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CURRENT STATUS OF FRESHWATER MUSSELS (ORDER UNIONOIDA) IN THE WABASH RIVER DRAINAGE OF INDIANA

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ABSTRACT. Seventy-five species of freshwater mussels (Order Unionoida) have historically inhabited the Wabash River drainage of Indiana. Nine of these species have always been restricted to Wabash River tributaries and never maintained reproducing populations in the mainstem Wabash River. Of the 66 remaining species, 18 are currently considered extirpated from the entire drainage and 18 maintain reproducing populations only in Wabash River tributaries. Currently, 30 species maintain reproducing populations in the mainstem Wabash River, which represents a 55% reduction in its freshwater mussel fauna. To date, the entire Wabash River drainage of Indiana has seen a 24% reduction in its freshwater mussel fauna.

Keywords: Freshwater mussels, Wabash River

The freshwater mussel (Order Unionoida) fauna of the Wabash River drainage has been well documented historically. Stein (1881) attempted the first complete list of the 'molluscous fauna of Indiana,' and referenced many species as inhabiting the Wabash River and its tributaries. Call (1894, 1896, 1897, 1900), Blatchley & Daniels (1903), Daniels (1903, 1915), and Goodrich & van der Schalie (1944) continued to add to the knowledge of Indiana's mollusca fauna and provided invaluable information on those species found in the Wabash River drainage.

Three important Wabash River studies were completed during the 1960s and 1970s. Meyer (1968) and Krumholz et al. (1970) studied the commercially valuable species of the Wabash and White rivers. Clark (1976) inventoried mussels from the lower Wabash River.

Between 1987 and 1991, Cummings et al. (1992) sampled 100 sites in the Wabash River drainage, including 53 sites on the mainstem Wabash River. Several of the lower Wabash River sites sampled by Cummings et al. (1992) were re-sampled in 1996 by Frankland (1996). Ball & Schoenung (1996) and EnviroScience (2006) intensively sampled freshwater mussels at several locations in the upper mainstem Wabash River. Page et al. (1992) and Cummings & Mayer (1997) provide information on the status of freshwater mussels in the Wabash River drainage of Illinois.

Many of the larger tributaries of the Wabash River have also had recent survey work completed (from upstream to downstream): Salamonie River (Ecological Specialists, Inc. 1995), Mississinewa River (Ecological Specialists, Inc. 1995), Eel River (upper Wabash River) (Henschen 1987), Tippecanoe River (Cummings & Berlocher 1990; Cummings et al. 1992; Ecological Specialists, Inc. 1993, 1998; Ball & Schoenung 1996; Commonwealth Biomonitoring 2005; EnviroScience 2006), Middle Fork Wildcat (Henschen 1990), small streams of Tippecanoe County (Myers-Kinzie et al. 2001), Jordan Creek (Szafoni et al. 2000), Sugar Creek (middle Wabash River tributary) (Lewis 1991), Brouilletts Creek (Tiemann 2005), East Fork White River drainage (Cummings et al. 1992; Ball & Schoenung 1996; Harmon 1998; Clarke et al. 1999; EnviroScience 2006), West Fork White River drainage (Cummings et al. 1992; Henschen 1993, 1995; L. Bowley, Muncie Bureau of Water Quality pers. comm.), and Patoka River (Ecological Specialists, Inc. 2001). Figure 1 illustrates the recent collections cited here, which include samples from 1987–2004.

In addition to this information, the Wildlife Diversity Section, Division of Fish and Wildlife, Indiana Department of Natural Resources, collected freshwater mussel information

