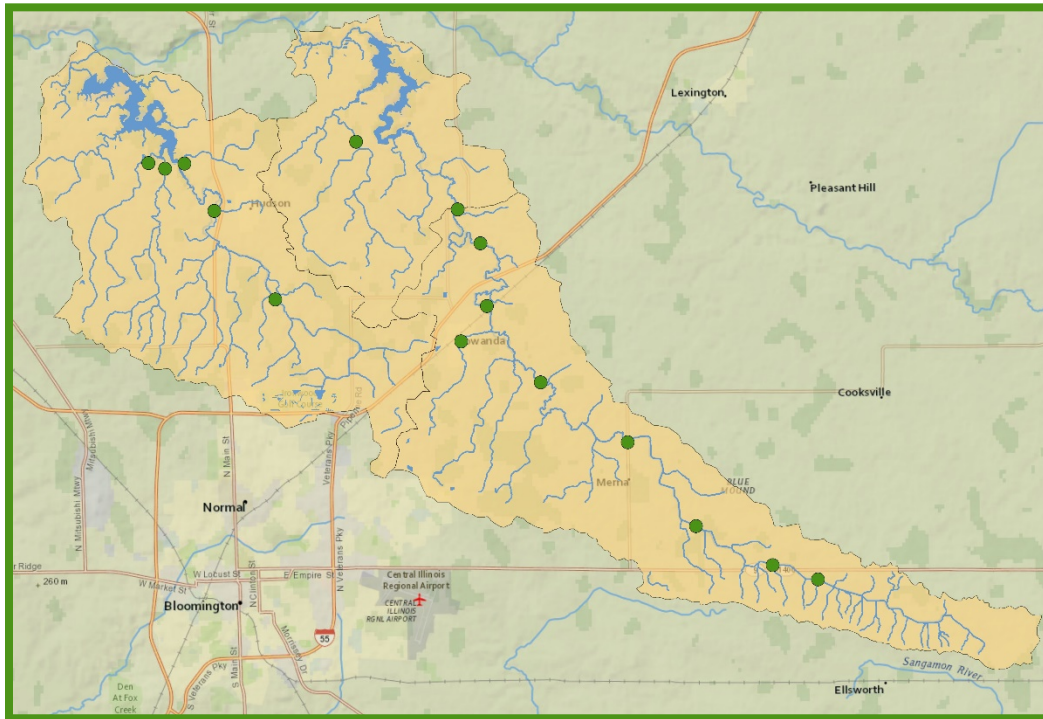




**ILLINOIS NATURAL
HISTORY SURVEY**
PRAIRIE RESEARCH INSTITUTE

Freshwater Mussels of Money and Six Mile Creeks, McLean County, Illinois



INHS Technical Report 2017 (33)

Prepared for The Nature Conservancy

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Preface

For the past six years, The Lake Bloomington Partnership Project has focused on wetland construction and nitrogen management conservation practices to improve local drinking water quality, environmental protection, and agricultural sustainability in two drinking water supply watersheds of the Mackinaw River, near Bloomington, Illinois (Money Creek and Six Mile Creek). In 2017, a project funded by The Nature Conservancy was completed to establish a baseline for interpreting the impact of water quality modifications on freshwater mussels in these drainages. These surveys will provide comprehensive results for the entire watershed for Six Mile and Money creeks.

Suggested Citation

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Introduction

Freshwater mussels are important biological indicators of stream quality and environmental degradation, due to their sensitivity to water pollutants and substrate instability (Van Hassel and Farris 2007). Their sensitivity to agricultural discharge and nonpoint source pollution is of particular relevance to the Mackinaw River system (Augspurger et al. 2003). Over 90% of the land use surrounding the Mackinaw River is agriculture and the use of subsurface tiling is extensive. Additionally, siltation caused by poor land use and agricultural pollution have been major issues in the watershed (Page et al. 1991). The Mackinaw River has been surveyed previously for freshwater mussels, though few surveys have been conducted in two of its tributaries, Money and Six Mile creeks. This report summarizes the mollusk surveys conducted in the Money and Six Mile creek watersheds in 2017 in partnership with the Nature Conservancy.

Money Creek originates northeast of Ellsworth, Illinois and flows southeast to northwest to its confluence with the Mackinaw River. The towns of Merna and Towanda lie within the Money Creek watershed, and Lake Bloomington impounds the lower portion of the Money Creek watershed. Six Mile Creek originates southwest of Towanda, Illinois and flows southeast to northwest. The town of Hudson lies within the Six Mile Creek watershed, and Evergreen Lake impounds the lower portion of the Six Mile Creek watershed. Lake Bloomington and Evergreen Lake supply water to the city of Bloomington, Illinois (Figure 1). The Money and Six Mile Creek watersheds lie within the Grand Prairie Natural Division and were historically occupied by tall-grass prairie (Schwegman 1973). Present cover is predominately cropland (Page et al. 1991).

The substrates in the upper reaches of the Money Creek watershed are dominated by silt and consolidated sand, with some areas of clay and gravel. The lower reaches are predominantly sand, fine gravel and cobble, with silted banks. The riparian habitat is variable, including areas of row crop agriculture to the bank edge, pasture, and forest (Figures 2 & 3). Substrates in the Six Mile Creek watershed are predominantly silt and fine gravel, with some areas of clay and sand. Undercut banks are prevalent. Restoration work completed in the lower section of the watershed, near Comlara Park, included adding cobble and artificial riffles to the system. The stream banks are largely cultivated cropland to the bank edge with some forested areas (Figures 4 & 5).

