Lake Ripley Management District

Assessment of Small, Nearshore, Non-Game Fish Populations in Lake Ripley, Jefferson County, Wisconsin, June 2020

The northwest shore of Lake Ripley from near site 14, June 23, 2020. John Lyons photo.

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Summary

Lake Ripley historically had a diverse fish community of at least 37 species, including many small, nearshore, non-game fishes intolerant of environmental degradation and uncommon at the state level. However, since the first comprehensive fish community surveys were completed in 1975, the lake may have lost five of these species, Pugnose Shiner (*Notropis anogenus*), Blackchin Shiner (*N. heterodon*), Blacknose Shiner (*N. heterolepis*), Western Banded Killifish (*Fundulus diaphanus menona*), and Least Darter (*Etheostoma microperca*). Funded by the Lake Ripley Management District, a wading electrofishing survey of 10 nearshore sites around the lake was conducted on June 23, 2020. Goals were to determine the current status of the small non-game fishes of the lake, to document possible changes that had occurred since previous surveys in 2012, 2004, and 1975, to assess current nearshore habitat conditions, and to evaluate whether re-introduction of the presumed extirpated species might be warranted.

The 2020 survey yielded 312 fish individuals representing 14 species. The most common were two sportfishes, Bluegill (*Lepomis macrochirus*; 109 individuals) and Largemouth Bass (*Micropterus salmoides*; 98 individuals, all small, young, recently hatched juveniles). Two Least Darters were collected, the first since 1975, indicating that this species had in fact not been extirpated from the lake, despite its absence from the 2004 and 2012 surveys. The other four presumed extirpated species were not collected, nor had they been found in 2004 or 2012. Some areas of nearshore habitat in Lake Ripley appear to be suitable for re-introducing these four species. Mostly in South Bay and East (Milwaukee) Bay, these areas have extensive and predominantly native aquatic vegetation and undeveloped shorelines. Based on recent successful experiences culturing and stocking Starhead Topminnows (*Fundulus dispar*) in the Wisconsin River system, Western Banded Killifish appear to be the best candidate for an experimental re-introduction project in Lake Ripley.

Introduction

Lake-health assessments generally focus on traditional trophic status indicators (i.e., water clarity and phosphorus and chlorophyll concentrations), macrophyte surveys, and sportfish inventories. This means that other important ecological indicators, such as small, nearshore, non-game fish diversity, are often overlooked in lake evaluations. Some of these nearshore fish species are intolerant of environmental change and degradation and have been described as "canaries in the coal mine." Small, nearshore, non-game fishes also provide important ecological linkages, feeding on algae, detritus, and/or small invertebrates and serving in turn as food for larger fish species. Changes in their population status may reveal ecosystem stresses that traditional monitoring parameters can miss. However, small nearshore, non-game fishes are not routinely surveyed, perhaps because they offer no perceived or direct economic benefit compared to more familiar sportfish populations. Yet periodic inventories of these small, nearshore, non-game fishes are useful in assessing individual species population status, fish community diversity, and overall ecosystem health.

Lake Ripley, 423 acres in size, 44 feet deep, and mesotrophic, is a valuable and highly used aquatic resource in southwestern Jefferson County in south-central Wisconsin. It is famous for its sport fishing. The Wisconsin angling record Largemouth Bass (*Micropterus salmoides*), at 11 pounds, three ounces, was caught from here on October 12, 1940, and anglers still flock to the lake to try their luck for Largemouth Bass and Smallmouth Bass, Northern Pike, Walleye, and panfish such as Bluegill, Pumpkinseed, Black Crappie, and Yellow Perch. The lake is also popular with boaters and swimmers and is heavily used during the summer (LRMD 2009).

In addition to a fine sport fishery, Lake Ripley historically supported a diverse non-game fish community, including several species intolerant to environmental degradation and uncommon at a statewide level. A comprehensive review of past fish surveys from the 1920's to the present reveals that the lake once supported at least 37 fish species, a relatively high number for Wisconsin lakes (Table 1). Of these, 36 are native and 18 are classified as non-game species. Of the 18 non-game species, five are considered intolerant to environmental degradation, Pugnose Shiner (*Notropis anogenus*), Blackchin Shiner (*N. heterodon*), Blacknose Shiner (*N. heterolepis*), Iowa Darter (*Etheostoma exile*), and Least Darter (*E. microperca*), and four are uncommon in the state, Pugnose Shiner, formally listed as State Threatened, and Lake Chubsucker (*Erimyzon sucetta*), Western Banded Killifish (*Fundulus diaphanus* *menona*), and Least Darter, categorized as State Special Concern by the Wisconsin Department of Natural Resources (WDNR).

