Minnesota
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Study 2
Job 4

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

COMPLETION REPORT FOR MINNESOTA WATERS OF LAKE SUPERIOR

2014

by

Cory A. Goldsworthy and Keith A. Reeves

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Executive Summary

Sea Lamprey *Petromyzon marinus* wounding rates, which were measured as number of fresh wounds per 100 Lake Trout *Salvelinus namaycush*, increased shorewide from 4.2 fresh wounds in 2013 to 7.0 fresh wounds in 2014 in the May Lake Trout assessment. Lamprey wounding in management zone MN-1 decreased slightly from 8.3 fresh wounds in 2013 to 8.1 fresh wounds in 2014.

Lake Trout catch rates in May decreased from 11.2 fish per 1,000 feet of net in 2013 to 9.6 fish per 1,000 feet of net in 2014. Wild Lake Trout catch rates decreased from 10.7 to 9.2 fish per 1,000 feet of net from 2013 to 2014. Overall, 95% of Lake Trout caught in the May assessment were wild fish. In the juvenile Lake Trout assessment (fish less than 17 inches), catch rates increased from 11.4 in 2013 to 16.8 fish per 1,000 feet of net in 2014. Of the 315 juvenile Lake Trout sampled shore wide, 97% were wild fish.

Lake Trout harvest in the summer commercial assessment in MN-3 continued to increase towards established quotas, whereas the Lake Trout harvest in MN-2 declined from 2013. Lake Trout harvested in MN-2 decreased from 1,221 in 2013 to just 423 in 2014 and catch rates decreased from 7.2 Lake Trout per 1,000 feet of net to 4.0 Lake Trout per 1,000 feet of net in 2014. Netters in MN-2 harvested only 21% of the total-allowable catch of 2,000 Lake Trout. The number of Lake Trout harvested in MN-3 increased slightly from 1,960 in 2013 to 2,002 in 2014 and catch rates decreased from 38 Lake Trout per 1,000 feet of net in 2013 to 30 Lake Trout per 1,000 feet of net in 2014. Netters harvested 67% of the total-allowable-catch of 3,000 Lake Trout in MN-3.

Cisco *Coregonus artedi* abundance in the commercial catch increased from 1985 through 2000; however, harvest has recently decreased, particularly in the past two years, primarily due to a lack of a strong year-class since 2003. This lack of a strong year-class has been observed in three independent surveys: MNDNR hydroacoustics, USGS lakewide hydroacoustics, and USGS trawling. Cisco harvest in the traditional gill net fishery (all year excluding November) decreased 18% from 152,449 pounds in 2013 to 128,961 pounds in 2014 and CPUE decreased 6% from 208 pounds per 1,000 feet of net in 2013

to 196 pounds per 1,000 feet of net in 2014. Harvest during the November Cisco fishery decreased from 110,814 pounds in 2013 to 85,533 pounds in 2014 and CPUE decreased slightly from 474 pounds per 1,000 feet of net in 2013 to 463 pounds per 1,000 feet of net in 2014.

The commercial harvest of Rainbow Smelt *Osmerus mordax* decreased 90% and catch rates decreased 94% from 2013 to 2014. Rainbow Smelt catches in 2014 were near their lowest level during 1965-2014; only catches in 2003 were lower and catches in 2004 were slightly higher. The low catches of Rainbow Smelt were likely due to late ice cover. Other non-native species' behavior was affected by the late ice; for example, Rainbow Trout were seen entering rivers to spawn in late June when normally they would enter the streams in April or May. Rainbow Smelt continue to be an important food source for Lake Trout in spring, accounting for 76% of prey biomass in Lake Trout diets in the May assessment. Rainbow trout comprise less of the Lake Trout's summer diet, accounting for 18% of prey biomass in 2014. Between 2013 and 2014, the percentage of Rainbow Smelt in Lake Trout diets decreased by 11% for May and 17% for summer.

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Introduction

In 1995, the Minnesota Department of Natural Resources (MNDNR), working closely with stakeholders, developed a plan describing specific goals for Lake Superior fisheries and outlined management strategies to accomplish these goals over the next 10 years (Schreiner 1995). The plan was revised in 2006 after a two-year public participation process and was published as the *Fisheries Management Plan for the Minnesota Waters of Lake Superior* (LSMP; Schreiner et al. 2006). This plan is an important tool for implementing a variety of management strategies and for monitoring, via fisheries assessments, progress towards achieving the objectives put forth. This report summarizes annual assessment work conducted by the Lake Superior Area Office in Minnesota's portion of Lake Superior in 2014 including May Lake Trout *Salvelinus namaycush*, juvenile Lake Trout, summer commercial Lake Trout, and forage fish (Cisco *Coregonus artedi* and Rainbow Smelt *Osmerus mordax*) assessments.

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 (Horns et al. 2003). Lake Trout is the primary species caught by anglers and at present supports a recreational fishery with an average annual harvest of 22,838 fish (2008-2014) in the Minnesota waters of Lake Superior (Reeves 2014). Lake Trout are the dominant predator in Lake Superior and have a large influence on prey fish abundance, particularly the non-native Rainbow Smelt. Chinook Salmon *Oncorhynchus tshawytscha*, Coho Salmon *O. kisutch*, and Rainbow Trout *O. mykiss* are not vulnerable to MNDNR assessment gill nets. The status of these salmonid species is discussed in creel survey reports and reports on the operation of the French and Knife River traps (Blankenheim 2014).

Cisco and Rainbow Smelt are important forage species in Lake Superior and both support commercial fisheries. Population dynamics are monitored by analyzing commercial fishing records, hydroacoustic surveys, and MNDNR assessment netting (Goldsworthy 2014). Cisco abundance and its importance as forage, especially in summer and fall, has increased since the mid-1980s (Ray et al. 2007). Although Rainbow Smelt abundance has decreased since the 1960s, they are the primary prey item in the spring diets of Lake Superior predators (Ray et al. 2007).

Methods

Assessment methods for the May Lake Trout, juvenile, spawning Lake Trout, and forage fish populations have been previously described in Halpern and Schreiner (2003). This report summarizes assessment activities classified as: May Lake Trout, juvenile Lake Trout, summer commercial Lake Trout, spawning Lake Trout, and Cisco assessments. Commercial Cisco and Rainbow Smelt fisheries are also summarized.

A limited summer commercial Lake Trout assessment fishery was permitted, beginning in 2007 for MN-3 and in 2010 for MN-2. The annual Lake Trout limits were 3,000 fish in MN-3 and 2,000 fish in MN-2 and the season was open from June 1st through September 30th. In 2014, three commercial operators fished in MN-3 and three commercial operators fished in MN-2. This limited commercial fishery serves as a surrogate for the September Lake Trout assessment that was discontinued in 2010 due to reduced budgets and staff. Detailed information on the limited commercial Lake Trout fishery can be found in Goldsworthy (2014).

Beginning in 2006, catch per unit effort (CPUE) 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. Sampling locations are shown in Fig. 1 and statistical districts are shown in Fig. 2.

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 CPUE were recalculated for MN-1. Therefore, historical CPUEs in this report may be slightly different than in previous reports.

The MNDNR Cisco assessment consists of two gangs of three multi-mesh (2.0-, 2.5-, and 3.0-inch stretch mesh) net which are each 100 feet long for a total of 300 feet of net per gang. One gang is set at 12 feet below the surface and the other at 25 feet below the surface. Sampling began in the first week of October with a goal of 100 Cisco sampled per mesh size. Due to the time constraints of otolith aging and reporting, age data of Ciscoes sampled in 2014 were not yet available.

