Minnesota Statewide Fisheries Lake
and Stream Management Planning
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Segment 36, Year 1
Objective 2
03/22/2024

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
SECTION OF FISHERIES

COMPLETION REPORT FOR THE MINNESOTA WATERS OF LAKE SUPERIOR

2023

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Executive Summary

This report summarizes survey work completed in the Minnesota waters of Lake Superior by the Minnesota DNR. The overall catch rate of Lake Trout (*Salvelinus namaycush)* in the May assessment was 16.6 fish per 1,000 feet of net and above the third quartile (14.3) of the 43-year dataset. CPUE by management zone was 22.9 in MN-1, 8.2 in MN-2, and 17.1 in MN-3. Shorewide, 98% of Lake Trout were wild fish. The Sea Lamprey (*Petromyzon marinus*) wounding rate in the May Lake Trout assessment was above the target level of 5.0 fresh wounds per 100 Lake Trout at 9.2 fresh wounds per 100 Lake Trout. Wounding rates were above target in MN-1 (7.7) and MN-3 (12.9) but below target in MN-2 (1.3).

In the juvenile Lake Trout assessment, the overall CPUE was 17.5 fish per 1,000 feet of net, which was within the interquartile range of the 43-year dataset (14.4-25.8) and the highest since 2005. CPUE by management zone was 14.5 in MN-1, 16.6 in MN-2, and 25.6 in MN-3. Shorewide, 96% of juvenile Lake Trout captured were wild. Despite the discontinuation of stocking by the MNDNR in 2016, some clipped juveniles are still being caught and are likely originating from stocking efforts in Wisconsin waters.

In the summer expanded commercial Lake Trout assessment, commercial operators in MN-1 harvested 566 Lake Trout and the CPUE was 17.4 fish per 1,000 feet of net. Lake Trout harvest in MN-2 was 495 fish and the CPUE was 16.0 fish per 1,000 feet of net. In MN-3, 2,091 Lake Trout were harvested and the CPUE was 16.3 fish per 1,000 feet of net. Collectively, commercial operators harvested 57% of the available quota. Commercial operators accounted for 9% of the total shorewide Lake Trout harvest between sport (30,751) and commercial (3,152) fishers combined.

In the spawning Lake Trout assessment, CPUE by zone was 180.0 fish/1,000 feet of net in MN-1, 71.1 in MN-2, and 50.0 in MN-3. Only one net was set in MN-1 due to weather and time constraints, but participating commercial operators in MN-2 and MN-3 fished fully through the assessment period.

The estimated biomass of spawning-size Cisco (*Coregonus artedi*) from the fall hydroacoustic survey was 6.08 million pounds and represents a 107% increase from 2022. Offshore zones accounted for 97% of the total biomass and nearshore zones accounted for only 3%. The increase in biomass was likely attributable to recruitment of the 2020 year-class to the fishery. The Cisco from a massive 2022 year-class are still too small to be counted in hydroacoustic surveys or caught by commercial operators, but are expected to recruit to the fishery in a few years.

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Introduction

This report summarizes the assessment work conducted by the Lake Superior Area Office in Minnesota's portion of Lake Superior in 2023 including the May Lake Trout (*Salvelinus namaycush)*, juvenile Lake Trout, summer expanded commercial Lake Trout, spawning Lake Trout, and Cisco (*Coregonus artedi*) assessments.

Lake Trout are the top native predator in Lake Superior and historically supported important recreational and commercial fisheries. Rehabilitation of self-sustaining Lake Trout stocks has been the major goal for agencies around Lake Superior since the collapse of the Lake Trout fishery due to commercial over-exploitation and predation by Sea Lamprey (*Petromyzon marinus*) (Horns et al. 2003) in the mid-1950s. Over the past few decades, wild Lake Trout abundance has increased, limited commercial harvest of Lake Trout has resumed, and stocking was deemed no longer necessary and discontinued. Lake Trout is the primary species caught by anglers, presently supporting a recreational fishery with an average annual catch of 29,428 fish (2014-2023) in the Minnesota waters of Lake Superior (Beckman 2024). There are four recognized morphotypes of Lake Trout in Lake Superior: lean, Siscowet, humper, and redfin (Muir et. al 2014). The humper and redfin morphotypes are generally not encountered in the Minnesota portion of Lake Superior. However, the deepwater morphotype of Lake Trout, known as the Siscowet, along with the lean Lake Trout morphotype, are commonly observed in Minnesota waters. For consistency throughout this report, lean Lake Trout will be referred to as "Lake Trout" and Siscowet Lake Trout will be referred to as "Siscowet".

Cisco are an important native forage species in Lake Superior and have also supported a commercial fishery since the late 1800s. Cisco stocks crashed in the 1950s, and although populations have rebounded, they remain well below historic levels. Cisco population dynamics are monitored by hydroacoustic surveys, assessment netting, sampling the commercial catch, and analyzing commercial fishing records. Commercial harvest is summarized thoroughly in an annual commercial fishing report (Blankenheim 2024).

Chinook Salmon (*Oncorhynchus tshawytscha)*, Coho Salmon (*O. kisutch)*, and Rainbow Trout (*O. mykiss*) are generally not vulnerable to MN DNR assessment gill nets. The status of these salmonid species is discussed in creel survey reports (Peterson 2024a; Beckman 2024) and the Knife River trap report (Peterson 2024b).

Methods

Lake Superior is divided into statistical zones and grids. In Minnesota, zones include MN-1, MN-2, and MN-3 (Figure 1). MN-1 encompasses the area from the Duluth Entry to the Encampment River; MN-2 extends from the Encampment River to the Poplar River; MN-3 extends from the Poplar River to the Canadian border. These zones will regularly be referred to throughout this report.

The MN DNR conducts the May Lake Trout assessment in MN-1 while commercial operators provide data for MN-2 and MN-3. The May Lake Trout assessment utilizes 4.5-inch stretch-measure mesh. In MN-1 each gang consists of three 250-foot nets for a total of 750 feet per gang; commercial operators set gangs of variable length. Gangs were set in eight locations in MN-1, two in MN-2, and one in MN-3, with each gang set between 120 and 240 feet of water. Gangs set by the MN DNR were for one night unless weather interfered with net retrieval; participating commercial operators generally set gangs for one or two nights.

The juvenile Lake Trout assessment is conducted solely by the MN DNR. The assessment had consisted of five nets each 200 feet in length tied together for a total gang length of 1,000 feet. Mesh sizes included 1.5-, 1.75-, 2.0-, 2.25-, and 2.5-inch stretch-measure mesh. However, in 2022 the 1.75-inch and 2.25-inch meshes were dropped due to difficulty obtaining those mesh sizes, and because they were sizes not commonly used by other jurisdictions around the lake. Gangs were reconfigured as three nets each 300 feet in length for a total length of 900 feet, utilizing 1.5-, 2.0-, 2.5-inch stretch-measure mesh. Gangs were set in six locations in MN-1, four locations in MN-2, and three locations in MN-3,

with each gang starting in 120 feet of water and ending shallower than 240 feet. Gang sets were for two nights, except for at Hovland, which is always set for one night.

