

**Nearshore Fish Populations in Mud Lake and Rock Lake  
Lake Mills, Jefferson County  
2014**



**Jefferson County Land and Water  
Conservation Department**

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## Summary

Lake assessment projects usually focus on traditional eutrophication indicators (water clarity, phosphorus, and chlorophyll), aquatic vegetation diversity and abundance, and game fish inventories. Other important ecological indicators, including nearshore fish, are often overlooked in lake evaluations. Nearshore fish populations have been described as “canaries in the coal mine” but are not routinely surveyed since they offer no perceived or direct economic benefit associated with sport fish populations. These sensitive fish populations provide important ecological linkages that may reveal lake-ecosystem stresses even before traditional parameters reveal water quality problems.

Periodic inventories of nearshore fish are needed to determine species diversity, individual population status, and overall ecosystem health. Nearshore fish populations are represented by a diversity of species, including State Endangered, State Threatened, State Special Concern and other environmentally intolerant groups. These surveys, the long term trends, and data on habitat provide important information regarding the status of the fish population and how their required habitat conditions may be changing over time.

Fortunately for Rock Lake, data has already been established over the years (1974, 2004, 2006, and 2008) on the nearshore fish in the lake. In 2007, fish sampling was performed on Mud Lake.

With funding from the Wisconsin Department of Natural Resources, a survey of nearshore fish was performed in July and September on Rock Lake and Mud Lake. The goals of the project include:

- Evaluate the status of nearshore fish populations, including overall species diversity, composition of environmentally sensitive species, and presence/absence of Natural Heritage Inventory (NHI) species and introduced species.
- Evaluate factors that may be affecting species diversity, rare and endangered species, and the overall ecological balance in the lake.
- If sensitive fish species are rediscovered, determine location preferences with respect to various habitat types.
- Use this information to educate the public and local governments and recommend any needed actions that will protect the sensitive fish species.

## Nearshore Fish Classifications

### Rare Species

The Wisconsin Department of Natural Resources is responsible for identifying species that are rare in the state through the Natural Heritage Inventory program. Rare species are classified into three different categories:

- Endangered Species - any species whose continued existence as a viable component of the state’s wild animals is in jeopardy on the basis of scientific evidence.

- Threatened Species - any species which appears likely, within the foreseeable future, on the basis of scientific evidence to become endangered.
- Special Concern Species - those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

The rare fish species that have been found in Rock Lake and Mud Lake are noted in Table 1 and Table 4.

### **Environmental Sensitivity**

There are some fish that can be classified in terms of how tolerant they are to environmental degradation such as poor water quality, siltation and increased turbidity, and reduced habitat heterogeneity (Lyons 1992). The classification given is either “tolerant” or “intolerant.”

Noting that the classification of tolerant and intolerant species is somewhat subjective, Lyons provides the following criteria to classify a species as intolerant:

- A known high degree of sensitivity to poor water quality, siltation, increased turbidity, and reduced habitat heterogeneity.
- An observed major decline in distribution and abundance where there are severe environmental problems.
- Designation as intolerant in biotic indices used in central North America.

Lyons provides the following criteria to classify a species as tolerant:

- A known ability to survive poor water quality, particularly low dissolved oxygen, high levels of ammonia and other toxic substances, and high turbidity.
- An observed ability to persist in good numbers in Wisconsin streams with poor environmental quality.
- Designation as tolerant in biotic indices used in central North America.

The fish that have been found in the Mud and Rock Lakes that can be classified as either intolerant or tolerant to environmental degradation are noted in Table 1 and Table 4.

### **Description of Methods and Activities**

For Rock Lake, the 2013 survey include Sites 1-11 which were the sites sampled in 1974, 2004, 2006, and 2008. Additional sites were included in the 2013 survey and were located as follows:

- north end of the lake in front of the DNR-owned property (this site was chosen because it was added to the survey in 2008 at which time sensitive fish species were documented)
- the south bank of the channel connecting the main lake to the millpond

- the south bank of the millpond directly across from the fire station (this site was chosen because the millpond had not had any fish sampling performed in the past and had a healthy aquatic plant population)
- four sites in Marsh Lake, the southern basin of Rock Lake (these sites were chosen because Marsh Lake had not had any nearshore fish sampling in the past surveys).

Please see Map 1 which depicts the locations of the sampled sites in Rock Lake.

