

# MDOT Mussel Relocation Site Selection: M-46 - Black River, Sanilac County



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**Cover Photos:** Inset, Slippershell from site 2, a potential relocation site in the Black River, Sanilac County; Background, Black River at site 2 looking north (Photos by Peter J. Badra).

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## Introduction

The aim of this project was to assist Michigan Department of Transportation (MDOT) in identifying a suitable relocation site for the native unionid mussel community at the M-46 crossing of the Black River, Sanilac County. Identification of potential relocation sites followed guidance provided in Michigan's Mussel Survey Protocols (Hanshue *et al.* 2019).

## Methods

Before surveys took place, landowners with property adjacent to potential survey sites were contacted to ask for permission to access the river through their property. They were contacted again by phone the evening before each survey. Landowner A's property encompasses sites 1-2 and covers the reach from the M-46 bridge 485m upstream to the boundary of landowner B's property to the north. Landowner B's property covers the reach from 485m to 1,520m upstream of the M-46 bridge, including sites 3 and 4. Surveys took place September 17-18, 2019.

Unionid mussel surveys were performed at the M-46 bridge and three potential relocation sites upstream of M-46. At each site, a measuring tape was run parallel with the stream current and used to place three, one meter wide transects perpendicular to the stream current. The full width of the stream bank to bank was searched along the transect. Latitude and longitude of the downstream transect at each site was recorded with a Garmin GPS unit. The field crew consisted of three MNFI staff.

In order to ensure detection of small unionid species such as slippershell (*Alasmodonta viridis*) surveyors used tactile and visual methods of detection, searched a relatively small area at each site to allow for an intense search effort per square meter, and kept a search image of small unionid mussels such as slippershell in mind as surveys were being performed. Approximately 2-3 minutes of search effort was spent per square meter. Stream substrate was frequently excavated with hands 5-10cm down throughout each transect to help ensure buried mussels were not overlooked. Live unionids and shells were located with a combination of visual and tactile means. Glass bottom buckets were used to facilitate visual detection. The search area at each site was measured to standardize sampling effort among sites and allow unionid mussel density estimates to be made. Mussel surveys took place in wadable habitats less than 70 cm deep.

Live individuals were identified to species and placed back into the substrate anterior end down (siphon end up) in the immediate vicinity of where they were found. Shells were also identified to species and returned to the site they were found. The number of live individuals of each unionid mussel species was recorded at each transect. Length measurements were made on all live individuals found. The presence of other mollusks such as fingernail clams (Sphaeriidae), Gastropods, Asian clams (*Corbicula fluminea*) and zebra mussels (*Dreissena polymorpha*) was noted if found.

Habitat data were recorded to describe and document stream conditions at the time of the surveys. Substrate within each transect was characterized by estimating percent composition of each of the following six particle size classes (diameter): boulder (>256 mm); cobble (256-64 mm); pebble (64-16 mm); gravel (16-2 mm); sand (2-0.0625 mm); and silt/clay (<0.0625 mm) (Hynes 1970). Woody debris, aquatic vegetation, exposed solid clay substrate, and eroded banks were noted when observed. The percentage of the search area with pool, riffle, and run habitat, and a rough characterization of current speed were estimated visually. Conductivity, pH, and water temperature were recorded with an Oakton handheld meter.

## Results

Potential sites for mussel relocation were surveyed at 120m, 630m, and 1,370m upstream of the M-46 bridge. The M-46 bridge site (site 1) was also surveyed to provide data to compare to potential relocation sites (Table 1 and Figure 1). At site 1, the downstream transect (1A) was located near the corner of the south-west abutment wall and wing wall, the middle transect (1B) was located under the M-46 bridge 21m upstream from the downstream transect, and the upstream transect (1C) was located 18m upstream from the middle transect near the corner of the north-east abutment wall and wing wall. The downstream transect of site 2 (transect 2A) was located 120m upstream from the M-46 bridge. Transect 2B was located 20m upstream of transect 2A and transect 2C was located 18m upstream of transect 2B. The downstream transect at site 3 (transect 3A) was located approximately 630m upstream from the M-46 bridge, transect 3B 20m upstream of transect 3A, and transect 3C 18m upstream of transect 3B. The downstream transect at site 4 (transect 4A) was located approximately 1,370m upstream from the M-46 bridge, transect 4B 20m upstream of transect 4A, and transect 4C 18m upstream of transect 4B.

