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## **Freshwater Mussels of the Kankakee River**

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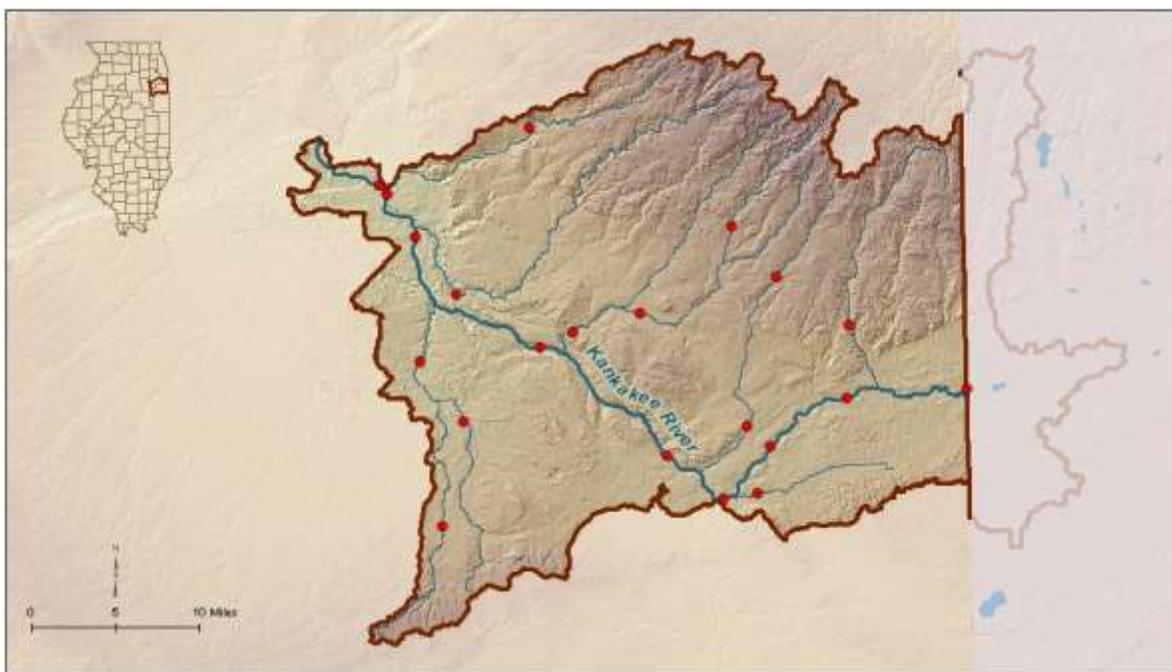
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# Freshwater Mussels of the Kankakee River in Illinois



2012

Illinois Natural History Survey, University of Illinois, Prairie Research Institute  
Illinois Department of Natural Resources

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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). The Kankakee River has been the subject of a myriad of surveys to document the aquatic fauna (summarized in Kwak 1993), and many of these surveys have focused on the rich mussel diversity that exists in the Kankakee River in Illinois. This report summarizes the mussel survey conducted in the Kankakee River basin in 2010 at IEPA/IDNR basin survey sites.

The Kankakee River basin drains nearly 13,400 km<sup>2</sup> (5173 mi<sup>2</sup>) in northeastern Illinois and northern Indiana, and approximately 5,600 km<sup>2</sup> (2170 mi<sup>2</sup>) of this drainage is contained in Illinois. The river flows westerly into Illinois from a large marsh in Indiana and merges with the Des Plaines River to form the Illinois River (Figure 1). The Kankakee River basin flows through the Grand Prairie and the Northeastern Morainal natural divisions, and the former makes up 90% of the basin (Schwegman 1973).

### **Land-use and Instream Habitat**

The primary land use of the Kankakee River basin is row crop agriculture, which comprises nearly 90% of the watershed (Illinois Department of Natural Resources 1998). The largest urban area in the basin is the Kankakee-Bradley Metropolitan Area with a population of about 110,000 (US Census Bureau 2010). The town of Kankakee withdraws water from the river for municipal use, and other municipalities rely on groundwater withdrawal that influences flow levels of tributary streams at times (Illinois Department of Natural Resources 1998). The Kankakee River is somewhat unique in Illinois, since channelization and impoundments are minimal on the mainstem of the river (Suloway 1981, Kwak 1993). The portion of the river that flows through Indiana has been extensively dredged beginning in the 19<sup>th</sup> century to improve drainage and currently exists as a sand-bottomed ditch (Suloway 1981, Kwak 1993). However, river reaches in Illinois were not significantly impacted by this dredging, since natural meanders and extensive runs of bedrock still dominate (Kwak 1993).

Much of the river in Illinois is on or near bedrock and contains areas of sand, gravel, and cobble that overlie the bedrock. The width of the river is highly variable and is nearly 300 meters wide in places. Large riffles comprised of cobble, bedrock, and fine sediments still exist in lower portions of the Kankakee River, and minor modifications to the channel in Illinois include low-head dams (>4 m height) in Momence, Kankakee, and Wilmington (Page et al. 1992). Tributary

streams vary substantially in habitat, as some streams are channelized agricultural ditches with sand, silt, and gravel substrate, while other tributaries contain large amounts of bedrock and emergent vegetation.

## Methods

During the 2010 survey, 21 sites were visited from June to September. Freshwater mussel data were collected at 20 sites: 7 mainstem and 13 tributary sites in the Kankakee River basin (Figure 1; Table 1). A standard mussel survey was not completed at site 1 (Table 1) due to non-wadeable water conditions. Locations of sampling sites are listed in Table 1 along with information regarding IDNR/IEPA sampling at the site. In most cases, mussel survey locations were the same as IDNR/IEPA sites. The results section only includes the 20 sites where standard data were collected.

