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Freshwater mussels of the Little Wabash River basin

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Preface

While broad geographic information is available on the distribution and abundance of mussels in Illinois, systematically collected mussel-community data sets required to integrate mussels into aquatic community assessments do not exist. In 2009, a project funded by a US Fish and Wildlife Service State Wildlife Grant was undertaken to survey and assess the freshwater mussel populations at wadeable sites from 33 stream basins in conjunction with the Illinois Department of Natural Resources (IDNR)/Illinois Environmental Protection Agency (IEPA) basin surveys. Inclusion of mussels into these basin surveys contributes to the comprehensive basin monitoring programs that include water and sediment chemistry, instream habitat, macroinvertebrate, and fish, which reflect a broad spectrum of abiotic and biotic stream resources. These mussel surveys will provide reliable and repeatable techniques for assessing the freshwater mussel community in sampled streams. These surveys also provide data for future monitoring of freshwater mussel populations on a local, regional, and watershed basis.

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Introduction

Freshwater mussel populations have been declining for decades and are among the most seriously impacted aquatic animals worldwide (Bogan 1993, Williams et al. 1993). It is estimated that nearly 70% of the approximately 300 North American mussel taxa are extinct, federally-listed as endangered or threatened, or in need of conservation status (Williams et al. 1993, Strayer et al. 2004). In Illinois, 25 of the 62 extant species (44%) are listed as threatened or endangered (Illinois Endangered Species Protection Board 2011). While broad geographic information is available on the distribution and abundance of mussels in Illinois, systematically collected mussel community data sets required to integrate mussels into aquatic community assessments do not exist. Published reports pertaining to the mussel fauna of the Little Wabash River basin include F. C. Baker (1906), Fechtner (1963), Parmalee (1967) and Cummings et al. (1989). Other mussel surveys have been conducted in the Little Wabash River basin including Matteson (1956) and Suloway (1979-1988). However, with the exception of Cummings et al. (1988) which surveyed 30 sites, many surveys of this basin have been of limited scope. This report summarizes the mussel surveys conducted in the Little Wabash River basin in 2010 and 2011 in conjunction with IDNR and IEPA basin surveys.

The Little Wabash River basin drains an area of approximately 8288 km^2 (3200 mi^2) in southeastern Illinois encompassing parts of 15 counties. The three main counties include Clay, Wayne, and Edwards, while parts of Coles, Shelby, Cumberland, Effingham, Jasper, Fayette, Marion, Jefferson, Hamilton, White, and Richland counties are included in this basin (Page et al. 1992). The drainage lies within three natural divisions, Grand Prairie, Southern Till Plain, and Wabash Border with the last two comprising the majority of the basin (Schwegman 1973). The topography of the basin includes broad flat uplands and U-shaped valleys; the mainstem of the Little Wabash meanders nearly twice the length of the basin. Major tributaries of the Little Wabash system include Skillet Fork, Elm River, Fox River and Big Muddy Creek (Figure 1).

Land-use and Instream Habitat

Nearly 80% of the Little Wabash River basin is agricultural land, mainly row crop with a small percentage of grassland. Approximately 15% of the basin is forest or woodland and 3% is wetland. Less than 1.5% of the watershed is urban, and only the city of Effingham, located in the upper portion of the basin, has a population greater than 10,000 residents (Illinois Department of Agriculture 2000). The mainstem of the Little Wabash has been impounded north of Effingham to form Lake Mattoon and Paradise Lake (Page et al. 1992). The threats to water quality in the Little Wabash River basin include agriculture, coal surface mining, and oil

production, which accounts for 1/3 of the oil produced in the state (Page et al. 1992). The substrates in most of the streams of this basin are dominated by some combination of sand, silt, and clay. Mainstem sites on the Little Wabash and Skillet Fork are comprised of sand, silt, clay, and gravel. Excessive siltation along with large woody debris and stream bank downcutting is common at many sites (Figures 2 and 3). Most of the sites in the basin have wadeable water depths; however, we limited sampling sites on the lower portion of the Little Wabash and Skillet Fork due to non-wadeable water depths (e.g., depth>1m).

Methods

During the 2010/2011 survey, freshwater mussel data were collected at 33 sites (Figure 1). Locations of sampling sites are listed in Table 1 along with information regarding IDNR/IEPA sampling at the site. In most cases, mussel survey locations were the same as IDNR/IEPA sites. Live mussels and shells were collected at each sample site to assess past and current freshwater mussel occurrences. Live mussels were surveyed by hand grabbing and visual detection (e.g., trails, siphons, exposed shell) when water conditions permitted. Efforts were made to cover all available habitat types present at a site including riffles, pools, slack water, and areas of differing substrates. A four-hour timed search method was implemented at each site. Live mussels were held in the stream until processing.

Following the timed search, all live mussels and shells were identified to species and recorded (Table 2). For each live individual, shell length (mm), gender, and an estimate of the number of growth rings recorded. Shell material was classified as recent dead (periostracum present, nacre pearly, and soft tissue may be present) or relict (periostracum eroded, nacre faded, shell chalky) based on condition of the best shell found. A species was considered extant at a site if it was represented by live or recently dead shell material (Szafoni 2001). The nomenclature employed in this report follows Turgeon et al. (1998) except for recent taxonomic changes to the gender ending of purple lilliput and lilliput (*Toxolasma lividum* and *T. parvum*), which follows Williams et al. (2008; Appendix 1). Voucher specimens were retained and deposited in the Illinois Natural History Survey Mollusk Collection. All non-vouchered live mussels were returned to the stream reach where they were collected.

