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Freshwater Mussels of the Cache River

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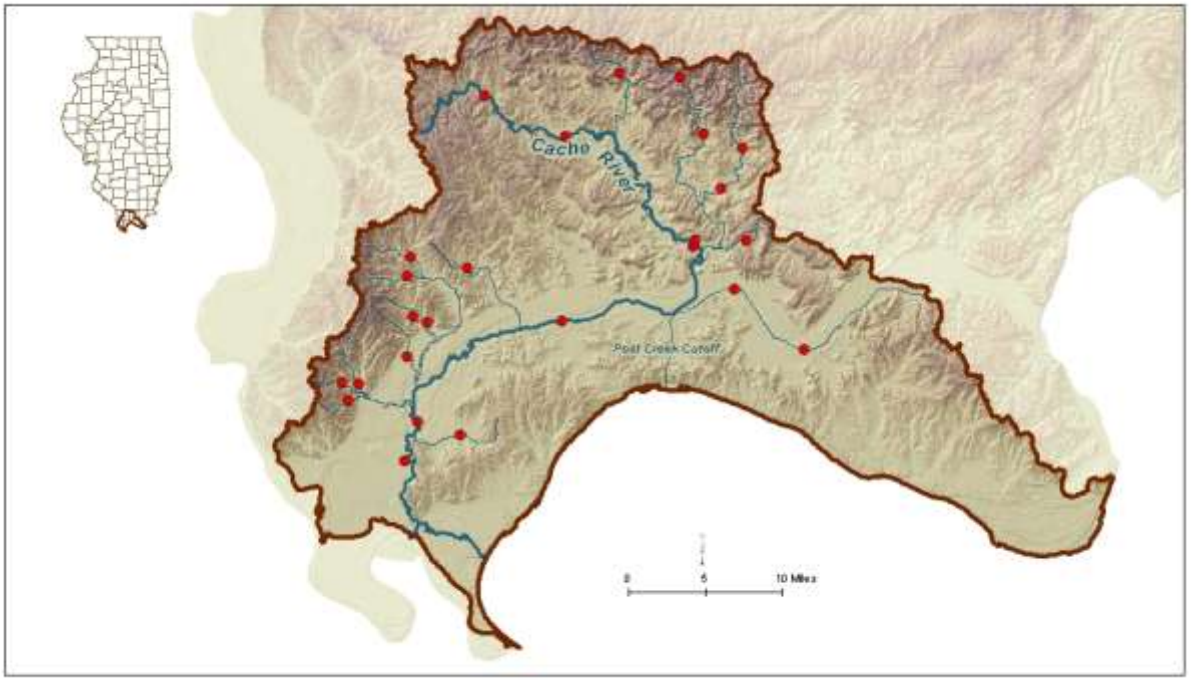

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Preface

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. Sampling of mussels has been very sporadic and limited in the Cache River Basin and only one report (Phillippi et al. 1986) pertaining to all aquatic fauna of the basin has been published. This report summarizes the mussel survey conducted in the Cache River basin in 2009 in conjunction with IDNR and IEPA basin surveys.

The Cache River basin drains 1910 km^2 (737 mi^2) in the southernmost part of Illinois and contains principal tributaries of Big, Cypress, Dutchman, Little Cache Creeks and Main Ditch. (Illinois Department of Natural Resources 1997). Originating near Cobden in Union County, the Cache River basin drains nearly the entire southern tip of the state including the counties of Alexander, Johnson, Massac, Pope, Pulaski and Union (Figure 1). The Cache River basin flows through three natural divisions, including the Shawnee Hills, Coastal Plains, and Ozark Southern divisions (Schwegman 1973). Located at the convergence of four major physiographic regions, the Cache River is also part of the largest complex of wetlands in Illinois, harboring 91% of the state's swamp and wetland communities (Illinois Department of Natural Resources 1997). The Cache River and its tributaries historically drained to the Ohio River. However, with the addition of the Post Creek Cutoff in the early 1900's, the system was divided into the Upper Cache draining through the Cutoff into the Ohio River and the Lower Cache draining via the Cache River Diversion Channel into the Mississippi River. Differing in appearance from the lower system, the Upper Cache is a fast flowing system that flows through the outcrops and bluffs of the Shawnee Hills. This portion of the basin runs through a narrow floodplain never wider than half a mile (Figure 2). In stark contrast, the Lower Cache drains through flattened lands with floodplains as wide as two miles. In this Coastal Plain area, the basin changes to a slow flowing, meandering stream system with numerous wetland areas (Figure 3; Illinois Department of Natural Resources 1997).