Live slippershell were found at site 1 and two of the three potential relocation sites; one transect at site 1, two transects at site 2, and two transects at site 4. Though no live slippershell were found at site 3, shells of slippershell were found in transect 3A and outside of the transects at site 3. More live slippershells were found at site 2 and at site 4 than at site 1 at the M-46 bridge. A total of 14 mussel species were recorded. In addition to the state threatened slippershell, five species of special concern were found (Tables 2 and 3). Photographs taken at sites 1-4 are provided in Appendix A. Lengths of all live mussels found are given in Appendix B.

Physical and chemical habitat characteristics are reported in Tables 4 and 5. Aquatic vegetation was present, water clarity was very high, and there was no excessive erosion of riverbanks at all four sites. Woody debris was absent from all four sites. Stream morphology was very similar among the four sites, with site 1 having a small area of riffle habitat. Current speed was nearly the same at sites 1, 2, and 4. Site 3 had lower current speed than the other three sites. Water depth at all survey sites ranged from approximately 10-40cm.

**Table 1.** Locations of mussel survey sites and transects in the Black River, Sanilac County.

Site	Transect	Location	Latitude (N)	Longitude (W)
1	1A	Near corner of south-west abutment wall and wingwall	43.42482	-82.72211
	1B	under M-46 bridge		
	1C	Near corner of north-east abutment wall and wingwall		
2	2A	120m upstream from M-46 bridge	43.42571	-82.72076
	2B	20m upstream from transect A		
	2C	18m upstream from transect B		
3	3A	630m upstream from M-46 bridge	43.43005	-82.71898
	3B	20m upstream from transect A		
	3C	18m upstream from transect B		
4	4A	1,370m upstream from M-46 bridge	43.43519	-82.71468
	4B	20m upstream from transect A		
	4C	18m upstream from transect B		



**Figure 1.** Survey sites 1-4 in the Black River, Sanilac County.

**Table 2.** Numbers of live unionid mussels (#), relative abundance (RA), and density (D, indivs./m<sup>2</sup>) recorded at each survey site (data from three transects combined for each site). An S indicates only shells of a species were found, the number shells found are given in parentheses for rare mussel species if no live were found (S(#)). Presence of other mollusk taxa is noted. (T= State threatened, SC= species of special concern)

Common name	Species	Site 1			Site 2			Site 3			Site 4		
		#	RA	D	#	RA	D	#	RA	D	#	RA	D
Elktoe (SC)	<i>Alasmidonta marginata</i>	1	0.027	0.036	1	0.032	0.035				1	0.040	0.037
Slippershell (T)	<i>Alasmidonta viridis</i>	1+S(1)	0.027	0.036	2+S(1)	0.065	0.065	S(2)			3+S(4)	0.120	0.110
Threeridge	<i>Amblema plicata</i>	13	0.351	0.466	16	0.516	0.561	11	0.458	0.349	12	0.480	0.440
Cylindrical papershell	<i>Anodontoides ferussacianus</i>				S								
Rainbow (SC)	<i>Cambarunio iris</i>	S(1)											
Wabash pigtoe	<i>Fusconaia flava</i>	2	0.054	0.072	1	0.032	0.035	1	0.042	0.032	4	0.160	0.147
Plain pocketbook	<i>Lampsilis cardium</i>	S									S		
Fatmucket	<i>Lampsilis siliquoidea</i>	2	0.054	0.072	2	0.065	0.070	2	0.083	0.063	1	0.040	0.037
White heelsplitter	<i>Lasmigona complanata</i>	5	0.135	0.179	5	0.161	0.175	2	0.083	0.063	1	0.040	0.037
Creek heelsplitter (SC)	<i>Lasmigona compressa</i>	S(1)											
Flutedshell (SC)	<i>Lasmigona costata</i>	9	0.243	0.323	2	0.065	0.070	4	0.167	0.127	2	0.080	0.073
Kidneyshell (SC)	<i>Ptychobranhus fasciolaris</i>				1	0.032	0.035						
Giant floater	<i>Pyganodon grandis</i>	2	0.054	0.072	3	0.097	0.105	3	0.125	0.095	2	0.080	0.073
Strange floater	<i>Strophitus undulatus</i>	2	0.054	0.072	S			1	0.042	0.032	2	0.080	0.073
Total # individuals and density		37		1.326	31		1.088	24		0.762	25		0.916
# species live		9			9			7			9		
# species live or shell		12			11			8			10		
Area searched (m <sup>2</sup> )		27.9			28.5			31.5			27.3		
Asian clams	<i>Corbicula fluminea</i>												
Zebra mussels	<i>Dreissena polymorpha</i>												
Fingernail clams	Sphaeriidae	X			X			X			X		
Snails/limpets	Gastropoda	X			X			X			X		

