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Freshwater mussels of the Vermilion and Little Vermilion Rivers in the Wabash River in Illinois

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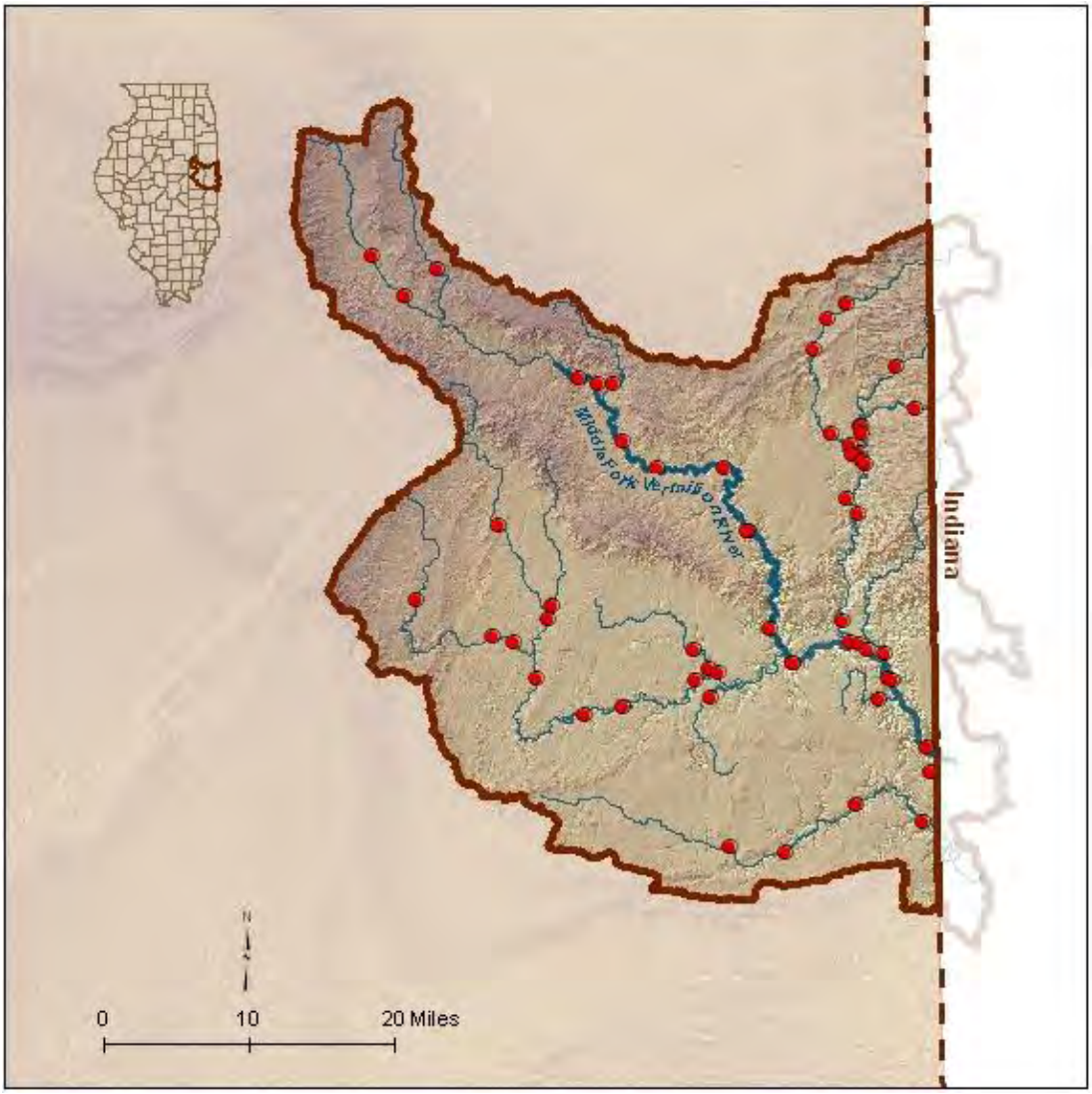

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Preface

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) and an additional 5 species are species in greatest need of conservation (SGNC; IDNR 2005). This report covers the Vermilion River of the Wabash basin (henceforth referred to as the Vermilion River) and the Little Vermilion River, a tributary of the Wabash River. We summarize the mussel surveys conducted in these basins from 2009 to 2012 in conjunction with IDNR and IEPA basin surveys and other targeted survey sites.

Location and Habitat

The Vermilion River basin is located in east-central Illinois and contains major tributaries of the Salt Fork, Middle Fork, and North Fork Vermilion Rivers. These principal tributaries combine to form the Vermilion River, which flows southeasterly from Vermilion County, Illinois into Vermillion County, Indiana. It flows into the Wabash River near Cayuga, Indiana (IDNR 2000). The Salt Fork Vermilion River originates in Champaign County, and drains an area of 1310 km^2 (506 mi^2). The Salt Fork flows eastward until it joins the Middle Fork Vermilion River; the confluence of the Salt Fork and Middle Fork form the Vermilion River near Catlin, Illinois. The Middle Fork originates in Livingston County and flows southeasterly through Ford, Champaign, and Vermilion Counties. The Middle Fork drains an area of 1134 km^2 (438 mi^2). The North Fork Vermilion River, located east of the Middle Fork, originates in Iroquois County and flows southward through Vermilion County and Benton and Warren Counties, Indiana. The North Fork drains an area of 761 km^2 (294 mi^2) and joins the Vermilion River near Danville, Illinois. The Little Vermilion River, located south of the Vermilion River basin, flows into the Wabash River near Newport, Indiana. The Little Vermilion originates in Champaign County, flows through Vermilion County, Illinois and Vermillion County, Indiana, and drains an area of 600 km^2 (213 mi^2) (Page et al. 1992; Cummings et al. 1998b; IDNR 2000). The Vermilion and Little Vermilion River basins flow through the Grand Prairie and Wabash Bottomlands natural divisions (Schwegman 1973).

Land use in this region is 89% agriculture, primarily row-crops, and forests or wetlands make up about 5% of the remaining area (IDNR 2000). Urban and developed areas make up 5% of land use, and lakes or open water account for the remaining 1% of land use (IDNR 1999). Major municipalities in the Vermilion River basin include Champaign-Urbana (urban population ~130,000), Danville (population 33,000), and Rantoul (population 13,000), and several smaller

townships exist throughout the basin (US Census Bureau 2010). The largest reservoir in the Vermilion River basin is Lake Vermilion, an impoundment built in 1925 on the North Fork Vermilion River, and it serves as the municipal water supply for Danville (Suloway et al. 1981, Marcelin 2002). A small low-head dam is also located south of Danville and is slated for possible removal (IDNR 2013, personal communication). A small impoundment on the Salt Fork Vermilion River near the town of Homer existed from 1900 to 1958 when it washed away (Suloway et al. 1981). The Little Vermilion River was impounded in 1936 near the town of Georgetown to form Georgetown Reservoir (Cummings et al. 1998b), which impacts about a mile of the river. Waste water treatment plants for Danville, Hoopeston, Paxton and Urbana release effluent into tributaries throughout the basin. A major source of aquatic pollution in the Salt Fork Vermilion River was untreated effluent from Urbana and other townships; while wastewater treatment plants have lessened the impact, degradation from effluent still persists (Baker 1922, Van Cleave 1940, Matteson and Dexter 1966, Suloway et al. 1981). The Vermilion River basin also has a history of shaft and strip-mined coal operations, and sand and gravel mines are present throughout the basin (IDNR 2000).

Much of the Vermilion River basin is characterized by a level plain that has been carved into steep valleys and ravines by the Vermilion River and its tributaries. Parts of the floodplain contain broad areas that were previously glacial lakes, and some terrace deposits persist from glaciation. Substrates vary throughout the drainage, but are primarily a mix of sand, gravel and cobble (Page et al. 1992, IDNR 2000). The upper reaches of each tributary are mainly sand and gravel, and areas of cobble, boulder and bedrock exist in lower reaches of the Vermilion River. Substrates in the Little Vermilion River are primarily gravel, sand, and silt in the upper reaches, and boulder, cobble, and gravel in the reach below Georgetown Reservoir (Page et al. 1992, Cummings et al. 1998b). Extensive dredging and channelization has occurred in the upper Salt Fork Vermilion River and the Little Vermilion River, and the upper reaches of the North Fork and Middle Fork drainages have been widened and dredged (Suloway 1981, IDNR 2000, Szafoni et al. 2000). The Middle Fork Vermilion River remains free-flowing and is Illinois' only National Wild and Scenic River (IDNR 2000).

Methods

Freshwater mussel data were collected at 58 sites between June and September of 2009-2012: 14 Salt Fork, 12 Middle Fork, 18 North Fork, 10 Vermilion River, and 4 Little Vermilion basin sites (Figure 1, Table 1). Locations of sampling sites are listed in Table 1 along with information regarding IDNR/IEPA sampling at the site. Site locations for mussel surveys matched those of IDNR/IEPA basin survey sites when applicable. Mussel data were collected twice at four sites to fulfill sampling objectives for other analyses, thus there were a total of 62 sampling occasions across 58 sites (Table 1).

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 most sites, although a 16-hour survey was implemented at 4 sites to fulfill sampling objectives for other analyses (Table 1).

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 *Toxolasma* species (*T. parvum* and *T. lividum*), 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). We were unable to collect length and growth rings at site 31 due to field conditions, thus we did not calculate an MCI (Table 2c).

Results

Species Richness

A total of 42 species of freshwater mussels were observed in the Vermilion River basin, 36 of which were live (Table 2). The number of species collected at a site ranged from 0 to 17 live, 0 to 18 extant (live + dead), and 0 to 23 total (live + dead + relict). Across all sites, the fatmucket (*Lampsilis siliquoidea*) was the most widespread species, collected in 40 of 62 sampling occasions (65% of sites). The fatmucket was also the most widespread species in the Salt Fork, Middle Fork, and North Fork drainages, collected at 53%, 86%, and 72% of sampling occasions (Figures 2a, 2b and 2c). In the Vermilion River drainage, the plain pocketbook (*Lampsilis cardium*), mapleleaf (*Quadrula quadrula*) and pistolgrip (*Tritogonia verrucosa*) were collected at

each site on the mainstem (Figure 2d). Threeridge (*Amblema plicata*), Wabash pigtoe (*Fusconaia flava*), plain pocketbook, and fatmucket were collected at all four sites in the Little Vermilion drainage (Figure 2e).

