2005

Diversity of the Unionidae in the Rocky River, Ohio

Robert A. Krebs
Cleveland State University, r.krebs@csuohio.edu

Louie J. Rundo
Cleveland State University, louie.rundo@lnoca.org

Recommended Citation

Krebs, R. A. and L. J. Rundo. 2005. Diversity of Unionidae in the Rocky River, Ohio. Journal of Freshwater Ecology 20(3): 603-608.

Diversity of the Unionidae in the Rocky River, Ohio

Robert A. Krebs and Louie J. Rundo
Department of Biological, Geological, and Environmental Sciences
Cleveland State University
2121 Euclid Ave., Cleveland Ohio 44115-2406
r.krebs@csuohio.edu, louie.rundo@lnoca.org

ABSTRACT

We surveyed the freshwater mussels (Mollusca: Bivalvia: Unionidae) of the Rocky River, Ohio, USA, a river surrounded by suburban development. The survey produced 253 live unionid specimens and 572 empty shells. Most occurred in the west branch. Species living in the West Branch Rocky River included *Anodontoides ferussacianus, Elliptio dilatata, Lampsilis cardium, Lampsilis radiata luteola, Lasmigona compressa, Lasmigona costata, Pyganodon grandis grandis, Strophitus undulatus undulatus, and Toxolasma parvus*. Two additional species (*Utterbackia imbecillis* and *Villosa iris iris*) were represented as dead shells. Three species (*Potamilis alatus, Quadrula quadrula* and *Leptodea fragilis*) were found only near the mouth of the main stem of the river. No live mussels were found in the east branch. Although mussel diversity changed along the river, the presence of healthy mussel populations downstream of two expanding suburban areas suggests that these developments so far have minimally impacted populations.

INTRODUCTION

The Rocky River is a modest stream that drains parts of Medina, Summit, Lorain and Cuyahoga counties in northeast Ohio. These counties south of Cleveland include some of the most rapidly expanding suburban areas (Clapham 2003), and therefore they may add additional stress to a river that already suffers downstream from effluent originating near a major airport (Cleveland-Hopkins International) and extensive development through Cleveland's west side. The Rocky River enters Lake Erie a few kilometers west of Cleveland, Ohio.

Freshwater mussels (Mollusca: Bivalvia) are an important component of the benthic community of many lakes, rivers, and creeks. They maintain a sedentary life surviving by suspension feeding in the water column. These methods of feeding and respiration make mussels excellent indicators of the overall health of rivers and lakes (Smith et al. 2002); they are quite susceptible to water column contaminants and thus are declining in number and diversity throughout North America (Williams et al. 1993; Richter et al. 1997). Siltation, impoundments, mining, pollutants, exotic species, and poaching have reduced mussel populations in Ohio (Watters 1995; Schloesser et al. 1998; Tevesz et al. 2002) and elsewhere (Metcalfe-Smith et al. 1998; Brown and Banks 2001).

The investigation of the Rocky River mussel fauna is important for two significant reasons. First, there has not been a comprehensive survey of mussels of this watershed; second, there is a strong community interest in the faunal health of the local waterways. The Rocky River is a watershed of Lake Erie, and the exotic zebra and quagga mussels (*Dreissena polymorpha* and *D. bugensis*) have recently imperiled the unionid populations of

the lake (Schloesser et al. 1998; Strayer 1999; Nichols and Amberg 1999). Waterways that flow into Lake Erie may contain similar species as those lost from the lake, and these riverine species may also share genetic similarities to populations that once inhabited Lake Erie. Maintaining mussel populations in waterways such as the Rocky River may be the only means to propagate species and to establish variation lost from this region. Thus, the purpose of this survey was to provide a current account of the mussel species inhabiting the Rocky River system.

METHODS AND MATERIALS

The Rocky River was surveyed beginning in the summer of 2001, a period in which rainfall had been unusually low, thereby enabling extensive access to the lower portion of the river. The West Branch Rocky River was surveyed in July 2003. Surveys at each site were predominantly visual. In areas where water turbidity was high, sampling was done by feeling with hands and feet. Survey sites were determined by accessibility, and included every major river crossing for the west branch and main stem, plus six areas of the east branch, comprising a total of 33 sites (Fig. 1). Each site survey was timed to standardize effort (Green et al. 1985) with approximately 1.5 person hours spent at each site.

