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OYSTER MORTALITY IN THE CHARLOTTETOWN REGION, 1937.

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Introduction. During the summer and fall of 1936 oysters in the Hillsborough river, Tracadie bay, and in the Covehead-Brackley area died in large numbers. The present investigation was undertaken in an effort to follow the course of the mortality this year and if possible to determine the cause.

A number of places in the affected areas were selected as bases at which periodic examinations of oysters were carried out in order to determine the time of appearance and progress of the disease. In anticipation of a spread of the disease locations were selected in adjacent unaffected areas at which samples of oysters were to be examined periodically. Examinations were commenced on June 21st and continued until November 25th.

Symptoms of the disease. Diseased oysters were identified chiefly by the occurrence of yellow-green lesions, circular or oval in outline, and varying in diameter from about one-half of a millimetre to as much as five millimetres, on the body of the affected oyster. Lesions were found on the "liver-gonad" region, the pericardial region, on the adductor muscle, and on the mantle, with that section of the liver-gonad region facing the left shell being the most common place of appearance. About the beginning of November these lesions were superseded by yellow-green lesions of a blotchy appearance. These two types of lesions seemed to grow in size and number as the disease progressed and eventually the oyster died. Other symptoms of an unhealthy condition were observed, such as almost complete cessation of growth, weakness of the adductor muscle, shrinkage of the body so as to occupy only a portion of the shell. In some cases the body became almost translucent in appearnce. Some were observed to undergo a gradual weakening finally resulting in gaping of the shell.

Spread of the disease and mortality. Further mortality occurred this year in the areas affected last year and, in addition, the disease spread to three new areas with many oysters being killed. A preliminary survey of the spread and the resultant mortality is given on the following pages.

Elliott river. Locally known as the West river. This river or inlet opens into Charlottetown harbour almost directly opposite the mouth of Hillsborough river and, has in the past, produced many hundreds of barrels of oysters.

Periodic examinations about one week apart were made from June 21st to November 24th at three localities on the river as follows: (Table I)

(1) Yorke Point. Near the mouth of the river. The intertidal zone contained early in the summer quite a goodly number of cupshaped oysters, varying in size from 1½ to 3½ inches. These oysters were apparently healthy, showed good growth tips, and no recently opened shells could be observed. On August 10th recently opened shells were noticed in considerable numbers on the beach and, in several instances pieces of meat (in most cases the adductor muscle or part thereof) were found adhering to the shell. A large number of living oysters were examined but no indications of a diseased condition could be seen. A week later yellow-green lesions were observed on the bodies of a number of living oysters. A yellow-green discolouration, not noticed before, was present on the inside surfaces of the shells of these diseased oysters. After exposure to air for 1 to 2 hours the yellow-green colour of the lesions faded and became indistinct. From this date to the end of the observation period on November 24th diseased oysters were observed on each examination. The epidemic seemed to be at its peak during October. (See Table I)

In order to have a basis for computing the amount of mortality a number of oysters were collected and placed together in a pool. Records were kept of the actual number of deaths that occurred among this group. Unfortunately at the end of October the experiment was terminated due to unavoidable circumstances. Up to that time fifty-three per cent of the oysters had died. The largest number died during the last week of August and in the first week of September. It is estimated that about sixty per cent of all oysters in this locality have died during the past summer and fall. Size does not appear to be a factor as oysters of all sizes appeared to die in equal numbers.

(2) Long Creek. A tidal tributary about seven miles above Yorke Point. Periodic examination of oysters was begun on July 12th and repeated at intervals of about one week to the end of November. A fair number of oysters, ranging in size from 2 to 5 inches, were present on the intertidal zone; considerable quantities of marketable oysters were to be found in the channel.

Characteristic disease symptoms were first found among these oysters on September 8th. The first recently opened shells were observed on the same date. Diseased oysters were found present to the last day of examination. The epidemic seemed to be present in greatest concentration from October 15th to November 15th. As at Yorke Point a check was kept on the amount of mortality. Fifty-nine per cent of a number kept on the intertidal zone died. It is estimated that about sixty per cent of the oysters (all sizes) at Long Creek, both in the channel and on the flats, have died this past summer and fall.

TABLE I

Records of Disease and Mortality among native oysters in the Elliott river, 1937.

West River Bridge

Date	No. Exam.	No. Diseased#
June 21	75	0
" 28	30	0
July 5	35	0
" 12	30	0
" 20	35	0
" 28	40	0
Aug. 10	65	0
" 30	50	1
Sep. 6	60	10
" 14	49	17
" 28	42	15 + 2#
Oct. 4	28	7 + 5#
" 14	40	16 + 7#
" 25	16	5 + 6#
Nov. 6	59	19
" 17	31	4 + 1#

Long Creek branch

Date	No. Exam.	No. Diseased#	No. dead in lot of 201
July 12	55	0	
" 28	36	0	[illegible] placed in pool
Aug. 10	34	0	0
" 16	51	0	0
" 30	33	0	0
Sep. 6	35	3	3
" 14	22	3	9
" 28	26	1	11
Oct. 14	35	4	28
" 25	54	9	37
Nov. 3	19	2	26
" 18	21	10 + 3#	4
" 24	41	5	1
			total = 110 % = 59.2

Yorke (North) Point

Date	No. Exam.	No. Diseased#	No. dead lot of 200
June 21	65	0	
" 28	90	0	
July 5	35	0	
" 12	55	0	
" 20	50	0	
" 28	35	0	
Aug. 10	58	0	placed oyster
" 16	31	3	4 pool
" 19	60	12	0
" 23	27	3	3
" 30	65	3	21
Sep. 8	63	7	45
" 14	30	3	4
" 28	26	8	13
Oct. 6	55	9	8
" 14	24	10	7
" 25	30	8	Rem. Oysters missing
Nov. 6	23	6 + 4#	
" 17	30	9	-
" 24	64	1	-
			total = mortality = [illegible]%

#Note: Second figure for translucent oysters. Other "diseased" oysters with yellow lesions.

