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"1945 Investigations - Clams and Oysters"

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and

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INTRODUCTION

In 1945 the senior author's headquarters was shifted from the Prince Edward Island Biological Station to the Atlantic Biological Station at St. Andrews, N.B., and Mr. Claude Hayes was engaged as a technician to assist in the work and the Department of Fisheries continued the employment of two guardians to protect our experimental plots and assist with field work. These were Mr. Charles Hayes on the Sissiboo River, N.S., and Mr. Lloyd Young at East Petpeswick, N.S.

Almost no research was done on oysters but the scope of the clam studies was greatly increased by the transfer of responsibility for the investigation of the paralytic shellfish poison problem from Dr. Wilder and Dr. Leim to the clam investigator. Two reports on efforts in this field have already been filed separately (Medcof and Gibbons 1945, Medcof 1949).

The present report is an incomplete account of 1945 investigations in another respect. Mr. L. W. Thurber was engaged in 1949 to study meat-yield and water content of meats of clams and it was considered best to have him present many of the yield data gathered in 1945 (see Thurber 1949). This having been done, there is no need for their inclusion here.

Besides the investigational work, a good deal of effort was spent in obtaining special information as a basis for advice to the Department of Fisheries on shellfish administrative problems and the senior author was appointed station librarian. Miss Natalie Rollins was engaged to assist with paralytic poison and library work.

Much of this report was composed by Mr. J. S. MacPhail who was appointed to the staff in 1946. He has patiently built it up from field and laboratory records that were filed when the work was done.

J. C. Medcof
St. Andrews, N.B.,
January 1951.

1. 1945 RESULTS OF THE SISSIBOO RIVER EXPERIMENTS ON GROWTH AND SURVIVAL OF NORMAL AND STUNTED CLAMS.

The digging this summer consisted of each "d" quadrant in the main 75-ft. block and the four quadrants of adjacent plots No. 6, 7 and 8, which were planted 80 per sq. ft. Since the N 80's were planted in 1942 these results are for the third year.

The length-frequency distribution is shown in tables 1 and 2 and the results summarized in table 3. Their study supports several conclusions.

Conclusions

1. Normal clams planted 10, 20 and 40 per sq. ft. show a mean increase since planting of 24/32 inches or 56%. This brings the mean size to 68/32 inches - 1/8 inch under the 2 1/4 inch commercial size limit.

2. Stunted 10's and 20's show a mean increase of 18/32 inches or 41%. Their mean size is now 62/32 - over 1/4 inch less than the 2 1/4 inch legal size limit.

3. This digging completed the plots with N 80's which were planted in 1942. Unlike previous years their growth rate declined. The 51% increase in the three years since planting is equal to that of N 10's in 1944 after their third year.

4. An average of 74% of the clams that lived until 1944 survived this year. This figure corresponds closely with that for 1944 and 1943 - 76% and 77% - from which it may be judged that the annual natural mortality is about 25%. Only 25% of the original stock is left now.

5. N 80's have shown the best survival rate for a three-year period - 50% compared with 32% for the other stocks and densities in the third year.

6. The 1946 digging will complete this experiment. Indications are that few of the plots will reach the 2 1/4 inch size by that time.

Table 1. Size-frequency distribution and counts in 1945 of clams surviving from 1941 Sissiboo River plantings.

Clam length 32nds	D1 July 1	D2 July 18	D3 Aug. 1	D4 Aug. 2	D5 Aug. 11	D6 Aug. 13	D7 Aug. 25	D8 July 30	D9 July 30	D10 Aug. 6	D11 July 25	D12 Aug. 15	D13 Aug. 14	D14 Sept. 11	D15 July 23	D16 Sept. 11	D17 July 28	D18 July 28	D19 Aug. 20	D20 Aug. 13	D21 Aug. 21	D22 Aug. 22	D23 Sept. 3	D24 July 31	D25 July 31
48	2	2								1	1									2					
49		2	2	2					1		1		2												
50	1	2		4					3		1										2				
51		1									1									1					
52	2	3	3	4					2	6	1		6							4	4				
53		3	1	3					3	3			1							2	3				
54		3	3	8						2	1		4							8	4				
55		3	1	8					3	3	2		6		1					2	7				
56	1	3	3	9		3			6	15	8	4	7		2			5		5	8		1		2
57	1	1	1	5	2	3			3	3	9		4					1	1	6	13			1	
58	2	2	2	10	1		1		7	9	11	1	8					3	3	15	9	2			1
59	3	4	3	5	1	2	5		2	14	6		3		2				2	8	10	2		3	
60	4	4	8	8	6	10	6	2	6	19	10	13	8	4	3			5	8	19	15	5	2	2	7
61	3	3	1	3	4	4	2	1	6	13	3	3	2	1				5		7	7	1	3	2	3
62	8	8	6	11	7	7	2	2	1	12	4	8	3	1	1	5	1	7	1	15	2	1		4	7
63	3	1	6	5	3	7	1	1	2	10	5	3	2	3		4	2	6	2	12	5	5	1	1	5
64	6	3	13	9	10	7	11		3	14	18	7	6	5	5	5	6	3	5	23	6	12	3	2	4
65	6	3	4	4	9	6	6	1		3	7	6	4	3	6	8	3	3	8	19	6	1	4		8
66	8		18	4	6	4	10	2		7	8	8	1	6	5	9	3	2	15	10	2	6	11	2	6
67	4		10			9	4	2		2	6	6	2	4		2	4		4	5		3	3		6
68	4	3	7	4	9	13	11	2		6	9	16	5	6	6	7	3	4	12	12	1	9	11	3	8
69	1	2	6		10	12	14	3			2	6	4	6	5	3	4		6	6	1	6	5	2	5
70	3		12		7	15	14				3	8		8	4	7	5		12	0	1	5	10		6
71	1		9		7	12	10				1	3	2	7	3	3			7	4		8	2		2
72	1	1	11		6	16	12	1				6	1	8	2	2	3		13			12	13	3	2
73	1		5		3	5	7	2				1		5		1	2		4		3	6	6	2	3
74	2	1	6		1	6	5	1				5		8	5	4	2		11			7	6	2	2
75	2		2		3	2	4								2	2	1		6			1	7	1	2
76			4			5	10					3		2	2	6			9			6	3	2	1
77			2			5	2							2					2			3	3		1
78	1						1					1		4					1			4	6		1
79			2			1	1												4			2	2		2
80	1		2			1	2							1								2	2		
81						1																0			
82																						5			
83						1																			
84																									
Total No.	71	58	151	106	99	157	141	20	48	142	118	108	87	84	54	68	42	44	136	185	109	114	104	32	84
Mean length	64.2	58.9	66.7	58.8	66.5	68.1	69.0	66.7	57.6	60.2	60.1	66.2	60.0	59.5	67.2	68.2	65.6	64.5	68.9	62.0	59.3	69.8	71.8	66.2	66.6

Table 2. Size-frequency distribution and counts in 1945 of surviving clams planted 80 per square foot in 1942 and dug July 19, 1945.

Lengths	Plot No.											
32nds"	6A	6B	6C	6D	7A	7B	7C	7D	8A	8B	8C	8D
46							1					
47							1					
48									1			
49												
50									1	1		
51												
52						2				1	1	
53					1	2	1		1			
54					2						1	1
55	4			1	1		1		2	1	2	
56	1		1		2		2	1	5	2	1	1
57			1	2		2			4			
58	2	5	4	1	3	2	1	3	1	2	2	2
59	4	1	1	1	8	2	1	2	1	1	1	2
60	2	2	3	4	6	2	3	5	9	3	4	2
61	1		1		5	3	4		4	2	1	5
62	8	2	3	2		4	3	3	3	4	8	6
63	3	2	2	2	1	1	3	1	2	3	2	1
64	5	1	2	2	2	1	1	1	5	4	7	
65	2	5	2	3	1	4	4	5		3	2	
66	3	7	7	9	2	5	3	5	2	5	4	3
67	4	1		5	3		1			1	3	1
68		1	3	2	4	4	5	1		2	2	2
69		1	1	4	1			2		1		2
70	3	6	1	1		1	2	2			2	
71		2	2	1	1	2	1	1		1	1	2
72			3	1		3	2	1		2	1	1
73		1		2		5	1					
74				1			1	3				
Totals	42	37	37	44	43	45	40	36	41	38	47	31
Mean Length	64.3	65.1	64.3	65.3	61.4	64.2	64.2	64.6	59.4	62.6	60.0	63.1

Table 3. Summary of data on growth and survival of clams in the Sissiboo River experimental plots, 1941-1945.
A - In this table all percentages are calculated from the numbers and actual sizes of the clams when planted in 1941.
B - In this table the percentages for each year are based on the sizes and numbers of the clams found to be alive at the beginning of that particular year and the size of all stocks in 1941 is assumed to have been 42/32". This assumption accounts for minor differences in the records for the first year in parts A and B which would otherwise have been identical.

Table A.

Type of stock	Density per sq. ft.	Original mean length 32nds inches	First Year (1941-1942) Increase 32nds inches	Increase %	Recovered alive %	"Mortality" during 1st year %	Second Year (1942-1943) Increase 32nds inches	Increase %	Recovered alive %	"Mortality" during 2nd year %	Third Year (1943-1944) Increase 32nds inches	Increase %	Recovered alive %	"Mortality" during 3rd year %	Fourth Year (1944-1945) Increase 32nds inches	Increase %	Recovered alive %	"Mortality" during 4th year %
Normal	10	Varied	7	18	57	43	16	37	34	23	22	50	30	4	24	56	18	12
"	20	about	8	20	57	43	18	45	48	9	23	58	33	15	24	55	27	6
"	40	42	8	20	58	42	17	41	47	11	24	59	37	10	25	57	28	9
"	*80	ranged	10	25	59	41	18	42	49	10	21	51	50	-1				
Stunted	10	from	6	12	67	33	10	25	48	19	17	44	30	18	19	45	28	2
"	20	38-44	5	12½	72	28	12	28	55	17	17	42	31	24	16	37	25	6
		42	7	18	62	38	15	36	46	15	21	51	35	12	22	50	25	7

Table B.

Type of stock	Density per sq. ft.	Original mean length 32nds inches	Average length 32nds inches	Increase %	Recovered alive %	"Mortality" during 1st year %	Average length 32nds inches	Increase %	Recovered alive %	"Mortality" during 2nd year %	Average length 32nds inches	Increase %	Recovered alive %	"Mortality" during 3rd year %	Average length 32nds inches	Increase %	Recovered alive %	"Mortality" during 4th year %
Normal	10		49	17	57	43	58	18	60	40	64	10	64	36	66	7	51	49
"	20		50	19	57	43	60	20	89	11	65	8	69	31	68	9	82	18
"	40		50	19	58	42	59	18	81	19	66	12	79	21	69	9	81	19
"	*80	42	52	24	59	41	60	15	83	17	63	5	103	-3				
Stunted	10		48	14	67	33	52	8	72	28	59	12	63	37	62	7	70	30
"	20		47	12	72	28	54	15	77	23	59	10	67	33	60	6	84	16
			49	18	62	38	57	16	77	23	63	10	76	24	65	8	74	26

* The 80 per-sq.-ft. plots were established in 1942, a year later than the other plots. To facilitate comparisons with the other plots the 80's are represented as being dug in '42, '43 and '44 rather than in '43, '44 and '45 as was truly the case.

2. 1945 RESULTS OF THE PETPESWICK COVE EXPERIMENTS ON GROWTH AND SURVIVAL

This year the first quadrant (NE) in each of the 25 plots was sampled. All the clams were dug from an area five feet square set in approximately $1\frac{1}{2}$ feet from the boundary of the 15 foot square to avoid possible "border effects". All the clams recovered were counted and a random sample of 100 removed for measurement. The number recovered and the length-frequency distribution of those measured is shown in table 4. The data are further summarized in table 5. In this the number of clams recovered from each five-foot block is expressed as a percentage of the number originally planted and taken as a measure of survival. The actual % survival is without question higher than the recovery since some clams in the five-foot squares are bound to be overlooked and left in the soil. No attempt was made to measure the efficiency of the diggers in recovering clams. Had this been done it would have provided an approximate measure of the error created in regarding "survival" as equivalent to "recovery".

The winter of 1944-45 was peculiar in that at no time was the depth of ice great. It formed several times, broke up and went out. When it lay on the flats it was not for long. This information was supplied by Mr. Lloyd Young, Guardian of the Department of Fisheries who protects the experimental area.

After digging, counting and measuring, all the undamaged clams recovered were re-planted in the areas from which they were taken, so that the original conditions in the plot were restored insofar as possible.

The comparison drawn between the results from Sissiboo and Petpeswick in Appendix No. 32 of the Annual report of the Atlantic Biological Station for 1945 shows that at Petpeswick:

1. Survival was better.

2. Growth was poorer.

3. Crowding beyond 20 per square foot reduced growth.

4. The effect of crowding on growth was greater in the case of stunted than in normal clams.

5. There seems to have been no significant difference in survival in any of the plantings either as a result of different degrees of crowding or different types of stock - stunted or normal.

6. In the course of the next few years more severe crowding will probably develop as the size of the individual clams increases. Effects not now apparent may then show themselves.

12 July 18	13 Aug. 25	14 Sept. 3	15 Aug. 9	16 Sept. 5	17 Aug. 6	18 Aug. 17	19 July 19	20 Aug. 31	21 Aug. 27	22 Aug. 8	23 Sept. 5	24 Aug. 6	25 Aug. 6
								1					
	1			2					1		1		
2	4	2	2		1		1	5			7		2
2	5	8	1	4			2	6	10	2	6		
9	24	11	2	4	2	7	6	10	10	5	13	3	7
8	19	16	4	9	4	14	6	19	16	4	12	2	6
14	28	24	6	22	5	18	12	29	20	9	12	7	10
9	25	27	6	18	9	17	15	21	29	11	13	3	10
20	25	19	17	24	12	22	25	28	31	17	21	15	11
24	23	17	35	26	25	25	24	26	26	22	23	24	30
11	18	24	24	26	29	22	15	22	19	28	20	27	34
25	10	27	26	19	26	23	24	20	20	24	20	19	28
15	4	13	21	20	27	26	11	8	9	24	21	19	21
11	2	6	19	17	20	10	9	3	8	19	23	21	16
14	1	2	20	5	17	10	8			18	3	26	15
6	1		4	2	5	2	5	1		8	2	12	1
4			4		3		2			2		10	5
1			4		2	3	1			1		3	1
							1		1	1		3	1
2			1							1		4	
												1	
177	190	196	196	198	187	199	167	199	199	196	197	199	198
45.7	43.1	44.1	46.6	45.0	46.6	45.4	45.4	43.7	44.0	46.4	44.8	47.5	46.1
943	854	1759	446	1849	434	442	904	812	922	940	1742	436	419
94	85	88	89	93	87	88	90	81	92	94	87	87	84

Table 4. Length-frequency distribution of Petpeswick clams from the NE quadrants of the 25 plots in the 75-foot block together with numbers recovered from areas of 25 square feet in 1945.

	Plot Number and Date Dug										
Length mm.	1 July 20	2 July 31	3 July 24	4 Aug. 18	5 Aug. 11	6 Aug. 10	7 Aug. 14	8 Not dated	9 Aug. 18	10 Aug. 20	11 Aug. 23
	Frequencies										
34	1		1								
35											
36			1								
37	1		1				1				
38		2	1	3	1		2		1	2	
39	1	3	3	8	5		5	1	1	6	6
40	4	9	7	8	16	3	9	1	5	27	12
41	6	13	17	21	14	5	9	2	8	24	25
42	10	18	17	24	20	9	19	9	24	28	15
43	6	21	23	17	18	8	14	6	11	25	22
44	17	24	21	21	16	16	21	14	32	22	27
45	19	17	16	37	28	27	21	23	28	28	29
46	20	22	15	20	26	25	23	22	25	11	20
47	25	24	25	20	21	27	31	20	27	14	17
48	14	14	14	6	13	23	27	21	17	6	9
49	22	13	12	2	8	15	10	27	11	6	8
50	20	7	9	2	3	18	6	26	6	1	6
51	11	2	3	1	1	11		14	1		
52	6		4			7		3	1		
53	6		2			2		3			
54	5		1					2			
55	1										
56	1										
57											
58											
59											
60											
61											
No. measured	196	189	193	191	190	196	198	194	198	200	196
Mean	47.0	44.8	45.0	43.9	44.3	46.7	45.0	47.2	45.1	43.2	44.
No. recovered from 25 sq.'	366	453	908	966	1720	951	1827	446	475	845	407
Recovery %	73	91	91	97	86	95	92	89	95	85	81

Table 5. Growth and survival of clams in various plots in the 75' square at Petpeswick 1944 to 1945.

