East and West Crooked Lakes
Livingston County, T02N/R05E/Sections 21, 22, 27, and 28
Huron River Watershed, Last Surveyed 2021
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Environment

East (Big) Crooked Lake is a 248-acre natural lake located in Genoa Township, two miles northwest of the City of Brighton in southeast Livingston County. It is connected to a second lake, West (Little) Crooked Lake (183 acres), by a wetland and open channel (navigable by small-medium boats) on the western side of the lake. A public boat access (42.542241 -83.840192) with a gravel ramp and parking for 8-10 cars with trailers is located in a channel on the southeast corner of East Crooked Lake that can be reached by a dirt road at the corner of Conrad and Challis roads.

East Crooked Lake has a maximum depth of about 40 feet with 45% of the lake area being 15 feet or deeper and a shoreline perimeter of 4.1 miles. There are some extensive shallows (<3 feet deep) with sand, rock, or marl bottom substrates. West Crooked Lake has a maximum depth of about 19 feet with most of the lake being less than five feet deep and a shoreline perimeter of 5.2 miles (Figure 1). The bottom is composed of marl, pulpy peat, fibrous peat, sand, and gravel substrates. There are four islands in the lake.

Surface topography and geology of Livingston County are glacial in origin; moraines and ground moraines are characteristic near the lakes. Lakes of the area have formed in depressions and are fed by spring and surface waters. Ground moraines exist northeasterly of the Crooked Lake system. Outwash and glacial channels along Chilson Creek probably serve as subsurface water paths for groundwater leaving the lake area. High ground in the area is a glacial moraine.

East and West Crooked lakes are situated near the surface water divide of the Huron River watershed. The mainstem Huron River is five miles south of the lakes. East Crooked Lake has a network catchment area of 2,207 acres (Figure 2). Land cover in the adjacent watershed is 51% urban, 19% wetland, 19% forest, 10% agriculture, and 1% or less of water, grass, and barren. West Crooked Lake has a network catchment area of 2,788 acres. Land cover in the adjacent watershed is 47% urban, 17% wetland, 17% forest, 8% agriculture, 10% water, and 1% or less of grass and barren (Figure 3). The total catchment area for both lakes is 4,995 acres (7.8 square miles).

Limnological sampling was conducted in both lakes on August 18, 2021. East Crooked Lake dissolved oxygen (D.O.) levels were 8.7 ppm at the surface and remained consistent through 12 feet, then slowly dropped down to 5.0 ppm at 16 feet. Below that depth, D.O. levels quickly dropped to <1 ppm by 17 feet (Figure 4). Water temperatures were 79 ˚F near the surface with a very slow decline down to 78 ˚F at 16 feet. Below that, the water temperature steadily dropped to 56 ˚F by 30 feet. Critical depth (i.e., D.O. less than 0.5 ppm) was at 18 feet, with the thermocline at 20 feet. West Crooked Lake dissolved oxygen levels were 8.4 ppm at the surface and remained above 8 ppm through 7 feet, then slowly dropped to 6.1 ppm at 12 feet. Below that depth, D.O. levels quickly declined to <1 ppm by 14 feet at the lake bottom. Water temperatures were 79 ˚F near the surface with a very slow decline down to 78 ˚F at 7 feet. Below that, the water temperature gradually dropped to 76 ˚F by 14 feet. Critical depth was at 14 feet, with no true thermocline present because of the shallow maximum depth (Figure 5).

Water quality and chemistry samples were also collected. East Crooked Lake values were as follows: total alkalinity 114 mg/L; chlorophyll *a* 2.93 ug/L; total Kjeldahl nitrogen 0.875 mg/L; nitrogen, ammonia 0.0738 mg/L; nitrogen, nitrate + nitrite <0.004 mg/L; total phosphorus 10.9 ug/L, and a

Secchi disk reading depth of 13.5 ft. Using Secchi depth, total phosphorus, and chlorophyll *a* to calculate a Carlson's Trophic State Index (TSI) resulted in a value of 39.8, indicating that East Crooked Lake is a mesotrophic, moderately nutrient-rich lake. West Crooked Lake values were as follows: total alkalinity 112 mg/L; chlorophyll a 14.33 ug/L; total Kjeldahl nitrogen 0.814 mg/L; nitrogen, ammonia 0.1366 mg/L; nitrogen, nitrate + nitrite <0.004 mg/L; total phosphorus 10.1 micrograms/L, and a Secchi disk reading depth of 10 ft. Using Secchi depth, total phosphorus, and chlorophyll *a* to calculate a Carlson's Trophic State Index (TSI) resulted in a value of 46.1, indicating that West Crooked Lake is also a mesotrophic, moderately nutrient-rich lake.

A point-intercept aquatic vegetation survey was conducted by a private lake management company on East Crooked Lake in September of 2017. Twenty-two different species were collected. The top six most abundant species, Chara, Starry Stonewort, Eurasian Watermilfoil, Water Lily, Illinois Pondweed, and Water Stargrass, comprised 78% of the total cumulative cover of aquatic vegetation within the lake. Chara and Starry Stonewort combined made up 41% of the existing plant cover.

Approximately 75% of the shoreline is developed with residences, but large expanses of natural shoreline and some emergent wetlands are still present which account for the remaining 25% of the shoreline. At the time of this survey, East Crooked Lake had a total of 90 small docks, 30 large docks, 113 dwellings, zero submerged trees near the shoreline, and an average of 44% of the shoreline was armored with vertical walls or rip-rap. West Crooked Lake had a total of 111 small docks, 20 large docks, 166 dwellings, three submerged trees near the shoreline, and an average of 50% of the shoreline was armored with vertical walls or rip-rap.

There is a water level control structure on the outlet of West Crooked Lake (Chilson Creek) that maintains the water level in both East and West Crooked lakes. This dam is privately owned by the Oak Point Condominium Association and is operated by an understanding with the Tri-Lakes Riparian Association. The dam was constructed in 1925 and water levels have been mandated by a court order since 1990 to maintain the winter level (939.75 feet). The order also stipulates that the change from winter level to summer level (940.66 feet) will occur at ice out each spring as is monitored by the Livingston County Drain Commission.

Fishery Resource

History

Bluegill and Largemouth Bass were stocked in West Crooked Lake in 1929 and 1930, and East Crooked Lake in 1945 (Table 1). East Crooked Lake's fish population has been surveyed by Fisheries Division several times in the recent past (1977, 1984, 1993, and 2000). Despite being naturally connected via a stream channel, no fish community surveys have been conducted by Michigan DNR on West Crooked Lake in more recent years. However, a fish community survey was conducted in 1926 and a winter creel census was conducted in 1973. Each survey on East Crooked Lake found relatively similar fish community with panfish populations exhibiting slow growth but with good size structure. Pumpkinseed average sizes equaled or exceeded Bluegill, which is not commonly observed in lakes throughout the state. Largemouth Bass were very slow growing, but present in good numbers with an adequate size range. Northern Pike populations have been excellent with good numbers of legal-size fish caught in each survey, but pike growth rates were also below average. The introduction of Redear Sunfish occurred in 1995, 1997, and 1998. The Redear Sunfish stocked here came from the Michigan State University rearing ponds (managed by DNR Fisheries Division), which contained a range of ages and sizes, each containing two to three year classes.

The 2000 fish community survey of East Crooked Lake used only trap nets and one gill net. A total of 542 fish were caught, weighing over 348 pounds and comprised of 15 different fish species. Panfish such as Redear Sunfish, Bluegill, Black Crappie, Rock Bass, and Pumpkinseed made up over 68% of the total catch by number and 50% by weight. Larger gamefish such as Largemouth Bass and Northern Pike comprised almost 5% of the total catch by number and 13% by weight. Bullheads comprised over 23% of the catch by number and 22% by weight. Other species such as Bowfin and Longnose Gar made up almost 3% of the catch by number and 14% by weight. The 2000 survey found that the Redear Sunfish stocking program in East Crooked Lake was successful in establishing a self-reproducing population. All year classes since the initial year of stocking were found and many trophy-sized fish are present in the population. Bluegill and Pumpkinseed numbers declined compared to surveys taken before the Redear Stocking program began in 1995. Only one Pumpkinseed smaller than five inches or younger than five years was collected during this survey. All Bluegill year classes and sizes were collected, although in lower abundance than in previous surveys.