(3) West River Bridge. Crossed by highway No. 2A, about three miles above Long Creek. Weekly examinations began on June 21st. No oysters were found on the flats, but good quantities were present in the channel. These were vari-shaped, and many were of marketable size. All appeared early in the summer to be healthy and growing well. Diseased specimens bearing the characteristic lesions were first seen on August 30th and a few recently opened shells were observed. Diseased oysters were present throughout to the last day of examination on November 17th. The infection was quite severe, particularly during the last week of September and the first two weeks of October. On September 8th, and again on September 14th shells were found with portions of oyster meat adhering, and many recently opened shells were observed. The amount of mortality in this locality is estimated at 70 to 75 per cent of the total oyster population.

From the above facts it would seem to be highly probable that oysters began to die in early August at Yorke Point and the mortality spread up-river gradually until by early September all oyster areas in the river had become affected. It is quite certain that the mortality among the oysters in the Elliott river passed 65 per cent during the past year. (See Table I)

Yorke river. Locally known as the North river, opens into Charlottetown harbour at a point between the Elliott and Hillsborough rivers. Samples of oysters (mostly less than three inches in diameter) gathered from the flats near Brighton (a Charlottetown suburb) were examined at about weekly intervals, beginning on June 21st and continued to November 24th.

These oysters were of good shape and showed very good growth. Oysters with yellow-green lesions were first observed on August 30th. Recently opened shells, indicating that oysters had died, were observed as early as August 10th, in small numbers. The last characteristic lesions were observed on November 17th; a large sample examined on November 24th showed no traces of a diseased condition. The estimated mortality for the oyster population of the Yorke river in 1937 is about 40 to 50 per cent. (See Table II)

Hillsborough river. Locally known as the East river. Weekly examinations of oysters were made at two points, commencing June 24th and ending on November 26th. Occasional visits were made at several other locations.

(1) Scotchfort. (Table III) Very few oysters in this locality survived the mortality of 1936. Three hundred and fifty-nine survivors (mostly large) were held on trays moored in the river channel. These oysters showed very little or no growth during the growing season. On July 22nd the first dead were observed and removed. The death rate rose rapidly, reaching its maximum by August 19th. Close examinations were made of living specimens, but no indications of a diseased condition could be detected during that period. It was not until August 31st that characteristic lesions were observed. During the period of observation fifty-three per cent of these native oysters died. Approximately 2,600 1936 native spat were held in a tray during

TABLE II

Records of Disease among oysters at Brighton (Yorke R.) 1937.

Date	No. Exam.	No. Diseased
June 21	60	0
28	2	0
July 3	40	0
5	20	0
12	30	0
20	42	0
28	42	0
Aug. 10	24	0
16	21	0
30	26	1
Sep. 8	50	0
14	35	4
28	36	9
Oct. 6	21	5
14	16	2
25	31	8
Nov. 6	20	3 - 2#
17	28	5
24	55	0

#Note: Second figure refers to translucent oysters. Other "diseased" oysters showed yellow lesions.

TABLE III

Records of Disease and Mortality among Oysters at Scotchfort, 1937.

Date	"East River survivors" No.Exam.	No.found diseased#	No.found dead in trays	"Oysters from Wallace, N.S." No.Exam.	No.found diseased#	No.found dead in trays
June 24	9	0	0	-	-	-
29	30	0	0	7	0	0
July 9	14	0	0	15	0	0
15	5	0	0	5	0	0
22	5	0	2	5	0	5
29	6	0	2	5	0	3
Aug. 4	5	0	31	5	0	10
13	5	0	16	4	0	6
19	4	0	12	5	0	3
31	5	2	4	-	-	-
Sep. 7	5	0	6	5	1	0
17	5	1	3	5	2	0
27	4	0	2	6	0	6
Oct. 8	16	6	10	6	2	0
20	-	-	-	-	-	-
28	10	3	2	10	5	1
Nov. 5	5	1 + 1[J]	6	5	0	3
10	5	+ 1[J]	0	5	1	0
17	13	7	3	-	-	0
26	5	0	0	5	0	0

#Note: Second figure refers to translucent oysters.
Other "diseased" oysters showed yellow lesions.

the period June to November 30th. These maintained a healthy appearance to near the middle of November. During the last two weeks of November a small number (63) died.

(2) Mt.Stewart. (Table IV) Oysters in this locality and in the nearby Pisquid river apparently were not so hard-hit by the 1936 mortality as were the remainder of the Hillsborough river oyster areas. Fair numbers of oysters were raked in both of these areas. The water in the two localities is of low salinity and this may have had a retarding influence on the progress of the disease. These surviving oysters were of poor shape and showed only fair growth. Examinations were commenced on June 24th and carried on to November 18th., Yellow-green discolouration on the inside surfaces of the shells was noticed on August 13th in large numbers. On August 25th characteristic lesions were first observed. No recently opened shells had been observed up to this time. The estimated amount of mortality here in 1937 is 20 to 30 per cent.

1936 spat were observed at Apple-tree wharf, Red point and Duffy's point. Good growth was shown at all three localities. Not more than 25 per cent of last year's spat has died in 1937. A heavy set of spat occurred this year in the Scotchfort area and farther down-stream in the Apple-tree wharf area. This spat grew very fast, approaching 1½ inches in diameter by the end of the growing period.

