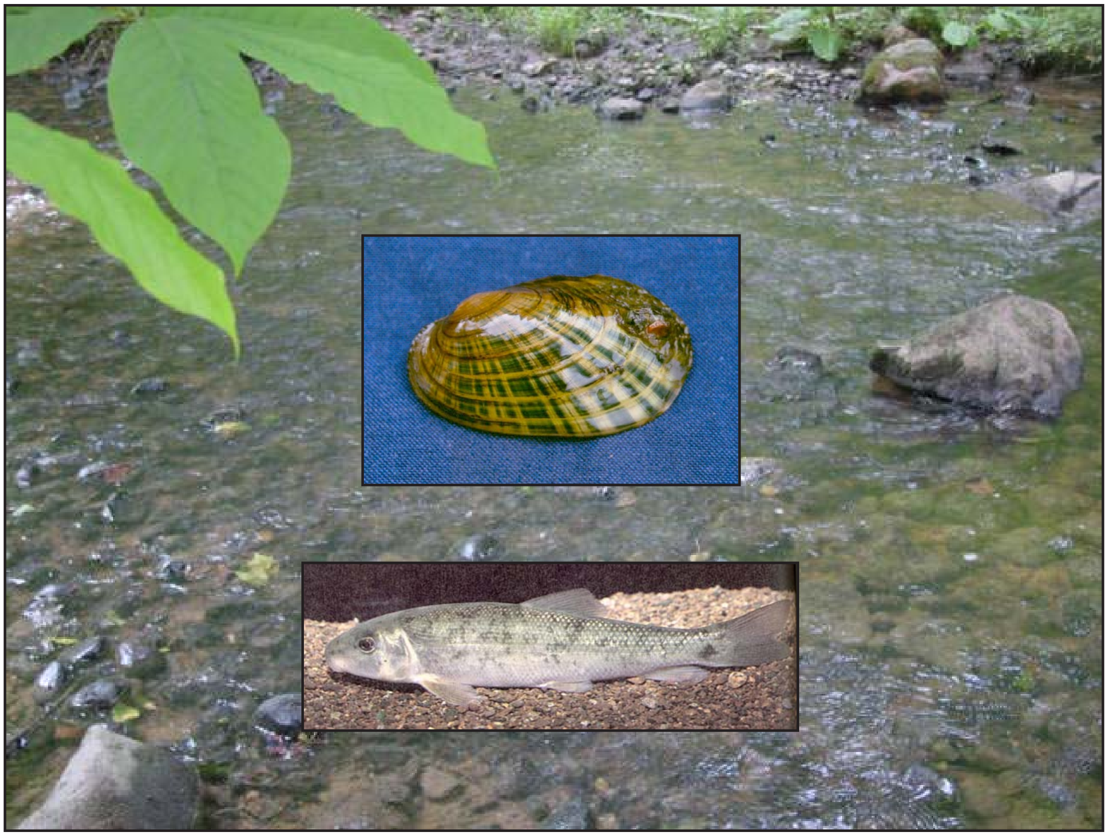
Surveys for Freshwater Mussels (Unionidae) in the Bean Creek Watershed, Hillsdale and Lenawee Counties, Michigan.



Prepared by:
Peter J. Badra
Michigan Natural Features Inventory
P.O. Box 30444
Lansing, MI 48909-7944
www.msue.msu.edu/mnfi/

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Background photo: Riffle habitat with sand, gravel, pebble, and cobble substrate in the Bean Creek watershed. Photo by Colleen McLean. **Top inset photo:** *Lampsilis siliquoidea* (fatmucket). Photo by Peter Badra. **Bottom inset photo:** *Catostomus commersoni* (white sucker). Photo by Konrad Schmidt.