Normal

Planted 20 per sq.':

Plot No.	Growth mm.	Growth %	Survival %
1	3.7	8.5	73
8	3.0	6.8	89
15	2.6	5.9	89
17	2.7	6.2	87
24	3.6	8.2	87
Mean	3.1	7.1	85

Planted 40 per sq.':

Plot No.	Growth mm.	Growth %	Survival %
3	1.9	4.4	91
6	2.7	6.1	95
12	3.0	7.0	94
19	2.7	6.3	90
22	2.6	5.9	94
Mean	2.6	5.9	93

Planted 80 per sq.':

Plot No.	Growth mm.	Growth %	Survival %
5	-0.4	-0.9	86
7	1.4	3.6	92
14	0.5	1.1	88
16	0.8	1.8	93
23	0.7	1.6	87
Mean	0.6	1.4	89

Stunted

Planted 20 per sq.':

Plot No.	Growth mm.	Growth %	Survival %
2	1.1	2.5	91
9	3.0	7.2	95
11	1.1	2.6	81
18	3.3	7.8	88
25	1.6	3.6	84
Mean	2.0	4.7	88

Planted 40 per sq.':

Plot No.	Growth mm.	Growth %	Survival %
4	-0.3	-0.7	97
10	0.2	0.5	85
13	1.0	2.3	85
20	1.3	3.1	81
21	1.7	4.1	92
Mean	0.8	1.9	88

3. A TEST FOR POSSIBLE "BORDER EFFECTS" ON GROWTH RATE OF CLAMS IN THE PETPESWICK 75' PLOT.

The design of the Petpeswick experiment was different from the Sissiboo in that there were no barren spaces within the 75' plot (Medcof 1944, page 7). This was arranged as a precaution to eliminate possible border effects which might mask the effects which crowding to different densities might produce. Ingalls (1942) found no difference in the growth rate of clams subjected to the three densities - 10, 20, and 40 per square foot - but as pointed out before (Medcof 1944) he used very small plots and left wide barren paths all around their edges. His results may be misleading. This year and in the following three there is an opportunity for testing whether or not there are border effects in the Petpeswick plots and whether the Sissiboo results of crowding tests are reliable.

Dr. L. P. Chiasson took samples of about 200 clams from the outer edges of outside plots and compared their mean size with that of samples from inside the same plots. The latter were taken in the routine work of sampling the 75' plot as proposed in the 1944 MS report. In addition samples were taken from the very centre of these 25 sq. plots and from inside edges where each plot adjoins another plot. The plots so studied and the results obtained are described in table 6 and summarized in table 7. Reference to figure 1 Medcof 1944 will make this discussion clearer.

Discussion of Results

The data indicate no consistent within-plot difference in rate of growth which could be ascribed to differential crowding. This is rather surprising considering the clear plot-to-plot differences resulting from crowding to different densities indicated by the results of the regular sampling (Table 5). This may be due to the positions of the plots (#1-5 all on east side) on which the test was conducted.

It is proposed to replicate this test in 1946 using different plots. As the size of the clams increases the effects if present may be expected to reveal themselves more clearly because of the extra crowding entailed.

Table 6. Data on samples studied in test for border effects. For data on regular samples see table 4.

Length mm.	Description of Sample: Plot 1			Plot 2			Plot 3			Plot 4			Plot 5		
	Outside	Inside	Centre	Outside	Inside	Centre	Outside	Inside	Centre	Outside	Inside	Centre	Outside	Inside	Centre
	Size-frequency Distribution														
35				2											
36				1											
37	1	1		1			1	2							
38	2	1	3	2	3		1	1	2	5	2	1	3	6	1
39	1	3	2	9	6	2	3	1	1	10	1	5	6	4	1
40	5	5	6	7	6	2	6	6	9	25	13	17	10	19	8
41	4	7	6	11	16	1	13	11	8	23	11	9	21	18	4
42	17	12	5	12	18	6	20	17	10	18	12	18	19	20	15
43	9	22	7	18	14	7	20	15	16	19	11	16	15	20	9
44	22	16	8	16	14	7	13	20	15	23	14	21	22	22	20
45	18	26	14	17	19	10	23	16	15	27	30	27	29	22	26
46	24	32	9	14	11	8	21	23	21	23	8	18	18	27	19
47	17	20	15	12	7	6	21	33	18	10	18	22	14	19	28
48	7	14	13	10	8	5	15	18	17	16	6	12	11	15	15
49	9	9	5	8	3	3	18	13	16	6	6	8	8	6	15
50	13	13	4	2		1	10	11	14	2	1	2	11	2	10
51	10	7	1			1	6	6	7	1			2	1	4
52	7	6	1	2			3	1	6				1		
53	3	2				1	4		3						
54	3	1					2						1		
55															
56	1		1												
57	1														

Table 7. Summary of data in test for border effects, Petpeswick Harbour, N.S., 1945.

		Outside Border Eastern 1		Inner Border Western 2		Adjoining Plot		Centre 3
Plot Number	Stock and Density	Mean Length mm.	Number in Sample	Mean Length mm.	Number in Sample	No.	Stock and Density	Mean Length mm.
1	N-20	46.1	174	46.2	197	6	N-40	44.6
2	S-20	43.9	144	43.6	126	7	N-80	45.0
3	N-40	45.5	200	45.6	197	8	N-20	45.9
4	S-40	43.5	208	44.2	133	9	S-20	44.3
5	N-80	44.4	191	43.9	201	10	S-40	45.6
Totals		223.4		223.5				225.4
Means		44.7		44.7				45.1

Regular Sample	4		Differences			
Number in Sample	Mean Length mm.	Number in Sample	1-2	1-3	1-4	4-3
100	42.4	196	-0.1	1.5	3.7	-2.2
60	44.8	189	0.3	-1.1	-0.9	-0.2
178	45.0	193	-0.1	-0.4	0.5	-0.9
176	43.9	191	-0.7	-0.8	-0.4	-0.4
175	44.3	190	0.5	-1.2	0.1	-1.3
	220.4		-0.1	-2.0	2.0	-5.0
	44.1		- .02	-0.4	0.4	-1.0

4. SEASONAL GROWTH AND EFFECTS OF DISTURBANCE ON GROWTH OF CLAMS, SISSIBOO RIVER, N.S. 1945.

This experiment (Medcof, 1944) was continued to determine if the late fall diggings had any effect on survival and also to determine what growth, if any, occurred during the winter months. Six of the eight plots set up in this experiment were each dug three times in 1945, plots 7 and 8 were dug twice and once respectively.

The results are compiled in table 8 and summarized in table 9.

Conclusions.

1. Growth during the winter months is insignificant, averaging only 0.34 32nds in 3½ months.

2. There was practically no growth from March to May or from May to June. Growth seems to start later at Sissiboo than in Bideford River, P.E.I. (cf. Medcof, 1944).

3. Because the growth was so slight any effects disturbances (digging and re-planting) may have had on it during the period November 1944 to June 1945 are not apparent. However the general tendency towards smaller sizes in the most-dug plots (low numbered) apparent last year still obtains and suggests that at Sissiboo disturbance discourages growth to some extent.

4. The survivals (recoveries) in plots 7 and 8 that were undisturbed for approximately a twelve-month period were almost the same (56 and 53%) as that of corresponding stocks (normals) planted 10, 20 and 40 per sq.' for a similar period, 1941-42 (57, 57 and 58%) in the 75' plot (see table 3, this report). The mortality in both instances is composite of the annual natural mortality and the planting mortality.

5. The growth in plot 7 which was undisturbed for a year was 13.5/32" or 42%. In the 75' plot 217' up the beach from plot 7, the growth of normal clams of the same size was only 34% in 1941-42. The 18% difference is attributed largely to difference in beach level.

6. If the drop in the numbers of clams recovered at successive diggings can be taken as a measure of mortality, it may be judged that losses from early spring digging (March 1945) are much higher than for late fall (Nov. 1944) or for late spring (June 1945).

June 14-15

				Plot No.				
7	1	2	3	4	5	6	7	8
						1		
2	1		2		1	1	1	
			1				1	
2	3	1	1	2			1	
	2	2	1	2	2			
2	3	3	2	9	3	4	2	
1	7	2	6	2	3	2	1	
1	4	5	7	8	4	2	2	6
8	5	4	5	7	6	1	5	
4	5	8	9	6	2	5	6	8
6	3	2	4	7	4	4	2	4
9	3	3	2	5	5	11	8	7
6		1	1	2	3	2	7	4
4	2		4	1	4	6	7	3
3	1		3	1	1	3	3	4
3			4		2	1	4	7
1								1
2								3
1								2
1							1	2
								2
56	39	31	52	52	40	43	51	53
53.5	50.5	50.8	51.7	50.9	52.0	52.7	53.5	55.4
	3	-3	1	4	1	1	5	
	7	-7	2	7	2	2	9	
				7%				

Table 8. Size-frequency distribution of clams in different plots on different dates to show seasonal growth and effects of disturbance on growth.

	March 6-8						May 5-7					
	Plot No.						Plot No.					
Length/32"	1	2	3	4	5	6	1	2	3	4	5	6
39												
40											1	
41												
42												1
43												
44	2	2					1		2		1	2
45	2	1	1	2					1			
46	4	2	3		3	1	5	1	2	3	1	
47	6	3	2	3		1	1	2				1
48	11	4	2	9	5		7	3	1	9	4	3
49	3	4	4	10	6	2	5	2	3	2	3	3
50	14	4	11	6	5	5	8	6	7	8	6	1
51	4	5	6	4	6	4	3	5	7	7	4	3
52	6	11	11	10	6	6	4	3	7	11	2	2
53	4	2	4	5	5	6	4	3	5	3	4	9
54	2	3	11	4	7	7	2	3	5	7	8	5
55	3	2	3	2	5	9			2	2	4	3
56			4	2	6	6	2		7	3		5
57			1	5	5	3			2		2	2
58			2	2		3			2	1	1	2
59												
60												
61												
62												
63												
Totals	61	43	65	64	60	53	42	28	53	56	41	42
Mean	49.5	50.2	51.8	51.3	52.3	53.3	49.9	50.5	53.0	51.2	51.5	52.3
Lost since last digging (No.	8	11	5	2	2		19	12	12	8	19	11
Lost since last digging (%	12	20	7	3	3		31	28	18	13	32	21
Av.	9%						24%					

Table 9. Summary of data on seasonal growth of clams in Sissiboo River, N.S., 1945.

Plot Number	Time Interval	No. Days	Growth 32nds"	Time Interval 1945
1	25 Nov.,1944 - 7 Mar., 1945	103	0.1	7 Mar. - 5 May
2	25 Nov.,1944 - 7 Mar., 1945	103	0.0	7 Mar. - 5 May
3	27 Nov.,1944 - 8 Mar., 1945	102	0.7	8 Mar. - 5 May
4	27 Nov.,1944 - 8 Mar., 1945	102	0.0	8 Mar. - 5 May
5	28 Nov.,1944 - 6 Mar., 1945	99	0.9	6 Mar. - 7 May
6				6 Mar. - 7 May
7				
Totals		509	1.7	
Mean		102	0.34	
Growth per day			0.003	

No. Days	Growth 32nds"	Time Interval 1945	No. Days	Growth 32nds"
60	0.4	5 May - 14 June	41	0.6
60	0.3	5 May - 14 June	41	0.3
59	1.2	5 May - 14 June	41	-1.3
59	-0.1	5 May - 14 June	41	-0.3
64	0.8	7 May - 15 June	40	0.5
64	-1.0	7 May - 15 June	40	0.4
		8 May - 15 June	40	0.0
366	1.6		284	0.2
61	0.27		41	0.03
	0.004			0.0005

5. SEASONAL GROWTH AND THE EFFECTS OF DISTURBANCE ON THE GROWTH OF CLAMS, PETPESWICK HARBOUR, N.S. - 1945.

Experiment "A".

On 9 May, 1945, a series of six 2' x 2' plots were staked out on the Cove Flat about 25' north of the 75-ft. plot by J. C. Medcof. The soil here has a surface of sand with a mixture of sand and mud. All the native clams were removed from this area and each plot was stocked with approximately 50 clams. These clams were dug across a small gully that lies west of the plot. They were carefully chosen normal clams, 38-50 mm. in length and each lot was measured to the nearest mm. before planting. A small amount of 1945 growth had already taken place.

At intervals throughout the summer these plots were dug up successively and the clams measured and replanted. At the time each new plot was dug all the plots handled up to that date were also redug, remeasured and replanted.

Experiment "B".

This experiment was essentially like that described in Experiment "A". The plots were set up in identical soil conditions, except that this portion of the flat drained totally dry during the low-tide periods. The plots were situated about 20 to 25 ft. west of the "A" plots. The clams were planted on 12 June, 1945, by Dr. L. P. Chiasson and Mr. E. J. Casey.

Little information was provided about the stock used in Experiment B and it is possible that some may have been stunted.

The results appear in tables 10 and 11 and are summarized in table 12.

Conclusions.

1. The season's growth was slight (3-5% for the five-month period under test) approximately one third that of similar plots set up on the Sissiboo River, N.S. (Medcof 1944, table 15).

2. Neither table 10 nor 11 shows any consistent relationship between the amount of growth and the digging frequency. From this it may be concluded that whatever the effects of disturbance on growth rate may have been, they were slight.

3. The period of most active growth rate appear to be in late summer and early autumn.

4. The apparent shrinkage during the summer that is prevalent in both "A" and "B" plots but expressed more clearly in "B" (Table 11) may be caused by the erosion of the shells by the sand due to the repeated handling and by the burrowing activity of the clams themselves.

5. It was concluded earlier from general observations (Medcof 1944) that the season's most vigorous growth at Petpeswick took place in May and June and that the total growth for the year for clams of this size was in the order of 3 mm. The evidence just presented is not considered truly representative. The disparity may have resulted from having set up the plots just at the time the clams would normally be growing most actively and interrupting this growth to such an extent that no recovery was possible. Growth in the 75' plot nearby (Table 5) was about 50% better.

6. The losses in numbers of experimental animals during the season seem high but compare favourably with those in similar tests conducted elsewhere. (Compare tables 10 and 11 with table 16 of this report and with Medcof '44, table 15.) Losses in Bideford River were low (See Medcof '44, table 14).

7. It is proposed to have these plots redug in the spring of 1946 in order to determine what growth, if any, takes place during the winter months.

Table 10. Size-frequency distribution of clams measured in the 1945 Petpeswick experiment "A" on seasonal growth and the effect of disturbance on growth.

Length in mm.	Plot A1						Plot A2					Plot A3				Plot A4			Plot A5		Plot A6
	May 9	June 6	July 14	Aug. 9	Sept.7	Oct.17	May 9	July 14	Aug. 9	Sept.7	Oct.17	May 9	Aug.9	Sept.7	Oct.17	May 9	Sept.7	Oct.17	May 9	Oct.17	May 9
35																					
36													1								
37		1		1	1							1	1						1		
38	1	2	2	3	4		1	1	2	1		4	3	2		3	2	1	4	2	1
39	2	2	2	2	1	1	5	3		3	1		2	1		6	2	1	1	1	6
40	3	4	3	2	1	1	8	6	7	1	2	1	5	1	2	4	3	2	5		4
41	3	3	3		1	1	6	7	4	3	2	6	4	3	1	4	3	2	4	1	5
42	5	6	2	5	4	1	7	4	3	4	1	2	4	5	3	5	6	2	2		6
43	6	3	5	1	1	3	6	7	4	3	2	7	4	2	4	7	5	3	8	3	3
44	4	4	4	3	2	2	2	5	1	3	5	6	9	4	2	8	4	4	7	2	6
45	5	4	2	2	2	5	3	3	3	5	4	6	4	3	4	3	4	3	6	5	8
46	7	4	2	1	1		5	4	4	3	3	6	3	5	1	3	3	5	5	4	4
47	1	2	2	2	3	1	2	3	1	2	4	4	3	3	3	3	2	1	3		2
48	6	2	3	1	2	1			1		2	4	4	3	4	2	3	2	1	6	2
49	5	1		1		1	2	2	1	1	2	2	2	3	2	2	1	2	1	1	2
50	2		1			1	2	1		1	1	1			2			1	1	1	
51	1												2							1	
52																			1		
53																				1	
No. measured	51	38	31	24	23	18	49	46	31	30	29	50	51	35	28	50	38	29	50	28	49
Mean	44.7	43.0	43.3	42.5	42.7	44.3	42.8	42.8	43.4	43.4	44.8	43.9	43.4	44.2	45.1	42.9	43.3	44.3	43.4	45.5	43.1
Season's Growth mm.			-0.4					2.0					1.2				1.4			2.1	
Season's Growth %			-1.0					4.7					2.7				3.0			4.8	
No. of disturbances			5					3					2				1			0	
Growth to 1st digging mm.			-1.7					0.0					-0.5				0.4			2.1	
Growth to 1st digging %			-3.8					0.0					-1.1				0.9			4.8	
Lost during season No.			33					20					22				21			22	
Lost during season %			65					41					44				42			44	

Table 11. Size-frequency distribution of clams measured in the 1945 Petpeswick experiment "B" on seasonal growth and the effect of disturbance on growth.

