Aquatic Inventory of Three State Recreation Areas: Island Lake State Recreation Area, Pontiac Lake State Recreation Area, and Proud Lake State Recreation Area






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Huron River in Island Lake State Recreation Area. Photo by Amy Derosier
Wavy-rayed lampmussel courtesy of Kevin Cummings, Illinois Natural History Survey
Huron River in Proud Lake State Recreation Area. Photo by Amy Derosier
Johnny darter courtesy of Ohio Department of Natural Resources
Huron River in Pontiac Lake State Recreation Area. Photo by Amy Derosier
Pumpkinseed sunfish courtesy of Ohio Department of Natrual Resources

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INTRODUCTION

The Parks and Recreation Division (PRD) supplied the initial funds to complete a terrestrial inventory of state natural areas. The Michigan Natural Features Inventory (MNFI) has conducted extensive surveys of many state parks and recreation areas to reconfirm historical and/or describe new occurrences of rare plants and wildlife. As a result, the Parks Division has requested that MNFI continue performing these surveys for Michigan State Recreation Areas.

The state parks in Michigan have considerable aquatic resources. During the previous inventories supported by the Parks and Recreation Division, these aquatic resources were essentially overlooked. As a result, there are significant gaps in the aquatic data the MDNR currently has for state parks and limited information in the MNFI database. These gaps in data may impede the MDNRs successful management of the array of natural features in the state recreation areas.

Moreover, native aquatic species are continuously threatened by introduced species such as the Asiatic clam (*Corbicula fluminea*), zebra mussel (*Dreissena polymorpha*), and round goby (*Neogobius melanostomus*). The invasive species are frequently more aggressive and as a result habitat and food supplies become less available for the native species. In the case of mussels, lower densities of fish hosts and their own species increases the likelihood that the unionid life cycle will remain incomplete. Round gobies aggressively compete with native fishes for spawning habitat, thus limiting the viable spawning grounds for native fish. Without knowledge of the aquatic natural features in Michigan state recreation areas, the ability to reduce the effects of these invasive species and manage for increased habitat, food, and hosts remains limited.

This project aims to improve upon the information known about aquatic features found within state recreation areas to allow the State of Michigan to better manage their natural resources. This report is the culmination of aquatic surveys conducted at Island Lake, Pontiac Lake, and Proud Lake State Recreation Areas. Included in the report are summaries of the fish and mussel species found in each park and a short discussion of relevant management recommendations.

LANDSCAPE CONTEXT

Island Lake State Recreation Area (ILSRA)

Island Lake State Recreation Area encompasses 4,000 acres in Livingston County. Four lakes are on the property (Island, Kent, Trout, and Spring Mill) as well as wetland areas. The Huron River flows from the northeast to the southwest through the park. The park encompasses wooded terrain, rolling hills, fens, and marshes. Prior to the current survey, MNFI and others have found species of concern within the recreation area (Table 1).

In the regional landscape of Michigan, ILSRA is located within the Jackson Interlobate (VI.1.3) and Lake Erie Basin (Figure 1) (Albert 1995). Jackson Interlobate is a sub-section of the Southern Lower Michigan ecoregion and is characterized by coarse-textured end moraine, outwash, and ice-contact topography; oak savannah and oak-hickory forest, hardwood swamp, prairie fens, and bogs (Albert 1995).

In the 1800's, ILSRA consisted of oak barrens with fragments of conifer swamp and even a patch of black ash swamp. Kent Lake was a wet prairie and Trout Lake was oak barrens. There were wet prairies along the southern boarder of the park and pockets of it around the Huron River. Currently, the vegetation is mostly remnants of oak barrens and old fields (Higman 2001). Many exotics such as, honeysuckle and autumn olive occur throughout the recreation area (Higman 2001). Kent Lake exists due to the damming of the Huron River and Trout Lake due to the mining of gravel. The Huron River is now bordered by forest and grassland rather than swamp. ILSRA is surrounded by urban/residential land on all sides, thus making it an important refuge for many species.

Pontiac Lake State Recreation Area (POSRA)

Pontiac Lake State Recreation Area includes 3,800 acres in Oakland County. There is 1 lake on the property (Pontiac) as well as 2 marshes (one labeled Robinson Lake). The Huron River flows west from Pontiac Lake and north through the park. The area consists of woodland terrain including Dry Southern Oak Forest and Mesic Southern Forest. Previously, MNFI and others have found other species of concern within the recreation area (Table 1).

In the regional landscape of Michigan, POSRA is also located within the Jackson Interlobate (VI.1.3) and

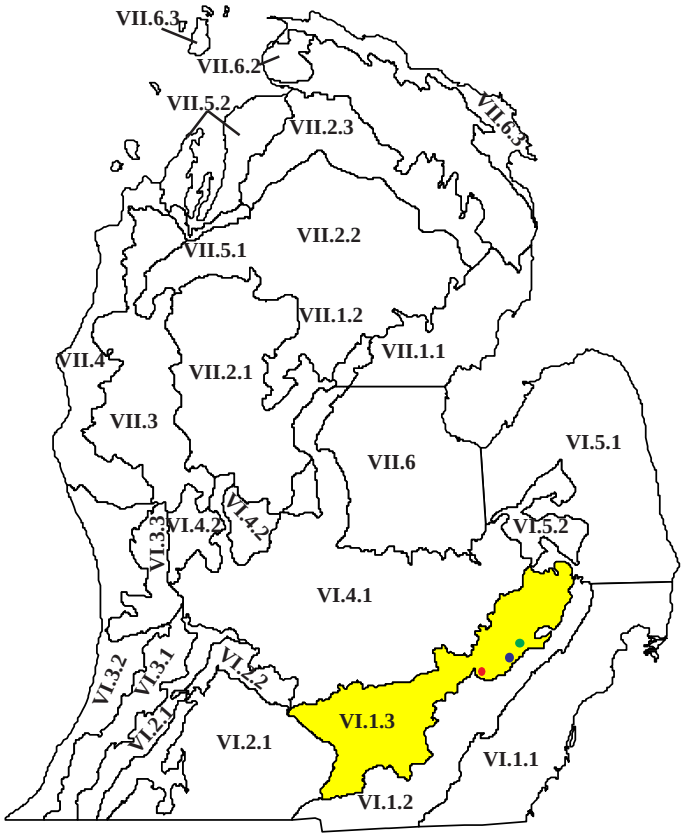


Figure 1. Ecoregional, subsection, and sub-subsectional boundaries of Lower Michigan. The Jackson Interlobate Subsection (Subsection VI.1.3) is highlighted in yellow. The colored dots indicate state recreation area locations, where red - Island Lake, blue - Proud Lake, and green - Pontiac Lake

Lake Erie Basin (Figure 1). The circa 1800's land use maps indicate patches of mixed hardwood swamp were present in the northeast portion of the park and the remainder of the recreation area was black oak barrens. Pontiac Lake was originally conifer swamp and oak-hickory forest. The area labeled Robinson Lake was also a conifer swamp. The Huron River was surrounded as it flowed north by mixed hardwood swamp. A recent land use map of POSRA indicates the recreation area is predominantly forested with patches of grassland. Red maple dominates much of the historical oak barrens (Higman 2001). Pontiac Lake is an actual lake while Robinson Lake remains a wetland. The Huron River corridor remains relatively undisturbed with highly diverse wetlands dominated by silver maple (*Acer saccharinum*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), and musclewood (*Carpinus caroliniana*) (Higman, 2001). The east side of Pontiac Lake is urban, agricultural, and bare ground.

<u>Proud Lake State Recreation Area (PRSRA)</u>

Proud Lake State Recreation Area has 4,700 acres of land in Oakland County. The recreation area has 2 lakes (Proud and Moss) and the Huron River runs from Proud Lake to the west. Exceptional communities such as Oak Barrens, Marly Sedge Meadow, Emergent Marsh, Submergent Marsh, Southern Wet Meadow, Conifer Swamp, and Mesic Southern Forest occur within the recreation area boundaries. In past years, MNFI and others have seen species of concern within the recreation area (Table 1).

