Cub Lake

Hillsdale, T7S/R3W/Sec. 34
St. Joseph of the Maumee, 2021

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Environment

The Cub Lake chain of lakes is located in south-central Hillsdale County, approximately six miles south of the city of Hillsdale. Cub Lake is part of this naturally occurring chain of lakes, which also includes Cambria and Reed lakes upstream, and Rubles Lake downstream. Cub Lake, which is the main and largest basin, is 69 acres in size and the entire chain of lakes covers 122 acres (Figure 1). The water source is mainly from springs and the outlet from Rubles Lake eventually flows into the St. Joseph of the Maumee River system to the south. Basin substrates of Cambria, Reed, and Cub lakes are similar. These basins are largely composed of a mixture of marl, pulpy peat, fibrous peat, and sand. However, marl and sand are the most common substrate types in shallow water areas. The basin of Rubles Lake is almost entirely fibrous peat.

The surficial geology of the surrounding area is glacial outwash sand, gravel, and end moraines of coarse-textured till. These soil types are well drained and allows good movement of groundwater. The land cover for the surrounding watershed area of Cub Lake is mostly agricultural (43%) with some forest (24%), wetland (21%), urban development (8%), and other small waterbodies (2%) (Fry et al. 2011) (Figure 2). The perimeter of the Cub Lake chain totals 3.5 miles with a network catchment area (lake watershed) of 596 acres (Figure 3). Cub and Cambria lakes reach depths of roughly 43 feet. All lakes combined hold a water volume of 1,775 acre-feet and 48% of this volume is 10 feet deep or less.

Rubles Lake is much shallower and has a much greater abundance of aquatic plants compared to the other lakes in this system. The aquatic vegetation community is healthy, with a total of 26 different aquatic plant species throughout the entire lake chain (EGLE 2022 - unpublished data). The most abundant species include white waterlily, Chara sp., various leaf milfoil, yellow waterlily, starry stonewort, large-leaf pondweed, Eurasian watermilfoil, whorled watermilfoil, sago pondweed, and bladderwort.

Water temperature and dissolved oxygen profiles were collected in both Cub Lake and Cambria Lake in summer of 2022 and 2021, (Figures 4 & 5) respectively. Each profile was collected in the deepest portion of the basin, intended to identify the stratification zones established throughout the water column along with the associated temperatures and dissolved oxygen levels. Lake stratification occurs where the water density gradient, caused by warming of the upper waters, is large enough that it prevents wind currents from mixing waters throughout the water column (Wehrly et al. 2015). The epilimnion is the upper layer of warm water that is well mixed with uniform temperature and dissolved oxygen levels. The epilimnion in Cub Lake reached a depth of 9 feet. The metalimnion, the middle layer of cool water in which the temperature changes rapidly with depths, occurred at depths of 10 to 31 feet in Cub Lake with the thermocline at 18 feet. The hypolimnion is the bottom layer of cold water where the temperature decreases slowly with depth, and in Cub Lake it occurred at a depth of 38 feet. Most fish species found in Michigan require dissolved oxygen levels of 3.0 mg/L or higher for suitable habitat (Schneider 2002). There were suitable dissolved oxygen levels in Cub Lake as they stayed above 3.0 mg/L down to 19 feet.

Water temperature and dissolved oxygen profiles in Cambria Lake yielded an epilimnion depth of 7 feet, the metalimnion occurred at 9 to 29 feet with the thermocline at 18 feet, and the hypolimnion began at a depth of 32 feet. Similar to Cub Lake, dissolved oxygen levels in Cambria Lake were unsuitable in deeper waters, as in most of the metalimnion the dissolved oxygen dropped below 3.0 mg/L at around 16 feet deep. Fish kills have not been reported to Michigan DNR Fisheries Division for Cub Lake until the first time in mid-April of 2023 when a small-scale mortality event impacting bass, bluegill, and yellow perch occurred.

Specific conductivity and pH were also measured throughout the entire water column. Conductivity measurements in the Cub Lake basin ranged from 406 to 472 microsiemens/cm and pH ranged from 9.9 to 8.3, respectively. Whereas conductivity measurements in the Cambria Lake basin ranged from 354 to 415 microsiemens/cm and pH ranged from 9.7 to 8.1, respectively. Secchi depth readings ranged from 14 to 17 feet in each of the lake basins. Water chemistry results were also collected on 8/29/2022 as part of the Status and Trends Inland Lakes Sampling Program. Cub Lake results were as follows: Total alkalinity 20 mg/L; Chlorophyll a 0.0002 ug/L; Total Kjeldahl nitrogen 0.3 mg/L; Nitrogen, ammonia 0.04 mg/L; Nitrogen, nitrate + nitrite 0.005 mg/L; Total phosphorus 0.003 mg/L.

Only 1% of the lakes' shorelines are armored with vertical walls or artificial rip-rap. About one-third of the shorelines of Reed, Cub, and Rubles Lakes are developed with both permanent homes and summer cottages and only a few homes are found on the shores of Cambria Lake. A total of 61 dwellings, 62 small docks, and 9 large docks exist around the entire lake chain shoreline with a total of 68 submerged trees observed. The Michigan Department of Natural Resources (DNR) owns and manages a Boating Access Site (BAS), which is located on the lake's main basin at the northeast end. The ramp and parking lot consists of paved concrete, 10 parking spaces, a public toilet, and one pier.

History

Survey efforts conducted by Fisheries Division occurred throughout the entire chain of lakes which will hereafter be referred to as Cub Lake. Bluegills, largemouth bass, and yellow perch were stocked in Cub Lake from the late 1930's to the mid-1940's. This common practice was discontinued after research showed that it was unnecessary to stock these species because they all reproduce naturally and effectively in most Michigan lakes. Cub Lake was first surveyed with a boomshocker (i.e., boat electrofishing) in June of 1966. Bluegills were the most abundant species captured and they ranged in size from 1-9 inches. Gamefish species caught during this survey included pumpkinseed sunfish, yellow perch, bullhead, northern pike, and black crappie. Sixty-three largemouth bass were also captured ranging in size from 5-21 inches. Additionally, several large bass, pike, and bowfin were observed but not captured. Fish scales were used to determine growth. Bluegill, crappie, pumpkinseed sunfish, and yellow perch exhibited growth rates that were slightly above state averages. Largemouth bass exhibited growth rates somewhat below the state average but were not considered to be stunted.

