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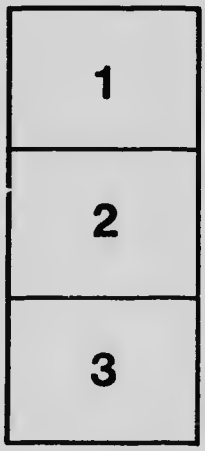

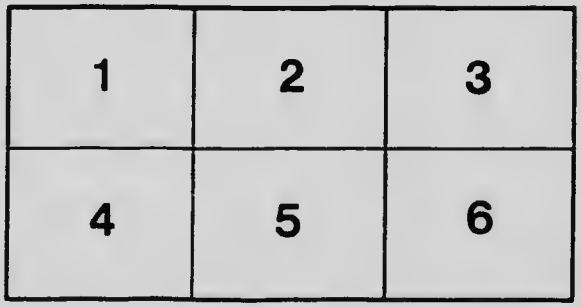

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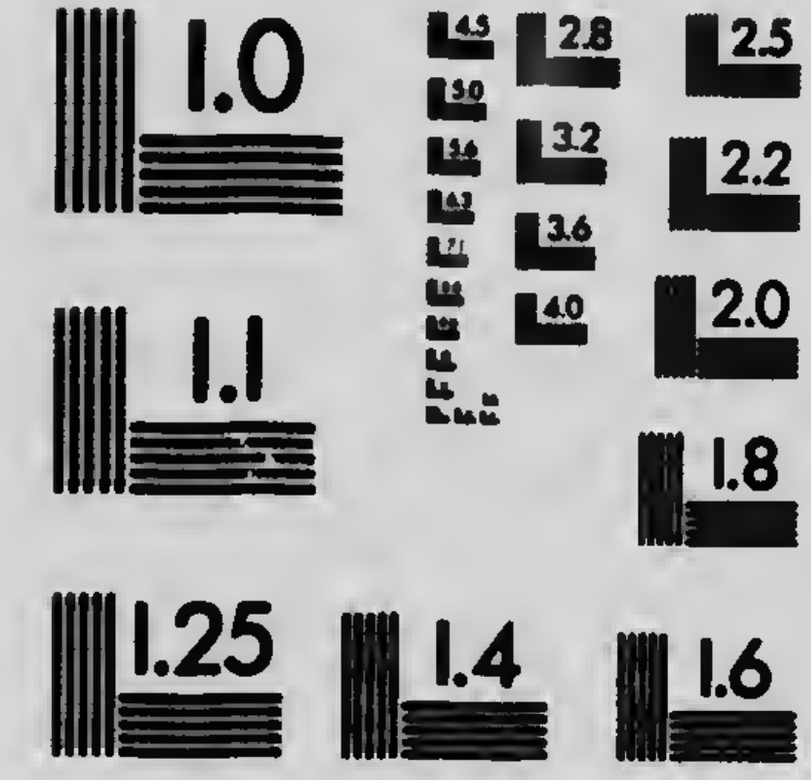

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THE AGE AND GROWTH OF THE POLLOCK

IN

THE BAY OF FUNDY

By Professor JAMES W. MAVOR, Ph.D., Union College, Schenectady, N.Y.

(With One Diagram).

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ON THE AGE AND GROWTH OF THE POLLOCK IN THE BAY OF FUNDY.

I.—INTRODUCTION.

The present report represents the results of studies on the age and growth of pollock caught in the Bay of Fundy during the years 1915 and 1916. A report Mr. Douglas Macallum, prepared under the direction of the present writer, then curator of the St. Andrews Biological Station, dealing with the pollock caught in 1914, is already in the press. Mr. Macallum's report refers particularly to the older pollock of from three to six or more years growth, as determined by their scales. Besides working out the rate of growth of these pollock, he obtained indications that the most frequent year class was that of 1909. Some of the results of this report are included in the present paper for comparison with the data obtained in 1915 and 1916.

The object of the investigation has been to determine: (1) the distribution of the young pollock, (2) the rate of growth of young pollock during their first two or three years, (3) the relative frequency of the different year classes in typical commercial catches.

The writer is indebted to the members of the staff of the Biological Station at St. Andrews in 1915 and 1916 for assistance in measuring and taking the scales from fish. He is particularly indebted to Mr. E. Horne Craigie for the measurements made in July, 1915, and to Dr. A. G. Huntsman, the curator of the Station, for assistance and advice in obtaining the young pollock in 1916.

II.—METHODS OF MEASURING FISH AND STUDYING SCALES.

