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INTERIM PROGRESS REPORT

SURVEY OF MUSSELS IN THE UPPER MISSISSIPPI RIVER
POOLS 3 THROUGH 8

(3-276-R)

by

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INTRODUCTION

Mussel fishing on the Mississippi River was an important fishery in the late 1800's and early 1900's. The mussel shells were used for the manufacture of pearl buttons (Carlander, 1954). In 1899, at the peak of the button era, 8,000 tons of shells were harvested (Nord, 1967). The harvest gradually declined until all major clamming died out by the 1930's. The decline was attributed to the combination of over-harvesting, siltation, pollution, and permanent changes in the river by the various channel projects of the U. S. Army Corps of Engineers. With the advent of the plastic button industry, all clamming stopped. The clamming industry remained dormant until the 1960's when the Japanese cultured pearl industry found a new use for the shells. Small pellets are cut from the shells and inserted into saltwater oysters. After 2 or 3 years the oyster surrounds the pellets with layers of nacre, thus forming the cultured pearl (Stephens, 1963). Again the clamming industry on the Mississippi River briefly flourished with 800 tons of mussels being harvested during 1965. Commercial clamming still occurs presently, but has been reduced to several small operations.

Since 1970, concern has been expressed for the decline of several mussel species in the Mississippi River. As a result, three species, the Higgins' Eye Pearly Mussel (Lampsilis higginsii), the Pink Mucket Pearly Mussel (Lampsilis orbiculata), and the Fat Pocketbook Pearly Mussel (Potamilus capax), were placed on the Federal Fish and Wildlife Endangered Species List during 1976.

The primary objective of this survey is to determine relative abundance, distribution, species composition, and the extent of commercial harvest of mussel populations in the Upper Mississippi River. Secondary objectives are to sample and identify mussel species and to characterize the commercial clamming industry. The clamming industry will be studied by identifying people involved in the industry, determining current markets, and monitoring the clam harvest.

The study area includes 136 miles of the Mississippi River extending from Lock and Dam 8 at Genoa, Wisconsin, to Lock and Dam 2 at Prescott, Wisconsin. The study is scheduled to run from February 1977 to February 1979.

The first year's sampling included Pools 8 through 5A and the Black River from the Onalaska Spillway downstream. Included were 59 miles of Mississippi River main channel, 5 miles of the Black River, and a number of backwater areas, side channels, and sloughs. The field sampling was conducted from May through October, 1977.

METHODS

Mussels were sampled using a ten foot clam bar or brail equipped with 2,000 dovetail hooks (Figure 1). The dovetail hooks, with beaded prongs do not snag on the bottom or injure the delicate viscera of undersized mussels as do the conventional crowfoot hooks (Finke, 1967). In addition, dovetail hooks are the standard commercial gear used on the Mississippi River.

The clam bar was dragged over selected areas for five minutes or approximately 300 feet. Drag sites were chosen to sample all river habitat types and areas suspected to be inhabited by mussels. Sites of known mussel beds received additional sampling effort to determine the width and lengths of the beds. A 16 foot motorized jon boat was used to drag the bar in a downstream direction at approximately 0.5 mph. The actual speed varied slightly due to wind conditions and current velocity.

The location of the clam bar or brail drags were recorded on 1973 aerial photographs (not included) and U. S. Army Corps of Engineers Navigation Charts (Figures 2 - 45). Bottom sediment types and water depths were recorded at the beginning and end of each run.

Bottom sediments were sampled using a Petite Ponar dredge. The bottom was then classified into three types: sand, hard, and muck. A sand bottom consists of more than 90 percent sand. Bottom types consisting of rubble, gravel, or shale, were classified as hard. A muck bottom is made up of 90 percent silt, clay, or a combination of the two. Table 5 correlates mussels to the three bottom types.

Water depths for the runs were divided into 5 foot intervals. The correlation of mussels to water depths is given in Table 6.

Mussels caught were identified and measured for length (Table 4). A subsample was examined for sexual maturity (Table 7). A maximum of 2 specimens for each species, per run, viscera excluded, were catalogued for a reference collection.

The abundance of any given mussel species sampled is represented by Tables 1 and 2. Table 1 describes abundance in 4 categories ranging from rare to abundant. Each category is based arbitrarily on the percentage of a species to the total sample. Table 2 represents abundance mathematically as the percent of abundance. The percent of abundance is equal to the number of each species divided by the total number of all species times 100 percent.

The occurrence of a mussel species during sampling is represented as the percent of frequency of occurrence (Table 3). The percent of frequency of occurrence is equal to the number of runs in which the species occurred divided by the total number of runs times 100 percent.

SCUBA gear was used for limited sampling in the Black River and Pools 8, 7, and 6. A 5 foot square frame was lowered to the bottom at selected sites. All mussels within the frame, both alive and dead, were collected by the diver. Mussel species collected, both live and dead, are presented in Table 9. Diving sites are described on page 6.

Commercial shell buyers were provided with a volunteer questionnaire indicating total tonnage, species harvested, location of clamming operations, quantity of equipment leased, price paid per ton, and principal markets. In addition, species composition and length-width measurements were subsampled monthly from the commercial shell piles.

RESULTS

Drag runs and the number of mussels per run for all runs in the Black River and Pools 8 through 5A are plotted on copies of U. S. Army Corps of Engineers Navigation Charts (Figures 2 - 45) in the Appendix. Other tables in the Appendix include species present, abundance, frequency of occurrence, correlation to depths and bottom types, length frequency, gravity, commercial harvest, and past surveys. These tables will be referred to throughout the report.

Length Frequency Data and Juvenile Specimens

The clam bar is selective in that it does not often catch small species such as the Fawnfoot *Truncilla donaciformis* and young specimens of the larger species. Length frequency data (Table 8) indicates that dovetail hooks are most effective for catching mussels longer than 3 cm. The beads on the dovetail hooks, which are approximately 4 mm in diameter, are too large to pass through the valve opening of mussels less than 3 cm in length.

Juvenile specimens as small as 4 mm were picked up by the clam bar when their byssus became entangled on the dovetail hooks. On one run, 129 juveniles were captured in this manner. A total of 1,251 juveniles were caught during the sampling season. Mr. Samuel Fuller, Invertebrate Zoologist with the Philadelphia Academy of Natural Sciences, identified the majority of these juveniles as either the Deertoe *Truncilla truncata* or the Fawnfoot *Truncilla donaciformis*. One juvenile Black Sandshell *Ligumia recta* was also identified.

Brail Runs and Mussels Collected

Eight-hundred and six runs were made using the clam bar in the Black River and Pools 8, 7, 6, and 5A of the Mississippi River. Runs made per pool are listed in Tables 3 and 5. The location of the runs and the number and species of mussels captured are given in Figures 2-9, 18-19, 22-25, 30-33, and 38-41. The density of mussels, represented as the total number of mussels per run, are presented in Figures 10-17, 20-21, 26-29, 34-37, and 42-45.

