Ohio Biological Survey Notes 1: 19-24, 1998. © Ohio Biological Survey

Freshwater Mussel Surveys of the Big Darby Creek System in Central Ohio

G. THOMAS WATTERS

Ohio Biological Survey, 1315 Kinnear Rd., Columbus, OH 43212-1192

Introduction

Big Darby Creek in central Ohio, for its size, has the greatest diversity of freshwater mussels in North America (Watters, 1994). Forty species have been reported from the system, including two federally endangered species, seven Ohio endangered species, four Ohio threatened species, and three Ohio special interest species. A survey in 1986 found 38 of these species (Watters, 1986), whereas a follow-up survey in 1990 found 35 (Watters, 1990). These surveys suggest that the fauna was declining, both in species richness and numbers of individuals. A third survey was conducted in 1995-1996 (Watters, 1996a). The purpose of these surveys was to establish baseline data against which future changes may be gauged.

Establishing baseline data for mussels in a watershed is difficult. Results are confounded by variations in water levels, collecting methods, and the constantly changing nature of the sites. Sites that once were soybean fields are now bedroom communities. Wooded riparian corridors are replaced by mowed, fertilized, insect-free lawns. Bridges are replaced or moved. Agricultural methods change on a regular basis. Thus the goal of baseline data may be unreachable, as the creek system rapidly changes.

Methods

One hundred sites were sampled over the three surveys (Figure 1). Sites were surveyed by wading, and glass-bottom buckets were used for locating mussels. All individuals, living, dead, and weathered, were collected and identified. All living animals were returned to the stream. Shells were kept as vouchers as needed and deposited at The Ohio State University Museum of Biological Diversity.

Results and Discussion

Thirty-five species were found in the 1995-1996 survey, the same number (but not species) as found in 1990, but less than in the 1988 survey (Table 1). Nine listed species were encountered. Figure 2 depicts the species diversity site-by-site from mouth to headwaters by river mile (RM). Fewer species were found at most sites in 1990 and 1996 than in 1986. This may be due, at least in part, to the exceptional survey conditions in 1986. A severe drought in 1986 resulted in the stranding of numerous mussels, rendering collection extremely easy. By contrast, 1996 had above-normal precipitation. Although survey work was conducted to maximize the likelihood of encountering as many species as possible, no mussels were stranded or otherwise unburied. This alone probably accounts for some of the departure in terms of diversity of 1996 from 1986. Most of the species not encountered in 1996 were rare in 1986. The 1986 drought continued for several years and undoubtedly resulted in the death of a large portion of the mussel fauna.

The greatest diversity of mussels in Big Darby Creek occurs in the lower half of the main stem, from the Battelle-Darby Metro Park region to Fox (Figure 2). However, this area has experienced a pronounced increase in water turbidity. Several very rare species, including the Northern Riffleshell, which previously existed in this stretch, were not found in this survey. A number of areas have unusually low diversity. Hellbranch Run, with its runoff and sewage outfall problems, enters Big Darby Creek at ~RM 26. Its impact can be seen for several miles downstream. Other problem areas include the confluence of Buck Run, devoid of mussels for much of its length, and Big Darby at ~RM 65, and abandoned quarries at RM 45. Site 33 at Ohio Route 104 is a mystery. In 1988, 19 species were found there, but in 1990 and 1996, only two and six species, respectively. This area has a high fish diversity and suitable habitat is present. The near extirpation of mussels from this site has not been explained.