Two measurements for length have been employed. The *standard length* is measured from the tip of the snout to the end of the vertebral column (easily determined by feeling with the fingers). The *total length* is measured from the tip of the snout to the end of the tail, the caudal fin having its normal spread. In the case of fish over 20 cm. in length the measurements are always to the nearest centimeter; in the case of the smaller fish, under 20 cm., to the nearest millimeter. The standard length was chosen at the beginning of these investigations for the following reasons: (1) It can be more accurately determined by the ordinary methods, (2) it is not affected by the position or spread of the tail or by injuring the tail, (3) it measures the actual length of the body of the fish, (4) it has been found by Hjort, in the case of herring, that a better correspondence between actual lengths and lengths as calculated from the position of the rings on the scales is obtained by taking a length V measured from the anterior end of the pectoral fin to the end of the vertebral column, than by taking the total length. The standard length differs from V by the length of the head only, while the total length differs by the length of head and tail. The total length has been recorded for comparison with the measurements of the European investigators who use this length.

In 1914 the standard length only was recorded. In 1915, for catches No. 1 and No. 2, both the standard and total lengths were recorded, and for catches No. 3 to No. 5 only the standard lengths. In 1916 for catches No. 1 to No. 40, both standard and total lengths were recorded and for catches No. 41 to No. 62, the total length only.

The scales of the fish were taken in most cases from a region marked by the end of the right pectoral fin when extended along the side of the body in a posterior

direction. When the region had been injured either in capture or transport, the nearest uninjured region to this was used. The scales were stored in envelopes on which the length of the fish and other data were written. For microscopic study the scales were cleaned and flattened between two slides. In calculating the proportional lengths from the position of the winter rings, the positions of the outer edges of the winter rings were marked on strips of paper so placed that the edge of the paper coincided with the camera lucida image of the antero-posterior diameter of the scale in its anterior part. These strips were then placed on the apparatus devised by Hjort and the proportional lengths read off. For each fish, at least two scales were examined in this way.

III.—THE FIRST YEAR'S GROWTH.

A number of small Pollock, shown by their scales to be in their first year of growth were obtained. The greater number of these were caught in a shore seine about two fathoms in depth and twenty fathoms in length. The hauls were made in two localities and were as follows:

A.—North of Wilson's beach, Campobello island. Wilson's beach is on the western side of Campobello island and faces a stretch of tidal water lying between this island and the islands to the west of it, often called by the fishermen "The River". The Western shore of Campobello island descends somewhat abruptly, and, in consequence, the tidal current comes close to the shore. The hauls were made at about the time of low water on the morning of August 4, at which time many small pollock ranging around 35 cm. in length were seen in schools inshore. The results of these five hauls all made within a mile or two of each other, are grouped together and labelled catch No. 19. The separate hauls are given below.

Haul No. 1.—The seine was set a considerable distance from the shore so that the corks went under. The catch consisted of four pollock under 11 cm. and 1 pollock 42 cm. total length, and one flounder.

Haul No. 2.—The seine was set so that the cords just remained afloat. The catch consisted of seventeen pollock between 28 and 47 cm. total length, and no other fish.

Haul No. 3.—This was a short haul, the seine being set at about its own depth. The catch consisted of a few flounders and skulpins.

Haul No. 4.—This was a deep haul, the seine being set at about twice its own depth, the corks being completely under, on a beach covered with kelp. The catch consisted of fifteen pollock under 11 cm. total length, four skulpins, four flounders, and two sea ravens.

Haul No. 5.—This haul was made in shallow water and went foul of rocks. The catch consisted of a few flounders and a few skulpins.

B.—Bliss island. These hauls were made on the shores of a small island in the bay of Fundy, northeast of Campobello island and southwest of L'Etang harbour, where, as in the case of Wilson's beach, strong tides run. In all, six hauls were made and the catches numbered 28 to 33. Three hauls were made at low water on the evening of August 16, the seine being set in about its own depth. The hauls yielded the following small gadoids:—

Haul No. 1.—Two hake.

Haul No. 2.—Two pollock, forty-four cod, numerous hake.

Haul No. 3.—One pollock, two cod.

Three hauls were taken at the next low water on the morning of August 17, yielding the following small gadoids:—

Haul No. 1.—Numerous hake.

Haul No. 2.—Five pollock, four cod, and four hake.

Haul No. 3.—Four hake.

The length frequencies of the twenty-seven small pollock obtained in catches 19 and 29 to 32 are given in table 1.