Abundance and Recruitment

Live mussels were collected at 49 of 58 sites, and a total of 4878 individuals were collected during 298 collector hours. The range of live individuals collected at a site during a 4-hour sample was 1 to 278. The most commonly collected species was the fatmucket (n=1045), which comprised 21% of all individuals collected (Table 2f). Other common mussels were the threeridge (n=949, 19%), Wabash pigtoe (n=711, 15%), and plain pocketbook (n=328, 7%). The most common mussel collected varied by drainage; threeridge were most common in the Middle Fork and Salt Fork drainages, fatmuckets in the North Fork and Little Vermilion drainages, and pink heelsplitters (*Potamilus alatus*) in the Vermilion River drainage (Table 2a-e).

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 observed at individual sites ranged from none to high across the basin; and 18 sites had observed recruitment in at least one species (Figure 3). We observed recruitment in >50% of species collected at site 8, the Salt Fork Vermilion River, and site 37, the Middle Branch North Fork Vermilion River. Six other sites had recruitment in 30-50% of species collected (sites 15, 16, 42, 47, 49, and 53) and 10 sites had recruitment in at least one species (reproduction values of “3”, Figure 3). Thirty sites had no recruitment (Figure 3).

Mussel Community Classification

Based on our survey data, nearly half of our sampled sites in the Vermilion River basin are classified as Highly Valued or Unique mussel resources (27 of 58 sites) under the current MCI classification system (Figure 3). Unique mussel resources were located at two sites in Big Four Ditch (Middle Fork Vermilion; sites 15 and 16), three Vermilion River sites (46-48), and one Little Vermilion River site (57). Highly Valued mussel resources were found at three Salt Fork sites (9, 10, and 14), seven Middle Fork sites (17-19, 21-23, and 26), eight North Fork sites (27-29, 33, 36, 38, 39, and 44), two Vermilion River sites (49 and 53), and two Little Vermilion River sites (55 and 58). Thirteen additional sites were Moderate mussel resources and two sites were Limited mussel resources (Figure 3). Nine sites were Restricted mussel resources because no live mussels were collected.

Noteworthy Finds

We found several populations of state-listed freshwater mussels through the Vermilion River basin and Little Vermilion River (Table 2f). State-endangered species found alive include rabbitsfoot (*Quadrula cylindrica*; n=13, 3 sites), wavyrayed lampmussel (*Lampsilis fasciola*; n=41, 11 sites), purple lilliput (*Toxolasma lividum*; n=1), and rainbow (*Villosa iris*; n=11; 4 sites). State-threatened species found alive include purple wartyback (*Cyclonaias tuberculata*; n=81, 11 sites), slippershell mussel (*Alasmidonta viridis*; n=2, 2 sites), black sandshell (*Ligumia recta*; n=13, 3 sites) and little spectaclecase (*Villosa lienosa*; n=146, 12 sites). While black sandshell had relict shell records from the Vermilion River, our survey was the first to locate live individuals. Other records of listed species include relict shell records of state-threatened spike (*Elliptio dilatata*; 17 sites), state-endangered round hickorynut (*Obovaria subrotunda*; 8 sites), and federally-endangered clubshell (*Pleurobema clava*; 15 sites). We collected dead shell of state-endangered kidneyshell (*Ptychobranchus fasciolaris*; 1 site dead, 6 sites relict) and federally-endangered (presumed extirpated) rayed bean (*Villosa fabalis*; 1 site dead, 2 sites relict). Our survey also documented two new records for the Vermilion River basin; we collected fawnsfoot (*Truncilla donaciformis*; n=6) and threehorn wartyback (*Obliquaria reflexa*; n=3) at two sites each in the Vermilion River.

Discussion

Historical Species

The Vermilion River basin has been surveyed several times over the past century and comprehensive publications are available (Baker 1922, Matteson and Dexter 1966, Suloway et al. 1981, Cummings et al. 1998, and Marcelin 2002). These surveys provide a rare opportunity to track species composition of this drainage over time (Table 5). Our survey was the most intensive effort to date to document the mussel fauna of the Vermilion River; we collected 42 species in the Vermilion River drainage (2 of which were new species records) although 45 are known historically (Table 2). While the basin maintains fairly intact fauna when examined broadly, many sites have undergone species' loss that is similar to loss seen in other areas of Illinois and North America (Williams et al. 1993, Tiemann 2007). In many cases, the historical species data for a specific site generally exceeded the live or extant collections during our survey (e.g., sites 25, 32, or 39 in Table 2). Continued monitoring or further investigation of these areas may be warranted to prevent further loss or potential extirpation.

Species records from published surveys or documented in the INHS Mollusk Collection that we did not find include fanshell (*Cyprogenia stegaria*), northern riffleshell (*Epioblasma rangiana*), snuffbox (*Epioblasma triquetra*), salamander mussel (*Simpsonaias ambigua*), and washboard (*Megalonaias nervosa*). With the exception of the washboard, these species are state- or

federally-endangered and are rare throughout their ranges. With the exception of the re-introduced northern riffleshell (more discussion below), we presume that these species are likely extirpated in the Vermilion River drainage. The washboard was only collected in Matteson and Dexter's survey (1966) and is common in medium to large rivers in Illinois. Other species that may be extirpated from the Vermilion River drainage are spike, round hickorynut, ellipse (*Venustaconcha ellipsiformis*), kidneyshell, and rayed bean. Although relict or dead shells were collected of these species during our surveys, they have not been located alive since at least 1966 (e.g., Matteson and Dexter). The clubshell, located alive in the Middle Branch North Fork in 1998 (Szafoni 2000), was only collected as relict shell in our survey; this species, however, was also re-introduced into the Salt Fork Vermilion River in 2012 (personal communication with IDNR and INHS biologists). Shells of the salamander mussel have been collected a few times in the Vermilion basin since the 1990s (INHS Mollusk Collection) and this thin-shelled species may persist in specific habitats where its host, the mudpuppy (*Necturus maculosus*), is extant.

The Little Vermilion was surveyed more intensively by Cummings et al. (1998b), and 24 species were documented compared to the 19 found by our survey (Table 5). We did not find elktoe (*Alasmidonta marginata*), paper pondshell (*Utterbackia imbecillis*), pimpleback (*Quadrula pustulosa*), pondhorn (*Uniomerus tetralasmus*), mucket (*Actinonaias ligamentina*), purple lilliput, or rainbow. Elktoe, paper pondshell, pimpleback and pondhorn are found throughout Illinois and are considered stable in their ranges, and mucket is quite common in larger rivers in Illinois. Purple lilliput and rainbow, both state-endangered, are rare throughout their ranges and may be extirpated in the Little Vermilion River. Our failure to locate these species in our survey may indicate that they are no longer extant in the Little Vermilion River; more intensive sampling would be needed to determine the species' existence. We did find new records of pistolgrip (dead shell at site 58) and pink heelsplitter (n=6, 2 sites), and these species may be colonizing the lower portion of the Little Vermilion River.

Mussel communities of the Vermilion River drainage

The Salt Fork Vermilion River has a history of disturbance and water quality issues, yet areas with highly valuable mussel populations still persist. The upper portion was completely dredged and channelized prior to 1920, and both treated and untreated wastewater has been released into the river since at least 1900. Historical publications described portions of the upper Salt Fork as inhospitable to aquatic life due to untreated effluent (Baker 1922 and Matteson 1966). Suloway et al. (1981) reported that nitrogen levels continued to exceed IEPA standards, and siltation had increased markedly since Baker's study (1922). Current IEPA nitrogen standards are within an acceptable range, although total phosphorus levels are elevated in the upper Salt Fork (site 1; IEPA 2012). Our survey found few live mussels in the

upper portion of the Salt Fork, with the Spoon River being an exception. Mussels have persisted in the Spoon River since Baker's study and, optimistically, may serve as a source population for the upper Salt Fork in the future. Mussel populations in the Salt Fork improve in the lower portion of the watershed (e.g., more individuals and species seen at site 9 and areas downstream than in most of upper watershed; Figure 1), and populations of diverse, reproducing mussels (i.e., Highly Valued mussel resources) remain in a few areas in the Salt Fork (sites 9, 10, and 13). Furthermore, the Salt Fork (as well as the Middle Branch North Fork) was selected as a relocation site for the federally-endangered northern riffleshell due to optimal habitat and presence of the bluebreast darter (*Etheostoma camurum*), the host fish (Tiemann 2008; and personal communication with INHS and IDNR staff).

The Middle Fork Vermilion River supports several sites with noteable mussel populations. Several sites ranked as Unique (sites 15 and 16 in Big Four Ditch) or Highly Valued mussel resources (sites 17-19, and 21-23, Wall Town Drainage Ditch and Middle Fork Vermilion River). Big Four Ditch in particular supports high densities of the state-threatened little spectaclecase (n=78 at site 16 during a 16-hour survey) and other high densities of common mussels such as cylindrical papershell, threeridge, and Wabash pigtoe (Table 2b). Additionally, we collected over 100 individuals at 4 different sites (sites 15-17 and 22) and each of these sites had at least 8 species collected alive, indicating evenness in the population. A few conservation areas exist in this drainage, such as Middle Fork Forest Preserve, Kickapoo State Park and Middle Fork Fish and Wildlife Area, although much of the river near and downstream of site 24 (Figure 1) have been strip-mined for gravel or minerals in the past. The mussel populations appear to have suffered, since our survey recorded Moderate, Limited or Restricted mussel resources in the lower section of the Middle Fork River (Figure 3).

