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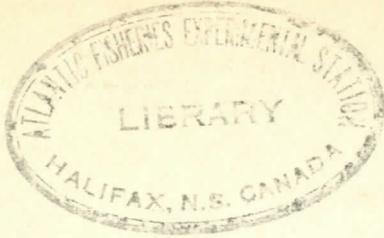
Rate of growth of oysters in Bideford river

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1930-31

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Rate of Growth of Oysters in Bideford River.

by

Alfreda Berkeley Needler.

During the summer and autumn of 1930 a number of measurements were made of adult oysters from several different beds, of oysters known to be in their second summer and of that year's spat. All these oysters were collected in Bideford river and the investigation was carried out at the Prince Edward Island Marine Station. A review of the figures obtained in this way throws some light on the rate of growth of oysters in this neighbourhood although the figures are not as complete as could be desired and the work is rather of a preliminary nature. In the following account only the adult oysters and those in their second summer (1+) are considered and the growth of the spat will be treated later under a different heading in conjunction with A.W.H. Needler.

Adult Oysters

Throughout the summer of 1930 measurements were taken of the oysters from two beds, one (Pulpit bed, Station 2002) near the mouth of the river and the other (Paugh's bed, Station 2001) much farther up towards the head. These oysters had been transplanted from the other side of the island during the summer of 1929 and had evidently become infected by the disease still present amongst the immune native oysters. In June, when the work began, they still seemed to be comparatively healthy but it was not long before the disease began to be very noticeable and by the autumn the majority were dead. As the year went on it became more and more difficult to find enough oysters to measure and, although the shells showed that there had been some growth in the early summer, it almost ceased at spawning time. The few oysters that survived did manage another spurt of growth between August and November but even this was rather a feeble effort. However, it seems worth while to give the figures here for comparison with native, healthy oysters. In the case of each oyster the length and width were measured and the age (as shown by the rings on the shell) was noted. After July 12th measurements were also made as accurately as possible of the current year's growth. By multiplying the length by the width a figure is obtained for each oyster which, for want of a better name, is called the "area". Since there is a good deal of variation in the shape of the oysters it is believed that this "area" is more comparable than either length or width. Very few oysters were taken on either bed that had not reached their third summer (2+) or older than in the fifth summer (4+), thus it is only worth while to give the figures for these three main year-groups. The following tables, then, give the averages of these measurements for the Pulpit bed.

Table I. Pulpit bed.

Oysters taken June 20 to August 1.

Date	June 20,23,30.			July 2, 4, 7.			Jul.12,15,18.			Jul.25 - Aug.1.		
Total number.	58			69			109			57		
Age.	2+	3+	4+	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number.	5	29	15	16	30	13	24	47	28	17	23	11
Average length.	5.7	7.5	8.7	6.0	8.1	8.7	5.7	7.7	8.5	6.1	8.7	9.5
Average growth in 1930 (cm.)							1.3	1.5	1.2	2.5	2.2	2.3
Average previous growth (cm.)							4.4	6.2	7.3	3.6	6.5	7.2
Average width (cm.)	3.8	3.6	5.6	3.8	5.0	5.7	3.9	4.9	5.7	3.9	4.8	5.5
Average area.	21.4	34.8	49.4	23.4	40.1	50.0	22.2	37.6	49.2	23.9	41.5	52.3

Table II. Pulpit bed.

Oysters taken August 13 to November 11.

Date	August 13, 21, 29.			Sept. 3, 16.			Nov. 11.		
Total number.	81			56			150		
Age.	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number.	15	30	29	5	26	18	21	77	42
Average length (cm.)	6.4	8.4	9.1	5.3	7.9	8.9	7.5	8.1	9.2
Average growth in 1930 (cm.)	1.6	1.7	1.4	1.8	1.6	1.6	2.2	1.9	1.5
Average previous growth (cm.)	4.8	6.7	7.7	3.5	6.3	7.3	5.3	6.2	7.7
Average width (cm.)	4.4	5.0	5.6	3.7	5.2	5.6	4.3	5.3	6.0
Average area	28.1	42.6	52.0	19.5	41.2	49.6	32.4	42.7	55.3

A consideration of these two tables shows that the growth during the year was indeed small. The fluctuations may be explained by the oysters being taken sometimes from one part of the bed and sometimes from another or by some uncertainty in the age computations. Considering the small amount of growth made the numbers of oysters measured were not sufficient to smooth out these flaws.

The next two tables give similar averages of measurements for oysters from Paugh's bed. Here again all measurements were made in centimetres and were taken to the nearest 0.5 of a centimetre. This was done with all measurements of adult oysters.

Table III. Paugh's bed.

Oysters taken June 21 to August 7.

Date	June 21, 24, 27, 30.			July 2, 5, 7.			July 10, 14, 19.			Jul. 25-Aug. 7.		
Total number	79			75			96			70		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	14	32	24	22	19	12	20	43	15	14	25	15
Average length	5.6	7.3	8.6	6.3	7.1	9.0	6.2	8.1	9.1	6.4	8.1	9.8
Average growth in 1930 (cm.)							1.2	1.3	1.3	1.9	1.7	1.7
Average previous growth							5.0	6.8	7.8	4.5	6.4	8.1
Average width	3.6	4.6	5.4	3.6	4.6	5.9	3.5	4.6	5.2	3.5	5.0	5.9
Average area	20.7	33.5	46.4	22.9	32.3	53.3	21.9	38.3	47.5	22.4	40.0	58.7

Table IV. Paugh's bed.

Oysters taken August 15 to November 11.

