Minnesota
Statewide Fisheries Lake and Stream Management Planning
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Segment 34, Year 1
Study 2
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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
SECTION OF FISHERIES

COMPLETION REPORT FOR THE MINNESOTA WATERS OF LAKE SUPERIOR

2019

Prepared by:

Josh Blankenheim

Reimbursed under Federal
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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)* in MN-1 (12.6) but below the target level in MN-2 (2.3) and MN-3 (3.5). The shorewide wounding rate was slightly above the target at 5.9 wounds per 100 fish. The overall catch rate of Lake Trout in the May assessment was 18.6 fish per 1,000 feet of net. CPUE by management zone was 22.1 in MN-1, 12.2 in MN-2, and 32.7 in MN-3. Shorewide, 98% of Lake Trout were wild fish.

In the juvenile Lake Trout assessment (fish less than 17 inches), the CPUE was 10.8 fish per 1,000 feet of net. The 2019 CPUE was the lowest on record, but the CPUEs have been relatively consistent since the mid-2000s especially when considering wild juveniles only. CPUE by management zone was 14.7 in MN-1, 8.6 in MN-2, and 5.4 in MN-3. Shorewide, 96% of juvenile Lake Trout captured were wild. Despite annual stocking in MN-1 through 2015, 95% of juvenile Lake Trout captured in MN-1 were wild fish.

In the summer expanded commercial assessment, commercial fishermen in MN-1 harvested 349 Lake Trout and the CPUE was 13.7 fish per 1,000 feet of net. Lake Trout harvest in MN-2 was 576 fish and the CPUE was 7.0 fish per 1,000 feet of net. In MN-3, 2,353 Lake Trout were harvested and the CPUE was 28.0 fish per 1,000 feet of net. Collectively, commercial fishermen harvested 63% of the available quota.

In the Lake Trout spawning assessment, the CPUE was 107.3 fish/1,000 feet of net in MN-1, and 79.8 fish/1,000 feet of net in MN-3. Forty-five percent of the Lake Trout captured in MN-1 were wild fish, whereas 100% were wild in MN-3. The commercial operator who assists in MN-2 did not set nets so no data were collected for that zone.

The estimated biomass of spawning size Cisco from the fall hydroacoustic survey was 3,407 metric tons and represents a 7% decrease from 2018. Although the USGS recruitment index for the 2015 was not large, it likely buffered the population from a steeper decline. Cisco harvest in the traditional gill net fishery (all months excluding November) was 106,824 pounds and the catch rate was 193 pounds per 1,000 feet of net. Harvest during the November fishery was 75,655 pounds and the catch rate was 596 pounds per 1,000 feet of net.

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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 2019 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 harvest of 24,875 fish (2010-2019) in the Minnesota waters of Lake Superior (Reeves 2020). 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, and analyzing commercial fishing records. Commercial harvest is summarized thoroughly in an annual commercial fishing report (Blankenheim 2020).

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 2020a; Reeves 2020) and Knife River and French River trap reports (Peterson 2020b; Peterson 2020c).

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 fishermen 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. Gang sets were for one night unless weather interfered with net retrieval.

The juvenile Lake Trout assessment is conducted solely by MNDNR. The assessment utilizes five nets each 200 feet in length tied together for a total gang length of 1,000 feet. Mesh sizes include 1.5, 1.75, 2.0, 2.25, and 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 set starting in 120 feet of water and ending shallower than 240 feet. Gang sets were for two nights, with the exception of 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 evenly based on the number of applicants per zone, with a maximum of 1,000 Lake Trout per fisherman. The season is open from June 1st through September 30th. Detailed harvest information on the limited commercial Lake Trout fishery can be found in Blankenheim (2020).

MNDNR conducts the Lake Trout spawning assessment in MN-1 while commercial operators assist in MN-2 and MN-3. Spawning assessment nets utilize 5.5 inch stretch-measure mesh. In MN-1 each net is a single 250 foot panel; commercial fishermen occasionally fish longer gangs. Nets were set in four locations in MN-1 (Fitger's Reef, Moen Tire, Stoney Point, Bluebird Landing), and one location in MN-3 (Grand Marais). The commercial fisherman in MN-2 who normally assists with the survey unfortunately did not set any nets. Additionally, the last two net sets in MN-1 were scratched due to extremely cold weather in early November. Spawning assessment sets begin in 20 feet of water and typically end by 50 feet of depth. Net sets were set for one night unless weather interfered with retrieval.

Statistical zones, grids, and locations for May Lake Trout, juvenile Lake Trout and spawning Lake Trout net sets are shown in Figure 1. Detailed specifications for survey nets can be found in Ebener (2001). In all surveys length, weight, sex, fin clips, and lamprey wounds were recorded for each Lake Trout caught. MNDNR collected otoliths and stomach contents on all Lake Trout while commercial operators did so on a subsample of the fish they harvested in the May assessment, summer expanded commercial assessment, and spawning 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 mesh) nets, with 100 feet of each mesh size per net. Two gangs were set: one at 12 feet below the surface and the other at 25 feet below the surface. Sampling began in late October with a goal of collecting length, weight, sex, and otoliths from at least 100 fish. Additional Cisco samples were collected from commercial fishermen 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 2019 were not yet available but 2018 age data are presented in 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. Beginning in 2017, all hydroacoustic work has been conducted aboard the Large Lakes Observatory's R/V Blue Heron rather than split between the R/V Blue Heron and the MNDNR vessel. Sampling MN-3 nearshore 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 12.6 in MN-1, 2.3 in MN-2, and 3.5 in MN-3 (Table 1, Figure 2). The overall wounding rate was 5.9 (Figure 3). The target wounding rate for all zones is not more than 5 fresh wounds per 100 Lake Trout. Overall, wounding rates increased by size category (Table 1).

The overall CPUE of Lake Trout was 18.6 fish per 1,000 feet of net in the May assessment, which was very similar to the record-high CPUE observed in 2018 (Table 2, Figure 4). The wild Lake Trout CPUE was 18.3 fish per 1,000 feet of net while stocked Lake Trout CPUE was 0.3 fish per 1,000 feet of net (Figure 4). Wild fish comprised 98% of all Lake Trout sampled in the assessment (Table 3, Figure 4). By zone, Lake Trout CPUEs for MN-1, MN-2, and MN-3 were 22.1, 12.2, and 32.7 fish per 1,000 feet of net (Table 3, Figure 5). Creel survey data and anecdotal reports have indicated that a higher proportion of the summer Lake Trout catch in MN-1 is stocked fish compared to what is observed in the May assessment, so Lester River/Brighton Beach was added as a station starting in 2015 after not being sampled since 2008. Even with the addition of this station, wild fish have still accounted for over 90% of the catch in MN-1 each year since it was added back into the survey.

Lake Trout ages ranged from age-4 to age-21 (Table 4). By design, the May assessment typically captures Lake Trout age-6 to age-10. Eighty-seven percent of Lake Trout captured were age-6 to age-10.

The age and growth patterns observed on otoliths help confirm correct species identification from the calls made in the field by MNDNR staff and commercial operators. In some years there are discrepancies between species identification in the field compared to otolith analysis, with some Siscowet mistakenly identified as Lake Trout, primarily in MN-3. In 2019, the commercial operators who assisted with the May Lake Trout Assessment did a good job identifying Lake Trout and Siscowet. In MN-2 only three fish were identified as Lake Trout in the field but were likely Siscowet based on the otoliths (98% agreement, n=147), and in MN-3 only one fish was called a Lake Trout but was likely a Siscowet based on the otoliths (99% agreement, n = 97). There were no discrepancy fish in MN-1. Misidentifying Lake Trout could create a variety of problems such as biased CPUEs or poorly functioning Lake Trout models.

