THE COMMERCIALLY VALUABLE MUSSELS

OF THE GRAND RIVER IN MICHIGAN

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AMONG the rivers in Michigan, the Grand has always been a potentially productive source of mussels for the pearl button industry. Yet, few published records are available to give an historical account of the relative abundance and distribution of these animals in that stream. At a period of high production, Coker, Shira, Clark and Howard (1921) published a list of the mussels in the river and emphasized particularly the progressive increase in the number of species from its headwaters to its mouth. In 1940, van der Schalie made essentially the same kind of survey but included all of the major tributaries. Several minor differences in the results of these studies are attributed to changes in environment which came about in the generation that separates the published observations.

Some figures have been published (van der Schalie, 1938) to show the rapid decline of the mussels in Michigan during the nineteen-thirties. Depletion became more severe until it was deemed necessary for the Michigan Conservation Commission to declare a closed period of five years beginning January 1, 1944, in order to allow these animals to re-establish themselves naturally in the streams. Fortunately, this time for recuperation coincided with the years of war activity when few individuals had either the time or the incentive to engage in clamming operations. The report that follows represents the results of a survey undertaken for the Fish Division of the Michigan Department of Conservation to determine whether the abundance of mussels in the Grand River has increased as a result of the respite from exploitation.

The dredging was done largely by a professional clammer, Mr. Sheldon Meyers of Saranac, who was hired to work with the writer on this experimental clamming. He has successfully operated his "John-boat" and crow-foot bars on the area studied for a number of years prior to the closing order. His boat and gear (Figures 1 and 2) were in good condition and the equipment used consisted essentially of his 16-foot "John-boat" provided with a small outboard motor and two 18-foot crow-foot bars. The method of operation was to make a half-dozen hauls in the morning over about as many miles of stream bed. Mr. Louis Kahl, conservation officer stationed at Ionia, arranged to follow the boat by car until noon, when the boat was tied up for the day. This procedure allowed sufficient time to clean and label the material properly during the afternoon. With such a schedule it was possible to establish the

45 stations listed in the report. The splendid cooperation of Mr. Meyers and Mr. Kahl during the course of the field work is deeply appreciated.

Especial indebtedness to members of the staff of the Fish Division's Institute for Fisheries Research is acknowledged. The photographs of the samples were carefully made by Mr. William Cristanelli of that organization, who also prepared the map showing the stations along the river and the drawing reproduced in Fig. 1. To Mr. Cristanelli and others who contributed their time and efforts in furthering the work, the author wishes to express appreciation.

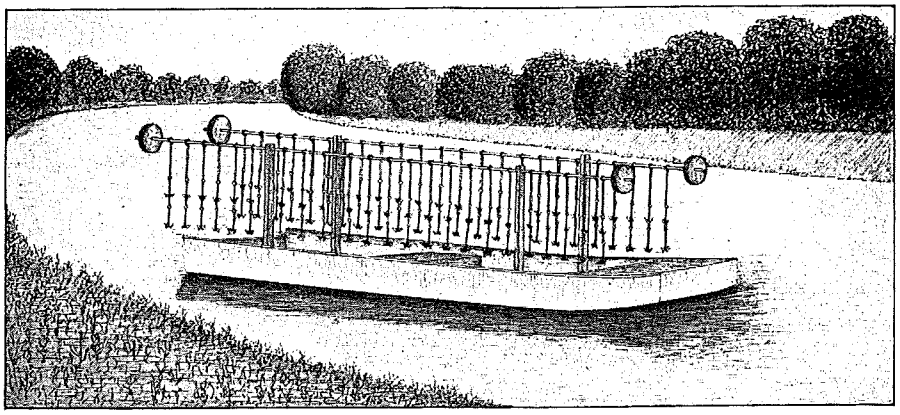

Figure 1.—Sketch of the "John-boat" and crow-foot bars used in making the 1945 Grand River mussel survey.

Originally, plans were made to study the beds by sampling quadrats, but the murkiness of the water in the Grand from below the mouth of Maple River on down to Grand Rapids made the quadrat method impractical. It is known that mussels are sensitive and respond positively to increased light intensities. Several workers have demonstrated reactions of this kind experimentally, but the significance of such behavior in nature is not properly known. At the time of this survey (early September, 1945) the water remained decidedly turbid with visibility extending not more than a few inches below the surface on a bright day. Since most of the mussels were taken at depths ranging from 5 to 20 feet, collecting by means of quadrats became impossible. The unusual amount of flocculent material in suspension at present is especially interesting when we note that Coker (1921) in a comparative table showed that Grand River was the least turbid among 13 productive rivers examined in 8 mid-western states.

The stations shown in Figure 3 are located on the most productive commercial mussel beds of the drainage. Relatively few stations were sampled in this very significant region in previous studies. The reason for this failure is perhaps to be traced to the fact that the zone considered is faunistically a

unit in that the population throughout is made up of practically the same assemblage of species. Minor differences are noticeable, however; for instance, Coker *et al.* (1921) reported *Proptera alata* in the river at Lowell. We failed to find this mussel, locally called the "Purple Heel-Splitter," but a suggested reason for its absence at present is furnished in the same report where Coker (*op. cit.*) stated that *P. alata* was found associated with an abundance of rooted vegetation. The apparent absence of aquatic plants at the present time may be the result of the failure of light to penetrate the turbid water, and the disappearance of rooted plants in turn may have caused the elimi-

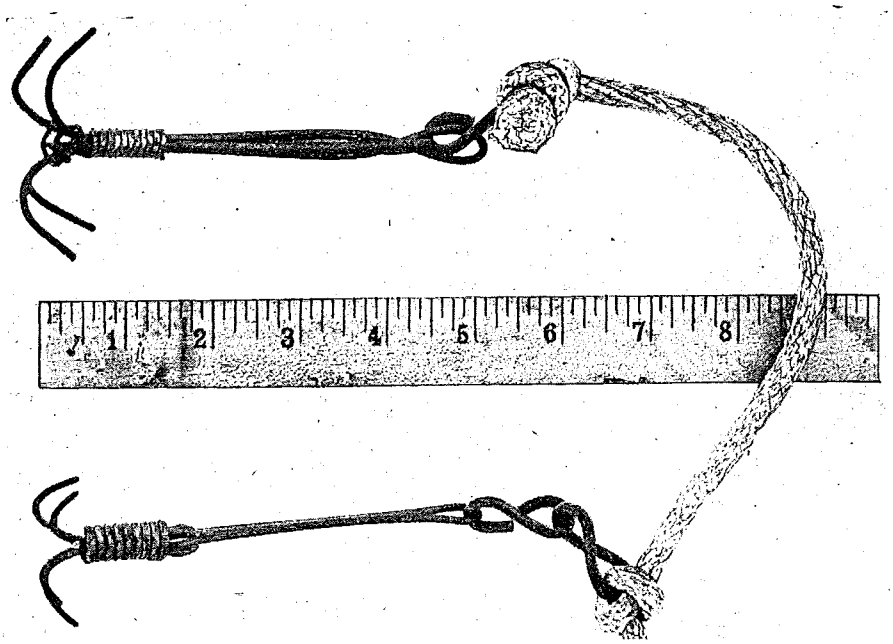

Figure 2.—Close-up of bar hooks showing size and method of construction.

nation of this species. However, with the exception of a few relatively unimportant commercial species, the fauna is strikingly uniform throughout the region investigated.

It is generally known that three of the species of mussels occurring in Michigan are considered to be of prime importance commercially: the Mucket[1], the Pocketbook[2], and the Three-Ridge[3]. Other species are suitable but considered on the basis of weight, the standard for measuring yield, they become less important. In order to present the information gathered by this survey in an objective way, the mussels taken at each station have been tabulated

[1]*Actinonaias carinata*
[2]*Lampsilis ventricosa*
[3]*Amblema costata*

in the order of their relative value for manufacturing buttons. The more important button-producing forms appear at the top of each list, and in addition a space is used to separate the useful ones from those not commercially important.

In summary, the following tables show that the 2,623 specimens collected had a total weight of about 741 pounds. Of this total, 1,966 specimens with a weight of 624 pounds represented material of value to the button industry. If the amount of time necessary for travelling the 55 miles (more or less) of river by boat is deducted and only the time actually spent at collecting is considered, then approximately 9½ hours were spent in accumulating about

Table 1.—Number of each species of mussels

Scientific and common name	STATION																					
	1	2	3	4	5	6	7	8	9	10	10a	11	12	13	14	15	16	17	18	19	20	21
Actinonaias carinata Mucket	1	1	6	4	8	13	5	19	12	19	2	10	10	16	8	11	1	37	6	6	26	7
Lampsilis ventricosa Pocketbook	12	3	3	5	8	9	6	10	5	...	3	7	7	15	....	4	....	9	18	2	11	1
Lampsilis siliquoidea Fat Mucket	1	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
Amblema costata Three Ridge	3	1	1	6	1	2	3	11	2	3	1	3	6	26	1	3	15	13	1	15	6	11
Quadrula pustulosa Warty-back	1	1	4	6	11	2	10	11	9	...	5	4	6	50	....	8	2	7	19	26	14	3
Quadrula quadrula Mapleleaf	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
Fusconaia flava Pig Toe	6	...	3	2	6	3	7	22	9	7	2	9	17	45	....	4	10	19	6	7	6	4
Pleur. c. coccineum Pig Toe	...	1	1	3	3	1	4	6	1	3	1	....	3	8	....	....	2	1	4	....	3	...
Total, commercial varieties	24	7	18	26	37	30	36	79	38	32	14	33	50	157	9	30	30	86	55	56	66	26
Actinonaias ellipsiformis Rainbow Shell	...	...	1	...	2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Alasmidonta marginata Floater	...	...	2	7	6	6	6	8	2	3	...	2	1	22	1	2	1	4	3	2	3	3
Anodonta grandis Floater	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...
Cyclonaias tuberculata Purple Warty-back	....	1	2	1	5	5	2	2	2	1	2	1	....	6	....	....	1	....	1	....	....	1
Elliptio dilatatus Lady-Finger	...	4	4	15	17	8	10	12	19	6	1	3	6	28	17	4	13	12	2	2	1	11
Lasmigona costata Fluted Shell	1	...	...	1	4	...	1	2	1	3	1	2	3	5	....	1	2	....	....	....	1	1
Lig. recta latissima Black Sand Shell	...	...	1	...	3	3	3	1	...	...	...	...	2	1	....	1	1	....	....	....	1	...
Micromya iris Rainbow Shell	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Strophitus rugosus Squaw Foot or Floater	...	1	1	3	2	...	1	...	1	1	...	1	2	6	....	....	....	....	....	1	....	1
GRAND TOTALS	25	13	29	53	76	52	59	105	63	46	59	42	64	228	27	38	49	102	61	61	72	43

600 pounds of marketable shells. If we assume that a clammer would receive $40 per ton for these mussels, it is evident that at the average yield a clammer could at present earn approximately $10 per day. Not only do the tables indicate that at least some of the beds have recuperated substantially but it was evident that at several stations it would be feasible to open the mussel shoals to clamming operations.

In order to give a better picture of the variation in the mussel assemblage from station to station (progressively downstream), photographs (Figs. 3-17) showing the populations at about a third of the stations are included with the statistics which follow.

collected at the several stations on the Grand River.

