Littlefield Lake

Isabella County, T16N, R5W, Sec 17
Chippewa River watershed, last surveyed 2021

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Environment

Littlefield Lake is a 183-acre lake located five miles north of Weidman in northern Isabella County, T16N, R5W, Sec 17 (Figure 1). In addition to Sucker Creek, several springs feed into Littlefield Lake which flows into the Coldwater River, and eventually to the Chippewa River. Littlefield Lake was previously defined as an oligotrophic lake, a classification which typically has lower levels of nutrients and, therefore, has high water clarity supporting less productive aquatic communities. However, the recent fish community and limnology leans toward a mesotrophic system. Temperature and dissolved oxygen profiles indicate that a thermocline is established between 17 and 18 feet deep and hypoxic conditions (i.e., dissolved oxygen < 3.0 mg/L) begin at 34 feet (Table 1). The lake bottom consists of shoals that are made up of mostly sand and marl with a bit of gravel. The littoral zone is narrow with steep drop-offs, and there are several deep holes ranging from 30 to 60 ft. The dominant fish habitat for Littlefield Lake are the drop-offs, docks, and aquatic vegetation.

Michigan Department of Environment, Great Lakes, and Energy (EGLE) conducted an aquatic plant survey in August of 2022 (Table 2). A total of 10 submerged plants and six emergent plants (included attached floating species) were identified. The dominant submerged plant species was Chara spp. with a cumulative cover value of 5.97. Chara spp. were found at eight of the 31 Aquatic Vegetation Assessment Sites (AVAS) at a density of less than 2% to 60% per site. The cumulative cover value is a unitless amount that is calculated by determining the percent cover at each site, multiplying the density with a weighted value for standardization, and dividing by the total number of AVAS sites. The dominant emergent plant species was White water lily (Nymphaea odorata) with a cumulative cover value of 2.68. White water lilies were found at three of the eight AVAS at a density of < 2% to up to 60% per site. Of the invasive species found, Eurasian watermilfoil was the most common and found at three of the eight AVAS at a density of < 2% to up to 20% per site. There has not been a change in abundance since the 2000 aquatic plant survey.

Littlefield Lake has a convoluted shoreline (roughly 4.8 miles excluding canals and islands) with many small coves. Shoreline development index (DL) measures the shape of a waterbody and estimates the amount of littoral zone (Cole et al. 2016). Little Lake has a DL of 2.4, which refers to how convoluted the shoreline is compared to a perfectly circular lake (DL=1). This appears to be an appropriate estimate of littoral zone present. Much of the shoreline is natural although currently 28% is armored by seawalls installed by property owners, which is less than the statewide average. Most of the development is concentrated on the southeastern end of lake. The immediately surrounding area is dominated by forested land (Figure 2). Agriculture is the dominant land-use in the Chippewa River watershed, but Littlefield Lake is located near the headwaters of the watershed (Figure 3). The surrounding topography is mainly flat with high wooded hills northwest of the lake. There is a DNR public access site with a concrete boat ramp, a vault toilet, and parking for 10 vehicles with trailers located on the southwest shoreline. Additionally, boating and recreational activity is popular during the warmer months.

History

Littlefield Lake was first managed as two-story trout fishery because it stratifies and, therefore, can support coldwater species in its lower depths. This lake characteristic also supported an inland Cisco and Rainbow Smelt fishery. The management of Littlefield Lake began by stocking 4,000 (4.8 in) Lake Trout in 1979 and 1980. A survey was conducted in June 1980 using inland gillnets to evaluate stocking efforts. Northern Pike made up 38% of the total catch by number, and no trout were captured. In 1981, Lake Trout was replaced by Splake (Brook Trout x Lake Trout hybrid). Splake stocking occurred in 1981 and 1983. In October 1984, a survey was conducted using inland gillnets, and one 16-in Splake was captured as well as 32 Northern Pike. All stocking discontinued until 1989 when Brown Trout were stocked. Brown Trout were stocked for two years (~10,000 total) and evaluated in August 1990. The 1990 survey captured one Brook Trout (13 in), one Brown Trout (9 in), five Northern Pike (average total length [TL] = 24 in), and 23 Rainbow Smelt (avg TL = 5.5 in). Stocked trout didn't survive likely due to the combined effects of interspecies competition and predation by Northern Pike. As such, trout stocking ceased, and trout-centric management was abandoned.

In 1991, the management focus changed from trout to Walleye through supplemental stocking (Table 3). The goal of this initial stocking plan was to create a population that would increase angling opportunities without burdening the remaining Rainbow Smelt population. A fall electrofishing survey was conducted in 1991 to evaluate the first Walleye stocking event. Twelve Walleye averaging 7.8 in (range: 3-9 in) were captured indicating post-stocking survival. In addition to Walleye, two Brown Trout were captured and several 3-4 in Rainbow Smelt were observed.