Date	Aug. 15, 26.			Sept. 3, 11.			Nov. 11.		
Total number	56			42			119		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	13	23	15	2	21	11	29	55	24
Average length	6.6	8.3	10.0	5.7	7.2	9.0	7.4	8.4	9.9
Average growth in 1930	1.6	2.0	1.7	0.9	1.3	1.6	1.9	1.5	1.4
Average growth previously	6.0	6.3	8.3	4.8	5.9	7.4	5.5	6.9	8.5
Average width	3.7	5.0	5.7	3.4	4.4	5.0	4.1	5.0	5.8
Average area	24.5	41.6	57.1	19.0	32.0	45.2	30.5	42.4	57.5

Here, again, it can be seen that there was but little growth during the summer. It may be noted that the oysters from the Pulpit bed were generally slightly larger for their age than those from Paugh's bed. As will be seen when considering the native oysters, this is not what might be expected since Paugh's bed is near the mouth. But it was noted that the oysters on Paugh's bed were more severely attacked by the disease than those on the Pulpit bed. This is doubtless the explanation of their growing more slowly although they were in warmer water.

Unfortunately no such constant measurements throughout the summer were taken of any of the native oysters. In fact only five collections were made that were large enough to be worth noting. Of these only two collections were in the same area, Ellis' cove, and there was only a month between the two collections. All ages from 1+ to 5+ are given in the tables although, here again, the 2+, 3+ and 4+ groups are much the most important, especially the first two. As an indication of the shape of the oysters the length divided by the width is given for each year-group. Table V summarizes the measurements of two collections of oysters made at

Ellis' cove on August 18 and September 24 respectively. This cove is about midway between Dawson's cape and Paugh's creek (not Paugh's bed), roughly half a mile above Shipyard point. It can easily be seen that the growth made by the oysters during these weeks was considerable - almost as much as they made in the whole of the remainder of the summer. This is only to be expected since early in the year much of the effort would be taken up in spawning. By the middle of August the oysters would have recovered from spawning and be ready to put energy into shell production.

Table V. Ellis' cove.

Oysters taken August 18 and September 24.

Date	August 18					September 24				
Total number	74					79				
Age	1+	2+	3+	4+	5+	1+	2+	3+	4+	5+
Number	3	11	33	22	5	6	36	50	6	1
Average length	4.2	6.0	8.5	10.3	12.4	5.2	9.0	10.1	13.8	15.5
Average growth in 1930	2.8	1.7	1.7	1.8	1.7	3.2	3.4	2.8	3.1	3.0
Average previous growth	1.4	4.3	6.8	8.5	10.7	2.0	5.6	7.3	9.7	12.0
Average width	2.5	3.8	4.9	5.7	6.3	3.0	4.9	5.6	6.4	5.5
Average area	11.0	24.6	42.7	59.1	73.5	17.4	43.5	57.0	87.5	85.0
Length width	1.7	1.6	1.7	1.8	2.0	1.7	1.8	1.8	2.2	2.8

Table VI gives the sizes of the oysters in two collections made at Dawson's cape and Paugh's creek respectively. Dawson's cape is towards the north of the river while Paugh's creek is at the head.

Table VI.

Oysters taken at Dawson's cape and Paugh's creek.

Date	October 7					September 27				
Locality	Dawson's cape					Paugh's creek				
Total number	125					125				
Age	1+	2+	3+	4+	5+	1+	2+	3+	4+	5+
Number	15	53	43	11	3	2	47	64	10	2
Average length	5.6	7.1	8.5	9.5	10.7	7.3	9.9	11.3	14.0	16.5
Average growth in 1930	3.0	2.7	2.6	2.3	1.8	3.8	3.7	3.4	3.6	3.5
Average previous growth	2.6	4.4	5.0	7.0	8.9	3.5	6.2	7.9	10.4	13.0
Average width	3.4	4.3	5.0	5.3	5.4	4.8	5.3	6.0	6.4	8.0
Average area	19.8	29.8	42.6	50.2	61.3	34.5	52.9	69.1	88.6	130.5
Length width	1.6	1.7	1.7	1.8	2.0	1.5	1.9	1.9	2.2	2.1

Now it is interesting to compare the size of the oysters of the same age at Dawson's cape, Ellis' cove (September collection) and Paugh's creek. The collections were made near enough in time to be quite comparable. It can be seen that the growth is much greater at the head of the river than it is towards the mouth. For

instance in the 2+ year-group the average area is 29.8 at Dawson's cape, 43.5 at Ellis' cove and 52.9 at Paugh's creek. On the other hand the shape of the oysters towards the head of the river is not as good as that of those towards the mouth. For instance in the 2-year-group the length of the oysters from Paugh's creek is 1.9 times the width while at Dawson's cape the length is 1.7 times the width. It has also been noticed in general that the oysters from the head of the river have thinner shells than those from near the mouth. Of course this is no new fact, for oyster men have long distinguished between the rapidly growing "river oysters" and the slower growing but better quality "cup oysters" from the colder water of open bays. The only thing we can add here is some data on the difference in growth of oysters in certain areas and in a particular year. It may also be noted that in all localities considered in the river the oysters tend to be longer in proportion to the width the older they get.

Lastly table VII gives a summary of the measurements of oysters taken at Grant's bed on July 8th. This bed is a little farther up the river than Ellis' cove. Here the oysters were planted during the summer of 1929 but they were only moved there from creeks at the head of the river not from the other side of the island as were those on Paugh's bed and the Pulpit bed. It is interesting to give the figures here since they show fairly conclusively that these oysters had not suffered from transplanting. The Grant's bed collection was made more than a month before the first one taken at Ellis' cove but the two are near enough in time and place to be comparable and to show the general well-being of the Grant's bed oysters.