The 2007 work that was done on Mud Lake included seining of 4 sites. That same year, an aquatic plant survey was also completed. In 2013, 3 sites were chosen based on areas that had the highest habitat potential according to the 2007 aquatic plant survey results and visual observations. Only one site was included in both the 2007 and 2013 surveys and is the one located on the east side of the lake near the wooden walkway. Map 2 depicts the 2013 sampled sites in Mud Lake.

The 2013 fish surveys on Rock and Mud Lakes were designed to sample populations of nongame species and juvenile stages of sport fish. The surveys are indicators of ecological diversity and distribution of fishes that inhabit nearshore areas. The survey did not evaluate the growth rates, size distribution or population densities of sport fish populations.

The surveys on the lakes included both small-mesh seining (30 ft. x 6 ft. bag and 1/8 in. mesh) and a towed DC single probe electro-shocker. Previous surveys on each lake only involved the use of a seine. The combination of sampling gear is needed to effectively sample the different niches and behaviors of diverse fish populations. There were a few sites where conditions did not allow the use of one or more of the sampling techniques. The sites are as follows:

- All of the sites in Marsh Lake – baited minnow traps were used because the substrate was too mucky and wouldn't support the sampling team. The minnow traps were 17"L x 9"W with a 3/16" mesh and a 7/8" diameter entrance hole. The bait used was Wheaties.
- Mud Lake site #2 – the shocker was the only gear used because the area would have been difficult to effectively pull the seine.
- The DC electro-shocker was the only gear used at sites 13 and 14 of Rock Lake. The seining was not done at these sites because the time allotted for the seining did not cover these additional sites.

Surveys were performed in the main basin of Rock Lake on July 23 and 24, 2014. Separate seining and electrofishing crews commenced sampling at opposite ends of the lake, working in a clockwise fashion until all sites were sampled. Site 6 was also sampled on September 23, 2013 in order to re-identify an unexpected fish caught in July. The Marsh Lake sites had the minnow traps deployed on September 23, 2013 and they were retrieved approximately 6 hours later.

On Mud Lake, the surveys were completed on September 23, 2013. The two crews performed their work at the same time at the same sites by starting at a nearby point and walking away from each other.

The crews identified each species and counted the total numbers of each species caught. All specimens were immediately released, except when immature specimens required further review. Additional information collected included GPS coordinates, length of survey, substrate composition, aquatic vegetation cover, bank and shoreland characteristics, water temperature, dissolved oxygen, and conductivity.

### Findings on Rock Lake

The species numbers and designations are documented in Table 1 for every year of nearshore fish surveys on Rock Lake (not including Marsh Lake sites). In 2013, the species richness (23) was greater than the number found in the previous sampling years due in large part to the addition of electrofishing. The species richness in 2013 for the seining sites was 15 species – which is not a significant difference to the previous years. The additional species found with electrofishing were northern pike, yellow bullhead, bowfin, fantail darter, johnny darter, bluntnose minnow, central mudminnow, and slender madtom. Figure 1 shows the total number of species found over all of the sampling years.

Table 1. Nearshore Fish Data for Rock Lake (does not include Marsh Lake sites added in 2013)

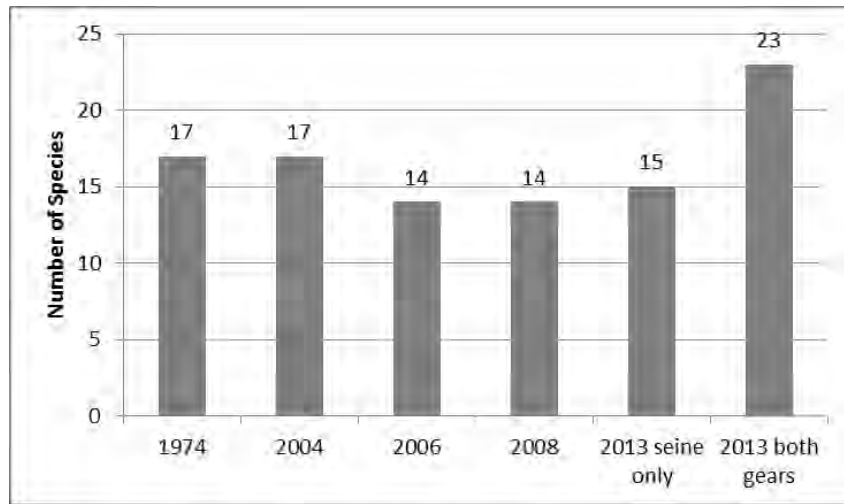
Species	Designation	May 1974	July 2004	May 2006	August 2008	July 2013**
Longnose Gar			3			1
Bowfin						2
Golden Shiner	tolerant	1	1			69
Pugnose Shiner	Threatened intolerant	2	40	3	11	
Emerald Shiner		1				
Blackchin Shiner	intolerant		27	14		61
Blacknose Shiner	intolerant	15				
Mimic Shiner		354*				
Bluntnose Minnow	tolerant	144	23	30	156* (507)	1
Central Mudminnow	tolerant					1
Black Bullhead			3			
Yellow Bullhead	tolerant		1		1	7
Slender Madtom	Endangered intolerant					5
Tadpole Madtom				1	1	
Banded Killifish	Special Concern	5				8
Blackstripe Topminnow		3				