Unfortunately, by the mid-1990s the Rainbow Smelt population appeared to have crashed putting the future of Walleye management in jeopardy. This crash was assumed to be the result of beaver activity making the smelt spawning habitat on Sucker Creek inaccessible, which made the population more vulnerable to over-predation. A trap net survey was conducted in 1995 to evaluate the fish community of Littlefield Lake. The fish community was comprised of Black Crappie, Bluegill, Largemouth Bass, Northern Pike, and Walleye. Following the smelt crash, management focus shifted to restoring the Rainbow Smelt fishery by discontinuing the Walleye stocking efforts. However, by 2002 a prescription for 9,150 spring fingerling Walleye stocked triennially was initiated, and the hopes of reestablishing the Rainbow Smelt was abandoned.

In 2002, the Michigan DNR established the Inland Lake Status and Trends Program (STP), which is a statewide program with annual management unit obligations. The purpose is to conduct standardized fishery and limnological sampling on public inland lakes greater than 10 acres that allows for statewide comparisons. The surveys are conducted over a one-to-two-week period in late spring or early summer when water temperatures are between 55 and 80°F). Multiple gear types are used to randomly sample different habitats and to collect information on a range of species and size classes (Wehrly et al. 2015):

- Large-mesh fyke net consist of a lead (4' x 100'), a front frame made up of two rectangles (4' x 6'), and a pot end made up of three hops (4' diameter) and two throats. The mesh size of 1.5 in captures larger (> 3 in) species that inhabit the littoral zone or move inshore at night. Nets are set overnight perpendicular to the shoreline.
- Small-mesh fyke net consist of a lead (3.5' x 50'), a front frame made up of two rectangles (3.5' x 6'), and a pot end made up of three hops (3' diameter) and two throats. The mesh size of 3/16 in captures small (< 3 in) species that inhabit the littoral zone or move inshore at night. Nets are set overnight perpendicular to the shoreline.

- Experimental gill nets consist of five monofilament panels of 1.5, 2.0, 2.5, 3.0, and 4.0- in-stretch mesh, each 25 feet in length. Gill nets should be set in offshore areas and may not be suitable for all lakes biologically or socially.
- Seine is 5' tall and 25' long with a mesh size of 3/16 in to capture small (< 3 in) species that inhabit the littoral zone. Seines should be deployed parallel to shore and then formed into a semi-circle by keeping the nearshore end stationary and pulling the offshore end in an arc. The seine can then be pulled toward shore trapping fish between the shoreline and the seine.
- Boom shocking is completed at night as catch rates and the number of species encountered tends to be higher than during the day. A minimum of three 10-minutes passes should be made in the littoral zone parallel to the shore. All species of all sizes should be netted.
- Trap net consist of a lead (6' x 100'), two wings and heart (3' x 6'), and a pot with a single throat. The mesh size of 1.5 in captures larger (< 3 in) species that inhabit the littoral zone or move inshore at night. Nets are set overnight perpendicular to the shoreline.

In 2008, a STP survey was conducted on Littlefield Lake. The Littlefield Lake shoreline was comprised of 98 small docks, 64 large docks, and 889 submerged trees with 46.5% of the shoreline armored. This is twice the estimate that was calculated in 2021 and is likely due to a sampling error not a true decrease in armored shoreline. Sampling gear used in 2008 include two large-mesh fyke nets, two experimental gillnets, and four trap nets. There was a total of 20 net-nights, three boomshock transects, and three seine net hauls. Bluegill were the most abundant species with nearly 48% of the catch by number caught in the survey. A total of 807 fish (286.9 lbs) representing 16 species were captured during the fisheries survey. Mean TL was 5.0 (range:1-9 in). Larger Bluegills were caught in trap nets where the average size was 5.9 in. Thirty percent of the overall bluegill catch was ≥ 6 in. Ten year-classes of Bluegills were present in the catch. Bluegills were growing at 0.3 in below statewide average, which was similar to past growth estimates. Bluegills in Littlefield Lake were ranked as "acceptable-satisfactory" according to the Schneider Index (Schneider 1990). Too few Bluegills were captured in the previous surveys to allow temporal comparisons. Two walleyes were captured during the survey with TL of 24 and 26 in. The age estimates did not match years in which Walleye were stocked. All other sport fish with enough individuals captured had a mean growth index within an acceptable range compared to the statewide average.

