Minnesota
Statewide Fisheries Lake and Stream Management Planning
F19AF00978
R29G60F29RP35
Segment 35, Year 2
Study 2
03/24/2023

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

# COMPLETION REPORT FOR THE MINNESOTA WATERS OF LAKE SUPERIOR

# 2022

Prepared by:

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Reimbursed under Federal
Aid by the Sport Fish
Restoration Act

## Executive Summary

The Sea Lamprey (*Petromyzon marinus*) wounding rate in the May assessment was above the target level of 5.0 fresh wounds per 100 Lake Trout (*Salvelinus namaycush)* at 6.9 wounds per fish. Wounding rates were above target in MN-1 (9.6) and MN-3 (5.6) but below target in MN-2 (0.0). The overall catch rate of Lake Trout in the May assessment was 22.3 fish per 1,000 feet of net and the was the highest in the past 43 years. CPUE by management zone was 35.2 in MN-1, 11.8 in MN-2, and 18.2 in MN-3. Shorewide, 98% of Lake Trout were wild fish.

In the juvenile Lake Trout assessment, the overall CPUE was 7.7 fish per 1,000 feet of net, which was the poorest in the past 43 years. CPUE by management zone was 7.7 in MN-1, 5.8 in MN-2, and 10.5 in MN-3. Shorewide, 89% of juvenile Lake Trout captured were wild. Despite the discontinuation of stocking by the MNDNR in 2015, some clipped juveniles are still being caught and are likely originating from stocking efforts in Wisconsin waters.

In the summer expanded commercial assessment, commercial operators in MN-1 harvested 496 Lake Trout and the CPUE was 20.7 fish per 1,000 feet of net. Lake Trout harvest in MN-2 was 294 fish and the CPUE was 7.6 fish per 1,000 feet of net. In MN-3, 1,770 Lake Trout were harvested and the CPUE was 20.2 fish per 1,000 feet of net. Collectively, commercial operators harvested 45.6% of the available quota. Commercial operators accounted for 11.3% of the total shorewide Lake Trout harvest between sport (20,195) and commercial (2,560) fishers combined.

Two sites were chosen for experimental assessment as possible Lake Trout spawning areas. Sites were selected because they were shallow reef structures adjacent to deep water, and because both were part of a research project studying *Didymosphenia.* Gooseberry Reef was chosen in MN-2, and the CPUE was 88.0 fish/1,000 feet of net. Alligator Island was selected in MN-3, and the CPUE was 112.0 fish/1,000 feet of net.

The estimated biomass of spawning size Cisco (*Coregonus artedi*) from the fall hydroacoustics survey was 2.94 million pounds and represents a 62% decrease from 2021. Offshore zones accounted for 81% of the total biomass and nearshore zones accounted for 19%. Biomass of spawning size Cisco is unlikely to increase unless there is a successful recruitment event.

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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 2022 including the May Lake Trout (*Salvelinus namaycush)*, juvenile Lake Trout, summer expanded commercial 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 28,072 fish (2013-2022) in the Minnesota waters of Lake Superior (Beckman 2023). The deepwater morphotype of Lake Trout, known as the Siscowet, generally lives in depths greater than 240 feet and is the most abundant predator in Lake Superior. 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, MNDNR assessment netting, sampling the commercial catch, and analyzing commercial fishing records. Commercial harvest is summarized thoroughly in an annual commercial fishing report (Blankenheim 2023).

Chinook Salmon (*Oncorhynchus tshawytscha),* Coho Salmon (*O. kisutch),* and Rainbow Trout (*O. mykiss*) are generally not vulnerable to MNDNR assessment gill nets. The status of these salmonid species is discussed in creel survey reports (Peterson 2023a; Beckman 2023) and the Knife River trap report (Peterson 2023b).

## Methods

MNDNR 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, one in MN-2, and one in MN-3, with each gang set between 120 and 240 feet of water. Gangs set by MNDNR 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 MNDNR. 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 are 3,000 fish in MN-3, 2,000 fish in MN-2, and 500 fish in MN-1. Commercial operators must select the statistical zone and grid they wish to fish in, with no more than two operators per grid. Lake Trout are allotted based on

the number of applicants per zone, with a maximum of 1,000 Lake Trout per operator. The season is open from June 1st through September 30th. Detailed harvest information for this fishery can be found in the annual commercial fishery summary report (Blankenheim 2023).

Although 2022 was not a Lake Trout spawning assessment year, a small amount of 5.5-inch stretch-measure mesh was set to explore possible spawning locations outside of areas that are routinely sampled in Lake Trout spawning assessments. Gooseberry Reef in MN-2 and Alligator Island in MN-3 were chosen as sampling locations. These locations were chosen because they are shallow reefs adjacent to deep water, and because of concurrent *Didymosphenia* research in both locations. Net sets were 250 feet of 5.5-inch mesh fished on the bottom in 20 to 40 feet of water for one night.

Statistical zones, grids, and locations for May Lake Trout and juvenile Lake Trout 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. MNDNR 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 assessment and summer expanded commercial assessment.

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 MNDNR 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 2022 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 2003-2013 hydroacoustic surveys were conducted in the summer but have been conducted in the fall since 2014. From 2017 to 2021, all hydroacoustic work was conducted aboard the Large Lakes Observatory's R/V Blue Heron rather than split between the R/V Blue Heron conducting the offshore transects (>240 foot depths) and the MNDNR Blackfin conducting the nearshore transects (<240 foot depths). In 2022 nearshore transects were once again conducted aboard the MNDNR Blackfin. The advantage to utilizing the smaller MNDNR 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 contributes very little to the overall Cisco biomass estimate. Data analysis procedures are described in the MNDNR Lake Superior Hydroacoustics Standard Operating Procedure.

## Results and Discussion

May Assessment

Sea Lamprey control is conducted by the U.S. Fish & Wildlife Service and Fisheries and Oceans Canada. Control efforts have kept the population 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 (wounding rate) in the May assessment was 9.6 in MN-1, 0.0 in MN-2, and 5.6 in MN-3 (Table 1, Figure 2). The overall wounding rate was 6.9 (Figure 3). The target wounding rate for all zones is not more than 5 fresh wounds per 100 Lake Trout. Wounding rates were particularly high at >27 wounds per 100 fish for Lake Trout larger than 25 inches in MN-1, and not simply due to low sample size as is sometimes seen in the larger size categories.