Table VII. Oysters taken at Grant's bed on July 8.

Total number	98				
	1+	2+	3+	4+	5+
Age					
Number	11	49	32	4	2
Average length	4.1	6.4	8.0	10.6	10.8
Average growth in 1930	1.5	1.7	1.7	2.8	1.8
Average previous growth	2.6	4.7	6.3	7.8	9.0
Average width	2.5	4.0	4.8	6.4	6.3
Average area	11.2	25.0	38.7	68.5	64.5
Length width	1.6	1.6	1.7	1.7	1.7

Oysters in their second summer.

During the summer of 1929 spat collected in Bideford river was planted on several prepared beds in the neighbourhood. Two of these beds were selected for examination during 1930 and samples were taken throughout the summer and autumn. One bed, being near a boathouse, was christened "Boathouse bed" and the other is known as "Totten bed". The two beds are on opposite sides of the river a little distance above the Pulpit bed and below Shipyard point. The conditions on both are quite similar although the Totten bed was somewhat cleaner before planting and the spat placed there was more homogeneous. On the Boathouse bed

spat was planted that had been collected at several different places.

The following tables give a summary of these measurements. Lengths and widths were all recorded in millimetres.

Table VIII. Oysters from the Boathouse bed.

Date	18.6.30	3.7.30	30.7.30	16.8.30	8.9.30	22.11.30
Number examined	125	51	52	53	60	86
Average total length	13.1	18.5	26.0	30.6	45.1	55.1
Average growth in 1930	2.5	5.8	13.4	18.1	31.3	38.4
Average growth in 1929	10.6	12.7	12.6	12.5	13.8	16.7
Average width	10.2	14.3	18.7	24.2	34.9	39.1
Average area	154.6	294.7	583.4	882.9	1668.2	2100.6
Length width	1.27	1.29	1.53	1.36	1.29	1.40

Table IX. Oysters from Totten bed.

Date	8.6.30	11.7.30	21.8.30	15.9.30	22.11.30
Number examined	96	100	74	53	111
Average total length	17.9	23.8	40.6	49.0	50.8
Average growth in 1930	5.2	12.2	28.5	36.8	37.8
Average growth in 1929	12.7	11.6	12.1	12.2	13.0
Average width	13.7	17.7	23.5	34.4	35.7
Average area	271.9	446.0	1329.1	1756.5	1858.4
Length width	1.30	1.34	1.42	1.42	1.42

A comparison of the measurements of these oysters from the two beds gives the impression that at the beginning of the summer the Totten bed oysters were growing more rapidly than those on the Boathouse bed and that they kept this lead until the autumn, then that the oysters on the Boathouse bed overtook and passed the others in length and width. To a certain extent this is true but an examination of the records of the increase in length during 1930 shows that part of this impression is due to the variations in the spat planted on the Boathouse bed. Had the spat been more or less the same over the whole bed the average growth made in 1929 should be fairly constant no matter from what part of the bed the sample comes. This may be seen to be true of the samples from the Totten bed where the average growth made in 1929 only varies from 11.6 mm. to 13.0 mm. On the Boathouse bed, however, it varies from 10.6 mm. to 16.7 mm. An attempt was made to discover the degree of survival and of rate of growth in the second summer as compared with the growth in the first summer. It scarcely seems worth while to give all the figures for this here but the general findings may be summarized as follows. In June the two beds had about the same percentage of spat that had not reached 10 mm. the previous year. On the Boathouse bed there seemed to be quite a high mortality amongst those that had grown less than 10mm. in 1929. This was not nearly so apparent on the Boathouse bed later in the year or on the Totten bed at any time. On both beds the oysters which had made most growth during the first year began to grow first in the second and grew more quickly early in the year. Later on, however, this advantage disappeared. Now it appears that the difference in growth during 1929 on the Boathouse bed between 10.6 mm. in the June collection and 12.7 mm. in the next collection may have been due to the aforementioned mortality amongst the small oysters. Still this will not explain the sudden jump to 16.7 at the end of the year and we can only return to the first explanation - a lack of homogeneity in the spat planted. Figure I. expresses graphically the increase in total length and the growth during 1930 on the two beds. This graph also

