FRESHWATER MUSSEL (BIVALVIA: UNIONIDAE) SURVEY OF THE BROUILLETTS CREEK BASIN IN ILLINOIS AND INDIANA

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ABSTRACT. The freshwater mussel assemblage of Brouilletts Creek basin in eastern Illinois and western Indiana was sampled at 35 sites for 55 person-hours. A total of 765 live individuals of 20 species were collected, including the state-listed little spectaclecase (*Villosa lienosa*); seven additional species were represented only as valves, including three state-listed (spike (*Elliptio dilatata*), round hickorynut (*Obovaria subrotunda*), and kidneyshell (*Ptychobranchus fasciolaris*)), and one federally-endangered species (clubshell (*Pleurobema clava*)). This survey describes the status of the assemblage and provides baseline data if disturbances should occur in the basin.

Freshwater mussels (Bivalvia: Unionidae) are a vital component of stream ecosystems (Strayer & Smith 2003). Their sensitivity to stream habitats and their sessile, filter-feeding habits allow them to be good biological indicators of stream integrity. They play an important role in aquatic ecosystems by providing a food source for many animals, including muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*) and fishes (e.g., redear sunfish (*Lepomis microlophus*) and freshwater drum (*Aplodinotus grunniens*)). Their valves provide habitat for algae and aquatic insect larvae and provide nests and refugia for certain species of fishes, such as madtoms (*Noturus* spp). In addition, freshwater mussels help stabilize stream substrate against the scouring effects of floods.

North American freshwater mussels have undergone a drastic decline during the past century (Williams et al. 1993), and have become one of the most imperiled groups of animals. Nearly two-thirds of the approximate 300 species are extinct, federally–listed as endangered or threatened, or are in need of conservation status. Several factors are responsible for the decline in freshwater mussels, including anthropogenic disturbances to stream habitats (e.g., habitat destruction and water quality problems), commercial harvest, and invasion of exotic species (e.g., zebra mussel (*Dreissena polymorpha*)).

The drastic decline in freshwater mussels also applies to streams in the Midwest. For instance, the number of live species in the Wabash River has dropped from 72 to 29 post-1969 (Cummings & Mayer 1997). However, not all drainages in the Midwest have been sufficiently sampled to assess the fauna. One such example is Brouilletts Creek basin in the Wabash River drainage. Prior to this project, no comprehensive study on the freshwater mussel assemblage of Brouilletts Creek basin had been conducted, and both historical and current data on the fauna consequently were limited. Freshwater mussels in Brouilletts Creek basin were sampled with the objectives of obtaining data on the

present distribution and structure (e.g., richness and relative abundance) of the assemblage.

METHODS

Description of study area.—Brouilletts Creek is located within the Wabash Border Natural Division (Page et al. 1992). The creek originates in the southeast corner of Vermilion County and the northeast corner of Edgar County, Illinois, and flows southeast through Vermillion County, Indiana, before depositing its waters in the Wabash River approximately 3.5 km east of Shepardsville in Vigo County, Indiana (Fig. 1; Appendix 1). Brouilletts Creek has a total basin area of approximately 900 km^2 with nearly 650 km^2 occurring in Illinois. Prior to this survey, 18 species of freshwater mussels were known from the basin (Table 1); of those species, three are state-listed in Illinois and/or Indiana: spike (*Elliptio dilatata*), kidneyshell (*Ptychobranchus fasciolaris*), and little spectaclecase (*Villosa lienosa*), with only *V. lienosa* having been collected alive (data were taken from Call [1896] and from the Illinois Natural History Survey (INHS) Mollusk Collection, Champaign on 1 January 2004).

Freshwater mussel survey methodology.—A freshwater mussel survey of Brouilletts Creek basin in eastern

Illinois and western Indiana was conducted at 35 sites from 2 September 2004 to 4 October 2004 (except one site, which was sampled on 28 April 2004). Live freshwater mussels and valves of dead specimens were collected by hand-grabbing for 1 or 2 person-hours at each site. The timed-search technique is the most effective method for obtaining data on relative abundance and species richness, especially for rare species (Vaughn 2003). At each site, live individuals were identified, measured (shell length), aged (external growth rings), and if possible, sexed while noting signs of reproduction, before being returned alive to the stream. Voucher specimens of all species from each site were deposited in the INHS Mollusk Collection. An effort was made to sample all available habitats, but particular emphasis was placed on areas that appeared likely to support freshwater mussels; also, because the mudpuppy (*Necturus maculosus*) has been found in the basin (Petzing et al. 2002), a conscious effort was made to look in pockets of silt and sand under cobble for the state-listed (Illinois state-endangered and Indiana state-special-concern) salamander mussel, (*Simpsonaias ambigua*), which uses *N. maculosus* as a host (Watters 1994). Species were identified using Cummings & Mayer (1992); for nomenclature, the list of common and scientific names of mollusks

prepared by the Council of Systematic Malacologists and the Committee on Scientific and Common Names of the American Malacological Union was followed (Turgeon et al. 1998), except for the recognition of subspecies.

Habitat survey methodology.—Instream habitat was assessed at each site from 25 October 2004 to 19 November 2004. Transects were established at 5 m intervals along the length of the area sampled for freshwater mussels; points were then spaced 1 m apart on the streambed along each transect and substrate composition, substrate compaction, and stream velocity were calculated at (Tiemann et al. 2004). Substrate composition was assessed by scraping the surface of the substrate with a spade shovel and visually estimating the contents as proportions of clay/silt, sand, gravel, pebble, cobble, and boulder. Substrate compaction was coded by touch, where scores were either 1 (loose), 2 (moderate), or 3 (firm). Stream velocity was measured at 60% water depth using a Swoffer Model 2100 current meter (Swoffer Instruments, Inc.; Seattle, WA). For each variable at each site, scores were averaged from all points to acquire a mean site instream habitat description.