The overall CPUE of Lake Trout was 22.3 fish per 1,000 feet of net in the May assessment and all size classes were represented (Table 2). The 2022 CPUE was the highest during the past 43 years (Table 3). The wild Lake Trout CPUE was 21.9 fish per 1,000 feet of net while the stocked Lake Trout CPUE was 0.4 fish per 1,000 feet of net (Table 3, Figure 4). 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 relatively recently (2015) and Wisconsin stocks Lake Trout annually. By zone, Lake Trout CPUEs for MN-1, MN-2, and MN-3 were 35.2, 11.8, and 18.2 fish per 1,000 feet of net (Table 4, Figure 5). The CPUE for MN-1 was the highest on record, while the CPUEs for MN-2 and MN-3 were above and within their respective interquartile ranges (MN-2: 5.8-10.9; MN-3: 11.9-18.4).

There were 22 different types of prey consumed by Lake Trout captured in the May assessment (Table 5). 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 2022, Rainbow Smelt biomass comprised 88.6% of the total prey biomass, and 66% of Lake Trout stomachs contained at least one Rainbow Smelt. Other prominent diet items included Burbot (*Lota lota*; 5.3%), unidentifiable fish remains (3.5%), and Coregonids (1.3%). Fifteen percent of Lake Trout (n=60) had no prey items in their stomachs, which was similar to the previous five years (9% to 28%).

Juvenile Lake Trout Assessment

The overall CPUE of juvenile Lake Trout (less than 17 inches) was 7.7 fish per 1,000 feet of net, which represents an all-time low during the past 43 years (Table 6). The CPUE of wild juveniles was 6.9 Lake Trout per 1,000 feet of net and the CPUE of stocked juveniles was 0.8 Lake Trout per 1,000 feet of net (Table 6, Figure 6). CPUEs in MN-1, MN-2, and MN-3 were 7.7, 5.8, and 10.5 Lake Trout per 1,000 feet of net, respectively (Table 7, Figure 7). The CPUEs for MN-1 and MN-2 were both historic lows, and the MN-3 CPUE was below the interquartile range (19.2-32.8). 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.

Eighty-nine percent of the juvenile Lake Trout catch was wild (Tables 6 and 7, 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 after 2015, but despite this only 78% of juveniles caught in MN-1 were wild. The Wisconsin DNR continues to stock Lake Trout which contributes to the lower percent wild fish in MN-1, especially at the Lester River/Brighton Beach and Pumping Station locations which are nearest to Wisconsin stocking locations.

By weight, juvenile Lake Trout diets were comprised primarily of Rainbow Smelt (37.0%), terrestrial insects (25.1%), unidentifiable fish remains (19.4%), and *Mysis* (14.4%) (Table 5). Forty

percent (n = 61) of juvenile Lake Trout stomachs contained no prey items, which was above the range observed the previous five years (10% to 36%).

Summer Expanded Commercial Assessment

In accordance with the 2016 Lake Superior Management Plan (LSMP; Goldsworthy et al. 2017), a limited commercial fishery for Lake Trout in MN-1 was established in 2017 and commercial operators in this zone got to target Lake Trout for the first time since the 1960s. The quota for MN-1 was set at 500 Lake Trout. In 2022 a total of 496 Lake Trout and two Siscowet were harvested, and the CPUE was 20.7 Lake Trout per 1,000 feet of net (Figure 8). Commercial operators harvested 99.6% of the total-allowable-catch (TAC; Lake Trout and Siscowet combined). Commercial harvest of Lake Trout represented 3.4% of the estimated total Lake Trout harvest in MN-1 between sport (14,207) and commercial (496) fishers combined.

In MN-2, the number of Lake Trout harvested by commercial operators was 294 and the CPUE was 7.6 Lake Trout per 1,000 feet of net (Figure 8). Twenty-eight Siscowet were also harvested. Commercial operators harvested 16.1% of the 2,000 fish TAC from MN-2. Commercial harvest of Lake Trout represented 7.4% of the estimated total Lake Trout harvest in MN-2 between sport (3,685) and commercial (294) fishers combined.

In MN-3, commercial operators harvested 1,770 Lake Trout and the CPUE was 20.2 Lake Trout per 1,000 feet of net (Figure 8). An additional 125 Siscowet were harvested. Commercial operators harvested 63.2% of the 3,000 fish TAC. Commercial harvest of Lake Trout represented 43.5% of the estimated total Lake Trout harvest in MN-3 between sport (2,303) and commercial (1,770) fishers combined. In the three zones combined, commercial operators harvested 45.6% of the TAC. Overall, commercial harvest accounted for 11.3% of the total estimated Lake Trout harvest between sport (20,195) and commercial (2,560) fishers.

Lake Trout diet composition by weight in the summer commercial assessment was predominately Rainbow Smelt (52.2%), unidentifiable fish remains (15.9%), terrestrial insects (11.6%), coregonids (7.7%), Burbot (4.5%), and *Mysis* (4.3%) (Table 5). Thirty-six percent of Lake Trout stomachs (n = 193) had no diet items, which was similar to the previous five years (31% to 46%).

Spawning Lake Trout Assessment

The Lake Trout CPUE in MN-2 at Gooseberry Reef was 88.0 fish/1,000 feet of net, and in MN-3 at Alligator Island the CPUE was 112.0 fish/1,000 feet. At Gooseberry Reef 82% of fish were male and at Alligator Island 89% were male. Males are much generally more common in the spawning assessment, as they seem to congregate while awaiting the arrival of females. The high catch rates suggest spawning may occur at or near these sites. Both locations should be strongly considered for future spawning assessment work.

Cisco Assessment

USGS trawling data continues to indicate that Cisco recruitment is very sporadic. Since 2003, only relatively weak or nonexistent year-classes have been produced (Figure 9). Due to the lag in otolith preparation and aging, age data from the commercial Cisco samples and MNDNR Cisco survey were not available for inclusion in this report.

The estimated biomass of spawning size Cisco in the fall of 2022 was 2.94 million pounds (Figure 10). This represents a 62% decrease in biomass from 2021. Biomass will likely continue to decrease until there is a successful recruitment event. MN-2 offshore accounted for 38% of the overall biomass, followed by MN-3 offshore (33.3%), MN-1 nearshore (17.6%), MN-1 offshore (9.4%), and MN-2 nearshore (1.7%). Although the biomass estimate was low, a high number of juvenile Cisco were caught during the midwater trawls aboard the RV Blue Heron, indicating there may have been a successful recruitment event in 2022. The USGS trawling efforts targeting age-1 fish in 2023 will shed light on the strength of a potential 2022 year-class.