The North Fork Vermilion River reportedly supports more state-listed aquatic species than any other medium sized river in Illinois (Szafoni et al. 2000), and our survey of the freshwater mussel fauna corroborates this statement. We found state-listed mussels at several sites, and in some cases, these are the only locations of the species known in Illinois. The North Fork has been the only location in Illinois in the past decade with multiple collection records of live rabbitsfoot, and we found 15 live individuals across 3 sites (site 36 in the Middle Branch North Fork and sites 38 and 39 in the North Fork). Another notable find was a dead shell of the presumed-extirpated rayed bean at site 38, which provides slight evidence that these rare, tiny mussels (maximum size = 1.5", Cummings and Mayer 1992) may persist in this drainage. The only purple lilliput collected in our survey was found in the Middle Branch North Fork (site 32), and the only other known populations of this mussel in Illinois are in Big Grand Pierre Creek, an Ohio River tributary (INHS Mollusk Collection) and Brushy Fork in the Embarras River basin (Shasteen et al. 2012). While we did not locate live or dead clubshell, we found relict shells at 7 sites in this drainage, and this drainage is the location of the last known live clubshell in Illinois

(Szafoni et al. 2000). One potentially troubling find in our survey were the age and condition of listed mussels encountered; although these species are persisting, we did not document much, if any, reproduction and many individuals collected appeared old and weathered (Figure 4).

In the Vermilion River mainstem, we found Unique or Highly Valued mussel resources at every site sampled (sites 46-49 and 53). Additionally, we collected the most live species at site 47 (n=17 live species), and this included state-threatened black sandshell. Based on historical collections, it appears that black sandshells have recently colonized the Vermilion River in Illinois (Table 5). Other species that seem to have colonized the Vermilion River within the past decade include fawnsfoot, hickorynut, pink papershell, pink heelsplitter (also found in North Fork, Middle Fork, and Little Vermilion drainages), and threehorn wartyback (Tables 2d and 5). Reproducing individuals of several species were found at each site on the Vermilion River mainstem (Figure 3). We are encouraged by these trends as they may represent improvement in water quality and host fish populations in the lower Vermilion River.

Little Vermilion River

The Little Vermilion River is a direct tributary to the Wabash River and has a smaller drainage area than the Vermilion River, hence having fewer species. Nevertheless, each site sampled in this drainage was a Highly Valued or Unique mussel resource (Table 2e, Figure 3). Notable collections include a live slippershell mussel (site 55), and live little spectaclecase at 2 sites (55 and 56). Relict shells of little spectaclecase were collected at the remaining 2 sites (57 and 58). Additionally, sites sampled in the Little Vermilion supported high densities of mussels, although the species distribution was skewed towards one or two species (e.g., fatmucket or threeridge; Table 2e). Threats to the Little Vermilion River include intensive agriculture in the upper portion of the drainage (e.g., the vicinity of sites 55 and 56), and Georgetown Reservoir, which hinders fish host movement upstream and has altered the flow velocity of areas upstream. The reservoir, however, also serves as a catch basin for silt and sedimentation from runoff, and this may be preserving the integrity of substrates downstream (Cummings et al. 1998b).

Summary

The Vermilion River of the Wabash continues to support diverse, abundant, and rare populations of freshwater mussels. The basin, however, has undergone species' loss concurrent with other areas in Illinois and North America (Williams et al. 1993 and Tiemann 2007). Aquatic impairments, such as municipal wastewater effluent, channelization, impoundments, or mining operations, likely have contributed to the decline in species in this drainage and further disturbance may exacerbate species' loss. Although some species are considered extirpated from this basin, many rare and listed species persist. The condition of the populations (e.g., weathered and aged individuals) should be noted, and further sampling

may be needed to determine current reproductive status of these rare populations. The Vermilion River drainage is unique due to its high diversity in a mid-sized watershed, and populations of mussels that exist only in this basin are invaluable. Protecting the aquatic habitat should be of the utmost importance to conservation managers and the public.

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Table 1. 2009-2012 Vermilion River basin tributary sites. Types of samples include MU-mussel sampling, W-water chemistry, F-fish sampling, FF-fish flesh, M-macroinvertebrate, H-habitat. *16-hour survey, [a]multiple samples.

Site Number	IEPA Code	Stream	Types of Samples	County	Location
Salt Fork Vermilion River drainage					
1	BPJG-01	Upper Salt Fork Drainage Ditch	MU,W,F,M,H	Champaign	2 mi E Rantoul, 1900E
2	BPJD-02	Spoon River	MU,W,F,M,H	Champaign	3.5 mi N St. Joseph, 1950N
3	BPJ-07	Upper Salt Fork Drainage Ditch	MU,W,F,M,H	Champaign	2.5 mi N St. Joseph, 1850N
4	BPJC-08	Saline Branch Drainage Ditch	MU,W,F,M,H	Champaign	1.5 mi N Urbana, 2000N
5[a]	BPJC-06	Saline Branch Drainage Ditch	MU,W	Champaign	3.7 mi WNW St. Joseph, 1900E
6	BPJC-10	Saline Branch Drainage Ditch	MU,W,F,M,H	Champaign	2 mi WNW St. Joseph, 1700N
7	BPJ-09	Salt Fork Vermilion River	MU,W,F,M,H	Champaign	1.5 mi SSW St. Joseph, 1500N
8	BPJ-12	Salt Fork Vermilion River	MU,W,F,FF,M,H	Champaign	4.8 mi SSE St. Joseph, 1200N
9	BPJ-10	Salt Fork Vermilion River	MU	Champaign	2 mi NNE Homer, 2800E
10	BPJ-18	Salt Fork Vermilion River	MU	Vermilion	2 mi S Muncie, 500E
11	BPJB-03	Stony Creek	MU,W,F,M,H	Vermilion	Muncie, 500E
12	BPJB-01	Stony Creek	MU	Vermilion	1.25 mi SE Muncie, 1600N
13	BPJ-08	Salt Fork Vermilion River	MU,W,F,M,H	Vermilion	2 mi SSE Muncie, 1550N
14	BPJA-01	Jordan Creek	MU,W,F,M,H	Vermilion	2 mi NNE Fairmount, 600E
Middle Fork Vermilion River drainage					
15	BPKP-06	Big Four Ditch	MU	Ford	3.6 Mi S Melvin, 800N
16*[a]	BPKP-05	Big Four Ditch	MU,W,F,M,H	Ford	1.5 mi NW Perdueville, 1300E
17	BPKS-01	Wall Town Drainage Ditch	MU	Ford	4 mi NW Paxton, 700N
18	BPK-15	Middle Fork Vermilion	MU	Champaign	6 mi N Gifford, 2500E
19	BPK-13	Middle Fork Vermilion	MU,W,F,M,H	Champaign	5 mi N Penfield, 3500N
20	BPKK-01	Sugar Creek	MU	Champaign	5.5 mi N Penfield, 3500N
21	BPK-14	Middle Fork Vermilion River	MU	Champaign	2 mi N Penfield, 3200N
22*	BPK-12	Middle Fork Vermilion River	MU	Vermilion	0.75 mi SW Armstrong, Rt 49
23	BPK-11	Middle Fork Vermilion River	MU	Vermilion	0.5 mi S Potomac, 750E
24	BPKE-01	Collison Branch	MU	Vermilion	2 mi NE Collison, 900E
25[a]	BPK-10	Middle Fork Vermilion River	MU,W,F,M,H	Vermilion	2.5 mi ENE Collison, 900E
26	BPK-07	Middle Fork Vermilion River	MU,W,F,M,H	Vermilion	Kickapoo State Park, 1450N
North Fork Vermilion River drainage					
27	BPG-97	North Fork Vermilion River	MU	Vermilion	1.5 mi E Hoopeston, Rt 9
28	BPG-12	North Fork Vermilion River	MU,W,F,M,H	Vermilion	1.5 mi S Hoopeston, 4000N
29	BPG-10	North Fork Vermilion River	MU	Vermilion	3.5 mi S Hoopeston, 3800N
30	BPG-14	North Fork Vermilion River	MU	Vermilion	3.5 mi S Rossville, Rt 1
31	BPGE-06	Middle Branch North Fork Vermilion River	MU	Vermilion	5 mi ENE Rossville, 3650N
32	BPGE-05	Middle Branch North Fork Vermilion River	MU	Vermilion	3.5 mi SE Rossville, 1700E
33	BPGC-02	Jordan Creek	MU,W,F,M,H	Vermilion	6 mi ESE Rossville, 2100E
34	BPGC-03	Jordan Creek	MU	Vermilion	4 mi SE Rossville, 1700E
35	BPGE-03	Middle Branch North Fork Vermilion River	MU	Vermilion	1 mi NNW Alvin, 3200N
36	BPGE-01	Middle Branch North Fork Vermilion River	MU	Vermilion	0.5 mi W Alvin, Barlow Park
37	BPGE-04	Middle Branch North Fork Vermilion River	MU	Vermilion	3.5 mi ENE Henning, 1650E
38	BPG-13	North Fork Vermilion River	MU	Vermilion	1 mi W Alvin, 3045N
39	BPG-11	North Fork Vermilion River	MU	Vermilion	0.75 mi WSW Alvin, 3020N
40	BPG-06	North Fork Vermilion River	MU	Vermilion	0.75 mi SW Alvin, Rt 119
41	BPG-09	North Fork Vermilion River	MU,W,F,M,H	Vermilion	2 mi W Bismarck, 2750N
42	BPG-96	North Fork Vermilion River	MU	Vermilion	1.25 mi SW Bismarck, 2650N
43	BPG-02	North Fork Vermilion River	MU	Vermilion	Danville, Harrison Park Golf Course
44	BPG-01	North Fork Vermilion River	MU	Vermilion	Danville, Ellsworth Park
Vermilion River and tributaries					
45	BPI-01	Butler Branch	MU	Vermilion	2.7 mi NNW Catlin, 1580N
46	BP-04	Vermilion River	MU,W,F,FF,M,H	Vermilion	2.5 mi N Catlin, 1200E
47	BP-10	Vermilion River	MU	Vermilion	Danville, downstream of dam
48	BP-05	Vermilion River	MU	Vermilion	Danville, I-74 bridge
49	BP-01	Vermilion River	MU,W	Vermilion	3.5 mi SE Danville, 1860N
50	BPFA-01	Lick Creek	MU	Vermilion	2 mi ESE Danville, 1650N
51	BPF-01	Stony Creek	MU	Vermilion	3.6 mi SE Danville, 1440N
52	BPE-03	Grape Creek	MU,W,F,M,H	Vermilion	2 mi NE Westville, Twin Hills Rd.
53	BP-03	Vermilion River	MU,W,F,M,H	Vermilion	4 mi E Westville, Forest Glen canoe launch
54	BPB-01	Whippoorwill Branch	MU	Vermilion	5 mi E Georgetown, 2100E
Little Vermilion River drainage					
55*[a]	BO-08	Little Vermilion River	MU,W,F,M,H	Vermilion	1 mi N Sidell, 600E
56*	BO-09	Little Vermilion River	MU	Vermilion	1 mi SE Indianola, Hwy 16
57	BO-05	Little Vermilion River	MU	Vermilion	1 mi S Georgetown, Hwy 150
58	BO-07	Little Vermilion River	MU,W,F,M,H	Vermilion	4 mi SE Georgetown, 500N

Table 2. Mussel data for sites sampled during 2009-2012 surveys (Table 1) in the Illinois tributaries. 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. Species in bold are listed species or SGNC. 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.