Land-use and Instream Habitat

The Cache River basin is uniquely rural by Illinois standards; the basin is home to approximately

62,000 people with no town in the area larger than 7,000 people. Less than a third of the land in the basin is used to cultivate row crops, fruits, and nursery stock. The Cache River basin has significantly less land in crops and towns and more in grasslands, timber, and wetlands as compared to the rest of Illinois (Illinois Department of Natural Resources 1997). While considered rural, the area has seen many anthropogenic changes including logging and land clearing, draining of wetlands for farming, and dredging of the Post Creek Cutoff and Diversion Channel These changes in the landscape of the basin may have had an adverse effect on the mussel communities.

Substrates throughout the Cache River basin were highly variable, but were primarily comprised of gravel, cobble, boulder, silt, and clay dependant on location. Mainstem sites and tributaries in the upper portion of the Cache basin (northern Johnson County), and the Lower Cache tributaries located in Alexander County were comprised of a combination of gravel, cobble, boulder, and bedrock. Nearly all of the sites in these regions of the basin were naturally meandering and located in heavily forested areas. Tributaries located in southern Johnson, Massac, and Pulaski counties were very different from all other sites in the basin. Predominating substrates for these tributaries were silt and clay and/or sand with small percentages of gravel and cobble. Due to extensive agricultural practices in these areas, most streams are channelized and lack natural vegetation in the riparian zone. Substrates in the Lower Cache mainstem sites below the Post Creek Cutoff were dominated by silt. Uniform water depths were detected in most of these tributaries due to farm drain tiles. In contrast, far upper and Lower Cache tributaries were dominated by shallow water depths and intermittent pools. The Upper Cache mainstem sites were wadeable, with average depths less than two feet, however the Lower Cache mainstem sites averaged a depth of over 4.5 feet, hindering sampling efficiency. The presence of ephemeral streams with predominately cobble/boulder/bedrock substrates are features that may limit mussel occupancy in the Cache River Basin especially in the far upper reaches and the tributaries of the lower portion of the basin.

Methods

During the 2009 survey, freshwater mussel data were collected at 25 stations: seven mainstem and 18 tributary sites in the Cache River basin (Figure 1). Thirteen sites were sampled on the Lower Cache and 12 sites on the Upper Cache. 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 stations.

Live mussels and shells were collected at each sample station 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 station including riffles, pools, slack water, and areas of differing substrates. A four-hour timed search method was implemented at each station. 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 station if it was represented by live or recently dead shell material (Szafoni 2001). The nomenclature employed in this report (Appendix 1) follows Turgeon et al. (1998) except for recent taxonomic changes to the gender ending of lilliput (*Toxolasma parvum*), which follows Williams et al. (2008). 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 was considered to indicate recent recruitment if individuals less than 30 mm in length or with three 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 23 species of freshwater mussels were observed in the Cache River basin, 21 of which were live (Table 2). Across all sites, the number of live species collected, the number of extant species collected (live + dead), and the total number of species collected (live + dead + relict) ranged from zero to 11. The giant floater (*Pyganodon grandis*) and the Texas lilliput (*Toxolasma texasiensis*) had the most occurrences across sites sampled with live mussels present (six of 13 sites; 46%; Figure 4). The fragile papershell (*Leptodea fragilis*), paper pondshell (*Utterbackia imbecillis*), pondmussel (*Ligumia subrostrata*), mapleleaf (*Quadrula quadrula*) and the white heelsplitter (*Lasmigona complanata*) were other commonly occurring species (Figure 4), occupying between 30% and 40% of these sites. Site 2, the Cache River north of Mt. Pleasant had the greatest species richness with 11 live species.

Abundance and Recruitment

A total of 451 individuals were collected across 25 sites. The number of live specimens collected

at a given station ranged from zero to 173, with an average of 35 mussels per site where live mussels were collected (13 of 25 sites; Table 2). A total of 100 collector-hours were spent sampling with an average of seven mussels collected per hour. Nine sites yielded more than 10 individuals and four of the nine sites (sites 2, 8, 9, and 25) yielded more than 50 live individuals. The most common species collected at mainstem sites were fatmuckets (*Lampsilis siliquoidea; n*=52), threeridge (*Amblema plicata*; n=49), yellow sandshell (*Lampsilis teres*; n=36) and little spectaclecase (*Villosa lienosa*; n=31), which together comprised over 50% of the mainstem collections. It is interesting to note that 87% of these individuals (146 out of 168) were collected at one mainstem site (site 2) on the Upper Cache. In the tributary streams, pondmussel (n=64), giant floater (n=21), and Texas lilliput (n=11) were most common comprising 80% of the collections. In the basin as a whole, twelve species made up 90% of the total collection (Table 2). These species included the species listed above plus pistolgrip (T*ritogonia verrucosa*; n=27), mapleleaf (n=23), washboard (*Megalonaias nervosa*; n=23*)*, white heelsplitter (n=22), and fragile papershell (n=13).