With the exception of the Mt. Stewart and Pisquid river areas practically no oysters other than the above mentioned 1936 and 1937 stocks remain in the Hillsborough river. The total mortality of the older stocks has passed ninety per cent.

Chapel creek. (Table V) Chapel creek opens into Rustico bay. Examinations were commenced on July 13th and continued at periods of about two weeks until October 29th. Oysters occurred on the flats and in the channel. The quantity was small but the shape and quality excellent. Good growth was shown. No indications of disease were observed until October 6th on which date a number of oysters stored in a Charlottetown warehouse showed yellow-green lesions. Specimens examined at Chapel creek on October 9th showed similar lesions. A very small number of recently opened shells were observed on the flats. Lesions were found on oysters to the end of October, at which time examinations were discontinued as commercial fishing had reduced the oysters to almost total extinction. The mortality other than fishing in the autumn of 1937 is estimated at ten to fifteen per cent.

Pownal bay.(Table VI) Examinations were commenced on June 22nd and continued at intervals of about two weeks until October 6th, and at weekly intervals thereafter until November 23rd.

Goodly numbers of cup-shaped oysters of the green-gilled variety were present on the flats. They varied in diameter from 1½ to 6 inches. Large numbers of clustered oysters were found on reefs lying adjacent to the shore line and about 100 to 200 yards out from the low tide mark. All oysters showed good growth.

Yellow-green lesions were first observed on October 6th, and continued to be present on oysters to the end of the observation period. The estimated mortality was not higher than 10 or 15 per cent.

Table IV

Record of disease among oysters near Mt. Stewart (Hillsborough R.) 1937.

Date	No. Exam.	No. Diseased*
June 24	25	0
July 2	30	0
9	40	0
16	33	0
22	29	0
Aug. 4	25	0
13	41	0
25	54	1
31	43	4
Sept. 7	40	5
17	27	7
30	20	8
Oct. 8	26	3
20	10	8
28	88	15
Nov. 5	13	5 + 3*
10	23	7 + 1*
18	19	5 + 2*

*Note: Second figure refers to translucent oysters. Other "diseased" oysters showed yellow lesions.

TABLE V

Records of Diseased oysters in the areas fished. 1937.

Chapel creek			Oyster Bed Bridge		
Date	No. Exam.	No. Diseased*	Date	No. Exam.	No. Diseased*
July 13	33	0	Aug. 25	25	0
26	22	0	Sept. 5	10	9
Aug. 10	14	0	27	21	0
Sept. 5	56	0	Oct. 9	12	2
27	17	0	25	67	21
Oct. 9	19	6	Nov. 8	12	4 + 1*
23	16	5	19	18	13
29	32	4	25	15	5

*Notes Second figure refers to translucent oysters; Other ordinary "diseased" oysters showed yellow lesions.

rapid spread of the disease in this newly infected area did not occur perhaps due to the lateness of its appearance. It is probable that a much higher mortality will take place during 1938.

Vernon river. (Table VI) Examinations commenced on June 22nd and were continued as at Kornal bay. Oysters were found on the flats in considerable numbers, with lesser numbers present on the channel bottom. They were of variable shape and size, and showed but medium to poor growth.

Diseased specimens were first observed on October 6th. The percentage of diseased oysters was higher among the channel oysters than among those picked from the flats. Fishermen found dying oysters, dead oysters, and recently opened shells on the opening of the fishing season on October 1st. They were unable to locate oysters in commercial quantities in the channel. The yellow-green lesions continued to be present to the end of the observation period. The mortality is estimated at 35 per cent among the channel oysters and at about 20 per cent among those on the flats. This area will probably suffer a higher mortality in 1938.

Orwell river and bay. (Table VI) Examinations made on same dates as for Kornal bay and Vernon river.

Examinations were made from ten barrels of "culls" placed on the flats last fall (1936) by Mr. J. A. Macleod and from oysters native to the flats. All oysters were of fairly good shape and showed good growth.

Characteristic lesions were first observed on October 6th. A few recently opened shells were noticed on the flats. On the last date of examination (November 23rd) a large sample showed no traces of disease, although specimens showing lesions had been observed up to the week previous. The mortality is estimated at 15 to 20 per cent among oysters on the flats and at 20 to 25 per cent among those in the channel. A higher mortality percentage is to be expected during 1938.

Pinette river. (Table VI) There are no public fishing areas on the river flats or in the channel, all oysters being held on leased rounds. The leases hold a relatively small number of oysters.

Examinations commenced on July 6th and were made twice monthly until November 4th. Oysters examined were of medium to large size, apparently healthy, but showed little growth. The lack of growth may be explained by the fact that these oysters had been transferred from Orwell in 1935.

Yellow-green lesions were first seen on October 15th when 75 per cent of all oysters examined showed them. Recently opened shells with gonads still attached were found. The mortality is estimated at 30 to 40 per cent.

Adult oysters were not observed in the Kornal-Vernon-Orwell district until late in the fall. There is no evidence to show that the disease may have been carried into the area by fishermen who came into the Pinette river at the end of September. These fishermen fished this area in 1936. It is more probable that the disease was

TABLE VI

Records of Disease among oysters in the Areas fished, 1937.