A July 1978 boomshocker survey of Cub Lake resulted in the capture of relatively few fish. However, 75 largemouth bass were captured, and they comprised nearly 40% of the total catch by number. Only 39 bluegills were caught and they ranged in size from 3-7 inches. Bluegill growth rates were nearly one-inch below the state average. Pumpkinseed sunfish and largemouth bass exhibited growth rates that were slightly below average.

A fish community survey was conducted on Cub Lake using trap nets, gill nets, and a boomshocker in June of 1984. Over 100 bluegills were collected with trap nets, averaging nearly 7 inches. The boomshocker was the most effective gear used and resulted in the capture of 279 fish. A high number of small bluegills were caught indicating good recruitment of this species. For most species, growth rates were only slightly below average. While largemouth bass exhibited growth rates that were nearly 2 inches below the state average.

A fish community survey using trap and gill nets of Cub Lake in July of 1988 resulted in the capture of 113 bluegills averaging 7.4 inches. Over 90% of the catch was over 6 inches or what anglers consider large enough to harvest. Growth rates of bluegills had improved somewhat since the previous survey. Few other fish species were caught during this survey, which may be attributable to the time of year when it was conducted (Table 1). Because of Cub Lake's marl basin and clear water, redear sunfish fingerlings were stocked in 1985 (Table 2). However, the July 1988 survey resulted in the capture of only seven redear sunfish.

Redear sunfish fingerlings were stocked again in 1989 and the fishery was evaluated by conducting a fish community survey with trap and gill nets in the spring of 1993. This survey resulted in the capture of 195 redear sunfish averaging 7.4 inches with growth rates 0.3 inches below the state average. Scale analysis confirmed that significant natural reproduction of redear had occurred in the Cub Lake chain. Nearly 300 bluegills were also collected in trap nets, and they averaged 7.4 inches. Bluegills exhibited growth rates that were 0.5 inches above the state average. Twenty-seven yellow perch averaging 8.7 inches were caught in gill nets and they also exhibited above average growth rates. Nearly all these perch were over 7 inches or what anglers consider to be "keeper" size. Because of angler concerns about poor crappie fishing, approximately 400 black crappie adults averaging 5 inches were transferred to Cub Lake from Lake Hudson (Lenawee County) in 1991.

A fish community survey was conducted using trap and gill nets in 1997 which resulted in the capture of 61 redear sunfish ranging in size from 5 to 10 inches and representing seven age groups. Although redear had successfully naturally reproduced in this lake, they were somewhat slow growing. The largest redear exhibited the slowest growth rates. This may have been directly related to low densities of snails in the lake, which are the preferred food of redear adults. Even though redear were growing slightly below (0.8 in.) the state average, they appeared healthy and in excellent condition. Bluegills were the most abundant fish species caught with trap nets. From a sample of 117 fish, bluegills averaged 8 inches and over 90% of them were of acceptable size to anglers. Bluegills exhibited growth rates that were 0.5 inches above the state average and are identical to bluegill growth rates observed in 1993. Bluegills are targeted for sampling in inland lakes because of their role in determining fish community structure and overall sportfishing quality (Schneider 1981). A ranking system was developed in 1990 that allows fish managers to get an idea of the relative quality of a lake's bluegill population. On a scale of 1 to 7 (Schneider 1990), the quality of the bluegill population in Cub Lake based on the 1997 trap net catch was calculated as 6.75 or near "superior". Black crappie abundance has always been low in Cub Lake. Although few (17) black crappies were captured, they averaged 10.1 inches and exhibited growth rates at 1.8 inches above the state average. The yellow perch population in Cub Lake appeared impressive. Eighty perch averaging nearly 10 inches were caught in trap and gill nets. Eight consecutive year-classes (ages-3 through 10) of perch were represented in the sample and perch exhibited growth rates that were 1.5 inches above the state average.

Current Status

A fish community survey was conducted on Cub Lake in May of 2021 as part of the random lake sampling for the Status and Trends Program (Wehrly et al. in press). Gears were set throughout the lake chain as it is a very connected and open system. A variety of sampling gears were used, including three large-mesh fyke nets, two small-mesh fyke nets, two experimental gill nets, a 25-foot seine, and an electrofishing boat. During the week of May 17, 2021, both types of fyke nets and experimental gill nets were deployed, with large-mesh fyke nets and experimental gill nets set for three net nights and small-mesh fyke nets two net nights. On May 18, 2021, three seine hauls were conducted during the daylight hours and three electrofishing transects were conducted after dark for 10 minutes each. The objective of the survey was to evaluate the current status of the fish community and future management needs for the fishery.

All sampling gears combined captured 7,345 fish, representing 22 different species (Table 3). A huge school of mimic shiners were caught in the small-mesh fyke nets, which represented 74% of the total catch by number. Panfish (redear sunfish, bluegill, warmouth, yellow perch, hybrid sunfish, black crappie, and pumpkinseed) composed 18% of the total catch by number (69% if excluding mimic shiners from the catch). Large predators (largemouth bass, bowfin, and northern pike) composed approximately 1% of the total catch by number (3% if excluding mimic shiners from the catch). Various forage species (blacknose shiner, brown bullhead, blackchin shiner, blackstripe topminnow, lake chubsucker, yellow bullhead, grass pickerel, golden redhorse, Iowa darter, sand shiner, and tadpole madtom) made up approximately 7% of the total catch by number (27% if excluding mimic shiners from the catch).

