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The Unionid Mussel Fauna of Northeastern Ohio's Grand River¹

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ABSTRACT. Unionid mussel distribution, numbers, and species were examined in the Grand River to provide a recent and comprehensive study of mussels from northeast Ohio's longest river. The entire length of the Grand was canoed and examined for unionid mussel beds, with the exception of upstream areas where the river was small; SCUBA was used to survey just upstream of Fairport Harbor. The lower river, designated Grand River's Wild and Scenic section, was studied in 1995, the middle reaches, called the Scenic section, were surveyed in 1996, and completion of the headwater region followed in 1998. Finally, a survey near the mouth of the river was made in 2002. A total of 95 sites were examined visually, by hand, with bottom sieves, dip nets, or by diving, as conditions demanded; riverbanks were searched for dead shells. A total of 11,625 living mussels and 4,514 dead shells comprising 27 species were identified. All species found were represented by living specimens. Comparisons to earlier collections indicated that the unionid fauna is changing, especially in downstream areas, but the diversity of these threatened macroinvertebrates in the Grand River has been much less affected than in the neighboring Ohio rivers to the west.

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INTRODUCTION

The first extensive reports of the unionid fauna of the Grand River, OH, were published by Ortmann (1924), who identified 17 species despite surveying only a small proportion of the river. Since this time, periodic collections of mussels has continued, with most collections dating to the 1960s by Professor David Stansbery. Although unpublished, the records of these collections, which include shells from 24 different species, are available in a database from the Ohio State Museum of Biological Diversity.

The Grand River is the largest stream in NE Ohio and it drains portions of Lake, Ashtabula, Trumbull, and Geauga counties (Fig. 1). Although it is in the St. Lawrence basin, the Grand River is adjacent to Mississippi drainage, with Pymatuning Creek to the east and the Mahoning River to the southeast. On its western and southwestern edges, the Grand River adjoins the Chagrin and Cuyahoga river watersheds, respectively. Like the Cuyahoga, the Grand River has had a complex history that joined it with the Mississippi drainage during glacial times. In 1974, the Ohio Department of Natural Resources designated about 55 km of the Grand River as Scenic, from US Route 322 in southern Ashtabula County downstream to the Harpersfield Dam (Fig. 1). Another 39 km of the river, from the Harpersfield Dam down to the Norfolk and Western railroad bridge in Painesville, was designated as Wild and Scenic. The main channel of the Grand River's headwaters extends upstream from US Route 322 for another 37 km through Trumbull and Geauga counties, providing in total, over 120 km of potentially high quality mussel habitat. Many tributaries join the Grand River as it flows through woodlands, fields, and wetlands and eventually empties into Lake Erie at Painesville.

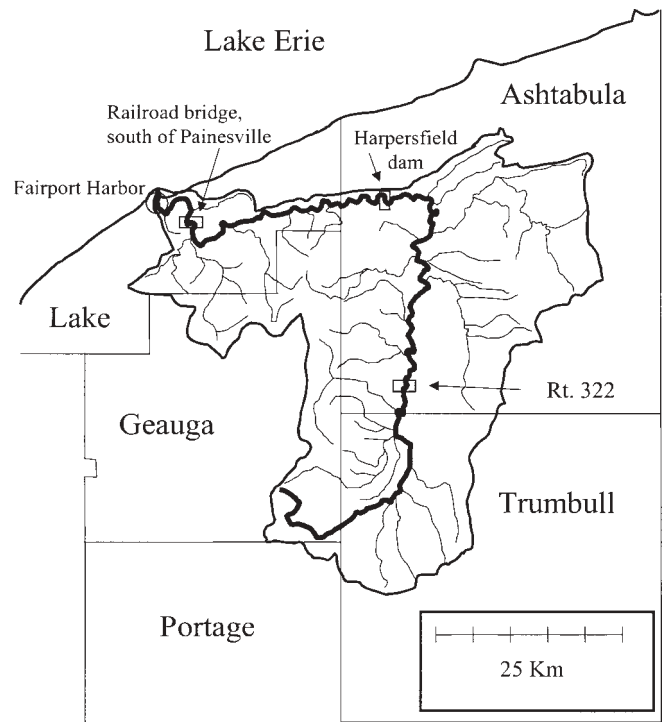


FIGURE 1. The watershed of the Grand River, OH, which encompasses parts of Lake, Ashtabula, Trumbull, and Geauga counties. Indicated by rectangles are the locations where the river changes classification, from headwater to Scenic at Route 322, to Wild and Scenic at Harpersfield dam, and functionally ending at the railroad bridge south of Painesville. Collections at the mouth of the river were made just above the dredging region of Fairport Harbor.