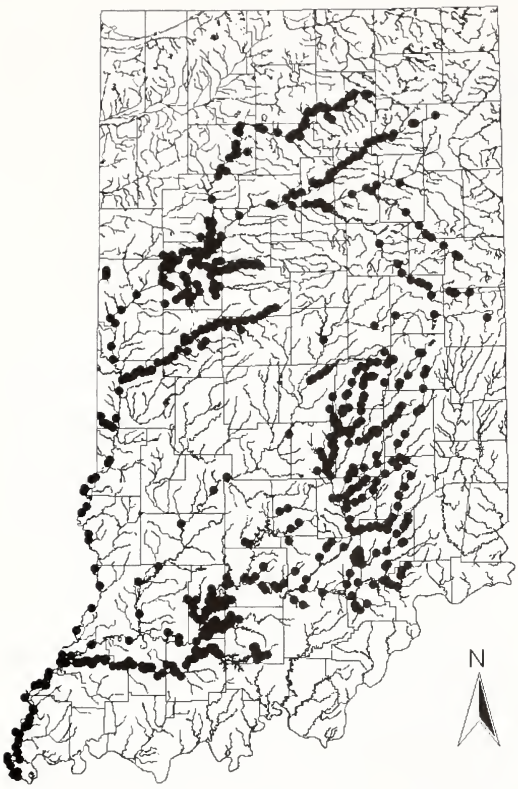

Figure 1.—Freshwater mussel sample locations reported from cited literature for the Wabash River drainage, Indiana (1987–2004).

Figure 2.—Freshwater mussel sample locations reported from cited literature and collected by the Wildlife Diversity Section, Indiana Department of Natural Resources, for the Wabash River drainage, Indiana (1987–2006).

from nearly 900 sites within the Wabash River drainage between 1995–2006 (Fig. 2). This information, along with the previously cited surveys, was used to determine the current status of freshwater mussel species within the Wabash River drainage of Indiana.

METHODS

Several different collecting methods were used in the previously cited surveys; the individual reports should be reviewed to determine the specific methods used by those researchers.

An informal sampling design (Strayer & Smith 2003) was utilized for most of our surveys within the Wabash River drainage. Sampling locations were chosen to provide information from watersheds where few or no previous freshwater mussel surveys had been completed. Locations were waded and visually (if possible) and physically searched for live freshwater mussels and dead shell material. At locations where visibility was limited, the stream bottom was searched with hands or shoed-feet.

Live freshwater mussels were identified on-site and returned; representative dead shell material was retained from most locations. Species lists indicating the best condition of shell material (live, fresh dead, weathered dead, or subfossil) encountered were prepared for all sampled locations. All shell material retained from our sampling efforts is currently vouchered at the Atterbury Fish and Wildlife Area, Edinburgh, Indiana.

Besides the specific freshwater mussel sampling described, additional information was obtained incidentally while completing survey work for fishes. Notes were made on live freshwater mussels and shell material encountered, although no formal surveys were completed.

Table 1.—Current status of freshwater mussels (Order Unionoida) in the Wabash River drainage of Indiana. Scientific and common names follow Turgeon et al. (1998). L = reproducing populations of species still found in mainstem Wabash River and its tributaries; XT = reproducing populations of species historically found in mainstem Wabash River but now restricted to its tributaries; T = reproducing populations of species always restricted to Wabash River tributaries; X = species extirpated from entire Wabash River drainage.

