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Changes in Freshwater Mussel Populations of the Ohio River: 1,000 BP to Recent Times[1]

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ABSTRACT. Through the use of literature records and new data, it was possible to compile a list of species of freshwater mussels that inhabited the upper Ohio River (Ohio River Mile [ORM] 0-300) around a thousand years ago. This information was derived from specimens found associated with Indian middens located along the banks of the Ohio.

Analysis of these data indicates that at least 31 species of mussels were present in the river. Arnold Ortmann recorded 37 species from the same area as a result of his many years of collecting around the turn of the 20th century. Thirty-three species have been collectively documented as currently residing in limited numbers in the river. The number of species present has remained essentially unchanged through time. There have been, however, significant changes in species composition and total numbers of individual mussels present. Occasionally, healthy populations can be found presently but much of the upper Ohio River is devoid of mussel life. Several large-river species have become established in this reach of the river as a consequence of damming and the resulting increase in depth, greater siltation and slowed rate of flow. Seventeen species known to have previously inhabited the upper Ohio River are listed as presumed to no longer survive there.

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INTRODUCTION

For thousands of years, the Ohio River flowed freely for nearly 1,000 mi—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 visited only occasionally by native-born Americans. The river existed as a series of riffles and pools with an occasional waterfall. A wide variety of types of habitat prevailed, and aquatic life was abundant in this clean, undisturbed, virgin stream. Jones (1920) characterized the "original" river as much obstructed through its entire length by snags, rocks, and sand and gravel bars. He also mentioned that at minimum flow the average depth between Pittsburgh and Cincinnati was one ft.

By the late 1700's, white man made his way into the Ohio Valley and settlements sprang up and grew rapidly. Early settlements at Mariettta, Pomeroy, and Cincinnati, OH and Louisville, KY began as forts, metamorphosed into trade centers and matured into densely-populated urban centers. As the number of inhabitants of the area grew into the millions, a concomitant degradation of the environment began. The by-products of lumbering, agriculture, mining, and human sewage flowed, in ever-increasing quantities, into the previously uncontaminated river.

The conversion of the river to a completely different habitat type began in the year 1885 (Jones 1920) as the first dam was constructed. Between the years 1910-1919, a series of Chanoine movable wicket dams was built by the United States Army Corps of Engineers and a minimum nine ft (3 m) slackwater pool navigation system was created. Habitat modification continued, however, and in 1938 a series of higher dams was begun. With the completion of Willow Island Locks and Dam in 1976, coupled with the current expansion of Gallipolis Locks and Dam, it appears that the present series of high-rise dams (12 ft [3 m] navigation channel) will meet the barge traffic needs well into the 21st century. The original river, that averaged less than one ft depth along its course of swiftly flowing waters (Jones 1920), in no way resembles the deep, stable, unchanging waterway that exists today. The only remaining free-flowing portion of the Ohio River is the lower 18.4 mi just before confluence with the Mississippi River (Williams and Schuster 1989).

The French naturalist Rafinesque reported in 1820 that the Ohio River supported a vast assemblage of aquatic life, which included at least 68 species of freshwater mussels (Stansbery 1971). Following the environmental degradation mentioned above, one would naturally expect that a reduction and/or change in the composition of the freshwater mussel population would follow. By the late 1800's, the effects of environmental degradation were already being felt by the mussels. Samuel Rhoads (1899) wrote "Owing to the steady extermination of the molluscan life in the Ohio River in western Pennsylvania, due to the pollution and damming of the waters of that river and 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." In his prefatory note to Vol. VIII, W. J. Holland, the editor of the Memoirs of the Carnegie Museum, commented that the work of cataloging the species of freshwater mussels of the Ohio River by Arnold Ortmann (1919) had occurred at the "eleventh hour"; several species were already in dire danger of being extirpated from the Ohio River.

This paper is an attempt to document the changes that have occurred in the freshwater mussel population over the last 1000 years. A species list for the pre-1700 Ohio River has been prepared based upon literature records of mussels found in Indian middens. Additional recent unpublished data from the Clover site (ORM

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288) are also included. Through the writings of Ortmann, one can piece together a faunal list for the period 1880-1920. The current species list, as presented herein, is a composite of research by this author and other published accounts. No attempt is made at comparing numbers of individuals present; the collecting methods are not comparable and time frames are widely varied. This paper will address only species richness and how it has changed through time.

MATERIALS AND METHODS

Literature references have been used in formulating the early river period species list (Table 1). The Marshall University Archeology Field School worked for five weeks each during the summers of 1986 and 1987. The shell material was made available for identification purposes. Other than the fact that *Pleurobema coccineum* is absent, the species composition at the Clover site is identical to that at the Lewis-Old Town site (Spurlock 1981). A publication on the total findings at the site is in preparation.