All suitable and accessible habitats were observed. Both live and dead specimens were identified, counted and recorded. Identification was done using Watters (1995) and Cummings and Mayer (1992). Most dead specimens were collected for identification purposes and as voucher specimens. Whole recently dead specimens were collected as well as individual valves and large fragments. Shells were considered recently dead when they had an intact periostracum and non-deteriorated nacre. All shells are currently stored in the Department of Biological, Geological and Environmental Sciences at Cleveland State University. Live specimens were photographed, assigned a GPS location, and returned to the substrate.

RESULTS AND DISCUSSION

A total of 253 live unionid specimens and 572 shells were found during this survey. Fourteen species were represented overall (Table 1). Seven species were identified near the mouth of the river along with the shells of two species that occurred upstream. Eleven species were found in the West Branch Rocky River, and nine of these species were represented by live specimens. No live individuals were found in the East Branch Rocky River, although shells of five species were identified.

Main Stem Rocky River

Live specimens of seven species were collected near the mouth of the river (*Strophitus undulatus undulatus, Lasmigona compressa*, *Lasmigona costata*, *Lampsilis radiata luteola,* and three species that were found only there, *Potamilis alatus*, *Quadrula quadrula* and *Leptodea fragilis*. In addition, shells of *Eliptio dilatata* and *Lampsilis cardium* were recovered.

Low water levels during the survey may have contributed to one aspect of the biology of unionids in this shallow river. We found a large number of recently dead mussels; these individuals still contained tissue inside the shells. Among these recently dead were 11 *L. fragilis*, one *L. radiata luteola,* and one *L. costata*. *Leptodea fragilis* is of particular concern because this species dominated the list of recently dead; it made up (78%) of the empty shells observed within this region but only 32% of the live animals. This population of *L. fragilis* therefore may be sensitive to warm water. However, the cause of mortality, whether as a direct effect of heat, reduced oxygen or a combination of factors that can arise with low flow in shallow water, is not known.

West Branch Rocky River

The West Branch Rocky River is a much more expansive habitat for mussels as it meanders south from above the escarpment. Nine species were found in this stretch of the river, four of which were not present in the main stem. The nine were *Anodontoides ferussacianus, Elliptio dilatata, Lampsilis cardium, Lampsilis radiata luteola, Lasmigona compressa, Lasmigona costata, Pyganodon grandis grandis, Strophitus undulatus,* and *Toxolasma parvus.* Two additional species (*Utterbackia imbecillis* and *Villosa iris iris*) were represented as empty shells. *Utterbackia imbecillis* is a thin-shelled unionid that prefers quiet backwaters (Watters 1995), and these areas are typically deep and silty, which may be a reason why *U. imbecillis* was not found alive. Likewise, while three old valves of *V. iris* were collected, this species is relatively small with a maximum size of only 7 cm. This small size may have contributed to our failure to find live individuals.

Lampsilis radiata luteola represented 36% of the total number of live mussels found in the west branch. Watters (1995) suggested that this species may be found in many different substrates, which may account for the large numbers of specimens identified in this survey. The next most common species were *S. undulatus* (26% of the total) and *L. costata* (14%). Only one live individual of *E. dilatata* was discovered.

The same three species that were most abundant as live mussels also were best represented by dead shells. *Lampsilis radiata luteola* (183 shells), *L. costata* (73 shells), and *S. undulatus* (57 shells) collectively represented 73% of the total dead specimens. Among the less common species, the numbers of live and dead specimens also correlated well, except for *L. compressa* for which few shells were found.

Mussels live partially buried and sometimes fully buried in the substrate, which can make finding live individuals challenging. In addition, unionid shells are typically camouflaged to their surroundings with colors of brown, black, green and perhaps even covered with algae. Dead individuals often are more easily discovered because of their brilliant iridescent nacre that reflects light well even in turbid water. Additionally, low areas of the river, especially sand and gravel bars, were excellent sources of dead unionids as the result of water flow deposition. These differences in visibility of live and dead are expected to bias collections against finding many small individuals alive, but not necessarily affect our ability to find shells of all species. For that reason, three old dead *V. iris* valves and four old *E. dilatata* shells were included in this survey because of the otherwise low accounts for their occurrence, past or present.

East Branch Rocky River

Less effort was expended surveying the East Branch Rocky River, which is the smaller of the two forks, because few shells and no live individuals were found in initial efforts. Of 31 shells and shell fragments found, only 14 appeared fresh. Much of the east branch appeared visibly to be good mussel habitat, but live mussels were absent. Records from the Ohio State Museum of Biological Diversity (http://www.biosci.ohio-state.edu/~molluscs/OSUM2/) list only three of the species that we found plus two small species, *T. parvus* and *A. ferussacianus*.