RESULTS

Freshwater mussel survey.—In 55 person-hours, 765 live individuals of 20 species, including the state-listed *V. lienosa*, were collected; an additional seven species, including three state-listed species and one federally-endangered species, also were found but only as valves (Table 1; Appendix 1). Plain pocketbook (*Lampsilis cardium*), fat mucket (*Lampsilis siliquoidea*), and fragile papershell (*Leptodea fragilis*) were the most abundant species collected in terms of live individuals (Table 1; Appendix 2). *Lampsilis cardium*, *L. siliquoidea*, and Wabash pigtoe (*Fusconaia flava*) were found alive at the most number of sites (Table 1; Appendix 2). *Villosa lienosa* was the only listed species (either at the state or federal level) collected alive in the basin. Thirty-five live individuals of *V. lienosa* were found (Figure 2) at six sites (all of which were in Illinois), and valves were discovered at an additional 12 sites (Table 1; Appendix 2). The only historic freshwater mussel of Brouilletts Creek basin not found either alive or dead was the pondmussel (*Ligumia subrostrata*), which was reported by Call (1896) from "Bruiett's Creek, Vigo County" in Indiana; however, a voucher specimen for this record could not be found.

Live individuals were found at 28 sites, and valves were found at an additional six; one site did not have any evidence of freshwater mussels (Appendix 2). The number of live individuals per site varied from 0 to 87; the number of live species per site varied from 0 to 10, whereas the number of total species per site varied from 0 to 17 (Appendix 2).

Habitat survey.—Habitat in Brouilletts Creek basin was highly variable. The headwaters of the mainstem were a continuous series of compacted silt-laden substrates (mainly clay/silt and cobble) with sluggish flows, but changed to a series of moderately compacted, free-flowing sandy, cobble riffles and compacted sandy pools with lethargic flows near its confluence with the Wabash River. Tributaries were a series of riffles and pools with compacted clay/silt and cobble substrates with minimal flow in their headwaters, but changed to a series of loosely compacted, free-flowing gravel riffles and compacted clay/silt substrate pools with lethargic flows near their confluences with the mainstem.

DISCUSSION

Freshwater mussel survey.—Brouilletts Creek basin supports a highly diverse freshwater mussel fauna for its

size (900 km^2) with 20 extant species. This number is similar to the number reported for North Fork Vermilion River basin (Wabash drainage) in Illinois / Indiana, which has been described as one of the most diverse streams in the Midwest with 23 extant species in a basin size of 762 km^2 (Szafoni et al. 2000). The 28 total species is equivalent to the number recorded for Wildcat Creek (Wabash drainage) in Indiana, which was called an exceptional stream with 26 total species in a basin size of 2085 km^2 (Myers-Kinzie et al. 2001). The 28% decline in present-day species richness compared to historical data is analogous to the other principal tributaries of the Wabash River (Tippecanoe = 33%, Vermilion = 29%, Embarras = 27%, and Little Wabash = 30%), all of which are some of the Midwest's most species-rich streams (Cummings & Berlocher 1990; Cummings & Mayer 1997).

Seven species were represented only by relict valves. One species, the flutedshell (*Lasmigona costata*), has been described as uncommon-to-rare in the area (Cummings et al. 1998), whereas four others are listed at the state or federal level (Table 1). The federally-endangered clubshell (*Pleurobema clava*), which once was widely scattered in smaller streams in the upper Wabash River drainage, is now disappearing from much of its historical

range (Cummings & Berlocher 1990). A similar trend is apparent with three state-listed species: *E. dilatata*, round hickorynut (*Obovaria subrotunda*), and *P. fasciolaris* (Cummings & Mayer 1997). The last two species (pimpleback (*Quadrula pustulosa*) and mucket (*Actinonaias ligamentina*)) represented only as valves during this survey are common, but sporadic, throughout their ranges in Illinois (Cummings & Mayer 1997). The only historic species not found was *L. subrostrata*, which was interesting because this species is still found in smaller streams in adjacent basins (Cummings & Mayer 1997).

The freshwater mussel assemblage of Brouilletts Creek basin appears to be moderately stable. Based on size class distributions, growth rings, and sexual morphological features, several species (e.g., *L. cardium*, *L. siliquoidea*, and *L. fragilis*) appear to be thriving and reproducing in the basin. However, other species (e.g., threeridge (*Amblema plicata*), pistolgrip (*Tritogonia verrucosa*), and fawnsfoot (*Truncilla donaciformis*)) appear imperiled in the basin, whereas others (e.g., *E. dilatata*, *P. clava*, and *P. fasciolaris*) apparently have been extirpated from the basin. These trends might be the result of specific habitat and/or fish host requirements present in the basin.

The high diversity is surprising considering that smaller basins typically do not offer as much habitat or potential fish hosts as larger nearby drainages (Cummings et al. 1998; Szafoni et al. 2000). High freshwater mussel diversity often is associated with high fish diversity (Szafoni et al. 2000). Brouilletts Creek basin historically has supported at least 50 fish species (data were taken from the INHS Fish Collection, Champaign on 7 May 2004). Some fish hosts might only use Brouilletts Creek basin during the spawning season and would therefore provide little opportunity for continued existence of certain species. It was beyond the scope of this study to determine whether the distributions and abundances of fish hosts were sufficient to facilitate the subsistence of any of the eight freshwater mussel species no longer found in Brouilletts Creek basin. A comprehensive fish survey would provide better information of the status of this assemblage.

One species of note is *V. lienosa* (Appendix 3 – Picture 3), which was present at 51% of the sites surveyed (Appendix 2). This percentage is comparable to that of the Middle Branch of the North Fork of the Vermilion River, which supports one of the largest populations in Illinois (Szafoni et al. 2000). Based on length frequency

distributions, (Figure 2), three size classes appear to be evident. Eight individuals were between 61-63 mm, which is approaching the maximum size of about 64 mm for *V. lienosa* (Cummings & Mayer 1992); five individuals were less than 27 mm. Lack of smaller individuals collected might be attributed to survey methods; timed searches are biased against small freshwater mussels, including juveniles (Hornbach & Deneka 1996). These data suggest that *V. lienosa* is successfully reproducing in the basin. Fish hosts have not been determined for *V. lienosa*, but a congeneric species, the rainbow (*Villosa iris*), is known to use the black basses (*Micropterus* spp.) and the rock bass (*Ambloplites rupestris*) as hosts (Watters 1994). If these fishes also were hosts for *V. lienosa*, then potential hosts in Brouilletts Creek basin include smallmouth bass (*M. dolomieu*), spotted bass (*M. punctulatus*), largemouth bass (*M. salmoides*) and *A. rupestris* (data were taken from the INHS Fish Collection on 7 May 2004).