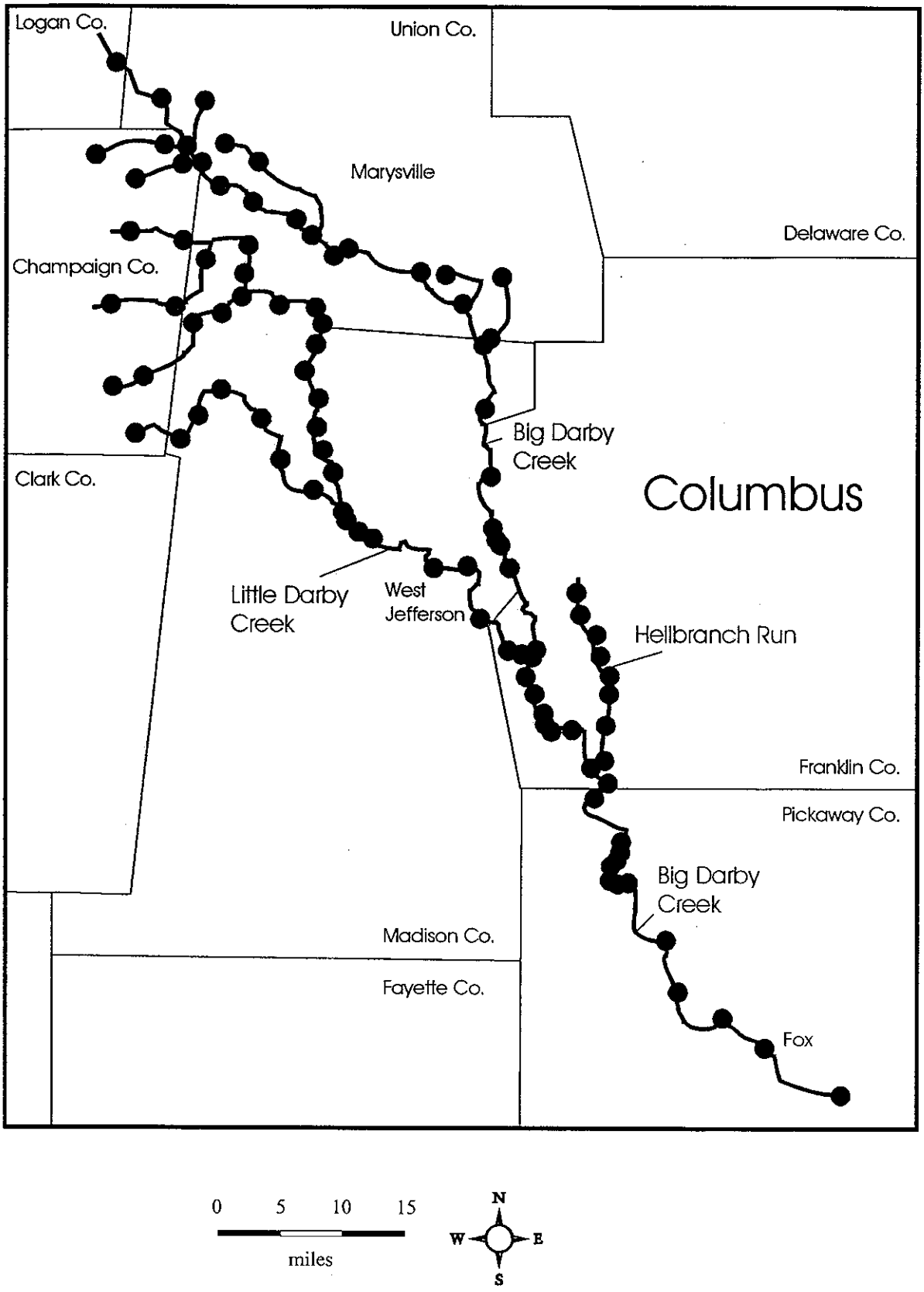

Figure 1. Map of collection locations (solid circles) on Big Darby Creek and Little Darby Creek.

Table 1. Comparison of 1986, 1990, and 1996 surveys.

Taxon	Common Name	Status	1986	1990	1996
Ligumia recta	Black Sandshell	OT	X	X	
Pleurobema clava	Clubshell	FE, OE	X	X	X
Lasmigona compressa	Creek Heelsplitter		X	X	X
Anodontoides ferussacianus	Cylindrical Papershell		X	X	X
Truncilla truncata	Deertoe	OSI	X		
Elliptio crassidens	Elephant Ear	OE	X		
Alasmidonta marginata	Elktoe		X	X	X
Lampsilis radiata luteola	Fat Mucket		X	X	X
Truncilla donaciformis	Fawnsfoot	OT	X	X	X
Lasmigona costata	Fluted-shell		X	X	X
Leptodea fragilis	Fragile Papershell		X	X	X
Pyganodon grandis	Giant Floater		X	X	X
Ptychobranchus fasciolaris	Kidneyshell		X	X	X
Toxolasma parvus	Lilliput		X	X	X
Quadrula quadrula	Mapleleaf		X	X	X
Epioblasma rangiana	Northern Riffleshell	FE, OE	X	X	X
Utterbackia imbecillis	Paper Pondshell		X	X	X
Quadrula pustulosa	Pimpleback		X	X	X
Potamilus alatus	Pink Heelsplitter		X	X	
Potamilus ohiensis	Pink Papershell		X	X	X
Tritogonia verrucosa	Pistolgrip		X	X	X
Lampsilis cardium	Plain Pocketbook		X	X	X
Uniomerus tetralasmus	Pondhorn	OT	X	X	
Cyclonaias tuberculata	Purple Wartyback	OSI	X	X	X
Quadrula cylindrica	Rabbitsfoot	OE	X	X	X
Villosa iris	Rainbow		X	X	X
Villosa fabalis	Rayed Bean	OE	X	X	X
Obovaria subrotunda	Round Hickorynut		X	X	X
Pleurobema sintoxia	Round Pigtoe		X	X	X
Simpsonaias ambigua	Salamander Mussel	OSI	X	X	
Alasmidonta viridis	Slippershell		X	X	X
Epioblasma triquetra	Snuffbox	OT	X	X	X
Elliptio dilatatus	Spike		X	X	X
Strophitus undulatus	Squawfoot		X	X	X
Amblema plicata	Threeridge		X	X	X
Fusconaia flava	Wabash Pigtoe		X	X	X
Megalonaias nervosa	Washboard	OE	X	X	
Lampsilis fasciola	Wavy-rayed Lampmussel		X	X	X
Lasmigona complanata	White Heelsplitter		X	X	X
		Total	**38**	**35**	**35**

Status codes: FE - Federally endangered; OE - Ohio endangered; OT - Ohio threatened; OSI - Ohio special interest

In all, Little Darby Creek appears to be in better condition than Big Darby Creek. Beginning at Chuckery, a high diversity is maintained to West Jefferson, with few interruptions (Figure 3). The Federal endangered Clubshell and Ohio endangered Rabbitsfoot were found living and reproducing in this area at several sites, but nowhere else in the system. Areas of unusually low diversity included West Jefferson. At the site immediately above the town, 124 living or freshly dead individuals of 12 species were found. At the first site below the town, no living or freshly dead mussels were encountered, despite apparently good habitat.