**Table 3.** Numbers of live unionid mussels (#), relative abundance (RA), and density (D, indivs./m<sup>2</sup>) recorded in each transect. An S indicates only shells of a species were found, the number shells found are given in parentheses for rare mussel species if no live were found (S(#)). (T= State threatened, SC= species of special concern)

Common name	Species	Site 1								
		Transect A			Transect B			Transect C		
		#	RA	D	#	RA	D	#	RA	D
Elktoe (SC)	<i>Alasmidonta marginata</i>							1	0.143	0.108
Slippershell (T)	<i>Alasmidonta viridis</i>	S(1)						1	0.143	0.108
Threeridge	<i>Amblema plicata</i>	5	0.417	0.538	6	0.333	0.645	2	0.286	0.215
Cylindrical papershell	<i>Anodontoides ferussacianus</i>									
Rainbow (SC)	<i>Cambarunio iris</i>	S(1)								
Wabash pigtoe	<i>Fusconaia flava</i>	S			2	0.111	0.215			
Plain pocketbook	<i>Lampsilis cardium</i>	S								
Fatmucket	<i>Lampsilis siliquoidea</i>	1	0.083	0.108	S			1	0.143	0.108
White heelsplitter	<i>Lasmigona complanata</i>	3	0.250	0.323	2	0.111	0.215	S		
Creek heelsplitter (SC)	<i>Lasmigona compressa</i>	S(1)								
Flutedshell (SC)	<i>Lasmigona costata</i>	2	0.167	0.215	6	0.333	0.645	1	0.143	0.108
Kidneyshell (SC)	<i>Ptychobranhus fasciolaris</i>									
Giant floater	<i>Pyganodon grandis</i>	1	0.083	0.108	S			1	0.143	0.108
Strange floater	<i>Strophitus undulatus</i>	S			2	0.111	0.22			
Total # individuals and density		12		1.29	18		1.94	7		0.753
# species live		5			5			6		
# species live or shell		11			7			7		
Area searched (m <sup>2</sup> )		9.3			9.3			9.3		