Mussel abundance at individual stations ranged from none to moderately high, with CPUE ranging from zero - 43 individuals/collector-hour (Table 2). In the Lower Cache, extant mussel populations were found at only four locations and CPUE averaged 1.5 individuals per collector-hour. The collection from one station (site 25; Cache River located on US Fish and Wildlife property east of Unity) accounted for 66% of the mussels collected on the Lower Cache. The Upper Cache displayed a more even distribution of mussel communities and higher mussel abundance with all but one location having an extant mussel population. Average CPUE for the Upper Cache was nearly eight individuals per collector-hour.

Recruitment for each species was determined by the presence of individuals less than 30mm or with three 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 stations ranged from none observed to high across the basin. Recruitment levels, referred to in Table 3 as Reproduction Factor, varied from one to five, and seven of the sites in the Upper Cache exhibited high to very high recruitment. At four of the Upper Cache stations (sites 2, 6, 7, and 8) recruitment was over 50% and at three other sites (1, 11, and 12) recruitment was 30 to 50% (Figure 5). The Lower Cache system exhibited no observed recruitment during this survey.

Mussel Community Classification

Based on the data collected in the 2009 basin survey, many of the stations in the Cache River basin have restricted or limited mussel communities using the current MCI classification system (Table 4, Figure 5). Only one station, the Cache River mainstem (site 2), ranked as a Unique mussel resource due to its high species richness, listed species present, abundance and presence of disturbance intolerant species and very high recruitment. One other mainstem station (site 1) ranked as a Highly Valued mussel resource. Six stations (sites 6 - 9, 11, and 12) in the Upper Cache were ranked as moderate mussel resources. Two other stations in the Upper Cache are listed as restricted, including the upper reach of Dutchman Creek (site 4) and a Cache mainstem site (site 10) where mussels were removed and relocated in 1997 due to bendway weir placement. In the Lower Cache, only one mainstem site (site 25) ranked as a moderate mussel resource and another (site 24) ranked as limited. All other stations in the Lower Cache were classified as restricted.

Noteworthy Finds

This survey collected 21 live species and 23 total species (live+ dead + relict). According to historical records, 19 species are known from the Cache River basin (Tiemann et al. 2007). Of the 23 species recorded during this survey, five species, Wabash pigtoe (*Fusconaia flava),* southern mapleleaf*, (Quadrula nobilis),* threehorn wartyback (*Obliquaria reflexa)*, bleufer (*Potamilus purpuratus)*, and the little spectaclecase, have never been recorded in the Cache River basin. Threehorn wartyback and southern mapleleaf were represented by one and three live specimens, respectively, detected in the Cache River at site 25. One live specimen of bleufer was recorded at site 2 while one relict shell of Wabash pigtoe was recorded from the Cache River at site 10. The little spectaclecase is an Illinois threatened species with current populations known from basins to the north and east of the Cache River including the Wabash, Little Wabash, Vermilion (Wabash drainage), Middle Fork Vermilion, Little Vermilion, Salt Fork Vermilion, Embarras, and the Ohio River tributaries (INHS Collections database). A total of 31 individuals of this particular species were found in the Upper Cache River mainstem (sites 1 and 2). Only one historically known live species from the basin, the rock pocketbook (*Arcidens confragosus*), was not detected during this survey.

Discussion

Five species of mussels were found during our survey that had previously been undetected in the Cache River basin. The threehorn wartyback and the Wabash pigtoe are fairly common species in creeks and large rivers throughout its range. Fish hosts for these species include several minnow species (threehorn wartyback) and bluegill and crappie for the Wabash pigtoe (Williams et al. 2008). The other three new species detected (bleufer, southern mapleleaf, and

little spectaclecase) are known from basins to the south and east of the Cache River basin and appear to be expanding their ranges. Several other theories could explain the occurrence of new species in the Cache River, including colonization from a fish introduction, movement from other water bodies (e.g., farm ponds during a flood event), and failure to detect a population in previous surveys or lack of surveys in the basin.