Species	Designation	May 1974	July 2004	May 2006	August 2008	July 2013**
Brook Silverside		36	97	1	398* (1040)	217
Northern Pike				1	0	1
Rock Bass	intolerant	4	14	1	28	44
Pumpkinseed		16	1	32	19	9
Bluegill		102	484* (600)	160* (227)	528* (560)	1097
Green sunfish	tolerant				1	25
Smallmouth Bass	intolerant	1	21	1	49	69
Largemouth Bass		9	185	35	323* (456)	243
Black Crappie			1	1	4	1
Fantail Darter						76
Iowa Darter	intolerant	4	115	10	5	3
Johnny Darter						1
Least Darter	Special Concern intolerant	2	7	33		5
Yellow Perch		60	62		188	47
Total Species		17	17	14	14	23
Total Fish Collected		759*	1085* (1211)	323* (389)	1712* (2870)	1994
Total Rare Species		3	2	2	1	3
Total Intolerant Species		4	6	6	4	6
Total Tolerant Species		2	3	1	3	5

\* In 1974, catch counts for a particular species at a particular site were truncated at 99. An asterisk indicates totals that include one or more truncated counts. For the other years, all captured fish were counted but for comparative purposes, totals have been calculated with counts truncated at 99, indicated by an asterisk. The actual 2004, 2006, and 2008 totals are given in parentheses.

\*\* In 2013, two gear types were used: seining and shocking. Previous sampling efforts only included seining. The data is not shown as truncated due to the fact that there was extra effort. Totals from the extra sampling date at site 6 in September 2013 are included in the numbers.

Figure 1. Fish species documented during nearshore fish surveys (not including Marsh Lake sites added in 2013)



The minnow traps deployed in Marsh Lake were not an effective gear type for sampling our target species. A total of 8 young-of-the-year bluegills were found. The results are shown in Table 2.

Table 2. Minnow Trap Data for Marsh Lake, 2013

Site	Fish	Numbers
M-1	Bluegill	6
M-2	Bluegill	2
M-3	0	0
M-4	0	0

### Endangered Species

2013 marks the first year that an endangered fish species was documented in Rock Lake – the slender madtom (*Noturus exilis*). The State considers this species critically imperiled in Wisconsin. The critically imperiled rank is given because of extreme rarity, typically 5 or fewer occurrences and/or very few (<1,000) remaining individuals or acres, or due to some factor(s) making it especially vulnerable to extirpation from the state.

The slender madtom is a unique find in Rock Lake because it has never been documented in a Wisconsin lake before. It prefers clear, moderate to swift currents of streams and wide rivers over bottoms of gravel and boulders interspersed with fine sand. Slender madtoms are mostly nocturnal. The fish spawns from late May through June. 150-200 eggs are laid under a flat rock where water can percolate between the developing eggs. Newly hatched young will crowd together in a tight cluster.



The slender madtom was found with the electrofishing gear at a site in Rock Lake. That site had low aquatic vegetative cover (mostly submerged vegetation), and the substrate consisted of primarily boulder, cobble, and gravel.

### **Threatened Species**

The pugnose shiner (*Notropis anogenus*) is a Wisconsin Threatened Species that has been documented in Rock Lake. The fish was not found in the 2013 survey. The last time this fish was documented in the lake was during a fall electrofishing survey conducted in 2011.

