

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

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Spawning, and Behaviour and Growth of the Young,
Summer of 1917

By A. G. Huntsman

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Spring Spawning at the Magdalen Islands

At the Magdalen Islands the herring spawned in the spring during the month of May. The first herring appeared at Grindstone Island and House Harbour on May 6th and at Amherst Harbour on May 15th. On May 26th the spawning was not yet over and the temperature of the water in Amherst Harbour over the herring eggs was 8.9°C. On June 18th the islands were again visited. The eggs were said to have hatched a week previously and none were seen. The temperature of the water was practically the same as before (8.59°C.). The larval herring were taken regularly in the tows that were made from Amherst Harbour to a point 25 miles a little east of South from Entry Island on the route to Cheticamp, Cape Breton Island. Inside Amherst Harbour larvae from 5 to 9 mm. in length, some of them still with considerable yolk, were taken. Just outside the harbour the lengths of the larvae varied from 7 to 9 mm. Outside Entry Island the lengths were from 8 to 10 mm. The centre of abundance of the vast school of young herring was just outside Entry Island. The numbers decreased rapidly on going into Plessent Bay and Amherst Harbour, and less rapidly on the route to Cheticamp. Large numbers were taken 17 miles from Entry Island, but at a distance of 25 miles only three were obtained. Doubtless the number of larvae taken in Plessent Bay outside Amherst Harbour would have been much larger if the tow had been taken at night as was the case with the others to which reference has been made.

TABLE I

Clupea harengus. Magdalen Islands, June, 1917.

Locality	Amherst Harbour	Pleasant Bay	'Prince' Sta. 33	'Prince' Sta. W	'Prince' Sta. 32	'Prince' Sta. X	'Prince' Sta. Y	'Prince' Sta. 31	'Prince' Sta. Z
Date	June 18	June 19	June 19	June 19	June 18	June 19	June 20	June 18	June 20
Time	10.10 P.M.	3.20 P.M.	8.25 P.M.	9.55 P.M.	11.10 A.M.	11.25 A.M.	12.55 A.M.	8.00 A.M.	2.55 A.M.
Depth (metres)	c. 6	c. 10	22	c. 30	31	c. 40	c. 60	59	c. 70
Distance from Entry Is.	---	---	2½ miles	9½ miles	10½ miles	17½ miles	25½ miles	28 miles	33½ miles
Surface Temperature	8.59°C.	---	6.05°C.	8.33°C.	8.34°C.	8.56°C.	10.18°C.	8.64°C.	10.55°C.
Deep Temperature	---	---	(10 metres) 5.21°C.	---	(20 metres) 3.74°C.	---	---	(20 metres) 3.64°C.	---
Larvae in Vertical Haul.	---	---	2	---	4	---	---	0	---
Larvae in 0-2 m. Tow	6	38	218	135	20	124	3	0	0
Larvae in 18-23m. Tow	---	---	(10-12m) 78	17	?	22	0	0	0

The data are given in full in Table I. All hauls were made with a net having a diameter of one metre and made with No. 0 bolting cloth.

In Table II are given the measurements to the nearest millimetre of, where possible, as many as twenty-five larvae taken at random from the total number at each station.

TABLE II.

Clupea harengus. Magdalen Islands, June 18-20, 1917.

'Length (mm.)'	'Amherst 'Harbour'	'Pleasant 'Bay'	'Prince' 'Sta. 33'	'Prince' 'Sta. W.'	'Prince' 'Sta. X.'	'Prince' 'Sta. Y'
5	1					
6	3					
7		4				
8	1	15	12	5		1
9	1	6	11	12	10	
10			2	6	5	1
11				2		

These results indicate clearly that there was a regular increase in size from the spawning ground in Amherst Harbour (and the shores of Pleasant Bay) out to the open sea. The extensive shoal of larval herring, more than twenty-five miles across, had all come from the shores of the Magdalen Islands and was being gradually thinned and extended by the action of the tidal and other currents as well as by the movements of the larvae themselves.