**Table 3.** Continued...

Common name	Species	Site 2								
		Transect A			Transect B			Transect C		
		#	RA	D	#	RA	D	#	RA	D
Elktoe (SC)	<i>Alasmidonta marginata</i>	1	0.125	0.105						
Slippershell (T)	<i>Alasmidonta viridis</i>	1	0.125	0.105	A			1+S(1)	0.059	0.105
Threeridge	<i>Amblema plicata</i>	1	0.125	0.105	7	0.875	0.737	8	0.471	0.842
Cylindrical papershell	<i>Anodontoides ferussacianus</i>	S								
Rainbow (SC)	<i>Cambarunio iris</i>									
Wabash pigtoe	<i>Fusconaia flava</i>	S			S			1 <sup>C</sup>	0.059	0.105
Plain pocketbook	<i>Lampsilis cardium</i>									
Fatmucket	<i>Lampsilis siliquoidea</i>				1	0.125	0.105	1	0.059	0.105
White heelsplitter	<i>Lasmigona complanata</i>	4	0.500	0.421	S			1	0.059	0.105
Creek heelsplitter (SC)	<i>Lasmigona compressa</i>									
Flutedshell (SC)	<i>Lasmigona costata</i>				S			2	0.118	0.211
Kidneyshell (SC)	<i>Ptychobranhus fasciolaris</i>				B			1	0.059	0.105
Giant floater	<i>Pyganodon grandis</i>	1	0.125	0.105	S			2	0.118	0.211
Strange floater	<i>Strophitus undulatus</i>				S					
Total # individuals and density		8		0.842	8		0.842	17		1.789
# species live		5			2					
# species live or shell		7			7			8		
Area searched (m <sup>2</sup> )		9.5			9.5			9.5		

<sup>A</sup> Two broken slippershell shells were found outside transect

<sup>B</sup> One live kidney-shell was found outside transect

<sup>C</sup> An additional Wabash pigtoe was found outside transect

**Table 3.** Continued...

Common name	Species	Site 3								
		Transect A			Transect B			Transect C		
		#	RA	D	#	RA	D	#	RA	D
Elktoe (SC)	<i>Alasmidonta marginata</i>	S(2)			D					
Slippershell (T)	<i>Alasmidonta viridis</i>									
Threeridge	<i>Amblema plicata</i>	3	0.375	0.286	3	0.500	0.286	5	0.500	0.476
Cylindrical papershell	<i>Anodontoides ferussacianus</i>									
Rainbow (SC)	<i>Cambarunio iris</i>									
Wabash pigtoe	<i>Fusconaia flava</i>				S			1	0.100	0.095
Plain pocketbook	<i>Lampsilis cardium</i>									
Fatmucket	<i>Lampsilis siliquoidea</i>	1	0.125	0.095	S			1	0.100	0.095
White heelsplitter	<i>Lasmigona complanata</i>	S(2)			1	0.167	0.095	1	0.100	0.095
Creek heelsplitter (SC)	<i>Lasmigona compressa</i>									
Flutedshell (SC)	<i>Lasmigona costata</i>	1	0.125	0.095	1	0.167	0.095	2	0.200	0.190
Kidneyshell (SC)	<i>Ptychobranhus fasciolaris</i>									
Giant floater	<i>Pyganodon grandis</i>	2	0.250	0.190	1	0.167	0.095			
Strange floater	<i>Strophitus undulatus</i>	1	0.125	0.095				S		
Total # individuals and density		8		0.762	6		0.571	10		0.952
# species live		5			4			5		
# species live or shell		7			6			6		
Area searched (m <sup>2</sup> )		10.5			10.5			10.5		

<sup>D</sup> Two slippershell shells were found outside transect

**Table 3.** Continued...

		Site 4								
Common name	Species	Transect A			Transect B			Transect C		
		#	RA	D	#	RA	D	#	RA	D
Elktoe (SC)	<i>Alasmidonta marginata</i>				1	0.091	0.110	S(1)		
Slippershell (T)	<i>Alasmidonta viridis</i>	S(1)			1+S(1)	0.091	0.110	2+S(2)	0.182	
Threeridge	<i>Amblema plicata</i>	3	0.500	0.330	6	0.545	0.659	3	0.273	0.273
Cylindrical papershell	<i>Anodontoides ferussacianus</i>									
Rainbow (SC)	<i>Cambarunio iris</i>									
Wabash pigtoe	<i>Fusconaia flava</i>	2	0.333	0.220	1	0.091	0.110	1	0.091	0.091
Plain pocketbook	<i>Lampsilis cardium</i>	S								
Fatmucket	<i>Lampsilis siliquoidea</i>	S			S			1	0.091	0.091
White heelsplitter	<i>Lasmigona complanata</i>	S						1	0.091	0.091
Creek heelsplitter (SC)	<i>Lasmigona compressa</i>									
Flutedshell (SC)	<i>Lasmigona costata</i>	1	0.167	0.110				1	0.091	0.091
Kidneyshell (SC)	<i>Ptychobranhus fasciolaris</i>									
Giant floater	<i>Pyganodon grandis</i>				1	0.091	0.110	1	0.091	0.091
Strange floater	<i>Strophitus undulatus</i>				1	0.091	0.110	1	0.091	0.091
Total # individuals and density		6		0.659	11		1.209	11		1.209
# species live		3			6			8		
# species live or shell		7			7			9		
Area searched (m <sup>2</sup> )		9.1			9.1			9.1		