The pugnose shiner prefers weedy shoals of glacial lakes and low-gradient streams over bottoms of mud, sand, cobble, silt, and clay. Spawning occurs from mid-June through mid-July. Pugnose shiners are omnivores that consume both filamentous algae and cladocerans (water fleas). The pugnose shiner is sensitive to turbidity, loss of aquatic plant habitat and other water quality impairments (Lyons 2009, 1992). The species population has either significantly decreased or disappeared from lakes with high pier densities and documented intensive herbicide treatments.

### **Special Concern Species**

The banded killifish (*Fundulus diaphanous*) is on the State Special Concern list. There were 8 banded killifish found in the 2013 survey with the seine at a site with abundant submerged vegetation. The substrate of the site was 60% silt/marl, 30% cobble, and 10% gravel. The banded killifish was also found during a 2013 fall electrofishing survey on the lake. Previous to 2013, the last time the fish was documented in Rock Lake was during the 1974 nearshore seining survey.

The banded killifish is known to prefer clear water of bays, moderate levels of aquatic vegetation over gravel, sand, silt, marl, clay detritus or cobble. It feeds primarily on small crustaceans and insects, and to a lesser degree on algae. Spawning occurs from June through mid-August.

The least darter (*Etheostoma microperca*), a fish listed as State Special Concern, was found at two different sites in Rock Lake with two different gear types. The electrofishing gear was used when 1 individual least darter was found at a site with abundant submerged, floating-leaf and emergent vegetation. The substrate at the site had 40% boulders, 30% sand, and 30% silt/marl. The seining gear was used when 4 least darters were found at a different site with high plant cover that mostly consisted of submerged vegetation and a small amount of floating vegetation. The substrate had 60% silt/marl, 30% cobble, and 10% gravel. The last time the least darter was documented in Rock Lake was during the 2006 nearshore fish seining survey.

The least darter prefers clear, warm, quiet waters of overflow ponds, pools, lakes and streams over substrates of gravel, silt, sand, boulders, mud or clay with dense vegetation or filamentous algal beds. Spawning occurs from late April into July. The least darter has a strong affinity for

aquatic vegetation and is vulnerable to habitat degradation. Becker (1983) reported that the least darter declined from a combination of turbidity, domestic and agricultural pollutants, and habitat changes.

Lake chubsucker (*Erimyzon sucetta*), a State Special Concern Species, was not found in 2013 or any of the previous nearshore fish seining surveys, but it is sometimes found in fall electrofishing surveys (2009, 2010, 2012). It was most recently found during a fall electrofishing survey in 2013. It prefers moderately clear lakes, oxbow lakes, sloughs of weedy lakes and their associated marshy streams dense with organic debris over bottoms of cobble, sand, boulders, mud or silt. Spawning occurs from mid-May through early July.

### **Environmentally Sensitive Fish**

In terms of intolerant fish species, the 2013 survey found 6 species that are classified as intolerant: blackchin shiner, slender madtom, rock bass, smallmouth bass, Iowa darter, and least darter. In previous surveys, the number of intolerant species ranged from 4 to 6 species.

It is important to note that 2013 was the first year in which the pugnose shiner, an intolerant and State Threatened species, was not found in the nearshore fish seining survey. The description of the pugnose shiner can be found in the text above.

The blackchin shiner (*Notropis heterodon*) inhabits slow, clear, weedy areas of large streams, and the shallow parts of lakes. It appears to be intolerant of silt and the loss of aquatic plant habitat, and is becoming uncommon over much of its range (Lake Champlain to Wisconsin). Documented losses of this species in south central Wisconsin include Lake Mendota (Lyons 1989) and Lake Ripley (Lyons et al. 2000).

In 2013, the blackchin shiner was found at 2 sites with the seine. At the site where 58 individuals were found, the aquatic plant cover was high and consisted mostly of submerged aquatic plants and some floating-leaf aquatic plants. The substrate included 60% silt/marl, 30% cobble, and 10% gravel. At the site where 3 individuals were found, the aquatic plant cover was also high, consisting mostly of submerged aquatic plants and some floating-leaf vegetation. The substrate had 60% silt/marl, 20% sand, 10% cobble, and 10% gravel.

The least darter is an intolerant species that is explained in the Special Concern section above.