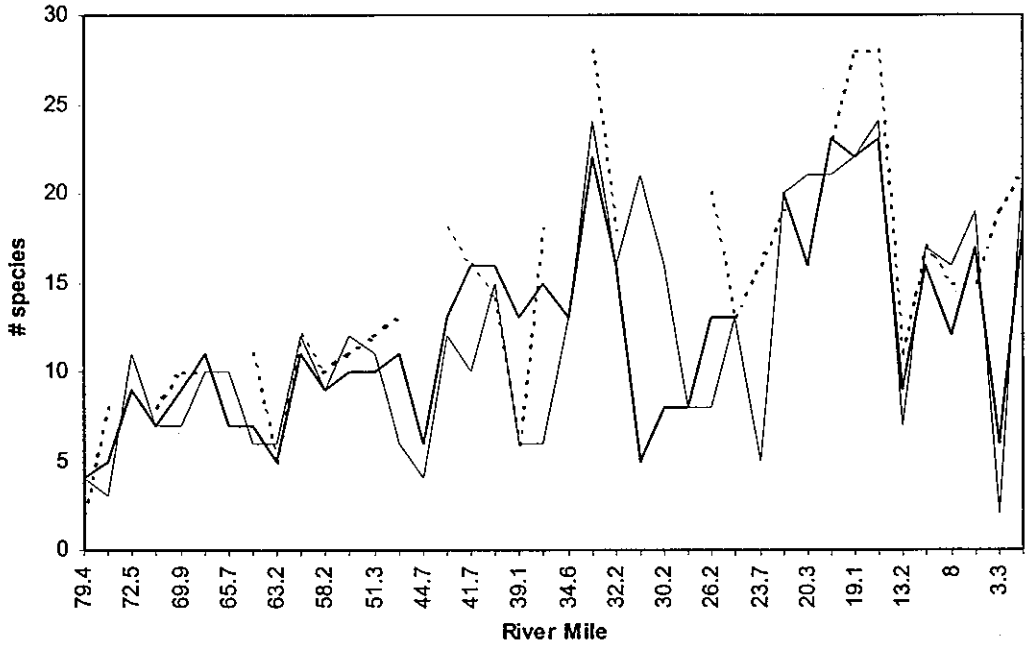

Figure 2. Big Darby Creek - number of species by river mile. Heavy line - 1996. Light line - 1990. Dashed line - 1986.

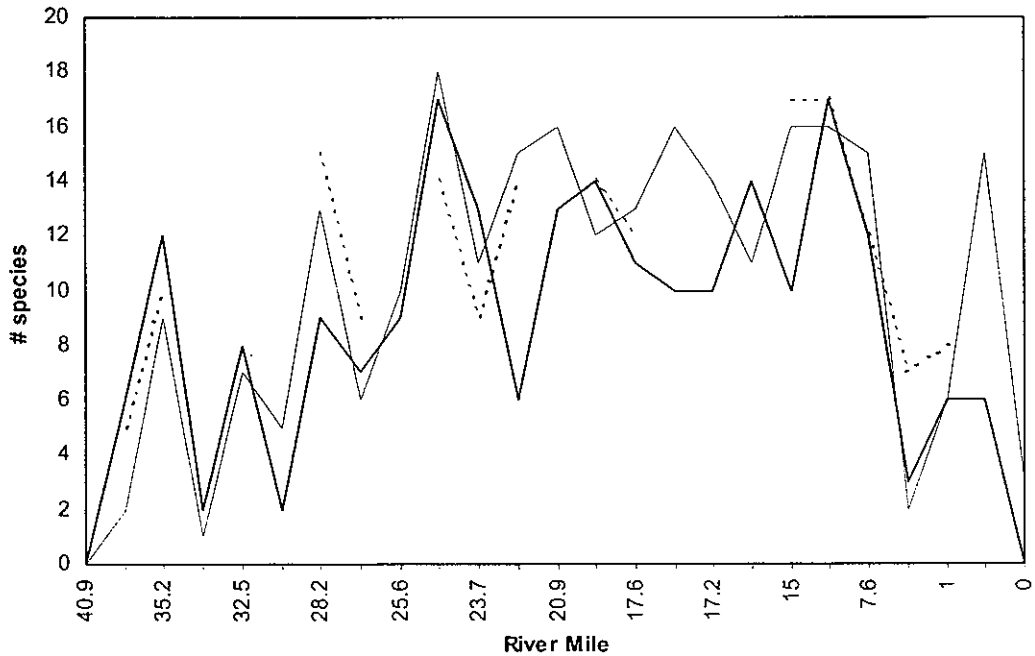

Figure 3. Little Darby Creek - number of species by river mile. Heavy line - 1996. Light line - 1990. Dashed line - 1986

Several tributaries no longer support any mussels at their downstream sites. Buck Run historically has had problems with livestock-induced runoff and pollution. Hellbranch Run lacks any evidence that mussels ever existed in its lowest stretch, where portions of the creek were buried under more than a foot of wastewater treatment effluent. The rare Pondhorn Mussel, known in the system only from this tributary, apparently has been extirpated.