**Table 4.** Percent of each substrate particle size class estimated visually at each transect. Diameter of each size class: boulder (>256mm), cobble (256-64mm), pebble (64-16mm), gravel (16-2mm), sand (2-0.0625mm), silt/clay (<0.0625mm).

Site #	Transect	Boulder	Cobble	Pebble	Gravel	Sand	Silt	Note
1	1A	0	15	25	30	20	10	
	1B	0	20	30	20	15	15	
	1C	0	10	15	30	20	15	10 slab of blue sandstone
2	2A	2	15	23	30	20	10	
	2B	0	10	30	25	25	10	
	2C	2	5	20	30	30	13	
3	3A	5	25	20	20	20	10	
	3B	3	20	20	20	22	15	
	3C	0	15	20	15	35	15	Thin layer of substrate over hard bottom
4	4A	2	10	30	20	23	15	
	4B	2	8	25	25	30	10	
	4C	3	7	30	25	25	10	

**Table 5.** Physical habitat characteristics and water chemistry measures recorded at each survey site.

Site #	Current speed (m/sec.)	Aquatic vegetation?	Woody debris?	Eroded banks?	%Pool	%Riffle	%Run	Water clarity	pH	Conductivity (µS)	Water temp. (C)
1	0.27	Y	N	N		10	90	very clear	8.54	837	20.9
2	0.29	Y	N	N			100	very clear	8.80	842	24.5
3	0.19	Y	N	N			100	very clear	8.23	933	17.4
4	0.28	Y	N	N			100	very clear	8.51	933	20.8

## Discussion

Based on recommended attributes of potential relocation sites from Michigan Freshwater Mussel Survey Protocols and Relocation Procedures (Hanshue et al. 2019) sites 2 and 4 appear to be suitable relocation sites. Site 2 is recommended as the primary relocation site due to its closer proximity and substrate more closely matching site 1. Site 4 is recommended as a backup relocation site.

Live slippershell were found at sites 2 and 4, and both sites are upstream of the M-46 bridge (site 1). Both have similar mussel communities to site 1; e.g. all species found live at site 1 are present at sites 2 and 4 with the exception of strange floater (*Strophitus undulatus*) being absent at site 2, the most abundant species at site 1 is also the most abundant at site 2 and 4, and the number of species found live is the same (9) at sites 1, 2, and 4. Live slippershell and elktoe (*Alasmidonta marginata*) were not seen at site 3 and overall density there was a little more than half that found at site 1.

There was evidence for recent recruitment of mussels at all four sites. A flutedshell (*Lasmigona costata*) with a length of 50mm was found at site 1. A 42mm long threeridge (*Amblema plicata*), a 69mm long flutedshell, and a 44mm long giant floater (*Pyganodon grandis*) were documented at site 2. A 25mm long threeridge was found at site 3, and a Wabash pigtoe (*Fusconaia flava*) with a length of 24mm was found at site 4.

Since site 2 is only 120m upstream of site 1, transport of mussels during relocation would be quicker and simpler than transporting them to site 4, which is 1,370m upstream of site 1. Relocation to site 4 would require packing mussels in vehicles and driving them to the site. Site 2 is close enough that they could be transported by foot along the edge of the river without hauling them up and down the steep riverbank to and from a vehicle.