The present study was conducted to satisfy a pressing need for recent and comprehensive information of the Grand River's unionid mussel fauna, and it presents the results in two parts. Part I supplies detailed information about unionid populations and their distribution in the

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river as categorized by these four primary divisions: river mouth, Wild and Scenic, Scenic, and headwaters. Part II contrasts changes in the mussel fauna over the past half century plus. Further details are available from the Ohio Department of Natural Resources as final project reports for each of these sections of the river (Huehner 1996, 1997, 1999), and from EnviroScience, Inc. (2002). Names of the species described here follow Turgeon and others (1998).

MATERIALS AND METHODS

Field collections were performed in the Grand River's Wild and Scenic section (River Mile 30.9 to RM 9.0) during July of 1995, in the Scenic portion (from Route 322 to Harpersfield Dam, RM 64.7 to RM 30.9) during July of 1996, in the headwaters section (Parkman to Route 322, RM 99.0 to 64.7) during August and September of 1998, and in the city of Fairport Harbor (RM 0.5-1.75) in 2002. The river was accessed at road crossings, by private property, from County Parks, and from State Wildlife Areas. We established 12 sites near the river mouth, 18 collection sites in the Wild and Scenic section, 27 sites in the Scenic section, and 26 sites in the headwater section. The search strategy employed to locate mussel populations was to move downstream while observing conditions such as water velocity, depth, bottom composition, extent of submergent vegetation, and flood or muskrat deposited shells on the banks. Once a potential site was located, searchers examined the bottom by hand to determine its composition, extent of available habitat, and to determine whether mussels were present. If suitable habitat was limited or if no or very few mussels were found within a few minutes, another site was investigated downstream. When a preliminary search yielded a reasonable number of mussels (10-15 or more), then a full search was performed. Exact locations of collecting sites were logged on 7.5-minute USGS topographic maps in 1996 and 1998. A Garmin GPS 40 geographic positioning unit was used to fix latitude and longitude for each stop. All surveys at the river mouth followed preset transects.

Mussel collection methods were determined by the physical conditions encountered at each site, and usually they consisted of hand searching through the bottom, snorkeling or SCUBA (river mouth only) as determined by water visibility and depth. The most upstream reach (RM 99.0 - 90.4) of the Grand River was accessed by foot, but from RM 90.4 to RM 9.0 the entire length was canoed to locate mussel populations. Banks were examined for flood-deposited shells and muskrat middens; dip nets were used to scoop fine sediments from under flat rocks and logs where salamander mussels (*Simpsonaias ambigua*) would be found. Buckets with 1.25 cm mesh bottoms were used to sort fine sediments for smaller mussels. The actual time spent collecting mussels was recorded for each site and varied from 1/2 to 1-1/2 hours. Living specimens encountered were maintained under water in nylon mesh bags, identified to species, and returned to the river bottom in a natural position. Dead mussel shells were similarly collected, measured,

and returned to the stream. Representative specimens (no living special status species were removed) with collection site information were verified by Dr. David Stansbery and deposited in the Ohio State Museum of Biological Diversity.

RESULTS

The number of live individuals and shells found in each of the three regions of the Grand River are summarized in Table 1. Specific site data were recorded and submitted to the Ohio Department of Natural Resources (Huehner 1996, 1997, 1999). Live individuals of 27 species were observed. Early results for historical collections of the unionid fauna were compiled only with respect to the entire river from Ortmann (1924), and this reference provides only the presence or absence of a species (Table 2). In contrast, records from the Ohio State Museum of Biological Diversity, under the bivalve search (<http://www.biosci.ohio-state.edu/~molluscs/OSUM2/>), lists 3,555 specimens, not including those deposited for the present study (Table 2). These results also were recorded by county (Table 1), which approximates the recreational designations used here: Wild and Scenic region is predominantly Lake County, with a small section of Ashtabula; the Scenic section is entirely within Ashtabula County; and the headwater region is predominantly in Trumbull and Geauga counties, with only a short stretch penetrating into Ashtabula. Thus, for contrast, comparing county collections to these three divisions of the river enabled us to compare faunal changes along the river that have occurred over the past 30-40 years. The depth of the river near the mouth and the absence of *Q. quadrula* in any museum collections suggest that no previous information on this zone exists.