Invasive Zebra Mussels were first documented in East and West Crooked lakes in 2001. Nuisance plant species such as Starry Stonewort and Eurasian Watermilfoil were documented in the lakes over one decade ago, with Curly-leaf Pondweed being a relatively new occurrence in the lakes first documented in 2019. The Aquatic Nuisance Control Program administered by the Department of Environment, Great Lakes, and Energy (EGLE) has permitted small-scale aquatic herbicide treatments for mixed plant species, and algae on these waterbodies beginning in 2006 on East Crooked Lake, and 2002 on West Crooked Lake. Lake-wide treatments for both lakes started in 2013 using fluoridone to control Eurasian Watermilfoil, with treatments for Starry Stonewort starting the following year. Diquat and flumioxazin were the herbicides used in the treatments 2019 onward and Starry Stonewort has been treated using copper sulfate or flumioxazin.

Current Status of the Fish Community

Methods
The Status and Tends program initiated statewide use of standardized survey data collection and procedures as part of its random sites sampling component, which is intended to provide a comprehensive survey of all types of inland lakes (e.g., small, medium, large, shallow, deep) in Michigan. In 2021, the Michigan DNR conducted a survey of East and West Crooked lakes following Status and Trends inland lake survey protocols to gather water chemistry, physical habitat, and fish community information. A fish community survey was conducted in May of 2021. A variety of sampling gears were used, including three large-mesh fyke nets, two small-mesh fyke nets, two experimental gill nets, four 25-foot seine hauls, and three boat electrofishing transects. The objective of the survey was to evaluate the current fish community and future management needs for the fishery.

Fish samples from 2021 were also submitted to EGLE and Michigan Department of Health and Human Services (MDHHS) staff to analyze as part of the Eat Safe Fish Program. MDHHS toxicologists calculate Fish Consumption Screening Values (FCSVs) for Michigan fish based on scientific literature around exposures and potential health effects associated with a chemical of concern. These FCSVs are then used in combination with the data from the recommendation sheets to set fish consumption guidelines.

Results
All sampling gears combined from both East and West Crooked captured 2,379 fish, representing 28 different species (Table 2 and 3). Bluegill was the most abundant fish species (n=1,253) accounting for 53% of the total catch, ranging from 1 to 8 inches in length and averaging 4.0 inches (Table 4). All age

classes were represented ranging from age-1 to age-7, with age-4 fish having the highest proportion. The average mean growth index (MGI) (i.e., the average deviation from the state average length at age) was slightly below the state average length at age, with a value of -0.7 which equates to 0.7 inches below the state average (Table 5).

Redear Sunfish was the second most abundant fish species (n=323) accounting for 14% of the total catch, ranging from 1 to 10 inches in length and averaging 6.6 inches. All age classes were represented ranging from age-1 to age-8, with age-4 fish having the highest proportion. The average MGI was below the state average length at age, with a value of -1.4.

Yellow Perch (n=56) accounted for 2% of the total catch, ranging from 2 to 8 inches in length and averaging 5.6 inches. All age classes were represented ranging from age-1 to age-6, with age-3 fish having the highest proportion. The average MGI was below the state average length at age, with a value of -1.5.

Pumpkinseed (n=39) accounted for 2% of the total catch, ranging from 2 to 7 inches in length and averaging 5.2 inches. Consistent age classes were represented ranging from age-2 to age-5. The average MGI was slightly below the state average length at age, with a value of -0.6.

Northern Pike (n=28) accounted for 1% of the total catch, ranging from 19 to 27 inches in length and averaging 23.9 inches. Consistent age classes were represented ranging from age-3 to age-6, with age-4 fish having the highest proportion. The average MGI was slightly below the state average length at age, with a value of -0.8.

Largemouth Bass (n=26) accounted for 1% of the total catch, ranging from 2 to 17 inches in length and averaging 10.8 inches. Consistent age classes were represented from age-1 to age-5, with one eight-year-old fish also caught. Age-4 fish had the highest proportion. The average MGI was slightly above the state average length at age, with a value of +0.5.

Brown Bullhead (n=123) and Bluntnose Minnow (n=108) each accounted for 5% of the total catch by number, with Spotfin Shiner (n=93) accounting for 4% of the total catch. Hybrid Sunfish and Warmouth each accounted for 3% of the total catch. Black Crappie (n=8) captures were very low and therefore, MGI could not be calculated. We did observe four different age-classes, with lengths ranging from 4 to 12 inches.

A high diversity of forage species were caught during the fish community survey. Ten new species were documented in East and West Crooked lakes during this survey (Table 3). Blacknose Shiner, Blackstripe Topminnow, Mimic Shiner, Northern Sunfish, Spotfin Shiner, and Stonecat were the new species only found in East Crooked Lake (Table 7). Banded Killifish and Blackchin Shiner were the new species only found in West Crooked Lake (Table 8). Bluntnose Minnow and Tadpole Madtom were newly detected in both East and West Crooked lakes. All other species not mentioned above that were caught during this survey and accounted for 1% or less of the total catch by number were: Green Sunfish, Rock Bass, Yellow Bullhead, Bowfin, Longnose Gar, Lake Chubsucker, Brook Silverside, and Golden Shiner (Table 2).

Twenty-five turtles consisting of three different species (Spiny Softshell, Map, and Musk) were recorded during the survey on East and West Crooked lakes. There were no threatened, endangered, or special concern species captured or observed during this survey. Grass Pickerel were not caught during this survey and have not been detected since the 1977 survey on East Crooked Lake.

Mercury was detected by the MDHHS in several fish samples collected from East and West Crooked lakes. Recommended serving sizes by species are shown in Table 6, with Bluegill and other sunfish

species being the best choice for consumption. Bass and Northern Pike over 16 inches are not recommended for consumption.

Analysis and Discussion

East and West Crooked lakes continue to support a diverse fish community and quality fishery. During the 2021 survey there were 28 fish species observed, which is above average (18 species) for lakes in the Lake Erie Management Unit (LEMU) and greater than the state median (14 species) found through the Status and Trends program (Wehrly et al. 2015). Ten additional native fish species were added to the occurrence list in East and West Crooked lakes while implementing this standardized sampling protocol (i.e., Status and Trends) which is an expected benefit of utilizing a variety of fisheries sampling gear. The predator to prey ratio appears to be balanced with a high number and diversity of forage species. Bluntnose Minnow and Spotfin Shiner accounted for 9% of total catch by number, and several predator species (e.g., Brown Bullhead, Yellow Perch, Northern Pike, Largemouth Bass, Black Crappie, Bowfin, and Longnose Gar) comprised 10% of total catch by number. The absence of Common Carp in this survey and all previous surveys is unique, and it is possible this lake is one of the few in southern Michigan to avoid the introduction of this undesirable, non-native species.

East and West Crooked lakes offer a quality panfish fishery with a variety of species for anglers to target. Bluegill and Redear Sunfish are the most abundant species in these lakes. Michigan DNR's Master Angler Program is a voluntary program that rewards anglers with patches if they catch and report fish meeting species-specific minimum length criteria. This helps promote fishing as a popular sport in Michigan and provides other anglers with valuable information on where big fish in our state can be found. From 1997 to 2025, eight different species of Master Angler fish (n=52) were submitted from East and West Crooked lakes: Redear Sunfish (n=23), crappie species (n=13), Pumpkinseed (n=4), Bluegill (n=4), Bowfin (n=4), Largemouth Bass (n=2), Northern Pike (n=1), and bullhead species (n=1).

Studies attempting to evaluate changes in relative abundance, growth rates, and size structure of Bluegill and Pumpkinseed populations following an introduction of Redear Sunfish within several waterbodies have been evaluated by MDNR staff in earlier years. It was assumed that introducing Redear Sunfish would not impact Bluegill populations due to their difference in diet. Small negative impacts to Pumpkinseed populations were expected because of their similar diet preferences of snails as their primary food source. The Redear Sunfish introduction in Joslin Lake for example, appeared to have no impact on size structure and growth of Bluegill (Braunscheidel and Towns 2017). However, relative abundance of medium-sized Bluegill declined. Similarly, a study of several southern Michigan lakes where Redear Sunfish had been introduced found the relative abundance of Pumpkinseed significantly declined with no observed changes to growth (Huckins 2000). However, hybridization appeared to confound those results as some hybrids with increased growth rates and larger size may have been incorrectly identified as Pumpkinseeds.