Substrate particle size was generally similar among all the survey sites with three exceptions. No boulders were recorded within transects at site 1 and an exposed slab of blue sandstone comprised 10% of the substrate at transect 1C. All other particle size classes were represented at all sites. The third exception was that the substrate at transect 3C was only a thin layer (5-10cm thick) over a hard slab bottom. The mean percent of each size class at site 1 was within 10% of the mean at each of the other three sites (Table 6). Substrate composition at site 1 is closer to site 2 than sites 3 or 4.

Other physical habitat and water quality characteristics (Table 5) were also very similar among the four survey sites and do not limit any of the sites as potential locations to relocate mussels from site 1 at the M-46 bridge. The lower current speed at site 3 compared to site 1 may give slight preference to sites 2 and 4 as relocation sites in terms of this habitat characteristic.

The variation in pH observed among the four sites likely reflects natural diurnal fluctuations in pH more than differences between sites, especially considering the proximity of the sites to each other. Diurnal fluctuations in pH of river water is attributed to varying levels of photosynthesis and respiration of aquatic organisms throughout the day and night (Bourg and Bertin 1996). From morning until evening pH typically becomes more basic. The four survey sites were sampled at different times over a two-day period. Site 3 was sampled in the morning, sites 1 and 4 in the early afternoon, and site 2 in the late afternoon. Measures of pH were more basic the later in the day the measurement was taken. Water temperature increased as the day went on and is not likely indicating a difference in water temperature based on site location.

Any fish hosts available to slippershell at site 1 would presumably be available at sites 2 and 4 due to their close proximity and similar habitat. Known hosts for slippershell include mottled sculpin (*Cottus bairdi*), banded sculpin (*Cottus carolinae*), and Johnny darter (*Etheostoma nigrum*) (Watters *et al.* 2009). The Black River within the project area is a heavily engineered channel that is not likely to be dredged in the foreseeable future. The likelihood of mussels being impacted by dredging, chemical spills, etc. does not appear to be any greater at the potential relocation sites than at the M-46 bridge site. No zebra mussels (*Dreissena polymorpha*) were found during these surveys.

**Table 6.** Mean percent of each substrate particle size class estimated visually at each transect for sites 1-4. Diameter of each size class: boulder (>256mm), cobble (256-64mm), pebble (64-16mm), gravel (16-2mm), sand (2-0.0625mm), silt/clay (<0.0625mm).

Site #	Boulder	Cobble	Pebble	Gravel	Sand	Silt
1	0	15.0	23.3	26.7	18.3	13.3
2	1.3	10.0	24.3	28.3	25.0	11.0
3	2.7	20.0	20.0	18.3	25.7	13.3
4	2.3	8.3	28.3	23.3	26.0	11.7

## Literature Cited

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## Appendix A. Photographs From Sites 1-4. Taken September 17-18, 2019 by Peter Badra.



**Site 1** – Slippershell (*Alasmodonta viridis*)



**Site 1** – A young fluted-shell (*Lasmigona costata*)



**Site 1** – Substrate



**Site 1** – Looking upstream (north)



**Site 1** – Looking downstream (south)



**Site 2** – Slippershell (*Alasmidonta viridis*)



**Site 2** – Slippershell (*Alasmidonta viridis*) and substrate



Site 2 – A young threeridge (*Amblema plicata*)



Site 2 – A young fluted-shell (*Lasmigona costata*)



