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Freshwater Mussels of the La Moine River

Alison L. Price, Diane K. Shasteen, Sarah A. Bales

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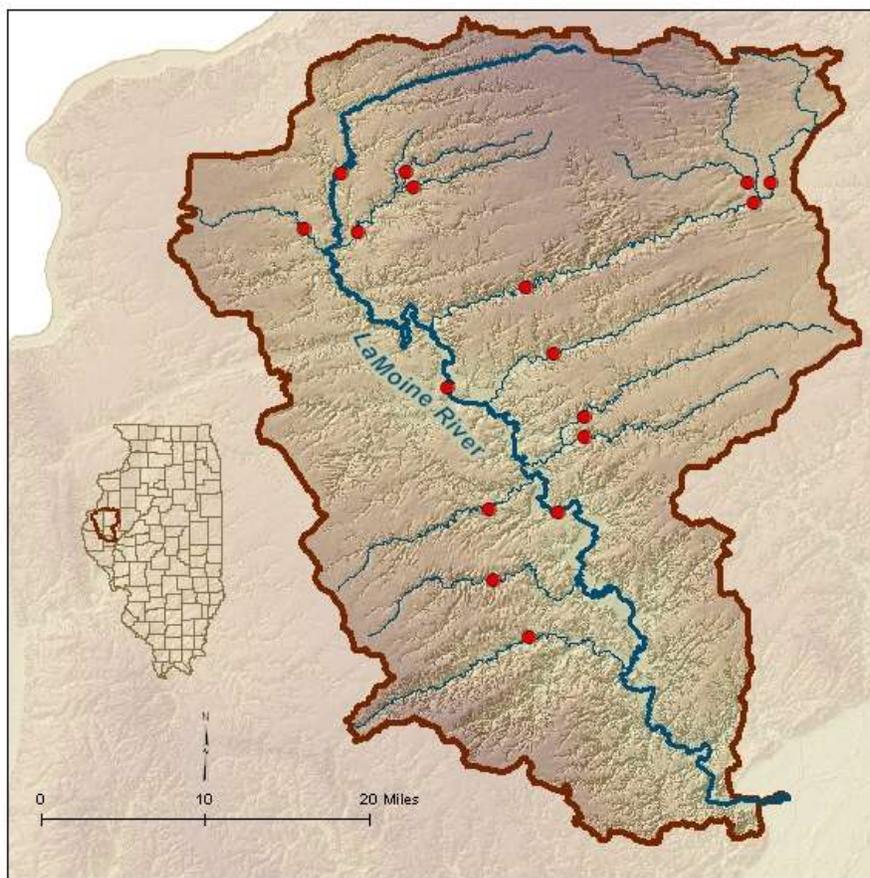
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Prairie Research Institute, University of Illinois at Urbana Champaign
William Shilts, Executive Director

Illinois Natural History Survey
Brian D. Anderson, Director
1816 South Oak Street
Champaign, IL 61820
217-333-6830



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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.

Agency Contacts

Kevin S. Cummings, INHS, ksc@inhs.illinois.edu, (217)333-1623

Bob Szafoni, IDNR, Robert.szafoni@illinois.gov, (217)348-0175

Ann Marie Holtrop, IDNR, ann.holtrop@illinois.gov, (217)785-4325

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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 information regarding the species that inhabit the La Moine River basin is available, no intensive freshwater mussel survey has been published to date. This report summarizes the mussel survey conducted in the La Moine River basin in 2010 and 2011 at IEPA/IDNR basin survey sites.

The La Moine River basin drains approximately 4550 km² (1758 mi²) in west-central Illinois. The river flows southeasterly from its origin in Warren County and eventually dumps into the Illinois River (Figure 1) near Beardstown. The La Moine River basin flows primarily through the Galesburg portion of the Western Forest-Prairie natural division and enters the Illinois River Bottomlands natural division at the confluence with the Illinois River (Schwegman 1973).