NUMBER

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
53	24	4	....	7	6	3	6	9	3	8	26	17	3	....	2	16	6	21	23	14	6	14	.....
2	2	2	....	....	5	6	3	1	2	1	....	2	....	....	3	5	1	....	1	2	....	1	.....
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	.....
6	12	16	13	....	6	....	13	8	12	3	5	6	1	4	15	5	8	12	3	9	3	12	3
....	3	16	16	10	27	14	12	20	7	....	7	4	6	1	21	12	9	7	9	22	8	8	4
....	....	....	....	....	....	....	1	....	....	....	....	2	1	....	....	5	2	4	1	6	4	7	6
....	7	18	15	2	8	6	10	8	6	1	1	8	4	3	32	7	6	10	5	20	12	8	5
1	1	....	2	1	11	1	5	6	2	1	....	3	2	1	2	1	1	2	2	3	....	4	1
62	49	56	46	20	63	30	50	52	32	14	39	42	17	9	75	51	33	56	45	76	33	54	19
....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	.....
2	3	1	....	3	2	1	....	3	1	....	2	1	....	....	5	4	....	6	1	1	....	3	.....
....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
1	1	....	....	3	1	1	1	....	1	....	2	2	....	....	1	4	....	4	6	1	2	4	1
2	8	3	2	9	10	3	7	8	....	1	3	9	1	....	6	10	14	24	8	6	3	29	2
....	....	1	....	....	....	....	....	....	....	1	....	....	....	....	1	....	....	1	....	1	1	1	.....
....	....	....	....	....	1	....	....	....	....	....	1	....	....	....	....	....	....	1	....	2	....	....	.....
....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
....	....	1	....	....	2	....	....	3	....	1	1	2	....	....	2	1	....	....	....	....	....	1	1
67	61	62	48	36	80	36	58	66	34	17	48	57	18	9	90	70	47	92	60	87	39	92	23

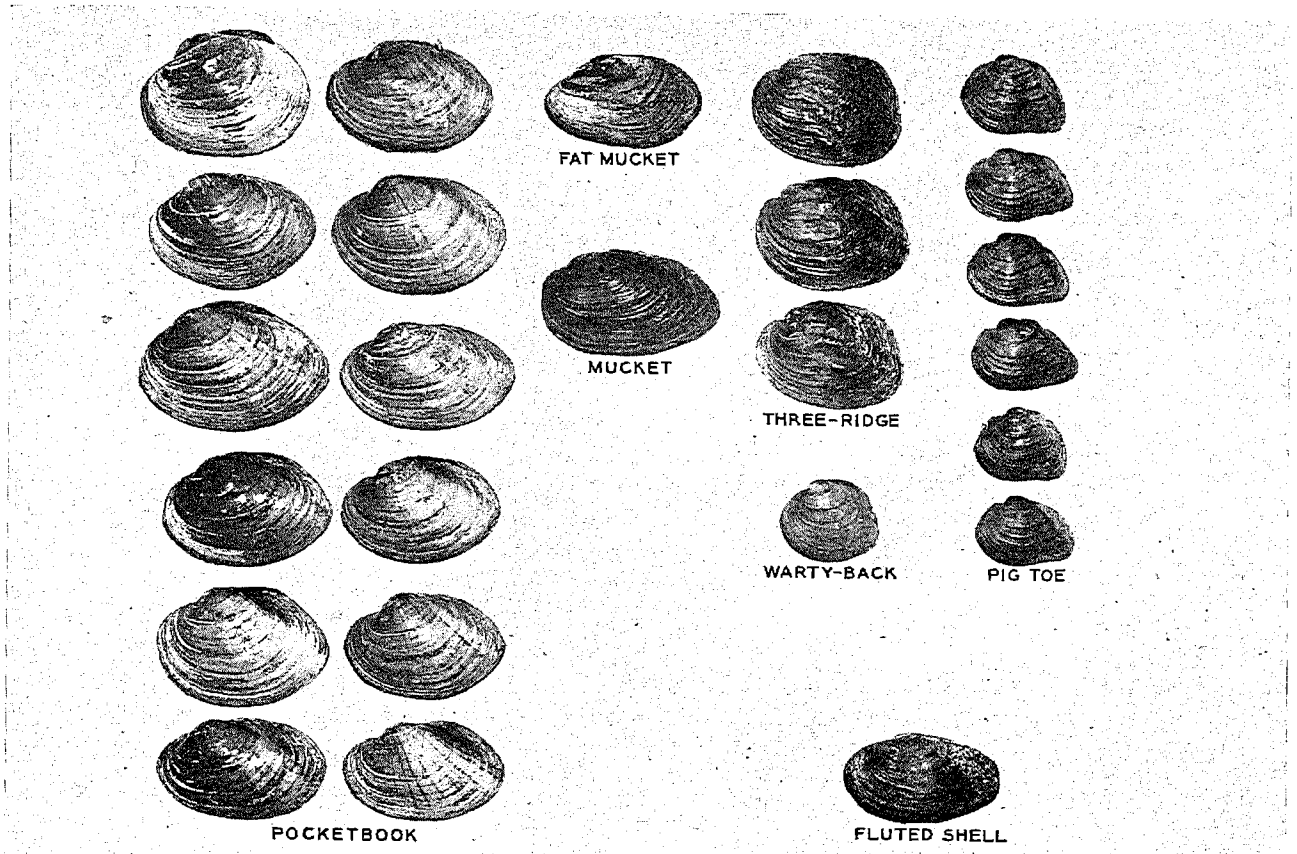

Figure 3.—Collection from Station 1. Apparently Pocketbooks are common and the proportion of good shells runs high, but the yield was relatively poor.

Table 2.—Detailed collection data by individual stations. Totals for the commercially valuable species are given followed by figures for non-commercial forms and grand totals.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 1				Single	2	15
Actinonaias carinata	1	0	9.0			
Lampsilis ventricosa	12	7	7.5			
Lampsilis siliquoidea	1	0	8.5			
Amblema costata	3	1	11.0			
Quadrula pustulosa	1	0	4.0			
Fusconaia flava	6	1	1.0			
Total Commercial Varieties	24	11	9.0			
Lasmigona costata	1	0	7.0			
Grand Total	25	12	0.0			
Station 2				Forking		10
Actinonaias carinata	1	0	5.0			
Lampsilis ventricosa	3	0	13.0			
Amblema costata	1	0	1.5			
Quadrula pustulosa	1	0	4.5			
Pleurobema c. coccineum	1	0	4.5			
Total Commercial Varieties	7	1	12.5			
Cyclonaias tuberculata	1	0	8.5			
Elliptio dilatatus	4	0	9.5			
Strophitus rugosus	1	0	2.0			
Grand Total	13	3	0.5			
Station 3				Single	2	20
Actinonaias carinata	6	2	12.5			
Lampsilis ventricosa	3	1	10.0			
Amblema costata	1	0	3.5			
Quadrula pustulosa	4	0	15.5			
Fusconaia flava	3	0	10.0			
Pleurobema c. coccineum	1	0	3.5			
Total Commercial Varieties	18	6	7.0			
Actinonaias ellipsiformis	1	0	2.5			
Alasmidonta marginata	2	0	4.0			
Cyclonaias tuberculata	4	0	8.5			
Ligumia recta latissima	1	0	10.0			
Strophitus rugosus	1	0	2.0			
Grand Total	29	8	14.5			

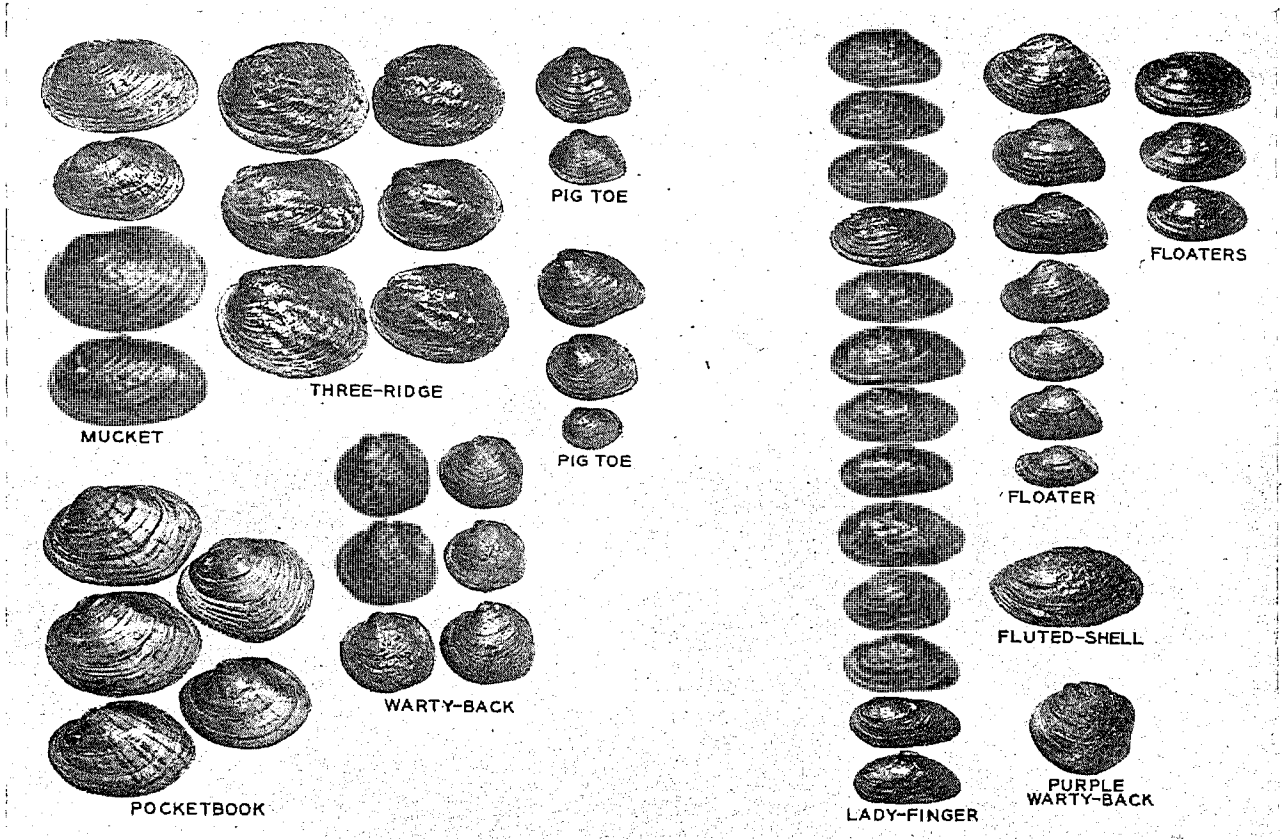

Figure 4.—Collection from Station 4. Although there is good proportion among the best button species, about half the yield here is made up of culls.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 4				Single	2	10
Actinonaias carinata	4	1	13.0			
Lampsilis ventricosa	5	2	1.0			
Amblema costata	6	3	9.0			
Quadrula pustulosa	6	1	9.5			
Fusconaia flava	2	0	5.0			
Pleurobema c. coccineum	3	0	7.5			
Total Commercial Varieties	26	9	13.0			
Alasmidonta marginata	7	0	12.0			
Cyclonaias tuberculata	1	0	5.5			
Elliptio dilatatus	15	2	3.5			
Lasmigona costata	1	0	6.5			
Strophitus rugosus	3	0	5.0			
Grand Total	53	11	13.5			
Station 5				Forking		30
Actinonaias carinata	8	4	1.0			
Lampsilis ventricosa	1	2	13.5			
Amblema costata	1	0	1.0			
Quadrula pustulosa	11	2	11.0			
Fusconaia flava	6	0	12.0			
Pleurobema c. coccineum	3	1	0.0			
Total Commercial Varieties	37	11	6.5			
Actinonaias ellipsiformis	2	0	4.0			
Alasmidonta marginata	6	0	13.0			
Cyclonaias tuberculata	5	1	10.0			
Elliptio dilatatus	17	2	7.0			
Lasmigona costata	4	1	15.0			
Ligumia recta latissima	3	2	0.0			
Strophitus rugosus	2	0	4.0			
Grand Total	76	20	11.5			
Station 6				Single	3	40
Actinonaias carinata	13	6	6.0			
Lampsilis ventricosa	9	2	14.0			
Amblema costata	2	0	11.0			
Quadrula pustulosa	2	0	5.5			
Fusconaia flava	3	0	7.0			
Pleurobema c. coccineum	1	0	4.0			
Total Commercial Varieties	30	10	15.5			
Alasmidonta marginata	6	0	11.0			
Cyclonaias tuberculata	5	1	2.0			
Elliptio dilatatus	8	1	3.0			
Ligumia recta latissima	3	1	9.5			
Grand Total	52	15	9.0			

