverness county

The similarity of the annual variations of the catches within these districts may be due to two principal factors - to either or both. The fish of each district may be derived from the same spawning grounds, or grounds subject to the same annual variations in conditions favourable to spawning and larval development. On the other hand the similarity may be attributed to migration be-

tween the different parts of the districts even with varying spawning conditions. Probably both the factors - centres of reproduction and migration - play a part.

The catch of cod is relatively constant from year to year. The average percentage deviation of the catch each year from the mean annual catch was calculated in 33 districts on the coast. All districts with catches smaller than 500 cwt. annually were omitted. The average of the values obtained was 40% as compared with 124% in the case of the capelin. This shows the difference in variability between the catches of the two fish.

Monthly variations.

The monthly catches were available for about 75 districts in 1924, 1925, and the first two months of 1926. For convenience many of these districts were combined for graphic representation. Care was taken, however, to combine only districts with similar monthly variations of the catch. In 1924 the catch was not specified as inshore and offshore. On this account those districts in which the offshore catch plays a conspicuous part were omitted for this year. The monthly catches were plotted as follows, those districts omitted for 1924 being denoted with an asterisk.

Graph 10. The Bay of Fundy.

1. Grand Manan
2. Western islands and Passamaquoddy bay.
3. Charlotte county east of Passamaquoddy bay and St.John county
4. Albert, Cumberland, Colchester and Hants counties.
5. Kings county, N.S.
6. Annapolis, Digby and Yarmouth counties.

Graph 11. The open Atlantic coast of Nova Scotia.

*7. Shelburne county
*8. Queens county
*9. Lunenburg county
*10. Halifax county
*11. Guysboro county
*12. Richmond, Cape Breton and Victoria counties.

Graph 12. Magdalen bay.

13. Inverness county.
14. Antigonish and Pictou counties.
15. Prince Edward island.
16. New Brunswick south of the Miramichi river
*17. New Brunswick north of the Miramichi river
18. Magdalen islands.

Graph 13. The Gaspé peninsula.

19. Miguacha to Paspebiac point
20. Paspebiac pt. to Point Macquereau.

21. Pt. Macquerequ to Grand river
22. Grand river to Point St. Peter
23. Gaspé bay
24. Cape Rosier to Fame point
25. Fame point to Rimouski county .

Graph 14. The north shore of the Gulf of St. Lawrence.

26. Godbout to Pijon river
27. Pijon river to Eskimo point
28. Eskimo pt. to Kegoshka.
29. Kegashka to Mutton bay
30. Mutton bay to Blanc Sablon.

Graph 15. The whole coast.

I. The Bay of Fundy
*II. Open Atlantic coast of Nova Scotia.
*III. Magdalen bay
IV. Gaspé
V. North shore of the Gulf of St. Lawrence.

Considering first the coast as a whole, as shown on Graph 15, we see that the difference between the various parts consists almost entirely of the extent to which the catch is interrupted during the winter. The maximum catch is made in all cases in July or in June and July. On the north shore of the Gulf of St. Lawrence no catch is made in seven months of the year - November to May. On the Gaspé coast a very small catch is made in May and November. In Magdalen bay a relatively greater catch is made in the latter two months, with a small catch in December. In the two southern districts the catch is entirely interrupted during no month of the year, it being understood that this does not apply locally within the districts. The minimum catch is negligible, however, when compared with the maximum. The minimum is reached by December in the Bay of Fundy, but not until February on the open coast.

Thus we have an increase from the minimum catch in March and a very small catch in April to the maximum in July, and a decrease to a small catch in November and the minimum again in February or March. Graph 16 gives the total monthly catches for the Canadian shore fisheries. In interpreting this seasonal fluctuation of the catch the weather must be considered as an extremely important factor. The winter conditions discourage small boat fishing such as produces most of the shore catch. This is particularly true of the northern part of the coast and here we find the catch most completely interrupted. In the southern parts of the coast some fishery is carried on throughout the winter - for example from Grand Manan and parts of Shelburne county. In the southern Gulf of Maine a considerable fishery depends on the spawning cod in the winter months. As cod spawn in shoal water, easily accessible in summer, a similar fishery might be expected in parts of the Gulf

of St. Lawrence if the weather permitted its development.

In the Bay of Fundy we have everywhere but in St. John county a summer fishery as outlined above. It decreases very much, in the winter months, at Grand Manan and completely disappears at the head of the bay. In St. John county, however, there is a winter fishery extending from January to May and early June. In the rest of the year few or no cod are caught. This suggests the presence of a spawning ground off the western coast of St. John county. This suggestion is to some degree corroborated by the fact that eggs are to be found in the spring in the Passamaquoddy bay region. The movement of the water is from St. John county to Passamaquoddy bay, i.e., westward along the north shore of the Bay of Fundy. The fishery, if it does depend on spawning cod, is similar to the winter fishery in the southern part of the Gulf of Maine and on the nearer offshore banks. The question is at least worthy of further investigation.