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Introduction

The Bean Creek watershed encompasses approximately 200 square miles of land in southern Michigan. It is located within a zone of loamy end and ground moraines, oak-hickory forest, beech-maple forest, and deciduous swamp forest (Albert 1995). The current predominant land-use is agriculture. Bean Creek flows into Ohio and becomes the Tiffin River, part of the Maumee Watershed which drains into Lake Erie. Little information is available on freshwater mussels in the Bean Creek watershed. While no formal surveys have been performed, local residents have observed live individuals and shells at several sites. The biogeographic history of the watershed is also favorable for unionids, e.g. the Maumee drainage as a whole has relatively high unionid diversity. The purpose of this project is to describe the abundance and species richness of unionids at sites within the Bean Creek watershed, Hillsdale and Lenawee Counties, Michigan.

There are four families of freshwater mussel occurring in Michigan. The Unionidae ("clams" or "mussels") and the Sphaeriidae (pea clams or fingernail clams) are native to North America, while the Corbiculidae (Asian clams) and Dreissenidae (zebra mussels) are exotic to this continent. Unionids are characterized by their relatively large size (3-25cm) and reliance on fish hosts in order to complete their life cycle. There are 45 species native to Michigan. While some species occur throughout many of the state's river and lake systems, others are very rare. Unionids have undergone drastic reductions in their global status and range (Williams *et al.* 1993). Reasons for their widespread decline over the last century include habitat degradation, loss of fish hosts, poor water quality, and impact from exotic species (Fuller 1974, Williams *et al.* 1993, Box and Mossa 1999, Strayer 1999).

The main characteristic that separates unionids from other freshwater bivalves is their unique life cycle. Unionids produce larvae that require a fish host to complete their life cycle, whereas other mussel families produce free-swimming larvae. Unionid larvae, called glochidia, are released into the water and must attach to a suitable fish host to survive and transform into the adult form. Glochidia attach to the gills or fins of fish. They are very small (length approximately 1/10mm), and are not known to have negative effects on their host. Each unionid species has one or more particular fish species that it uses as hosts. One species, *Simpsonaias ambigua* (salamander mussel), uses an aquatic salamander, *Necturus maculosus* (mudpuppy), as a host.

Unionids have evolved ways of attracting fish to facilitate the completion of their life cycle. The females of some species have structures resembling small fish, crayfish, or other prey which are displayed when the glochidia are ready to be released. When a fish bites the lure, the mussel releases its glochidia, giving them much better chances of attaching to a host than if they were released into the water without a fish present. Some species display packets of glochidia (called conglutinates) that are trailed out in the stream current attached to the mussel by a clear strand so that the mussel appears to be "fishing" for a host. Lures are displayed mid to late summer. Glochidia complete metamorphosis and drop off their host in the adult form after a period of time ranging from 6-160 days, depending on the mussel species (Kat 1984). Since adult mussels move very little throughout their lifetime, the ride glochidia get while attached to their fish host allows unionids to migrate to new habitat and interbreed among populations (Kat 1984, Watters 1995). Without the presence of fish host populations, unionids are unable to reproduce.

Unionids play a significant ecological role in rivers and lakes. Both live individuals and empty shells provide habitat for aquatic insects. Empty shells also provide habitat for crayfish. Unionids play a substantial role in completing the food chain in stream ecosystems. They often comprise the highest percentage of biomass relative to other benthic stream animals (Strayer *et al.* 1994) and are a key link in the food chain between aquatic microorganisms like algae, and predators such as crayfish, birds, and muskrats.

Unionids are useful water and habitat quality indicators for several reasons. Most species are long-lived, some with life spans up to 50 years or more. They are generally sessile, spending most of their lives within a small section of stream. Because they are filter feeders, mussels are sensitive to and tend to accumulate contaminants. Also, empty shells can reveal which species were present at a site in the past since they remain intact for many years after death. Habitat requirements for unionids vary among species, but the most diverse mussel beds are usually found in areas with the following characteristics: a mixture of pebble, gravel, and sand stream bottom with relatively little silt; clear water without excessive suspended particles; and good stream current (riffles or runs). Because they are sensitive to changes in habitat quality, the status of unionid populations over time can be indicative of the status in overall stream habitat quality and other factors in the ecosystem.