For East and West Crooked lakes, the survey conducted in 2000 found that Bluegill and Pumpkinseed relative abundance declined compared to surveys before the Redear Stocking program began in 1995. The most recent survey conducted in 2021 showed that Bluegill abundance may have rebounded back to previous abundance levels, surpassing Redear Sunfish as the dominant species occurring in the lakes. Bluegill were the most abundant fish caught during this survey, with 53% by number. However, the majority of the Bluegill were 3 inches or smaller, with an average length of 4.0 inches overall. Differences and greater variety in gear types used for the current survey likely explain why higher numbers of smaller Bluegill were caught when compared to prior surveys only using trap nets. Bluegill growth metrics appear to be slightly improved since much earlier surveys (-1.0 in 1984 and 1993),

prior to the Redear Sunfish introduction. Redear Sunfish abundance decreased drastically since the 2000 survey from 37% by number to only 14% by number currently. Redear Sunfish growth indices also shifted from positive (+0.8) in 2000's to negative now (-1.4), although average length was still 6.6 inches. Pumpkinseed abundance has remained steady since the 2000 survey, currently accounting for 2% of catch by number (2.4% in 2000 survey). However, this is a continuing drastic reduction in relative abundance compared to surveys in 1984 and 1993 (29% and 9%, respectively), prior to the Redear Sunfish introduction. Growth indices of Pumpkinseed were not measured in the 2000's but are currently (-0.6) with an average length of 5.2 inches. Other than Largemouth Bass having a slightly positive mean growth index, growth indices for all other species were negative (Table 5). This could be attributed to poor nearshore shallow water habitat (e.g., the lack of woody habitat present throughout the lake, and vertical seawalls) with an associated lack of aquatic macroinvertebrates as a food supply and loss of refuge and nursery habitat for younger, smaller fish.

Hybrid Sunfish are more abundant now than ever before with 3% of the total catch by number, which is also higher than the abundance of Pumpkinseed. Hybrid Sunfish appear to be growing to much larger sizes than Pumpkinseed (Figure 7) with 8- and 9-inch hybrids present. Although the size structure of Bluegill and relative abundance of Pumpkinseed decreased dramatically, the overall quality of the panfish fishery in East and West Crooked lakes perhaps could be considered improved by some, with a more diverse fishing opportunity and larger-sized panfish (Hybrid and Redear Sunfish) available to anglers.

While fisheries biologists attempt to draw relatively simple conclusions about complex issues, aquatic ecosystems and food web dynamics are often much more complicated. One major confounding variable includes the invasive Zebra Mussel, which were detected in East and West Crooked as early as 2001. This invasive mussel can have bottom-up negative impacts on the food web by reducing plankton densities throughout the water column and subsequently increasing water clarity. Although, Redear Sunfish were introduced and established around the same time, which may have been opportunistic in reducing the success of Zebra Mussels due to the fish species' feeding behavior.

Yellow Perch relative abundance has increased substantially since the 2000 survey. They accounted for 2% of the total catch (n=56) during this survey, whereas the 2000 survey only caught two individuals. Northern Pike have continued to reproduce successfully in East Crooked Lake and maintain a decent population. Enough wetlands and other habitat essential to maintaining a natural Northern Pike population seems to be present despite the large amount of developed shoreline. Growth indices remain slightly below the state average consistent with historic values for the system.

Largemouth Bass growth indices have continued to improve since previous surveys, which previously featured values well below the statewide average (–1.7 in 1984 and –2.7 in 1993). Growth indices of Largemouth Bass were not measured in the 2000's but are currently 0.5 inches above the statewide average. East and West Crooked lakes are popular destinations for bass tournament anglers, ranking near the top 25% (110th of 422) of lakes throughout the state of Michigan in number of tournaments held (Figure 6). Bass tournament pressure is higher in southern Michigan compared to northern Michigan due to proximity to population centers and the quality bass fisheries present. Although there is a public boating access site, it is not big enough to accommodate large number of anglers. The DNR supports bass tournament angling as part of our strategy to provide diverse fishing opportunities. East and West Crooked lakes have and continue to support a quality bass fishery. There are no indications that bass tournament pressure has negatively affected the fishery.

East and West Crooked lakes retain some natural and undeveloped areas in the riparian zone. When compared regionally across southeast Michigan, the 30 dwellings/mile of shoreline and 27 docks/mile

found on East and West Crooked lakes are slightly lower than the Lake Erie Management Unit (LEMU) averages of 36 dwellings/mile and 39 docks/mile. However, dwelling and dock densities are still considered high compared to statewide averages (> 11.7 dwellings/mile and >8.5 docks/mile) Status and Trends Inland Lake Habitat Viewer. O'Neal and Soulliere (2006) reported that alterations or development on more than 25% of the shoreline can have detrimental effects on a lake's nearshore ecosystem through habitat degradation and loss of woody material. The density of submersed trees (0.3 trees/mile) in East and West Crooked lakes compared to the LEMU average (14 trees/mile) shows that these lakes are severely lacking large woody habitat. Woody habitat less than 0.43 trees/mile is considered low density statewide. The lakes shoreline is also 47% armored with vertical walls or rip-rap, which is well above the statewide average and 30% is considered highly armored. Musk turtles are a species of greatest conservation need in Michigan's Wildlife Action Plan 2015-2025 because of population declines or local extirpation in recent years, especially where lake edge habitat alteration has taken place due to residential development. Threats to Musk Turtles include loss of lake habitats due to alternations such as aquatic vegetation removal for recreational or aesthetic purposes and reduction in water quality (Derosier et al. 2015).

Management Direction

The loss of natural shorelines is the biggest threat to the overall health of Michigan Lakes (National Lakes Assessment). The Michigan Wildlife Action Plan (WAP) for 2015 – 2025 provides a strategic framework for conservation of wildlife and their habitat, identifying priorities and goals (Derosier et al. 2015). Vertical walls at the shoreline severely disrupt the connection between the aquatic and terrestrial ecosystems, having a direct negative impact on reptiles and amphibians by eliminating an exit point from the water to the terrestrial environment. Vertical walls also reduce habitat complexity in the dynamic nearshore area, which supports the life history of many aquatic organisms, including many fish species found in East and West Crooked lakes. Much of the shallow nearshore habitat in East and West Crooked lakes has been altered with vertical walls and development. Providing protection for the remaining natural shoreline and restoring natural shorelines where seawalls currently exist, would greatly benefit the water quality, habitat, and aquatic ecosystem of East and West Crooked lakes (Michigan Natural Shoreline Partnership).

Eutrophication (human-induced nutrient input) is another significant threat to aquatic food webs and water quality. Emphasis should be placed on reducing or eliminating sources of nutrient loading in the watershed. Lands in the watershed, especially those adjacent to East and West Crooked lakes and its tributaries, should incorporate best management practices such as wetland protection, no-mow or native vegetated buffer strips around the lake, limiting use of fertilizers and pesticides on lakefront properties, and bioengineered shorelines in place of vertical seawalls to address nutrient loading into the lake. The importance of using best management practices to protect the lake against eutrophication should be conveyed to residents in the watershed. These actions will help maintain the water quality and fisheries on East and West Crooked lakes (Shoreland Stewards).

Woody habitat such as fallen trees, limbs, and sticks provide structure in which fishes feed and hide from predators. In addition to fish, woody habitat is commonly used by frogs, turtles, birds and other animals. Larger woody habitat can also serve as a wave break, which decreases shoreline erosion and sediment resuspension. Woody habitat in Michigan's inland lakes has declined and is much less common in lakes with high housing and cabin densities. This pattern is due to declines in the number of trees along lake shorelines as property owners remove them and also due to the common practice of removing trees and branches that fall into the lake. Studies have shown that when woody habitat is

removed from a lake, fish populations decline. Large woody habitat installation projects should be implemented on East and West Crooked lakes in the future to help restore this valuable resource.

