Assessment of Nearshore Fish Populations in Lake Ripley, Jefferson County, Wisconsin

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Summary

Lake-health assessments generally focus on traditional trophic status indicators (i.e., clarity, phosphorus and chlorophyll), macrophyte surveys, and gamefish inventories. This means that other important ecological indicators, such as nearshore and nongame fish diversity, are often overlooked in lake evaluations. Some nearshore fish species are very intolerant of environmental change and degradation, and have been described as "canaries in the coal mine." These fish provide important ecological linkages, and changes in their population status may reveal ecosystem stresses that traditional monitoring parameters can overlook. However, such species are not routinely surveyed, perhaps since they offer no perceived or direct economic benefit compared to more familiar gamefish populations.

Periodic inventories of these biological indicators are useful in assessing individual population status, community diversity, and overall ecosystem health. Fortunately for Lake Ripley, baseline data had been collected on nearshore, nongame fish species in 1975. Surveys were then repeated in 2004 and again in 2012 as part of this study, yielding important information on the status of these fish populations and how their required habitat conditions may be changing over time. It should be noted that significant water quality and macrophyte community improvements have been documented since the 1975 survey (LRMD 2009). Another notable change was the recent discovery of zebra mussels in 2005. These events combined with evolving nearshore development practices may have affected the status of the nearshore fish populations under investigation.

With funding through a Wisconsin DNR Small-Scale Lake Planning Grant, a survey of Lake Ripley's nearshore fish populations was performed on June 14 and July 2, 2012. The primary objective was to determine the extent of population changes compared to previous surveys conducted in 1975

and 2004, and to more specifically assess the status of nongame, intolerant (Lyons 1992), and rare fish species as identified by the Wisconsin DNR Bureau of Endangered Resources. Species of interest included the blackchin shiner (*Notropis heterodon*), blacknose shiner (*Notropis heterolepis*), the State Special Concern lake chubsucker (*Erimyzon sucetta*), the State Threatened pugnose shiner (*Notropis anogenus*), the State Special Concern least darter (*Etheostoma microperca*), and the State Special Concern banded killifish (*Fundulus diaphanous*). Profiles on each of these species are included as an addendum to this report. While the above-listed species were documented during the 1975 survey, they were not recaptured during the 2004 and 2012 follow-up surveys. Recent survey findings suggest that the species of interest are likely extirpated from the lake, with the exception of the lake chubsucker, which has continued to be documented during large boom shocking surveys since 1975.

Methods

The 2012 survey was specifically designed to sample nearshore, nongame fishes and juvenile gamefish. It was not intended as a tool for evaluating the growth rates and size distributions of gamefish populations. The 2012 survey was unique in that it involved more intensive sampling, both in terms of gear and number of sites sampled. In addition to the baseline small-mesh seining used in prior surveys (30 ft. x 6 ft. bag with 1/8-in. mesh), a towed DC electro-shocker (3.5 amps, 150 volts) was employed at each sample site. The total number of sample sites was also increased from 10 to 14. Both seining and electrofishing were performed at the 10 baseline sample sites, whereas the four additional sites were subject to electrofishing methods only. The combination of gear types was chosen to more effectively sample the different niches, behaviors and habitat preferences of diverse fish populations. Nearshore electrofishing, in particular, allowed for the sampling of fish species that are less likely to be collected using seines, particularly where habitats included physical impediments such as piers, boatlifts, large rocks or submerged timber.

Both sampling methods were used on June 14, 2012, targeting the 10 site locations established during the 1975 baseline survey. Separate seining and electrofishing crews commenced sampling at opposite ends of the lake, working in a clockwise fashion until all sites were sampled using both gears. Four additional sites, selected specifically to represent what were believed to be favorable habitat conditions (i.e., natural or relatively undisturbed shorelines, abundance of littoral macrophyte cover, and/or proximity to Critical Habitat Area designations), were sampled using only electrofishing methods on July 2, 2012. The 14 sampling locations are shown in Figure 1.