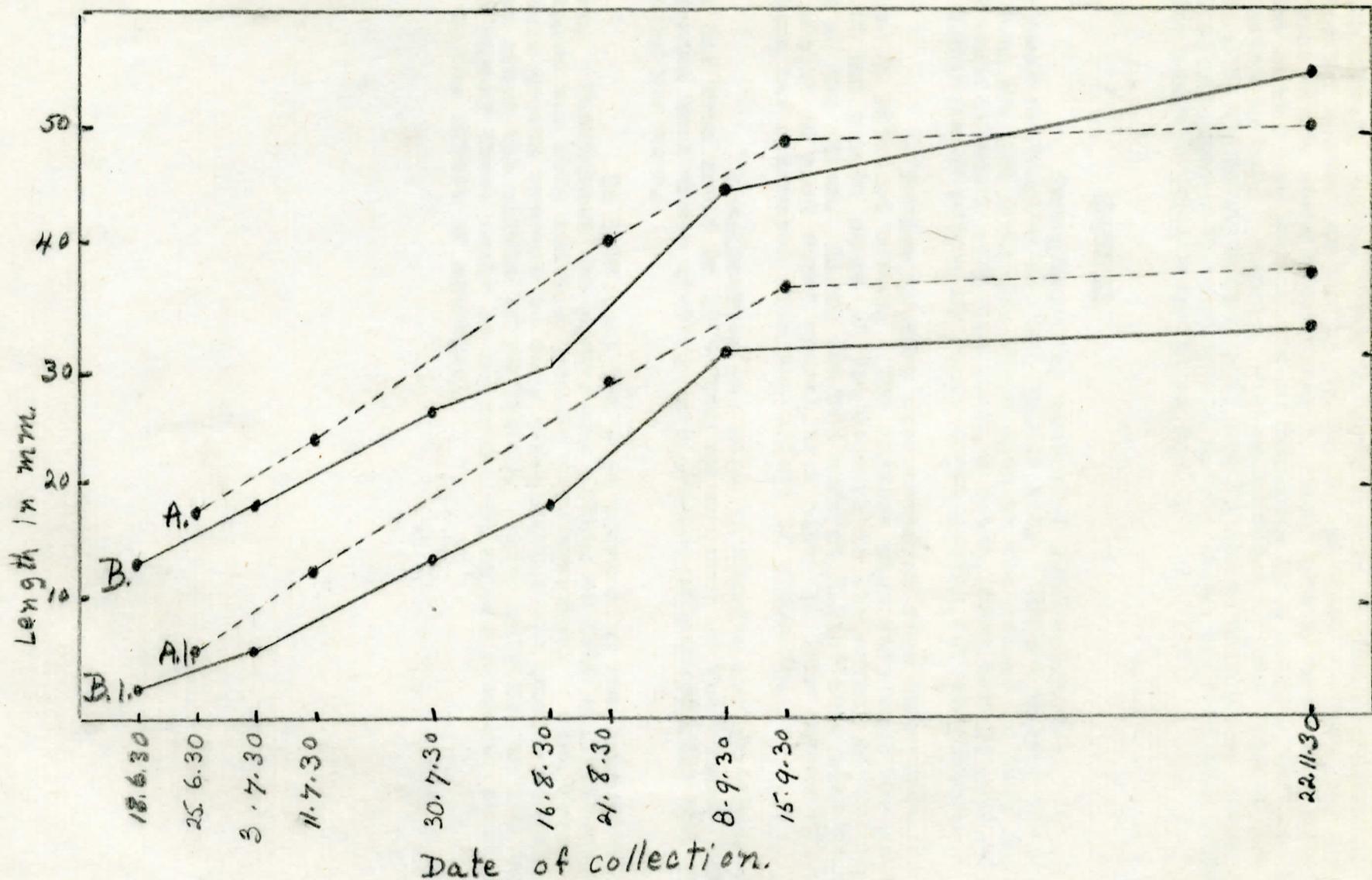


Fig. 1. Increase in length of oysters on Totten and Boathouse beds.
 A. Totten bed, total length. A.1. Totten bed, growth in 1930.
 B. Boathouse bed, total length. B.1. Boathouse bed, growth in 1930.

shows plainly that the period of rapid growth on both beds was during the summer. Between the middle of September and the end of November growth almost ceased. Now an examination of these oysters in the 1+ year-group showed that only 16% to 18% of them produced any spawn. As a result there would be nothing to check growth under the good conditions of the summer and this would be followed by a natural slowing down as the water cooled. Lastly, a consideration of the figures for length divided by width in tables VIII and IX shows that these young oysters tend to get longer in proportion to the width as they grow older just as the adult oysters were found to do.

Summary

1. Throughout the summer of 1930 collections of oysters were made at Paugh's bed and Pulpit bed. Unfortunately these oysters had been brought from the other side of the island in 1929 so that they were infected with the local disease, they hardly grew at all and their measurements are only worth giving for comparison.

2. Native oysters were measured from three beds at various points up Bideford river. The figures show very well the more rapid growth but poorer shape of the oysters in the warmer water towards the head of the river. These records made at Ellis' cove also show that the period of most rapid growth took place in late summer after the oysters had recovered from the effort of spawning.

3. A collection was made on Grant's bed of native oysters that had been moved in 1929 from other parts of the river. Comparison indicates that these oysters were growing satisfactorily and were unhurt by the move.

4. In 1929 spat had been planted on two beds in Bideford river. Throughout the summer and autumn of 1930 collections were made on these two beds and the oysters were measured. With these young oysters growth appears to take place during the summer and almost to cease after the middle of September. Since only 16% to 18% spawned that summer there would be no reason to expect a summer check in growth due to the effort of spawning.

Rate of Growth of Oysters in Bideford River.

by Alfreda Berkeley Needler.

The investigation outlined in the following pages was started in June, 1930. That year it covered the period from June to November and the following year it was carried on from May to November. During the winter months the oysters do not grow so that they were not examined at that time. The work was all carried out at the Prince Edward Island Marine Station and only dealt with oysters collected in Bideford river but this river is fairly typical of many in Prince Edward Island and it is believed that the data obtained may throw some light on the rate of growth of oysters in this locality.

The rate of growth of the spat has been dealt with to a certain extent but it is not considered here. This paper only treats of oysters that are in their second summer (1+) or older. In all cases the conclusions are based on measurements of a great many oysters in which the length, width and current year's growth of each oyster were recorded together with the age of the oyster as computed from the rings on the shell. As there is a good deal of difference in the shape of the oysters a figure has been obtained by multiplying the length of each oyster by the width and so getting something which is believed to be more comparable than either length or width. For want of a better name this figure is called the "area" of the oyster. Also in each collection the average length has been divided by the average width, the resultant figure giving some idea of the average shape of the oysters in that collection.