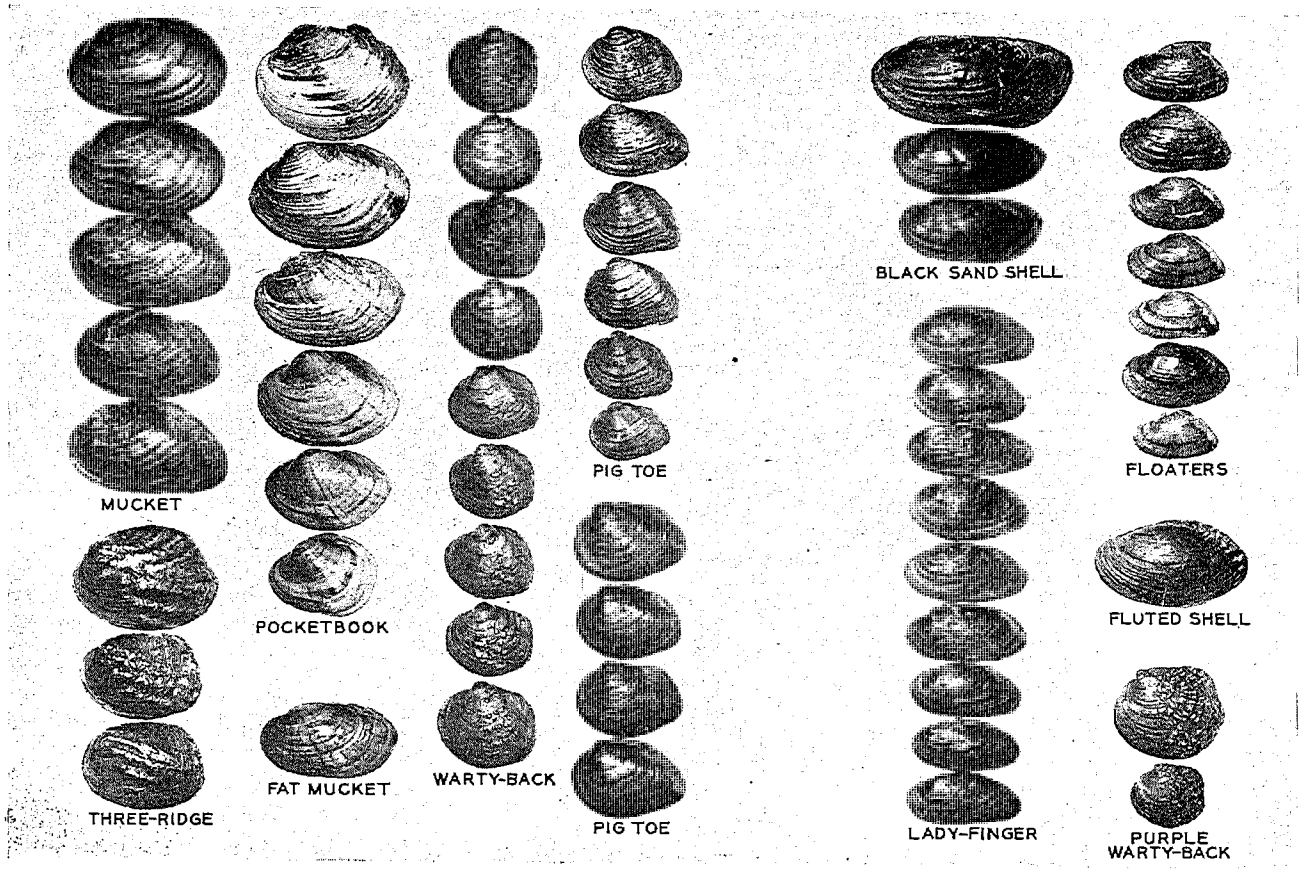

Figure 5.—Collection from Station 7. The proportions of good button material and the yield are relatively high on this shoal.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 7				Double	1	10
Actinonaias carinata	5	2	7.0			
Lampsilis ventricosa	6	2	9.0			
Lampsilis siliquoidea	1	0	5.0			
Amblema costata	3	1	4.0			
Quadrula pustulosa	10	2	7.0			
Fusconaia flava	7	1	3.0			
Pleurobema c. coccineum	4	1	0.0			
Total Commercial Varieties	36	11	3.0			
Lasmigona costata	1	0	6.0			
Ligumia recta latissima	3	1	2.0			
Elliptio dilatatus	10	1	5.0			
Cyclonaias tuberculata	2	0	8.0			
Alasmidonta marginata	6	0	7.0			
Strophitus rugosus	1	0	2.0			
Grand Total	59	15	1.0			
Station 8				Double	1	10
Actinonaias carinata	19	9	10.0			
Lampsilis ventricosa	10	3	2.0			
Amblema costata	11	5	14.0			
Quadrula pustulosa	11	2	7.0			
Fusconaia flava	22	3	6.0			
Pleurobema c. coccineum	6	1	12.0			
Total Commercial Varieties	79	26	3.0			
Actinonaias ellipsiformis	1	0	3.0			
Alasmidonta marginata	8	0	14.0			
Cyclonaias tuberculata	2	0	5.0			
Elliptio dilatatus	12	1	9.0			
Lasmigona costata	2	0	14.0			
Ligumia recta latissima	1	0	6.0			
Grand Total	105	30	6.0			
Station 9				Single	2	17
Actinonaias carinata	12	6	4.0			
Lampsilis ventricosa	5	1	9.0			
Amblema costata	2	0	10.0			
Quadrula pustulosa	9	2	3.0			
Fusconaia flava	9	1	4.0			
Pleurobema c. coccineum	1	0	3.0			
Total Commercial Varieties	38	12	1.0			
Alasmidonta marginata	2	0	4.0			
Cyclonaias tuberculata	2	0	11.0			
Elliptio dilatatus	19	2	5.0			
Lasmigona costata	1	0	4.0			
Strophitus rugosus	1	0	2.0			
Grand Total	63	15	11.0			

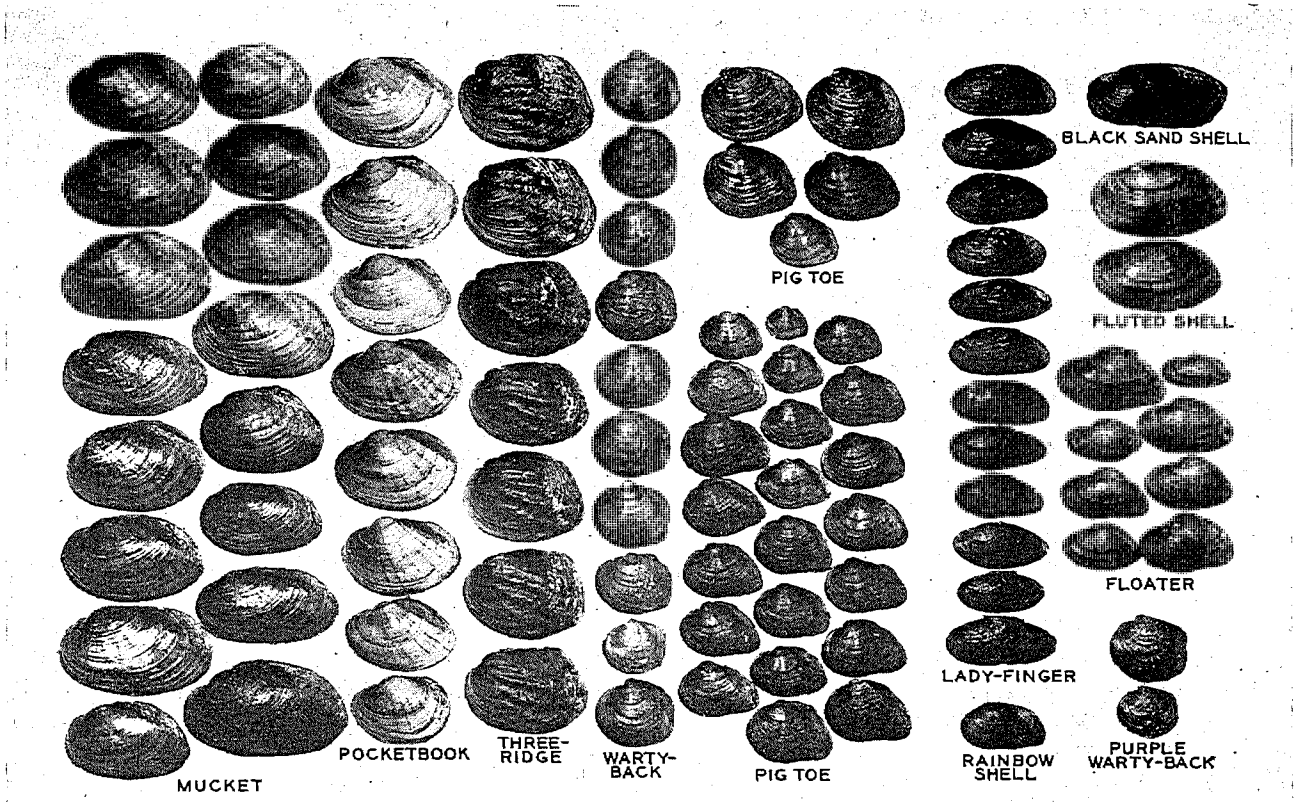

Figure 6.—Collection from Station 8. This assemblage is one of the best taken in the upper portion of the region collected.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 10				Single	2	15
Actinonaias carinata	19	10	8.0			
Amblema costata	3	1	7.0			
Fusconaia flava	7	1	1.0			
Pleurobema c. coccineum	3	0	10.0			
Total Commercial Varieties	32	13	10.0			
Alasmidonta marginata	3	0	5.0			
Cyclonaias tuberculata	1	0	2.0			
Elliptio dilatatus	6	0	10.0			
Lasmigona costata	3	1	6.0			
Strophitus rugosus	1	0	2.0			
Grand Total	46	16	3.0			
Station 10a				Single	1	5
Actinonaias carinata	2	0	13.0			
Lampsilis ventricosa	3	0	12.0			
Amblema costata	1	0	6.0			
Quadrula pustulosa	5	1	0.0			
Fusconaia flava	2	0	5.0			
Pluerobema c. coccineum	1	0	4.0			
Total Commercial Varieties	14	3	8.0			
Cyclonaias tuberculata	2	0	12.0			
Elliptio dilatatus	1	0	2.0			
Lasmigona costata	1	0	4.0			
Grand Total	18	4	10.0			
Station 11				Single	2	20
Actinonaias carinata	10	5	1.0			
Lampsilis ventricosa	7	2	5.0			
Amblema costata	3	1	3.0			
Quadrula pustulosa	4	0	15.0			
Fusconaia flava	9	1	13.0			
Total Commercial Varieties	33	11	5.0			
Alasmidonta marginata	2	0	4.0			
Cyclonaias tuberculata	1	0	5.0			
Elliptio dilatatus	3	0	6.0			
Lasmigona costata	2	0	12.0			
Strophitus rugosus	1	0	3.0			
Grand Total	42	13	3.0			