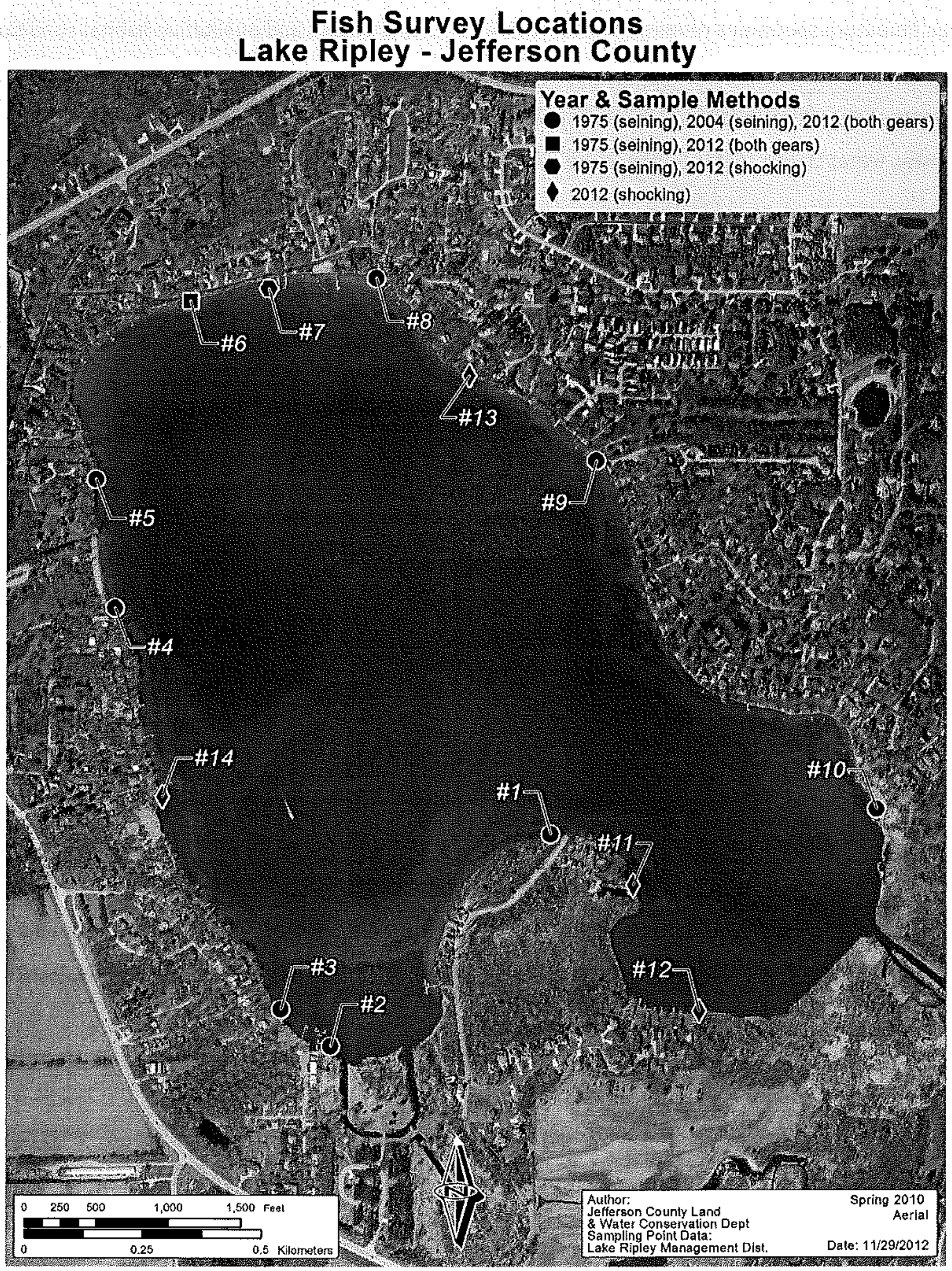

Figure 1: Survey site locations

All specimens were immediately released after field identification and enumeration, except when immature specimens required further review. GPS coordinates and qualitative habitat conditions were documented for each sample site. Qualitative habitat estimates focused mainly on the relative amounts of shoreline and littoral plant cover found at each site. Substrate composition, macrophyte diversity, water clarity, water temperature, and dissolved oxygen concentrations were also recorded.