Parameters recorded included extant and total species richness, presence of rare or listed species, and individuals collected, which was expressed as catch-per-unit-effort (CPUE; Table 2). A population was considered to indicate recent recruitment if individuals less than 30 mm in length or with 3 or fewer growth rings were recorded. Finally, mussel resources were classified as Unique, Highly Valued, Moderate, Limited, or Restricted (Table 2) based on the above parameters (Table 3) and following criteria outlined in Table 4 (Szafoni 2001).

Results

Species Richness

A total of 31 species of freshwater mussels were observed in the Little Wabash River basin, 27 of which were live (Table 2). Across all sites, the number of live species collected ranged from 0 to 15, the number of extant species collected (live + dead) ranged from 0 to 16, and the total number of species collected (live + dead + relict) ranged from 0 to 17. Tributaries, with the exception of Skillet Fork, contained fewer species than the mainstem (0 to 11 live species, 0 to 13 extant species, and 0 to 14 total species). The lilliput and Texas lilliput (*Toxolasma texasiensis*) had the most occurrences across sites and were collected at nearly 43% of all sites (Figure 4). The mapleleaf (*Quadrula quadrula*), giant floater (*Pyganodon grandis*), fragile papershell (*Leptodea fragilis*), white heelsplitter (*Lasmigona complanata*), and threeridge (*Amblema plicata*) were other commonly occurring species (Figure 4), occupying between 30% and 40% of these sites.

Abundance and Recruitment

A total of 2330 individuals were collected across 33 sites. The number of live specimens collected at a given site ranged from 0 to 460, with an average of 71 mussels per site (Table 2). A total of 132 collector-hours were spent sampling with an average of 18 mussels collected per hour. Eighteen sites yielded more than 10 individuals and 11 of those 18 sites yielded more than 45 live individuals. The most common species collected in the basin were the mapleleaf (n=548), pistolgrip (*Tritogonia verrucosa*; n=520), threeridge (n=198), paper pondshell (*Utterbackia imbecillis*; n=174), Texas lilliput (n=98), deertoe (*Truncilla truncata*; n=83), and lilliput (n=70) which together comprised approximately 73% of the collections (Table 2). Mussel abundance at individual sites ranged from none to high, with CPUE ranging from 0 - 114 individuals/collector-hour (Table 2). Extant mussel populations were found at 27 of the 33 sites.

Recruitment for each species was determined by the presence of individuals less than 30 mm or with 3 or fewer growth rings. Smaller (i.e., younger) mussels are harder to locate by hand grab methods and large sample sizes can be needed to accurately assess population reproduction. However, a small sample size can provide evidence of recruitment if it includes individuals that are small or possess few growth rings. Alternatively, a sample consisting of very large (for the species) individuals with numerous growth rings suggests a senescent population.

Recruitment at individual sites ranged from none observed to very high across the basin. Recruitment levels, referred to in Table 3 as Reproduction Factor, varied from 1 to 5, with 11

sites exhibiting high to very high recruitment. Skillet Fork (site 25) and Horse Creek (site 26) exhibited recruitment over 50% and recruitment was 30 to 50% at 9 other sites (8, 10, 21, 22, 27, 28, 29, 31, and 32; Figure 5). Four other sites exhibited moderate recruitment, while no observed recruitment was recorded at 18 sites during this survey.

Mussel Community Classification

Based on the data collected in the 2010/2011 basin surveys, nearly 50% of the sites in the Little Wabash River basin are classified as Moderate, Highly Valued, or Unique mussel resources under the current MCI classification system (Table 4, Figure 5). The mainstem site near Hord and Skillet Fork near Crisp (sites 8 and 25) stand out as Unique resources due to the presence of intolerant species, the number of mussels collected, and the species richness of the site. Six additional sites, three mainstem sites (9, 10, and 32), two Skillet Fork sites (22, 31) and Brush Creek (site 24) were classified as Highly Valued mussel resources. One mainstem site and 7 tributaries were ranked as Moderate mussel resources while the 17 remaining sites were considered Limited or Restricted mussel resources.

Noteworthy Finds

This survey collected 27 live species and 31 total species; historically 47 species were known from the Little Wabash River basin (Tiemann et al. 2007). Sixteen species known historically from this basin but not collected during this survey include: slippershell mussel (*Alasmidonta viridis*), flat floater (*Anodonta suborbiculata*), creek heelsplitter (*Lasmigona compressa*), flutedshell (*Lasmigona costata*), creeper (*Strophitus undulatus*), purple wartyback (*Cyclonaias tuberculata*), ebonyshell (*Fusconaia ebena*), rough pigtoe (*Pleurobema plenum*), pyramid pigtoe (*Pleurobema rubrum*), monkeyface (*Quadrula metanevra*), mucket (*Actinonaias ligamentina*), butterfly (*Ellipsaria lineolata*), snuffbox (*Epioblasma triquetra*), round hickorynut (*Obovaria subrotunda*), kidneyshell (*Ptychobranchus fasciolaris*), and purple lilliput. Many of these species are threatened, endangered or species of greatest need of conservation (SGNC) in Illinois.

Four species, elephantear (*Elliptio crassidens*), Ohio pigtoe (*Pleurobema cordatum*), fat pocketbook (*Potamilus capax*), and little spectaclecase (*Villosa lienosa*) were only represented by dead or relict shell. This species list includes one federally endangered mussel (fat pocketbook) along with state endangered and threatened mussels. Two of the 20 listed species (federal, state, or greatest need) known historically from the basin were collected live. Eight individuals of rock pocketbook (*Arcidens confragosus*, IL SGNC) were collected at four sites in the basin and spike (*Elliptio dilatata*, state threatened) was collected from one site during our survey.