Eight-hundred and eighty-five mussels representing 18 different species were taken during the study (Tables 1 - 4). In addition, six other species were found only as half shells or empty valves (Table 1). The Threeridge was the most abundant and most frequently occurring species in Pools 8 through 5A and the Black River (Tables 2 and 3 respectively). The rarest species found, denoted by the presence of few live specimens, were Pink Heelsplitter, *Proptera alata*, the Butterfly, *Ellipsaria lineolata*, the Monkeyface, *Quadrula metanerva*, and the Strange Floater, *Strophitus undulatus* (Tables 1 and 2). No endangered species were collected during this study. However, a small specimen of *Lampsilis higginsii* was found in Pool 8 near Brownsville, Minnesota, by Terry Bills (Bills, 1978).

Correlation of Mussels to Bottom Type

The three bottom types, sand, hard, and muck, were analyzed for mussel habitation (Table 5). Runs with varying bottom types, such as sand to muck, were not included due to the difficulty in classification. A higher percentage of runs over a hard bottom produced five mussels or more per run than runs over either sand or muck (Table 5). In fact, only runs over a hard substrate accounted for more than 10 mussels per run with one exception in the Black River. This particular area was characterized by a very slow current over a sand bottom with sparse vegetation. This accounted for a stable sand bottom and consequent a thriving mussel population.

The majority (53.3 percent) of the runs where no mussels were taken occurred over a sand bottom (Table 5). This was due, no doubt, to the instability of sand in an area of current. Current constantly shifts the sand downstream thus offering a poor substrate for long term mussel habitation (Leonard and Murray, 1962).

No run over a muck bottom accounted for more than five mussels. Muck or silt has long been regarded as an undesirable substrate for many mussel species (Scruggs, 1960).

Correlation of Mussels to Water Depth

The majority (74.7 percent) of all mussels captured were taken at depths between 6 and 15 feet (Table 6). This depth range also accounted for the areas of greatest mussel concentration (runs with more than 5 clams captured). Fairly shallow water (6-10' deep) yielded 44.2 percent of all mussels taken and the most runs (11.3 percent) with mussels. Depths less than 6 feet and deeper than 15 feet had about the same percentage of mussels, 12.1 percent and 13.2 percent respectively. The percentage of runs with mussels was also similar, 5.2 percent for 6-10' and 5.0 percent for 16+ feet. Only one run deeper than 20 feet resulted in a drag of more than five clams. Overall only 28.7 percent of all runs yielded mussels with only 5.0 percent of all runs having more than five mussels per drag (Table 6).

Gravidity and Mussel Length

Gravid female mussels were first noted at the start of the clamming operations in May. The first mussels noted were the Threeridge and Pimpleback. The gills of both species were gravid with glochidia (larval mussels). The minimum length of a gravid Threeridge encountered was 5.3 cm (2.1 inches) (Table 7). The maximum was 11.5 cm (4.5 inches) in length. Gravid Pimplebacks ranged from 4.2 cm to 8.6 cm (1.7 inches to 3.4 inches) long. Gravidity data for other species can also be found in Table 7.

While examining the mussel species for gravidity, the following observations were made concerning the differences in gravidity:

Amblema plicata (Threeridge) - All 4 gills may contain eggs and glochidia.

Anodonta grandis (Giant Floater) - The outer gills contain eggs, the inner gills contain glochidia.

Obovaria olivaria (Hickorynut) - The posterior portion of the outer gills marsupial (brood pouches) with conglomerates (packets of glochidia).

Ligumia recta (Black Sandshell) - The posterior part of the outer gills are marsupial.

Obliquaria reflexa (Threehorn Wartyback) - The outer gills contain conglomerates.

Truncilla donaciformis (Fawnfoot) - Both pairs of gills contain conglomerates.

Fusconaia flava (Pigtoe) - Conglomerates were present in both pairs of gills. Red eggs were present in the conglomerates.

In addition, mites were noticed inside the valves of several species, usually in the area around the gills. Species with mites were the Pimpleback, Pink Heelsplitter, Floater, and Threehorn Wartyback. Chironomids were found on the gills of a live Black Sandshell.

Sampling With SCUBA Gear

SCUBA gear was primarily implemented to gauge the efficiency of the dovetail brail. Data for this aspect is not complete and will not be analyzed until the completion of the mussel survey in all pools. Eighteen dives were made in 1977 in Pools 8 through 6 and the Black River. No diving occurred in Pool 5A. Data regarding completed dives may be located in the Appendix on the maps with numbered drag runs (Figures 2 - 41). The following dives correspond directly to numbered drag runs:

<u>Pool</u>	<u>Run</u>	<u>Pool</u>	<u>Run</u>
8	16	6	94 (2 dives)
8	219	6	95 (2 dives)
Black R.	7	7	90
Black R.	11	7	124 (2 dives)
6	117 (2 dives)	7	136
6	91 (2 dives)	7	144
		7	89

Data gathered on species collected either live or dead, while diving is included in Table 9. Compared with species collected by the brail in all pools combined, diving did not offer any additional live species. In fact, four species were taken by the brail that were not found during diving operations. However, the diver did collect dead shells of species that may be extinct or are very rare in the surveyed area. Five species were taken by diving that were not found as live specimens. These are the Buckhorn, Tritogonia verrucosa; the Elktoe, Alasmidonta marginata; The Mucket, Actinonaias carinata; the Washboard, Megalonaias gigantea; and the Ohio River Pigtoe, Pleurobema cordatum (Table 9).

A single specimen of the Fat Mucket, Lampsilis radiata siliquoidea, was found in Pool 8 in a muskrat's shell pile. Diving and Clam bar runs in the area did not turn up any additional specimens.

Pool 8

Sixteen live mussel species were taken in this pool using brail, diving, and ponar grabs (Table 9). Thirteen of these were represented by brail runs (Tables 2 - 4). Five additional species were represented by the presence of empty valves (Table 1). The Threeridge was the dominant species in numbers and frequency of occurrence followed by the Hickorynut, Pimpleback, and Pigtoe respectively (Tables 2 and 3).

Threeridge averaged 9.2 cm in length. Pimplebacks averaged 6.9 cm, Pigtoes 6.6 cm, and Hickorynuts 7.0 cm. Lengths of other species may be found in Table 4.

Threeridge made up 57.7 percent of all clams taken in Pool 8 (Table 2). Hickorynuts were next with 15.1 percent, followed by Pimpleback at 7.5 percent, and Pigtoes at 6.7 percent. Any other single species accounted for less than 4 percent of the total.

Threeridge also occurred more frequently on brail drags than any other species (Table 3). They appeared on 16.3 percent of all brail runs followed by Hickorynuts (5.8 percent), Pimplebacks and Pigtoes each with 5.1 percent of the total runs.

The majority (86.4 percent) of the runs were over sand or muck bottom (Table 5). Of this, 68.6 percent were over sand and 17.7 percent of the runs were over muck. The remaining runs were over a hard bottom. Runs resulting in more than 10 mussels per run occurred only where a firm or hard bottom existed. Most mussels (70.7 percent) were located in 5 to 15 feet of water (Table 6).

Black River

The Black River, a major tributary of the Mississippi River in Pool 8, yielded 7 different live species (Table 9). Only two were taken with the brail. The other five species were taken while diving. Three additional species were noted by the presence of empty valves (Table 9).