Findings

Based on seining results alone, overall species richness declined since 1975 when 22 species were documented, but did not change significantly between 2004 (11 species) and 2012 (9 species). The total number of fish species collected in 2012 using both sampling methods combined was 16. Nearshore electrofishing in 2012 revealed the blackstripe topminnow (*Fundulus notatus*), fantail darter (*Etheostoma flabellare*), tadpole madtom (*Noturus gyrinus*) and yellow bullhead (*Ameiurus natalis*). While relatively common within the basin and region, none of these species had been sampled during prior surveys that used only seining. Nonetheless, while six intolerant species were found in 1975, only two (smallmouth bass, *Micropterus dolomieu*, and Iowa darter, *Etheostoma exile*) were found in 2004 and three (rock bass, *Ambloplites rupestris*, smallmouth bass, *Micropterus dolomieu*, and Iowa darter, *Etheostoma exile*) in 2012.

Tables 1-2 and Figures 2-4 compare pooled catches from the 1975, 2004 and 2012 small-mesh seining surveys, and from the 2012 findings employing both gear types. The results reveal significant declines in total fish species richness, numbers of intolerant species, and numbers of rare species since 1975. Results also suggest that the least darter, banded killifish, blacknose shiner, blackchin shiner and pugnose shiner are extirpated from Lake Ripley. Given the intensive effort and expanded gear types involved in the 2012 study, one or more of these species would likely have been found if present in the lake.

Table 1: Nearshore Fish Survey Comparisons

Species	Status	Environmental Sensitivity*	1974-75	2004	2012	2012 expanded sites/gear
Golden shiner		Tolerant	17	3	4	255
Pugnose shiner	Threatened	Intolerant	17	0	0	0
Blackchin shiner		Intolerant	15	0	0	0
Blacknose shiner		Intolerant	3	0	0	0
Bluntnose minnow		Tolerant	152	1833	7	10
Fathead minnow		Tolerant	1	1	0	0
Common carp		Tolerant	0	0	0	1
Lake Chubsucker**	Special Concern		18	0	0	0
Central mudminnow		Tolerant	1	0	0	11
Grass pickerel			1			
Yellow bullhead		Tolerant	0	0	0	33
Tadpole madtom			0	0	0	1
Banded killifish	Special Concern		45	0	0	0
Blackstripe topminnow			0	0	0	1
Brook silverside			19	69	0	0
Rock bass		Intolerant	1	0	1	13
Green sunfish		Tolerant	3	0	0	6
Bluegill			171	324	226	217
Pumpkinseed			64	0	4	0
Hybrid sunfish			0	0	0	1
Smallmouth bass		Intolerant	0	44	7	2
Largemouth bass			153	783	715	76
Black (or unspecified) crappie			58	6	0	0
Iowa darter		Intolerant	1	25	0	2
Least darter	Special Concern	Intolerant	3	0	0	0
Johnny darter			2	17	7	15
Fantail darter			4	0	0	15
Yellow perch			316	89	22	4
Total Rare Species			**4**	**0**	**0**	**0**
Total Intolerant Species			**6**	**2**	**2**	**3**
Total Native Species			**22**	**11**	**9**	**16**

* As reported in Lyons 1992

** Lake Chubsuckers have been routinely collected during large boom shocking surveys since 1975.

Table 2: Intolerant and Rare Species Richness by Sample Site (1975, 2004 and 2012)

Site	1975	2004	2012
1	2	0	1
2	1	1	0
3	7	1	0
4	1	1	1
5	4	1	0
6	2	0	1
7	1	0	0
8	0	1	1
9	0	2	2
10	0	2	0
11	NA	NA	1
12	NA	NA	0
13	NA	NA	0
14	NA	NA	1