Based upon museum collection records, it appears that no species have been extirpated from the Cache River basin. One possible exception may be the rock pocketbook, which was not detected during this survey. However, this species was only known from the Heron Pond area and it was one of the species relocated to Wildcat Bluff in 1997 due to the placement of the bendway weirs. A survey done in 2010 by INHS and IDNR biologists at the Wildcat Bluff area did not detect this species, although an intensive search of the area would need to be completed to determine if this species has indeed been extirpated from the basin.

Recruitment

In the Upper Cache basin, seven of the 12 stations exhibited high to very high recruitment. This finding suggests that the mussel communities of the Upper Cache are viable and self-maintaining at this time. Data collected during this survey indicate that very recent recruitment may not be occurring at most sites in the Lower Cache basin. Many of the mussels found were highly eroded and over 20 years of age. Due to high water levels at the Lower Cache mainstem sites, we cannot conclusively state that the mussel communities of this system are void of recruitment. Sampling methods to target juvenile mussels would be necessary to better assess the reproductive status of these populations.

Mussel community of the Cache River basin

There is limited mussel community information relating to this basin from past surveys and reports. Nearly 90% of the sites sampled had no historical data available (Table 2), and only one intensive survey for mussels was completed in 1986. Twenty-three sites were sampled during that survey. Ten species of mussels were detected at three sites, with only three species being detected at more than one site (Phillippi et al. 1986, Page et al. 1992). Our surveys documented the existence of 23 species in the Cache River basin from which 19 species were known historically. Additionally, our surveys found that 21 of these species were represented by live individuals. The mussel communities collected at nearly all of the mainstem sites suggest relatively intact freshwater mussel communities, since the number of extant species was nearly the same or greater than historic species records or relict shell collected.

While the streams in the middle section of the watershed appear impacted by agriculture, our survey found that these tributaries and the mainstem of the Upper Cache region are capable of supporting a biologically significant freshwater mussel fauna due to their mussel abundance

and species richness. The nine sites sampled that are considered Moderate, Highly Valued or Unique Mussel Resources were all located in the upper section of the Cache River basin with one exception, site 25(Cache River mainstem). The Lower Cache mussel communities appear to be a sharp contrast to the Upper Cache communities. We found that the Lower Cache region, with the exception of sites 24 and 25 (Cache River mainstem), does not support extant mussel communities. Due to limited historical information, it is not known if this is due to the extirpation of species or merely due to the lack of suitable habitat. We postulate that it is the latter, based on the detection of less than five relict shells found in this region. As mentioned in the introduction, many of the tributaries of the Lower Cache basin are ephemeral and have bedrock/boulder/cobble substrates. The Lower Cache mainstem also changes markedly downstream of the Post Creek Cutoff, becoming a sluggish, wetland in many areas. These structural changes in the river are likely influencing the lack of intact freshwater mussel communities in this region.

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Table 1. 2009 Cache 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.

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed Area (km^2)
	Cache River Ohio River Drainage					
1	AD-06	Cache River	MU	Union	NE of Anna; Saratoga Rd and Plott Ln	58.05
2	AD-05	Cache River	MU,ES,H,M,S,W	Union	1 mi N of Mt. Pleasant; Mt. Pleasant Rd Br	109.43
3	ADLA-01	Buck Branch	MU,ES,H,M,S,W	Johnson	2.7 mi SW of Goreville; Happy Hollow Rd Br	17.96
4	ADD-05	Dutchman Creek	MU,ES,H,M,S,W	Johnson	SE of Goreville; Wagontown Ln Br	8.27
5	ADD-02	Dutchman Creek	MU	Johnson	2.8 mi NW of Vienna; Brown Rd Br	31.01
6	ADDB-03	Little Cache River	MU,ES,H,M,S,W	Johnson	NE of Vienna, in Bloomfield; Shelby Rd Br	43.76
7	ADDB -01	Little Cache River	MU	Johnson	Vienna at Bike path bridge	70.81
8	ADDA-01	Cave Creek	MU,ES,H,M,S,W	Johnson	4 mi SE of Vienna; Indian Point Rd Br	12.72
9	AD-20	Cache River	MU,BE,FF,M,S,W	Johnson	N of Foreman; US of Dutchman Ck confluence	401.72
10	AD-08	Cache River	MU,BE,FF,M,S,	Johnson	Heron Pond Foot Bridge; N of Foreman	632.84
11	ADCDA-01	Bear Creek Ditch	MU,ES,H,M,S,W	Massac	E of Mermet; Staton Ridge Rd Br	72.68
12	ADC-01	Main Ditch	MU,ES,H,M,S,W	Massac	3.5 mi NW of Mermet; Rt. 45 bridge	250.23
	Cache River Mississippi River Drainage					
13	IX-05	Cache River	MU,BE,FF,M,S,W	Pulaski	Rd, 1.3 mi S of Perks	1092.83
14	IXJAA-01	Crooked Creek	MU,ES,H,M,S,W	Union	Happy Holler Rd., 2.0 mi SW Dongola	13.51
15	IXFD-01	Lingle Creek	MU,ES,H,M,S,W	Union	Lingle Creek Rd. 0.75 mi. NW Mill Creek	16.24
16	IXFC-01	Cooper Creek	MU,ES,H,M,S,W	Alexander	County Line Rd, 0.75 mi. SW Mill Creek	22.76
17	IXFB-02	Hartline Creek	MU,ES,H,M,S,W	Alexander	Rifle Range Rd. 0.5 mi. SE Elco	9.36
18	IXFB-01	Hartline Creek	MU,ES,H,M,S,W	Alexander	Next to Rifle Range Rd. 1.5 mi. SE Elco	19.05
19	IXFA-01	Jackson Creek	MU,ES,H,M,S,W	Alexander	Tamms Prison Rd. 1.5 mi N Tamms	9.45
20	IXDB-01	West Branch	MU,ES,H,M,S,W	Alexander	Diswood Rd. 4 mi. W Tamms	9.48
21	IXD-02	Sandy Creek	MU,ES,H,M,S,W	Alexander	Grapevine Trail Rd. 3 mi. W Tamms	13.55
22	IXDA-01	Wolf Creek	MU,ES,H,M,S,W	Alexander	Wolf Creek Rd. 3.5 mi. WNW Sandusky	7.92
23	IXC-02	Boar Creek	MU,ES,H,M,S,W	Pulaski	Hwy 51, 2.0 mi S of Pulaski	12.27
24	IX-08	Cache River	MU,BE,H,M,S	Alexander	Cache River Bend Access area	1713.52
25	IX-06	Cache River	MU,BE,FF,M,S	Pulaski	Shiloh Road, east of Unity	1723.18