Land-use and Instream Habitat

Seventy-five percent of the La Moine River basin is agricultural land, both cropland and pasture (Illinois Department of Natural Resources 2005; Figure 2). Nearly 20% of the basin is forest or woodland, 2% is wetland, and less than 1.5% of the watershed is urban (Illinois Department of Natural Resources 2005). Channelization is present on only 4% of the stream miles in the basin, and no dams exist on the mainstem or major tributaries (Page et al. 1992). The threats to water quality in the La Moine River basin are primarily erosion from livestock and grazing practices (Figure 2) and degradation from coal surface mining (Page et al. 1992, Illinois Department of Natural Resources 2005). Substrates in the La Moine basin are primarily sand with some gravel riffles, although some streams are laden with silt from erosion due to upland and riparian land uses and instream processes (e.g., incised channels). Bedrock outcrops exist in several tributaries, and limestone bluffs are found in several areas along the La Moine River.

Methods

Freshwater mussel data was collected at 17 sites in August of 2010 and 2011: 3 mainstem and 14 tributary sites in the La Moine River basin (Figure 1; Table 1). Locations of sampling sites are listed in Table 1 along with information regarding IDNR/IEPA sampling at the site. Mussel survey locations were the same as IDNR/IEPA sites during the 2007 sampling year.

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 (Table 1). 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 were 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 lilliput (*Toxolasma 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, expressed as catch-per-unit-effort (CPUE; Table 2). A population indicated recent recruitment if individuals with lengths less than 30 mm or with 3 or fewer growth rings were observed. 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 21 species of freshwater mussels were observed in the La Moine River basin, and 20 of these species were live (Table 2). Across all sites, the number of live species collected ranged from 0 to 14, the number of extant species collected (live + dead) ranged from 0 to 15, and the total number of species collected (live + dead + relict) ranged from 1 to 15. White heelsplitter (*Lasmigona complanata*), lilliput (*Toxolasma parvum*), creeper (*Strophitus undulatus*) and mapleleaf (*Quadrula quadrula*) had the most occurrences across sites sampled and were collected at 7 of 17 sites (41%; Figure 3). Pistolgrip (*Tritogonia verrucosa*) was another commonly occurring species, occupying 35% of sites.

Abundance and Recruitment

A total of 671 individuals were collected across 17 sites. The number of live specimens collected at a given site ranged from 0 to 169, with an average of 38 mussels per site where live mussels

were collected (median=11). A total of 68 collector-hours were spent sampling with an average of 14 mussels collected per hour at sites where mussels were present. Live mussels were collected at most sampled sites in the basin (12 of 17 sites; Table 2). The most common species collected were pistolgrip, lilliput, and Wabash pigtoe (*Fusconaia flava*), with over 100 individuals of each species collected across all sites. These species comprised over 45% of total mussels collected. Other common species included the pimpleback (*Quadrula pustulosa*; n=63), creeper (n=60), and white heelsplitter (n=57).

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 may suggest a senescent population.

Recruitment at individual sites ranged from none observed to moderate across the basin. Recruitment levels, referred to in Table 3 as Reproduction Factor, varied from 1 to 5, and 50% of sites had no reproduction observed. Two sites, site 7 and 9, had a Reproduction Factor of four (indicating 30-50% of species exhibiting reproduction) and 4 sites (6, 7, 11, and 15) had a Reproduction Factor of 3 (1 – 30% of species exhibiting reproduction).

Mussel Community Classification

Based on the data collected in the 2010-2011 basin survey, around 40% of the sampled sites were classified as Moderate or Highly Valued under the current MCI classification system (Table 4, Figure 4). The sites classified as Highly Valued mussel resources were site 9 and site 11, the East Fork La Moine and La Moine River. Five sites (sites 6 – 8, 13 and 15) were considered Moderate mussel resources, and five sites (sites 1, 5, 10, 12, and 16) were considered Limited mussel resources. The remaining five sites (sites 2 – 4, 14, and 17) were Restricted mussel resources, and no live mussels were collected at these sites.

