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A SURVEY OF THE FRESHWATER MUSSELS OF THE OHIO RIVER FROM GREEN--ETC(U)
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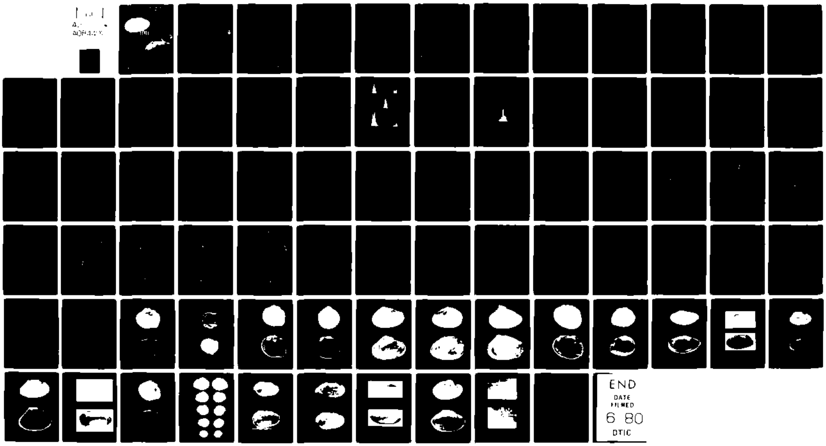
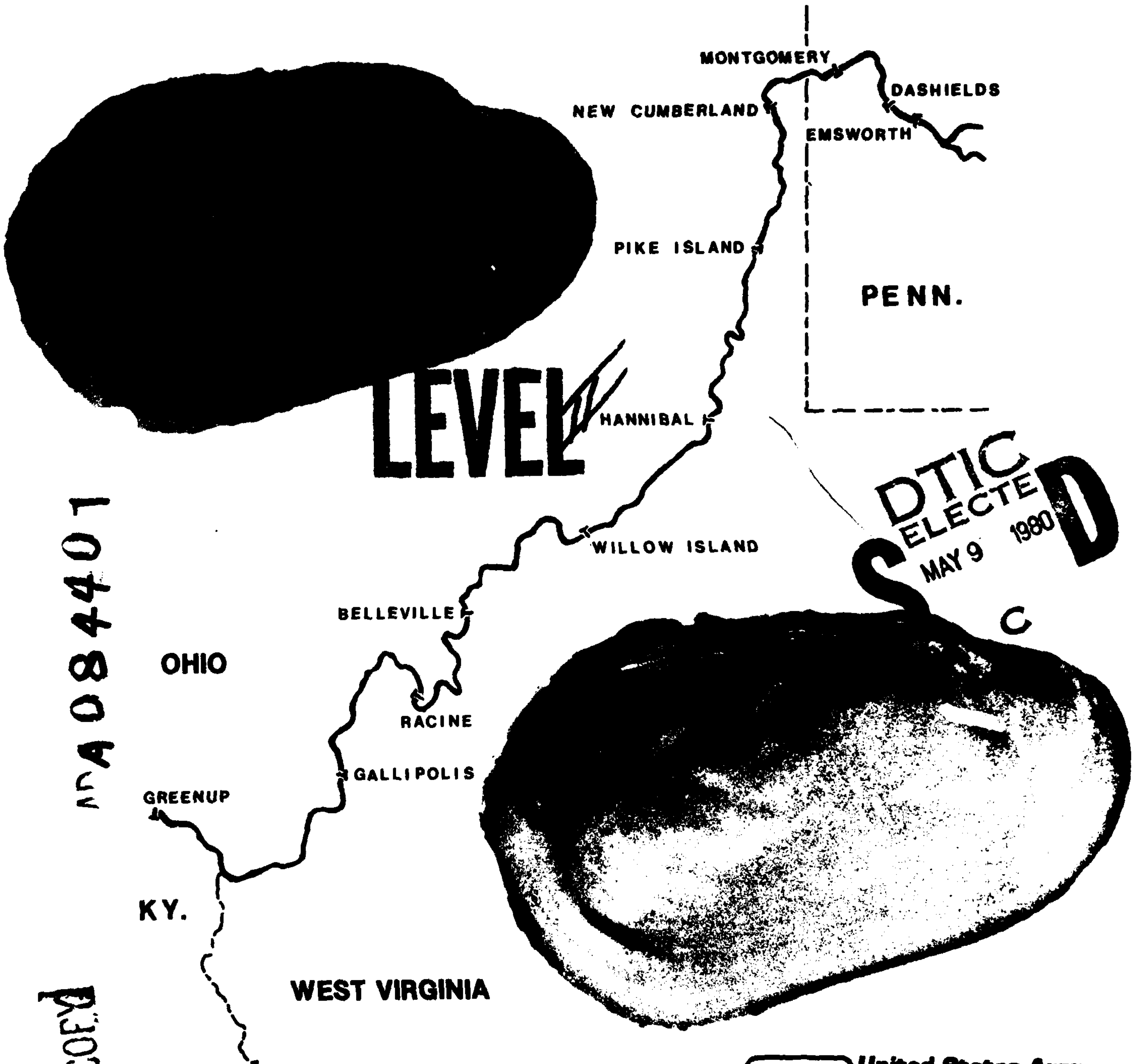


A Survey of the Freshwater Mussels of the Ohio River from Greenup Locks and Dam to Pittsburgh, Pa.



United States Army Corps of Engineers

Huntington District

Pittsburgh District

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6 A Survey of the Freshwater Mussels of the Ohio River

~~From~~ Greenup Locks and Dam to Pittsburgh, ~~Pa.~~ Pennsylvania

A Report Submitted To

The U. S. Army Corps of Engineers

Huntington District

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by

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JOB

"Owing to the steady extermination of the molluscan life of the Ohio River in western Pennsylvania, due to the pollution and damming of the waters of that river and of the Monongahela, and to a smaller extent of the Allegheny River, any information relating to the species still existing in these waters must be quickly put on record to be preserved."

Samuel Rhoads, 1899.

"The Ohio River, "La Belle Riviere" of the French explorers, has become a wide sewer, into which, under our benevolent, far-seeing, and wise Governments, the filth and vileness of hundreds of towns and cities, the contaminating water of thousands of mines, and the sewage of tens of thousands of cesspools and barn-yards is now being discharged in a nasty mass of corruption. "At the very nick of time," it was resolved, before it might be too late, to secure collections representing the fluviatile life of the state of Pennsylvania. This has been done. It cannot be done again, for, where we began fifteen years ago to collect shells from the rivers, there is now not a single shell to be found."

W. J. Holland
Director, Carnegie Museum
1921.

"It is altogether probable that some of our species have or will become extinct even before they are discovered."

David H. Stansbery, 1971.

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INTRODUCTION

For thousands of years the Ohio River flowed freely along for nearly 1000 miles from its origin at the junction of the Allegheny and Monongahela Rivers to its confluence with the Mississippi River. Prior to the 18th Century the river waters flowed through pristine lands frequented only by an occasional native-born American. The river existed as a series of riffles, pools and an occasional natural waterfall. A wide variety of natural habitat types prevailed and aquatic life was abundant in this clean, uncontaminated, virgin stream.

Toward the latter 1700's white man made his way into the Ohio Valley. Settlements sprang up and grew rapidly. Early settlements at Marietta, Pomeroy and Cincinnati, Ohio and Louisville, Kentucky began as forts, metamorphosed into trade centers and matured into densely populated urban complexes. By the beginning of the 19th Century the coal, petroleum, iron and lumbering industries developed in the valley and more people kept coming to man the factories and mills. As the number of inhabitants of this area grew into the millions, a concomitant degradation of the environment began. Siltation of streams increased as a result of lumbering and agricultural practices. Acid runoff from mining operations contributed to stream pollution and the smokestacks and effluents of factories poured millions of pounds of waste onto the land and into the waters of previously uncontaminated streams. By no means of small concern was the ever increasing flow into the river of billions of gallons of raw untreated human sewage generated by the burgeoning riverside population.

During the 1800's little or no concern was shown for the fate of the Ohio River or its aquatic inhabitants. One notable exception, Rafinesque, the famous French naturalist, toured much of the Ohio around 1820 and collected and recorded for posterity the existence of many life forms which were previously unknown. Notably among his finds was a vast assemblage of freshwater mussels. He reported 68 new species of bivalves as existing in the Ohio River alone. This was even more remarkable when one considers that this number of species is approximately five times the total number of species of mussels found in all of Europe (Stansbery, 1971).

As one might guess from the statements made above, environmental conditions in the Great Ohio were on the downswing. During the period 1800-1900 most of the resident species of the river were put under stress and as a result of this environmental degradation, a parade of species passing into extinction began and continues until this day.

In addition to the deplorable conditions that already existed, the death knell for aquatic species tolled even louder toward the end of the 19th Century as a new mode of habitat modification came on the scene. In the year 1885, the first dam was built on the Ohio River. In order to feed the insatiable diets of riverside industries for iron ore, pig iron, clay, sand and coal, an economical transportation system was sought. An inland waterway navigable throughout the year proved to be the answer. The river with its natural barriers to barge traffic had to be modified. The economics of life demanded it.

Between the years of 1910-1929 a series of Chanoine movable wicket dams was built by the United States Army Corps of Engineers and a minimum nine-foot slackwater pool navigation system was created such that a riverboat pilot could sail throughout the year from Pittsburgh, Pennsylvania to Cairo, Illinois and the Mississippi River unhindered. What had been, a few years before, a series of boulder strewn riffles distributed intermittently between shallow pools was now converted into a series of moderately deep navigation pools which flow one into the next along the course of the river. At one time as many as 54 of these dams existed. The change in the river was not complete, however, and in 1938 a series of larger higher dams was begun. These dams would meet the needs of the ever increasing barge industry. Bigger heavier barges occasionally require a fully-loaded draft greater than nine feet. With the completion of Willow Island Locks and Dam in 1976, coupled with a planned upgrading and expansion of the Gallipolis Locks and Dam facility, it seems that the present series of high rise dams will suffice to meet barge traffic needs until the 21st Century. Habitat modification and degradation now seems complete. The original river, subject only to the whims of mother nature, in no way resembled this modern, stable, unchanging navigable waterway that exists today.

As a result of this habitat modification and pollution, many of the resident species are gone from the river, no longer able to survive in a drastically changed habitat.

In recent years man has become concerned about his environment and has made significant advances in cleaning it up. Since about 1950 many federal, state and private agencies have concerned themselves with reversing the trend. Such agencies as the Ohio River Sanitation Commission (ORSANCO), U. S. Fish and Wildlife Service and the Departments of Natural Resources of the states adjacent to the river have made remarkable strides in their efforts to clean up the river. Through the efforts of these agencies, sewage flowing into the Ohio must be treated and the effluents of industry are closely monitored so that the influx of toxic substances is kept at a bare miminum. Other activities such as dredging, which may displace or disrupt aquatic life, are regulated and licensed. The Corps of Engineers is sensitive to the damage to aquatic life that may be effected by rapid changes in pool level and attempts as much as possible to carry out draw-downs, etc. at such times as the resultant damage to aquatic organisms will be minimal.

As conditions improve, many organisms are making a comeback. Fishing is improving, riverside birds are returning, and hopefully many of the mussels may return. Since the early travels of Rafinesque (1820) and the subsequent report of A. E. Ortmann (1920), which included the materials of many collectors of the late 1800's, little work has been done to document what freshwater mussels exist today in the upper Ohio River. We have no way of knowing when a species either becomes extinct or population numbers increase if we have no base line data upon which to make a judgment. John Williams' work published in 1969 did much to document the status of commercially valuable mussels in the lower Ohio River. The river between Greenup, Kentucky and Pittsburgh, however, has had no such definitive work carried out there. As far as the author can determine, no papers appear in the scientific literature with reference to the mussels of the river between Huntington, West Virginia and Marietta, Ohio--a distance of nearly 150 river miles. Ortmann's work gave considerable information about the river mussel population between Marietta and Pittsburgh, but this information is from 50 to 75 years old.

By virtue of the fact that little has been done to document the status of the Ohio River mussel population of this reach of the river for at least 50 years, the Huntington and Pittsburgh Districts of the United States Army Corps of Engineers entered into a contract with Marshall University to conduct a survey of the freshwater mussels of the river between Greenup Locks and Dam and Pittsburgh during the summer of 1979.

The Influence of Habitat Modifications and/or Degradation on Freshwater Mussels

Experts in the field disagree on the rate and extent of movement of freshwater mussels, but most will agree that these animals are basically sedentary and thus are highly susceptible to changes in environmental parameters wrought by man. Hirsch, et al. (1968) and Yokley and Gouch (1976) have demonstrated the deleterious effects of stream dredging on mussels. Imlay (1972) showed in a laboratory situation that mussels, when covered by debris and silt, often have difficulty resurfacing and many times will die as a result of being covered. Neff, et al. (1978) and Imlay (1973) discussed the harmful effects of heavy metals and other inorganics that are often found presently in river substrates. They also alluded to the fact that mussels, being filter feeders, will concentrate these pollutants to levels many times that found in the ambient environment.

Other factors have in theory been shown to contribute to the decline in numbers of freshwater mussels over the years in most streams in eastern North America. Among these factors are impounding of streams, overharvesting by commercial musselers, channelization, pollution and fish kills which remove the host fish required by mussels to complete their life cycle. Any one of the aforementioned factors could potentially have a devastating effect on mussel populations, but the combined affect of all these is of such an impact that whole mussel faunas have been seriously depleted or extirpated from a number of streams. No one factor seems to be the lone culprit but rather it appears that the combined impacts must be contemplated when one considers ways of reversing the trend and restoring the streams to a near natural state.

One sobering thought surfaced during this study. No matter how thoroughly the river is monitored, no matter how clean the water may become, the river has been permanently and irreversibly altered from a lotic to a lentic environment. A new mussel fauna may perhaps become reestablished, but its composition will not be the same. The shallow water species or those species that require swiftly flowing water are gone forever; their habitat no longer exists in the Ohio River.

Much research remains to be done to pinpoint the harmful effects of each of the habitat-altering phenomena mentioned herein. A more complete understanding of these phenomena might insure continued survival of affected species for future generations.

Commercial Harvesting

Several rivers in North America are exhibiting declining mussel populations resulting from the aforementioned environmental conditions. Additional pressure is being applied through overharvesting by commercial musselers. Within this reach of the Ohio River, however, this is not a problem since mussels are apparently nowhere found in sufficient abundance to make commercial collecting profitable. The West Virginia Department of Natural Resources and their counterparts in Ohio and Pennsylvania informed the author that no commercial musseling permits have been granted for use on this portion of the Ohio River for many years. Fifty years or so ago when the pearl button industry was at its peak, musseling in the Ohio was a thriving enterprise. One elderly gentleman, encountered (at WV RM 303.5) on our travels, remembered as a youngster sitting on the riverbank and watching barge loads of mussels being taken from the river just upstream of Guyandotte, West Virginia. His memory of the date was not exact but placed the event around 1920. At that same site we collected a few fresh Pleurobema cordatum and a variety of subfossils (see Table 5). That large population has apparently all but disappeared.

Coker (1919) documents the state of the mussel industry between the turn of the century and 1919. The use of shells in the manufacture of pearl buttons began in 1891. These buttons gained widespread and rapid acceptance and the industry flourished. The industry spread into the Ohio River and its tributaries as the Mississippi and other central basin stream faunas became depleted. Coker's data show that in 1912 alone shells valued in excess of $100,000 were taken from the Ohio. At one time as many as twenty-six shell processing plants were operating along the Ohio. Many of the major tributaries also had a thriving mussel industry (Muskinghum, Scioto, Kentucky, Green, Cumberland and Wabash).

With the invention of plastics around the time of World War II the demand for pearl buttons was reduced and it seemed that there would be a reduction in harvesting pressure over already seriously depleted mussel beds. At about the same time, however, a new use for mussels came into vogue. The Japanese had developed a way to use smooth round blanks, punched from mussel shells, in the manufacture of cultured pearls (Cahn, 1949). The demand again increased, prices of shells skyrocketed and mussel beds in many streams were again in danger of overharvesting and thus extirpation. The reach of the Ohio covered in this study has played an insignificant role in the pearl industry; however, pollution, impoundment, dredging, etc. have all contributed to a reduction in mussel populations to a point that since about the mid 1930's it has not been financially feasible to mussel commercially.

The present day real value of mussels in the Ohio River is not of commercial value but rather one of aesthetics and survival. Their real value lies in the fact that mussels are good indicators of suitable water quality, and as we monitor their increase or decrease in distribution and numbers we can evaluate man's efforts to clean up his environment. If we create an environment unsuitable for mussels, it will have long since been unsuitable for consumption and use by man.

Survey Method

During the months of May-September 1979 the Ohio River, from its origin at Pittsburgh, Pennsylvania to the Greenup Locks and Dam, Greenup, Kentucky, was surveyed in order to document the extant freshwater mussel fauna. This was accomplished by a team of biologists from Marshall University traveling the river in a sixteen foot bass boat powered by a fifty horsepower outboard motor. The river was traversed at approximately five miles per hour until either likely looking habitat or shell debris was spotted. Sighting of shell deposits was aided by using binoculars to scan the shore line. In either case, as shells were discovered the boat was beached and collections were made. All shells, old and new, were collected from the beaches, bagged and tagged with locality data and later returned to the laboratory for sorting and identification. Many additional shells were also hand picked from shallow waters. By virtue of the fact that mussels were already in short supply, very few live specimens were removed from the river. For the most part live specimens were collected, identified and returned to the water. Many sites were brailed, using a six foot sampling brail, but for the most part brailing proved unsatisfactory as there was so much debris on the river bottom that we spent more time cleaning the brail than we spent brailing. One brail became so entangled in debris in about thirty feet of water that the rope was cut and the brail abandoned. Brailing is a very effective collecting technique where substrates are composed of silt, sand and cobble ~~and~~ where mussels are present in high concentrations. For ~~the most part~~ this was not the case in the upper Ohio River.