Table 2. Mussel data for sites sampled during 2009 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). * Historic species based on Tiemann et al. 2007 ** represents # of species moved from location prior to bendway weir placement.

	Site Number																	Proportion of
Species	1	2	5	6	7	8	9	10	11	12	13	14	17	18	22	24	25	**Total**
Subfamily Anodontinae																		
Anodonta suborbiculata											D							0%
Arcidens confragosus																		0%
Lasmigona complanata		1					2									12	7	5%
Pyganodon grandis		9	4	12	5			R								3	2	8%
Utterbackia imbecillis	1		1		1				2	2								2%
Subfamily Ambleminae																		
Amblema plicata		30					12										7	11%
Fusconaia flava								R										0%
Megalonaias nervosa							2									D	21	5%
Quadrula nobilis																	3	1%
Quadrula quadrula		1					7									4	11	5%
Tritogonia verrucosa							27											6%
Uniomerus tetralasmus	7											R	R	R	2			2%
Subfamily Lampsilinae																		
Lampsilis siliquoidea		52																12%
Lampsilis teres	D	36							1	7								10%
Leptodea fragilis		2					1	1		4						5	D	3%
Ligumia subrostrata	2				1	62				1								15%
Obliquaria reflexa																	1	0%
Potamilus alatus							2											0%
Potamilus ohiensis										2								0%
Potamilus purpuratus		1																0%
Toxolasma parvum	5	3				2												2%
Toxolasma texasiensis	6	10			3	3			3	2				R				6%
Truncilla truncata							4											1%
Villosa lienosa	**3**	**28**																7%
																		Total
Individuals collected	24	173	5	12	10	67	57	1	6	18	0	0	0	0	2	24	52	451
Live Species	6	11	2	1	4	3	8	1	3	6	0	0	0	0	1	4	7	21
Extant Species	7	11	2	1	4	3	8	1	3	6	1	0	0	0	1	5	8	22
Total Species	7	11	2	1	4	3	8	3	3	6	1	1	1	2	1	5	8	23
Historical Species	NDA	3	NDA	NDA	NDA	NDA	**11	**11	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	19*
Catch per unit effort (CPUE)	6.02	43.36	1.25	3.01	2.51	16.79	14.29	0.48	1.5	4.51	0	0	0	0	0.5	6.02	13.03	
Mussel Community Index (MCI)	12	17	6	10	11	11	9	4	9	10	0	0	0	0	4	7	9	
Resource Classification	HV	U	L	M	M	M	M	R	M	M	R	R	R	R	R	L	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

