FISHERIES RESEARCH BOARD OF CANADA

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 408

Title

Observations on and Attempts to Control the Greater Clam Drill (Polinices heros).

Author

L. W. Thurber

(Revised by J. C. Medcof)

1949

TABLE OF CONTENTS

FOREWORD

This report is the second of two submitted by the writer on work carried out under Dr. J. C. Medcof's direction at the Atlantic Biological Station in the summer months of 1949.

The introduction to the first report "Meat Yield of Clams (Mya) and Percentage Total Dry Solids of Clam Meats", F.R.B. Ms. Rep. Biol. Stn. No. 399, summarizes the summer program as a whole and acknowledges the writer's indebtedness to assistants in the Polinices study.

Observations on and attempts to control the greater clam drill, Polinices heros.

INTRODUCTION

Since clam drills (Polinices) have been shown to be highly destructive of soft-shelled clams (Mya arenaria) several tests have been designed to measure their destructive capacity and efforts have been made to discover some means of controlling their numbers. In 1946 R. H. Stinson suggested it might be relatively easy to reduce their abundance by occasional systematic collections of the egg collars and adult snails. Since then these methods have been applied experimentally to P. triseriata (Wheatley, 1947, Larocque, 1948, Giglioli, 1949) at Belliveau Cove, Nova Scotia, and this year the writer conducted experiments with P. heros at Holt's Point, N.B., to measure the value of manual collection of adult snails as a means of improving the survival of clams.

Besides this some observations were made on the snail's behaviour and on the size-frequency composition of the Holt's Point snail population.

AREA

Holt's Point (Fig. 1) was chosen because of the abundance of P. heros and the absence of P. triseriata and the remarkable uniformity of the sandy part of the intertidal beach both as respects beach level and soil texture. The sand flat is bounded on three sides by a stoney shore which has a slope of about 140°. The stones are bare at upper levels but thickly overgrown with rockweed (Fucus) at lower levels. On the eastern side close to the sandy flat they also support a dense bed of common mussels.

Trial plantings of seed clams made here by Medcof and MacPhail in the sand in 1948 showed heavy mortality from clam drills and night surveys showed that the drills had a reasonably uniform distribution although more abundant towards the mussel bed than on the rest of the flat.

The flat has the disadvantage of being so low that it is not exposed at all at neap tides (higher than 2 to 3 feet above datum) and is exposed for only short periods (2 to 3 hours) at spring tides. This restricted the working program because the flats must be exposed for observations of the sort conducted in 1949.

DESIGN OF EXPERIMENT

The experiment was designed to show primarily how effective manual collection of snails could be in improving the survival of seed clams artificially planted in the area. Four square plots A, B, C and D, each 50 x 50' were marked out with wooden stakes as shown in Figure 1. In the centre of three of these a 10 x 10' square was uniformly planted with seed clams. The fourth was left blank. The plots received the following treatments (see Fig. 1):

A. was cleared of all apparent snails before clams were planted and every time the plot was visited all the snails that could be found in the whole 50 x 50' plot were picked up, counted and destroyed.

B. was cleared of all apparent snails before clams were planted and at each subsequent visit all the snails that could be found inside the 10 x 10' area were picked up, counted and replaced.

C. was planted with clams without altering the snail populations but at each visit counts were made of the snails found in the whole plot and a separate count of those in the 10 x 10' part of it.

D. was used purely as a control area. Counts were made of the number of snails apparent at each visit.

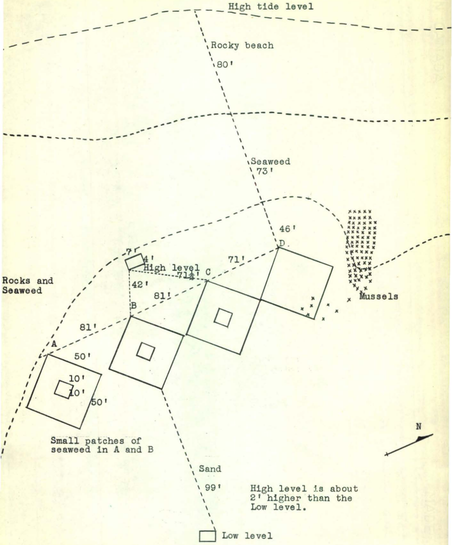
It was hoped that comparisons of clam survivals in plots A - C after a period of observation would show the effect of manual collection of drills and comparisons of snail counts in plots A - C and D would give some idea about the speed with which drills move about discovering prey.