Species	Status
Family Margaritiferidae	
Cumberlandia monodonta (spectaclecase)	X
Family Unionidae	
Actinonaias ligamentina (mucket)	L
Alasmidonta marginata (elktoe)	L
Alasmidonta viridis (slippershell mussel)	T
Amblema plicata (threeridge)	L
Anodonta suborbiculata (flat floater)	T
Andontoides ferussacianus (cylindrical papershell)	T
Arcidens confragosus (rock pocketbook)	XT
Cyclonaias tuberculata (purple wartyback)	L
Cyprogenia stegaria (fanshell)	XT
Ellipsaria lineolata (butterfly)	XT
Elliptio crassidens (elephantear)	XT
Elliptio dilatata (spike)	XT
Epioblasma flexuosa (leafshell)	X
Epioblasma obliquata perobliqua (white catspaw)	X
Epioblasma personata (round combshell)	X
Epioblasma propinqua (Tennessee riffleshell)	X
Epioblasma sampsonii (Wabash riffleshell)	X
Epioblasma torulosa rangiana (northern riffleshell)	X
Epioblasma torulosa torulosa (tubercled blossom)	X
Epioblasma triquetra (snuffbox)	XT
Fusconaia ebena (ebonyshell)	XT
Fusconaia flava (Wabash pigtoe)	L
Fusconaia subrotunda (longsolid)	X
Hemistena lata (cracking pearlymussel)	X
Lampsilis abrupta (pink mucket)	X
Lampsilis cardium (plain pocketbook)	L
Lampsilis fasciola (wavyrayed lampmussel)	L
Lampsilis ovata (pocketbook)	L
Lampsilis siliquoidea (fatmucket)	L
Lampsilis teres (yellow sandshell)	L
Lasmigona complanata (white heelsplitter)	L
Lasmigona compressa (creek heelsplitter)	T
Lasmigona costata (flutedshell)	L
Leptodea fragilis (fragile papershell)	L
Leptodea leptodon (scaleshell)	X
Ligumia recta (black sandshell)	L
Ligumia subrostrata (pondmussel)	T
Megalonaias nervosa (washboard)	XT
Obliquaria reflexa (threehorn wartyback)	L
Obovaria olivaria (hickorynut)	L
Obovaria retusa (ring pink)	X
Obovaria subrotunda (round hickorynut)	XT
Plethobasus cicatricosus (white wartyback)	X
Plethobasus cooperianus (orangefoot pimpleback)	X
Plethobasus cyphyus (sheepnose)	XT
Pleurobema clava (clubshell)	XT
Pleurobema cordatum (Ohio pigtoe)	XT
Pleurobema plenum (rough pigtoe)	X
Pleurobema rubrum (pyramid pigtoe)	X
Pleurobema sintoxia (round pigtoe)	L
Potamilus alatus (pink heelsplitter)	L
Potamilus capax (fat pocketbook)	L
Potamilus ohiensis (pink papershell)	L
Ptychobranchus fasciolaris (kidneyshell)	XT
Pyganodon grandis (giant floater)	L
Quadrula cylindrica cylindrica (rabbitsfoot)	XT
Quadrula fragosa (winged mapleleaf)	X
Quadrula metanevra (monkeyface)	L
Quadrula nodulata (wartyback)	L
Quadrula pustulosa pustulosa (pimpleback)	L
Quadrula quadrula (mapleleaf)	L
Simpsonaias ambigua (salamander mussel)	XT
Strophitus undulatus (creeper)	L
Toxolasma lividus (purple lilliput)	XT
Toxolasma parvus (lilliput)	T
Toxolasma texasiensis (Texas lilliput)	T
Tritogonia verrucosa (pistolgrip)	L
Truncilla donaciformis (fawnsfoot)	L
Truncilla truncata (deertoe)	L
Uniomerus tetralasmus (pondhorn)	T
Utterbackia imbecillis (paper pondshell)	L
Villosa fabalis (rayed bean)	XT
Villosa iris (rainbow)	XT
Villosa lienosa (little spectaclecase)	T

RESULTS AND DISCUSSION

For the purpose of this paper, freshwater mussel species are considered extirpated if they no longer maintain a reproducing population. It is possible remnant live individuals

Table 2.—Summary of status for freshwater mussels in the Wabash River drainage of Indiana.

Status	Number of species
Reproducting populations still found in the mainstem Wabash River and its tributaries	30
Reproducing populations historically found in the mainstem Wabash River but now restricted to its tributaries	18
Reproducing populations always restricted to Wabash River tributaries	9
Extirpated from the entire Wabash River drainage	18
Total species:	75

of some of the species considered extirpated may still be found. However, because their populations have reached levels that no longer support reproduction, they are deemed functionally extirpated. Viable populations refer only to those aggregations of freshwater mussels that are reproducing, as evidenced by the presence of live, young individuals.

Of the 75 species of freshwater mussels historically known from the Wabash River drainage of Indiana, 30 still maintain populations in both the mainstem Wabash River and its tributaries, 18 are extirpated from the mainstem, but maintain populations in some portion of the drainage, and 18 are now extirpated from the entire drainage (Tables 1, 2). The nine remaining species are small-stream species or species of unique habitats and probably never had populations in the mainstem Wabash River; they maintain populations in tributaries of the Wabash River drainage within Indiana.

In describing the distribution of some of the freshwater mussel species in the following discussion, the 'upper Wabash River' is used to describe the area upstream from where Sugar Creek enters the Wabash River in Parke and Vermillion counties. The 'lower Wabash River' refers to the area downstream from Sugar Creek to its confluence with the Ohio River.