The first detailed survey of the small non-game fishes of Lake Ripley took place in 1975. At that time, all of the intolerant and uncommon species were present. Subsequent non-game fish surveys in 2004 and 2012 and ten sportfish surveys between 1994 and 2015 failed to collect five of these species, Pugnose Shiner, Blackchin Shiner, Blacknose Shiner, Western Banded Killifish, and Least Darter, suggesting that they had been eliminated from the lake. During the 35-year period from 1975 to 2010 declines in habitat and water quality took place, and the lake was invaded by several nuisance aquatic species, most notably Eurasian Water Milfoil (*Myriophyllum spicatum*) and Curly-Leaf Pondweed (*Potamogeton crispus*) in the 1980's and Zebra Mussel (*Dreissena polymorpha*) in the 2000's, possibly accounting for the loss of the five species (LRMD 2009). However, in the last decade, watershed and shoreline work by the Lake Ripley Management District and the WDNR have improved habitat and water quality. Eurasian Watermilfoil, Curly-Leaf Pondweed, and Zebra Mussels, which all reached nuisance status soon after they appeared in the lake, have subsided to much lower levels. With the recent improvement in ecosystem health, it is possible that the lake is once again suitable for the five species that disappeared. A re-introduction effort might be able to bring them back, improving the diversity and resilience of the non-game fish community.

With that in mind, we undertook a small non-game fish survey of Lake Ripley in 2020. The primary goals were to determine the occurrence and relative abundance of fish species in nearshore areas of the lake and to compare catches with results from 1975, 2004, and 2012 surveys to detect possible trends. Secondary goals were to assess the condition of the nearshore habitat and to evaluate its suitability for possible re-introduction of one or more of the five extirpated fish species.

Table 1 – Fish species reported from Lake Ripley. For Common Name, W. equals Western. Tolerance refers to the species' relative sensitivity to environmental degradation (Lyons 1992). Size indicates the typical total length of adults (Becker 1983), with Small as less than 6 inches, Med (Medium) as 6-12 inches, and Large as greater than 12 inches. For WDNR Classification, WDNR is Wisconsin Department of Natural Resources and NG is non-game.

Common Name	Scientific Name	Tolerance	Size	WDNR Classification
Gar Family	Lepisosteidae			
Longnose Gar	*Lepisosteus osseus*	Intermediate	Large	Native, Rough
Bowfin Family	Amiidae			
Bowfin	*Amia calva*	Intermediate	Large	Native, Rough
Minnow Family	Cyprinidae			
Common Carp	*Cyprinus carpio*	Tolerant	Large	Non-Native, Rough
Golden Shiner	*Notemigonus crysoleucas*	Tolerant	Small	Native, Non-Game
Pugnose Shiner	*Notropis anogenus*	Intolerant	Small	Threatened, Non-Game
Emerald Shiner	*Notropis atherinoides*	Intermediate	Small	Native, Non-Game
Blackchin Shiner	*Notropis heterodon*	Intolerant	Small	Native, Non-Game
Blacknose Shiner	*Notropis heterolepis*	Intolerant	Small	Native, Non-Game
Bluntnose Minnow	*Pimephales notatus*	Tolerant	Small	Native, Non-Game
Fathead Minnow	*Pimephales promelas*	Tolerant	Small	Native, Non-Game
Sucker Family	Catostomidae			
Lake Chubsucker	*Erimyzon sucetta*	Intermediate	Med	Special Concern, NG
Bigmouth Buffalo	*Ictiobus cyrpinellus*	Intermediate	Large	Native, Rough

Table 1 – Continued.