Length in mm.		Plot B1 June 12	Plot B1 July 14	Plot B1 Aug. 9	Plot B1 Sept.7	Plot B1 Oct.17	Plot B2 June 12	Plot B2 July 14	Plot B2 Aug. 9	Plot B2 Sept.7	Plot B2 Oct.17	Plot B3 June 12	Plot B3 Aug. 9	Plot B3 Sept.7	Plot B3 Oct.17	Plot B4 June 12	Plot B4 Sept.7	Plot B4 Oct.17	Plot B5 June 12	Plot B5 Oct.17	Plot B6 June 12
35																					
36																					
37							1	1	1	1		1				1	2				1
38		3	2	2	3		2	1	2	1		0				4	1	1	2		2
39		5	4	8	3		2	1	1	2	1	4	2	3		1	3	1	5	2	6
40		2	4	1	3	2	2	3	2	1	2	5	3	2		5	3	3	3	1	5
41		5	5	4	4		2	2	1		2	5	4	4		3	2	2	6	4	4
42		3	1	3	3	2	1		1			2		2	5	4	3	0	5	3	4
43		5	1	2	2	2	3	2		6		4	3	4	1	8	4	3	6	3	3
44		4	8	7	6	4	9	8	4		1	10	5	7	1	5	5	3	3	1	3
45		7	7	6	4	5	6	6	6	6	3	6	6	4	7	7	1	4	6	4	7
46		6	7	7	5	6	6	7	3	4	1	4	4	2	5	3	5	2	8	3	6
47		6	4	4	2	2	5	4	1	3	2	6	3	2	1	5	2	3	3	5	6
48		3	4	2	2	4	5	4	2	1	3	3	2		1	3	4	4	2	1	2
49		1	1	2		1	6	1	1	1	1				1	1		1	1	2	1
50						1					1							1		0	
51																				1	
52																				1	
No. clams		50	48	48	37	29	50	40	25	26	17	50	32	30	22	50	35	28	50	31	50
Mean length		43.5	43.8	43.4	41.7	45.2	45.5	44.6	43.6	43.9	44.9	43.5	43.8	43.0	44.8	43.3	43.1	42.6	43.2	44.6	44.6
Season's Increase	mm.			1.7					-0.6				1.3				-0.7		1.4		
	%			3.9					-1.3				3.0				-1.6		3.2		
No. of disturbances		3							3				2				1		0		
Growth to first digging	mm.			0.3					-0.9				0.3				-0.2		1.4		
	%			0.7					-2.0				0.7				-0.5		3.2		
Lost during season	No.			21					33				28				22		19		
	%			42					66				56				44		38		

Table 12. Length-growth of clams (mm.) at different periods at Petpeswick, 1945.

Plot No.	Interval: 9 May - 6 June	6 June - 14 July	14 July - 9 Aug.	9 Aug. - 7 Sept.	7 Sept. 17 Oct.
A1	-1.7	0.3	-0.8	0.2	1.6
A2	-	-	0.6	0.0	1.4
A3	-	-	-	0.8	0.9
A4	-	-	-	-	1.0
Total	-1.7	0.3	-0.2	1.0	4.9
Mean	-1.7	0.3	-0.1	0.3	1.2
No. of Days	29	39	27	30	41
Growth per day	-0.06	0.008	-0.004	0.01	0.03
	12 June - 14 July	14 July - 9 Aug.	9 Aug. - 7 Sept.	7 Sept. - 17 Oct.	
B1	0.3	-0.4	-1.7	3.5	
B2	-0.9	-1.0	0.3	1.0	
B3	-	-	-0.8	1.8	
B4	-	-	-	-0.5	
Total	-0.6	-1.4	-2.2	5.8	
Mean	-0.3	-0.7	-0.7	1.5	
No. of Days	33	27	30	41	
Growth per day	-0.009	-0.03	-0.02	0.04	

6. SEASONAL GROWTH AND EFFECTS OF DISTURBANCE ON GROWTH OF CLAMS, BIDEFORD RIVER, P.E.I.

This experiment was commenced in 1944 (Medcof 1944) and was completed with the digging of all 7 plots on 22 October, 1945. Plots number 1, 2, 3 and 4 were dug 4, 4, 2 and 1 times respectively during the summer of 1944, while plots 5, 6 and 7 remained undisturbed from planting until digging in October of this year.

The data are compiled in tables 13 and 14 and summarized in table 15.

Conclusions:

1. Growth is very satisfactory - the mean rate being a 95% increase in shell height in two growing seasons. Present data give no indication of month-to-month differences in growth rate but these appear in last year's records.

2. The mean increase of the four plots dug several times in 1944 is 101%, while the mean increase for the remaining 3 plots is 88%. This is in concurrence with the findings of 1944 that digging and replanting stimulates growth on these flats. We cannot say from the records available, how long the advantages gained by the early diggings would have been maintained or whether further digging in 1945 would have added to it.

3. The % increase for the first growing season after planting was slightly over twice that of the second season.

4. The growth rate is about twice that of Sissiboo and more than five times that of Petpeswick clams planted 40 per sq. ft. in the experimental plots.

5. If we can judge from the numbers recovered in Oct. 1945 as compared with Oct. 1944 "survival" was high for clams that are being handled - over 75%.

Table 13. Height-frequency of clams planted in seasonal growth plots, Bideford River, P.E.I. - 1945.
Measurements on left valve from umbone to free margin of the shell.

Shell height mm.	Plot #1 22 Oct.	Plot #2 22 Oct.	Plot #3 22 Oct.	Plot #4 22 Oct.	Plot #5 22 Oct.	Plot #6 1st half 22 Oct.	Plot #6 2nd half 22 Oct.	Plot #7 1st half 22 Oct.	Plot #7 2nd half 22 Oct.
16									
17		1							
18									
19									
20									
21				1					
22									
23			1			1			
24			2	1					
25	1		1						
26	1		1	3	2	1			
27	1	3	1	4	2		1	1	
28	4	4	6	1	5	3	2		
29	1	5	3	4	3	3		1	
30	4	8	12	5	2	3	3	1	1
31	3	4	4	4	3	2	6	3	2
32	4		3	3	3	3	1		3
33	6		1	1	1	2	1	3	3
34		2		1	1	1	1	1	3
35	1		1	1	1		1	1	1
36							1	4	2
37								1	3
38								1	
39								1	
40									
No. recovered	26	26	36	29	23	19	17	18	17
Mean height	30.5	30.3	28.6	29.9	29.7	29.9	31.1	33.5	35.7
						Av. 30.5		Av. 34.6	
No. recovered in Oct.'44	33	38	41	40					
"Survival" % for year	79	69	88	73 - Av. 77%					

Table 14. Original height-frequency distribution of clams planted in Bideford River, P.E.I., seasonal growth plots #5, 6 and 7 on April 29, 1944. These heights were measured on the left valve from the umbone to the 1944 file notch.

Shell height to 1944 notch mm.	Plot #5 22 Oct. 1945	Plot #6 1st half 22 Oct. 1945	Plot #6 2nd half 22 Oct. 1945	Plot #7 1st half 22 Oct. 1945	Plot #7 2nd half 22 Oct. 1945
10		1			
11		1			
12	3	1			
13	2	3	2		
14	5	3	4		
15	5	4	3		
16		4	2		
17	3	1	2	1	
18	2		2	3	2
19	2	1	1	5	3
20	1			5	3
21				1	3
22			1	2	3
23				1	3
24					1
Total	23	19	17	18	18
Mean	15.3	14.4	15.9	19.7	20.8
		15.2		20.3	

Table 15. Summary of data on seasonal growth and effect of disturbance on growth of Bideford River clams for period 29 April, 1944, to 22 Oct., 1945.

Plot Number	Shell height mm. April 1944	Oct. 1944	Oct. 1945	Increase since April,1944 mm.	%	Increase since Oct.,1944 mm.	%	No. of diggings and replantings in 1944
1	14.9	24.4	30.5	15.6	104	6.1	25	4
2	14.9	23.6	30.3	15.4	103	6.7	28	4
3	14.5	23.8	28.6	14.1	98	4.8	20	2
4	14.9	23.0	29.9	15.0	101	6.7	29	1
5	15.3	-	29.7	14.4	94	-	-	0
6	15.2	-	30.5	15.3	100	-	-	0
7	20.3	-	34.6	14.3	70	-	-	0

7. SEASONAL GROWTH AND EFFECTS OF DISTURBANCE ON GROWTH OF CLAMS IN BRANDY COVE, ST. ANDREWS, N.B.

On May 4, 1945, a series of six, 2 x 2', plots was set up at about ¾ tide level in the workshop cove, immediately south of the station buildings. This cove is almost enclosed and the water circulation would be very poor. The stock used for this experiment was extremely stunted. At the time of planting 1945 growth had already begun, so that the measurements in table 16 are the sizes of clams at planting - not at the beginning of the 1945 growing season. The soil here is quite loose, being a mixture of sand, gravel and dark clay. The procedure followed in this experiment is essentially like that described for Petpeswick (see section 5 of this report). The results presented in table 16 are summarized in table 17.

Conclusions.

1. The growth rate here is quite slow, being about equal to that at Petpeswick the same season.

2. The late spring and early autumn seem the most favourable periods for growth.

3. The results are not consistent but digging and replanting do not seem to have any remarkable adverse effects on the growth rate in this area and may possibly stimulate growth.

4. By digging these plots in the spring of 1946 an estimate of winter survival and growth should be possible.

Table 16. Length-frequency distribution of clams in Brandy Cove plots to measure seasonal growth and effects of disturbance on growth in 1945.

	Plot 1						Plot 2				
Length mm.	May 4	June 4	July 4	Aug. 3	Sept. 13	Oct. 10	May 4	July 4	Aug. 3	Sept. 13	Oct. 11
32							3	1			
33							2	1	2		
34	3	3					3	1	1		
35	6	5	5	5		1	6	4	2	2	2
36	2	5	3	3	4		9	3	7		1
37	10	9	4	7	3	2	10	8	7	4	3
38	7	6	14	9	5	2	2	7	6	4	7
39	6	4	5	6	8	2	7	4	1	1	3
40	6	8	6	10	5	1	3	4	5	3	3
41	10	4	9	6	6	4	5	5	4	3	3
42	4	3	4	2	8	7	5	4	4	4	3
43	1		1		3	1		2	1	3	
44						1				1	1
45											1
46											
47											
48											
49											
50											
51											
52											
53											
Total No.	55	47	51	48	42	21	55	44	40	25	27
Mean Length	38.5	38.0	38.8	38.5	39.7	40.0	37.3	37.6	38.0	39.7	39.2
Season's increase	mm.		1.5					1.9			
	%		3.9					5.1			
No. of disturbances			4					3			

* only 55 of these were planted in plot #3. The others were preserved as a supply of the planting stock.

	Plot 3				Plot 4		Plot 5			Plot 6
	May 4	Aug. 3	Sept. 13	Oct. 11	May 4	Oct. 11	May 4	Sept. 13	Oct. 11	May 4
	7				2					2
	4	1			3		1			2
	6	2	2	1	3	1	1			3
	8	1	1	1	3	1	3	2		3
	10	4	1		6	1	4		1	3
	11	2		3	10		5	4	1	8
	8	3	5	3	4	4	5	2	1	5
	14	4	5	4	8	4	12	6	1	9
	18	5	4	1	10	3	10	2	3	7
	8	6	6	3	5	3	4	6	2	5
	13	4	1	5	1		6	5	2	5
	3	1		1	1	1	3	1	3	2
		1					1	2	1	1
	*110	34	25	22	56	18	55	34	15	55
	38.0	39.0	39.0	39.4	37.7	38.8	39.0	40.3	40.6	38.3
		1.4			1.1			1.6		
		3.7			2.9			4.1		
		2			0			1		

Table 17. Summary of data on seasonal growth in 32nds".

Plot No.	Interval 4 May - 4 June	4 June - 4 July	4 July - 3 Aug.	3 Aug. - 13 Sept.	13 Sept. - 11 Oct.
1	-0.5	0.8	-0.3	1.2	0.3
2	-	-	0.4	1.7	-0.5
3	-	-	-	0.0	0.4
5	-	-	-	-	0.3
Total	-0.5	0.8	0.1	2.9	0.5
No. days	32	31	31	42	29
Growth per day	-0.02	0.03	0.003	0.07	0.02

8. PETPESWICK EXPERIMENT TO SHOW HOW GROWTH RATE OF NATURAL CLAM POPULATIONS IS AFFECTED BY THINNING.

In October 1944 seed stock was removed by a system of controlled digging from a heavily-populated area in Mussel Gulley in the upper part of Petpeswick Harbour. There was a sharp line of division between the "dug" and the "un-dug" parts and several plots were worked out there for this experiment on May 10, 1945, (figure 1) in an area selected because it showed a very even distribution of stocks judging from the spacing of siphon holes.

Plot 6 which was three feet square, was left undisturbed but plots #1 - 4 each 1 foot square were dug out and all the clams found in them counted excepting the seed of 1943 and 1944 which were rare. The numbers found were:

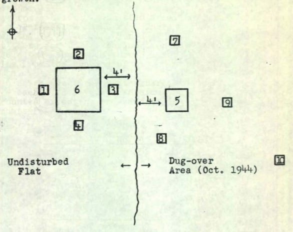
Plot No.	No. of clams
1	118
2	93
3	115
4	94
Total	420
Av.	105

The 420 clams were thoroughly mixed and a lot of 78 removed from them randomly. Their lengths were measured to the nearest millimetre and they were planted 20 per sq.' in plot 5. This was 2' square and was previously cleared of all native clams. The rest of the 420 clams were returned to plots #1 - 4 so as to approximately re-establish the conditions surrounding plot 6 to what they were before the establishment of the plots. It was noted that some 1945 growth had already been added to the shells but this was small - usually less than 1 mm. of length.

To get an idea of the reduction in the population brought about by the October 1944 digging four 1' square plots #7 - 10 were marked out randomly near plot #5 and dug out. The counts obtained were as follows:

Plot No.	No. of clams
7	19
8	27
9	21
10	19
Total	86
Av.	22

Figure 1. Set-up of Petpeswick Experiment on the effect of thinning on growth.



The planting in plot 5 was therefore at about the same density as the natural stock in the "dug-over" area and the 1944 digging apparently removed about 80% of the stock.

On October 18 and 19 plots 5 and 6 were dug out. All the clams (52) recovered from #5 and a random sample (67) of those from #6 were measured to the nearest mm.

All the measurements are presented in table 18. As a check on conclusions to be drawn from these data samples of 35 clams each from plots 5 and 6 were studied more carefully. Shell heights on the left valve from the umbone to the 1944-45 winter annulus and to the free edge of the shell were measured. The differences which represents the 1945 increase in shell height was then expressed as a percentage of the 1945 spring height. These data are summarized below by a listing of the means for the two lots.

Plot No.	Height to 1944-45 annulus (mm.)	Height to edge of shell Oct., 1945 (mm.)	1945 Increase mm.	%
6	24.4	25.3	0.9	3.7
5	24.2	26.4	2.2	9.1

Conclusions.

1. The growth rate of the thinned clams was much greater than that of the unthinned. The length data suggest that it was 13 times, the height data that it was 2.5 times as great.

2. Growth in the thinned area seems to be about normal for Petpeswick Harbour (see table 5 this report) and it may be safely assumed that thinning in other areas would have like effects.

3. Mr. Ross Carey of the General Seafoods shucking plant at Ostrea Lake reports that thinning improves meat quality as well as improving growth rate but no check was made to see if this was true at Mussel Gulley.

4. It is proposed to carry out confirmatory tests in 1946. It may be beneficial to commercial areas to systematically thin out the populations by removing or destroying under-sized clams in areas where crowding is excessive.

Table 18. Length frequency in mm. of clams in experimental plots to show effects of thinning natural populations on growth rate.

	Frequencies		
Date	10 May 1945	19 Oct. 1945	18 Oct. 1945
Length mm.	Plot #5	Plot #5	Plot #6
29	1		1
30			
31	1	1	
32			
33	2	1	
34	6		4
35	2	2	2
36	5	1	2
37	6	4	6
38	7	1	9
39	5	3	8
40	5	1	7
41	7	4	3
42	6	5	7
43	5	3	4
44	5	4	6
45	3	3	2
46	5	4	3
47	3	5	
48		5	1
49	2	1	1
50	2	1	
51		2	1
52		1	1
Total	78	52	67
Mean	40.3	43.0	40.5
Increase		2.7	0.2
% increase		6.7	0.5

9. THE EFFECT OF SIZE ON SURVIVAL AND GROWTH OF CLAMS ON A RIPPLED SANDY FLAT

In an earlier report (Medcof 1944) the 1944 commercial-scale transfer of stunted clams to "The Big Flat" in Petpeswick Harbour was described. This year repeated examinations showed that there was a considerable mortality of the transplanted stock especially in the higher parts of the flat and that the year's growth was surprisingly slight compared with that of the few large native clams that still persist in this area. From this it appeared that large clams were better able to withstand the rigours of the habitat than the small relaid seed.