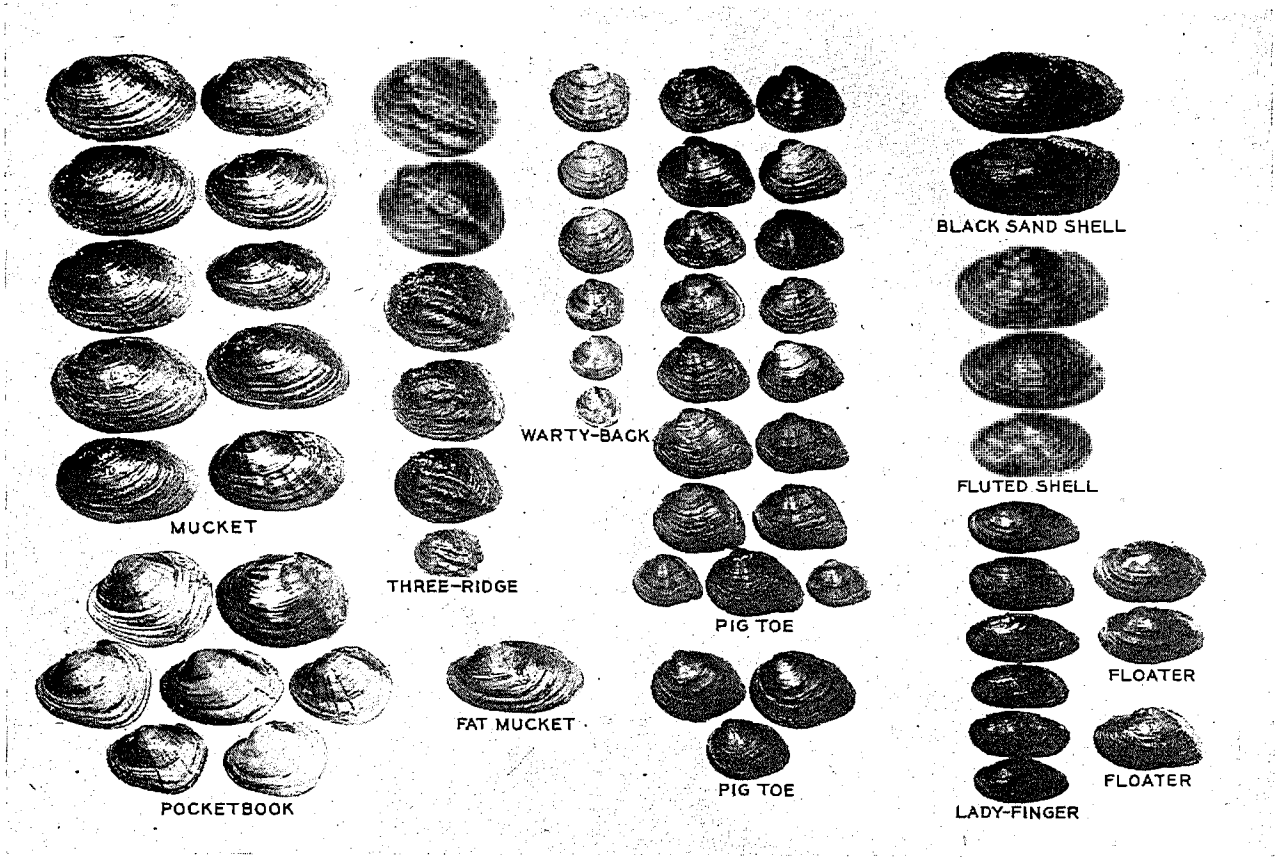

Figure 7.—Collection from Station 12. At this station the quantity is relatively good but the total weight indicates the bed needs more time for recuperation.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 12				1 Single 1 Double	2	15
Actinonaias carinata	10	4	4.5			
Lampsilis ventricosa	7	2	2.0			
Lampsilis siliquoidea	1	0	6.0			
Amblema costata	6	2	11.0			
Quadrula pustulosa	6	0	11.0			
Fusconaia flava	17	3	1.0			
Pleurobema c. coccineum	3	0	9.5			
Total Commercial Varieties	50	13	13.0			
Alasmidonta marginata	1	0	3.0			
Elliptio dilatatus	6	0	11.0			
Lasmigona costata	3	1	1.0			
Ligumia recta latissima	2	1	3.0			
Strophitus rugosus	2	0	3.5			
Grand Total	64	17	2.5			
Station 13				2 Single 1 Double	3	30
Actinonaias carinata	16	6	8.5			
Lampsilis ventricosa	15	1	5.0			
Amblema costata	26	10	0.5			
Quadrula pustulosa	50	8	9.5			
Fusconaia flava	45	6	1.0			
Pleurobema c. coccineum	8	1	10.0			
Total Commercial Varieties	160	34	2.5			
Alasmidonta marginata	22	1	12.5			
Cyclonaias tuberculata	6	1	8.0			
Elliptio dilatatus	28	3	6.0			
Lasmigona costata	5	1	7.5			
Ligumia recta latissima	1	0	4.0			
Strophitus rugosus	6	1	8.0			
Grand Total	228	44	0.5			
Station 14				Single	1	5
Actinonaias carinata	8	3	1.5			
Amblema costata	1	0	5.0			
Total Commercial Varieties	9	3	6.5			
Alasmidonta marginata	1	0	2.0			
Elliptio dilatatus	17	2	0.0			
Grand Total	27	5	8.5			

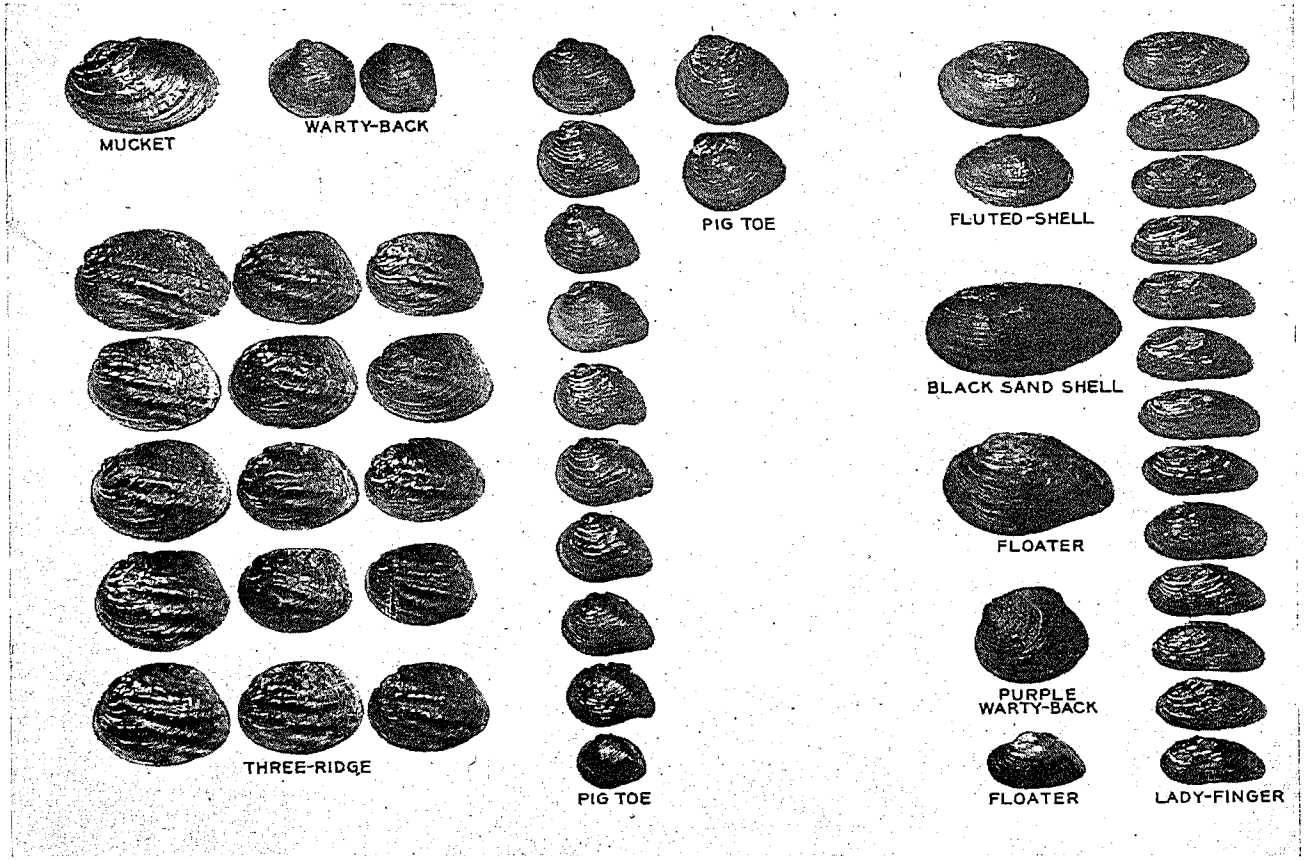

Figure 8.—Collection from Station 16. The number of Three-Ridge mussels is too high at this station and the total weight of good button shells too low.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 15				Double	1	5
Actinonaias carinata	11	5	4.0			
Lampsilis ventricosa	4	1	6.0			
Amblema costata	3	1	1.0			
Quadrula pustulosa	8	1	13.0			
Fusconaia flava	4	0	11.0			
Total Commercial Varieties	30	10	3.0			
Alasmidonta marginata	2	0	4.0			
Elliptio dilatatus	4	0	9.0			
Lasmigona costata	1	0	6.0			
Ligumia recta latissima	1	0	11.0			
Grand Total	38	12	1.0			
Station 16				Double	1	8
Actinonaias carinata	1	0	5.0			
Amblema costata	15	6	12.0			
Quadrula pustulosa	2	0	5.0			
Fusconaia flava	10	1	15.0			
Pleurobema c. coccineum	2	0	8.0			
Total Commercial Varieties	30	9	13.0			
Alasmidonta marginata	1	0	1.0			
Anodonta grandis	1	0	7.0			
Cyclonaias tuberculata	1	0	5.0			
Elliptio dilatatus	13	1	9.0			
Lasmigona costata	2	0	9.0			
Ligumia recta latissima	1	0	13.0			
Grand Total	49	13	9.0			
Station 17				Double	1	10
Actinonaias carinata	37	19	12.0			
Lampsilis ventricosa	9	4	4.0			
Amblema costata	13	6	8.0			
Quadrula pustulosa	7	1	10.0			
Fusconaia flava	19	3	11.0			
Pleurobema c. coccineum	1	0	5.0			
Total Commercial Varieties	86	36	2.0			
Alasmidonta marginata	4	0	7.0			
Elliptio dilatatus	12	1	14.0			
Grand Total	102	38	7.0			

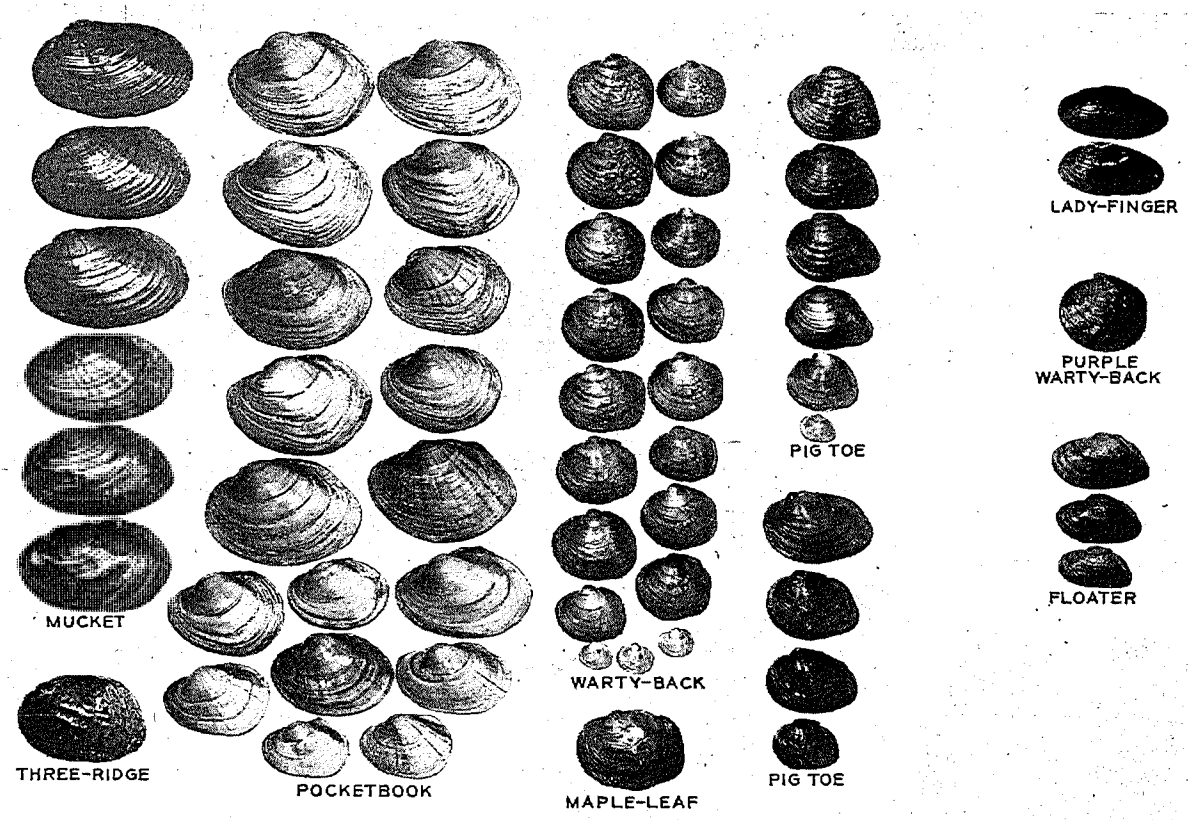

Figure 9.—Collection from Station 18. The number of Pocketbooks here is high but the specimens were not old enough to produce a proper yield.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 18				Double	1	7
Actinonaias carinata	6	3	11.0			
Lampsilis ventricosa	18	7	4.0			
Amblema costata	1	0	7.5			
Quadrula pustulosa	19	3	6.0			
Quadrula quadrula	1	0	6.0			
Fusconaia flava	6	1	2.0			
Pleurobema c. coccineum	4	0	13.5			
Total Commercial Varieties	55	17	2.0			
Alasmidonta marginata	3	0	3.5			
Cyclonaias tuberculata	1	0	4.5			
Elliptio dilatatus	2	0	4.5			
Grand Total	61	17	14.5			
Station 19				Double	1	10
Actinonaias carinata	6	2	14.0			
Lampsilis ventricosa	2	0	2.0			
Amblema costata	15	6	10.0			
Quadrula pustulosa	26	5	12.0			
Fusconaia flava	7	1	7.0			
Total Commercial Varieties	56	16	13.0			
Alasmidonta marginata	2	0	3.0			
Elliptio dilatatus	2	0	5.0			
Strophitus rugosus	1	0	3.0			
Grand Total	61	17	8.0			
Station 20				Double	1	10
Actinonaias carinata	26	12	7.0			
Lampsilis ventricosa	11	4	0.0			
Amblema costata	6	2	13.0			
Quadrula pustulosa	14	3	5.0			
Fusconaia flava	6	1	3.0			
Pleurobema c. coccineum	3	0	7.0			
Total Commercial Varieties	66	24	3.0			
Alasmidonta marginata	3	0	9.0			
Elliptio dilatatus	1	0	2.5			
Lasmigona costata	1	0	8.0			
Ligumia recta latissima	1	0	8.0			
Grand Total	72	25	14.5			