A possible range expansion may be occurring with the Louisiana fatmucket (*Lampsilis hydiana)* which occurs in the upper Arkansas, White and St. Francis rivers and in Louisiana and East Texas

(NatureServe 2011). Specimens collected during this survey were classified as *Lampsilis siliquoidea* (*hydiana*) due to morphological features that resemble the Louisiana fatmucket (pers. comm. Kevin Cummings). Additional genetic testing would need to be conducted to correctly determine which species, *Lampsilis siliquoidea* or *Lampsilis hydiana*, exists in the Little Wabash basin.

Discussion

Two mussel community assessments have been completed previously in the Little Wabash River basin. M.R. Matteson conducted surveys at 17 sites in 1956 and K.S. Cummings repeated surveys at 15 of those sites plus an additional 15 sites in 1988 (Cummings et al. 1989). All sites sampled by Matteson/Cummings were at different localities than this survey's sites, with the exception of the Little Wabash River mainstem site at New Haven. The mainstem sites at Louisville and Carmi were within close proximity to each other, Louisville being slightly downstream and Carmi being slightly upstream during our surveys. Although the site localities were different between this study and the two previous studies, similar results were found. The 3 surveys had 23 species in common. In 1956, 29 live species were detected, whereas 26 and 27 live species were detected in 1988 and 2010/2011, respectively. Thirty-two extant species were reported in 1988 with 31 being recorded in 2010/2011. In comparing his survey to Matteson, Cummings detected four new species (flat floater, butterfly, kidneyshell, and pondhorn) all represented by dead shell except for the flat floater (n=2). Matteson detected four live species not detected live by Cummings (pyramid pigtoe, fat pocketbook, lilliput, and little spectaclecase). Of these eight species, four were found during this survey, pondhorn (n=5), lilliput (n=70), and fat pocketbook and little spectaclecase represented by dead shell material. The flat floater, butterfly, kidneyshell, and pyramid pigtoe were not detected during this survey. Three other species detected by Matteson and Cummings, ebonyshell, creeper, and mucket, were not detected during this survey. Two species not detected in either the 1956 or 1988 surveys, round pigtoe (n=2) and Texas lilliput (n=98), were found live during our survey. However, both species have been collected at several other localities within this basin since 1988.

In 1956, 1207 individuals were collected and the three most abundant species in the Little Wabash River basin were the threeridge, mapleleaf, and pimpleback. In 1988, 1081 individuals were collected at the 15 common sites and the mapleleaf was most abundant, followed by threeridge and washboard. During this survey, the mapleleaf was again the most abundant mussel detected followed by the pistolgrip, and threeridge. The washboard and pimpleback fell to 11th and 15th in abundance rankings while the paper pondshell and white heelsplitter moved up to 4th and 6th, respectively.

Based on these surveys, we identified several species that may be extirpated in the Little Wabash River basin. Extant records for the creek heelsplitter, purple wartyback, rough pigtoe, monkeyface, butterfly, snuffbox, and round hickorynut were not located during this survey or recent past surveys. Page et al. (1992) reported that the snuffbox, rough pigtoe, and round hickorynut were presumed extirpated from the basin. The range of several of these species is limited to the Wabash River drainage while others such as the creek heelsplitter are at the southern most part of their range (Cummings and Mayer 1992). All of these species are considered rare and are state or federally listed or species in greatest need of conservation in Illinois.

Recruitment

Nearly half of the sites sampled (15) exhibited moderate to very high recruitment. These sites include four Little Wabash mainstem sites (Figure 6), four Skillet Fork sites (Figure 7), two Elm River sites, along with five Skillet Fork tributaries (sites 24, 26, 27, 28, and 29). These findings suggest that the mussel communities of the Skillet Fork drainage, Elm River and Little Wabash mainstem are viable and self-maintaining at this time. Data collected during this survey indicate that very recent recruitment may not be occurring at the 18 remaining sites in these drainages. However, nearly 40% of the mussels collected during these basin surveys were less than 10 years old (i.e., counted rings were less than 10 and shells had little or no erosion present). This finding indicates that the populations in most streams are within the age range thought to be reproductively active (Haag and Staton 2003). Sampling methods to target juvenile mussels would be necessary to better assess the reproductive status of these populations.

Mussel community of the Little Wabash River basin

Our surveys documented the existence of 31 extant species in the Little Wabash River basin. While these numbers are less than the historical species counts, they are nearly the same as the mussel communities known since 1956. In past assessments based on habitat and fish community data, the upper segments of the Little Wabash River basin have been classified as very good (Smith 1971) and as “B” streams (Highly Valued Aquatic Resource; Hite and Bertrand 1989), while the lower portion of the basin was rated as poor and Moderate Aquatic Resource, respectively. Cummings et al. (1989) reported that the 1988 mussel data did not coincide with these assessments, as the sites with the greatest mussel diversity were located in the lower portion of the basin. The results from this survey tend to concur with the results from Cummings et al. However during this survey, the greatest mussel diversity began further upstream in the middle reaches of the basin near Louisville and also included several sites on the mainstem of Skillet Fork.

In more recent assessments of the basin by IEPA biologists, only seven sites in the basin are

considered full support and thirteen sites are listed as impaired for aquatic life use based on biological, physiochemical, physical habitat, and toxicity data collected (IEPA 2010). Unfortunately, there seems to be no relationship between the stream classification of full support and mussel diversity. Of the seven streams considered full support, five streams were classified Restricted or Limited, one was Moderate, and one was Unique based on the current MCI values. There appears to be a slight relationship between aquatic life impaired sites and mussel communities, since approximately 70% (9 of 13) of these sites were classified as Restricted or Limited.