Simpsonaias ambigua was not found in the basin although it has been found in the Vermilion River basin or the Wabash River drainage (Cummings and Mayer 1992). However, it would not be surprising if small, isolated populations were present because its host recently has been found in the basin. Because of 1) its small size and thin

shell and 2) its precise habitat requirements (Cummings & Berlocher 1990), *S. ambigua* might have been overlooked. As with *V. lienosa*, the sample methodology (e.g., timed searches) might explain the failure to collect *S. ambigua*.

Competition from exotic mollusk species appears to be minimal in Brouilletts Creek basin at the present time. Although not specifically targeted, the Asian clam (*Corbicula fluminea*) was found only in the lower portions of the basin (downstream from the Illinois-Indiana state line). Also, no *D. polymorpha* was found; however, it has been reported in the Wabash River in Vermillion County, Indiana (INHS 22458), and could be a potential future threat.

Habitat survey.—The majority of the habitat in Brouilletts Creek basin was sandy gravel / pebble with some cobble present; this type of habitat was favorable to freshwater mussels (Cummings & Mayer 1992). However, some degree of habitat destruction from anthropogenic disturbances (e.g., construction projects, intensive farming practices, and all-terrain-vehicles (ATV) trails) was evident at several areas. Habitat destruction might be the most important threat to freshwater mussels (Williams et al. 1993). Freshwater mussels generally are intolerant to environmental perturbations and tend to concentrate

pollutants in their tissues due to their sessile filter-feeding habits (Cummings & Mayer 1992).

Various construction projects, including bridge construction and gravel mining, were occurring throughout Brouilletts Creek basin. Bridge construction, without proper siltation control measures, has been shown to cause alterations of substrate composition and substrate compaction in streams (Tiemann 2004), and gravel mining has been suggested to degrade habitat by increasing siltation (Vaughn 2003). Destabilization of substrate might be the most important factor in freshwater mussel decline by reducing habitat and interfering with respiration, excretion, feeding, reproduction, and juvenile recruitment (Obermeyer et al. 1997).

Several poor farming practices occur in Brouilletts Creek basin that can alter stream environments. For example, some areas completely lacked intact riparian zones. Riparian zones help reduce erosion, and removal of these areas can increase sediment loads in streams and occlude interstitial spaces in substrate (Tiemann 2004). Also, some areas had agricultural crops planted to the edge of the stream banks. This practice has been shown to result in increased siltation and agricultural pollution (Hoke 2004). Another example of destructive farming

practices is cattle watering in streams. Unimpeded access of livestock to streams can pollute the water, alter the substrate, and crush freshwater mussels (Hoke 2004).

Certain recreational activities create a potential threat to freshwater mussels via instream habitat degradation. The use of ATVs on the streambed was evident in the lower portions of Brouilletts Creek basin. As with unimpeded access of cattle, unrestricted access of ATVs to streambeds can cause alteration of habitats by compacting mud substrates, destabilizing sandy substrates, and crushing shells of freshwater mussels.

Brouilletts Creek basin has not been impounded by man-made dams; however, several beaver dams were present throughout the basin. Although these dams are small and not permanent, lowhead dams (<4 m) have been shown to modify habitat, such as changing flow and substrate conditions (Tiemann et al. 2004). As with most natural and anthropogenic disturbances, the resultant effects of lowhead dams on the freshwater mussel assemblage include lowered species richness and altered abundances of certain species (Dean et al. 2002).

Several of the tributary streams of Brouilletts Creek are intermittent and do not appear to function as refugia for freshwater mussels, which is similar to data from other

studies (e.g., Hoke 1997). Some of these streams appear to be "flashy" and have degraded, unstable habitats. Also, even though intermittent streams can offer diverse habitats (e.g., stable sand and gravel riffle area), periods of drought coupled with high temperatures create unsuitable habitat for freshwater mussels (Hoke 1997) by exposing portions of gravel bars and causing compaction of substrates through the drying of organic material in interstitial spaces (Tiemann et al. 2004). The unfavorable habitat might explain the absence of freshwater mussels in these areas.

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TABLE 1.– Native freshwater mussels of Brouilletts Creek basin in Illinois and Indiana. Site totals are the number of sites where the species was collected either as live (L) or only as valves of dead specimens (V) during this survey. Also included are the total numbers of live individuals of each species, and whether a species was added to the basin list as a result of this survey (X), where historic data were taken from Call (1896) and from the Illinois Natural History Survey Mollusk Collection, Champaign on 1 March 2004. Special status of the freshwater mussels include FE = U.S. federally-endangered, IL-SE = Illinois state-endangered, IN-SE = Indiana state-endangered, IL-ST = Illinois state-threatened, and IN-SSC = Indiana state-special-concern.

