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## Michigan DNR Fisheries– Southern Lake Huron Management Unit

# Crooked Lake – 2022 Status and Trends

*2022 Status and Trends Lake Report*



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*On the cover: 2.4 in Rainbow Darter captured in a small-mesh fyke net from Crooked Lake. Photo Credit: A. Simmons*

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## Introduction

The Inland Lake Status and Trends Program (LSTP) of the Michigan DNR 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 over a one-to-two-week period in late spring or early summer (55-80°F). Multiple gear types are used in an effort to randomly sample different habitats and to collect information on a range of species and size classes:

- *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 hoops (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 hoops (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-minute 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.

Fisheries management for Crooked Lake began as early as 1938 beginning with Bluegill stocking from 1938 to 1941, Smallmouth Bass in 1939, and Largemouth Bass from 1940-1942. The first inventory of Crooked Lake was in 1941 and species caught included a variety of panfish. It can be assumed that the managers at the time perceived the growth of panfish to be poor because there was a recommendation to reduce the panfish population. In 1958, Crooked Lake was treated with rotenone and then restocked. Rainbow Trout were stocked for one year following the treatment to provide an interim fishery until other species could be restocked and provide additional fishing opportunities. Subsequent stocking of Largemouth Bass, Northern Pike, and Bluegill occurred in 1958-59. Additionally, two pike marshes were constructed on



Crooked Lake and all fingerlings were stocked in the lake until 1962 once the public interest diminished.

Fish surveys were conducted post-treatment from 1958 to 1960. These indicated that the treatment was successful, and the Rainbow Trout stockings provided good fishing opportunities. By the last 1960s the panfish population became dense again and there was a shortage of larger individuals. Age data collected in 1983 found that most fish species were once again growing below the statewide average except for Largemouth Bass. Analysis indicated problems with excessive vegetation, poor panfish fishing, and fair to good bass and pike fishing. In effort to control the panfish population, predator stocking was initiated in 1985 (Table 1).

**Table 1.** Fish stocked in Crooked Lake, Clare County, 1985-2019.

| Year | Species        | Operation | Number | Average Length (in) |
|------|----------------|-----------|--------|---------------------|
| 1985 | Northern Pike  | State     | 5,280  | 8.9                 |
| 1986 | Northern Pike  | State     | 10,560 | 10.6                |
| 1987 | Northern Pike  | State     | 5,280  | 10.5                |
| 1988 | Northern Pike  | State     | 10,560 | 8.4                 |
| 1990 | Northern Pike  | State     | 5,280  | 8.9                 |
| 1991 | Northern Pike  | State     | 11,00  | 5.9                 |
| 2019 | Hybrid Sunfish | Private   | 1,984  | 6.0                 |
| 2019 | Hybrid Sunfish | Private   | 1,984  | 5.5                 |

A survey was conducted in 1991 to determine the success of these stocking efforts. The 1991 survey found fair to good Largemouth Bass populations and fair populations of larger panfish; however, all panfish were still growing below the statewide average. The main problem was believed to be excessive aquatic vegetation growth. Northern Pike stocking discontinued because their preference for soft-rayed fishes made them poor biological controls for overabundant panfish.

The first Status and Trends survey was conducted in 2008. Extensive details on this survey can be found in the Status of the Fishery files on the DNR website (<https://www.michigan.gov/dnr/managing-resources/fisheries/Status-of-the-Fishery-Resource-Reports>). The 2008 survey found that Crooked Lake offered the opportunity to catch acceptable sized Black Crappie, fair-sized Bluegill, large Rock Bass, and large Pumpkinseed. Northern Pike were present but skinny and slow growing. The Northern Pike population was assessed in 2018 using four large mesh fyke nets in early April. Ice-out surveys are successful at targeting Northern Pike that are moving inshore to spawn. Only 5% of the catch were 24 inches or larger with a mean growth index of 4.0 in below the statewide average. This is a decline since the 2008 survey (-2.9 in). This lake did not receive the liberalized pike regulation (daily bag limit of 5 with no MSL but one over 24 in) because the stunted population was believed to be the result of reduced predation effectiveness due to excess macrophyte growth.