Table 2a. Salt Fork Vermilion River (14 sites).

Species	Salt Fork Vermilion River															Prop.
	1	2	3	4	5a	5b	6	7	8	9	10	11	12	13	14	of total
Subfamily Anodontinae																
Alasmidonta marginata									R	1				1		1.02%
Alasmidonta viridis																-
Anodontoides ferussacianus	R	R	1	D	1	R	R	R				1	1		R	2.03%
Lasmigona complanata		D	1	D					R		R			R		0.51%
Lasmigona compressa	R			D												-
Lasmigona costata										2	R			3		2.54%
Pyganodon grandis		D		D		R		R								-
Strophitus undulatus	D	5	R					R	R	D	1	1				3.55%
Utterbackia imbecillis			R													-
Subfamily Ambleminae																
Amblema plicata		43	D				R	R	R	1	2			2		24.37%
Cyclonaias tuberculata										7	4			14		12.69%
Elliptio dilatata			R				R				R					-
Fusconaia flava		8					R	R	R		1			1		5.08%
Pleurobema clava											R			R		-
Pleurobema sintoxia									R		R			R		-
Quadrula metanevra														2		1.02%
Quadrula pustulosa									R	10	2			4		8.12%
Quadrula quadrula									R	4	1			8		6.60%
Tritogonia verrucosa										1	R			1		1.02%
Uniomerus tetralasmus				R	R	R		R								-
Subfamily Lampsilinae																
Actinonaias ligamentina										2	D			1		1.52%
Lampsilis cardium							R		R	4	11			9		12.18%
Lampsilis fasciola										5	2	D		6	R	6.60%
Lampsilis siliquoidea		2			1	R	R		3	3	1	8	2	R	5	12.69%
Obovaria subrotunda														R		-
Toxolasma lividum								R	R		R			R		-
Toxolasma parvum		R		D	R	R	R	R								-
Villosa fabalis																-
Villosa iris									R		1			1		1.02%
Villosa lienosa		D	D	R			R	R	R					R		-
Individuals collected	0	58	2	0	2	0	0	0	3	40	26	10	3	53	5	197
Live species collected	0	4	2	0	2	0	0	0	1	11	10	3	2	13	1	17
Extant species	1	7	4	5	2	0	0	0	1	12	11	4	2	13	1	21
Total species collected	3	9	7	7	4	5	8	9	13	12	18	4	2	20	3	28
Historical species richness	2	9	NDA	5	NDA	NDA	NDA	7	NDA	15	20	6	8	20	9	
Catch per unit effort (CPUE)	0	14.5	0.5	0	0.5	0	0	0	0.75	10	6.5	2.5	0.75	13.25	1.25	
Mussel Community Index (MCI)	0	11	7	0	4	0	0	0	9	14	13	9	6	13	6	
Resource Classification	R	M	L	R	R	R	R	R	M	HV	HV	M	L	HV	L	

Table 2b. Middle Fork Vermilion River (12 sites).

Species	Middle Fork Vermilion River														Prop.
	15	16a*	16b	17	18	19	20	21	22*	23	24	25a	25b	26	of total
Subfamily Anodontinae															
Alasmidonta marginata										R				R	-
Alasmidonta viridis									1						0.05%
Anodontoides ferussacianus	19	180	9	27	4	D	10	10	1		D		1		13.09%
Lasmigona complanata	D	22	5	D	2	1		R	3	D	R	R	R		1.65%
Lasmigona compressa			D	3		R		1							0.20%
Lasmigona costata		1			R				1	D			R	1	0.15%
Pyganodon grandis	1	38	10	2	1	R	1		D	R					2.66%
Simpsonaias ambigua															-
Strophitus undulatus	4	64	3	20	1	1	8	3	5	R		R		D	5.47%
Subfamily Ambleminae															
Amblema plicata	224	181	50	161	D	1		R	D	R	R	R			30.94%
Cyclonaias tuberculata					D			1	3	5					0.45%
Elliptio dilatata						R			R	R		R			-
Fusconaia flava	6	283	109	5	1	D		3	24	R	R	R	R	R	21.61%
Pleurobema clava									R	R	R				-
Pleurobema sintoxia		1	1			D		1	5	D					0.40%
Quadrula cylindrica									R						-
Quadrula pustulosa					D	1		R	41	3		R	R	D	2.26%
Quadrula quadrula					7	4		2	17	1				1	1.60%
Tritogonia verrucosa					R	2		1	52	1		D		R	2.81%
Uniomerus tetralasmus		2	1				1								0.20%
Subfamily Lampsilinae															
Actinonaias ligamentina						1			R	9	R				0.50%
Lampsilis cardium		2	1	R	8	25		6	19	13		1	3	16	4.71%
Lampsilis fasciola										2			R	R	0.10%
Lampsilis siliquoidea	1	57	20	12	12	25		6	4	2		1	2	5	7.37%
Leptodea fragilis															-
Ligumia recta															-
Obovaria subrotunda									R	R			R	R	-
Potamilus alatus														1	0.05%
Ptychobranchus fasciolaris						R			R		R				-
Toxolasma lividum															-
Toxolasma parvum	D	3	D	R	R	R	1	1							0.25%
Venustaconcha ellipsiformis										R			R		-
Villosa fabalis															-
Villosa iris									R	R					-
Villosa lienosa	1	78	6	1	1	1		3	2	R					4.66%
Individuals collected	256	912	215	231	37	62	21	38	178	36	0	2	6	24	1994
Live species collected	7	13	11	8	9	10	5	12	14	8	0	2	3	5	22
Extant species	9	13	13	9	12	13	5	12	16	11	1	3	3	7	22
Total species collected	9	13	13	11	15	18	5	15	23	22	7	9	10	12	30
Historical species richness	2	8	8	NDA	NDA	18	1	1	27	18	6	26	26	14	
Catch per unit effort (CPUE)	64	57	53.75	57.75	9.25	15.5	5.25	9.5	11.13	9	0	0.333	1.5	6	
Mussel Community Index (MCI)	16	18	15	14	15	12	9	15	14	13	0	4	6	10	
Resource Classification	U	U	HV	HV	HV	HV	M	HV	HV	HV	R	R	L	M	

Table 2c. North Fork Vermilion River (18 sites).

Species	North Fork Vermilion River																		Prop.
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	of total
Subfamily Anodontinae																			
Alasmidonta marginata			1	D		R			R			R	R	R		R		R	0.16%
Alasmidonta viridis					D	R			D										-
Anodontoides ferussacianus	1	10	2		R		1						R						2.22%
Lasmigona complanata	R	2	41	2	R		D	D	R		D	D	D	R	R	R		R	7.13%
Lasmigona compressa		2	1																0.48%
Lasmigona costata		1	D	R		R	1	R	R	1		D	R	R	D	R		R	0.48%
Pyganodon grandis	D	R	5	R	1		D	D	R	R			R	D			21	7	5.39%
Simpsonaias ambigua																			-
Strophitus undulatus	D	7	10	R			R					D	R			R			2.69%
Utterbackia imbecillis																	1		0.16%
Subfamily Ambleminae																			
Amblema plicata	D	5	5	R	1	R	R	R		R	R	R	1	R	R	R			1.90%
Cyclonaias tuberculata				R				1		40	D	2	D	R	1	R			6.97%
Elliptio dilatata			R	R			R				R	R							-
Fusconaia flava	2	19	32	3	3	D	13	D	R	8		2	R	1	1	1		R	13.47%
Pleurobema clava				R						R	R	R	R		R	R			-
Pleurobema sintoxia	D	7	1	1	1	R	1	R	D	15	D	1	R	R	1	R			4.44%
Quadrula cylindrica										7		5	3	R		R			2.38%
Quadrula pustulosa																			-
Quadrula quadrula																	75	5	12.68%
Tritogonia verrucosa																	5	3	1.27%
Subfamily Lampsilinae																			
Actinonaias ligamentina												R							-
Epioblasma rangiana																			-
Lampsilis cardium	R	R	14	4	1	1	2		D	15	4	4	7	3	1	2			9.19%
Lampsilis fasciola			R		D	R			D	5		4	3	1		1		1	2.38%
Lampsilis siliquoidea	9	20	22	2	65	1	16	R	1	2	D	1	1	1	D	R	1	R	22.50%
Leptodea fragilis																	3	6	1.43%
Obovaria subrotunda																R			-
Potamilus alatus																	1	1	0.32%
Ptychobranchus fasciolaris									D										-
Toxolasma lividum	D	D		R		1	R		R		R		R						0.16%
Toxolasma parvum							R			R								1	0.16%
Truncilla truncata																	3		0.48%
Venustaconcha ellipsiformis											R								-
Villosa fabalis												D			R				-
Villosa iris				R		R	R	D	R	8	R	D	1	D	R				1.43%
Villosa lienosa	D	1	D			D	D		R	R		R	R	R		R			0.16%
Individuals collected	12	74	134	12	72	3	34	1	1	101	4	19	16	6	4	4	110	24	631
Live species collected	3	10	11	5	6	3	6	1	1	9	1	7	6	4	4	3	8	7	25
Extant species	9	11	13	6	8	5	9	5	6	9	5	12	8	6	6	3	8	7	28
Total species collected	11	13	15	15	10	12	15	9	14	14	11	18	18	14	11	15	8	12	33
Historical species richness	15	10	9	20	10	18	10	NDA	19	21	7	18	26	21	23	20	6	NDA	
Catch per unit effort (CPUE)	3	18.5	33.5	3	18	0.75	8.5	0.25	0.25	25.25	1	4.75	4	1.5	1	1	27.5	6	
Mussel Community Index (MCI)	12	14	15	7	-	9	12	9	9	15	11	13	12	11	11	11	11	12	
Resource Classification	HV	HV	HV	L	-	M	HV	M	M	HV	M	HV	HV	M	M	M	M	HV	

Table 2d. Vermilion River and tributaries (10 sites).