In the regional landscape of Michigan, PRSRA is also located within the Jackson Interlobate (VI.1.3) and Lake Erie Basin (Figure 1). In the 1800's, the western edge of the park was oak hickory forest with a strip of wet prairie. The remainder of the recreation area was black oak barrens. Proud Lake was surrounded by a mixed conifer swamp. Moss Lake did not exist and instead, on the western boarder of Proud Lake there

Table 1. Species of concern found within three state recreation areas during earlier inventories. E - State listed Endangered, T - State listed Threatened, SC - Special Concern

Recreation Area	Species	Common Name	Last Survey Year	Status
	Ammodramus henslowii	Henslow's sparrow	2002	T
	Angelica venenosa	Hairy angelica	1998	SC
	Bouteloua curtipendula	Sideoats grama grass	1998	T
	Terrapene carolina carolina	Eastern box turtle	1998	SC
Island Lake	*Ammocrypta pellucida*	Eastern sand darter	1997	T
	Prunus alleghaniensis var. davisii	Alleghany or Sloe plum	1967	SC
	Pyrgulopis letsoni	Gravel pyrg	1943	SC
	Valeriana edulis var. ciliata	Edible valarian	1927	T
	Lampsilis fasciola	Wavy-rayed lampmussel	1925	T
	Baptisia lactea	White false indigo	2003	SC
	Silphium laciniatum	Compass plant	2003	T
	Dendroica cerulea	Cerulean warbler	2002	SC
	Wilsonia citrina	Hooded warbler	2002	SC
Pontiac Lake	*Eyrnnis baptisia*	Wild indigo duskywing	2000	SC
	Panax quinquefolia	Ginseng	1997	T
	Hydrastis canadensis	Goldenseal	1997	T
	Jeffersonia diphylla	Twinleaf	1997	SC
	Sistrurus catenatus catenatus	Eastern massasauga	1995	SC
	Oecanthus lacris	Tamarack tree cricket	2000	SC
	Acris crepitans blanchardii	Blanchard's cricket frog	1997	SC
	Alasmidonta viridis	Slippershell	1996	SC
Proud Lake	*Anodonta glaudis*	Lake floater	1996	T
	Epioblasma triquetra	Snuffbox	1996	E
	Carex richardsonii	Richarson's sedge	1964	SC
	Cypripedium candidum	Small white lady's slipper	1927	T

was a muskeg/bog. Recent land cover maps indicate the upland forest and barrens, which were converted to agriculture, are now reverting to old field or second growth forest (Schools 2001). Mesic forests along the north side of the Huron River remain intact and most of the wetlands remain intact (Schools 2001). The most significant change was the creation of Moss Lake by damming the Huron River. The lakes are now surrounded by wetlands and the park is mostly forest with small patches of grassland. The park is surrounded by urban lands to the south and east and agricultural lands to the north and southwest.

METHODS

Huron River

Sites in the Huron River were sampled in June and August of 2005 (Figures 2-4). Fish were surveyed using a barge shocker (Smith Root) and a backpack shocker (Wisconsin). Each stream reach sampled was between 200-300 meters in length. Fish were identified, measured, and returned to the stream. Species that could not be readily identified and voucher specimens were kept and preserved in 10% formalin. Habitat measurements were also recorded.

Mussel surveys were conducted on a portion of the Huron River that flows through each park. A canoe was used to traverse the river to search for empty shells, live mussels, and suitable mussel habitat. When shells, mussels, or suitable habitat were found, the area was searched for 15-20 minutes using plexi-glass bottomed buckets. Some spent shells were kept for reference. Live individuals were identified, photographed, and returned to the stream.

Lakes

Lakes were sampled between August and September 2005, with the exception of Robinson Lake, because it is a wetland (Figures 2 and 4). Secchi depth, pH, dissolved oxygen, alkalinity, conductivity, and water color measurements were taken at each lake. Fish communities were sampled using seines, trap nets, minnow traps, and gill nets. At least 3 trap nets were set overnight in each lake; minnow traps were set

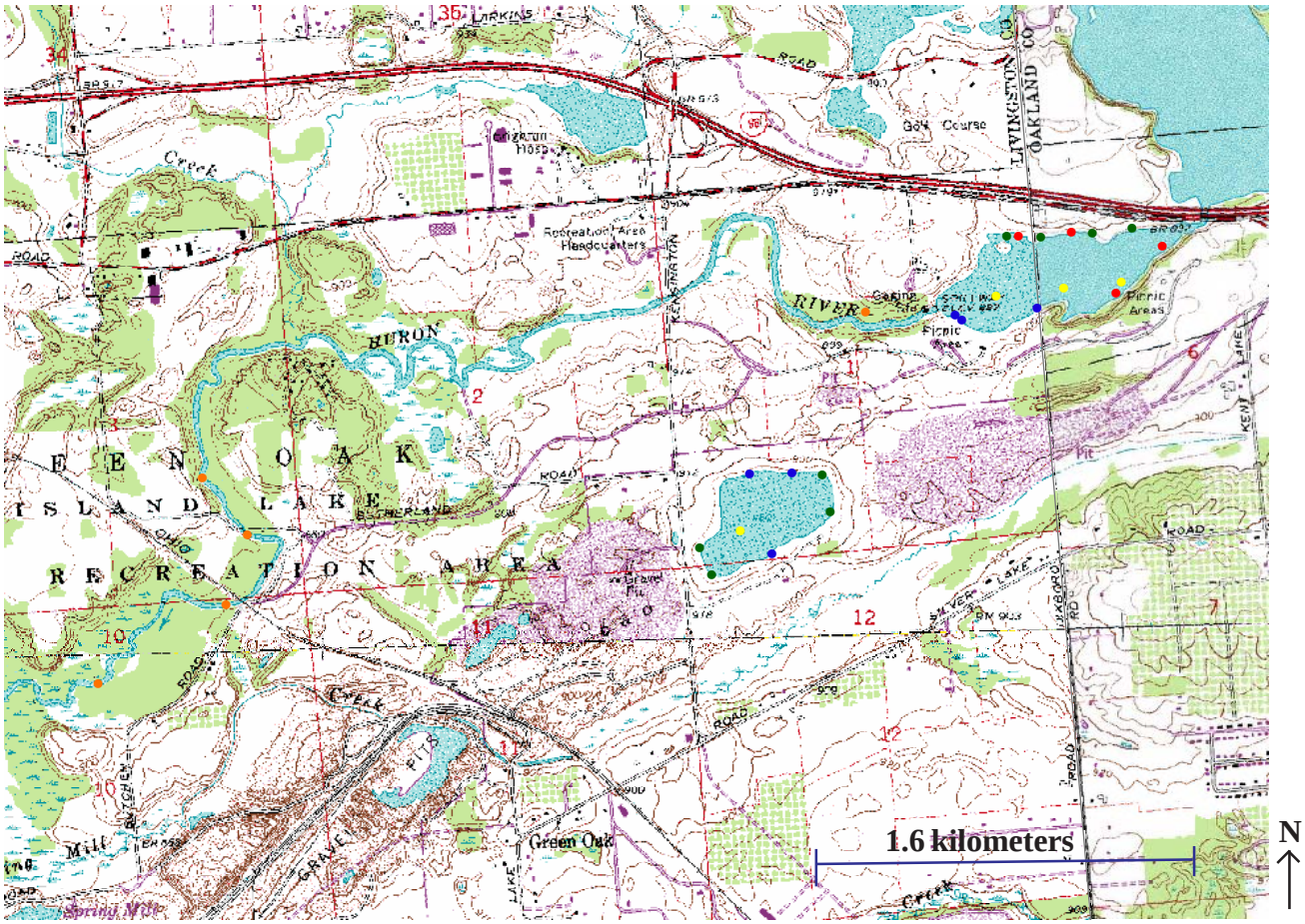


Figure 2. Island Lake State Recreation Area sampling sites. Points are color coded according to sampling method. Orange - mussel beds in Huron River, Yellow - gill net, Blue - seine, Red - minnow trap, Green - trap net. The Huron River fish sampling site is just 800m downstream from the last mussel bed (orange dot on the far left of the map).

overnight as well. Sampling effort was conducted in a variety of habitats to obtain species lists for each lake. The gill nets were set for a maximum of 5 hours to minimize fish mortality. Fish were identified, measured, and returned to the lake. Individuals that could not be identified as well as a few voucher specimens were kept and preserved in 10% formalin. Mussel surveys were conducted by visually examining the shoreline areas of each lake. Mussels were identified and returned to their original locations.