Results and Discussion

May Assessment

The number of fresh Sea Lamprey wounds per 100 Lake Trout, or wounding rate, observed in MN-1 during the May assessment was similar between 2013 and 2014, decreasing only slightly from 8.3 fresh wounds in 2013 to 8.1 fresh wounds in 2014. Lake Trout in the 29 + inch group had the highest wounding rate (Table 1; Figure 3). Wounding rates in MN-2 increased from 0.8 fresh wounds in 2013 to 3.6 fresh wounds in 2014. Wounding rates also increased in MN-3, from 4.9 fresh wounds in 2013 to 8.6 fresh wounds in 2014. Overall, wounding rates increased slightly for Minnesota waters of Lake Superior in 2014 (Figure 4).

Sea Lamprey 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 and in most years kill more Lake Trout than the sport, assessment and tribal fisheries combined. In 2005 and 2006, increased Sea Lamprey wounding was observed not only in Minnesota waters of Lake Superior, but in other jurisdictions of Lake Superior as well. Sea lamprey control efforts were intensified and wounding decreased in 2007. Wounding rates increased again in 2008, especially in MN-3 (Figure 3). Wounding rate declined from 2008 through 2013, which was encouraging and likely a result of increased treatments in the large rivers and lentic areas in the western Ontario waters of Lake Superior.

Lake Trout CPUE in the May assessment decreased from 11.2 fish per 1,000 feet in 2013 to 9.6 fish in 2014. Lake Trout CPUE was highest for fish in the 21-24.9 inch length range (Table 2; Figure 5). Lake Trout CPUE in 2014 for MN-1, MN-2, and MN-3 were 25.1, 4.3, and 18.2 fish per 1,000 feet of net, respectively (Table 3). A positive trend in the catch of wild Lake Trout has been observed since the mid 2000s in MN-1 and MN-3; however, a positive trend has not been observed in MN-2 (Figure 5). Wild fish comprised 95% of Lake Trout sampled in May 2014, which was very near the highest observed rate since Lake Trout restoration began (Figure 6).

Seven (n = 121), eight (n = 98), and nine (n = 84) year old Lake Trout were the most abundant age classes in 2014 (Table 4) and were also the most abundant of the past three years. Of the 303 Lake Trout sampled in this range of ages, only 1.0% (n = 3) were hatchery fish. This provides additional evidence that native Lake Trout populations are self-sustaining at current mortality rates and stocked Lake Trout survival is extremely low.

By weight, diet composition of Lake Trout in the 2014 May assessment was Rainbow Smelt (76%), unidentifiable fish remains (10%), coregonids (5%), Bloater *Coregonus hoyi* (3%) and other diet items (6%) including: Alewife *Alosa pseudoharengus*, Burbot *Lota lota*, fish eggs, aquatic and terrestrial insects, Kiyi *Coregonus kiyi*, Lake Trout, Mysis, and sculpin *Cottus* sp. Seventeen percent of Lake Trout sampled in the May assessment had no prey items in their stomachs (n = 96), which is considerably higher than the 3% of empty stomachs found in 2013 (Goldsworthy and Schreiner 2014). The higher rate of empty Lake Trout stomachs provides additional evidence the Rainbow Smelt spawning was delayed by the late ice cover.

Decreases in overall CPUE of Lake Trout, as well as increases in the proportions of wild and larger Lake Trout, have been observed by other agencies around Lake Superior as rehabilitation has progressed. It is likely that high Lake Trout abundance observed in the 1980s resulted from stocked fish filling niches made vacant by Sea Lamprey predation and increased availability of forage in the form of extremely high numbers of Rainbow Smelt. Subsequent decreases in overall Lake Trout abundance were predominantly the result of a decrease in the survival of stocked fish, probably due to direct predation and competition with wild fish (Hansen et al. 1996), and reflect a fishery approaching a more sustainable level (Corradin et al. 2008; Negus et al. 2008). Decreases in overall abundance of Lake Trout may also reflect changes in behavior and catchability of adult Lake Trout in the May assessment. As Rainbow Smelt population declined, a shift in forage to Cisco could have resulted in Lake Trout dispersing over broader areas in search of food.

<u>Juvenile Lake Trout Assessment</u>

In 2014, CPUE of juvenile Lake Trout (less than 17 inches) was 16.8 fish per 1,000 feet of net, an increase from 11.4 fish per 1,000 feet of net in 2013 (Table 5; Figure 7). Wild fish comprised 97% of the juvenile Lake Trout (Table 6). Juvenile diets were composed of Mysis (34%), unidentified fish remains (16%), terrestrial insects (15%), Rainbow Smelt (12%), Burbot (10%), and 13% other prey items such as aquatic insects, larval fish, and zooplankton. Twenty-four percent of juvenile Lake Trout stomachs contained no prey items (n = 86).

Lake Trout recruitment may be reaching a level representative of self-sustaining Lake Trout populations in Lake Superior due to higher proportions of wild adults and juveniles sampled in recent years. Continued stocking of large numbers of Lake Trout in areas where wild fish account for over 50 percent of the catch may depress the recovery of wild fish. Shorewide reductions in stocking numbers were initiated when criteria from the Lake Trout Rehabilitation Plan (LTRP) were met (Hansen 1996; Schreiner et al. 2006). In 2003, criteria were met in MN-3, and Lake Trout are no longer stocked in this zone. In MN-2, criteria were met, and during the revision of the LSMP (Schreiner et al. 2006) the decision was made to discontinue Lake Trout stocking in MN-2 beginning in 2007, and to reduce stocking in MN-1 to 170,000 yearlings per year. These changes in stocking will have, in and of themselves, resulted in higher proportions of wild fish in the population, since no new stocked fish will be entering the fishery in MN-2 or MN-3. We anticipate recommending discontinuing Lake Trout stocking in the 2016 *Fisheries Management Plan for the Minnesota Waters of Lake Superior* revision process.

Summer Commercial Assessment

In 2014, the limited commercial fishery for Lake Trout in MN-2 entered its fifth year. The number of Lake Trout harvested in MN-2 decreased from 1,221 to 423 fish and CPUE decreased to 4.0 Lake Trout per 1,000 feet of net between 2013 and 2014 (Figure 8). For comparison purposes, the estimated number harvested in the 2014 sport fishery in MN-2 was 4,920 Lake Trout, 91% more than the commercial harvest.

In 2014, the limited commercial fishery for Lake Trout in MN-3 entered its seventh year. Commercial netters harvested 2,002 Lake Trout in MN-3; however the catch rate decreased by 27% to 30 Lake Trout per 1,000 feet of net in 2014 (Figure 8). Commercial netters harvested 67% of the total-allowable-catch (TAC) of 3,000 Lake Trout. For comparison purposes, sport anglers harvested 2,799 Lake Trout in MN-3 in 2014, which was 40% more than the commercial harvest.

Lake Trout diet composition in the summer commercial assessment by weight was coregonids (24%), unidentifiable fish remains (24%), Rainbow Smelt (19%), Mysis (13%), Burbot (9%), sculpin (4%), terrestrial insects (3%), salmonids (2%), Rainbow Trout (1%), and other (1%). No Alewives were found in stomachs, compared to 2% of the diet in 2013. Fifty percent of Lake Trout sampled (n = 225) in the summer commercial assessment had no prey items in their stomach, compared to 41% in 2013.