The Headwaters Section

Twenty-five sites along the headwaters section (which runs from Geauga, through Trumbull, and into Ashtabula counties) were surveyed to yield a total of 3,579 living mussels of 19 species (Table 1). The most dominant mussel species found in the headwaters of the Grand River were *Elliptio dilatata* (29%), *Lampsilis radiata luteola* (24.2%), *Fusconaia flava* (13.8%), and *Actinonaias ligamentina* (9.4%). Subdominant species included *Lampsilis cardium* (4.8%), *Amblema plicata* (3.4%), *Lasmigona costata* (2.9%), and *Obovaria subrotunda* (2.9%). The remaining 11 species were less prominent, although some occurred in significant numbers locally (that is, *Pleurobema sintoxia*, 8.2% at RM 78.5 and *Utterbackia imbecillis*, 37.4% at RM 76.6).

No mussels were found in the Grand River's three most upstream sites. The first had a bedrock bottom, while the second and third had sandy gravel sediments, which are adequate substratum environments. These two sites were extensively searched visually and by excavating the substrata, but neither living nor relic mussels were found. The first mussel community was encountered at RM 91.8, where we counted 100 living mussels of nine species.

TABLE 1

Records of live mussels from the Grand River, OH, separated by location: the river mouth (river miles 0.5-1.75), the Wild and Scenic section (river miles 9-30), the Scenic section (river miles 31-65) and the headwaters of this river (river miles 66-99). Older records that combine living and dead mussels deposited in the Ohio State Museum of Biological Diversity are presented by county for contrast, where the county records fairly closely correspond to the recreational/ecological designations for the river (Fig. 1).

Species	Live Collections				Museum Specimens		
	River mouth	Wild & Scenic	Scenic	Headwaters	Lake County	Ashtabula County	Trumbull County [†]
<i>Actinonaias ligamentina</i>	2	2389	1774	335	89	176	1
<i>Alasmidonta marginata</i>		35			6	5	
<i>Amblyma plicata</i>		12	48	121	6	92	13
<i>Anodontoides ferussacianus</i>				12		5	4
<i>Elliptio crassidens</i>						1	
<i>Elliptio dilatata</i>		289	551	1036	58	478	75
<i>Epioblasma triquetra</i>		14			13		
<i>Fusconaia flava</i>		156	183	492	38	580	43
<i>Lampsilis cardium</i>		260	90	170	7	36	3
<i>Lampsilis fasciola</i>		4			5		
<i>Lampsilis radiata l.</i>	2	183	374	864	9	385	32
<i>Lasmigona compressa</i>		2	1	7		11	4
<i>Lasmigona costata</i>	1	394	418	103	23	121	9
<i>Leptodea fragilis</i>	9	17			3	1	
<i>Ligumia recta</i>		11	225	51	4	25	
<i>Obovaria subrotunda</i>		5	63	103	39	339	9
<i>Pleurobema sintoxia</i>		6	18	85	9	34	3
<i>Potamilus alatus</i>	55	24			1		
<i>Ptychobranhus fasciolaris</i>		102	45	9	59	213	
<i>Pyganodon grandis</i>	7	4	40	81		65	16
<i>Quadrula quadrula</i>	50						
<i>Simpsonaias ambigua</i>		67	11	1	1	13	
<i>Strophitus undulatus</i>	2	63	26	6	12	41	2
<i>Toxolasma parvus</i>		1	1 shell	10		2	
<i>Truncilla donaciformis</i>	2						
<i>Truncilla truncata</i>	1	1					
<i>Utterbackia imbecillis</i>		4 shells	1 shell	83			
<i>Villosa iris</i>		6	4	10	47	287	2
Total specimens	131	4045	3871	3579	429	2910	216

[†]Includes the few specimens found for Geauga County.

The Scenic Section

Examination of the 27 collection sites yielded 3,871 living mussels and 1,707 shells comprising 18 species, two of which were identified only from valves (Table 1). As the river slows in this region, several sites received

only a limited search effort, because conditions were essentially anaerobic. The mussel fauna of the Grand River's Scenic Section was dominated by *Actinonaias ligamentina*, which comprised 45.8% of all living mussels examined. Five less abundant species shared sub-

TABLE 2

Comparison of unionid collections from the Grand River across time: the first collections were made by Sterki (1907) and particularly by Ortmann (1924) who surveyed parts of the Grand River in all three counties. The Ohio State Museum of Biological Diversity records combine living and dead mussels that were deposited prior to 1990, present numbers are for collections 1995-2002.

