

2019 Fish Surveys and Projects

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This report covers activities for the following permits:

1. Minnesota Department of Natural Resources (MDNR), Section of Fisheries: 24464 and 24465.
2. MNDR Division of Ecological and Water Resources, Scientific and Natural Areas: 201-9R.
3. MDNR Division of Parks and Trails: 201945 and 201990.
4. Wisconsin Department of Natural Resources (WDNR): SCP-FM-2019-054.
5. Superior National Forest, Boundary Waters Canoe Area Wilderness (BWCAW).
6. Wisconsin Department of Natural Resources (WDNR): SCP-FM-2019-054.
7. National Park Service, St. Croix National Scenic Riverway: SACN-2019-SCI-0003.

No activity due to lake wind advisories or sustained high stream flows.

Activities and projects include but are not limited to the following (Figure 1)

1. Sensitive species translocations and monitoring in Twin Cities Metro Area (TCMA) lakes.
2. Pre-translocation survey for sensitive fishes in Glacial Lakes State Park.
3. Warmouth and Northern Sunfish surveys in Itasca County lakes.
4. Northern Sunfish and Deepwater Sculpin surveys in the BWCAW.
5. Pre-construction surveys of islands in Pigs Eye Lake (Mississippi River Pool 2 backwater).
6. Banded Killifish tissue collections (red squares) for a range-wide genetics study.

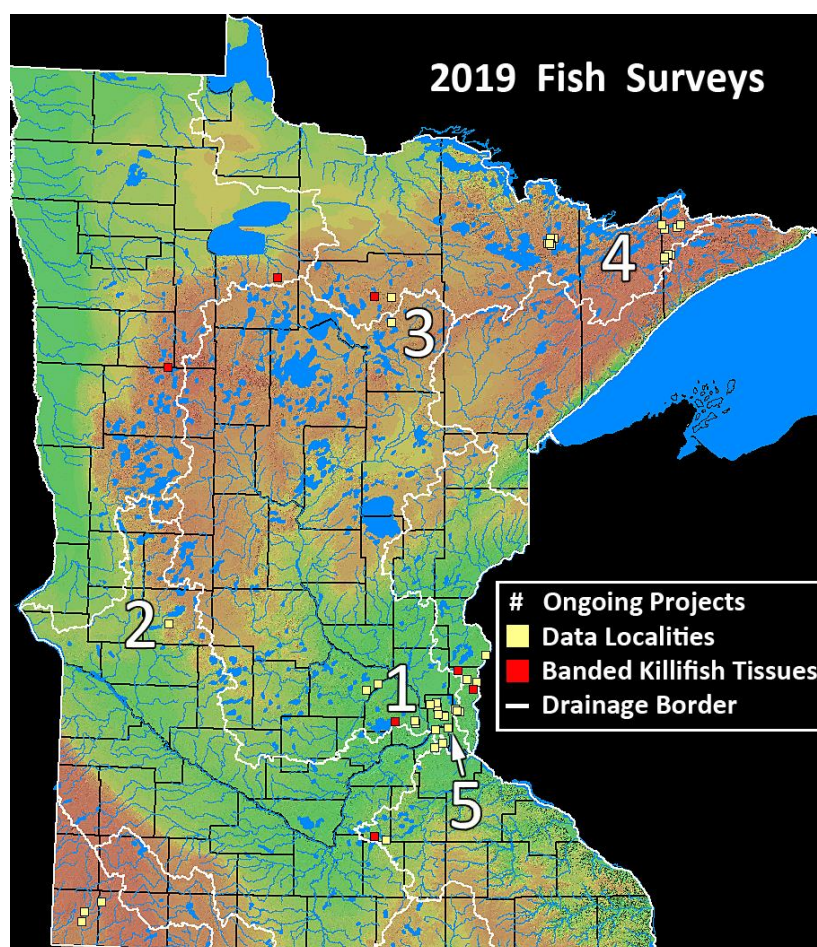


Figure 1. Fish Survey and Project Localities

Data collected and products resulting from these current and past permits have or will be utilized for the following applications:

1. *Fishes of Minnesota* by Jay Hatch, Gary Phillips, and Mike McInerny (in preparation).
2. MDNR [Rare Species Guide](#).
3. MDNR Natural Heritage Information Systems [Biotics](#) database.
4. MDNR [Fishes of Minnesota Mapper](#).
5. MDNR [Invasive Species Program](#).
6. North American Native Fishes Association (NANFA) [Photo Gallery](#).
7. NANFA [American Currents](#) articles.

Summary

This summary report was written to satisfy permit requirements and to disseminate survey information to interested parties. **All surveys conducted this year were done solely as a volunteer effort with no reimbursement for expenses or mileage.** I cannot adequately express in words my gratitude for those who assisted me in the surveys. Without them, I would have very little to report this year. My fellow dedicated volunteers include: Jenny Kruckenberg, Don Richmond, Bryan Stefansky, Bob Hrabik, Jay Hatch, John Olson, and Mitch and Jason Haag. The original scope of the 2019 field investigations were again southeastern river systems of the Shell Rock, Cedar, and Upper Iowa. However, 2019 was the wettest year on record and streams never returned to normal flows which switched the emphasis to various lake investigations.

Survey records are provided in the attached Excel file: **2019 Konrad Schmidt Fish Survey Records**. The year-end results include 70 visits to 37 lakes and 8 streams in 15 Minnesota counties. The cumulative catch was 63 species in 13 families. This includes the following Minnesota state listed species: Pugnose Shiner, Topeka Shiner, Plains Topminnow, Northern Sunfish, Least Darter, and Gilt Darter.

Project 1. TCMA Lakes Sensitive Species Translocations and Monitoring.

The goal of the reintroductions is to determine the feasibility of transplanting non-game fish, specifically sensitive species back into systems which were once degraded enough to extirpate these species. These lakes have recovered in terms of water quality, but not biologically and they cannot be recolonized naturally given the lack of connectivity and/or source populations. This work has potential to help address Aquatic Life Impairments where the lake IBI (Index of Biotic Integrity) scores don't meet water quality standards and natural recolonization is not feasible.