**Site 2** – A young giant floater (*Pyganodon grandis*)



**Site 2** – Substrate



**Site 2** – Looking upstream (north)



**Site 2** – Looking downstream (south) to the M-46 bridge crossing (site 1)



**Site 3** – A young threeridge (*Amblema plicata*)



**Site 3** – Substrate



**Site 3** – Looking upstream (north)



**Site 3** – Looking downstream (south)



**Site 4** – Slippershell (*Alasmidonta viridis*) and young Wabash pigtoe (*Fusconaia flava*)



**Site 4** – Elktote (*Alasmidonta marginata*)



**Site 4** – Looking upstream (north)



**Site 4** – Looking downstream (south)

## Appendix B. Length, in millimeters, of live mussels found in each transect.

Site #	Transect	Species	Length	Site #	Transect	Species	Length
1	1A	Amblema plicata	75	2	2A	Alasmidonta marginata	50
		Amblema plicata	83			Alasmidonta viridis	29
		Amblema plicata	97			Amblema plicata	102
		Amblema plicata	116			Lasmigona complanata	103
		Amblema plicata	126			Lasmigona complanata	111
		Lampsilis siliquoidea	45			Lasmigona complanata	131
		Lasmigona complanata	75			Lasmigona complanata	141
		Lasmigona complanata	120			Pyganodon grandis	44
		Lasmigona complanata	125		2B	Amblema plicata	42
		Lasmigona costata	108			Amblema plicata	93
		Lasmigona costata	120			Amblema plicata	100
		Pyganodon grandis	55			Amblema plicata	101
	1B	Amblema plicata	87			Amblema plicata	113
		Amblema plicata	96			Amblema plicata	131
		Amblema plicata	110			Amblema plicata	136
		Amblema plicata	111			Lampsilis siliquoidea	76
		Amblema plicata	113			Ptychobranthus fasciolaris*	64
		Amblema plicata	123		2C	Alasmidonta viridis	28
		Fusconaia flava	78			Amblema plicata	91
		Fusconaia flava	80			Amblema plicata	94
		Lasmigona complanata	112			Amblema plicata	94
		Lasmigona complanata	120			Amblema plicata	97
		Lasmigona costata	50			Amblema plicata	97
		Lasmigona costata	91			Amblema plicata	102
		Lasmigona costata	107			Amblema plicata	124
		Lasmigona costata	109			Amblema plicata	135
		Lasmigona costata	116			Fusconaia flava	62
		Lasmigona costata	132			Fusconaia flava*	31
		Strophitus undulatus	84			Lampsilis siliquoidea	93
		Strophitus undulatus	89			Lasmigona complanata	129
	1C	Alasmidonta marginata	67			Lasmigona costata	69
		Alasmidonta viridis	26			Lasmigona costata	112
		Amblema plicata	95			Ptychobranthus fasciolaris	69
		Amblema plicata	101			Pyganodon grandis	51
		Lampsilis siliquoidea	66			Pyganodon grandis	79
		Lasmigona costata	103				
		Pyganodon grandis	48				

\* Found outside transect

## Appendix B. Continued...

Site #	Transect	Species	Length
3	3A	Amblema plicata	25
		Amblema plicata	114
		Amblema plicata	124
		Lampsilis siliquoidea	82
		Lasmigona costata	124
		Pyganodon grandis	66
		Pyganodon grandis	74
		Strophitus undulatus	71
	3B	Amblema plicata	81
		Amblema plicata	104
		Amblema plicata	131
		Lasmigona complanata	131
		Lasmigona costata	124
		Pyganodon grandis	91
	3C	Amblema plicata	93
		Amblema plicata	98
		Amblema plicata	118
		Amblema plicata	124
		Amblema plicata	143
		Fusconaia flava	61
		Lampsilis siliquoidea	94
		Lasmigona costata	96
		Lasmigona complanata	136
		Lasmigona costata	121

Site #	Transect	Species	Length
4	4A	Amblema plicata	62
		Amblema plicata	87
		Amblema plicata	106
		Fusconaia flava	45
		Fusconaia flava	50
		Lasmigona costata	188
	4B	Alasmidonta marginata	52
		Alasmidonta viridis	30
		Amblema plicata	83
		Amblema plicata	102
		Amblema plicata	103
		Amblema plicata	105
		Amblema plicata	105
		Amblema plicata	160
		Fusconaia flava	72
		Pyganodon grandis	91
		Strophitus undulatus	79
	4C	Alasmidonta viridis	30
		Alasmidonta viridis	40
		Amblema plicata	73
		Amblema plicata	131
		Amblema plicata	132
		Fusconaia flava	24
		Lampsilis siliquoidea	90
		Lasmigona complanata	132
		Lasmigona costata	134
		Pyganodon grandis	78
		Strophitus undulatus	74