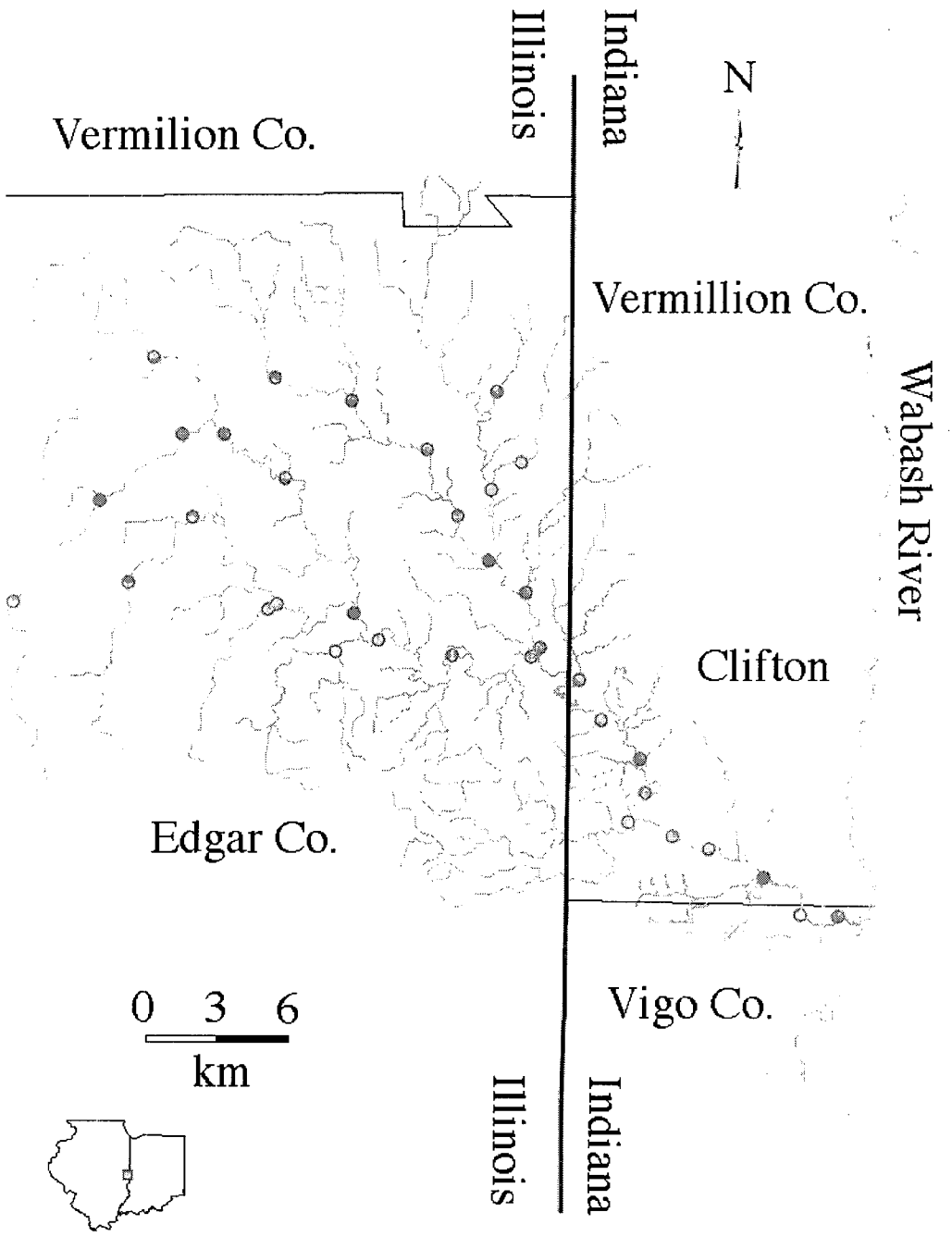
Scientific name	Common name	Status	New to basin list	Site totals	# indiv.
Anodontinae					
Anodontoides ferussacianus (Lea, 1834)	Cylindrical papershell			L (8), V (10)	24
Lasmigona complanata (Barnes, 1823)	White heelsplitter			L (7), V (5)	8
Lasmigona compressa (Lea, 1829)	Creek heelsplitter			L (5), V (4)	10
Lasmigona costata (Rafinesque, 1820)	Flutedshell		X	L (0), V (3)	0
Pyganodon grandis (Say, 1829)	Giant floater			L (3), V (5)	6
Strophitus undulatus (Say, 1817)	Creeper			L (10), V (5)	40
Utterbackia imbecillis (Say, 1829)	Paper pondshell		X	L (1), V (0)	1
Ambleminae					
Amblema plicata (Say, 1817)	Threeridge			L (2), V (8)	5
Elliptio dilatata (Rafinesque, 1820)	Spike	IL-ST		L (0), V (1)	0
Fusconaia flava (Rafinesque, 1820)	Wabash pigtoe			L (15), V (5)	52

Pleurobema clava (Lamarck, 1819)	Clubshell	IL-SE, IN-SE, & FE	X	L (0), V (2)	0
Quadrula pustulosa (Lea, 1831)	Pimpleback		X	L (0), V (2)	0
Quadrula quadrula (Rafinesque, 1820)	Mapleleaf		X	L (1), V (0)	3
Tritogonia verrucosa (Rafinesque, 1820)	Pistolgrip		X	L (2), V (1)	2
Uniomerus tetralasmus (Say, 1831)	Pondhorn			L (3), V (3)	9
Lampsilinae					
Actinonaias ligamentina (Lamarck, 1819)	Mucket			L (0), V (1)	0
Lampsilis cardium Rafinesque, 1820	Plain pocketbook			L (20), V (2)	240
Lampsilis siliquoidea (Barnes, 1823)	Fatmucket			L (20), V (5)	185
Lampsilis teres (Rafinesque, 1820)	Yellow sandshell			L (10), V (4)	27
Leptodea fragilis (Rafinesque, 1820)	Fragile papershell			L (11), V (2)	99
Ligumia subrostrata (Say, 1831)	Pondmussel			L (0), V (0)	0
Obovaria subrotunda (Rafinesque, 1820)	Round hickorynut	IL-SE & IN-SSC	X	L (0), V (4)	0
Potamilus alatus (Say, 1817)	Pink heelsplitter		X	L (2), V (0)	2
Potamilus ohiensis (Rafinesque, 1820)	Pink papershell		X	L (2), V (2)	8
Ptychobranchus fasciolaris (Rafinesque, 1820)	Kidneyshell	IL-SE & IN-SSC		L (0), V (2)	0
Toxolasma parvus (Barns, 1823)	Lilliput			L (6), V (7)	8
Truncilla donaciformis (Lea, 1828)	Fawnsfoot		X	L (1), V (0)	1
Villosa lienosa (Conrad, 1834)	Little spectaclecase	IL-SE & IN-SSC		L (6), V (12)	35

Figure Legend

Figure 1.–Map of Brouilletts Creek and its principal tributaries. Dots indicate collecting location sites for the 2004 Brouilletts Creek basin freshwater mussel survey in Illinois and Indiana.