Live species of mainstem Wabash River and its tributaries.—Thirty species of freshwater mussels still maintain populations in both the mainstem Wabash River and its tributaries (Table 1). The most widely distributed of these species can be found throughout the entire drainage, in a variety of stream sizes. These species include: threeridge (*Amblema plicata*), Wabash pigtoe (*Fusconaia flava*), plain pocketbook (*Lampsilis cardium*), fatmucket (*Lampsilis siliquoidea*), white heelsplitter (*Lasmigona complanata*), giant floater (*Pyganodon grandis*), and paper pondshell (*Utterbackia imbecillis*). Although common throughout the drainage, these species tend to be less common in the tributaries and mainstem of the extreme lowest section of the Wabash River.

Several species are primarily restricted to the mainstem Wabash River and the lower parts of its largest tributaries. These species include: yellow sandshell (*Lampsilis teres*), fragile papershell (*Leptodea fragilis*), threehorn wartyback (*Obliquaria reflexa*), hickorynut (*Obovaria olivaria*), pink heelsplitter (*Potamilus alatus*), pink papershell (*Potamilus ohiensis*), monkeyface (*Quadrula metanevra*), pimpleback (*Quadrula pustulosa pustulosa*), mapleleaf (*Quadrula quadrula*), pistolgrip (*Tritogonia verrucosa*), fawnsfoot (*Truncilla donaciformis*), and deertoe (*Truncilla truncata*). These species are also the most common inhabitants of the tributaries of the lower Wabash River, where most of the other live species are not found.

Some species are restricted to the tributaries and mainstem of the upper Wabash River and the upper watersheds of its other larger tributaries (East Fork and West Fork White rivers). These species include: mucket (*Actinonaias ligamentina*), elktoe (*Alasmidonta marginata*), wavyrayed lampmussel (*Lampsilis fasciola*), flutedshell (*Lasmigona costata*), round pigtoe (*Pleurobema sintoxia*), and creeper (*Strophitus undulatus*).

Black sandshell (*Ligumia recta*) is restricted to the lower sections of the larger tributaries and mainstem of the upper Wabash River. Purple wartyback (*Cyclonaias tuberculata*) and pocketbook (*Lampsilis ovata*) have similar distributions but are also found in the lower mainstem East Fork White River.

Fat pocketbook (*Potamilus capax*) and wartyback (*Quadrula nodulata*) have the most restricted ranges of these live species. Both are concentrated in the extreme lower section of the mainstem Wabash River. They do ascend some tributaries of the lower mainstem; however, their reproductive success in these areas is somewhat questionable.

Live tributary species extirpated from mainstem Wabash River.—Eighteen freshwater mussel species that once maintained populations throughout the Wabash River drainage are now restricted to populations that are viable only in the tributaries (Table 1). For many of these species, live individuals can be found in the mainstem Wabash River; however, they no longer constitute reproducing populations.

Many species that are now restricted to the tributaries of the Wabash River have been gone from the mainstem for a long time. These species include: butterfly (*Ellipsaria lineolata*), spike (*Elliptio dilatata*), snuffbox (*Epioblasma triquetra*), round hickorynut (*Obovaria subrotunda*), clubshell (*Pleurobema clava*), Ohio pigtoe (*Pleurobema cordatum*), salamander mussel (*Simpsonaias ambigua*), purple lilliput (*Toxolasma lividus*), rayed bean (*Villosa fabalis*), and rainbow (*Villosa iris*). Many of these species are now rare in the tributaries, and most have incurred a substantial reduction in their historic distribution.

Live individuals of the following species can occasionally be found in the mainstem Wabash River; however, all are functionally extirpated and restricted to the tributaries: rock pocketbook (*Arcidens confragosus*), fanshell (*Cyprogenia stegaria*), elephantear (*Elliptio crassidens*), ebonyshell (*Fusconaia ebena*), washboard (*Megalonaias nervosa*), sheepnose (*Plethobasus cyphyus*), kidneyshell (*Ptychobranchus fasciolaris*), and rabbitsfoot (*Quadrula cylindrica cylindrica*).