Excluding the abnormally high catch numbers of mimic shiner, redear sunfish were the most abundant species overall, comprising 36% of the catch by number (Table 3). Redear sunfish ranged from 1 to 10 inches and averaged 7.2 inches overall, with 86% larger than six inches (Table 4). Redear sunfish ages ranged from 1 to 11 years old and 62% were 4 to 11 years old, which is the age where the average size is 6 inches or greater (Table 5). The mean growth index (MGI) for redear sunfish was -1.6, suggesting the growth rate for redear sunfish is below average for populations around the state. The catch per unit effort (CPE) of redear sunfish in large-mesh fyke nets was 62.2 fish per net night and 17.5 fish per net night in small-mesh fyke nets (Table 6).

Continuing to exclude the high catch numbers of mimic shiner, bluegill were the second most abundant species overall, comprising 27% of the catch by number (Table 3). Bluegill length ranged from 1 to 10 inches and averaged 4.6 inches overall, with 41% larger than six inches (Table 4). Bluegill ages ranged from 1 to 11 years old and 64% were 4 to 11 years old, which is the age range where average size is 6 inches or greater (Table 5). The MGI for bluegill was +0.2, suggesting the growth rate for bluegill is slightly above average compared to populations around the state. The catch per unit effort (CPE) of bluegill in large-mesh fyke nets was 20.3 fish per net night and 48.3 fish per net night in small-mesh fyke nets (Table 6).

One way to classify the quality of a bluegill population is to use Schneider's Index (Schneider 1990), which provides a relative measure of the quality of bluegill size in a lake. It is based on a relative scale from one to seven, with seven being the best. Metrics used in the index include catch data from specific gear types (e.g. large-mesh fyke nets) and the MGI. The average size bluegill caught in large-mesh fyke nets was 8.1 inches and 99% were larger than six inches, 95% were seven inches or larger and 58%

exceeded 8 inches. The Schneider Index (Schneider 1990) for Cub Lake was 6.4, indicating the bluegill size structure is "Excellent".

Largemouth bass made up 3% of the overall catch by number (when excluding mimic shiner catch). Largemouth bass ranged in size from 3 to 20 inches, averaging 8.8 inches (Table 3). Of the 56 largemouth bass captured, only one fish was larger than the 14-inch minimum size limit (MSL) (Table 4). Largemouth bass captured ranged from 1 to 11 years old, with 70% being between 2 to 4 years old (Table 5). The MGI for largemouth bass was -1.2 suggesting they are growing slightly below the state average (Table 5). Representation from all year classes existed from ages 1 through 7, with ages 8 through 10 missing, indicating consistent recruitment to the population, with a lack of older individuals.

Other abundant panfish included brown bullhead and warmouth, which were the fifth and eighth (respectively) most abundant species captured overall (Table 3). Brown bullhead ranged in size from 7 to 12 inches, with an average length of 9.7 inches (Table 3). Warmouth ranged in size from 2 to 7 inches, with an average length of 5.4 inches. Other panfish including yellow perch, hybrid sunfish, black crappie, and pumpkinseed were caught in low numbers (Table 3).

A highly diverse and abundant group of forage species were caught during the fish community survey, with mimic shiners being the most abundant and ranging in size from 1 to 2 inches. Blacknose shiners were the fourth most abundant species caught in the survey ranging in size from 1 to 5 inches, with an average size of 2.2 inches (Table 3). Blackchin shiners were the sixth most abundant species caught and is another small-bodied species that ranged from 1 to 2 inches (Table 3).

Analysis and Discussion

Cub Lake continues to support a diverse fish community and quality fishery. During the 2021 survey there were 22 fish species observed, including one non-native fish (redear sunfish). Twenty-two species is above average for lakes in LEMU (18 species) and greater than that of the state median (14 species) found through the status and trends program (Wehrly et al. 2015). Eighty-five percent of the fish species historically found in Cub Lake were observed during this survey and it is likely the remaining 15% of species that were not re-collected in 2021 (golden shiner, green sunfish, longear sunfish, and white sucker) continue to persist (Table 1). Seven additional fish species were added to the list of species occurring in Cub Lake after implementing this standardized sampling program. The predator and prey ratios appear to be in good balance with a high number and diversity of forage species, excellent bluegill and redear sunfish size structure, and several predator species (e.g., largemouth bass, northern pike, black crappie, bowfin, brown bullhead, and yellow perch).

Cub Lake offers a quality panfish fishery with a variety of species for anglers to target. Redear sunfish and bluegill are the most dominant target species in Cub Lake, as evidenced by this survey. The relatively high catch rates and excellent size structure of both redear sunfish and bluegill, and the "Excellent" Schneider Index rating for bluegill, suggest Cub Lake supports an extremely high-quality redear sunfish and bluegill fishery. The statewide regulations appear to be sufficient to keep these populations at sustainable levels, as it has been over the years. The bluegill population has been extremely stable throughout the last few decades when comparing relative abundance, growth, and Schneider Index values from previous surveys, with only slight variability in those metrics. Longevity and survival of redear sunfish and bluegill were exceptional in Cub Lake with both species living up to 11 years of age.

Total annual mortality estimates from the current survey for both redear sunfish and bluegill were assessed using a catch curve regression analysis. Mortality estimate values of adult redear sunfish larger than 4-inch, and older than age-3 was 29%. Mortality estimate values of adult bluegill larger than 4-inch, and older than age-4 was 30%. This level of mortality is very low when compared to eleven Michigan lakes having mortality values for bluegills ranging from 37% to 83%, with the lowest value from a lake with no angler harvest (Schneider 1999).

The redear sunfish population continues to persist with successful recruitment each year. Although statewide growth comparisons indicate that redear sunfish in the Cub Lake chain, are 1.6 inches below the average index value, they appeared to be healthy and in excellent condition. A Master Angler redear sunfish was even documented in 2010 at 10.1 inches, which is somewhat expected after observing seven redear sunfish over ten inches during the current fisheries survey. There was an apparent shift from bluegills to redear becoming the dominant species collected in sampling gears based on total catch numbers throughout the years after redear sunfish were stocked. We also caught a higher proportion of young/small bluegills compared to a higher proportion adults/larger redear sunfish during the current survey (Table 4). Additionally, while it may appear that CPE or relative abundance of redear sunfish is much higher than CPE of bluegill (Table 6) in the Cub Lake chain for statewide and regional median values, not all lakes have been stocked with redear sunfish, therefore the CPE values regionally and statewide for redear sunfish are naturally much lower.