Figure 2.–Length frequency distribution (mm) for *Villosa lienosa* during the 2004 Brouilletts Creek basin survey.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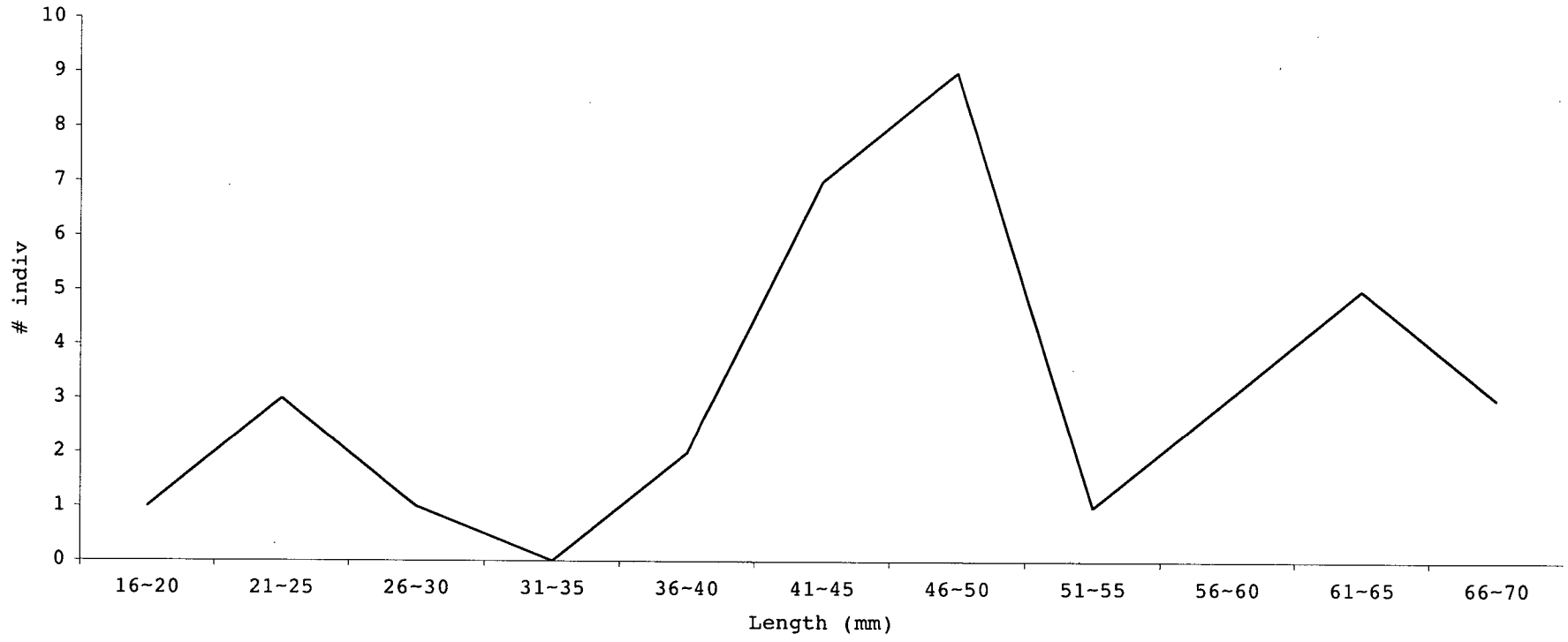
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Length (mm)

Appendix 1.–Collecting location sites for the 2004 Brouilletts Creek basin freshwater mussel survey in Illinois and Indiana. FWM is native freshwater mussel material, if any, collected at that site during this survey (L = those species collected alive, V = those species collected only as valves, and the numbers in parentheses indicate how many species were represented either as live or only as valves during this survey).

Site #	State: County	Stream	Common location	Latitude, Longitude	FWM
01	Illinois: Edgar	Brouilletts Creek	2 mi NNW Cherry Point	39.8227N, -87.7471W	L (7), V (1)
02		Brouilletts Creek	2 mi WSW Chrisman	39.7926N, -87.7114W	L (4), V (3)
03		Brouilletts Creek	2.5 mi S Chrisman	39.7756N, -87.6800W	L (7), V (5)
04		Brouilletts Creek	3.5 mi E Horace	39.7220N, -87.6446W	L (8), V (2)
05		Brouilletts Creek	2 mi SW Logan	39.7118N, -87.6325W	L (8), V (2)
06		Brouilletts Creek	3.75 mi NW Hunter	39.7058N, -87.5949W	L (7), V (1)
07		Brouilletts Creek	2 mi W St. Bernice, IN	39.7052N, -87.5547W	L (3), V (6)
08		Shiloh No. 3 Ditch	0.5 mi NW Garland	39.7256N, -87.8168W	L (0), V (1)
09		Shiloh No. 3 Ditch	2.25 mi SE Metcalf	39.7663N, -87.7735W	L (4), V (2)
10		Shiloh No. 3 Ditch	2.75 mi WSW Chrisman	39.7922N, -87.7323W	L (8), V (1)
11		South Fork Brouilletts Creek	1.25 mi ENE Horace	39.7256N, -87.6838W	L (3), V (2)
12		South Fork Brouilletts Creek	3 mi S Cherry Point	39.7598N, -87.7271W	L (3), V (4)
13		South Fork Brouilletts Creek	2.25 mi WNW Horace	39.7339N, -87.7588W	L (3), V (0)
14		Willow Creek	1 mi E Horace	39.7233N, -87.6886W	L (1), V (2)
15		Snake Creek	1.5 mi NE county airport	39.7076N, -87.6545W	L (1), V (1)
16		North Fork Brouilletts Creek	I mi NW Chrisman	39.8149N, -87.6859W	L (1), V (0)
17		North Fork Brouilletts Creek	1.5 mi E Chrisman	39.8062N, -87.6470W	L (0), V (1)
18		North Fork Brouilletts Creek	1.75 mi S Scottland	39.7870N, -87.6084W	L (2), V (0)
19		North Fork Brouilletts Creek	3 mi S Scottland	39.7614N, -87.5926W	L (7), V (3)
20		North Fork Brouilletts Creek	4.5 mi SSE Scottland	39.7434N, -87.5765W	L (3), V (4)
21		North Fork Brouilletts Creek	1.75 mi N Clays Prairie	39.7090N, -87.5499W	L (7), V (4)
22		Salt Fork Brouilletts Creek	2.5 mi SSE Scottland	39.7716N, -87.5754W	L (0), V (3)
23		Bonwell Branch	1.75 mi ENE Scottland	39.8100N, -87.5731W	L (0), V (1)
24		Lick Run	2.75 mi SE Scottland	39.7821N, -87.5603W	L (0), V (1)
25		Goose Creek	2.75 mi SE Logan	39.7307N, -87.5576W	L (0), V (1)