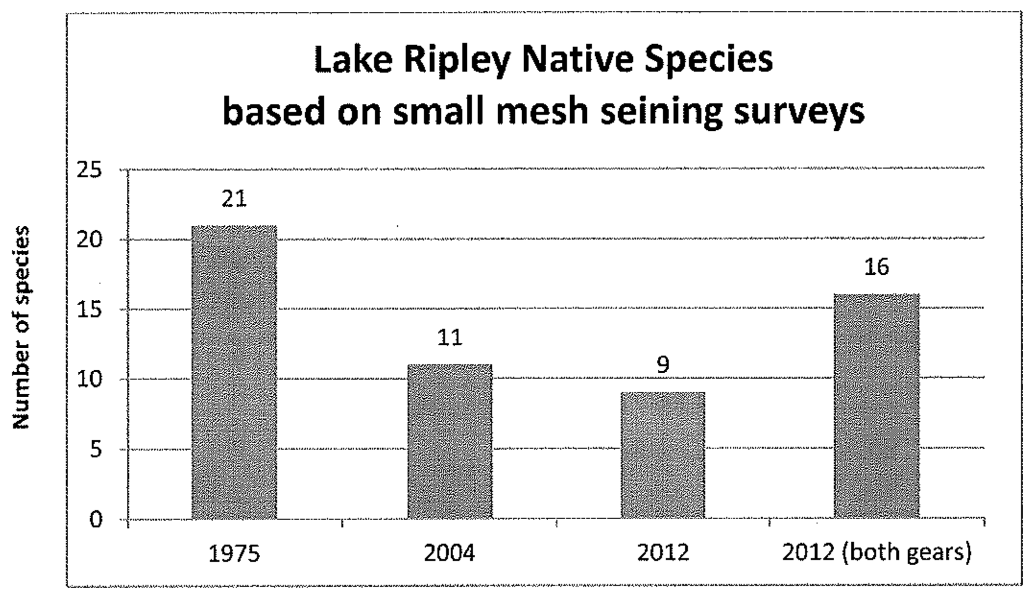

Figure 2: Native species found using seining and combined seining/electrofishing methods