Date	"Ppwnal bay"		"Vernon river"		"Orwell river"		"Pinette river"	
	No.Exam.	No.Diseased#	No.Exam.	No.Diseased#	No.Exam.	No.Diseased#	No.Exam.	No.Diseased
June 22	40	0	57	0	40	0	-	-
July 6	30	0	63	0	32	0	12	0
21	35	0	55	0	35	0	12	0
Aug. 3	35	0	39	0	30	0	12	0
17	28	0	36	0	16	0	12	0
24	59	0	45	0	29	0	-	-
Sep. 9	81	0	58	0	28	0	12	0
24	56	0	29	0	47	0	12	0
Oct. 6	25	6	43	21	33	6	-	-
15	42	7	22	9	166	6	28	21
20	36	6	-	-	37	10	-	-
27	43	10	37	15	22	3 + 1#	-	-
Nov. 4	48	3 + 4	35	14 + 1#	16	3	11	5
9	62	9 + 3#	42	9	22	3	-	-
18	35	8 + 1	29	4 + 3#	15	1 + 1#	-	-
23	45	2	58	11	36	0	-	-

#Note: Second figure refers to translucent oysters.
Other "diseased" oysters showed yellow lesions.

water-borne as was the case, apparently, in the Elliott and Yorke rivers.

The lateness of the season when the disease was first observed probably prevented a heavy mortality. A more extensive spread is to be expected with warming of the water during the summer of 1938.

Brackley bay. (Table VII) A number of native Brackley oysters, survivors of the 1936 mortality, were held in trays at Shaw's creek. These were of all sizes and showed little growth. Dead oysters were first found on July 22nd, the same date as at Scotchfort. Although careful examinations were made at regular intervals no indications of a diseased condition were seen until the end of September Many oysters had died before this date (see Table VII). During the observation period (June 23-November 25) 42 per cent of the oysters died

Hillsboro river, opens into Egmont bay. A number of spat from the 1936 set were held in a tray moored in the river. These began to die in early September. Examinations showed large numbers of living specimens carrying the yellow-green lesions. By the end of November about 50 per cent of these oysters had died. The oysters in this locality have been killed on several occasions, presumably by the same disease now killing the oysters in the Charlottetown region.

Introduced oysters. Starting in 1915 an epidemic disease appeared among the oysters in Malpeque bay killing all but a few. The symptom most commonly mentioned in reports was the occurrence on the body of yellowish lesions. When diseased the oyster exhibited other symptoms of weakness and unhealthy condition such as shrinkage of the body and weakening of the adductor muscle with consequent inability to keep the shell closed.

A few Malpeque oysters survived the disease, chiefly those at the heads of inlets. These survivors produced spat, some of which survived in turn. Finally, a variety of oyster has developed in Malpeque bay which was apparently resistant to the disease and capable of growing in its presence, since it is pretty certain that the disease is still present.

The symptoms shown by diseased Malpeque oysters were apparently similar to those exhibited by diseased oysters in the Charlottetown region. On this basis there is some grounds for suspecting the disease which killed oysters in Malpeque bay in 1915 et seq. to be the same as the one which killed oysters in the Charlottetown region in 1936 and 1937. If this be true Malpeque oysters should survive and grow well in the latter region.

To test this hypothesis sample lots of Malpeque oysters were transferred to two diseased areas: Brackley bay and Rustico bay.

A number of Malpeque oysters (large) were kept in trays at Shaw's creek, an inlet of Brackley bay. These were examined at weekly intervals during the period June 23rd to November 25th (see Table VII). Two deaths occurred on August 5th; between October 14th and November 9th 12 more deaths took place. This represented the total for the period

TABLE VII

Records of Disease and Mortality among native and Malpeque oysters in Brackley bay, 1937.

Date	No. Brackleys examined	No. diseased	No. dead in trays	No. Malpeques examined	No. diseased	No. dead in trays	No. Malpeques exam. from Brittain's lease	No. diseased
June 23	5	0	0	5	0	0	†	-
30	5	0	0	5	0	0	-	-
July 7	5	0	0	5	0	0	-	-
13	5	0	0	5	0	0	20	0
22	5	0	6	5	0	0	10	0
29	5	0	8	5	0	0	10	0
Aug. 5	4	0	6	6	0	2	10	0
10	5	0	4	5	0	0	-	-
19	5	0	4	5	0	0	-	-
25	5	0	1	5	0	0	10	0
Sep. 1	5	0	3	5	0	0	-	-
7	5	0	5	5	0	0	20	0
17	5	0	0	5	0	0	-	-
27	10	1	6	-	-	0	15	0
Oct. 12	5	0	14	10	0	1	15	0
30	5	+ 1*	5	5	0	7	-	-
Nov. 2	-	-	-	-	-	-	24	6 + 1#
9	5	+ 1#	1	12	2	4	-	-
16	-	-	0	5	0	0	39	2
25	5	0	0	5	0	0	41	2 + 1#
total	94		63 = 42% of total	103		14 = 4.9% of total		

Notes: Same as in other tables

amounting to about 5 per cent. On November 9th diseased specimens were observed for the first time. It is to be noted that during the same observation period 42 per cent of a lot of native oysters, held with them in the same trays, died.

In another section of Brackley bay twenty barrels of Malpeque oysters (mixed sizes) were planted on a private lease (lease held by Mr. A. H. Brittain). These were examined twice monthly from July 13th to November 25th (see Table VII). Diseased oysters were firs observed on November 2nd, when a number were found which showed the characteristic lesions. A number of recently opened shells were also found. From this date to November 25th oysters which showed yellow-green lesions were found at each examination, insmall numbers. It was not possible to make an accurate estimation of the number of oysters that died.

Around the 10th of August three bushels of Malpeque oysters (mixed sizes) were placed on sandy bottom near Oyster Bed Bridge, Rustico bay. These oysters were examined twice monthly from August 25th to November 25th. Oysters which showed characteristic lesions were observed for the first time on October 9th. On October 26th about 30 per cent of all oysters examined showed the yellow-green lesions (see Table V). On the same date a number of recently opened shells were found. On November 19th 13 out of 18 oysters examined showed lesions. The last occasion on which examinations were made, November 25th, 30 per cent of those examined showed typical lesions. It was not possible to compute the number of oysters that died during the observation period.