Besides these 4 plots 2 others approximately 4 x 7' were set up on July 1 - one at a high and another at a low level on the beach (Fig. 1). These were stocked with seed clams in the same way as the centres of plots A - C but the total numbers planted were less (Table 3). No counts were made of the numbers of snails in these plots and these were not disturbed in any way until they were dug on July 13 and 14. The purpose of including these plots was to learn: (1) the rate of destruction at different beach levels and (2) what effects the disturbance involved in counting of snails in plots A - C had on the destruction being wrought by them.

PROCEDURE

1. Comparisons of plots and of methods of clearing: In order to compare the snail populations in the several plots before the experiment began surface counts were made on June 27. The results appear in Table 1 and suggest that the population density in B and C is

Figure I. Plan of Experimental Area at Holt's Point



roughly the same and only half that in A and D.

Four more visits were made to the plots before the clams were planted (Table 1). At these times snails were removed from A and B. This removal makes direct comparison of the original populations of plots A and B with C and D difficult but the first two sets of counts accord very well with those of June 27. The total collection from A, 1432 snails, indicates that its snail population was about 1½ times that in plot B when only 1036 snails were gathered.

A third check was made of the relative densities of population in plots C and D by intensive work on four randomly chosen 3' x 3' areas within each. At the same time the efficiencies of different methods of clearing were compared. A surface count was made in each, first of all, and the observed snails removed. Following this some plots were raked with a garden rake, others cultivated with a hand cultivator. All the snails found in these treatments were counted and removed. Finally all the soil in the areas to a depth of 6", was screened through ¼" wire mesh and the catch of snails in each area recorded. The results appear in table 2.

Of the total of 45 snails recovered by various means from the upper 6" of the 72 square feet of beach surface studied, only 4 (10%) were found on the surface. In the 4 raked plots which yielded a total of 25 snails, 22 (90%) were removed by combined surface picking and raking. In the 4 cultivated plots which yielded a total of 20 snails, 12 (60%) were recovered by surface picking and cultivating combined.

From this it may be concluded that surface picking is not an efficient method of cleaning an area. Picking and cultivating is better and picking and raking is still better. However, none of these combinations is as effective as screening.

Equal effort was spent on equal areas in each plot but plot C areas yielded 16 snails (0.4 snails per sq.') whereas plot D areas yielded 29 (0.8 snails per sq.') - roughly twice as many. This comparison of the two plots accords well with that of June 27.

Besides this two 10' x 10' areas in plot C were raked on July 12th at 7:00 - 8:30 a.m. after a surface count which turned out to be one in each case. These animals were removed. By raking one area yielded 41 more snails and the other 22 more. There is therefore much within-plot variation in population density but the mean estimate for plot C (0.3 snails per sq.') when corrected to allow for raking efficiency (90% that of screening) turns out to be 0.4 per sq' - the same as that based on screenings of the four 3' x 3' areas in plot C.

To summarize it appears that the original snail populations in B and C were about the same - roughly 0.4 per sq.' in the upper 6" of soil. D plot had approximately double this number and A about 1½ times.

2. Clearing: Preliminary clearing of plots A and B was carried out after June 27 by two methods - picking and raking. All exposed snails were first picked into a bucket. After this garden rakes were used to expose snails that were near the surface and these too were picked up and destroyed. The recovery of 1036 snails from plot B and 1432 from plot A suggests that the estimates of the original stocks were reasonably good. These were 1000 and 1500 respectively.

3. Planting of seed clams 1½ - 2" long obtained from the Pottery Bridge flat at 16 per square foot was done through a 2' x 3' planting frame strung in two directions with cod line at three-inch intervals to give 16 squares per sq.'. The beach soil was loosened with a hand cultivator before planting. The clams were out of water for only a few hours between digging and planting and the stock was carefully culled to avoid damaged specimens. Examination of the plots at the low tide following planting suggested that the survival was so high that for practical purposes it could be considered 100%.