RESULTS

Island Lake State Recreation Area

Huron River

The Huron River is relatively protected with a wide riparian buffer on both sides. The longest portion of the Huron River, among the three recreation areas, resides in ILSRA with a length of 11971 m (Table 2). Impacts to the river at ILSRA may arise from park roads which run through the recreation area and close to the river. The roads are paved and appear to be heavily used. Along the river are several picnic and canoe drop in sites. The Huron River at ILSRA is much wider and deeper than it is at POSRA and PRSRA.

A total of 14 species were found in the Huron River at ILSRA. The predominant fish were spotfin shiners (*Cyprinella spiloptera*) and bluegills (*Lepomis macrochirus*) (Table 3). Several game fish were found

Figure 3. Pontiac Lake State Recreation Area sampling site. The Huron River fish sampling area is represented by a red line. The marsh that is called Robinson Lake is labeled with a blue dot.

Table 2. Habitat and water quality data for Huron River sampling sites within three state recreation areas

Variable	Island Lake	Pontiac Lake	Proud Lake
River Length in Park (m)	11970.98	3743.44	4518.49
Substrate	20% Cobble 20% Gravel 30% Sand 30% Silt	35% Cobble 35% Gravel 15% Sand 15% Silt	15% Cobble 35% Gravel 30% Sand 20% Silt
Woody Debris	20%	15%	20%
Clarity (m)	0.91 - 1.21	0.91	0.91 - 1.21
DO (mg/L)	7.93	none	none
Width at Survey Site (m)	9.14	3.05-4.57	6.09-7.62
Depth at Survey Site (m)	1.06-1.21	0.15-0.91	0.30-0.91

in the river, such as rock bass (*Ambloplites rupestris*), bluegill, smallmouth bass (*Micropterus dolomieu*), and yellow perch (*Perca flavescens*) (Table 3). The northern hog sucker (*Hypentelium nigricans*) was only found at ILSRA (Table 3). The special concern species brindled madtom (*Noturus miurus*) was found in one location in the Huron (Appendix 1). This individual is a new record occurrence of this species of concern.

A total of 9 species of mussels were found at ILSRA (Table 4). A special concern species (elktoe, *Alasmidonta marginata*) and a threatened species (wavy-rayed lampmussel, *Lampsilis fasciola*) were found among the 5 mussel beds at Island Lake. Both species are new species of concern occurrences for this portion of the Huron River. At ILSRA, 54 live mussels were found of which 11 were wavy-rayed lampmussel and 7 were elktoe (Table 4). The Huron River at ILSRA was the most diverse in terms of mussel species (Table 4). Zebra mussels were especially prevalent below the Kent Lake dam in ILSRA. Asiatic clams were seen at ILSRA as well. Most live mussels had several zebra mussels attached to them.

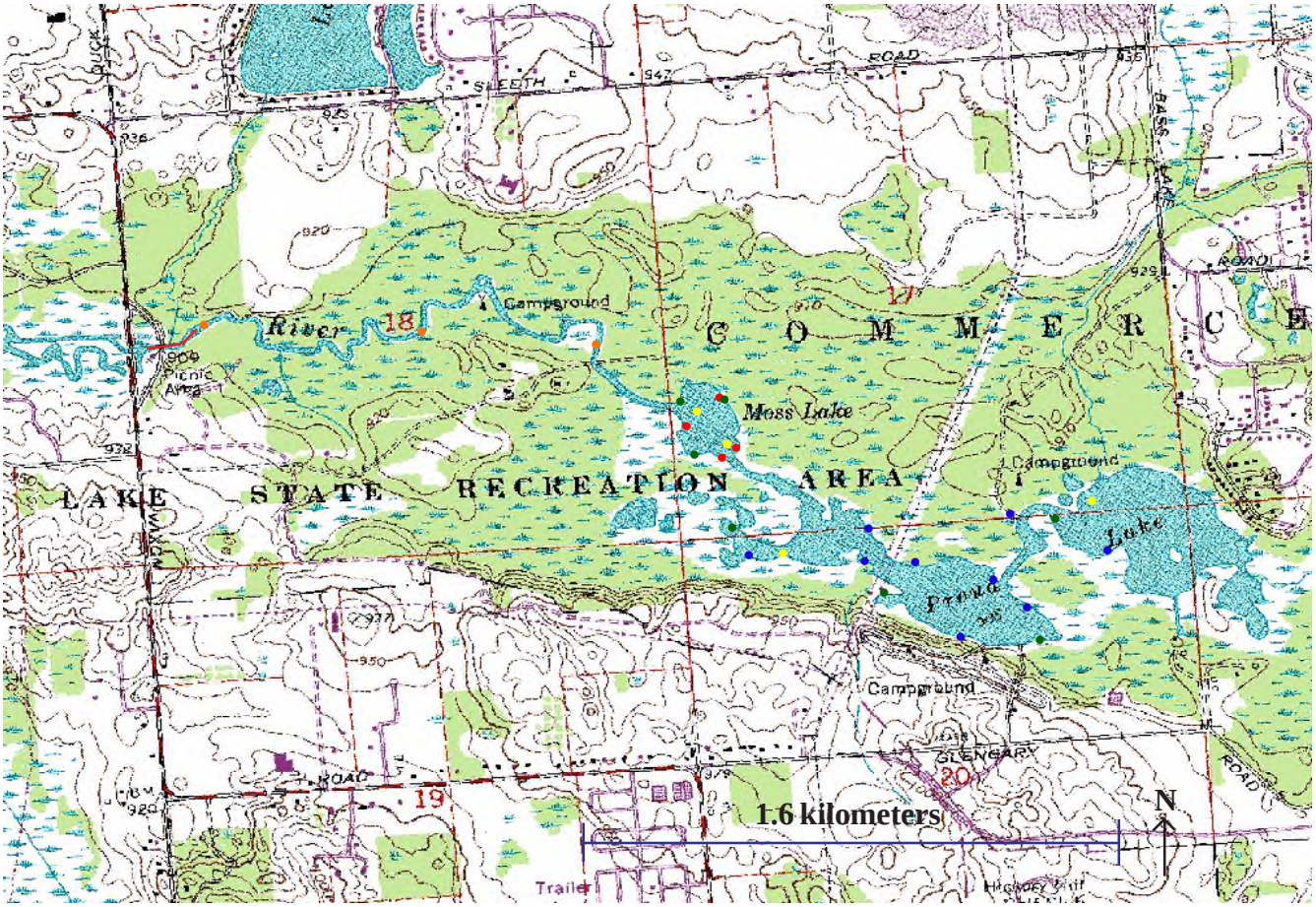


Figure 4. Proud Lake State Recreation Area sampling sites. Points are color coded according to sampling method. Orange - mussel beds in Huron River, Yellow - gill net, Blue - seine, Red - minnow trap, Green - trap net. The Huron River fish sampling site is denoted with a red line.

Lakes

The shallowest lake surveyed was Kent Lake at 4.6 m (Table 6). Trout Lake was quite different than the other lakes with a high alkalinity, low conductivity, and a deep Secchi depth (Table 5). There was relatively little difference in the dissolved oxygen profile for Kent and Trout Lakes (Table 5). Both lakes experience some sort of recreational use from boating, canoeing, fishing, and swimming. Kent Lake had the most fish species at 13, while Trout Lake had the fewest with 4 (Table 5). At Kent Lake, 91% of the fish captured were bluegills, many of which were young of the year (Table 5). It appears that Kent Lake may be functioning as a bluegill nursery for Kent Lake as a whole (including the portion on the other side of the highway). Juveniles and adults would migrate from ILSRA to the Kensington Metropark portion of Kent Lake. The majority of fish captured at Trout Lake were juvenile largemouth bass (Table 5). Black crappie (*Pomoxis nigromaculatus*), carp (*Cyprinus carpio*), green sunfish, pumpkinseed sunfish (*Lepomis gibbosus*), white sucker (*Catastomus commersoni*), and yellow perch were only found at Kent Lake (Table 5). Bluegills were encountered in both lakes (Table 5). A few shells of zebra mussels and the Asiatic clam were observed in Trout Lake. The common musk turtle (*Sternotherus odoratus*) was in both lakes and the painted turtle (*Chrysemys picta*) in Kent Lake (Table 5).