26	Indiana: Vermillion	Brouilletts Creek	1.25 mi N Blanford	39.6816N, -87.5213W	L (10), V (2)
27		Brouilletts Creek	1.25 mi E Blanford	39.6655N, -87.4991W	L (4), V (7)
28		Brouilletts Creek	1.25 mi SE Centenary	39.6521N, -87.4959W	L (6), V (0)
29		Brouilletts Creek	2 mi S Centenary	39.6348N, -87.4823W	L (6), V (6)
30		Brouilletts Creek	1.25 mi NW Universal	39.6302N, -87.4635W	L (3), V (14)
31		Brouilletts Creek	1.25 mi E Universal	39.6190N, -87.4363W	L (4), V (6)
32		Little Creek	0.5 mi W West Clinton	39.6963N, -87.5303W	L (0), V (0)
33		Coal Creek	2 mi SSE Blanford	39.6407N, -87.5046W	L (2), V (2)
34	Indiana: Vigo	Brouilletts Creek	0.5 mi N Shepardsville	39.6041N, -87.4173W	L (9), V (3)
35		Brouilletts Creek	1 mi E Shepardsville	39.6036N, -87.3987W	L (4), V (3)

Appendix 2.–Native freshwater mussels collected by site during the 2004 Brouilletts Creek basin in Illinois and Indiana. Site numbers are referenced in Appendix 1. FWM is native freshwater mussel material, if any, collected at that site during this survey (numbers represent the number of individuals of a given species collected alive, D = those species collected only as fresh dead specimens, and R = those species collected only as relict specimens)).

Species / site	01	02	03	04	05	06	07	08	09	10	11	12
A. ferussacianus	6		1		2				R	1	R	D
L. complanata		1	1		2					1		R
L. compressa	2	D	2	3			D		R	D		
L. costata				R								
P. grandis	3		2								R	
S. undulatus			R		D	2	D					1
U. imbecillis	1											
A. plicata				2		R	R					
E. dilatata												
F. flava	1	8	6	1	2	2	R			4	2	
P. clava												
Q. pustulosa												
Q. quadrula												
T. verrucosa												
U. tetralasmus			R						$	1		R
A. ligamentina												
L. cardium		D	2	16	11	12	19		1	1		
L. siliquoidea	4	4	23	26	17	9	3	D	12	24	7	5
L. teres			D	3	1	1						
L. fragilis				15	6	3	4					
O. subrotunda												
P. alatus												
P. ohiensis												
P. fasciolaris												
T. parvus	2	1	R	R	1		R			2		R
T. donaciformis												
V. lienosa	D	D	R	2	D	6	D		2	22	2	1
# individuals	19	14	37	68	42	35	26	0	19	56	11	7
# live species	7	4	7	8	8	7	3	0	4	8	3	3
Total # species	8	7	12	10	10	8	9	1	6	9	5	7
Effort (man-hrs)	2	2	2	2	2	2	2	1	1	2	2	1

Appendix 2 (cont.)

Species / site	13	14	15	16	17	18	19	20	21	22	23	24
A. ferussacianus		R		1		2	6	D	5			
L. complanata							1	R				
L. compressa							2		1			
L. costata												
P. grandis								R	D			
S. undulatus	12						1		3			
U. imbecillis												
A. plicata							R		R			
E. dilatata												
F. flava							7	2	1	R		
P. clava												
Q. pustulosa												
Q. quadrula												
T. verrucosa												
U. tetralasmus	4	R										
A. ligamentina												
L. cardium					R	5	8	9	22			
L. siliquoidea			1				12	4	8	R		
L. teres									R			
L. fragilis									3			
O. subrotunda												
P. alatus												
P. ohiensis												
P. fasciolaris												
T. parvus	1	1					D				D	R
T. donaciformis												
V. lienosa							D	R	R	R		
# individuals	17	1	1	1	0	7	37	15	43	0	0	0
# live species	3	1	1	1	0	2	7	3	7	0	0	0
Total # species	3	3	1	1	1	2	10	7	11	3	1	1
Effort (man-hrs)	1	1	1	1	1	1	2	2	2	1	1	1

Appendix 2 (cont.)

Species / site	25	26	27	28	29	30	31	32	33	34	35	Surv Tot
A. ferussacianus	R	R			R	R			R			24
L. complanata		1			R	R	R			1		8
L. compressa												10
L. costata						R	R					0
P. grandis					R	R			1	R		6
S. undulatus		4	1	13	R	R	R					40
U. imbecillis												1
A. plicata		3	R		R	R	R					5
E. dilatata		R										0
F. flava		7	D	5	1	D	3					52
P. clava						R				R		0
Q. pustulosa							R				R	0
Q. quadrula										3		3
T. verrucosa		1			R	1						2
U. tetralasmus												9
A. ligamentina											R	0
L. cardium		37	26	12	22	20	5		5	5	2	240
L. siliquoidea		9	2	13	R	R				1	1	185
L. teres		9	D	3	2	1	2		R	3	2	27
L. fragilis		15	8	33	6	R	2			4	D	99
O. subrotunda			R			R	R			R		0
P. alatus		1								1		2
P. ohiensis			R			R				5	3	8
P. fasciolaris			R			R						0
T. parvus												8
T. donaciformis										1		1
V. lienosa			R		R	R						35
# individuals	0	87	37	79	34	22	12	0	6	24	8	765
# live species	0	10	4	6	4	3	4	0	2	9	4	20
Total # species	1	12	11	6	12	17	10	0	4	12	7	27
Effort (man-hrs)	1	2	2	2	2	2	2	1	1	2	2	55

Appendix 2.–Native freshwater mussels collected by site during the 2004 Brouilletts Creek basin in Illinois and Indiana. Site numbers are referenced in Appendix 1. FWM is native freshwater mussel material, if any, collected at that site during this survey (numbers represent the number of individuals of a given species collected alive, D = those species collected only as fresh dead specimens, and R = those species collected only as relict specimens)).