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Minnesota
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F19AF00978
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# COMPLETION REPORT FOR MINNESOTA WATERS OF LAKE SUPERIOR

# 2022

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Area Fisheries Supervisor Date

Approved by: Leslie George Digitally signed by Leslie George Date: 2023.04.29 23:38:07 -05'00'
Regional Fisheries Approval Date

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**Table 1. Number of fresh lamprey wounds per 100 Lake Trout (>17") in 4.5-inch stretch-mesh May assessment gill nets, by size class and statistical district, 2022. Number of Lake Trout sampled in each length range 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 | 1.0 (102) | 6.2 (227) | 27.7 (83) | 28.6 (7) | 9.6 (419) |
| MN-2 | 0.0 (16) | 0.0 (73) | 0.0 (14) | 0.0 (0) | 0.0 (103) |
| MN-3 | 2.2 (90) | 6.3 (112) | 10.9 (46) | 4.6 (22) | 5.6 (270) |
| **TOTALS** | 1.4 (208) | 5.1 (412) | 19.6 (143) | 10.3 (29) | 6.9 (792) |

**Table 2. Number of Lake Trout by size class per 1,000 feet of 4.5-inch stretch-mesh May assessment gill nets, 2022.**

| | **Size Class** | | | | | |
|---|---|---|---|---|---|---|
| Assessment | <432 mm (<17 inches) | 432-532 mm (17-20.9 inches) | 533-634 mm (21-24.9 inches) | 635-736 mm (25-28.9 inches) | 737+ mm (29 + inches) | Overall |
| May | 0.2 | 5.8 | 11.5 | 4.0 | 0.8 | 22.3 |

**Table 3. Historical catch summary of Lake Trout caught in the May assessment, CPUE (number of fish per 1,000 feet) and percent wild Lake Trout, Minnesota waters of Lake Superior, 1980-2022.**

| 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 | 1,255 | 6.7 | 2.8 | 9.6 | 70% |
| 2003 | 892 | 5.3 | 1.9 | 7.3 | 73% |
| 2004 | 809 | 4.0 | 1.3 | 5.3 | 75% |
| 2005 | 666 | 3.6 | 1.0 | 4.7 | 78% |
| 2006 | 958 | 5.5 | 1.5 | 6.5 | 85% |
| 2007 | 1,284 | 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 | 1,034 | 10.7 | 0.5 | 11.2 | 96% |
| 2014 | 794 | 9.2 | 0.4 | 9.6 | 95% |
| 2015 | 541 | 8.0 | 0.2 | 8.2 | 98% |
| 2016 | 782 | 11.5 | 0.1 | 11.6 | 99% |
| 2017 | 1,033 | 15.2 | 0.1 | 15.3 | 99% |
| 2018 | 1,089 | 18.5 | 0.4 | 18.9 | 98% |
| 2019 | 863 | 18.3 | 0.3 | 18.6 | 98% |
| 2020 [1] | 583 | 9.7 | 0.2 | 9.8 | 98% |
| 2021 | 541 | 6.4 | 0.1 | 6.5 | 99% |
| 2022 | 799 | 21.9 | 0.4 | 22.3 | 98% |

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

**Table 4. Corrected Lake Trout catch by station in the May assessment, 2022.**

| 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) | 422 | 1,664 | 35.3 | 138.7 | 96.7 |
| MN-2 | | | | | | |
| Split Rock | | | | | | |
| Silver Bay | 5,570 (8,740) | 103 | 350 | 11.8 | 40.0 | 100 |
| Totals MN-2 | 5,570 (8,740) | 103 | 350 | 11.8 | 40.0 | 100 |
| MN-3 | | | | | | |
| Grand Marais | 12,750 (15,090) | 274 | 1,122 | 18.2 | 74.4 | 99.6 |
| **All locations** | | | | | | |
| **Shorewide** | **30,500 (35,830)** | **799** | **3,136** | **22.3** | **87.5** | **98.1** |

**Table 5. Diet composition by weight of prey items in Lake Trout stomachs in the May, juvenile, and summer expanded commercial assessments, 2022. The number of stomachs sampled with prey items is shown in parentheses.**

| | Lake Trout | | |
|---|---|---|---|
| **Diet item** | **May** | **Juvenile** | **Summer** |
| Aquatic insects | 0.1% (10) | 3.3% (23) | 1.1% (40) |
| Artificial fishing bait | 0.1% (2) | | |
| Bird | 0.1% (1) | | 0.1% (1) |
| Burbot | 5.3% (5) | | 4.5% (1) |
| Central Mudminnow | 0.0% (1) | | |
| Coregonid spp | 1.3% (7) | | 7.7% (11) |
| Creek Chub | 0.1% (1) | | |
| Deepwater Sculpin | 0.1% (3) | | |
| Empty | (60) | (61) | (193) |
| Fathead Minnow | 0.0% (1) | | |
| Fish eggs | 0.0% (2) | | |
| *Mysis* | 0.1% (5) | 14.4% (25) | 4.3% (41) |
| Ninespine Stickleback | 0.0% (1) | 0.2% (1) | |
| Northern Redbelly Dace | 0.1% (4) | | |
| Rainbow Smelt | 88.6% (259) | 37.0% (19) | 52.2% (112) |
| Rock | 0.2% (21) | | 0.1% (14) |
| Sculpin spp | 0.2% (9) | 0.1% (1) | 1.1% (23) |
| Slimy Sculpin | 0.1% (4) | | 0.9% (9) |
| Snake | | | 0.0% (1) |
| Stickleback spp | 0.0% (4) | 0.3% (1) | 0.3% (5) |
| Terrestrial insects | 0.1% (7) | 25.1% (21) | 11.6% (61) |
| Threespine Stickleback | 0.0% (1) | | |
| Unidentifiable fish remains | 3.5% (72) | 19.4% (26) | 15.9% (133) |
| Woody debris | 0.1% (10) | 0.2% (2) | 0.2% (11) |