Noteworthy Finds

This survey collected 20 live species and 21 total species, and 22 species were known to exist in the basin prior to this survey (INHS Collections database). Of the 21 species recorded during this survey, deertoe (*Truncilla truncata*), fawnsfoot (*Truncilla donaciformis*), threehorn wartyback (*Obliquaria reflexa*), and pink heelsplitter (*Potamilus alatus*) were collected alive for the first time by our intensive basin survey (i.e., they were only known by dead or relict shell prior to this survey). These species were all found live in the La Moine River at site 11, and no shells or live individuals were located at other sites during the 2010-2011 basin survey. We did not collect any records for the flat floater (*Anodonta suborbiculata*).

Discussion

Recruitment

In the basin, 6 of the 12 sites where live mussels were collected exhibited moderate to high recruitment. Four of these six sites were in the East Fork La Moine River or were a direct tributary to the East Fork. This finding suggests that mussel communities in the La Moine River basin, particularly in the East Fork La Moine River, are viable and self-maintaining at this time. While we did not observe very recent recruitment at the remaining six sites where live mussels were collected, several sites (such as sites 10 and 13) appeared to have viable populations; mussels had little to no erosion present and were within the age range to be reproductively active (i.e., counted rings were less than 10 ; 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 La Moine

The La Moine River system was relatively unsampled prior to 2009 and no published intensive surveys existed at time of this report. Concurrent to this basin survey, Western Illinois University master's student Josh Sherwood was collecting freshwater mussels for a basin-wide survey (Sherwood et al. 2013, manuscript submitted for publication), and his thesis research may provide more information about the freshwater mussel community of the La Moine River. The number of species previously known to the basin varies by source: 13 species were reported by Page et al. (1992), 17 species were reported by Illinois Department of Natural Resources (2005), and 15 extant (23 historic) species were reported by Tiemann et al. (2007). Our surveys documented the existence of 21 species in the La Moine River basin from which only 22 species were known historically (the published count of 23 species in Tiemann et al. 2007 was determined to be an identification error from a previous survey; Kevin Cummings, personal communication). Our surveys also found that 20 of these species were represented by live individuals. The mussel communities collected at all sites with historical data suggest relatively intact freshwater mussel communities in the La Moine river, since the number of extant species was nearly the same or greater than historic species records or relict shell collected. Mussel communities in the La Moine River also appear to be relatively even, since six species (pistolgrip, lilliput, Wabash pigtoe, pimpleback, creeper, and white heelsplitter) comprised three-fourths of the total individuals collected (Table 2). This relative evenness contrasts many basins in Illinois that are dominated by two to three species.

Four species, threehorn wartyback, pink heelsplitter, deertoe, and fawnsfoot, were found alive by our survey and were not known to exist in the basin prior to 2009 (INHS Collections database). These species share a common fish host, the freshwater drum (*Aplodinotus*

grunniens), and it can be hypothesized that the success of this fish in the Illinois River is leading to an increase in freshwater drum-hosted mussels. Another theory that could explain the occurrence of new species in the La Moine River is simply the failure to detect a population in previous surveys (or lack thereof). In addition to these new species records, we have little evidence that any known species are extirpated at this time. Our survey did not detect any live pink papershell or flat floaters (*Anodonta suborbiculata*), but these species occupy habitats that were not encountered during our surveys (sluggish pools and backwaters) and are widespread and stable elsewhere throughout their range (Cummings and Mayer 1992). Additional surveys would need to be conducted in these habitats to determine the status of these species in the La Moine River basin.

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Table 1. 2010-2011 La Moine River Intensive Basin Survey. Types of samples include MU-mussel sampling, W-water chemistry, S-sediment, BE-boat electrofishing, SH-minnow seine haul, ES-electric seine, M-macroinvertebrate, and H-habitat.