No evidence of zebra mussels was found in the system. Zebra mussels have been recorded from the Scioto River and neighboring Hargus Lake. As a tributary of the Scioto River, the Darby Creek system is thus exposed to potential infestation. It is not clear whether zebra mussels can successfully colonize a free-flowing creek such as Big Darby. Certainly the construction of an impoundment on or adjacent to the Darby system would greatly increase the chances of zebra mussel invasion.

Big Darby Creek is internationally known as a high-quality freshwater ecosystem. Single sites in the draianage have more species than all of Europe. Conservation efforts from wildlife agencies, conservation groups, and private citizens have frequently collided with the plans of developers, industry, and urbanization that encroach on the Darby system. As with most fragile habitats, it is not a single problem that destroys it, but the cumulative effect of numerous insults and injuries. Already these effects are visible, such as in the declining numbers and diversity of the Darby organisms.

Listed Species Accounts

Black Sandshell, *Ligumia recta*, an Ohio threatened species, was found living in the 1988 survey, but not in 1990 or 1996. It has never been common in the system, although its proposed hosts, various sunfish and bass, are present (Steg and Neves, 1997).

Clubshell, *Pleurobema clava*, a Federal and Ohio endangered species, was encountered as weathered shells at all but the extreme headwater sites. It was found living or freshly dead in the middle reach of Little Darby Creek, where it is not uncommon. Several size classes were encountered. Hosts include the common Striped Shiner and Blackside Darter (Watters and O'Dee, 1997).

Deertoe, *Truncilla truncata*, an Ohio special interest species, was rare in 1988 and was not found in subsequent surveys. It is a large river species. Hosts include Sauger and Drum (Wilson, 1916), which may have introduced this mussel from the Scioto River.

Elephant ear, *Elliptio crassidens*, another large river species, is endangered in Ohio. A single weathered shell was found in 1990. Hosts include Skipjack Herring (Howard, 1914). The Elephant Ear probably was never a common, reproducing resident of the Darby system.

Fawnsfoot, *Truncilla donaciformis*, an Ohio threatened species, is very rare in Big Darby Creek. A single weathered shell was found in 1996. Sauger and Drum are hosts (Surber, 1913). As with the Deertoe, it probably was introduced from the Scioto River.

Northern rifflesheli, *Epioblasma torulosa rangiana*, a Federal and Ohio endangered species, was historically common in Big Darby Creek mainstem. Although not encountered in 1996, it was found subsequently in the Battelle-Darby Metro Park region. Its numbers have steadily declined. Hosts include several darters and Mottled Sculpin (Watters, 1996b).

Snuffbox, *Epioblasma triquetra*, an Ohio endangered species, was once common in the lower mainstem of Big Darby Creek. It has become rare as its numbers dramatically decline. Logperch is a reported host (Hill, 1986).

Washboard, *Megalonaias nervosa*, an Ohio endangered species, occasionally is encountered in Big Darby Creek. These are all old, single individuals and probably represent stray occurances. Many fishes are known as hosts.

Pondhorn, *Uniomerus tetralasmus*, is threatened in Ohio, and known from only a few locales in the state. It historically lived in Hellbranch Run, but, curiously, nowhere else in Big Darby. It has been extirpated from the system. Golden Shiner is the only host reported (Stern and Felder, 1978).

Purple Wartyback, *Cyclonaias tuberculata*, an Ohio special interest species, was uncommon as living and freshly dead specimens in the middle mainstem. It does not appear to be reproducing. Known hosts are catfishes.

Rabbitsfoot, *Quadrula cylindrica cylindrica*, an Ohio endangered species, was found living or freshly dead at three Little Darby Creek sites. It has been extirpated from Big Darby Creek proper. This species appears to be reproducing, based on the several size classes and juveniles found in this survey. Hosts are probably species of shiners and chubs (Yeager and Neves, 1986).

Rayed bean, *Villosa fabalis*, an Ohio endangered species, and former Federal Category 2 species, was found as weathered shells in much of the Big Darby mainstem. It has been extirpated from most of its range in North America. The Tippecanoe Darter is believed to be a potential host.

Salamander mussel, *Simpsonaias ambigua*, an Ohio special interest species, and former Federal Category 2 species, was found as a freshly dead shell at a single site (T17). Its only known host, the Mudpuppy (Howard, 1915), was not encountered in 1996.

Museum records exist for two species not found in any of the three surveys discussed here. The Mucket, *Actinonaias ligamentina*, is common in many parts of Ohio, but peculiarly absent from Big Darby Creek. The Ridged Pocketbook, *Lampsilis ovata*, an Ohio endangered species, is known only from subfossil specimens and is presumed to be extirpated from the system.

Acknowledgments

All surveys were funded by the Ohio Chapter of The Nature Conservancy (TNC). Their support is greatly appreciated. Dr. Steve Sutherland (TNC) and Howard Albin (Columbus and Franklin County Metropolitan Park District) are acknowledged for the time and interest they gave to these studies.