**Table 6. 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, 1980-2022.**

| Year | No. 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% |

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

[2] No data due to coronavirus pandemic

**Table 7. 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 gill net) in the juvenile Lake Trout (less than 17 inches; 432 mm) assessment, 2022.**

| 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 | | 57% | 2.9 | 2.2 | 5.1 |
| Pumping Station | 900 | 1,368 | | 64% | 10.2 | 5.8 | 16.1 |
| Stoney Point | 900 | 1,368 | | 87% | 14.6 | 2.2 | 16.8 |
| Larsmont | 900 | 1,368 | | | 0.0 | 0.0 | 0.0 |
| Two Harbors | 900 | 1,368 | | 100% | 1.5 | 0.0 | 1.5 |
| Encampment Island | 900 | 1,368 | | 100% | 6.6 | 0.0 | 6.6 |
| **MN-1 Total** | **5,400** | **8,208** | **0** | **78%** | **6.0** | **1.7** | **7.7** |
| **MN-2** | | | | | | | |
| Split Rock | 900 | 1,368 | | 100% | 12.4 | 0.0 | 12.4 |
| Silver Bay | 900 | 1,368 | | 100% | 1.5 | 0.0 | 1.5 |
| Taconite Harbor | 900 | 1,368 | | 100% | 5.8 | 0.0 | 5.8 |
| Tofte | 900 | 1,368 | | 100% | 3.7 | 0.0 | 3.7 |
| **MN-2 Total** | **3,600** | **5,472** | **0** | **100%** | **5.8** | **0.0** | **5.8** |
| **MN-3** | | | | | | | |
| Grand Marais | 900 | 1,368 | | 100% | 14.6 | 0.0 | 14.6 |
| Hovland | 900 | 900 | | 100% | 7.8 | 0.0 | 7.8 |
| Grand Portage | 900 | 1,368 | | 100% | 8.0 | 0.0 | 8.0 |
| **MN-3 Total** | **2,700** | **3,636** | **0** | **100%** | **10.5** | **0.0** | **10.5** |
| **Shorewide Total** | **11,700** | **17,316** | **0** | **89%** | **6.9** | **0.8** | **7.7** |

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).