Lake Trout Modeling

In 2005, we developed a Statistical Catch-at-Age (SCAA) model for Lake Trout. This is an important tool for assessing the status of Lake Trout stocks in Minnesota waters of Lake Superior and will assist us in determining sport and commercial harvest levels. This type of model is presently used to help manage the tribal, sport and state commercial fisheries in Wisconsin and Michigan. A description of the model and discussion of the results from 2005 through 2009 can be found in Halpern (2010).

Lake Trout total annual mortality and spawning stock biomass (SSB) are parameters estimated in SCAA models. Healey (1978) suggested that a Lake Trout population would decline if it suffered more than 50 percent total annual mortality. Other models showed that Lake Trout spawner abundance decreased when total annual mortality exceeded 45% (Technical Fisheries Review Committee 1992; Ebener et al. 1989), so this figure was used as the maximum acceptable mortality in the LTRP (Hansen 1996) and in the LSMP (Schreiner et al. 2006). Total mortality in MN-1 was closest to the maximum target mortality of 45%, and we will continue to monitor the fishery closely and adjust harvest levels, if appropriate. We are monitoring SSB and investigating its usefulness as another criterion for managing the Lake Trout population. Presently, we are updating and evaluating the Lake Trout SCAA model and investigating various means of assessing it, such as retrospective analysis, Monte Carlo simulations and others.

In general, Lake Trout restoration in Minnesota waters of Lake Superior has proceeded well. Although the relative CPUE of all Lake Trout has decreased since the extremely high levels of the 1980s, it has been increasing for several years. There is little expectation for further large increases in the number of Lake Trout (Schreiner et al. 2006; Corradin et al. 2008; Negus et al. 2008). Importantly, the transition from a fishery dominated by stocked fish to one dominated by wild fish has occurred; therefore, Lake Trout abundance should stabilize around a new equilibrium more aligned with forage availability, natural population dynamics, Sea Lamprey predation, and commercial and sport harvest. We are continuing to refine our assessment of fish stocks, and our models for Lake Trout and Cisco, in order to better understand the population dynamics of these important fish in Minnesota waters of Lake Superior.

MNDNR Cisco Assessment

Commercial Cisco harvest has declined since 2012, which is evidence for the lack of a strong Cisco year class in recent years (Figure 9). As supporting evidence of declining Cisco abundance, no major year-classes have appeared in USGS trawl surveys since the 2003 year class (Figure 10; Gorman et al. 2012). Ciscoes from the 1998 year-class were first observed in the commercial fishery in 2001 and by

2003 the 1998 year-class made up about 60% of the commercial Cisco catch (Geving and Schreiner 2004). The 2003 year-class first began to show up in the commercial fishery in 2005, and in 2012 made up more than 39% of the November Cisco fishery (Goldsworthy 2014). In 2012, the 2005 and 2009 year-classes contributed approximately 8 percent and 24 percent to the November roe fishery, respectively.

A management strategy to assess forage species as stated in the LSMP is to use hydroacoustic sampling and trawl surveys to monitor year-class strength and determine biomass of Cisco and Rainbow Smelt in Minnesota's portion of Lake Superior. In late summer of 2003 a pilot project was initiated to address this objective. The Lake Superior Area fisheries staff collaborated with Dr. Tom Hrabik from the University of Minnesota Duluth to develop a hydroacoustic program that would quantify prey fish abundance (Hrabik et al. 2006). From 2003- 2013, hydroacoustic surveys of Minnesota waters of Lake Superior were conducted. These surveys have confirmed that the 2003 year-class is relatively strong in Minnesota waters of Lake Superior, and have yielded estimates of Cisco biomass that are being used to determine the TAC for Cisco (Hrabik et al. 2006; Schreiner et al. 2006; Goldsworthy and Schreiner 2012). The feasibility of using a harvest-based model for Cisco is being explored by the Quantitative Fisheries Center at Michigan State University, and in the future may be used to complement the hydroacoustic surveys in determining the TAC in the commercial Cisco fishery.

Commercial Cisco and Rainbow Smelt Harvest

Since the mid-1960s, Cisco stocks recovered in all Minnesota waters of Lake Superior and catch increased substantially in the commercial fishery into the middle 1990s (Figure 10. In 2001 the November harvest started to increase, due to a developing roe fishery, however the overall harvest did not increase, rather the traditional gill net fishery (i.e. all months except November) declined. During the mid-1990s through the early 2010s the overall Cisco harvest fluctuated between 301,000 and 450,000 pounds per year, except for a low harvest of 275,700 pounds in 2010. Cisco harvest declined in the past two years to 263,263 pound in 2013 and 214,494 pounds in 2014, which is considerably less than the average of 344,308 pounds per year in the previous 12 years (Figure 9). Overall Cisco CPUE declined to 255 fish per 1,000 feet of net in 2014. Compared to 2013, overall harvest and CPUE decreased 23% and 22%, respectively. The declines in 2014 follow declines in 2013 of 46% for harvest and 35% for CPUE. Cisco harvest in 2014 was previously this low in 1988. Effort decreased 11% during the traditional season from 732,575 in 2013 to 657,345 feet of net in 2014. Otolith age analysis of commercial harvest in 2013 indicated a weak to moderate contribution of 39% from the 2009 year class, a weaker contribution of 9% from the 2003 year class, and stronger but diminishing year classes with 51% of the fish from 2005 and 44% from 1998. The few remaining fish in the sample were more than the 23 years old. Otolith ages were not yet available for 2014.

Beginning in 2006 in Minnesota waters, harvest was permitted thru November using total-allowable-catch (TAC) quotas established for each statistical district (Schreiner et al. 2006). Harvest during the November Cisco fishery decreased from 110,814 pounds in 2013 to 85,533 pounds in 2014 and CPUE decreased slightly from 474 pounds per 1,000 feet of net in 2013 to 463 pounds per 1,000 feet of net in 2014.

In 2014, the spring Rainbow Smelt spawning run along the Minnesota shore of Lake Superior remained at a very low level, and few fish were captured in the dip net fishery, compared to the pre-1980 period. From 1980-1990, commercial harvest had stabilized at approximately 15% of the average harvest during the 1970s. Since then, harvest has declined further, to less than five percent of the average harvest of the 1970s (Figure 11). In 2014, one commercial Rainbow Smelt operation located in MN-1 fished the pound net fishery and harvested only 2,685 pounds of Rainbow Smelt. Details on both the Cisco and Rainbow Smelt fisheries can be found in Goldsworthy (2014).

Stocking

Criteria regarding the use of Lake Trout stocking as a management tool in Lake Superior are discussed in *A Lake Trout Restoration Plan for Lake Superior* (LTRP, Hansen ed. 1996) and the LSMP (Schreiner et al. 2006). Lake Trout stocking has been discontinued in MN-3 (2003) and MN-2 (2007) and reduced to 170,000 fish in MN-1 (2007) because criteria established in these documents had been met.

In 2011-2014, Lake Trout stocking in MN-1 was further reduced due to a production bottleneck and to fish losses in the hatchery system. In 2013, the stocking criteria were re-evaluated for MN-1 and revealed low survival of stocked fish to age-7 and a high proportion of spawning sized Lake Trout in the May assessment. These results indicate the criteria have been met to discontinue stocking since 2001 and a recommendation to do so will be discussed during the revision of the 2006 LSMP.