The Threeridge and Pigtoe were the only two species taken with the brail (Table 9). Threeridge made up 92.8 percent of the total and Pigtoes 7.2 percent (Table 2).

Threeridge were also the most frequently appearing mussel being taken on 41.4 percent of the runs (Table 3). Pigtoes were taken on 6.9 percent of all runs.

Ponar grabs in the Black River showed sand as the prevalent bottom substrate (Table 5). The Black River had the only run of all surveyed pools where more than 10 clams were caught over a sand bottom. A higher percentage of runs over a sand bottom (31.8 percent) resulted in more mussels than either hard bottom (13.6 percent) or muck (4.5 percent). Muck bottoms were encountered on 13.6 percent of the runs.

Depths at which clams were taken ranged up to 15 feet (Table 6). About equal percentages 44.9 percent and 43.5 percent, of mussels were taken at the 0-5 foot range and 6-10 foot range respectively. The other 11.6 percent were taken between 11 feet and 15 feet deep.

Pool 7

Fourteen live species were taken in this pool, 13 of which were taken on the brail (Table 9). Dead specimens added seven species. The Threeridge was the most abundant species found in this pool followed by the Pimpleback, Pigtoe, and Hickorynut respectively (Table 2). Four-hundred and fifty mussels were collected in this pool, about twice the number found in any other pool.

The average Threeridge measured 9.1 cm with Pimplebacks measuring 6.1 cm, Pigtoes 6.5 cm, and Hickorynuts 6.4 cm. The lengths of other species taken with the brail may also be found in Table 4.

Threeridge accounted for 63.8 percent of all clams taken in Pool 7 on the brail (Table 2). Pimplebacks were next in abundance making up 15.1 percent followed by Pigtoes with 8.9 percent of the total. No other species accounted for more than 4 percent of the total.

The mussel occurring most often (27.3 percent) on the brail runs was the Threeridge, closely followed by the Pimpleback at 25.1 percent (Table 3). Pigtoes appeared on 10.6 percent of the drags. Any one other species showed up on less than 7 percent of the brail drags.

The majority (69.2 percent) of the runs in this pool were over a strictly sand or muck bottom (Table 5). Of this 66.0 percent were over a sand bottom.

Prime mussel habitat was most abundant in this pool even though the majority was sand. Outside bends of the river channel with gravel or rubble substrate yielded good numbers of clams. Runs where more than ten clams per run were taken accounted for 10.1 percent of the runs in Pool 7 (Table 5).

The majority (82.9 percent) of mussels in this pool were located in the 6-15 foot depth range (Table 6).

Pool 6

Mussels representing 13 species were found during operations in Pool 6 (Table 9). Four additional species were represented by empty valves collected by the diver. The Threeridge again was the most abundant and frequent mussel encountered on the brail runs (Tables 2 and 3). The Hickorynut, Fawnfoot, Pigtoe, and Pimpleback (in that order) followed in both abundance and frequency.

Threeridge averaged 10.3 cm in length (Table 4). Pimplebacks averaged 7.4 cm, Pigtoes 7.7 cm, and Hickorynuts 7.8 cm long. Fawnfoot, a small, non-commercial species, averaged 1.4 cm long. The lengths of other species are also listed in Table 4.

Threeridge accounted for 27.5 percent of the mussels in Pool 6 (Table 2). Hickorynuts and Fawnfoot each made up 16.5 percent of the total. Pigtoes and Pimplebacks followed with 14.3 percent and 8.8 percent respectively. Any other single species made up less than 5 percent of the total.

The most frequent mussel caught on the clam bar was the Threeridge appearing on 8.8 percent of all runs (Table 3). The next most prevalent mussel was the Hickorynut showing up on 5.2 percent of the runs. The occurrence of other mussels in Pool 6 may also be found in Table 3.

Again, the majority (72.7 percent) of runs were over a sand or muck bottom (Table 5). Twenty-seven point three percent of the runs were over firm bottom, however, few areas were inhabited by good populations of mussels. Only one run occurred where more than ten mussels appeared on the brail.

In this pool, as in previous pools, the majority of the mussels (69.2 percent) were found in 6-15' of water (Table 6). However, the range 6 to 10 feet accounted for 53.8 percent of all mussels taken with the brail.

Pool 5A

This pool yielded 11 live species and 2 species represented by empty valves (Tables 9 and 1). The dead specimens were taken by ponar dredge and shoreline handpicking as no diving was conducted in this pool during 1977. As usual, the Threeridge was the dominant species in numbers and frequency of occurrence (Tables 2 and 3). Being the shortest pool surveyed in 1977, fewer specimens were taken and fewer runs were made (Table 3). One species not found live in the other pools was the Strange Floater, Strophitus undulatus.

Threeridge averaged 10.0 cm long (Table 7). Pimplebacks averaged 6.3 cm, Pigtoes 6.2 cm and Hickorynuts 7.9 cm long.

Very few mussels were taken during operations in Pool 5A. Threeridge made up 33.3 percent of all mussels and occurred on 5.5 percent of the runs (Tables 2 and 3). The other commercial species, Pimpleback, Pigtoe, and Hickorynut, made up 19.4 percent, 11.1 percent, and 5.6 percent of all mussels respectively (Table 2). One other species, the Fragile Papershell, comprised 11.1 percent of all mussels. These and any other single species (other than Threeridge) occurred on less than 5 percent of the drags.

The amount of sand in Pool 5A was considerable. Over three-fourths (76.5 percent) of all runs were over a sand bottom followed by hard bottom with 13.9 percent and runs over a muck bottom with 9.6 percent (Table 5). No concentrations of mussels were found in any of the bottom types.

Clams that were taken were fairly evenly distributed in four of the five depth ranges (Table 8). Five point six percent of the mussels sampled were from a depth of over 21 feet.

Commercial Harvest

No commercial clambers operated in any of the pools covered by the survey in 1977. Donald Lessard of Prairie du Chien, the only commercial clammer operating in the Wisconsin boundary waters, took 98 percent of his clams in Pool 10 from the Iowa backwaters. The other 2 percent came from "pollywoggers" (hand pickers, wading) working in the shallows near Prairie du Chien. Due to low water conditions during 1977, clam bars could not be used because the river current was too slow to propel the mule-driven boats. Diving rigs were the only gear utilized in Mr. Lessard's operation this year. He had a maximum of 12 diving rigs in operation at one time. His divers were very selective in picking only large Washboards, *Megaloniais gigantea*, and Threeridge, *Amblema plicata*. Two other species, the Mapleleaf, *Quadrula quadrula*, and the Pimpleback, *Quadrula pustulosa*, were taken but amounted to approximately 0.5 percent of his total catch (Table 10).

Washboards and Threeridges were taken in about equal numbers. The Washboards, being more massive, accounted for a larger proportion of the total tonnage than did the Threeridge. Mr. Lessard's total reported tonnage for the 1977 mussel season amounted to 149.64 tons. A price of \$100 per ton of green clams was paid to his divers.

As part of the mussel survey, Mr. Lessard's clam pile was subsampled for species, size, and proportion of each species in the catch. A total of 1,456 mussels were sampled (Table 10). This included 749 Washboards, 697 Threeridge, 8 Mapleleaf, and 2 Pimpleback. Washboards averaged 15.5 cm long and made up 51.4 percent of the sample. Threeridge averaged 9.6 cm long and made up 47.9 percent of the sample. Mapleleaves (8.5 cm long) and Pimplebacks (7.7 cm long) accounted for the remainder of 0.7 percent.