Of these species, rock pocketbook, elephantear, ebonyshell, and washboard are the most likely to be collected live. Though these species may still maintain small, isolated, reproducing populations somewhere in the mainstem Wabash River, their continued presence is uncertain at best. We are considering them extirpated until further collections are made that can repudiate this claim.

Fanshell, sheepnose, kidneyshell, and rabbitsfoot are much rarer in the mainstem Wabash River than the previously mentioned species. All have been found sporadically in the mainstem in recent years (Cummings et al. 1992; Ball & Schoenung 1996; EnviroScience 2006). Occasional live individuals of these species could be entering the Wabash River from the lower Tippecanoe River where populations of these species remain.

Tributary species.—Nine species are found live in tributaries of the Wabash River drainage (Table 1) and likely never maintained populations in the mainstem Wabash River in Indiana. These species include: slippershell mussel (*Alasmidonta viridis*), flat floater (*Anodonta suborbiculata*), cylindrical papershell (*Anodontoides ferussacianus*), creek heelsplitter (*Lasmigona compressa*), pondmussel (*Ligumia subrostrata*), lilliput (*Toxolasma parvus*), Texas lilliput (*Toxolasma texasiensis*), pondhorn (*Uniomerus tetralasmus*), and little spectaclecase (*Villosa lienosa*). Shell material of these species is occasionally found in the mainstem Wabash River, likely washing in from tributaries.

Slippershell mussel, cylindrical papershell, creek heelsplitter, and lilliput are small-stream species found in the smaller watersheds throughout the Wabash River drainage (except the southwest portion). These species are likely found live in the very upper mainstem Wabash River in Ohio.

Flat floater, pondhorn and Texas lilliput are primarily restricted to the southwest portion of the Wabash River drainage, where they inhabit the ditches, oxbows, and other similar habitats of the region. Pondmussel can be found in this portion of the drainage as well but is also an inhabitant of the natural lakes of the upper Wabash River drainage.

Little spectaclecase is a small- to medium-sized stream species. It has a rather sporadic distribution within the Wabash River drainage. It inhabits tributaries of the middle Wabash, East Fork White, and West Fork White rivers.

Extirpated species.—Eighteen freshwater mussel species are now considered extirpated from the entire Wabash River drainage (Table 1). All 18 species are also extirpated from the entire state of Indiana. These species include: spectaclecase (*Cumberlandia monodonta*), leafshell (*Epioblasma flexuosa*), white catspaw (*Epioblasma obliquata perobliqua*), round combshell (*Epioblasma personata*), Tennessee riffleshell (*Epioblasma propinqua*), Wabash riffleshell (*Epioblasma sampsonii*), northern riffleshell (*Epioblasma torulosa rangiana*), tubercled blossom (*Epioblasma torulosa torulosa*), longsolid (*Fusconaia subrotunda*), cracking pearlymussel (*Hemistena lata*), pink mucket (*Lampsilis abrupta*), scale-

shell (*Leptodea leptodon*), ring pink (*Obovaria retusa*), white wartyback (*Plethobasus cicatricosus*), orangefoot pimpleback (*Plethobasus cooperianus*), rough pigtoe (*Pleurobema plenum*), pyramid pigtoe (*Pleurobema rubrum*), and winged mapleleaf (*Quadrula fragosa*). Most of these species have been lost from the fauna for many years, and several are even extinct.

A single live rough pigtoe was collected from the East Fork White River in 1992 (Ball & Schoenung 1996). A single live longsolid was collected from Sugar Creek in 1991 (Lewis 1991). These represent the last known live collections of either species from Indiana waters. If these species are live in the Wabash River drainage they are extremely rare and are no longer reproducing.

Federally-endangered species.—Three federally-endangered freshwater mussel species maintain populations in the Wabash River drainage of Indiana. Clubshell is found throughout the Tippecanoe River in the upper Wabash River drainage. Fanshell is found in the lower Tippecanoe River (below Lake Freeman) and the lower East Fork White River. The fat pocketbook survives in the extreme lowest section of the mainstem Wabash River, where it is one of the most common live freshwater mussels found.

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