In the series of hauls made at the middle of July with the metre plankton net at the stations between Cheticamp and the

Magdalen Islands, no herring larvae were obtained. Hauls with the young fish trawl did provide specimens.. In Pleasant Bay at a depth of from 2 to 3 metres, thirty-four were obtained, at a depth of 4 to 6 metres one only, and at a depth of 18 to 22 metres two. None were taken in a haul about 14 miles from Entry Island at a point near where so many were obtained in June, where the depth was about 40 metres.

The maximum size observed at this time was 21 mm., which gives a growth of slightly more than 10 mm. in a month. A specimen only 6 mm. long was taken, indicating that part of the spawning was very late.

Nothing was found out with regard to the fate of the immense school of larvae that drifted eastward from the Magdalen Islands. It was presumed that they would drift around Cape North (Cape Breton Island), but an investigation of that region at the end of July was unsuccessful in discovering any larvae.

Nor was it possible to demonstrate their presence at the Magdalen Islands in the middle of August when hauls were made at depths of 35, 25 and 15 metres without any being taken. It is possible that night hauls would have been successful, but these were not made.

Fall Spawning at the Magdalen Islands

Mr. J. J. Cowie has already demonstrated in his fishing experiments the presence of fall spawning herring in the Gulf of St. Lawrence. The fall herring larvae were obtained first on the September cruise to the Islands. They were present at all of the three stations outside Entry Island, but none were found in

Pleasant Bay although both plankton nets and young fish trawl were used. Only a few larvae were obtained at each station. The data are given in Table III. Station 60 was in Pleasant Bay.

TABLE III

Clupea harengus. Magdalen Islands, September, 1917.

Locality	'Prince' Sta. 63	'Prince' Sta. 33	'Prince' Sta. 32	'Prince' Sta. 31
Date	Sept. 14	Sept. 14	Sept. 14	Sept. 13
Time	6.35 a.m.	4.40 a.m.	2.45 a.m.	11.25 p.m.
Depth (metres)	11	21	31	59
Distance from Entry Id.	---	2½ miles	10½ miles	28 miles
Surface Temperature	14.06°C.	13.98°C.	13.76°C.	14.75°C.
Deep Temperature (10 m)	14.21°C. (10 m)	14.07°C. (10 m)	13.64°C. (20 m)	13.35°C. (20 m)
Larvae in vert. haul.	---	0	0	0
Larvae in 0-2 m. tow.	0	0	0	1
Larvae in deep tow.	---	4 (10-12 m)	3 (18-23 m)	2 (18-23 m)

TABLE IV

Clupea harengus. Magdalen Islands, September 13 and 14, 1917.

Length (mm)	'Prince' Sta. 33	'Prince' Sta. 32	'Prince' Sta. 31
8	2		
9	1	2	
10			2
11		1	
12			1

It is evident from Table IV that there is again an increase in size as we proceed from the Magdalen Islands, showing that the spawning ground was close to the Islands. The absence of larvae in Pleasant Bay indicates that the spawning was outside. It is apparent that the spawning took place at an appreciable depth, perhaps twenty metres. The numbers of larvae obtained, though small, show a decrease as we pass out into the deep water. The fact that they were not even carried into Pleasant Bay is doubtless owing to their not coming to the surface. Although these hauls were taken at night only one larva was obtained in a surface tow.

The absence of larvae in the vertical hauls confirms the results shown by the tows that the number present was relatively small. The fall spawning must be of far less extent than the spring spawning. Judging by the sizes of the larvae the eggs must have been deposited about the middle of August.

Fish Spawning at Cheticamp, Cape Breton

A similar condition was found on the Cape Breton shore. No larvae were taken in the fall in the harbour. On September 6th very large numbers of herring larvae recently hatched and with yolk sack still large were obtained at Station 29, the depth being 31 metres. The following week on September 12th only a few were obtained, but there were at the same time a few at the outer station two days later.