The list for the period 1880-1920 (Table 2) is based primarily upon Ortmann's monograph on the naiads of Pennsylvania.

The list of the current inhabitants of the upper Ohio River (Table 2) is a composite of the published works of Taylor (1980) and others (Williams and Schuster 1989, Tolen et al. 1987, Zeto et al. 1987). collecting techniques involved the use of SCUBA, brailing, and hand-picking from the banks. Reference specimens are on deposit at the Marshall University Malacological Collections, Marshall University, Huntington, WV and The Museum of Zoology, The Ohio State University, Columbus, OH. Collecting techniques and time spent in making collections are not intended to be comparable. Simply stated, one or more live or fresh-dead specimens of each of the species listed has been collected within the last decade from the upper 300 mi of the Ohio River. Scientific names used in this paper are those of Turgeon et al. (1988).

RESULTS

In the pre-1800 time period, there were at least 31 species of freshwater mussels living in the upper 300 mi of the Ohio River. In the 1888-1920 time frame, 37 species were resident; recently, the number of extant species has apparently declined to 33 (Table 2). When one compares the Indian midden list to that of Ortmann, there is a 70% similarity. The recent list is 59% similar to Ortmann's but only 51% similar to the midden list. These data indicate nearly a 50% change in the mussel faunal composition over the last 200 years and a 41% change during the 75 years since the collection of Ortmann was made. *Anodontoides ferussacianus* and *Ptychobranchus fasciolaris* were the only two species found in middens and not in either of the other time periods. Both of these species are normally found in small- to medium-size rivers (Williams and Schuster 1989) and apparently never enjoyed widespread distribution in the Ohio. A comparison of the midden and recent lists shows that there are at least 18 species that resided, at least in small numbers, in the Ohio at an earlier time that must now be presumed to be no longer present (Table 3).

DISCUSSION

Notably absent from the midden list are representatives of small species, juveniles, and thin-shelled species. Matteson (1953), Morrison (1942) and Parmalee (1956) all reported similar results. Each author indicated a selective collecting technique that would have produced the maximum amount of food energy for the work involved, and thus excluded the small species. The thin-shelled species are usually found in sandy, silty or muddy bottoms in quite deep water with little or no current (Murray and Leonard 1962). This type of habitat is not indicated either by the species found, and what we know of their habitat requirements, or by the early historical reports of the physical qualities of the river prior to damming. It must, therefore, be presumed that the Anodontines (thin-shelled toothless species indicated by TH in Table 2) simply were not present.

The difference in numbers of species between the midden and Ortmann lists in no way implies that the environment had drastically improved in the intervening 400 years or so since the time of Indian inhabitation. These differences, in fact, reflect the efforts of a skilled collector who gathered everything of scientific interest including juvenile specimens. All of Ortmann's species may have been in the river at the earlier time, but some were simply overlooked. Many of his extra species, which are typically found in smaller streams and probably were present in the Ohio River near the mouths of these small tributaries, would not normally be considered as part of the fauna of a large river system. Species in this category would include: *Fusconaia flava, Truncilla truncata, Tritogonia verrucosa, Lasmigona costata, L. complanata,* and *Lampsilis fasciola*. Their small numbers and very limited distribution could easily ex-

TABLE 1

Native American shell sites referenced during this study

Site Name	River Mile	Age/yrs	# spec. found	Reference
Globe Hill	51	4000	7	Parodiz (1955)
Bartlett-Bird	170	1000	17	Taylor (1981)
Neale's Landing	188	1000	14	Stansbery (1977)
Miller Site	218-219	1000	16	Murphy (1981)
Lewis-Old Town	261.3	700	17	Spurlock (1981)
Rolfe-Lee Farm	273	700	18	Spurlock (1981)
Clover	288	250	16	Taylor (this paper)

TABLE 2

A comparison of the species present in the upper Ohio River during different time periods.