Brown bullhead, warmouth, yellow perch, hybrid sunfish, black crappie, and pumpkinseed also contribute to the quality panfish fishery. While bullheads and warmouth are not typically targeted by anglers, their overall abundance was relatively high. Yellow perch catch rates were above the statewide and regional average for large mesh fyke nets and there were also a fair number of individuals at harvestable sizes. While it is likely attributed to differences in sampling methods such as gears used and overall effort, the yellow perch population has appeared to decline slightly in Cub Lake based on average growth values, total catch, and year classes present from the 1997 survey to the current survey. Black crappies have always been observed at relatively low levels, but statewide growth rates were slightly above average. There were also two Master Angler size crappies caught (1994 and 2020) at 15 and 14 inches, respectively.

Largemouth bass are part of another popular fishery found in Cub Lake. They were the seventh most abundant species caught in Cub Lake during this survey and their relative density was higher than the statewide 75th percentile using electrofishing gear. However, only one legal-sized largemouth bass was caught during the survey. Slow growth in largemouth bass observed in Cub Lake is not uncommon in southeast Michigan lakes. Even though largemouth bass are growing slowly, longer-lived individuals can attain large sizes as evidenced by fish reaching 20.5 inches. Tournament fishing on Cub Lake is very low, with only two registered bass tournaments since 2013. The low competitive interest could be due to the relatively remote location, boat launch size, and smaller size structure of bass in Cub Lake. There was only one northern pike captured during this survey that measured at a healthy 33 inches and was aged as a 10-year-old fish. Low catch numbers of northern pike are typically expected during these fish community surveys because the timing of sampling occurs well beyond their spawning period, when they are occupying deeper waters.

Cub Lake has a substantial amount of natural undeveloped areas, a high diversity and abundance of aquatic vegetation, and deep-water areas that continues to support good water quality and habitat in the

nearshore and offshore zones. When compared regionally, the 17 dwellings/mile and 20 docks/mile found on Cub Lake is much lower than the Lake Erie Management Unit (LEMU) averages of 36 dwellings/mile and 39 docks/mile. This low development is also the reason for above average numbers of submersed trees (19 trees/mile) as large woody habitat, compared to the LEMU average (14 trees/mile). O'Neal and Soulliere (2006) reported that alterations or development of the shoreline that is higher than 25% can have detrimental effects on a lake's nearshore ecosystem through habitat degradation and loss of woody material. A large area of natural shoreline, including wetland complexes that are beneficial for the aquatic community remains and those natural shorelines should be protected from development such as shoreline armoring and dredging.

Management Direction

Historically and even recently, anglers have reported good catches of large bluegills and yellow perch from Cub Lake. The past stocking of redear has added an additional element of trophy panfish to the fishery in this chain of lakes. Anglers have reported catching numerous big redear and seemed very pleased with the management efforts. Age analyses of bluegill and redear showed that consistent natural reproduction is occurring in the Cub Lake chain. Eleven consecutive year classes of both species currently exist in Cub Lake (Table 5). Cub Lake provides a quality fishery for many species, which is likely due to the large remaining areas of natural shoreline, abundance and diversity of aquatic vegetation, and relatively lower angler effort. While the redear sunfish stocking program has had great success, we do not recommend any future stocking efforts in Cub Lake in order to sustain the excellent fishery that continues to persist.

Efforts to protect the remaining natural shoreline around Cub Lake that benefits many fish species and other wildlife should be prioritized. When the opportunity exists, riparian owners on this lake should be made aware of the variety of shoreline protection techniques that use softening options, such as coir logs and native plantings, that have fewer negative impacts to the aquatic ecosystem compared to hard armoring. We recommended that a representative of the Cub Lake Homeowners Association enrolls in the MiCorps - Cooperative Lakes Monitoring Program https://micorps.net/lake-monitoring/. The primary purpose of this cooperative program is to help citizen volunteers monitor indicators of water quality in their lake and document changes in lake quality over time.

Zebra mussels were observed in Cub Lake in 2012 by landowners who alerted MDNR Fish Division. A low number of zebra mussels were also observed on our fisheries sampling gear during the current survey. Eurasian watermilfoil was noted to be common during a 1997 fisheries survey and persists in low abundance as of 2021. In addition, an aquatic vegetation survey conducted by EGLE in 2022 also documented two other non-native plant species (e.g., starry stonewort and curly-leaf pondweed) in low abundance. Only one Aquatic Nuisance Control pesticide treatment permit has been issued by DEQ/EGLE in the year 1997 and for a single property. Mechanical removal of nuisance aquatic plants has never been conducted on Cub Lake. While there have been no large-scale, long-term treatments of nuisance aquatic plants, the spread and density of aquatic invasive plant species has been relatively limited both spatially and temporally. Education campaigns and signage at the boat ramp to encourage "Clean, Drain, Dry, Dispose" can help reduce risks of further introductions of non-native species. Efforts are currently underway to provide and post this type of signage at the boating access site. Landowners in the watershed should consider best management practices such as restricting fertilizer applications with phosphorus ingredients, thus reducing subsequent runoff and nutrient input into the lake to maintain water quality and limit excess plant and algae growth.

References

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Table 1. History of fish species detected from several survey years since 1984 in Cub Lake. All surveys were general fish community sampling efforts using a variety of gear types as indicated.