While several surveys have been conducted in this basin over half (19) of all sites sampled during this survey had no previous mussel data. Extant mussel populations ranging from 1 to 10 species were found at 13 of these sites. Furthermore, at approximately 65% of the sites with historic data available (9 of 14 sites), the 2010/2011 survey turned up as many or more species than were historically known. The mussel communities collected suggest relatively intact freshwater mussel communities, since the number of extant species was greater than or nearly the same as historic species records or relict shell collected. Although many threatened, endangered, and rare species have been lost from this basin, unique mussel communities still persist in many locations.

While the streams in the upper section of the basin tend to be less susceptible to disturbance based on past IEPA data, it appears that mussel communities in the middle and lower portions of the basin are capable of supporting biologically important mussel communities. The eight sites sampled that are considered Highly Valued or Unique Mussel Resources were all located in the middle to lower portion of the Little Wabash River basin. In contrast to this, many of the sites with Limited, Restricted, and no mussels found were located in the upper reaches of the basin. Based on this information, it seems that the middle and lower portions of this basin are capable of supporting a diverse freshwater mussel fauna and should be protected from further disturbance.

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Table1. 2010/2011 Little Wabash River Intensive Basin Survey. Types of samples include MU-mussel sampling, BE-boat electrofishing, ES-electric fish seine, SH-fish seine hauls, FF-fish flesh contaminate, H-habitat, M-macroinvertebrate, S-sediment, W-water chemistry, CM-continuous water monitoring, P-pesticides (water organics).

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed Area (km²)
1	C-24	Little Wabash River	MU,ES,H,M,S,W	Coles	1 mile south of Lake Paradise Dam	53.43
2	CT-01	W. Branch Little Wabash	MU	Shelby	5 miles west of Neoga	168.51
3	CSB-07	E. Branch Green Creek	MU,ES,H,M,S,W	Effingham	1.8 miles south of Sigel	28.07
4	C-21	Little Wabash River	MU,BE,SH,FF,H,M,S,W	Effingham	Rt 40 southwest of Effingham	619.80
5	C-12	Little Wabash River	MU,BE,FF,H,M,S,W	Effingham	Rt 37; 3 miles northeast of Mason	960.44
6	CPD-01	Second Salt Creek	MU,ES,H,M,W	Effingham	1.25 mile north of Teutopolis	25.72
7	COC-09	Dieterich Creek	MU	Effingham	2000 E Rd; southwest of Dieterich	28.67
8	C-42	Little Wabash River	MU	Clay	1850 N, 3.2 miles southwest of Hord	1585.22
9	C-05	Little Wabash River	MU	Clay	Water tower in Louisville	1914.35
10	C-43	Little Wabash River	MU	Clay	1300 E; 5.9 miles southeast of Louisville	1968.72
11	CJAE-01	Big Muddy Diversion Ditch	MU,ES,H,M,S,W	Clay	0.5 miles north of Rt. 50	22.38
12	CJ-08	Big Muddy Creek	MU	Clay	2025 E; northeast of Sailor Springs	386.66
13	CJ-04	Big Muddy Creek	MU,BE,H,M,S,W	Clay	Rt. 50; 3 miles east of Clay City	595.47
14	CHEA-02	Big Creek	MU,ES,H,M,S,W	Richland	Sunnybrook Rd; 2 miles southwest of Olney	48.05
15	CH-11	Fox River	MU,BE,SH,FF,M	Richland	Ford; 6 miles south, 3 miles west of Olney	438.51
16	CG-02	Sugar Creek	MU,ES,H,M,S,W	Richland	Ford; 1.5 miles southeast of Seminary	36.17
17	CE-02	Village Creek	MU,ES,H,M,S,W	Wayne	1100 N; 4miles northeast of Golden Gate	78.89
18	CD-09	Elm River	MU,ES,H,M,S,W	Wayne	2200 N; 3.7 miles northwest of Enterprise	319.00
19	CDB-01	Deer Creek	MU,ES,H,M,S,W	Wayne	1750 E; 3.8 miles northeast of Geff	54.45
20	CD-01	Elm River	MU,S,W,P	Wayne	6 miles northeast of Fairfield	648.61
21	CA-09	Skillet Fork	MU,ES,H,M,W	Marion	2 miles east of Forbes Fish Hatchery	97.29
22	CA-08	Skillet Fork	MU,BE,H,M,W	Marion	Ford; 2.5 miles southeast of Iuka	402.78
23	CA-06	Skillet Fork	MU,H,M,W	Marion	7.5 miles southeast of Iuka	536.32
24	CAR-01	Brush Creek	MU,ES,H,M,W	Wayne	1500 N; Bridge 3.3 miles northwest of Crisp	136.08
25	CA-07	Skillet Fork	MU,BE,H,M,W	Wayne	Ford; 2 miles west of Crisp	848.80
26	CAN-02	Horse Creek	MU,ES,H,M,W	Jefferson	2050 N; 2.2 miles northeast of Harmony	98.12
27	CANB-	Puncheon Creek	MU	Wayne	2400 E; Jefferson Wayne County Line	37.83
28	CAK-01	Four Mile Creek	MU,ES,H,M,W	Wayne	450 N; 1.6 miles southwest of Keenes	75.45
29	CAJ-02	Dry Fork	MU,ES,H,M,W	Wayne	1100 E; 2.1 miles east of Sims	148.59
30	CAGC-02	Auxier Creek	MU,ES,H,M,W	Jefferson	2350 E; 1.5 miles northeast of Belle Rive	79.31
31	CA-02	Skillet Fork	MU,BE,H,M,W	White	475 E; 4 miles east/southeast of Springerton	2533.44
32	C-02	Little Wabash River	MU,BE,FF, M	White	North of Carmi Water Intake	7899.37
33	C-01	Little Wabash River	MU,BE,FF,H,M,S,W	White	Rt 141; New Haven	8147.28