Literature Cited

Hill, Donley M. 1986. Cumberlandian Mollusks Conservation Program, activity 3: Identification of fish hosts. Office of Natural Resources and Economic Development. Tennessee Valley Authority. Knoxville, Tennessee. 57 p.

Howard, Arthur D. 1914. Experiments in propagation of fresh-water mussels of the *Quadrula* group. Report of the U.S. Commissioner of Fisheries for 1913, Appendix 4:1-52 + 6 plates [Issued separately as U.S. Bureau of Fisheries Document 801].

Howard, Arthur D. 1915. Some exceptional cases of breeding among the Unionidae. Nautilus 29: 4-11.

Steg, Michelle B. and Richard J. Neves. 1997. Fish host identification for Virginia listed unionids in the upper Tennessee River drainage. Triannual Unionid Report 13: 34.

Stern, Edward M. and Darryl L. Felder. 1978. Identification of host fishes for four species of freshwater mussels (Bivalvia: Unionidae). American Midland Naturalist 100: 233-236.

Surber, Thaddeus. 1913. Notes on the natural hosts of fresh-water mussels. Bulletin of the Bureau of Fisheries 32: 103-116 + 3 plates [Issued separately as U.S. Bureau of Fisheries Document 778].

Watters, G. Thomas. 1986. A survey of the unionid molluscs of the Big Darby Creek system in Ohio. Final Report to the Ohio Chapter of The Nature Conservancy. 149 p.

Watters, G. Thomas. 1990. 1990 Survey of the unionids of the Big Darby Creek system. Final Report to the Ohio Chapter of The Nature Conservancy. Columbus, Ohio. 118 p.

Watters, G. Thomas. 1994. Unionidae of the Big Darby Creek system in central Ohio, USA. Malacological Review 27: 99-107.

Watters, G. Thomas. 1996a. 1996 Freshwater mussel survey of Big Darby Creek. Final Report to the Ohio Chapter of The Nature Conservancy. Columbus, Ohio. 4 p. + 2 appendices.

Watters, G. Thomas. 1996b. Hosts for the Northern Riffle Shell (*Epioblasma torulosa rangiana*). Triannual Unionid Report 10: 14.

Watters, G. Thomas and Scott H. O'Dee. 1997. Identification of potential hosts. Triannual Unionid Report 13: 38-39.

Wilson, Charles B. 1916. Copepod parasites of fresh-water fishes and their economic relations to mussel glochidia. Bulletin of the Bureau of Fisheries 34: 333-374 + 15 plates [Issued separately as U.S. Bureau of Fisheries Document 824].

Yeager, Bruce L. and Richard J. Neves. 1986. Reproductive cycle and fish hosts of the Rabbit's Foot Mussel, *Quadrula cylindrica strigillata* (Mollusca: Unionidae) in the Upper Tennessee River drainage. American Midland Naturalist 116: 329-340.

Ohio Biological Survey Notes 1: 25-29, 1998.

Freshwater Mussel Surveys of the Fish Creek System in Ohio and Indiana

G. THOMAS WATTERS

Ohio Biological Survey, 1315 Kinnear Rd., Columbus, Oh 43212-1192

Introduction

Fish Creek in Ohio and Indiana is one of the most diverse and biologically important mussel streams in North America. In all, thirty species have been recorded from the Fish Creek drainage, including three Federal endangered species, six Ohio endangered species, and five Indiana endangered species (Watters, 1988; 1996). The Federal endangered White Catspaw (*Epioblasma obliquata perobliqua*) may occur nowhere else.

Fish Creek was last surveyed, system-wide, in 1988. Since that time, the watershed has changed in several ways. Tree plantings and other bank-stabilization activities have reduced runoff potential to the stream. Changes in land usage, both improvements and detriments, are continually occurring. Finally, the lowest, most diverse reach of the stream was the site of a diesel fuel spill. The status of the mussel fauna of Fish Creek was unknown following these changes. It was not known if the overall health of the mussel populations had become better or worse since 1988.

Methods

Mussels were collected by hand picking during low-water conditions in 1996. All 30 sites studied in the 1988 survey in the Fish Creek system were resurveyed (Figure 1). All specimens were counted and identified. No live individuals were collected, but shells were vouchered at The Ohio State University Museum of Biological Diversity as allowed by permit.

Results and Discussion

Twenty-five species were found in this survey, slightly fewer than the 28 species found in 1988 (Table 1). Five listed species were encountered.

Salamander Mussel, *Simpsonaias ambigua*, an Indiana special concern and Ohio special interest species, and former Federal Category 2 species, was found as a freshly dead shell at a single site (79). This species has been found in most Fish Creek surveys, but never is common. Its only known host, the Mudpuppy, was not encountered in 1996.

Rayed Bean, *Villosa fabalis*, an Ohio endangered species, and former Federal Category 2 species, was found as freshly dead shells at four sites on the Ohio side. It has been extirpated from most of its range nationwide. Its hosts are unknown.