No material of later date than September 14th is available. It follows from the data that the spawning ground of the fall herring at Cheticamp was in the vicinity of Station 29, that is not along shore or in the harbours, nor yet in deep water, but at moderate depths offshore in the neighbourhood of the thirty-metre line. Owing to the steep slope of the bottom the depth cannot be considered as very certain in spite of the very large number of young larvae obtained at Station 29.

The time of deposition of the eggs must have been the latter part of August, as the young had not appeared on the 9th of that month, but were present in large numbers on September 6th and were apparently still hatching on September 12th.

The tidal currents are coastwise. The prevailing set of the current is said to be along shore to the north. There would therefore be little tendency for the larvae to be carried offshore or inshore. This may explain the failure of the larvae hatched in the harbour in the spring to reach Stations 29 and 30, if we neglect the specimens of doubtful origin at the outer

TABLE V

Clupea harengus. Cheticamp, Cape Breton Island, September 1917.

Locality	Date	Time	Temperature					Larvae in vert. haul	Larvae in 0-2 m tow	Larvae in 18-23 m tow	
			Depth	0 m	10 m	20 m	30 m				40 m
'Prince' 'Sta. 29	'Sept. 6'	8.50 a.m.	31 m	17.76	17.50	11.93	9.67	---	14	3	98 x 4
'Prince' 'Sta. 29	'Sept. 12'	7.38 a.m.	31 m	15.68	15.78	16.18	15.91	---	0	2	---
'Prince' 'Sta. 30	'Sept. 14'	2.40 p.m.	92 m	15.57	15.51	15.41	10.13	3.14	0	1	1

station. On the other hand we have to explain the appearance of the autumn larvae at Station 30 three miles offshore from Station 29 and their non-appearance at Station 34 in the Harbour only two miles from Station 29 and with considerable tidal currents to carry them. One however was taken at Station 35 at the mouth of the Harbour on September 13, near the bottom.

Two factors appear to be responsible for this apparently anomalous distribution. The larvae for the most part remain at some depth in the water and cannot be carried far inshore. During the week between the 6th and 12th of September there was a movement of the warm surface water of the Gulf against the Cape Breton shore, where it was heaped up, so that at Station 29 it formed the only element from surface to bottom. The comparatively cold water (from 9 to 14° C.) that on September 6th formed the lower half of the entire depth of water at that station, was displaced downward and outward and quite disappeared from the station. This phenomenon was observed several times during the summer. Its effect will have been to carry the larvae downward and outward. To compensate for the inshore movement of the warm surface water, there will have been an offshore return current of the cold deep water. This is sufficient to explain the occurrence of the larvae at Station 30 in such a short time, as well as the great diminution in ^{their} ~~xxx~~ numbers at Station 29. The change in conditions is shown by the fact that whereas on September 6th the surface water of almost uniform temperature formed a layer of little more than 10 metres in depth at both of the stations, on September 12th it was over

30 metres in depth at Station 29, and on September 14th over 29 metres in depth at Station 30. At the former Station on September 6th there was a difference of more than 8° C. in temperature between the surface and bottom water, the difference on September 12th was less than half a degree.

From Mr. O'Donnell of the Meteorological office, Toronto, I have been able to obtain the following summary of the wind conditions that doubtless produced this change. For the two days previous to September 6th there was a moderate breeze in the Gulf of St. Lawrence from the North and North-east. As this wind was coastwise, it would have no effect either in driving the surface water offshore and thinning that layer or in driving it against the shore and heaping it up. From the 6th day of the month until the 14th there was a moderate to fresh breeze from the west, shifting twice from the southwest to the northwest and back again. This will have been sufficient to drive the warm surface water of the Magdalen Bay against the Cape Breton shore.