The whole of the work was carried out under the auspices of the Biological Board of Canada and the writer is indebted to them for providing facilities for the investigation.

Growth of Oysters in Various Parts of the River

At the beginning of the growing season and again at the end collections of oysters were made at each of three stations in Bideford river. A similar series of collections had been made the previous autumn at the same three places. Of these stations Paugh's creek is at the head of the river, Dawson's cape is at the mouth of the Government's reserved area and Ellis' cove is between the two but nearer to Paugh's creek. In the following tables only the 2+, 3+ and 4+ oysters are recorded as there were too few oysters of other ages taken to be worth consideration. All measurements are in centimetres.

Table I. Oysters from Paugh's creek.

Date	Sept. 27, 1930			May 7, 1931			Nov. 12, 1931		
	125			100			125		
Total number									
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	47	64	10	7	66	25	36	55	12
Average length	9.9	11.3	14.0	8.5	10.5	12.5	9.9	13.0	16.2
Average current year's growth	5.7	3.4	3.6	0	0	0	3.5	3.5	3.7
Average previous growth	6.2	7.9	10.4	8.5	10.5	12.5	6.4	9.5	12.5
Average width	5.3	6.0	6.4	4.1	5.5	5.9	4.9	5.4	6.0

Date	Sept. 27 1930			May 7, 1931			Nov. 12, 1931		
Average area	52.9	69.1	88.6	35.1	58.6	73.9	49.3	70.8	98.8
Length width	1.9	1.9	2.2	2.1	1.9	2.1	2.0	2.4	2.7

Table II. Oysters from Ellis' cove.

Date	Sept. 24, 1930			May 7, 1931			Nov. 28, 1931		
Total number	79			100			100		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	36	50	6	7	39	52	32	37	12
Average length	9.0	10.1	13.8	7.3	8.9	11.4	8.1	11.6	13.2
Average current year's growth	3.4	2.8	3.1	0	0	0	2.9	2.7	2.5
Average previous growth	5.6	7.3	9.7	7.3	8.9	11.4	5.2	8.8	10.7
Average width	4.9	5.6	6.4	3.9	4.5	5.1	3.8	4.6	4.6
Average area	43.5	57.0	87.5	28.9	42.0	58.7	34.0	63.9	73.2
Length width	1.8	1.8	2.2	1.9	2.0	2.2	2.1	2.5	2.9

Table III. Oysters from Dawson's cape.

Date	Oct. 7, 1930			May 7, 1931			Dec. 1, 1931		
Total number	125			100			100		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	53	45	11	21	42	33	59	36	2
Average length	7.1	8.5	9.3	6.2	7.5	8.9	7.8	9.3	11.0
Average current year's growth	2.7	2.6	2.3	0	0	0	2.9	2.4	1.0
Average previous growth	4.4	5.0	7.0	6.2	7.5	8.9	4.8	6.9	10.0
Average width	4.3	5.0	5.3	3.3	4.4	5.0	4.1	4.6	5.8
Average area	29.8	42.6	50.2	21.1	33.0	44.6	32.3	42.9	63.5
Length width	1.7	1.7	1.8	1.9	1.7	1.8	1.9	2.0	1.9

The main fact clearly brought out by these figures is that the oysters from the head of the river grow much more quickly than do those from farther down. For instance the average area of the 3 oysters from Paugh's creek in November 1931 is 70.8 while at Dawson's cape it is only 42.9. Also it can be seen that the farther up the river the oysters are taken the longer they tend to be in proportion to their width. Thus at Paugh's creek the average length in the 3 oysters in November is 2.4 times the average width while at Dawson's cape it is 2.0 times the width. It may be noted that in both rate of growth and relation of length to width the Ellis' cove oysters are nearer those from Paugh's creek than those from Dawson's cape. This is what might be expected considering the relative positions of the three beds. Now it was also observed that the oysters from up the river tended to have thin shells and not to be so plump or of such good flavour as those from nearer the mouth. Of course this is no new fact, it is merely a confirmation of the distinction that oyster growers have long made between the rapidly growing "river oysters" and the slower growing but better quality "cup oysters" from the colder waters of the open bay. It is of some interest, however, to know about how old the oysters are in this locality when they reach marketable age. At present the legal size limit is 4 inches for long oysters or $3\frac{1}{2}$ inches for cup oysters. At Paugh's creek most of

the oysters are long and so would have to reach 4 inches before they could be sold while at Dawson's cape many are the round or cup shape and would only have to be $3\frac{1}{2}$ inches. In spite of this many oysters reach a marketable size in Paugh's creek in the third autumn of their lives (2+) whereas at Dawson's cape most of the oysters are not fit for sale until their fourth autumn (3+).

A similar comparison to that outlined above was made between two beds which had been cleaned and planted with spat in the autumn of 1930. One of these beds (England's bed) is opposite the Biological Station while the other (Cooper bed) is at the mouth of Bideford river and subject to conditions similar to those found in the open bay. Since the spat planted on the two beds in 1930 was similar it was thought interesting to make a collection at each bed in November 1931. The following table gives the results of this work. Measurements were taken in millimetres.

Table IV. Oysters from Cooper bed and England's bed. (1930 spat)

Locality	England's bed	Cooper bed
Date	Nov. 24, 1931	Nov. 17, 1931
Number examined	100	100
Average length	56.6	44.9
Average width	33.5	35.0
Average area	1926.	1621.
Length width	1.7	1.3

Here it is easily seen that even in the second autumn of their lives the oysters are distinctly taking on the shapes characteristic of the environment in which they are growing. The average length and area of the England's bed oysters are much greater than those of the Cooper bed oysters but the average width is actually less so that the England's bed oysters are assuming a long narrow shape while the Cooper bed oysters are becoming round and cup shaped.