By weight, diet composition of Lake Trout in the May assessment was almost entirely Rainbow Smelt (92.4%) and unidentifiable fish remains (6.6%) (Table 5). Rainbow Smelt commonly comprise the greatest weight of diet items in Lake Trout stomachs during the May assessment. Nine percent of Lake Trout (n=38) had no prey items in their stomachs, which was within the range observed the previous five years (9% to 30%).

Juvenile Lake Trout Assessment

The overall CPUE of juvenile Lake Trout (less than 17 inches) was 10.8 fish per 1,000 feet of net (Table 6). The 2019 CPUE was the lowest on record, but too much emphasis should not be placed on a single year's CPUE. CPUE has been relatively consistent since the mid-2000s, especially when considering only the wild fish (Figure 6). CPUEs in MN-1, MN-2, and MN-3 were 14.7, 8.6, and 5.4 Lake Trout per 1,000 feet of net, respectively (Table 6, Figure 7). The CPUE of wild juveniles was 10.4 Lake Trout per 1,000 feet of net and the CPUE of stocked fish was only 0.4 Lake Trout per 1,000 feet of net. Ninety-six percent of the juvenile Lake Trout catch was wild (Table 7, Figure 6). Even though annual stocking occurred in MN-1 through 2015, 95% of the juvenile Lake Trout catch in MN-1 were wild fish. Lake Trout recruitment may be reaching a level representative of self-sustaining Lake Trout populations in Lake Superior indicated by a plateauing CPUE.

By weight, juvenile Lake Trout diets were comprised primarily of unidentifiable fish remains (31.7%), Rainbow Smelt (25.3%), salmon species (13.8%), *Mysis* (13.8%), and sculpin species (11.0%) (Table 5). It should be noted that even though salmon species comprised a relatively high proportion of diet biomass, the biomass of salmon was from a single specimen. Twenty-five percent (n = 44) of

juvenile Lake Trout stomachs contained no prey items, which was slightly below the range observed the previous five years (26% to 35%).

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 fishermen 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. A total of 349 Lake Trout were harvested and the CPUE was 13.7 Lake Trout per 1,000 feet of net (Figure 8). Commercial fishermen harvested 70% of the total-allowable-catch (TAC). Commercial harvest of Lake Trout represented 2.7% of the estimated total Lake Trout harvest in MN-1 between sport (12,715) and commercial (349) fishers combined.

In MN-2, the number of Lake Trout harvested by commercial fishermen was 576 and the CPUE was 7.0 Lake Trout per 1,000 feet of net (Figure 8). Forty-six Siscowet were also harvested. Commercial netters harvested 31% of the 2,000 fish TAC (Lake Trout and Siscowet) from MN-2. Commercial harvest of Lake Trout represented 12.3% of the estimated total Lake Trout harvest in MN-2 between sport (4,126) and commercial (576) fishers combined.

In MN-3, commercial fishermen harvested 2,353 Lake Trout and the CPUE was 28.0 Lake Trout per 1,000 feet of net (Figure 8). An additional 158 Siscowet were harvested. Commercial fishermen harvested 84% of the 3,000 fish TAC. Commercial harvest of Lake Trout represented 52.1% of the estimated total Lake Trout harvest in MN-3 between sport (2,163) and commercial (2,353) fishers combined. In the three zones combined, commercial fishermen harvested 63% of the TAC. Overall, commercial harvest accounted for 14.7% of the total shorewide Lake Trout harvest between sport (19,004) and commercial (3,278) fishermen.

Lake Trout diet composition by weight in the summer commercial assessment was predominately unidentifiable fish remains (24.9%), coregonids (Bloater, Cisco, Kiyi, and coregonids that couldn't be identified to species; 24.5%), Rainbow Smelt (18.7%), terrestrial insects (13.8%), and *Mysis* (12.1%) (Table 5). Lake Trout will eat a variety of prey, as evidenced by a bird and a shrew being consumed. Thirty-eight percent of Lake Trout stomachs (n = 259) had no diet items, which was very similar to the previous five years (37%-46%).

Spawning Lake Trout Assessment

The commercial fisherman who normally assists with the spawning assessment in MN-2 did not set nets, so no data were collected in MN-2. The CPUE in MN-1 was 107.3 Lake Trout per 1,000 feet of net, while in MN-3 the CPUE was 79.8 Lake Trout/1,000 feet of net (Table 8, Figure 9). Males outnumbered females a ratio of 10:1 in MN-1 and 3:1 in MN-3. Males are much more common in the spawning assessment, as they seem to congregate while awaiting the arrival of females. The percent wild Lake Trout is one of the most important metrics in the spawning survey. All fish were wild in MN-3, while 45% were wild fish in MN-1 (Figure 10). The trend in MN-1 is a positive one, but is progressing at a slower rate than seen in the other management zones.

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 11). Due to the backlog of otoliths, age data from the 2019 spring and fall commercial Cisco samples and MNDNR Cisco assessment were not yet available at the time of this reporting. However, age analysis from the 2018 spring and fall Cisco samples collected from commercial fishermen (n=480) showed the 2003, 2009, 2015, and 2014 year-classes accounted for 25%, 22%, 22%, and 15% of their catch (Figure 11). In total there were 20 year-classes present, ranging from age-3 to age-32. The MNDNR fall Cisco assessment uses multi-mesh nets that includes smaller mesh sizes (2.0 and 2.5 inch) than used by commercial fishermen. From the 2018 samples (n=150), the same four year-classes comprised 86% of the catch. The 2015, 2014, 2009, and 2003 year-classes accounted for 43%, 24%, 12%, and 7% of the catch. Sixteen year-classes were represented in the MNDNR survey, with fish ranging from age-2 to age-26. Young fish

seemed to be more common in the fall catches than in the spring commercial catch.

The estimated biomass of spawning size Cisco in the fall of 2019 was 3,407 metric tons, and represents a 7% decrease in biomass from the previous year, but was not statistically different (Figure 12). Based on USGS trawling, the 2015 year-class appears weak but recruited to the fishery in 2019 and likely helped buffer the population from a larger decrease in biomass.

Zone MN-1 Nearshore accounted for 34% of the total Cisco biomass estimate, followed by MN3 Offshore (32%), MN2 Offshore (24%), MN2 Nearshore (9%), and MN1 Offshore (1%). Both nearshore zones had a much higher proportion of the total biomass estimate compared to previous years. Prior to 2019, MN1 Nearshore and MN2 Nearshore only averaged 5% and 1% of the yearly total biomass estimates. The data were analyzed in several ways and checked for errors by two biologists, but both concluded that there simply appeared to be high densities of Cisco in the nearshore waters in 2019. It should be noted however that no data were collected in the MN2 Nearshore zone, and the biomass estimate for this zone was modelled from MN1 Nearshore data because generally the two zones correlate well and historically have not contributed much to the overall estimate. Given the high nearshore estimates and the general lack of spatial sampling in nearshore waters, it is advisable to collect more nearshore data in future years.