A limited summer expanded commercial Lake Trout assessment fishery was permitted beginning in 2007 for MN-3, 2010 for MN-2, and 2017 for MN-1. The annual Lake Trout limits had been 3,000 fish in MN-3, 2,000 fish in MN-2, and 500 fish in MN-1, but in 2023 the MN-1 quota was increased to 700 fish. Commercial operators selected the statistical zone and grid they wished to fish in, with no more than two operators per grid. Lake Trout were allotted based on the number of applicants per zone, with a maximum of 1,000 Lake Trout per operator. The season was open from June 1st through September 30th. Detailed harvest information for this fishery can be found in the annual commercial fishery summary report (Blankenheim 2024).

Historically, a Lake Trout spawning assessment occurred every other year in odd years. However, as Lake Trout became rehabilitated, the spawning assessment has become a lower priority during the busy fall survey season. In 2023, the MN DNR set in one location a single time, one commercial operator set nets in MN-2, and one commercial operator set in MN-3. Higher priority work and uncooperative weather precluded additional assessment work in MN-1. Net sets were 250 feet of 5.5-inch stretch-measure mesh fished on the bottom in less than 100 feet of water for one night.

Statistical zones, grids, and locations for the May Lake Trout, juvenile Lake Trout, and spawning Lake Trout assessments are shown in Figure 1. Detailed specifications for survey nets can be found in Ebener (2001). In all surveys the length, weight, sex, fin clips, and lamprey wounds were recorded for each fish caught. The MN DNR collected otoliths and stomach contents on all Lake Trout retained, while commercial operators did so on a subsample of the fish they harvested in the May Lake Trout, summer expanded commercial, and spawning Lake Trout assessments.

Figure 1. Statistical zones, grids, and sampling stations for May (M), juvenile (J), and spawning (S) assessments, Minnesota waters of Lake Superior.

Beginning in 2006, catch per unit effort (CPUE) for Lake Trout has been corrected for soak time (i.e., the numbers of nights the nets were fished). Correction factors for gill net CPUE developed by G.L. Curtis (Great Lakes Science Center, unpublished; cited in Hansen et al. 1998) were used to standardize 2- and ≥3-night sets to a uniform base of one night. Thus, the net length was multiplied by 1.52 for 2-night sets and 1.8 for ≥3-night sets.

Previously in MN-1, Lake Trout CPUE was calculated using an average of individual net CPUE's:

$$\overline{CPUE_i} = \frac{\sum \frac{C_i}{f_i}}{n},$$

where C_i = individual net catch (number of Lake Trout), f_i = fishing effort (1,000 feet of gill net), and n = the number of net sets in a given year. The benefit of this equation is confidence limits can be calculated for the CPUE value, which we do not utilize in this report. For data clarity, consistency between statistical districts, and ease of understanding in reporting, the CPUE calculation was changed to:

$$CPUE = \frac{\sum C_i}{\sum f_i},$$

and all previous years' CPUEs were recalculated for MN-1. Therefore, historical CPUEs in this report may be slightly different than in some previous reports.

Cisco are assessed in two ways: netting assessments and hydroacoustic surveys. The MN DNR Cisco assessment consists of 300-foot multi-mesh (2.0-, 2.5-, and 3.0-inch stretch-measure mesh) nets, with 100 feet of each mesh size per net. Two nets are fished east of Two Harbors in Burlington Bay. One net is fished 12 feet below the surface while the other is fished 24 feet below the surface in approximately 150 feet of water. Nets are checked daily until a minimum of 100 Cisco total are collected. Length, weight, sex, and otoliths are collected from each fish. Additionally, length, sex, and otoliths are collected from commercial operator Cisco samples in both spring/summer and fall from each statistical zone. Due to the time constraints of otolith aging and reporting, age data of Cisco sampled in 2023 from the MN DNR assessment and the commercial fishing sampling were not yet available for this report.

Hydroacoustic surveys with accompanying mid-water trawls have been conducted since 2003; methodology can be found in Hrabik et al. (2006). From 2003-2014 hydroacoustic surveys were conducted in the summer but have been conducted in the fall since 2015. From 2017 to 2021, all hydroacoustic work was conducted aboard the Large Lakes Observatory's R/V Blue Heron. In all other fall surveys, the offshore transects (>260 feet) were completed from the R/V Blue Heron and the nearshore transects (<260 feet) were completed aboard the MN DNR Blackfin. The advantage to utilizing the smaller MN DNR vessel for nearshore transects is that it can more thoroughly cover shallow water where the larger R/V Blue Heron cannot go. Sampling the MN-3 nearshore transect was discontinued after 2015 because it contributed very little to the overall Cisco biomass estimate. Prior to 2023, Biosonics hydroacoustic equipment was used for all surveys, but beginning in 2023 Simrad equipment was utilized. Data analysis procedures are described in the MN DNR Lake Superior Hydroacoustic Standard Operating Procedure.

Results and Discussion

<u>May Assessment</u>

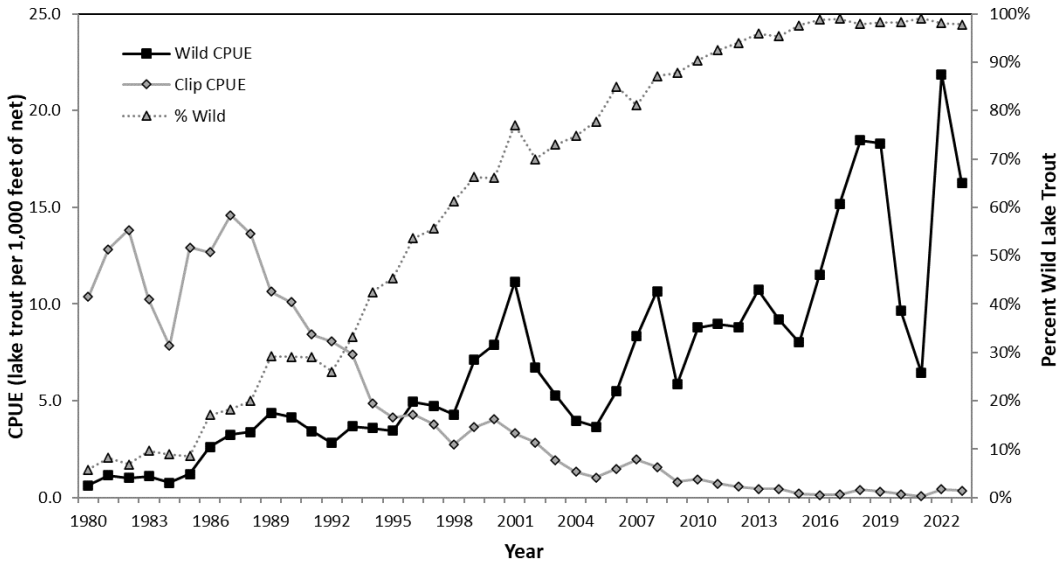
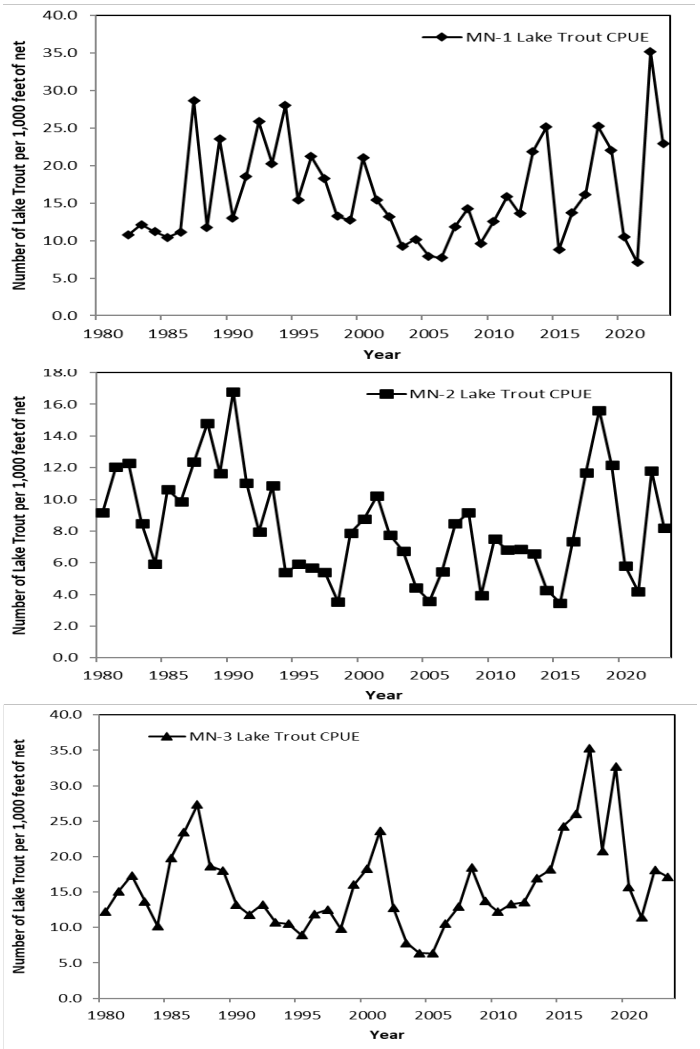