Upon returning to the laboratory specimens were cleaned, labeled, aged, cataloged and classified as to whether they were without a doubt distinctly fresh or whether they were sub-fossils. Stansbery has used this term in many papers to label those shells that have been dead for some years. These shells are characterized as having a peeling, flaking periostracum (outer layer of shell) and a chalky appearance to the nacre (inner surface of shell). Throughout this paper those species found only as sub-fossils will be so designated and the name followed by an asterik. Sub-fossils are included so that the original distribution patterns may be documented. These data on presently extinct forms give a clue as to how serious the impact of civilization has been on the river fauna.

Voucher specimens have been placed in the Ohio State University Museum. Dr. David Stansbery of that institution kindly identified and verified the taxonomic designation of many of our specimens.

All localities where mussels were found were photographed and some descriptive information on the sites is included later in this report. Localities are plotted on the maps and included in Table 4.

All scientific names are those used by Stansbery (1979).

Results of Survey

During the study we were able to locate a total of 38 sites that we consider to be active (based on the fact that some fresh material was found).

Several other shore line localities where shells were abundant were found, but these were presumed, by virtue of the antiquity of the shells and the abundance of flint and bone fragments, to be Indian midden heaps. These shells are not included in this report.

Cont.

The total number of species identified was 35. ~~(see Table 6).~~ Of this number eight were found only as sub-fossil shells and must be presumed to be presently extinct or very nearly so in this reach of the river.

The following is a list of species compiled as a result of the survey with a note on the relative abundance.

SPECIES	Presumed Extinct	Rare	Frequently Found	Abundant
	RELATIVE ABUNDANCE			
Anodonta imbecillis Say, 1829		X		
Anodonta grandis grandis Say, 1829		X		
Anodonta grandis corpulenta Cooper, 1834		X		
Strophitus undulatus undulatus (Say, 1817)		X		
Lasmigona complanata (Barnes, 1823)		X		
Lasmigona costata (Raf., 1820)		X		
Lasmigona compressa (Lea, 1829)		X		
Quadrula quadrula (Raf., 1820)				X
Quadrula metanevra (Raf., 1820)			X	
Quadrula pustulosa pustulosa (Lea, 1831)			X	
Amblema plicata plicata (Say, 1817)				X
Fusconaia ebena (Lea, 1831)		X		
Fusconaia maculata maculata (Raf., 1820)		X		
Fusconaia flava (Raf., 1820)			X	
Cyclonaias tuberculata (Raf., 1820)		X		
Plethobasus striatus* (Raf., 1820)	X			
Pleurobema cordatum (Raf., 1820)		X		
Elliptio crassidens crassidens* (Lamarck, 1819)	X			

	Presumed Extinct	Rare	Frequently Found	Abundant
Elliptio dilatata* (Raf., 1820)	X			
Uniomerus tetralasmus (Say, 1830)		X		
Obliquaria reflexa Raf., 1820			X	
Cyprogenia stegaria* (Raf., 1820)	X			
Actinonaias ligamentina carinata* (Barnes, 1823)	X			
Plagiola lineolata (Raf., 1820)		X		
Obovaria retusa* (Lamarck, 1819)	X			
Leptodea fragilis (Raf., 1820)				X
Potamilus alatus (Say, 1817)				X
Potamilus ohiensis (Raf., 1820)			X	
Toxolasma parvus (Barnes, 1823)		X		
Villosa iris iris (Lea, 1829)		X		
Lampsilis teres form teres (Raf., 1820)		X		
Lampsilis radiata luteola (Lamarck, 1819)			X	
Lampsilis orbiculata* (Hildreth, 1828)	X			
Lampsilis ventricosa (Barnes, 1823)		X		
Lampsilis ovata* (Say, 1817)	X			

These designations presumed extinct and rare are valid only for the Ohio River. Most of these species are in fact very common in other streams within their respective ranges. See Appendix 1 for species that are reported herein that appear on State or Federal Rare and Endangered Lists.

One sees from the data presented that only a few species were found in relative abundance. By far the most abundant shell found was Quadrula quadrula. With a little work bushels of this shell could have been collected at certain sites. One particularly active site is located at the head of Halfway Island (RM 178) where fresh shell material lay several inches deep all along the beach and in the surrounding shallow water. Many live specimens were noted here also. Williams (1969) reported that Q. quadrula comprised approximately 15 percent of the mussels in his area of the river, whereas in the upper Ohio we found the numbers of this species to exceed that of all other species combined. Amblema plicata plicata, Leptodea fragilis and Potamilus alatus were the only other species found in large numbers. All other species were either found in limited numbers or their distribution was limited to one or two pools. The species found in each pool are listed in Table 7.

Greenup, Gallipolis, Racine, Belleville and Hannibal Pools all had fairly active mussel populations; but Belleville Pool was by far the most productive of all pools in total numbers and diversity of species. It may be well to mention at this point that the Belleville Pool area is the most scenic section of the river and exhibits the least influence of man. At this point there is little industry and the river flows through a primarily rural agricultural community. Pools and their resident species are listed in Table 7. Willow Island has only a very scanty mussel population and Pike Island, New Cumberland and Montogomery Pools are essentially devoid of mussel life. It is interesting to note that we found no mussels at all in the first ninety or so miles below Pittsburgh. Even the very abundant Q. quadrula was not collected upstream of RM 131.

The only bivalve found in the upper reaches of the river was the exotic import, Corbicula leana, Prime 1864, the Asian clam. This small clam, considered a pest by most, is apparently able to do well even in the extremely polluted waters in and around the Pittsburgh area as we found them just a few miles below the origin of the Ohio. I would assume that Corbicula is well into the Allegheny and Monongahela Rivers by now. Corbicula is extremely abundant in the lower pools and on some beaches shells were numbered in the thousands. They were present in every pool although numbers decreased toward the origin of the river. Corbicula is not given a lot of consideration in this study as it is not considered a native resident species having first been reported in the Ohio River around 1960.

When looking at the state of health of any living organism one must look at such things as average age of the individuals, numbers of young and old specimens and the age of attainment of sexual maturity. To have meaningful statistical data one must have sufficient numbers fairly widely distributed throughout the range of the study. The only mussel that satisfies both these criteria is Quadrula quadrula. The data presented in Table 1 are based on 1244 specimens from the Greenup, Gallipolis, Racine, Belleville and Willow Island Pools. These data indicate that Q. quadrula grows rapidly until the fifth or sixth year and then increases slightly each year thereafter. One could assume that sexual maturity is reached at about age five. The number of individuals over ten years of age falls off sharply with the maximum age being approximately fifteen years. A good number of two, three and four year old individuals indicates reproduction is taking place and recruitment of new individuals into the resident population is occurring.

One other species was represented by as many as fifty fresh specimens—Amblema plicata. Data are presented in Table 2 on age and growth patterns of this species. A preponderance of individuals in the five to eight year old category plus the fact that there were several two, three and four year old specimens found coupled with the fact that no specimen over ten years old was found could indicate a young population just becoming reestablished. Williams (1969) reported individuals in the lower Ohio as old as 20 years with the majority of specimens ranging from eight to fifteen years old. At least this species, Amblema plicata, may have been absent from this part of the river for a while but presently is making a limited comeback.

All other species were found in limited numbers with several represented by only one or two specimens. See Table 3 for total numbers collected. Several species (Obliquaria reflexa, Potamilus alatus, Potamilus ohiensis, Quadrula pustulosa and Leptodea fragilis) while never found in large numbers seem to be holding their own as sub-adult individuals were found for all these species. Populations of species in this group might be categorized as small but stable. All other species are probably accidentals and exist there only as a result of being washed out of smaller streams or by virtue of there being a small area of suitable habitat still available.

Table 1

Average size for each age group of _Quadrula quadrula_ by pool.*
Data based upon ten randomly selected specimens (when numbers permitted).

Quadrula quadrula — Greenup Pool

Age	No.	Avg. length mm	Avg. height mm
2	6	33.7	28.6
3	10	38.7	33.0
4	10	48.0	40.5
5	10	51.2	42.7
6	10	63.3	53.3
7	10	67.2	55.7
8	10	68.0	55.3
9	3	72.5	60.7

Quadrula quadrula — Gallipolis Pool

Age	No.	Avg. length mm	Avg. height mm
2	2	31.5	26.7
3	10	45.0	37.8
4	10	51.1	44.4
5	10	61.5	50.6
6	10	65.5	55.0
7	10	71.5	59.6
8	3	81.5	66.6
9	1	86.0	68.2

Quadrula quadrula — Racine Pool

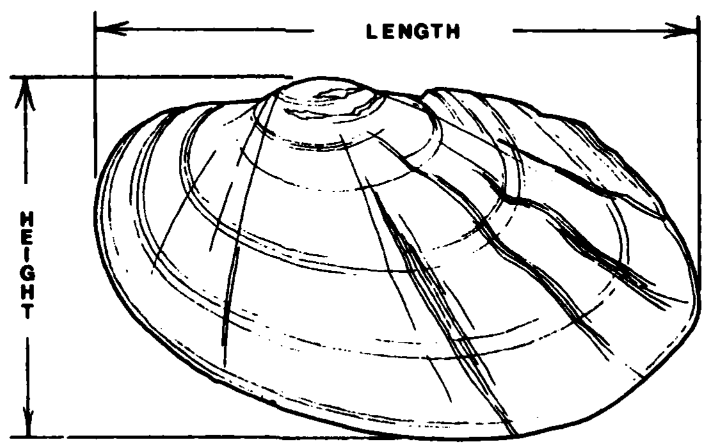
Age	No.	Avg. length mm	Avg. height mm
3	3	40.3	32.9
4	9	45.1	38.7
5	10	57.4	47.3
6	10	60.9	50.8
7	10	70.5	55.9
8	10	80.0	62.1
9	10	85.6	66.1
10	9	82.4	64.9
11	1	85.0	65.6
12	2	89.2	70.0
13	1	90.5	64.9

Table 1 (continued)

Quadrula quadrula		Belleville Pool	
Age	No.	Avg. length mm	Avg. height mm
2	10	35.5	29.0
3	10	50.5	41.9
4	10	53.6	44.2
5	10	52.2	42.6
6	10	61.8	49.4
7	10	67.0	54.3
8	10	71.2	57.0
9	10	72.0	57.5
10	10	84.5	65.4
11	10	79.6	63.2
12	8	80.9	66.2
13	5	80.1	66.6
14	1	80.3	65.0

Quadrula quadrula		Willow Island Pool	
Age	No.	Avg. length mm	Avg. height mm
2	1	32.7	27.5
3	1	39.5	31.7
4	8	49.2	40.9
5	6	53.6	44.6
6	3	55.4	45.7
7	10	73.2	58.9
8	9	77.1	61.4
9	10	81.5	65.4
10	5	79.8	65.0

*Greatest length and height measurements of a typical shell.



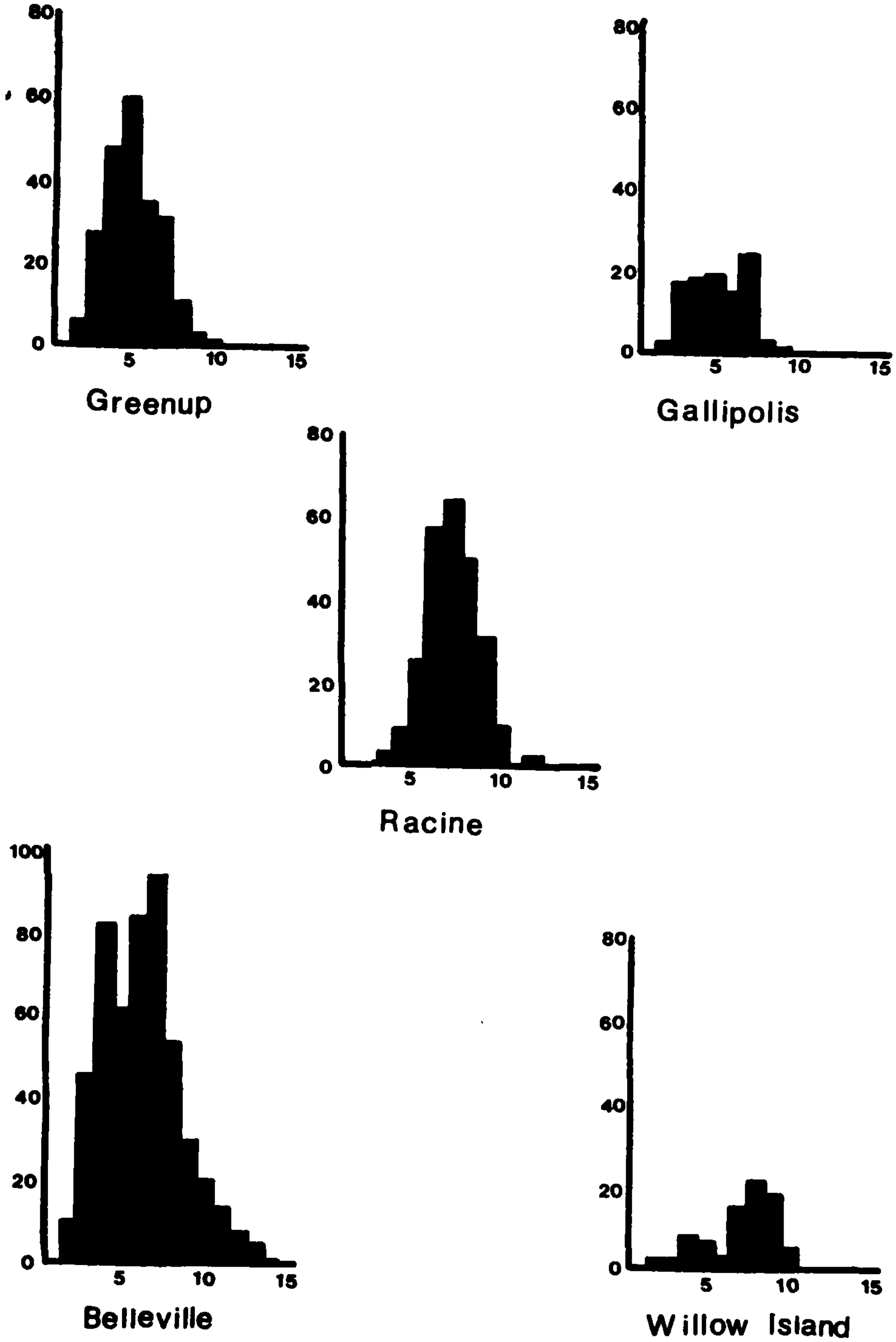


Figure 1. Age distribution of Quadrula quadrula by river pool.

(Age on the abscissa)
(Number of individuals on the ordinate)

Table 2

Average size for each age group of *Amblema plicata plicata* for reach of river (RM 0-341).*

Age	No.	Avg. length mm	Avg. height mm
2	3	33.7	26.0
3	4	46.0	36.2
4	7	56.1	46.0
5	20	65.4	51.7
6	9	76.5	59.4
7	8	80.0	63.7
8	3	91.0	74.0
9	0	—	—
10	1	105.0	76.5

*Numbers insufficient to evaluate by pools.

Figure 2. Number of individuals by age group - Amblema plicata plicata (Say, 1817).

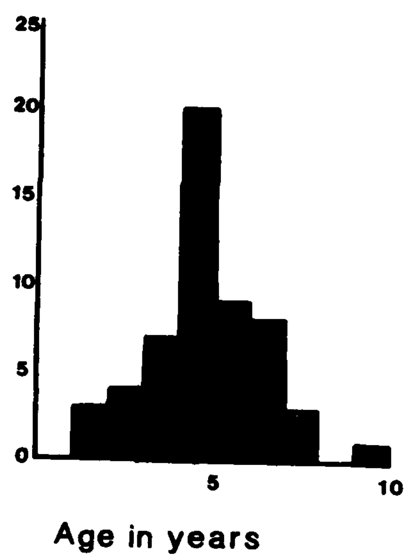


Table 3

Species list and total numbers of specimens collected (represented by distinctly fresh material) during survey.

Species	Total number collected
Anodonta imbecillis Say, 1829	3
Anodonta grandis grandis Say, 1829	19
Anodonta grandis corpulenta Cooper, 1834	1
Strophitus undulatus undulatus (Say, 1817)	3
Lasmigona complanata (Barnes, 1823)	4
Lasmigona costata (Raf., 1820)	1
Lasmigona compressa (Lea, 1829)	2
Quadrula quadrula (Raf., 1820)	1244
Quadrula metanevra (Raf., 1820)	5
Quadrula pustulosa pustulosa (Lea, 1831)	34
Amblema plicata plicata (Say, 1817)	55
Fusconaia flava (Raf., 1820)	10
Cyclonaias tuberculata (Raf., 1820)	10
Pleurobema cordatum (Raf., 1820)	6
Uniomerus tetralasmus (Say, 1830)	2
Obliquaria reflexa Raf., 1820	21
Plagiola lineolata (Raf., 1820)	1
Leptodea fragilis (Raf., 1820)	36
Potamilus alatus (Say, 1817)	22
Potamilus ohiensis (Raf., 1820)	26
Toxolasma parvus (Barnes, 1823)	6
Villosa iris iris (Lea, 1829)	2
Lampsilis teres form *teres* (Raf., 1820)	1
Lampsilis radiata luteola (Lamarck, 1819)	10
Lampsilis ventricosa (Barnes, 1823)	2
Total	1526

81.5% *Quadrula quadrula* by actual numbers.