Pontiac Lake State Recreation Area

Huron River

At POSRA, the Huron River is much narrower and has more cobble and gravel than at either of the other state recreation areas (Table 2). This portion of the river is very near to the Huron River headwaters. The river is well protected with a wide riparian buffer on both sides. Recreation area roads are not close to the river and only a few trails even approach the rivers edge. POSRA appears to have the least impacted section of the Huron River due to the lack of access.

The Huron River at POSRA had the fewest number of fish species with 8 (Table 3). Darters (*Etheostoma*

Table 3. Fish species, abundance, and size ranges for the Huron River within three state recreation areas. SC - Special Concern.

Huron River

Species	Common Name	Island Lake		Pontiac Lake		Proud Lake	
		Total	Size Range (mm)	Total	Size Range (mm)	Total	Size Range (mm)
Ambloplites rupestris	Rock bass	6	107-197			16	142-235
Ameiurus natalis	Yellow bullhead	1	152			2	80-94
Amia calva	Bowfin	2	61-76			1	188
Catastomus commersoni	White sucker			5	25-33		
Cottus bairdi	Mottled sculpin					1	64
Cyprinella spiloptera	Spotfin shiner	10	57-86			57	50-95
Erimyzon sucetta	Lake chubsucker					8	63-98
Esox americanus vermiculatus	Grass pickerel					1	252
Esox lucius	Pike	observed					
Etheostoma flabellare	Fantail darter			25	32-72		
Etheostoma nigrum	Johnny darter	3	57-66	5	44-73		
Fundulus notatus	Blackstripe topminnow	1				2	47-61
Hypentelium nigricans	Northern hog sucker	1	276				
Lepomis cyanellus	Green sunfish					1**	135
Lepomis cyanellus	Green sunfish					3	110-115
Lepomis gibbosus	Pumpkinseed sunfish					94*	47-177
Lepomis macrochirus	Bluegill	6	56-135	4	70-88	14	88-142
Micropterus dolomieu	Smallmouth bass	2	102-132			5	34-42
Micropterus salmoides	Largemouth bass	observed		3	30-320	16	34-44
Notropis hudsonius	Spottail shiner					94	39-98
Noturus miurus	Brindled madtom (SC)	1	66			1	65
Perca flavescens	Yellow perch	2	109-140	2	79-81		
Pimpephales notatus	Bluntnose minnow	8	65-86			3	52-75
Semotilus atromaculatus	Creek chub			10	17-164	1	71
Umbra limi	Mudminnow			2	60-65	6	66-93
Species Total		**14**		**8**		**19**	

* Some of these individuals may be a hybrid with the Red-eared sunfish and Pumpinkseed sunfish
** Species may be a hybrid with the Warmouth bass

sp.) were common at POSRA. Like the other two recreation areas bluegill were seen at POSRA. Fantail darters (*Etheostoma flabellare*) and a white sucker were found only at POSRA. Two game species were seen at POSRA, bluegill and largemouth bass (*Micropterus salmoides*). Mussels were not seen at POSRA. The substrate was appropriate for mussel beds and additional surveys would be necessary to determine if they are further upriver.

Lakes

Robinson Lake was slated to be surveyed at POSRA. However, the lake is a marsh. No other small lakes are present in the recreation area.

Proud Lake State Recreation Area

Huron River

The Huron River, as it flows through PRSRA, is protected with a relatively wide riparian buffer. Downstream from the picnic area on Wixom Road at PRSRA, the river becomes sandier and deeper, with very little aquatic habitat to support a diverse number of fish species. Upstream from this picnic area and to the dam the river has a variety of substrates and habitat features to support diverse fish species as well as mussels (Table 2). Recreation area roads are not near the Huron River, but there are trails and picnic sites that approach the rivers edge.

PRSRA had the greatest number of fish species with 19 (Table 3). Pumpkinseed sunfish shiners

Table 4. Mussel species and abundances for Huron River sampling within two state recreation areas. a. - Island Lake State Recreation Area, b. Proud Lake State Recreation Area. T - State listed Threatened, SC - Special Concern.

a. Island Lake State Recreation Area

Species	Common Name	Island Lake				
		Site 1	Site 2	Site 3	Site 4	Site 5
Actinonaias ligamentina	Mucket	1	3	1	2	2
Alasmidonta marginata	Elktoe (SC)		3	shell	2	2
Elliptio dilatata	Spike		1			
Fusconaia flava	Wabash pigtoe		3		1	3
Lampsilis fasciola	Wavy-rayed lampmussel (T)		8		1	2
Lampsilis siliquoidea	Fatmucket		6		3	3
Potamilus capax	Fat pocketbook		shell			
Ptychobranchus fasciolaris	Kidneyshell		2	1	2	2
Pyganodon grandis	Giant floater	shell				
Strophitus undulatus	Creeper	shell				
Species Total						**9**

b. Proud Lake State Recreation Area

Species	Common Name	Proud Lake		
		Site 1	Site 2	Site 3
Actinonaias ligamentina	Mucket	6		2
Elliptio dilatata	Spike	shell	shell	
Lampsilis fasciola	Wavy-rayed lampmussel (T)		shell	shell
Potamilus capax	Fat pocketbook	10		4
Ptychobranchus fasciolaris	Kidneyshell	7	shell	10
Species Total				**5**

Table 5. Lake water quality information for two state recreation areas

Variable	Island Lake State Rec. Area		Proud Lake State Rec. Area	
	Kent Lake	Trout Lake	Moss Lake	Proud Lake**
Size (Ha)	medium (27.17)*	medium (17.25)	small (4.41)	medium (43.08)
Maximum Depth (m)	15	8.5	7	11.5, 8.5
Alkalinity (ppm)	240	136	245	235, 224
Conductivity (uS)	658	389	697	712, 703
DO (mg/L) Max. at Depth (m)	6.60 at 0	8.19 at 7	7.46 at 2	8.83 at 2, 8.02 at 2
DO (mg/L) Min. at Depth (m)	5.66 at 3.5	7.95 at 1	0.14 at 6.5	0.09 at 8, 0.11 at 7
pH	8.38	8.55	8.45	8.54, 8.47
Secchi Depth (m)	1.8	8.3	2.6	2, 2.6
Water Color	26	2	6	10, 12

*Kent Lake area outside of Island Lake State Recreation Area = 312.04 Ha
**Proud Lake limnology parameters are listed for both the East and West lobes of the lake respectively

(*Cyprinella* sp., *Notropis* sp.) were the prevalent fish species found in PRSRA. Unlike the other two parks, the Huron at Proud Lake had mottled sculpin (*Cottus bairdi*), grass pickerel (*Esox americanus vermiculatus*), green sunfish (*Lepomis cyanellus*), pumpkinseed sunfish, and spottail shiners (*Notropis hudsonius*) (Table 3). Game species such as, bluegill, rock bass, green sunfish, smallmouth bass, and largemouth bass were seen at PRSRA (Table 3). The special concern species brindled madtom was also found at PRSRA (Appendix 1). This is a new occurrence for this fish species of concern for the surveyed portion of the Huron River.