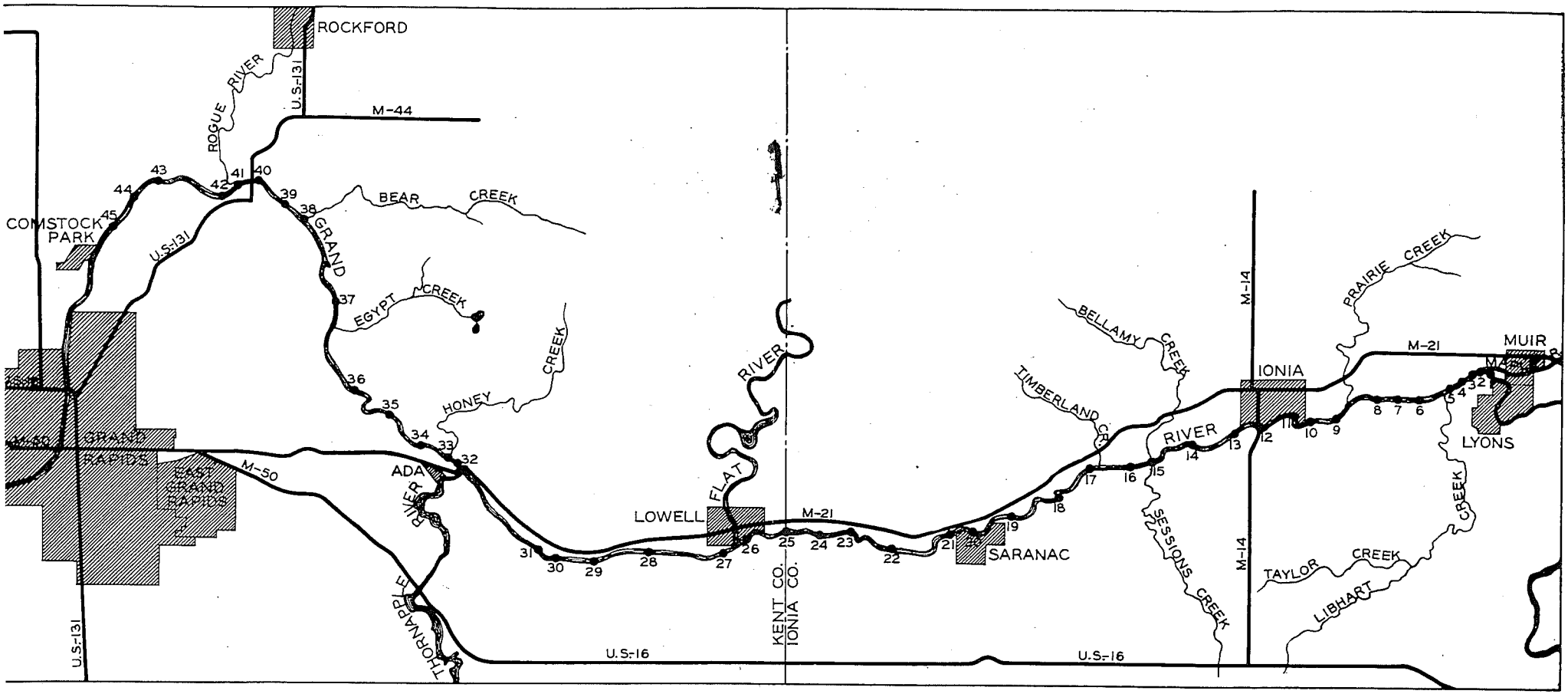

Figure 10.—Map[1] showing collecting stations established along the Grand River during the 1945 mussel survey.

1. Bend in River just below Lyons
2. At mouth of Maple River
3. ¼ mile below mouth of Maple River
4. ½ mile below mouth of Maple River
5. 1 mile below mouth of Maple River
6. 2 miles below mouth of Maple River
7. 3½ miles (by road) below Lyons
8. 6 miles (by road) below Lyons
9. Just below P.M. R.R. bridge
10. ¼ mile above Cleveland Street Bridge at Ionia

10a. ¼ mile below Cleveland Street Bridge at Ionia

11. Near Ionia Pottery Plant
12. Dexter Street Bridge, Ionia
13. ¼ mile below Fair Grounds, Ionia
14. ½ mile below Grand Trunk R.R. bridge, below Ionia
15. Near mouth of Bellamy Creek
16. Near Indiana Gravel Pit
17. About 3 miles above Saranac (by road)
18. About 2 miles above Saranac (by road); below "Stevenson's Riffles"
19. About ½ mile above Saranac (by road)
20. Just below bridge at Saranac
21. ½ mile below Saranac
22. About 2 miles below Saranac (by road)
23. About 3 miles below Saranac; at mouth of Hawn's Creek
24. About 1 mile above Ionia-Kent County line
25. At Ionia-Kent County line
26. Upper bridge at Lowell
27. ½ mile below Lower bridge at Lowell
28. About 2 miles below Lowell (by road)
29. About 3½ miles below Lowell (by road)
30. About 4½ miles below Lowell (by road)
31. About 5 miles below Lowell (by road)
32. At bridge at Ada
33. ¼ mile below bridge at Ada
34. 1 mile below bridge at Ada
35. 2 miles below bridge at Ada
36. 3 miles below bridge at Ada
37. ½ mile below Knapp Street Bridge
38. At mouth of Bear Creek
39. About 2½ miles above Plainfield (by road)
40. Just above Plainfield Bridge
41. Near mouth of Rogue River
42. About 1 mile below Plainfield Bridge
43. About 2½ miles below Plainfield Bridge (by road); "Belmont Clam Camp"
44. About 3 miles below Plainfield Bridge
45. 1 mile above Comstock Park; near "Target Range"

[1]Map compiled from General Highway County maps, issued 1940.

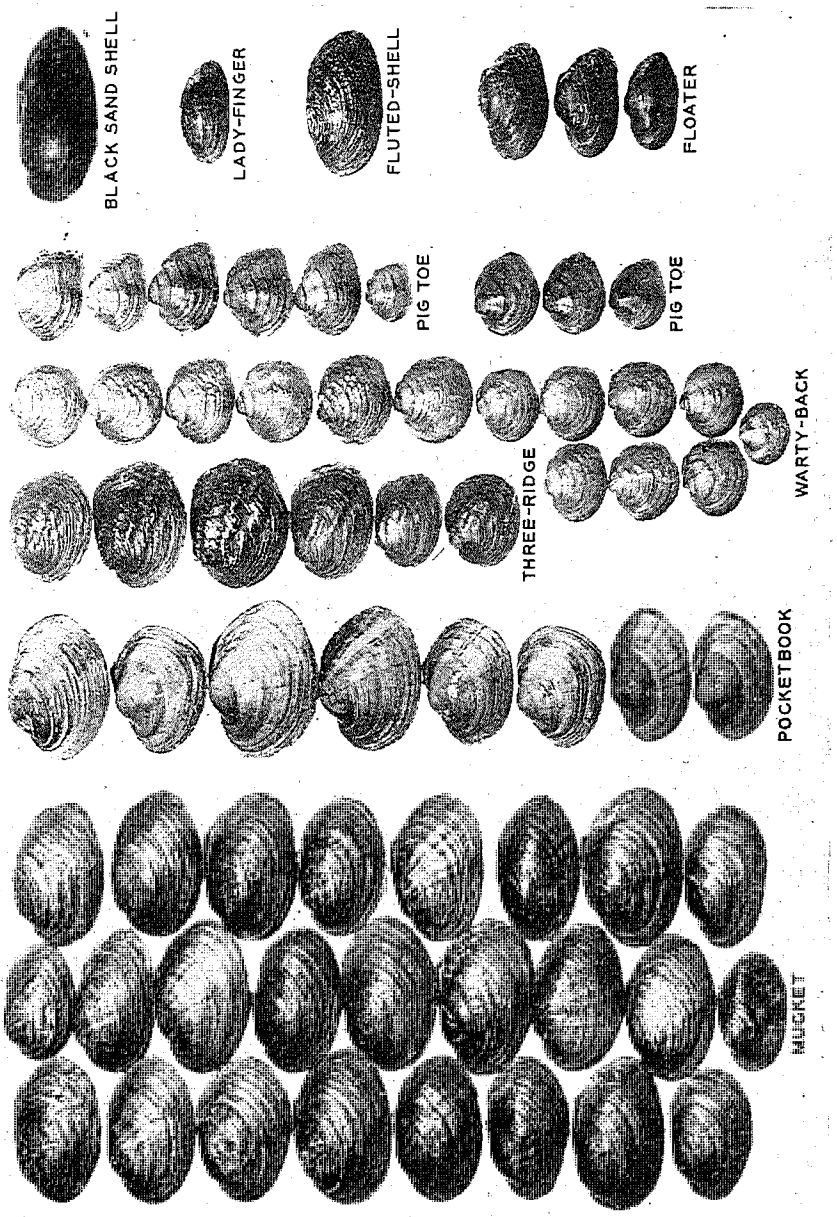

Figure 11.—Collection from Station 20. Production here is good with relatively few culls.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 21				Double	1	10
Actinonaias carinata	7	3	10.0			
Lampsilis ventricosa	1	0	3.5			
Amblema costata	11	5	3.5			
Quadrula pustulosa	3	0	13.0			
Fusconaia flava	4	0	11.0			
Total Commercial Varieties	26	10	9.0			
Alasmidonta marginata	3	0	7.0			
Cyclonaias tuberculata	1	0	4.5			
Elliptio dilatatus	11	1	10.0			
Lasmigona costata	1	0	12.0			
Strophitus rugosus	1	0	2.0			
Grand Total	43	13	12.5			
Station 22				Double	1	8
Actinonaias carinata	53	29	1.0			
Lampsilis ventricosa	2	1	6.0			
Amblema costata	6	2	10.0			
Pleurobema c. coccineum	1	0	3.5			
Total Commercial Varieties	62	33	4.5			
Alasmidonta marginata	2	0	3.0			
Cyclonaias tuberculata	1	0	7.0			
Elliptio dilatatus	2	0	5.5			
Grand Total	67	34	4.0			
Station 23				Double	1	7
Actinonaias carinata	24	13	2.0			
Lampsilis ventricosa	2	1	2.0			
Amblema costata	12	6	9.5			
Quadrula pustulosa	3	0	14.0			
Fusconaia flava	7	1	5.5			
Pleurobema c. coccineum	1	0	5.0			
Total Commercial Varieties	49	23	6.0			
Alasmidonta marginata	3	0	6.5			
Cyclonaias tuberculata	1	0	5.0			
Elliptio dilatatus	8	1	5.5			
Grand Total	61	25	7.0			