Species Account

The number in parenthesis represents the number of sites at which the mussel was collected.

Anodonta imbecillis Say, 1829 (3)

Common Name - Paper Pond Shell
Host Fish - Lepomis sp.
Relative Abundance - Never common in Ohio River

Ortmann reports this species as preferring the quiet waters of creeks, ponds and small rivers and indicates no Ohio River specimens although the type locality is listed as the Ohio. Our records indicate a limited distribution occurring between River Miles 186 and 206.

Anodonta grandis grandis Say, 1829 (13)

Common Name - Floater
Host Fish - Carp, bluegill, rock bass, white crappie
Relative Abundance - Nowhere common in Ohio River

This species should not be in the Ohio River. Starrett (1971) quotes Stansbery as saying that A. grandis grandis is a subspecies of ponds, lakes, and all but the largest rivers. Ortmann says that it decidedly avoids the larger rivers, and is not found in the Ohio. Williams did not report this species from the lower river. Our records indicate that this species is virtually absent from the river below RM 175, but is presently fairly abundant from that point upstream to RM 90.

Anodonta grandis corpulenta Cooper 1834 (1)

Common Name - Floater
Host Fish - Skipjack herring
Relative Abundance - Rare, found only at one site

Williams and Ortmann do not list A. grandis corpulenta as being in the Ohio even though Starrett lists it as a species of larger rivers occurring only in the lower pools of the Illinois River. Only a single fresh damaged valve found.

Strophitus undulatus undulatus (Say, 1817) (3)

Common Name - Squaw Foot
Host Fish - Largemouth bass, creek chub
Relative Abundance - Rare

Ortmann refers to this species as common in local small streams but being averse to large streams and probably absent from the Ohio. Williams' specimens were all from the uppermost portion of his study area. My specimens were limited to the Belleville Pool. It is an obviously rare species in the Ohio and may occur infrequently only as escapes from small tributaries.

Lasmigona complanata (Barnes, 1823) (4)

Common Name - White Heel Splitter
Host Fish - Not known
Relative Abundance - Rare in Ohio River; common in local smaller tributaries

This species is not normally found on a regular basis in large rivers but rather in smaller tributaries. Ortmann says it is absent from the Ohio proper and Williams found only two specimens. We found four specimens at four localities. This species is probably an escape from the lesser tributaries and should not be considered part of the Ohio fauna.

Lasmigona costata (Raf., 1820) (2)

Common Name - Fluted Shell
Host Fish - Not known
Relative Abundance - Rare in Ohio River; very abundant in small streams of West Virginia and Kentucky

Ortmann found a single specimen in the Ohio while Williams does not report this species at all. Our data agree as only a few identifiable fragments were found at two localities.

Lasmigona compressa (Lea, 1829) (1)

Common Name - Creek Heel Splitter
Host Fish - Not known
Relative Abundance - Rare; seems to be a species of northern midwest although specimens have been found as far south as the Kentucky River

Ortmann says it is a form of smaller streams and he never collected it in the Ohio proper. Williams did not find it in the lower Ohio.

Quadrula quadrula (Raf., 1820) (38)

Common Name - Maple Leaf
Host Fish - Not known
Relative Abundance - Very common

Ortmann called it a species of lakes and larger rivers, but continues in saying that it is never abundant in the Ohio. Williams' work, however, proved just the opposite to be true as he found Q. quadrula to be the most abundant shell comprising nearly 16 percent of his total catch in the lower river. In our work we also found Q. quadrula to be, by far, the most abundant shell. Several beds consisting of enormous numbers of individuals will be discussed elsewhere in this paper. Recruitment of new individuals is good. Numbers seem to be increasing rather than declining.

Quadrula metanevra (Raf., 1820) (3)

Common Name - Monkey Face
Host Fish - Bluegill, sauger
Relative Abundance - Rare

Quadrula metanevra (continued)

Ortmann refers to this species as one which prefers large rivers and which is most abundant in the Ohio River below Pittsburgh. Williams found them fairly frequently in the lower Ohio, but I found only a few shells at three scattered localities.

Quadrula pustulosa pustulosa (Lea, 1831) (15)

Common Name - Pimple Back, Warty Back
Host Fish - Channel catfish
Relative Abundance - Common, but I have never found it in large numbers at any particular site

Ortmann says it is quite characteristic of the Ohio and its larger tributaries and is found in abundance there. Williams' catch of *Q. pustulosa* in the lower Ohio made up 8.6 percent of the total. My own collections showed the mussel to be of widespread distribution but never common at any one locality.

Amblema plicata plicata (Say, 1817) (15)

Common Name - Three Ridge
Host Fish - Crappie, yellow perch, rock bass, bluegill, green sunfish, pumpkinseed
Relative Abundance - Common

Ortmann states that there is no real preferred habitat for this species as it is found in lakes, small tributaries and large rivers alike. His work reports several localities in the upper Ohio where *A. plicata plicata* were taken. Williams found *A. p. plicata* to be the third most abundant shell (11.6%) in the lower Ohio. We found this species to be presently fairly abundant over most of the area surveyed. A good number of juveniles found would seem to indicate a healthy stable population which suffers little or no stress under present conditions.

Fusconaia ebena (Lea, 1831) (2)

Common Name - Ebony Shell (Niggerhead)
Host Fish - Skipjack herring
Relative Abundance - Rare

Ortmann does not report this species at all while Williams found it to be the second most abundant species in his study area. It was found in relatively large numbers, however, only in the lower reaches of the river. We found only a few specimens in the Racine Pool and nowhere else. Large numbers of sub-fossils of this species, found in archeological deposits, indicated that it was very abundant and widely distributed over much of this reach of the Ohio prior to the activities of modern man. It is more than likely nearing extinction in the upper Ohio as no young specimens were found.

Fusconaia maculata maculata (Raf., 1820) (4)

Common Name - Long Solid
Host Fish - Not known
Relative Abundance - Rare in Ohio River

Ortmann's records indicate a widespread distribution of this species in the Ohio River fifty years ago and mention is made of populations present in the larger tributaries. Williams, on the contrary, found only two specimens in the lower 600 miles of river. Our study indicates that this is another species that is in dire danger in the Ohio proper. It is, however, still abundant in many of the larger tributaries.

Fusconaia flava (Raf., 1820) (8)

Common Name - Wabash Pigtoe
Host Fish - White crappie, black crappie
Relative Abundance - Rare in Ohio River

Ortmann says this is a distinctly small stream species that occasionally is found in the Ohio River. Williams found small numbers all along the lower river. Our studies indicate a similar situation prevalent in the upper river. We found them at several localities but never more than one or two specimens per site.

Cyclonaias tuberculata (Raf., 1820) (6)

Common Name - Purple Warty Back, Pink Pimple Back
Host Fish - Not known
Relative Abundance - Rare in Ohio River

Ortmann lists C. tuberculata as a species having a rather wide distribution and frequently found in small streams as well as the Ohio and its larger tributaries. He also states that it is never abundant and should be considered rare (50 years ago). The situation has apparently not changed as Williams found only 18 specimens in the lower river. Most of our material must be considered sub-fossil. This species may also soon be gone from the Ohio River.

Plethobasus striatus* (Raf., 1820) (1)

Common Name - None in local common usage
Host Fish - Not known
Relative Abundance - Extinct in Ohio drainage

Ortmann reports this species as being quite abundant in the Ohio River near St. Mary's and Marietta. Williams did not find it at all and Stansbery (1971) feels that it is extinct in the Ohio River drainage. Our specimens were from a single site and were badly deteriorated shells that had been dead for sometime.

Pleurobema cordatum (Raf., 1820) (15)

Common Name - Pigtoe
Host Fish - Not known
Relative Abundance - Rare in Ohio River

Pleurobema cordatum (continued)

According to Ortmann, this is the prevailing species of the shell beds along the entire course of the Ohio River. Williams found it fairly regularly in his study (8% of total), but we only rarely found a fresh shell. Large deposits of shells were found on several occasions but without exception they consisted for the most part of subfossils. Very rarely did we find any fresh material. This is another example of a mussel that could be found in enormous quantities 50 years ago but may very well be limited in numbers today.

Elliptio crassidens crassidens* (Lamarck, 1819) (20)

Common Name - Elephant's Ear
Host Fish - Not known
Relative Abundance - Rare in Ohio; common in local streams

According to Ortmann this species is restricted to large rivers but is extremely abundant in them. Williams found them to be abundant in his study. While we found shells in large numbers through our entire study area, very few specimens show evidence of being fresh material. E. crassidens is a major constituent of midden heaps along the river in this area. No young specimens were found which leads me to believe that what we found are remnants of a population of considerable magnitude that once existed but which may presently be headed toward extinction.

Elliptio dilatata* (Raf., 1820) (10)

Common Name - Lady Finger, Spike
Host Fish - Not known
Relative Abundance - Very common throughout eastern North America; presently rare in Ohio River

Ortmann lists E. dilatata as the second most abundant species in the Ohio River. Williams found only fifteen specimens in the whole lower river. We found shells of this species over a wide area but not a single fresh specimen was found. This species must therefore be considered at best very rare and possibly presently extinct in this reach of the Ohio.

Uniomerus tetralasmus (Say, 1830) (2)

Common Name - Pond Horn
Host Fish - Not known
Relative Abundance - Very rare in Ohio River

Neither Ortmann nor Williams report this species. This species is definitely one which usually inhabits small streams and ponds in the upper midwest. The localities at which the two specimens were found in this study approximate the southwestern limits of distribution of the species. Both specimens were found in close proximity to small streams (Congress Run and Briscoe Run) which leads me to believe these specimens are escapes from these streams and not a normal component of the Ohio River fauna.

Obliquaria reflexa Raf., 1820 (8)

Common Name - Three-Horned Warty Back, Three Horn
Host Fish - Not known
Relative Abundance - Fairly common

Ortmann restricts O. reflexa to the larger streams and refers to it being very abundant in the Ohio River. Williams found it regularly throughout the lower Ohio. While we did not find this species at a large number of sites, where they were found they were fairly abundant. A good number of juveniles of O. reflexa were found and thus this species seems to be one of the few where recruitment is good and its future in the Ohio seems secure.

Cyprogenia stegaria* (Raf., 1820) (1)

Common Name - None in common local usage
Host Fish - Not known
Relative Abundance - Rare in Ohio River

Ortmann refers to this species as one found only in large rivers and the largest tributaries. He reports it as being found with some frequency between Pittsburgh and Cincinnati. Williams did not find it and I found only a single sub-fossil. Probably not part of the Ohio faunal assemblage at the present time.

Actinonaias ligamentina carinata* (Barnes, 1823) (6)

Common Name - Mucket
Host Fish - Green sunfish, bluegill, smallmouth and largemouth bass, yellow perch, white bass, white crappie
Relative Abundance - Rare

Ortmann says Actinonaias l. carinata is a species which favors large streams and at that time was a major constituent of the shell banks between Pittsburgh and Cincinnati. Williams found only five specimens and we had equally poor luck. While we report shells from several localities, not a single specimen could definitely be called fresh material. This species may well be no longer present in the Ohio proper.

Plagiola lineolata (Raf., 1820) (1)

Common Name - Butterfly
Host Fish - Freshwater drum
Relative Abundance - Rare in Ohio River

Ortmann lists P. lineolata as a species of the larger rivers of the interior basin and being quite common in the Ohio River below Pittsburgh. Williams produced 36 specimens while we were not so lucky and found only a single fresh specimen. This species thus appears to be yet another one that presently exists only as an occasional isolated individual and could not be considered as part of the extant Ohio fauna.

Obovaria retusa* (Lamarck, 1819) (8)

Common Name - None in common usage
Host Fish - Not known
Relative Abundance - Extinct in Ohio River

In Ortmann's list O. retusa is listed as being restricted to the Ohio River and not being found in any of its tributaries. Williams did not report it. While we did find shells at a number of localities, none were thought to be recent material. On the basis of specimens collected we must agree with Stansbery (1971) that O. retusa is extinct in the Ohio River.

Leptodea fragilis (Raf., 1820) (13)

Common Name - Fragile Paper Shell
Host Fish - Not known
Relative Abundance - Fairly common in Ohio River

Ortmann suggests that L. fragilis seems to prefer large rivers and lakes. Williams did not collect it. We found it distributed throughout our study area and where found to be fairly abundant. The creation of navigable pools may have been beneficial to this species as it seems to be doing well (all size classes were found).

Potamilus alatus (Say, 1817) (11)

Common Name - Pink Heel Splitter
Host Fish - Not known
Relative Abundance - Fairly common

This shell was a major constituent of the deep channel shell banks in the Ohio according to Ortmann and was taken in large numbers by clammers. Williams found 32 specimens in the lower river and we found this species to be doing quite well in our stretch of the river. Many young specimens were found indicating a healthy self-propagating population.

Potamilus ohiensis (Raf., 1820) (5)

Common Name - Fragile Heel Splitter, Papershell
Host Fish - White crappie, freshwater drum
Relative Abundance - Fairly common

Ortmann did not mention P. ohiensis. Williams collected 10 specimens and we found them to be abundant in the Belleville Pool. Starrett states that this species is tolerant to pollution and prefers the quiet waters of larger rivers. Both of these factors help to explain why this species seems to be doing quite nicely, at least in part of our survey area.

Toxolasma parvus (Barnes, 1823) (4)

Common Name - Liliput Shell
Host Fish - Not known
Relative Abundance - Rare in Ohio River

Toxolasma parvus (continued)

This species seems to have no preferred habitat. It is reported from lakes, shallow backwater sloughs, and large and small streams. Ortmann does not report it from the Ohio. Williams found a single shell. We found T. parvus at four localities but three of these four sites were in close proximity to small streams and this species would most likely be considered an escape instead of a normal resident of the Ohio.

Villosa iris iris (Lea, 1829) (2)

Common Name - Rainbow Shell
Host Fish - Not known
Relative Abundance - Very rare in Ohio River

Ortmann says this species is never found in abundance and never found in large rivers. Williams does not report it and the two specimens we report were found at the confluence of Bull Creek and Flaugherty Run. These specimens are probably escapes from the creeks and not legitimate residents of the Ohio River.

Lampsilis teres form teres (Raf., 1820) (1)

Common Name - Slough Sand Shell, Yellow Sand Shell
Host Fish - White crappie, short nose gar, shovelnose sturgeon
Relative Abundance - Very rare in Ohio River

Ortmann makes no mention of this species while Williams collected 20 specimens. We collected a single fresh specimen on the sand and gravel bar at the mouth of Big Seven Mile Creek (RM 299.9).

Lampsilis radiata luteola (Lamarck, 1819) (8)

Common Name - Fat Mucket
Host Fish - Bluegill, yellow perch, walleye
Relative Abundance - Moderately rare in Ohio River; common in local smaller streams

Ortmann gives as the preferred habitat lakes and the small tributaries of large rivers but having an aversion to large rivers as such. Williams does not report this species. At the sites where we found them they were always few in number and were predominantly old shells with very few being fresh material.

Lampsilis orbiculata* (Hildreth, 1828) (2)

Common Name - None in common usage locally
Host Fish - Sauger (?)
Relative Abundance - Probably extinct in Ohio River

Ortmann says it is a species which prefers larger streams and lists it as a major constituent of the shell beds of the Ohio between Pittsburgh and Cincinnati. Williams does not list it and we found only subfossil shells.

Lampsilis ventricosa (Barnes, 1823) (1)

Common Name - Pocketbook
Host Fish - White crappie, sauger
Relative Abundance - Very rare; probably extinct in Ohio River

According to Ortmann it was a very common form found in the upper Ohio and surrounding smaller tributaries. He reports several localities in the Ohio proper. Williams did not report it and the only specimens that we have are sub-fossils.

Lampsilis ovata* (Say, 1817) (2)

Common Name - None is common usage locally
Host Fish - Not known
Relative Abundance - Extinct in Ohio River proper

Ortmann states that L. ovata is abundant in the Ohio River below Pittsburgh and distinctly prefers the large river habitat. Williams did not find it and the only specimens we were able to find were associated with Indian midden heaps.

Site Locations and Descriptions

(The L and R refer to left descending bank and right descending bank.)

Note: A site may represent a find of only one fresh specimen. All such finds have been listed herein.