Five species of mussels were found in the Huron River at PRSRA (Table 4). Shells of the threatened wavy-rayed lampmussel were found in the Huron at

Table 6. Fish, mussel, and other species found in lakes at two state recreation areas. a. Island Lake State Recreation Area, b. Proud Lake State Recreation Area. YOY - young of year. Carapace length is recorded for turtles.

a. Island Lake State Recreation Area

Species	Common Name	Kent Lake		Trout Lake	
		Total	Size Range (mm)	Total	Size Range (mm)
Catostomus commersonii	White sucker	1	520		
Cyprinus carpio	Common carp	1	610		
Etheostoma sp.	Unknown darter	1	46		
Etheostoma nigrum	Johnny darter	2	44-47		
Lepomis cyanellus	Green sunfish	1	128-133		
Lepomis gibbosus	Pumpkinseed sunfish	2	45-131		
Lepomis macrochirus	Bluegill	1968	26-196	67	79-137
Micropterus dolomieu	Smallmouth bass	35	52-218		
Micropterus salmoides	Largemouth bass	37	61-270	166	45-140
Notropis hudsonius	Spottail shiner			103	52-66
Perca flavescens	Yellow perch	7	60-108		
Percina carodes	Northern logperch	1	77		
Pimephales notatus	Bluntnose minnow	90	41-70	60	60-83
Pomoxis nigromaculatus	Black crappie	1	76		
Chrysemys picta	Painted turtle	1	148		
Sternotherus odoratus	Common musk turtle	9	68-105	8	42-100
Species Total		**15**		**5**	

b. Proud Lake State Recreation Area

Species	Common Name	Moss Lake		Proud Lake	
		Total	Size Range (mm)	Total	Size Range (mm)
Ambloplites rupestris	Rock bass			12	50-180
Cyprinella spiloptera	Spotfin shiner	3	20-37	2	72-73
Etheostoma nigrum	Johnny darter	1	52	3	37-43
Fundulus diaphanus menona	Western banded killifish			1	43
Labidesthes sicculus	Brook silverside			110	39-77
Lepomis gulosus	Warmouth sunfish	1	115		
Lepomis macrochirus	Bluegill	4	30-39	98	23-143
Lepomis megalotis	Longear sunfish			7	58-167
Lepomis sp.	YoY longear sunfish	1	33		
Lepomis sp.	YoY sunfish			2	
Micropterus salmoides	Largemouth bass	3	25-73	11	61-262
Notropis hudsonius	Spottail shiner			501	35-62
Percina caprodes	Northern logperch			1	80
Pimephales notatus	Bluntnose minnow			11	51-75
Chrysemys picta	Painted turtle	3	75-150	2	118-120
Graptemys geographica	Common map turtle			1	95
Sternotherus odoratus	Common musk turtle	1		4	80-105
Pyganodon grandis	Giant floater			3	
Species Total		**8**		**16**	

Proud Lake (Table 4). The majority of mussels found at PRSRA were old shells or recently deceased individuals. These shells were new occurrences of wavy-rayed lampmussel in the surveyed portion of the Huron River. Zebra mussels were found attached to almost anything in the river and many of the live mussels were covered with them.

Lakes

The deepest lake surveyed was the eastern lobe of Proud Lake at 11.5 m (Table 5). Since Proud Lake and Moss Lake are connected, they have similar water quality parameters. Moss Lake is more neutral and had less oxygen than Proud Lake (Table 5). Proud Lake had 12 species of fish and Moss Lake had 6 (Table 5). Spottail shiner and brook silverside (*Labidesthes sicculus*) were the species most frequently encountered at Proud Lake. Moss Lake had very few species and few individuals were collected. Rock bass, western banded killifish (*Fundulus diaphanous menona*), and brook silverside were the species only found at Proud Lake (Table 5). Bluegills were encountered in both lakes (Table 5). A single mussel species, the giant floater (*Pyganodon grandis*), was observed in Proud Lake at low numbers (Table 5). Zebra mussels were observed in Proud Lake. Painted turtles and common musk turtles were seen in both lakes and the common map turtle (*Graptemys geographica*) in Proud Lake (Table 5).

Species of Concern Life History Information

Brindled madtoms prefer pools below riffles, soft bottoms, gravel and sand mixed with sticks and leaves in medium sized rivers (Appendix 1). This species is sensitive to siltation and other forms of habitat degradation, thus making riparian zones very significant. Spawning habitat is in woody debris with emergent vegetation. Males guard the nest of amber colored eggs (Appendix 1). The invasive round goby competes with the brindled madtom for hiding places and spawning grounds. The brindled madtom is secretive and nocturnal (Appendix 1).

Elktoe are found in small-to-large sized streams and small-to-medium rivers. The species prefers faster currents over packed sand and gravel substrates in clear water (Appendix 2). The known host species for elktoe glochidia include the white sucker, northern hog sucker, shorthead redhorse (*Moxostoma macrolepidotum*), rockbass, and warmouth (*Lepomis gulosus*) (Appendix 2). Rock bass were seen at ILSRA and PRSRA. The wavy-rayed lampmussel prefers small-medium sized shallow streams in and near riffles with sand and/or gravel (Appendix 3). The single host fish species for wavy-rayed lampmussel is the smallmouth bass (*Micropterus dolomieu*) (Appendix 3). The smallmouth bass was found at ILSRA and PRSRA.

MANAGEMENT RECOMMENDATIONS

Management to promote biodiversity within the aquatic ecosystems at these state recreation areas includes three general practices. The first is to preserve and establish vegetated riparian buffers. Riparian zones are a key way to preserve habitat within the Huron River and the lakes. These areas provide bank stability, erosion control, inputs of woody structure, and shade. The special concern brindled madtom and threatened wavy-rayed lampmussel occur in the Huron River at two of the recreation areas and the special concern elktoe at ILSRA. All three species of concern are sensitive to pollution and siltation (Appendices 1-3). Brindled madtoms prefer the emergent vegetation and woody debris from riparian zones for cover and spawning (Appendix 1). The addition of structure and vegetation to the lakes and the Huron River will also encourage the presence of host species (such as smallmouth bass, rock bass, and white sucker) for the elktoe and wavy-rayed lampmussel (Appendices 2-3). The presence of shade provided by a vegetated riparian buffer will keep water temperatures within normal range.

A second management recommendation is education of the public which uses the recreation areas. This information would include signs enlightening the public of the species of concern, but also of invasive aquatic species. Signs could be posted at boat access points and swimming areas. Brindled madtoms compete with the invasive round goby for habitat (Appendix 1). Educational signs could inform fishermen to report any sightings of the round goby as well as prevent introduction of the species. The Huron River and some of the lakes already have been invaded by zebra mussels and some by the Asiatic clam. However, education of the public will inform them of the effects of these invasives and help limit their spread from lake to lake.

Finally, take into consideration aquatic needs while conducting park maintenance. This would include bridges, trails, and roads that run through the park as well as canoe routes. Maintenance efforts are especially significant at Pontiac Lake State Recreation Area which is near the headwaters of the Huron River. Limiting erosion and sediment inputs into the lakes and river is crucial for the special concern species and other species. Retaining large woody debris in the

lakes and Huron River will provide structure and cover for the brindled madtom and other fish species.

ACKNOWLEDGEMENTS

Funding for this project was provided by Ray Fahlsing of the Michigan Department of Natural Resources, Parks and Recreation Division. Thank you to Amy Derosier for the extensive help in planning, preparation, field work, and editing for this project. Furthermore, I appreciate the assistance of Colleen McClean, Melanie Weber, Josh Moffi, and Kristin Konath in sampling the lakes and the Huron River.

LITERATURE CITED

Albert, D.A. 1995. Regional Landscape Ecosystems of Michigan, Minnesota, and Wisconsin: A Working Map and Classification. Gen. Tech. Rep. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 250p.

Higman, P.J., J.L. Cooper, Y. Lee, et al. 2001. Inventory and Management Recommendations for Island Lake State Recreation Areas Natural Communities, Rare Plants, and Rare Wildlife. Report submitted to the Michigan Department of Natural Resources, Parks and Recreation Division, Lansing. 64p.

Higman, P.J., M.A. Kost, H.D. Enander, and E.H. Schools. 2001. Pontiac Lake State Recreation Area Natural Features Inventory and Management Recommendations. Report submitted to the Michigan Department of Natural Resources, Parks and Recreation Division, Lansing. 25p.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer (Accessed: September 16, 2005).

Schools, E.H., J.L. Cooper, Y. Lee, et al. 2001. Inventory and Management Recommendations for Proud Lake State Recreation Area Natural Communities, Rare Plants, and Rare Wildlife. Report submitted to the Michigan Department of Natural Resources, Parks and Recreation Division, Lansing. 58p.