Fall Spawning at Grand Manan, Bay of Fundy

At Grand Manan is to be found what is perhaps the most important spawning ground for herring on the southern part of our coast. It was investigated on two occasions, - on September 19 and 20, and again on October 2 and 3.

On the first occasion the work was done on Patrol Boat 'G', commanded by Captain Greene. This boat was placed at our disposal by the Deputy Minister of the Naval Service, Mr. G. J. Desbarats, and the Inspector of Fisheries, Mr. J. F. Calder

kindly arranged for its service.

At the time of this investigation the larvae were hatching out and being distributed from a centre which was located near the mouth of Seal Cove Sound. The data are given in Table VI.

It is evident from the table that the mouth of Seal Cove was the centre of abundance of the larvae and also the point where was found the largest proportion of recently hatched individuals, as shown by the presence of yolk. Spawning must have taken place at the beginning of September and close inshore. The larvae were being distributed to some extent in all directions by the tidal currents. There is no indication of their being carried north into the Bay of Fundy. This is shown by the small number obtained off Southern Head, and by their absence in the tow off Dark Harbour, near the north end of the Island on the west side. Also at a later date we were unable to get them at the southern end of Campbell to the north.

On the 2nd and 3rd of October the conditions were quite different. Observations were made at a series of stations from Seal Cove to the southwest past Machias Seal Island. The results are given in Table VII. Table VIII gives the numbers of larvae of each millimetre class in length at each of the various stations.

TABLE VI

Clupea herengus. Grand Manan, September, 1917

'Locality	'Mouth of Seal Cove	'Mouth of Seal Cove	'Head of Seal Cove	'Off White-head Island	'Off South-ern Head	'Off Dark Harbour
'Date	'Sept. 19	'Sept. 19	'Sept. 20	'Sept. 20	'Sept. 20	'Sept. 20
'Time	'5.30-6.30	'8.15 p.m.	'7.30 a. m.	'10.00 a. m.	'11.45 a. m.	'1.00 p. m.
'Tide	'3/4 ebb	'Low	'Low	'1/2 flood	'3/4 flood	'High
'Depth (m)	'c. 20	'c. 20	'9	'c. 15	'c. 50	'c. 20
'Surface Temper.	'8.7-9.4°C.	'---	'9.8° C.	'9.9° C.	'9.°° C.	'9.1° C.
'Deep Temper.	'8.8°C. (20m)	'---	'---	'---	'---	'8.9°C. (9m)
'Larvae in 0-2 m. tow	'2	'61	'---	'---	'---	'---
'Larvae in Deep tow	'49 (c. 9 m.)	'---	'11 (c. 6 m.)	'15 (c. 9 m.)	'4 (c. 15 m.)	'0 (c. 9 m.)
'% age of larvae with yolk	'60%	'50+%	'30%	'15%	'25%	'---

TABLE VII

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Clupea herengus. Grand Manan, October, 1917.

Prince										
Sta.No.	65	66	67	68	69	70	71	72	73	
Position	'off White-Head Id.	'Mouth of Seal Cove	' $1\frac{1}{2}$ miles off South-ern Head	' $4\frac{1}{2}$ miles off South-ern Head	' $7\frac{1}{2}$ miles off South-ern Head	'11 miles off South-ern Head	'15 miles off South-ern Head	'20 miles off South-ern Head	'25 miles off South-ern Head	
Date	Oct. 2	Oct. 2	Oct. 2	Oct. 2	Oct. 2	Oct. 2	Oct. 3	Oct. 3	Oct. 3	
Time	9.33 a.m.	6.45 p.m.	8.00 p.m.	9.05 p.m.	10.20 p.m.	11.30 p.m.	12.30 a.m.	1.30 a.m.	2.30 a.m.	
Tide	$1/2$ flood	low	1 hr.flood	2 hr.flood	$3\frac{1}{2}$ hr.flood	$3/4$ flood	e. high	$1/2$ hr.ebb	$1\frac{1}{2}$ hrs. ebb	
Depth(m)	15	$11\frac{1}{2}$	c. 28	c. 35	c. 70	c. 35	c. 70	c. 70	c. 70	
Surface Temper.	9.39°C.	8.82°C.	8.78°C.	8.72°C.	8.59°C.	8.34°C.	8.12°C.	8.07°C.	8.08°C.	
Deep Temper.	9.24°C. (10m)	8.98°C. (10m)	8.81°C. (20m)	8.82°C. (20m)	8.61°C. (20m)	8.34°C. (20m)	8.11°C. (20m)	8.07°C. (20m)	8.06°C. (20m)	
Larvae in 0-2 m. tow	0	0	1	30	11	15	4	0	1	
Larvae in 18-23 m. tow	0(10-12m.)	1(8-11 $\frac{1}{2}$ m)	2	17	14	6	6	10	1	
Larvae with yolk	0	0	0	2	1	1	0	0	0	
Eggs	0	0	0	6	0	0	0	0	0	