4. Counting snails: Preparatory to counting either by day or by night a cod line marking the perimeter of the plot to be counted was tied to the four corner stakes then the ground was covered in strips. To avoid overlapping and incomplete coverage one end of a five-foot stick was carried in one hand and the other end allowed to drag on the beach making a mark indicating the margin of the area already covered. This was especially useful at night when the work was done with the aid of a flashlight.

As long as any part of a snail was exposed above the beach surface it was counted. To avoid errors in counting all snails seen were gathered into a bucket and counted after the whole plot had been covered. Depending on which plot was involved the collected animals were either destroyed or returned to the plot from which they came. In several instances interest in discovering the speed with which snails migrate into areas prompted separate recording of the numbers of snails in the plots as a whole and in their 10 x 10' areas planted with clams. The results appear in Table 1. In some cases (e.g. Plot C) the numbers of snails cleared and replaced exceeded those counted on the surface. This was because some snails whose positions showed up because of the lump they made on the sand were gathered up with those that were exposed on the surface.

The preliminary clearing involved the removal of approximately 0.5 snails from every square foot of plots A and B. That is, nearly all the snails that could have been screened from the upper 6" of the soil. This, however, did not interfere with the appearance of large numbers inside the plots subsequent to planting.

It seems that close to 4000 others entered plot A in the next 12 days (Table 1) keeping the daytime surface counts of the plot as a whole, at about the same level as before clearing and of its 10 x 10' area four to five times higher than before clearing in spite of the steady collecting efforts to keep these counts down. This apparently means that snails were entering the plot at a rate of about 350 per day.

Plots B and C seem to have suffered similar immigrations. One might judge from Table 1 that their snail populations were quadrupled during the twelve-day experiment.

A comparison of the numbers of snails in the plots as a whole and in the 10 x 10' plots before and after planting and of the relative numbers in plot D and in plots A - C before and after planting suggests that the snails move about a good deal and that once they have found a supply of food they stay there. Whether they are attracted by the clams or merely encounter them in the course of their extensive wandering is hard to say.

The night emergence is roughly 3 - 6 times the day emergence.

SURVIVAL ESTIMATES

On July 13 and 14, twelve days after the experiment was set up, the 10 x 10' squares inside plots A - C were carefully dug over with clam hoes and all living clams and empty shells from each plot separately collected and brought to the Biological Station for counting.

The results of the counts appear in Table 3. These show that clam survivals were low in all plots. When no effort at all was made to remove snails about 20% of the clams survived for 12 days. Systematic clearing of the plot before planting improved survival by about 1½ times and preliminary clearing plus regular subsequent clearing improved this slightly. Because of the original differences in the snail populations of the three plots it is difficult to make more precise statements as to the effects of the clearing. In spite of this one cannot escape the conclusion that the effort required to protect clams by manual collection of drills is so great that the slight advantage it provides could never be worthwhile as a practical measure for increasing the production of clams from naturally-produced or articicially-planted beds. The animals would have to be gathered every day from populated areas because they stream in from outside.

The "high" and "low" plots (Table 3) which were never disturbed at any time during the experiment showed even poorer survival than A - C. This suggests that the disturbance involved in the counting interfered with the snails' destructive work. The results also suggest that the lower beach levels are safer (survival 21%) for clams than the upper (survival 11%). Medcof and MacPhail's 1948 experiment indicated that the reverse is true. The writer cannot account for the discord.

There were several instances in which the shells showed the beginning of drill holes. These are described as "attacked" in Table 3. "Dead" shells that showed no signs of drilling were described as "not attacked". This is possibly an erroneous description in some and possibly in most cases because the snails are known to destroy clams without drilling the shells. The writer is inclined to the view that there may have been a small "planting mortality" but that this was negligible (less than 10% of the total mortality). In any case it is reasonable to assume that planting mortality would have been the same in all plots and therefore impertinent to the principal conclusions of our study which are based on comparisons between plots.