Table 2. Mussel data for sites sampled during 2010/2011 surveys (Table 1). Numbers in columns are live individuals collected; "D" and "R" indicates that only dead or relict shells were collected. Shaded boxes indicate historic collections at the specific site location obtained from the INHS Mollusk Collection records. Species in bold are federally or state-listed species or species in Greatest Need of Conservation by IL DNR. Proportion of total is number of individuals of a species divided by total number of individuals at all sites. Extant species is live + dead shell and total species is live + dead + relict shell. NDA represents no historical data available. MCI scores and Resource Classification are based on values in Tables 3 and 4 (R= Restricted, L= Limited, M= Moderate, HV= Highly Valued, and U= Unique). *includes *Alasmidonta viridis*, *Anodonta suborbiculata*, *Lasmigona compressa*, *Lasmigona costata*, *Strophitus undulatus*, *Cyclonaias tuberculata*, *Pleurobema plenum*, *Quadrula metanevra*, *Ellipsaria lineolata*, *Obovaria subrotunda*, *Ptychobranchus fasciolaris* which are not represented in the table.

	1	2	4	5	6	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Proportion of Total
Anodontinae																															
Anodontoides ferussacianus	R	R	R							2	R												1								0.1%
Arcidens confragosus								1					1		R							5						1			0.3%
Lasmigona complanata			R	D		2	8	4	D	1			4		2		2		6		R	9				R		12	4	3	2.4%
Pyganodon grandis	9		D				2	R	R	41		D	4	3	6		6	R	29	2	7	25		R	D	1	D		1	R	5.8%
Utterbackia imbecillis							1						D	D					8							R	1		164		7.5%
Ambleminae																															
Amblema plicata						8	2	12	1	14									10		5	118							9	19	8.5%
Elliptio crassidens																														R	0.0%
Elliptio dilatata						1																									0.0%
Fusconaia ebena																															0.0%
Fusconaia flava						1				R									1		2	11		R							0.6%
Megalonaias nervosa						13	19	16																				8	2	1	2.5%
Pleurobema cordatum														R																	0.0%
Pleurobema rubrum																															0.0%
Pleurobema sintoxia						1		1		R																					0.1%
Quadrula nodulata																												8		R	0.3%
Quadrula pustulosa						10	D	4														20								1	1.5%
Quadrula quadrula			D	7		176	4	81	3	138				2	R				2		1	56						23	21	34	23.5%
Tritogonia verrucosa						205	12	247		3							1				3	45							1	3	22.3%
Uniomerus tetralasmus		R										R		R				R			1		2		R		2				0.2%
Lampsilinae																															
Actinonaias ligamentina																															0.0%
Epioblasma triquetra																															0.0%
Lampsilis cardium	R	R		1		8	1	3	2	1									1		D	13									1.3%
Lampsilis siliquoidea									D	R					6				32	1	15	5	R	6							2.8%
Lampsilis teres						R		R	1	R			D		R		6		5	5	1	10						5	21	2	2.4%
Leptodea fragilis				R		9	3	4	2	2					1		4		6	1		14						14	14	0	3.2%
Ligumia subrostrata					R							D		R	1		D	14	11	1	6		R			R	10				1.8%
Obliquaria reflexa						2		6																					1	2	0.5%
Potamilus alatus							D																						1	1	0.1%
Potamilus capax																														D	0.0%
Potamilus ohiensis			R	1				D					1															11	6		0.8%
Toxolasma lividum																															0.0%
Toxolasma parvum		R				R	4							1	4	1		11	8		2	2	2		4	2	4	19	6		3.0%
Toxolasma texasiensis										2		7		4	1		D	23	22	1	5	9	6	1	1	R	11		5		4.2%
Truncilla donaciformis								9																							0.4%
Truncilla truncata						23	3	29	R	R												25						1	2	0	3.6%
Villosa lienosa																			R		D	D									0.0%
																															Total
Individuals	9	0	0	9	0	460	59	417	9	204	0	7	10	10	21	1	19	48	141	11	48	367	11	7	5	3	28	102	258	66	2330
Live Species	1	0	0	3	0	13	11	13	5	9	0	1	4	4	7	1	5	3	13	6	11	15	3	2	2	2	5	10	15	9	27
Extant Species	1	0	2	4	0	13	13	14	7	9	0	3	6	5	7	1	9	3	13	6	13	16	3	2	3	2	6	10	15	12	29
Total Species	3	4	5	5	1	15	13	16	9	14	1	4	6	8	10	1	9	5	14	6	14	17	5	4	4	7	6	10	15	15	31
Historical Species	NDA	NDA	5	6	NDA	12	2	18	NDA	10	NDA	NDA	NDA	NDA	6	NDA	7	NDA	13	NDA	5	18	NDA	8	NDA	NDA	NDA	NDA	26	8	47*
Catch per unit effort (CPUE)	2.26	0.00	0.00	2.25	0.00	114.43	14.75	103.73	2.00	51.00	0.00	1.75	2.50	2.50	5.25	0.25	4.75	11.82	34.73	2.71	12.00	91.75	2.75	1.72	1.23	0.74	6.90	25.50	64.50	16.50	
Mussel Community Index (MCI)	6	0	0	7	0	19	12	15	7	10	0	6	7	7	10	4	10	10	14	7	14	18	10	9	9	7	7	13	15	10	
Resource Classification	L	R	R	L	R	U	HV	HV	L	M	R	L	L	L	M	R	M	M	HV	L	HV	U	M	M	M	L	L	HV	HV	M	

Table 3. Mussel Community Index (MCI) parameters and scores.