Methods

Visual searches for mussels were performed with the aid of glass bottom buckets. Sites were surveyed in the upstream direction so that silt stirred up from the stream bottom would not obscure the view through the water. A flag was placed by each live unionid mussel. At the end of the reach, live mussels were identified, measured for length, and replaced, siphon end up, in the stream bottom where they were found. Empty shells were also identified. Length and width of the survey reaches were recorded to estimate the area surveyed at each site, and time spent searching was recorded at each site. Permission from landowners to access survey sites was obtained for sites located within private land.

Results

Glass bottom bucket surveys were performed at nine sites within the Bean Creek watershed in the summer of 2004 (Table 1). Sixteen unionid species were found, including three species of special concern in Michigan. Two species were represented by empty shell alone (Table 2). Live individuals and shell of Sphaeriidae were also seen throughout the watershed. The number of species per site varied from zero to nine (Table 3). Substrate composition varied from sand, gravel, and pebble with very little silt at sites BC1-BC4 and BC7-BC9, to an even mix of sand and silt at sites BC5 and BC6. The youngest unionid found was a *Lampsilis siliquoidea* (fatmucket) with two external rings, indicating reproduction had occurred within the last 3 years at site BC8. Fish species observed incidentally were, *Cottus bairdi* (mottled sculpin), *Esox americanus vermiculatus* (grass pickerel), *Etheostoma nigrum* (Johnny darter), and *Hypentelium nigricans* (northern hog sucker). No *Dreissena polymorpha* (zebra mussels) or *Corbicula fluminea* (Asian clam) were found at the study sites in the Bean Creek watershed.

Table 1. Location of sites surveyed in the Bean Creek watershed, and area searched at each site.

Site	Creek	Location	Town Range Section	m^2
BC1	St. Joseph Creek	approx. 600m south of the corner of Beecher and Gardner Rds., 200-300m downstream of BC2	T7S R1W S11 SW1/4NW1/4	344
BC2	St. Joseph Creek	approx. 600m south of the corner of Beecher and Gardner Rds., 200-300m downstream of BC3	T7S R1W S11 SW1/4NW1/4	286
BC3	St. Joseph Creek	approx. 600m south of the corner of Beecher and Gardner Rds.	T7S R1W S11 SW1/4NW1/4	243
BC4	St. Joseph Creek	approx. 300m upstream of US-127, on the north side of Beecher Rd.	T7S R1W S1 S1/2SE1/4	546
BC5	Silver Creek	Morenci Sportsmen's Club, on the north side of West Mulberry Rd.	T8S R2E S28 SW1/4SW1/4	226
BC6	Silver Creek	north side of M-120	T9S R2E S5 center	1172
BC7	Lime Creek	west side of Ingall Hwy.	T8S R1E S22 NW1/4SW1/4	208
BC8	Bean Creek	Riverside Park off M-156 in the city of Morenci	T8S R2E S31 E1/2SW1/4	250
BC9	Bean Creek	Medina Park off of Warwick Rd., near the city of Medina	T8S R1E S1 NE1/4SW1/4	294

Table 2. Unionid species found in the Bean Creek watershed July 6-7 and August 2, 2004. SpC=Species of special concern in Michigan.

Species	Common Name	Bean Watershed
Alasmidonta viridis (SpC)	Slippershell	L
Amblema plicata	Threeridge	L
Anodontoides ferussacianus	Cylindrical papershell	L
Elliptio dilatata	Spike	L
Fusconaia flava	Wabash pigtoe	L
Lampsilis siliquoidea	Fatmucket	L
Lampsilis ventricosa	Pocketbook	L
Lasmigona complanata	White heelsplitter	L
Lasmigona compressa	Creek heelsplitter	L
Lasmigona costata	Fluted-shell	L
Leptodea fragilis	Fragile papershell	L
Pleurobema sintoxia (SpC)	Round pigtoe	S
Potamilus alatus	Pink heelsplitter	L
Pyganodon grandis	Giant floater	L
Strophitus undulatus	Strange floater	S
Villosa iris (SpC)	Rainbow	L
# species live		14
# species live or shell		16