Rabbitsfoot, *Quadrula cylindrica cylindrica*, an Indiana and Ohio endangered species, was found living or freshly dead at five Ohio sites. This species appears to be reproducing, based on the several size classes and juveniles found in this survey. Hosts are probably species of shiners and chubs based on studies of the subspecies *Quadrula cylindrica strigillata* (Yeager and Neves, 1986).

Purple Wartyback, *Cyclonaias tuberculata*, an Ohio special interest species, was common as living and freshly dead specimens throughout the lower quarter of the system. It appears to be reproducing. Known hosts are catfishes (Hove *et al.*, 1997).

Clubshell, *Pleurobema clava*, a Federal, Ohio, and Indiana endangered species, was encountered as weathered shells at all but the extreme headwater sites. It was found living or freshly dead at nine sites, most within Ohio. It may be reproducing, as several size classes were encountered. Hosts are the Striped Shiner and Blackside Darter (Watters and O'Dee, 1997).

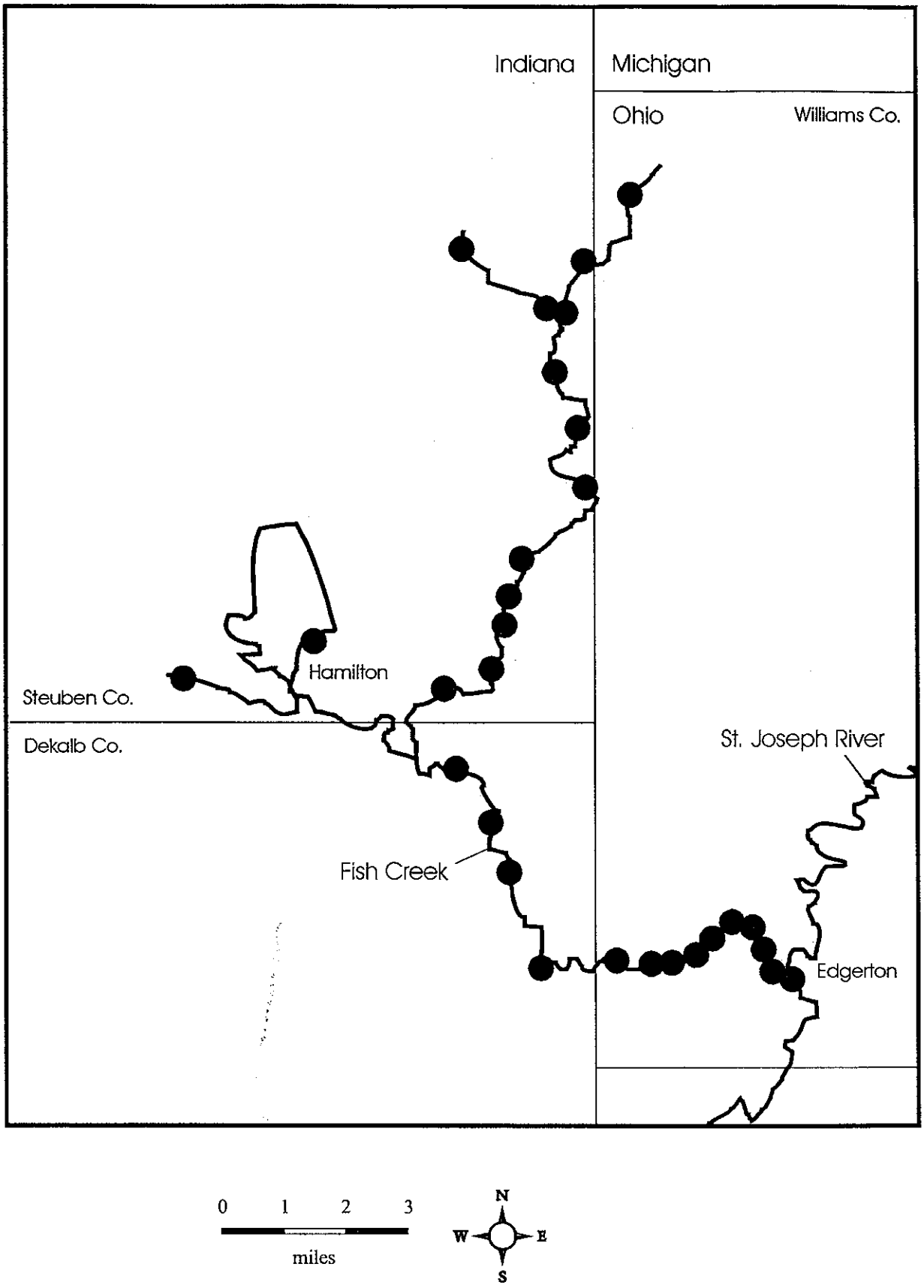

Figure 1. Map of collection locations on Fish Creek.

Table 1. Comparison of 1988 and 1996 surveys.