Scientific Name	Pre-1800	1880-1920	Recent
Actinonaias ligamentina (Lamarck)		X	X
Amblema p. plicata (Say)	X	X	X
Anodonta grandis Say (TH)			X
Anodonta imbecillis Say (TH) (SM)			X
Anodontoides ferussacianus (Lea) (TH) (SM)	X		
Cyclonaias tuberculata (Raf.)	X	X	X
Cyprogenia stegaria (Raf.)	X	X	
Ellipsaria lineolata (Raf.)	X	X	X
Elliptio crassidens (Lamarck)	X	X	X
Elliptio dilatata (Raf.)	X	X	X
Epioblasma flexuosa (Raf.) (SM)	X		
Epioblasma t. torulosa (Raf.) (SM)	X	X	
Epioblasma triquetra (Raf.) (SM)		X	
Fusconaia ebena (Lea)			X
Fusconaia flava (Raf.) (SM)		X	X
Fusconaia subrotunda (Lea)	X	X	X
Lampsilis abrupta (Say) (=orbiculata)	X	X	X
Lampsilis fasciola (Raf. (SM)		X	
Lampsilis ovata (Say)	X	X	
Lampsilis siliquoidea (Barnes)	X	X	X
Lampsilis teres (Raf.)	X		X
Lasmigona compressa (Lea) (SM)			X
Lasmigona c. complanata (Barnes)		X	X
Lasmigona costata (Raf.)		X	
Leptodea fragilis (Raf.) (TH)		X	X
Ligumia recta (Lamarck)	X	X	X
Megalonaias nervosa (Raf.)			X
Obliquaria reflexa Raf.	X	X	X
Obovaria olivaria (Raf.)	X	X	
Obovaria retusa (Lamarck)	X	X	
Obovaria subrotunda (Raf.)	X	X	X
Plethobasus cicatricosus (Say)	X	X	
Plethobasus cooperianus (Lea)	X	X	
Plethobasus cyphyus (Raf.)	X	X	X
Pleurobema clava (Lamarck) (SM)	X		
Pleurobema coccineum (Conrad)	X	X	
Pleurobema cordatum (Raf.)	X	X	X
Pleurobema pyramidatum (Lea)	X	X	
Potamilus alatus (Say)	X	X	X
Potamilus ohiensis (Raf.)			X
Ptychobranchus fasciolaris (Raf.)	X		
Quadrula c. cylindrica (Say)	X	X	
Quadrula metanevra (Raf.)	X	X	X
Quadrula p. pustulosa (Lea)	X	X	X
Quadrula quadrula (Raf.)		X	X
Strophitus undulatus (Say) (SM)			X
Toxolasma parvus (Barnes) (SM)			X
Tritogonia verrucosa (Raf.)		X	
Truncilla donaciformis (Lea) (SM)		X	X
Truncilla truncata (Raf.) (SM)		X	
Uniomerus tetralasmus (Say)			X
Villosa iris (Lea) (SM)			X
TOTAL NUMBER	31	37	33

SM = small species
TH = Thin-shelled species

TABLE 3

Species of freshwater mussels which are probably currently extirpated from the upper Ohio River

Cyprogenia stegaria
Epioblasma flexuosa
Epioblasma torulosa
Epioblasma triquetra
Lampsilis fasciola
Lampsilis ovata
Obovaria olivaria
Obovaria retusa
Plethobasus cicatricosus
Plethobasus cooperianus
Pleurobema clava
Pleurobema coccineum
Pleurobema pyramidatum
Ptychobranchus fasciolaris
Quadrula cylindrica
Tritogonia verrucosa
Truncilla truncata

plain how they were missed by the Indians. When one removes these species from Ortmann's list, the two lists become almost identical. Species for species, the mussel faunal assemblage has probably remained unchanged for at least 1,000 years.

There are significant changes in the make-up of the mussel population between Ortmann's time and the present. Many of these differences may be attributable to the fact that the river today is much different from that of 1900. What was a shallow, relatively free-flowing river is now a series of deep pools where at times during the year there is considerable depth and no perceptable current. These two factors may adversely affect certain species (Williams and Schuster 1989). As the change from lotic to lentic environment may have caused the elimination of certain species, it also created conditions that were favorable for others. *Megalonaias nervosa* and *Quadrula quadrula* are species usually associated with large rivers. *Q. quadrula* was not known to live in the Ohio upstream of Cincinnati according to Ortmann (1919); today it is the most commonly found species. *M. nervosa* is today frequently found throughout the Greenup Pool (ORM 279-341). *Anodonta grandis* seems to be very comfortable in this environment of slow current and the resulting increase in sediments.

Table 3 lists 17 species that have not been found since Ortmann's time, and must be considered as extirpated from the upper Ohio. The recent rediscovery of *Lamsilis abrupta* by Tolin et al. (1987) in the Greenup Pool, coupled with the discovery of a small population of *Lampsilis teres* in the same area by this author (unpubl.) in 1987, raises the hope that there are additional populations of the species currently thought to have been extirpated yet to be found.

The most significant change that has occurred since the time of Ortmann's work is not the reduction in species, but the reduction in numbers of individuals. I have spoken with local older persons who remember the shelling dredges shipping bargeloads of shells from the area of Huntington, WV (ORM 304) in the 1920's. Coker (1919) tells of the large number of pearl button factories that were present along the upper Ohio during the early 1900's. They existed in the region only because of the plentiful supply of freshwater mussel shells. Today there is not a single commercial musseler working in the river upstream of Maysville, KY. Shells are still quite valuable as raw material for the Japanese cultured pearl industry. If the mussels were present today in large numbers, the musselers would be there also. The mussel community in the upper Ohio River is still present. It is, however, in a fragile state in my opinion and merits constant monitoring to assure its continued existence.

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