Commercial Cisco Harvest

Some caution should be used when assessing commercial Cisco CPUE data because it is not adjusted for soak time. It is possible that commercial fishermen could leave their nets in the water for longer periods of time to catch more fish when fishing is poor, thereby artificially inflating CPUE.

Cisco harvest in the traditional fishery (all months except November) was 106,824 pounds in 2019. Harvest in the traditional fishery has been remarkably consistent over the past three years and varied by only 3,100 pounds (Figure 13). The CPUE was 192 pounds per 1,000 feet of net (Figure 13).

Experimental netting for a potential November roe fishery started in 2001 in Minnesota waters, and beginning in 2006 harvest was permitted during November using TAC quotas established for each statistical district (Schreiner et al. 2006). The yearly November TAC is calculated from hydroacoustic data and for 2019 was set at 262,267 pounds for Minnesota waters. Beginning in 2016, the Grand Portage Band of Chippewa set a November Cisco TAC for their waters. With permission, some Minnesota-licensed commercial fishermen are allowed to harvest from Grand Portage waters. Commercial fishermen operating in Minnesota waters harvested 56,645 pounds of Cisco and Minnesota-licensed commercial fishermen fishing in Grand Portage waters harvest 19,010 pounds for a combined harvest of 75,655 pounds of Cisco in the November season (Figure 13). The CPUE was 596 pounds per 1,000 feet of net. Further detail of commercial Cisco harvest is available in the annual Commercial Fishing Summary (Blankenheim 2020).

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
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COMPLETION REPORT FOR MINNESOTA WATERS OF LAKE SUPERIOR

2019

Prepared by:

Josh Blankenheim

Approved by:  3/13/2020
Area Fisheries Supervisor Date

Approved by:  8/31/2020_
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, 2019. 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	1.8 (56)	10.5 (133)	25.8 (62)	20.0 (10)	12.6 (261)
MN-2	0.0 (90)	3.1 (191)	4.2 (24)	0.0 (0)	2.3 (305)
MN-3	0.0 (75)	2.3 (178)	17.2 (29)	20.0 (5)	3.5 (287)
TOTALS	0.5 (221)	4.8 (502)	19.1 (115)	20.0 (15)	5.9 (853)

Table 2. Number of Lake Trout by size class per 1,000 feet of 4.5 inch stretch mesh May assessment gill nets, 2019.

	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	4.8	10.8	2.5	0.2	18.6

Table 3. Corrected Lake Trout catch by station in the May assessment, 2019.

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)	265	1022 [1]	22.1	85.2	94.3
MN-2						
Split Rock	4,500 (4,500)	80	318	17.8	70.7	100
Silver Bay	14,500 (21,000)	232	815	11.0	38.8	100
Totals MN-2	19,000 (25,500)	312	1,133	12.2	44.3	100
MN-3						
Grand Marais	7,500 (8,800)	288	989	32.7	112.4	100
All locations						
Shorewide	**38,500 (46,300)**	**865**	**3,144**	**18.6**	**67.9**	**98.3**

[1] Eighty-one fish were released in MN-1, so Total Pounds was estimated based on the average weight of fish sacrificed in the survey.

Table 4. Age-length frequency distribution of otolith-aged Lake Trout in 4.5 inch stretch measure gill nets, May assessment, 2019. Bold numbers indicate fish that were identified as Lake Trout but age analysis suggested they were Siscowet.

Length (in)	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI+
9.0 - 9.9														
10.0 - 10.9														
11.0 - 11.9						1								
12.0 - 12.9														
13.0 - 13.9		1												
14.0 - 14.9			1											
15.0 - 15.9			1											
16.0 - 16.9			2											
17.0 - 17.9				5										
18.0 - 18.9				7	2									
19.0 - 19.9			1	3	20	4	1			1	**1**			
20.0 - 20.9				1	44	4	1	1						
21.0 - 21.9					36	24	6	3	1		1			**3**,1
22.0 - 22.9					7	38	3	5	4					1
23.0 - 23.9					8	16	32	6	1			2		1
24.0 - 24.9					2	11	27	8	2					2
25.0 - 25.9						3	11	4	3	2	1			1
26.0 - 26.9						3	1	2	3	1	1			2
27.0 - 27.9								3	3	1				2
28.0 - 28.9							1			1	1		1	1
29.0 - 29.9													1	
30.0 - 30.9														
31.0 - 31.9														
32.0 - 32.9														
33.0 - 33.9														
34.0 - 34.9														
35.0 - 35.9														
36.0 - 36.9														
37.0 - 37.9														
38.0 - 38.9														
39.0 - 39.9														
Total	0	1	5	16	119	104	83	32	17	6	5	2	2	10
Average Length		13.1	16.5	18.5	20.9	22.4	23.8	24.0	24.8	25.5	25.2	23.1	29.3	25.1

Table 5. Diet composition by weight of prey items in Lake Trout stomachs in the May, juvenile, summer, and spawning assessments, 2019. The number of stomachs sampled with prey items is shown in parentheses.

	Lake Trout							
Diet item	May		Juvenile		Summer		Spawning	
Aquatic insects	0.0%	(5)	3.0%	(26)	0.2%	(37)		
Artificial fishing bait	0.0%	(1)						
Bird	0.1%	(1)			0.3%	(1)		
Bloater					0.8%	(1)		
Brook Stickleback								
Burbot					1.7%	(3)		
Central Mudminnow								
Cisco (lake herring)					9.1%	(2)		
Clam sp.								
Coregonid sp.	0.5%	(5)			12.4%	(24)	47.9%	(1)
Deepwater Sculpin	0.0%	(1)			0.1%	(1)		
Detritus	0.0%	(1)						
Empty		(38)		(44)		(259)		(85)
Fish eggs								
Kiyi	0.1%	(1)			2.2%	(2)		
Larval fish	0.1%	(1)			0.3%	(1)		
Mammal					0.5%	(1)		
Minnow sp.								
Mysis			13.8%	(48)	12.1%	(102)		
Ninespine Stickleback	0.0%	(2)			0.0%	(1)		
Rainbow Smelt	92.4%	(318)	25.3%	(13)	18.7%	(69)		
Rainbow Trout								
Rocks	0.1%	(17)	0.1%	(1)	1.2%	(27)	1.7%	(1)
Round Whitefish								
Salmonid sp.			13.8%	(1)				
Sculpin sp.	0.1%	(3)	8.2%	(13)	0.8%	(11)		
Slimy Sculpin	0.0%	(1)	2.8%	(3)	0.5%	(4)		
Spoonhead Sculpin								
Stickleback sp.	0.0%	(1)			0.0%	(2)		
Terrestrial insects	0.0%	(4)	0.8%	(15)	13.8%	(105)	1.7%	(1)
Unidentifiable fish remains	6.6%	(177)	31.7%	(57)	24.9%	(188)	47.8%	(1)
Woody debris	0.0%	(9)	0.5%	(7)	0.4%	(20)	0.9%	(1)

Table 6. Summary of fishing effort, catch, percentage of wild Lake Trout and CPUE (number of fish per 1,000 feet) in the juvenile Lake Trout (less than 17 inches; 432 mm) assessment, 2019.