Species	Vermilion River and Tributaries								Prop.
	46	47	48	49	50	51	52	53	of total
Subfamily Anodontinae									
Alasmidonta marginata				R					-
Lasmigona complanata				R					-
Lasmigona costata	3	1	1					R	0.96%
Pyganodon grandis		2					R	1	0.57%
Strophitus undulatus	6								1.15%
Subfamily Ambleminae									
Amblema plicata	14		1					R	2.87%
Cyclonaias tuberculata	3	R	R						0.57%
Elliptio dilatata		R	R	R				R	-
Fusconaia flava	10	1							2.11%
Pleurobema clava			R	R				R	-
Pleurobema sintoxia	4		R						0.77%
Quadrula cylindrica									-
Quadrula metanevra	1	2						1	0.77%
Quadrula pustulosa	17	1	D	1				1	3.83%
Quadrula quadrula	6	15	1	3				5	5.75%
Tritogonia verrucosa	5	6	2	2				2	3.26%
Subfamily Lampsilinae									
Actinonaias ligamentina	2	1						R	0.57%
Epioblasma rangiana									-
Lampsilis cardium	15	50	12	3				1	15.52%
Lampsilis fasciola	11	D		R					2.11%
Lampsilis siliquoidea	1	2	R						0.57%
Lampsilis teres		1		R				1	0.38%
Leptodea fragilis		41	13	3				3	11.49%
Ligumia recta		7	5	1				R	2.49%
Obliquaria reflexa				1				2	0.57%
Obovaria olivaria				D				2	0.38%
Obovaria subrotunda				R				R	-
Potamilus alatus		113	72	18				23	43.30%
Potamilus ohiensis		1		2				5	1.53%
Ptychobranchus fasciolaris				R					-
Toxolasma lividum									-
Toxolasma parvum						R			-
Truncilla donaciformis		2						4	1.15%
Truncilla truncata		32	2	3				10	9.00%
Venustaconcha ellipsiformis									-
Villosa lienosa									-
Individuals collected	98	278	109	37	0	0	0	61	522
Live species collected	14	17	9	10	0	0	0	14	24
Extant species	14	18	10	11	0	0	0	14	24
Total species collected	14	20	15	19	0	1	1	21	31
Historical species richness	16	27	28	NDA	NDA	NDA	NDA	24	
Catch per unit effort (CPUE)	24.5	69.5	27.25	9.25	0	0	0	15.25	
Mussel Community Index (MCI)	16	19	16	14	0	0	0	15	
Resource Classification	U	U	U	HV	R	R	R	HV	

Table 2e. Little Vermilion River (4 sites).

Species	Little Vermilion River					Prop.
	55a*	55b	56*	57	58	of total
Subfamily Anodontinae						
Alasmidonta viridis	1	R				0.07%
Anodontoides ferussacianus	3	2	6	R		0.75%
Lasmigona complanata			8	64	4	5.19%
Lasmigona compressa	1	1	1		R	0.20%
Lasmigona costata				40	12	3.55%
Pyganodon grandis	1	D	D	8	R	0.61%
Strophitus undulatus				D	1	0.07%
Utterbackia imbecillis						-
Subfamily Ambleminae						
Amblema plicata	179	35	12	26	5	17.55%
Elliptio dilatata					R	-
Fusconaia flava	97	6	66	1	4	11.89%
Quadrula quadrula				9	3	0.82%
Tritogonia verrucosa					D	-
Uniomerus tetralasmus						-
Subfamily Lampsilinae						
Actinonaias ligamentina						-
Lampsilis cardium	1	1	19	28	22	4.85%
Lampsilis siliquoidea	591	67	7	60	3	49.73%
Leptodea fragilis				10	1	0.75%
Potamilus alatus				5	1	0.41%
Ptychobranchus fasciolaris					R	-
Toxolasma lividum						-
Toxolasma parvum	R	R		R		-
Villosa iris						-
Villosa lienosa	29	16	7	R	R	3.55%
Individuals collected	903	128	126	251	56	1464
Live species collected	9	7	8	10	10	15
Extant species	8	8	9	11	11	16
Total species collected	9	10	9	14	16	19
Historical species richness	11	11	12	16	16	
Catch per unit effort (CPUE)	56.44	32	7.875	62.75	14	
Mussel Community Index (MCI)	14	12	12	16	12	
Resource Classification	HV	HV	HV	U	HV	

Table 2f: All sites sampled in the Vermilion River and Little Vermilion River (58 sites, 62 sampling occasions). *includes *Cyprogenia stegaria*, *Epioblasma rangiana*, *Epioblasma triquetra*, *Megalonaias nervosa*, and *Simpsonaias ambigua*, not included in the table.

Species	Total individuals	No. sites live	No. sites extant	No. sites relict	Proportion of total live
Subfamily Anodontinae					
Alasmidonta marginata	3	3	4	15	0.06%
Alasmidonta viridis	2	2	4	6	0.04%
Anodontoides ferussacianus	290	20	23	32	5.92%
Lasmigona complanata	155	12	22	37	3.16%
Lasmigona compressa	10	7	9	12	0.20%
Lasmigona costata	68	13	17	29	1.39%
Pyganodon grandis	99	14	23	34	2.02%
Strophitus undulatus	140	16	22	31	2.86%
Utterbackia imbecillis	1	1	1	2	0.02%
Subfamily Ambleminae					
Amblema plicata	949	20	24	42	19.38%
Cyclonaias tuberculata	81	11	14	19	1.65%
Elliptio dilatata	0	0	0	17	-
Fusconaia flava	711	28	31	42	14.52%
Pleurobema clava	0	0	0	15	-
Pleurobema sintoxia	40	13	18	27	0.82%
Quadrula cylindrica	15	3	3	6	0.31%
Quadrula metanevra	6	4	4	4	0.12%
Quadrula pustulosa	81	10	13	17	1.65%
Quadrula quadrula	167	18	18	19	3.41%
Tritogonia verrucosa	83	13	15	18	1.69%
Uniomerus tetralasmus	4	3	3	7	0.08%
Subfamily Lampsilinae					
Actinonaias ligamentina	16	6	7	11	0.33%
Lampsilis cardium	328	35	36	41	6.70%
Lampsilis fasciola	41	11	15	21	0.84%
Lampsilis siliquoidea	1045	40	42	49	21.34%
Lampsilis teres	2	2	2	3	0.04%
Leptodea fragilis	80	8	8	8	1.63%
Ligumia recta	13	3	3	4	0.27%
Obliquaria reflexa	3	2	2	2	0.06%
Obovaria olivaria	2	1	2	2	0.04%
Obovaria subrotunda	0	0	0	8	-
Potamilus alatus	235	9	9	9	4.80%
Potamilus ohiensis	8	3	3	3	0.16%
Ptychobranchus fasciolaris	0	0	1	6	-
Toxolasma lividum	1	1	3	12	0.02%
Toxolasma parvum	6	4	7	21	0.12%
Truncilla donaciformis	6	2	2	2	0.12%
Truncilla truncata	50	5	5	5	1.02%
Venustaconcha ellipsiformis	0	0	0	3	-
Villosa fabalis	0	0	1	2	-
Villosa iris	11	4	7	16	0.22%
Villosa lienosa	146	12	18	32	2.98%
					Totals
				Individuals collected	4878
				Live species collected	36
				Extant species collected	38
				Total species collected	42
				Historical species (collected prior to 2009)	45*

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

Table 5. Summary of published historical surveys and our survey (2013). L=live, D=dead shell, R=relict shell, and (known) refers to a species reported by the publication but not found during the actual surveys. Species in bold are listed or SGNC.