Discussion

A number of factors influence the abundance and distribution of unionids including exotic species, host fish distribution, biogeography, geology, habitat quality, and water chemistry. If one or more factors are unsuitable, unionids can be excluded or extirpated from the area. The Bean Creek watershed appears free of exotic bivalves, so these have probably not affected unionid communities. Twenty fish species have been documented in the Bean Creek watershed (Table 4)(Kosek 1996, Goodwin personal communication 2004). It is not known if fish populations are currently providing adequate availability of hosts for unionids there, however, the fact that a fairly rich fish community is present suggests that hosts may be readily available. The surface geology of the watershed (Table 5) provides a source of suitable substrate for unionids. The sand, gravel, and pebble substrates found in the region are generally conducive to high unionid species richness and abundance. Water quality in the Bean Creek watershed is clearly high enough to support unionids at sites where live individuals were found, though some water quality issues could still be present. For example, ammonia disproportionately affects juveniles versus adults (Mummert *et al.* 2003), and could prevent recruitment in the population in spite of an abundance of live adults.

Eight species of unionids were found in St. Joseph Creek. Among these were 3 species of special concern in MI. (Information on special concern, threatened, and endangered species in Michigan can be found at http://web4.msue.msu.edu/mnfi/). The occurrence of live *Alasmidonta viridis* (slippershell) is especially significant because most of the records in the state are based on empty shell alone. The water has relatively little suspended particles and good flow. The St. Joseph Creek has natural habitat structure (pools, riffles, and runs), and a forested riparian zone that shades the stream from direct sunlight, provides input of energy in the form of leaves, habitat for fish and mussels from woody debris, and prevents erosion of the stream banks and resulting siltation.

Silver Creek at M-120 (BC6) had very little riparian forest remaining, and had less habitat for fish and more silt than sites in St. Joseph Creek. The habitat structure was almost entirely run, with fewer pools and riffles than St. Joseph Creek. The stream appeared as if it had been dredged and/or channelized in the past. Empty shell of *Lampsilis siliquoidea* (fatmucket) were found, indicating live individuals were present at least as recently as a couple years previous. *L. siliquoidea* is a tolerant species that is able to survive in silty substrates and does not require good stream current like most unionids. They are widespread and common, and thought to be one of the first species to re-colonize degraded habitat and one of the last to remain in degraded habitat. Silver Creek at Mulberry Rd (BC5) looked less impacted and did have a forested riparian zone. The lack of unionid mussels may have been due to the fact that the site was located far up in the headwaters of the stream and was very small (approx. 1m wide). For ecological and geographical reasons, bigger rivers tend to have more mussels and more fish. Unionid species richness and fish species richness are related. Rivers with many fish species tend to have many unionid species and rivers with few fish species tend to have few unionids (Watters 1992).

The Lime Creek site (BC7) was the only site with *Elliptio dilatata* (spike). It had sand, gravel, pebble and cobble substrate with some silt on top. The Bean Creek site at Riverside Park (BC8) had the highest abundance and species richness of all the sites. Three species found at this site were not found anywhere else in the watershed (Table 3). There was a mostly intact forested riparian zone and the substrate was a mixture of sand, gravel, and pebble with some silt. Riffles, runs, and pools were present, with a majority of the site consisting of riffle habitat.

An occurrence of the state endangered *Simpsonaias ambigua* (salamander mussel) from 1930 was documented near Morenci (University of Michigan Museum of Zoology mollusk collection). This species is most often found under flat rocks and is very small (length to 5.0cm), making it easy to overlook during general unionid surveys. Additional surveys focusing on the specialized habitat of this species should be performed.

The number of unionid species found in the Bean Creek watershed indicates the overall conditions are favorable for unionids. The difference in unionid communites among sites within the watershed may be due, at least in part, to changes in habitat quality (channelization, dredging, and increased siltation from surrounding land uses/loss of forested riparian zones), water quality (suspended particles/turbidity), and indirect effects of these changes such as decline or loss of fish host populations over the past 100+ years. With the absence of more detailed information about the historic status and distribution of unionids in the Bean Creek watershed, the true impact of these factors to date is difficult to determine. The data gathered in this survey provides a snapshot of the range and status of unionids in the Bean Creek watershed. Future surveys will allow general trends in the status of these unionid populations to be assessed.