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

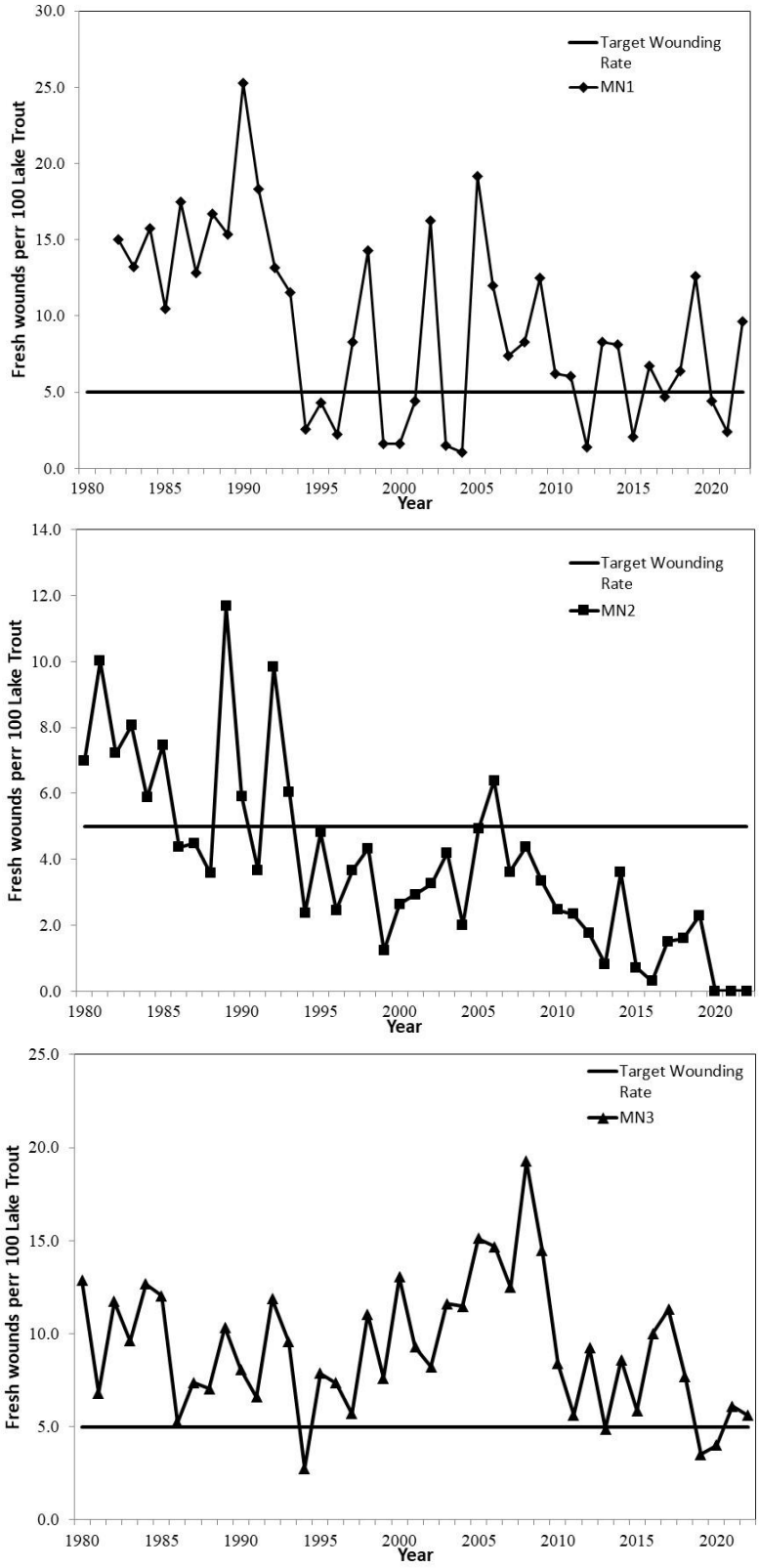


**Figure 2. Number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, by statistical district, 1980-2022.**

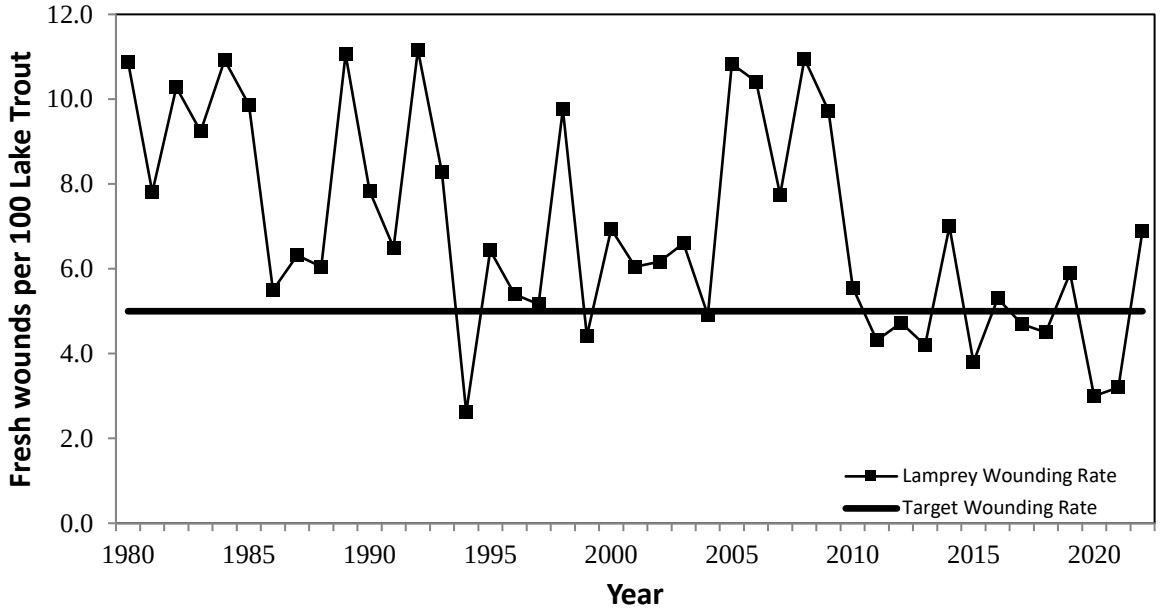


**Figure 3. Shorewide number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, 1980-2022.**

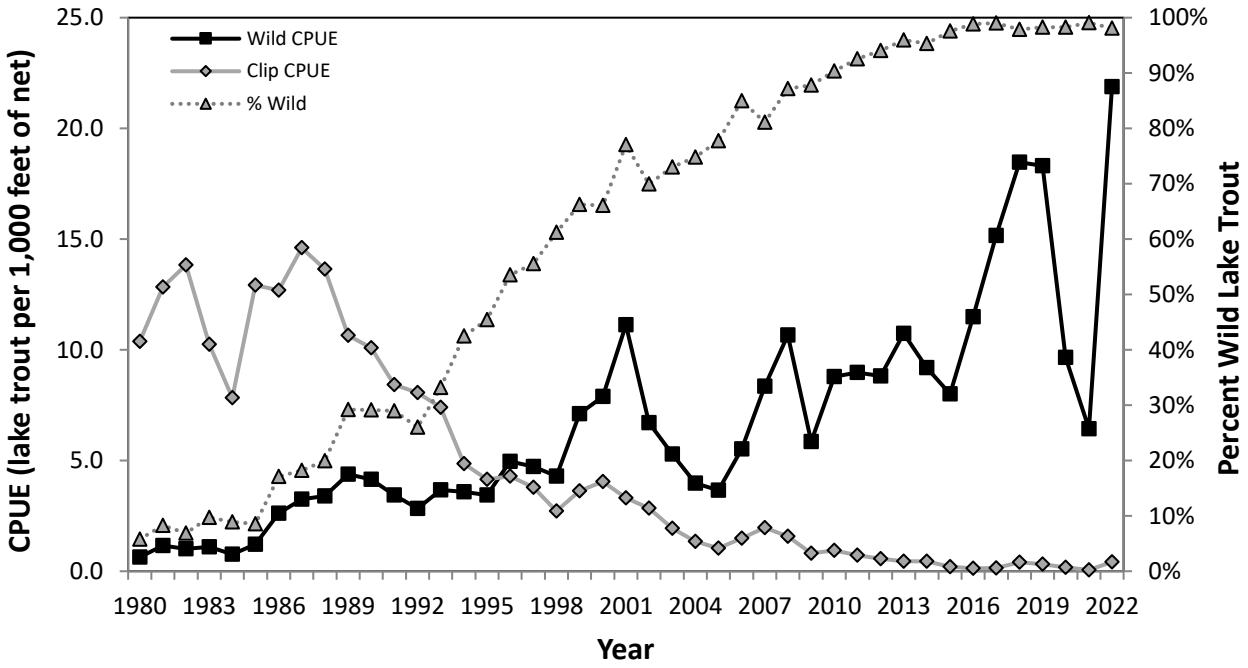


**Figure 4. Catch rate (number of fish per 1,000 feet of net) of wild and stocked Lake Trout, and percentage wild Lake Trout in the May assessment, 1980-2022.**