Starry Stonewort and Eurasian Watermilfoil are two aquatic invasive plant species that have been well established throughout East and West Crooked lakes for several years, with Curly-leaf Pondweed as a more recent invader. Invasive aquatic plants can negatively impact water quality and disrupt the balance of the ecosystem by outcompeting beneficial native plants. Native plants serve as essential aquatic habitat, produce dissolved oxygen, stabilize shorelines and lake bottom sediments, and filter excess nutrients. Alternative or additional control options other than solely aquatic herbicides, such as diver assisted suction harvesting (DASH) should be implemented. This method is a more eco-friendly, safe, and effective approach for long-term invasive plant management by more effectively targeting only the invasive plant at its root system, while leaving the desirable native species intact.

Overall, East and West Crooked lakes provide excellent and diverse fisheries for the public to enjoy. Protecting and restoring natural shorelines, using best management practices to reduce eutrophication, re-establishing woody habitat, and more careful management of aquatic plants in these lakes would greatly benefit the aquatic food web and water quality to ensure a healthier and more resilient ecosystem for future generations.

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Tables and Figures

Table 1. Fish stocking records for East and West Crooked Lake from 1929 - 2025 by the Michigan DNR Fisheries Division.

Year	Species	Number	Average Length (in.)
1929*	Bluegill	1,250	–
1930*	Largemouth Bass	180	–
1945	Bluegill	5,600	1.5
1945	Largemouth Bass	1,080	3.5
1995	Redear Sunfish	25,200	1.8
1997	Redear Sunfish	28,058	2.5
1998	Redear Sunfish	2,512	3.3

* West Crooked Lake only.

Table 2. East and West Crooked lakes combined - Species catch numbers and percent composition in descending order from the 2021 fisheries survey.

Species	Number	Percent by number
Bluegill	1253	53%
Redear Sunfish	323	14%
Brown Bullhead	123	5%
Bluntnose Minnow	108	5%
Spotfin Shiner	93	4%
Hybrid Sunfish	80	3%
Warmouth	70	3%
Yellow Perch	56	2%
Pumpkinseed	39	2%
Green Sunfish	33	1%
Rock Bass	29	1%
Northern Pike	28	1%
Largemouth Bass	26	1%
Blackstripe Topminnow	23	1%
Blackchin Shiner	18	1%
Yellow Bullhead	17	1%
Banded Killifish	12	1%
Mimic Shiner	12	1%
Black Crappie	8	<1%
Bowfin	8	<1%
Longnose Gar	8	<1%
Northern Sunfish	4	<1%
Tadpole Madtom	4	<1%
Lake Chubsucker	2	<1%
Blacknose Shiner	1	<1%
Brook Silverside	1	<1%
Golden Shiner	1	<1%
Stonecat	1	<1%
TOTAL	**2,379**	–

Table 3. History of fish species detected from survey years since 1977 in East Crooked Lake. 2021 is the first survey that sampled both East and West Crooked lakes. All surveys were general fish community sampling efforts using a variety of gear types.

Species Name	1977 (East)	1984 (East)	1993 (East)	2000 (East)	2021 (East and West)
Banded Killifish	–	x	–	–	x
Black Bullhead	–	–	–	x	–
Black Crappie	x	x	x	x	x
Blackchin Shiner	–	–	–	–	x
Blacknose Shiner	–	–	–	–	x
Blackstripe Topminnow	–	–	–	–	x
Bluegill	x	x	x	x	x
Bluntnose Minnow	–	–	–	–	x
Bowfin	x	x	x	x	x
Brook Silverside	x	x	–	–	x
Brown Bullhead	x	–	x	x	x
Channel Catfish	–	–	x	–	–
Golden Shiner	x	x	–	x	x
Green Sunfish	x	x	–	–	x
Grass Pickerel	x	–	–	–	–
Hybrid Sunfish	–	–	–	–	x
Lake Chubsucker	x	x	–	–	x
Largemouth Bass	x	x	x	x	x
Northern Sunfish	–	–	–	–	x
Longnose Gar	x	x	x	x	x
Mimic Shiner	–	–	–	–	x
Northern Pike	x	x	x	x	x
Pumpkinseed	x	x	x	x	x
Redear Sunfish	–	–	–	x	x
Rock Bass	x	x	x	x	x
Spotfin Shiner	–	–	–	–	x
Stonecat	–	–	–	–	x
Tadpole Madtom	–	–	–	–	x
White Sucker	x	–	x	–	–
Warmouth	x	x	–	x	x
Yellow Bullhead	x	x	–	x	x
Yellow Perch	x	x	x	x	x
Species Count	**18**	**15**	**12**	**15**	**28**

Table 4. Number caught per inch group of select species collected with all gears combined from East and West Crooked lakes fisheries survey in 2021.

Inch Group	Bluegill	Redear Sunfish	Pumpkinseed	Yellow Perch	Warmouth	Northern Pike	Largemouth Bass
1	26	1	–	–	–	–	–
2	224	12	1	3	5	–	2
3	425	16	6	4	26	–	–
4	363	44	9	8	19	–	–
5	140	54	12	25	18	–	3
6	42	54	8	6	2	–	–
7	32	56	3	6	–	–	3
8	1	55	–	4	–	–	1
9	–	27	–	–	–	–	2
10	–	4	–	–	–	–	2
11	–	–	–	–	–	–	3
12	–	–	–	–	–	–	–
13	–	–	–	–	–	–	1
14	–	–	–	–	–	–	3
15	–	–	–	–	–	–	4
16	–	–	–	–	–	–	1
17	–	–	–	–	–	–	1
19	–	–	–	–	–	2	–
21	–	–	–	–	–	5	–
22	–	–	–	–	–	1	–
23	–	–	–	–	–	6	–
24	–	–	–	–	–	4	–
25	–	–	–	–	–	6	–
26	–	–	–	–	–	3	–
27	–	–	–	–	–	1	–
TOTAL	**1253**	**323**	**39**	**56**	**70**	**28**	**26**
Average Length (in)	**4.0**	**6.6**	**5.2**	**5.6**	**4.3**	**23.9**	**10.8**

Table 5. East and West Crooked lakes combined age data. Mean length and age composition of select species collected during the fisheries survey of East and West Crooked lakes in 2021.

Species	Age	No. aged	Length range (in.)	State avg. length (in.)	Mean growth index*
Black Crappie	–	–	–	–	**NA (Avg.)**
Black Crappie	2	1	4.9	6	NA
Black Crappie	3	4	6.0-6.6	7.5	NA
Black Crappie	4	2	6.7-7.3	8.6	NA
Black Crappie	7	1	12.10	10.8	NA
Bluegill	–	–	–	–	**-0.7 (Avg.)**
Bluegill	1	15	1.4-2.7	1.8	+0.2
Bluegill	2	5	2.8-2.9	3.8	-1.0
Bluegill	3	11	3.5-4.0	5	-1.3
Bluegill	4	19	3.9-7.8	5.9	-0.2
Bluegill	5	17	4.8-7.6	6.7	-0.6
Bluegill	6	4	5.6-6.7	7.3	NA
Bluegill	7	1	8.50	7.8	NA
Largemouth Bass	–	–	–	–	**+0.5 (Avg.)**
Largemouth Bass	1	2	2.3-2.5	4.2	NA
Largemouth Bass	2	4	5.5-7.9	7.1	NA
Largemouth Bass	3	7	7.8-11.0	9.4	+0.1
Largemouth Bass	4	5	7.3-14.1	11.6	0.0
Largemouth Bass	5	5	14.8-16.9	13.2	+2.3
Largemouth Bass	8	1	17.90	17.4	NA
Northern Pike	–	–	–	–	**-0.8 (Avg.)**
Northern Pike	3	2	19.0-19.6	20.8	NA
Northern Pike	4	13	21.4-26.5	23.4	+0.2
Northern Pike	5	8	21.4-26.4	25.5	-1.2
Northern Pike	6	5	23.5-27.0	27.3	-1.8