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 30 species of freshwater mussels were observed in the Kankakee River basin, 27 of which were live (Table 2). Across all sites, the number of live species collected ranged from 1 to 16, the number of extant species collected (live + dead) ranged from 2 to 16, and the total number of species collected (live + dead + relict) ranged from 3 to 20. Tributaries contained fewer species than the mainstem, with 1 to 9 live species, 2 to 10 extant species, and 3 to 12 total species. Mainstem species richness ranged from 8 to 16 live species, 11 to 16 extant species, and 16 to 20 total species. In tributary sites, the plain pocketbook (*Lampsilis cardium*) and fatmucket (*Lampsilis siliquoidea*) had the most occurrences and were each collected at six of 13 sites (46%; Figure 2a). The mucket (*Actinonaias ligamentina*), cylindrical papershell (*Anodontoides ferussacianus*), creeper (*Strophitus undulatus*), giant floater (*Pyganodon grandis*), white heelsplitter (*Lasmigona complanata*), and ellipse (*Venustaconcha ellipsiformis*) were other commonly collected species, occupying 38% of tributary sites (Figure 2a). In mainstem sites, the mucket and fluted-shell (*Lasmigona costata*) had the most occurrences across sites and were collected at all mainstem sites (100%; Figure 2b). Other commonly occurring species in mainstem sites were the plain pocketbook, black sandshell (*Ligumia recta*), threeridge (*Amblema plicata*) and pimpleback (*Quadrula pustulosa*), with collections at six of seven sites (86%; Figure 2b).

### Abundance and Recruitment

A total of 1636 individuals were collected across 20 sites and the number of live specimens collected at a given site ranged from 1 to 343. The range of live specimens collected at tributary sites ranged from 1 to 141 and from 58 to 343 at mainstem sites. A total of 80 collector-hours were spent sampling, with an average of 9.5 mussels collected per hour at tributary sites and 40 mussels per hour at mainstem sites. The most abundant species across all sites was the mucket, which comprised 40% of all individuals collected. If only mainstem sites are considered, muckets made up nearly 60% of all mussels collected (Table 2). In tributary sites, the cylindrical papershell was the most common species and made up 25% of all mussels in our samples.

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 high across the basin. Recruitment levels, referred to in Table 3 as Reproduction Factor, varied from 1 to 5, and 75% of sites had no reproduction observed. Two sites, South Branch Rock Creek and West Branch Horse Creek (sites 14 and 17), had Reproduction Factors of 4 and 5 respectively, which indicates that greater than 30% of species exhibited reproduction. Reproduction factors at 3 sites, the Kankakee River at Kankakee, the I-55 bridge, and Forked Creek (sites 5, 8, and 19), indicated that between 1 and 30% of mussel species had recent recruitment. All other sites had less than 30% of species exhibiting reproduction.

### **Mussel Community Classification**

Based on the data collected in the 2010 basin survey, 70% of the sites in the Kankakee River basin are classified as Moderate, Highly Valued, or Unique mussel resources under the current MCI classification system (Table 4, Figure 3). The mainstem sites at Kankakee, Kankakee River State Park, and Des Plaines, sites 5, 6, and 8 respectively, stand out as Unique Resources due to the presence of intolerant species, the number of mussels collected, and the species richness of the site. The remaining four mainstem sites were classified as Highly Valued Mussel Resources. The tributary sites classified as Highly Valued mussel resources were Forked Creek (site 19), Trim Creek (site 9), East and West Branches of Horse Creek (sites 16 and 17) and Horse Creek (site 18). Six sites, Rock Creek, Spring Creek, and sites on Exline Slough and Prairie Creeks (sites 15, 10-12, and 20-21) were considered Limited or Restricted mussel resources.

### **Noteworthy Finds**

This survey collected 27 live species and 30 total species. Forty species were known historically from the Kankakee River basin, 10 of which were not collected at all during this survey, including the snuffbox (*Epioblasma triquetra*), ebonyshell (*Fusconaia ebena*), Higgins eye (*Lampsilis higginsii*), yellow sandshell (*Lampsilis teres*), spectaclecase (*Cumberlandia monodonta*), pink papershell (*Potamilus ohioensis*), salamander mussel (*Simpsonia ambigua*), pistolgrip (*Tritogonia verrucosa*), pondhorn (*Unio merus tetralasmus*), and rainbow (*Villosa iris*).

Three species, slippershell (*Alasmidonta viridis*), threehorn wartyback (*Obliquaria reflexa*) and paper pondshell (*Utterbackia imbecillis*) were only represented in these surveys by relict shell. Our survey also found relatively few live occurrences for the creek heelsplitter (*Lasmigona compressa*), mapleleaf (*Quadrula quadrula*), and fawnsfoot (*Truncilla donaciformis*), although dead and relict shell records were found at multiple sites.

Several state-listed species were found in our survey in mainstem sites on the Kankakee River (Table 2). Of particular note is the collection of federally-endangered sheepsnose (*Plethobasus cyphus*) at two sites, Aroma Park and at Route 17 (sites 4 and 5). The state-threatened black sandshell (*Ligumia recta*) was collected alive at six of seven mainstem sites, and relict shell was

collected at the remaining site (at Des Plaines Fish and Wildlife Area). The purple wartyback (*Cyclonaias tuberculata*), another state-threatened species, was located alive at four sites (sites 2, 3, 5, and 8) and dead shell material was collected at two additional sites (6 and 7). The state-threatened species, spike (*Elliptio dilatata*), was located alive at three sites (2 – 4), and relict shell was collected at three additional sites (5, 7, and 8).