Common Name	Scientific Name	Tolerance	Size	WDNR Classification
Catfish Family	Ictaluridae			
Black Bullhead	*Ameiurus melas*	Tolerant	Med	Native, Sport
Yellow Bullhead	*Ameiurus natalis*	Tolerant	Med	Native, Sport
Brown Bullhead	*Ameiurus nebulosus*	Intermediate	Med	Native, Sport
Tadpole Madtom	*Noturus gyrinus*	Intermediate	Small	Native, Non-Game
Pike Family	Esocidae			
Grass Pickerel	*Esox americanus vermiculatus*	Intermediate	Med	Native, Non-Game
Northern Pike	*Esox lucius*	Intermediate	Large	Native, Sport
Mudminnow Family	Umbridae			
Central Mudminnow	*Umbra limi*	Tolerant	Small	Native, Non-Game
Silverside Family	Atherinopsidae			
Brook Silverside	*Labidesthes sicculus*	Intermediate	Small	Native, Non-Game
Topminnow Family	Fundulidae			
W. Banded Killifish	*Fundulus diaphanus menona*	Intermediate	Small	Special Concern, NG
Blackstripe Topminnow	*Fundulus notatus*	Intermediate	Small	Native, Non-Game

Table 1 – Continued.

Common Name	Scientific Name	Tolerance	Size	WDNR Classification
Temperate Bass Family	Moronidae			
White Bass	*Morone chrysops*	Intermediate	Med	Native, Sport
Sunfish Family	Centrarchidae			
Rock Bass	*Ambloplites rupestris*	Intolerant	Med	Native, Sport
Green Sunfish	*Lepomis cyanellus*	Tolerant	Med	Native, Sport
Pumpkinseed	*Lepomis gibbosus*	Intermediate	Med	Native, Sport
Bluegill	*Lepomis macrochirus*	Intermediate	Med	Native, Sport
Smallmouth Bass	*Micropterus dolomieu*	Intolerant	Large	Native, Sport
Largemouth Bass	*Micropterus salmoides*	Intermediate	Large	Native, Sport
White Crappie	*Pomoxis annularis*	Intermediate	Med	Native, Sport
Black Crappie	*Pomoxis nigromaculatus*	Intermediate	Med	Native, Sport
Perch Family	Percidae			
Iowa Darter	*Etheostoma exile*	Intolerant	Small	Native, Non-Game
Fantail Darter	*Etheostoma flabellare*	Intermediate	Small	Native, Non-Game
Least Darter	*Etheostoma microperca*	Intolerant	Small	WI Special Concern, NG
Johnny Darter	*Etheostoma nigrum*	Intermediate	Small	Native, Non-Game
Yellow Perch	*Perca flavescens*	Intermediate	Med	Native, Sport
Walleye	*Sander vitreus*	Intermediate	Large	Native, Stocked, Sport

Methods

We conducted the survey on June 23, 2020, visiting 10 nearshore site around the lake (Figure 1). We used electroshockers to sample fish, a battery-powered backpack unit at five of the sites and a generator-powered mini-tow-barge unit at the other five. Both units had a single hand-held anode, output of about 3-5 amps and 150-300 volts, and were thought to be similar in effectiveness. Previous surveys used small-mesh seines (1975, 2004) or a combination of seines and the mini-tow-barge shocker (2012). Seines work best in open unobstructed areas for midwater or surface schooling species whereas shockers are most effective for bottom-dwelling species and those that are associated with aquatic vegetation, downed trees, large rocks, and other structurally complex habitats. We chose electroshocking for the 2020 survey because all five of the presumed extirpated fish species were associated either with the bottom (Least Darter) or areas of aquatic vegetation (all five species).

At each site we followed a standardized sampling procedure. We tried to shock 200 feet of shoreline, but at several sites piers or very soft bottom limited the survey length to a lesser distance. We attempted to collect all fish observed, which were held alive until the end of the survey and then identified, counted, and released. After shocking, we did a visual qualitative habitat assessment, focusing on bottom substrate, aquatic vegetation, hiding cover for fish, and shoreline and riparian conditions.