The unusually low figures listed in Table 3 in the column "Total recovery, dead and alive" apparently result from the drill's feeding habits. They burrow into the sand to seize their prey then bring them up to or near the surface to feed on them. At this level the shells of dead animals are easily washed out by wave action and large numbers were thus carried away from the plot and widely strewn about the beach. There was no evidence that important numbers of living clams were carried out of the area in this way. For this reason the low total recoveries are not considered significant in the interpretation of the results.

In this discussion of the results no allowance has been made for the numbers of living clams that were overlooked in the digging of the plots. Observations by MacPhail in 1947 showed that in similar soils at Petpeswick his digging efficiency was 80 - 90%. Even if allowance is made for this the general picture of poor survival is not altered and the conclusions as to the value of collecting snails are not altered at all.

MISCELLANEOUS OBSERVATIONS

1. Size Composition of Snail Population: The shell heights of the snails in one day's and one night's collection were measured (Table 4). These collections may not be considered as truly representative of the population as is clear from the fact the day and night collections show considerable differences in size composition. In spite of this the data exhibit certain features that are worth mention.

The distribution is uni-modal the mode falling at about 30 mm. in the night collection and about 27 in the day collection. In the writer's opinion there are several year classes represented in the population. Had the sexes been separately measured within-sex size classes might have been apparent because Stinson showed that this was the case in P. triseriata. Sexual dimorphian is probably responsible in part for the unimodal distribution.

The night collections contained relatively more small specimens than the day. This probably resulted from the snail's nocturnal habits. They present a larger and brighter target when they extrude the foot and crawl about at night than during the day when the white foot is withdrawn and only the small and sand-coloured shell is apparent.

The smallest snails found were 13 mm. high and, judging from the appearance of their shells, several years old. Somewhere there must be large numbers of juvenile snails to maintain the population of adults found on the sand beach. We have no idea where this nursery ground is but the writer is confident that it is not on the sand beach itself. This peculiar absence of young snails of this species was also noted by Stinson at Belliveau Cove, N.S. It may have been this circumstance which led early students to mistake the smaller P. triseriata for the young of P. heros.

There are few snails more than 40 mm. high at Holt's Point which is surprising because in the Gulf of St. Lawrence area they attain a height of 80 to 90 mm.

2. Drilling Time: Some conception of the drilling time might be had from the work on plot A. For present purposes it may be assumed that all the snails were removed preliminary to planting. Records show that thereafter 350 snails moved in each day and were removed and that after 12 days 970 clams (66% of 1476) were destroyed. In other words as a result of 4200 (i.e. 350 x 12) snail-days 970 clams were destroyed or 1 clam per snail every 4 to 5 days.

A more precise measure of drilling rate emerged from observations on a single pair of animals. A snail measuring roughly 76 mm. in height was discovered just after it had brought a 4" native clam to the surface of the flat at Holt's Point on July 6. The two were brought to the station and placed in one of the basement tanks. The snail immediately attacked the clam again and held it constantly in its foot until July 12. The released shell was perfectly empty and was perforated by a single hole 9 mm. in diameter. The animals were not disturbed in any way during this six-day period.

These rough estimates of destructive capacity and drilling time at this time of year are open to criticism because both presumably involved snails that were hungry and in search of food and because the animals were disturbed during feeding. If there is any considerable rest period between successive feedings or slowing down because of disturbance these estimates could scarcely be representative.

3. Egg-collar Formation Without Sand: In June several snails from Holt's Point, including 29 females, were placed in the large basement tanks of flowing salt water. Most of these failed to produce collars in the course of the next two and a half months, although most of them were in spawning condition when collected, i.e. they were extruding jelly as described by Giglioli (1949).

Six sandless collars were formed. All were small and irregular in various ways. The size and arrangement of the capsules was atypical and the numbers of eggs per capsule were also most variable. They are described by Giglioli.

4. Method of Feeding: The extruded proboscis of the snail was often observed by pulling snails quickly off the clams they were feeding on. Frequently it had a pinkish colour especially at the free end and the end was sometimes dislocated so that it stuck in the drill hole and resulted in breakage of the proboscis.