To provide more information on this subject two lots of seed of the 1943 set were taken by Dr. Chiasson from the Big Island Flat in Musquodoboit Harbour and relaid on the Big Flat at Petpeswick in plots contiguous with the northern margin of the commercial-scale transfer of 1944. This small seed was collected by sifting the top two-to-three inches of sand through fly screening, under water. It was not separated from certain debris that remained on the screen after sifting. The numbers of seed clams in two separate pint jars filled with this mixutre proved to be 712 and 628. The size-frequency distribution of the seed is indicated in table 19. Previous to planting the ground was scuffled and a pint of the mixture spread on three-foot-square sections of the two plots which were each three feed wide and 12 feet long. This provided for a clam population density of between 70 and 80 per square foot.

First Planting August 3.

The seed was gathered August 2 and scattered during the first stages of the flood tide on August 3. Apparently all the clams buried themselves during the flood tide because many had already started to go down in the moist sand even before they were covered by water.

An examination on August 4, 24 hours after planting, showed that the clams were well established. The siphon holes showed clearly in the sand and the numbers of these per square foot indicated that there had been no appreciable loss in planting. On August 7 no seed could be found either on the surface or in the ground. The meteorological records (Appendix I) show there were light south and southwest winds during the three-day period, Aug. 4-7, and no heavy weather that might have produced any exceptional disturbance of the flat.

Second Planting August 21.

The seed were gathered on August 21 and planted as before on the exposed flat 1½ hours before the flood tide. During the 24 hours exposure to air between collecting and planting particular pains were taken to keep the seed moist, well aerated and protected from mechanical damage by packing it in seaweed whereas in the August 3 planting they were merely placed in galvanized-iron buckets. Successive observations on the plant are summarized below.

<u>Aug. 23</u>. A large number of siphon holes were observed in the plot indicating the presence of over 50 clams per square foot.

<u>Aug. 24</u>. There was no appreciable change from Aug. 23.

<u>Aug. 27</u>. Very few siphon holes were observed and clams were found only where holes were showing.

<u>Sept. 1.</u> The entire planting of seed had practically disappeared. The only clams left were the very largest planted.

The meteorological records (Appendix I) show no especially strong winds that might have created unusual disturbance of the flats during this period.

Observations of the flat even on calm days at late ebb and early flood tides showed that the ordinary tidal currents were sufficient to keep the surface sand in constant motion and shift the positions of the ripples which characterize this flat.

Table 19. Size-frequency distribution of samples of the seed clams of 1943 set on Big Island flat, Musquodoboit Harbour, that were transferred to the Big Flat, Petpeswick Harbour, N.S., 1945.

Length mm.	7	8	9	10	11	12	13	14	15	16	17	18	19	No. in Sample	Mean Length mm.
							Frequencies								
Aug. 3 sample		4	5	9	14	13	20	15	13	4	1		2	100	12.8
Aug. 22 sample			2	6	12	14	24	15	11	6	2	2		94	13.1

The combined observations on the Big Flat indicates:

1. Shifting sand flats are not likely to be satisfactory for restocking even though they at one time may have supported vigorous populations of clams and may still harbour a few large old clams.

2. Smaller clams are less able to withstand the rigours of shifting sand than larger, older clams.

3. The failure of these flats to repopulate themselves since the eelgrass disappeared is probably due to the shifting nature of the surface soil in which the seed must settle.

4. Some change in these conditions may be expected when the eelgrass recovers its former luxuriance. Until then the flat will remain barren.

10. FIVE ISLANDS GROWTH EXPERIMENT

Last year (Medcof 1944) it was concluded from the study of shell annuli that the growth rate of clams at Five Islands, N.S., was very slow and that it dropped off sharply above a length of 1½". This was the basis on which the size limit of 2¼" was waived in that district. On May 13, 1945, three 3'-square plots were staked out in the middle of the principal areas being dug by commercial fishermen - one just west of the mouth of Harrington River in sandy-mud soil, one at Broodrick Beach in gravel and one at Sand Point in clay - planted with notched clams of various sizes but principally of those above 1½". Growth had barely started at this time. At most the annulus of new shell was 1 mm. wide.

On October 19 only the second and third of these plots could be found. The clams in these were dug and their heights measured from the umbone to the notch and to the free margin of the shell. These are recorded in tables 20 and 21.

These data have not been analysed minutely because they are so clearly in accord with the conclusions drawn in 1944 as to justify the change in the fishery regulations in the Five Islands district.

Table 20. 1945 growth of notched clams at Five Islands, N.S. Broodrick Beach Plot in gravel soil. Clams notched and planted May 13, redug and measured October 19, 1945.

Shell height to notch mm.	Shell height to margin mm.	Increase in height mm.	Remarks
*14.5	17	2.5	
*16	18	2	
*16	18.5	2.5	
*16	19.5	3.5	
*17	19.5	2.5	
*17.5	20	2.5	* The heights were measured from the umbone to what seemed certainly to be the 1944-1945 winter annulus and to the free margin of the shell.
23	25.5	2.5	
24	26	2	
27	27	0	
27	28	1	
29	29	0	
29	29.5	.5	
29.5	30.5	1	
30	30	0	
33	33	0	
33.5	33.5	0	
*35	36.5	1.5	
40	40	0	
*42	43	1	
44	44	0	

Table 21. 1945 growth of notched clams at Five Islands, N.S., Sandy Point plot in clay soil. Clams notched and planted 13 May, 1945, redug and measured 19 Oct., 1945.

Shell height to notch mm.	Shell height to margin mm.	Increase in height mm.	Remarks
* 11	13.5	2.5	
* 14	18	4	* See footnote to table 20.
15.5	18	2.5	
15.5	18.5	3	
* 21	22.5	1.5	
22	23	1	
* 22	24	2	
26	26	0	
27	27	0	
27.5	27.5	0	
27.5	27.5	0	
28	28.5	.5	
29	29.5	.5	
29.5	29.5	0	
29.5	30	.5	
30	30	0	
30	31	1	
31	31	0	
* 31	31	0	
32	32	0	
32	32.5	.5	
33	33	0	
* 33	34.5	1.5	
34	34.5	.5	
37.5	37.5	0	

11. GROWTH OF SEED CLAMS OF THE 1943 SET AT SISSIBOO RIVER, N.S., BELLIVEAU COVE, N.S. AND ST. ANDREWS, N.B.

This year another sample (Table 22) was taken on July 4 of the 1943 set of seed that was first noticed at Sissiboo last year (Medcof 1944). By following this age group which is still conspicuous on the Sissiboo flats until it reaches $1\frac{1}{4}$", it should be possible with the results now available from the 75 foot plot to tell how many years it takes clams to grow from the egg to marketable size.

For comparison, samples of what appear to be the same age class were taken May 30 from half-tide level on the Pottery Bridge flat, St. Andrews, N.B., and from high and low levels at Belliveau Cove, N.S.

It is impossible to make a close comparison of these lots because of differences in sampling dates. In spite of this, it is apparent that growth conditions are roughly the same in all three areas.

The St. Andrews seed showed what were interpreted as 1943-44 winter annuli whose lengths varied from 2 to 5 mm.

It would appear that 1943 was a better than average year for clam spat in the Fundy area, otherwise this age class could not be so prominent.

Table 22. Length-frequency distribution of clams in samples, (1) July 13 from high and low levels on the beach at Belliveau Cove, N.S., opposite the wharf, (2) intermediate beach level, Sissiboo River, N.S., July 4, (3) intermediate beach level, Pottery Bridge flat, N.B., May 30.

Length mm.	Belliveau Cove low level sample	Belliveau Cove high level sample	Sissiboo River	Pottery Bridge
9	1	0		
10	2	2		
11	1	4		
12	1	8		
13	2	8	3	
14	3	11	3	
15	1	14	6	1
16	0	9	12	1
17	3	15	12	1
18	1	10	13	1
19	11	5	12	2
20	10	9	14	2
21	10	2	12	1
22	13	1	6	
23	16	2	3	
24	20		2	
25	19		1	
26	20		1	
27	16			
28	14			
29	6			
30	5			
31	8			
32	8			
33	3			
34	2			
35	4			
36	0			
37	1			
No. in sample	200	100	100	9
Mean length mm.	24.6	16.0	18.6	18.3

12. THE EFFECTS OF COMMERCIAL DIGGING ON THE SURVIVAL OF RESIDUAL CLAM POPULATIONS

Ingalls (1942) reported the results of tests showing the destructive effects of digging large clams on the residual stock of legal- and sub-legal-sized clams. In his tests the mean size of the residual population varied considerably and the results showed the effects ordinary commercial digging generally have in clayey soils.

In 1945 heavy populations of seed clams of the 1943 set were discovered on the government reserve on the Sissiboo River, N.S.. These were clearly distinguished from all older clams by their much smaller size and glossy white-and-gold shells with clearly-defined annual rings. The size of these is indicated in table 22. It was decided to test the effects of digging particularly on this age class in two experiments designed essentially like Ingalls. The field work was carried out entirely by Mr. Charles Hayes, the Dept. of Fisheries Guardian of the Reserve.

Two blocks 5' square were laid off in areas where the 1943 set appeared to be uniformly distributed and sub-divided into four quadrants A, B, C, and D, each 2½' square. Quadrants A and D which were diagonally opposite, were dug over and all clams 2¼" or more in length removed. The plots were then left without smoothing off the ground for two or three weeks then all the quadrants were dug over and all the live clams in each screened out and counted.

The first plot was at half-tide level approximately 200' to the southwest of the southwest corner of the 75' plot in a part of the flat that was well stocked. It was dug on June 14 and July 5. The ground here was compact and contained pieces of rock and broken shell.

The second plot was laid off in a section of the 75' block that had been dug out on October 13, 1942, and was therefore barren of all clams older than those of the 1943 set when this experiment was conducted - July 2 and July 16. Consequently no clams at all were removed on July 2. The ground was merely turned over as though it were being dug commercially. The soil here had a more even texture than in the first plot. It was less compact, free of rock or broken shell and turned rather easily.

The results of the two tests are summarized in table 23. A study of the data leads to the following conclusions:

<u>Conclusions</u>.

1. The table suggests that our assumption that the clams were present in about equal numbers in the several quadrants of each plot was not wholly justified but insofar as the 1943 set was concerned

the actual conditions approached the assumed reasonably well. The original population of 1943 seed in plots I and II was approximately 5 and 140 per sq.' respectively.

2. The destruction of 1943 seed in the areas was 60% and 37% - the heavier loss occurring in the more compact soil. Ingalls (1942) got similar variations.

3. Soil texture is apparently of great importance in determining the extent of destruction occasioned by turning over the soil. This conclusion accords with that drawn from a comparison of Chiasson's Petpeswick results (Medcof 1944, p. 50) with Ingalls 1942 Sissiboo results (Ingalls 1942, tables 13-17, and Needler and Ingalls 1944).

4. The destructive effects of digging on legal-sized and on sub-legal-sized clams other than those of the 1943 set is not computable from this experiment because the basic assumption of uniform distribution was not met.

Table 23. Data showing effect of digging on the survival of clams.

Stock fished and counted	Fishing date	Catch in Quadrant A	D	B	C	Difference (B + C) - (A + D) Actual	%
			Plot I				
Commercial-sized clams	June 14	51	33	-	-		
	July 5	26	27	87	106	56	29
Total		137		193			
Sub-legal clams over 2 years old	July 5	101	59	69	92	1	1
Total		160		161			
Clams of 1943 set	July 5	18	7	32	31	38	60
Total		25		63			
			Plot II				
Clams of 1943 set	July 14	611	542	839	938	624	35
Total		1153		1777			

13. THE EFFECT OF WASHING ON THE ABILITY OF CLAMS TO BURY THEMSELVES

Mr. Bernard Collins of Orleans, Massachusetts, raised the question in April, 1945, as to whether it is best to wash or leave seed clams unwashed before planting.

Two experiments were carried out at Petpeswick by Dr. Chiasson using lots of 300 clams 2 to $2\frac{1}{2}$ inches long in an attempt to get an answer to Mr. Collins' question. Actually this size is too great for a critical test of some of the factors involved in handling ordinary seed $1\frac{1}{4}$ - $1\frac{3}{4}$" long. For one thing, firmness of shell increases with size and again the burrowing activity of large and small clams is quite different (Medcof 1944).

In planting the clams were scattered on a sandy flat in Petpeswick Cove after scuffling it with a hand cultivator. No more than 6 "floaters" were found in any of the lots when the tide covered them. The effects of three treatments were tested.

1. After fishing and culling for size, the clams were left unwashed and undisturbed in the hod until planting time.

2. The hodful of clams was gently shaken in air in such a way as to simulate the disturbance which is occasioned by ordinary washing and let stand until planting.

3. The hodful was washed in the regular manner under water and let stand until planting.

The two experiments differ only in the length of time the clams were left out of water between treating and planting. In experiment #1 this was 24 hours and in #2, 12 hours. The results appear in table 24.

Presumably the numbers of clams of each lot still on the surface at successive low tides following planting are proportional to the difficulty of burial. On this basis it is impossible to draw any definite conclusions from the two tests. Such differences as were observed were too inconsistent to be indicative of trends.

It may be concluded that any effects the treatments had were minor and probably not consequential in clam farming trials.

Table 24. Results of experiments to determine the effects of washing on the ease of burial of planted clams.

Treatment	No. of clams placed on surface	No. of clams still on surface at 1st low tide after planting	2nd low tide after planting
Experiment I			
unwashed and undisturbed	300	117	52
shaken in air	300	103	41
washed in water	262	97	32
Experiment II			
unwashed and undisturbed	300	93	31
shaken in air	300	82	30
washed in water	300	109	26

14. THE DEPTH OF CLAMS IN THE SOIL RELATIVE TO THEIR SIZE

Last year (Medcof 1944) data on this subject were compiled for Bideford River, P.E.I., Sissiboo River, N.S., and for Brandy Cove, N.B. Further records were compiled on May 26 and September 19 at Sissiboo. So far there has been no opportunity to analyze them. All measurements on May 26 and June 19 were made by Mr. Chas. Hayes in inches. On September 19 the writer measured the depths in millimetres and Mr. Hayes the lengths in inches. The conversions of inches to millimetres were made by Mr. J. S. MacPhail. The data assembled appear in tables 25-28. A summary of these data and those assembled last year (Medcof 1944) appeared in a 1950 Progress Report (Medcof 1950).

Table 25. Preliminary observations by Chas. Hayes at half-tide level in tough clay soil at Sissiboo River, 26 May, 1945.

Shell length mm.	Shell length 32nds"	Depth in soil mm.	Depth in soil 32nds"
14	18	13	16
20	25	25	32
25	32	51	64
34	43	51	64
41	52	51	64
43	55	51	64
43	56	64	80
44	56	64	80
44	56	76	96
45	57	76	96
47	59	51	64
54	68	76	96
57	72	64	80
67	75	64	80
67	75	95	120

Table 26. Observations by Chas. Hayes on June 19, 1945, at same area as on May 26 (Table 25) on the size and depth of clams.

Shell length		Depth		Shell length		Depth	
mm.	32nds"	mm.	32nds"	mm.	32nds"	mm.	32nds"
17	21	25	32	38	48	40	50
16	20	32	40	39	49	49	62
36	46	38	48	41	52	59	74
27	35	35	44	44	56	63	80
40	50	38	48	40	50	56	70
53	67	51	64	51	64	73	92
45	57	51	64	39	49	28	36
33	42	49	62	33	41	40	50
35	44	51	64	26	33	40	50
37	47	30	38	41	51	57	72
53	67	71	96	36	46	48	60
48	60	71	96	45	57	57	72
33	41	36	46	45	57	49	62
32	40	32	40	41	51	48	60
37	47	27	34	34	43	30	38
21	26	19	24	49	62	70	88
31	39	22	28	61	77	78	98
15	19	19	24	52	66	56	70
13	16	19	24	57	72	78	98

Table 27. Size-depth relationships of clams from Sissiboo River, N.S., on high level flats in gravel soil on 19 Sept., 1945.

Shell length mm.	Shell length 32nds"	Depth in soil mm.
16	20	40
25	32	30
25	32	38
27	34	43
30	38	42
32	40	32
32	40	35
32	40	37
32	40	49
33	42	58
35	44	43
40	50	39
40	50	49
41	52	40
41	52	48
41	52	50
44	56	37
44	56	45
46	58	49
48	60	44
48	60	52
51	64	42
51	64	44
54	68	51
67	84	50

Table 28. Size-depth relationships of clams from Sissiboo River, N.S., on low level flats in tough clayey soil, 19 Sept., 1945.

Shell length mm.	Shell length 32nds"	Depth in soil mm.
28	36	62
44	56	64
51	64	73
54	68	63
57	72	66
62	78	35
65	82	36
67	84	36
67	84	67
67	84	80
70	88	59
70	88	61
70	88	78
73	92	68
74	94	77
79	100	68
81	102	60
86	108	65
90	114	64
95	120	64
98	122	74
116	146	73
116	146	81
138	176	78

15. SCUFFLING - A MEANS OF PREPARING SOIL FOR CLAM RELAYS

During the latter part of June and the first week of July an attempt was made to relay a quantity of stunted clams from the high flats of Mussel Gully to the low, exposed Big Flat in Petpeswick Harbour, N.S. The area chosen for the transplant was immediately south of the half-acre relay completed in October, 1944, (Medcof 1944). The flat was prepared by scuffling this portion with an ox and farm harrow. The purpose was to discover if spring is a better time to make relays than the fall and to compare the results of broadcast seeding on scuffled soil with those of seeding with the aid of a hand plough (1944).