## **Discussion**

### **Richness, Abundance and Recruitment**

As documented in previous surveys (Suloway 1981), the community composition of the Kankakee River mainstem is highly skewed towards muckets. Muckets were collected at every site along the mainstem and was often the most common species collected (exception is site 3, where pimpleback dominated). Muckets are quite common in the Kankakee River but are found only occasionally or sporadically in other drainages in Illinois (Cummings and Mayer 1997). The large, stable riffles of the Kankakee River provide suitable habitat for the mucket that may be lacking in other Illinois drainages.

The Kankakee River basin has a relatively high proportion of sites that are classified as Moderate, Highly Valued, or Unique mussel resources as compared to other basins throughout Illinois (per other basin reports published by INHS). The mainstem sites along the Kankakee were either Unique (sites 5, 6, and 8) or Highly Valued (sites 2-4, and 7), and this coincides with the classification by Bertrand et al. (1993) that listed the Kankakee as a “B Stream”, or a Highly Valued Aquatic Resource. Several tributary streams also were found to be Highly Valued mussel resources, concurrent with previous stream classifications (Bertrand et al. 1993). Contrary to these classifications, our survey found that six tributary sites were Limited or Restricted mussel resources. Of these six sites, only three sites had historical mussel data (Exline Slough, Rock Creek, and Prairie Creek; sites 12, 15, and 21). However, bedrock was the dominant substrate and little suitable mussel habitat existed at these sites. In addition, Rock Creek (site 15) may be experiencing a decline in mussel populations. The previous sample from Rock Creek in 2004 located 6 live species, and our survey only found 2 live species; sampling conditions may also have influenced the number of live species collected in our most recent survey due to rocky substrate, water depth, and emergent aquatic vegetation. The remaining three Limited or Restricted sites (10, 11, and 20) have no historical mussel data and appeared to be impaired by sedimentation and sloughing banks, possibly due to poor agricultural practices.

We observed very little recruitment at most sites sampled in our survey. While all mainstem sites had many individuals collected (>50), nearly all of the mussels collected in our surveys were large, older individuals. We only observed reproduction occurring at two sites among one

species at each site. Although growth rings only provide an estimate of age, we also have evidence that indicates that some mussels collected in our surveys are nearly 30 years old. At site 4 (Aroma Park), for example, we collected mussels that were marked during a survey in the 1980s (personal communication, K.S. Cummings) and these mussels were similar in size and shape to most other individuals collected (Figure 4). The species composition and density of mussels in the Kankakee River is good compared to other river systems in Illinois (Kwak 1993), but recruitment of juvenile mussels into the mainstem system may be lacking. Sampling methods to target juvenile mussels are necessary to better assess the reproductive status of populations in the Kankakee River. Two tributaries to the Kankakee, South Branch Rock Creek and West Branch Horse Creek (sites 15 and 17, respectively), exhibited relatively high reproduction values compared to other tributaries we sampled. These streams may provide nursery habitat or source populations for the mainstem river.

### **Noteworthy Finds**

Based on this survey and past surveys summarized by Page et al. (1992) and Sulloway (1981), we have identified several species that are most likely extirpated in the Kankakee River basin. We did not collect live or shell data for spectaclecase, snuffbox, ebonyshell, salamander mussel, Higgins eye, yellow sandshell, or rainbow, and many of these species have not been collected alive or via shell in several decades (INHS Collections database). All of these species are federally- or state-endangered and are rare throughout their range in Illinois. Spectaclecase, ebonyshell, Higgins Eye, and the salamander mussel were listed as likely extirpated in the Kankakee River by previous surveys (Cummings and Mayer 1997), and our survey found no evidence to the contrary. However, shells of the salamander mussel have been collected five times in the 1990s (INHS Mollusk Collection) and this thin-shelled species may still be extant in specific habitats in the Kankakee River where its host – the mudpuppy (*Necturus maculosus*) is still extant. Other species that were not located alive in our survey that are known historically include pistolgrip, paper pondshell, pink papershell, and state-listed slippershell. Both pistolgrip and pink papershell are on the periphery of their range in the Kankakee basin, thus are not expected to be abundant (Cummings and Mayer 1992). Paper pondshell 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). Yellow sandshell and slippershell were not collected during our survey; the only live record of slippershell is from Baker Creek, and this site was not part of the 2010 survey. The paucity of historical collections of these species in the Kankakee basin lends evidence that they have always comprised a relatively small portion of the mussel fauna.

Our survey provided a new collection record of threehorn wartyback in the Kankakee River, which had not been collected since the 1920s (INHS Collection database). Threehorn

wartybacks are common and widespread in the Illinois River. Our collection was from the Des Plaines Fish and Wildlife Area, which is the most downstream collection site on the river and hence the closest site to the Illinois River. A collection of threehorn wartyback here is not surprising, and this species likely exists alive in the lower Kankakee River.