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed area (km ²)
1	DG-10	La Moine River	MU,W,S,BE,M,H	Hancock	5.2 mi SW LaHarpe, Co. Rd. 2300N bridge	204.3
2	DGPCA-01	Little Creek	MU,W,S,SH,M,H	Hancock	3.4 mi S LaHarpe, Co. Rd. 2300N bridge	25.9
3	DGPC-01	Baptist Creek	MU,W,S,SH,M,H	Hancock	4.3 mi S LaHarpe, Co. Rd. 2850E bridge	51.5
4	DGO-01	Rock Creek	MU,W,S,ES,M,H	Hancock	4.8 mi ENE Ferris, Co. Rd. 2200E bridge	35.7
5	DGP-01	La Harpe Creek	MU,W,S,BE,M,H	Hancock	7.5 mi NE Carthage, Co. Rd. 1950 bridge	213.7
6	DGLC-01	Drowning Fork	MU,W,S,ES,M,H	McDonough	2.5 mi SW Bushnell, Co. Rd. 1700N bridge	93.1
7	DGLD-01	Farmers Fork	MU,W,S,ES,M,H	McDonough	3.7 mi WSW Bushnell, Co. Rd. 1700N bridge	78.7
8	DGL-09	East Fork La Moine River	MU,W,S,BE,M,H	McDonough	4 mi SW Bushnell, Co. Rd. 1800 E bridge	360.5
9	DGL-03	East Fork La Moine River	MU,W,S,ES,M,H	McDonough	1.7 mi WNW Colchester, Co. Rd. 1100 N bridge	553.7
10	DGJ-01	Troublesome Creek	MU,W,S,ES,M,H	McDonough	3.5 mi S Colchester, Co. Rd. 600E bridge	127.4
11	DG-07	La Moine River	MU,W,S,BE,M,H	Hancock	3.6 mi N Plymouth, St. Mary's Rd. bridge	1516.3
12	DGI-01	Camp Creek	MU,W,S,ES,M,H	McDonough	5 mi S Fandon, Co. Rd. 800E bridge	196.3
13	DGIA-03	Grindstone Creek	MU,W,S,ES,M,H	McDonough	4.6 mi S Fandon, Co. Rd. 800E bridge	132.4
14	DGHA-01	Williams Creek	MU,W,S,ES,M,H	Schuyler	4.6 mi E Augusta, Williams Creek Rd. ford	100.6
15	DG-16	La Moine River	MU,W,S,ES,M,H	Schuyler	5.7 mi N Camden, Guinea Rd. bridge	2521.4
16	DGG-02	Cedar Creek	MU,W,S,ES,M,H	Schuyler	6.3 mi SE Augusta, Huntsville Rd. bridge	88.3
17	DGD-02	Missouri Creek	MU,W,S,SH,M,H	Schuyler	3.1 mi SW Camden, Missouri Creek Rd. bridge	109.1

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. 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 and Resource Classification are based on values in Tables 3 and 4 (R=Restricted, L=Limited, M=Moderate, HV=Highly Valued, and U=Unique). NDA = no data available. *includes *Anodonta suborbiculata*, not in table.