Since 2011, Fish Lake (Le Sueur County) has been the donor source for a "suite" of four sensitive species: Least Darter, Blackchin Shiner, Blacknose Shiner, and Banded Killifish. Annually, the MNDR Pathology Lab tests fish to certify Fish Lake is free of diseases to prevent infecting recipient lakes. The primary focus of reintroductions has been TCMA lakes where water quality and clarity are exceptional ([Nelson 2013](#); [Schmidt 2014](#)). If previous MDNR surveys reported any sensitive species in proposed recipient lakes, releases were restricted to species absent from the community. Pugnose Shiners comprise the fifth sensitive species present in Fish Lake and were released in the pilot project of lakes Elmo and Phalen (i.e., 2011-2013). Pugnose Shiners are established in Elmo and were found for the first time in Phalen during 2016 monitoring surveys. However, the species has since been elevated to threatened status which prohibits collection.

Annual monitoring of the recipient lakes will continue to determine if the remaining four fish species have become established. Currently, sensitive species have been released in 20 lakes and future efforts are planned for six more (Figure 2). In 2020, most of the candidate lakes will receive sensitive fishes if abundance is sufficient for translocations in the donor lakes. However, efforts will be postponed in two candidate lakes. The Minnesota Pollution Control Agency's (MPCA 2019) transparency trend for [Lake George](#) reports clarity is degrading and no translocations will be scheduled unless water conditions improve. A near-shore fish survey will be completed in 2020 of Loeb Lake to determine the composition of the non-game fish community before translocations occur. Continued monitoring will guide future

translocation efforts in determining lakes where and which species have not become established.

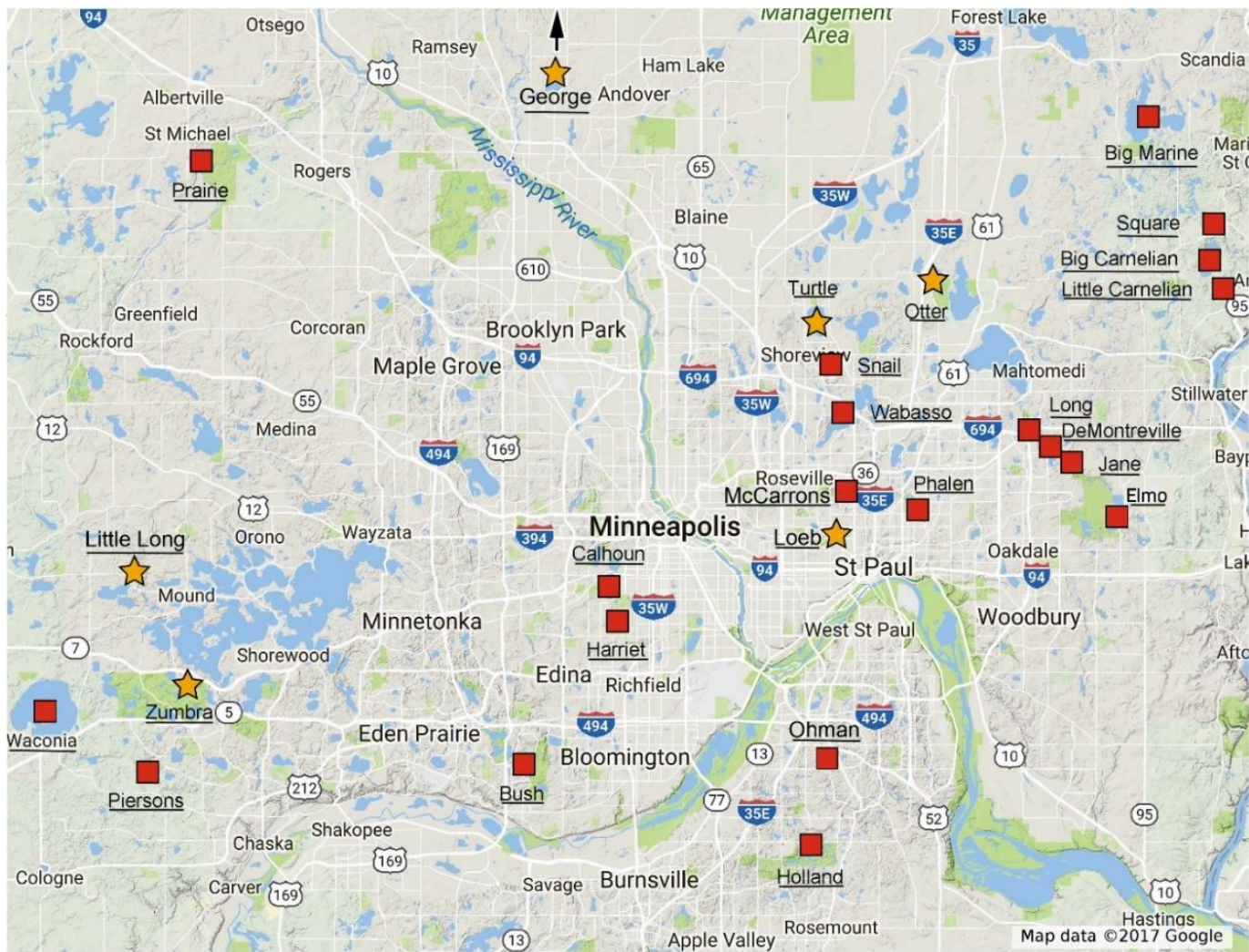


Figure 2. Stocked (squares) and candidate (stars) lakes selected for establishing sensitive fishes in the TCMA.

The near-shore submergent vegetation community of Fish Lake has dramatically changed in recent years. In 2011, dense Muskgrass (*Chara* spp.) beds dominated the wadeable depths of the lakes. In 2019, the near-shore dominant species was Coontail (*Ceratophyllum demersum*). Muskgrass beds still carpeted the deeper (non-wadeable) littoral zone of the lake, but fish capture was impossible using wadeable methods (i.e., seines and dip nets). However, in 2019, the abundance of Least Darters was far greater than any year since the translocations began in 2011. The population explosion produced sufficient numbers to stock five new lakes (Table 1). In past years, the catch was enough for only one or two lakes. The remaining sensitive species, including Pugnose Shiners, remain present in wadeable in areas, but are all too rare for translocations.

Table 1. 2019 Least Darter donor lakes and number stocked in TCMA recipient lakes.