A detailed study of the seasonal fluctuations of the catch elsewhere on the coast shows only irregular and minor departures from the monthly change considered above for the coast as a whole.

HADDOCK. Melanogrammus aeglifinus (L.)

Distribution

Haddock are found irregularly south of Cape Cod to Cape Hatteras, principally in deeper water. From Cape Cod to Cabot strait they are abundant. In the Gulf of St. Lawrence they are not abundant except near Cabot strait. There is a fishery in the southern part and haddock occur sparingly west of Gaspé and on the north shore.

The distribution of the commercial catch in the southern part of the Canadian coast was treated in a former report. The chart given there was revised after being submitted to criticism by fishery overseers and appears in this report as Chart 7. The corrections are local only. In the northern part of the coast so few haddock are caught that it was considered inadvisable to make a chart based on the returns from 1880 to 1892 as the latter are not very accurate particularly for small catches. To give this northern distribution and to provide a check on Chart 7 the distribution of the catch from 1918 to 1923 over the entire coast was plotted on Chart 8 of this report. This chart is plotted from figures given for fewer districts than Chart 7 (1910 to 1916) but giving the offshore and inshore catches separately. Only the latter are shown.

In the Bay of Fundy few haddock are caught on the north shore east of Point Lepreau. From the mainland and western islands of Charlotte county the catch is fairly good although variable, while it is small at Grand Manan. As we proceed up the south shore of

the bay from Digby county, where the catch is large, it decreases rapidly but extends in very small quantity to Cumberland county and Minas Basin.

From Digby county to Canso the catch is small with the exception of a large catch from Shelburne county and near Halifax. Large catches are made about Canso, Ile Madame and Richmond bay. Few are caught until we come to the northern part of Victoria county, about Ingonish, where a large catch results from the trap-net fishery. There is apparently no commercial catch in the Bras d'Or lakes.

In the Gulf of St. Lawrence the catch is very small. A considerable catch is made from inverness county particularly about Port Hood. From Antigonish, Pictou and the northern part of Kent counties very small catches are made as also from the north shore of Prince Edward island and the Magdalen islands. No haddock are caught in Northumberland strait. A few haddock are taken incidentally in the great cod fishery from Gloucester county, N.B., and Gaspé. North and west of Fame point, Gaspé county, no commercial catch is made.

Annual variations.

The annual variations of the catch were studied in a number of districts about the coast. It was found that minor changes from year to year, and even considerable changes, in the magnitude of the catch were not often synchronous over any great area. Certain years, however, showed particularly large catches in several different districts. These peaks in the catch do not occur often nor are they apparently confined to definite areas. The range over which the abundance occurs varies in different instances.

An example of such a year of abundance is shown on Graph 17. In 1919 particularly large catches of haddock were made from Queens to Inverness counties, Nova Scotia. In other years this area shown no distinct synchronous variation of the catch. Another example is 1924 when haddock were particularly plentiful from Charlotte county to Cape Breton. The effect was most noticeable in the Bay of Fundy. In connection with the latter year Dr. Huntsman and the author investigated the haddock caught at the Atlantic Biological Station, St. Andrews. This work is reported elsewhere but as it throws light on the subject of annual variations of the catch some of the results are summarized below.

Records of the lengths of haddock caught at the Station from 1916 to 1925 were studied. It was found that the majority of the fish caught during any year belonged to one age and size group. These schools were followed from year to year the fish increasing in length and decreasing in abundance after the first two years of

their appearance. During the ten years only two such schools were in evidence with a few fish evidently not belonging to either. The oldest school consisted of fish well advanced in size in 1916. The second school appeared first in the catches in 1921 with an average length of about 29 cm. and continued with increasing size throughout the last five years. In 1921 relatively few were caught owing probably to the small size. In 1924 the abundance of haddock in the vicinity was remarkably increased and was reflected in the statistical returns of the fishery.

The data given above are in support of the view that the annual fluctuations of the catch are due to variations in the success of breeding, from year to year. The years, such as 1919 and 1924 which show particularly large catches represent the effect of favourable conditions and the consequent success of former spawning seasons. The above investigation showed only two such seasons in ten years. This may be exceptional but it at least shows a probable explanation of the peaks in the catch. The same principle may apply in the case of other species.

Monthly variations

The monthly catches in eleven divisions of the coast are plotted on Graphs 18 and 19. Those districts in which the variation of the catch from month to month were the same were lumped together. The catch are given for the years 1924 and 1925 and the first two months of 1926. Those districts in which the offshore catch is important were omitted for 1924 when the offshore and inshore catches were not available separately.