Unionid Species	Presence Described In Ortmann, 1924	Museum Records Total Present	Museum Records Overall Frequency	Present Number Grand River	Present Frequency Grand River
<i>Actinonaias ligamentina</i>	X	266	.075	4500	.387
<i>Alasmidonta marginata</i>	X	11	.003	35	.003
<i>Amblema plicata</i>	X	111	.031	181	.016
<i>Anodontoides ferussacianus</i>	X	9	.003	12	.001
<i>Elliptio complanata</i> ***	X	0	0	0	.000
<i>Elliptio crassidens</i> **		1	<0.001	0	.000
<i>Elliptio dilatata</i>	X	611	.172	1876	.161
<i>Epioblasma triquetra</i> **		13	.004	14	.001
<i>Fusconaia flava</i>	X	661	.186	831	.071
<i>Lampsilis cardium</i>	X	46	.013	520	.045
<i>Lampsilis fasciola</i> *		5	.001	4	<.001
<i>Lampsilis radiata l.</i>	X	426	.120	1423	.122
<i>Lasmigona compressa</i>		15	.004	10	.001
<i>Lasmigona costata</i>	X	153	.043	916	.079
<i>Leptodea fragilis</i>		4	.001	26	.002
<i>Ligumia recta</i> **	X	29	.008	287	.025
<i>Obovaria subrotunda</i>	X	387	.109	171	.015
<i>Pleurobema sintoxia</i> *	X	46	.013	109	.009
<i>Potamilus alatus</i>	X	1	<0.001	79	.007
<i>Ptychobranchus fasciolaris</i>	X	272	.077	156	.013
<i>Pyganodon grandis</i>	X	81	.023	132	.011
<i>Quadrula quadrula</i>		0	0	50	.004
<i>Simpsonaias ambigua</i> *		14	.004	79	.007
<i>Strophitus undulatus</i>	X	55	.015	97	.008
<i>Toxolasma parvus</i>		2	.001	11	.001
<i>Truncilla donaciformis</i> **		0	0	2	<.001
<i>Truncilla truncata</i> *		0	0	2	<.001
<i>Utterbackia imbecillis</i>		0	0	83	.007
<i>Villosa iris</i>	X	336	.095	20	.002
Total specimens		3554		11626	

*Ohio Special Interest.

**Ohio Threatened or Endangered.

***Extirpated from Ohio.

dominance; these are, in order of decreasing abundance: *Elliptio dilatata* (14.2%), *Lasmigona costata* (10.8%), *Lampsilis radiata luteola* (9.7%), *Ligumia recta* (5.8%), and *Fusconaia flava* (4.7%). These six species comprised 91% of all the living mussels found in the present study

and, with the exception of *L. recta*, all are widely distributed and are common species in Ohio.

The Wild and Scenic Section

Collection at 19 sites yielded 4,045 living mussels and

2,137 shells comprising 24 species, one of which was identified only from valves (Table 1). As in the Scenic Section, *Actinonaias ligamentina* dominated the system, and made up 59% of all individuals found alive. *Lasmigona costata* (10.4%), *Elliptio dilatata* (7.4%), *Lampsilis cardium* (6.5%), and *Lampsilis radiata luteola* (5.1%), also were common.

The River Mouth

Although a more restricted area, collections along 12 transects yielded 130 live mussels of 10 species. *Potamilus alatus*, a rare species of the Wild and Scenic section, and *Quadrula quadrula*, a species not found elsewhere in the river, comprised 81% of the individuals found. Another nine individuals (7%) were of *Leptodea fragilis*, which like *P. alatus*, is a rare species of the Wild and Scenic section. A single specimen of *Truncilla donaciformis* was found here, but nowhere else.