Figure 2. Catch rate (number of fish per 1,000 feet of net) of wild and stocked Lake Trout, and percentage wild Lake Trout in the May assessment, 1980-2023.



The overall CPUE of Lake Trout was 16.6 fish per 1,000 feet of net in the May assessment (Table 1). The 2023 CPUE was above the third quartile (14.3 fish/1,000 feet) for the 43-year time series. The wild Lake Trout CPUE was 16.2 fish per 1,000 feet of net while the stocked Lake Trout CPUE was 0.4 fish per 1,000 feet of net (Table 1, Figure 2). Wild fish comprised 98% of all Lake Trout sampled in the assessment. Stocked fish are uncommon in MN-2 and MN-3, but some are still caught in MN-1 because stocking was discontinued in Minnesota waters only relatively recently (2016) and Wisconsin stocks Lake Trout annually.

By zone, Lake Trout CPUEs for MN-1, MN-2, and MN-3 were 22.9, 8.2, and 17.1 fish per 1,000 feet of net (Table 2, Figure 3). The CPUE for MN-1 was slightly above its interquartile range (11.2-21.2 fish/1,000 feet), while the CPUEs for MN-2 and MN-3 were within their respective interquartile ranges (MN-2: 5.8-10.9; MN-3: 11.9-18.3).

Figure 3. Lake Trout catch rate (number of fish per 1,000 feet of net) by statistical district in the May assessment, 1980-2023.

Sea Lamprey control is conducted by the U.S. Fish & Wildlife Service and Fisheries and Oceans Canada. Control efforts have kept the population of Sea Lamprey at or below 10% of peak abundance. Nevertheless, Sea Lamprey are still a major cause of Lake Trout mortality in Minnesota waters. The number of fresh Sea Lamprey wounds per 100 Lake Trout (hereafter referred to as the wounding rate) in the May assessment was 9.2 for all management zones combined (Table 3, Figure 4). By management zone, wounding rates were 7.7 in MN-1, 1.3 in MN-2, and 12.9 in MN-3 (Table 3, Figure 5). The

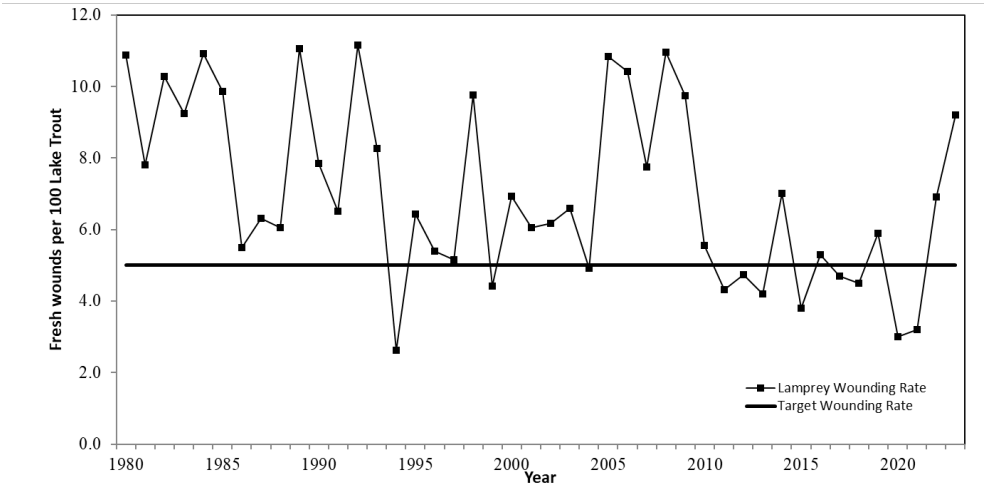
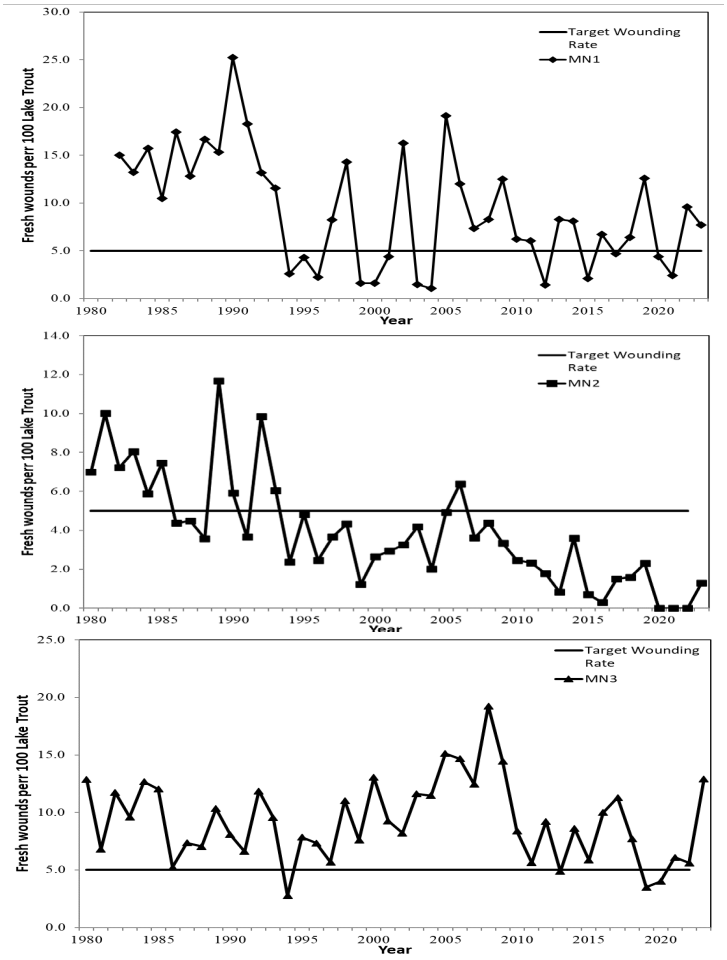


Figure 4. Shorewide number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, 1980-2023.



target wounding rate for all zones is not more than 5 fresh wounds per 100 Lake Trout. Wounding rates increased with length category.