Three individual Iowa darters (*Etheostoma exile*), an intolerant species, were found at 3 different sites in 2013 using both gear types. At two of the sites, the aquatic vegetation cover was high, and at one site the cover was classified as medium. The Iowa darter species prefers cool, clear to slightly turbid, slow-moving vegetated streams and weedy portions of lakes. It spawns in late April to early June in shallow water among submerged vegetation.

The smallmouth bass (*Micropterus dolomieu*) was found at seven different sites in the lake. The preferred habitat for this species is clear lakes with gravel or rocky shorelines. The rock bass

(*Ambloplites rupestris*) was found at six different sites in the 2013 survey. The rock bass prefers areas with vegetation on firm to rocky substrates in clear-water lakes. Through yearly fall electrofishing surveys, it is known that smallmouth bass and rock bass are consistently caught in the lake. These surveys also note that the rock bass population is “sizeable and robust.” Smallmouth bass are naturally reproducing in the lake and fish stocking is not conducted.

The blacknose shiner (*Notropis heterolepis*) was not documented in the 2013 survey. The last time it was found in a nearshore fish seining survey was 1974. It was documented in the 2009 fall electrofishing survey. This species lives in vegetated shallow area of lakes. It requires clean, cool, well-oxygenated lakes with abundant aquatic vegetation. It is intolerant of turbid water and pollution.

It is interesting to compare the number of rare and intolerant species that were found at each site over the years (Table 3). Among the sites where the rare and intolerant species were found, it is interesting to consider the average number of these species found per site. As of June 2013, the 1974 and 2006 data per site was not on hand and will be provided at a later date. The data appears to show that the number of rare and intolerant species found at sites containing these species is declining.

Table 3. Intolerant and Rare Species Richness by Sample site: 1974, 2004, 2006, 2008, 2013

Site	1974	2004	2006	2008	2013
1		3		3	
2		5		3	1
3		6		1	
4		2		2	4
5		3		1	1
6		1		1	3
7				1	1
8				1	1
9		1		2	2
10		1			1
11		1		3	1
12	NA	NA	NA	1	3
13	NA	NA	NA	NA	
14	NA	NA	NA	NA	2
Total sites where found at sites 1-11		9		10	9
Average # intolerant per site		2.6		1.8	1.7

## **Habitat**

When considering the rare and intolerant species whose preferred habitat includes moderate to dense aquatic vegetation, it is not surprising that they were all found at sites with primarily high aquatic plant cover. The exception is the rock bass which was found at sites with low, medium, and high vegetative cover. But this fish is probably the exception because it is more abundant than the other species and thus would be located in more habitat types throughout the lake.

The woody habitat at all of the sites sampled was either absent or low.

Low numbers of species and overall total number of fish were found in front of the seawall at Bartel's beach. This site also has very low submerged aquatic plant cover.

## **Rock Lake Discussion**

Despite nearshore habitat loss in Rock Lake since 1974, compared to other lakes in southern Wisconsin Rock Lake still supports diverse nongame fish populations. It is not surprising that the rare and intolerant fish that are dependent on moderate to dense aquatic plant cover were found at the sites with that type of cover, and were not found at sites with low or absent plant cover.

Notable declines or losses from the lake include blackstripe topminnow (last documented in 1974) and blacknose shiner (last documented in 1974).

The electrofishing gear was able to document the fantail darter, which has not been found in previous surveys on the lake, and the very rare State Endangered slender madtom. These finds demonstrate the need to continue a multiple sampling gear strategy.

Sustaining this relatively high diversity of fish populations reinforces the need to monitor, protect and improve nearshore habitats.

## **Rock Lake Recommendations**

Based on the findings of the 2013 nearshore fish survey and the long-term trends of the fish found in the lake, the following are recommendations that will benefit the nearshore fish in Rock Lake:

### **Habitat & Fish**

- Lakefront property owners should be encouraged to protect or restore habitat: both aquatic vegetation, woody habitat in the lake, and native vegetation in on the land adjacent to the lake.

- There should be rock riprap added along the Bartels beach seawall to increase nearshore fish habitat including habitat for slender madtom.
- Lake Ripley has been investigating the merit and feasibility of reintroducing native nongame fish species (including banded killifish, blacknose shiner, blackchin shiner, least darter, and pugnose shiner) using approved conservation aquaculture methods. Given their future results, the reintroduction of these fish should be explored in Rock Lake.