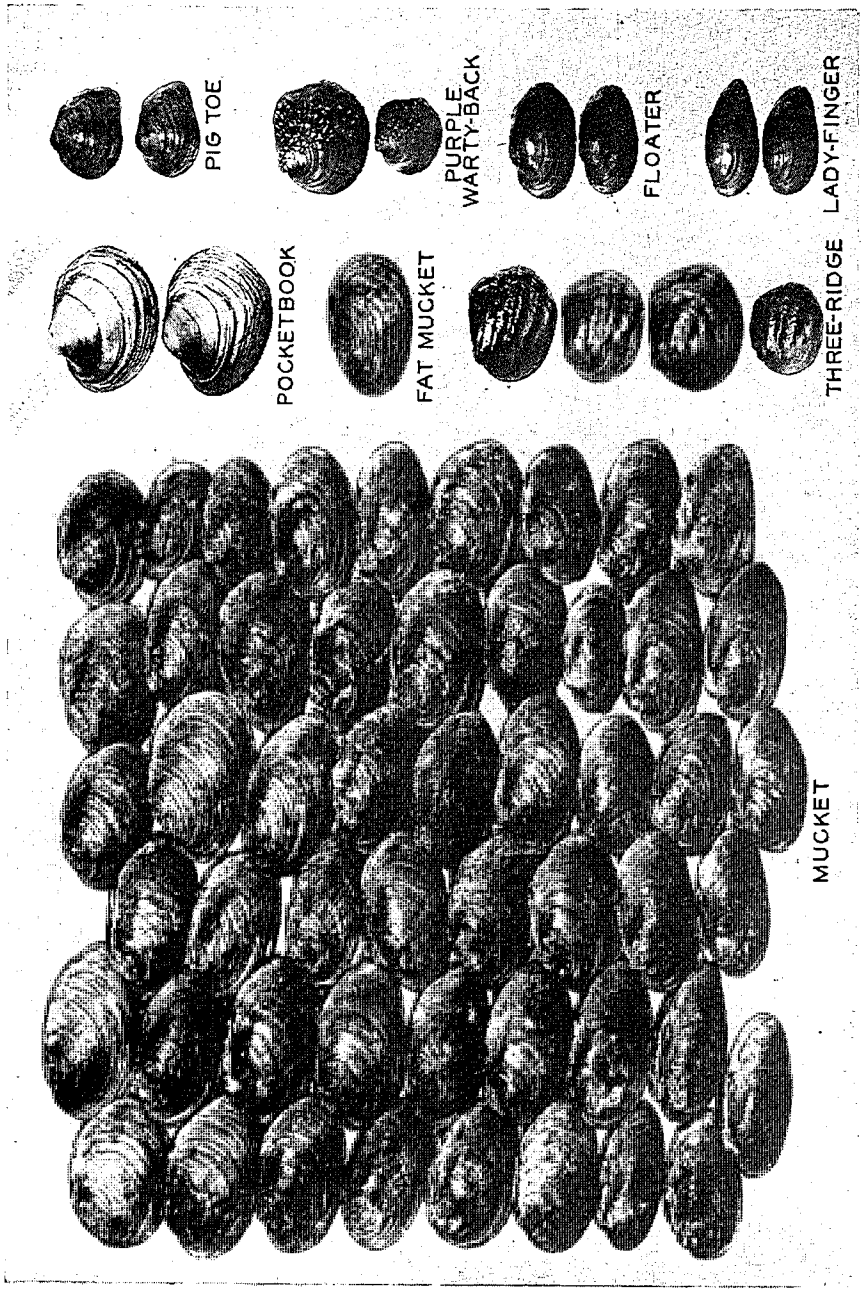

Figure 12.—Collection from Station 22. This shoal apparently produces the kind of shell a clammer dreams about.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 24				Double	1	9
Actinonaias carinata	4	2	6.0			
Lampsilis ventricosa	2	0	2.0			
Amblema costata	16	7	8.0			
Quadrula pustulosa	16	2	15.0			
Fusconaia flava	18	3	12.0			
Total Commercial Varieties	56	16	11.0			
Alasmidonta marginata	1	0	2.0			
Elliptio dilatatus	3	0	6.0			
Lasmigona costata	1	0	6.0			
Strophitus rugosus	1	0	2.0			
Grand Total	62	17	11.0			
Station 25				Double	1	8
Amblema costata	13	5	10.5			
Quadrula pustulosa	16	3	11.5			
Fusconaia flava	15	2	6.0			
Pleurobema c. coccineum	2	0	6.0			
Total Commercial Varieties	46	12	2.0			
Elliptio dilatatus	2	0	6.0			
Grand Total	48	12	8.0			
Station 26				Double	1	8
Actinonaias carinata	7	3	7.0			
Quadrula pustulosa	10	2	2.0			
Fusconaia flava	2	0	5.5			
Pleurobema c. coccineum	1	0	5.5			
Total Commercial Varieties	20	6	4.0			
Alasmidonta marginata	3	0	4.0			
Elliptio dilatatus	9	1	5.5			
Cyclonaias tuberculata	3	0	15.5			
Anodonta grandis	1	0	5.0			
Grand Total	36	9	2.0			

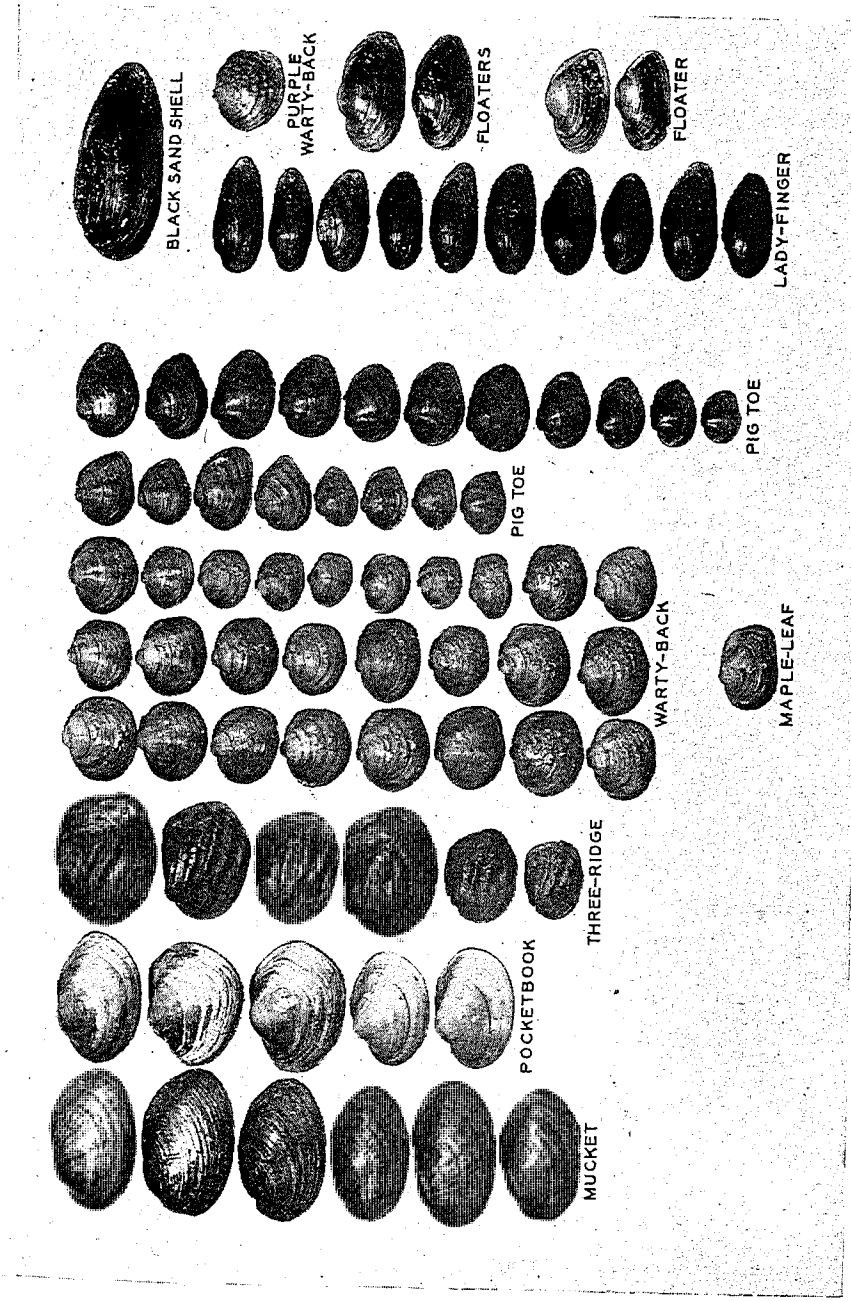

Figure 13.—Collection from Station 27. Small commercial species are numerous but the important large ones are too few at this station.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 27				Double	1	9
Actinonaias carinata	6	2	5.0			
Lampsilis ventricosa	5	1	11.0			
Amblema costata	6	2	7.0			
Quadrula pustulosa	27	4	8.0			
Quadrula quadrula	1	0	3.0			
Fusconaia flava	8	0	14.0			
Pleurobema c. coccineum	11	0	9.0			
Total Commercial Varieties	64	12	9.0			
Alasmidonta marginata	2	0	4.0			
Cyclonaias tuberculata	1	0	3.0			
Elliptio dilatatus	10	1	7.0			
Ligumia recta latissima	1	0	15.0			
Strophitus rugosus	2	0	5.0			
Grand Total	80	15	11.0			
Station 28				Double	1	6
Actinonaias carinata	3	1	3.0			
Lampsilis ventricosa	6	1	10.0			
Quadrula pustulosa	14	2	7.0			
Fusconaia flava	6	0	8.5			
Pleurobema c. coccineum	1	0	2.0			
Total Commercial Varieties	30	5	14.5			
Alasmidonta marginata	1	0	2.5			
Cyclonaias tuberculata	1	0	2.5			
Elliptio dilatatus	3	0	7.0			
Micromya iris	1	0	1.0			
Grand Total	36	6	11.5			
Station 29				Double	1	9
Actinonaias carinata	6	2	9.0			
Lampsilis ventricosa	3	1	1.5			
Amblema costata	13	5	5.5			
Quadrula pustulosa	12	2	5.0			
Quadrula quadrula	1	0	5.5			
Fusconaia flava	10	1	10.0			
Pleurobema c. coccineum	5	0	15.5			
Total Commercial Varieties	50	14	4.0			
Cyclonaias tuberculata	1	0	4.5			
Elliptio dilatatus	7	1	3.0			
Grand Total	58	15	11.5			

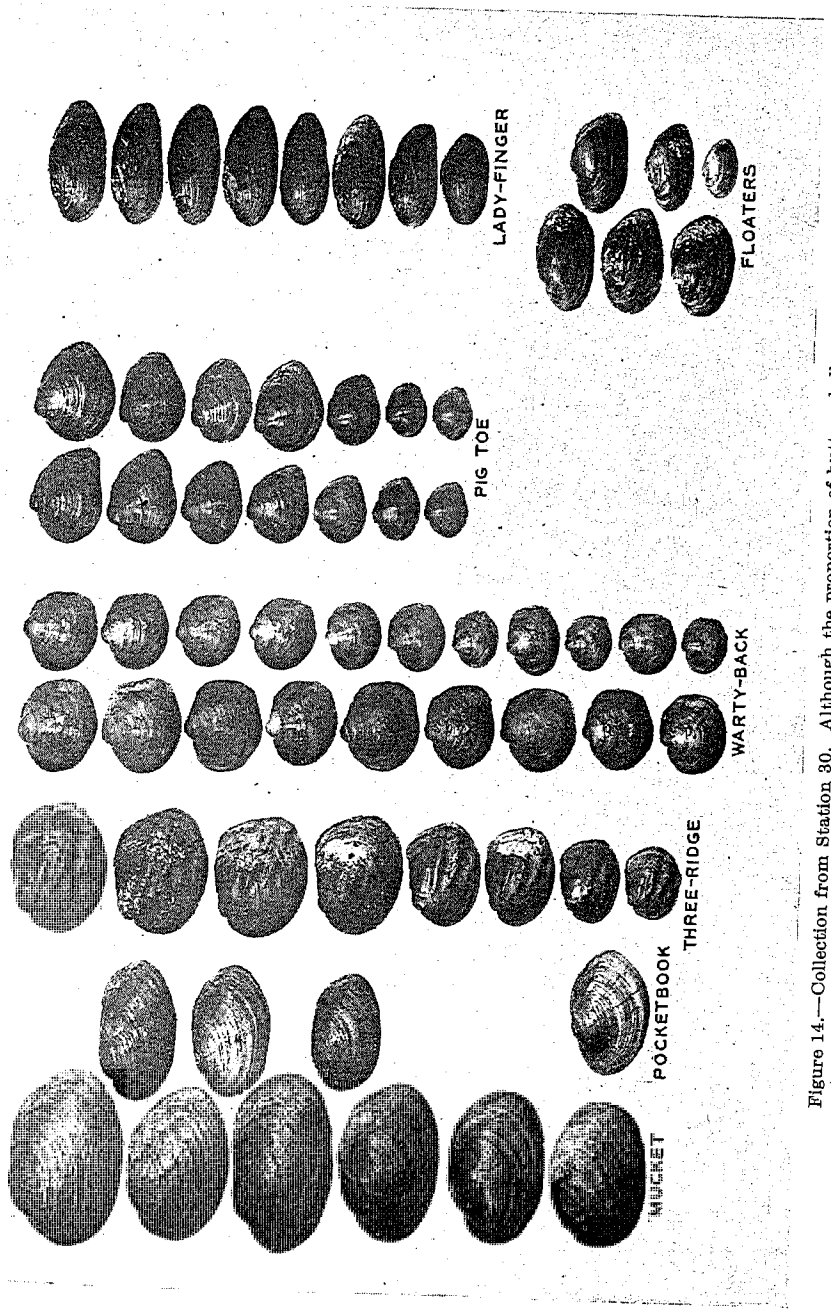

Figure 14.—Collection from Station 30. Although the proportion of button shells to culls is good at this station the total weight is rather low.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 30				Double	1	7
Actinonaias carinata	9	4	7.0			
Lampsilis ventricosa	1	0	3.5			
Amblema costata	8	2	12.5			
Quadrula pustulosa	20	3	14.0			
Fusconaia flava	8	1	2.0			
Pleurobema c. coccineum	6	1	0.0			
Total Commercial Varieties	52	13	7.0			
Alasmidonta marginata	3	0	3.5			
Elliptio dilatatus	8	1	1.5			
Strophitus rugosus	3	0	6.5			
Grand Total	66	15	2.5			
Station 31				Single	1	6
Actinonaias carinata	3	1	3.0			
Lampsilis ventricosa	2	0	10.0			
Amblema costata	12	4	9.0			
Quadrula pustulosa	7	1	11.0			
Fusconaia flava	6	0	15.0			
Pleurobema c. coccineum	2	0	6.5			
Total Commercial Varieties	32	9	6.5			
Alasmidonta marginata	1	0	2.0			
Cyclonaias tuberculata	1	0	3.0			
Grand Total	34	9	11.5			
Station 32				Single	1	5
Actinonaias carinata	8	3	15.0			
Lampsilis ventricosa	1	0	6.0			
Amblema costata	3	1	6.0			
Fusconaia flava	1	0	3.5			
Pleurobema c. coccineum	1	0	6.0			
Total Commercial Varieties	14	6	4.5			
Elliptio dilatatus	1	0	2.0			
Lasmigona costata	1	0	4.0			
Strophitus rugosus	1	0	1.5			
Grand Total	17	6	12.0			