Two strains of Rainbow Trout were stocked in Minnesota waters of Lake Superior in 2014; these were the steelhead and Kamloops strains. All steelhead originated from Minnesota stocks. Summaries of the 2014 stocking and proposed 2015 stocking are given in Table 7. In accordance with the *Rainbow Trout Management Plan for the Minnesota Waters of Lake Superior* (Schreiner 2003), steelhead smolts were stocked in the Knife River from 2003-2007 to evaluate returns and to determine appropriate stocking locations. This stocking has been discontinued and a synthesis of the Minnesota Rainbow Trout stocking program was published in 2012 (Negus et al.).

Summary

Overall, the fish community of Lake Superior represents a native fish community with Lake Trout as the dominant predator. The high proportion of wild juvenile and adult Lake Trout in Minnesota waters of Lake Superior is indicative of positive results from restoration efforts. The Lake Trout population may be reaching a new equilibrium more aligned with natural population dynamics, Sea Lamprey predation, and commercial and sport harvest. Managers, commercial operators, and sportsmen must use caution regarding increased harvest of Lake Trout, since history has proven long-lived fish species are quite vulnerable to overharvest.

Catch rates in the traditional and November commercial Cisco fishery have decreased due to a lack of a strong year-class since 2003. The strength of the 2009 year class has been only moderate at best. Cisco biomass declines have been observed in MNDNR hydroacoustics surveys, United States Geologic Survey (USGS) lakewide hydroacoustic surveys, and USGS bottom trawl surveys. Based on USGS bottom trawl surveys, no new year classes were produced from 2010-20103; therefore knowing that Cisco fully recruit to the commercial gear at age 4, no additional Cisco biomass will contribute to the commercial fishery through 2017. This will likely lead to reduced November quotas in the commercial Cisco fishery and will further strain the already diminished prey base in Lake Superior.

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Area Supervisor Date

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Table 1. Number of fresh lamprey wounds per 100 Lake Trout in 4.5 inch May 2014 assessment gill nets, by size class and statistical district. 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	2.5 (79)	9.3 (118)	9.3 (54)	37.8 (8)	8.1 (259)
MN-2	0 (74)	2.8 (106)	11.4 (35)	14.3 (7)	3.6 (222)
MN-3	1.5 (135)	12.9 (132)	14.3 (21)	300 (1)	8.6 (289)
TOTALS	1.4 (288)	8.7 (356)	10.9 (110)	43.8 (16)	7.0 (770)

Table 2. Number of Lake Trout per 1,000 feet of 4.5 inch stretch mesh May assessment gill nets, 2014.

	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	0.29	3.5	4.33	1.34	0.19	9.65

Table 3. Corrected Lake Trout catch, by station, in the May assessment, 2014.

Location	Effort in Feet (corrected effort)	Total Catch (number)	Total Weight (pounds)	Number per 1,000 feet	Pounds per 1,000 feet	Percent Wild
MN-1						
All Stations (n = 7)	10,500 (10,500)	264	907	25.1	86.4	90.9
MN-2						
Split Rock	30,250 (31,290)	113	424	3.6	13.6	94.7
Silver Bay	17,500 (24,470)	125	417	5.1	17	96
Totals MN-2	47,750 (55,760)	238	841	4.3	15.1	95.4
MN-3						
Grand Marais	13,500 (16,050)	292	864	18.2	53.8	99.3
Totals MN-3	13,500 (16,050)	292	864	18.2	53.8	99.3
All locations						
Shorewide	**71,500 (82,310)**	**794**	**2,612**	**9.6**	**31.7**	**95**

Table 4. Age-length frequency distribution of otolith aged Lake Trout in 4.5 in. gill net, May assessment, 2014.

Length (in)	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI+
9.5 – 10.4													
10.5 – 11.4													
11.5 – 12.4	1												
12.5 – 13.4	1												
13.5 – 14.4		2											
14.5 – 15.4		3											
15.5 – 16.4		2	3										
16.5 – 17.4		2	5			2							
17.5 – 18.4			6	7	3	1							
18.5 – 19.4			7	21	4			1					
19.5 – 20.4			5	43	13	4	1	1	1				
20.5 – 21.4				33	13	4	5		1				2
21.5 – 22.4				13	25	19	5	3	3			1	1
22.5 – 23.4				4	27	16	6	7				1	1
23.5 – 24.4					8	14	10	5	3	1			1
24.5 – 25.4					4	12	8	8	5			1	2
25.5 – 26.4					1	9	8	3	4				1
26.5 – 27.4						3	8	5	3		1		
27.5 – 28.4							2	2	2			1	1
28.5 – 29.4							1		3	1		1	3
29.5 – 30.4									1			1	4
30.5 – 31.4									1				1
31.5 – 32.4													1
32.5 – 33.4													
33.5 – 34.4													
34.5 – 35.4													
35.5 – 36.4													
36.5 – 37.4													
37.5 – 38.4													
38.5 – 39.4													
39.5 –40.4													
Total	2	9	26	121	98	84	54	35	27	2	1	6	18
Average Length	12.2	15.4	18.2	20.2	21.9	23.2	24.4	24.3	25.6	26.2	26.5	25.9	27

Table 5. 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, 2014.

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	30	77%	15.1	4.6	19.7
Pumping Station	1,000	1,520	26	96%	16.4	0.7	17.1
Stoney Point	1,000	1,520	24	96%	15.1	0.7	15.8
Larsmont	1,000	1,520	20	100%	13.2	0.0	13.2
Two Harbors	1,000	1,520	6	100%	3.9	0.0	3.9
Encampment Island	1,000	1,520	6	100%	3.9	0.0	3.9
MN-1 Total	**6,000**	**9,120**	**112**	**92%**	**11.3**	**1.0**	**12.3**
MN-2							
Split Rock	1,000	1,520	25	100%	16.4	0.0	16.4
Silver Bay	1,000	1,520	13	100%	8.6	0.0	8.6
Taconite Harbor	1,000	1,520	31	100%	20.4	0.0	20.4
Tofte	1,000	1,520	18	100%	11.8	0.0	11.8
MN-2 Total	**4,000**	**6,080**	**87**	**100%**	**14.3**	**0.0**	**14.3**
MN-3							
Grand Marais	1,000	1,520	47	100%	30.9	0.0	30.9
Hovland	1,000	1,000	17	100%	17.0	0.0	17.0
Grand Portage	1,000	1,520	61	100%	40.1	0.0	40.1
MN-3 Total	**3,000**	**4,040**	**125**	**100%**	**30.9**	**0.0**	**30.9**
Shorewide Total	**13,000**	**19,240**	**324**	**97%**	**16.4**	**0.5**	**16.8**

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

Table 6. Historical catch summary of Lake Trout less than 17 inches 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, 1980-2014.

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	586	1.2	29.6	30.9	4%
1981	914	2.2	51.7	54	4%
1982	551	1.9	37.7	39.6	5%
1983	454	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	350	6	16.8	22.8	26%
1988	271	3.7	12.7	16.4	23%
1989	168	2.7	8.6	11.3	24%
1990	242	3.7	11.1	14.7	25%
1991	384	4.8	15.5	20.3	24%
1992	278	5.1	11.7	16.8	31%
1993	389	6	18.5	24.5	24%
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	439	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%

*No data due to State of Minnesota government shutdown.