DONOR LAKES			
Fish		Cedar	
RECIPIENT LAKES			
Bush	226	Calhoun	85
Ohmans	290	Harriet	174
Piersons	254		
Prairie	132		
Waconia	478		

Cedar Lake in Hennepin County is the only lake in the Minneapolis chain of lakes where Least Darters still occur. In an initial effort to preserve genetics, Cedar had been used as a donor lake for Calhoun Lake (Bde Maka Ska) in 2017, but the abundance of Least Darters was low for translocations. In 2019, Cedar also exhibited a small spike in abundance and both Calhoun and Harriet lakes received Least Darters. Stocking will continue if the elevated abundance persists into 2020. In 2019, there were summer fish kills of game species reported in both lakes, but the impact on the Least Darters is unknown. The non-indigenous Zebra Mussel is another unknown threat to the establishment of sensitive fishes. As of 2019, they have been found in McCarrons and Waconia lakes, and their presence will require using dedicated gear for infested waters during monitoring surveys.

Since Fish Lake currently produces sufficient numbers of only Least Darter for translocation, additional donor lakes were assessed in 2019. Big Carnelian, Big Marine, and Square lakes in Washington County are likely donor candidates for Banded Killifish, Blackchin Shiners, and Blacknose Shiners. However, the annual disease certification of lakes will no longer be required in low risk counties such as Washington County.

There are now 20 lakes which have received sensitive fishes, and 20 is too great a number of lakes to continue monitoring on an annual basis. New lakes receiving fish will be monitored annually for three years following translocations. The rest will be done on a rotational basis. In 2019, nine lakes were monitored (Table 2).

Table 2. 2019 monitoring results of sensitive species release lakes.

LAKE	SENSITIVE SPECIES PRESENT
Dakota County	
Holland	Least Darter and Pugnose Shiner
Hennepin County	
Calhoun	None
Ramsey County	
McCarrons	Least Darter
Snail	Least Darter
Washington County	
Big Marine	Least Darter
DeMontreville	None
Jane	Banded Killifish, Least Darter, and Pugnose Shiner
Long	Least Darter
Square	Least Darter

There were some puzzling results in two lakes. In 2018, Blackchin Shiners were found in Holland and Jane lakes. In 2019, this species was not sampled, but Pugnose Shiners were found for the first time in both lakes. Blackchin Shiners are very likely still present in both lakes, but abundance will likely fluctuate from year to year. The Pugnose Shiners must be incidental translocations from Fish Lake. Coincidentally, the Chicago, Illinois translocation effort, on which the TCMA project is based, also found Pugnose Shiners during the monitoring phase, but this species was not detected during the translocations ([Bland 2002](#)).

Another mystery was solved in Big Marine Lake where Least Darters were introduced in 2015 and found in 2016 and 2017 with increasing abundance. However, in 2018, they had vanished along with the near-shore Muskgrass beds. In 2019, they were “re-discovered” using a Missouri benthic trawl to sample deeper Muskgrass beds now absent in shallow water (Figure 3).



Figure 3. Trawling deep Muskgrass beds and finding Least Darters in Big Marine Lake (photos Jenny Kruckenberg).

2. Pre-translocation survey for sensitive fishes in Glacial Lakes State Park.

A search for historical records of fishes present in Minnesota state parks revealed Signalness Lake (Pope County) supported state threatened Pugnose Shiners almost 60 year ago ([Schmidt 2018b](#) and [1993a](#)). However, this population was apparently extirpated from a rotenone treatment to improve the game fishery of the lake. A 1992 non-game fish survey also found Blacknose Shiners and Banded Killifish (Schmidt 1993b). Voucher specimens of both species are cataloged in the James Ford Bell Museum of Natural History fish collection. These three species constitute the majority of sensitive species found in high quality lakes and are often common associates of the remaining two (i.e., Blackchin Shiner and Least Darter). All five species occur in the Chippewa River system, and it is not a great leap to assume the entire suite of sensitive species once inhabited Signalness Lake. Again, to preserve the original genetics of the lake as much as possible, a search for donor lakes will first be done in the Chippewa River system. If this effort fails for any of the sensitive species, TCMA donor lakes will be used for translocations.

Signalness Lake was surveyed on 16-17 September 2019 using seines, dip nets, minnow traps, and mini-fyke nets. The water level was the highest in memory (Figure 4). The catch was restricted to six game species: Northern Pike, Green Sunfish, Pumpkinseed, Bluegill, Largemouth Bass, and Yellow Perch. Such a community is unusual due to the lack of any non-game species which serve as the forage base for piscivorous fishes. In Signalness, young-of-the-year game species are the forage base. The habitat on the other hand was incredible (Figure 5). There were dense and diverse beds of submergent vegetation and water transparency was over 11 feet. A question remains that cannot be answered - where are the non-game fishes? The lake is infested with Zebra Mussels, but this species' presence is not known for causing fish extirpations.



Figure 4 (top). Record high water at Signalness Lake boat ramp.
Figure 5 (bottom). Submergent vegetation in Signalness Lake (photos Konrad Schmidt).

3. Warmouth and Northern Sunfish surveys in Itasca County lakes.

Department of Conservation (now MDNR) fish rescue efforts of the early 1900s spread game fish species around the state. Documentation was poor, but fish rescue is the suspected source of Warmouth in Big Ole and East lakes near Marcell (Schmidt 2019). The species was last reported in East Lake during a 1982 survey, but it continues to thrive in Big Ole. Both lakes are in the Hudson Bay drainage about 240 air miles north of the species' nearest population in southeastern Minnesota. There had not been follow up surveys in East Lake since 1982. In 2018, East Lake was surveyed with seines and dip nets. This survey established a new locality for Pugnose Shiner but no Warmouth were found. In 2019, gill nets and mini-fyke nets were used and again no Warmouth, but this 2019 survey did add a new locality for Northern Sunfish (Figure 6). East Lake residents out on the lake during the survey were asked about Warmouth and informational flyers with contact information were left at unoccupied lake shore homes, but there has been no response.



Figure 6. Northern Sunfish from East Lake – Itasca County (photo Jenny Kruckenberg).