Species	Age	No. aged	Length range (in.)	State avg. length (in.)	Mean growth index*
Pumpkinseed	–	–	–	–	**-0.6 (Avg.)**
Pumpkinseed	2	5	2.6-3.6	3.8	-0.6
Pumpkinseed	3	5	3.7-4.9	4.9	-0.6
Pumpkinseed	4	3	4.4-5.9	5.6	NA
Pumpkinseed	5	2	4.9-5.4	6.2	NA
Redear Sunfish	–	–	–	–	**-1.4 (Avg.)**
Redear Sunfish	1	4	2.1-2.5	1.9	NA
Redear Sunfish	2	9	2.2-3.8	4.4	-1.6
Redear Sunfish	3	19	3.3-6.8	6.2	-1.7
Redear Sunfish	4	27	4.7-9.1	7.6	-0.7
Redear Sunfish	5	19	5.3-10.3	8.7	-1.0
Redear Sunfish	6	7	6.3-10.6	9.6	-0.5
Redear Sunfish	7	2	10.1-10.4	10.3	NA
Redear Sunfish	8	1	8.00	10.8	NA
Yellow Perch	–	–	–	–	**-1.5 (Avg.)**
Yellow Perch	1	1	2.80	3.3	NA
Yellow Perch	2	4	2.9-3.0	5.2	NA
Yellow Perch	3	18	3.5-6.1	6.5	-1.6
Yellow Perch	4	5	5.3-6.3	7.5	-1.7
Yellow Perch	5	11	6.1-8.5	8.5	-1.2
Yellow Perch	6	2	8.0-8.3	9.4	NA

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

Table 6. A snip of the table from the 2025 Eat Safe Fish Guide book published by the Michigan Department of Health and Human Service for East and West Crooked Lakes. The green fish symbol indicates the best choice for consumption as recommended by the MDHHS.

East and West Crooked Lakes

Type of Fish	Chemicals of Concern	Size of Fish (length in inches)	MI Servings per Month*
Bluegill	Mercury	Under 7"	8
		Over 7"	4
Largemouth Bass	Mercury	Under 16"	6 Per Year
		Over 16"	Do Not Eat▲
Northern Pike	Mercury	Under 30"	6 Per Year
		Over 30"	Do Not Eat▲
Smallmouth Bass	Mercury	Under 16"	6 Per Year
		Over 16"	Do Not Eat▲
Sunfish	Mercury	Under 7"	8
		Over 7"	4

Table 7. East Crooked Lake - 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) from the fisheries survey in 2021.

Species	Number	Percent by number	Length range (in.)*	Average length (in.)	Percent legal size**
Black Crappie	4	0.4	4-7	6.3	25
Blacknose Shiner	1	0.1	2-2	2.5	100
Blackstripe Topminnow	23	2.2	1-2	1.9	100
Bluegill	373	35.7	1-7	4.8	14
Bluntnose Minnow	107	10.2	1-3	2.4	100
Bowfin	7	0.7	19-24	22.2	100
Brook Silverside	1	0.1	3-3	3.5	100
Brown Bullhead	56	5.4	4-13	10.4	96
Golden Shiner	1	0.1	7-7	7.5	100
Green Sunfish	15	1.4	1-7	5.4	27
Hybrid Sunfish	45	4.3	3-9	5.8	64
Largemouth Bass	16	1.5	5-17	9.9	31
Longnose Gar	5	0.5	30-35	32.1	100
Mimic Shiner	12	1.1	1-1	1.5	100
Northern Pike	17	1.6	19-27	24.4	47
Northern Sunfish	4	0.4	2-3	3.3	0
Pumpkinseed	26	2.5	2-7	5.9	31
Redear Sunfish	152	14.5	1-10	6.3	68
Rock Bass	27	2.6	2-9	6	52
Spotfin Shiner	93	8.9	1-4	3.2	100
Stonecat	1	0.1	2-2	2.5	100
Tadpole Madtom	2	0.2	3-3	3.5	100
Warmouth	20	1.9	2-6	4.6	5
Yellow Bullhead	6	0.6	7-11	10.2	100
Yellow Perch	32	3.1	2-8	6.5	22
TOTAL	**1046**	–	–	–	–

* Some fish may be measured to 0.1 inch, others to inch group: ‘5’ = 5.0 to 5.9 inches; ‘12’ = 12.0 to 12.9 inches; etc.
** Percent legal or acceptable size for angling.

Table 8. West Crooked Lake - 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) from the fisheries survey in 2021.

Species	Number	Percent by number	Length range (in.)*	Average length (in.)	Percent legal size**
Banded Killifish	12	0.9	1-2	1.6	100
Black Crappie	4	0.3	6-12	8	25
Blackchin Shiner	18	1.4	1-2	2.4	100
Bluegill	880	66.3	1-8	4	3
Bluntnose Minnow	1	0.1	2-2	2.5	100
Bowfin	1	0.1	24-24	24.5	100
Brown Bullhead	67	5	3-12	8.8	96
Green Sunfish	18	1.4	1-4	3	0
Hybrid Sunfish	35	2.6	1-9	6.1	54
Lake Chubsucker	2	0.2	8-8	8.5	100
Largemouth Bass	8	0.6	2-15	6.4	25
Longnose Gar	3	0.2	28-34	31	100
Northern Pike	11	0.8	21-26	25.2	55
Pumpkinseed	13	1	3-7	5.3	23
Redear Sunfish	171	12.9	2-10	5.5	54
Rock Bass	2	0.2	3-7	5.5	50
Tadpole Madtom	2	0.2	2-2	2.5	100
Warmouth	50	3.8	2-6	4.9	2
Yellow Bullhead	5	0.4	4-8	6.9	80
Yellow Perch	24	1.8	3-8	5.8	13
TOTAL	**1327**	–	–	–	–

* Some fish may be measured to 0.1 inch, others to inch group: ‘5’ = 5.0 to 5.9 inches; ‘12’ = 12.0 to 12.9 inches; etc.
** Percent legal or acceptable size for angling.