	Survey year and sampling gears used				
	1984	1988	1993	1997	2021
	Trap net, gill net, boat electrofishing	Trap net, gill net	Trap net, gill net	Trap net, gill net	Large-mesh fyke, small-mesh fyke, gill net, seine, boat electrofishing
Fish species					
Black Crappie	x		x	x	x
Blackchin Shiner	x				x
Blacknose Shiner					x
Blackstripe Topminnow					x
Bluegill	x	x	x	x	x
Bowfin	x	x	x	x	x
Brown Bullhead	x	x	x	x	x
Golden Redhorse					x
Golden Shiner		x	x	x	
Grass Pickerel	x				x
Green Sunfish				x	
Hybrid Sunfish			x	x	x
Iowa Darter					x
Lake Chubsucker	x	x	x	x	x
Largemouth Bass	x	x	x	x	x
Longear sunfish	x				
Mimic Shiner					x
Northern Pike	x	x	x	x	x
Pumpkinseed	x	x	x	x	x
Redear Sunfish		x	x	x	x
Sand Shiner					x
Tadpole Madtom					x
Warmouth	x	x	x	x	x
White Sucker	x			x	
Yellow Bullhead	x	x	x	x	x
Yellow Perch	x	x	x	x	x

Table 2. Fish stocking records for Cub Lake from 1979 through 2021 completed by the Michigan DNR Fisheries Division.

Species	Year	Number	Average length
Redear sunfish	1985	13,200	1.8
Redear sunfish	1989	5,085	1.3
Black crappie	1991	400	5.0

Table 3. Species catch summary of fish collected with all gear types (large-mesh fyke nets, small-mesh fyke nets, gill nets, 25-foot seine, and boat electrofishing) combined during the Cub Lake fisheries fishery survey, May 17th, 2021.

Species	Number	Percent by number	Length range (in.)	Average length (in.)
Mimic Shiner	5466	74.4	1 - 2	2
Redear Sunfish	681	9.3	1 - 10	7.2
Bluegill	516	7	0 - 10	4.6
Blacknose Shiner	273	3.7	1 - 5	2.2
Brown Bullhead	91	1.2	7 - 12	9.7
Blackchin Shiner	85	1.2	1 - 2	2
Largemouth Bass	56	0.8	3 - 20	8.8
Warmouth	41	0.6	2 - 7	5.4
Blackstripe Topminnow	30	0.4	1 - 2	2.1
Yellow Perch	27	0.4	3 - 10	7.6
Hybrid Sunfish	25	0.3	7 - 9	8.3
Black Crappie	14	0.2	7 - 11	9.4
Lake Chubsucker	13	0.2	5 - 9	7.5
Yellow Bullhead	9	0.1	7 - 10	9.3
Pumpkinseed	5	0.1	2 - 5	3.9
Grass Pickerel	3	< 0.1	6 - 10	8.2
Bowfin	2	< 0.1	15 - 27	21.5
Golden Redhorse	2	< 0.1	16 - 18	17.5
Iowa Darter	2	< 0.1	1	1.5
Sand Shiner	2	< 0.1	2	2.5
Northern Pike	1	< 0.1	33	33.5
Tadpole Madtom	1	< 0.1	2	2.5
TOTAL	7,345			

Table 4. Number per inch group of select species collected with all gears combined from the Cub Lake fisheries survey, May 2021.

Inch group	Redear sunfish	Bluegill	Largemouth bass	Yellow perch	Black crappie	Pumpkinseed sunfish	Northern pike
0		3					
1	25	187					
2	36	57				1	
3	3	29	5	1		2	
4	13	19	1	1		1	
5	16	9	7	1		1	
6	100	12	5	6			
7	250	85	3	7	2		
8	183	101	9	6	3		
9	48	13	3	4	5		
10	7	1	8	1	3		
11			6		1		
12			7				
13			1				
20			1				
33							1
TOTAL	681	516	56	27	14	5	1

Table 5. Weighted mean length and age composition of select species collected during the fisheries survey of Cub Lake, May 2021.

Species	Age	Number aged	Length range (in.)	State avg. length (in.)	Weighted mean length (in.)	MGI*
Redear sunfish	I	17	1.4-2.2	1.9	1.88	-1.6
	II	6	2.0-3.3	4.4	2.56	
	III	12	4.2-5.1	6.2	4.65	
	IV	12	4.4-6.6	7.6	6.08	
	V	10	5.3-8.1	8.7	7.18	
	VI	14	6.9-9.2	9.6	7.78	
	VII	10	7.9-9.2	10.3	8.5	
	VIII	5	9.0-10.5	10.8	9.43	
	IX	3	9.6-10.1	--	9.69	
	X	1	10.0	--	10	
	XI	1	10.3	--	10.3	
Bluegill	I	19	1.5-2.6	1.8	1.9	+0.2
	II	9	3.0-3.8	3.8	3.27	
	III	17	3.1-6.3	5.0	4.54	
	IV	12	4.3-7.0	5.9	6.32	
	V	3	7.3-7.6	6.7	7.47	
	VI	7	7.7-8.6	7.3	7.95	
	VII	7	8.2-8.7	7.8	8.47	
	VIII	5	7.8-9.2	8.2	8.51	
	IX	5	9.1-9.2	8.6	9.14	
	X	3	9.1-9.4	8.9	9.23	
	XI	1	10.3	--	10.3	
Largemouth bass	I	4	3.1-4.5	4.2	3.61	-1.2
	II	12	5.2-7.5	7.1	6.05	
	III	12	7.4-10.1	9.4	8.52	
	IV	14	8.4-11.9	11.6	10.53	
	V	5	10.3-12.3	13.2	11.72	
	VI	4	10.3-12.7	14.7	11.88	
	VII	2	12.8-13.9	16.3	13.35	
	XI	1	20.5	--	20.50	
Yellow perch	III	2	7.4-7.9	6.5	7.65	-0.4
	IV	5	6.1-7.9	7.5	6.8	
	V	6	6.4-9.2	8.5	8.09	
	VI	5	8.7-10.4	9.4	9.33	

Table 5 (continued). Weighted mean length and age composition of select species collected during the fisheries survey of Cub Lake, May 2021.

	III	2	7.1-7.2	7.5	7.15	+0.7
	IV	6	8.8-9.8	8.6	9.25	
Black crappie	V	2	10.0-10.2	9.4	10.1	
	VI	1	10.2	10.2	10.2	
	VIII	1	11.3	11.4	11.3	

*Mean growth index is the average deviation from the state average length at age.