## **Summary**

Our surveys documented the existence of 30 of the 40 species known historically from the Kankakee River basin. Additionally, our surveys found that 27 of these species were represented by live individuals. Although many species of freshwater mussels still inhabit the Kankakee River, this basin is experiencing species' decline that has been investigated throughout the past 100 years (Suloway 1981, Kwak 1993, Illinois Department of Natural Resources 1998). All previous documented surveys noted a decline in historical species richness, and our survey was no exception. At most sites with historical data available (eight of 12 sites), we collected fewer extant species than known historically (Table 2). While sampling conditions may influence the species collected at a given sampling event, it appears that mussel populations are still declining in the Kankakee River (Suloway 1981, Kwak 1993). While the precise factors that have caused the decline in mussel fauna may never be known, commonly cited factors include industrial and agricultural pollution, habitat loss, and sedimentation (Suloway 1981). Sedimentation from mobilized sand is a specific concern, since moving sand bars are destructive to existing mussel beds and sand deposition has been observed in the upper reaches of the river (Suloway 1981; personal observation by INHS sampling crews). The Kankakee River has been recognized as a Highly Valued aquatic resource (Page et al. 1992) and is still known for its faunal diversity (Kwak 1993), thus noting these species' losses and gains will be important in future monitoring efforts.

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**Table 1.** 2010 Kankakee River Intensive Basin Survey. Types of samples include MU-mussel sampling, BE-boat electrofishing, ES-electric fish seine, FF-fish flesh contaminate, H-habitat, M-macroinvertebrate, S-sediment, and W-water chemistry.

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed area (km <sup>2</sup> )
1	F-03	Kankakee River	MU, E, H, M, W	Kankakee	2 mi S Illinois, state line	4896.0
2	F-02	Kankakee River	MU, E, H, M, W	Kankakee	Momence, at boat ramp on island	5826.5
3	F-06	Kankakee River	MU, E, H, M, W	Kankakee	3.6 mi NE Aroma Park, off Rt. 17	5936.8
4	F-09	Kankakee River	MU, E	Kankakee	Near Aroma Park, upstream of RR bridge	11539.7
5	F-12	Kankakee River	MU, E, H, M, W	Kankakee	Kankakee, Rt. 45, downstream of dam	11749.2
6	F-04	Kankakee R	MU, E, H, M, W	Will	5.5 mi ESE Ritchie, downstream Warner bridge, Kankakee River State Park	12232.8
7	F-11	Kankakee River	MU, E, H, M, W	Will	Wilmington, below dam	12653.0
8	F-01	Kankakee River	MU, E, H, M, S, W	Will	4 mi NW Wilmington, upstream I-55 bridge, Des Plaines Fish & Wildlife Area	13156.7
9	FQ-01	Trim Creek	MU, E, FF, H, M, W	Kankakee	1 mi SW Grant Park, Co. Rd. 7000N bridge	87.3
10	FM-02	Spring Creek	MU, E, FF, H, M, W	Kankakee	2.3 mi E Aroma Park, along E Boy Scout Rd.	71.2
11	FKA-02	Exline Slough	MU, E, FF, H, M, W	Kankakee	5 mi ENE Manteno, Co. Rd. 10000N bridge	48.7
12	FKA-01	Exline Slough	MU, E, FF, H, M, W	Kankakee	4.3 mi NNE Aroma Park, Co. Rd. 1000N	115.9
13	FFBA-01	Black Walnut Cr	MU, E, FF, H, M, W	Will	1.6 mi S Peotone, W Kennedy Rd. bridge	49.5
14	FFB-01	South Branch Rock Creek	MU, E, FF, H, M, W	Kankakee	2.5 mi SW Manteno, Co. Rd. 1000W bridge	152.9
15	FF-01	Rock Cr	MU, E, FF, H, M, W	Kankakee	2 mi S Deselm, Co. Rd. 500W bridge, Kankakee River State Park	310.0
16	FCC-01	East Branch Horse Creek	MU, E, FF, H, M, W	Kankakee	2 mi W Bonfield, Co. Rd. 2000N bridge	117.3
17	FCB-02	West Branch Horse Cr	MU	Kankakee	1.5 mi WNW Herscher, Hwy. 115 bridge	80.2
18	FC-01	Horse Cr	MU, E, FF, H, M, W	Kankakee	2 mi ENE Essex, Co. Rd. 1400W bridge	290.9
19	FB-01	Forked Cr	MU, E, FF, H, M, W	Will	Ritchie, 5.6 mi E Braidwood, Leasure Rd.	270.9
20	FA-06	Prairie Creek	MU, E, FF, H, M, W	Will	2.4 mi SW Manhattan, Cherry Hill Rd. bridge	71.8
21	FA-01	Prairie Creek	MU, E, FF, H, M, W	Will	2.5 mi NW Wilmington, River Rd. bridge	124.9

**Table 2.** Mussel data for sites sampled during 2010 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. Species in bold are federally or state-listed species, or species in Greatest Need of Conservation by IL DNR. \*includes *Cumberlandia monodonta*, *Fusconaia ebena*, *Lampsilis higginsii*, *Lampsilis teres*, and *Unio merus tetralasmus* that are not in table.