TABLE VIII

Clupea harengus. Grand Menan, October 2 and 3, 1917.

Length (mm.)	'Prince' Station Number							Total	
	66	67	68	69	70	71	72		75
6			3	2					5
7		1	4	2	5	1			12
8	1		11	12	11			1	36
9			10	2	1	4	2		19
10			4	3	2	1	1	1	12
11			1	2	1	1			5
12			2	3		2	1		8
13			1				1		2
14					1	1	1		3
15				1			3		4
16			1						1
17		1							1
18			1						1
19									0
20			1						1
21									0
22									0
23									0
24		1							1

The place where spawning appears to have occurred is very different from that found on September 19th. The place where the greatest of larvae and the greatest number of larvae with yolk, and at the same time the only place where eggs were taken, was Station 68, 4 1/2 miles southwest from Southern Head. This was quite evidently the nearest point to the ground from which recently hatched young were being dispersed. From the numbers of the various millimetre groups taken it is clear that for this lot hatching was nearly finished. The larvae from 6 to 11 millimetres in length form a well defined group with the mode in the neighbourhood of 8 millimetres, which may be considered as the typical because the prevailing length.

Passing in either direction from Station 68 there is seen to be a somewhat regular increase in the minimum size observed, and a less well marked increase in the average length of the smaller larvae. The smallness of the numbers obtained is doubtless accountable for the imperfection in the gradation. The total numbers of the ^{smaller} ~~xxxx~~ larvae show a similar gradation. To the northeast only one larva was obtained at each of Stations 67 and 66. To the southwest the numbers of larvae from 6 to 11 millimetres in length at the various stations in order are, 33, 22, 20, 7, 3, and 2. Even at a distance of over 20 miles to the southwest the number is larger than was found only three miles to the northeast. All these facts clearly indicate that Station 68 was the point of origin and that the young were being carried far to the southwest as compared with the northeast. The solitary in-

dividuals at Stations 66 and 67 would be purely a result of the tidal action. The main set of the current is therefore out of the Bay of Fundy but the rate of flow is very slow.

The larvae from 11 to 15 mm. in length may represent the lot hatched near the mouth of Seal Cove about September 19th. Their distribution is from Station 68 to Station 72, but they are not very abundant. It is remarkable that larvae above 15 mm. in length were obtained only at Stations 67 and 68. This suggests the possibility of the contranstant migration beginning to be effective at a very early stage. It would mean that the larvae are carried with the current at first to the southwest at a slow rate amounting to not more than a couple of miles a day, and that they gradually become able to stem the current and return to the spawning ground from which they came. This view receives support from the fact that on November 2nd a haul with the young fish trawl at Station 66 gave 27 larvae of which those that could be measured gave the following numbers of the various millimetre groups, - 16 mm.- 2, 17 mm.- 8, 18 mm.- 5, 19 mm.- 4, 20 mm.- 3, 23 mm.- 1. From the range shown these are evidently part of the lot hatched near Station 68 and now returned to the northeast past their point of origin. Further corroboration is however desirable.