Figure 5: Conducting bucket surveys in the Huron River at ILSRA

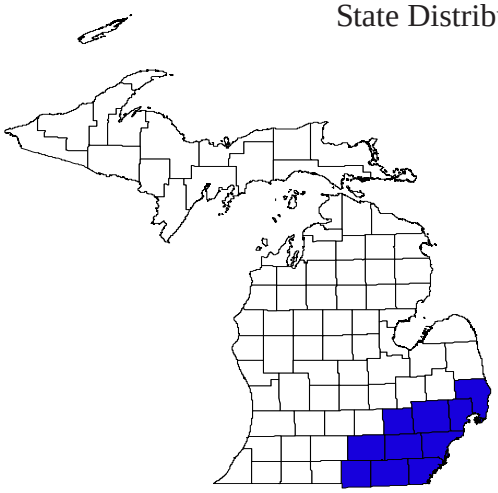
Figure 6: Wavy-rayed lampmussels found in the Huron River at ILSRA

Figure 7: Seining in the Huron River at PRSRA

Noturus miurus Jordan — Brindled Madtom

Photograph courtesy of the Ohio Department of Natural Resources

State Distribution



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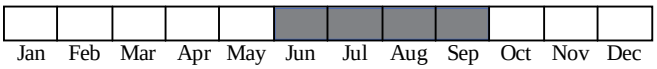


Status: State special concern

Global and state rank: G5/S2S3

Family: Ictaluridae (Bullhead Catfish)

Total range: The brindled madtom occurs in the lower Great Lakes drainage in Michigan, Ontario, and New York. It also occurs in Illinois and Indiana, east to the Ohio River basin and west to the Mississippi River basin (Scott 1973). Brindled madtoms have been collected in the western portions of Tennessee and in Oklahoma and southeastern Kansas. The species remains imperiled (S2) or vulnerable (S3) throughout the north and western portions of its range while in the south it is generally secure (S4/S5) (NatureServe).

State distribution: The brindled madtom is only found in the southeast corner of Michigan in the Lake Erie Basin (Bailey et al. 2004). Historically, the brindled madtom occurred in the Tiffin, Huron, Saline, and Raisin Rivers and Davis, Mill, and Portage Creeks. Within the last 20 years, brindled madtom have been found in the Huron, Raisin, Belle, and Pine Rivers and Stoney Creek. The species was also found in several lakes in the early 1900's, specifically, Portage, Base Line, Bass, Union, and Orchard Lakes. However, no surveys of the brindled madtom within these lakes have occurred within the last 20 years. Additionally, Lake St. Clair currently has viable populations of brindled madtom.

Recognition: The brindled madtom has four dark conspicuous saddle marks on its back, giving its name (Bailey et al. 2004). The species rarely grows larger than 50-76 mm in length (Scott 1973). This fish is stocky but then becomes strongly laterally compressed behind the anal fin (Scott 1973). They have one pair of long flattened barbels close to the eye and a moderately subterminal mouth (Scott 1973). The adipose fin is connected to the caudal fin and the last saddle band reaches the edge of this fin (Bailey et al. 2004). The dorsal fin is well ahead of the midpoint of the body and has a black tip (Bailey et al. 2004, Scott 1973). This species is most often confused with the northern madtom in Michigan (Taylor 1969, Trautman 1981).

Best survey time/phenology: The brindled madtom is likely best surveyed during the summer and early fall months when water flows and turbidity are low in riverine systems. Sampling in lakes may be more flexible. Because this species is nocturnal, night surveys may be the most successful (Scott 1973, Trautman 1981).

Habitat: The habitat of the brindled madtom varies throughout its range according to the latitudinal location of populations. In the Midwest, it is typically found in slow-moving rivers with soft substrates and scattered emergent vegetation (Trautman 1981). Within streams, individuals primarily inhabit pools below riffles in weedy areas (Smith 1985). They often hide under stones, organic material, and woody debris (Trautman 1981). In lakes, they are found over soft bottoms with an 'abundance of leaves and twigs' (Scott 1973).

Biology: Little is known about the life history of the brindled madtom. Taylor (1969) studied the species in Michigan and indicated that it spawns from July to early August in water temperatures around 25ºC. Nests are guarded by the males, which consist of a cluster of 34-46 large, amber eggs (Taylor 1969). Spawning occurs in areas with silty substrates and emergent vegetation. Like other madtoms, this species prefers to feed at night on aquatic insects, other drifting invertebrates, and plants (Scott 1973). Little is known about the predators of the brindled madtom; however predation may not be high due to the species secretive and nocturnal nature.

Conservation/management: The dwindling populations of the brindled madtom suggest that this species has very specific ecological requirements and is sensitive to habitat disturbance and degradation. Trautman (1981) suggests that increased turbidity and stream flow alteration has led to the decline of the species in Ohio. Brindled madtoms are intolerant to toxic pollutants and siltation (Parker 1987). Siltation decreases the quality of habitat for both eggs and adults by reducing the amount of oxygen in the water. Increased siltation may also limit the ability of brindled madtoms to feed. Thus, it is important to maintain broad riparian buffers. Additionally, the brindled madtom completes for spawning habitat and cover with the round goby, an introduced species. Areas where both brindled madtom and round goby occur should be especially considered when preserving the species and its habitat. Because little is known of the specific habitat and biology of the brindled madtom, it is important to preserve the natural state of the rivers where the species occurs.

Research Needs: Population assessments are needed. Due to the brindled madtoms nocturnal nature and penchant for hiding, effective survey and assessment techniques need to be determined. Updated and additional surveys are needed for lakes, since present lake population data for brindled madtoms is historical. Specific habitat requirements as well as tolerance levels to threats should be further studied for the brindled madtom.

Selected references:

Bailey, R.M., W.C. Latta, and G.R. Smith. 2004. An Atlas of Michigan Fishes. Museum of Zoology, University of Michigan, No. 192, Ann Arbor. 215p.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 20, 2005).

Parker, B.J. and P. McKee. 1987. Status of the brindled madtom, *Noturus miurus*, in Canada. *Canadian Field Naturalist* **101**:226-230.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184, Ottawa. 966p.

Smith, C.L. 1985. The inland fishes of New York State. New York State Department of Environmental Conservation. Albany, New York. 522 p.

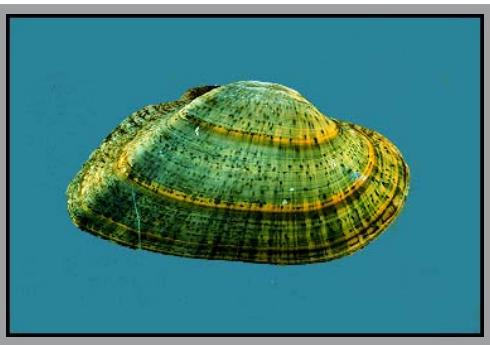
Taylor, W.R. 1969. A revision of the catfish genus *Noturus* Rafinesque, with an analysis of higher groups in the Ictaluridae. *U.S. National Museum Bulletin* **282**: 1-315.

Trautman, M.B. 1981. The Fishes of Ohio. Second Edition. Ohio State University Press, Columbus. 782p.

Abstract citation: Swart, S.L. 2005. Special Animal Abstract for *Noturus miurus* (Brindled Madtom). Michigan Natural Features Inventory. Lansing, MI. 2pp.

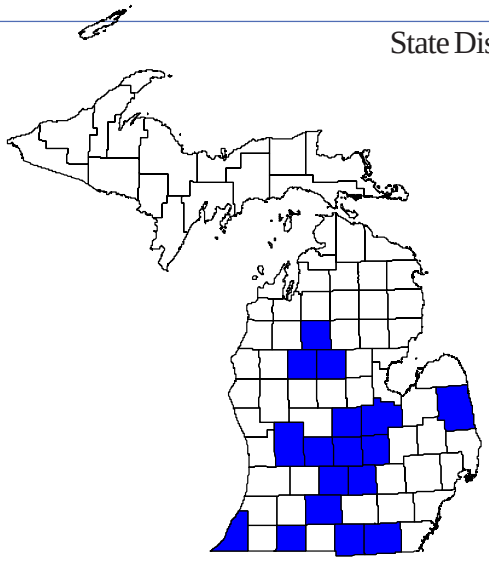
Funding for abstract provided by Michigan Department of Natural Resources-Parks and Recreation Bureau.

Alasmidonta marginata Say — Elktoe



Photograph courtesy of Kevin Cummings, Illinois Natural History Survey

State Distribution



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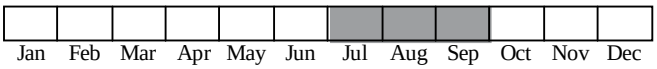

Status: State special concern

Global and State Rank: G4/S2S3

Family: Unionidae (Freshwater Mussels)

Synonyms: The elktoe has also been called the Ridged Wedge-Mussel (Clarke 1981).