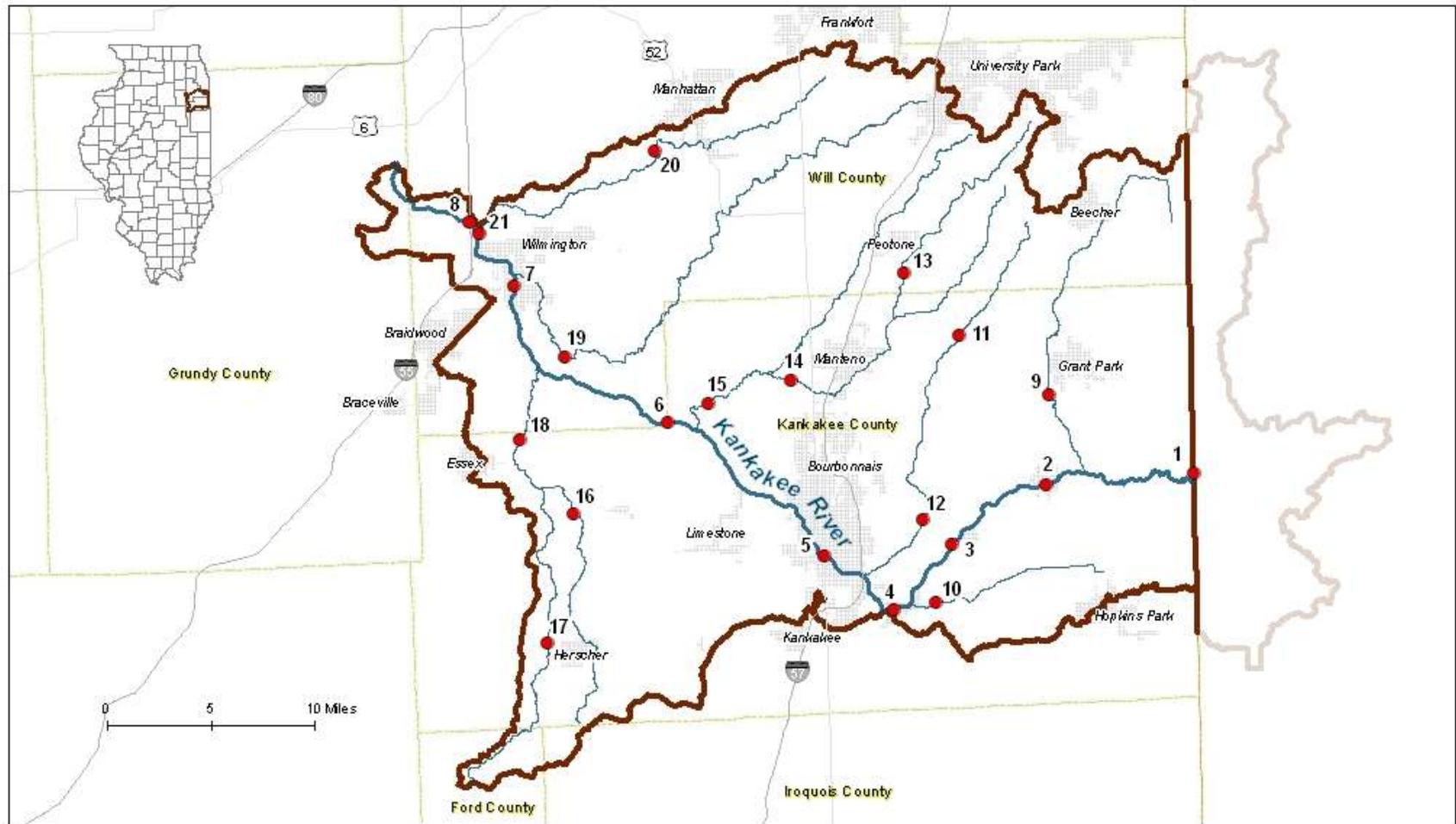
Species	Mainstem Site Number								Tributary Site Number											Proportion of total	Prop. of tributaries	Prop. of mainstem		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				21	
<b>Subfamily Anodontinae</b>																								
<i>Alasmidonta marginata</i>	1	3	D	5	2	2					R										0.8%	0.0%	1.1%	
<i>Alasmidonta viridis</i>								R			R			R				R		R	0.0%	0.0%	0.0%	
<i>Anodontoides ferussacianus</i>								D		2	R	98	1			26	D		1	R	7.8%	25.7%	0.0%	
<i>Lasmigona complanata</i>	1	5	1	3			D	1	40		R		D	4	R	R	7	1	1		3.9%	10.6%	1.0%	
<i>Lasmigona compressa</i>								R		R	D	R		2	R	R			R	R	0.1%	0.4%	0.0%	
<i>Lasmigona costata</i>	1	3	4	21	10	2	2									1		2	D		2.8%	0.6%	3.8%	
<i>Pyganodon grandis</i>	1	D	1	R				6		30	D			15	D	D	39	1		R	D	5.7%	18.3%	0.2%
<i>Simpsonia ambigua</i>																						0.0%	0.0%	0.0%
<i>Strophitus undulatus</i>					1	1	R	D				R	D	1	R	3	10	1	1	R	1.1%	3.2%	0.2%	
<i>Utterbackia imbecillis</i>		R																				0.0%	0.0%	0.0%
<b>Subfamily Ambleminae</b>																								
<i>Amblema plicata</i>	R	4	1	4	2	3	3	68				R						D	1		5.3%	13.9%	1.5%	
<i>Cyclonaias tuberculata</i>	3	6	R	18	D	D	1														1.7%	0.0%	2.5%	
<i>Elliptio dilatata</i>	4	1	1	R			R	R													0.4%	0.0%	0.5%	
<i>Fusconaia flava</i>	4	9	D	4	1	R	R								3		4	2			1.7%	1.8%	1.6%	
<i>Megalanaia nervosa</i>				10	1																0.7%	0.0%	1.0%	
<i>Plethobasus cyphus</i>	R	1	1					R													0.1%	0.0%	0.2%	
<i>Pleurobema sintoxia</i>	3	14	1	12	D	R	R											10			2.4%	2.0%	2.6%	
<i>Quadrula metanevra</i>	5	11	11	17	1		D														2.8%	0.0%	4.0%	
<i>Quadrula pustulosa</i>	15	110	34	25	D	3	1														11.5%	0.0%	16.5%	
<i>Quadrula quadrula</i>	1			R			R														0.1%	0.0%	0.1%	
<i>Tritogonia verrucosa</i>																					0.0%	0.0%	0.0%	