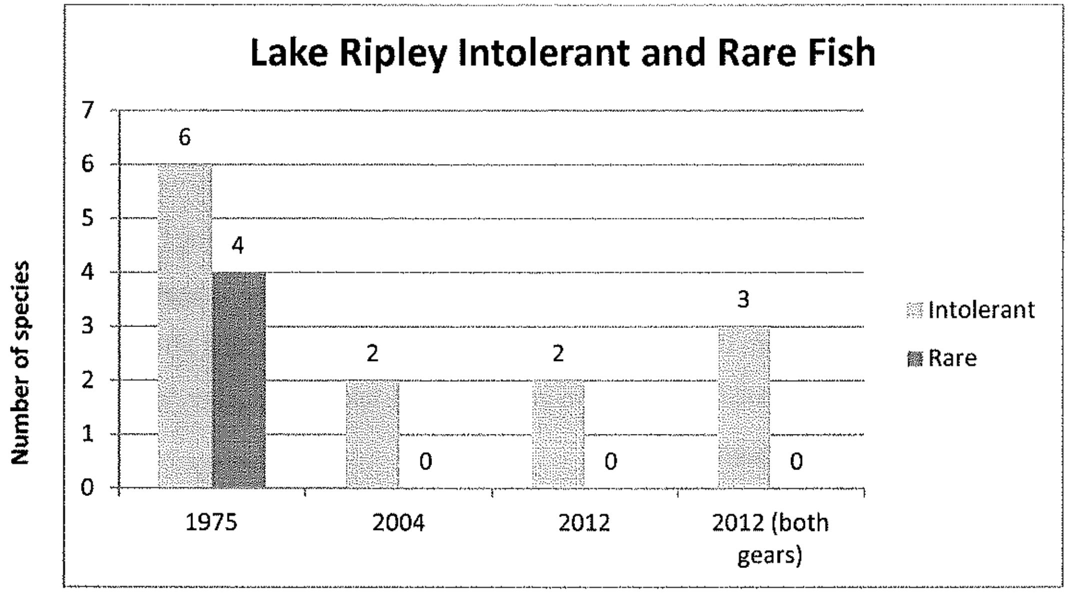

Figure 3: Intolerant and rare fish species found in 1975, 2004 and 2012

Discussion

Recent survey findings suggest that Lake Ripley has likely lost several intolerant and rare fish species since 1975. While the main objective of this study was to document the presence and relative abundance of nearshore fish species, preliminary regression analysis using the qualitative habitat estimates suggest that more quantitative habitat sampling and analysis may be warranted. Table 3 compares species richness with the relative abundance of different habitat types found at each of the 14 electrofishing sites. Although there was no clear relationship between species richness and individual habitat type, Figure 4 indicates a possible relationship between species richness and overall habitat value. In this case, habitat value was determined by summing the qualitative numerical rankings used to describe the relative amounts of shoreline vegetation, littoral macrophyte cover, and coarse woody habitat present at each site.

A variety of factors may have contributed to the apparent extirpation of several rare and intolerant nongame fish species in Lake Ripley. The poor fit observed in Figure 5 (R^2=0.2113) suggests much greater complexity among habitat variables, perhaps across multiple temporal and spatial scales, than our data can explain. For example, coarse woody habitat was included as a factor in determining habitat value, but represents a very small fraction of the overall habitat in the lake, especially compared to littoral macrophyte cover. Whenever present, numerical values were qualitatively assigned that may be skewed to the overall low amount of woody habitat in the lake.

Fish species richness was variable among sites with high to moderate macrophyte cover. This could be due to the fact that some sites were located adjacent to wetlands where seasonal affects can occur, such as low summer dissolved oxygen concentrations. Our data revealed lower summertime dissolved oxygen levels at sites with deep organic sediment adjacent to wetlands. While wetlands are a vital component of lake ecosystems, they may serve a more important habitat role during the spring fish-spawning season. Another possible explanation is that most of the macrophyte-obligate fish species had already declined or disappeared from the lake. These species, which show a strong affinity for aquatic vegetation, include the banded killifish, American grass pickerel, lake chubsucker, least darter, blacknose shiner, blackchin shiner and pugnose shiner.

Table 3: Habitat Values and Fish Species Richness at Each Electrofishing Sampling Site

Site	Dominant substrate	Shoreline Vegetative Buffer*	Littoral Macrophyte Cover**	Woody Habitat**	Total Habitat Value***	Species Richness
1	Cobble	3	2	2	7	7
2	Silt	3	3	0	6	5
3	Sand	0	1	0	1	7
4	Sand	1	1	0	2	5
5	Sand	0	1	0	1	3
6	Sand	0	1	0	1	3
7	Sand	0	1	0	1	2
8	Sand	0	1	0	1	3
9	Sand	2	1	0	3	10
10	Sand	3	3	0	6	4
11	Silt	3	3	0	6	6
12	Silt	3	3	0	6	4
13	Gravel	3	2	0	5	6
14	Sand	3	3	2	8	9

* Width of non-turf vegetation growing along the lake edge. Buffer>50 ft.=3, 10-50 ft.=2, <10 ft.=1, Absent=0
** High=3, Moderate=2, Low=1, Absent=0
*** Shoreline Vegetative Buffer Value + Littoral Macrophyte Cover Value + Woody Habitat Value