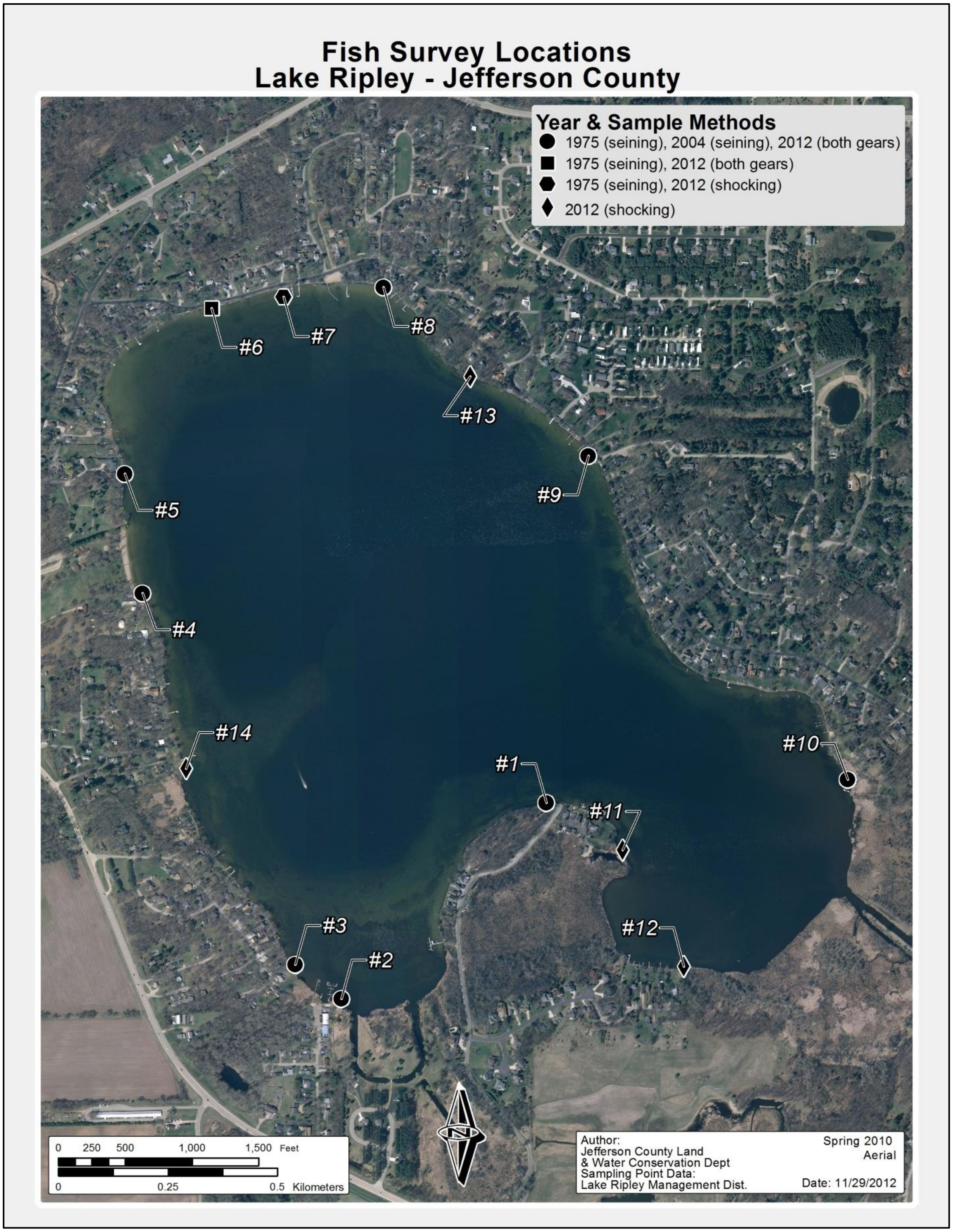

Figure 1 – Sampling sites for non-game fish surveys in 1975, 2004, 2012, and 2020. In 2020, 10 sites (1, 3, 4, 6, 8, 9, 10, 11, 12, and 14) were sampled by electroshocking.

Results

From all 10 sites combined we collected a total of 14 species and 312 individuals. Captures from individual sites ranged from 1 to 7 species and 1 to 61 individuals (Table 2). The most common fish species was Bluegill, which was found at every site, with 109 individuals. No other species was captured at all sites. The second most common species was Largemouth Bass with 98 individuals, but all were very small recently hatched fish. To our surprise, we collected 2 least darters from Site 3, indicating that they had not actually been extirpated from the lake. However, we did not catch any of the other four presumed extirpated species.