<b>Subfamily Lampsilinae</b>																								
<i>Actinonaias ligamentina</i>	23	10	94	203	222	31	56	2						1	3		3	1			39.7%	2.0%	56.2%	
<i>Epioblasma triquetra</i>																						0.0%	0.0%	0.0%
<i>Lampsilis cardium</i>	4	5	5	2	5	1	R	11	1				R	5	11	1	R	R	3	R	3.3%	6.4%	1.9%	
<i>Lampsilis siliquoidea</i>	1	1	1		R	D	R	13	D	R	R					1	19	R	2	2	5	2.8%	8.4%	0.3%
<i>Leptodea fragilis</i>				11	2	1	D															0.9%	0.0%	1.2%
<i>Ligumia recta</i>	3	2	8	7	4	1	R														1.5%	0.0%	2.2%	
<i>Obliquaria reflexa</i>								R														0.0%	0.0%	0.0%
<i>Potamilus alatus</i>					1	11	1															0.8%	0.0%	1.1%
<i>Potamilus ohioensis</i>																						0.0%	0.0%	0.0%
<i>Toxolasma parvum</i>					D			R			R	1	D	R	R	16			R	R	1.0%	3.4%	0.0%	
<i>Truncilla donaciformis</i>							1															0.1%	0.0%	0.1%
<i>Truncilla truncata</i>				1		1	1															0.2%	0.0%	0.3%
<i>Venustaconcha ellipsiformis</i>	1			D			D	1			2		R	R	1		2	10			1.0%	3.2%	0.1%	
<i>Villosa iris</i>																						0.0%	0.0%	0.0%
																						<b>Totals</b>	<b>Tributaries</b>	<b>Mainstem</b>
Individuals collected	71	185	163	343	252	58	66	141	1	32	2	99	28	12	13	117	14	31	3	5	1636	498	1138	
Live species collected	16	15	13	15	12	12	8	7	1	2	1	2	6	2	7	6	7	9	2	1	27	14	24	
Extant species	16	16	15	16	16	15	11	9	2	3	2	4	7	3	8	6	9	10	2	2	27	14	25	
Total species collected	18	17	16	19	17	19	20	12	3	5	11	5	8	9	11	7	12	11	8	4	30	16	27	
Historical species richness	13	6	25	24	14	14	26	13	NDA	NDA	4	NDA	NDA	12	NDA	NDA	13	NDA	NDA	4	40*			
CPUE	17.75	46.25	40.8	85.8	63	14.5	16.5	35.25	0.25	8	0.5	24.75	7	3	3.25	29.25	3.5	7.75	0.75	1.25				
MCI	14	15	15	18	16	14	16	12	4	6	6	11	8	6	12	12	12	15	4	6				
Resource Classification	HV	HV	HV	U	U	HV	U	HV	R	L	L	M	M	L	HV	HV	HV	HV	R	L				