Literature Cited

Albert, D. A. 1995. Regional Landscape Ecosystems of Michigan, Minnesota, and Wisconsin: A Working Map and Classification. Gen. Tech. Rep. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 250p.

Box, J. B. and J. Mossa. 1999. Sediment, land use, and freshwater mussels: prospects and problems. Journal of the North American Benthological Society 18:99-117.

Fuller, S. 1974. Clams and mussels (Mollusca: Bivalvia). In: Hart, C.W. Jr., Fuller S.L.H. eds. Pollution ecology of freshwater invertebrates. Academic Press, New York, pages 228-237.

Goodwin, K. 2004. Personal communication of data gathered during Michigan a Dept. of Environmental Quality qualitative fish survey in St. Joseph Creek and an unnamed tributary to St. Joseph Creek on June 10, 2003.

Kat, P. W. 1984. Parasitism and the Unionacea (Bivalvia). Biological Review 59:189-207.

Kosek, S. 1994. A Biological Survey of Bean Creek, Hillsdale and Lenawee counties, August 10, 1995. MDNR, Surface Water Quality Division, Report #MI/DEQ/SWQ-96/026.

Strayer, D.L., D.C. Hunter, L.C. Smith, and C.K. Borg. 1994. Distribution abundance, and roles of freshwater clams (Bivalvia, Unionidae) in the freshwater tidal Hudson River. Freshwater Biology 31(2):239-248.

Strayer, D. L. 1999. Effects of alien species on freshwater mollusks in North America. Journal of the North American Benthological Society. 18:74-98.

Watters, G. T. 1992. Unionids, fishes, and the species-area curve. Journal of Biogeography 19:481-490.

Watters, G. T. 1995. Small dams as barriers to freshwater mussels (Bivalvia, Unionoida) and their hosts. Biological Conservation 75:79-85.

Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. L. Neves.

Table 3. Numbers of unionids (#), relative abundance (RA), and density (D, individuals/m^2) at each site. S=species represented by shell only.

		BC1			BC2			BC3			BC4			BC5		
Species	Common Name	#	RA	D	#	RA	D	#	RA	D	#	RA	D	#	RA	D
Alasmidonta viridis (SpC)	Slippershell	S						3	0.04	0.01	1	0.08	<0.01			
Amblema plicata	Threeridge															
Anodontoides ferussacianus	Cylindrical papershell	S						1	0.01	<0.01	6	0.50	0.01			
Elliptio dilatata	Spike															
Fusconaia flava	Wabash pigtoe				3	0.23	0.01	7	0.10	0.03	1	0.08	<0.01			
Lampsilis siliquoidea	Fatmucket	1	1.00	<0.01	7	0.54	0.02	53	0.74	0.22	1	0.08	<0.01			
Lampsilis ventricosa	Pocketbook															
Lasmigona complanata	White heelsplitter															
Lasmigona compressa	Creek heelsplitter															
Lasmigona costata	Fluted-shell										2	0.17	<0.01			
Leptodea fragilis	Fragile papershell															
Pleurobema sintoxia (SpC)	Round pigtoe	S														
Potamilus alatus	Pink heelsplitter															
Pyganodon grandis	Giant floater	S						4	0.06	0.02						
Strophitus undulatus	Strange floater				S											
Villosa iris (SpC)	Rainbow				3	0.23	0.01	4	0.06	0.02	1	0.08	<0.01			
Total # of live individuals and density		1		<0.01	13		0.05	72		0.30	12		0.02	0		0
# species live		1			3			6			6			0		
# species live or shell		5			4			6			6			0		

Table 3 Continued...