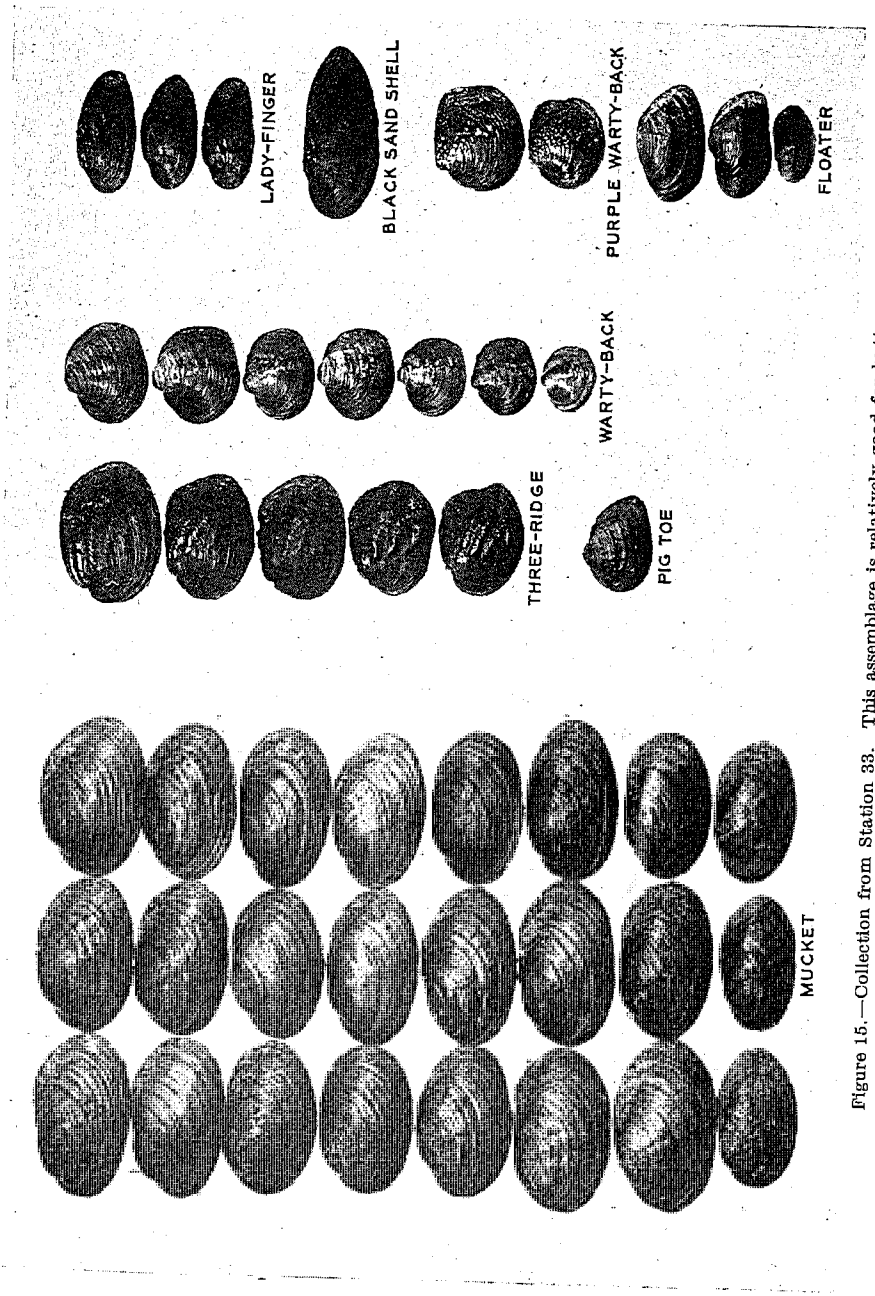

Figure 15.—Collection from Station 33. This assemblage is relatively good for button purposes.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 33				Double	1	7
Actinonaias carinata	26	12	12.0			
Amblema costata	5	2	3.0			
Quadrula pustulosa	7	1	6.0			
Fusconaia flava	1	0	4.0			
Total Commercial Varieties	39	16	9.0			
Alasmidonta marginata	2	0	4.0			
Cyclonaias tuberculata	2	0	11.0			
Elliptio dilatatus	3	0	8.0			
Ligumia recta latissima	1	0	7.0			
Strophitus rugosus	1	0	0.5			
Grand Total	48	18	7.5			
Station 34				Double	1	7
				Single	1	6
Actinonaias carinata	17	7	8.0			
Lampsilis ventricosa	2	0	9.0			
Amblema costata	6	2	7.5			
Quadrula pustulosa	4	1	1.0			
Quadrula quadrula	2	0	3.0			
Fusconaia flava	8	1	8.0			
Pleurobema c. coccineum	3	0	6.5			
Total Commercial Varieties	42	13	11.0			
Actinonaias ellipsiformis	1	0	1.0			
Alasmidonta marginata	1	0	3.0			
Cyclonaias tuberculata	2	0	13.0			
Elliptio dilatatus	9	1	7.5			
Strophitus rugosus	2	0	3.0			
Grand Total	57	16	6.5			
Station 35				Double	1	5
Actinonaias carinata	3	1	4.0			
Amblema costata	1	0	6.0			
Quadrula pustulosa	6	1	10.0			
Quadrula quadrula	1	0	8.0			
Fusconaia flava	4	0	12.0			
Pleurobema c. coccineum	2	0	6.0			
Total Commercial Varieties	17	4	14.0			
Elliptio dilatatus	1	0	2.0			
Grand Total	18	5	0.0			

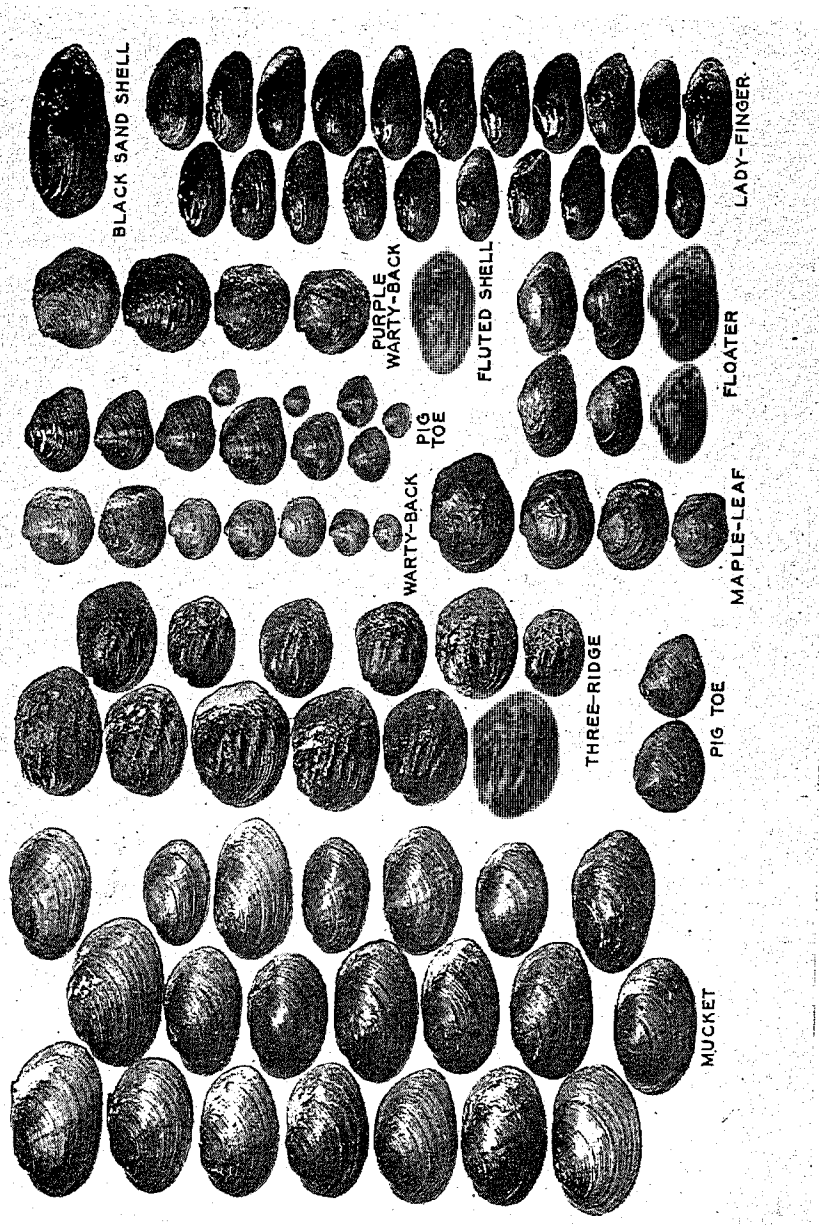

Figure 16.—Collection from Station 40. This assemblage is relatively good but not as productive as it might be if we consider it took a quarter-hour to get it.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 36				Double	1	7
Amblema costata	4	2	5.0			
Quadrula pustulosa	1	0	4.5			
Fusconaia flava	3	0	9.5			
Pleurobema c. coccineum	1	0	5.0			
Total Commercial Varieties	9	3	8.0			
Grand Total	9	3	8.0			
Station 37				Double	3	21
Actinonaias carinata	2	2	14.0			
Lampsilis ventricosa	3	0	9.0			
Amblema costata	15	6	7.0			
Quadrula pustulosa	21	4	8.0			
Fusconaia flava	32	4	1.0			
Pleurobema c. coccineum	2	0	3.5			
Total Commercial Varieties	75	18	10.5			
Alasmidonta marginata	5	0	5.0			
Cyclonaias tuberculata	1	0	4.5			
Elliptio dilatatus	6	0	15.0			
Lasmigona costata	1	0	7.0			
Strophitus rugosus	2	0	3.0			
Grand Total	90	20	13.0			
Station 38				Double	2	14
Actinonaias carinata	16	7	3.0			
Lampsilis ventricosa	5	1	15.0			
Amblema costata	5	0	11.0			
Quadrula pustulosa	12	2	13.0			
Quadrula quadrula	5	2	1.0			
Fusconaia flava	7	1	9.5			
Pleurobema c. coccineum	1	0	1.5			
Total Commercial Varieties	51	16	6.0			
Alasmidonta marginata	4	0	6.5			
Cyclonaias tuberculata	4	0	13.0			
Elliptio dilatatus	10	1	13.5			
Strophitus rugosus	1	0	3.0			
Grand Total	70	19	10.0			

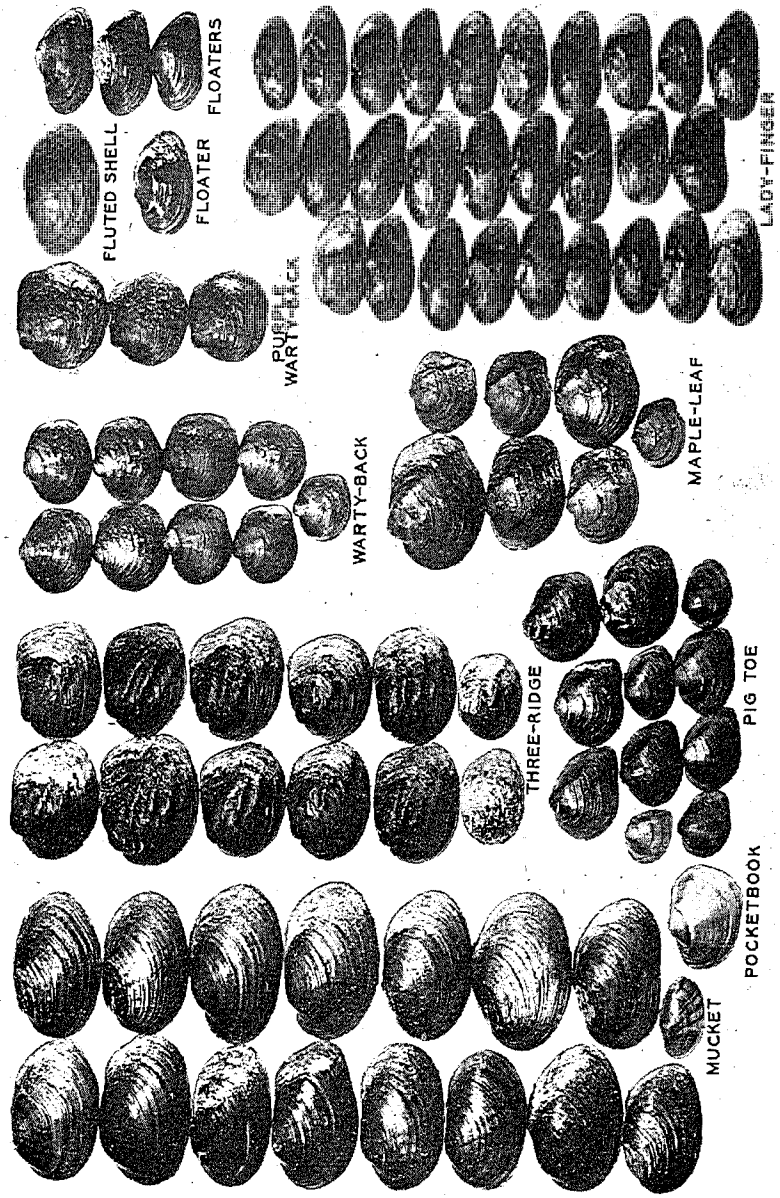

Figure 17.—Collection from Station 44. The proportion of good button shell to culls is good at this station but again it took considerable time to collect these specimens.