Big Ole Lake appears to be landlocked on 7.5-minute series topographical map, but a GIS hydrographic layer reveals a pour point on the western bay of the lake. Warmouth could possibly move during high water levels into Raft Lake and several lakes downstream via Johnson Creek to the Rice River; movement upstream to East Lake and beyond is also possible (Figure 7). A web application using high-resolution elevation data ([MnTOPO 2019](#)) shows the water level of the lake is higher than normal and may be less than a foot from overflowing (Figure 8). The survey results of East Lake are encouraging with no Warmouth found in 2017 or 2018. However, accessible lakes downstream of East and Big Ole should be surveyed for new occurrences. Downstream of East Lake, there is a carry-in access on Copenhagen and MDNR Conservation Officer Jayson Hanson offered access through his land adjacent to Canoe and Slauson lakes. Downstream of Big Ole, there appears to be road or carry-in access to Carpics, Forest, Jack-the-Horse, Johnson, Rice, Lundeen, and Batson lakes. Another field season of flooded streams could again divert the focus to surveys of some of these lakes in 2020.

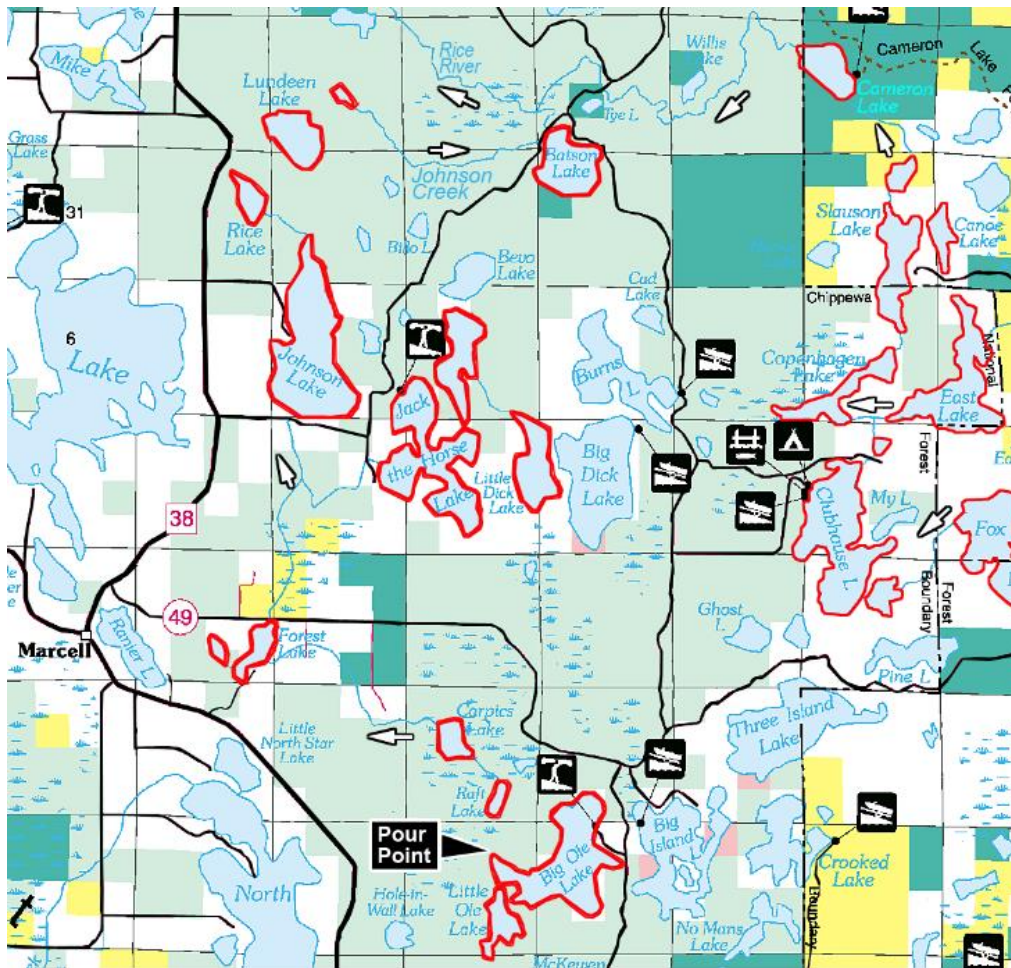


Figure 7. Red outlined lakes are potentially accessible to Warmouth. Arrows indicate direction of flow.