Considering first the coast as a whole we see that the catch of haddock shows characteristically two maxima each year. The intervening minima are most pronounced in the northern parts. The most important maximum occurs in the early summer at times varying from May to July or even August in a few cases. After this the catch decreases until the second maximum occurs in November or December. The winter minimum is the most pronounced its lowest point being reached in March.

In Charlotte county in the Bay of Fundy the catch is largest in July. In Digby county the summer maximum occurs in June and in Annapolis county and Kings county in July and August. All over the bay the autumn maximum occurs in November, but it is not very pronounced. The catch then decreases and none are taken in March.

From Yarmouth to Canso the changes are not as pronounced. Some catch is made even in March in Shelburne county and the decrease in late summer is slight. The two maxima do occur however in late July and in November.

From Canso to Victoria county June and December alone show large catches the latter month being the most productive. No catch

is made in February, March or April. In Victoria county we have an enormous catch in June with a winter catch in December and January. No catch is made from February to April or August to November. Here the trap-net and shoal water fishery plays the conspicuous part in June. In Inverness county the summer maximum is in June and is separated by some decrease from a large catch in November and December. In other parts of the Gulf of St. Lawrence the haddock catch is very small and shows no significant maxima. It is a summer catch, largely incidental to the cod fishery.

The decrease and in many places complete cessation of the catch in late summer suggests that at this time the haddock move into deeper water. Haddock do not depend for food to any great extent on inshore spawning fish as the cod depend upon capelin in the north, and herring in the south for much of their diet. The high catch in November and early winter would be explained by a migration into shallower water preparatory to spawning. The decline of the catch in winter may, as in the case of the cod, be largely due to weather conditions. Haddock fast when spawning and would not be caught on lines. This also might play a part. The summer maximum may be due to active feeding migrations and improved conditions for the fishery.

HAKE. Urophycis tenuis (Mitchill) and Urophycis chuss (Wallbaum)

Distribution

These two species, known as hake or as ling in some localities, are with difficulty distinguished. As they occur together and are not separated in the statistical reports, they are treated together here. They are found in large numbers from the Gulf of St. Lawrence to Cape Cod. In the Gulf of St. Lawrence they are limited to Magdalen bay and the west coast of Newfoundland. A few have been recorded from the north shore.

The commercial catch is greatest at either side of the mouth of the Bay of Fundy. Chart 9 shows the distribution based on the returns from 1910 to 1916. It is similar to a chart in a previous report but has been submitted to criticism by the fishery overseers. Chart 10 gives the distribution of the catch on the whole Canadian coast. This chart is based on the years 1918 to 1923 when the offshore catch could be eliminated. The local distribution was determined by reference to detailed figures for 1910 to 1916 and by inquiry from fishery overseers.

A large catch is made on the north shore of the Bay of Fundy west of St. John. It does not extend into Passamaquoddy bay to any great extent although hake are present there, but is made

principally between Point Lepreau and the north side of Grand Manan. On the south side of the Bay of Fundy a large catch is made from the west coast of St. Mary bay to Annapolis county and hake are caught in small quantities as far as Cape Chignecto and Scotsman bay.

Small catches are made over the entire coast as far as the north side of the Bay of Chaleur with the exception of Northumberland strait, Cape Breton county and the Bras d'Or lakes. The catch is somewhat increased in Shelburne county and Prince Edward island. No catch is made at the Magdalen islands or north of Gaspé bay.

Annual variations

The annual variations of the catch from 1918 to 1923 in four counties of the Bay of Fundy are given on Graph 20 as follows:

A. Charlotte county.
B. St. John county.
C. Annapolis county.
D. Digby county.
E. New Brunswick prices per cwt.
F. Nova Scotia prices per cwt.

Owing probably to the small catches little or no correlation is evident in other parts.

In the Bay of Fundy we see that the catch on each side acts as a unit showing the same changes in both counties. Thus we see that each side of the bay is visited by a single lot of hake. In 1921 and 1923 we have low catches and in 1922 very high catches all over the bay. During these years the same conditions prevailed throughout the bay. The changes are not explained by the prices shown on the graph or by any sudden change in the catch of cod or haddock which might turn the fishery to hake. They are apparently due to the abundance of the fish. The significance is doubtful. Perhaps the high catches in 1922 are to be explained, as suggested above for the haddock, by successful breeding seasons. This is doubtful, however, in view of the sudden decrease of the catch from 1922 to 1923 and perhaps it is more probably due to a temporary migration of the hake caused by search for food or temperature conditions. It is worthy of note that the districts most affected proportionally are those where the catch is small - St. John and Annapolis counties.

Monthly variations

The monthly catches in eight divisions of the coast are plotted in Graphs 21 and 22 for 1925 and for 1924 in those divisions not affected by the offshore catch.