Catches in 2020 differed from those of previous non-game species surveys in 1975, 2004, and 2020 (Table 3). The number of individuals was lowest and number of species second-lowest in 2020. However, 2020 was the only year in which all four species of darter known from the lake were collected. The number of intolerant species was highest in 1975, with six, compared to two in 2004, and three in both 2012 and 2020. Similarly, the number of uncommon species was also highest in 1975, with three, compared to zero in 2004 and 2012 and one in 2020.

Habitat conditions at the 10 sampling sites in 2020 varied. Sand and silt/marl was the most common bottom substate at most sites, ranging from 30 to 100% where present and comprising all of the substrate at five sites. The remaining five sites had at least some rocky bottom (gravel, cobble, or boulder) with Site 1 having 100%. Aquatic plants were observed at all sites and were in moderate to high abundance at seven. Most aquatic plants observed were native submergent species. Cover for fish was rated as high at eight sites and moderate at the remaining two, mainly in the form of aquatic plants, artificial rock rip-rap, and natural coarse woody habitat. Artificial rip-rap or seawall dominated the shoreline at eight sites and natural wetland was prevalent at the other two, Sites 10 and 14. Riparian areas were mainly residential lawns and houses, but Site 1 had a 50-foot wide buffer of natural trees and shrubs and Sites 10 and 14 had wetland buffers over 100 feet wide. It should be noted that large areas of the South and East (Milwaukee) bays had extensive undeveloped shorelines and riparian wetlands, but nearshore areas there had silt/marl substrates too soft to allow for sampling by wading.

Table 2 – Fishes collected from each site during the 2020 Lake Ripley survey.

	Catch per Site										
Species	1	3	4	6	8	9	10	11	12	14	Total
Bluntnose Minnow	1	0	10	0	0	0	0	0	0	0	11
Yellow Bullhead	5	0	19	0	2	3	0	9	0	0	38
Central Mudminnow	0	0	0	0	0	0	4	0	0	0	4
Brook Silverside	0	0	0	0	0	0	2	0	0	0	2
Rock Bass	3	0	0	0	0	0	0	0	0	0	3
Green Sunfish	4	0	4	0	0	0	0	0	1	0	9
Pumpkinseed	0	1	0	0	0	0	0	0	2	0	3
Bluegill	26	2	14	1	1	11	5	17	15	17	109
Largemouth Bass	0	3	2	0	0	1	42	33	7	10	98
Iowa Darter	0	5	1	0	0	0	0	0	0	0	6
Fantail Darter	1	0	1	0	9	0	0	2	0	0	13
Least Darter	0	2	0	0	0	0	0	0	0	0	2
Johnny Darter	0	0	0	0	0	0	0	0	2	0	2
Yellow Perch	0	2	0	0	0	0	2	0	8	0	12
Total Species	5	6	7	1	3	3	5	4	6	2	14
Total Individuals	40	15	51	1	12	15	55	61	35	27	312

Table 3 – Comparison of catches in the 1975, 2004, 2012, and 2020 non-game fish surveys of Lake Ripley. Small non-game species are indicated by "SN". In 1975 and 2004, eight sites were sampled with a small-mesh seine, in 2012, 14 sites were sampled with either a mini-tow-barge electroshocker or small-mesh seine, and in 2020, 10 sites were sampled with either a mini-tow-barge or backpack electroshocker. In 1975 when the total number of fish of a species at a site exceeded 99 individuals, the count was stopped at 99, leading to an underestimate of the total number of fish captured. An asterisk indicates species for which this occurred.

	Catch per Year			
Species	1975	2004	2012	2020
Golden Shiner (SN)	17	3	55	0
Common Carp	0	0	1	0
Pugnose Shiner (SN)	17	0	0	0
Blackchin Shiner (SN)	15	0	0	0
Blacknose Shiner (SN)	3	0	0	0
Bluntnose Minnow (SN)	152*	1833	10	11
Yellow Bullhead	0	0	33	38
Tadpole Madtom (SN)	0	0	1	0
Fathead Minnow (SN)	1	1	0	0
Central Mudminnow (SN)	1	0	11	4
Western Banded Killifish (SN)	45	0	0	0
Blackstripe Topminnow (SN)	0	0	1	0
Brook Silverside (SN)	19	69	0	2
Rock Bass	1	0	13	3
Green Sunfish	3	0	6	9

Table 3 – Continued.