There were 16 different categories of prey consumed by Lake Trout captured in the May assessment (Table 4). Rainbow Smelt (*Osmerus mordax*) commonly comprise the greatest weight of diet items in Lake Trout stomachs during the May assessment, sometimes exceeding 90% of the diet biomass. In 2023, Rainbow Smelt biomass comprised 85% of the total prey biomass, and 62% of Lake Trout stomachs contained at least one Rainbow Smelt. Other prominent diet items included unidentifiable fish remains (8.6%), Burbot (*Lota lota*; 4.4%), and Coregonids (both Cisco and unidentifiable Coregonids; 1.7%). Only ten percent of Lake Trout (n=37) had no prey items in their stomachs.

Figure 5. Number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, by statistical district, 1980 - 2023.

Juvenile Lake Trout Assessment

The overall CPUE of juvenile Lake Trout (less than 17 inches/432 mm) was 17.5 fish per 1,000 feet of net, which was within the 43-year interquartile range (14.4-25.8) and the highest since 2005 (Table 5). The CPUE of wild juveniles was 16.9 Lake Trout per 1,000 feet of net and the CPUE of stocked juveniles was 0.6 Lake Trout per 1,000 feet of net (Table 5, Figure 6).

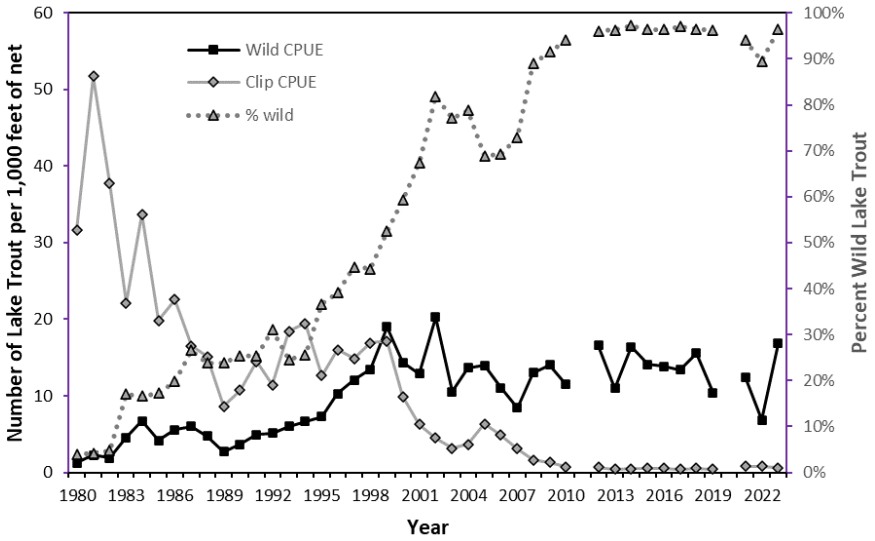
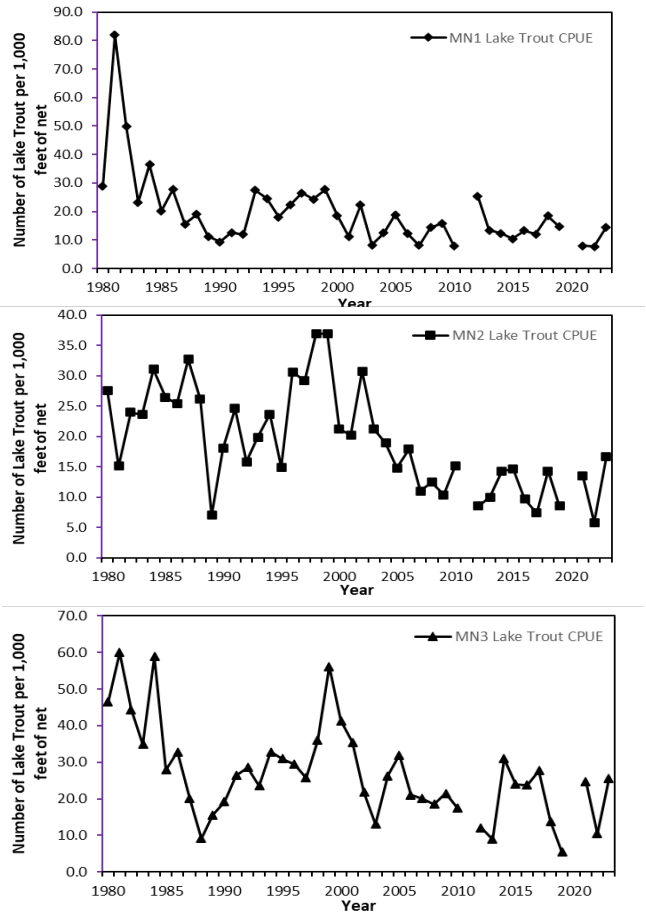


Figure 6. Catch rate (number of fish per 1,000 feet of net) of wild and stocked Lake Trout, and percent wild Lake Trout in the juvenile (<17") Lake Trout assessment, 1980-2023.



CPUEs in MN-1, MN-2, and MN-3 were 14.5, 16.6, and 25.6 Lake Trout per 1,000 feet of net, respectively (Table 6, Figure 7). The CPUEs for all three zones were within their respective interquartile ranges (MN-1: 12.1-24.1; MN-2: 13.7-25.2; MN-3: 19.4-32.6). Although the overall juvenile CPUE has been much lower than that observed in the 1980s, it is important to consider Lake Trout rehabilitation was still underway at that time and recent CPUEs likely represent recruitment levels of self-sustaining Lake Trout populations in Lake Superior.

Ninety-six percent of the juvenile Lake Trout catch was wild (Table 6, Figure 6). Zones MN-2 and MN-3 were 100% wild fish, as would be expected since stocking was discontinued in those zones in 2007 (MN-2) and 2003 (MN-3). Stocking was discontinued in MN-1 in 2016, but despite this, 9% of juveniles captured in this zone were fin clipped hatchery fish. The Wisconsin DNR continues to stock Lake Trout which likely contributes to the lower percentage of wild fish in MN-1, especially at the Lester River/Brighton Beach and Pumping Station locations which are nearest to Wisconsin stocking locations.

Figure 7. Lake Trout catch rate (number of fish per 1,000 feet of net) by statistical district in the juvenile Lake Trout assessment, 1980-2023.

There were 14 categories of diet items consumed by juvenile Lake Trout (Table 4). A higher than usual quantity of fish was consumed by juvenile Lake Trout, primarily because they were feeding on young Coregonids. By weight, juvenile Lake Trout diets were comprised primarily of unidentifiable fish remains (49.9%), Coregonid species (Cisco, Bloater, or Kiyi that couldn't be differentiated) (27.2%), Rainbow Smelt (9.4%), and *Mysis* (8.3%). Thirty-nine percent (n = 119) of juvenile Lake Trout stomachs contained no prey items, which was within the range observed the previous five years (10% to 40%).