Table 6. Comparison of catch-per-effort (CPE) for select species in Cub Lake (2021) along with statewide and Lake Erie Management Unit (LEMU) CPE generated from the Status and Trends Program (Wehrly et al. 2015). CPE for electrofishing is number of fish per minute. CPE for Large-mesh fyke, and small-mesh fyke is number of fish per lift.

Species	Gear	Statewide CPE			**Cub Lake 2021**	LEMU Median CPE
		25th percentile	Median	75th percentile		
Redear sunfish	Electrofishing	0.1	0.5	0.9	**1.7**	0.5
	Large-mesh fyke net	1.0	6.8	11.5	**62.2**	1.8
	Small-mesh fyke net	0.4	1.6	67.9	**17.5**	0.3
Bluegill	Electrofishing	1.2	3.9	7.6	**4.1**	8.4
	Large-mesh fyke net	2.5	11.7	31.9	**20.3**	21.8
	Small-mesh fyke net	2.3	8.5	36.5	**48.3**	25.5
Largemouth bass	Electrofishing	0.3	0.8	1.6	**1.7**	0.9
	Large-mesh fyke net	0.5	1.4	2.7	**0.6**	1.6
	Small-mesh fyke net	0.5	1	2.8	**0.3**	0.9
Yellow perch	Electrofishing	0.4	1.0	2.6	**0.3**	0.6
	Large-mesh fyke net	0.2	0.5	2.3	**1.0**	0.4
	Small-mesh fyke net	0.7	2.7	12.5	**0.0**	0.3
Black crappie	Electrofishing	0.0	0.1	0.2	**0.0**	0.1
	Large-mesh fyke net	0.5	2.2	4.3	**1.6**	2.4
	Small-mesh fyke net	0.5	1.1	3.0	**0.0**	0.29

Figure 1. Map of the Cub Lake chain of lakes, Hillsdale County with gear effort indicators for the fisheries survey conducted in May of 2021. The Michigan DNR Boating Access Site and depth (feet) information at various locations are also shown.

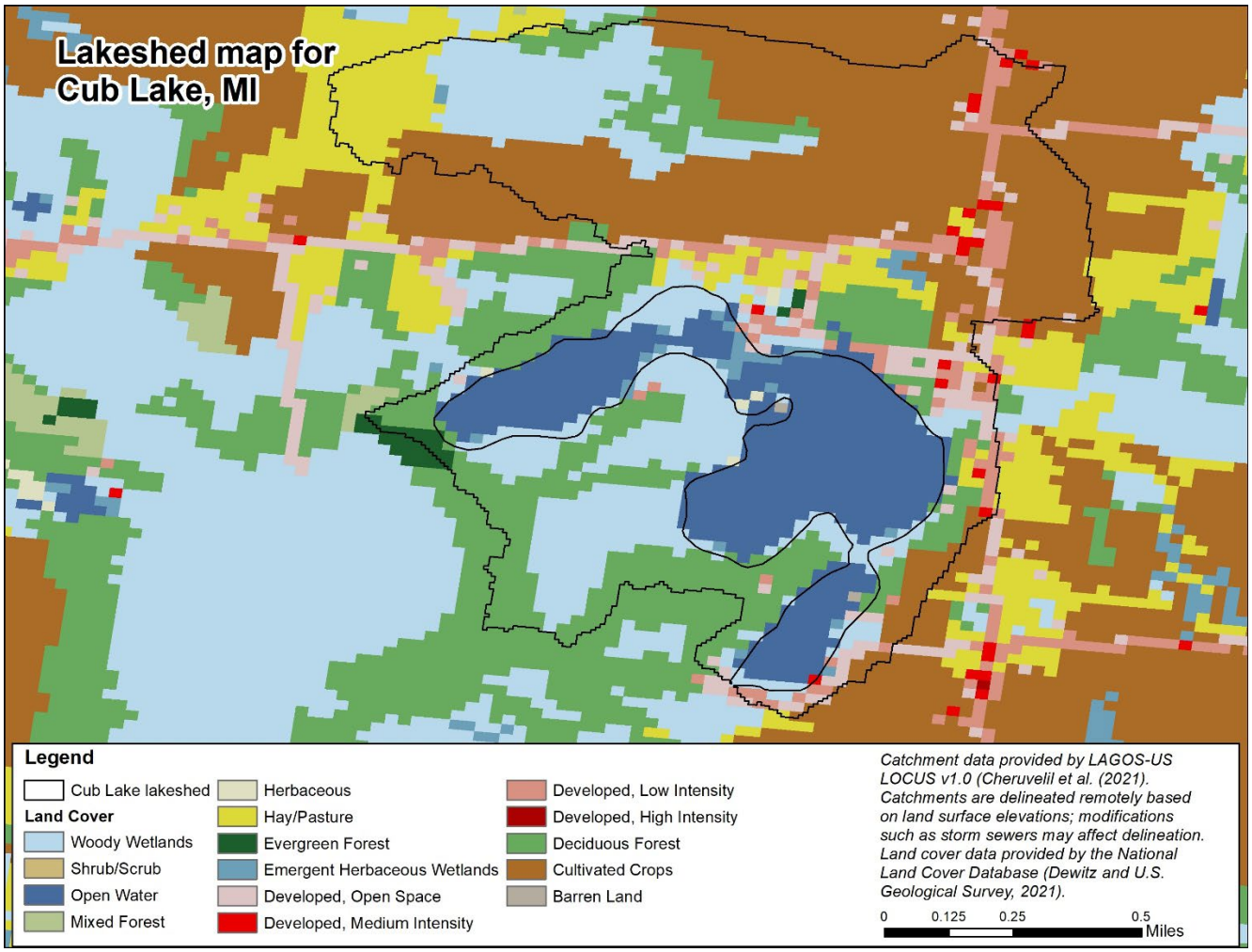

Figure 2. Lakeshed catchment (outer black line) and land cover map (colors) of Cub Lake, Hillsdale County.