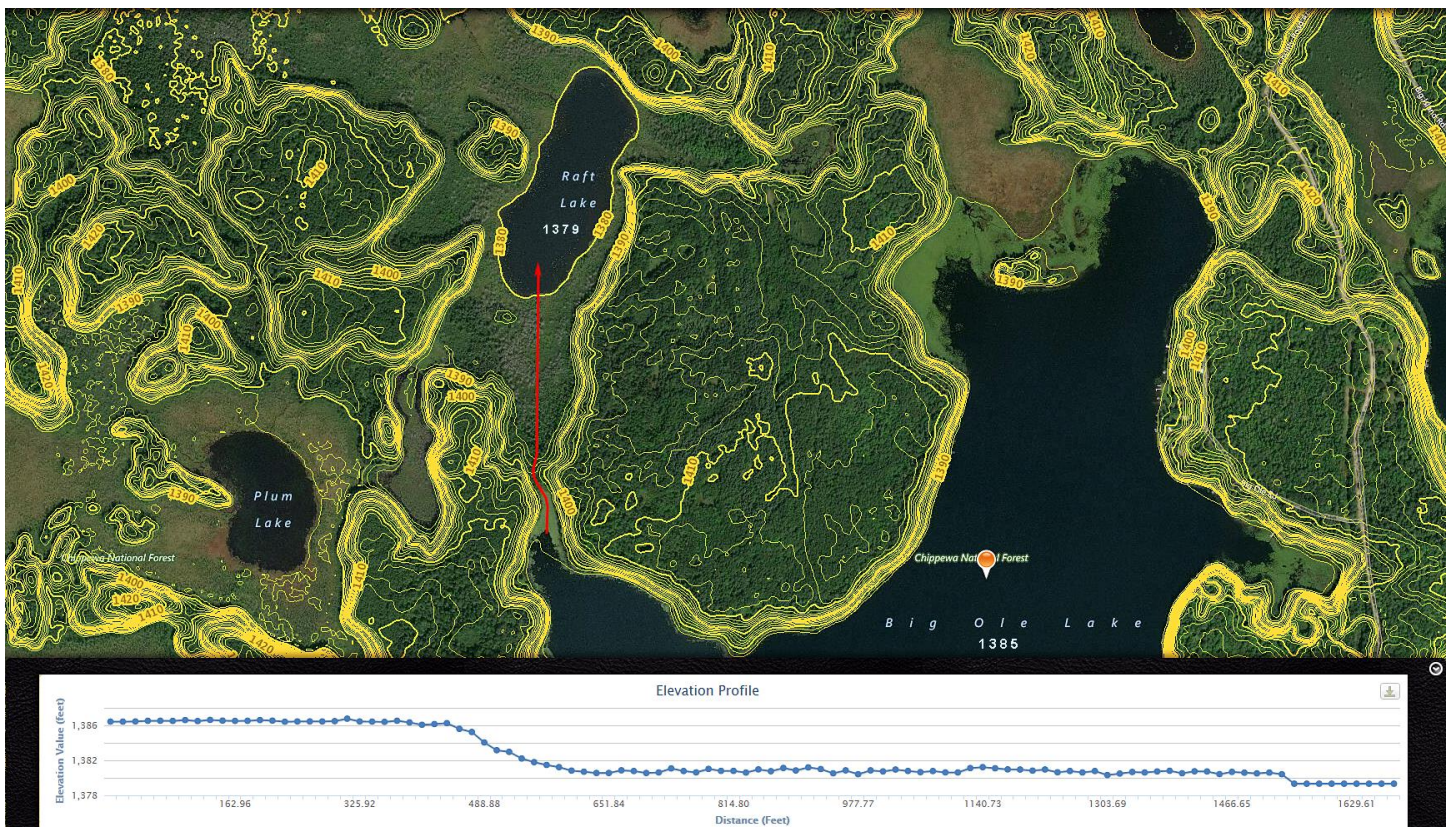


Figure 8. Elevation profile of Big Ole pour point into Raft Lake.

In 1945, both Pugnose Shiners and Northern Sunfish were reported in the Chippewa National Forest's Trout Lake near Marcell. Neither species has been found there since. In 2019, a lake survey found one Northern Sunfish (same as in 1945), but no Pugnose Shiners. Overall, the 1945 survey found 21 species. The 2019 survey collected 24 species which included a new locality for Least Darter. Minnow traps "baited" with LED drop lights and glow sticks were set at depths ranging from 50-87 feet for Deepwater Sculpin. None were found, but this sampling revealed that Trout Lake is only the seventh known lake in the Mississippi River Headwaters drainage (above St. Anthony Falls) for Slimy Sculpin and is only the sixth lake for Ninespine Stickleback. The latter species is a glacial relict at the southern periphery of its range. One final observation and question to limnologists: what is the source of Trout Lake's unique blue tint (Figure 9)?



Figure 9 Trout Lake's water color. Top: aerial photo. Bottom: shoreline (photo Jenny Kruckenberg).

Project 4. Northern Sunfish and Deepwater Sculpin surveys in the BWCAW.

Following the 2018 success finding Northern Sunfish at eight new localities in the BWCAW, two more trips were done in 2019 surveying eight lakes in the Cummings and Phoebe lakes areas of the BWCAW (Figures 10 and 11). In addition to dip nets and seines, gill nets were also used in 2019 and John Olson tried his hand with microfishing. No adult or juvenile Northern Sunfish were found and several young-of-the year (YOY) sunfish (Figure 12) were sent to John Lyons (University of Wisconsin Zoological Museum) and Bruce Bauer (University of Tennessee - Knoxville) for identification. Again, no Northern Sunfish. There was one surprise rarely seen in fish surveys. One Central Newt was found in Little Crab Lake and identified by Carol Hall (MDNR Herpetologist) (Figure 13).

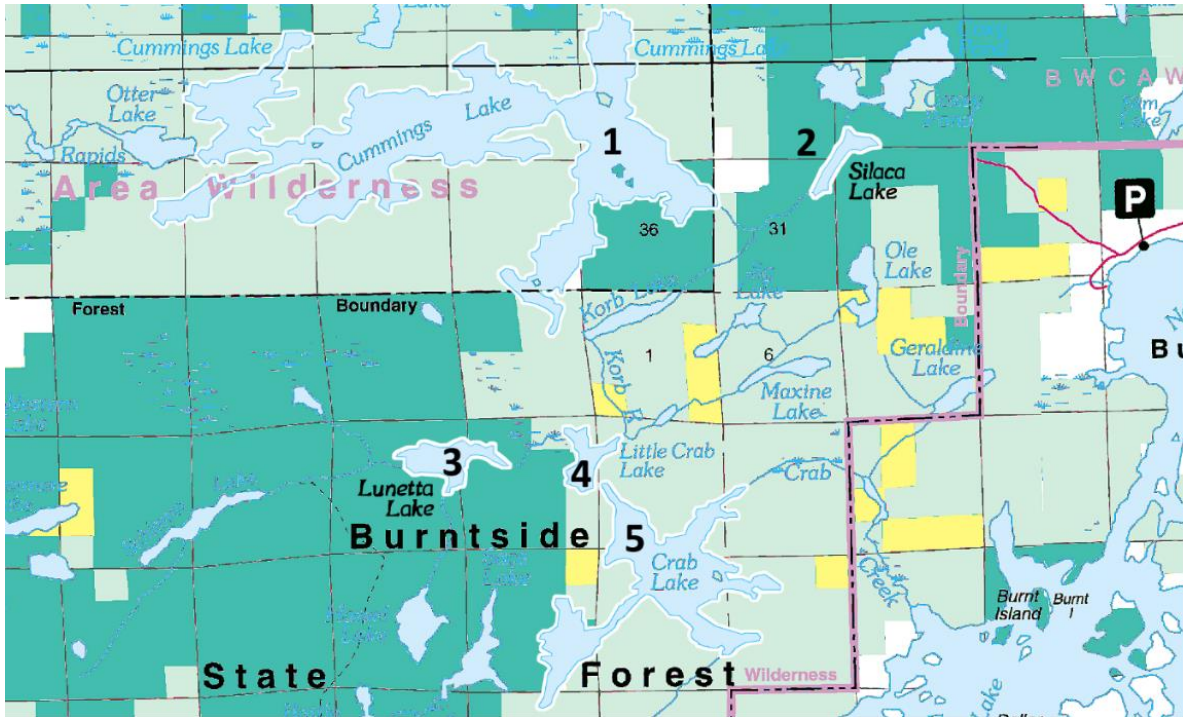


Figure 10. Lakes surveyed on trip one: Cummings, Silaca, Lunetta, Little Crab, and Crab.