Fourteen species of mussels have been recorded from the Money Creek watershed, and six species of mussels have been recorded from the Six Mile Creek watershed. Between 1987 and 2013, Money Creek was surveyed for freshwater mussels at three locations: the Co. Rd. 1975E bridge, the Old Route 66 bridge, and the Co. Rd. 1750N bridge (INHS Mollusk Collection data 2017). Twelve species were recorded live during those surveys, including the state threatened Slippershell (*Alasmodonta viridis*). Two additional species were recorded as relict shell. Six Mile Creek was surveyed for freshwater mussels in 2005 and 2010, at Co. Rd. 2000N bridge, and is the only previous survey location on the creek upstream of Evergreen Lake. Four species were recorded live and shells of two

additional species were encountered during those surveys. Prior to our surveys, no tributaries had been surveyed for mussels in either watershed.

Methods

Live mollusks and shells were collected at 15 sample sites: ten sites in the Money Creek watershed and 5 sites in the Six Mile Creek watershed (Figure 1) from August to October 2017. Specific locality and site number can be found in Table 1, and each site is referenced in text with a prefix of M for Money Creek and SM for Six Mile Creek.

Live mussels and snails were surveyed by hand grabbing and visual detection (e.g., trails, siphons, exposed shell). Banks and gravel bars were visually surveyed for the presence of fresh dead and relict shells. All surveys were conducted by INHS personnel Alison Stodola, Rachel Vinsel, and one field technician. Mussels were held in mesh bags in the stream prior to processing. Efforts were made to cover all available habitat types present at a site including riffles, pools, slack water, and areas of differing substrates.

Following the search, all live mussels and snails were identified to species and recorded (Tables 2, 3, & 4). For each live mussel, shell length (mm), gender, and an estimate of the number of external growth rings were recorded. Shell material was classified as fresh 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.

Voucher specimens were collected and curated in the Illinois Natural History Survey Mollusk Collection, at the University of Illinois and dead shells were vouchered if possible. All non-vouchered live mussels were returned to the stream reach where they were collected.

Nomenclature used for freshwater mussels discussed in this report follows Williams et al. (2017) (Appendix 1). The current statuses of threatened and endangered species of freshwater mollusks discussed in this report are taken from the Illinois Endangered Species Protection Board (IESPB 2015). Nomenclature for freshwater snails discussed in this report follows Johnson et al. (2013).

Mussel Community Index (MCI) score was calculated for each site using extant species richness, presence of intolerant species (Slippershell Mussel and Ellipse), individuals collected by sample time (expressed as catch-per-unit-effort [CPUE]; Tables 2 & 3), and recruitment. An individual with three or fewer observed external growth rings was classified as juvenile. Calculation of the MCI followed criteria outlined in Table 5 (Szafoni 2001).

Results

Money Creek Watershed

A total of 13 native species of freshwater mussels, one invasive bivalve species, and four families of freshwater gastropods were recorded in the Money Creek watershed (Table 2 & 4). Two hundred and ninety live mussels representing ten species were found alive. Across all sites, the number of live mussel species collected ranged from 0 to 7, the number of extant species (live+dead) ranged from 0 to 8, and total number of species collected (live+dead+relict) ranged from 0 to 12. The most commonly encountered species, and the only species found in the tributaries, was the Cylindrical Papershell (*Anodontooides ferussacinaus*), with collections at six sites (60%, Table 2; Figure 7).

The number of live individuals collected in the mainstem Money Creek sites ranged from 1 to 120 and from 0 to 2 in the tributaries. The most abundant species across all sites was the Wabash Pigtoe (*Fusconaia flava*), which comprised of 55% of all mussels collected in the watershed (Table 2). While more rigorous survey methods are required to accurately assess population reproduction, evidence of recruitment (individuals with 3 or fewer growth rings) was observed at six sites (60%, Table 2).

The Illinois threatened Slippershell Mussel was the only species encountered that is listed at the state or federal level, and Slippershell were found live at M5 and M8 and relict at M7 (Figure 8). One species designated in Illinois as a Species in Greatest Need of Conservation (SGNC; Illinois Department of Natural Resources [IDNR] 2005), Ellipse (*Venustaconcha ellipsiformis*), was recorded live in the watershed and ranked second in abundance for the entire watershed. Relict shells of SGNC Creek Heelsplitter (*Lasmigona compressa*) were also collected at one site. The other species encountered are common inhabitants of Illinois streams (Cummings and Mayer 1997; Tiemann et al. 2007). Two species with museum records from Money Creek were not encountered at all during our surveys. Live Paper Pondshell (*Utterbackia imbecillis*) and relict Pink Papershell (*Potamilus ohioensis*) were collected at M7 in 2013 and 2011, respectively (INHS Collections Database, accessed October 2017). They remain the only records of those species in the watershed.