Species	Common Name	BC6 #	BC6 RA	BC6 D	BC7 #	BC7 RA	BC7 D	BC8 #	BC8 RA	BC8 D	BC9 #	BC9 RA	BC9 D
Alasmidonta viridis (SpC)	Slippershell				S								
Amblema plicata	Threeridge							30	0.58	0.12	1	0.33	<0.01
Anodontoides ferussacianus	Cylindrical papershell							S					
Elliptio dilatata	Spike				3	0.75	0.01						
Fusconaia flava	Wabash pigtoe							5	0.10	0.02			
Lampsilis siliquoidea	Fatmucket	2	1.00	<0.01	1	0.25	<0.01	5	0.10	0.02	S		
Lampsilis ventricosa	Pocketbook							5	0.10	0.02	S		
Lasmigona complanata	White heelsplitter							3	0.06	0.01			
Lasmigona compressa	Creek heelsplitter							1	0.02	<0.01			
Lasmigona costata	Fluted-shell										S		
Leptodea fragilis	Fragile papershell							1	0.02	<0.01			
Pleurobema sintoxia (SpC)	Round pigtoe												
Potamilus alatus	Pink heelsplitter							2	0.04	0.01	2	0.67	0.01
Pyganodon grandis	Giant floater												
Strophitus undulatus	Strange floater												
Villosa iris (SpC)	Rainbow				S						S		
Total # of live individuals and density		2		<0.01	4		0.02	52		0.21	3		0.01
# species live		1			2			8			2		
# species live or shell		1			4			9			6		

Table 4. Qualitative fish sampling results from Michigan Department of Environmental Quality (Kosek 1996, Goodwin personal communication 2004).

Fish Taxa	Bean Creek 08/10/1995	St. Joseph Creek and an unnamed tributary to St. Joseph Creek 06/10/2003
Petromyzontidae (lampreys)		
Ichthyomyzon fossor (northern brook lamprey)		X
Umbridae (mudminnows)		
Umbra limi (central mudminnow)	X	X
Esocidae (pikes)		
Esox lucius (northern Pike)		X
Cyprinidae (minnows and carps)		
Campostoma anomalum (central stoneroller)	X	
Luxilus cornutus (common shiner)	X	
Pimephales notatus (bluntnose minnow)	X	
Semotilus atromaculatus (creek chub)	X	X
Rhinichthys atratulus (blacknose dace)	X	X
Cottidae (sculpins)		
Cottus bairdii (mottled sculpin)	X	X
Catostomidae (suckers)		
Catostomus commersoni (white sucker)	X	
Erimyzon oblongus (creek chubsucker)	X	X
Hypentelium nigricans (northern hogsucker)	X	
Centrarchidae (sunfish)		
Ambloplites rupestris (rock bass)	X	
Lepomis cyanellus (green sunfish)	X	X
Lepomis gibbosus (pumpkinseed)	X	
Percidae (perch)		
Etheostoma blennioides (greenside darter)	X	
Etheostoma caeruleum (rainbow darter)	X	
Etheostoma flabellare (fantail)	X	
Etheostoma nigrum (johnny darter)	X	
Percina maculata (blackside darter)	X	

Table 5. Surface geology type at each site.

Site	Creek	Surface geology
BC1	St. Joseph Creek	Medium textured glacial till
BC2	St. Joseph Creek	Medium textured glacial till
BC3	St. Joseph Creek	Medium textured glacial till
BC4	St. Joseph Creek	Medium textured glacial till
BC5	Silver Creek	Lacustrine sand and gravel
BC6	Silver Creek	Lacustrine sand and gravel
BC7	Lime Creek	End moraines of fine textured till/ Fine textured glacial till
BC8	Bean Creek	Lacustrine sand and gravel
BC9	Bean Creek	End moraines of fine textured till

1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18:6-22.

Mummert, A.K., R.J. Neves,T.J. Newcomb. 2003. Sensitivity of juvenile freshwater mussels (*Lampsilis fasciola, Villosa iris*) to total and un-ionized ammonia. Environmental Toxicology and Chemistry. 2003 22:2545-2553.

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