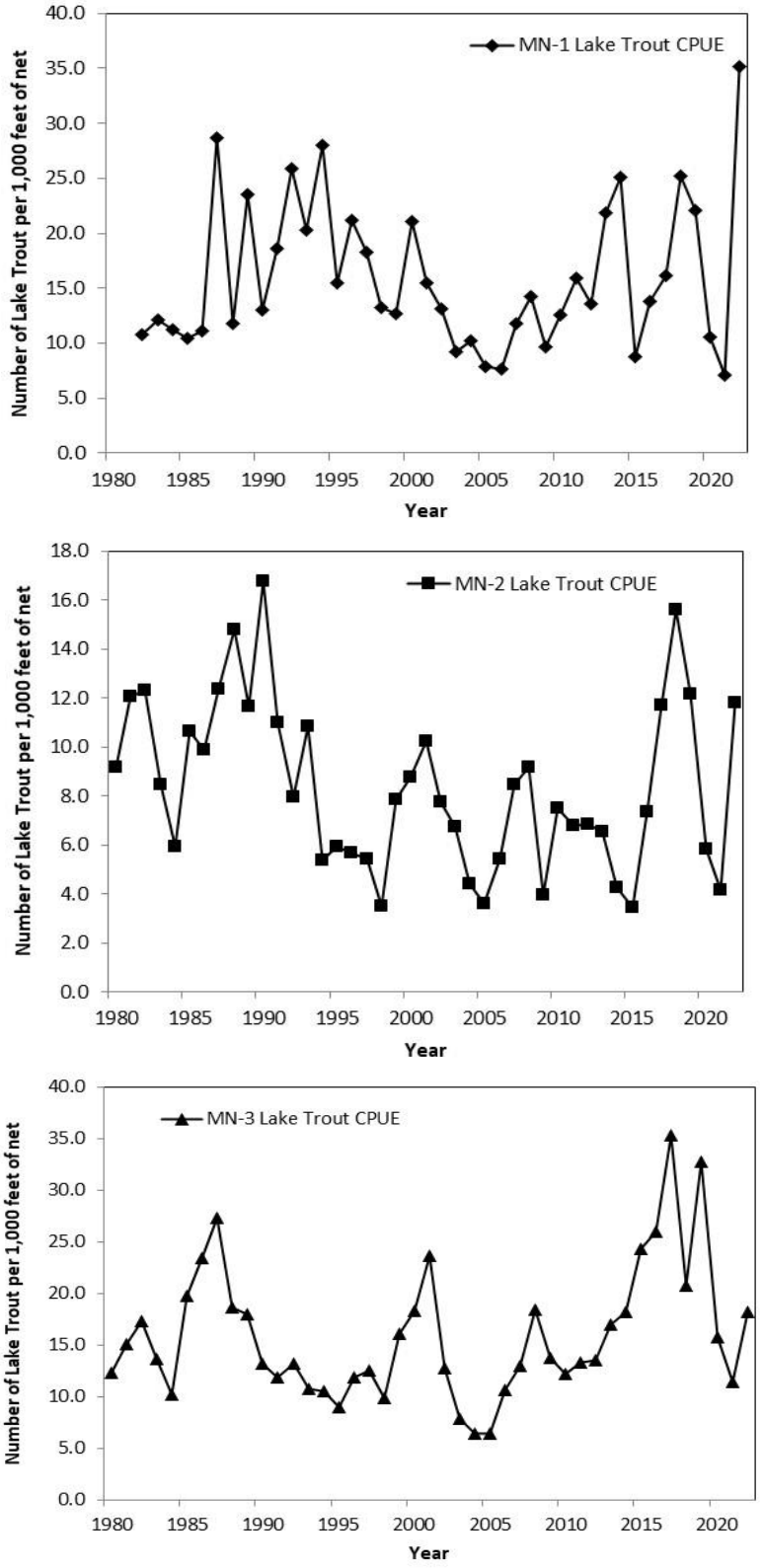


**Figure 5. Lake Trout catch rate (number of fish per 1,000 feet of net) by statistical district in the May assessment, 1980-2022.**

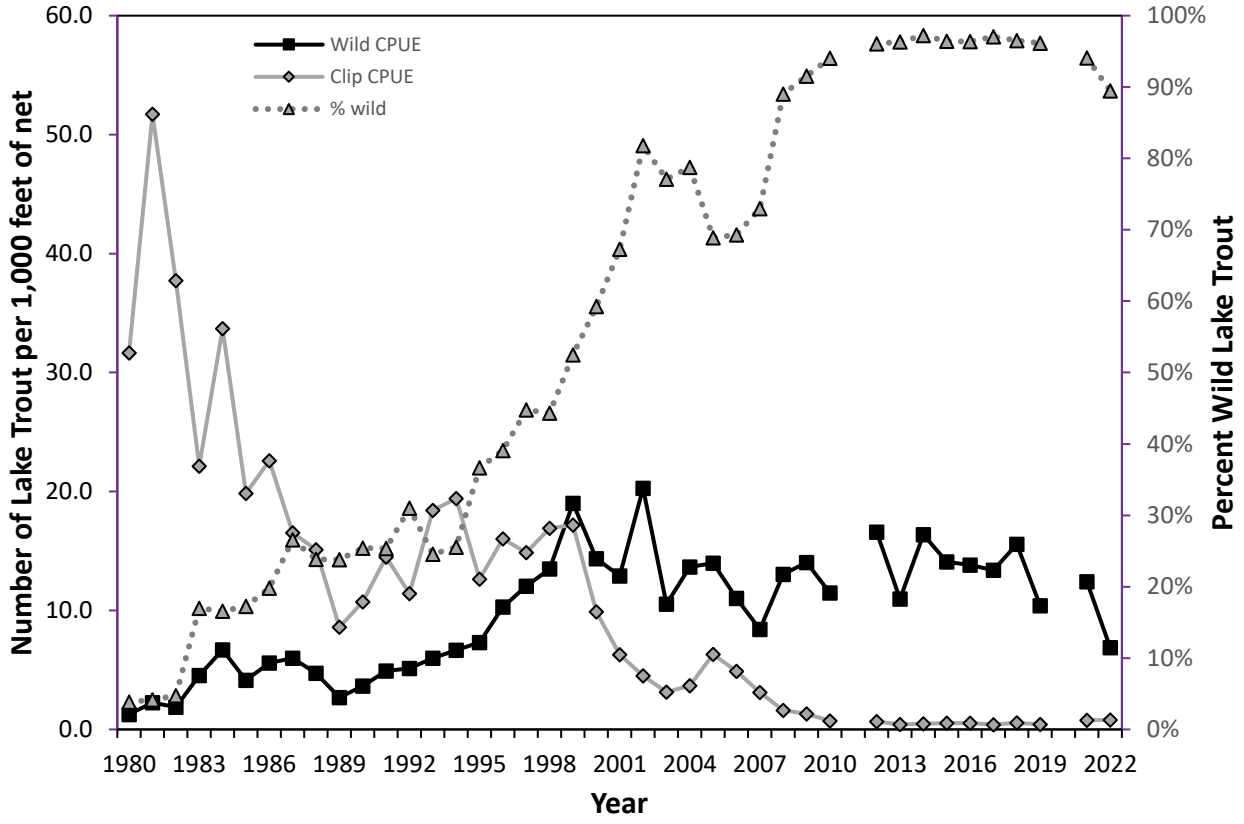


**Figure 6. Catch rate (number of fish per 1,000 feet of net) of wild and stocked Lake Trout, and percent wild Lake Trout in the juvenile (<17") Lake Trout assessment, 1980-2022.**