Graph 21.

A. Charlotte and St. John counties.
B. Digby, Annapolis and Kings counties.

Graph 22.A. Yarmouth to Shelburne counties.
B. Inverness county.
C. Antigonish and Pictou counties.
D. Prince Edward Island.
E. Kent county, N.B.
F. Restigouche, Gloucester, Bonaventure and Gaspé counties on the Bay of Chaleur.

Inshore catches only are shown.

A study of these graphs shows that the catch as a whole is made from late in May to January with the maximum during July or August. On the north shore of the Bay of Fundy the catch is made from June to December and on the south shore from late May to January. The maximum in both falls in August or September. The catch on the open coast is irregular but shows a maximum in the early autumn. In the Gulf of St. Lawrence the catch extends from June to December with the maximum in July or August - somewhat earlier than in the Bay of Fundy.

In those districts which show a considerable haddock catch - the south shore of the Bay of Fundy and Inverness county, there is a subsidiary maximum in November due probably to hake being caught incidentally in the late autumn haddock fishery.

The maximum catch of hake occurs a month or more later than that of cod. There is some possibility that the maximum is influenced by cod fishermen turning to hake. This is very improbable, however, in view of the fact that the maximum hake catch occurs when the cod catch is still large and the changes in the catch are quite regular.

The spawning season of hake lasts from late spring to early autumn. As the spawning takes place in shallower water than usually occupied by the hake this may have some influence on the catch and help to explain the maximum. This might explain the earlier maximum in Magdalen bay where summer water temperatures are reached sooner than in the Bay of Fundy.

HALIBUT. Hippoglossus hippoglossus (L).

Distribution

The halibut occurs in cold water in the North Atlantic, Arctic and North Pacific oceans. On the Atlantic coast of North

America they occur from the far north to New Jersey. They avoid extreme cold as shown by their absence from the Labrador side of Davis strait and the Arctic coasts of Asia and America. They ascend the St. Lawrence as far as the Saguenay river the limit of deep water, but are rare in the southern parts of Magdalen bay and in Northumberland strait. In the Bay of Fundy they range to Minas basin on the south shore but not past St. John on the north.

Halibut were formerly remarkably abundant and before the development of a market for them were at times a nuisance to the cod and haddock fishermen. Early in the nineteenth century a demand for them arose and since that time they have rapidly decreased first from the inshore grounds and then far afield. For the last fifty years the catch, particularly inshore, is very largely incidental to the cod and haddock fisheries. The small size of the catch and its artificial nature makes the fishery statistics of little quantitative value but the limits of the range have apparently not changed to any great extent.

In Chart 11 is shown the distribution of the catch in the southern part of the coast from 1910 to 1916. This has been submitted to criticism. Chart 12 shows the distribution in the northern part from 1880 to 1892. Chart 13 gives the distribution over the whole coast from 1918 to 1923. These charts disagree in no important particulars. In Chart 13 the inshore catch was listed separately but for fewer districts.

In the Bay of Fundy the catch extends to St. John on the north side and Minas basin on the south. Small catches are made over the entire open coast of Nova Scotia with larger catches about Cape Sable and Halifax. In the Gulf of St. Lawrence the catch is small. A few halibut are taken in Inverness county, at the Magdalen islands, but none in Northumberland strait. Small catches are occasionally made from the western end of Prince Edward island, Kent county and Gloucester county. From the Bay of Chaleur to Matane county and from Godbout to Natashquan including Anticosti island small but regular amounts are caught. East of Kegashka to the Strait of Belle Isle no catch is recorded.

Owing probably to the small catch and its dependence on other fisheries nothing of interest could be discovered from a study of the annual variations of the catch. This is also true of the monthly changes. The latter show the catch to be the result of summer fishing - from April to December. The maximum catch occurs generally in July, coincident with the maximum catch of cod.

HERRING and SARDINES. Clupea harengus L.

Distribution

Herring are found over the entire coast from Labrador to New York being winter visitors south of Cape Cod. From Cape Cod to Labrador they are abundant.

The young herring, one or two years old, come inshore early in the spring and spend the whole summer and autumn near the land. These are the "sardines" of commerce, and where sufficiently abundant to support a canning industry or to be separately valuable are shown in the statistics under that name. In this report separate charts showing their distribution are given. The young herring appear on our shores in sufficient numbers to be commercially valuable only in limited areas where special conditions obtain. The older herring come inshore only to spawn and, although caught along with sardines in the weirs especially built for the latter, their fishery is a distinct one - much more universal and not necessarily abundant in the same localities as the sardine fishery.