Current Status

A recent STP comprehensive fisheries community survey of Littlefield Lake was completed May 10 to 13, 2021. Sampling effort used included four seine hauls, five trap-net lifts, four experiment gillnet sets, five small mesh and 10 large mesh fyke net lifts (Figure 5). Three 600-second nighttime electrofishing transects were conducted totaling one mile of shoreline. Total effort for the survey was four seine hauls and 24 net-nights. All fish captured were measured (TL to 1-in bin). Fish weights were estimated from length to weight regression equations compiled by Schneider et al. (2000). For each game species, an aging structure (i.e., fin and scales) was removed for up to 10 individual fish per in bin, and age was estimated. Mean growth indices were calculated for species from age estimates of a minimum of five individuals (Schneider et al. 2000). Mean growth indices between -1.0 and 1.0 indicate similar growth rates compared to statewide averages; outside of that range indicates growth below or above statewide averages, respectively.

Analysis and Discussion

A total of 1,185 fish representing 18 species were captured in Littlefield Lake during the 2021 STP survey (Table 4). The fish community was dominated by Bluntnose Minnow making up 31.3% of the collection by number, but Largemouth Bass made up 28.7% of the biomass. All other species collected made up roughly 7% (by number) or less of the fish community, except Bluegill (16.5%) and Spotfin Shiner (25.1%). The sport predator community included Northern Pike, Largemouth Bass, and Walleye, which made up roughly 3.8% of the total catch by number but 47.5% by weight. The Panfish community included Bluegill, Black Crappie, and Yellow Perch and made up 23.3% of the collection by number. The fish forage base collected in this survey was Bluntnose Minnow, Brook Silverside, Iowa Darter, Johnny Darter, Sculpin spp., and Spotfin Shiner. These species made up 64.6% of the total catch, and TL ranged from one to three inches. The large increase in species richness and abundance compared to 2008 is due to the increase in survey effort (Figure 5).

A total of two Black Crappie averaging 12 in were collected with 100% of the catch larger than the 7-in minimum size limit (MSL). Age and growth analyses were not calculated due to the lack of ten individuals per inch bin.

A total of 195 Bluegill (mean TL = 4.4 in) were collected with all five survey gear types with 5% of the catch larger than the 6-in MSL. Small-mesh fyke-nets accounted for nearly half of the total catch with the remaining catch being captured by large-mesh fyke-nets and boat electrofishing. The small-mesh fyke-net collected smaller Bluegill on average compared to other gear types. Bluegill growth was similar to the statewide average with a mean growth index of +0.1 in. A Schneider Index score of one was calculated based on several of the above parameters, which indicated a poor Bluegill population (Table 5; Schneider 1990). Given that growth was similar to the statewide average, this calculation is likely skewed by the high number of age-1 Bluegill (118 individuals: 60.5%). The growth rate and multiple year classes (ages 1-5) suggest stable recruitment to the harvestable fishery.

Thirty-two Largemouth Bass (mean TL = 15.0 in) were collected with 59% of the catch larger than the 14-in MSL. Boat electrofishing accounted of 63% of the total catch followed by large-mesh fyke-nets and trap-nets. There were no differences in mean TL of Largemouth Bass captured among all three gear types. Largemouth Bass were growing faster than the statewide average with a mean growth index of +0.9. Multiple year classes (ages 3-10) were found suggesting stable recruitment to the harvestable fishery.

Three Northern Pike (mean TL = 21.8 in) were collected; one was larger than the 24-in MSL. Northern Pike were age three, four, and five, but age and growth analyses were not calculated due to the lack of ten individuals per inch bin.

Ten Walleye (mean TL = 19.6 in) were collected with 60% of the catch larger than the 15-in MSL. Growth rate was not calculated due to the lack of ten individuals per inch bin. Walleye ages were three and 9 - 12 with all ages besides 10 not aligning with stocking years indicating some level of natural reproduction.

Seventy-eight Yellow Perch (mean TL = 2.9 in) were collected with 0% of the catch larger than the generally accepted 7-in minimum size for harvest (although there is not a mandated MSL). Boat electrofishing accounted for nearly 100% of the total catch. Yellow Perch were not aged due to their small size and are assumed to be age-0 or age-1.

One Brook Trout (12 in) was collected. The Brook Trout was not aged and is assumed to originate from natural reproduction in a connected stream because Brook Trout are not stocked in Littlefield Lake. For an inland lake to sustain a trout population, it needs to be well-oxygenated and be deep enough or have direct groundwater flows to provide adequate cold water in the summer. Littlefield Lake has a history of disjunct and unfocused management approaches. Management for trout and smelt have been largely unsuccessful although Littlefield Lake has the limnology to marginally favor trout in its lower story, and warmwater species in its upper story. However, several efforts to establish a trout population have failed. This could be due to the lack of sufficient spawning habitat or over predation by more established species. Small numbers of Brook Trout have been captured in Littlefield Lake and likely come from a connected stream.