Table 7. Trout and salmon stocked in 2014, and proposed stocking for 2015, Minnesota waters of Lake Superior.

2014 Salmonid Stocking			
Species	**Number**	**Size**	**Fin Clip**
Lake trout	94,278	Yearling	Adipose (A)
Rainbow trout			
Kamloops	94,078	Yearling	Adipose Right-Rear (ARR)
Steelhead	233,989	Fry	None
	90	Adults	Right Maxillary, T-bar anchor tag

Proposed 2015 Salmonid Stocking			
Species	**Number**	**Size**	**Fin Clip**
Lake trout	170,000	Yearling	Left Rear (LR)
Rainbow			
Kamloops	92,500	Yearling	Adipose Left Rear (ALR)
Steelhead	500,000	Fry	None

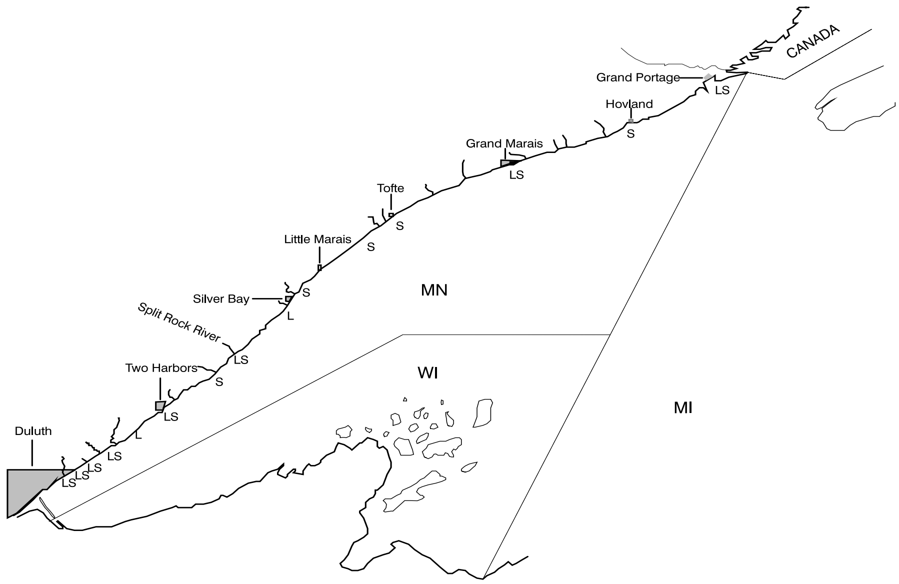

Figure 1. Sampling stations for large (L) and small (S) mesh assessments, Minnesota waters of Lake Superior.

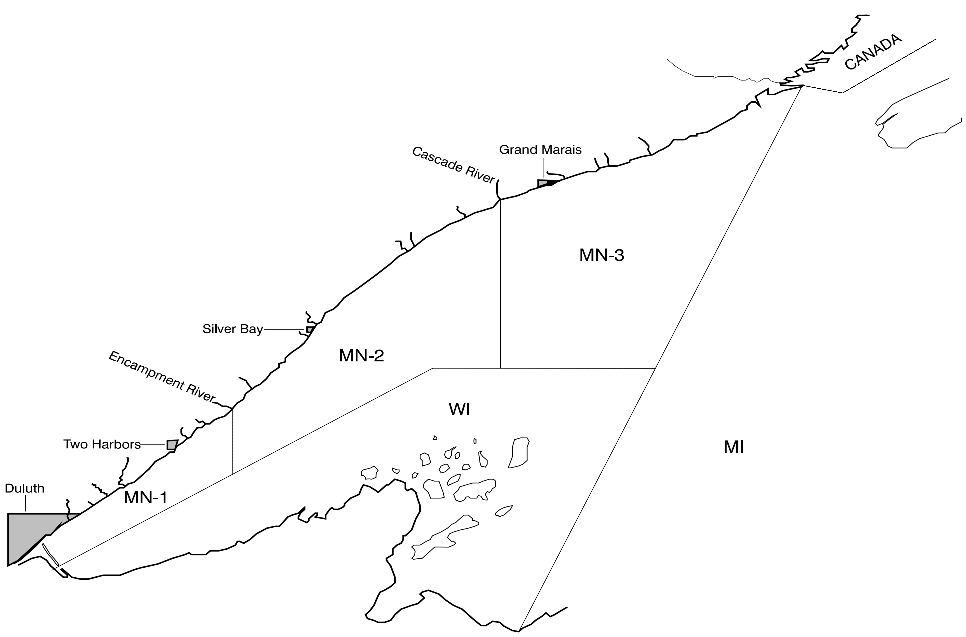

Figure 2. Statistical districts in Minnesota waters of Lake Superior.

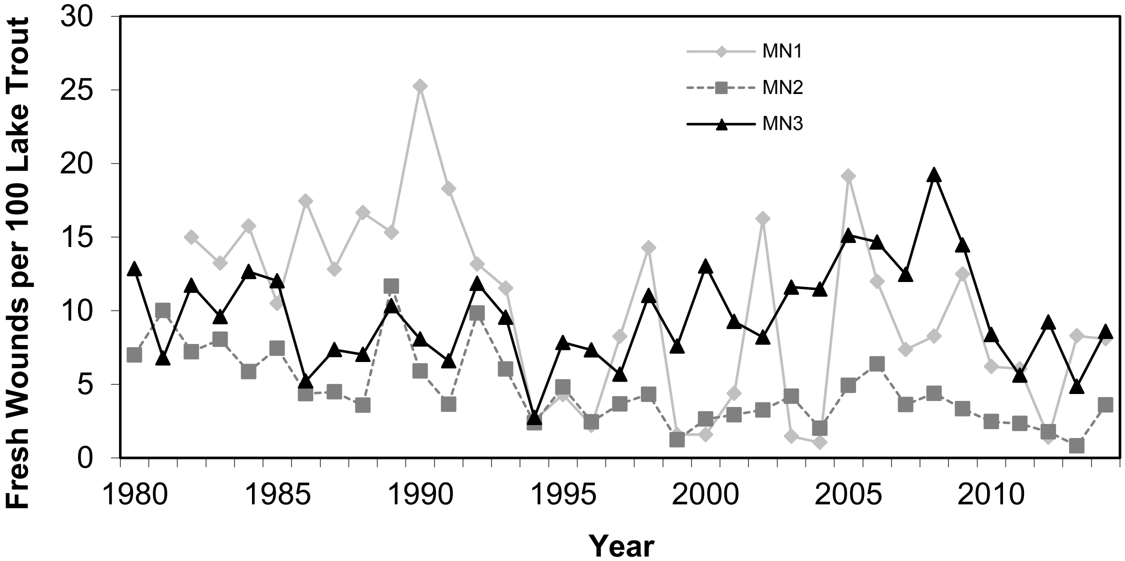

Figure 3. Number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, by statistical district, 1980-2014.