Species	Site Number																	Proportion of Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Subfamily Anodontinae																		
<i>Lasmigona complanata</i>	22		R	D	1	D	R	1		4	4	2	23	D				8.5%
<i>Pyganodon grandis</i>						6	19	D					D					3.7%
<i>Strophitus undulatus</i>	1					D	14	13	1	9	D	1	21					8.9%
<i>Utterbackia imbecillis</i>											1				1			0.3%
Subfamily Ambleminae																		
<i>Amblema plicata</i>									D		1			R				0.1%
<i>Fusconaia flava</i>						D	60	21	17		2			R	1			15.1%
<i>Quadrula pustulosa</i>						D	1	14	41		6				1			9.4%
<i>Quadrula quadrula</i>	1						1	5	4		6	1			1			2.8%
<i>Tritogonia verrucosa</i>	8							4	5		75	D	10		2			15.5%
<i>Uniomerus tetralasmus</i>		R		R		1				R						4		0.7%
Subfamily Lampsilinae																		
<i>Lampsilis cardium</i>					D				43	R	1		7		1			7.7%
<i>Lampsilis siliquoidea</i>									6					R				0.9%
<i>Lampsilis teres</i>					1				2		23				3			4.3%
<i>Leptodea fragilis</i>	R					D		R	D	R	5	R	3		1			1.3%
<i>Ligumia subrostrata</i>				R		9	10						2	6				4.0%
<i>Obliquaria reflexa</i>											3							0.4%
<i>Potamilus alatus</i>											1							0.1%
<i>Potamilus ohioensis</i>					R								R					0.0%
<i>Toxolasma parvum</i>	3	R		D	3	23	64	5		3		D	2	D		D	R	15.4%
<i>Truncilla donaciformis</i>											2							0.3%
<i>Truncilla truncata</i>											2							0.3%
	Totals																	
Individuals collected	35	0	0	0	5	39	169	63	119	16	132	6	72	0	11	4	0	671
Live Species	5	0	0	0	3	4	7	7	8	3	14	4	7	0	8	1	0	20
Extant Species	5	0	0	2	4	9	7	8	10	3	15	6	8	2	8	2	0	20
Total Species	6	2	1	4	5	9	8	9	10	6	15	7	9	5	8	2	1	21
Historical Species	NDA	NDA	NDA	NDA	NDA	6	NDA	NDA	NDA	NDA	6	5	7	NDA	NDA	NDA	NDA	22*
Catch per unit effort (CPUE)	8.8	0.0	0.0	0.0	1.3	9.8	42.3	15.8	29.8	4.0	33.0	1.5	18.0	0.0	2.8	1.0	0.0	
Mussel Community Index (MCI)	7	0	0	0	7	10	12	12	13	6	13	7	9	0	10	6	0	
Resource Classification	L	R	R	R	L	M	HV	HV	HV	L	HV	L	M	R	M	L	R	

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 \geq 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