Lastly, Littlefield Lake contained 152 small docks, 35 large docks, 196 dwellings, and 76 submerged trees at the time of this survey. Based on data collected in 20 segments around the shoreline, the average percentage of armored shoreline was approximately 28%. Docks provide some shade for fish, but submerged trees offer more valuable fisheries habitat.

Management Direction

Littlefield Lake is ranked as a Class 1 walleye lake with a level 5 natural reproduction rank (Table 6; Herbst et al. 2021). Lakes with a Class 1 ranking have the lowest Walleye habitat suitability, poor levels of natural reproduction, and highly vulnerable to climate change. These Walleye lakes are typically maintained through stocking. This specific characteristic is supported by the level 5 natural reproduction rank, which is defined as being solely on dependent routine stocking. The Walleye stocking prescription for 75/acre every odd year has lapsed. There is evidence of some level of natural reproduction for older Walleye, but no age 0-2 were collected. This could be due to aging errors for older individuals or inappropriate timing to capture young-of-year (YOY) Walleye. Without OTC markings it is difficult to confirm natural reproduction. Results of a fall Walleye YOY survey will provide insight on if this stocking prescription should be renewed for supplement stocking or if it should remain cancelled because it is not producing enough fish to be a priority stocking site for a limited resource.

The hard and sandy substrate of the littoral zone and depth of the main basin limits vegetation growth in Littlefield Lake. According to the 2022 Littlefield Lake aquatic plant survey (MiEnviro), the lake has a sparse vegetation community and no significant nuisance plant problems. Areas of concern are limited to canals; therefore, no lake wide treatments should occur. Emergent vegetation provides refuge from predation, spawning and nursery habitat, and increased primary production (i.e., zooplankton). Additionally, the long vertical root system of aquatic emergent vegetation stabilizes the lake bottom and reduces the rate of erosion (Figure 6). Given the near absence of emergent vegetation, no removal or treatment should target emergent vegetation unless it is for boat access, such as canals with homes.

Littlefield Lake appears to have a healthy and stable fishery that is heavily utilized by recreational anglers. Management actions will remain Walleye focused until further evaluations can occur.

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Table 1. Temperature, dissolved oxygen (DO), and pH profile from the water surface to the bottom in Littlefield Lake, Isabella County, Michigan, August 2021.

Depth (ft)	Temperature (°F)	Dissolved Oxygen (ppm)	pH	Specific conductance (mS/cm)
0	78.30	8.31	9.35	.3700
3	78.10	8.32	9.36	.3700
6	77.80	8.26	9.36	.3690
9	77.50	8.27	9.36	.3690
12	77.10	8.26	9.35	.3700
15	73.60	8.20	9.27	.3740
18	69.20	7.48	9.15	.3690
21	61.40	7.12	9.07	.3770
24	56.30	5.85	8.89	.3760
27	53.20	5.61	8.82	.3770
30	50.90	4.84	8.71	.3780
33	49.20	3.43	8.60	.3790
36	48.20	2.59	8.53	.3780
39	47.60	1.77	8.45	.3780
42	46.60	1.45	8.40	.3800
45	46.30	1.15	8.36	.3790
48	46.30	0.97	8.30	.3780
51	45.70	0.68	8.26	.3800
54	45.60	0.53	8.26	.3800
57	45.60	0.35	8.22	.3810
60	45.50	0.31	8.20	.3820
63	45.40	0.31	8.18	.3820
66	45.30	0.30	8.16	.3840

Table 2. Results of the Aquatic Vegetation Survey conducted by EGLE on Littlefield Lake in September 2022. Found = less than 2%, Sparse = 2% to 20%, Common = 21% to 60%, Dense = greater than 60%.

Plant Species	Cumulative Cover Value	Number of AVAS Found	Density
Submergent Plant Species			
Eurasian watermilfoil	1.13	8	Found – Sparse
Chara	5.97	23	Found – Common
Flat-stem pondweed	0.35	2	Found – Sparse
Illinois pondweed	2.87	23	Found – Common
Native milfoil	0.39	3	Found – Sparse
Coontail	1.61	2	Sparse – Common
Elodea	1.39	4	Found, Common
Bladderwort	0.35	2	Found – Sparse
Najad	0.42	4	Found – Sparse
Sago pondweed	0.06	2	Found – Sparse
Emergent Plant Species			
Bur-Reed	0.39	3	Found – Sparse
Aquatic moss	0.03	1	Found
White water lily	2.68	8	Found – Common
Small duckweed	0.03	1	Found
Bulrush	0.32	1	Sparse
Swamp loosestrife	0.03	1	Found

Table 3. Fish stocked by the MI DNR in Littlefield Lake, Isabella County, 1979-2019.