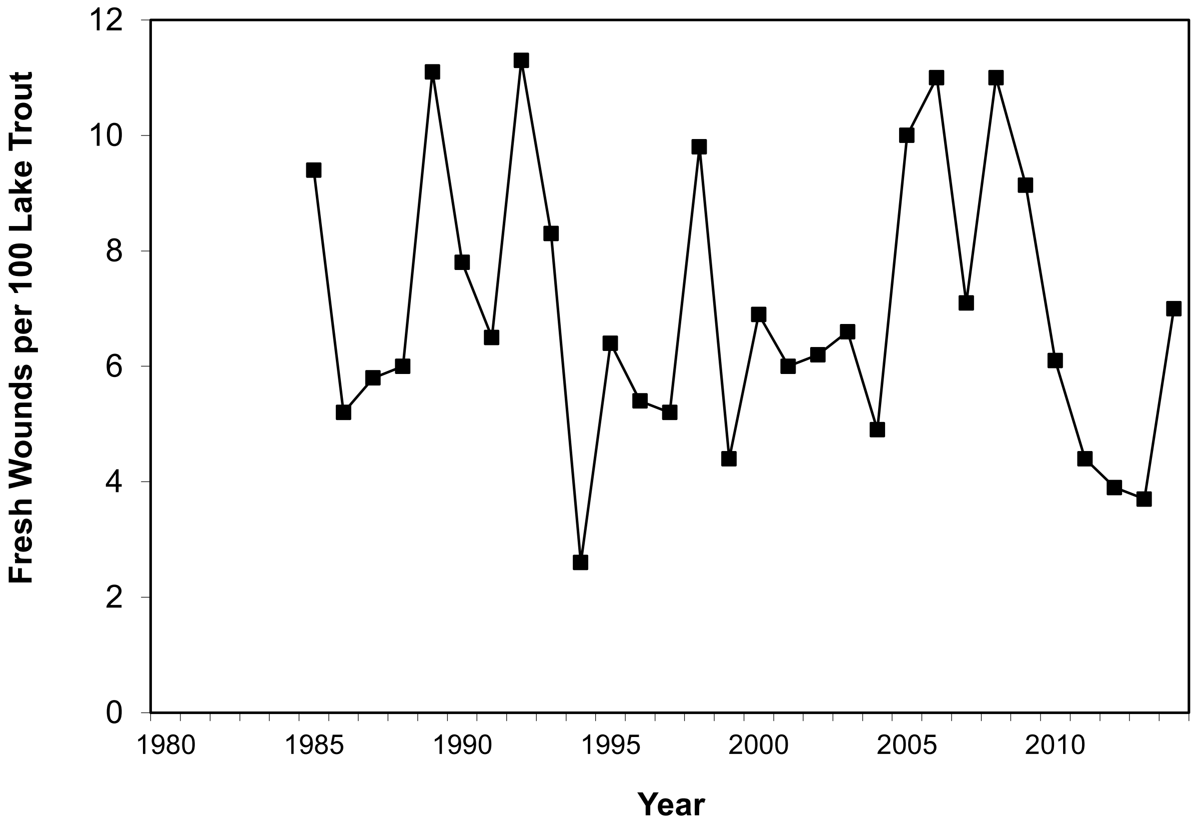

Figure 4. Shorewide number of fresh Sea Lamprey wounds per 100 Lake Trout in the May assessment, 1985-2014.

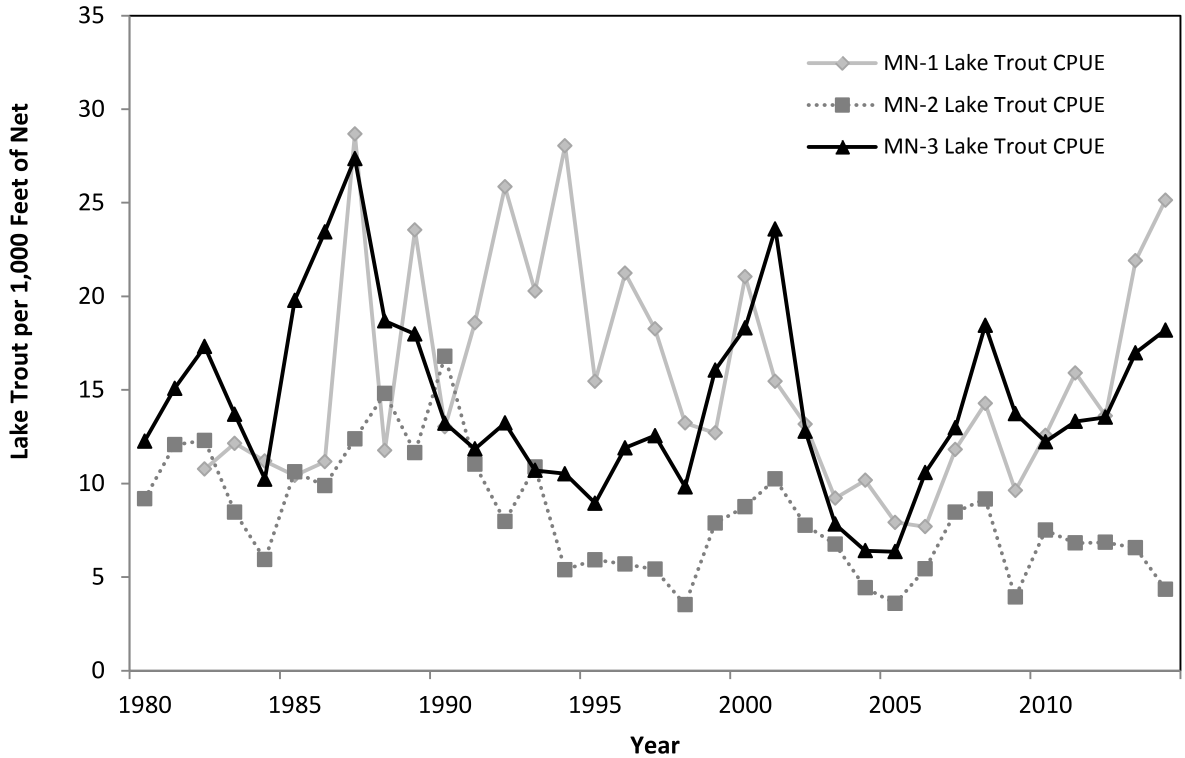

Figure 5. Lake Trout catch rate (number of fish per 1,000 feet of net; CPUE) by statistical district in the May assessment, 1980-2014.