Extant species in sample	Species Richness		Catch per Unit Effort (CPUE)	Abundance (AB) Factor
0	1		0	0
1-3	2		1-10	2
4-6	3		>10-30	3
7-9	4		>30-60	4
10+	5		>60	5
% live species with recent recruitment	Reproduction Factor		# of Intolerant species	Intolerant species Factor
0	1		0	1
1-30	3		1	3
>30-50	4		2+	5
>50	5			

Table 4. Freshwater mussel resource categories based on species richness, abundance, and population structure. MCI = Mussel Community Index Score

Unique Resource MCI ≥ 16	Very high species richness (10 + species) &/or abundance (CPUE > 80); intolerant species typically present; recruitment noted for most species
Highly Valued Resource MCI = 12- 15	High species richness (7-9 species) &/or abundance (CPUE 51-80); intolerant species likely present; recruitment noted for several species
Moderate Resource MCI = 8 - 11	Moderate species richness (4-6 species) &/or abundance (CPUE 11-50) typical for stream of given location and order; intolerant species likely not present; recruitment noted for a few species
Limited Resource MCI = 5 - 7	Low species richness (1-3 species) &/or abundance (CPUE 1-10); lack of intolerant species; no evidence of recent recruitment (all individuals old or large for the species)
Restricted Resource MCI = 0 - 4	No live mussels present; only weathered dead, sub-fossil, or no shell material found

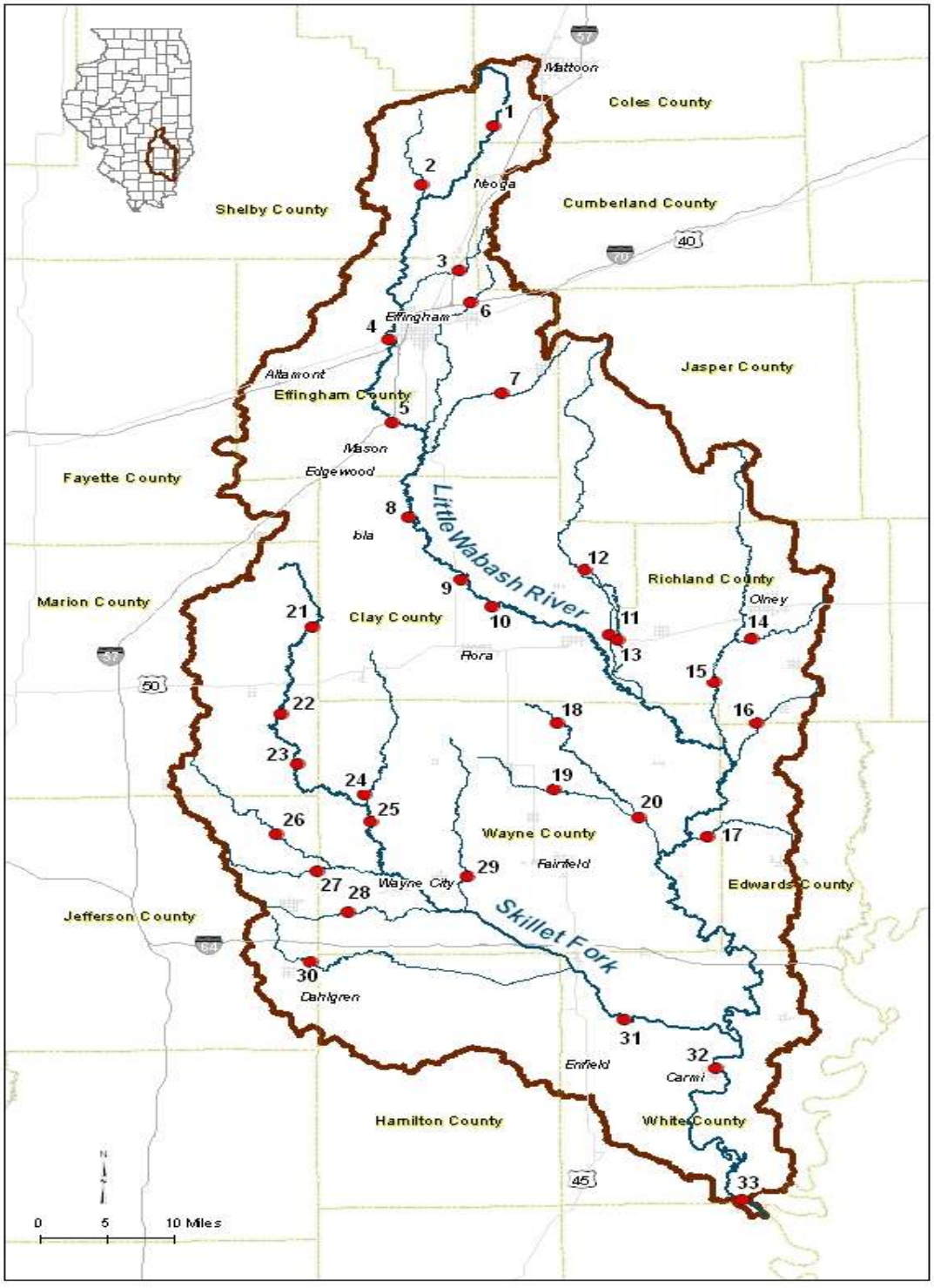

Figure 1. Sites sampled in the Little Wabash River basin during 2010 and 2011. Site codes referenced in Table 1.