Asian Clams (*Corbicula fluminea*), an invasive species, were recorded at half of the mainstem Money Creek sites (Table 4). Live Fingernail Clams (*Sphaerium sp.*) were encountered at all but one of the mainstem Money Creek sites. Little is known about the status of Fingernail Clams in Illinois or North America but some populations have declined where they were previously abundant (Cummings and Mayer 1992). Additionally, four families of freshwater gastropods were encountered in the Money Creek watershed (Table 4). The most commonly encountered snails were Bladder Snails (*Physella sp.*). Bladder Snails are among the most widespread freshwater gastropods found in North America and may be the most resistant to water pollution (Burch 1982).

Six Mile Creek Watershed

Twenty-three individuals representing ten species of freshwater mussels were observed in the Six Mile Creek watershed. Five species were found alive, the remainder were represented only by shell material. Across all sites, the number of live species collected ranged from 0 to 3, the number of extant species ranged 0 to 5, and the total number of species ranged from 0 to 9. The most commonly encountered mussel species were Giant Floater (*Pyganodon grandis*) and Pondhorn (*Uniomerus tetralasmus*), both of which were found at two sites (40%, Table 3; Figure 9).

The number of live individuals collected in the mainstem Six Mile Creek sites ranged from 4 to 17 and the number recorded in the Six Mile tributaries ranged from 0 to 1. The most abundant species across all sites was Threeridge (*Amblema plicata*), representing 48% of all live individuals in the Six Mile watershed (Table 3). Evidence of recruitment was observed at one site, SM3.

All mussel species recorded in the Six Mile Creek surveys are common inhabitants of Illinois streams (Cummings and Mayer 1997; Tiemann et al. 2007). One species with a museum record was not recorded during our surveys. Relict shell of Yellow Sandshell (*Lampsilis teres*) was found in 1998 downstream of Evergreen Lake.

Live Asian Clams were encountered at both mainstem Six Mile Creek sites but none of the tributaries. Two families of freshwater gastropods were recorded during our Six Mile surveys, including Bladder Snails, which were collected at every site (Table 4).

Discussion

Across both watersheds, we collected 12 live species of freshwater mussels and 15 total species. In the Money Creek watershed we added a new species record for Creek Heelsplitter (*Lasmigona compressa*), which was found as relict shell at M7. Our surveys also added records for Asian Clams and four species of snails that had never been recorded in the watershed: Golden Fossaria (*Galba obrussa*), Pygmy Fossaria (*Galba parva*), Creeping Ancyloid (*Ferrissia rivularis*), and Two-ridge Ramshorn (*Helisoma anceps*). In the Six Mile Creek watershed we added a new species record for Cylindrical Papershell, which was found as relict shell at SM2. Additionally, our surveys included new records for Marsh Ramshorn (*Planorbella trivolvis*) and Bladder Snails. We did document new drainage records, though all species encountered are common inhabitants of central Illinois streams and had previously been recorded in the Mackinaw River drainage.

Summer and autumn seasons of 2017 were marked by lower than average rainfalls. Several sites, most notably M4, contained large stretches (>20 m long) of dried stream bed, shallow waters, and low to no flow. Page (1991) while discussing the Mackinaw River system wrote “the Mackinaw River is one of the most variable in the state in the

quantity of water it carries; it floods in the wet seasons and is nearly dry during periods of drought". While most species of freshwater mussels prefer sustained water flow and stable substrates (Haag 2012), live mussels were encountered at all but two tributary sites (Tables 2 & 3). In general, species richness and MCI score increased with watershed size, and the most diverse site sampled during this survey was M7. Sites with larger watersheds may be less likely to dry out during drought periods and also typically have more diverse host fish assemblages.

The Mussel Community Index (MCI) calculations broadly summarize species richness and abundance, presence of sensitive species, and presence of reproduction (Table 5; Figure 6). MCI scores from these surveys were greatest at sites M8, M7, and M5, driven primarily by the number of extant species present, the presence of "intolerant species" (Slippershell Mussel and Ellipse), and a relatively large number of individuals collected. The MCI calculations also demonstrated that several sites had reproducing populations of freshwater mussels, which indicates that conditions are favorable for supporting host fish populations at those specific sites. The MCI is a useful tool to summarize site characteristics, but comparison of the total MCI score across sites should be used with caution due to the wide range of values for each component score.

Relatively large populations of Ellipse were recorded at sites 7-9 in Money Creek. Ellipse is an Illinois species in greatest conservation need and is found in small to medium streams throughout the upper Mississippi watershed. It persists in both soft substrates, such as sand, and coarser substrates like cobble or bedrock, and requires flowing water habitat. It metamorphoses from the larval to juvenile stage on host fishes of sculpin and darters, which also prefer flowing water and coarser substrates (Smith 1979; Freshwater Mussel Host Database 2017). Ellipse was documented in similar relative densities at four other sites in the upper Mackinaw River drainage during a basin-wide survey of the Mackinaw River basin, and ~20 Ellipse per site were collected at an unnamed tributary, two sites on the Mackinaw River, and Henline Creek (Price et al. 2011).

Unfortunately, no surveys were conducted in either watershed prior to the construction of Bloomington and Evergreen lakes. Impoundments negatively impact mussel populations through increased siltation upstream of the dam, altering flow regimes, limiting host movement, and isolating populations from potential source populations, such as the Mackinaw River (Tiemann et al. 2016 and references within). Due to the lack of historical records it is unknown if the species compositions observed during our surveys differ from the historic assemblage. Other threats to the existing mollusk populations of Money and Six Mile creeks include detrimental factors attributed to intensive agricultural practices, including loss of habitat due to channelization, sedimentation from eroded fields, eutrophication from fertilizer application, and widespread pesticide use (summarized in Haag 2012).