Crooked Lake is a highly productive system. Previous surveys and file notes document a long history of abundant aquatic vegetation and extensive annual weed treatment since the mid-1990s. Michigan Department of Environment, Great Lakes, and Energy (EGLE) conducted an aquatic plant survey in August of 2018. A total of 28 plant species were found to some extent in Crooked Lake with the dominant plant species being *Chara* spp. and Wild Celery. More detail can be found on [MiEnviro](#).

The objectives of this survey were to 1) identify all fish species present, 2) determine age and growth to evaluate the sport fish community, and 3) collect limnological data including temperature and dissolved oxygen profiles, nutrient concentrations, and shoreline alterations.

### **Study Area**

Crooked Lake is located in the village of Lake Station (Clare County) just south of US 10 and approximately seven miles west of Clare (Figure 1). Crooked Lake is 264 ac with a maximum depth of 73 ft. This eutrophic lake flows through a control structure into Cranberry Lake at the headwaters of the North Branch of the Chippewa River. The topography of the watershed is flat-to-gently-rolling hills. Soils are classified as sandy and the predominant land use in the area is mixed farm and woodland. The immediate shoreline of the lake is characterized as high-banked with sandy soils. The littoral zone of Crooked Lake drops off steeply and the lake basin is angular like the name suggests. The bottom substrate in the deeper areas is pulpy peat and muck, and the shoals are a mixture of pulpy-peat, sand and marl.

Public access to Crooked Lake is via a state DNR boat launch located on the northeast end of the lake. Parking is limited to 15 vehicles and trailers. The boat ramp is concrete, and the access site has a vault toilet. The access site is closed from 11:00 pm to 4:00 am.



**Figure 1.** Crooked Lake in Clare County, Michigan. The red circle is the location of the public boat launch.

## Methods

Crooked Lake was surveyed using a variety of gear types outlined in the Status and Trends Lakes protocol from May 16 to May 19, 2022, as described by Wehrly et al. (in press; Figure 2). Sampling gears used included one seine net, one trap net, two experiment gillnets, two small mesh and three large mesh fyke nets. Three 600 s boat electrofishing transects were conducted on the night of May 19. The total effort for the survey was three seine hauls and 23 net-nights. A limnological survey (e.g. dissolved oxygen and temperature regime, shoreline alteration) was conducted on August 4, 2022.



**Figure 2.** Location of gear set May 16-19, 2022 on Crooked Lake. Each contour line is 5 ft intervals.

## Results

### *Limnology*

The shoreline had 14 submerged trees. A total of 303 docks and 354 dwellings were noted in the 26 sampled segments along with 58.5% of the shoreline characterized as armored. Submerged trees offer valuable fisheries habitat and are important in reducing erosion rates by stabilizing shoreline areas.

The maximum depth measured was 72.4 ft and temperature declined from 76.0°F at the surface to 43.8°F at the bottom (Table 1). The thermocline was relatively shallow, occurring between 17



and 20 feet deep with a Secchi depth of 26 ft. This depth is where the dissolved oxygen rapidly declines below 3.0 ppm, which is considered hypoxic and inadequate for many fish species. The pH of Crooked Lake varied from 9.5 at the surface to 8.4 at the bottom. The specific conductivity ranged from 268-295  $\mu$  S/cm. Water temperatures during fish sampling ranged from 62 – 67° F.

**Table 2.** Temperature (°F), dissolved oxygen (ppm), specific conductance (mS/cm) and pH profile from the water surface to the bottom in Crooked Lake, Clare County, August 2022.