The most important region of the sardine fishery is on the north shore of the Bay of Fundy and the Gulf of Maine. The fishery centres about the mouth of Passamaquoddy bay, but extends from St. John, N.B. to Mount Desert island, Me. The tidal currents among the islands at the mouth of Passamaquoddy bay cause a mixing of the warmer brackish water of the estuaries and the deeper colder water of the Bay of Fundy. The resulting temperature and salinity conditions are uniquely favourable to the presence of the young herring along the shores. The general set of the current is west from Passamaquoddy bay and this, together with similar tidal conditions, causes a greater westward than eastward extension of the fishery. Chart 14 shows the approximate distribution of the sardine catch in this region. The chart is based on the average for the years 1902 and 1905 of figures given in the Reports of the U.S. Commissioner of Fisheries 1904 and 1906, of the weir catch of herring in the individual counties of Maine. The more detailed data available for the New Brunswick coast was plotted on a chart in a former report.

The only other place on the Atlantic coast where a similar sardine fishery exists is in the St. Lawrence river. Here, at the mouth of the Saguenay, the action of the tides on the sudden rise of the bottom causes a mixing of the deeper cold water from the eastward with the warmer brackish water coming down the river. The result is similar to that in Passamaquoddy bay. The water from this mixing flows eastward along the south shore of the river St. Lawrence. The sardine fishery in the river is most abundant about Isle Verte opposite the mouth of the Saguenay where the mixing occurs. It extends from R. Ouelle on the west to Gaspe county on the east. Small catches of sardines are made on the northwest side of the river from St. Pauls bay on the west to Bersimis on the east. Chart 15 shows the distribution of the sardine catch in this district during the years 1880-1885. Of recent years, as there is no sardine canning industry here, the figures have all been included under the herring catch.

Chart 16 shows the distribution of the catch of herring, exclusive of sardines, in the southern part of the coast. It is a revision of a chart in a former report in the light of local criticism. It is based on statistics for the years 1910 to 1916. Chart 17 shows

the catch in the northern part of the coast from 1880 to 1885.

These charts show that herring are caught in small quantities over the entire coast, including the Bras d'Or lakes, entering the Bay of Fundy to its head and ascending the St. Lawrence river as far as Kamouraska on the south shore and Malbaie on the north - i.e. about fifty miles above the mouth of the Saguenay. Large catches are made at Grand Manan and from Pugwash to Richibucto. The latter district on the southwest shore of Northumberland strait shows an annual catch of over 100,000 cwt. A relatively large catch is also made in the Bay of Chaleur and at the Magdalen islands, where a much larger catch has been made in more recent years than 1880 to 1885.

Monthly variations

Graphs 23 and 24 show the monthly catches of herring in 1924 and 1925, in nine divisions of the coast. Enough data is not available to attempt any complete interpretation of the variations but they are outlined below. Sardines are separately treated later.

At Grand Manan and elsewhere on the north side of the Bay of Fundy the maximum catch is made in the autumn from August to November. A winter catch is made from February to April and small catches during the remainder of the year. The autumn maximum is due probably to the presence of the schools of spawning herring.

On the south shore of the Bay of Fundy, from Kings county to Digby county, most of the catch is made during June, July and August with the maximum catch in July. A similar condition prevails on the coast of Yarmouth to Guysboro counties but here the maximum is later and a considerable catch is made in September. It is doubtful how much this variation depends on the migrations of the herring and how much on their use as bait in the cod, haddock, and hake fisheries having summer maxima.

About Cape Breton island, Prince Edward island, the Magdalen islands and the entire coast of the Gulf of St. Lawrence south of Gaspé there is a very decided maximum in May, with relatively smaller catches continuing until October or November. Over half the catch is made in May in almost all parts and at the Magdalen islands and in Northumberland strait catches in other months are almost negligible. In the Gulf of St. Lawrence as shown by direct observation and as might be deduced from the variations of the catch, the herring approach the shores in May to spawn.

In the St. Lawrence river and on the north shore of the Gulf the maximum in May is not evident and the catch extends evenly from June to November or shows a maximum in July and August. On the north shore, particularly, the chief use to which the herring are put is as bait in the cod fishery and this is probably the limiting factor here.

Graph 25 shows the monthly variations of the catch of sardines

in the Bay of Fundy. The catch is erratic in any individual district being perhaps controlled by climatic variations or by the abundance of food in different localities. When the catch is large at Grand Manan it is made from April to November with distinct maxima on the first arrival of the sardines and in the early autumn. At Campobello and Deer islands in the mouth of Passamaquoddy bay the same phenomenon occurs with both maxima somewhat later and hardly any catch in April. The catch in Passamaquoddy bay follows that at Campobello to some extent but the decrease in the summer is not as distinct; indeed the catch may be largest in July and August. The catch on the coast of Charlotte county east of Passamaquoddy bay shows great irregularity; a fair catch may be made in April or very small. The catch in St. John county rises slowly, starting in May or June to a maximum in September.