The length frequencies of the fish caught in the seine catches 19 and 29-32 form rather even curves with a mode at 8 cm. and 9 cm. The mean standard length of these fish, as calculated from measurements made to the nearest millimeter, is 8·7 cm., and the mean total length, as calculated in the same way is 9·7 cm.

The scales of these fish show a series of rings of plates corresponding to the centres of the scales of longer pollock. The number of these rings is from 4 to 10. In no case were the rings of plates close together, indicating winter growth.

In 1913 five small pollock were caught in the shore seine at Sandy Cove, N.S. Their length frequencies were as follows:—

Total lengths	7 cm.	8 cm.	9 cm.	Standard lengths	7 cm.	8 cm.
Frequency	1	1	3	Frequency	2	3

The measurements were made to the nearest millimeter, and the mean total length was 8·2 cm. and the mean standard length 7·4 cm.

Seven other small pollock were obtained, five from weirs which had been seined for herring and two caught on hook and line from the station wharf. The length frequencies of these fish are given in table 2, and show that these fish were larger than those caught in the shore seine. Their mean standard length was 12·2 cm. and their mean total length was 13·3 cm. Their scales corresponding to their larger size show a greater number of rings of plates but do not show any winter rings. So far as any importance can be attached to the occurrence of these seven fish, it would seem to indicate that the young, after they attain a certain length, about 11 cm., move into slightly deeper water where they are not caught by the shore seine.

IV—THE SECOND YEAR'S GROWTH.

Among the pollock caught in the shore seine at Wilson's beach on August 4, as described in the previous section and grouped together as catch No. 19, eighteen were between 29 and 45 cm. total length. Two of these, specimens No. 660 and No. 661, 29 and 32 cm. total length, show only a single winter ring in their scales. The lengths of these fish at the end of their first winter as calculated from the positions of the winter rings in the scales is shown in table 3.

It is to be noted that these fish are probably large for their age being caught in a shoal with large fish. They constitute, however, the only data the writer has been able to obtain on pollock in their second year's growth. It is hoped in future work to fill this unfortunate gap in the investigations.

V.—THE THIRD YEAR'S GROWTH.

In all seventy-three pollock in their third year were caught. They were all caught in the shore seine near Wilson's beach, Campobello island, and are included in catches 17 and 19.

Catch 17 was taken on the morning of August 3, 1916, when numerous schools of small pollock were seen close inshore just north of Wilson's beach, and the shore seine was set at low water. One haul yielded fifty-seven specimens ranging between 30 cm. and 47 cm. in total length. The seine was rapidly hauled in over a rocky bottom and the only other fish caught was one *Pseudopleuronectes americanus* 35 cm. in length. The scales of these pollock all show two winter rings. The length frequencies are given in table 4. The mean total length is 39.3 cm. and the mean standard length is 36.4 cm.

Catch No. 19 has already been described in a previous section. It included sixteen pollock whose scales showed two winter rings. The total lengths of these fish at the ends of their first and second winters, as calculated from their scales, are given in table No. 5. The lengths given are, in each case, the average of two measurements on different scales. The mean total lengths of two-year old fish of the catch are, at the end of the first winter, 15.4 cm. and at the end of the second winter, 31.8 cm. The mean length of the fish when caught on August 4 was 39.2 cm. The mean increase in total length during the second year, t_2, was 16.4 cm. and the mean increase during the third year up to August 4 was 7.4 cm. The length frequencies of the fish in the different years of their growth are shown in table 6. The corresponding figures for the standard lengths are: mean standard length at end of first winter, 14.1 cm.; mean standard length at end of second winter, 31.3 cm; mean standard length when caught on August 4, 35.9 cm.

VI.—THE FREQUENCY OF THE DIFFERENT YEAR CLASSES IN THE YEARS 1914, 1915 AND 1916.

From measurements made on 1,250 pollock caught in July, 1914, Mr. Douglas Macallum constructed a length frequency curve, given in the paper already referred to. This curve, as Mr. Macallum noted, shows two modes, one at 63 cm., and one at 68 cm., the former being the more prominent one. The mean length of 6-year old fish (67.8 cm.) corresponds closely with the frequency curve at 68 cm., as scale studies show, and the mean length of 5-year old fish (63· cm.) with the mode at 62 to 63 cm. The most prominent mode is at 63 cm., i.e., 5-year old fish, or the class of 1909.