Species / site	01	02	03	04	05	06	07	08	09	10	11	12
A. ferussacianus	6		1		2				R	1	R	D
L. complanata		1	1		2					1		R
L. compressa	2	D	2	3			D		R	D		
L. costata				R								
P. grandis	3		2								R	
S. undulatus			R		D	2	D					1
U. imbecillis	1											
A. plicata				2		R	R					
E. dilatata												
F. flava	1	8	6	1	2	2	R			4	2	
P. clava												
Q. pustulosa												
Q. quadrula												
T. verrucosa												
U. tetralasmus			R						$	1		R
A. ligamentina												
L. cardium		D	2	16	11	12	19		1	1		
L. siliquoidea	4	4	23	26	17	9	3	D	12	24	7	5
L. teres			D	3	1	1						
L. fragilis				15	6	3	4					
O. subrotunda												
P. alatus												
P. ohiensis												
P. fasciolaris												
T. parvus	2	1	R	R	1		R			2		R
T. donaciformis												
V. lienosa	D	D	R	2	D	6	D		2	22	2	1
# individuals	19	14	37	68	42	35	26	0	19	56	11	7
# live species	7	4	7	8	8	7	3	0	4	8	3	3
Total # species	8	7	12	10	10	8	9	1	6	9	5	7
Effort (man-hrs)	2	2	2	2	2	2	2	1	1	2	2	1

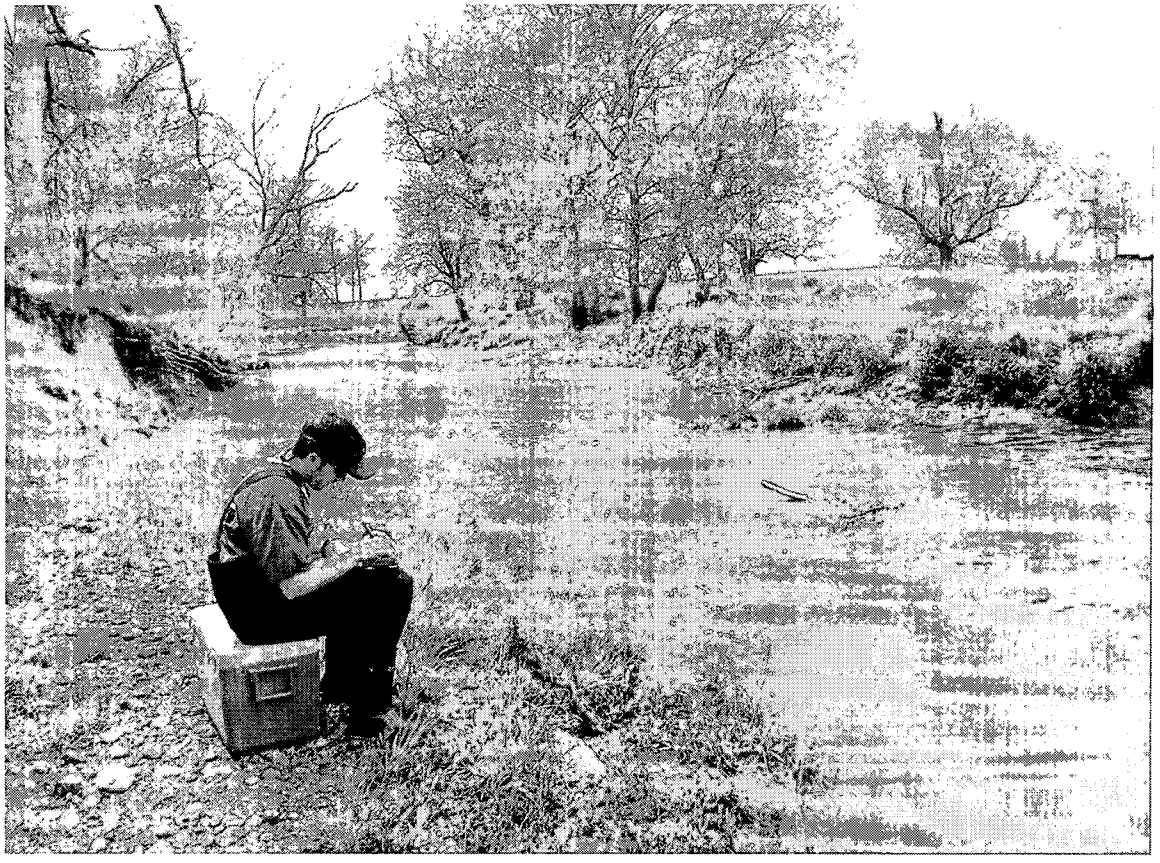
Appendix 2 (cont.)

Species / site	25	26	27	28	29	30	31	32	33	34	35	Surv Tot
A. ferussacianus	R	R			R	R			R			24
L. complanata		1			R	R	R			1		8
L. compressa												10
L. costata						R	R					0
P. grandis					R	R			1	R		6
S. undulatus		4	1	13	R	R	R					40
U. imbecillis												1
A. plicata		3	R		R	R	R					5
E. dilatata		R										0
F. flava		7	D	5	1	D	3					52
P. clava						R				R		0
Q. pustulosa							R				R	0
Q. quadrula										3		3
T. verrucosa		1			R	1						2
U. tetralasmus												9
A. ligamentina											R	0
L. cardium		37	26	12	22	20	5		5	5	2	240
L. siliquoidea		9	2	13	R	R				1	1	185
L. teres		9	D	3	2	1	2		R	3	2	27
L. fragilis		15	8	33	6	R	2			4	D	99
O. subrotunda			R			R	R			R		0
P. alatus		1								1		2
P. ohiensis			R			R				5	3	8
P. fasciolaris			R			R						0
T. parvus												8
T. donaciformis										1		1
V. lienosa			R		R	R						35
# individuals	0	87	37	79	34	22	12	0	6	24	8	765
# live species	0	10	4	6	4	3	4	0	2	9	4	20
Total # species	1	12	11	6	12	17	10	0	4	12	7	27
Effort (man-hrs)	1	2	2	2	2	2	2	1	1	2	2	55

Appendix 3.–Pictures of study area and study species.