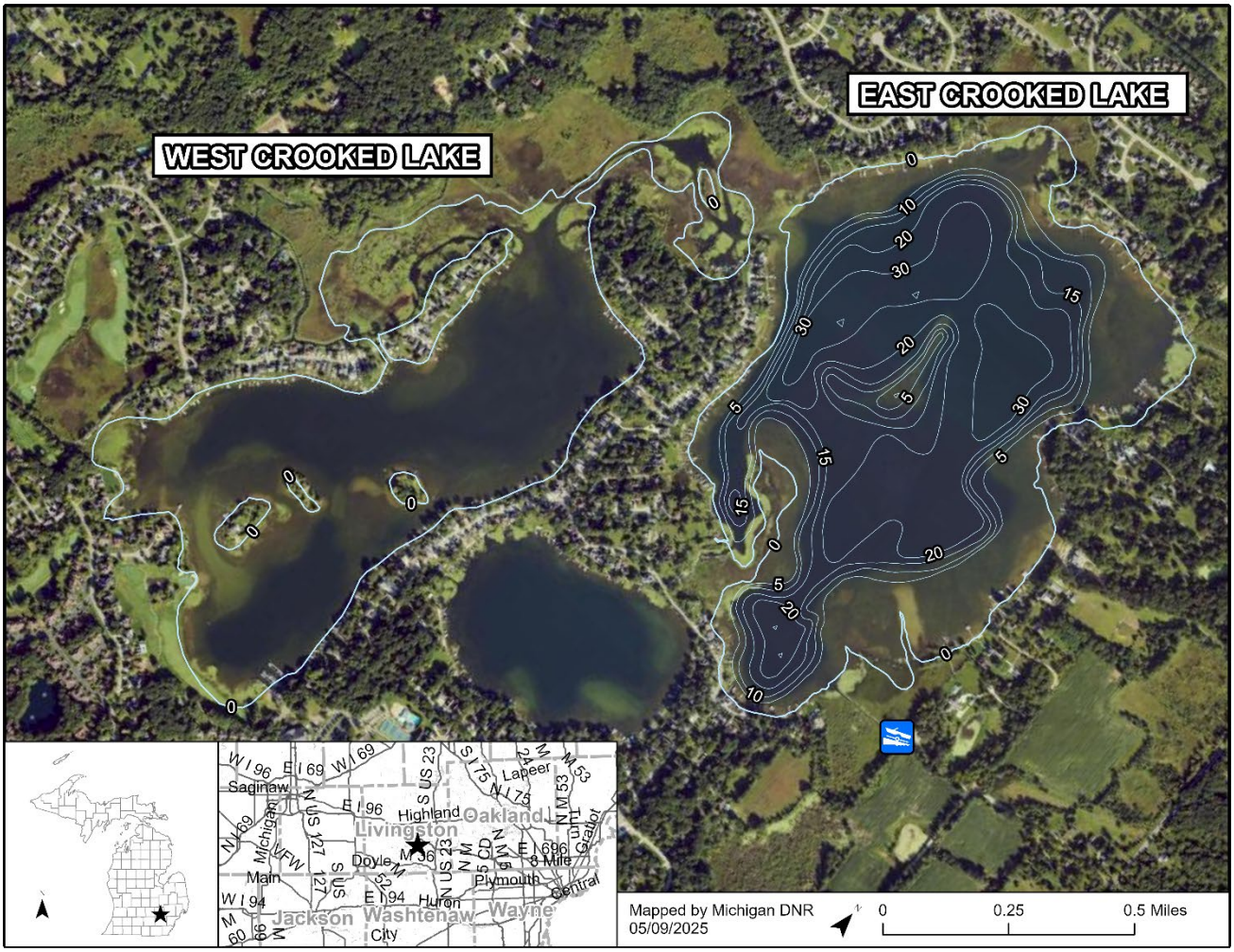


Figure 1. Bathymetric map of East (Big) and West (Little) Crooked lakes, Livingston County. The Michigan DNR Boating Access Site and depth contour lines (feet) are shown combined with aerial satellite imagery. West Crooked Lake does not have bathymetry data available.

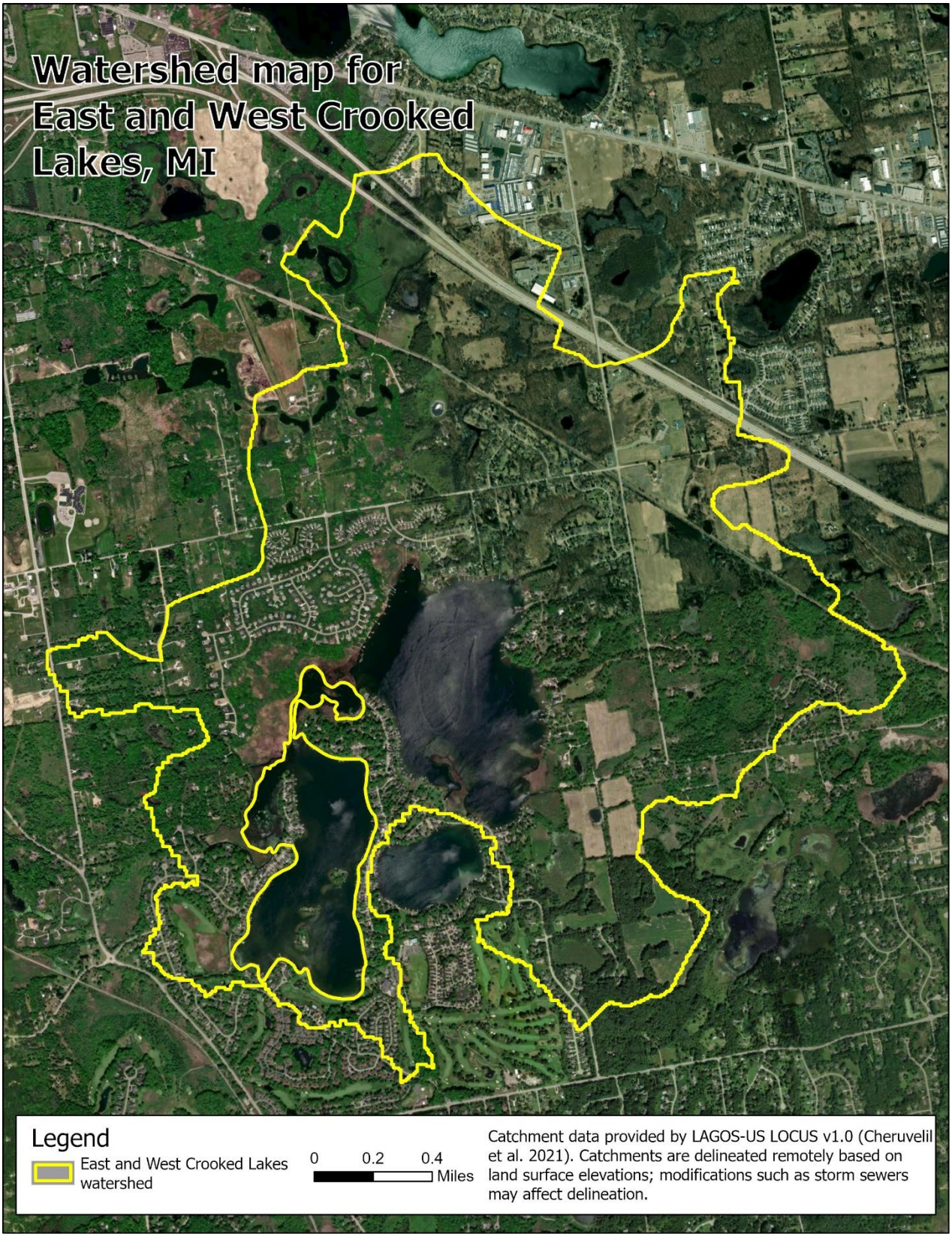


Figure 2. Lakeshed catchment (outer yellow line) and aerial satellite map of East and West Crooked lakes, Livingston County.

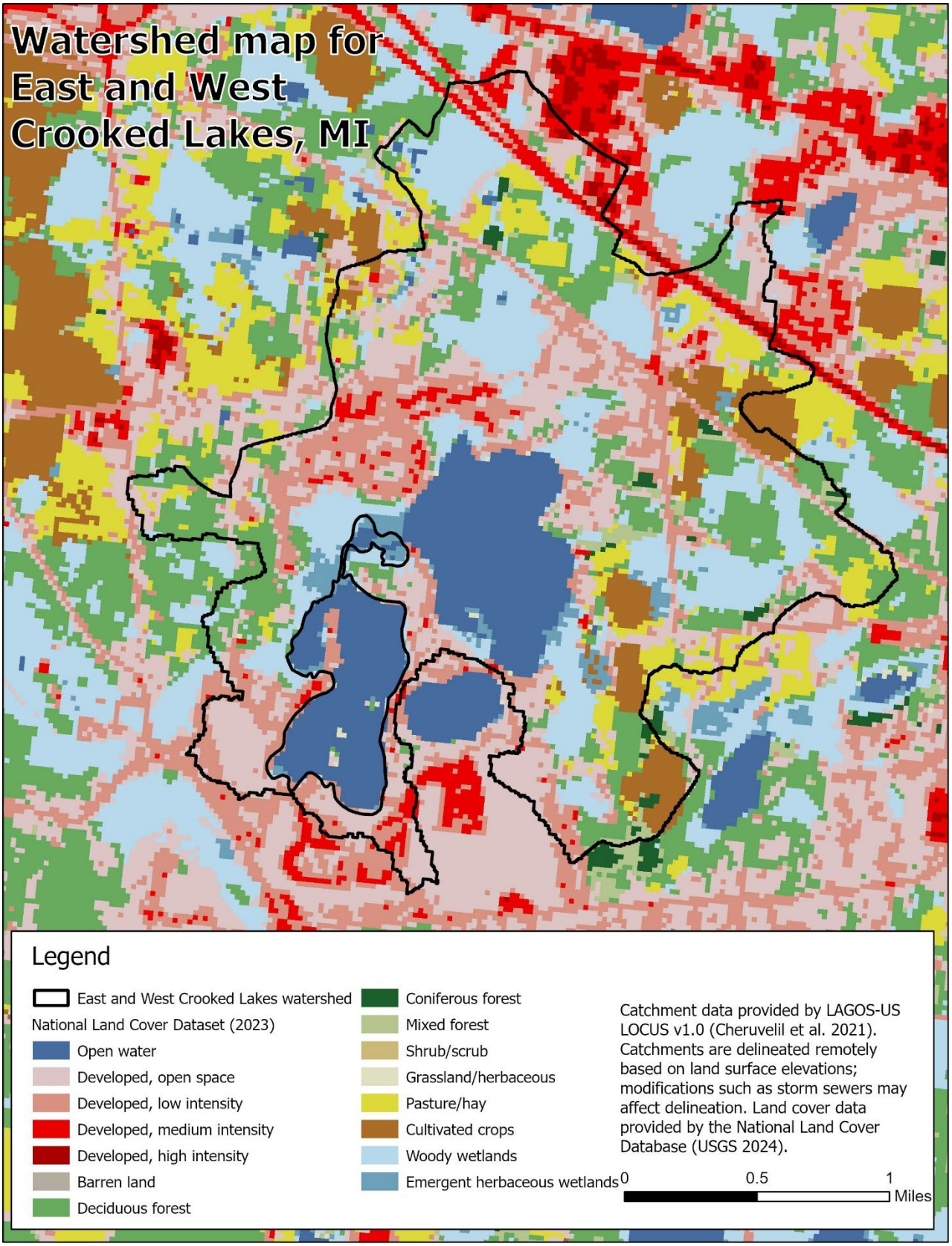


Figure 3. Lakeshed catchment (outer black line) and land cover map (colors) of East and West Crooked lakes, Livingston County.