| Depth (ft) | Temperature | Dissolved Oxygen | pH  | Specific conductance |
|------------|-------------|------------------|-----|----------------------|
| 0          | 77.1        | 7.7              | 9.3 | 0.278                |
| 6          | 76.0        | 7.7              | 9.5 | 0.268                |
| 10         | 75.8        | 7.7              | 9.4 | 0.268                |
| 19         | 61.9        | 3.0              | 9.1 | 0.286                |
| 66         | 43.8        | 0.3              | 8.4 | 0.289                |
| 2.9        | 76.2        | 7.7              | 9.5 | 0.268                |
| 13.2       | 74.7        | 6.4              | 9.3 | 0.274                |
| 14.2       | 74.4        | 6.3              | 9.3 | 0.274                |
| 15.9       | 72.4        | 4.8              | 9.2 | 0.280                |
| 17         | 69.1        | 4.2              | 9.2 | 0.285                |
| 17.8       | 65.7        | 3.3              | 9.1 | 0.286                |
| 20.2       | 58.9        | 2.9              | 9.1 | 0.287                |
| 21.3       | 55.9        | 2.6              | 9.0 | 0.285                |
| 23.7       | 51.9        | 1.2              | 8.9 | 0.285                |
| 27.3       | 49.9        | 0.1              | 8.9 | 0.286                |
| 30.6       | 47.7        | 0.1              | 8.8 | 0.286                |
| 33.5       | 46.9        | 0.1              | 8.8 | 0.285                |
| 36.3       | 46.6        | 1.2              | 8.7 | 0.284                |
| 40.4       | 45.5        | 1.7              | 8.7 | 0.283                |
| 42.5       | 45.0        | 1.9              | 8.6 | 0.284                |
| 45.3       | 44.7        | 2.1              | 8.6 | 0.283                |
| 48.1       | 44.4        | 2.0              | 8.6 | 0.283                |
| 51         | 44.1        | 1.6              | 8.5 | 0.285                |
| 54.3       | 44.00       | 1.1              | 8.5 | 0.285                |
| 57.4       | 44.0        | 0.8              | 8.5 | 0.286                |
| 60.4       | 44.0        | 0.5              | 8.5 | 0.286                |
| 63.2       | 43.9        | 0.3              | 8.4 | 0.288                |
| 68.1       | 43.8        | 0.3              | 8.4 | 0.289                |
| 71.3       | 43.8        | 0.3              | 8.4 | 0.290                |
| 72.4       | 43.8        | 0.3              | 8.4 | 0.295                |



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### ***Fisheries***

A total of 1,101 fish representing 15 species and 1 hybrid were captured in Crooked Lake (Table 3). The fish community was dominated by Bluegill making up 31.3% of the collection followed closely by Pumpkinseed (21.9%). Most of the remaining species collected made up 6% or less of the fish community, except for Northern Pike (8.5%) and Yellow Bullhead (12.4%). Panfish species made up 58.3% by number and only 10.5% by weight and included previously mentioned species in addition to Black Crappie, hybrid sunfish (Green Sunfish x Bluegill), Longear Sunfish, and Yellow Perch. The sport predator community includes Largemouth Bass, Northern Pike, and Rock Bass which made up only 21% of the total catch by number but 43.2% by weight. The forage base for small piscivorous fish species collected in this survey included Bluntnose Minnow, Golden Shiner, and Iowa Darter. These species made up 2.1% of the total catch and all ranged from 2 to 5 in. Bullhead, Bowfin, and Common Carp comprised the non-sport fish community captured and made up just 18.5% by number, but nearly half of the weight at 46.1%.

A total of 20 Black Crappie averaging 9.4 in were collected with 90% of the catch larger than the generally accepted harvest length of 7 in. Large mesh fyke nets captured majority of the Black Crappie. Qualitative examination of the data indicated that mean TL of Black Crappie did not differ by more than 1 in between gear types that captured more than one individual. Age and growth analysis indicated Black Crappie were growing slightly above the statewide average with a mean growth index of +0.6 in. Multiple year classes (ages 2-9) were found suggesting stable recruitment to the harvestable fishery.

A total of 345 Bluegill (mean TL = 5.2 in) were collected with all five survey gear types with 12% of the catch larger than the generally accepted harvest length of 6-in. Boomshocking accounted for 64% of the total catch. Qualitative examination of the data indicated that mean TL of Bluegill did not differ by more than 1 in between gear types that captured more than one individual. Age and growth analysis indicated Bluegill were growing similar to the statewide average with a mean growth index of +0.3 in. A Schneider Index score of 3.2 was calculated based on several of the above parameters, which indicated a Bluegill population of acceptable ranking (Schneider 1990). Multiple year classes (ages 1-10) were found suggesting stable recruitment into a harvestable fishery.

A total of 66 Largemouth Bass averaging 11.7 in were collected with 29% of the catch larger than the 14-in MSL. There were no differences among gear types for Largemouth Bass. Age and growth analysis indicated Largemouth Bass were growing above the statewide average with a mean growth index of 1.9 in. Multiple year classes (ages 1-9) were found suggesting stable recruitment to the harvestable fishery.