Although the physical and chemical appearance of the East Branch Rocky River rate as "good," especially since the removal of a number of waste water treatment plants in the early 1900's, its water quality is only fair based on analysis of fish communities (Rocky River Watershed Council, 2002). The absence of live mussels further attests to the polluted state of this stream in the recent past.

Variation among sites: does urbanization reduce diversity?

The diversity of unionids varied within the watershed of the Rocky River even applying analyses of means across close collection sites (Fig. 2), which helps to reduce effects of sampling artifacts (Cam et al. 2002). Some of these effects are due to habitat requirements; three large-river species occurred only near the mouth (*L. fragilis*, *P. alatus*, and *Q. quadrula*), while *A. ferussacianus* was found only in headwaters, its preferred environment (Watters 1995). Overlaid on these natural expectations of change is the potential impact of urbanization on mussel communities, however, the highest levels of diversity existed in the lower west branch.

The Rocky River supports a healthy and species-rich group of freshwater mussels for a small river. The unionid communities of the larger Cuyahoga River to the east (Tevesz et al. 2002) and Black River to the west (Ohio State Museum of Biological Diversity) are no more diverse, with 10-14 extant species. The Ohio State Museum of Biological Diversity, which is the largest repository in Ohio for collected material on molluscs, possesses only 45 individuals representing 10 species for the Rocky River. We found three species not previously observed; all three of these were found in the first surveys of the main stem of the Rocky River, to which *P. alatus*, *L. fragilis*, and *Q. quadrula* appear to be restricted. Each of these species also occurs only in the lower portion of the Cuyahoga River (Tevesz et al. 2002). Upstream, identifying *U. imbecillis* from shells provided a new record for the West Branch Rocky River, but otherwise neither were any new species identified by live individuals nor were any species missed that were found historically. While mussel diversity varies within the river, only in one stretch are anthropogenic rather than natural habitat effects potentially the cause of low diversity. Thus, with the exception of the east branch, the Rocky River has apparently held up well against the effects of urban sprawl emanating from Cleveland.

ACKNOWLEDGEMENTS

We thank Shanta Harsa for helping us survey the main stem of the river and Tom Watters from The Ohio State University Museum of Biological Diversity (Mollusc

Division) for his assistance with specimen identification. The research was supported by a small grant for exploratory research from NSF (DEB 0002305), by Ohio Sea Grant, and by a President's Initiative award from Cleveland State University.

LITERATURE CITED

Brown, K. M. and P. D. Banks. 2001. The conservation of unionid mussels in Louisiana rivers: diversity, assemblage composition, and substrate use. Aquatic Conserv. Mar. Freshw. Ecosyst. 11: 189-198.

Cam, E., J. D. Nichols, J. E. Hines, J. R. Sauer, R. Alpizar-Jara and C. H. Flather. 2002. Disentangling sampling and ecological explanations underlying species-area relationships. Ecology 83: 1118-1130.

Clapham, W. B., Jr. 2003. Continuum-based classification of remotely sensed imagery to describe urban sprawl on a watershed scale. Remote Sensing Environ. 86: 322-340.

Cummings, K. S. and C. A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey, Manual 5, Champaign, Illinois. 194 pp.

Green, R. H., S. M. Singh, and R. C. Bailey. 1985. Bivalve molluscs as response systems for modeling spatial and temporal environmental patterns. Science Total Environment 46:147-169.

Metcalfe-Smith, J. L., S. K. Staton, G. L. Mackie, and N. M. Lane. 1998. Changes in the biodiversity of freshwater mussels in the Canadian waters of the lower Great Lakes drainage basin over the past 140 years. J. Great Lakes Res. 24: 845-858.

Nichols, S. J. and J. Amberg. 1999. Co-existence of zebra mussels and freshwater unionids: population dynamics of *Leptodea fragilis* in a coastal wetland infested with zebra mussels. Can. J. Zool. 77: 423-432.

Rocky River Watershed Council. 2002. The State of the Rocky River. Northeast Ohio Areawide Coordinating Agency. www.noaca.org.

Richter, B. D., D. P. Braun, M. A. Mendelson, and L. L. Maser. 1997. Threats to imperiled freshwater fauna. Conserv. Biol. 11: 1081-1093.