Taxon	Common Name	Status	1988	1996
Actinonaias ligamentina	Mucket		X	X
Alasmidonta marginata	Elktoe		X	X
Alasmidonta viridis	Slippershell		X	X
Amblema plicata	Threeridge		X	X
Anodontoides ferussacianus	Cylindrical Papershell		X	X
Cyclonaias tuberculata	Purple Wartyback	OSI	X	X
Elliptio dilatatus	Spike		X	X
Epioblasma o. perobliqua	White Catspaw	FE, OE, IE	X	
Epioblasma rangiana	Northern Riffleshell	FE, OE, IE	X	
Fusconaia flava	Wabash Pigtoe		X	X
Lampsilis cardium	Plain Pocketbook		X	X
Lampsilis fasciola	Wavy-rayed Lampmussel		X	X
Lampsilis radiata luteola	Fat Mucket		X	X
Lasmigona complanata	White Heelsplitter		X	X
Lasmigona compressa	Creek Heelsplitter		X	X
Lasmigona costata	Fluted-shell		X	X
Ligumia recta	Black Sandshell	OT	X	
Obovaria subrotunda	Round Hickorynut		X	X
Pleurobema clava	Clubshell	FE, OE, IE	X	X
Pleurobema sintoxia	Round Pigtoe		X	X
Ptychobranchus fasciolaris	Kidneyshell		X	X
Pyganodon grandis	Giant Floater		X	X
Quadrula cylindrica	Rabbitsfoot	OE, IE	X	X
Simpsonaias ambigua	Salamander Mussel	OSI, ISC	X	X
Strophitus undulatus	Squawfoot		X	X
Utterbackia imbecillis	Paper Pondshell		X	X
Villosa fabalis	Rayed Bean	OE	X	X
Villosa iris	Rainbow		X	X
		Total	**28**	**25**

Status codes: FE - Federally endangered; OE - Ohio endangered; IE - Indiana endangered; OT - Ohio threatened; OSI - Ohio special interest; ISC - Indiana special concern

The White Catspaw, *Epioblasma obliquata perobliqua*, a Federal, Ohio, and Indiana endangered species is now believed to occur only in Fish Creek. Only two living specimens have been found in the past eight years. No specimens, in any condition, were encountered in this survey. It may still exist in Fish Creek, but its numbers may have fallen below the level of detection.

The Northern Riffleshell, *Epioblasma torulosa rangiana*, another Federal, Ohio, and Indiana endangered species, was historically rare in Fish Creek. No evidence was found in this survey that it still occurs in the drainage. Like the White Catspaw, it may still live in Fish Creek, but it is very rare.

Figure 2 depicts the species diversity from mouth to headwaters for both surveys. Twenty-three of the 30 sites have fewer species in 1996 than in 1988. I believe this is due, at least in part, to the exceptional survey conditions in 1988. A severe drought in 1988 resulted in the stranding of numerous mussels, rendering collection extremely easy. By contrast, 1996 had above-normal precipitation. Although survey work was conducted to maximize the likelihood of encountering as many species as possible, few mussels were stranded or otherwise unburied. This alone probably accounts for most of the departure in terms of diversity of 1996 from 1988. The 1988 drought continued for several years and undoubtedly resulted in the death of a significant portion of the mussel fauna.

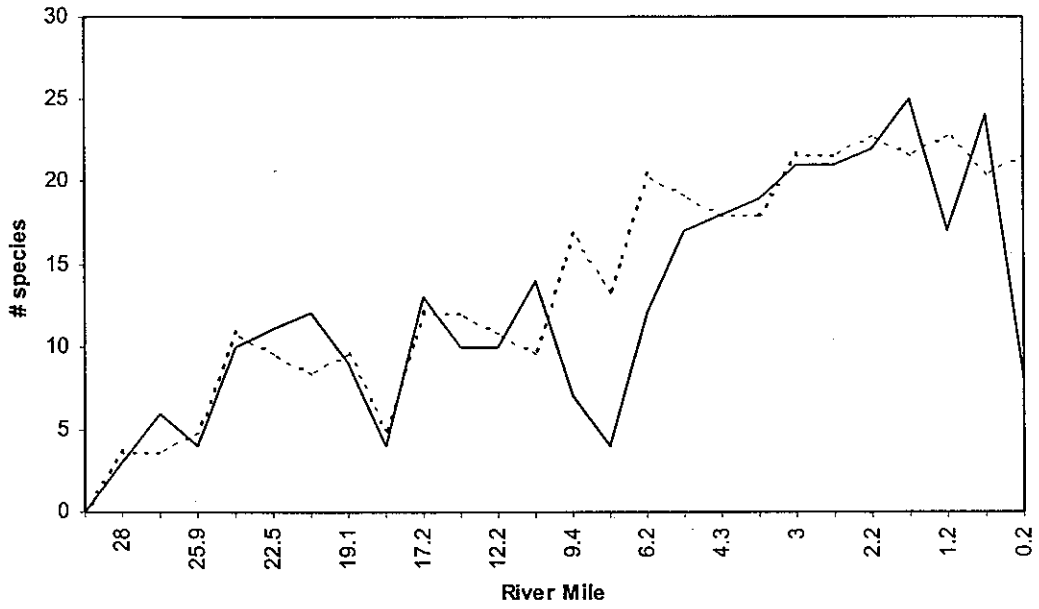

Figure 2. Number of species by river mile. Solid line - 1988. Dashed line - 1996.