Growth of Oysters in a Mixed Population.

Not far from Paugh's creek is a bed (Grant's bed) which in 1929 was planted with oysters of all sizes picked from the shores of the nearby creeks. Throughout the growing season of 1931 collections of oysters were made on this bed at intervals of two or three weeks. The investigation was designed to show the season of most rapid growth but the method is a poor one. Evidently there is so much variation between the oysters from different parts of the bed that it would have been necessary to take much larger samples in order to get satisfactory results. The following tables give the results for what they are worth but it can be seen that it is impossible to trace the rate of growth at any age from these samples. Only oysters that are 2+, 3+, and 4+ are given in the tables as too few were taken of other ages but the figure given under the heading "total number" shows the total number of oysters in a given sample.

Table V. Oysters from Grant's bed, May and June 9.

Date	May 13, 1931			May 29, 1931			June 9, 1931		
Total number	124			97			107		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	19	84	19	21	64	12	22	72	13
Average length	7.2	9.3	11.8	7.6	10.5	12.5	7.7	10.6	13.7
Average growth in 1931	0	0	0	.2	.3	.4	.6	.6	.8
Average previous growth	7.2	9.3	11.8	7.4	10.2	12.1	7.1	10.0	12.9
Average width	3.7	4.7	4.8	3.6	4.5	4.9	3.7	4.7	5.5
Average area	25.9	42.2	57.3	28.1	48.4	63.2	28.9	50.1	75.0
Length ÷ width	1.9	2.0	2.5	2.1	2.3	2.5	2.1	2.3	2.4

Table VI. Oysters from Grant's bed, June, July and August

Date	June 18 and 29			July 13 and 16			August. 7 and 12.		
Total number	175			109			108		
Age	2+	3+	4+	2+	3+	4+	2+	3+	4+
Number	29	105	29	15	76	18	8	70	30
Average length	6.7	10.4	12.9	7.5	11.0	12.3	6.8	11.2	12.8
Average growth in 1931	.5	.7	.6	1.4	1.5	1.4	1.6	2.1	1.8
Average previous growth	6.2	9.7	12.4	6.1	9.5	10.9	5.2	9.1	11.2
Average width	3.5	4.5	5.5	4.0	5.0	6.0	3.9	4.6	5.5
Average area	24.9	47.9	70.7	30.3	55.0	72.9	27.5	52.1	71.9
Length ÷ width	1.9	2.3	2.4	1.9	2.2	2.1	1.7	2.5	2.3

Table VII. Oysters from Grant's bed, August and September.

Date	Aug. 31, 1931			Sept. 15, 1931		
Total number	153			113		
Age	2+	3+	4+	2+	3+	4+
Number	25	69	16	13	71	29
Average length	7.7	12.1	14.3	8.3	11.2	13.3
Average growth in 1931	3.2	2.7	2.4	2.5	2.2	2.1
Average previous growth	4.6	9.4	12.9	5.8	9.9	11.2
Average width	4.1	4.9	5.6	4.4	5.0	5.5
Average area	32.0	59.9	83.6	36.6	56.6	73.4
Length ÷ width	1.9	2.5	2.5	1.9	2.2	2.4

Table VIII. Oysters from Grant's bed, October and November

Date	Oct. 1, 1931			Nov. 28, 1931		
Total number	114			116		
Age	2+	3+	4+	2+	3+	4+
Number	21	76	17	57	73	6
Average length	9.5	12.0	14.5	10.1	13.0	15.0
Average growth in 1931	3.2	2.7	2.6	3.9	3.3	3.2
Average previous growth	6.3	9.3	11.9	6.2	9.6	11.8
Average width	4.3	5.2	5.7	4.1	4.9	5.1
Average area	40.0	62.4	82.7	41.7	62.8	76.8

The increase in length and area for 2 and 3 oysters are also given in the graph shown in figure 1.

Growth of Oysters of Known Age.

In the autumn of 1929 spat was planted on a clean bed a little distance above Dawson's cape. This bed is known as the Totten bed. Now the oysters here were of known age and throughout the growing season of 1930 and 1931 samples were taken and measured at fairly regular intervals. The following tables give the results of these measurements. In 1930 all the oysters were measured in millimetres while in 1931 they were measured in centimetres.

Table IX. Oysters from Totten bed, 1930.

Date	25.6.30	11.7.30	21.8.30	15.9.30	22.11.30
Number examined	96	100	74	53	111
Average total length	17.9	23.8	40.6	49.0	50.8
Average growth in 1930	5.2	12.2	28.5	36.8	37.8
Average previous growth	12.7	11.6	12.1	12.2	13.0
Average width	13.7	17.7	23.5	34.4	35.7
Average area	271.	446.	1229.	1756.	1858.
Length ÷ width	1.30	1.34	1.42	1.42	1.42

Table X. Oysters from Totten bed, May and June 1931.