Mr. Lessard preferred shells over 2 5/8" (6.7 cm) in the smallest dimension. A Threeridge this size would be 3.2" (8.0 cm) or longer.

The Threeridge mussels taken in the Black River and Pools 8 through 5A have the only shells large enough in size (9.2 cm, Table 4) and abundant enough to be of commercial value. The majority of the Threeridge were taken in Pool 7 (54.6 percent) and 8 (26.2 percent) (Table 2).

This is the smallest practical size (2 5/8" or 6.7 cm) from which to punch out pellets large enough for the cultured pearl industry. Even with a mussel of this size, approximately only one-fourth of a valve is useable due to the thinness of the shell's outside edge and staining of the interior nacre.

Markets for small shells or shells unsuitable for cultured pearl, are used for chicken grit, fertilizer, aquarium chips, and "mother-of-pearl" inlays.

Mr. Lessard's market for the dried mussel shells is the Tennessee Shell Company of Camden, Tennessee. These shells are bagged whole and exported to Japan.

DISCUSSION

Two previous mussel studies were conducted in areas similar to the present study. Before the locks and dams were constructed, Ellis (1930) surveyed the river in 14 zones (Van der Schalie, 1950). Zone III extended from Lynxville, Wisconsin to Dakota, Minnesota. This zone encompasses part of Pool 7, all of Pool 8, and most of Pool 9. The results of Ellis' study are given in Table 11.

A portion of Finke's survey (1965) also included Pool 7 as well as Pool 6. Although no direct comparisons are possible between the three surveys, due to difference in sampling areas, some observations can be made. Ellis reported 28 mussel species. In Pools 7 and 6, Finke sampled 16 species while 13 species were found during the present survey. The clam bar was used in all three studies.

The number of mussel species appears to have declined sharply from the time of Ellis' study to Finke's survey. Ellis found 12 more species than did Finke. Many of these species such as the Ebony Shell, *Fusconaia ebenus*, the Buckhorn, *Tritogonia verrucosa*, the Mucket, *Actinonaias carinata*, and the Higgins' Eye Pearly Mussel, *Lampsilis higginsii*, appear to be either extinct, rare, or endangered. Finke found two specimens of the Higgins' Eye and one specimen of the Ebony Shell (Tables 12 and 13). Neither of these two species were found in the present survey. Finke may have sampled the last remnant population of the Higgins' Eye and Ebony Shell in Pools 6 and 7. Declining species diversity is further indicated by the present study. The Buckhorn, Fat Mucket, Mucket, Elktoe, and Washboard mussels (Table 1) were found only as dead shells.

The Threeridge, indentified as *Amblema costata* or *Amblema peruviana* by Van der Schalie and Finke, was the most abundant mussel found in previous studies as well as in the present one.

Tables 12 and 13 present the mussel data for Finke's runs and corresponding runs made during the present survey. Finke collected 3.4 clams per run for Pools 7 and 6 compared to 2.0 clams per run collected during 1977. In most cases, the number of mussels surveyed decreased since 1965 (Tables 12 and 13). In addition, mussels were collected in fewer locations (Figures 2 - 45) than were collected by Finke. This indicates a definite trend in habitat decline and consequently, reduction in mussel populations.

The average size of the Threeridge, the most abundant species, has increased from 7.9 cm in 1965 to 9.1 cm in 1977 (Pool 7) and from 9.2 cm to 10.3 cm in Pool 6. An increase in the average size denotes low recruitment of juveniles into the population. Adequate recruitment is necessary for healthy mussel populations.

In all the areas surveyed in 1977, sand was the predominant bottom type (Table 5). However, hard bottom types resulted in the highest percentage of runs producing mussels. For example, 56.5 percent of the runs over a hard bottom resulted in clams. Twenty-three point one percent of the runs over sand produced clams. Muck was lowest with 17.2 percent of the runs being successful.

The 1977 study indicated that a hard substrate is prime mussel habitat. Sand may be a suitable substrate providing it is stabilized. Prime mussel habitat in Pools 8 through 5A is located in the outside bends of the main river channel where the bottom is kept free of shifting sand and silt by the scouring action of the current. The substrate consists of a combination of shale, rubble, large gravel, and lesser amounts of sand.

Commercial clamming is limited in the Mississippi River to localized beds of Threeridge and Washboard clams such as in Pool 10. Nowhere in the area studied were Washboards abundant enough to be harvested commercially.

The 2 5/8 inch width size limit resulting from the cultured pearl industry's shell requirement is preventing the harvest of sexually immature Threeridge clams. This may also be true for the Washboard, though none of these species were examined for sexual maturity. Threeridge clams that are 2 5/8 inches wide are approximately three inches long, well over the minimum size of the gravid females reported in Table 7.

The preliminary data from the 1977 mussel study indicates that the accumulations of sand in Pools 8 through 5A is limiting prime mussel habitat. This habitat is limited to the outside bends of the river channel and other areas kept free of shifting sand by the scouring action of current. Although the sand is coming from a number of sources, the major cause for its deposition must be the impoundment action of the locks and dams (U. S. Army Corps of Engineers, 1974).

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Table 1. The abundance of mussels sampled from the Black River and Pools 8 through 5A of the Mississippi River.

COMMON NAME	SPECIES	POOL				
		8	BLACK RIVER	7	6	5A
Black Sandshell	<i>Ligumia recta</i>	U	R	R	U	R
Blackhorn	<i>Tritogonia verrucosa</i>	**	**	**	**	---
Butterfly	<i>Ellipsaria lineolata</i>	R	R	R	**	R
Cartoe	<i>Truncilla truncata</i>	U	**	U	U	R
Cartoe	<i>Alasmidonta marginata</i>	---	---	**	---	---
Clamucket	<i>Lampsilis radiata siliquoidea</i>	**	---	---	---	---
Clamfoot	<i>Truncilla donaciformis</i>	U	R	U	C	U
Clam Floater	<i>Anodonta grandis</i>	U	R	R	U	U
Cossey Papershell	<i>Proptera laevissima</i>	R	R	R	U	R
Crabapple Papershell	<i>Leptodea fragilis</i>	R	R	R	R	U
Corkorynut	<i>Obovaria olivaria</i>	C	R	U	C	U
Crooked	<i>Elliptio dilatata</i>	**	R	R	U	R
Crookedleaf	<i>Quadrula quadrula</i>	U	R	R	R	R
Crookedface	<i>Quadrula metanevra</i>	R	R	**	U	**
Crooked	<i>Actinonaias carinata</i>	**	---	**	---	---
Crookedtoe	<i>Fusconaia flava</i>	U	U	U	U	U
Crookedback	<i>Quadrula pustulosa</i>	U	**	C	U	C
Crooked Heelsplitter	<i>Proptera alata</i>	R	R	R	R	**
Crooked River Pigtoe	<i>Pleurobema cordatum</i>	**	---	**	**	---
Crookedbook	<i>Lampsilis ovata ventricosa</i>	U	R	R	U	U
Crooked Floater	<i>Strophitus undulatus</i>	R	R	**	R	R
Crookedhorn Wartback	<i>Obliquaria reflexa</i>	R	R	U	R	U
Crookedridge	<i>Amblyma plicata</i>	A	A	A	C	C
Crookedboard	<i>Megalonaias cinantea</i>	---	---	**	---	---

A - Abundant* = Species is 50% or greater of the mussels sampled per pool.