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes
		Pounds	Ounces			
Station 39				Double	2	13
Actinonaias carinata	6	2	6.0			
Lampsilis ventricosa	1	0	2.5			
Amblema costata	8	3	1.5			
Quadrula pustulosa	9	2	11.0			
Quadrula quadrula	2	0	9.0			
Fusconaia flava	6	0	11.0			
Pleurobema c. coccineum	1	0	5.5			
Total Commercial Varieties	33	9	14.5			
Elliptio dilatatus	14	2	2.5			
Grand Total	47	12	1.0			
Station 40				Double	2	14
Actinonaias carinata	21	8	15.0			
Amblema costata	12	5	11.0			
Quadrula pustulosa	7	0	15.0			
Quadrula quadrula	4	1	6.0			
Fusconaia flava	10	1	4.0			
Pleurobema c. coccineum	2	0	8.0			
Total Commercial Varieties	56	18	11.0			
Alasmidonta marginata	6	0	14.0			
Cyclonaias tuberculata	4	1	13.0			
Elliptio dilatatus	24	3	14.0			
Lasmigona costata	1	0	3.0			
Ligumia recta latissima	1	0	13.0			
Grand Total	92	26	4.0			
Station 41				Double	1	31
Actinonaias carinata	23	9	9.5			
Lampsilis ventricosa	1	0	3.5			
Lampsilis siliquoidea	1	0	5.5			
Amblema costata	3	0	11.5			
Quadrula pustulosa	9	1	11.0			
Quadrula quadrula	1	0	4.0			
Fusconaia flava	5	0	11.0			
Pleurobema c. coccineum	2	0	6.0			
Total Commercial Varieties	45	13	14.0			
Alasmidonta marginata	1	0	7.0			
Cyclonaias tuberculata	6	1	15.0			
Elliptio dilatatus	8	1	3.5			
Grand Total	60	17	7.5			

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Station 42				Double	1	10
Actinonaias carinata	14	5	12.0			
Lampsilis ventricosa	2	0	9.0			
Amblema costata	9	2	1.0			
Quadrula pustulosa	22	3	12.0			
Quadrula quadrula	6	1	3.0			
Fusconaia flava	20	2	9.0			
Pleurobema c. coccineum	3	0	9.0			
Total Commercial Varieties	76	16	7.0			
Alasmidonta marginata	1	0	2.0			
Cyclonaias tuberculata	1	0	5.0			
Elliptio dilatatus	6	0	14.0			
Lasmigona costata	1	0	8.0			
Ligumia recta latissima	2	1	5.0			
Grand Total	87	19	9.0			
Station 43				Single	1	5
Actinonaias carinata	6	2	10.0	Double	1	5
Amblema costata	3	1	0.0			
Quadrula pustulosa	8	0	15.5			
Quadrula quadrula	4	1	0.0			
Fusconaia flava	12	1	6.0			
Total Commercial Varieties	33	6	15.5			
Cyclonaias tuberculata	2	0	7.0			
Elliptio dilatatus	3	0	8.0			
Lasmigona costata	1	0	8.0			
Grand Total	39	8	6.5			
Station 44				Double	2	17
Actinonaias carinata	14	7	8.0			
Lampsilis ventricosa	1	0	3.0			
Amblema costata	12	5	0.0			
Quadrula pustulosa	8	2	1.0			
Quadrula quadrula	7	2	5.5			
Fusconaia flava	8	1	7.5			
Pleurobema c. coccineum	4	0	11.5			
Total Commercial Varieties	54	19	4.5			
Alasmidonta marginata	3	0	5.5			
Cyclonaias tuberculata	4	1	4.5			
Elliptio dilatatus	29	4	7.0			
Lasmigona costata	1	0	5.5			
Strophitus rugosus	1	0	1.5			
Grand Total	92	25	12.5			

Table 2.—Continued.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minute
		Pounds	Ounces			
Station 45				Double	1	
Amblema costata	3	1	5.0			
Quadrula pustulosa	4	0	11.0			
Quadrula quadrula	6	2	2.0			
Fusconaia flava	5	1	0.0			
Pleurobema c. coccineum	1	0	4.5			
Total Commercial Varieties	19	5	6.5			
Cyclonaias tuberculata	1	0	6.0			
Elliptio dilatatus	2	0	6.0			
Strophitus rugosus	1	0	3.0			
Grand Total	23	6	5.5			

The information available in the preceding tables (1 and 2) enables o to compute the number of commercially valuable mussels a clammer usi a "John-boat" and two crow-foot bars could take per hour at each statio By assuming an average price of $40 per ton for these shells one can al estimate the probable earnings at each station per hour.

Table 3.—Computed number of pounds of commercially valuable mussels per hour of dragging (double bar) at each station and estimated earnings per hour at an assumed price of $40 per ton. The unweighted means for the 45 stations are 92 pounds per hour and $1.84 per hour.

Station Number	Pounds of mussels per hour	Estimated earnings per hour	Station Number	Pounds of mussels per hour	Estimated earnings per hour	Station Number	Pounds of mussels per hour	Estimated earnings per hour
1	96	$1.92	16	75	$1.50	31	180	$3.60
2	12	.24	17	216	4.32	32	144	2.88
3	36	.72	18	144	2.88	33	144	2.88
4	120	2.40	19	102	2.04	34	106	2.12
5	22	.44	20	144	2.88	35	60	1.20
6	33	.66	21	66	1.32	36	30	.60
7	66	1.32	22	247	4.94	37	57	1.14
8	156	3.12	23	195	3.90	38	64	1.28
9	72	1.44	24	112	2.24	39	48	.96
10	112	2.24	25	90	1.80	40	82	1.64
11	66	1.32	26	45	.90	41	28	.56
12	92	1.84	27	86	1.72	42	99	1.98
13	98	1.96	28	60	1.20	43	51	1.02
14	72	1.44	29	92	1.84	44	66	1.32
15	120	2.40	30	110	2.20	45	33	.66
						Totals	4,149	$82.98
						Means	92	1.84

The figures in Table 3 indicate that the smallest amount by weight was found at Station 2, with 12 pounds per hour; while the largest was at Station 22, where the yield is estimated to be 247 pounds per hour. The comparative earnings at these same stations are computed as 24 cents per hour at station 2 and $4.94 per hour at Station 22. There are 8 stations that produced below 50 pounds per hour; 20 stations that yielded between 50 and 100 pounds per hour; and 17 that produced an estimated yield of over 100 pounds per hour. The means for the 45 stations examined are 92 pounds of mussels per hour and $1.84 per hour.

In order to appreciate the relative value of the computations in Table 3, the following variables must be considered: (1) The value per ton of mussels is set at the average price paid to clammers in recent years. An adjustment corresponding to the change in market prices can be made based upon prices for any given year. (2) The computed number of pounds taken per hour is based on the assumption that two crow-foot bars are used simultaneously and that this gear is in operation continuously for an hour. That unforeseen interruptions may occur becomes obvious when we consider that during the closed season many snags have accumulated along the bottom of the river. Mr. Meyers recently experienced considerable difficulty with his gear due to snarling among the large amount of fallen timber that covered most of the mussel beds. Although such difficulties may at first cause a lowering of the estimated yield, there is reason to believe that as the snags are swept from the shoals by the clamming gear there is apt to be a compensating increase in the quantity of mussels taken. The samples on which this table is based were taken at a time when these obstructions were a decided hindrance to our catch. Consequently, the estimated yields may well be somewhat too low. However, after all allowances are made for the variables in this table, the figures will show that at present the river contains a substantial amount of mussels suitable for the button industry.

Although it is illegal to do so, fishermen at times collect mussels by hand-picking for use as bait in setting catfish lines. During our recent survey Mr.

Kahl discovered, at the side of a bar in the river about 2 miles above Ionia, a large quantity of mussels which had recently been taken from the stream for that purpose. Three men escaped and left their plunder. The time it took for them to make this collection is estimated to have been about 2 hours. An examination of the figures in Table 4 reveals how destructive this practise can be to the mussel population.

Table 4.—Number and weight of mussels taken by three men in 2 hours of illegal hand-picking. Data arranged as in Table 2.

Species	Number of specimens	Weight		Kind of drag (Single or double)	Number of hauls	Total time (minutes)
		Pounds	Ounces			
Lot				Hand Picking	3 men	120
Actinonaias carinata	10	4	3.0			
Lampsilis ventricosa	21	6	10.0			
Amblema costata	28	8	14.0			
Quadrula pustulosa	33	7	10.0			
Fusconaia flava	76	10	14.0			
Pleurobema c. coccineum	13	2	15.0			
Total Commercial Varieties	181	41	2.0			
Actinonaias ellipsiformis	1	0	2.0			
Alasmidonta marginata	8	0	14.0			
Cyclonaias tuberculata	4	1	1.0			
Elliptio dilatatus	134	16	14.0			
Lasmigona costata	7	3	2.0			
Ligumia recta latissima	3	0	15.0			
Strophitus rugosus	6	0	12.0			
Grand Total	344	64	14.0			

While cleaning the specimens taken from the river it was possible to secure additional information regarding the presence or absence of developing larvae (glochidia) in the gills of both Muckets and Pocketbooks. About 10 years ago information bearing on this subject was published (van der Schalie, 1937) emphasizing that an open season for clamming during August and September permitted the removal of many of the best button shells while the animals were in a gravid condition. Of the 288 Muckets taken at the first 32 stations during the early part of September of 1945, 141 were gravid. Of 105 Pocketbooks examined during the same period from the first 27 stations, 41 were gravid. If we assume that the sexes are in a 50:50 ratio it seems quite possible that all of the females of both of these important commercial species were gravid at the time of this survey, and it is of interest to note that the facts were found to be essentially the same as given in the previous report.

CONCLUSION

The quality and the quantity of the mussels taken in this study indicate that the closed season has already been beneficial to the stock. Most of the beds have become replenished although a few obviously would benefit if the shoals remained unmolested for another few years. In view of the increased loads of industrial waste entering the Grand River at Jackson and Lansing during the war period it was of special interest to find that the mussels were not harmed as seriously as might well have been expected.

The influence of a dam at Lyons is detrimental to the best interests of the mussel industry. Water below this dam was remarkably clear and apparently suitable for the production of mussels. However, in September the river bottom was covered with only 2 to 8 inches of water. Not only is this fluctuation in water level harmful to the production and growth of mussels but it is also difficult for clammers to operate their gear effectively when the water is abnormally low. If this dam could be operated so as to prevent a wide fluctuation in water levels below it, more wholesome living conditions for the mussels on the shoals would be insured.

The Maple River carried in suspension a heavy load of flocculent material so that the Grand below the mouth of the Maple was decidedly murky. This condition persisted throughout the stream. A Secchi disc reading was not taken, but it was obvious that visibility was not more than a few inches on a sunny day. This turbidity prevented sampling with the aid of a quadrat.

Continued use of crow-foot bars and suppression of the illegal practices of forking and hand-picking are strongly urged. Among the series of mussels taken during this survey very few small individuals were captured. The proper use of the crow-foot bar, therefore, leaves the young on the beds to replace the stock of older individuals taken. Judicious regulation of the size of the wire employed in making the bar hooks may be worth-while.

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