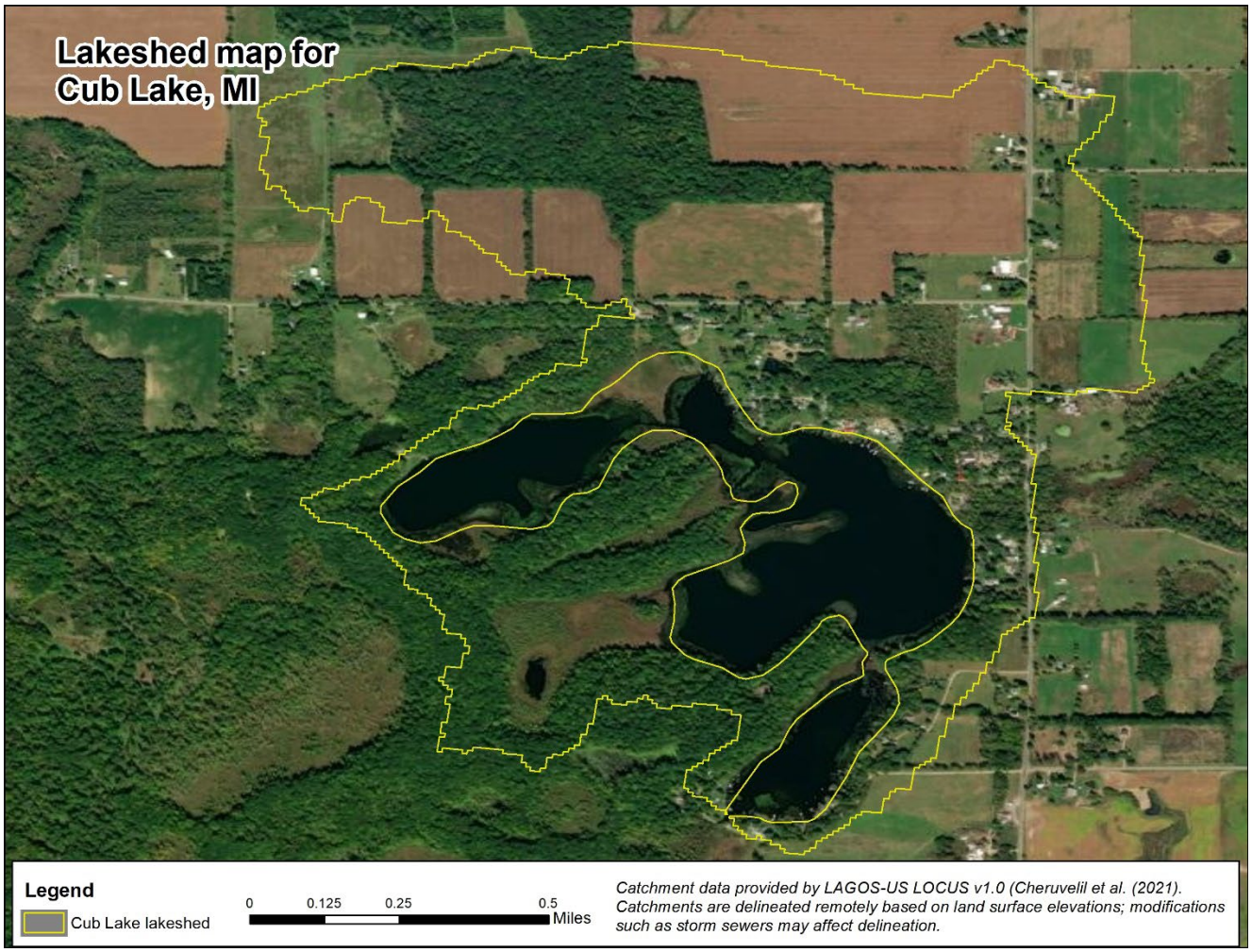

Figure 3. Lakeshed catchment (outer yellow line) and aerial satellite map of Cub Lake, Hillsdale County.