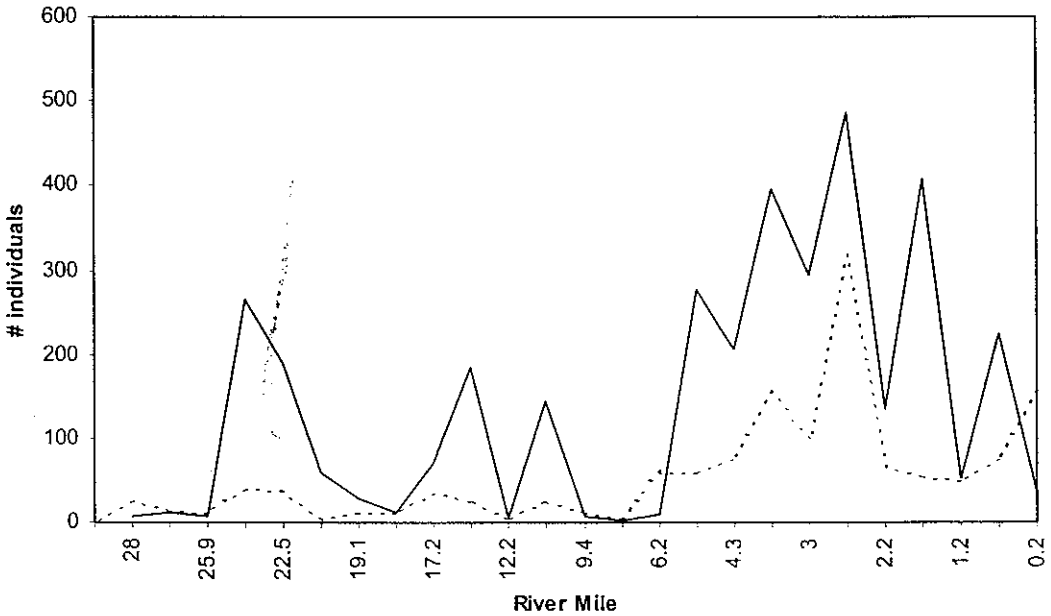

Figure 3. Number of living and freshly dead individuals of all species by river mile. Solid line - 1988. Dashed line - 1996.

Figure 3 depicts the numbers of living or freshly dead individuals encountered in 1996 and 1988. There is a significant difference between the two surveys that cannot be explained solely as the result of drought conditions in 1988. In 1988, 3520 individuals were encountered; in 1996, only 1189. The four most abundant species in Fish Creek were Threeridge, Kidneyshell, Fat Mucket, and Spike, although these species occupy different habitats within the system. All four were encountered less frequently in 1996. However, as fewer total individuals were encountered in the 1996 surveys as a whole, this result was not unexpected. But differences between each of these four species expressed as the percentage of the total individuals found of all species at a site, indicate that all four species have declined in relative abundance, particularly the Threeridge. This species was dramatically less common at several sites, notably Site 25, where 101 living individuals were found in 1988, but only one in 1996. This result is mirrored in other midwestern systems. These data indicate that certain species may be declining for unknown reasons.

Fish Creek remains among the most important sources of mussel diversity in North America. This survey suggests that declines in mussel populations found throughout the Midwest are evident in Fish Creek as well. Although overall diversity has not dramatically deteriorated, there is a suggestion that overall abundance of individuals, particularly of some once common species, has declined. The reasons for this are not clear, and certainly are not due to any one cause.

Acknowledgments

The 1988 survey was funded by the US Fish and Wildlife Service and the Indiana Department of Natural Resources. The 1996 survey was funded by the Indiana Chapter of The Nature Conservancy (TNC). Larry Clemens' (TNC) support of this survey, both in the field and in the office, is greatly appreciated.

Literature Cited

Hove, Mark C., Robin A. Engelking, Margaret E. Peteler, Eric M. Peterson, Anne R. Kapuscinski, Laurie A. Sovell, and Elaine R. Evers. 1997. Suitable fish hosts for glochidia of four freshwater mussels. Pages 21-25 *in* Conservation and Management of Freshwater Mussels II. Proceedings of a UMRCC Symposium, 16-18 October 1995, St. Louis, Missouri. Kevin S. Cummings, Allan C. Buchanan, Christine A. Mayer, and Teresa J. Naimo, editors. Upper Mississippi River Conservation Committee. Rock Island, Illinois. 293 p.

Watters, G. Thomas. 1988. A survey of the freshwater mussels of the St. Joseph River system, with emphasis on the federally endangered White Cat's Paw Pearly Mussel. Final Report to the Indiana Department of Natural Resources and US Fish & Wildlife Service. 127 p.

Watters, G. Thomas. 1996. 1996 survey of the freshwater mussels of the Fish Creek drainage. Final Report to the Indiana Chapter of The Nature Conservancy. Indianapolis, Indiana. 4 p., appendices.

Watters, G.Thomas and Scott H. O'Dee. 1997. Identification of potential hosts. Triannual Unionid Report 13: 38-39.

Yeager, Bruce L. and Richard J. Neves. 1986. Reproductive cycle and fish hosts of the Rabbit's Foot Mussel, *Quadrula cylindrica strigillata* (Mollusca: Unionidae) in the Upper Tennessee River drainage. American Midland Naturalist 116: 329-340.