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Table 1. 2017 survey sites on Money and Six Mile creeks. Types of samples indicate mollusk sampling conducted by the Illinois Natural History Survey (M) and fish sampling conducted by Eastern Illinois University.

Site Number	Watershed	Stream	Common Location	Latitude	Longitude	Type of Samples
M1	Money	Money Creek	3.8 mi NE Holder, Co. Rd. 2700E	40.48362	-88.74535	M
M2	Money	Money Creek	3.3 mi NE Holder, Co. Rd. 2600E	40.48841	-88.76466	M, F
M3	Money	Money Creek	1.8 mi SE Merna, Co. Rd. 1500N	40.50132	-88.79731	M, F
M4	Money	Money Creek	0.8 mi N Merna, Co. Rd. 2300E (Rt. 165)	40.52890	-88.82632	M, F
M5	Money	Money Creek	3 mi NW Merna, Co. Rd. 1800N	40.54862	-88.86341	M, F
M6	Money	trib. Money Creek	Towanda, S. Madison St.	40.56221	-88.89741	M, F
M7	Money	Money Creek	5.1 mi NW Merna, Historic Rt. 66	40.57370	-88.88621	M
M8	Money	Money Creek	2.5 mi N Towanda, Co. Rd. 1975E bridge	40.59416	-88.88884	M, F
M9	Money	Money Creek	7.2 mi NNW Merna, Co. Rd. 2200N	40.60527	-88.89842	M, F
M10	Money	Big Slough	8.3 mi NNE Normal, Co. Rd. 2350N	40.62758	-88.94185	M
SM1	Six Mile	Six Mile Creek	4.4 mi N Normal, Co. Rd. 2000N	40.57630	-88.97700	M, F
SM2	Six Mile	Six Mile Creek	6.3 mi N Normal, Ducati Drive, W of Hudson	40.60529	-89.00294	M, F
SM3	Six Mile	trib. Six Mile Creek	Comlara Park, just upstream Evergreen Lake, E 2300N Rd.	40.62082	-89.01561	M, F
SM4	Six Mile	trib. Six Mile Creek	6.2 mi ENE Carlock, Comlara Park, Pheasant Run Trail	40.61914	-89.02395	M, F
SM5	Six Mile	trib. Six Mile Creek	5.9 mi ENE Carlock, Comlara Park Trail, off Co. Rd. 2300N	40.62106	-89.03109	M, F

Table 2. Mussel data for sites sampled in the Money Creek watershed during our 2017 surveys (Table 1). Numbers in columns are live individuals collected, “D” and “R” indicates that only dead or relict shells were collected. “M” indicates museum records at the specific site location obtained from the INHS Mollusk Collection. Extant species is live + dead shell and total species is live + dead + relict shell. Proportion of total is number of individuals of a species divided by total number of individuals at all sites. MCI scores are based on values in Table 5. Species in bold are state-listed species or species in Greatest Need of Conservation by IL DNR.

Species	Common Name	Money Creek										Proportion of Total
		1	2	3	4	5	6	7	8	9	10	
<i>Alasmidonta viridis</i>	Slippershell Mussel					2		R	1			1.0%
<i>Amblema plicata</i>	Threeridge					1			M			0.3%
<i>Anodontoides ferussacianus</i>	Cylindrical Papershell	1	R	6	1	1		6	D	1		5.5%
<i>Fusconaia flava</i>	Wabash Pigtoe					4		49	105	1		54.8%
<i>Lampsilis siliquoidea</i>	Fatmucket					R		15	4	5		8.3%
<i>Lasmigona complanata</i>	White Heelsplitter							2	M	D		0.7%
<i>Lasmigona compressa</i>	Creek Heelsplitter							R				0.0%
<i>Leptodea fragilis</i>	Fragile Papershell							R	D	D		0.0%
<i>Potamilus ohiensis</i>	Pink Papershell							M				0.0%
<i>Pyganodon grandis</i>	Giant Floater		1		1	5		R	M	R		2.4%
<i>Strophitus undulatus</i>	Creeper							3	D			1.0%
<i>Toxolasma parvum</i>	Lilliput					3		3	M		2	2.8%
<i>Unio merus tetralasmus</i>	Pondhorn							R	D	D		0.0%
<i>Utterbackia imbecillis</i>	Paper Pondshell							M				0.0%
<i>Venusta concha ellipsiformis</i>	Ellipse							42	10	15		23.1%
												Totals
Individuals collected		1	1	6	2	16	0	120	120	22	2	290
Live Species		1	1	1	2	6	0	7	4	4	1	10
Extant Species		1	1	1	2	6	0	7	8	7	1	12
Total Species		1	2	1	2	7	0	12	8	8	1	13
Catch per unit effort (CPUE)		0.5	0.5	3.0	1.0	5.3	0.0	30.0	40.0	5.5	1.0	
Mussel Community Index (MCI)		8	8	6	10	12	0	14	16	10	6	

Table 3. Mussel data for sites sampled in the Six Mile Creek watershed during our 2017 surveys (Table 1). Numbers in columns are live individuals collected, “D” and “R” indicates that only dead or relict shells were collected. “M” indicates museum records at the specific site location obtained from the INHS Mollusk Collection. Extant species is live + dead shell and total species is live + dead + relict shell. Species in bold are 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. MCI scores are based on values in Table 5.