**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		

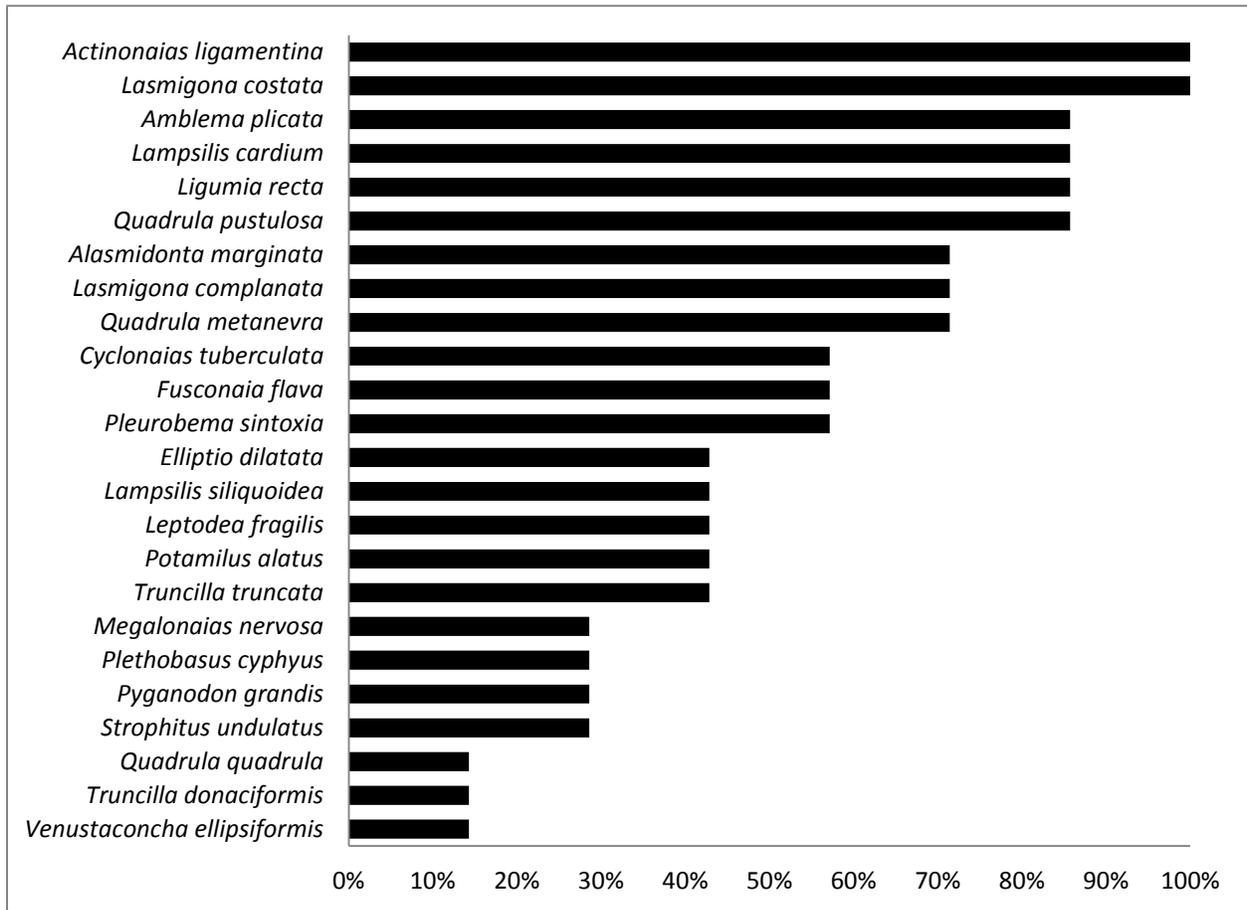
**Table 4.** Freshwater mussel resource categories based on species richness, abundance, and population structure. MCI = Mussel Community Index Score