Year	Species	Strain	Number	Average Length (in)	Operation
1979	Lake Trout	NA	4,000	4.84	State
1980	Lake Trout	NA	4,000	4.88	State
1981	Splake	Hybrid	6,000	5.98	State
1983	Splake	Hybrid	5,040	5.87	State
1989	Brown Trout	Plymouth Rock	5,000	6.26	State
1990	Brown Trout	Soda Lake	4,999	5.28	State
1991	Walleye	Muskegon	9,223	1.89	State
1994	Walleye	Muskegon	10,569	1.85	State
2002	Walleye	Tittabawassee	9,317	1.50	State
2006	Walleye	Tittabawassee	9,018	1.60	State
2011	Walleye	Muskegon	25,884	1.90	State
2013	Walleye	Muskegon	10,279	1.49	State
2015	Walleye	Muskegon	14,533	2.05	State
2017	Walleye	Muskegon	23,490	1.65	State
2019	Walleye	Muskegon	39,142	1.68	State

Table 4. Fish species captured during the May 2021 Status and Trends survey on Littlefield Lake. Columns represent number of fish, percent by number, length range (in) and mean length of each species captured.

Species	Number	Percent by number	Length Range (in)	Mean Length (in)
Black Crappie	2	0.2	11-12	12.0
Bluegill	195	16.5	1-7	4.4
Bluntnose Minnow	371	31.3	1-2	2.0
Brook Silverside	69	5.8	2-2	2.0
Brook Trout	1	0.1	12-12	12.0
Brown Bullhead	1	0.1	13-13	13.0
Common Carp	8	0.7	18-27	22.7
Iowa Darter	12	1.0	1-2	2.0
Johnny Darter	13	1.1	1-2	2.0
Largemouth Bass	32	2.7	6-19	15.0
Northern Pike	3	0.3	19-24	21.8
Rock Bass	85	7.2	4-9	6.5
Sculpin (spp.)	3	0.3	1-3	2.5
Spotfin Shiner	297	25.1	2-3	2.8
Walleye	10	0.8	13-26	19.6
White Sucker	4	0.3	18-20	20.0
Yellow Bullhead	1	0.1	12-12	12.0
Yellow Perch	78	6.6	2-4	2.9

Table 5. Littlefield Lake Bluegill classification using fyke and trap net data and the Schneider Index (Schneider 1990).

	2008		**2021**	
Metric	Value	Score	Value	Score
Average length (in)	6.65	5	3.4	1
% ≥ 6 in	44.8	3	6.4	1
% ≥ 7 in	22.4	4	2.6	2
% ≥ 8 in	8.7	5	0	1
Mean Growth Index	-0.3	3	+0.1	4
Schneider Index	4		1.8	
Rank[1]	Satisfactory		Very Poor - Poor	

[1]1 = very poor, 2 = poor, 3 = acceptable, 4 = satisfactory, 5 = good, 6 = excellent, 7 = superior

Table 6. Habitat description of the lake classifications prioritized for Walleye management actions described within MDNR IWMP. Degree days were calculated (from a base of 32F) as the product of the duration of the ice-free period and mean water temperature during the ice-free period. This table was amended from Wehrly et al. (2012).

Class	Description
1	High degree-days (4,415), high mean temperature (61.2 °F), small surface area (163 acres), and intermediate depth (16.6 ft); these lakes are predominately located in the Lower Peninsula. These lakes are considered a low priority for Walleye management efforts because of their low habitat suitability and high vulnerability to climate change.
2	High degree-days (4,315), intermediate mean temperature (59.9 °F), large surface area (1,572 acres), and deep (22.7 ft); these lakes are found primarily in the Lower Peninsula. Expected to be resilient to climate change because of their large surface area and relatively deep depths.
3	Low degree-days (3,293), low mean temperature (57.7 °F), large surface area (2,363 acres), and deep (24.7 ft); these lakes are concentrated in the western Upper Peninsula, with limited distribution in the northern Lower Peninsula. Currently most suitable for Walleye and expected to be resilient to climate change because of their large surface area and relatively deep depths.
4	Low degree-days (3,441), intermediate mean temperature (59.9 °F), small surface area (94 acres), and intermediate depth (14.7 ft); these lakes are very common in the Upper Peninsula and northern Lower Peninsula. Expected to be the most vulnerable to climate change because of their relatively small surface area, shallow depths, and predicted temperature increases in northern regions where these lakes are located.
5	Intermediate degree-days (3,719), intermediate mean temperature (60.1 °F), intermediate surface area (616 acres), and intermediate depth (14.4 ft); these lakes are found in the Upper Peninsula and northern Lower Peninsula. Expected to have variable response to climate change, which will primarily be determined by surface area, depth, and latitude with lakes within this classification being more resilient in northern latitudes.
6	Low degree-days (3,304), intermediate mean temperature (59.7 °F), intermediate surface area (1,258 acres), and shallow (10.3 ft); these lakes are found primarily in the Upper Peninsula. Expected to have variable response to climate change, which will primarily be determined by surface area and depth with larger and deeper lakes within this classification being more resilient.