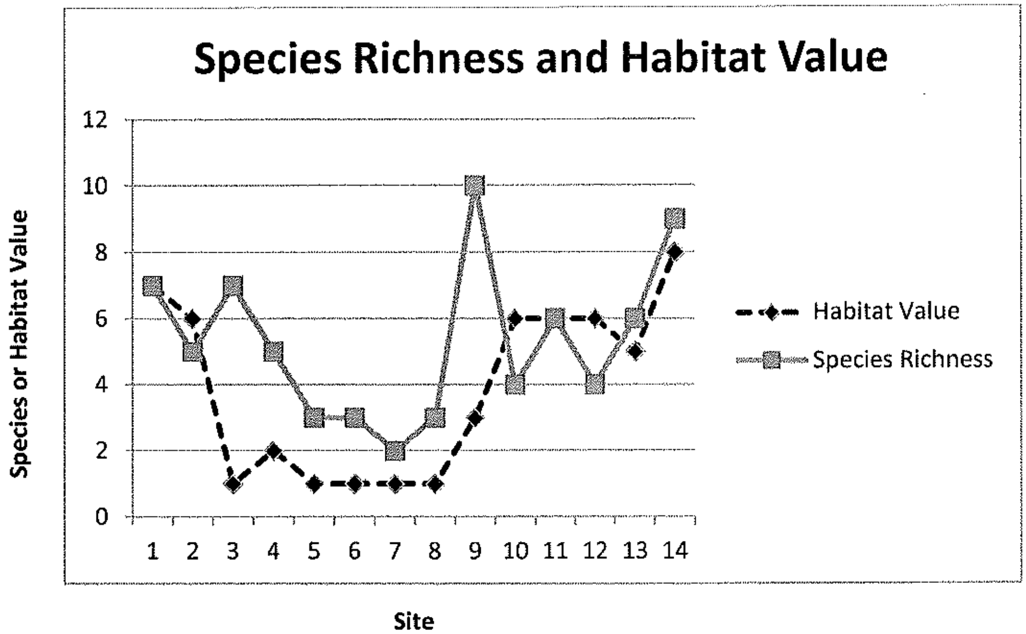

Figure 4: Fish species richness versus overall habitat value from Table 2

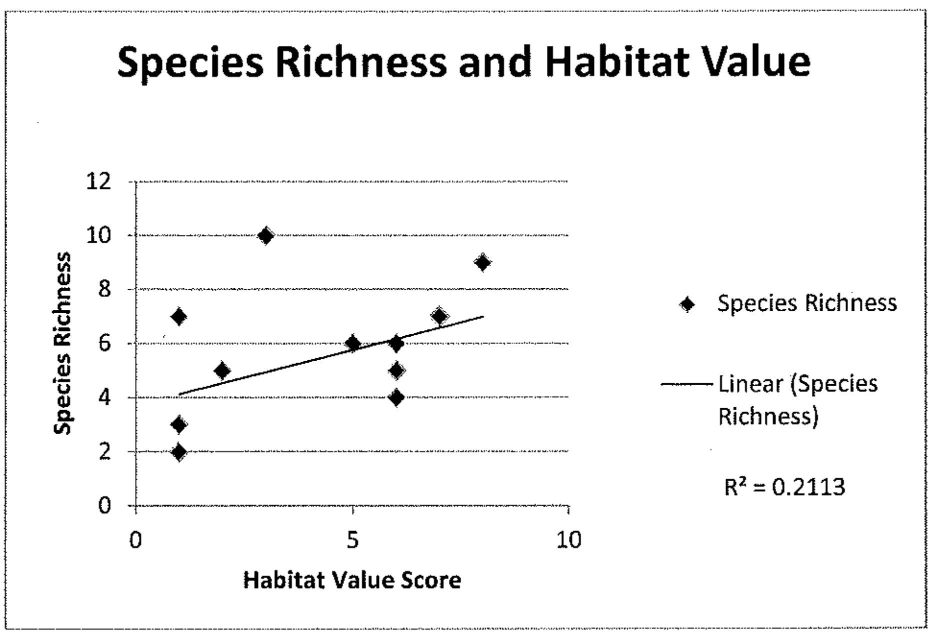

Figure 5: Regression of fish species richness versus overall habitat value from Table 3