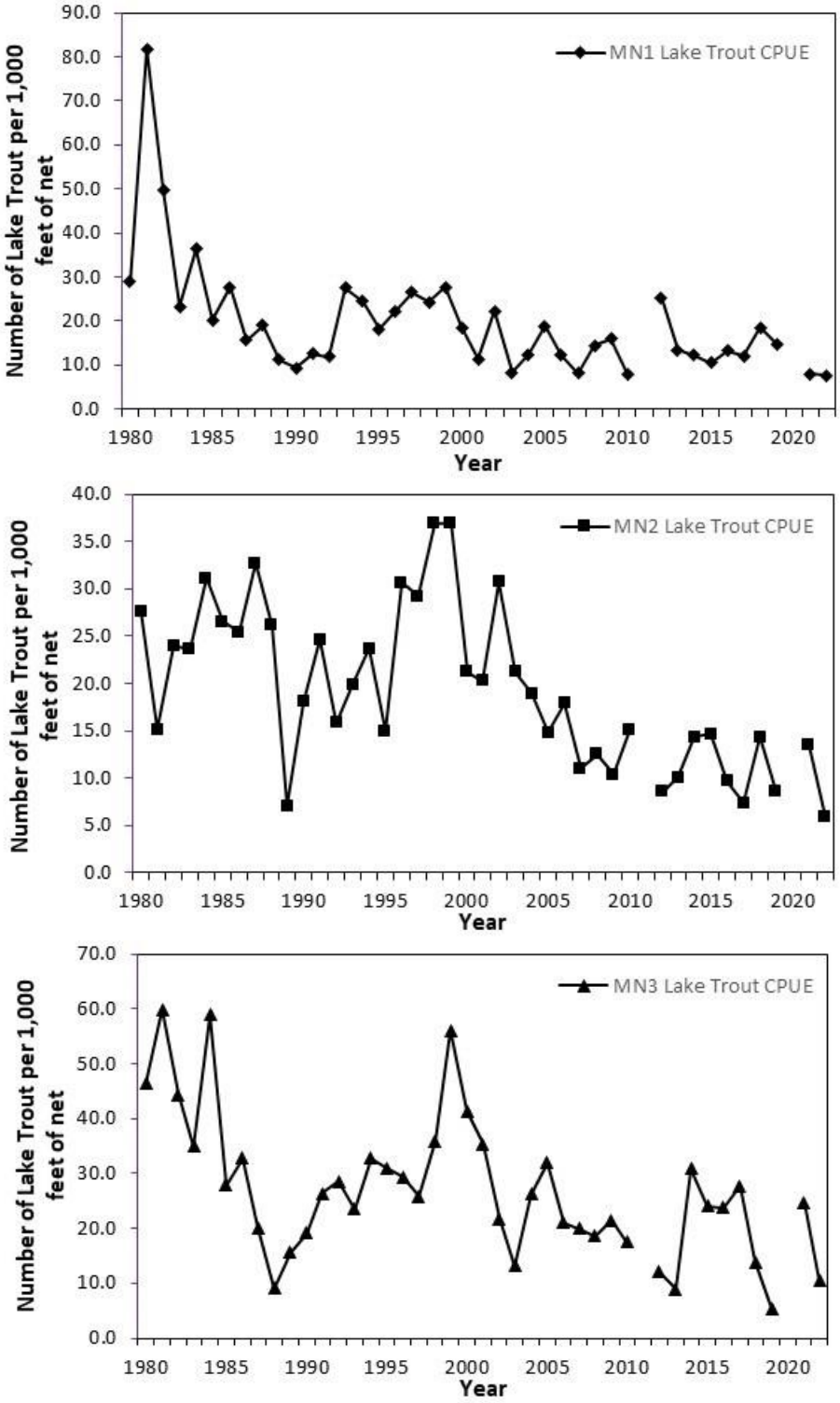


**Figure 7. Lake Trout catch rate (number of fish per 1,000 feet of net) by statistical district in the juvenile Lake Trout assessment, 1980-2022.**

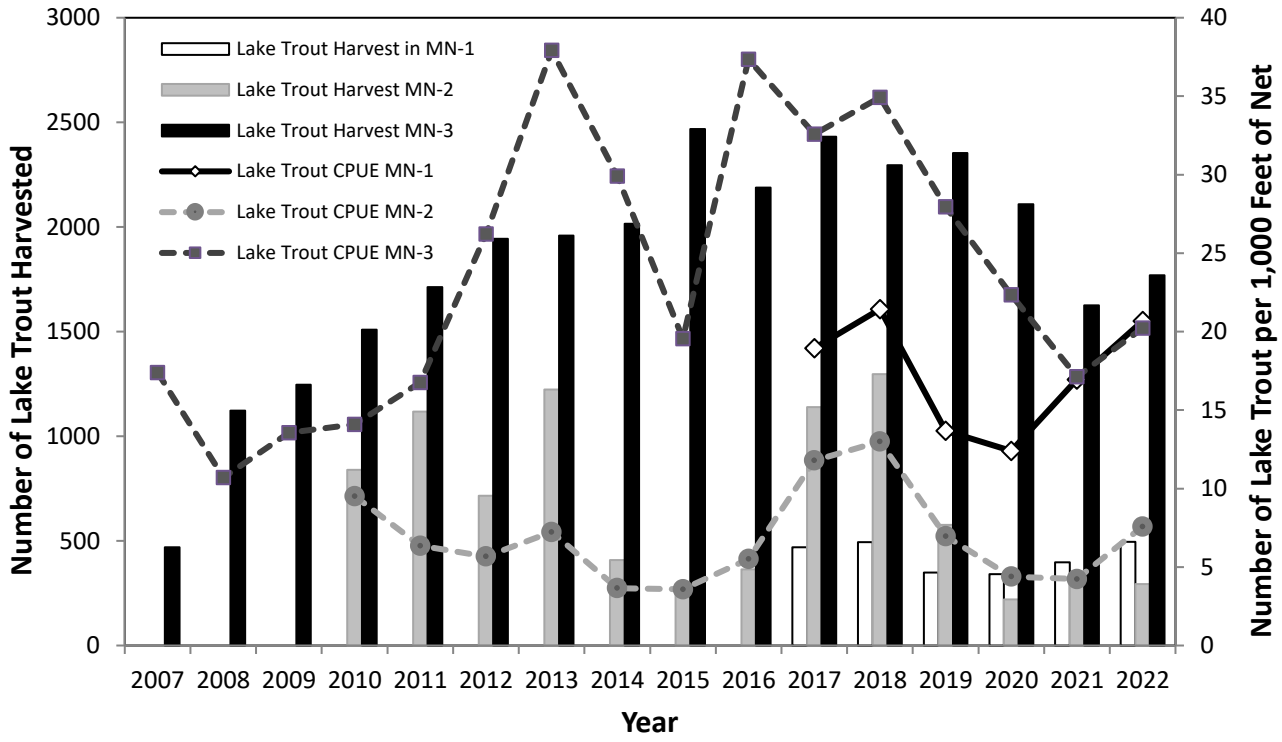


**Figure 8. Lake Trout harvest and catch rate (number of fish per 1,000 feet of net) in the summer commercial assessment, 2007-2022.**