The ability of Malpeque oysters to successfully resist the disease which has killed most of the oysters in the Charlottetown region has not been sufficiently tested by experiment to warrant the drawing of conclusions. The scanty data at our disposal does show that in Brackley and Rustico bays a number of Malpeque oysters were observed which showed the characteristic lesions which are believed to be a symptom of the disease. The data also shows that a small number of Malpeque oysters have died, presumably as a result of the disease. The single instance where we have accurate information indicates that the mortality was small, about 5 per cent. A mortality as low as this is strongly indicative that Malpeque oysters, in this instance at least, possessed a high resistance to the disease. The oysters that survived showed an extremely rapid growth. The rather large number of oysters in Rustico bay which showed disease symptoms is a matter which suggests a far more serious situation.

It is strongly recommended that further investigations on the resistance to the disease of Malpeque oysters be carried out in diseased areas on a fairly extensive experimental scale during 1938 and in following years if deemed necessary. The experiments conducted in 1937 should, of course, be continued. In addition Malpeque oysters should be planted in the following locations:

(1) Scotchfort, on the Hillsborough river
(2) Yorke point, or some other suitable location on the Elliott river
(3) A suitable location in the Bernal-Orwell area.

A number of oysters were brought from Wallace, Nova Scotia, an area free from disease, and held in trays at Stoneheart. Examinations were commenced on June 29th and continued at weekly intervals to November 24th.

These oysters began to die on July 22nd and the mortality continued until November 5th. The greatest number of deaths occurred before the middle of August, but the yellow-green lesions were first observed only as late as September 7th (see Table III). During the period of observation 36 per cent of the Wallace oysters died. This figure is somewhat surprising when compared with the mortality among the native Hillsborough river oysters (53 per cent mortality). Both lots of oysters were subjected to identical conditions. It might be expected that the natives, survivors of the 1936 epidemic, would show a greater resistance to the disease than the Wallaces which were being subjected to the disease for the first time.

Ecological factors. Temperature and salinity records were kept for each location at which oysters were periodically examined. (See Appendix). These records do not show any exceptional conditions, the existence of which could be held responsible for the heavy mortality among oysters in the Charlottetown region duringthe observation period. In fact these records showed that the temperature and salinity ranges for the diseased areas were exceedingly favourable for the continued existence of the oyster. The hydrographic tables have been inserted at the end of this report as appendix A.

The manner in which the disease started in one locality and spread to others over a period of months almost precludes the possibility of explaining the mortality among oysters in these areas on the basis of exceptional physical conditions in the environment. It has been argued that the oysters have been smothered to death on shifting and soft bottoms. This argument cannot hold as a general explanation for oysters died in places where the bottom was almost rock-hard, and in trays floating at the surface of the water.

Histological study. Specimens of normal and diseased oysters from the Charlottetown area have been collected from representative localities and preserved for histological study. It is hoped that a study of this preserved material will help identify the causative organism of the disease.

The information that has been gathered concerning the disease and its spread during the past year is necessarily of a preliminary nature. In order to round out the picture more completely the course of the disease should be followed closely in 1938.

Discussion and conclusions. It can be concluded that during the past summer and fall there occurred a spread of the disease which killed many oysters in the Hillsborough River and adjacent bays during 1936. The spread resulted in mortalities of varying severity among the oyster populations in the newly infected areas. Those areas which escaped with a light mortality this year will, in all probability, suffer a heavier one in 1938.

The disease appears to be contagious and epidemic. The fact that oysters died in most localities before lesions were observed indicates that the lesions may be a secondary factor in the life history of the disease.

The disease appears to require some time to develop virulence. All indications point toward the fact that the disease is present for some time before it develops an epidemic of sufficient proportions to be observable. However, once this state has been attained the spread is very rapid and a heavy mortality results in a short time.

Oysters of all sizes fell prey to the disease. However, there is some evidence which shows that those less than about one year old suffer less heavily than older oysters. Survivors of the disease apparently suffered no impairment of their spawning abilities. A very large set of spat occurred this year in some sections, at least, of the Hillsborough river. Yet this river has had over 90 per cent of its oysterskilled in the past two years. A fair set of spat was also noticed in the Elliott and Yorke rivers. Therefore, it seems probable that numbers of small oysters will continue to be present in the diseased areas as long as there remain a few mature oysters.

It was observed that diseased oysters showed very little, if any, growth. Oysters which were survivors of the 1936 epidemic in most cases showed no shell growth at all. A few showed a small growth. In no instance did the growth approach the average normal.

When diseased the oysters apparently were unable to stand much exposure to air. Normal, healthy oysters when kept cool are capable of withstanding prolonged exposure to air. Oysters taken from diseased areas exhibited considerable susceptibility to air exposure, many opening up in a few hours. A number of buyers suffered losses during October and November because of this fact.

There can be little doubt the disease is caused by a microscopic parasite, the nature and identity of which is at present unknown. The fact that the disease started in one locality and spread to others over a period of years and the apparent absence of exceptional physical conditions in the environment is good indication that an organism of some sort is responsible.

APPENDIX

Hydrographic Records. 1937.