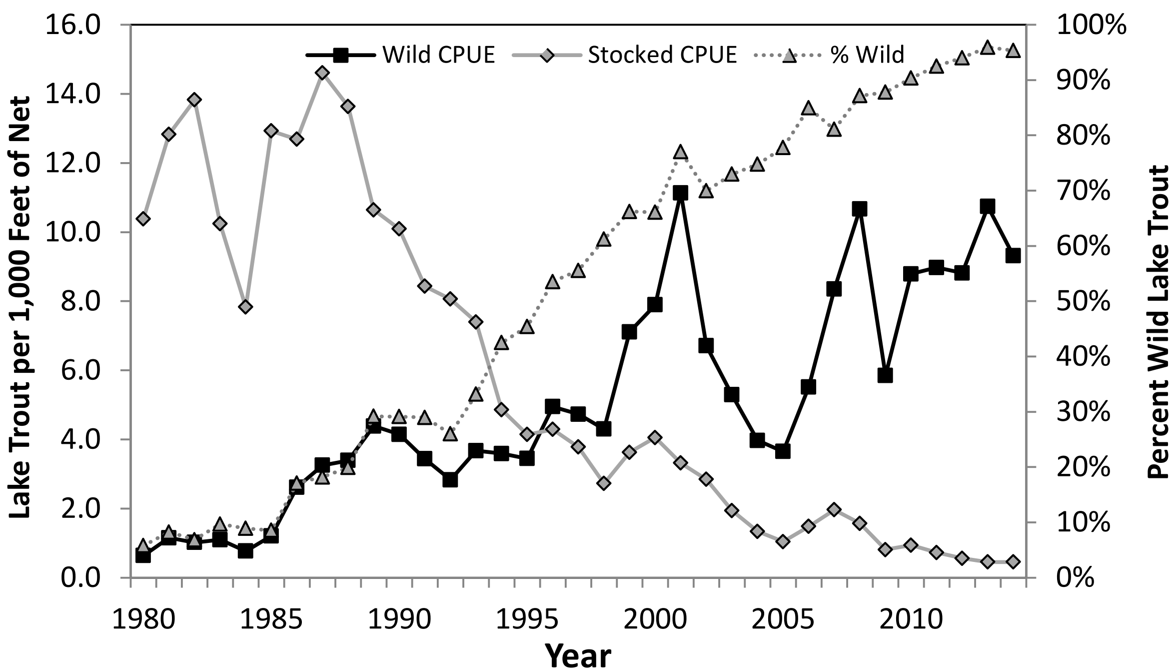

Figure 6. Catch rate (number of fish per 1,000 feet of net; CPUE) of wild and stocked Lake Trout, and percentage wild Lake Trout in the May assessment, 1980-2014.

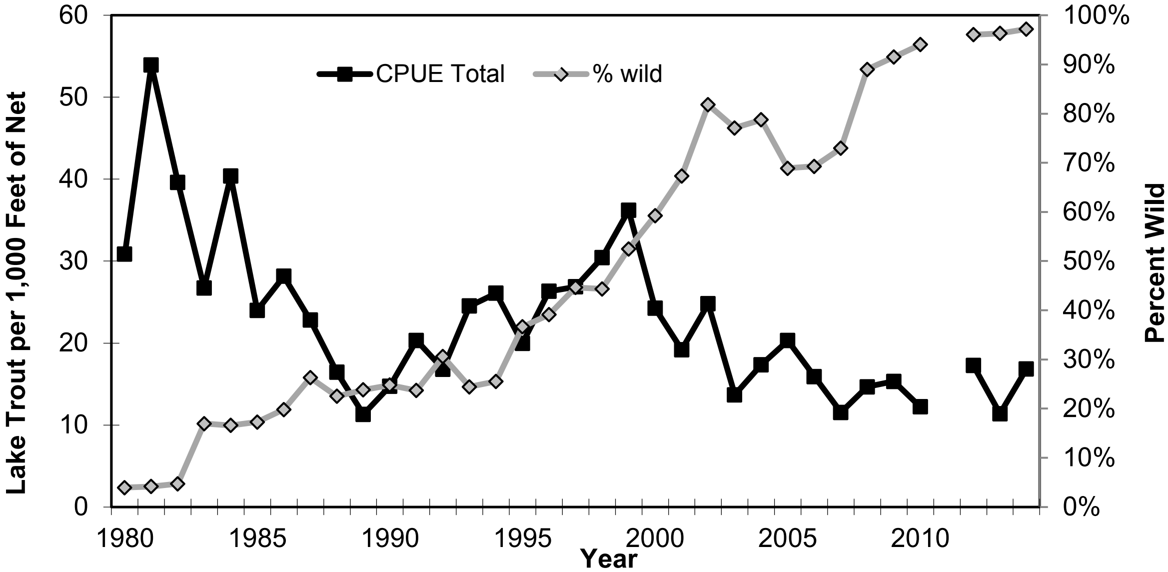

Figure 7. Catch rate (number of fish per 1,000 feet of net; CPUE) and percent wild Lake Trout in the juvenile (<17") Lake Trout assessment, 1980-2014.

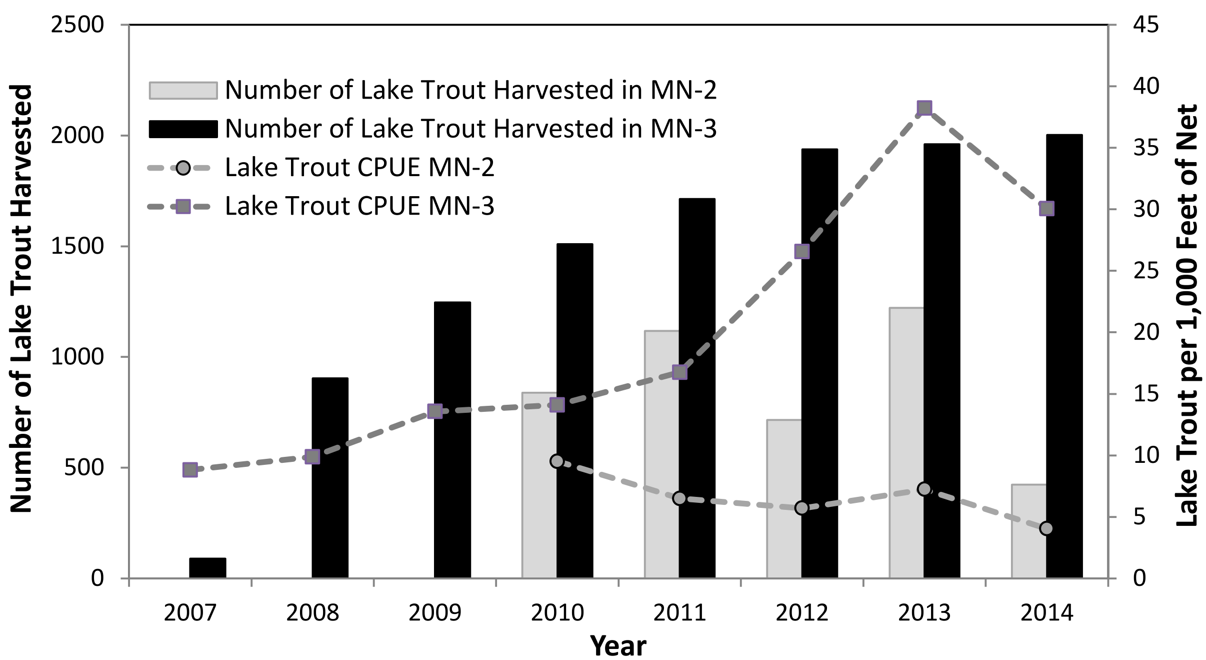

Figure 8. Lake Trout harvest and catch rate (number of fish per 1,000 feet of net; CPUE) in the summer commercial assessment, 2007-2014.