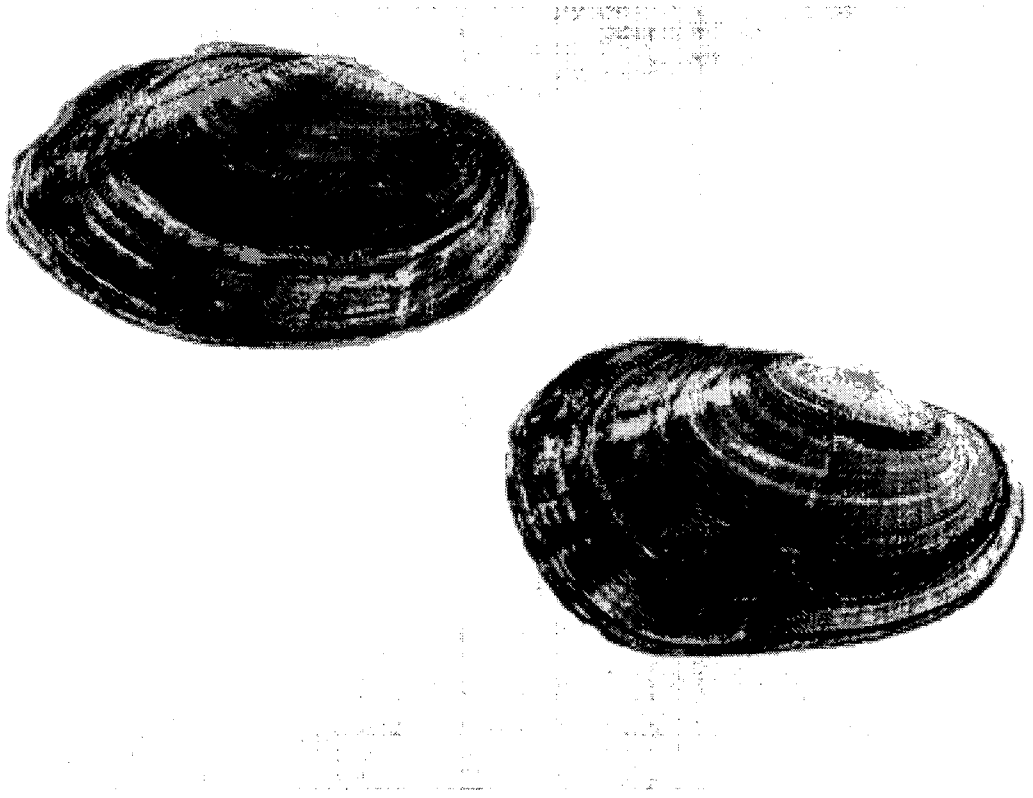
Picture 1 = Site 16 (North Fork Brouilletts Creek – Illinois: Edgar County – 1 mi NW Chrisman).

Appendix 3 (cont.)



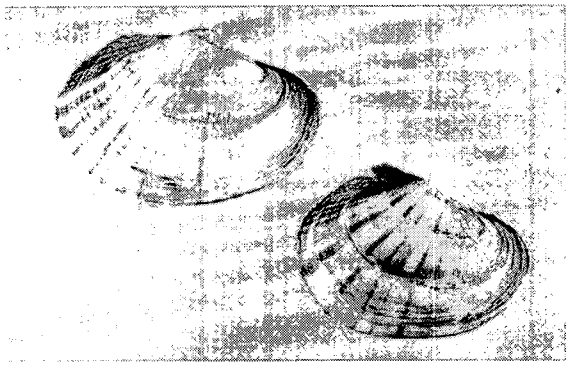
Picture 2. Author entering data after sampling Site 2 (Brouilletts Creek – Illinois: Edgar County – 2 mi WSW Chrisman).

Appendix 3 (cont.)

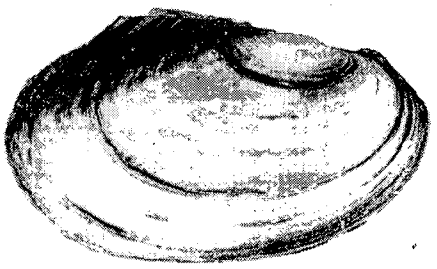


Picture 3. Male (top) and female (bottom) little spectaclecase *Villosa lienosa* [INHS 4844 – North Fork Vermilion River, Vermilion County, Illinois] (photograph courteous of K.S. Cumming, Illinois Natural History Survey, Champaign).

Appendix 3 (cont.)

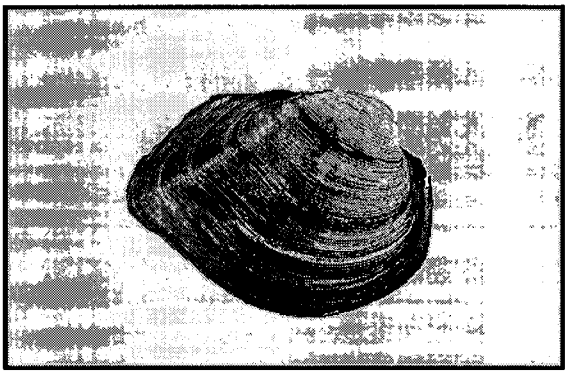


Picture 4. Male (top) and female (bottom) plain pocketbook *Lampsilis cardium* [INHS 8898 – East Fork Spoon River, Stark County, Illinois] (photograph courteous of K.S. Cumming, Illinois Natural History Survey, Champaign).



Picture 6. Fragile papershell *Leptodea fragilis* [INHS 8019 – Henderson Creek, Henderson County, Illinois] (photograph courteous of K.S. Cumming, Illinois Natural History Survey, Champaign).

Picture 5. Male (top) and female (bottom) fat mucket *Lampsilis siliquoidea* [INHS 3259 – Sangamon River, Piatt County, Illinois] (photograph courteous of K.S. Cumming, Illinois Natural History Survey, Champaign).



Picture 7. Wabash pigtoe *Fusconaia flava* [INHS 11802 – Mississippi River, Buffalo County, Wisconsin] (photograph courteous of K.S. Cumming, Illinois Natural History Survey, Champaign).