Summer Expanded Commercial Assessment

In 2023, a total of 566 Lake Trout were harvested in MN-1, and the CPUE was 17.4 Lake Trout per 1,000 feet of net (Table 7, Figure 8). Commercial operators harvested 81% of the 700 fish total-allowable-catch (TAC; Lake Trout and Siscowet combined). Commercial harvest of Lake Trout represented 3% of the estimated total Lake Trout harvest in MN-1 between sport (18,402) and commercial (566) fishers combined.

In MN-2, the number of Lake Trout harvested by commercial operators was 495 and the CPUE was 16.0 Lake Trout per 1,000 feet of net (Table 7, Figure 8). Sixteen Siscowet were also harvested. Commercial operators harvested 26% of the 2,000 fish TAC for MN-2. Commercial harvest of Lake Trout represented 6% of the estimated total Lake Trout harvest in MN-2 between sport (8,450) and commercial (495) fishers combined.

In MN-3, commercial operators harvested 2,091 Lake Trout and the CPUE was 16.3 Lake Trout per 1,000 feet of net (Table 7, Figure 8). An additional 58 Siscowet were harvested. Commercial operators harvested 72% of the 3,000 fish TAC. Commercial harvest of Lake Trout represented 35% of the estimated total Lake Trout harvest in MN-3 between sport (3,899) and commercial (2,091) fishers combined. In the three zones combined, commercial operators harvested 57% of the TAC. Overall, commercial harvest accounted for 9% of the total estimated Lake Trout harvest between sport (30,751) and commercial (3,152) fishers.

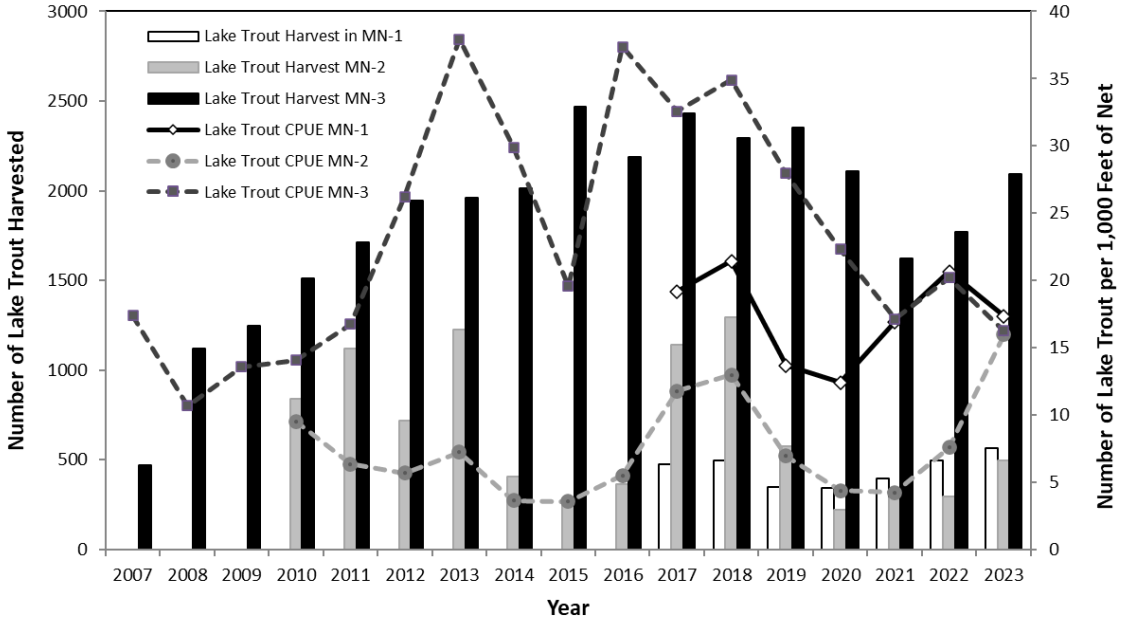


Figure 8. Lake Trout harvest and catch rate (number of fish per 1,000 feet of net) in the summer expanded commercial assessment, 2007-2023.

Twenty-one categories of diet items were consumed by Lake Trout in the summer expanded commercial assessment. Lake Trout diet composition by weight was predominately Coregonid species (both Cisco and Coregonids that could not be differentiated) (32.7%), unidentifiable fish remains (30.6%), Rainbow Smelt (23.3%), Burbot (4.0%), and *Mysis* (3.0%) (Table 4). In recent years, Lake

Trout diets in the summer expanded commercial assessment have contained more insects and *Mysis* and less Coregonid biomass compared to 2023, and the Coregonids that had been consumed were adult fish. However, the Coregonids consumed this year were primarily small specimens from the phenomenally large year-class of 2022. Twenty-seven percent of Lake Trout stomachs (n = 198) had no diet items, which was less than the previous five years (31% to 46%).

Spawning Lake Trout Assessment

The Lake Trout CPUE in MN-1 was 180.0 fish/1,000 feet of net and all fish (n=45) were males (Table 8). Ninety-one percent were wild fish. Sampling took place in mid-November when the water temperature was already colder than the temperature for peak spawning activity, which may explain why no females were captured. Typically, there are three other stations sampled in MN-1, and all stations are sampled more than once, but poor weather and higher priority projects precluded additional sampling beyond the one set at Stoney Point.

In MN-2, the Lake Trout CPUE was 71.1 fish/1,000 feet of net, and the CPUE in MN-3 was 50.0 fish/1,000 feet of net (Table 8). Males outnumbered females by a ratio of 5:1 in MN-2 and 2:1 in MN-3. The commercial operators who assisted in these two zones fished throughout the mid-October to early November sampling period. Ninety-nine percent of Lake Trout in MN-2 were wild fish, and 100% were wild in MN-3. Caution should be used when considering CPUEs from spawning assessment sets due to the possibility of net saturation.

Diet data from fish during the spawning Lake Trout assessment is generally not very informative, as the fish tend to refrain from eating. Of the stomachs examined, 76% (n=84) were empty. By weight, prey was either Rainbow Smelt (74.3%) or unidentifiable fish remains (24.8%) with a small amount of rock (0.8%) and woody debris (0.1%) mixed in (Table 4).

Cisco Assessment

The estimated biomass of spawning-size Cisco in the fall of 2023 hydroacoustic survey was 6.08 million pounds (Figure 9). The majority of the adult Cisco biomass was in the offshore zone, which is defined as water depths greater than 260 feet (80 meters). By zone, MN-3 offshore accounted for 69% of the total Cisco biomass, followed by MN-2 offshore (26%), MN-1 nearshore (2%), MN-1 offshore (2%), and MN-2 nearshore (1%).