Species	Catch per Year			
	1975	2004	2012	2020
Pumpkinseed	64	0	0	3
Bluegill	171	324	217	109
Smallmouth Bass	0	44	2	0
Largemouth Bass	153*	783	76	98
Black Crappie	58	66	0	0
Iowa Darter (SN)	0	25	2	6
Fantail Darter (SN)	0	0	15	13
Least Darter (SN)	3	0	0	2
Johnny Darter (SN)	2	17	15	2
Yellow Perch	316*	89	4	12
Total Species	18	11	16	14
Total Individuals	1041*	3252	462	312

Discussion

Results from the 2020 survey provide important new information on the status of the non-game fishes of Lake Ripley. Prior to the survey, we had assumed that five once-common species had disappeared from the lake. The 2020 results indicate that one of those species, the Least Darter (Figure 2), still occurs in the lake. Presumably, this species has remained present since 1975 and had been missed in the 2004 and 2012 surveys. A recent recolonization since 2012 seems extremely unlikely. There are no nearby sources of Least Darter, and the nearest known population is nearly 50 river miles away, much of that distance through unsuitable large river habitat in the Rock River and unsuitable large lake habitat in Lake Koshkonong (Fago 1992). Furthermore, Least Darters do not appear to undertake long-distance migrations (Becker 1983). The possibility that the species re-entered the lake via a bait-bucket release is remote. The Least Darter is very small, uncommon, and fragile, and has never been observed being used for bait anywhere in its range. The Least Darter is a difficult species to catch, being small, bottom-dwelling, and associated with areas of aquatic plant cover. Thus it is not surprising that it could have been missed in 2004 and 2012, particularly if the population in the lake is small. The four other presumed-extirpated species, Pugnose Shiner, Blackchin Shiner, Blacknose Shiner, and Western Banded Killifish, were not captured in 2020. Given that they are likely easier to catch than the Least Darter when they are present (Lyons 1986), their absence in the 2020 survey is further evidence that they are probably truly extirpated from Lake Ripley.

Comparisons of catches from the four non-game surveys in 1975, 2004, 2012, and 2020 indicate that the largest changes in the small nearshore fish community probably took place between 1975-2004. At some point during this time period four species, Pugnose Shiner, Blackchin Shiner, Blacknose Shiner, and Western Banded Killifish, appear to have been lost. As discussed above, we believe these represent permanent extirpations from the lake. Conversely, since 1975, four small non-game species have been captured for the first time in the surveys. However, three of these species, Tadpole Madtom, Iowa Darter, and Fantail Darter, are bottom dwellers associated with structurally complex areas (Becker 1983) that can be difficult to catch with the seine used in the 1975 survey (Lyons 1986), and the fourth, Blackstripe Topminnow, is uncommon and thus easily could have been missed in earlier sampling. We believe that these four species have always been present but were not captured during the 1975 survey. All other species that were present in 1975 still occur in the lake. There has been substantial variation in the abundance of some of these species across the years, most likely from a combination of differences in sampling techniques, conditions, and locations across surveys combined with natural variation in the annual abundance of individual species, which can be high (Lyons 1987, 1992).

Why did the four species disappear between 1975 and 2004? We can only speculate, but we believe the primary cause was the appearance and expansion to nuisance levels of the non-native submerged aquatic plant Eurasian Water Milfoil (EWM). When EWM became established in the 1980's, it quickly became dominant, forming thick and almost impenetrable growths covering large areas of the nearshore area of the lake and crowding out many native plant species. This rapid change in habitat conditions could have eliminated the four species, all of which do best in areas of diverse native aquatic plants. In the nearby Madison lakes, the disappearance of several small, nearshore, non-game species, including all four of those lost from Lake Ripley, was also hypothesized to be the result of an EWM invasion (Lyons 1989). Since the 1980's, EWM abundance has declined in Lake Ripley due to a combination of natural processes (invasive species often reach nuisance levels soon after they invade and then gradually drop back to lower levels years later) and control efforts by the Lake Ripley Management District. Many native plant species have made a comeback, and in our 2020 survey native submerged vegetation was more common than EWM at our study sites. Habitat appeared suitable for all four species (Figure 3). However, since they were probably eliminated 20 or more years ago, they remain absent now despite adequate habitat.