The material for the study of the pollock in 1915 consisted of the measurements and scales of 652 fish obtained in five catches from Casco bay, off Campobello island, New Brunswick. The first two of these catches were made on June 22, and included 331 fish, the other three catches were made on July 16, and included 321 fish. The length frequencies of these pollock, both the actual numbers caught and the per cent in each centimeter class, are given in table 7. In catches 1 and 2, both the standard and the total lengths were measured while the catches 3 to 5, only the standard lengths were taken. The table gives the standard lengths for all five catches and, in addition, the total lengths for catches 1 and 2. From the column in the table giving the per cent of specimens in each centimeter class for the first two catches and the similar column for the last three catches, it will be seen that they agree in showing the most frequent classes at 65 and 66 cm. Since the distribution of lengths in the catches is similar and since the catches were chosen at random, it would seem fair to assume that they represent correctly the distribution in point of size of fish caught during June and July in the vicinity of Campobello island. The frequency curve for the standard lengths of catches 1 to 5 is shown in the graph where the lengths have been grouped in 2 cm. classes and the frequencies plotted in per cent. This curve has a single mode at 66 cm., corresponding to the most frequent class in the per cent column. An examination of the scales of the fish from a typical catch, catch 2, was made in the

following manner: The envelopes, each containing the scales of a single fish, were arranged in the order of the standard lengths of the fish; the scales from every fourth envelope were examined and the number of rings counted. In this way, without examining scales from all the fish, scales from a representative sample of the catch were examined. The numbers of fish in each year class are shown in table 8. The mean standard length of the 5-year old fish of the class of 1910 was 63·9 cm., and that of the 6-year-old fish of the class of 1909 was 67·4 cm. The mode on the 1915 frequency curve is therefore seen to be due to the greater frequency of the 6-year-old fish of the class of 1909, or the same which gave rise to the most prominent mode in the 1914 frequency curve. The mean standard length of catches 1 and 2 is 67·5 cm., and the mean total length is 72·8 cm.

The material for the study of the pollock of three winters and over, in 1916, consisted of measurements of thirty-two catches made near Campobello island between July 10 and October 16. The first eleven of these catches, Nos. 2 to 18, were measured by the writer, both the standard and the total length being recorded and scale samples taken from each fish. The remaining catches were measured by Capt. Sheppard Mitchell of the Biological Station staff, and the total lengths recorded. The dates and locations of the catches and the number of pollock they contained are given in table 9.

The length frequencies of these catches have been tabulated and catches grouped according to the date of capture. Catches 2 to 12 were made betwen July 10 and 14; their standard length frequencies are given in table 10, columns I to X. From column IX it can be seen that the mode for these catches is about 66 c.m. The mode for catches 15 to 18 is seen from column XIV to be also 66 cm., although the frequencies of the 67 and 68 cm. classes are also large. Catches 2 to 18, which contain 567 fish, have been combined in columns XVI and XVII, which give the length frequencies in per cent. These columns show that the mode, in this case, is to be placed at 67 cm. The mode at 67 cm. is slightly in advance of the mode of the 1915 curve which is at 66 cm.

In the case of the remaining catches, numbers 41 to 62, the total length only was recorded. The catches are grouped according to the time of capture, July, August, first half of September, latter half of September, and October. In each of these groups the combined length frequencies of the separate catches, the per cent length frequency obtained by reducing the combined frequencies to per cent of the total number of fish concerned and the per cent frequency in classes of 2 centimeter intervals are given. The later percentages are each obtained by adding two of the percentages of the previous column. They are entered opposite the length of even number although they really correspond to a length which is the mean of the length of the two classes, the percentages of which were added, e.g. in column IV the per cent 8·0 corresponds to a length of 63·5 cm. The percentages in 2 centimeter classes are given because they make possible a more rapid inspection of the table. From table 11 it will be seen that the mode for catches 2 to 18 is 74cm., which may be taken to be the total length corresponding to 67 cm. The mode for catches 41 to 62 is at 80 cm. and it will be noted that this is approximately the mode of the separate groups of catches. The total length 80 cm., may be considered to correspond approximately to a standard length of $67/74 \times 80$ cm. or 72·5 cm.

During the summer of 1916, pollock were scarce around Campobello island, but they became more plentiful in the autumn. The catches 41 to 62 measured by Captain Mitchell are therefore regarded as more typical. It is these measurements which I have used in constructing the curve for 1916 in the graph. As these were measurements of the total length and the measurements for 1914 and 1915 were of the standard length the curve has been moved in the diagram so that its actual mode at 80 cm. comes at 72 cm. This has been done merely for the purposes of comparison. The form of the curve for total lengths is of course different from that for standard lengths. It is also to be considered that this curve represents fish caught later in the year than those used

for the 1914 and 1915 curves, a fact which would make the corresponding modal length less than that shown.