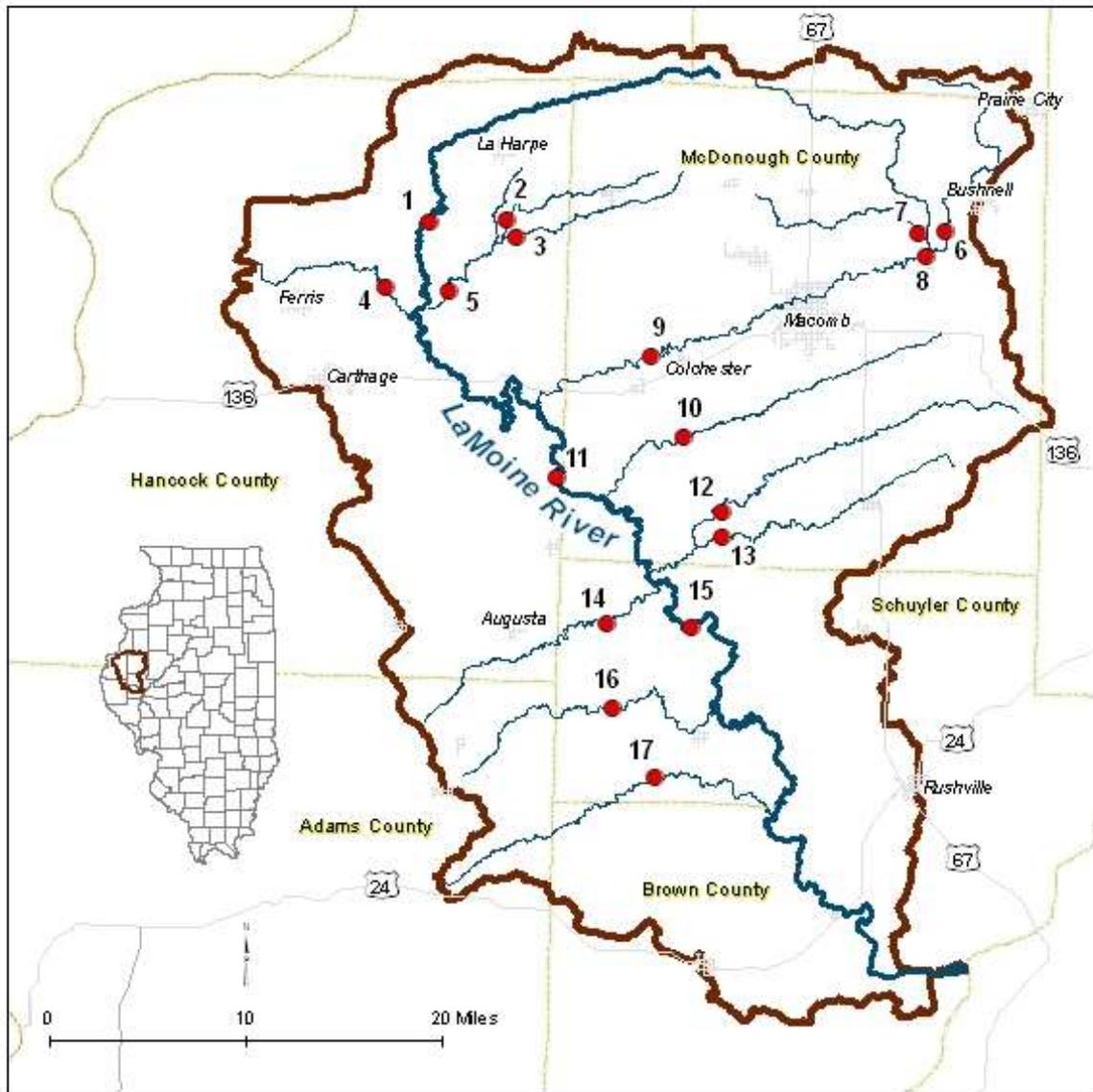


Figure 1. Sites sampled in the La Moine River basin in 2010-2011. Site codes referenced in Table 1.



Figure 2. Many sites had active pastureland bordering the stream and in-stream (clockwise from top left: Site 3 upstream of bridge, downstream of bridge, Site 7 downstream of bridge, and Site 6 upstream of bridge—cattle present but not pictured).