RM 303.5-L	Located immediately upstream of Gulf Oil Co. Refinery. Site 60 yards long, ten feet deep. Sparsely scattered pebbles over sand.
RM 303.0-L	Long gravel beach. Few mussels but a large accumulation of *Corbicula* shells.
RM 302.3-L	On a downstream side of confluence of Three Mile Creek. Found only large numbers of *Corbicula*.
RM 299.9-L	Immediately upstream of confluence of Big Seven Mile Creek. Long cobble covered sandy beach.
RM 299.0-R	Directly across the river from Nine Mile Creek between Michael's Run and McCall Creek. 200 yards long, ten yard deep stretch of grassy, weed covered gravel beach.
RM 296.7-R	Immediately upstream of Two Mile Creek. Gravel bank approximately 60 yards long.
RM 284.3-L	300 yard long sand bar below the confluence of Eighteen Mile Creek.
RM 284.0-L	Sand and gravel bar immediately above Eighteen Mile Creek.
RM 283.3-L	Directly below Ashton Light and Daymark. Sand and gravel bar.
RM 282.8-L	Sand and gravel bar extending approximately 100 yards downstream from confluence of Sixteen Mile Creek.
RM 271.8-R	A long gravel and sand bar which extend approximately one-half mile downstream of the mouth of Evans Run.
RM 267.4-L	Sand and gravel bar running 60 yards upstream of Two Mile Creek.
RM 252.6-L	Approximately 100 yard long rocky, sandy beach on both banks.
RM 222.0-R	Sandy Creek Bar. 200 yard long sand bar which extends 50 yards into the river. Just downstream of new Ravenswood/Meigs Co. Ohio Bridge.
RM 219.5-R	Long narrow mud bank. Substrate fine sand and silt.
RM 214.1-R	200 yards downstream of Lock's Run. Substrate of gravel, sand and debris.
RM 212.1-R	Extending 200 yards above and below the mouth of DeWitt Run.

RM 211.5-R	Just beneath DeWitt Bar Light and Daymark. Shallow bank with shale and rubble over sand. Some red clay present.
RM 209.7-R	Beneath Shade River Bend Light and Daymark near area called Long Bottom. Substrate outcrop of large rocks.
RM 209.8-L	Across river and slightly downstream of the above locality. Near village of Murraysville. Large debris covered sandy beach.
RM 207.7-R	Directly across river from Neptune Light and Daymark. 600 yards long, 30 feet deep sandy beach with few pebbles. Considerable amount of coal fines.
RM 207.0-R	One-half mile downstream of Forked Run, 200 yard long sandy beach.
RM 206.7-L	Across the river from and 400 yards upstream of the mouth of Forked Run. 300 yard long sand and gravel beach.
RM 206.1-R	Sandy beach running for 100 yards below mouth of Little Forked Run.
RM 186.3-R	Small gravel bar across from upper end of Blennerhassett Island. 200 yards downstream of Cross Landing Light and Daymark.
RM 183.4-R	Extends from 200 yards above the new Parkersburg Bridge upstream to Congress Run. 20 feet deep gravel bar.
RM 178.1	Upstream end of Halfway Island. 600 yard long clay bank.
RM 175.6-R	Debris strewn sand bar 300 yards upstream of Marietta Industrial Enterprises.
RM 175.2-L	1000 yard long sand and muck deposit off end of Muskinghum Island.
RM 175.0-L	Sand Bar. 0.2 mile upstream of the above site.
RM 167.7-168.8-L	Cobble-covered sandy beach extending upstream from Island Run.
RM 167.2-164.5-L	Three mile long gravel and cobble sand bar. Area known as Carpenter's Bar.
RM 164.8-R	300 yard long sand bar covered with rubble.
RM 151.4-R	Very small exposed gravel bank (10 feet long).
RM 131.8-R	Small mud and sand beach along Rock Bar immediately upstream of Patton Run.
RM 115.6-L	Directly beneath Cline's Bar Light and Daymark. Large sand bar.
RM 97.0-L	300 yard long gravel bar.
RM 13.4-L	Long pebble covered, sandy beach. 500 yards below Dashields Dam.

Table 4.

List of localities and number of species collected per site.

Localities	No. species per site
RM 303.5-L	7
RM 303.0-L	6
RM 302.3-L	7
RM 299.9-L	5
RM 299.0-R	7
RM 296.7-R	4
RM 284.3-L	1
RM 284.0-L	8
RM 283.3-L	7
RM 282.8-L	2
RM 271.8-R	2
RM 267.4-L	3
RM 252.6-L & R	3
RM 222.0-R	1
RM 219.5-R	4
RM 214.1-R	3
RM 212.1-R	4
RM 211.5-R	13
RM 209.7-R	2
RM 209.8-L	13
RM 207.7-R	5
RM 207.0-R	5
RM 206.7-L	8
RM 206.1-R	3
RM 186.3-R	3
RM 183.4-R	6
RM 178.1-Halfway Island	6
RM 175.6-R	13
RM 175.2-L	6
RM 175.0-L	5
RM 168.8-167.7-L	10
RM 167.2-164.5-L	12
RM 164.8-R	8
RM 151.4-R	2
RM 131.8-R	2
RM 115.6-L	1
RM 97.0-L	8
RM 13.4-L	1

Table 5.

List of Localities with a List of Species Collected at each Site

Species	River Mile 175.2-S	175.0-S	168.8-167.7-S	167.2-164.5-S	164.8-N	151.4-N	131.8-N	115.6-S	97.0-S	13.4-S
Anodonta imbecillis										
Anodonta g. grandis	x	x	x	x		x	x	x		
Anodonta g. corpulenta										
Strophitus u. undulatus										
Lasmigona complanata		x								
Lasmigona costata					x					
Lasmigona compressa										
Quadrula quadrula	x	x	x	x	x		x		x	
Quadrula metanevra					x					
Quadrula p. pustulosa			x		x					
Amblema plicata plicata	x		x	x	x					
Fusconaia ebena										
Fusconaia m. maculata									x	
Fusconaia flava			x	x					x	
Cyclonaias tuberculata									x	
Plethobasus striatus										
Pleurobema cordatum			x	x					x	
Elliptio c. crassidens			x	x	x				x	
Elliptio dilatata			x	x					x	
Uniomerus tetralasmus										
Obliquaria reflexa										
Cyprogenia stegaria										
Actinonaias l. carinata									x	
Plagiola lineolata										
Obovaria retusa										
Leptodea fragilis		x	x	x						
Potamilus alatus	x		x							
Potamilus ohiensis				x	x					
Toxolasma parvus				x						
Villosa iris iris				x						x
Lampsilis teres form teres										
Lampsilis r. luteola	x			x	x	x				
Lampsilis orbiculata										
Lampsilis ventricosa										
Lampsilis ovata	x									

Table 5 (continued)

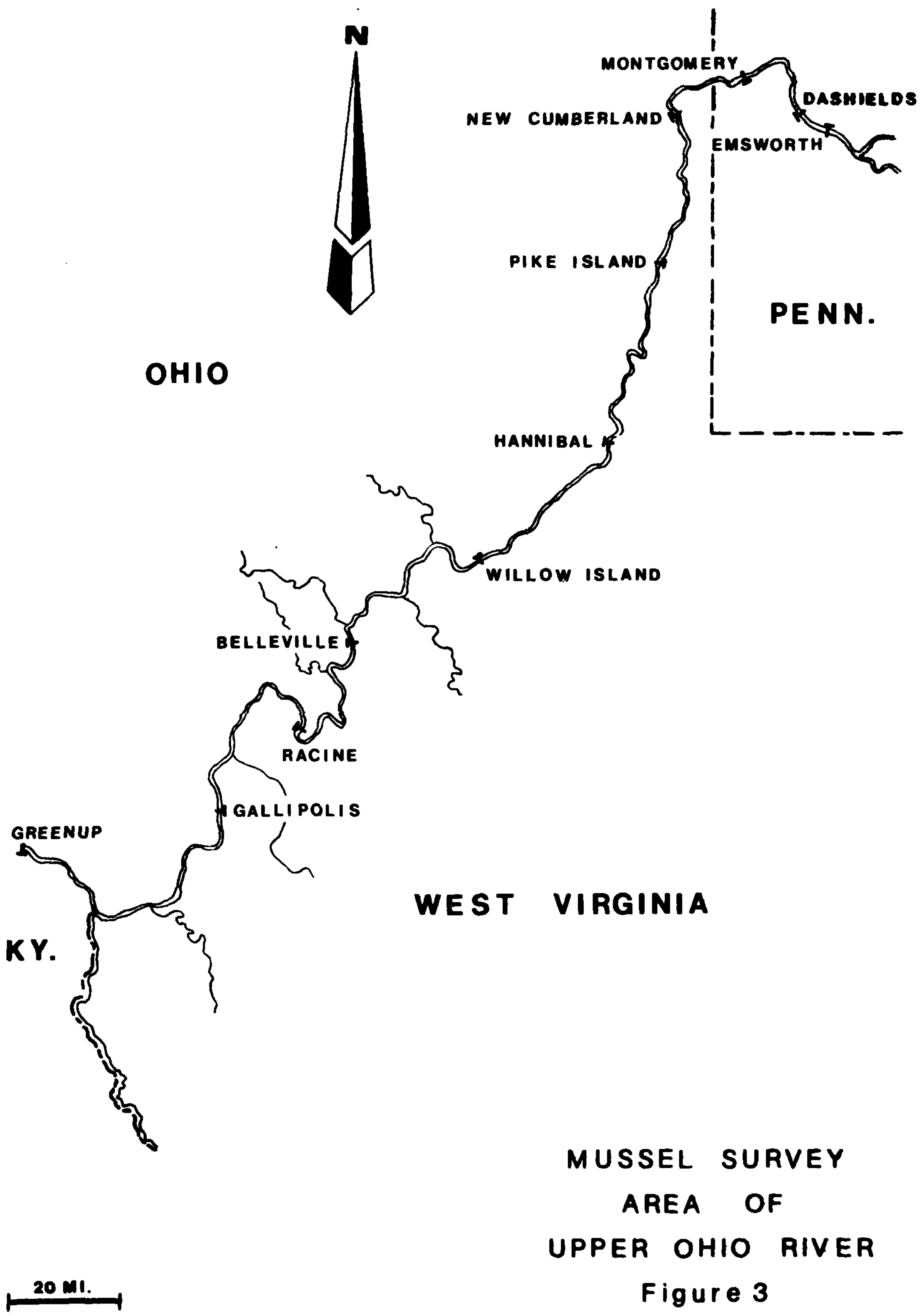
Species	River Mile													
	219.5-N	214.1-N	212.1-N	211.5-N	209.7-N	209.8-S	207.7-N	207.0-N	206.7-S	206.1-N	186.3-N	183.4-N	178.1	175.6-N
Anodonta imbecillis										x	x			x
Anodonta g. grandis	x					x			x					x
Anodonta g. corpulenta														x
Strophitus u. undulatus						x							x	
Lasmigona complanata							x							x
Lasmigona costata													x	
Lasmigona compressa														x
Quadrula quadrula	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Quadrula metanevra														
Quadrula p. pustulosa				x								x	x	x
Amblema p. plicata			x			x	x	x						x
Fusconaia ebena				x					x					
Fusconaia m. maculata														
Fusconaia flava	x					x		x	x					
Cyclonaias tuberculata				x					x					
Plethobasus striatus				x										
Pleurobema cordatum				x					x			x		x
Elliptio c. crassidens			x	x		x			x			x		
Elliptio dilatata		x		x								x		
Uniomerus tetralasmus												x	x	
Obliquaria reflexa			x											x
Cyprogenia stegaria				x										
Actinonaias l. carinata		x		x										
Plagiola lineolata														
Obovaria retusa				x		x			x					
Leptodea fragilis					x	x	x	x					x	x
Potamilus alatus	x					x	x	x		x				x
Potamilus ohiensis						x								x
Toxolasma parvus						x					x			
Villosa i. iris														
Lampsilis teres														
Lampsilis r. luteola						x								
Lampsilis orbiculata				x										
Lampsilis ventricosa						x								
Lampsilis ovata				x										

Table 5 (completed)

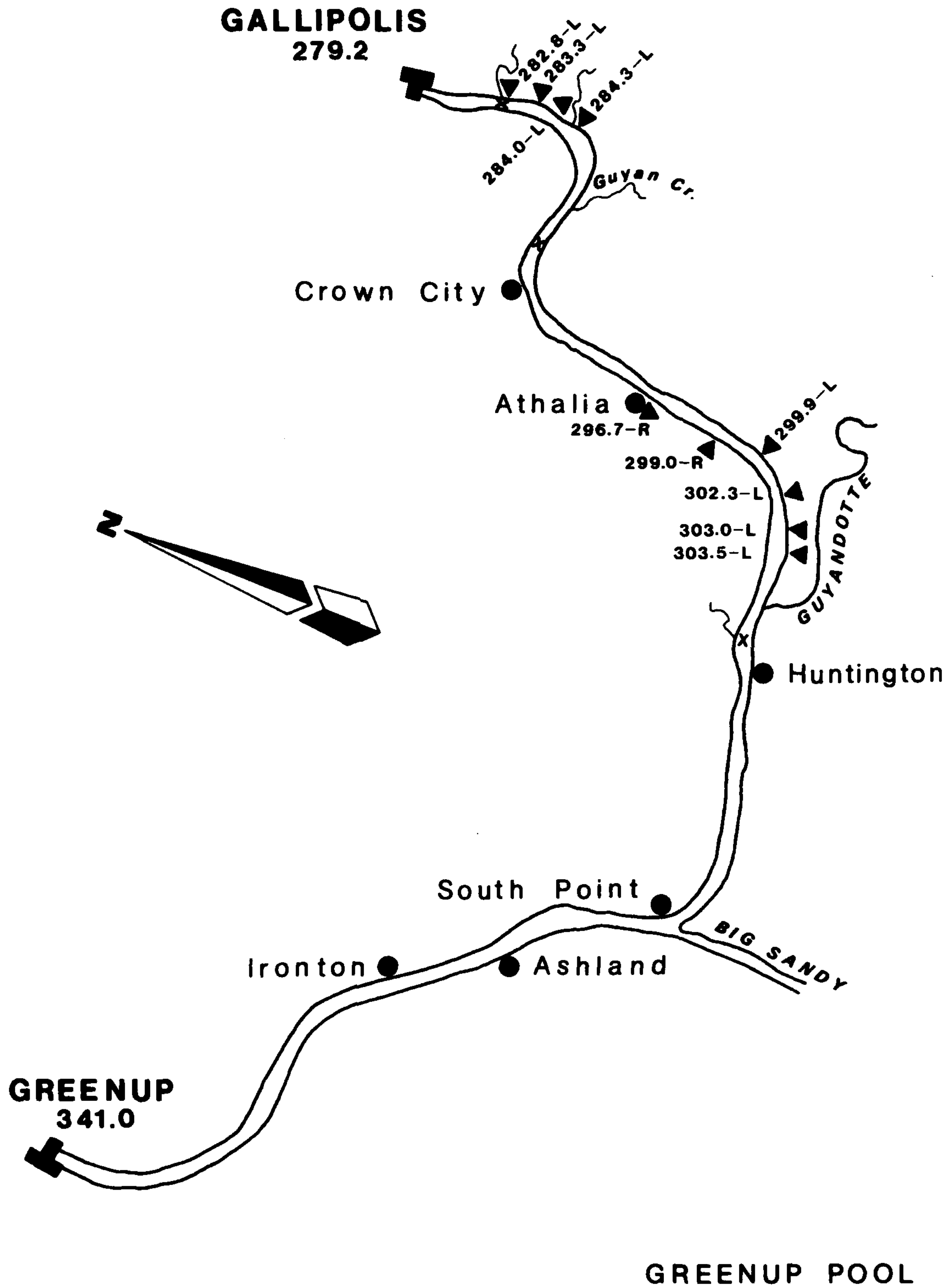
Species	River Mile													
	303.5-S	303.0-S	302.3-S	299.9-S	299.0-N	296.7-N	284.3-S	284.0-S	283.3-S	282.8-S	271.8-N	267.4-S	252.6-N,S	222.0-N
Anodonta imbecillis														
Anodonta g. grandis														x
Anodonta g. corpulenta														
Strophitus u. undulatus														
Lasmigona complanata												x		
Lasmigona costata														
Lasmigona compressa														
Quadrula quadrula	x	x	x	x	x	x	x	x	x	x	x	x	x	
Quadrula metanevra	x		x											
Quadrula p. pustulosa	x	x	x	x	x	x			x					
Amblema p. plicata	x	x	x	x	x									
Fusconaia ebena														
Fusconaia m. maculata								x						
Fusconaia flava					x									
Cyclonaias tuberculata					x			x						
Plethobasus striatus														
Pleurobema cordatum	x	x				x			x			x		
Elliptio crassidens	x	x	x			x		x	x					
Elliptio dilatata														
Uniomerus tetralasmus														
Obliquaria reflexa		x	x	x	x			x					x	
Cyprogenia stegaria														
Actinonaias l. carinata								x	x					
Plagiola lineolata								x						
Obovaria retusa	x							x						
Leptodea fragilis					x						x			
Potamilus alatus			x						x	x				
Potamilus ohiensis														
Toxolasma parvus														
Villosa i. iris														
Lampsilis teres				x										
Lampsilis r. luteola									x				x	
Lampsilis orbiculata														
Lampsilis ventricosa														
Lampsilis ovata														