The numbers of winter rings have been counted for the scales of the fish of catches 3, 6 and 7, and the results are shown in table 12. The table shows that these catches, which had a mode at 67 cm., were composed predominately of 6-year-old fish. This being the case, the mode at 72 cm. of the curve for catches 41 to 62 shown in fig. 1, probably corresponds to the 7-year-old fish or the fish of the 1909 year class, the same which gave rise to the modes in the 1914 and 1915 curves.

VII.—SUMMARY.

1. It has been found that young pollock showing in their scales no winter rings and therefore probably in their first year's growth occur in shallow tidal water on the western coast of the Bay of Funday.

2. Data as to the rate of growth during the first two years are given.

3. Evidence is given for believing that the 1909 class has been the most abundant during the three years 1914, 1915, and 1916.

VIII.—TABLES.

TABLE 1.—Length Frequencies of Small Pollock caught in shore seine in 1916.

A. Standard Lengths—Numbers in columns represent number of specimens in centimeter groups.

Length	7 cm.	8 cm.	9 cm.	10 cm.	11 cm.
Catch 19	3	6	8	2	-
Catch 29-32	-	3	-	4	1
Total	3	9	8	6	1

B. Total Lengths—Numbers in columns represent number of specimens in centimeter groups.

Length	7 cm.	8 cm.	9 cm.	10 cm.	11 cm.	12 cm.
Catch 19	2	4	7	5	1	-
Catch 29-32	-	1	2	-	4	1
Total	2	5	9	5	5	1

TABLE 2.—Length Frequencies of Small Pollock, Catches Nos. 21-26, five seined in herring weirs and two caught with hook and line from Station wharf August 3 to 9.

A—STANDARD LENGTHS.

Lengths	11 cm.	12 cm.	13 cm.	14 cm.	15 cm.
Frequency	3	1	1	2	-

B—TOTAL LENGTHS.

Lengths	11 cm.	12 cm.	13 cm.	14 cm.	15 cm.
Frequency	1	2	1	1	2

TABLE 3.—Calculated Lengths of Pollock from Catch No 19, showing a Single Winter Ring.

	Standard Lengths.		Total Lengths.	
	1st. Ring.	Length.	1st. Ring.	Length.
Specimen 660	19 cm.	27 cm.	20 cm.	29 cm.
" 661	20	29	22	32

TABLE 4.—Length Frequencies of Pollock of Catch 17.

A. Standard Length Frequencies in Centimeter Classes.

Cm. Class	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Frequency	1	-	1	-	-	1	1	8	10	16	3	3	2	3	3	3	1	1

B. Total Length Frequencies in Centimeter Classes.

Cm. Class	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Frequency	1	-	1	-	-	1	1	7	11	14	5	2	2	2	4	3	2	1

TABLE 5.—Lengths of Pollock of Catch 19 at the end of each of their first two winters as calculated from their scales and their lengths when caught.

Specimen No.	Standard Length.			Total Length.		
	1st. Ring. 1915.	2nd. Ring. 1916.	Edge. 1916.	1st. Ring. 1915.	2nd. Ring. 1916.	Edge. 1916.
662	12	27	32	13	30	35
663	12	29	34	13	32	37
664	14	28	33	15	32	37
665	13	31	35	14	34	38
666	14	29	35	15	32	38
667	14	28	36	15	30	39
668	13	32	36	14	35	39
669	14	31	36	16	34	39
670	15	32	36	16	35	39
671	17	31	36	19	33	39
672	14	32	36	15	36	40
673	14	33	37	15	36	40
674	17	34	37	19	37	40
675	13	33	38	14	36	41
676	13	33	37	14	36	41
677	17	37	41	19	40	45
Mean	14·1	31·3	35·9	15 4	31·8	39 2

TABLE 6.—Length Frequencies of Pollock of Catch No. 19, those at the end of first and second winters being calculated from their scales.

Length cm	13	14	15	16	17	18	19
Frequency	2	4	5	2	-	-	2

Length cm	30	31	32	33	34	35	36	37	38	39	40
Frequency	1		3	1	2	2	4	1	-	-	1

Length cm	35	36	37	38	39	40	41	42	43	44	45
Frequency	1	-	2	2	5	3	2	-	-	-	1

TABLE 7.—Length Frequencies of Pollock caught in 1915 and Comprising Catches Nos. 1 to 5.