Schloesser, D. W., W. P. Kovalak, G. D. Longton, K. L. Ohnesorg, and R. D. Smithee. 1998. Impact of zebra and quagga mussels (Dreissena spp.) on freshwater unionids (Bivalvia: Unionidae) in the Detroit River of the Great Lakes. Am. Midl. Nat. 140: 299-313.

Smith, D. C., M. A. Gates, R. A. Krebs, and M. J. S. Tevesz. 2002. A survey of the freshwater mussels (Unionidae) and other molluscs in the Cuyahoga Valley National Park. Ohio Biological Survey Miscellaneous Contributions No. 8. 31p.

Strayer, D. L. 1999. Effects of alien species on freshwater mollusks in North America. J. North Amer. Benthol. Soc. 18: 74-98.

Tevesz, M. J. S., L. Rundo, R. A. Krebs, B. G. Redmond, and A. S. Dufresne. 2002. Changes in the freshwater mussel (Mollusca: Bivalvia) fauna of the Cuyahoga River, Ohio, since late prehistory. Kirtlandia 53:13-18.

Watters, G. T. 1995. A Guide to the Freshwater Mussels of Ohio, 3rd ed. Ohio Division of Wildlife, Department of Natural Resources, Columbus, Ohio. 122p.

Williams, J. D., M. L. Warren, K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18: 6-22.

Table 1. Mussel species found in the Rocky River system, Ohio. L=live specimens; S=shells or shell fragments.

Species	Main stem	West Branch	East Branch
Anodontoides ferussacianus (Lea, 1834)		L	
Elliptio dilatata (Rafinesque, 1820)	S	L	
Lampsilis cardium (Rafinesque, 1820)	S	L	
Lampsilis radiata luteola (Lamarck, 1819)	L	L	S
Lasmigona compressa (Lea, 1829)	L	L	S
Lasmigona costata (Rafinesque, 1820)	L	L	
Leptodea fragilis (Rafinesque, 1820)	L		
Potamilis alatus (Say, 1817)	L		
Pyganodon grandis grandis (Say, 1829)	S	L	S
Quadrula quadrula (Rafinesque, 1820)	L		
Strophitus undulatus undulatus (Say, 1817)	L	L	S
Toxolasma parvus (Barnes, 1823)		L	
Utterbackia imbecillis (Say, 1829)		S	S
Villosa iris (Lea, 1829)		S	

Figure 1. Map of the watershed and sampling sites along the Rocky River, Ohio.

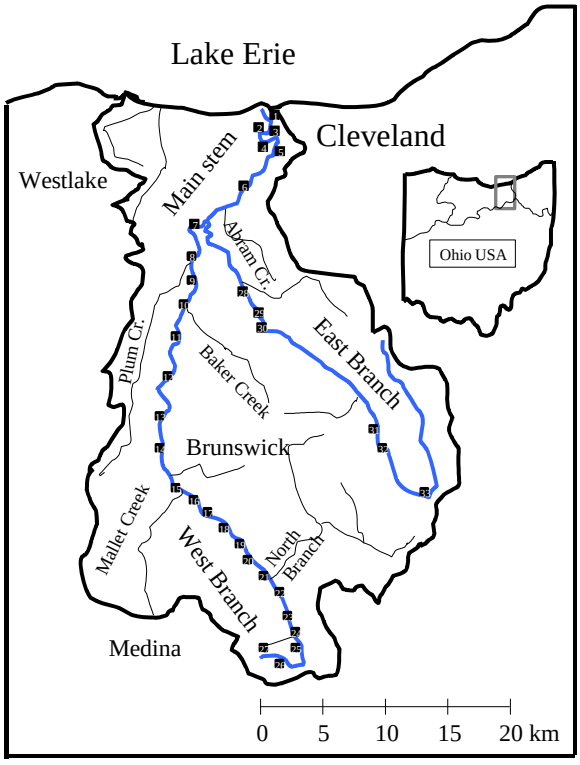

Figure 2. Mussel diversity as indicated by the number of species present in the main stem (sites 1-6) and the west branch (7-27) of the Rocky River. Site 1 was near the mouth of the main stem, and sequentially site numbers increased towards the headwaters. Results are presented by actual species found alive at each site and as a sliding average/total by considering the means, the total alive, and the total found either alive or dead using the site indicated plus the four upstream sites.