The length of the proboscis is considerable. It should be quite easy for a snail to reach all parts of the meat inside the shells of clams of the size they regularly attack (Stinson, 1946) because the hole is usually about the middle of the shell. There might be some difficulty in clearing all the meat when the snail attacks from foot end of the clam as Wheatley describes.

5. Emergence Time: Snails were observed on the flats at Holt's Point at all times of the day and night and seem to lack the strictly nocturnal habits of P. triseriata as described by workers in that area. They are nevertheless more abundant at the surface at night and seemed most abundant about midnight.

The numbers at the surface during the day in the areas planted with clams seemed higher than on unplanted areas even when allowance was made for their greater abundance in the plots. Apparently the presence of food and some other factors influence their reactions to light.

6. Methods of Shell Marking: In order to be able to identify animals being held in the tank or in the field, Mr. Giglioli wished to mark them. He dried their shells and applied red copper paint to some and red and black Volger's opaque inks to others and placed the animals in the basement tanks to see how well these markings persisted. After 2½ months the copper paint had disappeared, but both colours of ink marks were still bright. The red was the more conspicuous of the two.

SUMMARY

1. In the course of ten manual collections spread over a twelve-day period over 5000 clam drills were removed from a 50 x 50' plot in which a central 10 x 10' square had been planted with seed clams 16 per square foot.

2. Roughly 1500 of these were in the plot to begin with, the rest entered from outside at the rate of 350 per day.

3. In spite of clearing the plot preliminary to planting and almost daily subsequent clearing only 34% of the planted clams survived for 12 days. A second plot where only preliminary clearing was carried out and where the original snail population was only two thirds that in the first plot showed a survival of 31%. In a third plot where no clearing was done and where the original snail population was the same as in second plot the survival was 19%.

4. The conclusion to be drawn is that a small reduction in the rate of destruction of clam stocks can be effected by manual collection of adult snails but that the reduction is so slight and the effort involved so great that the device could never by considered practicable for the protection of naturally-producing or artificially-stocked beds.

5. The size composition of the snail population of the Holt's Point flat is peculiar in that small animals are absent. This same condition has been observed elsewhere.

6. This species can produce sand-less egg collars in aquaria but the arrangement of the capsules in these and the numbers of eggs per capsule are abnormal.

7. Picking up such snails as appear on the surface is a most inefficient means of clearing ground of clam drills; picking combined with hand-cultivating is better; picking combined with raking is still better but screening is the most effective means of all.

8. "Volgers" opaque ink (carbolic acid base) is a more effective marking fluid than copper paint when applied to the shells of snails because it stays on and retains its brightness.

9. The destructive capacity of drills was crudely estimated at one clam per drill every 4 to 5 days.

10. Polinices heros differs in its habits from Polinices triseriata at Belliveau Cove in not being strictly nocturnal.

11. The proboscis of snails feeding in clams is easy to observe if a snail is suddenly pulled off a clam it has drilled and is feeding on.

REFERENCES

Giglioli, M. E. C. Some observations on the biology of the whelks Polinices heros Say (1822) and Polinices triseriata Say (1826), at Belliveau Cove, Nova Scotia. Fish. Res. Bd. Can. Ms. Rep. Biol. Stn. 398, 1949.

Larocque, A. Polinices in Belliveau Cove. Ibid. No. 372, 1948.

Stinson, R. H. Observations on the natural history of clam drills (Polinices). Ibid. No. 383, 1946.

Wheatley, J. M. Investigations of Polinices and clams at Belliveau Cove, N.S. Ibid. No. 371, 1947.