As the catch is made in weirs it depends on the activity of the schools as well as on the presence of the fish and this possible factor must not be neglected. The variations show some indication of the progressive appearance of the sardines - first at Grand Manan, then at Campobello, and last at St. John. But not only is the spring maximum later at Campobello, as might be expected with fish approaching Passamaquoddy bay, but the catch lingers later than at Grand Manan. The data are too meagre to be able to generalize when such an erratic thing as a weir catch is concerned.

LOBSTERS.

Annual variations

In the last report by the author it was found, by a study of the annual variations of the catch of lobsters, that the coast was divisible into three districts within which similar increases or decreases occurred from year to year. The catches for several years were plotted in a number of districts about the coast and similarities in the graphs showed that the districts fell into three groups. The two most important, in distinctness and in the amount of the catch were (1) the Bay of Fundy and the coast of Nova Scotia as far as Lunenburg, and (2) the southern part of the Gulf of St. Lawrence including almost all the lobster fishing in the Gulf.

It was suggested, as an explanation of the similarities in the variations of the catch in different parts of each district, that they were due to the dispersal of the lobsters from breeding grounds or to uniform changes in conditions favourable to breeding throughout the district. The variations might be caused principally by successful and unsuccessful breeding seasons. In this case we would expect the principal breeding grounds to be near the centres of the districts. Towards the boundaries the catch would decrease, the variations would become less and the average size of the lobsters increase.

As regards the first point it was found that the boundaries of

the districts fall at places where the catch is low - as, for example, at Halifax. On the last point no data were available.

The amount of variation, expressed as the average deviation of the catch each year from the mean catch was determined for a number of districts. The catch in the Gulf of St. Lawrence is less variable than in the southern district. In the former the average variability of the districts was 33% and in the latter 21%. This may be due to the more constantly favourable conditions of breeding in Magdalen bay than about the south end of Nova Scotia.

As no care was taken to compare only districts with catches of the same order of magnitude it was found that the greater effect of chance on the small catches obscured the effect of the distance from the breeding grounds and the variability remained high. Since that time, however, the figures have been reconsidered as shown below.

In the Bay of Fundy the temperature conditions inhibit the development of larval lobsters and here we have one of the very few places where we do not have to deal with the distance of the breeding grounds in two directions. St. Mary bay is the nearest locality where favourable conditions occur. From the east side of this bay westward the variability of the catch was studied. Adjacent districts in the statistics were considered together in such a way as to make the amounts of the catch in the different districts studied as nearly comparable as possible. In each of the districts thus formed the average percentage deviation of the catch from the mean catch was calculated and the figures obtained are shown in the following table:

Districts	Average catch (cwt.)	Average percentage deviation from mean-variability	
Meteghan to Saulnierville	1,550	20	Average varia-
Little Br. to Comeauville	2,258	32	bility in St.
Church Pt. to Smith's Cove	1,192	46	Mary bay - 36
Westport	2,078	14	Average variabil-
Freeport	1,886	10	ity of catch in
Tiverton and Central Grove	2,140	9	Bay of Fundy side
Tiddville to Whale cove	2,265	13	of Digby Neck - 12
Sandy cove to Waterford	2,067	3	Average variabil-
Bay View to Litchfield	1,402	10	ity on south
Hilsburne to Hants Co.	1,080	16	shore of Bay of Fundy - 10
Grand Manan	5,279	28	
Charlotte county remaining	2,579	16	
St. John county	2,078	13	

From these figures it is apparent that the catch becomes less variable on each side of the Bay of Fundy as we proceed away from the mouth. St. Mary bay, a known breeding ground, shows the greatest variation of the catch. The fact that the catch at Grand Manan, although so large, is more variable than that on the Bay of Fundy side of Digby neck suggests that there is an immigration of lobsters to Grand Manan from the Maine coast. In any case the evidence shows a decreasing variability of the catch with increasing distance from breeding grounds. In this way, it is in favour of the view that the similar variations, in the divisions of the coast mentioned above, are due to the dispersal of lobsters from breeding grounds in successful and unsuccessful years.

MACKEREL. Scomber scombrus Linnaeus.

Distribution.

Mackerel are found, on the eastern coast of North America, from the neighborhood of Cape Hatteras to the Gulf of St. Lawrence and Newfoundland. The Strait of Belle Isle may be taken as the northern limit of their normal range, but they are, at present, of only irregular occurrence on the north shore of the Gulf, although abundant in Magdalen bay.

The distribution of the catch in the southern part of the coast was shown on a chart in a former report. Chart 18 of this report is a revision of that chart on the acquisition of local information. The changes were entirely local and were chiefly concerned with the distance offshore and the position of the fishing grounds.