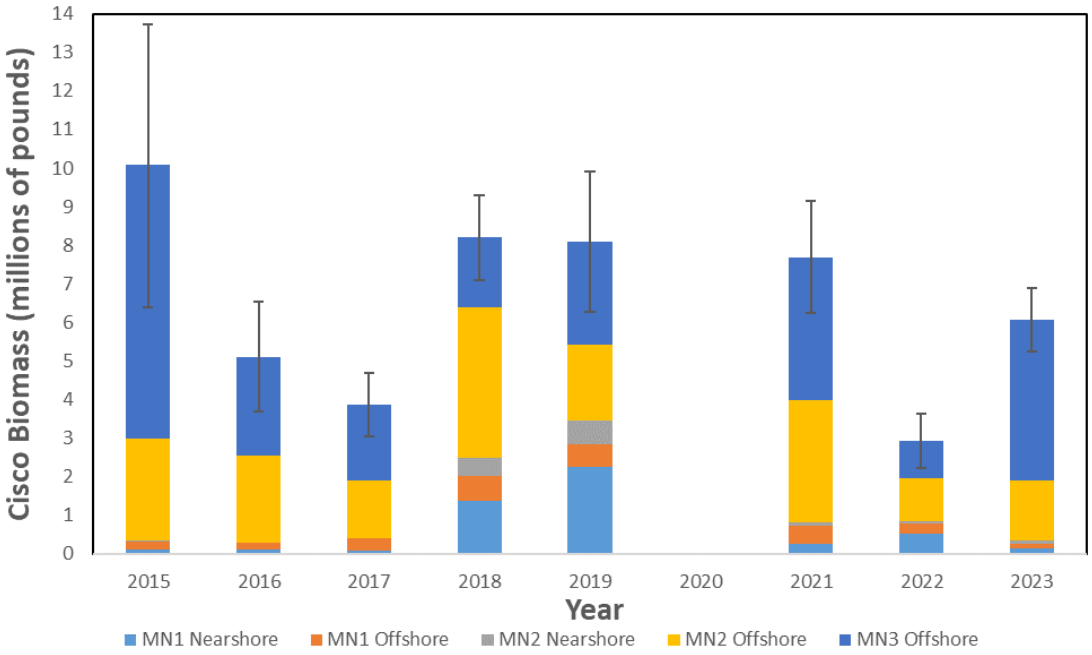


Figure 9. The estimated biomass of spawning-size Cisco from fall hydroacoustic surveys, 2015-2023. Upper and lower 95% confidence intervals are shown.

The 2023 estimate represents a 107% increase in biomass from 2022. The increase in biomass may be attributable to a modest 2020 year-class of Cisco. During their annual trawl survey in 2021, the USGS recorded a density of 10 age-1 Cisco/ha for the 2020 year-class (Vinson 2024). These fish were age-3 during the 2023 sampling season and would likely have been large enough to be above the minimum target threshold of -35.2db used in analysis of our hydroacoustic data. Thus, the addition of their biomass to the adult population could be accountable for the bump in Cisco biomass observed in our 2023 hydroacoustic survey. Furthermore, some relatively small Cisco in the 12-to-13-inch range were caught in the fall by commercial operators (Figure 10). But surprisingly, no similarly small Cisco were caught in the MN DNR assessment, even though it utilizes smaller mesh sizes than what commercial operators fish. Assessment of age structures collected from commercial operators during November and those collected during the MN DNR Cisco survey have not yet been completed, but will be useful in determining if the 2020 year-class has indeed contributed to the fishery. Additionally, a record-setting year-class of young Cisco was observed during the USGS's 2023 survey, in which age-1 Cisco density was 1,019/ha (Vinson 2024). These fish should provide substantial biomass to the fishery in future years.

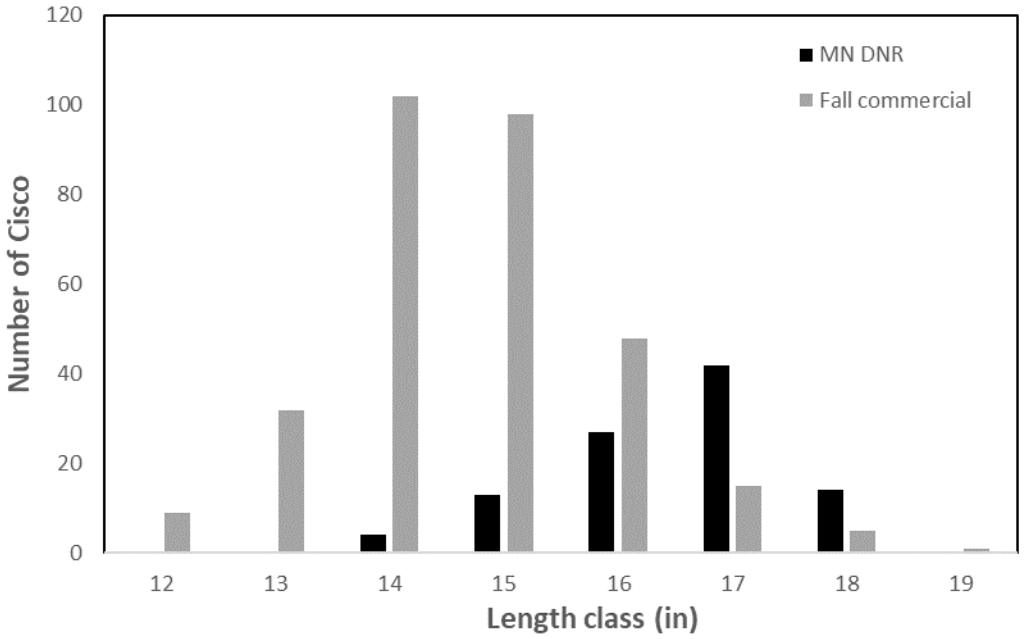


Figure 10. The length-frequency distribution of Cisco from the MN DNR Cisco survey and from Cisco sampled from fall commercial fishing operations, 2023.

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
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SECTION OF FISHERIES

COMPLETION REPORT FOR MINNESOTA WATERS OF LAKE SUPERIOR

2023

Prepared by:

Josh Blankenheim

Approved by: Cory Goldsworthy Digitally signed by Cory Goldsworthy Date: 2024.06.12 10:46:17 -05'00'
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Area Fisheries Supervisor Date

Approved by: David Weitzel Digitally signed by David Weitzel Date: 2024.06.26 11:35:16 -05'00'
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Regional Fisheries Approval Date

Reimbursed under Federal Aid by the Sport Fish Restoration Act

Table 1. Historical catch summary of Lake Trout caught in the May Lake Trout assessment, CPUE (number of fish per 1,000 feet) and percent wild Lake Trout, Minnesota waters of Lake Superior, 1980-2023.

Year	Number of Fish Sampled	Number of Wild Fish Per 1,000 Feet	Number of Stocked Fish Per 1,000 Feet	Total Number Per 1,000 Feet	Percent Wild
1980	2,436	0.6	10.4	11.0	6%
1981	3,080	1.2	12.8	14.0	8%
1982	3,017	1.0	13.8	14.8	7%
1983	2,930	1.1	10.2	11.3	10%
1984	2,580	0.8	7.8	8.6	9%
1985	2,698	1.2	12.9	14.1	9%
1986	3,117	2.6	12.7	15.3	17%
1987	2,882	3.3	14.6	17.9	18%
1988	2,846	3.4	13.6	17.0	20%
1989	3,201	4.4	10.6	15.0	29%
1990	2,860	4.1	10.1	14.2	29%
1991	2,402	3.4	8.4	11.9	29%
1992	2,197	2.8	8.1	10.9	26%
1993	2,197	3.7	7.4	11.1	33%
1994	1,847	3.6	4.9	8.4	43%
1995	1,612	3.4	4.1	7.6	45%
1996	1,490	4.9	4.3	9.2	54%
1997	1,157	4.7	3.8	8.5	56%
1998	887	4.3	2.7	7.0	61%
1999	1,306	7.1	3.6	10.7	66%
2000	1,542	7.9	4.1	11.9	66%
2001	1,290	11.1	3.3	14.5	77%
2002	1,250	6.7	2.8	9.6	70%
2003	890	5.3	1.9	7.2	73%
2004	809	4.0	1.3	5.3	75%
2005	666	3.6	1.0	4.7	78%
2006	957	4.9	1.4	6.3	78%
2007	1,286	8.3	2.0	10.3	81%
2008	1,207	10.7	1.6	12.2	87%
2009	845	5.8	0.8	6.7	88%
2010	892	8.8	0.9	9.7	90%
2011	1,030	9.0	0.7	9.7	93%
2012	1,004	8.8	0.6	9.4	94%
2013	1,035	10.3	0.4	10.8	96%
2014	794	8.8	0.4	9.2	95%
2015	541	7.7	0.2	7.9	98%
2016	782	11.5	0.1	11.6	99%
2017	1,033	15.1	0.1	15.2	99%
2018	1,089	18.5	0.4	18.9	98%
2019	865	18.4	0.3	18.7	98%
2020 [1]	581	9.7	0.1	9.8	99%
2021	541	6.4	0.1	6.5	99%
2022	799	21.9	0.4	22.3	98%
2023	650	16.2	0.4	16.6	98%