	Little Vermilion		Vermilion-Wabash basin					
publication name	Cummings et al.	Current Survey	Baker	Matteson & Dexter	Sulloway et al.	Cummings et al.	Marcelin	Current survey
publication year	1998	2013	1922	1966	1981	1998	2002	2013
# sites and/or sampling hours (if known)	20 sites	4 sites, 44 hours	31 sites	26 sites	28 sites, 72 hours	12 sites	18 sites	58 sites, 298 hours
Subfamily Anodontinae								
Alasmidonta marginata	D	-	L	L	L	L	L	L
Alasmidonta viridis	L	L	-	-	-	-	D	L
Anodontoides ferussacianus	L	L	L	L	L	L	L	L
Lasmigona complanata	L	L	L	L	L	L	L	L
Lasmigona compressa	L	L	L	L	L	L	L	L
Lasmigona costata	L	L	L	L	L	L	L	L
Pyganodon grandis	L	L	L	L	L	L	L	L
Strophitus undulatus	L	L	L	L	L	L	L	L
Utterbackia imbecillis	L	-	L	L	-	-	-	L
Subfamily Ambleminae								
Amblema plicata	L	L	L	L	L	L	L	L
Cyclonaias tuberculata	-	-	L	L	L	L	L	L
Elliptio dilatata	R	R	-	L	-	R	R	R
Fusconaia flava	L	L	L	L	L	L	L	L
Megalonaias nervosa	-	-	-	L	-	-	-	-
Pleurobema clava	-	-	L	L	-	R	D	R
Pleurobema sintoxia	-	-	L	L	L	L	L	L
Quadrula cylindrica	-	-	L	L	L	L	L	L
Quadrula metanevra	-	-	L	L	-	-	L	L
Quadrula pustulosa	R	-	L	L	L	-	L	L
Quadrula quadrula	L	L	L	L	L	L	L	L
Tritogonia verrucosa	-	D	L	L	L	L	L	L
Uniomerus tetralasmus	L	-	L	-	-	-	-	L
Subfamily Lampsilinae								
Actinonaias ligamentina	D	-	L	L	L	-	L	L
Epioblasma rangiana	-	-	(known)	-	-	-	-	-
Lampsilis cardium	L	L	L	L	L	-	L	L
Lampsilis fasciola	-	-	L	L	L	L	L	L
Lampsilis siliquoidea	L	L	L	L	L	L	L	L
Lampsilis teres	-	-	L	-	-	-	R	L
Leptodea fragilis	L	L	-	-	-	L	L	L
Ligumia recta	-	-	-	-	-	-	R	L
Obliquaria reflexa	-	-	-	-	-	-	-	L
Obovaria olivaria	-	-	-	-	-	-	D	L
Obovaria subrotunda	-	-	L	L	L	R	R	R
Potamilus alatus	-	L	-	-	-	-	R	L
Potamilus ohiensis	-	-	-	-	-	-	L	L
Ptychobranchus fasciolaris	R	R	-	L	-	R	D	D
Toxolasma lividum	R	-	L	L	-	L	L	L
Toxolasma parvum	L	R	L	L	-	L	R	L
Truncilla donaciformis	-	-	-	-	-	-	-	L
Truncilla truncata	-	-	D	-	-	L	L	L
Venustaconcha ellipsiformis	-	-	L	L	-	-	-	R
Villosa fabalis	-	-	-	L	-	R	R	D
Villosa iris	R	-	D	L	L	L	L	L
Villosa lienosa	L	L	L	L	L	L	L	L
Total species	**24**	**19**	**32**	**32**	**22**	**27**	**37**	**42**

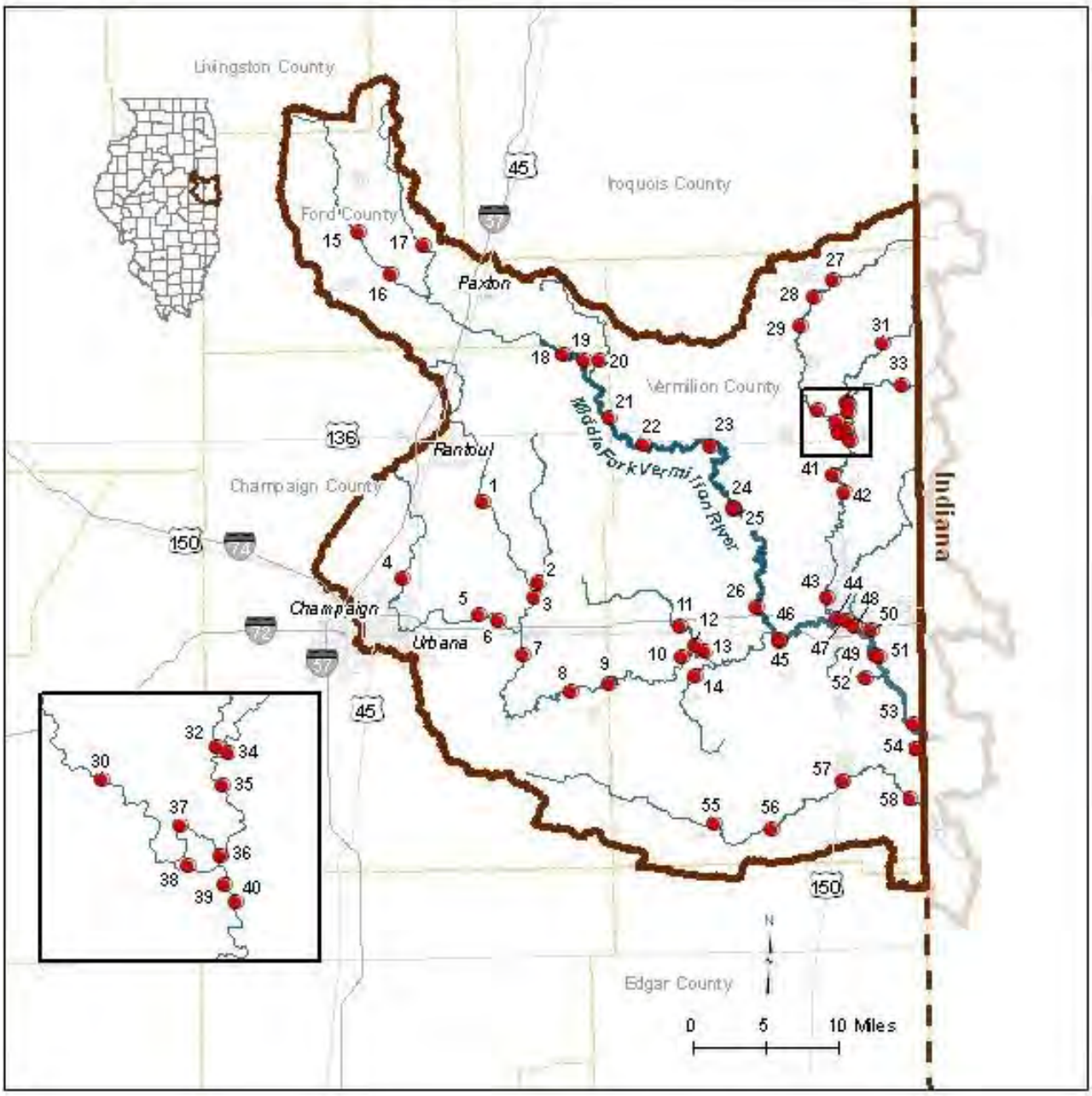

Figure 1. Sites sampled in the Vermilion-Wabash River basin in 2009 - 2012. Site codes referenced in Table 1.

Figure 2a. Salt Fork Vermilion River (14 sites)

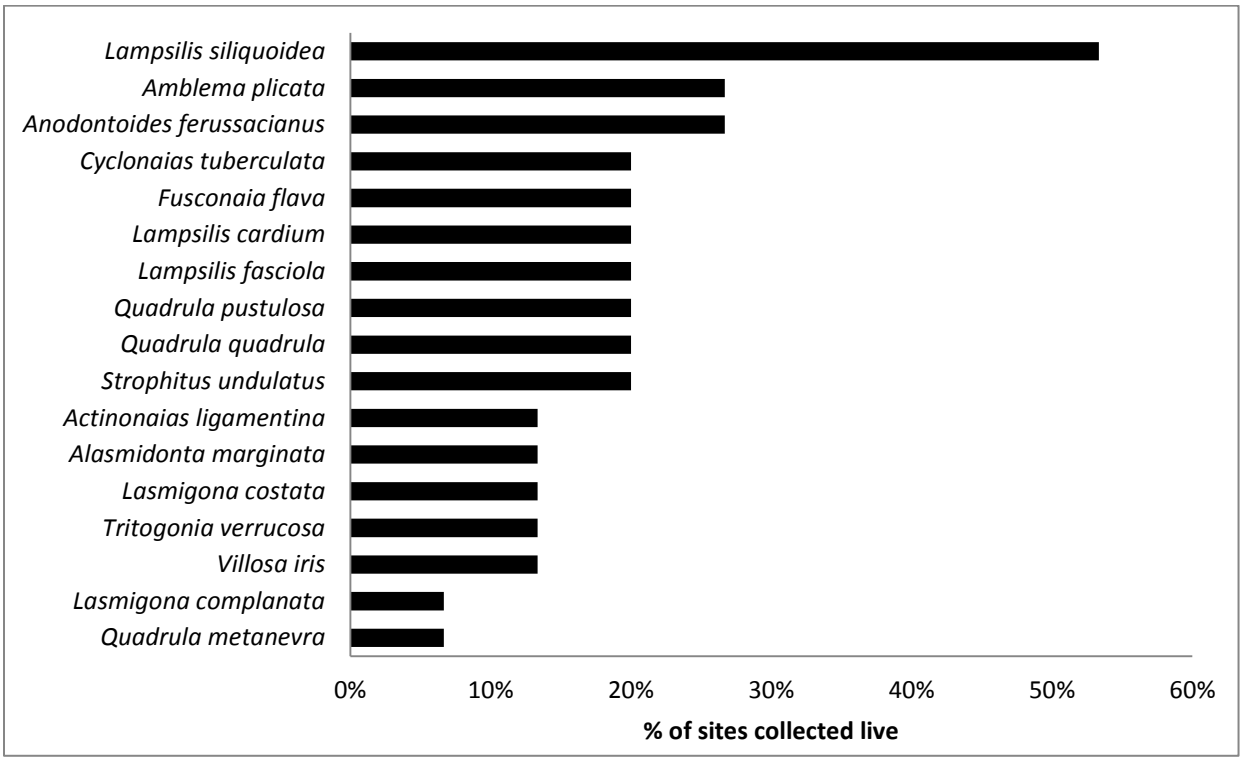

Figure 2b. Middle Fork Vermilion River (12 sites)