DISCUSSION

Of 27 species found alive in the Grand River, a number have important status and provide the Grand River with distinction for its diversity. Of Special Interest status in Ohio are seven extant species from this one river: *Epioblasma triquetra*, *Lampsilis fasciola*, *Ligumea recta*, *Pleurobema sintoxia*, *Simpsonaias ambigua*, *Truncilla donaciformis*, and *Truncilla truncata*. Three of these Special Interest species are present in reasonable numbers, *Ligumea recta*, *Pleurobema sintoxia*, and *Simpsonaias ambigua*. The other four were very rare. In addition, two rare *Elliptio* species are known from the Grand River historically, but these were not found in this extensive survey. Of importance to conservation is that the species of Special Interest cover the entire length of the river. The rare finds of the *Truncilla* species, *Lampsilis fasciola* and *Epioblasma triquetra* were all found at downstream locations. *Simpsonaias ambigua* also occurs mainly in the lower reaches, while the State Endangered Black Sandshell mussel, *Ligumia recta*, is common in the middle reaches, and the Round Pigtoe mussel, *Pleurobema sintoxia*, can be found mostly in the headwaters. As isolated individuals of both *Ligumia recta* and *Pleurobema sintoxia* also were encountered in upstream areas not used for sampling sites, they may occur throughout the headwater areas of the Grand River.

None of the once common species have been lost. We failed to find only one species reported present by Ortmann (1924), *Elliptio complanata*, which is gone from the Grand River, and this species apparently has been extirpated from Ohio (Watters 1995). The other 16 species Ortmann identified remain present. Four species are new records for the Grand River, the two specimens of *Truncilla truncata* and *T. donaciformis*, the presence of *Utterbackia imbecillis* in the headwaters, and the apparently abundant population of *Q. quadrula* near the mouth of the river all add to the community composition of already the most diverse unionid fauna in the NE Ohio region.

The unionid fauna of the Grand River is characteristic of the mussels known from the Lake Erie watershed.

Almost all of the species found once occurred in Lake Erie (La Rocque 1967), with *A. ligamentina* a surprising exception, and *T. truncata* potentially rare enough to have been overlooked in the lake. Our results for the Grand River include 24 of the 28 species ever reported for the Cuyahoga River (Krebs and others 2002; Tevesz and others 2002). The only three missing are *Ligumia nasuta*, a local endemic, *Cyclonaias tuberculata*, which is known from a single subfossil, and *Lasmigona complanata*, which probably invaded the Cuyahoga via the Ohio Canal (Dean 1890). Likewise 12 of 14 species from the Chagrin River (but not *Lampsilis ovata* or *Ligumia nasuta*) and the six from the west branch of the Mahoning (Hoggarth 1990) support a common base for the formation of the fauna of the Grand River and its neighboring watersheds. The Grand River undoubtedly provides the most important source of unionid diversity present in the region following the loss of unionids from Lake Erie, caused by zebra mussels (Gillis and Mackie 1994), and from the lower Cuyahoga River due to pollution and dredging (Tevesz and others 2002; Krebs and others 2002). In contrast, the majority of the Grand River's habitat has been relatively unaffected by dredging, dams, pollution, and zebra mussels, and the river may still experience substantial fish migrations from Lake Erie. The Grand River therefore may provide an important native mussel source population for nearby streams and coastal marshes in the Lake Erie watershed through larval glochidia attached to migrating fish.

Although species composition has not changed markedly in the Grand, abundances of several species have shifted. As for the Cuyahoga watershed, the headwaters have remained remarkably unaffected. For the upper part of the Grand River, the only species for which the frequency of individuals was about twice as high in museum collections as in the river today was for the giant floater, *Pyganodon grandis*. This species is pollution tolerant (Metcalf-Smith and others 2000), and it is probably the most abundant species in NE Ohio.

In contrast to the headwaters, five species have declined in abundance in the Scenic section of the river and eight in the lower Wild and Scenic section. In these two regions, one species, *Actinonaias ligamentina*, now composes more than 50% of the extant unionid fauna. In the Scenic region, *Fusconaia flava*, *Obovaria subrotunda*, *Pleurobema sintoxia*, *Ptychobranhus fasciolaris*, and *Villosa iris* all declined to less than a third of the frequencies indicated by past collections. All five of these species have likewise declined in the lower section, where *Amblema plicata*, *Lampsilis fasciola*, and *Ligumea recta* also have become reduced in number. As a consequence of changing conditions, these latter three species compose less than 1% of the fauna in the Wild and Scenic section. Concurrently, *P. fasciolaris* has dropped in frequency from 14% of past collections to 7% of current shells, and only 2% of live individuals. *Fusconaia flava*, which has declined as well, has concurrently increased in frequency in the headwater regions, suggesting that present changes in the Grand do not threaten its existence. Therefore, contrasts

between historical and the present surveys indicate that the Grand River fauna has changed, and these changes are likely greater in the main stem and mouth of the river than in the headwaters.

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