Location	Effort in Feet	Corrected Effort in Feet*	Number of lake trout	Percent Wild	CPUE Wild	CPUE Stocked	CPUE Total
MN-1							
Lester River	1,000	1,520	18	83%	9.9	2.0	11.8
Pumping Station	1,000	1,520	30	97%	19.1	0.7	19.7
Stoney Point	1,000	1,520	46	93%	28.3	2.0	30.3
Larsmont	1,000	1,520	26	100%	17.1	0.0	17.1
Two Harbors	1,000	1,520	11	100%	7.2	0.0	7.2
Encampment Island	1,000	1,520	3	100%	2.0	0.0	2.0
MN-1 Total	**6,000**	**9,120**	**134**	**95%**	**13.9**	**0.8**	**14.7**
MN-2							
Split Rock	1,000	1,520	22	100%	14.5	0.0	14.5
Silver Bay	1,000	1,520	9	100%	5.9	0.0	5.9
Taconite Harbor	1,000	1,520	16	94%	9.9	0.7	10.5
Tofte	1,000	1,520	5	100%	3.3	0.0	3.3
MN-2 Total	**4,000**	**6,080**	**52**	**98%**	**8.4**	**0.2**	**8.6**
MN-3							
Grand Marais	1,000	1,520	10	100%	6.6	0.0	6.6
Hovland	1,000	1,000	8	100%	8.0	0.0	8.0
Grand Portage	1,000	1,520	4	100%	2.6	0.0	2.6
MN-3 Total	**3,000**	**4,040**	**22**	**100%**	**5.4**	**0.0**	**5.4**
Shorewide Total	**13,000**	**19,240**	**208**	**96%**	**10.4**	**0.4**	**10.8**

For CPUE calculations fishing effort was corrected for two night sets (1,000 ft. actual effort x 1.52 = 1,520 feet except for Hovland, which was a one night set).

Table 7. 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, 1980-2019.

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	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	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	18.4	24.4	25%
1994	458	6.7	19.4	26.1	26%
1995	352	7.3	12.6	20	37%
1996	468	10.3	16	26.3	39%
1997	440	12	14.9	26.9	45%
1998	557	13.5	16.9	30.4	44%
1999	640	19	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	6.3	20.3	69%
2006	306	11	4.9	15.9	69%
2007	222	8.4	3.1	11.5	73%
2008	282	13	1.6	14.7	89%
2009	295	14	1.3	15.3	92%
2010	235	11.5	0.7	12.2	94%
2011*		-	-	-	
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%

*No data due to State of Minnesota government shutdown.

Table 8. Effort, catch and CPUE (number per 1,000 feet) of Lake Trout in the 2019 spawning assessment.

	MN-1	MN-2	MN-3
Total effort (feet)	1,500	0	1,630
Total catch (number)	161	0	130
Number/1,000 feet	107.3	0	79.8
Percent native	45%	0	100%
Number by Sex			
male	146	0	97
female	15	0	33
not examined	0	0	0

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

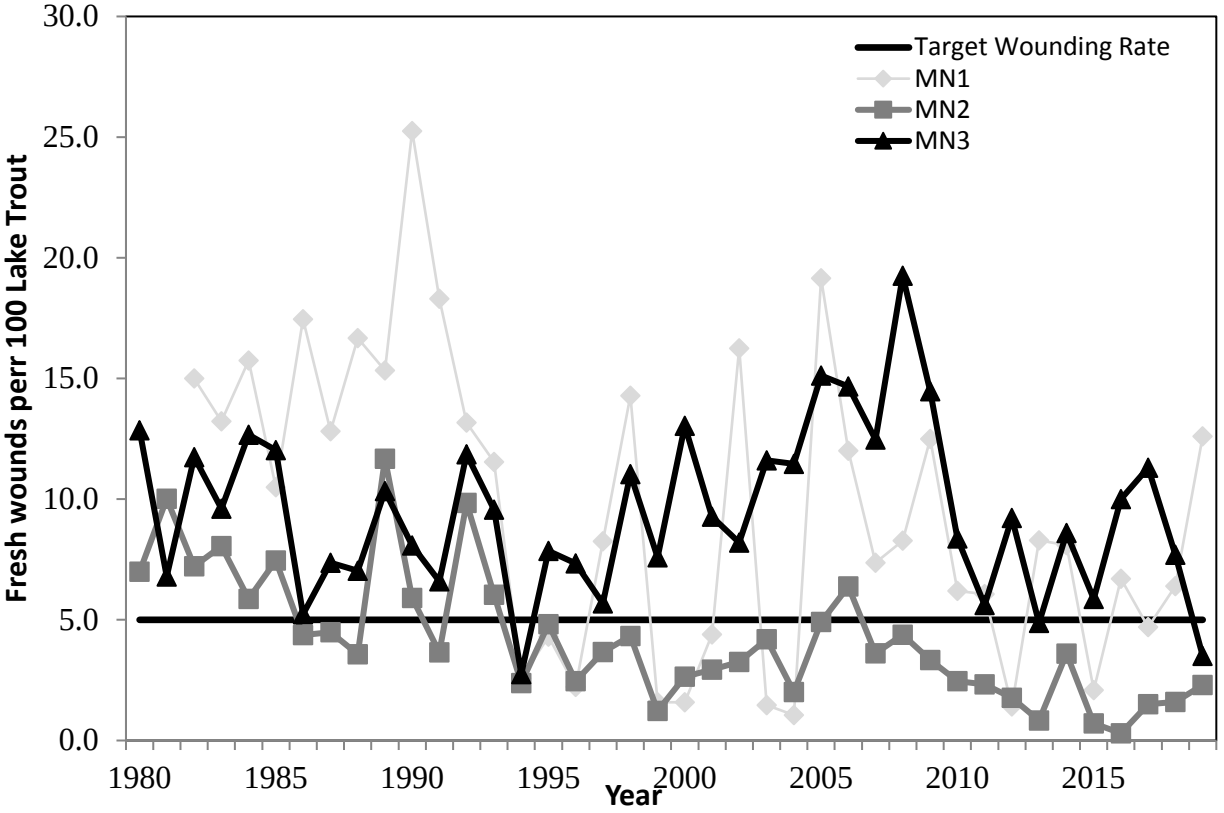

Figure 2. Number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, by statistical district, 1980-2019.