C - Common* = Species is 15% to 49% of the mussels sampled per pool.

U - Uncommon* = Species is 1% to 14% of the mussels sampled per pool.

R - Rare = Species is less than 1% of the mussels sampled.

* Percentages based only on mussels sampled with the clam bar.

** Dead specimens only, gear used included clam bar, SCUBA (except 5A), Ponar dredge, and hand picking.

Table 2. The percent abundance of mussels sampled with the clam bar from the Black River and Pools 8 through 5A of the Mississippi River.

SPECIES	POOL 8		POOL 7		POOL 6		POOL 5A		BLACK RIVER		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Threeridge	138	57.7	287	63.8	25	27.5	12	33.3	64	92.8	526	59.4
Pimpleback	18	7.5	68	15.1	8	8.8	7	19.4	--	--	101	11.4
Pigtoe	16	6.7	40	8.9	13	14.3	4	11.1	5	7.2	78	8.8
Hickorynut	36	15.1	14	3.1	15	16.5	2	5.6	--	--	67	7.6
Pink Heelsplitter	1	0.4	1	0.2	--	--	--	--	--	--	2	0.2
Pocketbook	9	3.8	8	1.8	2	2.2	1	2.8	--	--	20	2.3
Fawnfoot	3	1.3	9	2.0	15	16.5	1	2.8	--	--	28	3.2
Deertoe	4	1.7	10	2.2	1	1.1	--	--	--	--	15	1.7
Butterfly	--	--	1	0.2	--	--	1	2.8	--	--	2	0.2
Spike	--	--	2	0.4	2	2.2	--	--	--	--	4	0.4
Black Sandshell	3	1.3	2	0.4	4	4.4	--	--	--	--	9	1.0
Threehorn Wartyback	1	0.4	5	1.1	--	--	2	5.6	--	--	8	0.9
Giant Floater	5	2.1	3	0.7	3	3.3	1	2.8	--	--	12	1.4
Monkeyface	--	--	--	--	2	2.2	--	--	--	--	2	0.2
Mapleleaf	3	1.3	--	--	--	--	--	--	--	--	3	0.3
Strange Floater	--	--	--	--	--	--	1	2.8	--	--	1	0.1
Fragile Papershell	--	--	--	--	--	--	4	11.1	--	--	4	0.4
Glossy Papershell	2	0.8	--	--	1	1.1	--	--	--	--	3	0.3
TOTAL	270	--	450	--	87	--	76	--	75	--	886	--

SPECIES	POOL 8		POOL 7		POOL 6		POOL 5A		BLACK RIVER		TOTAL	
	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%
Threeidge	45	16.3	49	27.3	17	8.8	7	5.5	12	41.4	130	20.7
Pimpleback	14	5.1	45	25.1	7	3.7	6	4.7	--	--	72	11.5
Pigtoe	14	5.1	19	10.6	8	4.1	3	2.3	2	6.9	46	7.3
Hickorynut	16	5.8	12	6.7	10	5.2	2	1.6	--	--	40	6.4
Pink Heelsplitter	1	0.4	1	0.6	--	--	--	--	--	--	2	0.3
Socketbook	9	3.3	8	4.5	2	1.0	1	0.8	--	--	20	3.2
Tawnfoot	2	0.7	3	1.7	9	4.6	1	0.8	--	--	15	2.4
Peertoe	4	1.4	7	3.9	1	0.5	--	--	--	--	12	1.9
Butterfly	--	--	1	0.6	--	--	1	0.8	--	--	2	0.3
Pike	--	--	1	0.6	2	1.0	--	--	--	--	3	0.5
Lack Sandshell	3	1.1	2	1.1	4	2.0	--	--	--	--	9	1.4
Breehorn Wartyback	1	0.4	5	2.8	--	--	2	1.6	--	--	8	1.3
Giant Floater	5	1.8	2	1.1	3	1.5	1	0.8	--	--	11	1.8
Monkeyface	--	--	--	--	2	1.0	--	--	--	--	2	0.3
Appleleaf	3	1.1	--	--	--	--	--	--	--	--	3	0.5
Orange Floater	--	--	--	--	--	--	1	0.8	--	--	1	0.2
Fragile Papershell	--	--	--	--	--	--	4	3.1	--	--	4	0.6
Lossy Papershell	2	0.7	--	--	1	0.5	--	--	--	--	3	0.5
TOTAL RUNS MADE	276		179		194		128		29		806	

Percent frequency occurrence = $\frac{\text{Number of runs which the species occurred}}{\text{Total number of runs}} \times 100\%$

Pools 8 through 5A of the Mississippi River.

NUMBER OF MUSSELS/ RUN	POOL 8						POOL 7						POOL 6					
	Sand		Hard		Muck		Sand		Hard		Muck		Sand		Hard		Muck	
	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%
0	114	51.8	11	5.0	32	14.5	69	43.4	15	9.4	4	2.5	103	59.9	27	15.7	6	3.5
<5	35	15.9	12	5.5	7	3.2	34	21.4	16	10.1	1	0.6	16	9.3	16	9.3	---	---
5-10	2	0.9	1	0.5	---	---	2	1.3	2	1.3	---	---	---	---	3	1.7	---	---
>10	---	---	6	2.7	---	---	---	---	15	10.1	---	---	---	---	1	0.6	---	---
TOTAL RUNS	151	68.6	30	13.6	39	17.7	105	66.0	49	30.8	5	3.1	119	69.2	47	27.3	6	3.5
GRAND TOTAL RUNS	220 (276)						159 (179)						172 (194)					

NUMBER OF MUSSELS/ RUN	POOL 5A						BLACK RIVER						TOTAL					
	Sand		Hard		Muck		Sand		Hard		Muck		Sand		Hard		Muck	
	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%	No. runs	%
0	74	64.3	9	7.8	9	7.8	7	31.8	2	9.1	2	9.1	367	53.3	64	9.3	53	7.7
<5	14	12.2	6	5.2	2	1.7	6	27.3	1	4.5	1	4.5	105	15.3	51	7.4	11	1.6
5-10	---	---	1	0.9	---	---	---	---	1	4.5	---	---	4	0.6	8	1.2	---	---
>10	---	---	---	---	---	---	1	4.5	1	4.5	---	---	1	0.1	24	3.5	---	---
TOTAL RUNS	88	76.5	16	13.9	11	9.6	14	63.6	5	22.3	3	13.6	477	69.3	147	21.4	64	9.3
GRAND TOTAL RUNS	115 (128)						22 (29)						688 (806)					

% = Number of runs used (runs over varying bottom types eliminated) / Grand total x 100%

Number in parentheses = total number of runs, including runs over varying bottom types.

Sand = Bottom consists of more than 90% sand.