LEGEND FOR ALL MAPS

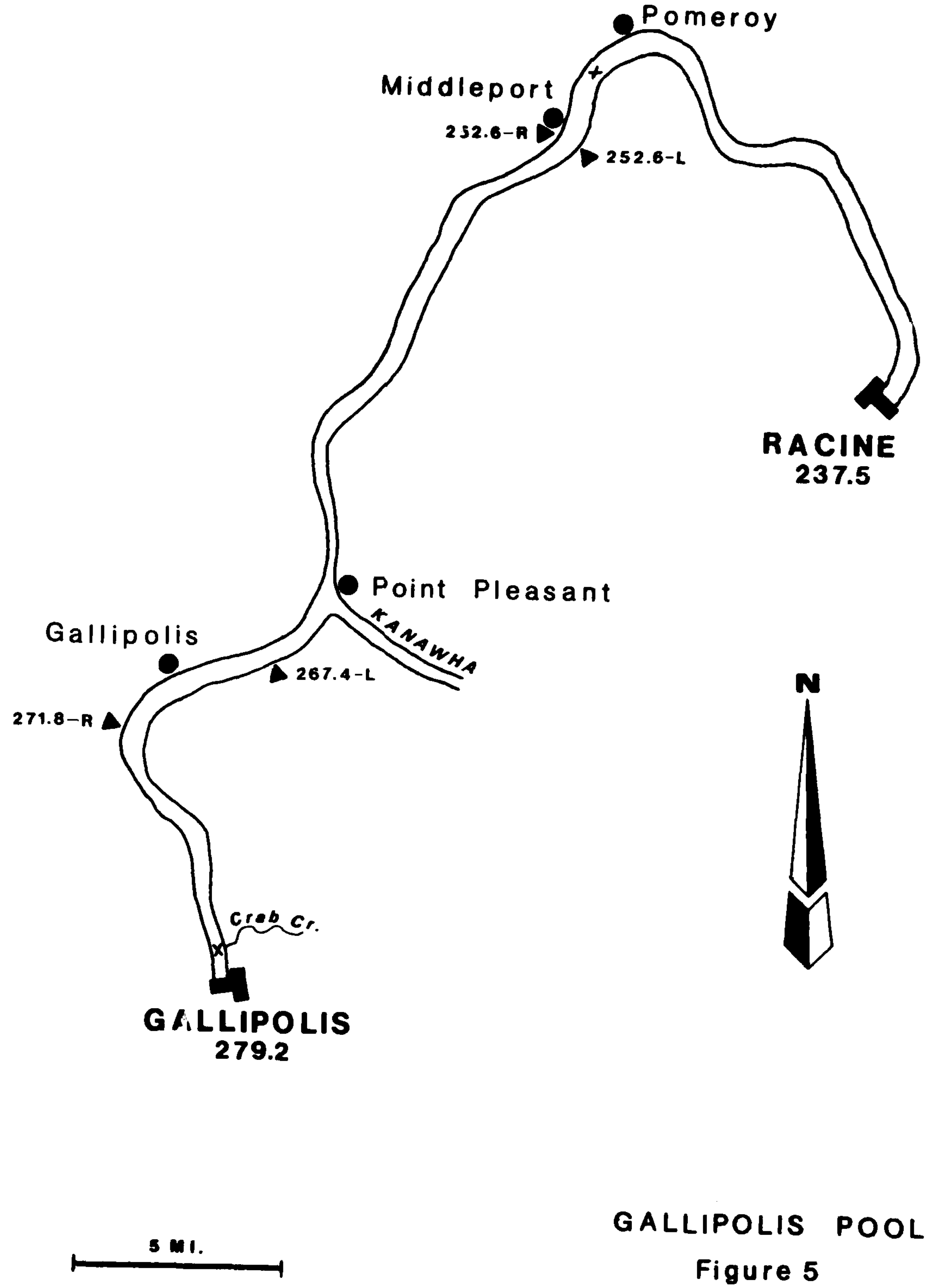
- LOCKS AND DAM
- ▲ MUSSEL SITE
- DEMONSTRATIVE BRAILING SITE



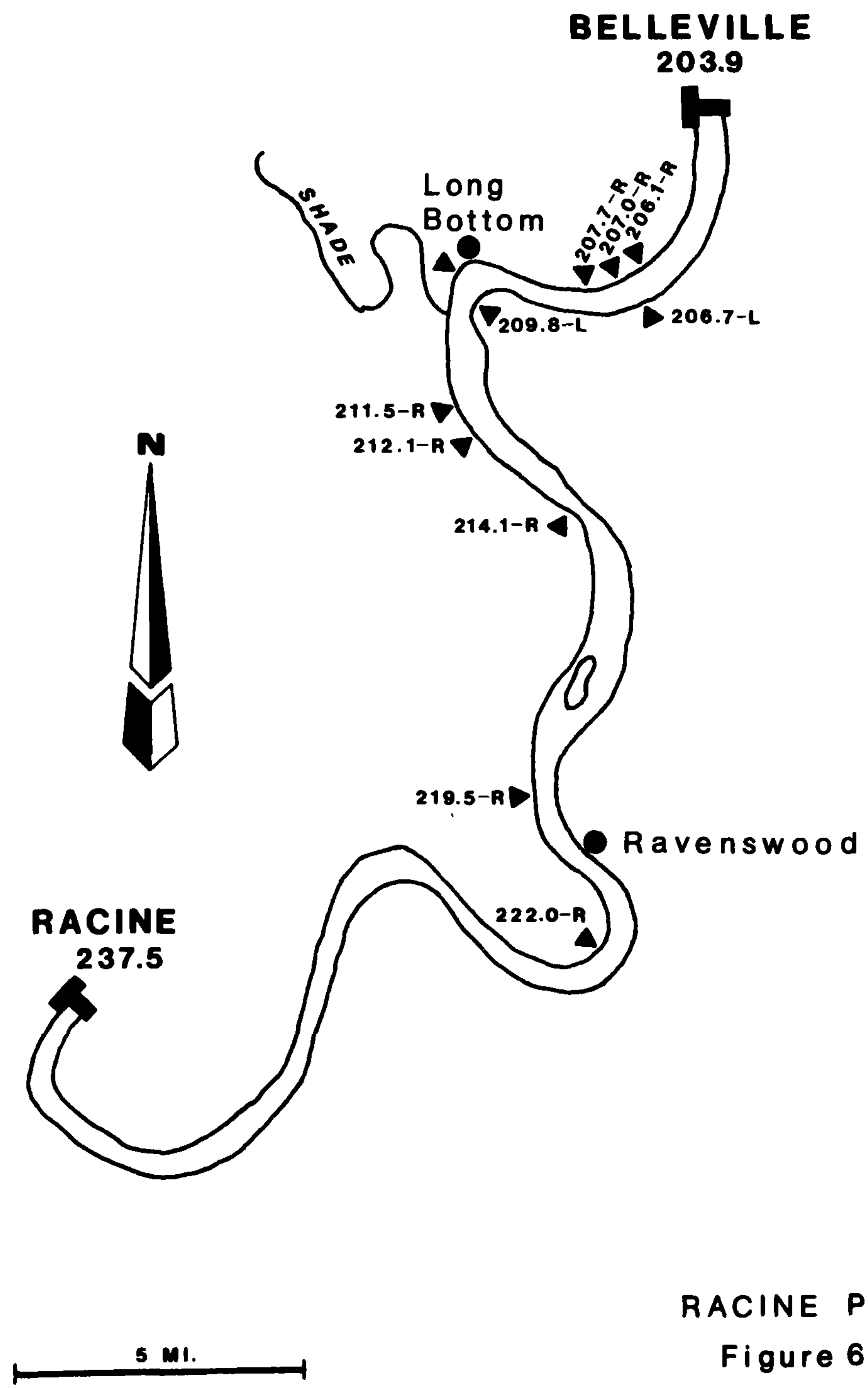
MUSSEL SURVEY
AREA OF
UPPER OHIO RIVER
Figure 3



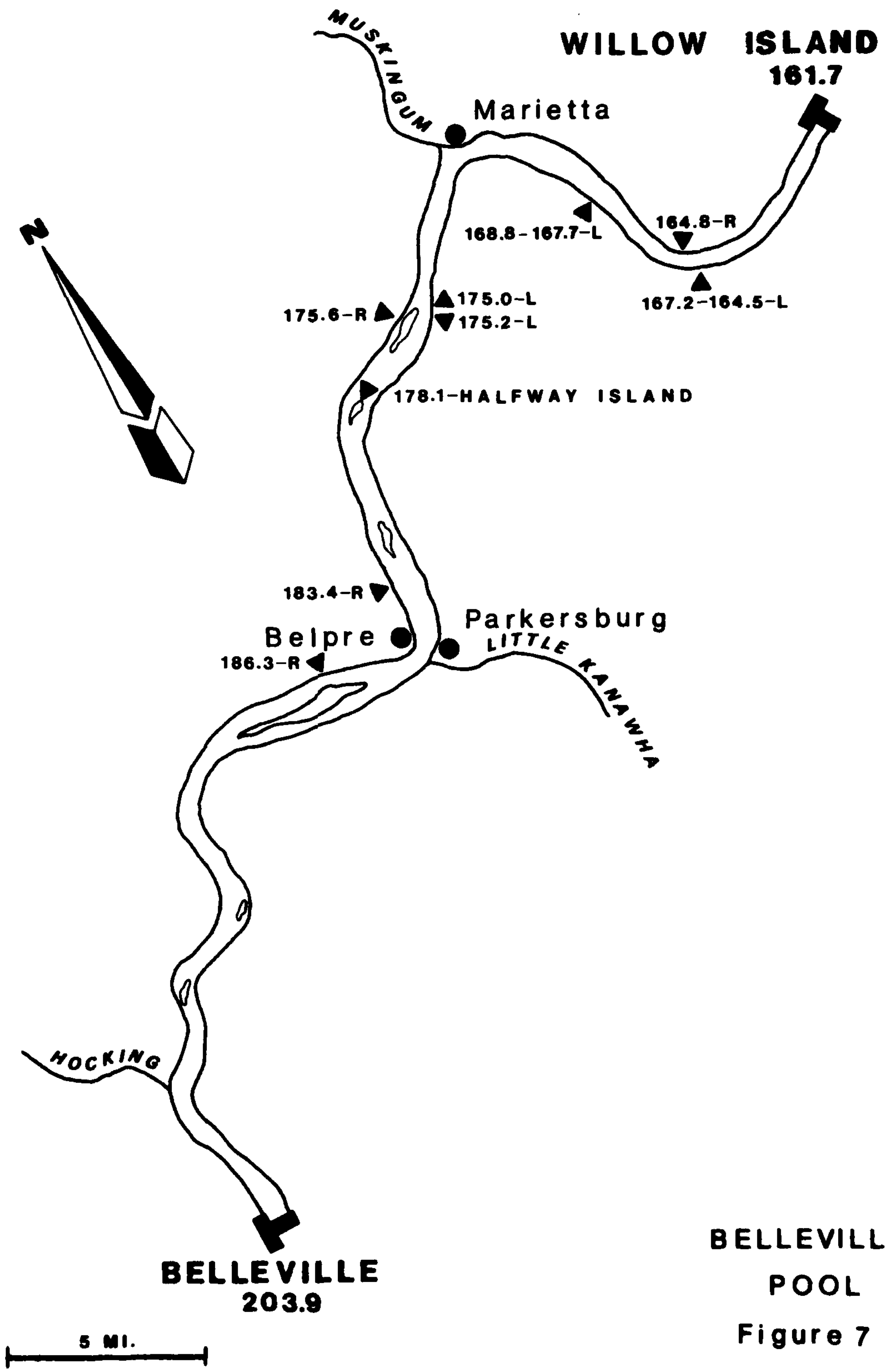
GREENUP POOL
Figure 4



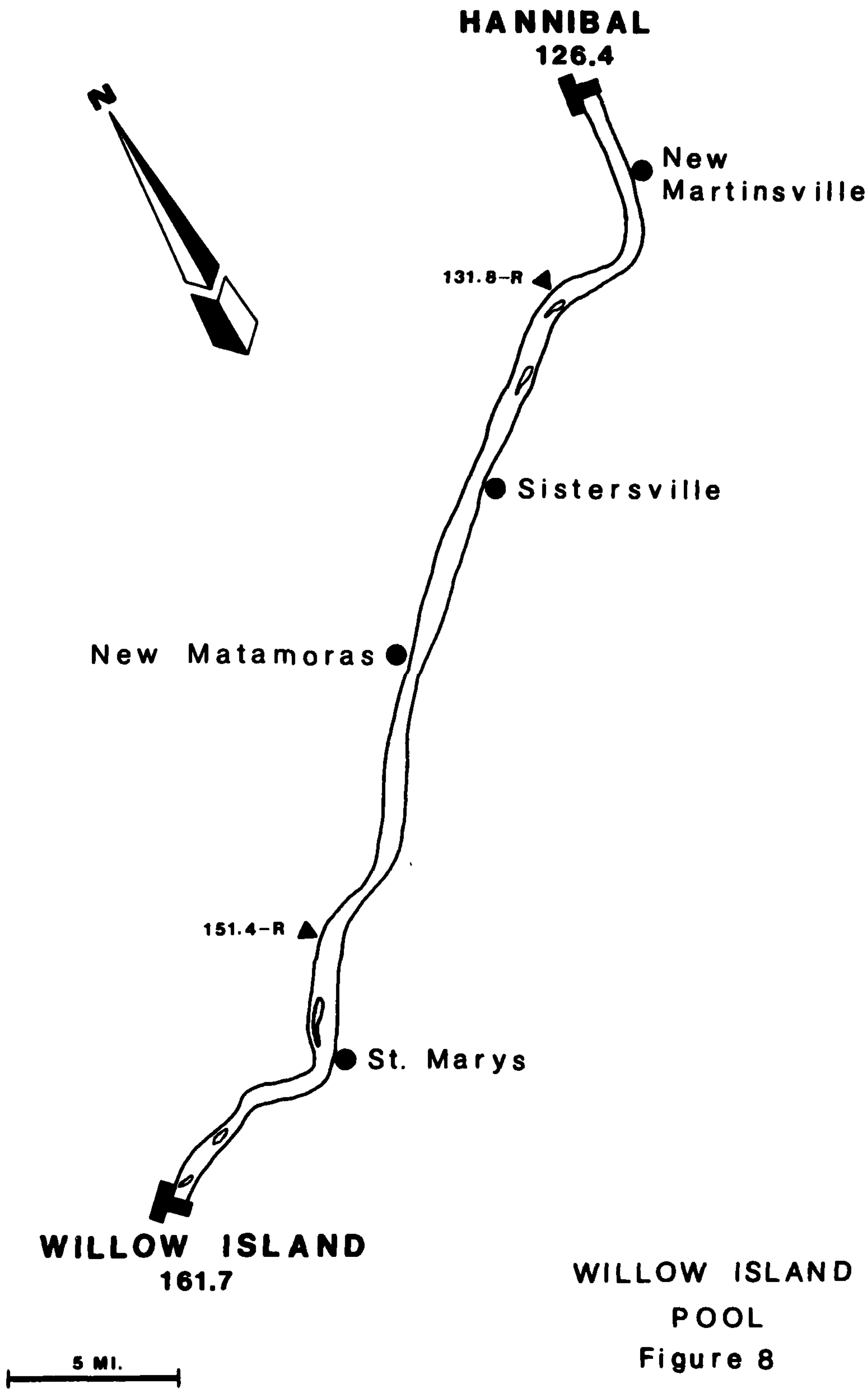
GALLIPOLIS POOL
Figure 5



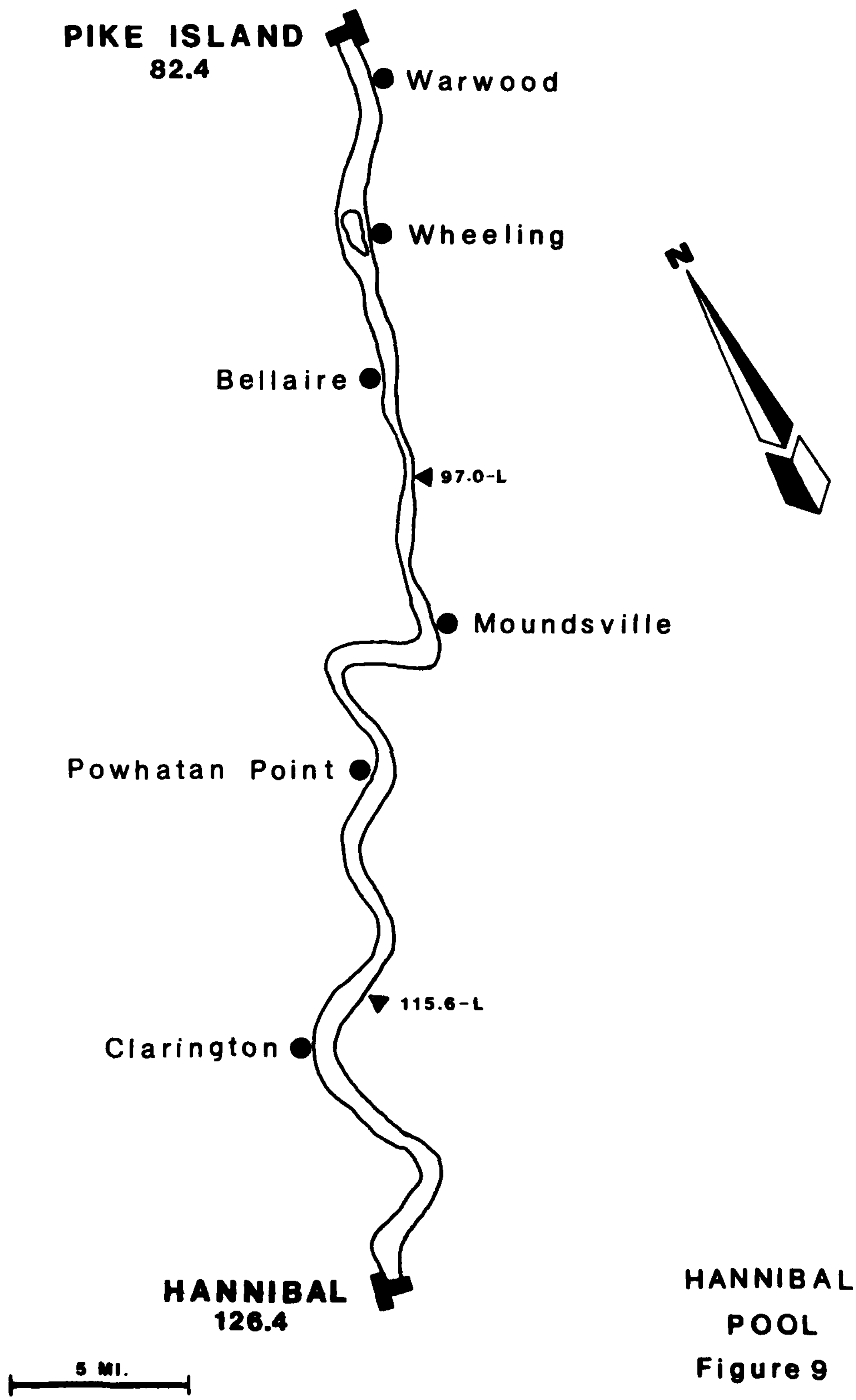
RACINE POOL
Figure 6



BELLEVILLE
POOL
Figure 7



WILLOW ISLAND
POOL
Figure 8



HANNIBAL
POOL
Figure 9

Changes in the Naiad Fauna of the Ohio River Between 1900 and 1979

Rhoads' (1899) statement quoted on the frontispiece of this paper showed the urgency, which he felt, to establish base line data on the mussel populations of the Ohio River. His work documented those species which were still present. As best I can determine this was the first serious, though far from complete, attempt to record the naiad fauna of the Ohio.