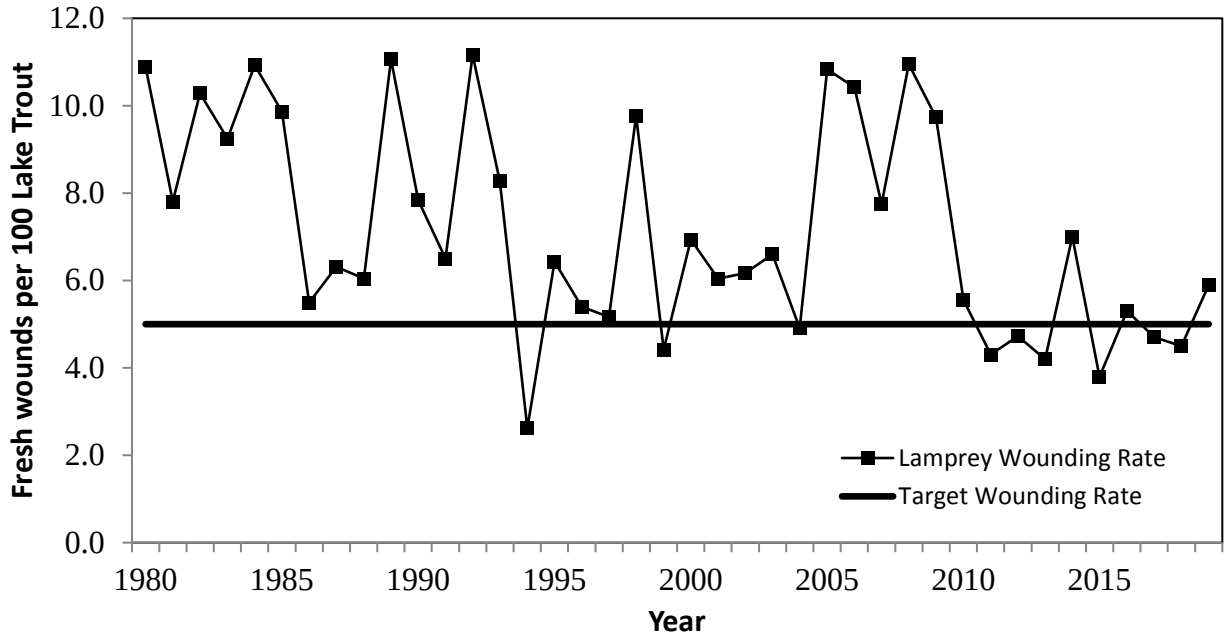

Figure 3. Shorewide number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, 1980-2019.

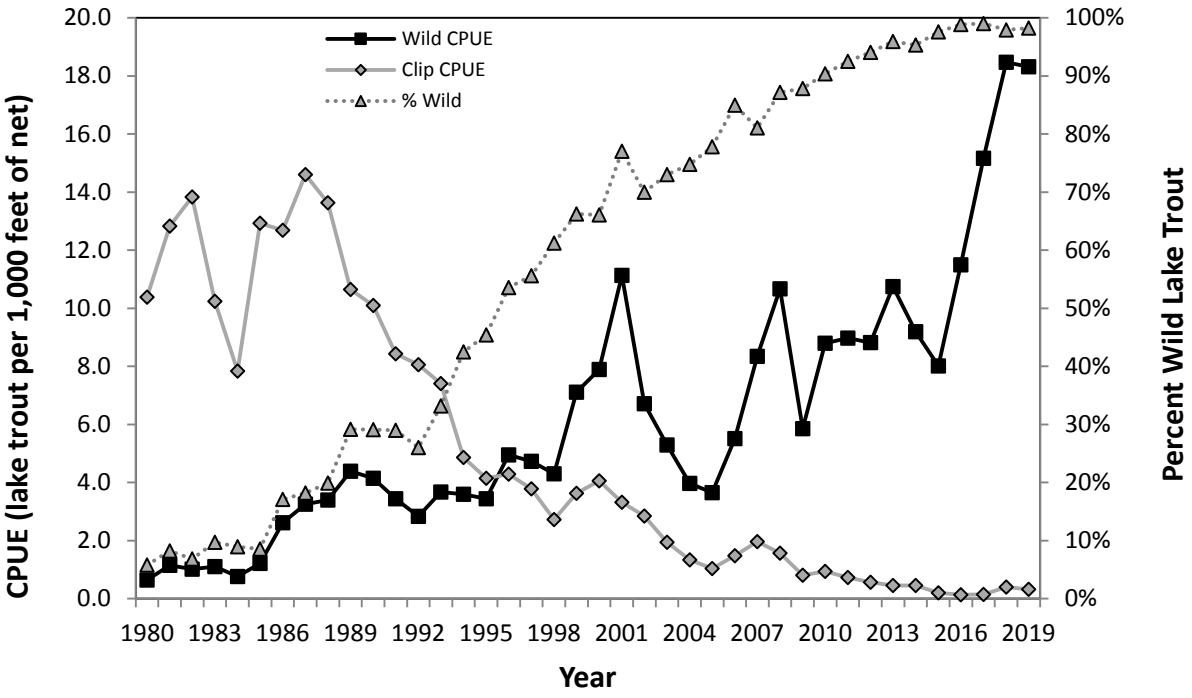

Figure 4. Catch rate (number of fish per 1,000 feet of net; CPUE) of wild and stocked Lake Trout, and percentage wild Lake Trout in the May assessment, 1980-2019.

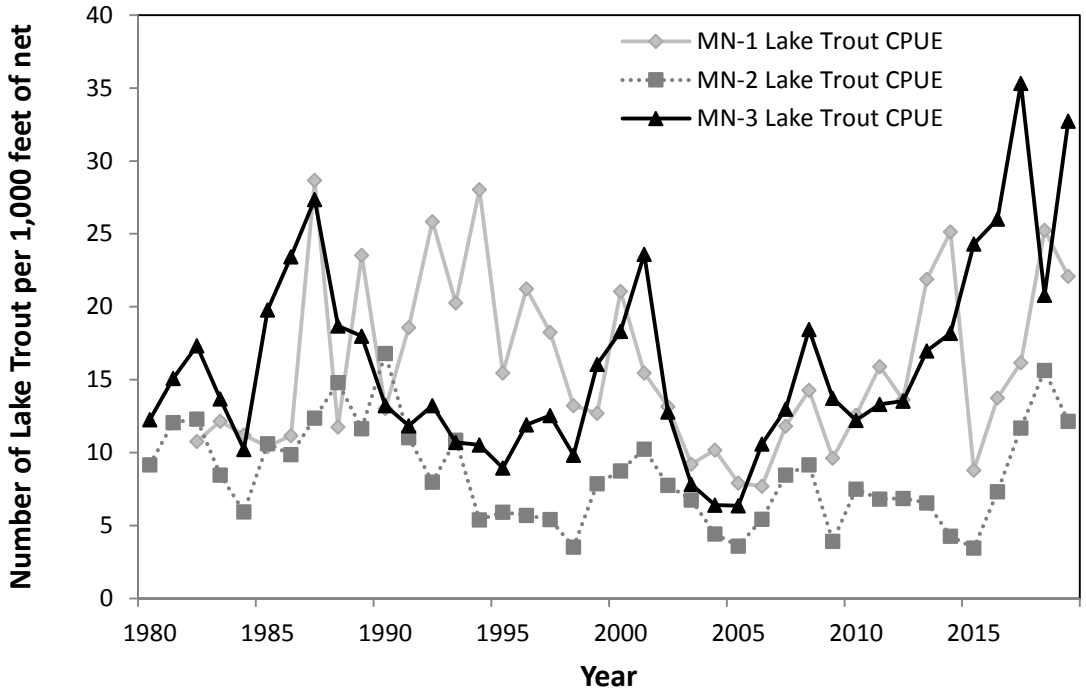

Figure 5. Lake Trout catch rate (number of fish per 1,000 feet of net; CPUE) by statistical district in the May assessment, 1980-2019.