Hard = Bottom consisting of rubble, gravel, or hardpan.

Muck = Bottom made up of 90% silt, clay, or a combination of the two.

TABLE 6. The correlation of mussels to water depths. mussels were sampled with the clam bar from the Black River and Pools 8 through 5A of the Mississippi River.

	POOL 8						POOL 7						POOL 6					
	Depth (Feet)						Depth (Feet)						Depth (Feet)					
	0-5	6-10	11-15	16-20	21+	Total	0-5	6-10	11-15	16-20	21+	Total	0-5	6-10	11-15	16-20	21+	Total
Number of mussels	20	89	80	29	21	239	40	216	157	37	--	450	8	49	14	20	--	91
%	8.4	37.2	33.5	12.1	8.8	--	8.9	48.0	34.9	8.2	--	--	8.8	53.8	15.4	22.0	--	--
Number of runs with mussels	7	27	20	12	8	74	19	33	24	7	--	83	4	21	6	7	--	38
%	2.5	9.8	7.2	4.3	2.9	26.8	10.6	18.4	13.4	3.9	--	46.3	2.1	10.8	3.1	3.6	--	19.6
Number of runs with >5 mussels	1	4	3	2	1	11	1	7	9	3	--	20	--	2	1	1	--	4
%	0.4	1.4	1.1	0.7	0.4	4.0	0.6	3.9	5.0	1.7	--	11.2	--	1.0	0.5	0.5	--	2.1
TOTAL RUNS MADE	276						179						194					

	POOL 5A						BLACK RIVER						TOTAL					
	Depth (Feet)						Depth (Feet)						Depth (Feet)					
	0-5	6-10	11-15	16-20	21+	Total	0-5	6-10	11-15	16-20	21+	Total	0-5	6-10	11-15	16-20	21+	Total
Number of mussels	8	7	11	8	2	36	31	30	8	--	--	69	107	391	270	94	23	885
%	22.2	19.4	30.6	22.2	5.6	--	44.9	43.5	11.6	--	--	--	12.1	44.2	30.5	10.6	2.6	--
Number of runs with mussels	7	5	5	5	2	24	5	5	2	--	12	42	91	57	31	10	23	287
%	5.5	3.9	3.9	3.9	1.6	18.8	17.2	17.2	6.9	--	41.4	5.2	11.3	7.1	3.8	1.2	1.2	28.7
Number of runs with >5 mussels	--	--	1	--	--	1	1	2	1	--	4	3	15	15	6	1	40	
%	--	--	0.8	--	--	0.8	3.4	6.9	3.4	--	13.8	0.4	1.9	1.9	0.7	0.1	5.0	
TOTAL RUNS MADE	128						29						806					

Table 7. Length of gravid mussels sampled from the Black River and Pools 8 through 5A of the Mississippi River.

Species	LENGTHS FOUND GRAVID		
	Centimeters	Inches	Number Gravid
Threeridge	5.3-11.5	2.1-4.5	54
Hickorynut	4.6-9.2	1.8-3.6	15
Pimpleback	4.2-8.6	1.7-3.4	23
Pigtoe	4.8-8.9	1.9-3.5	13
Pocketbook	8.0-12.7	3.1-5.0	3
Giant Floater	4.2-16.9	1.7-6.7	7
Black Sandshell	8.3-15.5	3.3-6.1	4
Deertoe	4.2	1.7	1
Fawnfoot	1.3-4.0	0.5-1.6	4
Pink Heelsplitter	8.5-13.0	3.3-5.1	2
Threehorn Wartyback	3.0-6.7	1.2-2.6	4
Monkeyface	8.0	3.1	1
Spike	10.9	4.3	1

Table 8. Length frequency of all mussels sampled with the clam bar from the Black River and Pools 8 through 5A of the Mississippi River.

Length (CM)	SPECIES AND NUMBER																		
	Black Sandshell	Butterfly	Deertoe	Fawnfoot *	Giant Floater	Glossy Papershell	Fragile Papershell	Hickorynut	Spike	Mapleleaf	Monkeyface	Pigtoe	Pimpleback	Pink Heelsnitter	Pocketbook	Threeshorn Wartyback	Threeridge	Strange Floater	
0- 0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.5- 0.9	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0- 1.4	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.5- 1.9	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0- 2.4	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
2.5- 2.9	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.0- 3.4	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
3.5- 3.9	-	-	3	1	-	1	-	3	-	-	-	-	2	-	3	1	-	-	-
4.0- 4.4	-	-	2	1	1	1	-	4	-	-	-	3	4	-	-	1	-	-	-
4.5- 4.9	-	-	4	-	-	-	-	2	-	-	-	2	5	-	1	1	3	-	-
5.0- 5.4	-	1	1	-	1	-	1	2	-	-	-	3	9	-	1	1	2	-	-
5.5- 5.9	-	-	-	-	-	-	2	2	-	-	-	14	15	-	-	-	-	-	-
6.0- 6.4	-	-	-	-	-	-	-	3	-	-	-	7	13	-	-	-	-	3	-
6.5- 6.9	-	-	-	-	-	-	-	5	-	-	-	13	15	-	1	1	7	1	-
7.0- 7.4	-	-	-	-	-	-	-	11	-	-	-	18	19	-	-	-	10	-	-
7.5- 7.9	-	-	-	-	-	-	-	12	-	1	1	9	10	-	-	-	34	-	-
8.0- 8.4	1	-	-	-	-	1	-	11	-	1	1	5	3	-	1	-	61	-	-
8.5- 8.9	-	1	-	-	-	-	-	8	-	-	-	2	3	1	-	-	75	-	-
9.0- 9.4	-	-	-	-	-	-	-	3	-	-	-	1	-	-	-	-	86	-	-
9.5- 9.9	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	86	-	-
10.0-10.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	87	-	-
10.5-10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	87	-	-
11.0-11.4	1	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	37	-	-
11.5-11.9	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	18	-	-
> 12.0	6	-	-	-	8	-	-	-	1	-	-	-	-	1	4	-	7	-	-
TOTAL	9	2	15	28	12	3	4	67	4	3	2	78	101	2	20	8	526	1	-

* Fawnfoot less than 2.0 CM were attached by their byssus.

Table 9. Mussel species sampled by SCUBA gear from the Black River and Pools 8 through 6 of the Mississippi River.