A total of 94 Northern Pike averaging 17.9 in were collected with 3% of the catch larger than the 24-in MSL. Status and Trends surveys are not ideal for targeting Northern Pike because the warmer water temperatures push them into deeper, cooler water making them less likely to encounter our gear. Gillnetting accounted for nearly 60% of the total catch and caught longer individuals than other gear types. Age and growth analysis indicated Northern Pike were





growing above the statewide average with a mean growth index of -2.3 in. Multiple year classes (ages 1-7) were found suggesting stable recruitment into a harvestable fishery.

A total of 241 Pumpkinseed averaging 5.6 in were collected with 22% of the catch larger than the generally accepted harvest length of 6 in. Boomshocking captured majority of the Pumpkinseed (48.5%). Qualitative examination of the data indicated that mean TL of Pumpkinseed did not differ by more than 1 in between gear excluding small mesh fyke net. Age and growth analysis indicated Pumpkinseed were growing above the statewide average with a mean growth index of 1.3 in. Multiple year classes (ages 1-8) were found suggesting stable recruitment to the harvestable fishery.

A total of 32 Yellow Perch (mean TL = 3.6 in) were collected with 3% of the catch larger than the generally accepted 7-in minimum size for harvest (although there is not a mandated MSL). Age and growth analysis was not calculated. Other popular sport fish species collected included Longear Sunfish and Rock Bass.

**Table 3.** Fish species captured during the May 2022 Status and Trends survey on Crooked Lake. Columns represent number of fish, length range (in), mean length of each species captured and mean growth index (MGI) were appropriate.

| Species          | Number | Length Range (in) | Average Length (in) | Percent of Harvestable Size | MGI  |
|------------------|--------|-------------------|---------------------|-----------------------------|------|
| Black Crappie    | 20     | 6 – 11            | 9.4                 | 90                          | +0.6 |
| Bluegill         | 345    | 1 – 10            | 5.2                 | 12                          | +0.3 |
| Bluntnose Minnow | 7      | 2 – 2             | 2.5                 | 100                         | -    |
| Bowfin           | 34     | 15 – 26           | 20.7                | 100                         | -    |
| Brown Bullhead   | 31     | 5 – 14            | 9.7                 | 87                          | -    |
| Common Carp      | 2      | 29 – 31           | 30.5                | 100                         | -    |
| Golden Shiner    | 11     | 4 – 5             | 4.9                 | 100                         | -    |
| hybrid sunfish   | 3      | 2 – 3             | 3.2                 | 0                           | -    |
| Iowa Darter      | 5      | 2 – 2             | 2.5                 | 100                         | -    |
| Largemouth Bass  | 66     | 2 – 18            | 11.7                | 59                          | +1.9 |
| Longear Sunfish  | 1      | 3 – 3             | 3.5                 | 0                           | -    |
| Northern Pike    | 94     | 11 – 24           | 17.9                | 3                           | -2.3 |
| Pumpkinseed      | 241    | 1 – 9             | 5.6                 | 22                          | +1.3 |
| Rock Bass        | 72     | 2 – 9             | 6.1                 | 75                          | -    |
| Yellow Perch     | 32     | 1 – 7             | 3.6                 | 3                           | -    |
| Yellow Bullhead  | 137    | 4 – 14            | 10.5                | 94                          | -    |