Date	Time	Tide	Depth	Temp.	Salinity	Locality
June 22	2:30P	¾ ebb	Surf.	20.0	27.5	Townsal bay
July 6	2:30P	full ebb	"	23.7	27.8	"
21	1:15P	¾ ebb	"	27.0	29.3	"
Aug. 3	1:30P	full ebb	"	25.2	29.3	"
17	2:55P	¾ ebb	"	27.8	29.1	"
24	4:15P	full ebb	"	22.6	28.8	"
Sept. 9	10:00A	¾ ebb	"	14.5	26.8	"
24	6:05P	¾ ebb	"	16.5	27.4	"
Oct. 6	3:45P	¾ ebb	"	14.2	27.9	"
15	12:10P	full ebb	"	5.5	28.1	"
20	3:40P	¾ ebb	"	11.9	28.3	"
27	11:05A	1/5 rise	"	13.0	28.2	"
Nov. 4	10:30A	¾ ebb	"	2.2	27.2	"
9	11:10A	¾ rise	"	7.5	25.1	"
18	11:50A	full rise	"	6.5	25.5	"
23	2:10P	¾ rise	"	1.1	25.8	"

June 22	5:15P	¾ rise	Surf.	19.4	----	Vernon river
July 6	5:25P	1/3 rise	"	27.6	26.0	" "
21	3:30P	¾ rise	"	30.5	27.0	" "
Aug. 3	3:45P	full ebb	"	26.9	26.5	" "
17	4:50P	1/3 rise	"	28.5	27.2	" "
24	4:55P	full ebb	"	22.0	27.4	" "
Sept. 9	12:30P	full ebb	"	15.3	26.0	" "
24	3:40P	¾ ebb	"	19.5	26.3	" "
Oct. 6	2:55P	¾ rise	"	13.8	26.4	" "
15	2:40P	1/6 rise	"	6.8	23.8	" "
27	12:15P	¾ rise	"	11.5	20.7	" "
Nov. 4	11:45A	4/5 ebb	"	5.2	26.2	" "
9	1:35P	2/3 rise	"	8.1	25.4	" "
18	12:40P	full rise	"	6.0	24.8	" "
23	3:30P	full rise	"	3.0	24.0	" "

2--Appendix Continued.

Date	Time	Tide	Depth	Temp.	Salinity	Locality
June 22	4:30P	1/5 rise	Surf.	18.7 C	----	Orwell
July 6	3:30P	1/5 rise	"	27.0	27.8	"
21	1:45P	full ebb	"	30.1	27.6	"
Aug. 3	2:15P	" "	"	25.2	27.3	"
17	1:30P	" "	"	28.0	26.2	"
24	5:40P	" "	"	21.6	22.2	"
Sept. 9	10:15A	4/5 ebb	"	14.5	27.1	"
24	2:00P	1/2 ebb	"	18.0	27.6	"
Oct. 6	2:30P	1/2 rise	"	13.4	27.4	"
15	10:45A	4/5 ebb	"	7.6	26.4	"
20	2:15P	2/3 ebb	"	12.8	26.4	"
27	11:45A	1/2 rise	"	11.8	26.8	"
Nov. 4	11:10A	full ebb	"	5.2	27.0	"
9	11:45A	1/2 rise	"	8.4	26.2	"
18	11:50A	full rise	"	5.8	26.3	"
23	2:45P	4/5 rise	"	2.4	26.0	"
July 6	4:30P	1/2 flow	Surf.	24.1	16.2	Minette river
21	2:30P	full ebb	"	27.8	26.7	(W.Jenny's
Aug. 3	3:15P	" "	"	24.8	19.7	lane & creek)
17	4:15P	" "	"	27.6	20.3	"
Sept. 9	11:50A	" "	"	15.2	17.8	"
24	6:40P	" "	"	19.4	18.5	"
Oct. 15	2:10P	" "	"	9.0	20.1	"
Nov. 4	1:45P	" "	"	5.6	18.9	"
July 13	10:20A	1/2 ebb	Surf.	20.9	26.4	Chapel creek
26	2:35A	1/2 ebb	"	23.0	27.1	" "
Aug. 10	11:05A	1/2 rise	"	23.1	27.2	" "
Sept. 5	11:00A	full rise	"	16.0	26.5	" "
27	9:10A	ebb	"	16.4	27.0	" "
Oct. 9	10:30A	1/2 ebb	"	11.5	25.8	" "
23	1:00P	4/5 rise	"	12.7	27.3	" "
29	10:25A	1/2 rise	"	13.9	27.0	" "
Aug. 15	10:45A	1/2 ebb	Surf.	19.5	27.0	Oyster Bed Bridge
Sept. 5	1:30P	full rise	"	17.0	26.5	" " "
27	11:45A	4/5 ebb	"	17.2	26.4	" " "
Oct. 9	1:15P	1/2 ebb	"	11.7	26.0	" " "
26	10:15A	2/3 rise	"	12.8	26.4	" " "
Nov. 6	1:30P	1/2 ebb	"	5.0	27.4	" " "
19	10:40A	1/2 ebb	"	6.7	26.2	" " "
5	1:45P	4/5 ebb	"	7.2	26.4	" " "

3--Appendix Continued.

Date	Time	Tide	Depth	Temp.	Salinity	Locality
June 21	11:00A	½ ebb	Surf.	16.1 C	23.8	West River bri
			Bot.	16.1	24.6	
28	9:30A	¾ ebb	Surf.	18.7	25.2	" " "
			Bot.	18.7	25.2	
July 5	11:30A	½ rise	Surf.	27.0	26.6	" " "
			Bot.	27.0	26.6	
12	8:35A	full ebb	Surf.	21.9	27.3	" " "
			Bot.	21.9	27.3	
20	1:55P	" "	Surf.	23.4	27.6	" " "
			Bot.	23.4	27.6	
28	10:30A	" "	Surf.	25.6	23.2	" " "
			Bot.	25.6	23.2	
Aug. 10	2:45P	½ ebb	Surf.	24.5	26.2	" " "
			Bot.	24.5	26.2	
30	3:35P	½ ebb	Surf.	22.5	27.0	" " "
			Bot.	22.5	27.0	
Sept. 6	8:30A	¼ rise	Surf.	18.0	25.9	" " "
			Bot.	18.1	25.9	
14	10:40A	¾ ebb	Surf.	21.7	24.0	" " "
			Bot.	21.7	24.0	
28			Surf.	12.3	24.0	" " "
			Bot.	12.3	24.0	
Oct. 4	12:15P	full rise	Surf.	11.0	24.2	" " "
			Bot.	11.0	24.2	
14	12:45P	1/3 rise	Surf.	13.2	27.0	" " "
			Bot.	13.0	27.0	
25	12:30P	¼ rise	Surf.	13.3	27.0	" " "
			Bot.	13.2	27.0	
Nov. 6	9:45A	1/3 rise	Surf.	8.5	26.3	" " "
			Bot.	8.5	26.3	
17	2:40P	5/6 ebb	Surf.	7.0	23.0	" " "
			Bot.	7.0	23.0	