Species	Common Name	Six Mile Creek					Proportion of Total
		1	2	3	4	5	
<i>Amblema plicata</i>	Threeridge		11				47.8%
<i>Anodontoides ferussacianus</i>	Cylindrical Papershell		R				0.0%
<i>Lampsilis cardium</i>	Plain Pocketbook		R				0.0%
<i>Lampsilis siliquoidea</i>	Fatmucket		R				0.0%
<i>Lasmigona complanata</i>	White Heelsplitter	R					0.0%
<i>Lasmigona compressa</i>	Creek Heelsplitter		R				0.0%
<i>Pyganodon grandis</i>	Giant Floater	2	2			R	17.4%
<i>Toxolasma parvum</i>	Lilliput	2	D			D	8.7%
<i>Unio merus tetralasmus</i>	Pondhorn	R	4			1	21.7%
<i>Utterbackia imbecillis</i>	Paper Pondshell	M	D	1			4.3%
							Totals
Individuals collected		4	6	1	0	1	12
Live Species		2	2	1	0	1	5
Extant Species		2	4	1	0	2	5
Total Species		4	8	1	0	3	10
Catch per unit effort (CPUE)		1.3	1.3	1.0	0.0	0.4	
Mussel Community Index (MCI)		6	7	10	0	4	

Table 4. Mollusk data (excluding freshwater mussels) for sites sampled during our 2017 surveys (Table 1). Numbers in columns are live individuals collected, “D” and “R” indicates that only dead or relict shells were collected. Species in bold are invasive in Illinois.

Species	Family	Common Name	Money Creek										Six Mile Creek					
			1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	
<i>Corbicula fluminea</i>	<i>Cyrenidae</i>	Asian Clam					L		L	L	L			L	L			
<i>Sphaerium sp.</i>	<i>Sphaeriidae</i>	Unidentified Fingernail Clam	L	L	L	L	L		L	L								
<i>Galba obrussa</i>	<i>Lymnaeidae</i>	Golden Fossaria				R		R	R									
<i>Galba parva</i>	<i>Lymnaeidae</i>	Pygmy Fossaria				D												
<i>Physella sp.</i>	<i>Physidae</i>	Unidentified Bladder Snail	L	R	L		L	R	L			L		L	L	L	L	L
<i>Ferrissia rivularis</i>	<i>Planorbidae</i>	Creeping Ancyloid									L							
<i>Helisoma anceps</i>	<i>Planorbidae</i>	Two-ridge Ramshorn							R									
<i>Planorbella trivolvis</i>	<i>Planorbidae</i>	Marsh Ramshorn	L	D	L	D	D	D	D						L		L	L
<i>Pleurocera acuta</i>	<i>Pleuroceridae</i>	Sharp Hornsnail									R							
Live Species			3	1	3	1	3	0	3	2	2	1		2	3	1	2	2
Extant Species			3	2	3	3	4	1	4	2	2	1		2	3	1	2	2
Total Species			3	3	3	4	4	3	6	2	3	1		2	3	1	2	2