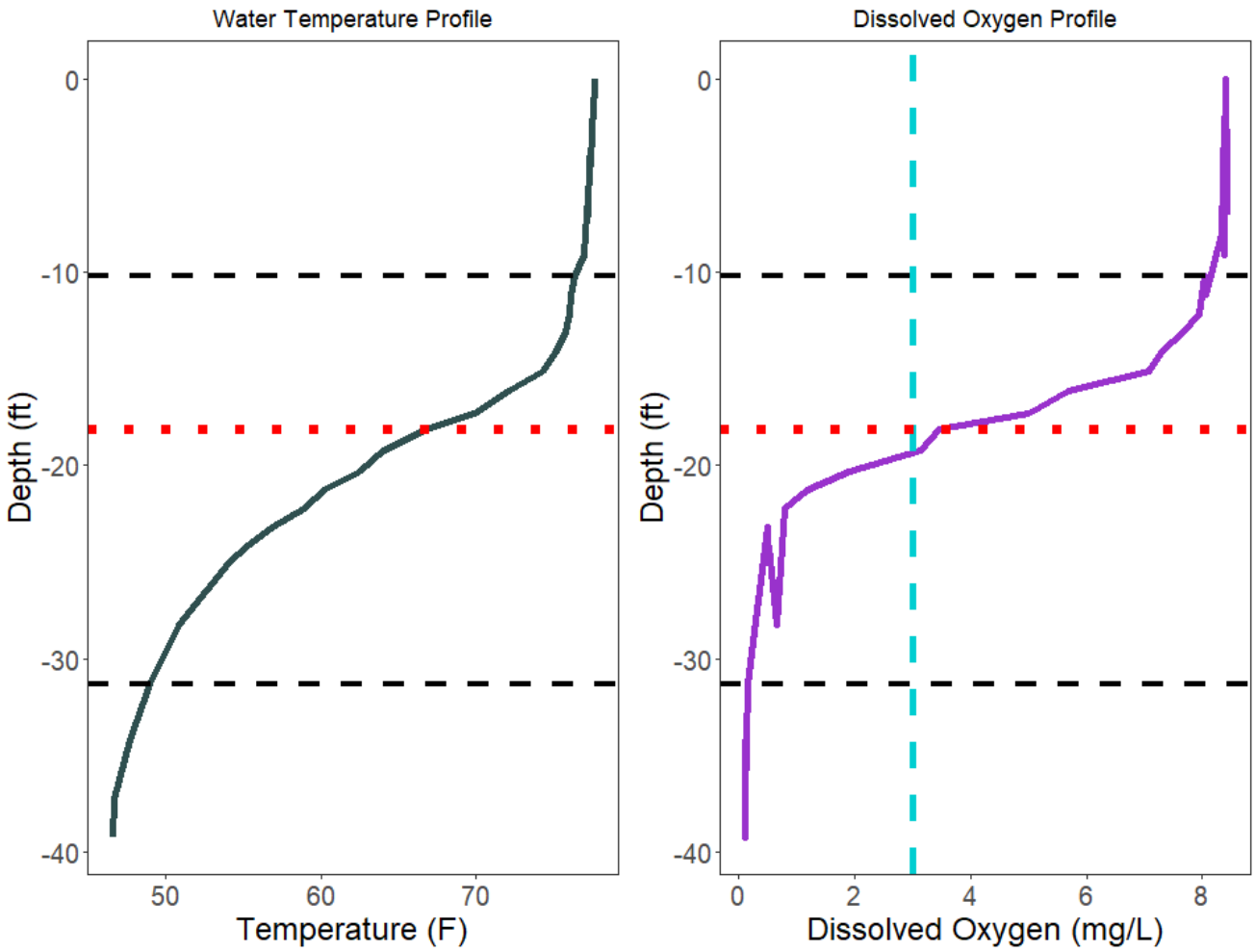

Figure 4. Water temperature and dissolved oxygen profiles collected in Cub Lake in summer of 2022. Readings were collected in the deepest portion of the basin.

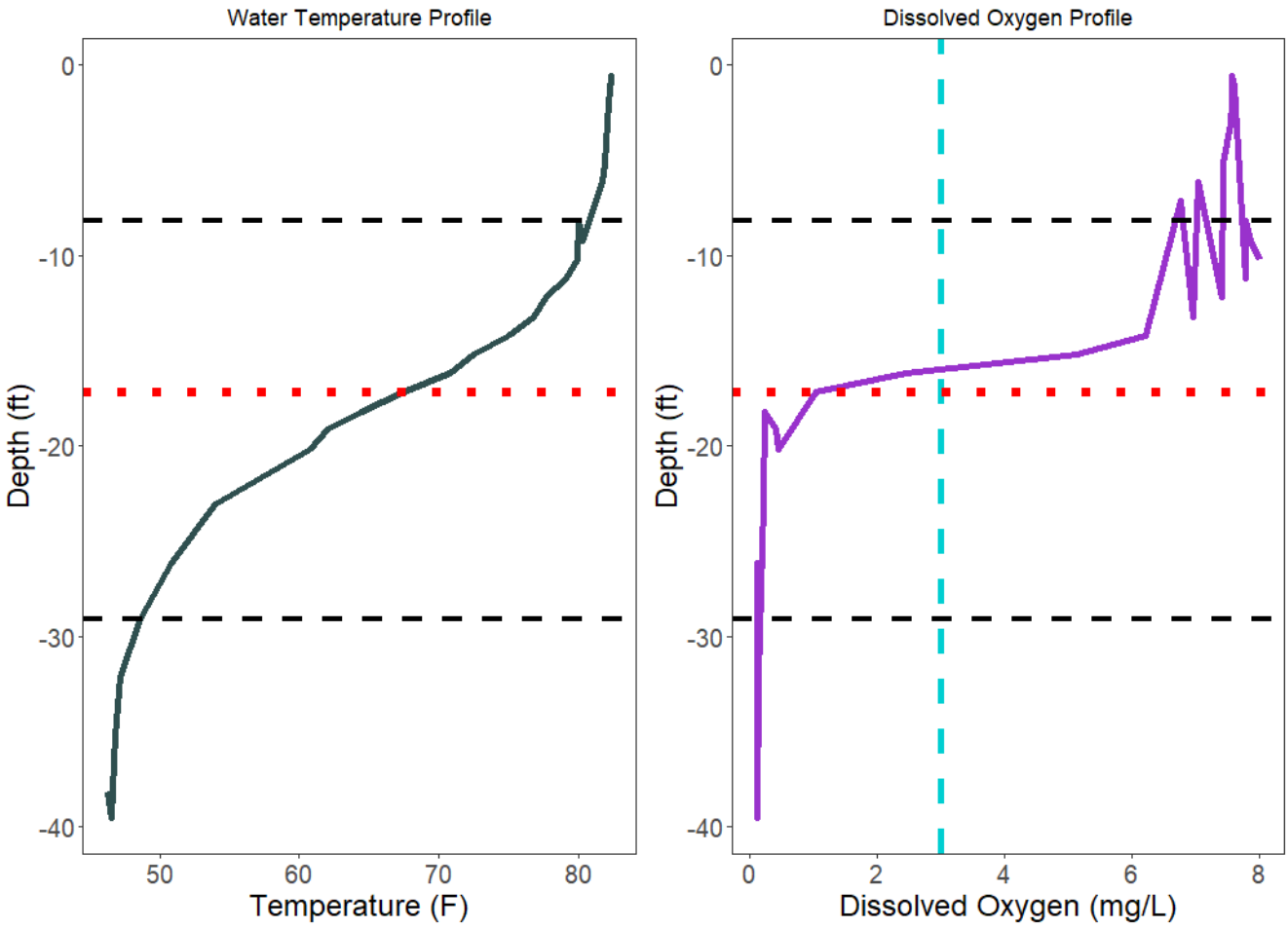

Figure 5. Water temperature and dissolved oxygen profiles collected in Cambria Lake in summer of 2021. Readings were collected in the deepest portion of the basin.

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