In the first trial 40 hods (8 bbls.) of clams were used. A very strong wind was blowing so that seeding was impossible on the day the stock was dug. It was necessary to hold the clams overnight. During this period they were exposed to continuous rain. The following morning they were broadcast in shallow water but a strong wind was still blowing. Observations 24 hours later showed that all the clams had disappeared. There were few indications of siphon holes and it was evident that the strong wind and tide had washed most of them off the planting area.

The second attempt was somewhat more successful. Twenty-four hods (5 bbls.) of clams were sown in 20 - 24 inches of water over the prepared flat. At the next low tide about 50% remained on the surface and 48 hours later an estimated 25% had not dug in. However, many were still living and it seems probable that a high percentage of the 24 hods was successful in burial.

Observations in September showed that many survived for two months. From this it would appear that the great reduction in the cost of planting by this method as compared with hand ploughing-in justifies its adoption for future relays of this kind.

The scuffling achieved by the ox-drawn harrow was little different from that produced by a hand cultivator and for small plots the latter is less expensive.

16. COMMERCIAL TYPE RELAYS OF SEED CLAMS IN DIFFERENT HARBOURS

This year plantings of about 1/4 to 1/3 acre each were made at Clam, Musquodoboit and Chezzetcook Harbours, at Gilberts Cove in N.S., and at Maisonnette in N.B.. The circumstances attending the last-named relay were more involved than the others so that it is treated separately. All relays were made by broadcasting the seed on the flats after scuffling the soil surface with a hand cultivator.

The size-frequency distribution of a measured, random sample from each planting stock is found in tables 29 and 30.

The plan is to follow the growth and survival of these for several years to see if "clam farming" is commercially feasible on our coast. Records of the costs of the operations have been compiled.

1. Clam Harbour (Figure 2, Medcof 1944). On July 16 and 17, 1945, eighty-eight hods of stunted seed clams with a mean length of 47.6 mm. were obtained from the flat immediately west of Laybolt Point. This seed was transferred to the middle ground bar and covered an area about 1/3 acre where the soil is sand-mud mixture.

2. Musquodoboit Harbour (Figure 1, Medcof 1944).

(a) Indian Point. On 17 Sept., 1945, four hods of stunted seed clams with a mean length of 49.8 mm. were obtained from high levels of this same flat and planted on a barren sand-mud area between the low-water mark and half-tide level just east of the Widgeon Gut opposite Flat Island.

(b) Bird Ledges (Flat Island). On 18 October, 1945, three hods of stunted seed stock with a mean length of 49.6 mm. were transferred from the high levels of the "Coke" flat to this area which is just west of the Widgeon Gut. A half bucket of small fast-growing seed clams (mean length 33.3 mm.) were also taken from the Coke flat and planted with the above stock immediately west of the first relay, where the soil is sandy with a very small amount of mud mixed in.

(c) Coke Flat. The seed stock for this relay was removed from the higher levels of the same flat. Four hods were planted on 18 October, 1945, at a point half way between the low-water mark and half-tide level where the soil is sandy with a small amount of mud mixed in. The mean length of a random sample was 49.6 mm. Besides these a ½ bucket of 33.3 mm. size were also taken from the high levels of this flat and planted immediately north of the main relay which was just across Martinique Channel from Flat Island and near the entrance to the Do-gone Gully.

(d) Stock Cove. On 18 October, 1945, four hods of severely-stunted seed clams were removed from high levels on this flat and planted in sandy-mud soil just below half-tide level. There was no sample of this stock measured but the size range approximated that of the larger group relaid on the Coke flat.

3. Chezzetcook Harbour (Figure 3, Medcof 1944). On 16 and 17 July, 1945, a barren sandy area on the flat of the Murphy property and opposite Conrods Island was stocked with 124 hods of stunted seed clams taken from a badly crowded area from the same flat but closer to shore. The seed was dug from three different sections of this flat and was relayed in three lots A, B and C on the barren flat. The mean lengths of a random sample of each lot were 39.5, 45.7 and 36.4 mm. respectively.

4. Gilberts Cove (St. Mary's Bay). On July 17-18, 1945, 150 buckets (50 bushels) of clams were dug from the uppermost levels of the government reserve on the Sissiboo River, N.S., and taken to a barren area on Gilberts in muddy gravel at a low level close to "the bar". They were sowed at a density of 20 per sq. ft. and covered an area of 80' x 80'. The mean length of a random sample was 49.3 mm.

Table 29. Length-frequency distribution of stocks of stunted clams relayed to new areas in 1945.

Length mm.	Clam Hbr. Middle Ground	Musquodoboit Hbr. Indian Pt.	Musquodoboit Hbr. Bird Ledges and Coke Flats	Chezzetcook Hbr. A Portion	Chezzetcook Hbr. B Portion	Chezzetcook Hbr. C Portion	St.Mary's Bay Gilbert's Cove
30				1	3	1	
31				2	2	6	
32	2			6	4	8	
33	2			8	5	9	
34				13	11	13	1
35	1			17	9	22	1
36				13	8	16	
37	1			19	6	14	3
38	6	1		33	12	13	
39	3		1	23	11	11	1
40	5	1	1	34	16	18	
41	5			31	14	17	2
42	11			27	13	13	
43	14	4	1	10	13	2	2
44	20	2	3	10	15	2	2
45	14		3	23	15	4	1
46	11	4	2	8	21	1	5
47	14	2	5	4	27		3
48	16	5	5	3	14	1	1
49	10	8	5	4	13		1
50	13		4		15	1	2
51	13	4	1	1	24		5
52	14	6	7	1	19		2
53	17	2	3		10		4
54	19	1	1		9		3
55	14		3		13		3
56	9	2	2		10		
57	8	2	2		3		1
58	6				4		
59	1	2			4		2
60	2		1		2		3
61		1					1
62	1				1		
63	3				1		
64	3	1					1
65	1						
66	1						
67	2						
Total	273	48	50	290	347	171	50
Mean	47.6	49.8	49.6	39.5	45.7	36.4	49.3
Equiv. length ins.	1 7/8	1 15/16	1 15/16	1 9/16	1 13/16	1 7/16	1 15/16

Table 30. Length-frequency of fast-growing seed clams taken from high levels on the Coke Flat, Musquodoboit Hbr., and planted on the Bird Ledges and Coke Flats in the same harbour.

Length mm.	Frequency
24	2
25	
26	3
27	2
28	6
29	9
30	10
31	8
32	6
33	5
34	3
35	3
36	1
37	2
38	
39	
40	4
41	1
42	1
43	2
44	3
Total	71
Mean	33.3
Equiv. length ins.	1 5/16

Examination of relays subsequent to planting

All the relays just described were observed once or more after planting and all seemed to be surviving reasonably well except that at Gilbert's Cove.

On 20 Sept., 1945, about 2 months after planting it was visited and samples were dug from representative parts of the planted area. Many clams were found dead, many with decomposing meat still in them. The length-frequencies of the live clams and "dead" shells are recorded in table 31. None of the clams showed much growth since planting. There was an unusual number of "tape worms" (Macobdella) in the soil but these are not known to be clam predators. There was a heavy catch of '45 seed, 2-3 mm. long, on the upper beaches still attached by the byssus threads to sand grains.

Conclusions

1. The mortality has been heavy - 37% since planting.

2. The mean lengths of the "dead" shells is slightly lower than that of a random sample measured at the time of planting, whereas the mean length of those living was the reverse being slightly longer. These differences are not great and may not be significant but the indications are that there is a selective mortality involving the smaller clams.

3. The future of this relay does not appear to be very bright. All the clams were handled carefully and seemed to be vigorous on planting and we are at a loss to explain the mortality. The fact that a heavy catch of seed was observed here and that the cove as a whole is almost barren of clams suggests that whatever brought on the mortality of the relaid stock may be responsible for the failure of the cove to restock itself naturally.

Table 31. Length-frequency distribution of "dead" shells and live clams taken in random samples from the Gilbert Cove relay, 20 Sept., 1945.

Length mm.	Frequency "Dead" shells	Frequency Live clams
38	1	2
39	1	
40	1	2
41	2	2
42		4
43	1	2
44	5	7
45	4	4
46	2	5
47	7	9
48	3	9
49	3	11
50	3	2
51	2	8
52	4	6
53	2	7
54	4	2
55	1	5
56	1	1
57	2	
58	1	
59	1	
60		
61	1	1
62		1
Totals	52	90
Means	48.8	51.0

% dead 37
% living 63

17. COMMERCIAL SCALE RELAY AT MAISONNETTE, N.B.

Last year the condition of the clam fishery at Maisonnette was reviewed and trial planting of relaid seed was recommended as a possible means of re-establishing the clam populations (Medcof 1944). This year two such plantings were made - one involved small seed clams from Tracadie lagoon and the other stunted clams taken from St. Andrews, N.B.

On October 3, two bushels of seed clams were gathered at Point à Bouleau Bridge which crosses a stream tributary to Tracadie Lagoon at its southern end. These were part of a crowded population whose density was estimated to be over 300 per square foot. They were found only in the gravelly parts of a sand and gravel bar which supports the central butment of the bridge and is entirely protected from direct sunlight by the low bridge overhead. The length-frequency distribution of this seed is indicated in table 32. The total number of clams relaid from this source was estimated from Belding's table (Belding 1930) as 70,000.

The age of the stock could not be certainly determined because the shells were rough from growing in the gravel and as a result the growth annuli were obscure. As far as could be judged there were only two age groups represented, probably the 1942 and 1943 sets. They were classed as "normal" rather than "stunted" clams.

The seed was planted as the tide was rising on October 4 at Maisonnette by broadcasting onto the flat, had been previously scuffled with a hand cultivator. The estimated density of planting was 30 to 40 per square foot. They were scattered in two plots both inside the area reserved for bait digging (See Special Fisheries Regulations, N.B.). One was just east of Joe Cormier's Point where the soil was a mixture of sand and mud and the other 600 feet due east of it where the soil is more sandy and supports a sparce growth of short (6" long) eel-grass.

The St. Andrews clams relaid at Maisonnette were stunted stock taken from high levels on the Pottery Bridge flat. They ranged in size from 1 to 2" with an average of about 1¼". No careful measurements were made. Four barrels of these were dug on October 1, trucked to Maisonnette, and planted on October 4 at the same time as and in the same fashion as the Point à Bouleau stock and in plots adjacent to them, but to a density of only 20 per square foot.

One hour after the water covered the flats, observations from a boat showed that over half the Point à Bouleau clams had completely buried themselves. The St. Andrews clams were slower. Less than a quarter of these had started burrowing at that time. The next day at low tide when the plots were visited all the uninjured Point à Bouleau clams had buried themselves and the large number of clearly-visible siphon holes indicated that there had been very few losses at planting. About two thirds of the St. Andrews clams had buried themselves. Those on the surface were mostly large or damaged and showed little prospect of ever going down although they were almost all alive.

It is proposed to follow the growth and survival of these clams closely. This is the first time we have tried to plant Fundy stock in the Gulf of St. Lawrence.

No late autumn inspection was made of these relays but the local Department of Fisheries Guardian, Mr. H. Gogin, who assisted with the work reported that just before freeze-up the holes were still prominent in all plots and that all the clams seemed to be thriving.

Table 32. Length-frequency distribution of seed clams taken from the gravel under Point à Bouleau Bridge (near Tracadie, N.B.) 3 Oct., 1945, and planted 4 Oct., 1945, on the barren flats at Maisonnette, N.B.

Length mm.	Frequency
10	
11	
12	
13	
14	1
15	7
16	4
17	5
18	12
19	8
20	6
21	9
22	11
23	11
24	3
25	6
26	5
27	4
28	2
29	
30	
31	1
Total	95
Average	21 mm.

18. RELAY OF PETPESWICK, N.S., STUNTED CLAMS IN BIDEFORD RIVER, P.E.I.

On October 18, 1945, approximately 50 stunted clams were dug from Mussel Gulley (Petpeswick Harbour, N.S.) and taken to Ellerslie, P.E.I., on October 22. These were notched with a file and planted in two equal lots: one in #2 plot used in the experiment on seasonal growth and effects of disturbance on growth (Medcof 1944); and the other on the sand bar at the mouth of Claude Williams' creek. In spite of their lengthy exposure to air the animals seemed vigorous and began "pumping" soon after planting.

It is proposed to follow the growth of these and compare it with the growth of stunted clams that have been transferred to lower levels on their native flats in other districts, and with the growth of clams native to Bideford River itself as shown by the 1944 investigation.

This is the first attempt we have made to transfer outer-coast, Nova Scotia seed to the Gulf of St. Lawrence. The good survival and rapid growth observed for the last two years in the latter area (see section 6 this report) and the vast quantities of stunted clams in the former make it desirable to test the value of this sort of transfer because of the commercial possibilities that might be involved.

19. ESTIMATING DENSITY OF CLAM POPULATIONS FROM COUNTS OF SIPHON HOLES

On 11 and 12 July, 1945, when the relay was being made at Clam Harbour from Laybolt Point to the Middle Ground, a test was made to compare the number of clams present in the soil by counting the siphon holes and by the actual removal of the clams by digging. The soil at Laybolt Point has a surface of fine brown sand with a mixture of sand and clay underneath. The surface is not rippled and the mixture is firm throughout. Before the area was dug over to remove the seed stock, siphon-hole counts were made of four one-foot square plots after which the clams were dug and counted, table 33. This test was repeated on the same ground two days after the area had been dug over and the population reduced.

This experiment was duplicated (table 33) at Chezzetcook Harbour on 16-17 July, 1945, when the relay was made on the flats east of Murphy's property. Here the soil had a sandy surface with a mixture of clay, sand, and gravel underneath. The soil is very loose, in fact, many diggers prefer a shovel instead of the clam fork for digging, because water often seeps into their excavations when the surface soil is removed.

The weather in both areas during the tests would be described as normal summer conditions.

Conclusions

1. In Clam Harbour, before the area was dug, the number of clams present in the soil by siphon-hole counts was 2/3 or 66% that revealed by digging. After the area was dug over 3/5 or 59% of the clams present in the soil were located by siphon-hole counts. The difference is slight and may or may not be attributable to the disturbance of the soil by digging.

2. In Chezzetcook Harbour the reverse was true. Prior to digging the area, only 1/2 or 50% of the clams found in the soil were located by siphon-hole counts. After the ground was dug over, this increased to over 3/4 or 76%.

3. From these tests, it may be judged that half to three-quarters of the clams show siphon holes in sandy soils under normal summer weather conditions.

This conclusion has proved useful in estimating clam populations during surveys of clam flats. Fishermen report that season and weather conditions (wave action) affect this relationship. More observations of the sort just reported would therefore seem desirable.

Table 33. Comparison of densities of clam populations by siphon-hole counts and digging of one-foot-square plots in Clam and Chezzetcook Harbours, N.S., July 1945.

Clam Harbour - Before digging

Plot No.	No. of holes showing	No. of clams found	% of total showing
1	31	43	72.0
2	20	32	62.5
3	23	40	57.5
4	20	28	71.5
Means	23.5	35.8	65.8
	- After digging		
1	16	19	84.3
2	11	17	64.8
3	10	22	45.5
4	10	23	43.5
Means	11.8	20.2	58.5

Chezzetcook Harbour - Before digging

Plot No.	No. of holes showing	No. of clams found	% of total showing
1	33	74	44.6
2	37	65	57.0
3	28	50	56.0
4	37	84	44.1
Means	33.8	68.3	49.5
	- After digging		
1	25	33	75.8
2	21	28	75.0
3	37	53	69.8
4	29	33	87.8
Means	28	36.8	76.2

20 FACTORS INFLUENCING THE YIELD OF MEAT FROM CLAMS

Last year (Medcof 1944) some data on the yield of clams was presented and this year several sets of records of yield from commercial plants were gathered for analysis. These include 1944 and 1945 data from General Seafoods' Ostrea Lake shucking plant, 1945 data for the International Shellfish Company's plants at Musquodoboit Harbour and 1944 and 1945 data for the same company's plant at Digby, N.S.. The General Seafoods' records have since been analyzed by Thurber (1949) and included in his report. For this reason, they are not presented here except in graphic form (figure 2). The data obtained from the International Shellfish Company appear as tables 34-36 and some of these have been plotted in figure 3.

The stock processed at Digby came largely from Annapolis Basin with some from the Sissiboo River. The Ostrea Lake and Musquodoboit Harbour plants handled a mixture of stocks from Halifax County but drew heavily on Musquodoboit Harbour.

From the data one would judge that the stock from Annapolis Basin and Halifax County harbours were about equal in yield (cf. tables 35 and 36) but that the International Shellfish Company and General Seafoods were handling their product differently (cf. table 36 with table 27 Thurber, 1949). General Seafoods is inclined to put up a drier drained pack.

The effect of season on yield described by Thurber is apparent in tables 34 and 35 and these data show the fall recovery particularly well.