Date	May 1	May 28	June 8	June 15	June 25
Number examined	144	109	91	139	73
Average length	5.2	5.6	5.4	5.7	5.7
Average growth in 1931	0	.2	.4	.7	.6
Average previous growth	5.2	5.4	5.0	5.0	5.1
Average width	3.5	3.4	3.7	3.7	3.7
Average area	18.3	18.6	20.7	21.6	23.4
Length ÷ width	1.5	1.6	1.5	1.5	1.5

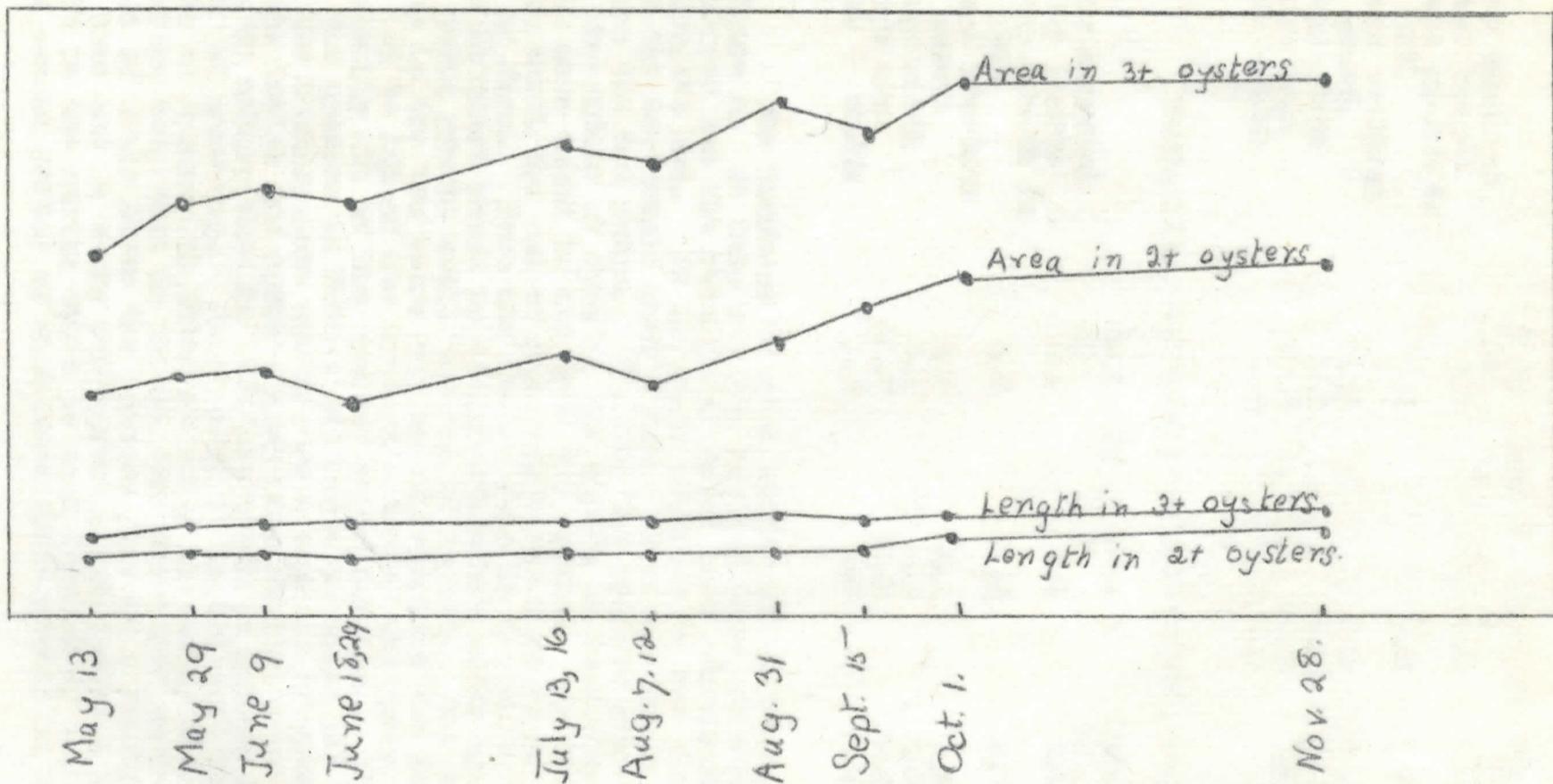


Fig. 1. Rate of growth of oysters on Grant's bed, 1931

Table XI. Oysters from Totten bed, July and August

Date	July 2 and 6	July 20	Aug. 6	Aug. 26
Number examined	113	76	37	30
Average length	5.9	6.1	6.7	7.9
Average growth in 1931	.9	1.2	2.4	3.0
Average previous growth	5.0	4.9	4.3	4.9
Average width	3.8	3.9	4.3	4.3
Average area	23.6	24.2	29.8	34.2
Length ÷ width	1.6	1.5	1.6	1.8

Table XII. Oysters from Totten bed, September, October, November.

Date	Sept. 15	Oct. 2	Nov. 24
Number examined	83	98	88
Average length	7.9	7.9	7.9
Average growth in 1931	3.0	2.8	2.7
Average previous growth	4.9	5.1	5.2
Average width	4.3	4.9	4.2
Average area	34.7	35.8	32.0
Length ÷ width	1.9	1.6	1.8

The increase in area during the two seasons is also given in figure 2. On this bed the samples have not been as big as could be desired but the results are much more satisfactory than they were for Grant's bed. It is quite possible to see the time of year at which the most rapid growth takes place and it is interesting to compare the two years. In 1930 the oysters grew fairly steadily from the middle of June to the middle of September with the growth a little more rapid in the last two months. In 1931 there was a spring growth until the end of June which was most rapid during the first week of June. From the end of June to the third week in July there was a distinct check in the growth after which came the period of most rapid growth until the end of August. Now the difference in growth in the two years may be explained by the fact that in 1930 only 16% to 18% of the oysters produced any spawn whereas in 1931 practically all of the oysters were spawning. It is not known just when the oysters on Totten bed began to spawn but in shallow water near the Station some oysters were seen to be spawning on July 2 and the Totten bed oysters must have started soon after this. It is worth noting that in 1931 the check in growth coincides with the period of spawning. In general it is believed that the seasonal growth of oysters in Bideford river is always similar to that found on Totten bed, that is to say from the first spring to the second autumn of their lives the oysters grow at a fairly even rate but the next year and in every subsequent growing season there is a period of growth in the spring which is soon checked by the spawning activity and a second period of much more rapid growth in the autumn.