The presence of suitable habitat suggests that re-introduction of one or more of the four eliminated species might be an effective strategy to improve the small, nearshore, non-game fish community in Lake Ripley. Such possible re-introductions were analyzed and considered a viable management approach after the 2012 survey (Marshall and Dearlove 2013). Successful re-introductions of small, non-game fishes, including the four eliminated species, have taken place in ponds in northern Illinois (Schaeffer et al. 2012; Ozer and Ashley 2013), small lakes in the Twin Cities Metro Area of Minnesota (Schmidt 2014), and a bay of Lake Ontario, New York (Carlson et al. 2019). The Illinois and Minnesota projects were based on transferring wild fish from one body of water to another, a method not legally allowed in Wisconsin because of concerns about spreading disease, parasites, or invasive species. The New York project was based on stocking large numbers of fish that had been raised in a New York State Department of Conservation hatchery, a type of facility not available for this sort of project in Wisconsin. However, a recent re-introduction project involving the Wisconsin-state-endangered Starhead Topminnow (*Fundulus dispar*) in the Wisconsin River system (Marshall et al. 2019), provides an example of what might work for Lake Ripley. For the Starhead Topminnow project, adults were collected from sloughs and backwaters of the Lower Wisconsin River in 2018 and 2019 and then transported to a small, isolated, heavily vegetated, artificial pond. There the adults were allowed to live and breed following established conservation aquaculture protocols, and they survived well and produced thousands of offspring. These offspring were collected and stocked in suitable habitats above the Prairie Du Sac Dam, a complete barrier to upstream movement, where the Starhead Topminnow had once occurred. Follow-up surveys in late 2019 indicated that survival of stocked fish was good and that they had successfully reproduced, the first and most crucial steps in becoming re-established. Additional stocking and monitoring will take place in 2020 and 2021.

The Starhead Topminnow is closely related and ecologically similar to the Western Banded Killifish (Figure 4), one of the four eliminated species, and an approach that is effective for re-introducing the Starhead Topminnow should also be effective for the Western Banded Killifish. This approach might also work for the other three eliminated species, the Pugnose Shiner, Blackchin Shiner, and Blacknose Shiner, but the Western Banded Killifish has two characteristics that make it the best choice for the initial re-introduction attempt in Lake Ripley. First, the Western Banded Killifish is more tolerant of environmental degradation than the other three species and is consequently likely to do better with the handling necessary for capture, breeding in an off-site pond, and eventual stocking. Second, it is also more common than the other three species in lakes in the Rock River Basin near Lake Ripley, including Rock Lake in Jefferson County and Lower Nemahbin Lake in Waukesha County, and thus more easily obtained for breeding. If the Western Banded Killifish re-introduction attempt were to be successful, additional attempts could be made with the other three species, using lessons learned from the Western Banded Killifish project.

Figure 2 – Least Darter. Breeding male from Darien Creek, Walworth County, Wisconsin, May 2, 2001. Photo by John Lyons