Figure 2. Upstream portion of Fox River, site 15, woody debris, trees abundant throughout stream

Figure 3. Upstream portion of Village Creek, site 17, downcutting of banks and exposed tree roots

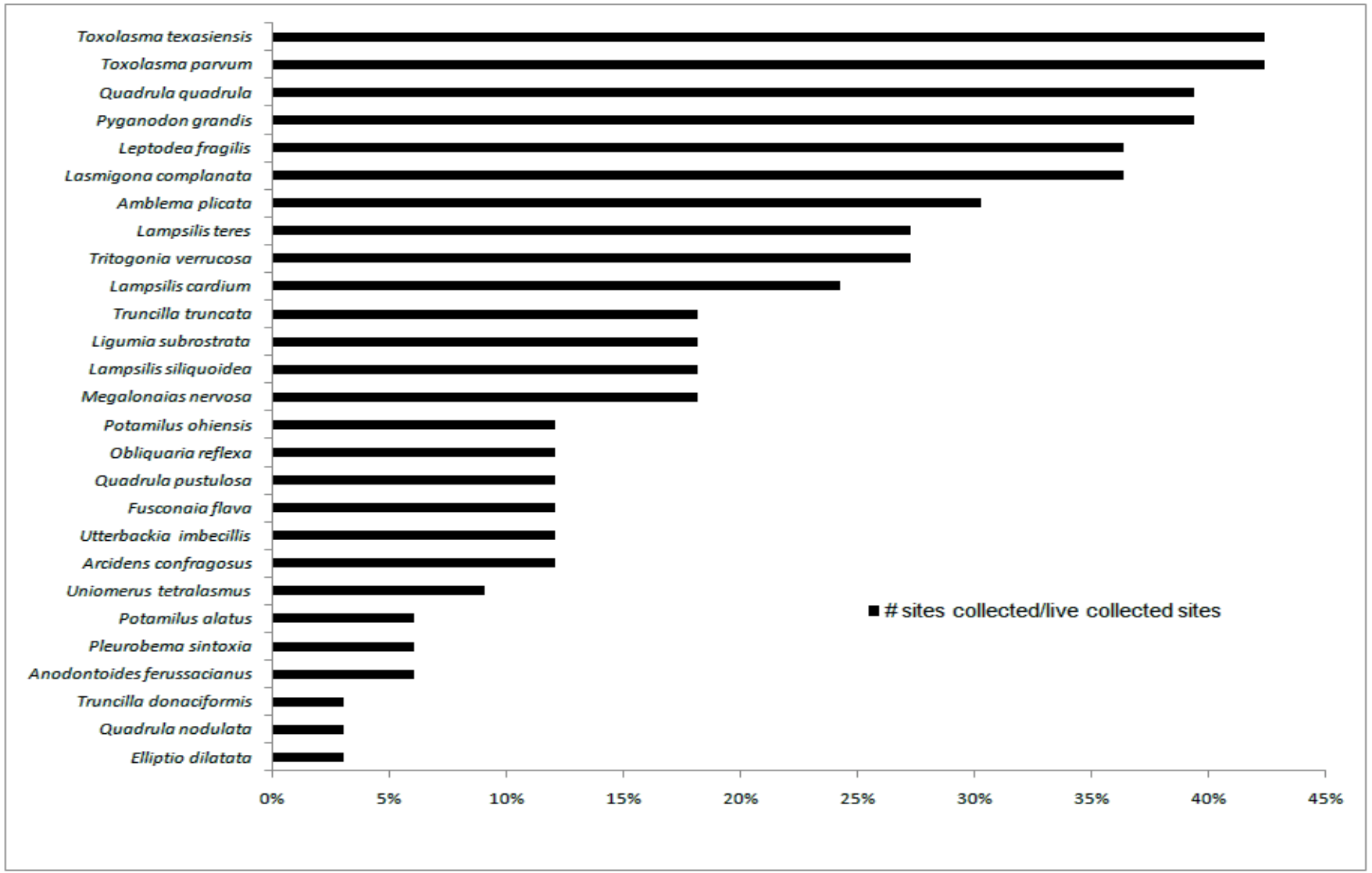

Figure 4. Number of sites where a species was collected live compared to the number of sites sampled (33 total sites).