Table 5. 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		

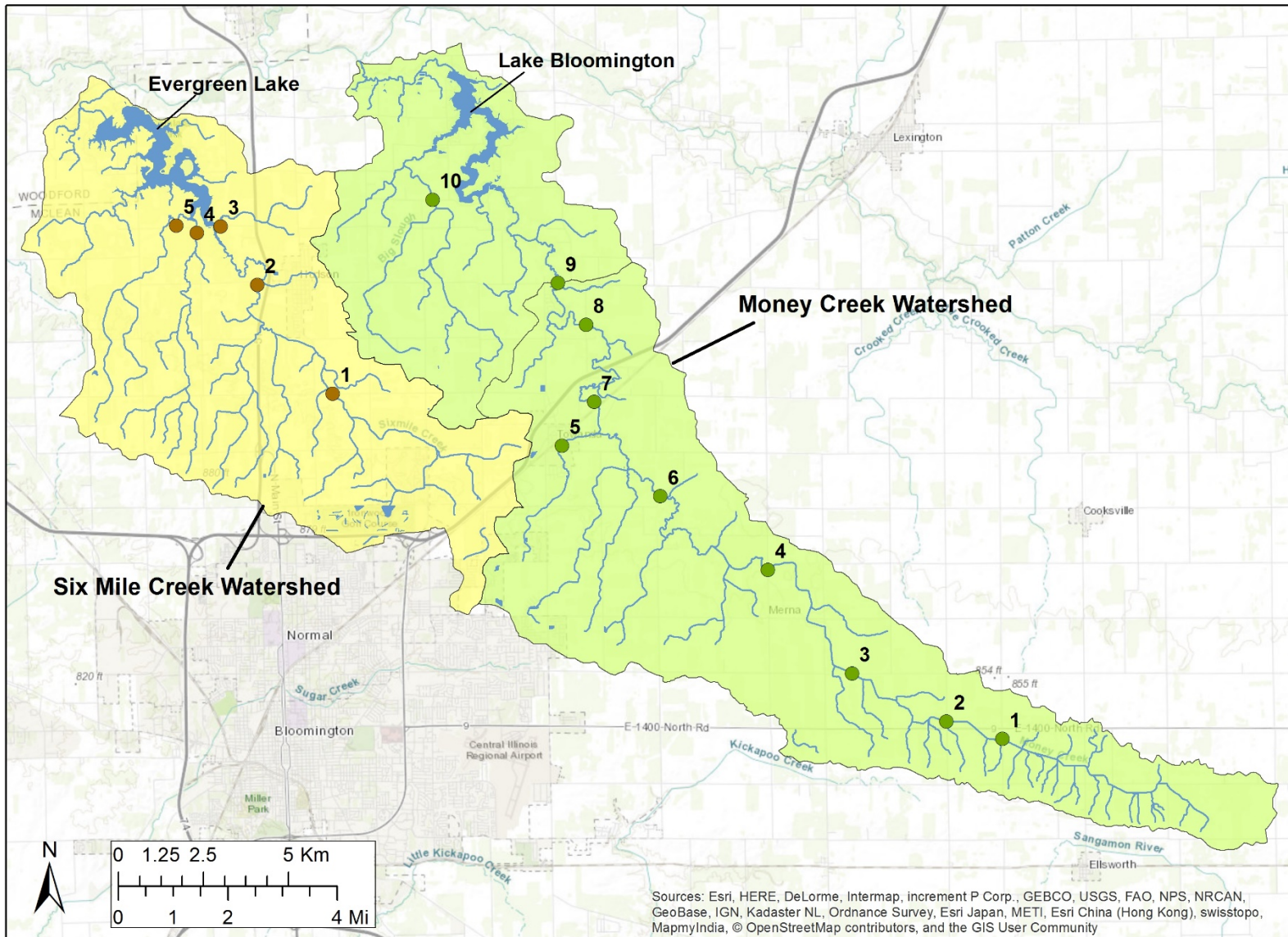


Figure 1. Map of sites sampled for mollusks in Money and Six Mile creek watersheds in August – October 2017.



Figure 2. Money Creek mainstem at Historic Route 66 (M7).



Figure 3. Money Creek mainstem at Co. Rd. 2600E (M2).



Figure 4. Six Mile Creek mainstem at Ducati Drive (SM2).



Figure 5. Tributary to Six Mile Creek at Comlara Park Trail (SM5).