## Conclusions

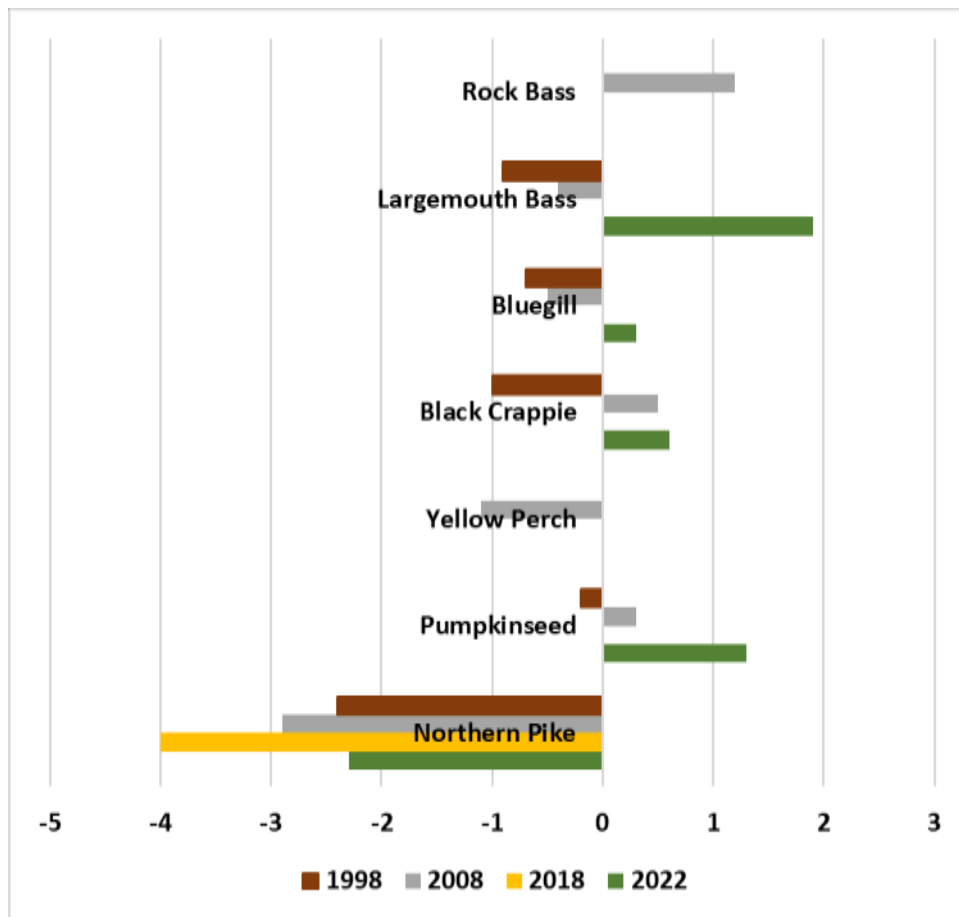
In 2008, Black Crappie and Pumpkinseed were the only sportfish growing (slightly) above the statewide average (Figure 3). However, the Crooked Lake Bluegill population still had a



Schneider index of “satisfactory”. These poor growth rate, specifically for Northern Pike, were thought to be associated with excessive aquatic vegetation growth. In 2022, all sportfish caught in large enough numbers were growing above or similar to the statewide average except for Northern Pike.

It should be noted that Michigan DNR Fisheries does not conduct aquatic vegetation surveys; therefore, all comments about vegetation densities relies on Michigan Department of Environment, Great Lakes, and Energy (EGLE) surveys and private company management data which can be limited. Michigan Lakefront Solutions LLC (ANC9806595) is actively treating the lake for algae, Starry Stonewort, Curly-leaf Pondweed, and Eurasian Watermilfoil totaling 117.25 acres over the course of four summer months. In 2018, EGLE staff conducted an [Aquatic Vegetation Assessment Site \(AVAS\) Survey](#). A total of 25 aquatic plant species were identified with densities from <2% (found) to >60% (dense). The dominant plant species was Wild Celery followed by *Chara* spp. which were found out 46 and 41 of the 46 AVAS, respectively, from <2% to over 60%. All other species were in similar (low) densities. Of the invasive species found, Eurasian watermilfoil was the most common and found at 41 of 46 AVAS at a density of < 2% to up to 60% per site. Starry Stonewort and Curly-leaf Pondweed, two species Michigan Lakefront Solutions treat for, were found in very low densities at 3 and 1 of the 46 sites, respectively.

Even though there are not high densities of invasive species, this survey provides evidence that the high density of macrophytes could be the cause of the stunted Northern Pike population. Property owners should work with Michigan Lakefront Solutions LLC to ensure Crooked Lake is being properly treated to maintain a target level of 20-30% vegetation coverage. Once weed management concerns are addressed, other management actions such as liberalized Northern Pike regulations, will be considered.



**Figure 3.** Mean growth index (x-axis) for sportfish captured in adequate numbers in 1998, 2008, 2018, and 2022. The larger the bar to the left or right of zero, the larger the deviation from the statewide average and the slower or faster the growth rate, respectively.

## References

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