### **Future Surveys**

- The nearshore fish survey should continue to be performed in future years to monitor the trends in nongame fish populations. Future surveys should be performed using both seining and electrofishing gear. The results of the 2013 survey suggest that towed DC electrofishing may be a more effective sampling technique over a range of habitats.
- There should be future electrofishing surveys in appropriate areas to document the presence of the slender madtom.
- The Department of Natural Resources should consider adding a boom shocking survey that specifically targets smaller, rare fish species. This can be accomplished with using fine-mesh dip nets (1/8") to capture the smaller fish. The seasonal timing of this survey needs to be investigated. Due to the deep muck substrate in Marsh Lake, a boom shocking survey would be ideal to document rare and intolerant fish.

### **Findings on Mud Lake**

The species numbers and designations for the nearshore fish surveys on Mud Lake are documented in Table 4. It is important to note that the 2007 survey included 4 sampling sites where as the 2013 survey included 3 sampling sites. The fact that more species were documented in 2007 (12 versus 9 species in 2013) may be attributed to the additional site done that year despite the fact that electrofishing was added in 2013. Another factor may be related to the timing of the surveys.

In terms of environmentally sensitive species, the 2013 survey found the Iowa darter which was not found in the 2007 survey. The blackchin shiner was the one intolerant species that was found in 2007. The lake chubsucker is a Special Concern species in Wisconsin that was documented in 2013.

Table 4. Nearshore Fish Data on Mud Lake

Species	Designation	June/August 2007	September 2013
Bowfin		1	1
Golden Shiner	tolerant	4	
Blackchin Shiner	intolerant	1	
Central Mudminnow	tolerant	1	37
Yellow Bullhead	tolerant		3
Brook Silverside		1	6
Northern Pike		2	1
Pumpkinseed			121
Bluegill		1693	1145
Largemouth Bass		94	6
Black Crappie		800	
Iowa Darter	intolerant		4
Johnny Darter		2	
Yellow Perch		27	2
Lake Chubsucker	Special Concern		1
Common Carp		3	
<b>Total Species</b>		<b>12</b>	<b>10</b>
<b>Total Fish Collected</b>		<b>2629</b>	<b>1327</b>
<b>Total Rare Species</b>		<b>0</b>	<b>1</b>
<b>Total Intolerant Species</b>		<b>1</b>	<b>1</b>
<b>Total Tolerant Species</b>		<b>2</b>	<b>2</b>

### Mud Lake Discussion

While Mud Lake is shallow and eutrophic, it is part of an important chain of lakes that drains the Lake Mills Wildlife Area. The undeveloped, small wilderness setting of the lake supports a fairly diverse fishery including the State Special Concern lake chubsucker, Iowa darter, and blackchin shiner.

The aquatic vegetation noted at the survey sites was not diverse and the cover provided by them was low at every site except for one site where the cover was classified as medium. In the 2001 Lake Management Plan for Mud Lake, it was noted that there was likely a carp problem in the lake that was the cause for the low densities of aquatic plants.

## Mud Lake Recommendations

Based on the findings of the 2007 and 2013 nearshore fish surveys, the following are recommendations that will benefit the nearshore fish in Mud Lake:

- Given that both rare and environmentally sensitive fish species have been documented in Mud Lake in 2007 and 2013, it is recommended that additional and more frequent nearshore fish sampling be performed. It is also recommended that additional sites be added to the survey.
- It is recommended that both seining and electrofishing gear be used in future sampling efforts – especially because the seine was not able to be deployed at one of the sites.
- Carp reduction techniques should be explored so that the native plants become more abundant and provide more fish habitat.

## Public Education

The Jefferson County Water Resources Specialist attended several meetings of the Rock Lake Improvement Association and the Joint Rock Lake Committee to educate them about nearshore fish and to share the project results.

In 2014, the DNR is performing their comprehensive fish survey on Rock Lake. Therefore, it is recommended that an education presentation be done in 2015 to share the results of the comprehensive survey and the 2013 nearshore fish survey. Included in this presentation should be information on protecting and enhancing nearshore habitat for fish.

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Map 1. Fish Survey Locations on Rock Lake or 2013.





Map 2. Fish Survey Locations on Mud Lake for 2013.