Figure 1. Littlefield Lake in Isabella County, Michigan. The circle indicates the location of the public boat launch.

Figure 2. Location of gear set May 10 to 13, 2021 on Littlefield Lake.

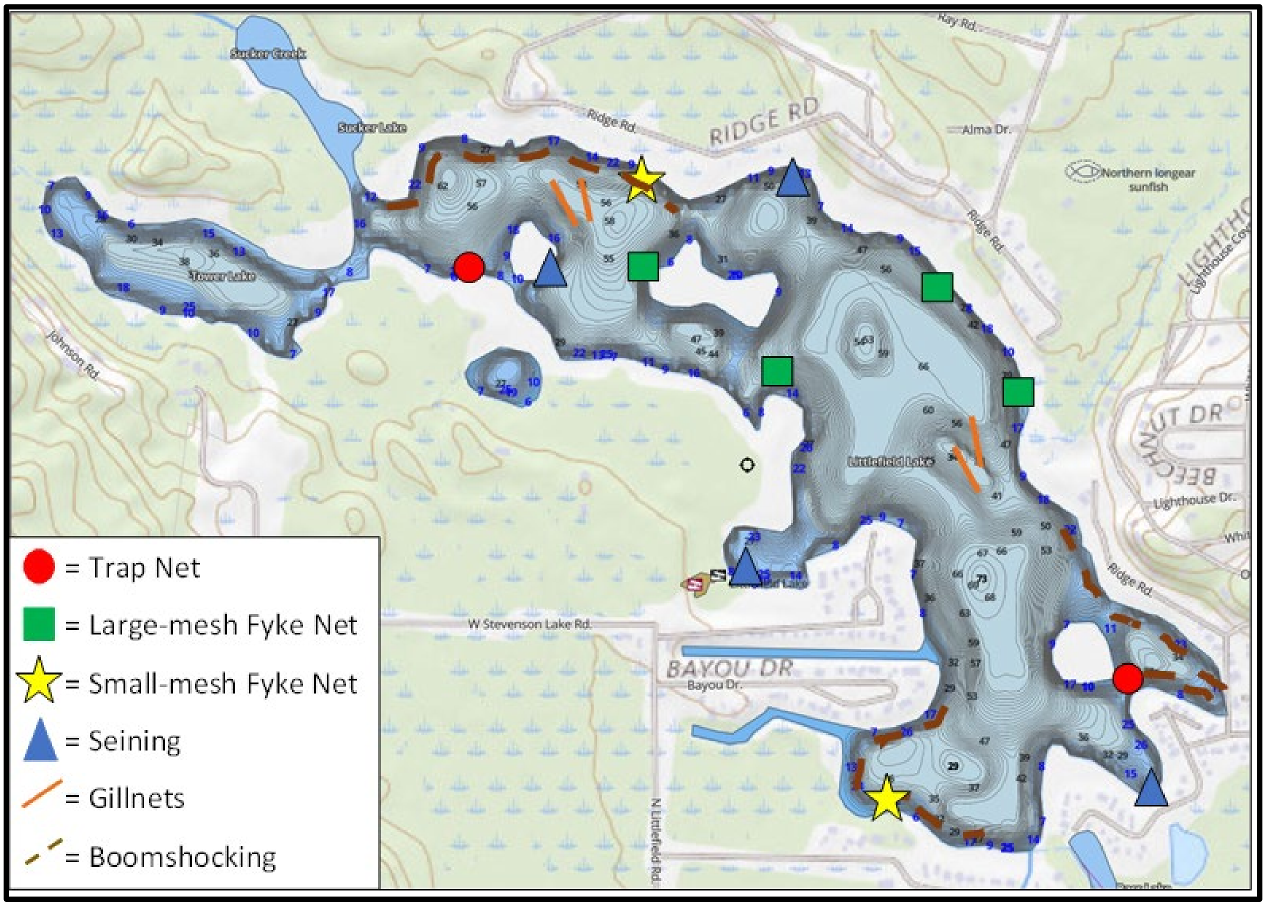


Figure 3. Land use for the Coldwater River sub-watershed.