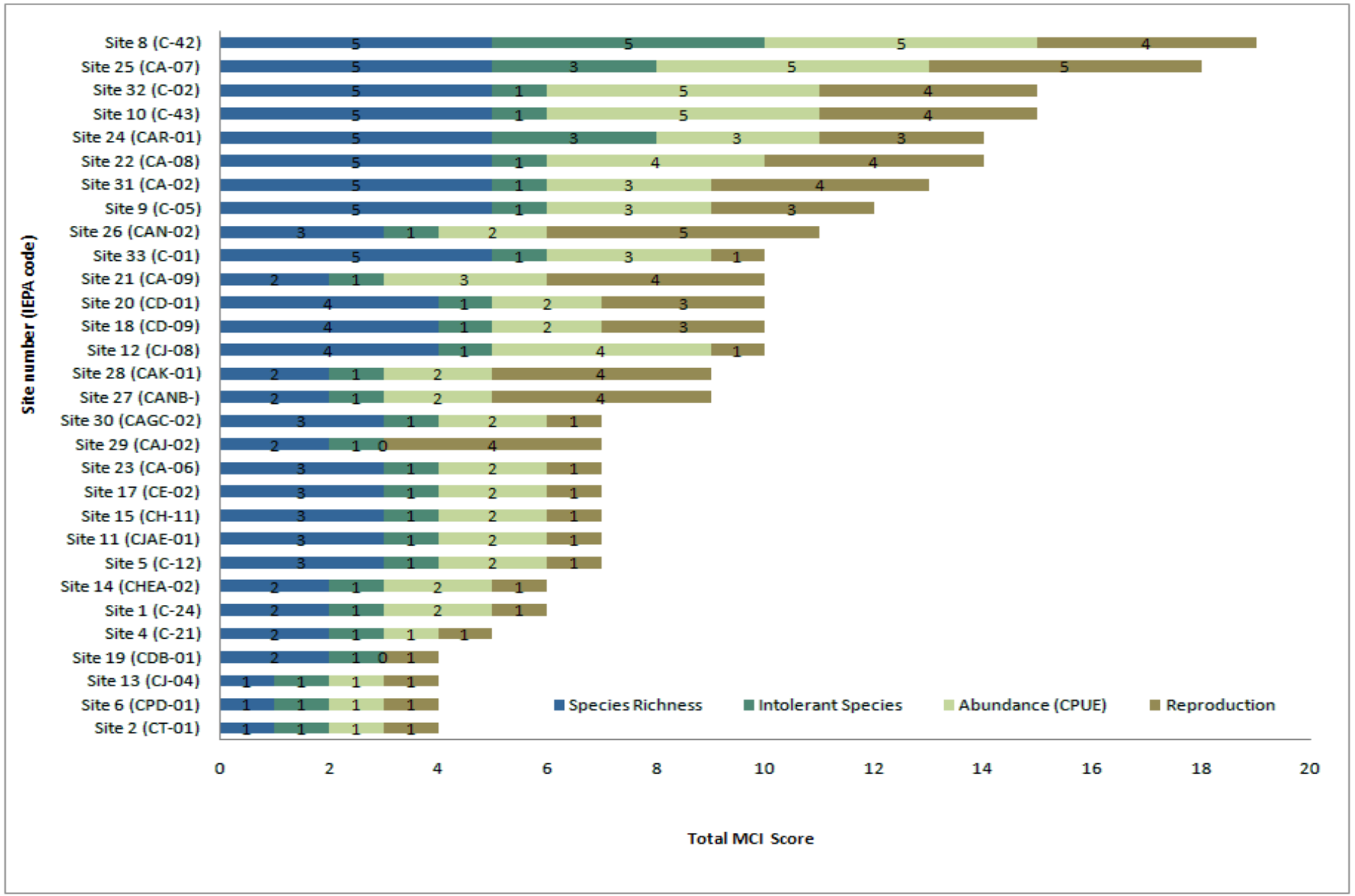

Figure 5. Comparison of Mussel Community Index (MCI) and MCI component scores for Little Wabash River basin sites based on factor values from Table 3.

Figure 6. Live mussel species (0-3 years) in the Little Wabash River mainstem, varying age classes of *Amblema plicata* collected in Skillet Fork mainstem.

Figure 7. Live mussel species (0-3 years) collected in the Skillet Fork mainstem.

Appendix 1. Scientific and common names of species. Status (in 2012): FE- federally endangered, SE- state-endangered, ST-state threatened, SGNC-Illinois' species in greatest need of conservation, X-extirpated.

Scientific name	Common name	Status
Subfamily Anodontinae		
Alasmidonta marginata	elktoe	
Alasmidonta viridis	slippershell mussel	ST
Anodonta suborbiculata	flat floater	
Anodontoides ferussacianus	cylindrical papershell	
Lasmigona complanata	white heelsplitter	
Lasmigona compressa	creek heelsplitter	SGNC
Lasmigona costata	flutedshell	SGNC
Pyganodon grandis	giant floater	
Simpsonaias ambigua	salamander mussel	SE
Strophitus undulatus	creeper	
Utterbackia imbecillis	paper pondshell	
Subfamily Ambleminae		
Amblema plicata	threeridge	
Elliptio dilatata	spike	ST
Fusconaia ebena	ebonyshell	ST
Fusconaia flava	Wabash pigtoe	
Megalonaias nervosa	washboard	
Plethobasus cyphyus	sheepnose	FE
Pleurobema clava	clubshell	FE
Pleurobema rubrum	pyramid pigtoe	X
Pleurobema sintoxia	round pigtoe	
Quadrula cylindrica	rabbitsfoot	SE
Quadrula metanevra	monkeyface	SGNC
Quadrula nodulata	wartyback	
Quadrula pustulosa	pimpleback	
Quadrula quadrula	mapleleaf	
Tritogonia verrucosa	pistolgrip	
Uniomerus tetralasmus	pondhorn	
Subfamily Lampsilinae		
Actinonaias ligamentina	mucket	
Cyprogenia stegaria	fanshell	FE
Ellipsaria lineolata	butterfly	ST
Epioblasma triquetra	snuffbox	FE
Lampsilis cardium	plain pocketbook	
Lampsilis siliquoidea	fatmucket	
Lampsilis teres	yellow sandshell	
Leptodea fragilis	fragile papershell	
Ligumia recta	black sandshell	ST
Ligumia subrostrata	pondmussel	
Obliquaria reflexa	threehorn wartyback	
Obovaria subrotunda	round hickorynut	SE
Potamilus alatus	pink heelsplitter	
Potamilus ohiensis	pink papershell	
Ptychobranchus fasciolaris	kidneyshell	SE
Toxolasma lividum	purple lilliput	SE
Toxolasma parvum	lilliput	
Toxolasma texasiensis	Texas lilliput	
Truncilla donaciformis	fawnsfoot	
Truncilla truncata	deertoe	
Villosa lienosa	little spectaclecase	ST