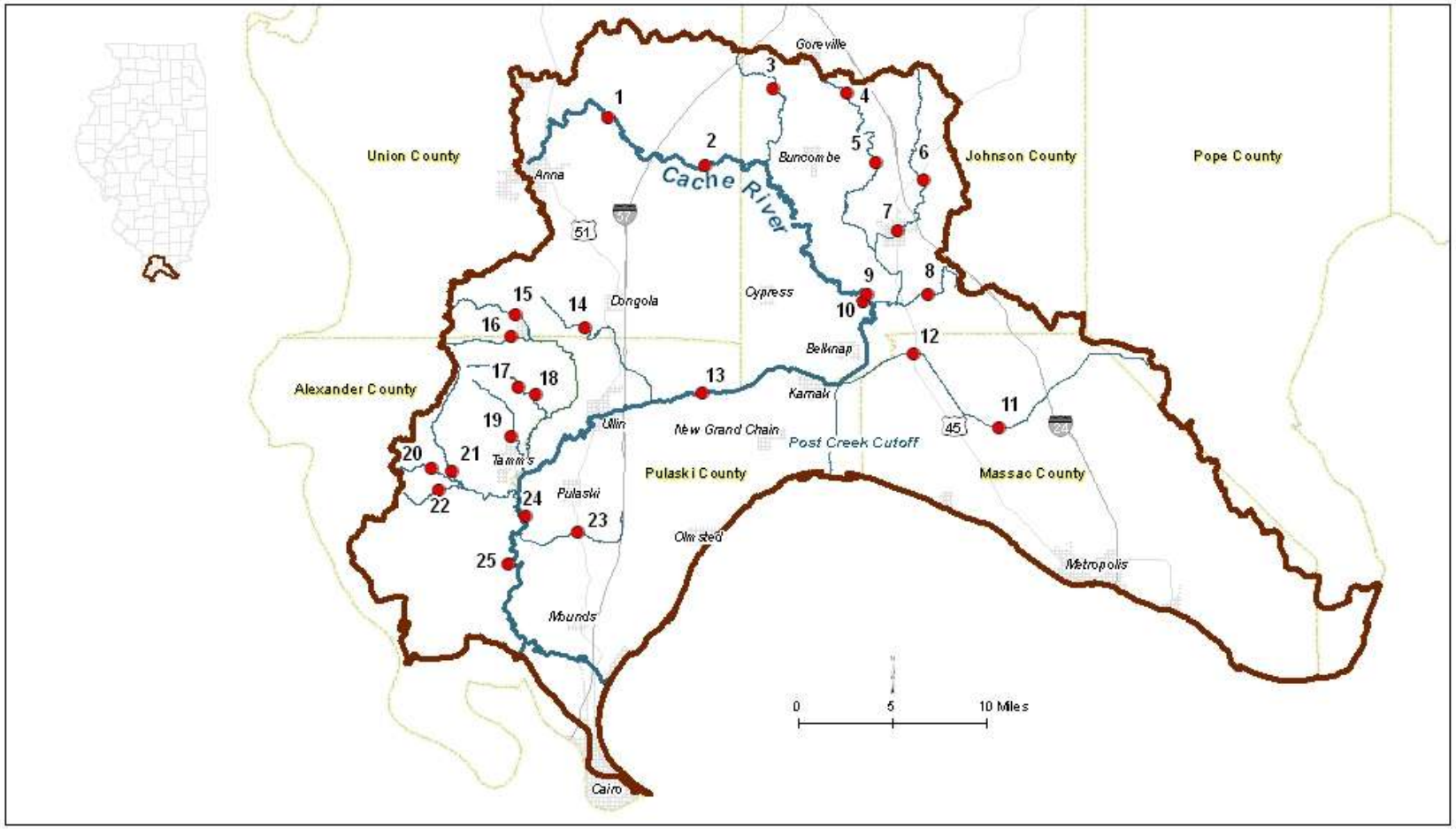

Figure 1. Stations sampled in the Upper and Lower Cache River Basins during 2009. Site codes reference in Table 1.

Figure 2. Upper Cache tributary at most upstream site sampled (Site 3). Note gravel/cobble substrate, lack of water, narrow floodplain and dense riparian zone. During the survey, zero individuals were collected.

Figure 3. Cache River mainstem near Heron Pond wetlands (Site 9). Note silt/clay banks, widening channel and floodplain, and dense riparian zone. During the survey, 57 individuals of eight species were collected.