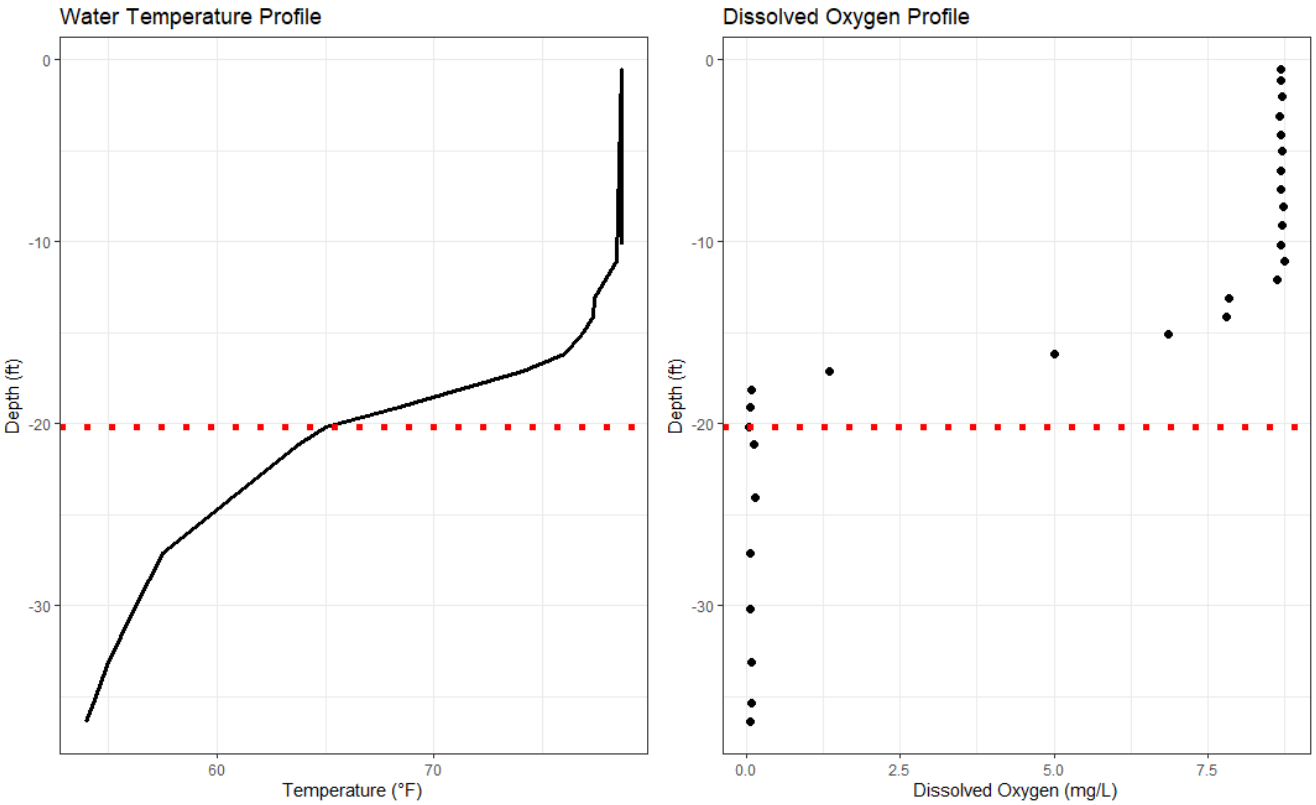


Figure 4. Water temperature (left panel) and dissolved oxygen (right panel) profiles for East Crooked Lake collected August 18, 2021. In the left panel, the solid black line indicates water temperature. In the right panel, the black dots indicate dissolved oxygen concentration. The horizontal, red-dashed lines represent the thermocline.

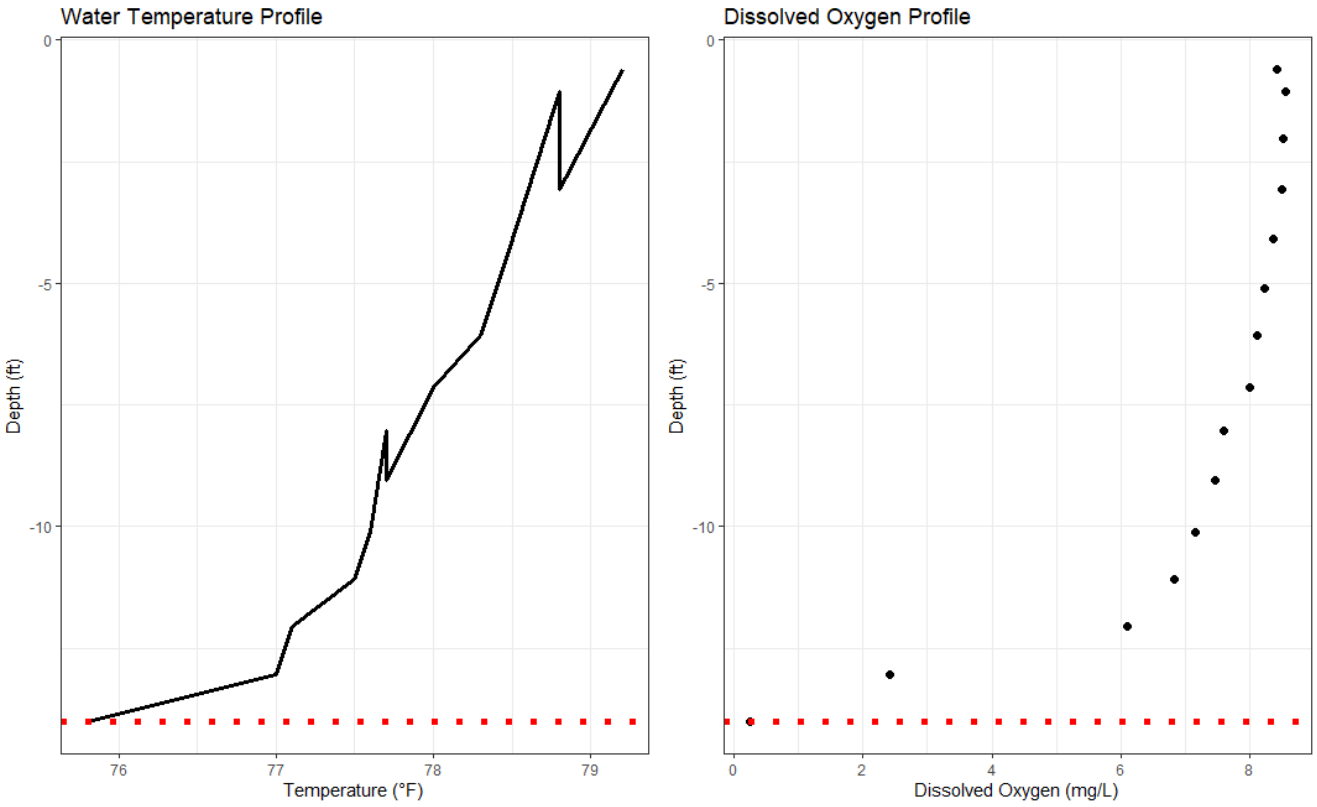
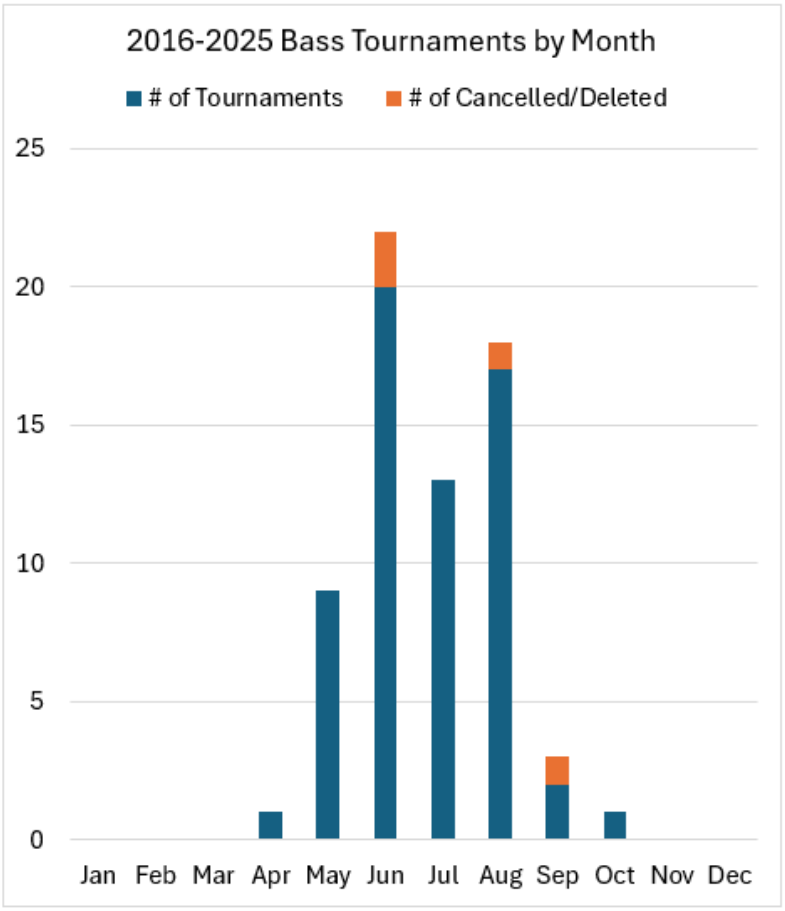