COMMON NAME	SPECIES	POOL 8		BLACK RIVER		POOL 7		POOL 6		POOL 5A		ALL POOLS COMBINED	
		Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Black Sandshell	<i>Ligumia recta</i>	*	x	-	-	*	x	*	x	-	-	*	x
Buckhorn	<i>Tritogonia verrucosa</i>	-	x	-	-	-	x	-	x	-	-	-	x
Butterfly	<i>Ellipsaria lineolata</i>	x	-	-	-	*	-	-	-	-	-	-	-
Deertoe	<i>Truncilla truncata</i>	x	x	-	-	*	-	-	-	-	-	*	x
Elktoe	<i>Alasmiconta marginata</i>	-	-	-	-	-	-	-	-	-	-	-	-
Fawnfoot	<i>Truncilla doncaiformis</i>	x	x	-	-	*	x	*	-	-	-	*	x
Giant Floater	<i>Anodonta granis</i>	*	-	-	-	*	x	*	x	-	-	*	x
Glossy Papershell	<i>Proptera laevisima</i>	x	-	-	-	*	-	*	x	-	-	*	x
Fragile Papershell	<i>Leptodea fragilis</i>	x	x	-	-	-	x	-	x	-	-	-	x
Hickorynut	<i>Obovaria olivaria</i>	x	-	-	-	*	x	*	-	-	-	*	x
Spike	<i>Elliptio dilatata</i>	x	x	-	-	*	x	*	-	-	-	*	x
Mapleleaf	<i>Quadrula quadrula</i>	x	x	-	-	-	-	-	-	-	-	-	-
Monkeyface	<i>Quadrula metanevra</i>	x	x	-	-	-	-	-	-	-	-	-	-
Bucket	<i>Actinonaias carinata</i>	x	x	-	-	-	-	-	-	-	-	-	-
Pigtoe	<i>Fusconaia flava</i>	-	o	-	-	-	o	-	x	-	-	-	o
Pimpleback	<i>Quadrula pustulosa</i>	x	x	*	x	*	x	*	x	*	x	*	x
Pink Heelsplitter	<i>Proptera alata</i>	x	x	-	-	*	x	*	x	*	x	*	x
Ohio River Pigtoe	<i>Pleurobema conlatum</i>	*	x	-	-	*	x	*	x	*	x	*	x
Pocketbook	<i>Lampsilis ovata ventricosa</i>	-	-	-	-	-	-	-	-	-	-	-	-
Strange Floater	<i>Strophitus undulatus</i>	-	x	-	-	*	x	*	x	*	x	*	x
Tareehorn Wartyback	<i>Obliquaria reflexa</i>	x	x	-	-	*	x	*	x	*	x	*	x
Threeridge	<i>Ambelma plicata</i>	x	x	*	x	*	x	*	x	*	x	*	x
Washboard	<i>Megalonaias gigantea</i>	-	-	-	-	-	-	-	-	-	-	-	-
NUMBER OF DIVES		2		2		6		8		NA		18	

x - Denotes live specimen of complete set of empty valves taken by diving.

* - Denotes species also taken on brail.

o - Denotes 1/2 shell.

Table 10. Commercial mussel species sampled from Mr. Donald Lessard's clamming operation, Prairie du Chien, Wisconsin.

Date	Species	No.	%	LENGTH (CM)		WIDTH (CM)	
				Average	Range	Average	Range
6-1-77	Washboard	83	63.8	15.7	14.0-18.3	9.8	9.6-16.6
	Threeridge	47	36.2	9.6	8.1-11.0	7.2	6.4- 8.5
	Total	130					
7-1-77	Washboard	61	38.4	16.1	14.3-18.3	11.1	10.0-13.1
	Threeridge	98	61.6	9.4	7.6-12.5	7.3	6.3- 9.2
	Total	159					
7-27-77	Washboard	173	40.4	15.1	12.1-18.0	11.1	8.3-13.0
	Threeridge	251	58.6	9.5	8.2-12.5	7.2	6.3- 9.2
	Mapleleaf	2	0.5	8.6	8.4- 8.7	7.2	7.1- 7.2
	Pimpleback	2	0.5	7.7	7.3- 8.0	7.3	7.0- 7.6
	Total	428					
8-22-77	Washboard	231	60.8	15.7	13.5-19.0	11.1	10.0-12.2
	Threeridge	146	38.4	10.0	8.6-12.0	7.5	6.8- 8.5
	Mapleleaf	3	0.8	8.9	8.7- 9.0	7.4	7.0- 7.7
	Total	380					
9-9-77	Washboard	201	56.0	15.4	12.5-17.8	10.7	7.2-12.3
	Threeridge	155	43.0	9.6	8.0-12.0	7.3	6.3- 8.6
	Mapleleaf	3	0.8	8.0	7.9- 8.2	6.9	6.5- 7.3
	Total	359					
Total	Washboard	749	51.4	15.5	12.1-19.0	10.8	7.2-16.6
	Threeridge	697	47.9	9.6	7.6-12.5	7.3	6.3- 9.2
	Mapleleaf	8	0.5	8.5	7.9- 9.0	7.1	6.5- 7.7
	Pimpleback	2	0.1	7.7	7.3- 8.0	7.3	7.0- 7.6
	Total	1,456					

Table 11. Zone III* of Ellis' 1930-31 mussel survey of the Mississippi River.

COMMON NAME	SPECIES	NUMBER
Ebony Shell	<i>Fusconaia ebenus</i>	2
Pigtoe	<i>Fusconaia undata</i>	21
Washboard	<i>Megalonaias gigantea</i>	5
Threeridge	<i>Amblema</i> sp.	24
Pimpleback	<i>Quadrula pustulosa</i>	11
Wartyback	<i>Quadrula nodulata</i>	1
Monkeyface	<i>Quadrula metanerva</i>	1
Buckhorn	<i>Tritogonia verrucosa</i>	16
Spike	<i>Elliptio dilatatus</i>	24
Rockshell	<i>Arcidens confragosus</i>	2
Pancake	<i>Lasmigona complanata</i>	8
Floater	<i>Anodonta</i> sp.	32
Strange Floater	<i>Strophitus undulatus</i>	38
Threehorn Wartyback	<i>Obliquaria reflexa</i>	23
Hickorynut	<i>Obovaria olivaria</i>	6
Mucket	<i>Actinonaias carinata</i>	32
Deertoe	<i>Truncilla truncata</i>	8
Fawnfoot	<i>Truncilla donaciformis</i>	4
Butterfly	<i>Ellipsaria lineolata</i>	6
Fragile Papershell	<i>Leptodea fragilis</i>	20
Pink Heelsplitter	<i>Proptera alata</i>	49
Black Sandshell	<i>Ligunia recta</i>	2
Yellow Sandshell	<i>Lampsilis anodontoides</i>	14
Slough Sandshell	<i>Lampsilis anodontoides fallaciosa</i>	4
Fat Mucket	<i>Lampsilis radiata siliquoidea</i>	38
Pocketbook	<i>Lampsilis ovata ventricosa</i>	29
Higgins' Eye	<i>Lampsilis higginsii</i>	2
TOTAL MUSSELS		422
TOTAL SPECIES		28

* Zone III includes the area one mile upstream from Dakota, MN (Pool 7) to Lynxville, WI (Pool 10).