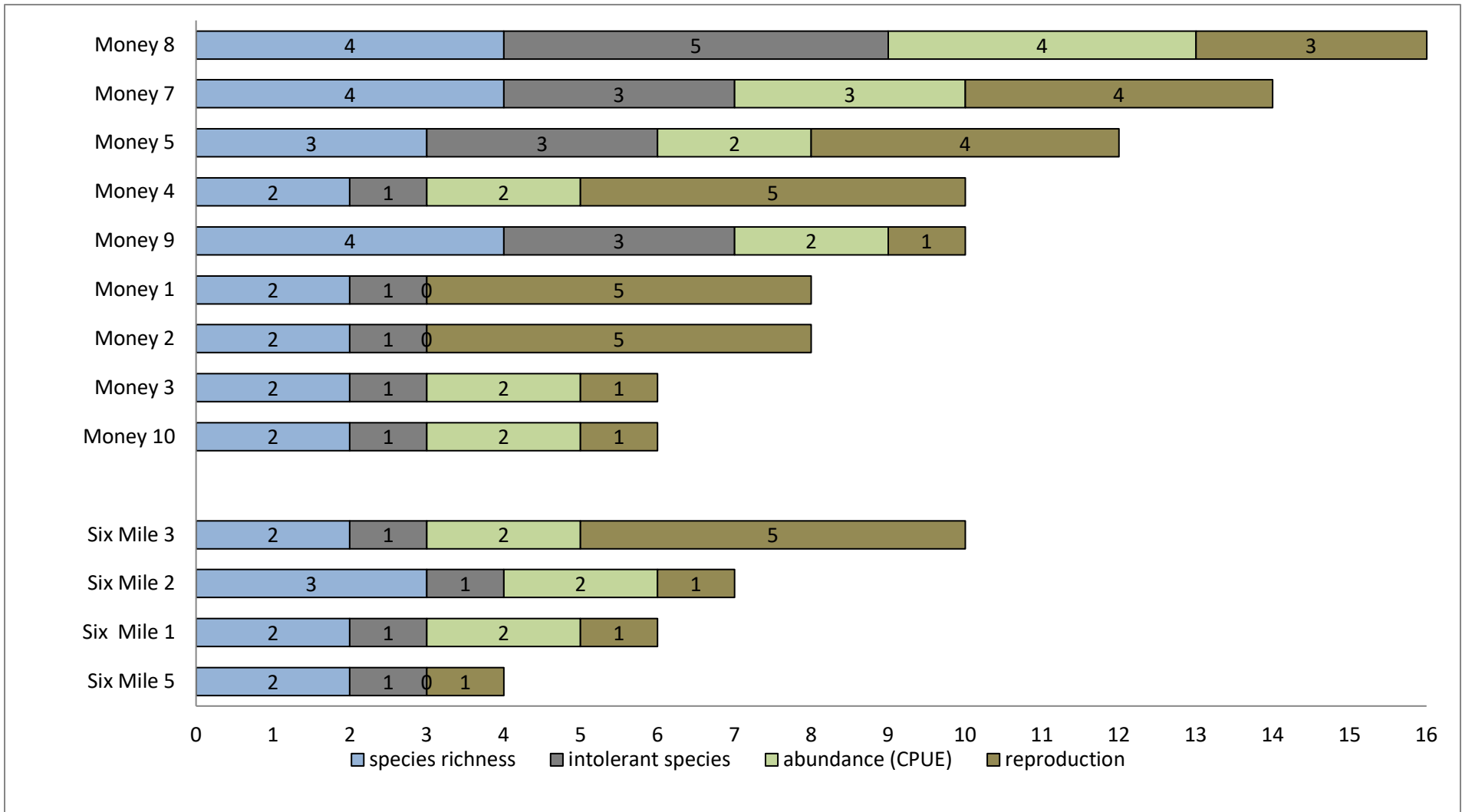


Figure 6. Comparison of Mussel Community Index (MCI) and MCI component scores for Money Creek and Six Mile Creek sites based factor values from Table 5.

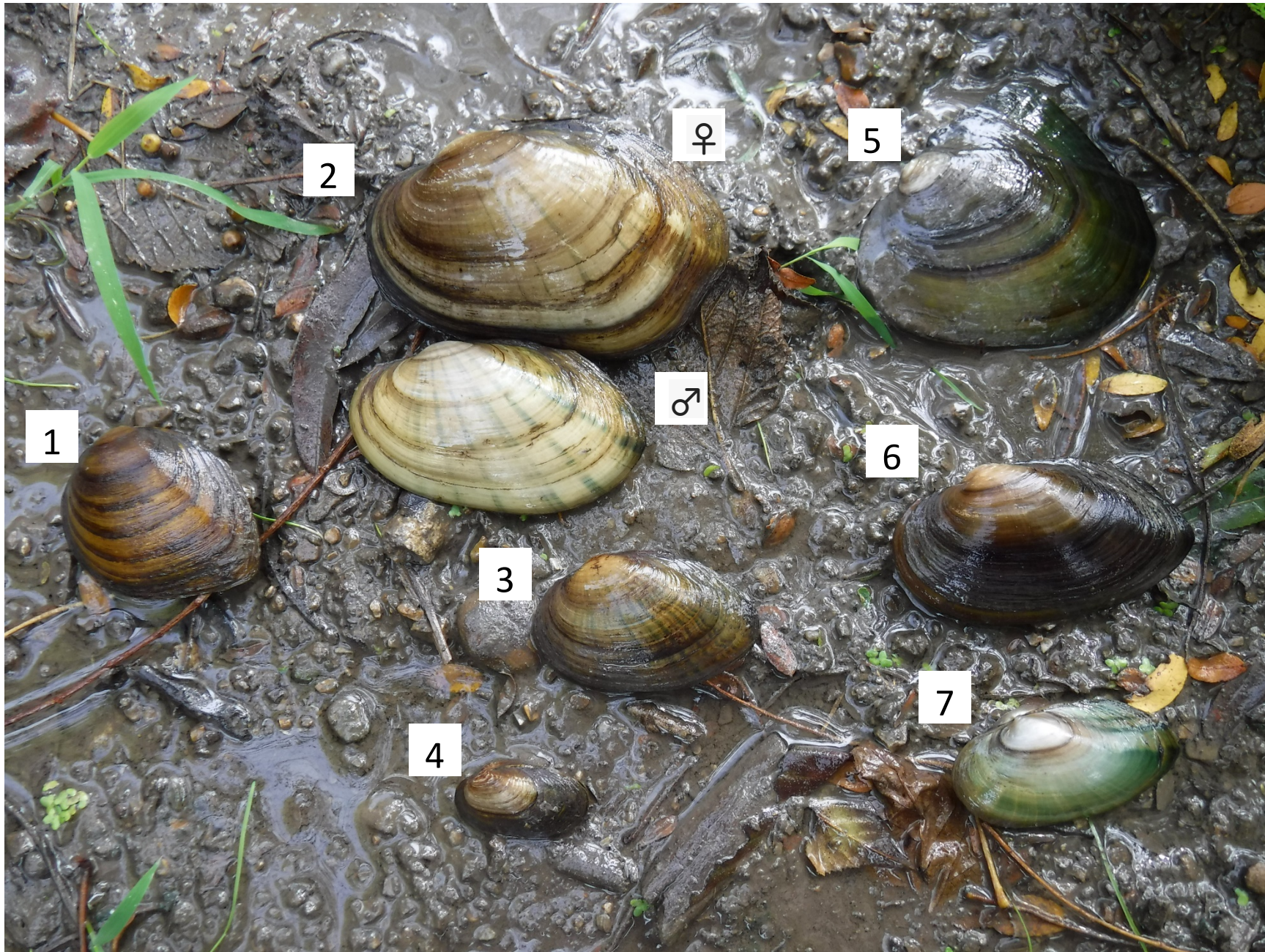


Figure 7. Mussel species encountered at M7: Wabash Pigtoe (1), Fatmucket (2 female and male), Ellipse (3), Lilliput (4), White Heelsplitter (5), Creeper (6), and Cylindrical Papershell (7).



Figure 8. Slippershell Mussel recorded at M8.