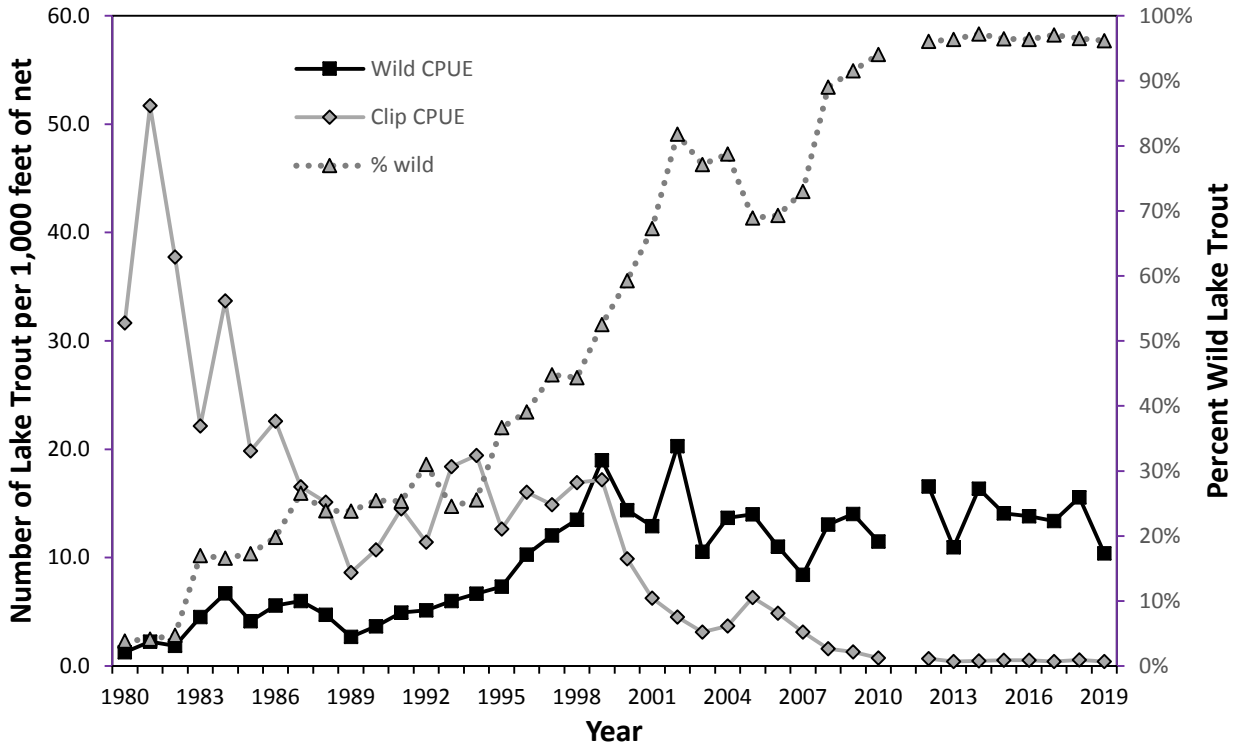

Figure 6. Catch rate (number of fish per 1,000 feet of net; CPUE) of wild and stocked Lake Trout, and percent wild Lake Trout in the juvenile (<17") Lake Trout assessment, 1980-2019.

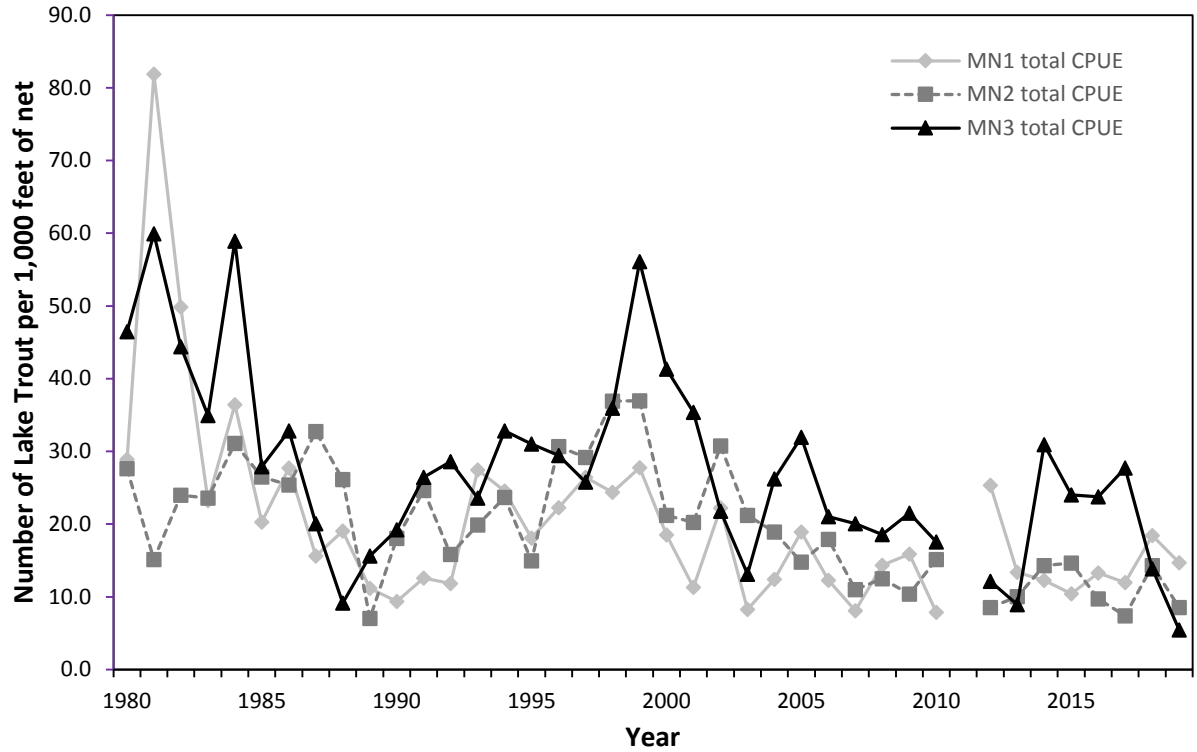

Figure 7. Lake Trout catch rate (number of fish per 1,000 feet of net; CPUE) by statistical district in the juvenile assessment, 1980-2019.

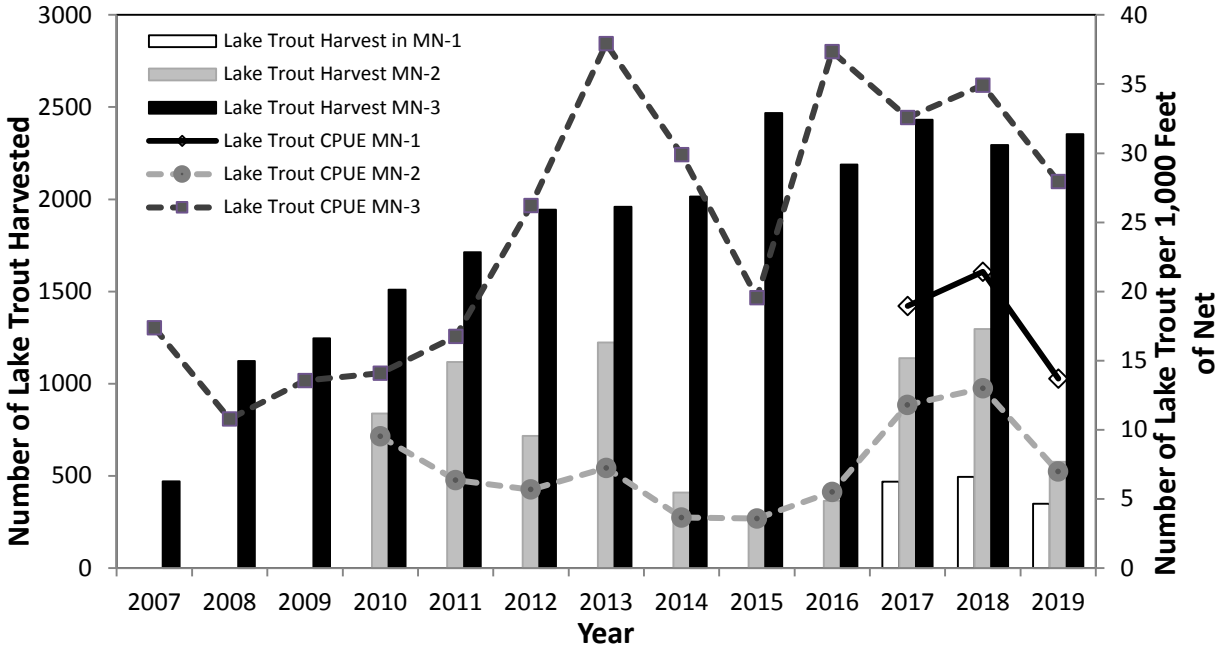

Figure 8. Lake Trout harvest and catch rate (number of fish per 1,000 feet of net; CPUE) in the summer commercial assessment, 2007-2019.