[1] entire survey was conducted by commercial operators due to Covid restrictions on MNDNR field work

Table 2. Corrected Lake Trout catch and yield by station in the May Lake Trout assessment, 2023.

Location	Effort in Feet (corrected effort)	Number Caught	Total Pounds	Number per 1,000 feet	Pounds per 1,000 feet	Percent Wild
MN-1						
All stations (n = 8)	12,000 (12,000)	275	1,128	22.9	94.0	94.9
MN-2						
Split Rock						
Silver Bay	7,000 (10,120)	83	270	8.2	26.7	100
Totals MN-2	7,000 (10,120)	83	270	8.2	26.7	100
MN-3						
Grand Marais	12,750 (17,040)	292	1,026	17.1	60.2	100
All locations						
Shorewide	**31,750 (39,160)**	**650**	**2,424**	**16.6**	**61.9**	**97.8**

Table 3. Number of fresh lamprey wounds per 100 Lake Trout (>17 inches/432 mm) in the May Lake Trout assessment, by size class and statistical district, 2023. Number of Lake Trout sampled in each length category is listed in parenthesis.

	Size Class				
	432-532 mm (17-20.9 in.)	533-634 mm (21-24.9 in.)	635-736 mm (25-28.9 in.)	737 + mm (29 + in.)	Total
MN-1	4.0 (76)	4.9 (142)	21.3 (47)	12.5 (8)	7.7 (273)
MN-2	0.0 (35)	2.7 (37)	0.0 (4)	0.0 (1)	1.3 (77)
MN-3	5.7 (105)	9.9 (131)	30.2 (43)	55.6 (9)	12.9 (288)
TOTALS	4.2 (216)	6.8 (310)	24.5 (94)	33.3 (18)	9.2 (638)

Table 4. Diet composition by weight of prey items in Lake Trout stomachs in the May, juvenile, summer expanded commercial, and spawning assessments, 2023. The number of stomachs sampled with prey items is shown in parentheses.

	Lake Trout							
Diet item	**May**		**Juvenile**		**Summer**		**Spawning**	
Aquatic insects	0.0%	(2)	0.5%	(6)	1.1%	(51)		
Artificial fishing bait					0.1%	(1)		
Bird					0.3%	(2)		
Burbot	4.4%	(9)			4.0%	(6)		
Cisco	0.1%	(2)			8.1%	(24)		
Coregonid spp	1.6%	(26)	27.2%	(15)	24.6%	(118)		
Deepwater Sculpin			1.2%	(2)	0.1%	(1)		
Eggs	0.0%	(2)			0.1%	(1)		
Empty		(37)		(119)		(198)		(84)
Leech			0.0	(1)				
Mysis	0.0%	(1)	8.3%	(47)	3.0%	(41)		
Ninespine Stickleback					0.1%	(4)		
Rainbow Trout					0.4%	(1)		
Rainbow Smelt	85.0%	(227)	9.4%	(17)	23.3%	(113)	74.3%	(9)
Rock	0.0%	(10)	0.1%	(2)	0.6%	(44)	0.8%	(1)
Salmonid	0.0%	(1)						
Sculpin spp	0.1%	(4)	0.7%	(2)	0.5%	(12)		
Slimy Sculpin	0.0%	(1)	0.5%	(1)	1.0%	(14)		
Snake					0.0%	(1)		
Spoonhead Sculpin			0.5%	(1)				
Stickleback spp	0.0%	(2)						
Terrestrial insects	0.1%	(4)	0.7%	(16)	2.0%	(41)		
Threespine Stickleback	0.1%	(2)			0.0%	(1)		
Troutperch			1.0%	(1)				
Unidentifiable fish remains	8.6%	(149)	49.9%	(112)	30.6%	(355)	24.8%	(16)
Woody debris	0.0%	(9)	0.0%	(1)	0.1%	(1)	0.1%	(1)

Table 5. Historical catch summary of Lake Trout less than 17 inches (432 mm) caught in small mesh gill nets (1.5-2.5 inch stretch-measure), CPUE (number of fish per 1,000 feet) and percent wild in the juvenile Lake Trout assessment, Minnesota waters of Lake Superior, 1980-2023.

Year	Number of Fish Sampled	Number of Wild Fish Per 1,000 Feet	Number of Stocked Fish Per 1,000 Feet	Total Number Per 1,000 Feet	Percent Wild
1980	625	1.3	31.6	32.9	4%
1981	914	2.2	51.7	54.0	4%
1982	551	1.9	37.7	39.6	5%
1983	453	4.5	22.2	26.7	17%
1984	585	6.7	33.7	40.4	17%
1985	336	4.1	19.9	24.0	17%
1986	404	5.6	22.6	28.2	20%
1987	346	6.0	16.5	22.5	27%
1988	285	4.7	15.1	19.8	24%
1989	168	2.7	8.6	11.3	24%
1990	236	3.7	10.7	14.4	25%
1991	363	4.9	14.5	19.4	25%
1992	274	5.1	11.4	16.6	31%
1993	387	6.0	18.4	24.4	25%
1994	458	6.7	19.4	26.1	26%
1995	352	7.3	12.6	20.0	37%
1996	468	10.3	16.0	26.3	39%
1997	440	12.0	14.9	26.9	45%
1998	557	13.5	16.9	30.4	44%
1999	640	19.0	17.2	36.2	53%
2000	454	14.4	9.9	24.3	59%
2001	370	12.9	6.3	19.2	67%
2002	484	20.3	4.5	24.8	82%
2003	249	10.5	3.1	13.7	77%
2004	334	13.7	3.7	17.4	79%
2005	402	14.0	6.3	20.3	69%
2006	306	11.0	4.9	15.9	69%
2007	222	8.4	3.1	11.5	73%
2008	282	13.0	1.6	14.7	89%
2009	295	14.0	1.3	15.3	92%
2010	235	11.5	0.7	12.2	94%
2011 [1]	-	-	-	-	-
2012	332	16.6	0.7	17.3	96%
2013	219	11.0	0.4	11.4	96%
2014	324	16.4	0.5	16.8	97%
2015	281	14.1	0.5	14.6	96%
2016	276	13.8	0.5	14.3	96%
2017	273	13.4	0.4	13.8	97%
2018	315	15.6	0.6	16.2	97%
2019	208	10.4	0.4	10.8	96%
2020 [2]	-	-	-	-	-
2021	254	12.4	0.8	13.2	94%
2022	133	6.9	0.8	7.7	89%
2023	303	16.9	0.6	17.5	96%

[1] No data due to State of Minnesota government shutdown

[2] No data due to coronavirus pandemic

Table 6. Summary of fishing effort, catch, percentage of wild Lake Trout and CPUE (number of fish per 1,000 feet of 1.5-2.5 inch stretch-measure gill net) in the juvenile Lake Trout (less than 17 inches; 432 mm) assessment, 2023.