Date	Time	Tide	Vent.	Temp.	Salinity	Locality
July 12	9:10A	full ebb	Surf.	12.0 C	14.0	Long creek (West river)
26	9:15A	" "	"	25.6	24.3	
Aug. 10	1:15P	½ ebb	"	26.0	24.9	" " "
16	11:05A	full ebb	"	29.4	24.7	" " "
30	3:35P	½ rise	"	26.5	24.4	" " "
Sept. 8	11:45A	1/3 rise	"	17.1	25.9	" " "
14	12:15P	full ebb	"	19.9	24.2	" " "
28	1:20P	1/3 rise	"	16.5	24.1	" " "
Oct. 14	1:15P	1/3 rise	"	13.4	26.3	" " "
25	1:00P	½ rise	"	13.5	27.1	" " "
Nov. 6	11:10A	rise	"	8.3	25.8	" " "
17	3:15P	½ rise	"	7.0	21.3	" " "
24	11:40A	½ rise	"	1.2	19.0	" " "

June 21	1:00P	4/5 ebb	Surf.	22.2	17.1	Yorke Point (West river)
28	10:45A	ebb	"	17.8	26.5	
July 5	10:10A	½ flow	"	20.1	26.4	" " "
12	7:25A	½ ebb	"	21.6	26.5	" " "
20	1:30P	ebb	"	25.0	28.1	" " "
28	9:35A	ebb	"	21.0	27.6	" " "
Aug. 10	3:45P	½ ebb	"	22.5	17.6	" " "
16	1:40A	½ ebb	"	28.7	20.0	" " "
19	2:15P	ebb	"	25.2	26.1	" " "
23	7:00P	½ ebb	"	17.0	20.4	" " "
30	1:15P	1/3 rise	"	17.6	23.1	" " "
Sept. 8	8:15A	½ rise	"	16.0	22.7	" " "
14	10:05A	½ ebb	"	20.6	25.6	" " "
28			"	11.8	27.5	" " "
Oct. 6	4:25P	½ ebb	"	14.5	27.2	" " "
14	11:55A	½ rise	"	12.6	10.4	" " "
25	11:35A	1/3 rise	"	13.0	27.0	" " "
Nov. 6	6:30A	½ rise	"	8.3	25.6	" " "
17	4:00P	1/3 rise	"	6.5	23.0	" " "
24	10:30A	1/3 rise	"	1.7	23.6	" " "

5--Appendix Continued.

Date	Time	Tide	Depth	Temp.	Salinity	Locality
June 21	3:06P	full ebb	Surf.	19.9 C	28.1	Brighton (North river)
28	7:30A	¼ ebb	"	15.5	26.4	" "
July 3	9:35A	¼ ebb	"	21.6	24.4	" "
5	10:40A	full ebb	"	27.4	24.4	" "
12	6:50A	¼ ebb	"	19.2	25.3	" "
20	12:05P	¼ ebb	"	24.9	26.5	" "
28	8:30A	full ebb	"	22.0	31.2	" "
Aug. 10	3:10P	full ebb	"	22.4	26.6	" "
16	9:15A	¼ ebb	"	24.8	25.7	" "
30	1:35P	¼ rise	"	27.6	26.8	" "
Sept. 8	7:45A	¼ rise	"	15.0	25.9	" "
14	9:15A	¼ ebb	"	20.8	25.8	" "
28		full ebb	"	16.8	25.5	" "
Oct. 6	3:50P	¼ ebb	"	14.3	26.6	" "
14	11:15A	1/5 rise	"	12.2	27.0	" "
25	10:45A	full ebb	"	12.6	22.9	" "
Nov. 6	7:45A	1/5 rise	"	8.0	25.8	" "
17	4:35P	¼ rise	"	6.8	23.4	" "
24	9:40A	1/6 rise	"	1.7	20.0	" "
June 24	3:40P	¼ ebb	Surf.	17.1	11.9	Scotchfort (East river)
			Bot.	17.1	13.0	
29	9:35A	full ebb	Surf.	21.0	15.1	" "
			Bot.	21.0	15.1	
July 9	3:30P	¼ ebb	Surf.	24.5	23.1	" "
			Bot.	24.4	23.3	
16	1:55P	¼ ebb	Surf.	21.6	19.2	" "
			Bot.	21.7	19.2	
22	10:20A	full rise	Surf.	22.5	21.4	" "
			Bot.	22.5	21.4	
29	4:30P	1/5 rise	Surf.	24.0	21.8	" "
			Bot	24.1	21.8	
Aug. 4	4:15P	1/5 rise	Surf.	23.0	16.9	" "
			Bot.	23.0	16.9	
13	9:15A	¼ ebb	Surf.	25.1	18.3	" "
			Bot.	25.1	18.3	
19	11:05A	¼ ebb	Surf.	22.3	20.6	" "
			Bot.	22.1	20.6	
31	11:45A	4/5 ebb	Surf.	21.3	20.2	" "
			Bot.	21.3	20.2	
Sept. 7	1:15P	full rise	Surf.	18.6	23.2	" "
			Bot.	18.8	23.2	

6--Appendix Continued.