Total Range: The elktoe is widespread in North America although patchy in distribution. It occurs in the Great Lakes and St. Lawrence drainages south to the Tennessee drainage. It is most abundant in the center of its range (NatureServe).

While in Wisconsin, Illinois, Tennessee, Pennsylvania and New York the elktoe is considered apparently secure (S4), in other areas of its range it is less secure. The elktoe is considered possibly extirpated (SH) in Alabama and critically imperiled (S1) in Quebec, South Dakota, Kansas, Oklahoma and Vermont. In Minnesota, Missouri, Kentucky, West Virginia and Virginia, the elktoe is considered imperiled (S2) and in Ontario, Iowa and Indiana it is vulnerable (S3). In several states, the elktoe is unranked (S?) (North Dakota, Nebraska, Arkansas, Ohio and Washington D.C.) (NatureServe).

State Distribution: The elktoe has been found in several areas of Lower Michigan. Historically, it was present in the Grand River in Kent and Ionia Counties (Van der Shalie 1945). Recent surveys indicate that it still occurs in the Grand River, but in reduced numbers (Goforth et al. 2000). Live specimens have also been found in the St. Joseph River in Berrien and Calhoun Counties, St. Joseph (Maumee) River in Hillsdale County, and the Raisin River in Lenawee County (Badra and Goforth 2002, Goforth et al. 2001, Badra and Goforth 2001). During a survey of the Muskegon River watershed in the summer of 2002, live elktoe were found in Osceola County and spent shells were found in Clare and Missaukee Counties. Other recent surveys have found live elktoe in the Pine River in Montcalm County, the Maple River in Gratiot and Clinton Counties, the Looking Glass River in Clinton County and the Red Cedar River in Ingham County. Spent shells have been found recently in the Tittabawassee River in Saginaw County, the Thornapple River in Eaton County, the St. Joseph River in St. Joseph County, and the Black River in Sanilac County, but no live specimens have been recovered in these areas (Badra and Goforth 2002).

Recognition: The elktoe is a relatively small, thin-shelled mussel, that may reach up to four inches in length. The shell of the elktoe is elongate, with a rounded anterior end and an angled, square posterior

end. It has a prominent posterior ridge, and the posterior slope is ribbed. The umbo is large and centrally located above the hinge line. Beak sculpture is heavy and consists of three to four double-looped ridges. Lateral teeth are generally absent, and one, occasionally two, thin, elongate pseudocardinal teeth are present. The exterior color of the elktoe shell is yellowish green, with prominent broad dark green rays and dots. The nacre is white and may have some salmon coloring near the beak. The foot of the elktoe is bright orange (Cummings and Mayer 1992, Watters 1995, NatureServe).

In Michigan, the elktoe may be confused most often with the strange floater (*Strophitus undulatus*). The strange floater lacks the rays and flecks of the elktoe, as well as the heavy beak sculpture. The elktoe may also be confused with the snuffbox (*Epioblasma triquetra*), slippershell mussel (*Alasmidonta viridis*) and deertoe (*Truncilla truncata*). These species lack the ribs found on the posterior dorsal area of the elktoe.

Best Survey Time: While the elktoe is present in its habitat throughout the year, it is easiest to locate these mussels from July through September, when water levels are typically low and turbidity is generally reduced.

Habitat: The elktoe is found in small to large sized streams and small to medium rivers. It is a riffle species, preferring swifter currents over packed sand and gravel substrates. The elktoe is typically only found in clean, clear water (Cummings and Mayer 1992, Watters 1995, NatureServe).

Biology: Little is known with regard to elktoe biology. It is a hermaphroditic species, containing both male and female sex parts (Clarke 1981). Fertilization is internal. Sperm is released into the water and is then taken in through the siphon from the water column. The elktoe is bradytictic, meaning that it is a long-term breeder. While fertilization generally occurs in July, the developing glochidia (larval mussels) are held in the gills until the following June, at which time the parasitic glochidia are released and adhere to a fish host (Oesch 1984). Known hosts include the white sucker (*Catostomus commersoni*), northern hog sucker (*Hypentelium nigricans*), shorthead redhorse (*Moxostoma macrolepidotum*), rockbass (*Ambloplites rupestris*) and warmouth (*Lepomis gulosus*) (Oesch 1984, NatureServe).

After metamorphosis, the young mussels drop to the substrate, where they spend the remainder of their lives buried in the substrate. The elktoe is a filter feeder, obtaining nutrition from material suspended in the water column.

Conservation/Management: The elktoe needs clean, fast-flowing water to survive. Therefore, changes to its habitat, such as river impoundment, siltation and channel disturbances, including dredging, negatively affect this species. Pollution from point (industrial and residential discharge) and non-point (siltation, herbicide and surface run-off) sources is also a threat to mussels and should be limited and monitored to insure compliance with the Clean Water Act. It is essential to protect not only the habitat of the elktoe, but also the white sucker, northern hog sucker, shorthead redhorse, rockbass and warmouth, as they serve as hosts for the glochidia.

Research Needs: A thorough survey needs to be completed to determine the current distribution of the elktoe in Michigan. A thorough review of literature and museum records needs to be completed to detail the historical distribution of the elktoe in Michigan. Historical sites need to be revisited to determine the extent of populations present, and suitable habitat surveyed for the presence of additional populations.

Selected References:

Badra, P.J. and R.R. Goforth. 2002. Surveys of native freshwater mussels in the lower reaches of Great Lakes tributary rivers in Michigan. Report for Michigan Department of Environmental Quality, Coastal Zone Management Unit. Michigan Natural Features Inventory Technical Report 2002-02.

Badra, P.J. and R.R. Goforth. 2001. Surveys for the clubshell (*Pleurobema clava*) and other rare clams in Michigan: Fianl Report – 2000. Report for the U.S. Fish and Wildlife Service. Michigan Natural Features Inventory Technical Report 2001-07.

Clarke, A.H. 1981. The freshwater mollusks of Canada. National Museum of Natural Sciences. Ottawa. 439 pp.

Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. 194 pp.

Goforth, R.R., P.J. Badra and R.S. Mulcrone. 2000. Evaluation of the current status of freshwater mussels at selected sites in the Grand River, Michigan. Michigan Natural Features Inventory Technical Report 2000-12. 106 pp.

Goforth, R.R., D.M. Stagliano, J.G. Cohen, M.R. Penskar, Y. Lee and J.L. Cooper. 2001. Biodiversity Analysis of Selected Riparian Ecosystems within a Fragmented Landscape.

Report for Michigan Great Lakes Protection Fund and Michigan Dept. of Environmental Quality, Office of the Great Lakes. Michigan Natural Features Inventory report number 2001-06. 148pp.

NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.6. Arlington, Virginia, USA: Association for Biodiversity Information. Available: http://www.natureserve.org/. (Accessed: February 22, 2002)

Oesch, R.D. 1984. Missouri naiads: a guide to the mussels of Missouri. Conservation Commission of the State of Missouri. 270 pp.

Van der Shalie, H. 1948. The commercially valuable mussels of the Grand River in Michigan. Michigan Department of Conservation. Misc. Publ. No. 4. Institute for Fisheries Research, Ann Arbor, MI. 42 pp.

Watters, G.T. 1995. A guide to the freshwater mussels of Ohio. Revised 3rd Edition. The Ohio Division of Wildlife, Columbus, OH. 122 pp.

Abstract citation: Carman, Stephanie M. 2002. Special animal abstract for *Alasmidonta marginata* (Elktoe). Michigan Natural Features Inventory, Lansing, MI. 3 pp.