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.

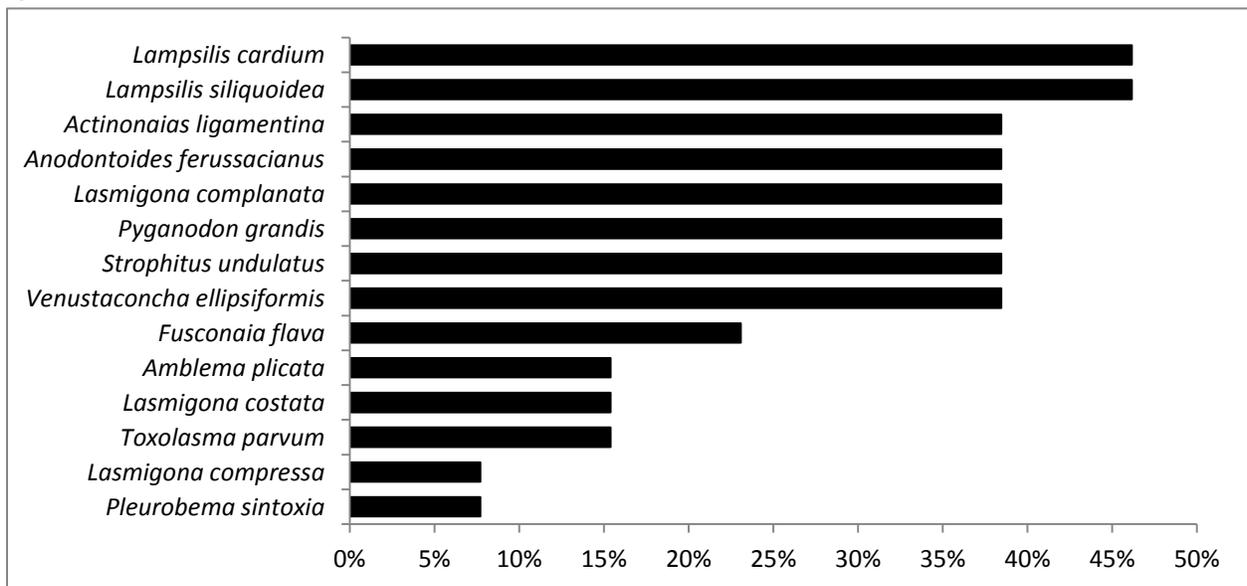


**Figure 1.** Sites sampled in the Kankakee River basin in 2010. Site codes referenced in Table 1.

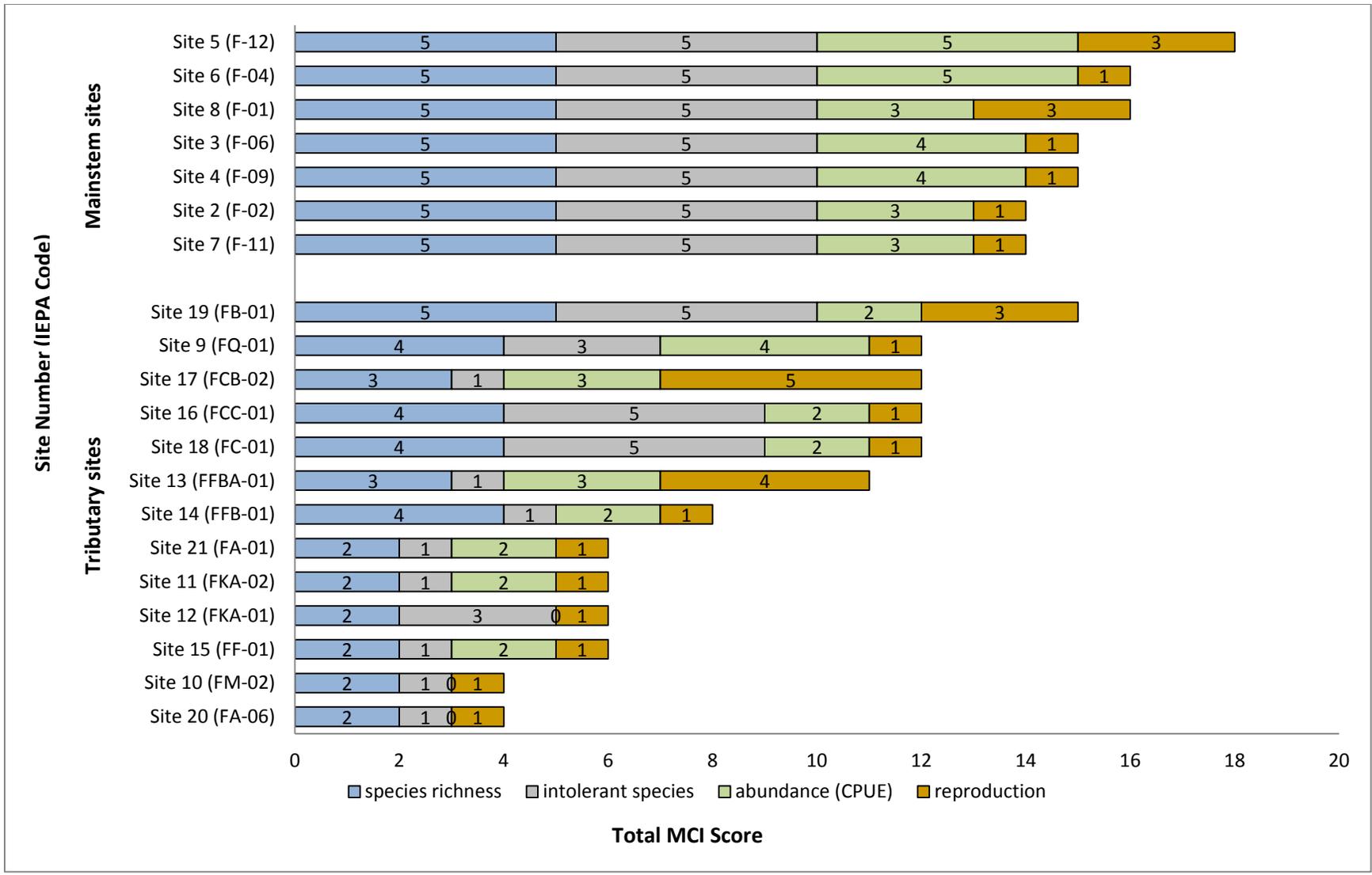
a)



b)



**Figure 2.** Number of sites where a species was collected live compared to the number of sites sampled in the mainstem (a. 7 sites) and tributaries (b.14 sites).



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

a)



b)



**Figure 4.** (a.) Mucket (*Actinonaias ligamentina*) collected and marked during 1980s in the Kankakee River at Aroma Park and recollected in 2010, compared to (b.) other freshwater mussels collected in the Kankakee River in 2010 at Kankakee River State Park (site 6).

Appendix 1. Scientific and common names of species. ST=state threatened, SE=state endangered, FE=federally endangered.

Scientific name	Common name	Status
<b>Subfamily Cumberlandinae</b>		
<i>Cumberlandia monodonta</i>	spectaclecase	FE
<b>Subfamily Anodontinae</b>		
<i>Alasmidonta marginata</i>	elktoe	
<i>Alasmidonta viridis</i>	slippershell	ST
<i>Anodontoides ferussacianus</i>	cylindrical papershell	
<i>Lasmigona complanata</i>	white heelsplitter	
<i>Lasmigona compressa</i>	creek heelsplitter	
<i>Lasmigona costata</i>	flutedshell	
<i>Pyganodon grandis</i>	giant floater	
<i>Simpsonaias ambigua</i>	salamander mussel	SE
<i>Strophitus undulatus</i>	creeper	
<i>Utterbackia imbecillis</i>	paper pondshell	
<b>Subfamily Ambleminae</b>		
<i>Amblema plicata</i>	threeridge	
<i>Cyclonaias tuberculata</i>	purple wartyback	ST
<i>Elliptio dilatata</i>	spike	ST
<i>Fusconaia ebena</i>	ebonyshell	ST
<i>Fusconaia flava</i>	Wabash pigtoe	
<i>Megalonaias nervosa</i>	washboard	
<i>Plethobasus cyphus</i>	sheepnose	FE
<i>Pleurobema sintoxia</i>	round pigtoe	
<i>Quadrula metanevra</i>	monkeyface	
<i>Quadrula pustulosa</i>	pimpleback	
<i>Quadrula quadrula</i>	mapleleaf	
<i>Tritogonia verrucosa</i>	pistolgrip	
<i>Unio merus tetralasmus</i>	pondhorn	
<b>Subfamily Lampsilinae</b>		
<i>Actinonaias ligamentina</i>	mucket	
<i>Epioblasma triquetra</i>	snuffbox	SE
<i>Lampsilis cardium</i>	plain pocketbook	
<i>Lampsilis higginsi</i>	Higgins eye	FE
<i>Lampsilis siliquoidea</i>	fatmucket	
<i>Lampsilis teres</i>	yellow sandshell	
<i>Leptodea fragilis</i>	fragile papershell	
<i>Ligumia recta</i>	black sandshell	ST
<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	
<i>Venustaconcha ellipsiformis</i>	ellipse	
<i>Villosa iris</i>	rainbow	SE