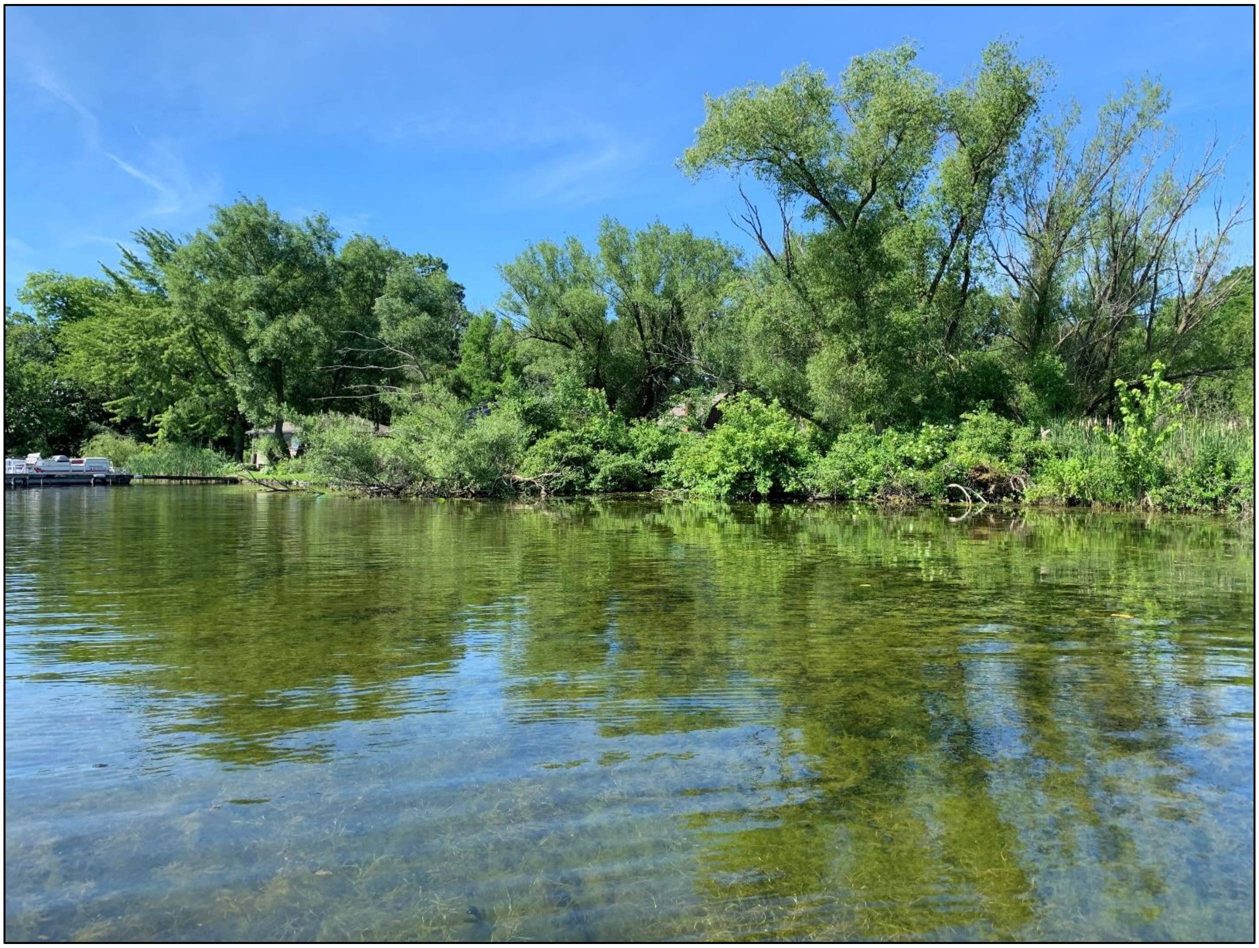

Figure 3 – Site 14, Lake Ripley, June 23, 2020, an area of natural shoreline and riparian area with extensive native submerged vegetation. Habitat at this and other naturally vegetated sites around the lake appeared suitable for Pugnose Shiner, Blackchin Shiner, Blacknose Shiner, and Western Banded Killifish. Photo by John Lyons.

Figure 4 – Western Banded Killifish. Big Sand Lake, Burnett County, Wisconsin, May 9, 2001. Photo by John Lyons.

Recommendations

1. Continue to encourage lakefront property owners, the Lake Ripley Management District, local governments, and the WDNR to protect and restore natural habitats within the nearshore areas of the lake, particularly with respect to native riparian and aquatic vegetation.

2. Repeat the nearshore non-game fish survey on a regular basis to monitor trends in non-game fish populations and their habitats.

3. Initiate a project to re-establish the Western Banded Killifish. Collect brood stock from other lakes in the Rock River basin, breed them in an offsite pond using appropriate conservation aquaculture protocols, and then stock large numbers of them into the lake. Conduct follow-up assessments to see if they have become re-established.

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