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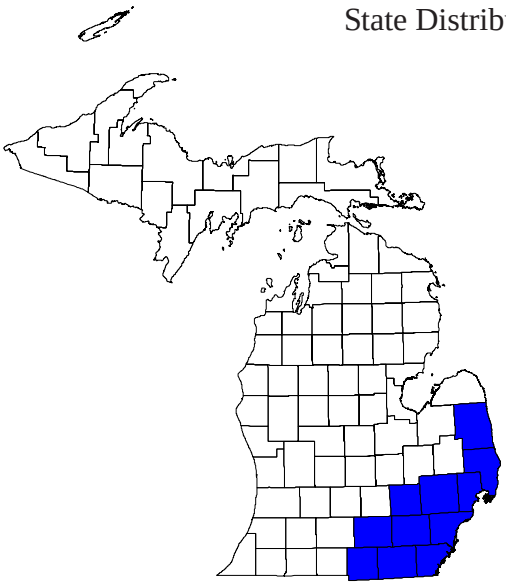
Lampsilis fasciola Rafinesque — Wavy-rayed Lampmussel

Photo by Kevin Cummings,
Illinois Natural History Survey

State Distribution



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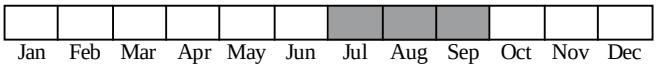

Status: State threatened

Global and State Rank: G4/S2

Family: Unionidae (Pearly Mussels)

Synonyms: *Ligumia fasciola*

Other Common Names: wavy-lined lampmussel

Total Range: The wavy-rayed lampmussel is discontinuously distributed in the Great Lakes tributaries of Lake Michigan, Lake Erie, Lake Huron, Lake St. Clair, and the Ohio-Mississippi and Tennessee drainage. While it was historically found frequently from Ontario to Alabama and Illinois to New York, its populations are currently declining (Watters 1993). It is seldom a common species where found, and peripheral populations are endangered. It is listed as critically imperiled in New York, Ontario, North Carolina and Alabama. It is also considered threatened in Michigan, Illinois, Indiana and Georgia (Nature Serve 2001). Populations are relatively stable in Kentucky, Tennessee and Virginia where they are reported to be more abundant within the mussel communities (S. Ahlstedt, personal communication).

State Distribution: Historically, the wavy-rayed lampmussel was found throughout southeastern Michigan streams and rivers. It is currently present in the Clinton River drainage in Macomb and Oakland Counties, the St. Joseph River in Hillsdale County, the Belle River in St. Clair County, the Huron River drainage in Washtenaw County and the River Raisin drainage in Jackson, Lenawee, and Washtenaw Counties. It was recently reported in the South Branch of the Kalamazoo River in Jackson County. Belle Isle and the Detroit River in Wayne County have historical occurances, but it is doubtful that they are still extant in these places. River Raisin records from Monroe County may also be outdated and new surveys are needed to verify these occurances.

Recognition: The wavy-rayed lampmussel has a rounded to ovate, moderately thick shell and is usually under 3.5 inches in length (7.5 cm). The shell is compressed to inflated (females) in shape. Shell color ranges from yellow to yellowish green with numerous thin wavy green rays. Anterior end is rounded, with the posterior bluntly pointed in males and rounded in females. The umbo is slightly elevated above the hinge line, and the beak sculture consists of 3-5 indistinct wavy ridges. The nacre is white, often iridescent posteriorly (Cummings 1992, Watters 1993, Burch 1994). Most similar to the plain pocketbook, *Lampsilis ventricosa,* but that species is less ovate, has highly

protruding umbos, a heavier hinge and green rays that are broader and straighter with fewer interruptions. The plain pocketbook also grows much larger in size (to 6 inches).

Best Survey Time: The wavy-rayed lampmussel is typically found in shallow, gravel riffle areas throughout the year, but it is easiest to find these mussels July through September when water and turbidity levels are typically low.

Habitat: The wavy-rayed lampmussel occurs in small-medium sized shallow streams, in and near riffles, with good current. It rarely occurs in medium rivers. The substrate preference is sand and/or gravel (Watters 1993).

Biology: Males and females are dimorphic. The breeding season of the wavy-rayed mussel is long-term, extending from early-August to the following July. Males release sperm into the water column and females siphon in the sperm by chance to fertilize awaiting eggs in brood pouches. Females can produce >100,000 eggs in a spawning season (Clarke 1981). Successful fertilization depends on males and females living in close proximity. Females are reported to hold glochidia (the parasitic larval stage of mussels) internally over winter for release through pores of their marsupial gills in the spring and summer. This release of glochidia coincides with host fish appearing in the shallow riffles (Zale and Neves 1982). To increase their effectiveness in parasitizing fish with their glochidia, wavy-rayed lampmussels, as well as other species in the Lampsilinae, attract predatory fish to their marsupial gills with a minnow-like mantle flap (Kreamer 1970). When fish approach and bite at the minnow lure, glochidia are released to infect the gills. *Lampsilis fasciola* glochidia resemble small purses without spines (0.24mm long and 0.29mm in height) (Clarke 1981). The single fish host of the wavy-rayed lampmussel is reported to be the smallmouth bass, *Micropterus dolomieu* (Zale and Neves 1982, Watters 1993). During a study to identify potential hot fish species, most innoculated non-host fish sloughed off the glochidia within 2-6 days (Zale and Neves 1982). Wavy-rayed lampmussel glochidia underwent metamorphosis on infected smallmouth bass in 30-47 days and 666 juveniles were recovered (Zale and Neves 1982). After completing the parasitic stage, juvenile wavy-rayed lampmussels drop from the host and grow relatively sessile within gravel substrate on the river bottom, probably not moving more that 100 meters in a lifetime. At this stage juveniles are vulnerable to predation by crustaceans, worms and other bottom feeders. Later in life, adult mussels are eaten by turtles, otters, fish, raccoons and primarily muskrats. The lifespan of the wavy-rayed mussel is not known. Like all mussels, the wavy-rayed lampmussel is a filter feeder, siphoning water and extracting particulate organic matter, algae and diatoms from the river currents.

Conservation/Management: Conservation of the watersheds surrounding the streams that the wavy-rayed mussel inhabits is essential for its protection. Like most mussels, the wavy-rayed lampmussel is sensitive to river impoundment, siltation and channel disturbance. Because they prefer riffles and shallow areas with moderate flow and high oxygen content, they are often the first to be affected by disturbance. Pollution from point (industrial and residential discharge) and non-point (siltation, herbicide and surface run-off) sources is also a great threat to mussels and should be limited. Non-point source pollutants have been the primary reason for population declines in the Midwest. Watters (1993) reported that this species now occurs only in clean streams in Ohio, such as Big Darby Creek. Because of the critical link to the fish host (smallmouth bass) for propagation, the ability to maintain good populations of the fish fauna in the streams inhabited by this mussel is as crucial as suitable habitat.

Photo by David Stagliano, MNFI

Research Needs: A thorough survey needs to be completed to determine the current distribution of this species in Michigan and throughout its range. A new occurrence was reported in 2000 from a watershed not previously reported to contain this species (Stagliano 2000). Thus, systematic surveys may turn up new populations that are not currently known. In order to better protect and manage current populations, life history data, and more thorough fish host relationships need to be evaluated.

Selected References:

Alhstedt, S.A. U.S. Geological Survey, Knoxville, TN Personal communication on Dec 12, 2000.

Burch, J.B. 1994. Mollusk: Species Accounts. Pages 395-410 in D.C. Evers, ed. Endangered and Threatened Wildlife of Michigan. University of Michigan Press, Ann Arbor, MI.

Clarke, A.H. 1981. The Freshwater Molluscs of Canada. National Museums of Natural Science, National Museums of Canada. Ottawa, Canada.

Cummings, K.S., and C.A. Mayer. 1992. Field Guide to Freshwater Mussels of the Midwest. Illinois Natural History Survey. Manual 5. 194 pp.

Kreamer, L.R. 1970. The mantle flap of three species of *Lampsilis* (Pelecypoda: Unionidae). Malacologia 10: 225-282.

NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.3 Arlington, Virginia, USA: Association for Biodiversity Information. Available: http://www. natureserve.org/. (Accessed: May 11, 2001).

Goforth, R. R., D. Stagliano, J. Cohen, M. Penskar, Y.M. Lee, J. Cooper. 2001. Biodiversity Analysis of Selected Riparian Ecosystems within a Fragmented Landscape. Report #2001-06 Michigan Department of Environmental Quality, Office of the Great Lakes. 148 pp.

Watters, G.T. 1993. A guide to the freshwater mussels of Ohio. Revised Edition. The Ohio Department of Natural Resources, 106 pages.

Zale, A.V. and R.J. Neves. 1982. Fish hosts of four species of Lampsiline mussels (Mollusca: Unionidae) in Big Moccasin Creek, Virginia. Can. J. Zool. 60: 2535-2542.

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