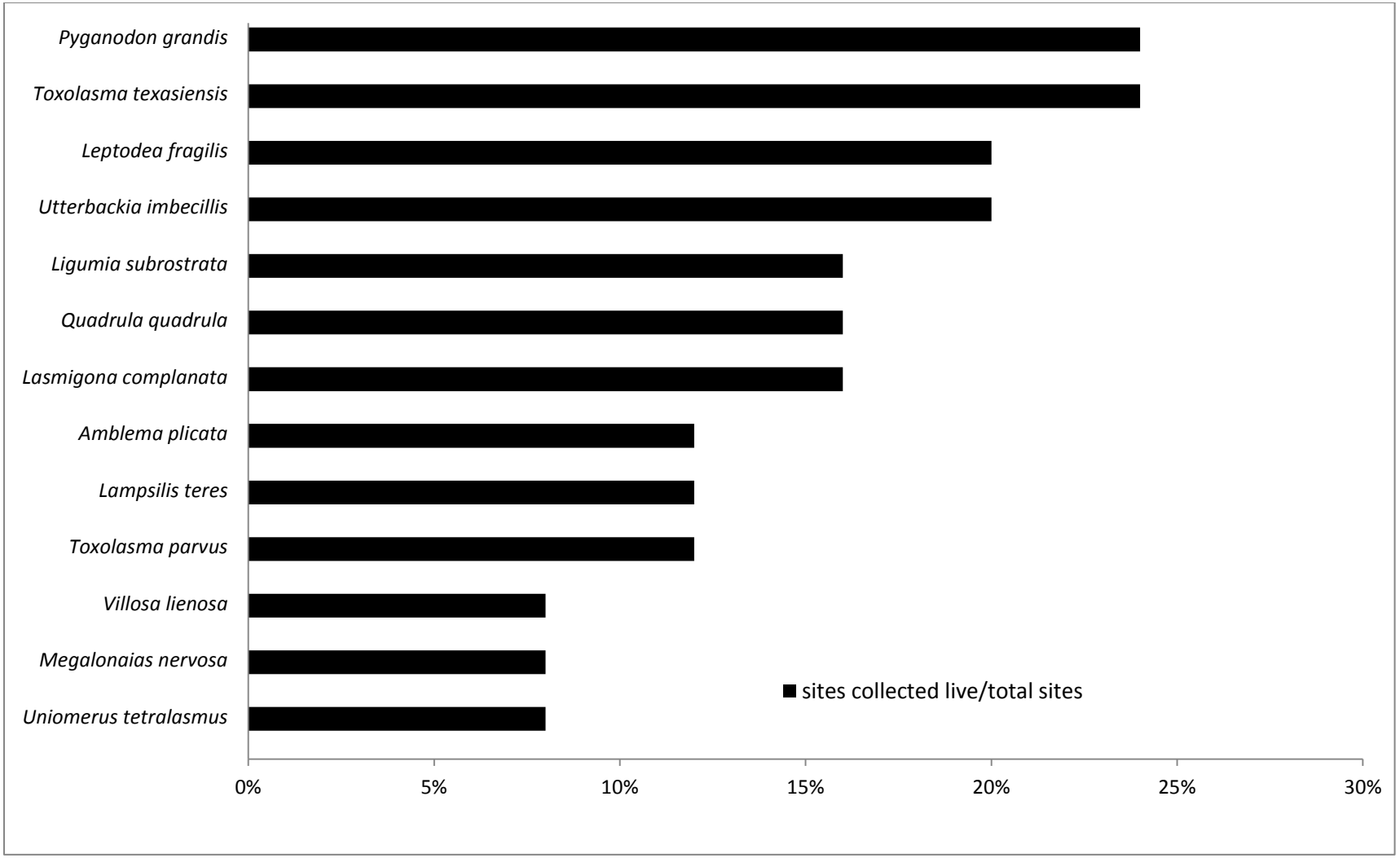

Figure 4. Number of sites where a species was collected live compared to the number of total sites sampled (25 total stations).