General Summary

Spawning

A. Location. In the Gulf of St. Lawrence the spring spawning takes place close inshore and in the harbours at the Magdalen

Islands.

In the fall the spawning is offshore and at moderate depths, the exact depths being uncertain, and occurs both at the Magdalen Islands and on the Cape Breton shore.

In the Bay of Fundy the spawning in the fall at Grand Manan takes place both inshore and also well offshore in rather deep water.

It is noteworthy that the chief spawning places both in the Magdalen Bay and the Bay of Fundy are on the left hand side (looking into the Bay) of the island near the mouth of the Bay and close to deep water. This may be significant of the herring coming from deep water to the nearest land to spawn and stemming the outgoing current which is on the left.

B. Time. In the Gulf of St. Lawrence commencing in the early part of May the herring spawn on the east coast of the Magdalen Islands, appearing first at the north, and do not appear to cease until some time in June. The fall spawning seems to have occurred during the month of August on both the Magdalen and Cape Breton shores.

In the Bay of Fundy at Grand Manan the spawning appears to have lasted from early in August to well on in September, the early spawning being near shore and the later in deep water (about 40 metres ?).

C. Temperature. At the Magdalen Islands in the spring the temperature of the water in Amherst Harbour during the spawning season was between 8 and 9° C. This was probably the max-

imum temperature of the water in which the eggs were hatched. Those on exposed shores or at some depth will have been exposed to lower temperatures.

The temperature of the water at Grand Manan where the herring eggs were hatching was also found to be between 8 and 9° C. Owing to the heavy tides the conditions are fairly uniform from surface to bottom. It is unlikely that there was any appreciable difference in temperature during the spawning period from the figure that has been given.

It is not possible to determine what temperatures prevailed in the water around the herring eggs spawned in the fall in the Gulf of St. Lawrence. At that time the difference in temperature at different depths was very great, and the exact depth at which the eggs were laid is not known. On the Cape Breton shore the eggs must have undergone extensive changes in temperature as a result of the great vertical oscillations of the water that have already been described. The temperature at the time of spawning may well have been in the neighbourhood of 9° C. For the Magdalen shore it is unlikely that the temperature was so low. During August and September the isotherm for 9° C. reached the bottom between Stations 32 and 33, but probably nearer the former Station. We have previously given reasons for the belief that the spawning ground was nearer to Station 33. However the facts do not exclude the possibility of spawning having taken place in every case at a temperature close to 9° C.

Movements of the Larvae

A. Passive. The larvae are for a time at least carried somewhat passively by the currents.

The tidal currents effect a distribution of the larvae in all directions for a short distance from the spawning ground. The movement will be chiefly coastwise or in and out of the estuaries, owing to the to and fro movement of the tides near the coast.

The general or prevailing current carries the larvae in a definite direction from the spawning ground. We have seen that they were carried from the Magdalen Islands for a distance of at least 25 miles to the eastward of south. It is probable that they would have been found to have been carried still farther to the eastward, since according to Dr. Dawson the general movement of the water in the Magdalen Bay is toward Cape North to form the strong outgoing Cape Breton current.

The currents produced by winds are also important. The on and off-shore movements of the surface water due to the winds and the deep return currents effect a distribution of the larvae at right angles to the coast where no other currents of that kind occur, as on the Cheticamp shore.

B. Phototactic. From Table I it is evident that the larvae are most abundant at the surface from early evening till after midnight at least. The only evidence for their being less abundant there during the day is the small number obtained at Station 32 at 11.10 a. m. as compared with the large numbers obtained at

the neighbouring stations (W and X) during the night.