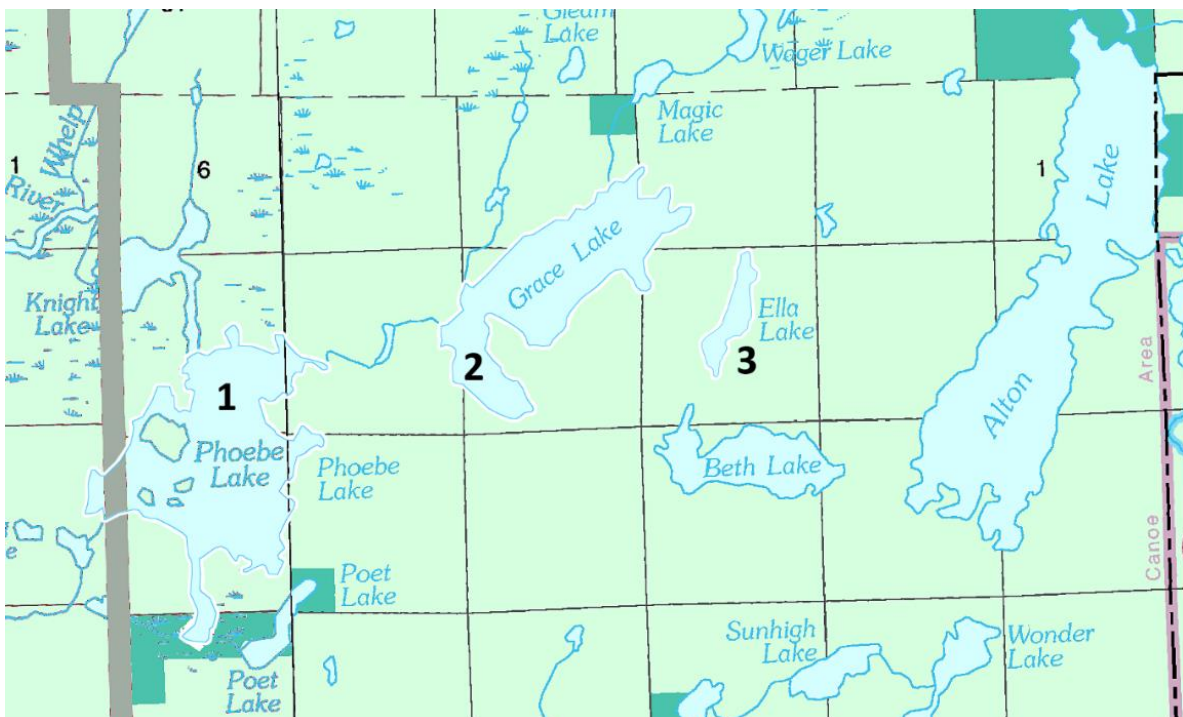


Figure 11. Lakes surveyed on trip two: Phoebe, Grace, and Ella.



Figure 12 (left). YOY sunfish seined in Phoebe Lake (photo John Olson).

Figure 13 (right). Central Newt dip netted in Little Crab Lake (photo Bob Hrabik).

John Olson was on the 2018 survey for Northern Sunfish and was on the second 2019 trip for this species. He is retired from the Iowa DNR where he worked in the Water Quality Assessment Section. He offered the following thoughts and possible explanations why Northern Sunfish were present in the 2018 survey but absent in the 2019 survey.

First, he looked at the differences in [bedrock geology](#) of the areas sampled on the two trips.

- 2018: **Mesoproterozoic, Precambrian bedrock: Duluth Complex anorthositic rocks** except for Lake One and Lake Two (**Mesoproterozoic, Precambrian bedrock: Lake One intrusion**).
- 2019: **Archean, Precambrian Bedrock: Beth Lake granophyre** (Pheobe); **Mesoproterozoic, Precambrian bedrock: Beth Lake granophyre** (Beth, Ella, and Grace lakes).

Granophyric rocks have alkali feldspars, and anorthositic rocks have calcium-rich feldspars: His initial hypothesis was that the difference between the alkali granophyres and the calcium-rich anorthosites might explain some of the difference in aquatic vegetation that was observed in the 2019 lakes compared to 2018. That is, the calcium-rich bedrock might be more conducive to lake water chemistry/quality (pH) that would favor growth of aquatic macrophytes as opposed to the alkali feldspars which maybe limit growth of the vegetation. He didn't explore this hypothesis very far, but did enough web searching to realize that alkaline conditions do not necessarily inhibit growth of aquatic macrophytes.

He also suggested that differences in bedrock geology might explain differences in littoral zone configuration which was strikingly different in the 2018 versus the 2019 lakes. He believes that this difference, through its impact on growth of submersed aquatic vegetation, may explain the lack of Northern Sunfish in lakes sampled in 2019. The near-shore areas of the 2019 lakes were much deeper and/or much rockier than the 2018 lakes, and their littoral zone substrates were predominantly angular boulders or a soft layer of peat. Perhaps the angular boulders and generally deeper near-shore areas of the 2019 lakes somehow limit growth of beds of submersed aquatic macrophytes which is where Northern Sunfish were found in 2018 (Figure 14). The littoral zones in the 2018 lakes were shallower with wading often possible a fair distance (e.g., 20 to 50 feet) from shore at sample sites, but in the 2019 lakes, sampling was almost always restricted to the shoreline's edge due to deeper water and/or soft substrates.

His conclusion is that littoral zone habitats of the 2019 lakes do not provide favorable habitat for Northern Sunfish. Barriers to fish movement and dispersal (e.g., waterfalls) could certainly be an important factor in explaining the lack of Northern Sunfish in the 2019 lakes. Also, the possibility exists that Northern Sunfish, while native to the Kawishiwi River system, are simply not native to the Phoebe River system.



Kawishiwi River, 9/7/2018: wadeable; *L. peltastes* present.



Malberg Lake, 9/6/2018: wadeable; *L. peltastes* present.



Kawaschong Lake, 9/5/2018: wadeable, *L. peltastes* present.



Square Lake, 9/5/2018: wadeable, *L. peltastes* present.