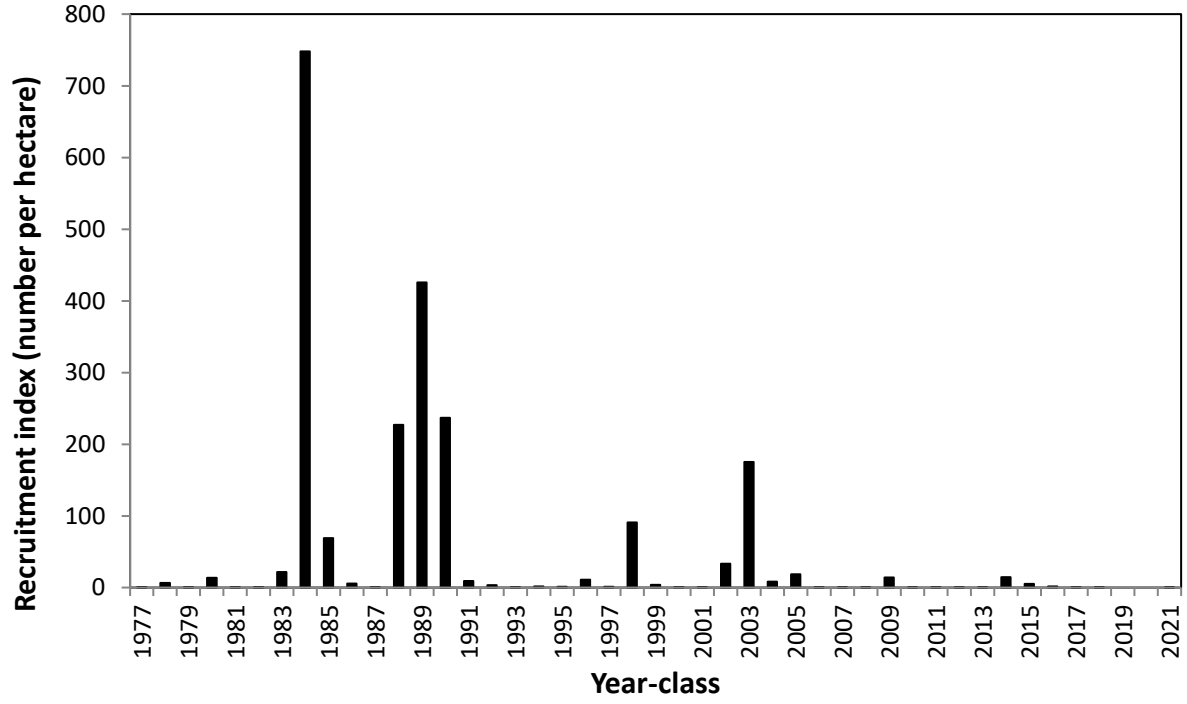


**Figure 9. Cisco year-class strength, as measured by the relative density of age-1 Cisco caught during USGS bottom trawl surveys, 1977-2021.**

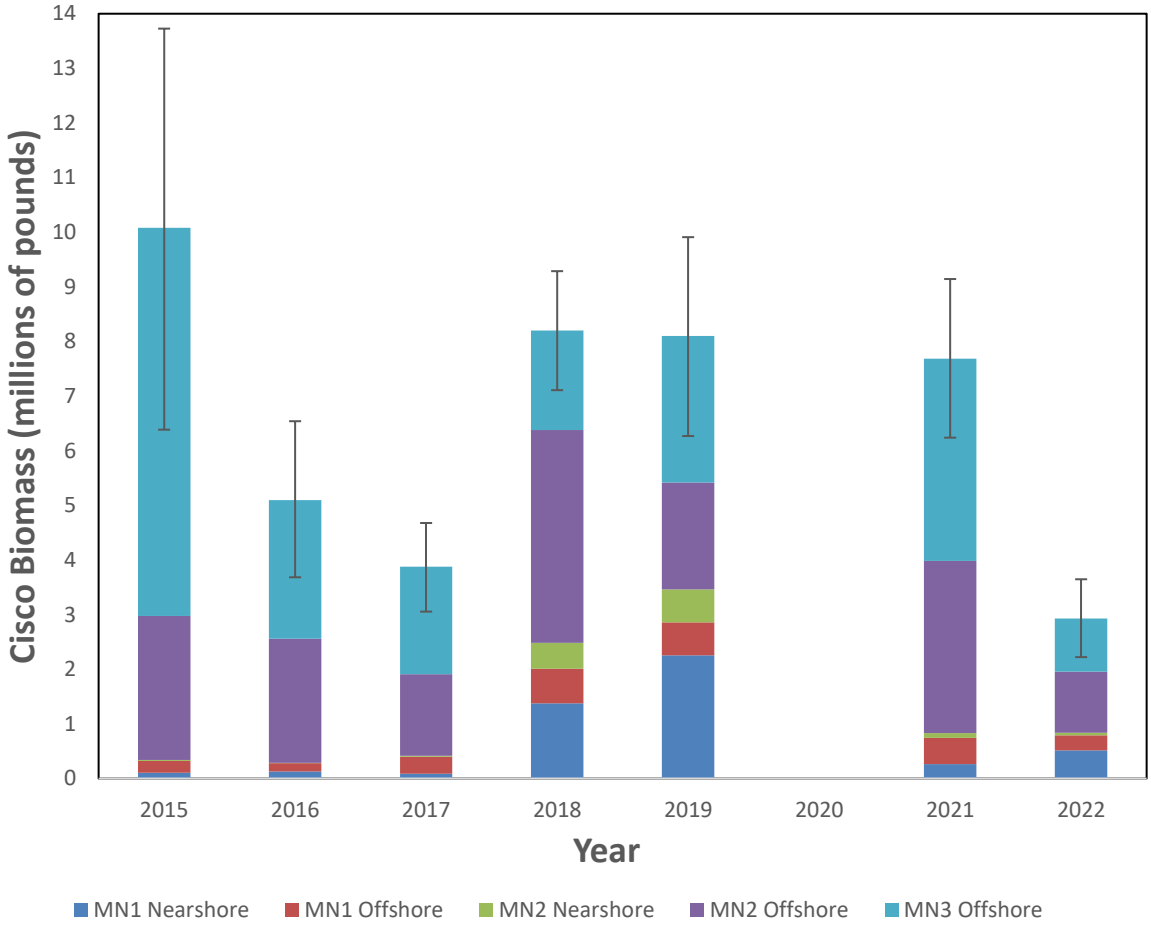


**Figure 10. The estimated biomass of spawning size Cisco from fall hydroacoustic surveys, 2015-2022. Upper and lower 95% confidence intervals are shown.**