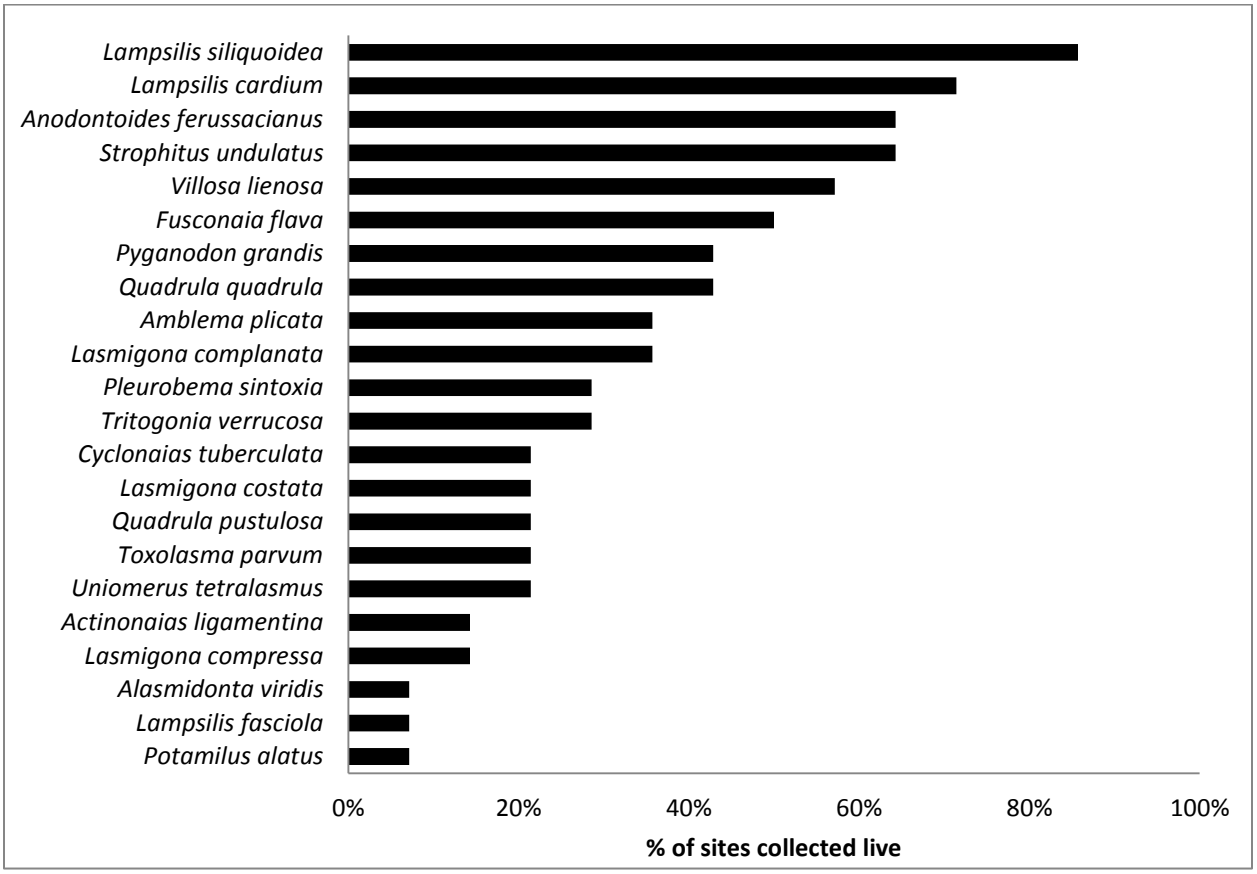

Figure 2c. North Fork Vermilion River (18 sites)

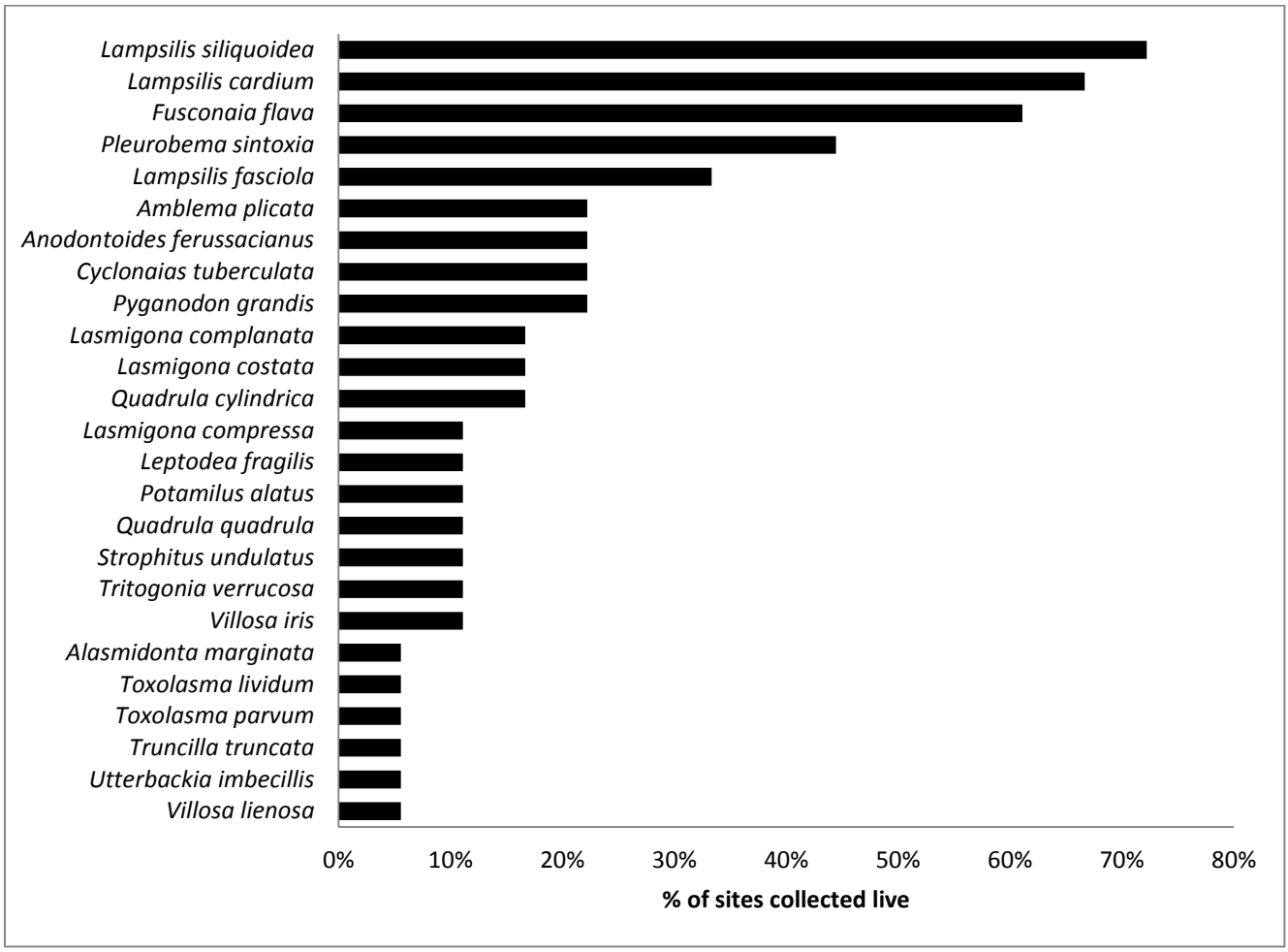

Figure 2d. Vermilion River and tributaries (10 sites)

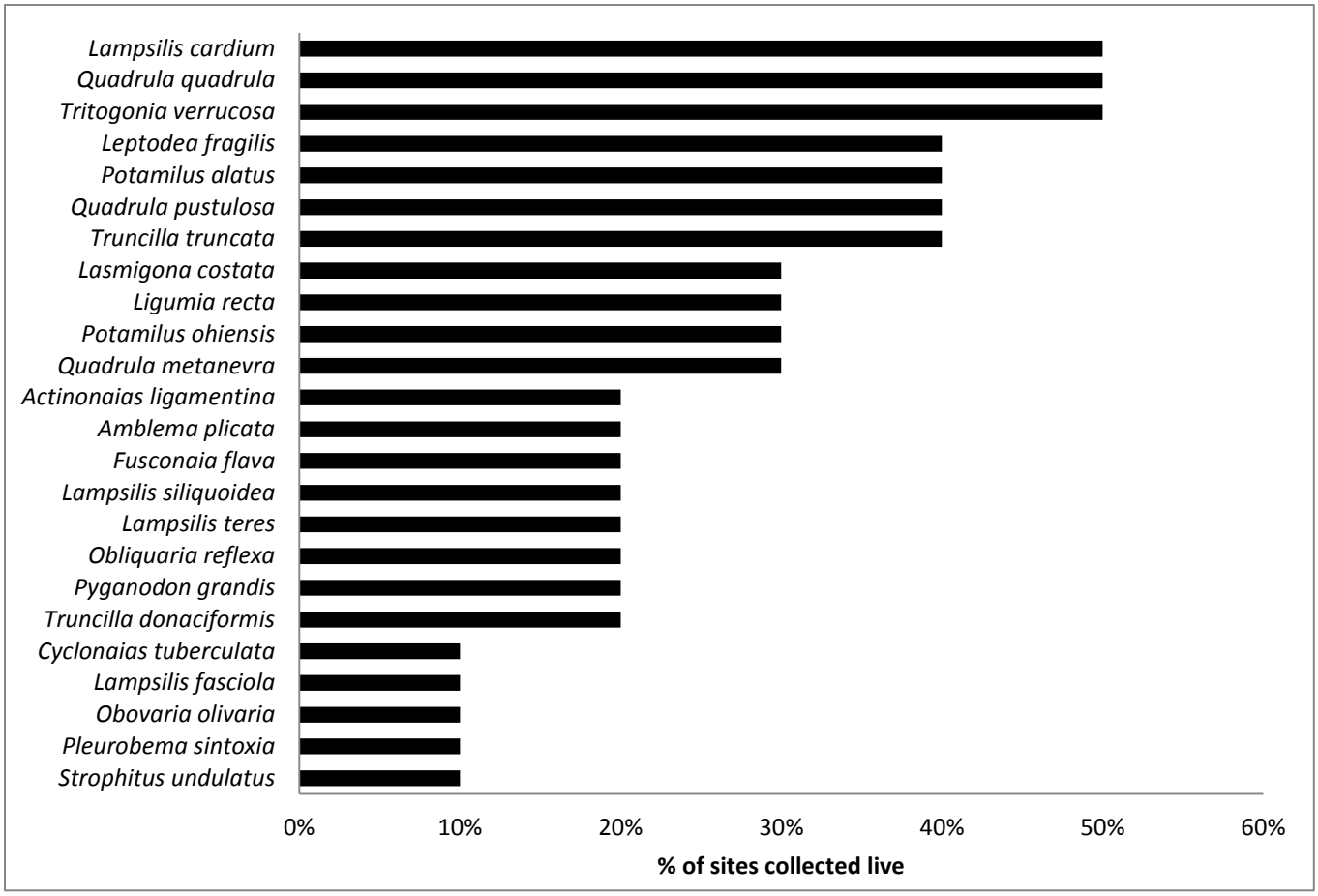

Figure 2e. Little Vermilion River (4 sites)