Phoebe Lake (left), 9/25/2019 and Grace Lake (right), 9/26/2019: only shoreline edges wadeable, *L. peltastes* absent.



Figure 14. 2018 and 2019 habitat comparison (photos John Olson).

Deepwater Sculpin surveys in the BWCAW wrapped up in 2011 after all the large, deep lakes had been surveyed. The species was found in only four lakes which were all over 4000 acres ([Schmidt 2013](#)). However, in 2017, Tower Area Fisheries collected Deepwater and Slimy sculpins from Kekekabic Lake (ca 1700 acres) in Lake County with minnow traps “baited” with glow sticks ([Schmidt 2018a](#)). This raised the question how small a lake Deepwater Sculpins may inhabit. Three lakes in western Cook County were surveyed in 2019 (Figure 14). Grand Marais Area Fisheries had previously found Slimy Sculpin in Gabimichigami Lake (ca 1200 acres) and Little Saganaga Lake (ca 1600 acres), in 2005 and 2011, respectively. In Minnesota, Deepwater Sculpins are always associated with Slimy Sculpins, but they are uncommon to rare and could easily be missed in a single survey effort. In 2019, both lakes were surveyed again as well as Tuscarora Lake (ca 800 acres). Slimy Sculpins were found in all three lakes, but no Deepwater Sculpin were found.

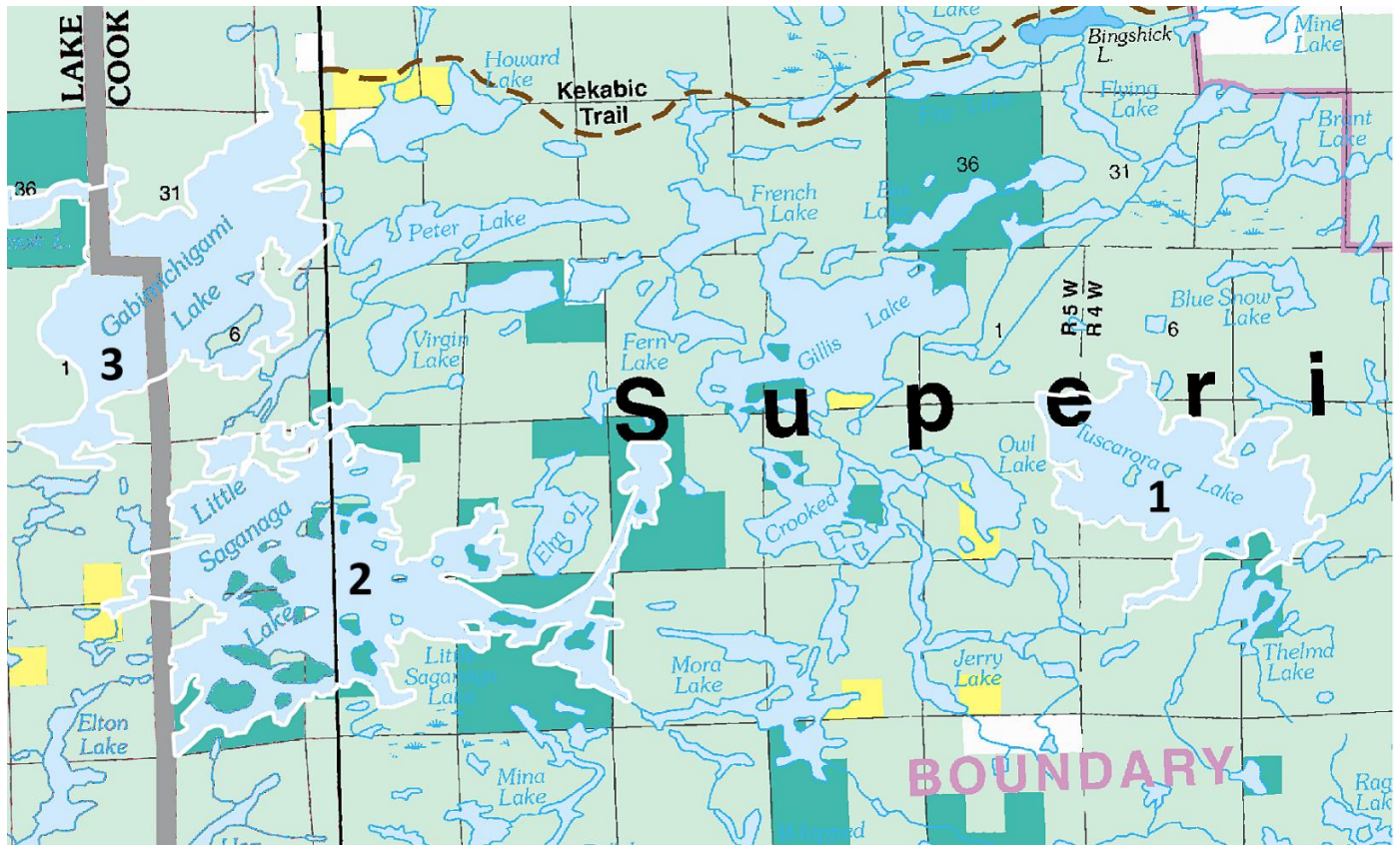


Figure 14. Lakes surveyed for Deepwater Sculpin: Tuscarora, Little Saganaga, and Gabimichigami.

Project 5. Pre-construction fish surveys of islands in Pigs Eye Lake.

Pigs Eye Lake is a 674-acre backwater of the Mississippi River in east St. Paul ([MDNR Lake Finder 2019](#)). Aquatic habitats and water quality have long been degraded due to sedimentation, high turbidity, and nutrient loading. Furthermore, the lake's large surface area promotes wind fetch conditions that erode the shoreline from wave action. A remedial project will construct seven islands beginning in 2020 to reduce wind fetch and shoreline erosion (Figure 15). The project will cost more than \$12 million dollars and will be completed in 2022. ([Vezner 2019](#)).

MDNR conducted lake surveys of Pigs Eye in 1978 and 1984 using trap nets ([MDNR Fishes of Minnesota Mapper 2019](#)). The cumulative catch of the two surveys was 1222 fish comprising a rather diverse community of 25 species in 11 families. However, the dominant species were Black Crappie (423), Common Carp (203), White Crappie (120), and Black Bullhead (106). Common Carp and Black Bullheads are very tolerant species, and their high abundance is a symptom of extremely poor habitat and water quality. Conditions have since likely worsened over the last 35 years.