Recommendations

1. Encourage lakefront property owners to protect or restore habitat within the nearshore (littoral) and riparian zones, particularly with respect to aquatic vegetation and coarse woody habitat.
2. Due to the low probability of natural recruitment, investigate the merit and feasibility of reintroducing native nongame fish species (i.e., banded killifish, blacknose shiner, blackchin shiner, least darter and pugnose shiner) using approved conservation aquaculture methods.
3. Repeat the nearshore fish survey at least every several years to monitor trends in nongame fish populations. Future surveys should be performed using 2012 sampling methods in terms of gear types and site locations. Study results suggest that towed DC electrofishing may be a more effective sampling technique over a range of habitats, and particularly in areas with floating-leaf and emergent vegetation, soft sediment, and coarse woody habitat.
4. Supplement Wisconsin DNR's annual boom shocking surveys with one that specifically targets smaller, rare fish species. This can be accomplished by repeating the large boom shocking survey, but focusing efforts on the capture of smaller fish with fine-mesh dip nets. The seasonal timing of this survey needs to be investigated.

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Lake Ripley Extirpated Fish Species Profiles

Pugnose shiner (*Notropis anogenus)*: Status is State Threatened. The pugnose shiner occurs in 45 waterbodies around the state with most collections in glacial lakes and low-gradient tributaries from southeast and northwest Wisconsin. Pugnose shiner declines have occurred in several southern Wisconsin glacial lakes over the past two decades (Lyons 2009).

The pugnose shiner is an environmentally intolerant, nongame species that is sensitive to turbidity, loss of aquatic plant habitat and other water quality impairments (Lyons 2009, 1992). It could be considered an macrophyte-obligate fish species. As lakes have become developed, critical aquatic plant habitat has become fragmented or lost due to pier construction, shoreline armoring, motorboat traffic or herbicide treatments (Marshall and Lyons 2008). The pugnose shiner has disappeared from lakes with high pier densities and documented intensive herbicides treatments. Due in part to scarce populations, there is no bioassay information on pugnose shiner sensitivity to organic pesticides. In Rock and Ripley lakes, juvenile and other small fishes were found in significantly lower densities around piers where aquatic plants were sparse due to excessive shading (Garrison et al. 2005).

Pugnose shiners are omnivores that consume both filamentous algae and cladocerans. The pugnose shiner is often associated with other environmentally-sensitive fish that have a strong affinity for aquatic vegetation, including blackchin and blacknose shiners (Becker 1983, Lyons 2008).

Blackchin Shiner (*Notropis heterodon*). Status is secure, but the species is considered environmentally intolerant. It has declined in some locations, including Lake Ripley. The blackchin shiner is found in a narrow geographic band from Lake Champlain to Wisconsin, and from the south shore of Lake Superior to northern Indiana, Illinois, and Iowa. It lives in 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. The blackchin feeds on a variety of prey found throughout all areas of a waterbody. Documented losses of this species in south central Wisconsin include Lake Mendota (Lyons 1989) and Lake Ripley (Lyons et al. 2000).

Blacknose shiner (*Notropis heterolepis)*. Status is secure, but this species is declining across its range and is classified as environmentally intolerant. The blacknose shiner requires clean and well vegetated waters. Because of its intolerance to silt and its need for dense aquatic plant beds, the blacknose is a good biotic indicator of water quality. The blacknose shiner has declined in southern Wisconsin, but is more common in northern Wisconsin lakes and connecting, low-gradient streams.

Banded killifish (*Fundulus diaphanus*). Status is State Special Concern. The banded killifish has declined throughout southeast and south central Wisconsin (Lyons et al. 2000). It has declined substantially since Becker (1983) reported its status as "common to abundant" in southeast Wisconsin. It prefers moderate levels of aquatic vegetation, and feeds primarily on small crustaceans and insects, and to a lesser degree on algae.

Least darter (*Etheostoma microperca)*. Status is State Special Concern. The least darter is environmentally sensitive and has been declining within its range. It 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.