Length in cm.	Standard Lengths.								Total Lengths.		
	No. in Catch.		% in each cm. class.	No. in Catch			% in each cm. class.		No. in Catch.		% in each cm. class.
	1	2	1-2	3	4	5	3-5	1-5	1	2	1-2
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
52	1		·3					·2			
55				2			·6	3			
56					2	1	1·0	·5			
57				1		2	1·0	·5	1		·3
58	4	1	1·5	1	1		·6	1·4			
59	2	3	1·5	2			·6	1·4			
60	2	4	1·8	3	3		1·9	1·8			
61	7	5	3·6	5		1	1·9	2·8			
62	19	10	8·8	6	9	6	6·7	7·7			
63	20	13	10·0	5	5	1	3·5	6·7			
64	24	12	10·9	8	12	2	7·1	8·9	4	1	1·5
65	27	11	11·5	10	15	13	12·2	11·7	2	3	1·5
66	19	20	11·8	9	15	7	9·9	10·7	1		·8
67	15	9	7·3	5	16	9	9·6	8·3	8	5	3·9
68	13	12	7·6	9	19	8	11·6	9·4	9	11	6·1
69	3	7	3·0	7	11	7	8·0	5·4	19	12	9·4
70	8	8	4·8	6	7	6	6·1	5·4	22	9	9·4
71	7	5	3·6	1	5	5	3·5	3·5	15	10	7·6
72	9	2	3·3	2	3	8	4·2	3·7	25	14	11·8
73	4	4	2·4	4	2	1	2·2	2·3	19	18	11·2
74	4	1	1·5	3	2	2	2·2	1·8	13	7	6·1
75	2	5	2·1	2	2	6	3·2	2·6	10	8	5·4
76	2	2	1·2	1		1	·6	·9	7	7	4·2
77	1	1	·6	1		4	1·6	1·4	5	5	3·0
78	2		·6		1	1	·6	·6	5	7	3·6
79	1		·3	1		2	·9	·6	7	4	3·3
80						2	·6	3	8	4	3·6
81					1		·3	·2	4	1	1·5
82						1	·3	·2	4	1	1·5
83									1	4	1·5
84									2	1	·9
85									2	3	1·5
86											
87									3		·9
Total..	196	135		94	131	96					

NOTE.—Lengths are to nearest centimeter.
Numbers refer to catch numbers.
Date of Catches Nos. 1-2, June 22.
Date of Catches Nos. 3-5, July 16.

TABLE 8.—The Age Frequencies of Pollock caught in 1915, Catches 1 to 5.

Number of winter rings	4	5	6	7	8
Year class	1911	1910	1909	1908	1907
Frequency	1	13	17	2	1

TABLE 9.—Catches of Pollock examined in 1915.

Catch.	Date.	Place.	No. of Pollock.
2	July 10..	Off East Quoddy Light, Campobello Island	10
3	" 11..	do.	66
6	" 12..	do.	45
7	" 13..	do.	74
10	" 14..	do.	29
11	" 14..	do.	45
12	" 14..	do.	31
15	Aug. 2..	Wolves	68
16	" 2..	"	168
18	" 3..	Off Casco Bay Island, Campobello Island	31
41	Sept. 4.	Off Pope's Folly, near Campobello Island	40
42	" 4..	do.	40
43	" 4..	do.	33
44	" 5..	do.	55
45	" 6..	do.	24
46	" 7..	do.	21
47	" 7..	do.	15
48	" 7..	do.	22
49	" 11..	do.	11
50	" 11..	Off Green Island Shoal, near Campobello Island	10
51	" 20..	do.	19
52	" 28..	do.	25
53	" 28..	do.	21
54	" 28..	do.	41
55	Oct. 2..	do.	96
56	" 3..	do.	139
57	" 4..	do.	87
58	" 5..	do.	98
59	" 6..	do.	89
60	" 7..	Off Pope's Folly, near Campobello Island	94
61	" 12..	Off Indian Island, near Campobello Island	100
62	" 16..	Off Green Island Shoal, near Campobello Island	78

TABLE 10.—Standard Length Frequencies of Catches 2 to 18.