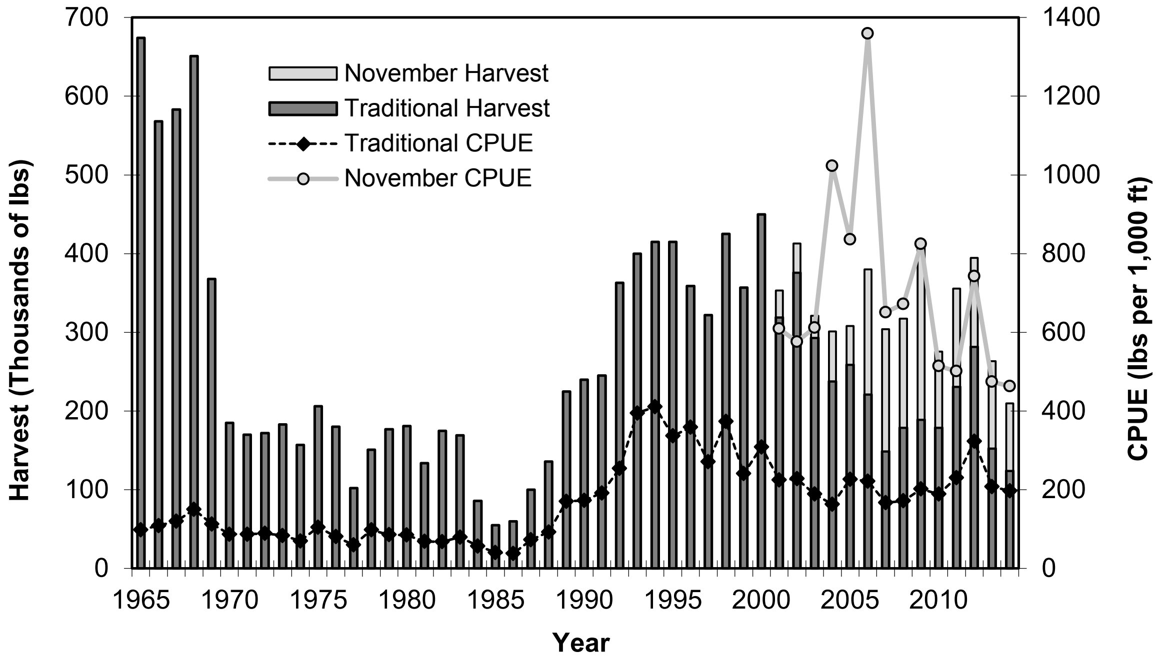

Figure 9. Cisco harvest (thousands of pounds) and catch rate (pounds per 1,000 feet of net; CPUE) in the commercial gill net fishery in Minnesota waters of Lake Superior, 1965-2014.

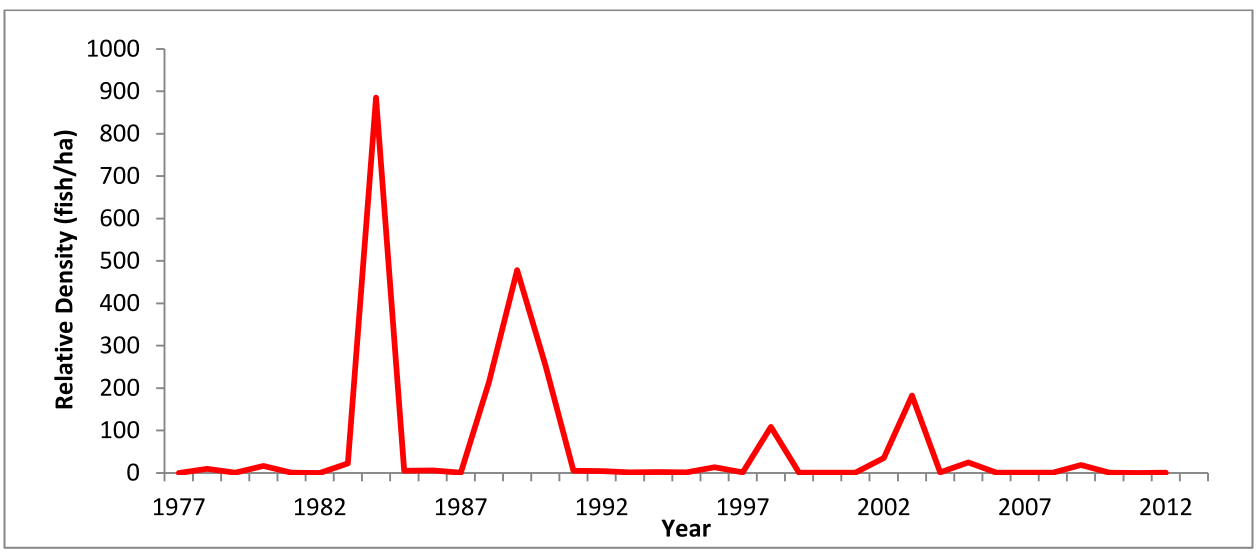

Figure 10. Cisco Year Class Strength, 1977-2013, as measured by the relative density of age-1 Cisco that were caught during USGS bottom trawl surveys.

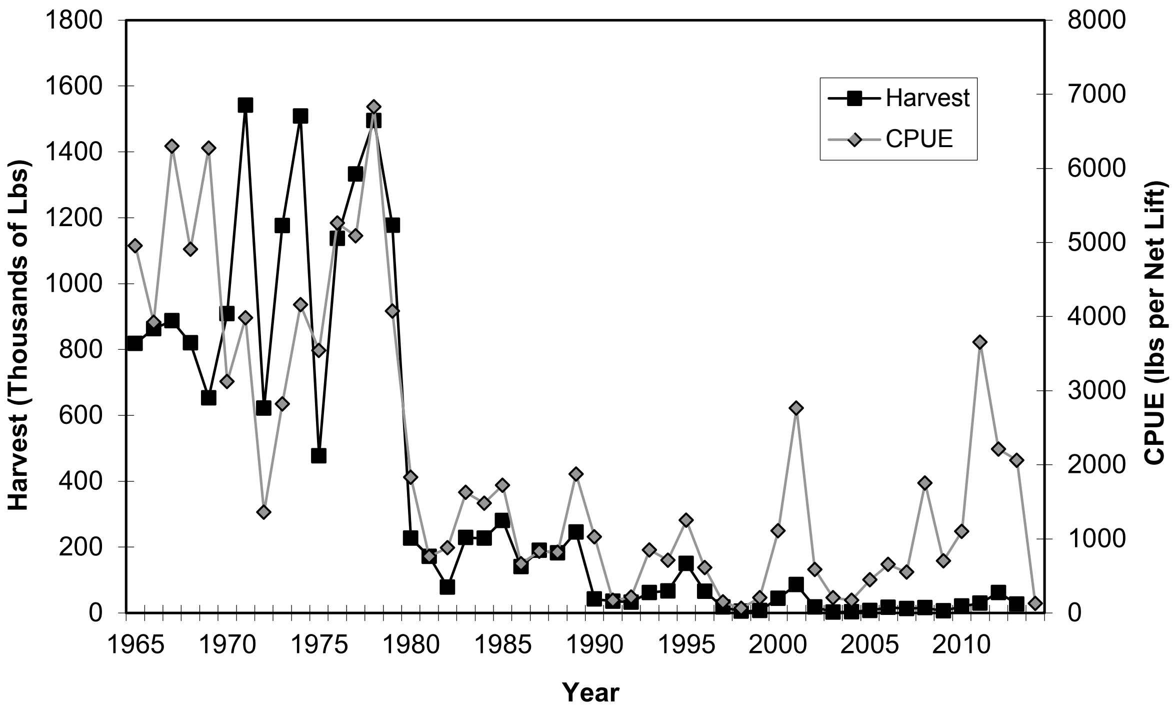

Figure 11. Rainbow Smelt harvest (thousands of pounds) and catch per unit effort (pounds per lift; CPUE) in the commercial pound net fishery, Minnesota waters of Lake Superior, 1965-2014.