There is no commercial catch on the north shore of the Bay of Fundy. On the south shore the catch decreases towards the head of the bay from a moderate catch in Digby county to extremely small catches in Scotsman bay, about Cape Chignecto and in Albert county. The catch in Digby county is principally in St. Mary bay and a moderately large catch is made from here to St. Margarets bay. About the latter and eastward to Halifax the catch is large. It is again moderately large about Canso and Ile Madame whence it falls off to a small catch in Victoria county. Mackerel do not enter the Bras d'or lakes except in the immediate vicinity of the entrances.

Chart 19 shows the distribution of the catch in the northern part of the coast for the years 1880 to 1885. The present distribution varies from this only in a larger catch at the Magdalen islands. Prior to 1880 in the early days of the fishery mackerel were abundant on the north shore of the Gulf of St. Lawrence but have been rare from 1880 to the present.

In Gulf of St. Lawrence the catch is greatest in Inverness county, at the Magdalen islands, and on grounds eastward from Shippegan and Miscou islands. In Northumberland strait it decreases

from each end towards the centre. Mackerel are rarely caught anywhere on the south shore of Prince Edward island, but at the western entrance to the strait they follow the general trend of the current eastward along the New Brunswick shore.

North of the Bay of Chaleur the catch is very small but irregular catches are scattered over the entire coast east of Godbout and Matane county on the St. Lawrence river.

Monthly variations

The monthly catches in 1924 and 1925 in six divisions of the coast are given on Graph 26. Some mackerel are caught in May on the open coast of Nova Scotia but none in the Gulf of St. Lawrence. All over the coast the most distinct maximum occurs in June. This is most important in the Gulf of St. Lawrence where fare more than half the catch is made in that one month and only small catches continue into October. On the open coast of Nova Scotia there is a second maximum in September and October after a decrease in the summer, and the catch continues into November.

The June maximum is due to the first appearance of the mackerel near shore and near the surface. They appear almost simultaneously along the Atlantic coast of Nova Scotia, but later in the Gulf of St. Lawrence. The sudden decrease and short season in the Gulf shows that soon after spawning, which is at its height about the end of June, the fish retire, if not from the Gulf, at least from the fishing grounds. The late maximum in the catch on the Nova Scotia coast suggests the latter as an attractive feeding ground after spawning and it is possible that some of the Gulf of St. Lawrence's spawners repair to this area.

POLLOCK. *Pollachius virens* Linnaeus.

Distribution

South of Cape Cod the pollock is a winter visitor as far as New York state. From Cape Cod to Cabot strait it is abundant especially in the Gulf of Maine. It ascends the Bay of Fundy only as far as the entrances to Chignecto bay and Cobequid basin. In the Gulf of St. Lawrence it occurs regularly only near the strait of Canso and is rare elsewhere in the Gulf east of Cape Chat.

The distribution of the catch (1910 to 1916) is shown on Chart 20 in which local information has been used. Owing to the size of the catch it has been impossible in some places to put all the cir-

cles in the position of the fishing grounds but this has been done as far as possible. The locality where least success was attained is at the mouth of Passamaquoddy bay where the catch is made almost entirely in the tideways between the islands. The same is true of Grand passage in Digby county.

On the north shore of the Bay of Fundy a very large catch is made at the mouth of Passamaquoddy bay and small catches extend as far as Albert county. On the south shore large catches are made in Grand and Petit passage and considerable catches as far as Scotsman bay and Cape Chignecto.

Fair catches are made from Yarmouth county to Halifax and about Canso. Small catches are made elsewhere on the open coast. In the Gulf of St. Lawrence only very small catches are made near the Strait of Canso and on the coast of Inverness county. Pollock are not fished in the Bras d'Or lakes.

Monthly variations

The monthly catches of pollock in four divisions of the coast in 1925 are shown on Graph 27. As one year is not enough on which to base generalizations only the salient features are mentioned here. Although a few pollock are caught throughout the year in the inshore cod fishery of Shelburne county no considerable catch is made until May. All divisions showed some catch in May 1925, from Charlotte county to Guysboro county. In Charlotte county a very large late summer and early autumn catch was made. No catch was made in November except in Digby county and Shelburne county where the catch extended to December.

SALMON. *Salmo salar* Linnaeus.

Distribution.

The Atlantic salmon is found from Cape Cod north to Hudson bay. Its abundance in salt water is limited to the neighborhood of rivers suitable for spawning. Of late years dams and pollution have rendered many rivers, where salmon were formerly abundant, unsuitable. Particularly this is true of the southern part of its range.

Chart 21 shows the distribution of the catch in the southern part of the coast and Chart 22 that in the northern part. Local information as regards the fishing grounds was used only in the former. Only sea fisheries are shown.