Ortmann's (1921) work on the naiads of Pennsylvania included considerable information on Ohio River mussels. The localities of species reported therein, however, were mostly concentrated in the river between Pittsburgh and Marietta, Ohio or the uppermost portion of the river.

Williams' (1969) survey covered approximately the lower six hundred miles but in doing so he paid little attention to non-commercially valuable species.

The current survey covered the river from River Mile 0 to 340. All of Rhoads' and Ortmann's collecting sites were revisited and there was a small amount of overlap with Williams' stretch of the river (RM 317.0-341.0).

By virtue of the fact that we did not study the same areas of the river and different habitats at different localities may support different species, it would be dangerous to try to compare too closely the results of each survey and draw concrete conclusions on trends. I do, however, think it worthwhile to present these data in tabular form and see what trends tend to stand out.

Rhoads' work was incorporated into Ortmann's paper so they will be considered together.

Table 6.

A comparison of the results of mussel studies on the Ohio River for the years 1920, 1969, 1979. (* designates a species found only as subfossils.)

Species	Ortmann Pre-1920	Williams 1969	Taylor 1979
Anodonta imbecillis Say, 1829			X
Anodonta grandis grandis Say, 1829			X
Anodonta grandis corpulenta Cooper, 1834			X
Strophitus undulatus undulatus (Say, 1817)	X	X	X
Arcidens confragosus (Say, 1829)		X	
Lasmigona complanata (Barnes, 1823)	X	X	X
Lasmigona costata (Raf., 1820)	X		X
Lasmigona compressa (Lea, 1829)	X		X
Megalonaias nervosa (Raf., 1820)		X	
Tritogonia verrucosa (Raf., 1820)	X	X	
Quadrula quadrula (Raf., 1820)	X	X	X
Quadrula cylindrica cylindrica (Say, 1817)	X		
Quadrula metanevra (Raf., 1820)	X	X	X
Quadrula nodulata (Raf., 1820)		X	
Quadrula pustulosa pustulosa (Lea, 1831)	X	X	X
Amblema plicata plicata (Say, 1817)	X	X	X
Fusconaia ebena (Lea, 1831)		X	X
Fusconaia maculata maculata (Raf., 1820)	X	X	X
Fusconaia flava (Raf., 1820)	X	X	X
Cyclonaias tuberculata (Raf., 1820)	X	X	X
Plethobasus cyphus (Raf., 1820)	X	X	
*Plethobasus striatus** (Raf., 1820)	X		X
Pleurobema cordatum (Raf., 1820)	X	X	X
Pleurobema rubrum (Raf., 1820)	X		
*Elliptio crassidens crassidens** (Lam., 1829)	X	X	X
*Elliptio dilatata** (Raf., 1820)	X	X	X

Table 6 (completed)

Species	Ortmann Pre-1920	Williams 1969	Taylor 1979
Uniomerus tetralasmus (Say, 1830)			X
Obliquaria reflexa Raf., 1820	X	X	X
*Cyprogenia stegaria** (Raf., 1820)		X	X
*Actinonaias ligamentina carinata** (Barnes, 1823)	X	X	X
Plagiola lineolata (Raf., 1820)	X	X	X
Obovaria olivaria (Raf., 1820)	X	X	
Obovaria subrotunda (Raf., 1820)	X		
*Obovaria retusa** (Lam., 1819)	X		X
Truncilla truncata Raf., 1820	X		
Truncilla donaciformis (Lea, 1827)	X	X	
Leptodea fragilis (Raf., 1820)	X		X
Potamilus alatus (Say, 1817)	X	X	X
Potamilus ohiensis (Raf., 1820)		X	X
Toxolasma parvus (Barnes, 1823)		X	X
Ligumia recta (Lam., 1819)	X	X	
Villosa fabalis (Lea, 1831)	X		
Villosa iris iris (Lea, 1829)	X		X
Lampsilis teres form *teres* (Raf., 1820)		X	X
Lampsilis radiata luteola (Lam., 1819)	X		X
*Lampsilis orbiculata** (Hildreth, 1828)	X		X
Lampsilis ventricosa (Barnes, 1823)	X		X
*Lampsilis ovata** (Say, 1817)	X		X
Lampsilis fasciola Raf., 1820	X		
Epioblasma triquetra (Raf., 1820)	X		
TOTALS	38	29	35

Summation of Table 6

Species previously unrecorded as occurring in the Ohio River:

Anodonta imbecillis Say, 1829

Anodonta grandis grandis Say, 1829

Anodonta grandis corpulenta Cooper, 1834

Uniomerus tetralasmus (Say, 1830)

Species which were previously reported but are most likely extinct presently in the upper Ohio River:

Quadrula cylindrica cylindrica (Say, 1817)

Plethobasus cyphus* (Raf., 1820)

Plethobasus striatus* (Raf., 1820)

Elliptio crassidens crassidens* (Lam., 1819)

Elliptio dilatata* (Raf., 1820)

Cyprogenia stegaria* (Raf., 1820)

Actinonaias ligamentina carinata* (Barnes, 1823)

Obovaria retusa* (Lam., 1819)

Truncilla truncata* Raf., 1820

Truncilla donaciformis* (Lea, 1827)

Ligumia recta* (Lam., 1819)

Lampsilis orbiculata* (Hildreth, 1828)

Lampsilis ovata* (Say, 1817)

Lampsilis fasciola* Raf., 1820

Epioblasma triquetra* (Raf., 1820)

Summary of River Faunal Changes

Three species and one subspecies are reported herein, for the first time, as occurring in the Ohio River. The fragile existence of these four mussels must be considered as accidental or occasional and could in no way be construed as newly established populations. The time for celebration is not at hand.

To the contrary, the picture is a rather grim one. As shown in the preceding list, as many as fifteen species have become extinct or very nearly so in the last eighty years. This fact causes even further concern when one considers that some species on the list are ones that in the first survey were major components of the vast shell beds that once existed (i.e. *Actinonaias ligamentina carinata*, *Elliptio crassidens crassidens*, *Lampsilis orbiculata*).

Table 7.

Species Collected by River Pool

GREENUP POOL:

Quadrula quadrula (Raf., 1820)
Quadrula metanevra (Raf., 1820)
Quadrula pustulosa pustulosa (Lea, 1831)
Amblema plicata plicata (Say, 1817)
Fusconaia flava (Raf., 1820)
Cyclonaias tuberculata (Raf., 1820)
Pleurobema cordatum (Raf., 1820)
*Elliptio crassidens crassidens (Lamarck, 1819)
Obliquaria reflexa Raf., 1820
*Actinonaias ligamentina carinata (Barnes, 1823)
Plagiola lineolata (Raf., 1820)
*Obovaria retusa (Lamarck, 1819)
Leptodea fragilis (Raf., 1820)
Potamilus alatus (Say, 1817)
Lampsilis teres form teres (Raf., 1820)
Lampsilis radiata luteola (Lamarck, 1819)
Corbicula leana Prime, 1864

GALLIPOLIS POOL:

Lasmigona complanata (Barnes, 1823)
Quadrula quadrula (Raf., 1820)
Fusconaia flava (Raf., 1820)
Pleurobema cordatum (Raf., 1820)
Obliquaria reflexa Raf., 1820
Leptodea fragilis (Raf., 1820)
Lampsilis radiata luteola (Lamarck, 1819)
Corbicula leana Prime, 1864

RACINE POOL:

Anodonta imbecillis Say, 1829
Anodonta grandis grandis Say, 1829
Strophitus undulatus undulatus (Say, 1817)
Lasmigona complanata (Barnes, 1823)
Quadrula quadrula (Raf., 1820)
Quadrula pustulosa pustulosa (Lea, 1831)
Amblema plicata plicata (Say, 1817)
Fusconaia ebena (Lea, 1831)
Fusconaia flava (Raf., 1820)
Cyclonaias tuberculata (Raf., 1820)
*Plethobasus striatus (Raf., 1820)
Pleurobema cordatum (Raf., 1820)

Table 7 (continued)

RACINE POOL: (continued)

*Elliptio crassidens crassidens (Lamarck, 1819)
*Elliptio dilatata (Raf., 1820)
Obliquaria reflexa Raf., 1820
*Cyprogenia stegaria (Raf., 1820)
*Actinonaias ligamentina carinata (Barnes, 1823)
*Obovaria retusa (Lamarck, 1819)
Leptodea fragilis (Raf., 1820)
Potamilus alatus (Say, 1817)
Potamilus ohiensis (Raf., 1820)
Toxolasma parvus (Barnes, 1823)
*Lampsilis orbiculata (Hildreth, 1828)
Lampsilis ventricosa (Barnes, 1823)
*Lampsilis ovata (Say, 1817)
Corbicula leana Prime, 1864

BELLEVILLE POOL:

Anodonta imbecillis Say, 1829
Anodonta grandis grandis Say, 1829
Anodonta grandis corpulenta Cooper, 1834
Strophitus undulatus undulatus (Say, 1817)
Lasmigona complanata (Barnes, 1823)
Lasmigona costata (Raf., 1820)
Lasmigona compressa (Lea, 1829)
Quadrula quadrula (Raf., 1820)
Quadrula metanevra (Raf., 1820)
Quadrula pustulosa pustulosa (Lea, 1831)
Amblema plicata plicata (Say, 1817)
Fusconaia flava (Raf., 1820)
Cyclonaias tuberculata (Raf., 1820)
Pleurobema cordatum (Raf., 1820)
*Elliptio crassidens crassidens (Lamarck, 1819)
*Elliptio dilatata (Raf., 1820)
Uniomerus tetralasmus (Say, 1830)
Obliquaria reflexa Raf., 1820
*Obovaria retusa (Lamarck, 1819)
Leptodea fragilis (Raf., 1820)
Potamilus alatus (Say, 1817)
Potamilus ohiensis (Raf., 1820)
Toxolasma parvus (Barnes, 1823)
Villosa iris iris (Lea, 1829)
Lampsilis radiata luteola (Lamarck, 1819)
Corbicula leana Prime, 1864

Table 7 (completed)

WILLOW ISLAND POOL:

Anodonta grandis grandis Say, 1829
Quadrula quadrula (Raf., 1820)
Lampsilis radiata luteola (Lamarck, 1819)

HANNIBAL POOL:

Anodonta grandis grandis Say, 1829
*Fusconaia maculata maculata (Raf., 1820)
Fusconaia flava (Raf., 1820)
Cyclonaias tuberculata (Raf., 1820)
Pleurobema cordatum (Raf., 1820)
Elliptio crassidens crassidens (Lamarck, 1819)
Elliptio dilatata (Raf., 1820)
Actinonaias ligamentina carinata (Barnes, 1823)
Corbicula leana Prime, 1864

PIKE ISLAND POOL:

No shells collected

NEW CUMBERLAND POOL:

No shells collected

MONTGOMERY POOL:

Villosa iris iris (Lea, 1829)
Corbicula leana Prime, 1864

Demonstrative Sites

The U. S. Army Corps of Engineers is presently conducting environmental studies in preparation for construction activity at the Gallipolis Locks and Dam facility (RM 279.2). As part of these studies five demonstrative sites have been designated and a variety of environmental parameters are currently being monitored. The locations of the test sites are as follows:

a. Rivermile 306 - Indian Guyan
b. Rivermile 289 - Glenwood Bend
c. Rivermile 282 - Sixteen Mile Creek
d. Rivermile 276 - Crab Creek
e. Rivermile 251 - Mason-Pomeroy

This contractor was required to intensively collect in the area of the above-mentioned demonstrative sites. In accordance with contractual requirements, the banks and shallows were checked for approximately 1000 yards above and below the locality markers. In addition detailed brailing was conducted in the immediate vicinity of the site. The results were as follows:

Indian Guyan -- This site, located on the Ohio shore near the mouth of Indian Guyan Creek produced only three live specimens. There was no shell litter or any other evidence of mussels present. The specimens were one each of *Amblema plicata*, *Obliquaria reflexa* and *Pleurobema cordatum*. The nearest site in this area that produced any quantity of mussels was 2.5 miles upstream on the West Virginia shore (RM 303.5).

Glenwood Bend -- At this site we collected only four live naiads and several live *Corbicula leana*. Two live specimens each of *Quadrula quadrula* and *Amblema plicata* were taken. No additional shells were found on the bank or in the water. The nearest productive site is approximately five miles upstream at RM 284.3 near the confluence of Eighteen Mile Creek.

Sixteen Mile Creek -- Brailing was unsuccessful at this site. Some fresh material was collected, however, along the shore just below the mouth of the creek. Several specimens of *Quadrula quadrula*, *Potamilus alatus* and *Corbicula leana* were collected. Sixteen Mile Creek was checked upstream from its confluence with the Ohio River for approximately one-quarter mile. Several specimens of *Lampsilis radiata luteola*, *Lasmigona complanata*, *Anodonta grandis*, *Quadrula quadrula* and *Anodontoides ferussacianus* were collected.

Crab Creek -- No evidence of mussel activity was noted at this site. The nearest active site is at least five miles away in either direction.

Mason-Pomeroy -- Nothing was collected at this site. A fairly active site was located approximately 1.6 miles downstream (RM 252.6). Specimens of *Quadrula quadrula*, *Lampsilis radiata luteola* and *Obliquaria reflexa* along with many *Corbicula leana* were taken.

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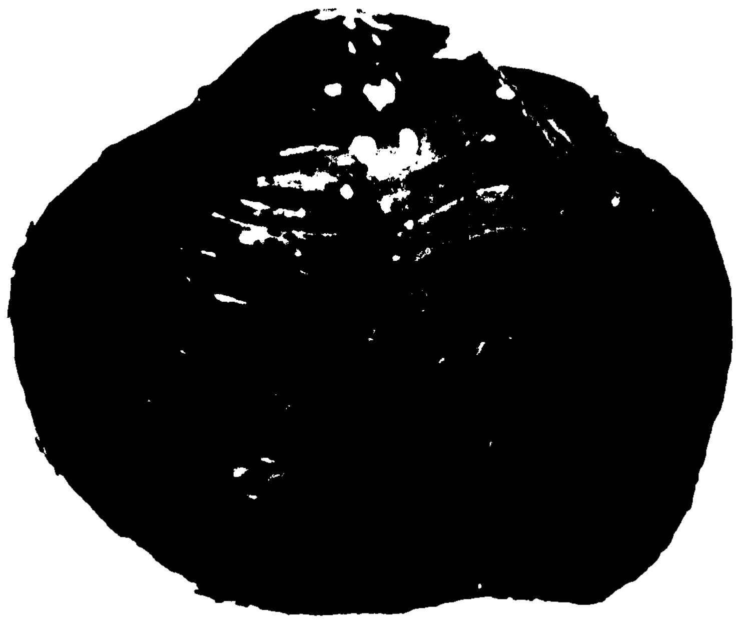
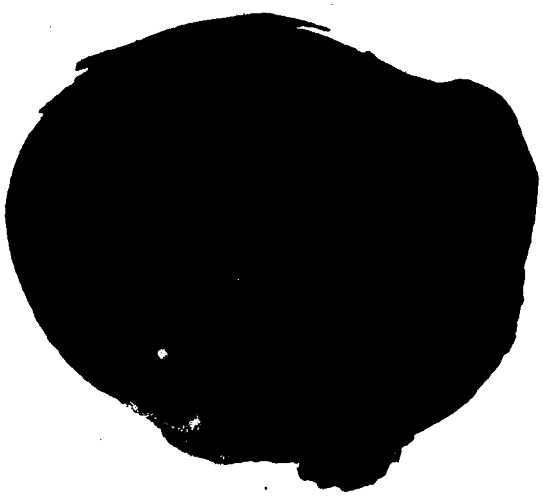