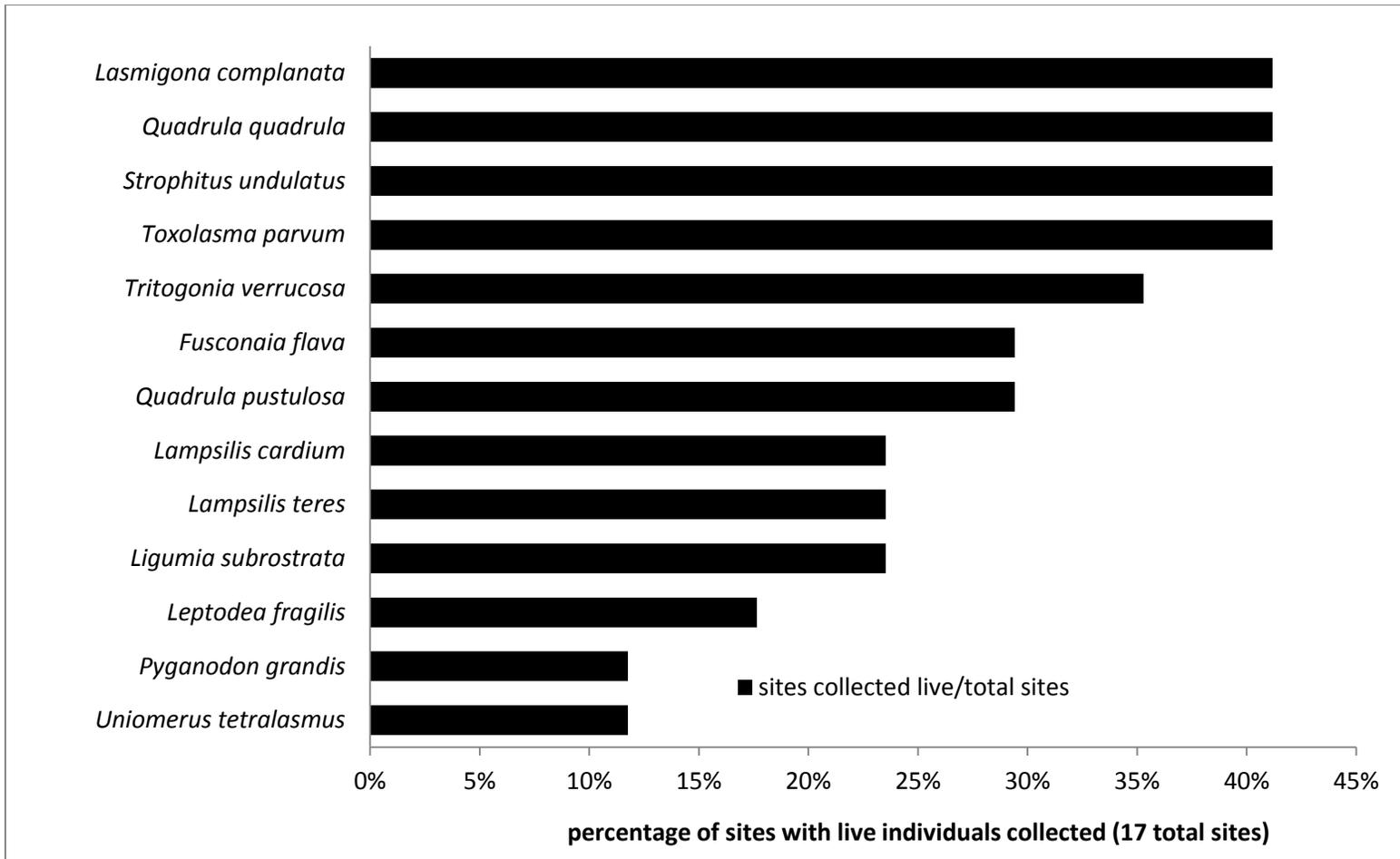


Figure 3. Number of sites where a species was collected live compared to the total number of sites sampled.