Besides this analysis of records compiled by commercial processing plants, Dr. Chiasson and Mr. Casey carried out tests designed to show how yield is affected by size of clams, crowding to different densities, beach level and position in the harbour. Other tests by these men show how yield varies from harbour to harbour. The results of all this work have already been presented by Thurber (1949) so they are only mentioned here.

Table 34. Meat-yield in American gallons (8 lbs. drained shucked meat) per bbl. of round clams at the International Shellfish Company's Digby, N.S., plant, 1944.

Date	April	May	June	July	Aug.	Sept.	Oct.
1			4.9		4.4	4.6	
2		5.0	4.4		4.4	4.5	4.6
3		5.0	4.6		4.4		4.6
4	4.7	5.0		4.1	4.5	4.5	4.7
5	4.7	5.0		4.4	4.5	4.6	
6	4.6	4.9	5.0	4.0		4.0	4.7
7			5.0	4.5	3.8		4.6
8	4.8	4.8	4.7	4.0	4.6	4.8	
9			5.2		4.3	4.7	4.4
10	4.8		4.8	4.4	4.4		
11	4.9	5.0		4.5	4.5	4.5	4.5
12	4.7	5.0	4.4	4.3	4.5		4.4
13	4.5	5.0	4.3	4.2		4.6	4.5
14			4.8	4.1	3.8	4.7	
15		5.0	4.6	4.3	4.3		
16		5.0	5.0		4.5	4.1	
17	4.9		4.4	3.9	4.5		
18	4.9	4.7		4.4	4.1	4.5	
19	5.0	5.0	4.0	4.3	4.5		
20	4.9	5.0	4.7	4.2		4.5	
21	5.0		4.8	4.3	4.5		
22	4.8	5.0	4.6	4.3	4.5	4.5	
23		5.0	4.5		4.8		
24		5.0	4.5	4.4	4.6		
25		5.0			4.4	4.5	
26		5.0	4.3	4.3	4.3	4.5	
27		4.8		4.4		4.5	
28			4.3	4.3	4.3	4.5	
29			4.2		4.4		
30		4.7	4.5		4.3	4.5	
31		4.7		4.1	4.5		
Av.	4.8	4.9	4.5	4.3	4.4	4.5	4.6

Table 35. Meat-yield in American gallons (8 lbs. drained meat) per bbl. of round clams at the International Shellfish Company's Digby, N.S., plant, 1945.

Date	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.7	4.7		4.1	4.4			
2		4.8	4.7		4.1				
3		4.8			4.1				
4		4.8	4.7	4.4	4.1	4.2			4.7
5			4.7	4.4					4.6
6			4.7	4.5		4.5			
7				4.3	4.2	4.5			4.7
8		4.8	4.7		4.2				
9	4.6	4.8	4.7	4.2	4.2				
10	4.8	4.7		4.2	4.1				
11	4.8	4.7	4.6	4.3	4.1				4.8
12	4.7	4.8	4.5	4.2		4.0			
13	4.8		4.7	4.3	4.1	4.5			
14	4.8	4.8	4.6	4.2	4.2				
15		4.8	4.7		4.2			4.7	
16	4.8	4.8	4.6	*3.6	4.3			4.7	
17	4.8	4.7		+5.8					
18	4.8	4.7	4.5		4.3				
19		4.7	4.5	4.0					
20	4.7		4.5	4.0	4.2				
21	4.7			4.0	4.3			4.7	
22		4.7	4.6		4.2				
23	4.7	4.7	4.5	3.8	4.4			4.7	
24	4.8	4.7		4.0	4.4			4.7	
25	4.7	4.8	4.6	4.0	4.4				
26	4.8	4.2	4.7	4.2				4.2	
27	4.8			4.1	4.3			4.3	
28		4.6	4.4	4.1				4.6	
29		4.7	4.5		4.4			4.3	
30		4.7	4.5	3.9	4.4				
31		4.7		4.1	4.5				
Av.	4.75	4.72	4.53	4.20	4.24	4.35		4.54	4.70

* This stock was held over the weekend in the shell in air storage which probably accounts for the low yield.

+ The whole of this day's pack came from the Sissiboo. This stock is usually fatter than that from Annapolis Basin.

Table 36. Meat-yield in American gallons (8 lbs. drained shucked meat) per bbl. and pounds per half-bushel hod at the Musquodoboit Harbour plant of the International Shellfish Co., 1945.

Date	Gallons per bbl.	Equivalent in lbs. per ½-bu. hod
April 9	4.6	7.3
10	4.8	7.7
11	4.8	7.7
12	4.7	7.5
13	4.8	7.7
14	4.8	7.7
16	4.8	7.7
17	4.8	7.7
18	4.8	7.7
20	4.7	7.5
21	4.7	7.5
23	4.7	7.5
24	4.8	7.7
25	4.7	7.5
26	4.8	7.7
27	4.8	7.7
May 1	4.7	7.5
2	4.8	7.7
3	4.8	7.7
4	4.8	7.7
Means	4.76	7.62

* Conversion factor gal. per bbl. x 8/5 = lbs. per hod

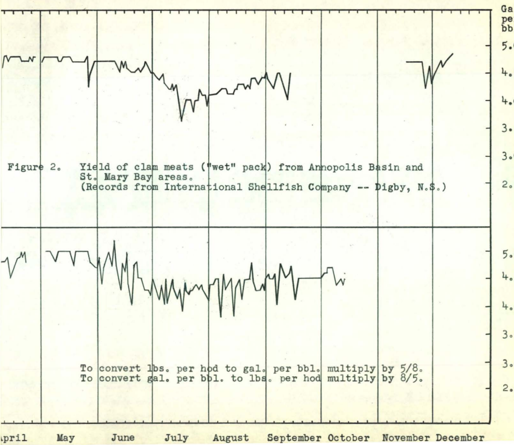


Figure 2. Yield of clam meats ("wet" pack) from Annopolis Basin and St. Mary Bay areas. (Records from International Shellfish Company -- Digby, N.S.)

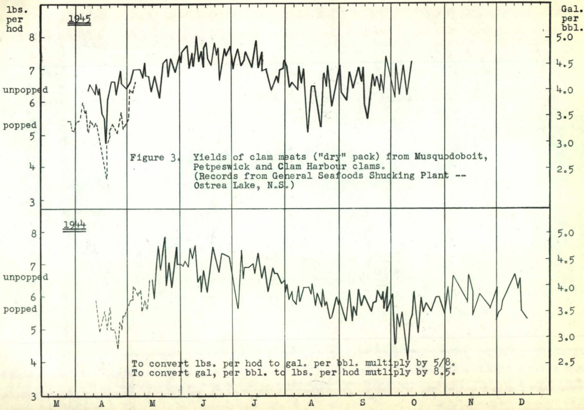


Figure 3. Yields of clam meats ("dry" pack) from Musquodoboit, Petpeswick and Clam Harbour clams. (Records from General Seafoods Shucking Plant -- Ostrea Lake, N.S.)

21 DESTRUCTION OF CLAMS BY HERRING GULLS

Between 4 and 5 o'clock on September 21, a warm day, during the course of an experiment to test the relative efficiency of random and systematic digging in Sissiboo River, about 30 herring gulls lit on the quarter-acre dug-over ground we were working at and ate clams that were left exposed on the surface. Many clams were held firm in the sticky clay soil and the gulls picked away at these until they had eaten out the meat except for the adductor muscles which were in most cases left in the shells. None of the birds tried to break the clams open by flying up and dropping them on the beach as they are often observed to do. The writer studied the behaviour of individual birds with binocular field glasses and their activities were recorded by Mr. Claude Hayes who also held the time-piece and made the time readings.

The average time required for a gull to eat a single clam was determined from several observations on five birds that seemed to be typical of the flock in their behaviour. Some of the animals were more voracious than those studied. Others ate almost no clams and wandered about on the flat for no apparent reason. The results are summarized below.

Time in seconds (from first to last peck) required for a gull to eat a clam.

Gull 1 - 60, 30, 30, 20 and 30.

Gull 2 - 60, 90, 10 and 20. The second-last clam was small and the last a very large specimen whose shell was broken before the bird began feeding on it.

Gull 3 - 55 and 55. Both these clams, one large and one small, had broken shells.

Gull 4 - 30, 20. In the interval of about two minutes between the eating of these two clams, the gull picked pieces from three others which would doubtless die as a result of the injury suffered.

Gull 5 - 20, 20.

Another series of observations summarized below was made on four gulls, #6 - 9, to learn something of their capacity for consumption per unit of time as well as of the time required for unit consumption.

Gull No.	Time taken to eat clam. seconds	Interval between finishing one and starting another clam. seconds	Remarks
6	25	30	
	90	32	This second clam was large (3-4" long).
	20	60	
	15	5	
	50	20	
	15		
7	50	20	
	30		
8	20	30	
	35		
9	20	15	
	65		The shell of this second clam was broken before the bird began eating
Means	36	27	

The mean time required for the first five gulls to eat a clam was 37 seconds and this is almost identical with that for the second four. Considering the interval between attacks on successive clams it appears that the gulls were eating about one per minute per bird. At this rate their movements appeared to be leisurely and Mr. Charles Hayes, the Department of Fisheries guardian of the government-reserved plots who watches the flats the year round, indicated that in his opinion the gulls were not "clam-hungry" at this time of the year because they feed on abundant refuse from fish plants and weirs up and down the St. Mary Bay shore. He claims they feed more rapidly and continuously in spring and late autumn. In consequence the number of birds present that day on the flats (about 200 were visible within the quarter-mile radius of observation with the binoculars) could not be considered large and they were feeding at "half-speed" or less. This harmonizes Kerswill's observations reported by Ingalls (1942) with those just reported.

Dr. Kerswill states his study was made in November 1942 and applies to one gull feeding on piles of clams he deliberately set out for it. He reports this gull to have eaten 10 clams in 60 seconds.

Even a daily average of only 50 gulls exploited these flats and fed at the observed one-a-minute rate for a half-hour period a day for eight months of the year on undamaged clams, they would destroy close to 600,000 clams, which, if they averaged 2¼" in length, would equal 600 bushels. From his observations, Mr. Hayes believes that this is an under-estimate of the clam destruction by gulls that goes on within sight of his cottage. He believes it would be worthwhile to regularly frighten off the gull populations by shooting because at times large numbers (approaching 1000) of birds swarm onto the flats behind the diggers and even get so bold as to steal clams from their boats. To prevent this the diggers are sometimes forced to cover their catch with sacks.

It appears that gulls are among the clam's more serious natural enemies.

22. ATTEMPTS TO ARTIFICIALLY INCREASE THE SET OF SEED CLAMS

The discovery of an economical means of substantially increasing the natural "set" of seed clams on our flats would be one of the greatest contributions this investigation could make towards the expansion of the clam industry. Previously there has been no exploration of the possibilities, but in 1945 a simple empirical experiment was carried out with this end in view.

Eddy currents and light were considered as probably important factors regulating sets of clam larvae since this has been proved to be the case for oysters. Obstructions were therefore set up on the experimental area in Petpeswick cove in June by Dr. Chiasson. These were designed to produce eddies or shading or both and occupied a uniform part of the beach.

Obstructions.

1. A small spruce tree (about 6' long) with the limbs trimmed off one side was held flat against the sand by nailing its trunk to stakes driven into the ground.

2. Spruce boughs about three feet long were nailed crosswise on a board about 10' long with the buts pointing alternately in opposite directions. The board was fixed to driven stakes so that it lay in contact with the flat. The convex sides of the boughs were uppermost.

3. A five-foot square made of 6" boards standing on edge was fixed to the flat by nailing to stakes driven at the corners.

4. A zig-zag arrangement of three 6" boards standing on edge and fixed to the flat with stakes.

5. A layer of sacking was tacked to a frame made by a pair of boards about five feet long held together by laths joining them. This structure was held 4" - 6" above the flat by nailing to stakes.

6. Beach gravel varying in size up to pebbles with a ½" diameter was scattered in 5' square plots marked off with stakes.

By Oct. 17 the larvae had settled and grown into seed that were large enough to be retained by 20-mesh-to-the-inch screening. The population density on the natural flat away from, at and near the obstructions was measured. This was done by Mr. C. R. Hayes by screening out and counting the seed from one-inch-deep, tenth-of-a-square-foot surface soil samples taken with a small shovel.

The results of the seed counts were as follows: The numbers refer to the series of obstructions described above.

1. 6 soil samples from edge, ends and beneath branches of spruce tree yielded: 0, 0, 1, 0, 1, 0.

2. 2 samples from under board: 1, 3.

   4 samples near edge of board under branches: 0, 1, 0, 0.

   2 samples taken 6 feet from board and 2 feet beyond the tips of the spruce boughs: 0, 0.

3. 4 samples from the corners of the enclosure gave: 0, 0, 1, 6 seed.

   1 sample from middle of enclosure: 0.

   5 samples taken outside the square and 2 feet from the sides gave: 0, 3, 2, 0, 2.

   1 sample 20 feet away gave: 2.

4. 9 samples taken a few inches from the boards both in the "zigs" and "zags" yielded:
   seaward side: 0, 0, 2.
   landward side: 1, 1, 2, 1, 3.
   under edge of board in pool of water: 2.

5. 4 samples under sacking near corners of obstruction: 3, 5, 5, 2.

   1 sample in middle: 9.

   2 samples just outside at corners: 8, 8.

   1 sample outside at middle: 1.

   3 samples outside 3' away: 10, 5, 7.

   4 samples outside 10 - 20' away: 3, 0, 4, 7.

6. 2 samples in gravel - very hard to handle: 0, 0.

7. Control

   3 samples were taken about 50' from any of these obstructions giving: 0, 2, 0 seed.

Conclusions from Study.

There was a great place-to-place variation in the density of the seed population on the open flat at a distance from the obstructions. This is assumed to have resulted from differences in the intensity of spatfall.

From the above data it appears that none of the obstructions had any remarkable effect on the set of seed such as Mead (1902 Report for 1901) records for his screened boxes. Nevertheless it does appear as though the intensity of the catch was influenced, possibly doubled in some cases, by the obstructions. It was impossible to separate the effects of light and eddy currents in this test.

This work should be continued along with studies of intensity patterns of natural spatfall in various inlets. Such work should give some indications as to what factors are important in regulating sets and how they operate.

23. PLANKTON STUDIES AT PETPESWICK - 1945 and 1944

Part 1. Abundance of Clam Larvae.

There was little study of the Petpeswick plankton in 1945 so that it is possible to make only a few general remarks. Mr. Casey did most of the work. All tows except those of July 26 came from Petpeswick Cove and, as in 1944, these were taken in ten-minute hauls with a net of 18 mesh silk bolting cloth. The size-frequency distribution of clam larvae observed in the catches is indicated in table 37. In a rough way the numbers of larvae measured are a measure of the abundance of clam larvae on the various dates and in different places mentioned. Stafford's (1912) figures were used for identification of larvae.

1. Clam larvae were scarce this year as compared with 1944.

2. Observations on July 26 indicated that larvae were more abundant in the middle reaches of the harbour than either above or below the narrows but this may have been a tidal effect.

3. The most abundant larvae in the plankton catches were straight-hinged stages corresponding to figures 8 and 9 in Stafford's series. Few advanced forms were observed at any time.

4. A large unidentified straight-hinged larva about 100μ long appeared in the plankton this year and was quite abundant on August 9. Possibly it is the larva of Macoma baltica since adults of this species are common on muddy flats in this district.

5. What appeared to be larval Teredo were found on one or two occasions.

6. No explanation is proposed for the scarcity of late-stage clam larvae. In this respect our observations differ from those reported by Sullivan (1942) for Bideford River. She noted a scarcity of the youngest stages.

Table 37. Size-frequency distribution of Petpeswick clam larvae.

Date	Description of tow \ Size in *Oc. Mic. divis.	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Remarks
July 25	10:30 a.m. tide H.F.: in cove.				1		1														
" 26	8:30 a.m. tide H.R.: channel opposite government wharf					1	2	2	1	1	3	2	3	1					2	2	
" 26	9:00 a.m. tide H.S.: in channel opposite Lower Turn bed	1								1		2		1		2		1		2	
" 26	10:30 a.m. tide H.F.: in cove			1												1					clam larvae rare
" 26	10:45 a.m. tide H.F.: in main channel outside cove															1					no clam larvae found
" 31	4:00 a.m. tide L.F.: in channel at entrance to cove						4	3	2	1											
Aug. 3	In cove				3	4	12	23	8	4	6		2								
" 6	In cove					1		1	1	6	6	10	2	3	1						
" 9	8:00 a.m. tide H.S.: in cove											1		5		6				2	
" 14	p.m. tide H.: in cove						3	2						1						1	
" 16	In cove			2		24		28		4		2									also 1 @28 and 1 @ 30
" 24	In cove		2	1																	water very clear: little plankton
" 27	In cove			1	2			1													
" 30	2 p.m. tide H.: in cove			4	3	11	9	5	6	5											
Sept. 5	In cove			2	1	1		1			2										

Frequency Distribution

* 1 ocular micrometer division = 9.3μ

Part 2. Seasonal Abundance of Phyto-plankton.