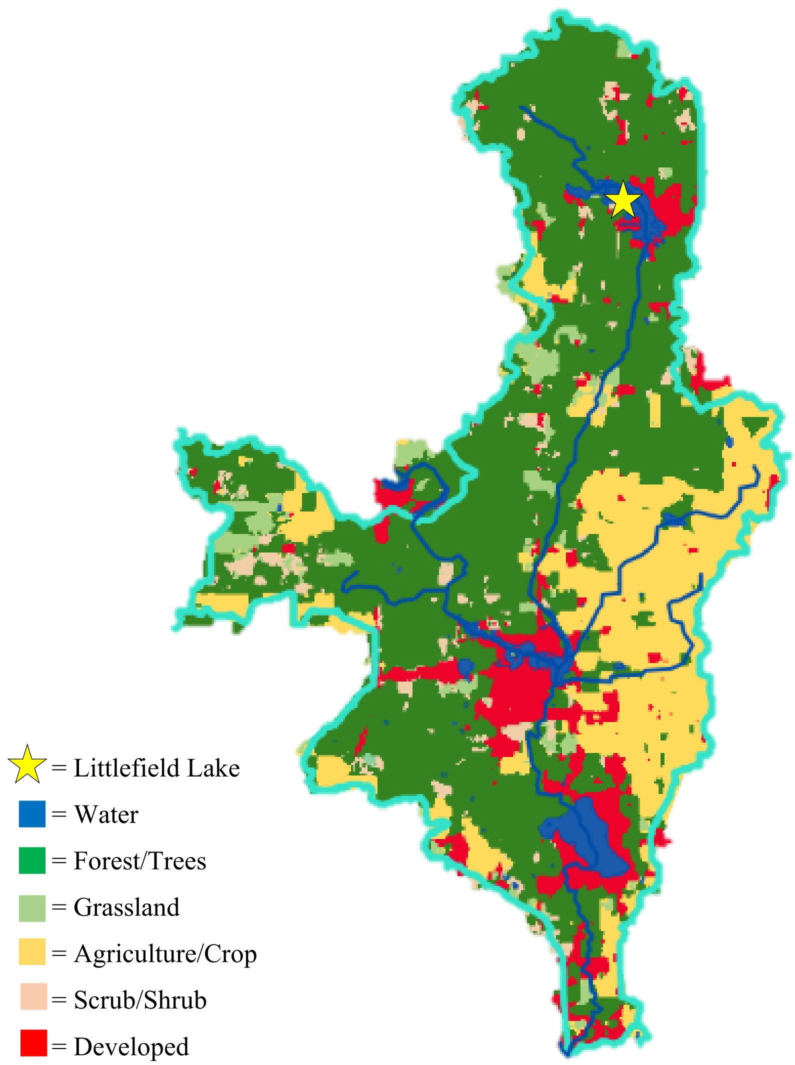


Figure 4. Land use for the larger Chippewa River watershed.