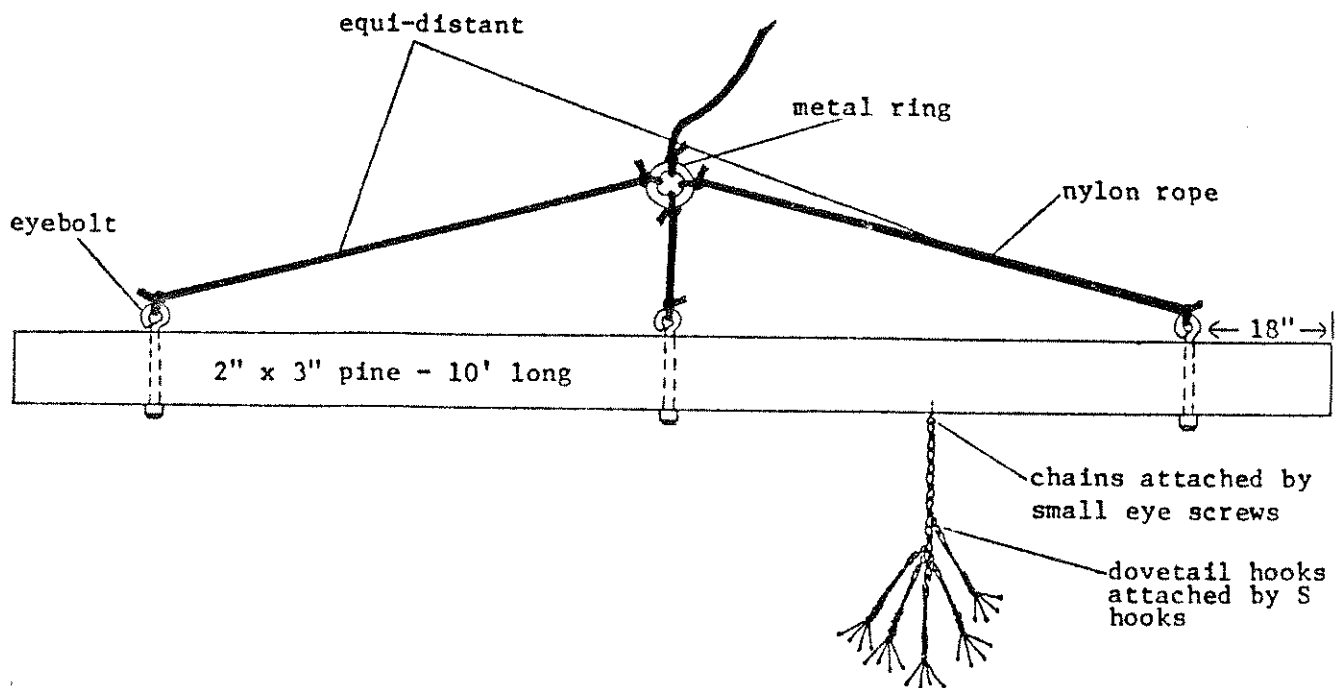
Table 12. The comparison of abundance and frequency of mussels in Pool 7, 1977, with Finke's study, 1965.

SPECIES	1965				1977				Total of All Runs In					
	No. Clams		% Abundance		No. Clams		% Abundance		No. Clams		% Abundance		No. Clams	
	No. Clams	% Abundance	No. Clams	% Abundance	No. Clams	% Abundance	No. Clams	% Abundance	No. Clams	% Abundance	No. Clams	% Abundance	No. Clams	% Abundance
Threeridge	245	60.6	42	50.6	157	67.1	25	32.0	287	63.8	49	27.3		
Pigtoe	35	8.7	17	20.5	20	8.5	11	14.1	40	8.9	19	10.6		
Pimpleback	81	20.0	38	45.8	34	14.5	22	28.2	68	15.1	45	25.1		
Hickorynut	21	5.2	13	15.7	9	3.8	8	10.3	14	3.1	12	6.7		
Pink Heelsplitter	1	0.2	1	1.2	-	-	-	-	1	0.2	1	0.6		
Pocketbook	1	0.2	1	1.2	5	2.1	5	6.4	8	1.8	8	4.5		
Fawnfoot	-	-	-	-	5	2.1	4	5.1	9	2.0	3	1.7		
Deertoe	1	0.2	1	1.2	3	1.3	3	3.8	10	2.2	7	3.9		
Butterfly	2	0.5	2	2.4	-	-	-	-	1	0.2	1	0.6		
Snike	-	-	-	-	-	-	-	-	2	0.4	1	0.6		
Black Sandshell	2	0.5	2	2.4	1	0.4	1	1.3	2	0.4	2	1.1		
Threehorn Wartyback	6	1.5	6	7.2	-	-	-	-	5	1.1	5	2.8		
Giant Floater	3	0.7	3	3.6	-	-	-	-	3	0.7	2	1.1		
Monkeyface	3	0.7	3	3.6	-	-	-	-	-	-	-	-		
Mapleleaf	1	0.2	1	1.2	-	-	-	-	-	-	-	-		
Higgins' Eye	2	0.5	2	2.4	-	-	-	-	-	-	-	-		
Ebony Shell	-	-	-	-	-	-	-	-	-	-	-	-		
TOTAL	404		83		234		78		450		179			

Table 13. The comparison of abundance and frequency of mussels in Pool 6, 1977, with Finke's study, 1965.

SPECIES	1965				1977				Total of All Runs In 1977 Study			
	No. Clams	% Abundance	No. Runs	% Frequency Occurrence	Runs Corresponding to Finke's Study		Runs Corresponding to 1977 Study		No. Clams	% Abundance	No. Runs	% Frequency
					No. Clams	% Abundance	No. Runs	% Frequency				
Threeridge	56	52.3	24	34.8	12	22.2	8	12.3	25	27.5	17	8.8
Pictoe	8	7.5	6	8.7	5	9.3	2	3.1	13	14.3	8	4.1
Pimpleback	14	13.1	8	11.6	6	11.1	5	7.7	8	8.8	7	3.7
Hickorynut	2	1.9	2	2.9	11	20.4	6	9.2	15	16.5	10	5.2
Pink Heelsplitter	-	-	-	-	-	-	-	-	-	-	-	-
Pocketbook	4	3.7	3	4.3	2	3.7	2	3.1	2	2.2	2	1.0
Fawnfoot	-	-	-	-	10	18.5	6	9.2	15	16.5	9	4.6
Deertoe	-	-	-	-	-	-	-	-	1	1.1	1	0.5
Butterfly	-	-	-	-	-	-	-	-	-	-	-	-
Spike	5	4.7	5	7.2	2	3.7	2	3.1	2	2.2	2	1.0
Black Sandshell	8	7.5	7	10.1	3	5.6	3	4.6	4	4.4	4	2.0
Threhorn Wartyback	4	3.7	2	2.9	-	-	-	-	-	-	-	-
Giant Floater	3	2.8	3	4.3	1	1.9	1	1.5	3	3.3	3	1.5
Monkeyface	-	-	-	-	-	-	2	3.1	2	2.2	2	1.0
Manleleaf	-	-	-	-	-	-	-	-	-	-	-	-
Higgins' Eye	-	-	-	-	-	-	-	-	-	-	-	-
Ebony Shell	1	0.9	1	1.4	-	-	-	-	-	-	-	-
Glossy Papershell	-	-	-	-	-	-	-	-	1	1.1	1	0.5
Slough Sandshell	2	1.7	2	2.9	-	-	-	-	-	-	-	-
TOTAL	107		69		54		65		91		194	

Figure 1. Dovetail brail used in sampling the Black River and Pool 8 through 5A of the Mississippi River.



Chains - 1' long
 5 hooks/chain
 400 chains and 2,000 hooks/bar
 3" spacing between chains

Figures 2 - 45 show on detailed river maps the locations of all mussels taken. These are on file in the original report, Department of Natural Resources, Madison.

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