This section was inadvertently omitted for last year's report (Medcof 1944) and it is thought wise to include it here.

On May 5, 1944, a ten-minute haul was made off the Government wharf in Petpeswick Harbour with a #18-mesh, silk bolting cloth plankton net with a circular mouth 1' in diameter. The catch was unusually heavy. Five minutes after adding formalin a brownish-green layer of sludge, 25 mm. deep, settled to the bottom of the pint collecting jar. Microscopic examination showed that it was composed principally of diatoms.

Several similar tows were made during the summer and another on November 16 but in no case did the catch approach that of May 5 for quantity. The depth of the deposit seldom exceeded 1 or 2 mm.

It is generally reported that May is the month of most vigorous clam growth in this area. Apparently it is related to this diatom flowering. Mr. Ross Carey, Manager of General Seafoods shucking plant at Ostrea Lake, reports that at this time of the year the presence of " tobacco juice" in the digestive glands and the enormous size of the digestive glands regularly necessitates "popping" (removal of the gland by squeezing) to produce a marketable pack. Sometimes this condition arises as early as March - long before growth begins.

It is interesting to speculate as to what effect such early "flowering" has on the growth rate of clams. It is conceivable that it comes before the water temperature is high enough to permit shell secretion. If this were the case the generally poor growth on the outer coast of Nova Scotia might be explained on the basis of unavailability of food rather than food shortage. This would be an interesting subject for investigation.

24. CLAM DRILLS (POLINICES) IN BELLIVEAU COVE, N.S.

Two visits were made to Belliveau Cove during the year - one in July, the other in October - which showed it to be of peculiar interest. This great area of pure sand is reported to have been formerly productive of large quantities of high quality clams but during the last several years it has yielded little or nothing. Details of the history are desirable.

At present there is a heavy population of seed stock. Judging from shell annuli which are presumed to be annual rings this stock is composed almost entirely of the 1943 year class. At the upper levels on the beach the stock seems to have grown much more slowly than lower down. The size-frequency distribution of random samples gathered by hand after turning up the soil with a clam hoe is shown in table 22.

In July many "sand collars", the egg cases presumably of the smooth whelk (Polinices heros) were found at all levels on the beach. Over considerable areas these averaged 4 to 6 per square metre and concentrations of as many as 10 to 14 per square metre were repeatedly observed. Many drilled shells of seed clams were found in the soil and many whelks too. The latter were chiefly of small and medium size, mostly less than 3 cm. high. Gull pellets composed almost entirely of broken shells of seed clams were found on the flats. The birds are therefore enemies of clams even in areas that are not being dug over by man to expose the mollusks for them to pick up.

The work of Kerswill (1941) and Medcof (1938) has shown that Polinices in Canada is an important enemy of our commercially important shellfish. American workers e.g. Mead (1903) and Belding (1930) long ago found this to be true on the New England coast.

Belliveau Cove apparently offers a good opportunity for a study of the life history and industrial importance of the whelk. There is also a good chance to study the growth characteristics of young clams and the various stages in the natural re-population of a flat that has long been barren. There are few such areas in the Maritimes.

It is hoped that next year some work of this kind may be undertaken.

25. THE RELATIVE EFFICIENCY OF SYSTEMATIC AND RANDOM DIGGING

Much interest has been exhibited lately in the possible conservation value of controlled digging of clam flats. It was decided to clear some ground on the Sissiboo this year of commercial-sized clams (those over 2¼" long) so that an experiment could be started there in 1946. This provided an opportunity for comparison of efficiencies of two digging methods "random" and "systematic" because it was planned to have another digging in 1946 just before the experiment began.

Two square, experimental areas each measuring 200 feet on a side were staked off.

Part I.

The first of these areas was sub-divided into eight 50' x 100' plots, as shown in figure 4 on July 17. Four of these were dug "systematically". In this method the diggers lined up abreast and worked across the plot turning every foot of ground and smoothing out their diggings to some extent as they went along. The boundaries of the other four plots were marked out with codline and the commercial clam diggers of the district advised that they might dig these plots however and whenever they pleased for the next week, so long as they observed the 2 1/4" minimum legal-size limit and allowed the quardian, Mr. Hayes, to measure their catch from each plot separately. The yields of the several plots are indicated in the figures and summarized in table 38.

Conclusions and Discussion.

1. If we assume that irregularities of the stocks are offset by the subdivision of the ground and the "randomization" of the treatments it would appear from the results that there was little or no difference in the efficiencies of the two methods of digging. This conclusion will be checked by the yields from these same plots in 1946 when they are all dug systematically preparatory to the experiment that is to begin then.

A feature of the performance of the diggers who worked the "random" plots should be mentioned here because it may have influenced the result. This ground inside the reserve had not been dug commercially since early in 1941 when the Sissiboo program was begun by Dr. Ingalls. For this reason it was particularly attractive to commercial diggers who swarmed over the "random" plots and turned over every inch of the ground in them - just about as thoroughly as if they had been asked to dig them systematically. None of the diggers were interested in going back to the plots once they were dug so they were turned over only the once.

Figure 4. Layout of eight 50' x 100' plots in the Sissiboo experiment to test the relative efficiency of systematic and random digging.

Channel

1	2	3	4	Plot No.
Systematic	Random	Systematic	Random	Type of Digging
165	176	156	142	Yield (Buckets)
5	6	7	8	
Random	Systematic	Random	Systematic	
57	70	76	93	

Beach

2. The catch from the lower plots was more than double that from the upper. This accords with general experience that upper levels are less productive than lower.

3. The catch per acre was high (929 buckets per 40,000 sq.' is equivalent to 380 Imperial bushels per acre). If no allowance were made for digging mortality that might have gone on as a result of digging that might have taken place if the area had not been a government reserve, this would have been equal to 76 bu. per acre per year for the five years during which the area was closed.

Part 2.

The second 200' x 200' square was sub-divided into 16 50' x 50' plots and the digging treatments randomized as shown in figure 5. The digging in this case took place in an eight-day period starting September 20. The digging methods were the same as those described in the report on Part 1 of this text. The catches from each plot are shown in the figure and summarized in table 39.

The following conclusions may be drawn from these records.

1. There is no consistent difference in the efficiencies of the two digging methods. This result may have been partly due to the treatment the diggers gave the "random" plots. This was the same as that described in the report in part 1 of this experiment. A check on this conclusion will be made in 1946 when all these plots are dug over systematically.

2. The catch was greatest in the two middle rows of plots and less at the lowest and highest levels that at the last being least of all. This feature has been observed in the Fundy area before and might be thought as discordant with conclusion 2 drawn in part 1 above. Actually there is no true discord. The falling off in catch at the lowest levels probably would have appeared in part 1 if the zonation of beach level had been more refined as it was in part 2.

3. The catch per acre of flat was in the order of 570 bushels. If this catch had been taken in the five seasons, 1941-45 inclusive, the yield would have been 114 bu. per acre if there had been no digging mortality.

Figure 5. Layout of sixteen 50' x 50' plots in Sissiboo experiment to test the relative efficiencies of systematic and random digging.

Channel

1	2	3	4	Plot No.
Random	Systematic	Systematic	Random	System of Digging
57	76	97	96½	Yield (buckets)
5	6	7	8	
Random	Systematic	Systematic	Random	
108	118	94½	117	
9	10	11	12	
Random	Systematic	Random	Systematic	
84	78	82	86½	
13	14	15	16	
Random	Random	Systematic	Systematic	
72½	65½	76	75½	

Beach

Table 38. Catch of clams in buckets (1 bucket = $1\frac{1}{2}$ pecks) from plots used in Part 1 of experiment to compare efficiencies of "systematic" and "random" digging.

Beach Level	Systematic Plot No.	Systematic Catch (Buckets)	Random Plot No.	Random Catch (Buckets)	
Lower Plots	1	165	2	176	
	3	156	4	142	
Totals		321		318	639
Upper Plots	5	57	6	70	
	7	70	8	93	
Totals		127		163	290
Grand Totals		448		481	929

Table 39. Catch of clams in buckets (1 bucket = $1\frac{1}{2}$ pecks) from plots used in Part 2 of experiment to compare efficiencies of "systematic" and "random" digging.

Beach level of rows of four plots	Systematic Plot No.	Systematic Catch (Buckets)	Random Plot No.	Random Catch (Buckets)	Totals Systematic	Totals Random	Totals Total
Lowest row	2	76	1	57			
	3	97	4	$96\frac{1}{2}$	173	$153\frac{1}{2}$	$326\frac{1}{2}$
Lower middle row	6	118	5	108			
	7	$94\frac{1}{2}$	8	117	$222\frac{1}{2}$	225	$447\frac{1}{2}$
Upper middle row	10	78	9	84			
	12	$86\frac{1}{2}$	11	82	$164\frac{1}{2}$	166	$330\frac{1}{2}$
Uppermost row	15	76	13	$72\frac{1}{2}$			
	16	$75\frac{1}{2}$	14	$65\frac{1}{2}$	$151\frac{1}{2}$	138	$289\frac{1}{2}$
Grand Totals					$711\frac{1}{2}$	$682\frac{1}{2}$	1394

26 GROWING CONDITIONS ON THE POTTERY BRIDGE FLAT, ST. ANDREWS, N.B.

According to the commercial clam fishermen, the Pottery Bridge flat at St. Andrews is one of the best in Charlotte Co., N.B. for growth and steady production. It was decided to check the growth there for comparison with other areas such as the Sissiboo River, N.S.

On May 30, 1945, 25 clams were dug at half-tide level on the flat at a point half way between the outfall of the brook from "The Gut" and the central ridge of Niger Reef. The soil here is a gravel-mud mixture.

The clams were notched and immediately planted in a staked 2½' square plot. Almost all showed a narrow, golden-coloured margin of newly-secreted shell representing the 1945 growth which was quite distinct from the 1944 secretion. Measurements on 8 of these selected randomly showed the average width (height) of this annulus to be 2.0 mm.

The plot was dug on November 9 and 24 of the clams recovered. The heights of these on the left valve from the umbone to the May 30 notch and to the free edge of the shell were measured (Table 40). These data show that there had been a growth of 23% in a little over five months. If the total growth for 1945 had been measured it would have amounted to 27 or 28%. This growth is much better than any we have observed at the Sissiboo (Table 3) or at Petpeswick (Table 5) and better than that obtained by Dr. Leim (See M'Gonigle 1940) on the workshop flat or by Newcombe (1935) in this district.

It should be pointed out that these clams were growing under most favourable conditions so far as crowding is concerned. Besides this the small size of the plot probably leaves the whole stock subject to border effects. In spite of this it appears that the opinion held by local clam fishermen is well founded.

The survival over the five months was 96% judging from this small trial the Pottery Bridge flat should be an excellent spot for clam farming trials.

Table 40. Height-frequency distribution of measurements of 24 Pottery Bridge flat clams to notch cut May 30 and to free edge of shell on Nov. 9, 1945.

Shell height mm.	Height-frequency distribution: To May 30 Notch	To edge of shell Nov. 9	Increase
20			
21	3		
22	4		
23	1		
24	5		
25	2		
26	3	2	
27	2		
28	3	2	
29	1	3	
30		6	
31		2	
32		6	
33		3	
34			
Mean height mm.	24.6	30.3	5.7 mm. 23%
Corresponding lengths mm.	41	50	9 mm. 23%

27. ABILITY OF CLAMS TO BURY THEMSELVES IN WINTER

There is much difference of opinion as to whether clams are able to bury themselves during the colder months of the year andthere are reported experimental observations bearing on this problem. Mr. Charles Hayes, guardian of the Sissiboo River government reserved clam flats conducted two tests to obtain precise information.

He built a $2\frac{1}{2}$' x $2\frac{1}{2}$' x 1' bottomless, roofed, cage made of $\frac{1}{4}$" mesh wire cloth supported by a wooden frame. This was so constructed that the lower parts of the sides could be buried in the beach and thus prevent clams that were placed under it from being washed out.

On October 29 and December 3, 1945, it was set out on the beach at half-tide level where there were no native clams and 100 freshly-dug "normal" clams, measuring $1\frac{1}{4}$ to $1\frac{1}{2}$" long, were placed under it at low tide. They were examined at low tide for four successive days. The results are summarized in the table below.

Numbers of clams still on surface

Planting Date	Days after Planting 1	2	3	4
October 29	5*	3	0	0
December 3	3**	0	0	0

* 3 of these clams were partly buried.
** all three were partly buried.

The conditions of the test were similar except that on December the surface of the soil under the cage was loosened with a clam hoe before the test began. The siphon holes of the buried animals were clearly visible.

It is clear from this trial that clams have the ability to bury themselves quickly in cold weather. Further tests of this type should be conducted if we wish to get a good comparison of the relative ease of burial at different seasons.

28. HEIGHT-LENGTH RELATIONSHIPS OF CLAMS FROM ST. ANDREWS, N.B., AND LOWER ECONOMY, N.S.

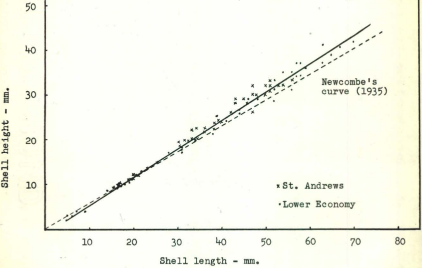
It is often necessary to convert lengths of clam shells to corresponding lengths or vice versa in dealing with experimental results. It is well known that the proportions of clams vary a good deal from place to place and with beach level at the same place. Newcombe (1935) has presented a graph for shells from the St. Andrews region without saying anything about the nature of the animals on which the measurements were made. Later (Newcombe and Kessler 1936) he used the same data as representative of the whole Fundy region without suggesting that there was variation from place to place within this region or variation at any one place (e.g. at St. Andrews itself) with such factors as beach level.

The writers' impressions are that many of the within-district variations they have encountered are as great as many of the between-district variations Newcombe has exhibited with much care. For this reason it was thought wise to examine the shell height-length ratio in two stocks that differed considerably. These were the fast-growing clams from Pottery Bridge flat taken this year at half-tide level from gravel-mud soil and Lower Economy clams taken in 1944. The latter are quite slow-growing (stunted) and taken from gravel-clay soil.

The data assembled are plotted in figure 6. The curve shown was drawn through the points purely by inspection and for comparison, Newcombe's curve (1935) has been included. The two differ considerably but that based on 1944 and 1945 data is preferred for our use because we know the characteristics of the clams to which they apply.

There is apparently little difference between the shell height-length proportions in the two stocks we examined. In this particular Newcombe's claim is justified but it is hard to explain why his curve does not conform more closely with our observations and why he has drawn it to pass through the origin as a straight line. It is well known that the shell proportions of the spat change radically during the early months of its life and that the graph cannot be rectilinear and at the same time pass through the origin.

Figure 6. The shell height-length relationship for St. Andrews, N.B., and Lower Economy, N.S. clams.



29. OBSERVATIONS ON MUSSELS ON CLAM FLATS

Under our directions, Mr. Charles Hayes, guardian of the government-reserved clam flat on the Sissiboo River, conducted several observations on mussels that seemed to be encroaching on the clam areas more than usual this year. These are reported below.

Effect of Raking Mussels.

Mussels were raked from their attachments and piled in mounds 2½' high and 5' across on three occasions Oct. 25-27, November 5 and 6 and November 19-22 and the fate of these piles was followed for several succeeding days.

After the first tide the pile was usually flattened to cover an area 10-12 feet across and about 4' deep. This spreading continued steadily and there was no sign that the animals on the insides of the piles had been killed by smothering. If the piles were placed on a smooth part of the beach all the mussels finally disappeared from the area but if it were rough or if it were in a depression clusters attached themselves firmly. Some of the areas that had been covered previous to raking remained clear even though mussels did wash back over them. In other words, the treatment did some good.

Effects of Ice on Mussel Beds.

In March 1946 the observations started in the fall of 1945 were extended. It was found that the moving ice sheets which settled on the beach at low tide on several frosty nights and floated off again in the morning carried away many of the mussels from the reserved plots. An estimated 3/4 of the total population disappeared in this way in the course of a few tides.

Presumably mussels could be carried to an area by ice just as easily as away from it but this was not observed to happen anywhere this spring.

Effects of Dumping Mussels into Channel.

The Sissiboo River has steep channel banks and several square yards of flat near the channel were cleared of mussels that were thrown into the channel. As far as Mr. Hayes could observe none of these were washed up again onto the cleared ground.

From the above observations it is clear that there are natural factors limiting the abundance of mussels on our flats and that there are simple means of control or partial control that can be resorted to if need arises.

It seems desirable that we should know more about the mutual relationships of clams and mussels since they are often associated. What effect, for instance, have mussels on the growth and quality of clams? How do they affect the spatfall of seed clams? How do they affect soil characteristics that might influence clam behaviour?

30. SURVEY OF CLAM FLATS - FIVE ISLANDS REGION, N.S.

In May 1945 a survey was made of the Five Islands clam flats. These grounds were visited last year (Medcof 1944) and in 1942 Ingalls made a sketchy survey of them. The gross features of the area are described in figure 7 which is a chart of this district.