Plate 1. Quadrula quadrula (Raf., 1820) Adult

Plate 2. Quadrula quadrula (Raf., 1820) Sub-adult



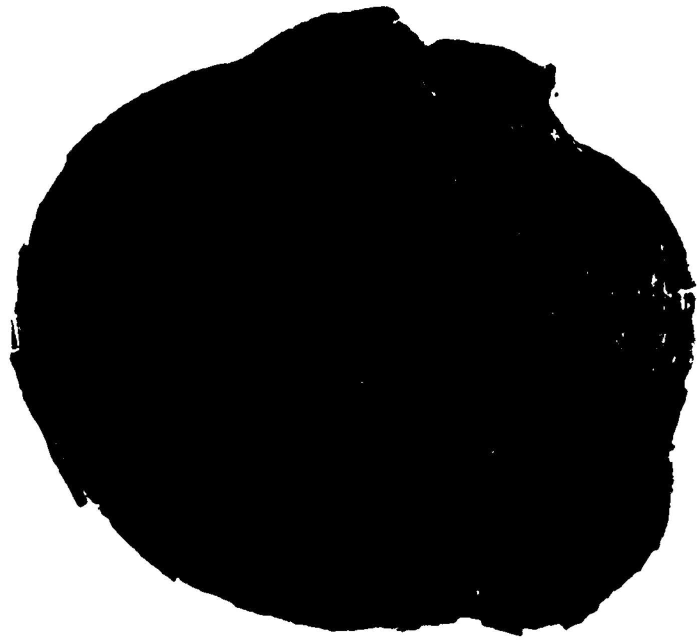
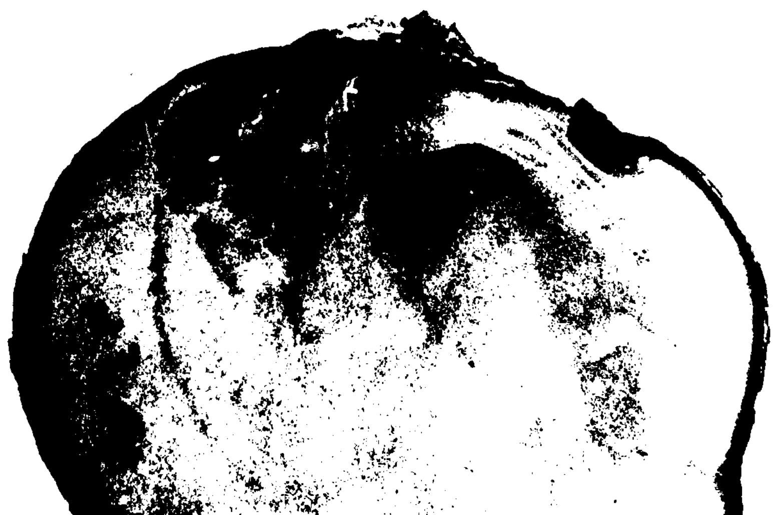


Plate 3. Quadrula metanevra (Raf., 1820) Adult



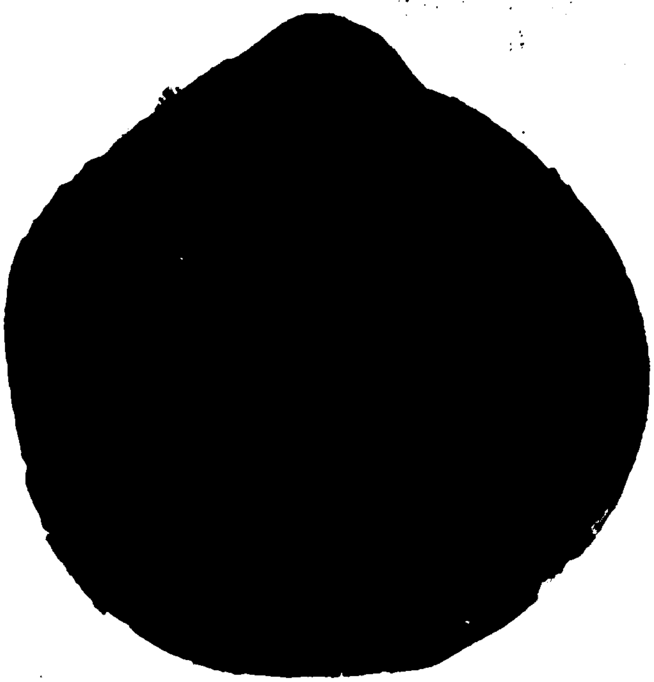


Plate 4. Quadrula pustulosa pustulosa (Lea, 1831) Adult

Plate 5. Potamilus ohiensis (Raf., 1820) Adult

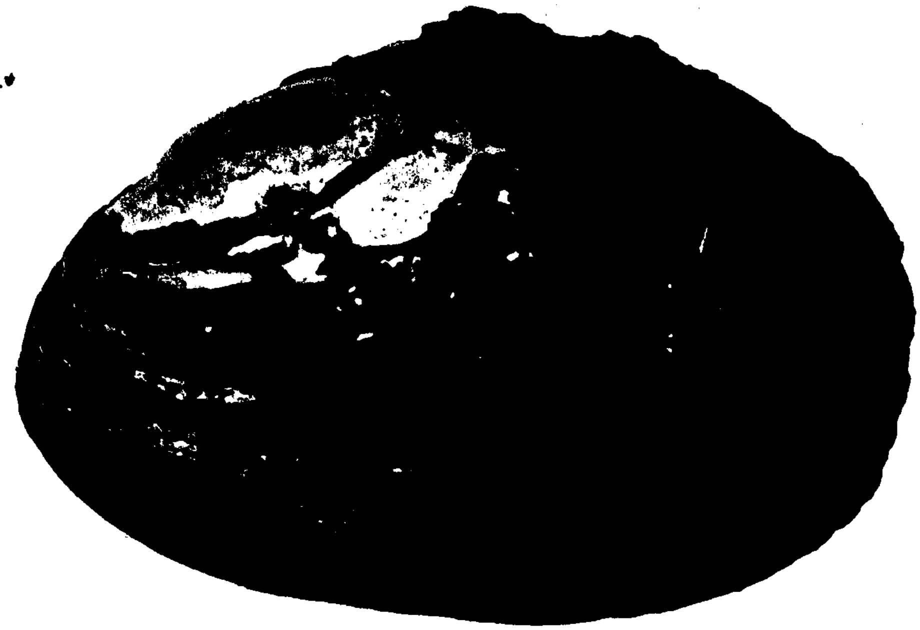


Plate 6. Potamilus alatus (Say, 1817) Old Adult

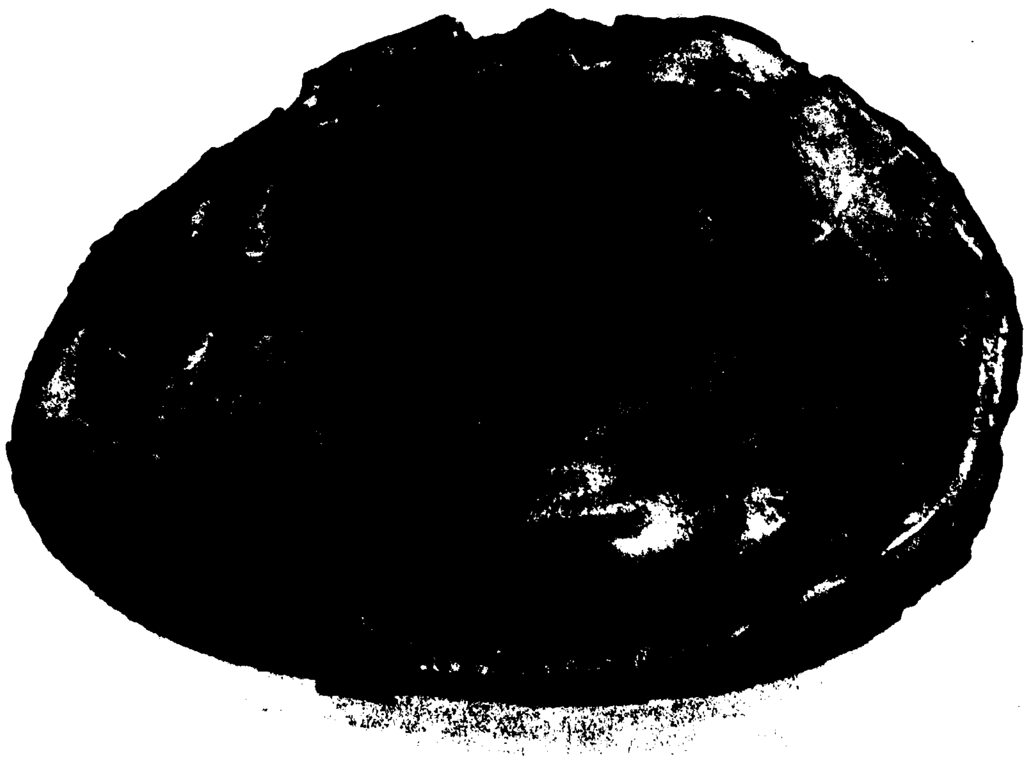
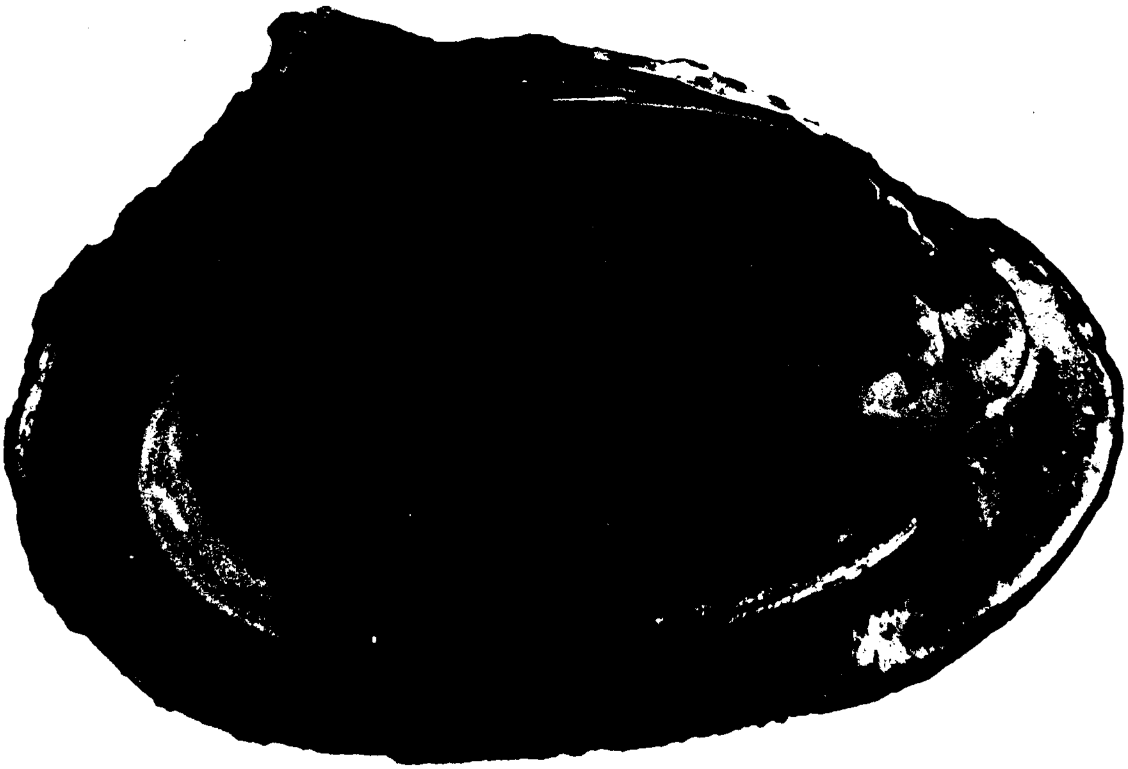


Plate 7. Potamilus alatus (Say, 1817) Young specimen with wing



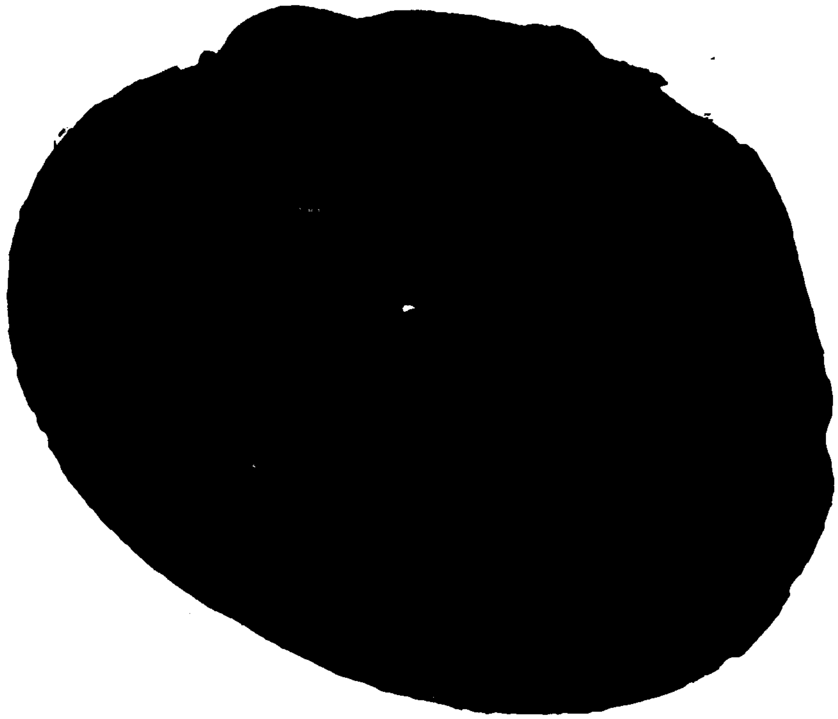


Plate 8. Amblema plicata plicata (Say, 1817) Adult

Plate 9. Fusconaia flava (Raf., 1820) Adult

Plate 10. Anodonta grandis grandis Say, 1829 Adult

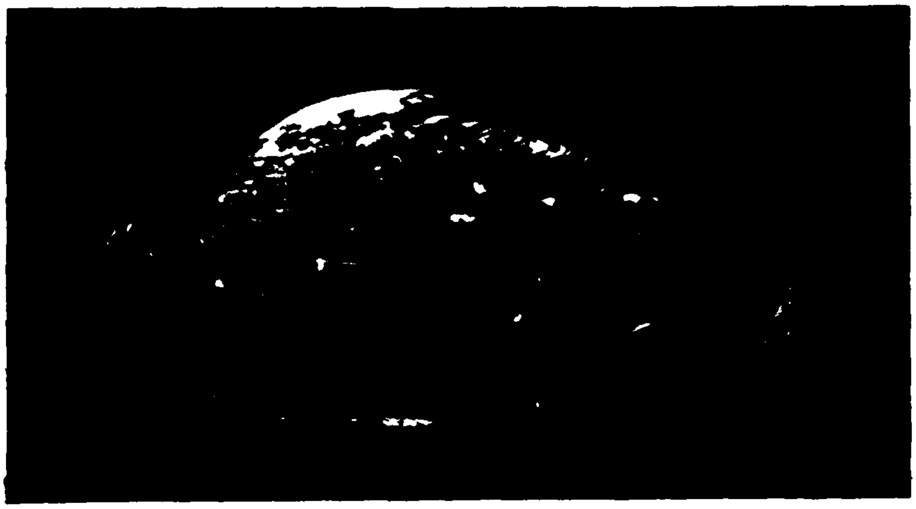


Plate 11. Strophitus undulatus undulatus (Say, 1817) Adult

Plate 12. Lasmigona compressa (Lea, 1829) Adult

Plate 13. Lasmigona complanata (Barnes, 1823) Adult

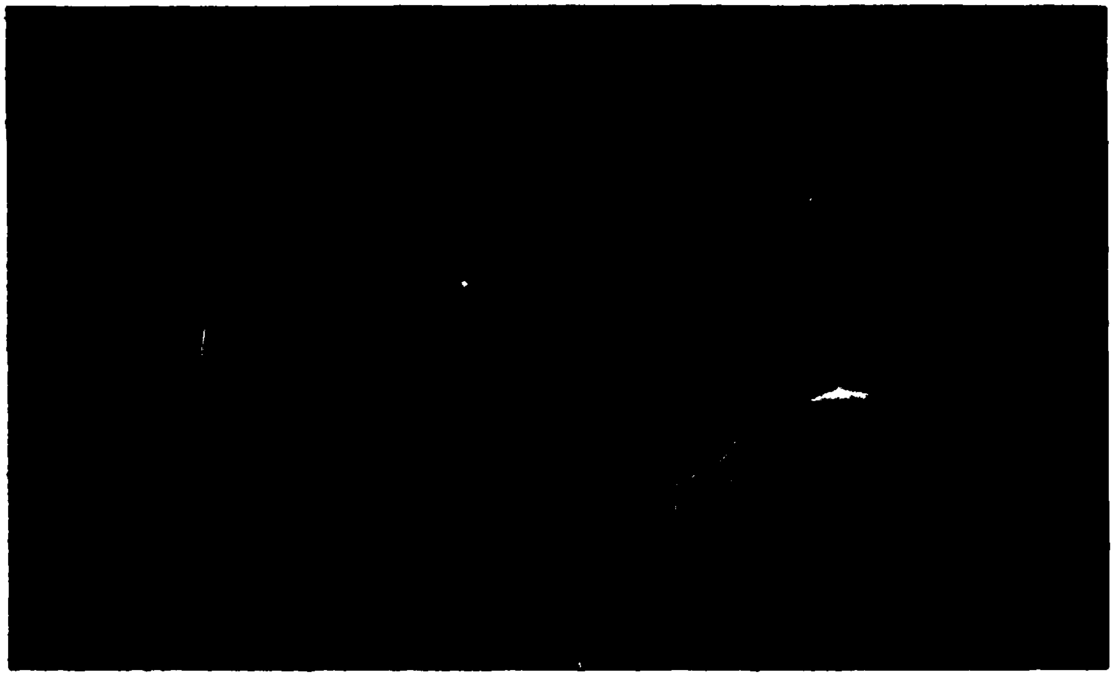


Plate 14. Leptodea fragilis (Raf., 1820)