In Table VI a confirmation of this appears. In the mouth of Seal Cove at about 6 p. m. on September 19th the larvae were more abundant below, whereas at 8.15 p. m. more were obtained at the surface than in both hauls previously. We may conclude that the light drives most of the larvae down during the day and when it lessens in intensity during the evening it brings them to the surface.

The data given in Table VII are conflicting in this respect. From Station 66 to Station 68 they seem to show that the larvae were more abundant below until after 8 p. m. (the evening was clear), and then became more numerous at the surface. The data from Station 69 to Station 73 are not uniform. There are very strong tidal currents in this region, which would tend to upset the vertical distribution of the larvae, particularly if the differences in the latter were not very pronounced.

C. Thermotactic. The data as to the influence of the temperature in determining the movements of the larvae are rather meagre.

If we compare Table I with Table III we see that the larvae were more abundant at the surface during the night in June when the surface water had a temperature of from 6 to 10° C. and the deep water one from 3 to 5° C., whereas in September they were more abundant below, when the temperature throughout was high and the differences slight. They may have been still more abundant in the deeper cold water but there is nothing to indicate it.

D. Rheotactic. The facts of distribution of the larvae at Grand Manan suggest that the larvae become contranstant very early, so that by the time they have attained a length of 18 millimetres they are making headway against a current of from one to two miles per day.

E. Gregational. The formation of 'schools' by the adult fish is a well known characteristic of the herring. This prevents a random catch from representing the abundance of the fish in a given region. From the data given it is evident that the very young larvae are quite uniformly distributed, showing that they do not yet exhibit the 'schooling' habit. Herring about 5 cm. in length were seen in large schools at St. Andrews in June. At what size are these schools formed? Owing to our failure to obtain larvae longer than 2 cm. (with three exceptions) in regions in which they must have been present, it is probable that schools^{are}/formed at about this size.

Growth

The duration of embryonic development is known to vary with the physical conditions. Two weeks would seem to be an average time. At the time of hatching the larvae are from 5 to 6 millimetres in length. Considering that the main mass of the herring at the Magdalen Islands began hatching the first of June we have in three weeks (June 19) a maximum size of 11 millimetres attained, and in six weeks (July 13) a size of 21 millimetres. This is at the rate of about one centimetre per month.

Owing to the long duration of the spawning period, the rate

of growth of the herring at Grand Manan is difficult to determine. I believe that the herring from 6 to 8 millimetres long on September 19th are represented on October 2nd by a group from 11 to 13 millimetres long, giving a growth of about one-half centimetre in 13 days. The main group on October 2nd has its mode at about 8 millimetres. The mode of the main group on November 2nd is about 17 1/2 millimetres. This would mean a growth of 9 1/2 millimetres for the month. These results harmonize. It is probable that growth lessens greatly or stops altogether during the winter. An attempt is being made to follow the growth of these young herring during the winter months.

On June 11 Mr. Frits Johansen obtained at St. Andrews with the plankton net in the evening a large number of young herring, the average length of which was 55 millimetres. These were without doubt from the fall spawning of 1916. From the facts of growth we already have, no other interpretation is possible. They were too small for spring-spawned herring of 1916. This would mean a growth of about 35 millimetres for seven months from November to June, which is a probable value, considering the slowing down in growth during the winter.

The very abundant young herring at St. Andrews in the fall of the year had on September 24th an average size of about 9 cm. Presuming these to be the same lot of fish as those seen in the spring, the growth for the intervening three and a half months would be 35 millimetres, or again at the rate of one centimetre per month for the summer. We have previously found by weekly

random measurements a more rapid growth for these yearlings during the summer, - namely of from one and a half to nearly two centimetres per month, but diminishing toward each end of the season. There is certainly considerable variation in the rate of growth and there is always doubt as to exact correspondence between groups taken on different occasions.

I desire to acknowledge the efficient way in which Mr. A. E. Calder and Captain Elmer Rigby of the Motor-Boat 'Prince' obtained such a large proportion of the material and data upon which this report is based.