Location	Effort in Feet	Corrected Effort in Feet*	Number of lake trout	Percent Wild	CPUE Wild	CPUE Stocked	CPUE Total
MN-1							
Lester River	900	1,368	12	83%	7.3	1.5	8.8
Pumping Station	900	1,368	31	87%	19.7	2.9	22.7
Stoney Point	900	1,368	32	88%	20.5	2.9	23.4
Larsmont	900	1,368	9	100%	6.6	0.0	6.6
Two Harbors	900	1,368	18	94%	12.4	0.7	13.2
Encampment Island	900	1,368	17	100%	12.4	0.0	12.4
MN-1 Total	**5,400**	**8,208**	**119**	**91%**	**13.2**	**1.3**	**14.5**
MN-2							
Split Rock	900	1,368	42	100%	30.7	0.0	30.7
Silver Bay	900	1,368	31	100%	22.7	0.0	22.7
Taconite Harbor	900	1,368	14	100%	10.2	0.0	10.2
Tofte	900	1,368	4	100%	2.9	0.0	2.9
MN-2 Total	**3,600**	**5,472**	**91**	**100%**	**16.6**	**0.0**	**16.6**
MN-3							
Grand Marais	900	1,368	55	100%	40.2	0.0	40.2
Hovland	900	900	12	100%	13.3	0.0	13.3
Grand Portage	900	1,368	26	100%	19.0	0.0	19.0
MN-3 Total	**2,700**	**3,636**	**93**	**100%**	**25.6**	**0.0**	**25.6**
Shorewide Total	**11,700**	**17,316**	**303**	**96%**	**16.9**	**0.6**	**17.5**

For CPUE calculations fishing effort was corrected for two night sets (900 ft. actual effort x 1.52 = 1,368 feet except for Hovland, which was a one night set).

Table 7. Commercial catch of Lake Trout (LAT) and Siscowet (SCT), Lake Trout CPUE (fish per 1,000 feet of net), percent of commercial quota harvested, Lake Trout harvest in the sport fishery, and percentage of total Lake Trout harvest taken by commercial fishing, 2007-2023.

	MN-1						MN-2						MN-3					
Year	LAT harvest	SCT harvest	LAT CPUE	Percent of quota	Sport LAT harvest	Commercial percentage of LAT harvest	LAT harvest	SCT harvest	LAT CPUE	Percent of quota	Sport LAT harvest	Commercial percentage of LAT harvest	LAT harvest	SCT harvest	LAT CPUE	Percent of quota	Sport LAT harvest	Commercial percentage of LAT harvest
2007													470	92	17.4	19%	4,350	10%
2008													1122	109	10.7	41%	1,310	46%
2009													1246	100	13.6	45%	2,450	34%
2010							839	119	9.5	48%	8,729	9%	1510	140	14.1	55%	2,118	42%
2011							1118	89	6.4	60%	4,711	19%	1713	106	16.8	61%	2,484	41%
2012							716	130	5.7	42%	3,899	16%	1944	121	26.2	69%	2,583	43%
2013							1224	113	7.2	67%	4,728	21%	1959	48	37.9	67%	1,638	54%
2014							409	166	3.7	29%	3,872	10%	2015	77	29.9	70%	2,190	48%
2015							287	88	3.6	19%	4,923	6%	2468	216	19.6	89%	3,254	43%
2016							364	36	5.5	20%	7,432	5%	2189	42	37.4	74%	3,872	36%
2017	475	0	19.2	95%	17,346	3%	1139	67	11.8	60%	5,294	18%	2431	64	32.6	83%	5,366	31%
2018	494	1	21.4	99%	18,352	3%	1297	20	13.0	66%	5,466	19%	2295	110	34.9	80%	3,683	38%
2019	349	0	13.7	70%	12,651	3%	576	46	7.0	31%	3,924	13%	2353	158	28.0	84%	2,163	52%
2020	341	0	12.4	68%	14,312	2%	220	29	4.4	12%	3,713	6%	2109	177	22.3	76%	2,620	45%
2021	398	2	16.9	80%	18,623	2%	288	44	4.2	17%	5,251	5%	1625	155	17.1	59%	2,672	38%
2022	496	2	20.7	100%	14,207	3%	294	28	7.6	16%	3,685	7%	1770	125	20.2	63%	2,303	43%
2023	566	0	17.4	81%	18,402	3%	495	16	16.0	26%	8,450	6%	2091	58	16.3	72%	3,899	35%

Table 8. Effort, catch, CPUE (number per 1,000 feet), percent wild, and number by sex of Lake Trout in the 2023 spawning assessment.

	MN-1	MN-2	MN-3
Total effort (feet)	250	2,250	3,000
Total catch (number)	45	160	150
Number/1,000 feet	180.0	71.1	50.0
Percent wild	91%	99%	100%
Number by Sex			
male	45	135	101
female	0	25	49
not examined	0	0	0

Table 9. Spawning-size Cisco biomass estimates (millions of pounds) from fall hydroacoustic surveys, 2015-2023. Lower and upper 95% confidence limits are shown.

Year	MN1 Nearshore			MN1 Offshore			MN2 Nearshore			MN2 Offshore			MN3 Offshore			Shorewide		
	Estimate	Lower	Upper	Estimate	Lower	Upper	Estimate	Lower	Upper	Estimate	Lower	Upper	Estimate	Lower	Upper	Estimate	Lower	Upper
2015	0.106	0.030	0.182	0.214	0.123	0.324	0.017	0.009	0.029	2.640	1.674	3.775	7.104	3.403	10.307	9.971	6.276	13.617
2016	0.127	0.057	0.211	0.156	0.083	0.230	0.005	0.004	0.006	2.271	1.191	3.402	2.539	1.631	3.441	5.127	3.713	6.570
2017	0.089	0.071	0.108	0.308	0.242	0.378	0.020	0.016	0.025	1.490	1.177	1.832	1.973	1.208	2.671	3.853	3.028	4.650
2018	1.377	0.716	2.085	0.631	0.455	0.810	0.478	0.257	0.714	3.892	3.294	4.547	1.821	1.343	2.341	8.224	7.135	9.313
2019	2.258	1.154	3.360	0.598	0.310	0.891	0.608	0.201	1.020	1.955	0.865	2.929	2.684	1.741	3.623	8.043	6.209	9.849
2020																		
2021	0.263	0.103	0.459	0.480	0.078	0.951	0.087	0.034	0.151	3.154	2.538	3.819	3.700	2.438	4.918	7.694	6.248	9.152
2022	0.515	-0.025	1.107	0.276	0.201	0.357	0.049	0.024	0.077	1.114	0.726	1.457	0.977	0.773	1.202	2.939	2.230	3.656
2023	0.140	0.096	0.192	0.130	0.125	0.134	0.074	0.044	0.124	1.562	1.241	1.881	4.149	3.421	4.919	6.076	5.280	6.900