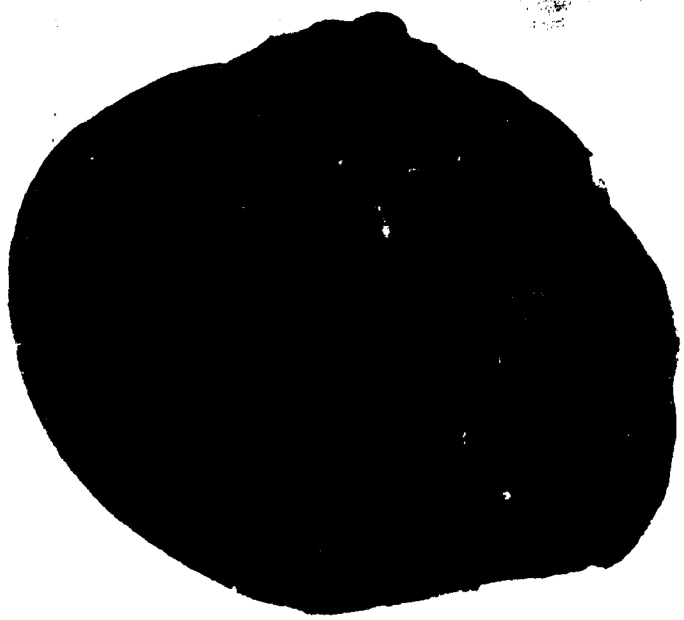


Plate 15. Obliquaria reflexa Raf., 1820 Adult

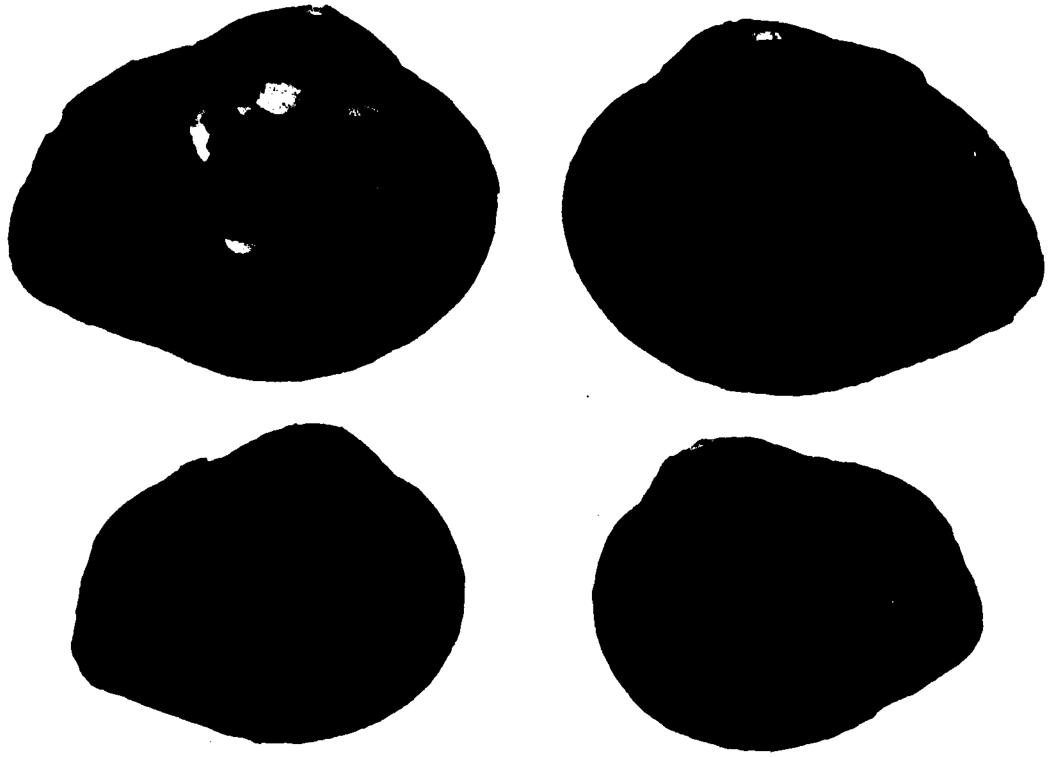
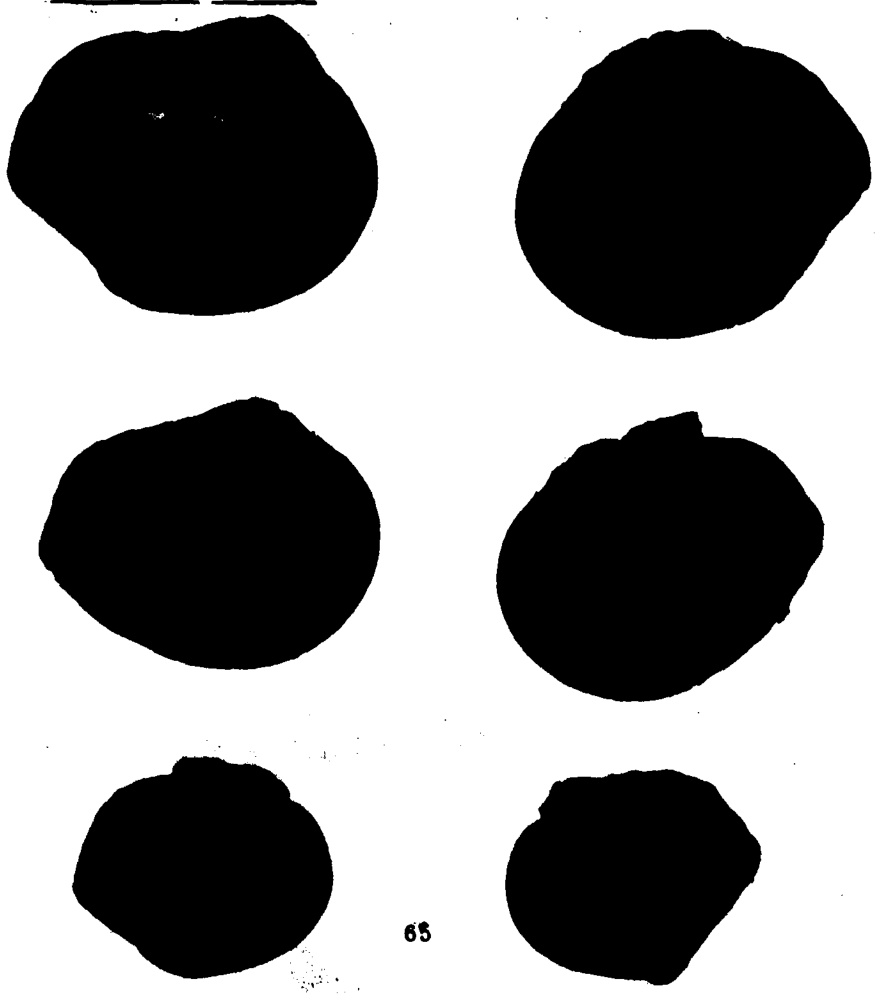


Plate 16. Obliquaria reflexa Raf., 1820 showing different size classes



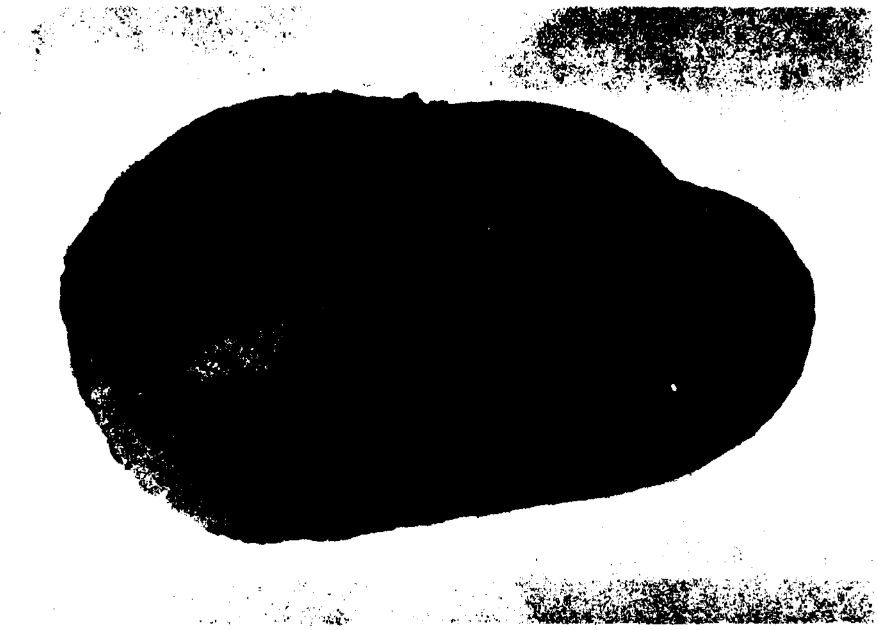
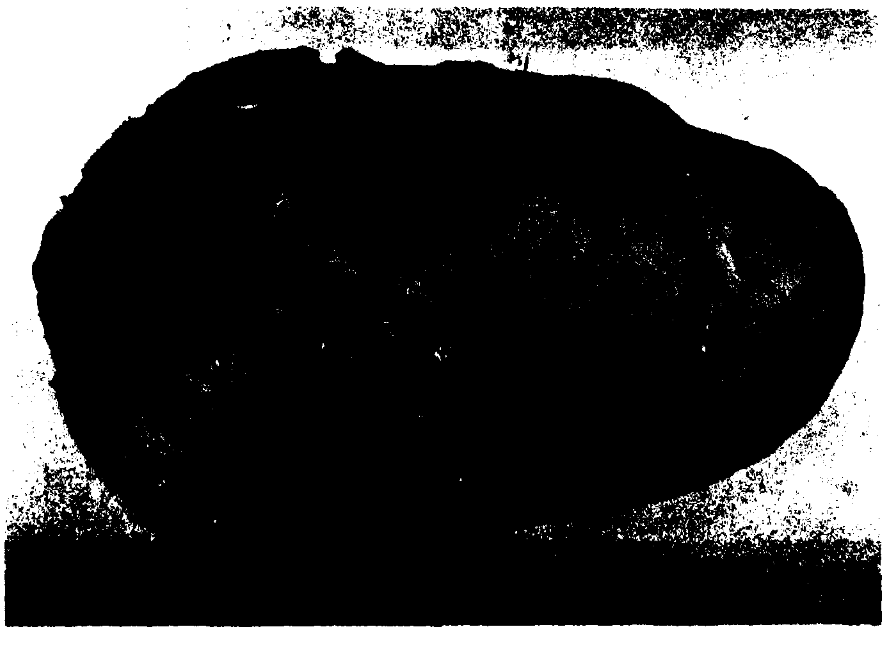


Plate 17. Lampsilis radiata luteola (Lamarck, 1819) Adult



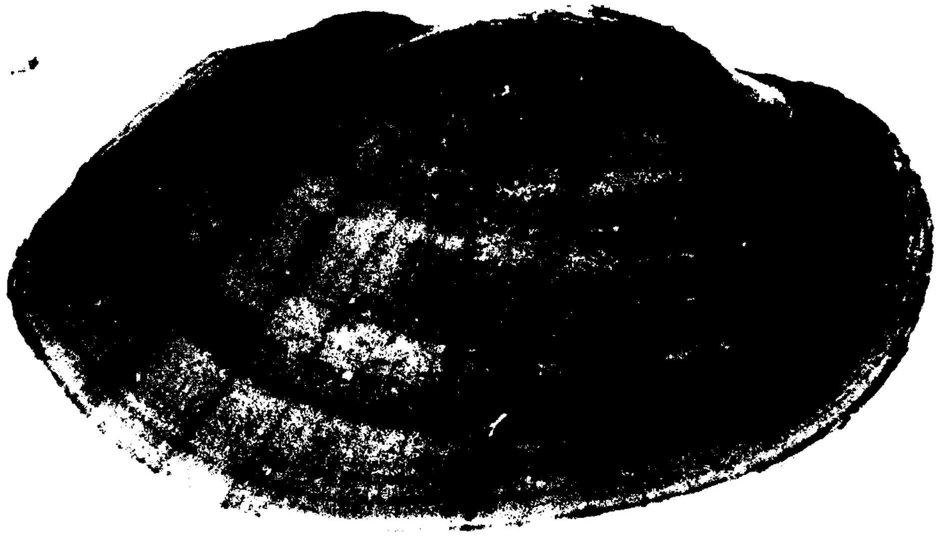


Plate 18. Lampsilis radiata luteola (Lamarck, 1819) Male above, female below

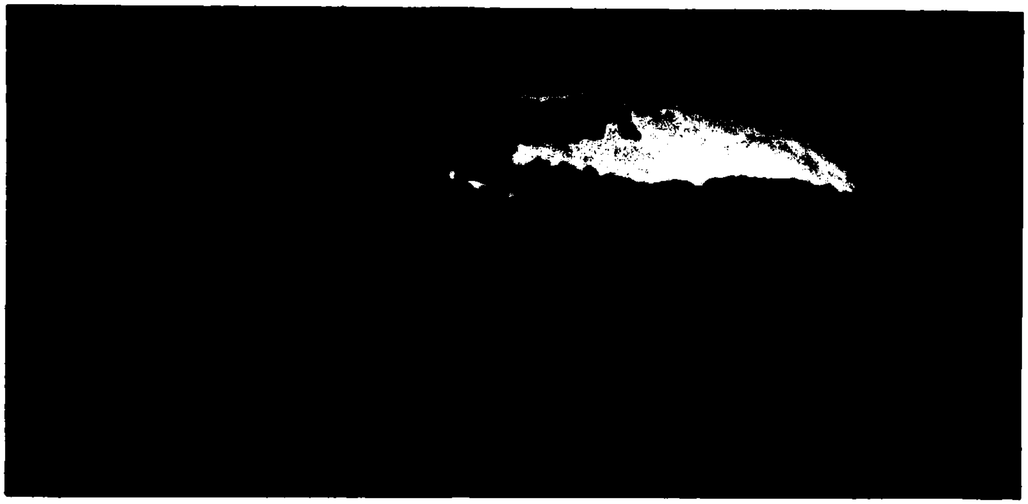


Plate 19. Lampsilis teres form teres (Raf., 1820) Adult

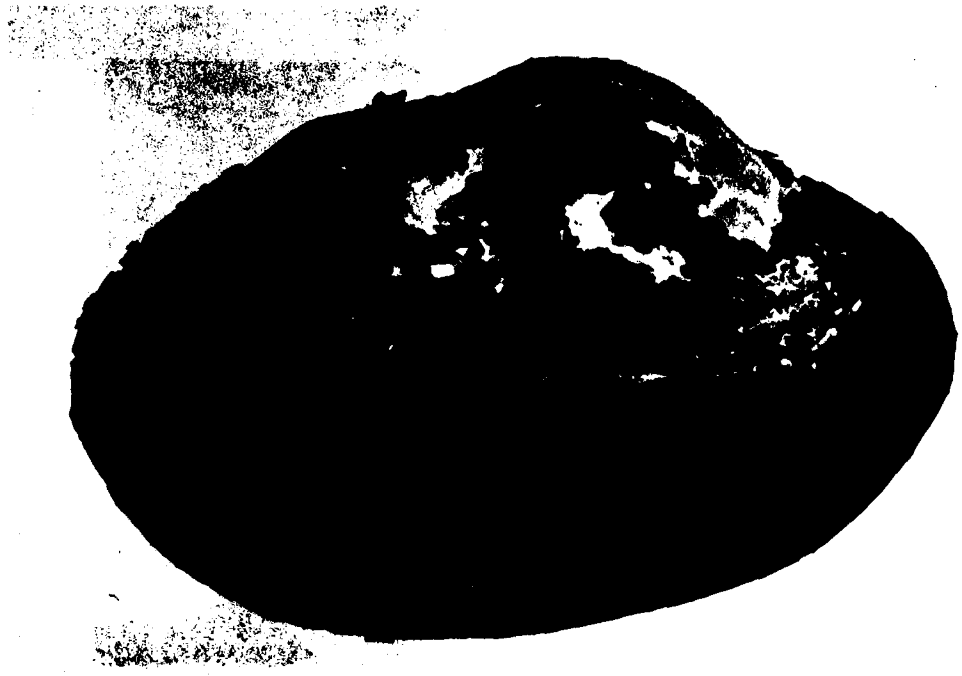


Plate 20. Actinonaias ligamentina carinata (Barnes, 1823) Adult

Plate 21. Typical collecting sites

Appendix I. List of mussels that were collected which appear on either an adjacent state or a federal Rare and Endangered Species List.

Species	Governmental Agency	X = Fresh shells found * = Subfossil shells only
Lampsilis orbiculata	Fed., WV, KY, Ohio	*
Lampsilis ovata	Ohio	*
Lampsilis teres	Ohio	X
Plethobasus striatus (cooperianus)	Fed.	*
Cyprogenia stegaria	Ohio	*
Potamilus ohiensis (laevissimus)	Ohio	X
Quadrula metanevra	Ohio	X
Plagiola lineolata	Ohio	X
Fusconaia maculata (subrotunda)	Ohio	*
Pleurobema cordatum	Ohio	X