Figure 5. Water temperature (left panel) and dissolved oxygen (right panel) profiles for West Crooked Lake collected August 18, 2021. In the left panel, the solid black line indicates water temperature. In the right panel, the black dots indicate dissolved oxygen concentration. The horizontal, red-dashed lines represent the thermocline which occurs on the bottom of the lake.

Michigan's Fishing Tournament Information System Program East (and West) Crooked Lakes 2016-2025 (Bass)

General Stats	
Total Number of Registrations	67
Total Number of Directors	11
Average Registrations / Director	6.1
Total Number of Deleted Tournaments	1
Total Number of Cancelled Tournaments	3
Number of Reports Received (N= 63)	61
Number of Missing Reports (N= 63)	2
Reporting Compliance w/ Cancelations (N= 66)	97%
Average # of Tournaments Per Year	6.3
Statewide Waterbody Rank (of 422 waterbodies)	110th
Tournament Summary Analytics	
# of Weight Based Tournaments Reporting	59
# of Length Based Tournaments Reporting	2
Average # of Anglers	19.7
Average # of boats	9.9
Average # of Bass Weighed/Measured per Event	36.1
Average # of Bass Weighed/Measured per Angler	1.83
Total Bass Weighed/Measured (estimate for all 63)	2,274
Percentage LMB Weighed/Measured	100%
Percentage SMB Weighed/Measured	0%
Total LMB Weighed/Measured (estimate for all 63)	2,273
Total SMB Weighed/Measured (estimate for all 63)	1
Weight Based Tournaments Stats Only (N= 59)	
AVG Weight of Bass Weighed-in (lb.)	2.24
Average Heaviest Fish (lb.)	3.70
Minimum # of Fish Reported Greater than 4 lb.	16
Length Based Tournament Stats Only (N= 2)	
Average Length of Measured Fish (in.)	15.5
Average Longest Fish (in.)	18.5
# of Fish Reported Greater than 20 inches	0



Fish Health Questions since 2022 (N=21)
Black Melanomas were reported in 0 tournaments
Sores/Lesions were reported in 0 tournaments

Prepared by Fishing Tournament Specialist Tom Goniea
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Figure 6. Michigan DNR's Fishing Tournament Information System summary statistics for bass tournaments from (2016-2025) on East and West Crooked lakes, Livingston County. LMB=Largemouth Bass, SMB=Smallmouth Bass.

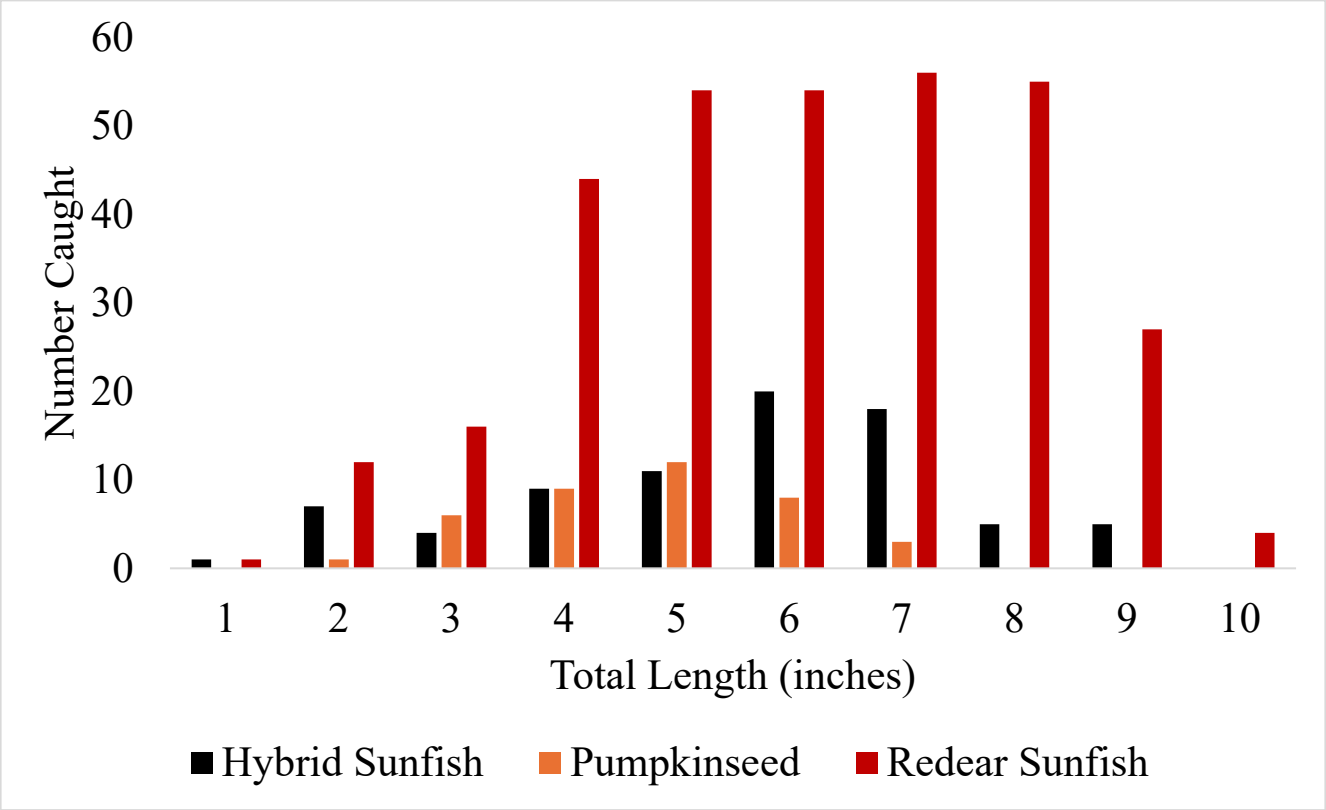


Figure 7. Length frequency (number caught per inch group) histogram for Hybrid Sunfish, Pumpkinseed, and Redear Sunfish for East and West Crooked lakes combined.

Literature Path

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