Pre-construction fish data would be valuable to have for a future evaluation of the effectiveness of island construction in habitat restoration. On September 4, 2019, a Pigs Eye fish survey using dip nets and seines found Pumpkinseed, Bluegill, Smallmouth Bass, Largemouth Bass, Johnny Darter, Logperch, and Yellow Perch. The substrate was deep silt which made sampling difficult. Sago Pondweed was the only submergent vegetation present and was restricted to widely scattered clumps. With a Secchi depth of only 0.3 meters, the lack of submergent vegetation was not surprising. One bed of American Lotus was observed in the southwestern bay of the lake. The most common wildlife present were flocks of White Pelicans (Figure 16). In 2020, surveys will utilize seines, dip nets, minnow traps, gill nets, and benthic mini-trawls. For consistency in comparisons to the earlier lake survey data, trap nets should be included as a sampling gear in 2020. However, at the time this report was submitted there were no available sources for trap nets to use on a loan basis and no funding to purchase them.

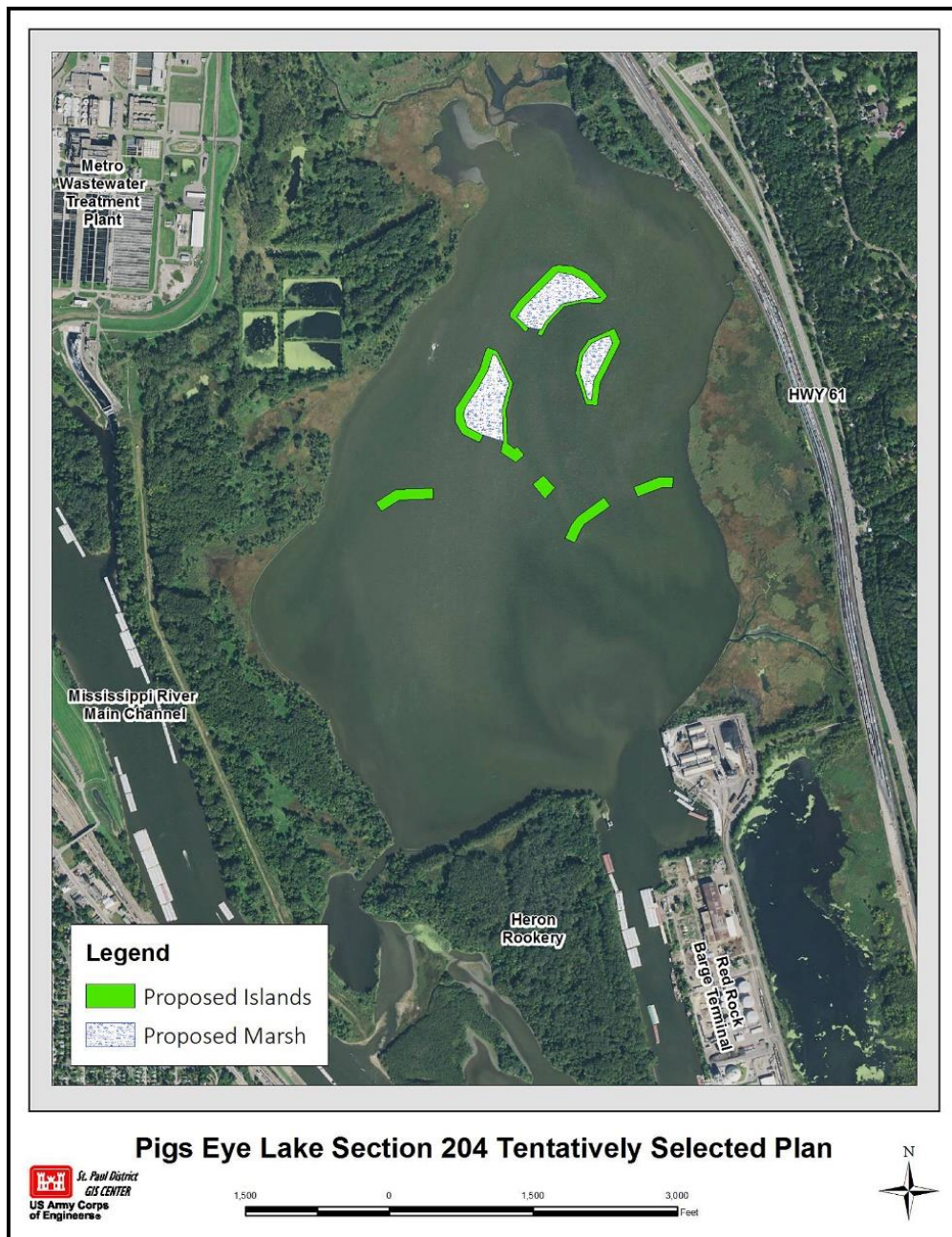


Figure 15. Proposed islands for Pigs Eye Lake



Figure 16. American Lotus flower and White Pelicans in Pigs Eye Lake (photos Jenny Kruckenberg).

Project 6. Banded Killifish tissue collections for a range-wide genetics study.

In the early 2000s, Banded Killifish occurrences began rapidly expanding in Ohio and Illinois where the species is listed threatened and endangered, respectively (Willink et al 2019). However, the initial celebration of what appeared to be a miraculous recovery of a rare and environmentally sensitive species was premature. A study of meristic and morphological characters revealed the new records were actually hybrids of two subspecies (Figure 17): Western Banded Killifish (*Fundulus diaphanus menona*) and Eastern Banded Killifish (*F. d. diaphanus*). Ohio recognizes subspecies in listing rare populations. Illinois does not, but with these preliminary results, the listing of subspecies is being considered in that state. The scope of the research has since expanded into a range-wide genetics study with the hope that indigenous, non-indigenous, and hybrid populations will be identified. In 2019, Minnesota tissues were contributed to this study from six localities in the Red River of the North, Lake of the Woods, Mississippi Headwaters, Mississippi River Southeast, and St. Croix River drainages ([Hatch 2015](#)).



Figure 17. Left: Western Banded Killifish. Right: hybrids (photos Philip Willink).

Acknowledgements

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