Frequency in each catch.								Catches 2-12, July 10-14.		Frequency in each catch.			Catches 15-18, August 2-3.		Catches 1-18, July 10-Aug. 3.	
Length in cm.	Catch 2, July 10.	Catch 3, July 11.	Catch 6, July 12.	Catch 7, July 13.	Catch 10, July 14.	Catch 11, July 14.	Catch 12, July 14.	Per cent in each cm. class. 1 cm.	2 cm.	Catch 15, Aug. 2-XI. " 16, " 2-XII. " 18, " 3-XIII.			Per cent in each cm. class. 1 cm.	2 cm.	Per cent in each cm. class. 1 cm.	2 cm.
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
40							1	·3	·3						·2	·2
47							1	·3	·3						·2	·2
50										2			·4	·4	·2	·2
51			1					·3	·3		1		·4		·4	
52				1				·3	·6					·4	·2	·6
53				3				1·0		1	1		·7		·9	
54				1		3		1·3	2·3	5	2		2·6	3·3	1·9	2·8
55		2		1	1	1	2	2·3		3	4		2·6		2·5	
56		1		1		3	2	2·3	4·6	4			1·5	4·1	1·9	4·4
57		3	1	3	4	3	2	5·3		1	6		2·6		4·1	
58			4	3		3	2	4·0	9·3		2	1	1·1	3·7	2·7	6·8
59		4	3	2		4	3	5·3			1		·4		3·0	
60		3	2	2		4	3	4·7	10·0		2		7·7	4·1	2·5	5·8
61	1	4	1	3	3	4	2	6·0		2	5		2·6		4·4	
62	2	5	2	6	2	4	1	7·3	13·3		1	3	1·5	4·1	4·6	9·0
63	2	2	2	4	1	5	2	6·0			8	1	3·4		4·8	
64	1		4	3	3	3	1	5·0	11·0	2	13	1	6·0	9·4	5·5	10·3
65		4	7	6	3		3	7·7		5	9	1	5·6		6·7	
66		6	3	6	4	4	1	8·0	15·7	8	18	2	10·3	15·9	9·2	15·9
67	1	3	2	5	1	2		4·7		7	16	2	9·4		6·9	
68	1	8	3	9	1	1	1	8·0	12·7	6	12	5	8·6	18·0	8·3	15·2
69		4	2	4		1	1	4·0		4	11	4	7·1		5·5	
70	1	5	3	2	1		2	4·7	8·7		13	1	5·3	12·4	5·0	10·5
71	1	2	1	1				1·7		6	5	3	5·3		3·4	
72		5		3	1		1	3·3	5·0		5	1	2·3	7·6	2·8	6·2
73		3		1	1			1·7		3	5	4	4·5		3·0	
74		1	1	1	1			1·3	3·0	1	5		2·3	6·8	1·8	4·8
75				2	2			1·3			7		2·6		1·9	
76		1						·3	1·6	4	3		2·6	5·2	1·4	3·3
77			1					·3		3	3		2·3		1·2	
78										1	1	1	1·1	3·4	·5	1·7
79											5		1·9		·9	
80			1					·3	·3		4		1·5	3·4	·9	1·8

81	......	......	1	......	......	......	......	·3	......	......	......	......	......	......	·2	
82	......	......	......	1	......	......	......	·3	·3	......	......	1	·4	·4	·1	·6
83	......	......	......	......	......	......	......	......	......	1	......	......	·4	......	·2	
84	......	......	......	......	......	......	......	......	......	......	......	......	......	·4	......	·2
Total	10	66	45	74	29	45	31	......	......	68	168	31	......	......	......	......

TABLE 11.—Total length frequencies of catches 2 to 62.