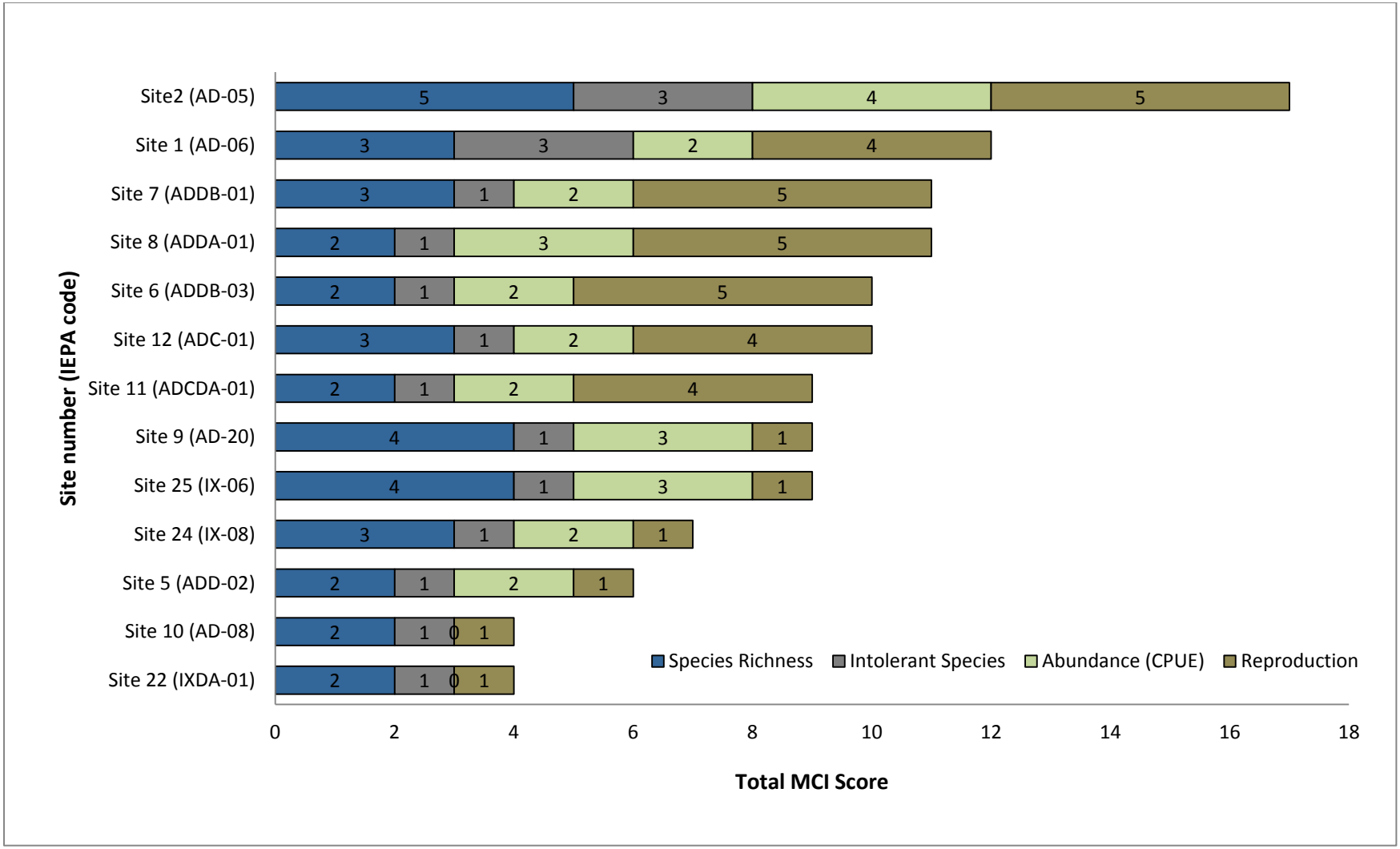

Figure 5. Comparison of Mussel Community Index (MCI) and MCI component scores for Cache River basin sites based on factor values from Table 3.

Appendix 1. Scientific and common names of species. Status refers to conservation status in Illinois at time of printing (December 2011); ST-state threatened, SE-state endangered, SC-special concern

Scientific name	Common Name	Status
Subfamily Anodontinae		
Anodonta suborbiculata	flat floater	
Arcidens confragosus	rock pocketbook	
Lasmigona complanata	white heelsplitter	
Pyganodon grandis	giant floater	
Utterbackia imbecillis	paper pondshell	
Subfamily Ambleminae		
Amblema plicata	threeridge	
Fusconaia flava	Wabash pigtoe	
Megalonaias nervosa	washboard	
Quadrula nobilis	southern mapleleaf	
Quadrula quadrula	mapleleaf	
Tritogonia verrucosa	pistolgrip	
Uniomerus tetralasmus	pondhorn	
Subfamily Lampsilinae		
Lampsilis siliquoidea	fatmucket	
Lampsilis teres	yellow sandshell	
Leptodea fragilis	fragile papershell	
Ligumia subrostrata	pondmussel	
Obliquaria reflexa	threehorn wartyback	
Potamilus alatus	pink heelsplitter	
Potamilus ohiensis	pink papershell	
Potamilus purpuratus	bleufer	SC
Toxolasma parvum	lilliput	
Toxolasma texasiensis	Texas lilliput	
Truncilla truncata	deertoe	
Villosa lienosa	little spectaclecase	ST