Table 1. Surface counts and clearings of snails

I Preliminary to Planting Clams

Date	Time	PLOT A Surface Count Whole Plot	PLOT A Surface Count 10x10	PLOT A Removals Whole Plot	PLOT A Removals 10x10	PLOT B Surface Count Whole Plot	PLOT B Surface Count 10x10	PLOT B Collected Whole Plot	PLOT B Collected 10x10	PLOT C Surface Count Whole Plot	PLOT C Surface Count 10x10	PLOT C Cleared and Replaced Whole Plot	PLOT C Cleared and Replaced 10x10	PLOT D Surface Count Whole Plot
June 27	5-8 a.m.	41	2	-	-	30	0	-	-	29	1	-	-	85
	5:30-7:30 p.m.	83	7	-	-	-	-	-	-	11	0	-	-	68
June 28	6:30-9:30 a.m.	29	1	1076	-	11	0	-	-	14	1	-	-	37
June 29	7:00-10:00 a.m.	7	0	-	-	16	0	454	-	-	-	-	-	-
	6:00-9:30 p.m.	-	-	-	-	-	-	-	-	59	-	-	-	110
June 30	7:00-10:30 a.m.	27	7	226	-	18	0	267	-	27	-	-	-	37
July 1	8:30-11:00 a.m.	28	0	130	-	25	-	315	-	26	-	-	-	75
		Av. 36	Av. 4	Total 1432		Av. 20	Av. 0	Total 1036		Av. 28	Av. 1			Av. 69

Table 1, continued.

II After Planting Clams

Date	Time	PLOT A Surface Count Whole Plot	PLOT A Surface Count 10x10	PLOT A Removals Whole Plot	PLOT A Removals 10x10	PLOT B Surface Count Whole Plot	PLOT B Surface Count 10x10	PLOT B Collected Whole Plot	PLOT B Collected 10x10	PLOT C Surface Count Whole Plot	PLOT C Surface Count 10x10	PLOT C Cleared and Replaced Whole Plot	PLOT C Cleared and Replaced 10x10	PLOT D Surface Count Whole Plot
July 1-2	10:30p.m. -2:00a.m.	-	-	912	-	-	-	-	106	-	-	-	-	-
July 2	9:00-11:00 a.m.	-	-	281	110	-	-	-	-	-	-	-	-	-
July 4-5	11:00p.m. -2:00a.m.	-	-	1253	267	340	-	-	178	-	-	-	179	-
July 6	1:30-3:30 p.m.	29	13	235	72	48	14	-	85	80	19	-	89	68
July 8	3:30-5:00 a.m.	285	62	412	99	301	38	-	68	628	81	-	152	536
July 11	5:00-8:00 a.m.	58	14	426	56	93	18	-	53	134	26	-	87	46
	6:30-8:00 p.m.	-	-	-	-	33	15	-	51	45	22	-	91	33
July 12	6:45-8:30 a.m.	23	6	182	33	74	17	-	43	111	11	-	29	51
		Av. 89	Av. 24	Total 3701	Total 637	Av. 148	Av. 20		Total 584	Av. 200	Av. 32		Av. 105	Av. 147

Table 2. Results of counts taken on snails in 3 x 3' areas in experimental plots C and D. June 26, 1949.

Plot	Area Number	Surface Count	Raking	Cultivating	Screening
C	1	0	4	-	1
	2	0	-	6	2
	3	0	2	-	0
	4	0	-	1	0
D	1	1	4	-	1
	2	1	-	1	5
	3	2	8	-	2
	4	0	-	3	1
	Total	4	18	11	12

Grand Total = 45 snails

Table 3. Clams planted in and recovered from various plots.

		Recoveries								
		Alive				Dead				Total Recovery
Plot	Number Planted	Total Number	Total % of No. Planted	Attacked	Not Attacked	Total	Drilled	Attacked	Not Attacked	Dead & Alive
A	1476	504	34%	28	476	48	17	6	25	552
B	1476	454	31%	17	437	60	24	3	33	514
C	1476	286	19%	35	251	60	26	4	30	346
Low Plot	576	121	21%	17	104	43	30	2	11	164
High Plot	444	47	11%	2	45	42	30	0	12	61

Table 4. Size composition of snails taken in day (July 6) and night (July 4-5) collections.

Size in mm.	Day (Afternoon) Number	Night (Midnight) Number
13		1
14		1
15		1
16	1	1
17		1
18		2
19		10
20	2	11
21	1	16
22	4	20
23	8	21
24	10	28
25	17	24
26	17	36
27	11	21
28	16	31
29	20	34
30	15	28
31	15	27
32	14	18
33	17	20
34	17	13
35	12	22
36	11	9
37	8	11
38	7	4
39	6	4
40	1	1
41	2	1
42	1	
43	1	2
44		
45		1
46	1	
47		
48		
49		
50		
Total	234	420