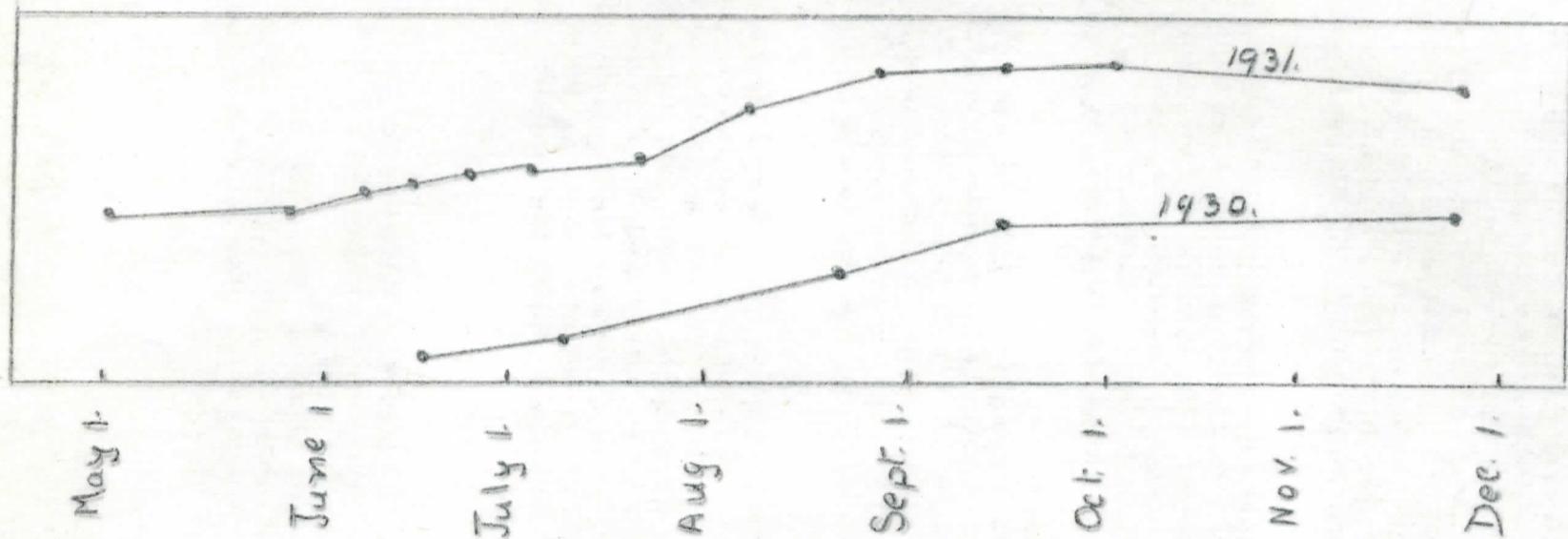


Fig. 2. Rate of growth of oysters on Totten bed.

Location of Beds in Bideford River.

7.

It may be convenient to refer the position of the beds mentioned above to the map issued by the Dept. of the Interior, Canada in 1930 and showing oyster leases in Malpeque bay. These beds are all on sheet No. 8 of this map.

Name of bed	Position on map
Paugh's creek	Division 206, Section O.
Dawson's cape	Division 194, Section R, Sub-sections 9 and 10.
Ellis' cove	Division 198, Section V, northern half.
England's bed	Division 198, Section R, northern half.
Cooper bed	Division 188, Section Y.
Grant's bed	Division 206, Section D, sub-section 12.
Totten bed	Division 199, Section F, eastern half.

Summary.

1. At three stations in Bideford river collections of oysters were made in the spring and autumn of 1931. One of these stations was at the mouth of the Government's reserved area, the second some distance up the river and the third was at the head of the river. These collections distinctly showed the difference in the rate of growth and shape of the oysters in the different parts of the river to the effect that the farther up the river the oysters grow the longer and narrower they are and the more rapidly they grow.

A comparison was also made in the autumn of 1931 of the oysters from two beds planted with spat in the autumn of 1930. Here it could distinctly be seen that the young oysters were already assuming the shapes characteristic of their environment so that the ones from the bed near the Biological Station were becoming long and narrow while those from the bed at the mouth of the river were becoming round and of good shape.

2. An attempt was made to trace the seasonal rate of growth of oysters in a mixed population by making collections of oysters on a bed some distance up the river at intervals of two or three weeks throughout the growing season and measuring the oysters. Unfortunately it was found that the samples taken were not large enough to compensate for the lack of homogeneity in different parts of the bed.

3. Throughout the growing season of 1931 collections of oysters were made on a bed planted with spat in 1929. Here the oysters were of known age and the work was a continuation of a similar taking of samples in 1930. A comparison of seasonal growth in the two years shows that in 1931, when only 16% to 18% of the oysters were spawning, the rate of growth was fairly uniform but in 1931, when practically all the oysters were spawning, there was a distinct check in the rate of growth during the spawning season and the most rapid growth came in the late summer and autumn.