Date	Time	Tide	Depth	Temp.	Salinity	Locality
Sept.17	1:35P	⅔ ebb	Surf.	20.4 C	19.6	Scotchfort (East
			Bot.	20.4	19.6	river)
27	12:15P	full ebb	Surf.	17.1	19.1	" "
			Bot.	17.1	19.1	
Oct. 8	12:30P	full rise	Surf.	13.6	22.2	" "
			Bot.	13.5	22.2	
20	11:15A	4/5 rise	Surf.	12.5	18.3	" "
			Bot.	12.5	18.3	
28	11:15A	4/5 ebb	Surf.	11.2	17.7	" "
			Bot.	11.2	17.7	
Nov. 5	11:40A	4/5 rise	Surf.	5.2	17.4	" "
			Bot.	5.0	17.4	
10	11:15A	full ebb	Surf.	6.0	15.5	" "
			Bot.	5.7	15.5	
17	10:30A	full rise	Surf.	4.9	16.6	" "
			Bot.	--	- -	
Nov. 26	10.30A	⅔ ebb	Surf.	1.1	15.8	" "
			Bot.	--	- -	
June 24	5:00P	ebb	Surf.	17.2	10.4	Mt.Stewart (East
July 2	4:00P	⅔ ebb	"	19.8	13.3	" river)
9	3:15P	⅔ ebb	"	23.6	13.7	" "
16	1:30P	½ rise	Surf.	24.1	22.6	" "
			Bot.	24.0	12.6	
22	9:45A	full rise	Surf.	23.9	13.1	" "
			Bot.	23.9	13.1	
29	1:30P	⅔ rise	Surf.	24.5	12.7	" "
			Bot.	24.5	12.7	
Aug. 4	4:00P	ebb	Surf.	23.0	12.7	" "
			Bot.	23.0	12.7	
13	10:30A	ebb	Surf.	24.4	14.3	" "
			Bot.	24.5	14.3	
25	3:00P	⅓ ebb	Surf.	19.9	15.0	" "
			Bot.	19.9	15.0	
31	10:45A	⅔ ebb	Surf.	21.6	15.5	" "
			Bot.	21.5	15.5	
Sept. 7	2:30P	1/5 ebb	Surf.	17.5	18.6	" "
			Bot.	17.5	18.6	
17	3:00P	full ebb	Surf.	20.0	15.1	" "
			Bot.	20.0	15.1	
30	5:15P	⅔ rise	Surf.	14.4	18.5	" "
			Bot.	14.4	18.5	

Date	Time	Tide	Depth	Temp.	Salinity	Locality
Oct. 8	11:45A	¾ rise	Surf.	14.4 C	16.2	Mt. Stewart (East river)
			Bot.	14.3	16.2	
20	9:25A		Surf.	9.8	11.9	" "
			Bot.	9.8	11.9	
28	10:10A	¾ ebb	Surf.	11.2	13.1	" "
			Bot.	11.1	13.1	
Nov. 5	10:40A	¾ rise	Surf.	4.6	12.1	" "
			Bot.	4.5	12.1	
10	10:05A	¾ ebb	Surf.	6.5	10.0	" "
			Bot.	6.5	10.0	
18	3:15P	4/5 ebb	Surf.	4.8	10.3	" "
			Bot.	4.8	10.3	
June 23	2:00P	¾ ebb	Surf.	18.3	26.4	Shaw's creek
30	10:30A	full rise	"	19.8	25.3	(Brackley Bay)
July 7	12:45P	¾ ebb	"	23.0	2935	" "
13	A	¾ rise	"	21.0	27.0	" "
22	10:30A	¾ ebb	"	23.6	24.4	" "
29	12:05P	full rise	"	23.1	27.0	" "
Aug. 5	10:30A	1/5 ebb	"	21.0	23.8	" "
10	12:20P	4/5 rise	"	20.5	27.5	" "
19	1:40P	¾ ebb	"	21.8	28.0	" "
25	11:15A		"	19.4	27.6	" "
Sep. 1	10:30A	full rise	"	20.0	27.4	" "
7	3:45P	" "	"	16.5	27.1	" "
17	4:35P	" "	"	16.8	27.5	" "
27	10:40A	¾ ebb	"	17.0	26.2	" "
Oct. 12	2:05P	full rise	"	8.0	25.1	" "
30	10:20A	¾ ebb	"	11.5	26.7	" "
Nov. 9	9:45A	¾ ebb	"	6.5	27.6	" "
16	3:00P	¾ rise	"	5.0	21.9	" "
25	11:20A	¾ ebb	"	1.8	21.8	" "
July 13	A	¾ rise	Surf.	20.4	27.8	Brittain's lease
22	10:30A	¾ ebb	"	22.4	27.2	(Brackley Bay)
29	11:00A	¾ rise	"	22.5	27.0	" "
Aug. 5	11:15A	¾ ebb	"	19.6	23.6	" "
25	12:40P	2/3 ebb	"	18.7	27.4	" "
Sept. 7	6:25P	1/6 ebb	"	16.2	26.8	" "
27	11:25A	¾ ebb	"	16.7	25.9	" "
Oct. 12	2:40P	full rise	"	7.8	25.0	" "
Nov. 2	2:35P	¾ ebb	"	5.8	28.7	" "
16	3:25P	¾ rise	"	5.0	21.9	" "
25	10:25A	¾ ebb	"	1.8	21.8	" "