Salmon are present in all parts of the Bay of Fundy except the coast of Charlotte county, but large catches are found only from the mouths of the rivers used by the salmon for spawning westward towards the mouth of the bay. The most important fishery is that of the St. John river. The sea fishery extends from St. John harbour to Point Lepreau. The rivers of Minas basin support a considerable fishery in the basin itself and on the coast of Kings and Annapolis counties.

From the Bay of Fundy to Cabot strait small catches are made particularly just west of Halifax and from Victoria county. A few salmon are found in the Bras d'Or lakes from Baddeck to West bay.

With the exception of the Magdalen islands and the south and west coasts of Prince Edward island salmon are caught over the entire coast of the Gulf of St. Lawrence east of Quebec. A considerable fishery depends on the Margaree river and extends over the northern half of the coast of Inverness county, C. B. From Pictou harbour to the Gut of Canso a fair catch is made. The largest fishery on the whole Canadian coast is at the mouth of the Miramichi river. The Restigouche river supports a considerable fishery from its mouth eastward along the south shore of the Bay of Chaleur. Elsewhere in the Gulf the catch is small.

Monthly variations

The significance of the monthly variations of the catch is lessened by the existence of a closed season for net fishing starting in tidal waters on September 1 and in non-tidal waters on August 16. The fishery shown on the chart and treated in the monthly figures is almost entirely a sea fishery. The monthly figures for the catch show, however, that salmon first appear in numbers, near the coast and where they are caught, in May. This is true for the entire coast except from Annapolis county to Halifax county where very small catches may be made in April. The catch has reached its height by June and continues so until the close of the season.

SMELT. *Osmerus mordax* Mitchill.

Distribution

Smelts are found regularly as far south as New Jersey and are reported from Virginia. Their range extends north to Newfoundland and the Gulf of St. Lawrence. On the north shore of the Gulf they are rare. They enter streams to spawn and are often landlocked. Smelts are limited to a narrow shore zone and the neighborhood of streams for spawning.

Chart 23 shows the distribution of the catch in the southern

part of the coast, and chart 24 that in the northern part. Local information as regards the fishing grounds was available only for the southern part. Where the catch is large it is made almost entirely between the mouths of estuaries and the head of the tide. In the case of some small rivers where a considerable catch is made it has been necessary to place the dots on the land bordering the fishing grounds.

Although smelts are present in small numbers all along the shores of the Bay of Fundy only small and isolated commercial catches are recorded at Passamaquoddy bay, Cumberland basin, Cobequid bay, Digby and St. Mary bay. Small catches are made at the heads of the bays all along the Nova Scotia coast outside the Bay of Fundy. Smelts are caught in the Bras d'Or lakes from Baddeck to West bay. The catch in Prince Edward island is somewhat larger particularly in the harbours on the north coast.

Large catches of smelts extend from Baie Verte on the south shore of Northumberland strait to the Restigouche river. The Miramichi at the centre of this district has the most productive fishery. In the southern part of this district the fishing is limited very largely to the mouths of rivers below the head of the tide, but in the Bay of Chaleur and about Shippegan and Miscou islands the catch may be made along the shore or in bays away from rivers.

Small catches are made from the Bay of Chaleur to the St. Lawrence river and on both sides of the river as far as Quebec. No catch is made about Anticosti island and the only catch recorded in the years on which the chart is based is in the neighborhood of Natashquan. The chart for the northern part of the coast (Chart 24) is based on the statistics for the years 1918 to 1923 as earlier reports did not give the smelt catch in Quebec.

Monthly variations

In the Maritime provinces smelt gill net fishing is permitted from October 15 to February 15 and smelt bag-net fishing from December 1 to February 15. Throughout this open season the catch shows no variation which may not be attributed to weather or chance. The fishery depends on the gathering of the smelt in the estuaries and harbours during the winter prior to the spawning migration in early spring.

SWORDFISH. Xiphias gladius L.

Distribution

The swordfish is an abundant summer visitor from New York to the Newfoundland banks. Swordfish do not enter the Bay of Fundy or

the Gulf of St. Lawrence except in the vicinity of Cabot strait.

The catch is made from Yarmouth county to Northern Inverness county. Within these limits which are fairly constant the districts of large catch change. From 1910 to 1916 the largest catches were made from Lunenburg to Halifax and in Guysboro county. More recently the largest catch has been made from Cape Breton county.

Monthly variations

Graph 28 gives the monthly catches in five districts from Yarmouth county to Inverness county for the years 1924 and 1925. In all parts of the coast the catch is at a maximum near the beginning of September. Small catches may be made in July - never in June, but no considerable catches are made until August. The catch decreases suddenly in October and for these years no catch is recorded in November. The forerunners of the swordfish appear late in July. The numbers increase until early in September and then decrease quickly so that few are caught in October and none in November. The time of arrival and departure appears to be almost the same over the entire coast.