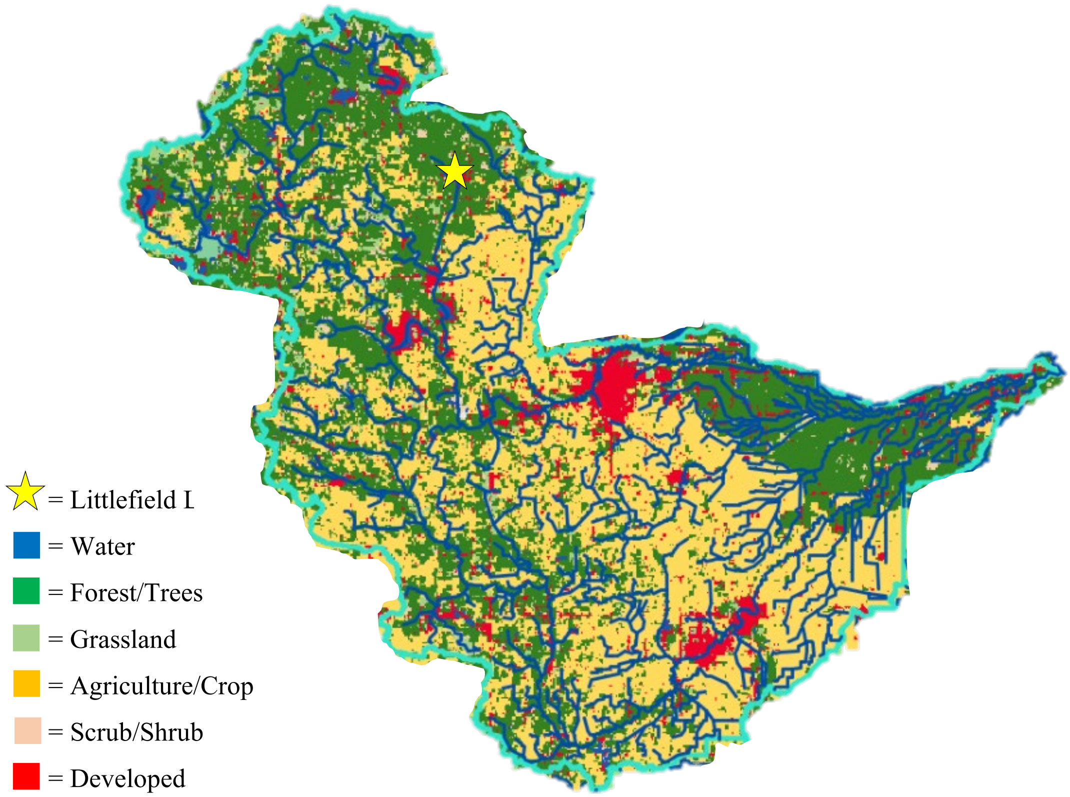
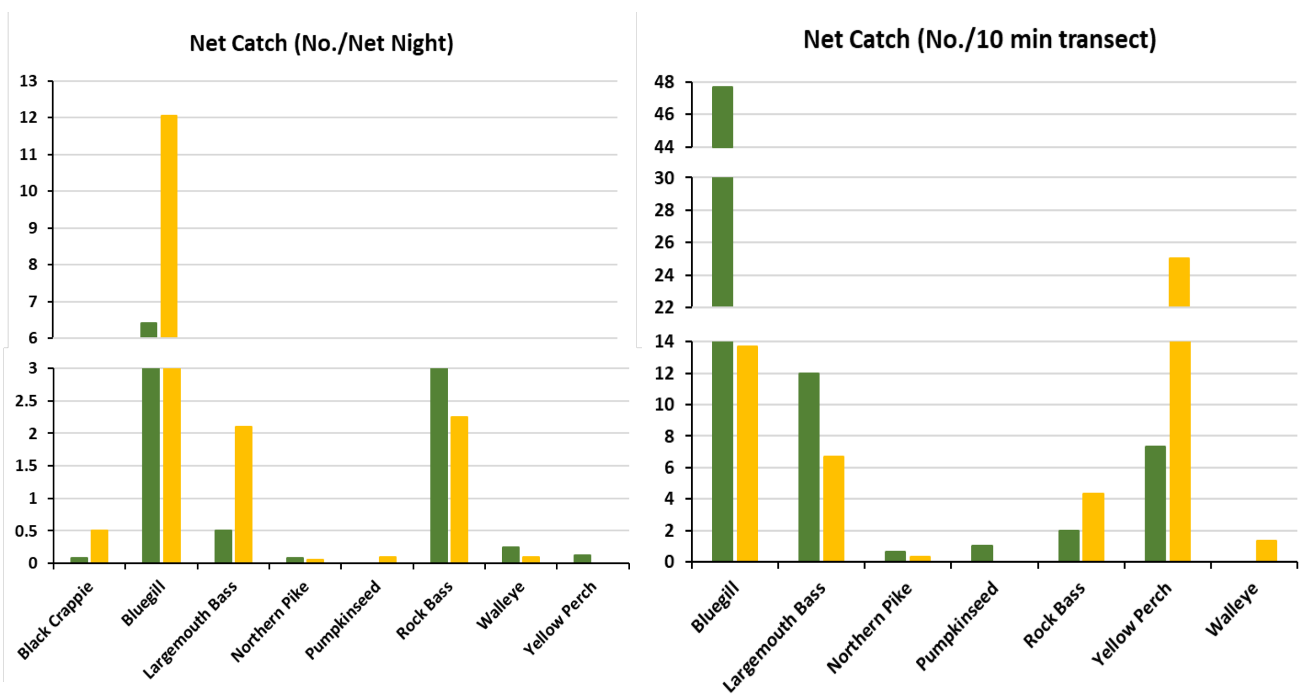


Figure 5. Comparison of the 2008 (green) and 2021 (gold) Status and Trends catch shown as the catch per unit effort by trap type. Seine catches were excluded because only one sport fish was caught for one year. Note the change of scale in the Y-axis.



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