	Catches 2-12, July 10-14.			Catches 15-18, August 2-3.			Catches 41-50, September 4-11.			Catches 51-54, September 20-28.			Catches 55-62, October 2-16.			Catches 2-18.		Catches 41-62.	
	Combined frequency.	% in each cm. class.	% in each 2 cm. class	Combined frequency.	% in each cm. class.	% in each 2 cm. class	Combined frequency.	% in each cm. class.	% in each 2 cm. class	Combined frequency.	% in each cm. class.	% in each 2 cm. class	Combined frequency.	% in each cm. class.	% in each 2 cm. class	% in each cm. class.	% in each 2 cm. class	% in each cm. class.	% in each 2 cm. class
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
44	1	3	3														2		
52	1	3	3														2		
55	0	0		1	4								1	1				1	
56	0	0	0	0	0	0							0	0	1		2	0	1
57	1	3		1	4								0	0	0			0	
58	3	10	13	2	7	11							0	0	0		13	0	0
59	3	10		5	19								2	3		14		2	
60	6	20	30	5	19	38							0	0	3	19	33	0	2
61	6	20		7	26								3	4		23		3	
62	8	27	47	2	7	33							1	1	5	18	41	1	4
63	12	40		7	26								3	4		34		3	
64	12	40	80	3	11	37							3	4	8	26	50	3	6
65	11	37		0	0								11	14		19		9	
66	13	47	84	2	7	7	1	4	4				11	14	28	26	45	10	19
67	15	50		3	11		2	7		1	9		20	26		32		20	
68	17	57	107	8	30	41	3	11	18	5	43	52	20	26	52	44	76	24	44
69	18	60		7	26		4	15		1	9		16	21		44		18	
70	13	47	107	7	26	52	1	26	41	2	17	26	28	33	54	35	79	30	48
71	15	50		15	56		3	11		4	34		29	37		53		31	
72	17	57	107	21	79	135	10	37	48	3	26	60	31	40	77	67	120	38	69
73	22	73		18	67		11	41		6	52		41	53		71		50	
74	16	53	126	26	98	165	6	22	63	6	52	104	58	74	127	74	145	50	110
75	27	90		19	71		16	59		12	103		42	54		81		60	
76	11	37	127	18	67	138	26	96	155	12	103	206	57		127	51	132	81	141
77	10	33		14	52		11	41		6	52		57			42		72	
78	7	23	56	10	37	89	20	74	125	14	121	173	33	54	180	30	72	86	158
79	10	33		8	30		23	85		9	77		23	76		32		86	
80	8	27	60	14	52	82	28	102	187	9	77	154	28	81	157	39	71	86	164
81	3	10		6	22		15	55		5	43		22	67		16		62	
82	6	20	30	4	15	37	16	58	113	9	77	120	32	42	109	18	34	56	112
83	2	10		5	19		17	63		5	43		22	28		14		38	
84	1	3	13	1	3	45	7	26	89	0	0	43	14	18	46	11	28	18	56

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85..........	1	·3	......	5	1·9	......	9	3·3	......	1	·9	......	8	1·0	......	1·1	......	1·5	......
86..........	......	......	·3	6	2·2	4·1	7	2·6	5·9	4	3·4	4·3	5	·6	1·6	1·1	2·2	1·4	2·9
87..........	......	......	......	1	·4	......	6	2·2	......	1	·9	......	3	·4	......	·2	......	·9	......
88..........	......	......	......	4	1·5	1·9	9	3·3	5·5	1	·9	1·8	4	·5	·9	·7	·9	1·2	2·1
89..........	......	......	......	4	1·5	......	6	2·2	......	......	......	......	3	·4	......	1·1	......	·8	......
90..........	......	......	......	1	·4	1·9	8	3·0	5·2	......	......	......	......	......	·4	·4	1·5	·7	1·5
91..........	......	......	......	0	·0	......	......	......	......	......	......	......	......	......	......	·0	......	......	......
92..........	......	......	......	1	·4	·4	......	......	......	......	......	......	......	......	......	·2	·2	......	......
Total in caches......	300	......	......	267	......	......	271	......	......	116	......	......	781	......	......	......	......	......	......

TABLE 12.—Length frequencies of the Pollock of catches 3, 6 and 7, arranged according to age and catch.

Length in millimetres	Catch 3. No. of winter rings.			Catch 6. No. of winter rings.			Catch 7. No. of winter rings.		
	4	5	6	4	5	6	4	5	6
51				1					
52							1		
53							3		
54							1		
55	2						1		
56	1						1		
57	3				1		2	1	
58				4				3	
59		4		1	2			2	
60		2	1		2			2	
61	1	2	1		1		1	1	1
62		5			2			6	
63		2			1	1		2	1
64					1	3	1	1	
65		1	3		4	2		1	4
66		2	2		3	1		2	3
67		2	2			2		1	4
68		5	5		1	2		1	8
69		3	3		1	1		1	3
70		2	2		2	1		1	2
71		1	1			1			
72		3	3					1	2
73		2	2						1
74		1	1			1			1
75								1	1
76		1	1	1					
77									
78									
79									
80									
81									
82									1
Total...	7	38	27	7	20	15	11	27	32
Mean lengths..	56·9	62·9	68·6	59·9	63·8	66·3	55·9	63·3	68·4

Curves showing length frequencies of Pollock caught in 1914, 1915 and 1916.

The curves for 1914 and 1915 are constructed from measurements of the standard length and are based upon measurements on 1,250 fish in the case of the 1914 curve and in the case of the 1915 curve on 652 fish. The curve for 1916 is based on measurements of the total length of 1,168 fish. In order to compare it with the curves for 1914 and 1915 the whole curve has been moved to the left so that the mode which was at 80 cm. is at 72 cm.