Harrington River Flat.

This flat is approximately 25 acres in area and lies west of the mouth of the Harrington River. The flat has an even surface unbroken by channels although near shore there are occasional boulders. The borders of the river channel are fairly steep. The soil is a mixture of sand and mud except at extreme high and low levels where there is a mixture of gravel and clay. Generally the soil affords easy digging. A fairly good and evenly distributed population of clams covers this area. The size range was good except that no 1943 or 1944 seed could be found. The clams found on this flat are typical of the Five Islands area as a whole. They show stunting, have firm thick shells and were full-meated. The average size of the clams fished here was below 2¼". This flat was dug heavily in 1944 and was being exploited again this year. It is an easily accessible area and a favourite place for digging in bad weather. It has always been a good area for clams.

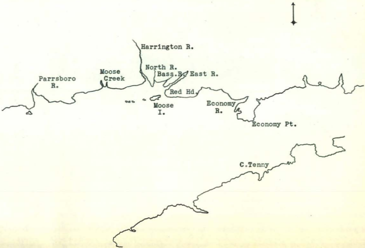
Broadrick Beach - 13 May 1945.

This is the largest flat visited in this area (estimated size 200 acres). It extends from the mouth of Harrington River on the west to North River on the east and part way up the estuary of the latter. This is an elevated beach ¼ mile in width much cut up by channels in the westward portions and the soil character varies from place to place. To the westward the gravel is so hard that it cannot be dug with a clam fork and in some places the clay is so soft that it slips through the tines. These areas while well populated would not be productive. The remainder is tough clay or a mixture of sand and clay being fairly easy to dig. The heaviest population appeared to be at half-tide level. The distribution is patchy with many barren areas over the flat. There was a good variety in size with many small clams, but no 1943 set in any quantity was found. White-shelled clams were found in the gravel areas while those in clay were blue. The greatest exploitation has been in the southern and eastern parts which are dug regularly. There has always been a good population in this area.

Bass River - 13 May 1945.

This is about a 100-acre flat lying between Bass and North Rivers with its western end extending into the estuary of North River. On the average it is rather high, cut up by channels and has a width of over ¼ mile. The surface of this flat is an extremely sticky red clay with either sand-mud or gray clay underneath that makes good digging. Only a fair population of clams with many barren areas was found on this flat. There was a considerable variety in sizes and the clams resembled the other areas

Figure 7. Five Islands Area (Ex British Admirality Chart #353)



in their degree of stunting.

This flat was exploited extensively in 1944 and is being dug steadily again this year. In the past there always appeared to be a good population.

Sand Point or East River Flat - 13 May 1945.

This flat is situated between Bass River and East River extending into the mouth of East River. The acreage appeared to be less than 100 and is somewhat smaller in size than the Bass River flat. It is a wide flat sloping gradually towards the main channel. The evenness of the surface is broken occasionally by lesser channels. The whole flat affords good digging, the soil being a mixture of blue clay, sand and gravel. There is a heavy population over most areas, but smaller-sized clams were less abundant than on the other flats. The growth appeared to be slightly better than that of the other areas, otherwise there was little difference in the stock. This flat was worked hard in 1944 and is being dug steadily this year.

Old Wife Flat - 15 May 1945.

This area was not visited and the following information was obtained from Mr. Fred Cogswell, a resident clam digger. This is a small flat, 3 to 4 acres, lying on the east side of East River immediately west and north of Red Head. The ground has a gentle slope to the channel, but is very exposed. The soil is easily dug. It is a mixture of mud and gravel. A fair population of clams is present on this flat, although there does not appear to be a great range in size. They resemble clams from other parts of this area. They are white-shelled in sand and gravel and blue in clay. This area is being dug regularly and in the past has always been able to yield a quantity of marketable clams each year.

31. METEOROLOGY PETPESWICK, 1945

Dr. Chiasson and Mr. Casey jointly made weather observations and recorded air temperatures daily with the same instruments as in 1944. The data are compiled in table 41. An examination will show the following characteristics:

1. Generally, the conditions were similar to those of 1944.

2. The amount of sunlight is reduced in the months of June and August by fog and cloudy weather.

3. Again this year, there were no violent fluctuations in temperature such as are found further inland.

Table 41. Summary of Petpeswick Meteorological Observations, 1945.

Date				Time	Max. °F.	Min. °F.	Present °F.	Remarks (wind, sun, etc.)
June	5	a.m.						
"	6	"	p.m.					
			"					
"	7	"		9:30	50	41	43	Leaden sky,cold,windy,rough sea.
"	8	"		8:45	54	39	47	Very fair,slight breeze, calm sea.
			"	6:30	65	39	61	Clear, light north wind.
"	9	"		9:00	59	33	54	Clear, warm.
			"	7:00	60	52	52	Clear, light south wind.
"	10		"	9:30	61	34	46	Clear, light north wind.
"	11		"	7:00	63	40	50	Rain, moderate S.W.wind.
"	12	"		9:00	51	47	50	Foggy, rain, lt.S.wind.
"	13	"		11:30	72	44	65	Clear, very lt.S.breeze.
			"	9:00	69	52	52	Clear, lt. S. breeze.
"	14	"		9:30	60	42	60	Foggy, lt. S. breeze.
"	15							
"	16	"		6:30	68	48	54	Cloudy, no apparent breeze.
"	17							
"	18	"		9:00	80	47	58	
"	19	"		9:30	70	49	58	Foggy, lt. S. wind.
"	20	"		8:30	72	50	72	Clear, lt. S. breeze.
			"	7:30	78	55	55	Heavy rain, mod.S.E.wind.
"	21	"		9:00	57	49	55	Foggy, lt. S. breeze.
"	22	"		9:00	70	47	54	Light rain, lt. S.E. wind.
			"	5:30	64	52	63	Cloudy, lt. S.E. wind.
"	23	"		9:00	64	50	55	Foggy, lt. S.E. breeze.
			"	6:30	65	54	56	Foggy with thunder,N.wind.
"	24		"	6:30	64	50	57	Cloudy, moderate N. wind.
"	25	"		9:00	58	43	54	Clear, very lt. S. breeze.
			"	6:30	66	53	56	Clear, lt. S. wind.
"	26	"		9:30	57	50	54	Cloudy, mod. S.W. breeze.
			"	6:00	61	53	55	Cloudy, mod. S.W. breeze.
"	27	"		9:00	56	51	56	Cloudy, mod. S.W. breeze.

Continued

Date				Time	Max. °F.	Min. °F.	Present °F.	Remarks (wind, sun, etc.)
June	28	a.m.		9:00	61	52	54	Cloudy,heavy rain, strong S.E.wind.
"	29	"		9:00	59	52	59	Cloudy, rain, mod. N. wind.
"	30	"		11:30	70	48	67	Clear, lt. S. breeze.
July	1		p.m.	4:00	75	49	72	Clear, lt. S. breeze.
"	2	"		9:00	74	53	56	Foggy, lt. S. wind.
"	3	"		7:30	75	52	64	Clear, lt. S. wind.
			"	7:00	74	58	61	Clear, lt. S. wind.
"	4	"		7:30	68	50	58	Clear, calm.
			"	6:30	70	58	63	Clear, lt. S.W. wind.
"	5	"		8:30	64	48	60	Clear, lt. S. wind.
			"	7:00	72	60	64	Foggy, lt. S. wind.
"	6	"		8:30	64	49	62	Clearing, lt. S. wind.
			"	7:50	72	59	59	Foggy, lt. S.W.wind.
"	7	"		8:30	61	56	61	Foggy, lt. S.W.wind.
			"	7:15	70	56	61	Clear, lt. S. wind.
"	8	"		9:00	68	50	65	Clear, lt. S. wind.
"	9	"		8:00	72	51	62	Clear, lt. S. wind.
"	10	"		9:00	73	50	64	Clear, lt. S. wind.
"	11	"		1:00	74	56	66	Foggy, lt. S. wind.
"	12	"		9:25	70	44	62	Clear, N.W.changing to S.W. at 9:00.
"	13	"		10:50	72	45	64	Foggy, lt.S. wind, clearing.
"	14	"		9:15	68	46	58	Cloudy, lt. E. wind.
"	15		"	6:15	68	54	60	Foggy, lt. S.E.wind.
"	16		"	6:00	71	54	62	Foggy, mod. S.wind.
"	17	"		8:30	66	46	62	Fair, lt. S. wind.
			"	6:30	73	50	64	Fair, mod. S. wind.
"	18	"		8:30	66	46	62	Fair, lt. S.W. wind.
			"	8:00	73	61	67	Fair, lt. S.W. wind.
"	19	"		8:30	70	56	69	Fair, lt. W. wind.
"	20		"	5:40	73	56	66	Fair, fresh S.W.wind.
"	21	"		7:00	72	52	64	Cloudy, lt. N.W.wind.
"	22		"	6:45	68	46	65	Clear, mod. S.W.wind.
"	24	"		6:00	70	49	62	Clear, lt. S.W.wind.
"	25	"		10:30	72	50	70	Cloudy, lt.fog,no breeze.
"	26		"	5:30	77	57	71	Cloudy, lt.S.W.breeze.
"	27	"		9:00	72	58	68	Clear, lt.N.breeze.
			"	6:20	79	68	73	Clear, mod. N.E.wind.
"	28		"	7:45	74	47	65	Clear, lt. S.breeze.
"	29		"	6:15	72	55	68	Heavy rain, mod. S.W.breeze.
"	30		"	6:10	78	56	76	Clear, lt. N.wind.
"	31		"	8:50	75	48	62	Clear, lt.S.W.wind.
Aug.	1		"	8:00	74	54	64	Clear, mod. W. wind.
"	2		"	6:30	76	52	69	Clear, mod. W. wind.
"	3		"	8:00	77	56	68	Partly cloudy, mod.S.W.wind.
"	4		"	6:00	78	62	73	Foggy, mod. S.W.wind.
"	5		"	5:15	78	51	66	Intermittent showers and sun. W. wind.
"	6		"	6:00	75	55	70	Clear, mod. S.W.wind.
"	7	"		9:00	71	56	69	Clearing, lt. S.wind.
			"	7:25	79	62	62	Lt. rain, mod. S.wind.

Continued

Date				Time	Max. °F.	Min. °F.	Present °F.	Remarks (wind, sun, etc.)
Aug.	8		p.m.	7:00	72	59	68	Clear, partly cloudy, lt. N. wind.
"	10		"	7:30	78	58	72	Light clouds.
"	11		"	6:30	79	52	71	Clear, lt.S. wind.
"	12		"	7:30	78	57	68	Foggy, lt.S.W. wind.
"	13		"	7:30	80	62	69	Partly foggy, lt.S.W.wind.
"	14	a.m.		9:30	69	60	69	Cloudy lt.S. wind.
			"	7:45	78	66	65	Cloudy, fresh S. W.wind.
"	15		"		73	52	68	
"	16		"	6:45	74	57	64	Fair, fresh S.W. breeze.
"	18		"	7:22	76	49	67	Fair, lt. S. breeze.
"	19		"	9:30	76	58	62	Cloudy lt. S.W.breeze. .
"	20		"	6:45	77	56	68	Clear, lt. S.W.breeze.
"	21		"	7:30	73	57	67	Foggy, mod. W. wind.
"	23	"		9:30	71	54	66	Partly cloudy, lt. S.W.wind.
"	24		"	6:30	75	43	64	Cloudy, lt. S.W.wind.
"	25		"	6:45	70	57	61	Foggy after heavy rain, mod. S. wind.
"	26		"	10:00	65	56	61	Raining, mod. S.W.wind.
"	27	"		9:30	74	53	60	Cloudy.
"	28		"		73	59	62	Partly cloudy, lt.S.breeze.
"	29		"		75	52	64	Fair, lt. S. breeze.
"	30		"		71	51	62	Partly cloudy, S.W.wind.
"	31		"	6:00	70	48	63	Cloudy, lt. N. wind.
Sept.	3	"		9:00	70	58	61	Clear, N. wind.
"	5	"		11:00	72	42	64	Clear.
"	6		"	8:15	74	52	63	Clear, lt. S.W.wind.
"	7	"		10:50	72	58	72	Clear, lt. S.W.wind.
"	8	"		9:30	75	60	70	Clear, lt. S.W.wind.

32. HYDROGRAPHY, PETPESWICK, 1945.

Hydrographic observations and beach soil temperatures like those of last year (Medcof 1944) were carried out in 1945 by Dr. Chiasson and Mr. Casey. These are summarized in tables 42 and 43. Although the data are much less comprehensive than those of 1944, comparison is possible.

Salinities.

According to these records the salinity in the harbour was on the average a little lower than in 1944. It nevertheless shows the same steady nature.

Water and Soil Temperatures.

Early in the season, 1945, water temperatures may have been slightly higher than in 1944. Other than this no comparisons are possible. The soil temperature data are too sketchy for comparison.

Table 42. Summary of water and soil temperatures at East Petpeswick Cove, 1945.

Date	Time	Tide	Water Temp.°C.	Time	Soil temperatures at low tide °C. at surface	°C. 5 in. below surface
19 June '45	1130	LW	15.0	1130	17	14
20 "		"		1230	27	24 (Clam Hbr.)
26 "	1600	"	13.5	1600	14	13
3 July '45	1130	"	17.0	1130	22	18
6 "		"	19.0			
17 "	1600	"	11.0			
18 "	1630	"	12.0			
19 "		"	17.0			
20 "		"	19.0			
27 "		"	22.0		22	20
1 Aug. '45		"	22.0			
3 "		"	20.0			
4 "		"	21.0			
6 "		"	19.0			
7 "		"	20.0			
10 "		"	19.5			
12 "		"	22.0			
14 "		"	21.5			
5 Sept.'45	1145	"	18.5			

Table 43. Summary of hydrographic observations at Petpeswick - 1945. Salinity Determinations.

Date	Depth	Temp. of sample °C.	Hydrometer reading	Salinity ‰	Locality and General Remarks
June 23	surface	17.0	1.0201	26.2	Cole Harbour
	bottom	17.0	1.0214	27.9	
June 25	S	12.8	1.0225	28.5	Petpeswick Cove
	B	12.8	223	28.3	
July 14	S	15.8	234	30.6	
	B	14.8	233	30.5	
" 19	S	21.6	231	30.3	
" 23	S	15.5	235	30.3	
	B	12.8	245	30.9	
" 25	S	19.6	201	27.0	
	B	17.0	225	29.3	
" 26	S	21.0	215	29.2	
Aug. 3	S	21.5	220	30.0	
	B	21.0	225	30.4	
" 8	S	20.4	220	29.6	
	B	21.0	218	29.6	
" 14	S	23.0	223	30.9	
" 16	S	21.6	216	29.5	
	B	21.2	220	29.9	
" 24	S	16.8	228	29.7	
" 27	S	18.8	222	29.5	
	B	18.2	220	29.1	
" 30	S	19.0	227	29.7	
	B	19.0	229	30.0	
Sept. 5	S	18.6	228	30.1	
	B	18.0	230	30.3	

33. GROWTH RATE OF OYSTERS ON DEEP-WATER BEDS IN MALPEQUE BAY

In 1943 (Medcof and Morrison 1943) a series of growth curves for oysters was constructed from measurements of annual diameters. At that time no samples of oysters from the deep-water beds of Malpeque Bay were examined. Such a lot was taken on May 12, 1944. They were from Beaton and Simmons lease in the middle of the bay which was barren of native oysters but had been stocked with collector spat, apparently of the 1937 set, that had been tray-reared for one year.

The results of the measurements appear in table 44. From these results it will be seen that cultivated oysters required six years to reach the minimum marketable size of 3½" on Beaton and Simmons bed. This must be considered a slow-growing area because even naturally-produced oysters grow this fast in some areas without the advantage of the fast growth in the second year spent on trays.

Table 44. Diameters (lengths) in mm. of successive annual rings on lower shells of 26 oysters taken May 12, 1944, from Beaton and Simmons deep-water bed in Malpeque Bay, P.E.I.

	Annual Ring No.						
	1	2	3	4	5	6	7
	13	39	58	69	82	97	109
	16	35	59	68	76	84	87
	16	44	60	72	84	92	
	16	51	64	77	84	95	101
	9	30	42	63	78	85	96
	17	37	60	70	77	85	95
	11	35	55	74	82	88	93
	10	28	60	75	82	88	93
	22	45	67	84	88	92	
	9	33	56	69	85	94	
	18	33	49	62	70	83	89
	13	37	53	70	81	86	
	13	43	59	70	79	89	92
	13	40	58	75	84	86	
	18	44	60	73	85	94	
	12	40	53	65	73	81	86
	19	37	54	68	79	83	92
	20	51	68	79	87	92	96
	10	44	60	73	91	97	
	13	40	55	68	80	86	94
	9	40	59	70	74	80	82
	13	40	67	67	75	92	96
	16	42	59	70	79	86	88
	22	47	63	74	82	88	
	15	33	51	64	73	81	91
	9	33	45	68	82	96	105
Totals	372	1021	1494	1837	2092	2300	1685
Means	14.3	39.3	57.5	70.7	80.5	88.5	93.6

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