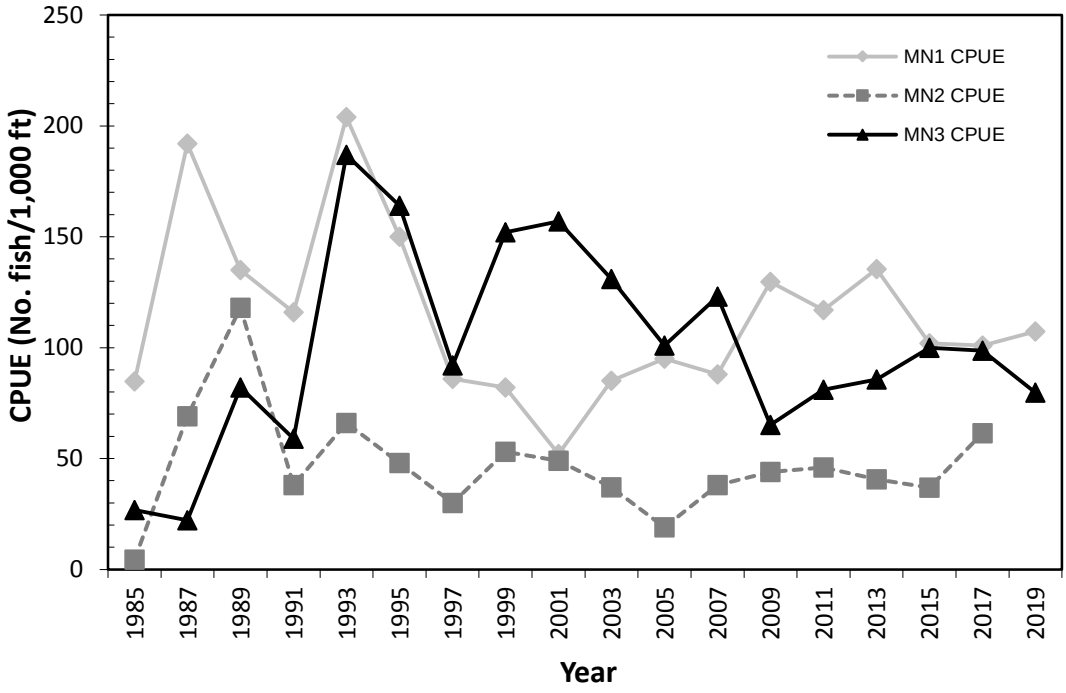

Figure 9. Catch per unit effort (CPUE) of Lake Trout in the spawning assessment, 1997-2019.

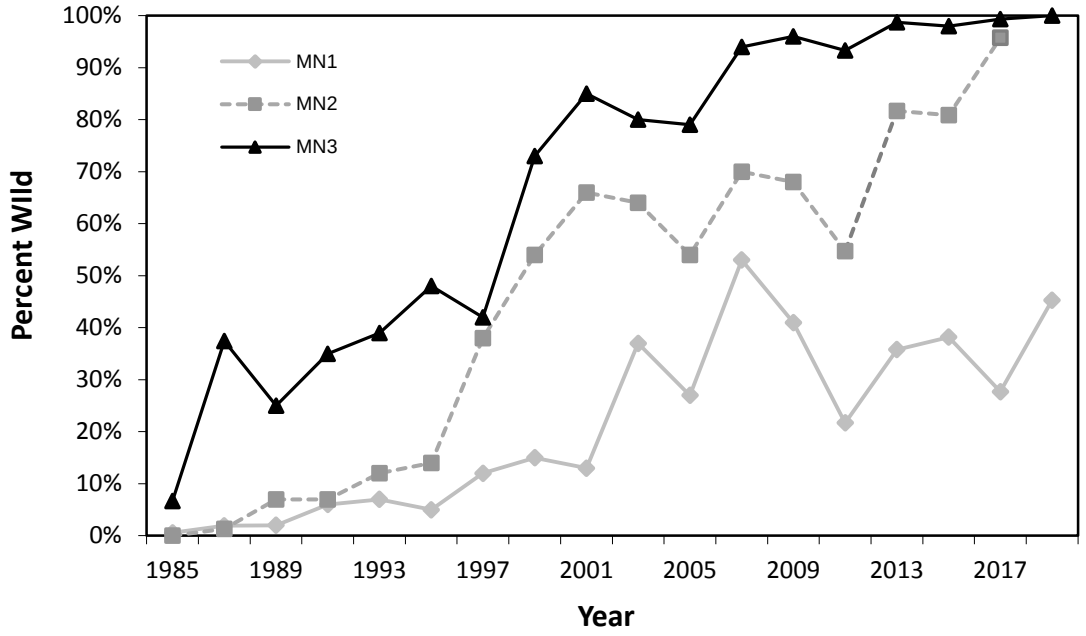

Figure 10. The percent wild Lake Trout by zone in the spawning assessment, 1985-2019.