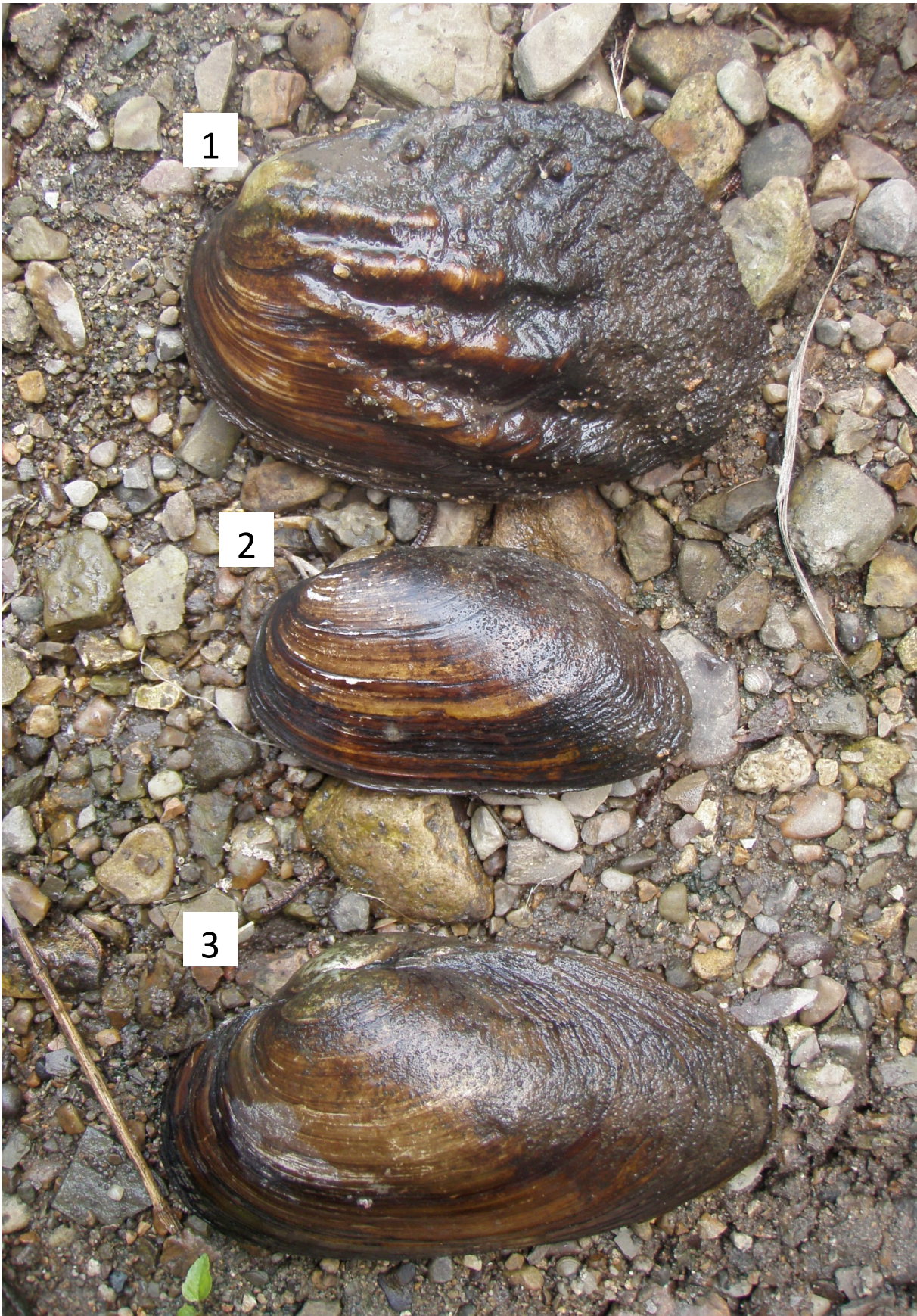


Figure 9. Mussel species encountered at SM 2: Threeridge (1), Pondhorn (2), and Giant Floater (3).

Appendix 1. Scientific and common names of species known from the Money and Six Mile creek watersheds. Status refers to conservation status in Illinois at time of printing (November 2017); ST-state threatened, SGCN-Species in Greatest Conservation Need.

Scientific Name	Common Name	Status
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Subfamily Anodontinae

Tribe Anodontini

<i>Alasmidonta viridis</i>	Slippershell Mussel	ST
<i>Anodontoides ferussacianus</i>	Cylindrical Papershell	
<i>Lasmigona complanata</i>	White Heelsplitter	
<i>Lasmigona compressa</i>	Creek Heelsplitter	SGCN
<i>Pyganodon grandis</i>	Giant Floater	
<i>Strophitus undulatus</i>	Creeper	
<i>Utterbackia imbecillis</i>	Paper Pondshell	

Subfamily Ambleminae

Tribe Amblemini

<i>Amblema plicata</i>	Threeridge	
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Tribe Pleurobemini

<i>Fusconaia flava</i>	Wabash Pigtoe	
<i>Unio merus tetralasmus</i>	Pondhorn	

Tribe Lampsilini

<i>Lampsilis cardium</i>	Plain Pocketbook	
<i>Lampsilis siliquoidea</i>	Fatmucket	
<i>Leptodea fragilis</i>	Fragile Papershell	
<i>Potamilus ohioensis</i>	Pink Papershell	
<i>Toxolasma parvum</i>	Lilliput	
<i>Venustaconcha ellipsiformis</i>	Ellipse	SGCN