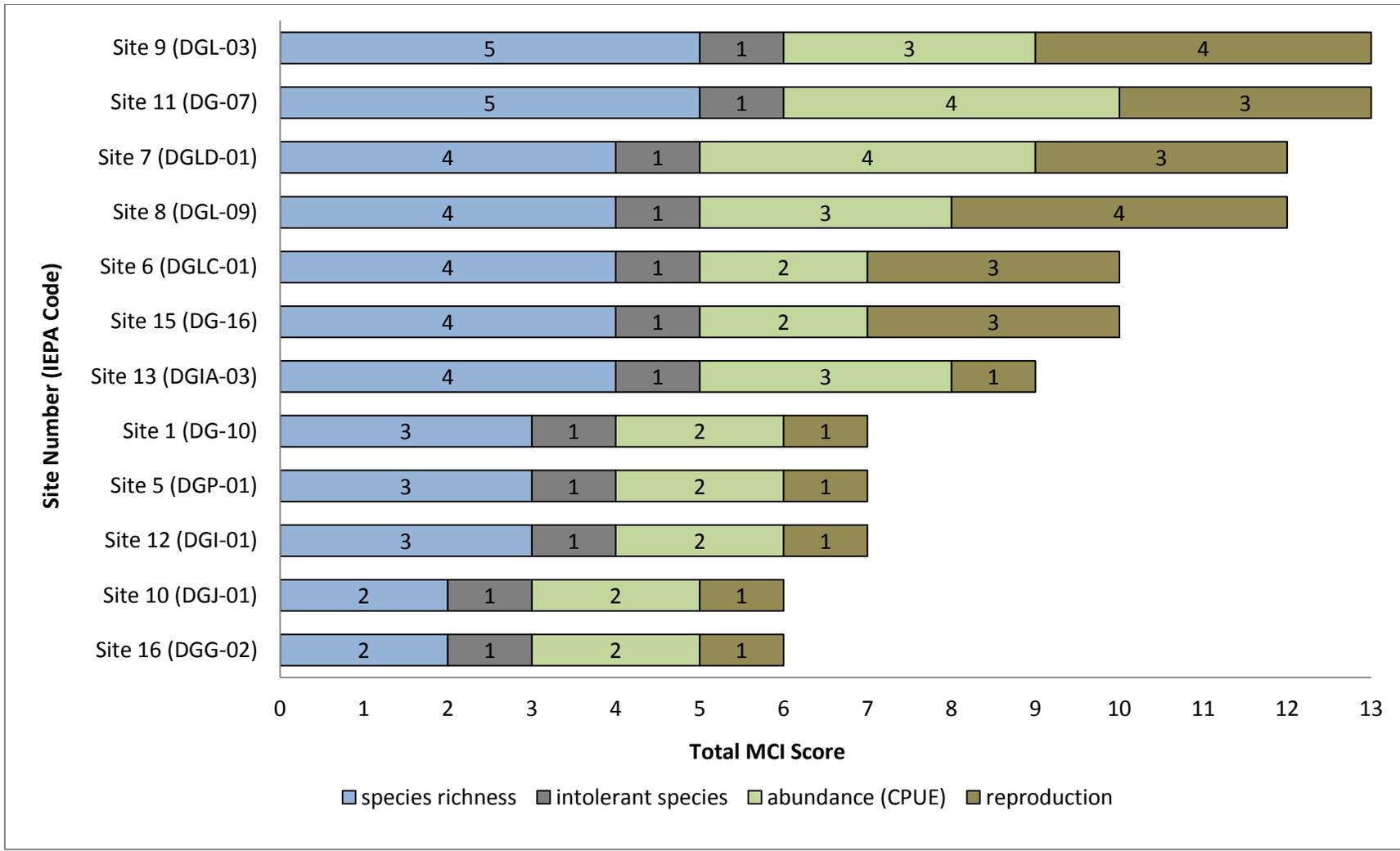


Figure 4. Comparison of Mussel Condition Index (MCI) and MCI component scores for La Moine River basin sites based factor values from Table 3.

Appendix 1. Scientific and common names of species.

Scientific name	Common Name
Subfamily Anodontinae	
<i>Anodonta suborbiculata</i>	flat floater
<i>Lasmigona complanata</i>	white heelsplitter
<i>Pyganodon grandis</i>	giant floater
<i>Strophitus undulatus</i>	creeper
<i>Utterbackia imbecillis</i>	paper pondshell
Subfamily Ambleminae	
<i>Amblema plicata</i>	threeridge
<i>Fusconaia flava</i>	Wabash pigtoe
<i>Quadrula pustulosa</i>	pimpleback
<i>Quadrula quadrula</i>	mapleleaf
<i>Tritogonia verrucosa</i>	pistolgrip
<i>Unio merus tetralasmus</i>	pondhorn
Subfamily Lampsilinae	
<i>Lampsilis cardium</i>	plain pocketbook
<i>Lampsilis siliquoidea</i>	fatmucket
<i>Lampsilis teres</i>	yellow sandshell
<i>Leptodea fragilis</i>	fragile papershell
<i>Ligumia subrostrata</i>	pondmussel
<i>Obliquaria reflexa</i>	threehorn wartyback
<i>Potamilus alatus</i>	pink heelsplitter
<i>Potamilus ohioensis</i>	pink papershell
<i>Toxolasma parvum</i>	lilliput
<i>Truncilla donaciformis</i>	fawnsfoot
<i>Truncilla truncata</i>	deertoe