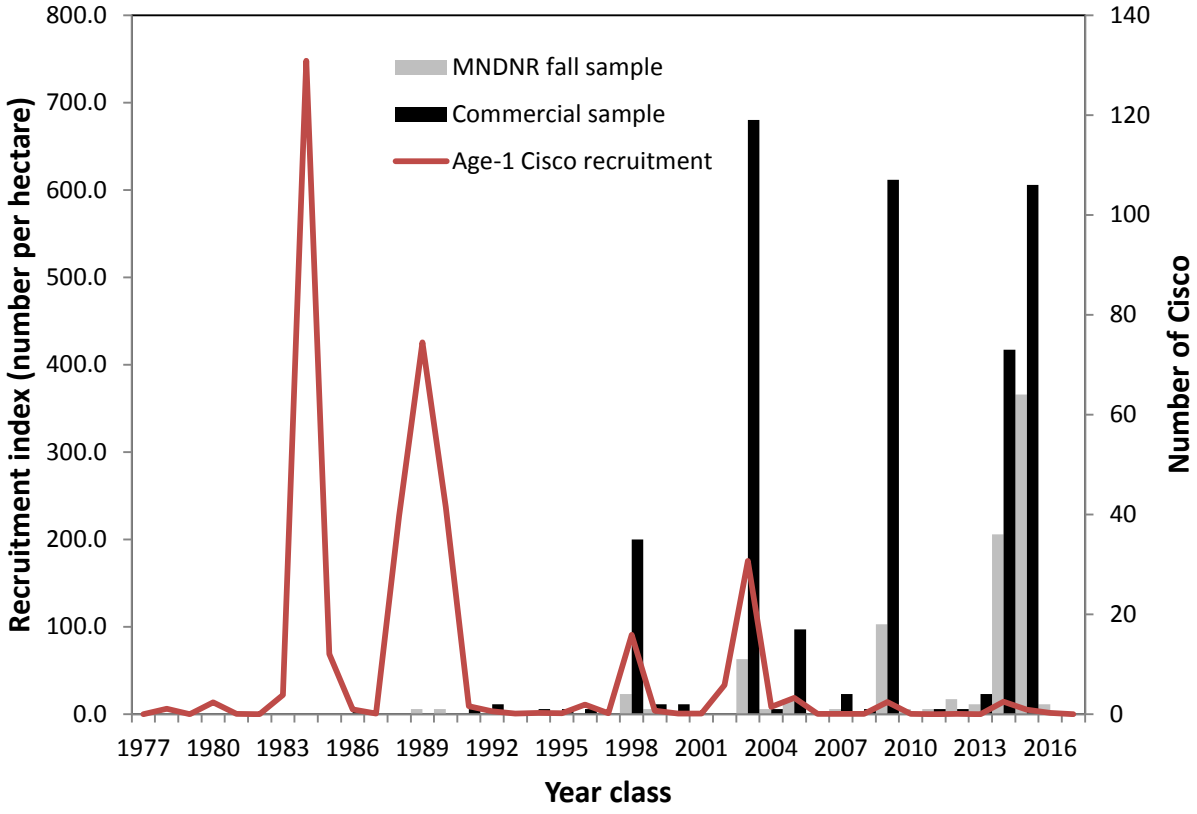

Figure 11. Cisco year-class strength, 1977-2018, as measured by the relative density of age-1 Cisco that were caught during USGS bottom trawl surveys, and the number of Cisco caught by year-class in MNDNR surveys and from commercial fishermen samples (spring and fall combined), 2018.

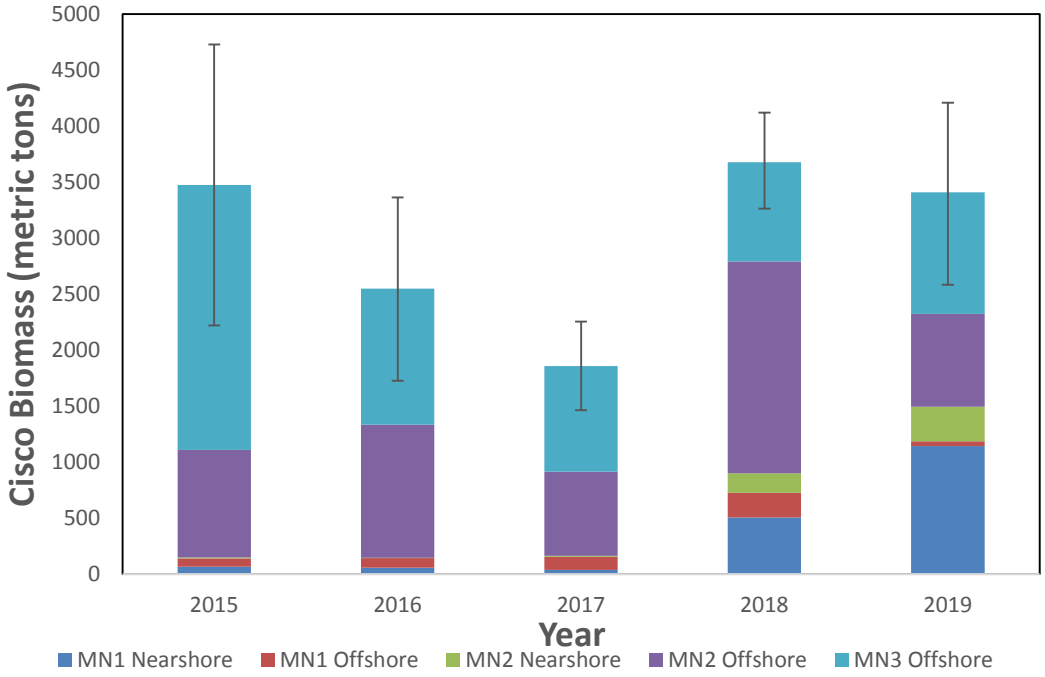

Figure 12. The estimated biomass of spawning-size Cisco from fall hydroacoustic surveys, 2015-2019.

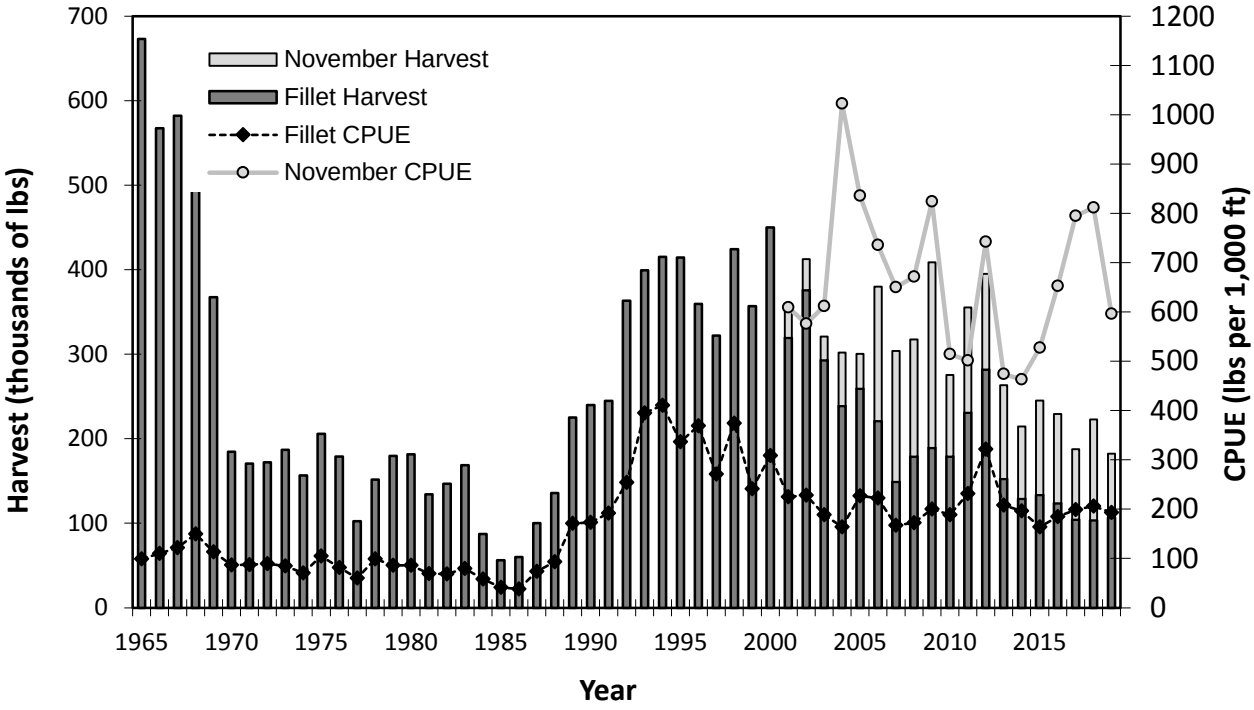

Figure 13. Cisco harvest (thousands of pounds) and catch rate (pounds per 1,000 feet of net; CPUE) in the commercial gill net fishery in Minnesota waters of Lake Superior, 1965-2019.