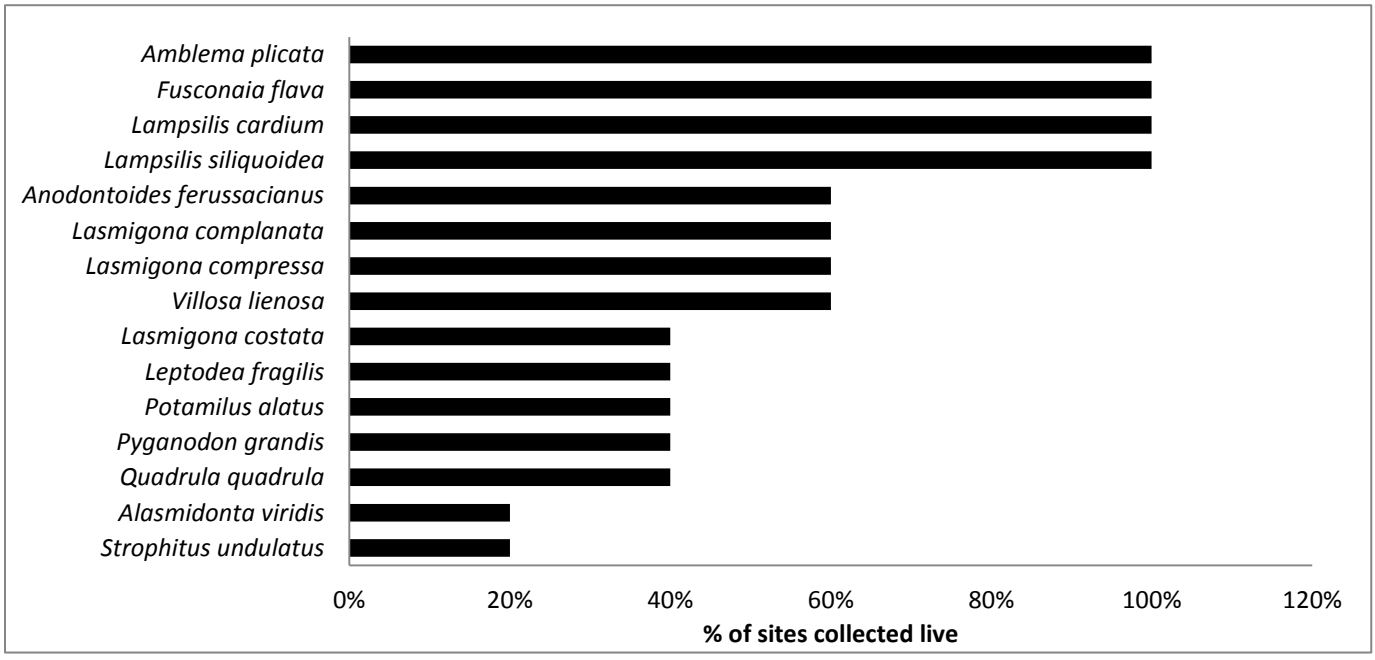

Figure 2. Number of sites where a species was collected live compared to the total number of samples collected in each drainage.

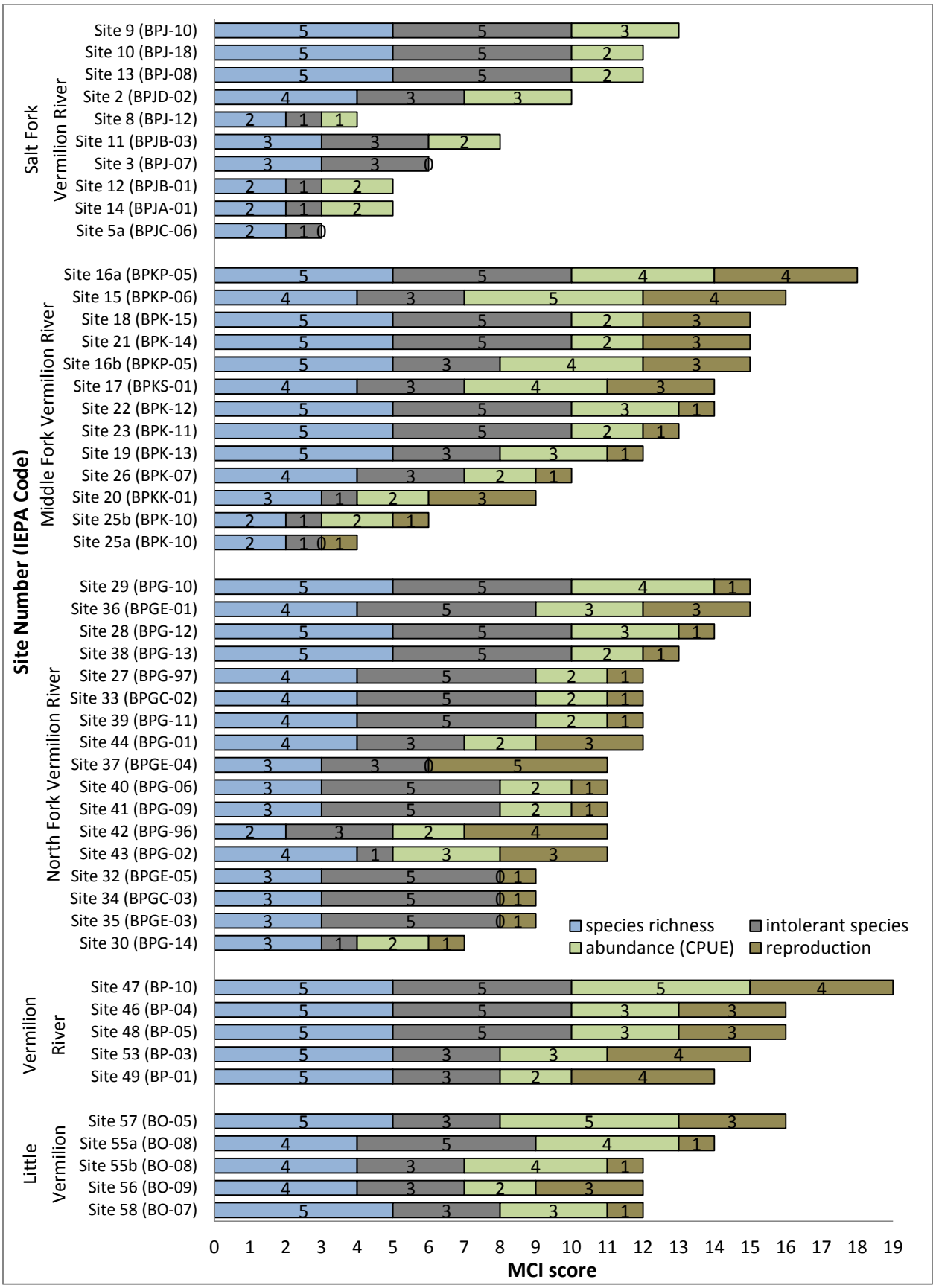

Figure 3. Mussel Community Index (MCI) and component scores for Vermilion River tributary sites based on Table 3.

Figure 4. State-endangered wavyrayed lampmussel (on left) and rabbitsfoot (on right) in North Fork Vermilion River (site 39, BPG-11). Note weathering of shells and growth rings, which may suggest a senescent population.

Appendix 1. Scientific and common names of species. Status (2013): SGNC-Illinois' species in greatest need of conservation, ST-state threatened, SE- state endangered, FE- federally endangered, X- extirpated.

Scientific name	Common name	Status
Subfamily Anodontinae		
Alasmidonta marginata	elktoe	
Alasmidonta viridis	slippershell mussel	ST
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	
Cyclonaias tuberculata	purple wartyback	ST
Elliptio dilatata	spike	ST
Fusconaia flava	Wabash pigtoe	
Megalonaias nervosa	washboard	
Pleurobema clava	clubshell	FE
Pleurobema sintoxia	round pigtoe	
Quadrula cylindrica	rabbitsfoot	SE
Quadrula metanevra	monkeyface	SGNC
Quadrula pustulosa	pimpleback	
Quadrula quadrula	mapleleaf	
Tritogonia verrucosa	pistolgrip	
Uniomerus tetralasmus	pondhorn	
Subfamily Lampsilinae		
Actinonaias ligamentina	mucket	
Cyprogenia stegaria	fanshell	FE
Epioblasma rangiana	northern riffleshell	FE
Epioblasma triquetra	snuffbox	FE
Lampsilis cardium	plain pocketbook	
Lampsilis fasciola	wavyrayed lampmussel	SE
Lampsilis siliquoidea	fatmucket	
Lampsilis teres	yellow sandshell	
Leptodea fragilis	fragile papershell	
Ligumia recta	black sandshell	ST
Obliquaria reflexa	threehorn wartyback	
Obovaria olivaria	hickorynut	
Obovaria subrotunda	round hickorynut	SE
Potamilus alatus	pink heelsplitter	
Potamilus ohiensis	pink papershell	
Ptychobranchus fasciolaris	kidneyshell	
Toxolasma lividum	purple lilliput	SE
Toxolasma parvum	lilliput	
Truncilla donaciformis	fawnsfoot	
Truncilla truncata	deertoe	
Venustaconcha ellipsiformis	ellipse	SGNC
Villosa fabalis	rayed bean	FE, X
Villosa iris	rainbow	SE
Villosa lienosa	little spectaclecase	SE