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SECTION OF FISHERIES

COMPLETION REPORT:

LAKE SUPERIOR SPRING CREEL SURVEY

2018

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BACKGROUND

Minnesota Department of Natural Resources (MNDNR) fisheries assessments and creel surveys provide data needed to implement the MNDNR Fisheries Management Plan for the Minnesota Waters of Lake Superior (LSMP; Goldsworthy et al. 2017). The LSMP supplements joint strategic documents for lake wide management formed by the Great Lakes Fisheries Commission and other agencies who manage the Lake Superior fishery (GLFC 1997; Horns et al. 2003). Angler creel surveys collect information to supplement data collected in fisheries assessments. Spring creel surveys are used to monitor fishing pressure, catch, catch rates and harvest of fish species in Minnesota waters of Lake Superior, particularly Rainbow Trout.

The first spring creel survey was implemented in 1992 to monitor the rehabilitation of Rainbow Trout in Minnesota waters after the species declined in the 1960s. The survey was designed to target anglers who fished for Rainbow Trout as they migrated upstream in tributaries to spawn. The State of Minnesota currently manages two types of Rainbow Trout in Lake Superior that were introduced from the west coast of North America. This includes steelhead, a migratory life-history form, and Kamloops, a domesticated hatchery strain. Steelhead were first introduced to Lake Superior in the late 1800s (Krueger et al. 1994). Steelhead have naturalized to Lake Superior streams and now provide a sought-after sport fishery in Minnesota waters. Kamloops were originally introduced into Ontario waters of Lake Superior in 1946 (Krueger et al. 1994), and then were introduced in Minnesota waters in 1972 to provide harvest opportunities for Rainbow Trout while steelhead populations were rehabilitated (Close and Hassinger 1981).

The first creel surveys on the North Shore were conducted in 1961 through 1967 (Hassinger et al. 1974), and then in 1981 and 1982 (Close and Siesennop 1984). The MNDNR spring creel survey has been conducted annually since 1985, except in 1991. From 1985 to 1990, the spring creel surveys used a non-uniform probability design that provided good shorewide information but did not permit statistically valid estimates for individual tributaries. In 1992, the survey was changed to a stratified random design to also obtain information from specific tributaries (Ostazeski and Morse 2002). A modified bus-route format was implemented in 1995, 2002, and for part of 2003, to enable a survey with two clerks when three clerks were unavailable. Data in this report are summarized and compared from 1992 to 2016 based on the stratified random design used in the creel survey throughout this time period.

The annual spring creel survey typically begins once tributaries thaw and are fishable. The spring creel survey has provided useful information for many other species in Lake Superior. Brook Trout (*Salvelinus fontinalis*), one of two native sport fish to Lake Superior, are typically the second most reported species in the spring creel survey. Public interest in Brook Trout has increased as agencies around Lake Superior examined protection and restoration strategies for the species (Newman et al. 2003; Schreiner et al. 2008). Many non-native sport fish in Lake Superior also provide angling opportunities in the spring and fall. Brown Trout (*Salmo trutta*), Atlantic Salmon (*Salmo salar*), Chinook

Salmon (*Oncorhynchus tshawytscha*), Coho Salmon (*Oncorhynchus kisutch*), and Pink Salmon (*Oncorhynchus gorbuscha*) are targeted by some anglers fishing in the spring, but the majority of these species are caught by anglers fishing in Lake Superior near rivers. Other than steelhead, very few non-native sport fish are caught in tributaries in the spring because they return to spawn in the fall. Lake Trout (*Salvelinus namaycush*), White Sucker (*Catostomus commersoni*), Longnose Sucker (*Catostomus catostomus*), and Round Whitefish (*Prosopium cylindraceum*) are also periodically caught in rivers and near river mouths in the spring.

The MNDNR recognized that fishing pressure was often high in winter and early-spring prior to the start of the annual spring creel survey, particularly in years when sufficient ice formed in Lake Superior. An early-spring creel survey was initiated in 2013 to evaluate angling pressure and catch of some species, particularly adipose fin clipped Rainbow Trout (hereafter referred to as Kamloops). The early-spring creel surveys are completed during the period prior to ice-out when shore anglers fish exclusively in Lake Superior. This survey includes five creel locations in the lower shore because most of the pressure for Kamloops occurs along the lower shore, near Duluth. The early-creel survey has also provided useful information for other species (e.g., Coho Salmon). The early-spring creel survey was completed in 2013, 2015 and 2016. A winter creel was completed on Lake Superior, from Duluth to Two Harbors, throughout winter 2018. The winter creel was used to estimate fishing pressure, catch and catch-rates for Lake Trout, Salmon (Coho and chinook), and Lake Herring (also called Cisco), and did not specifically target anglers who were specifically targeting Rainbow Trout (i.e., anglers fishing near shore at French River and in McQuade Harbor).

The Minnesota shore of Lake Superior is divided into two geographic regions. The area from the Lester River to the Split Rock River is referred to as the “Lower Shore,” while the area from the Beaver River to the Brule River is referred to as the “Upper Shore.” The spring creel survey collects interviews from anglers at nine tributaries in the lower shore and nine tributaries in the upper shore (Figure 1). Estimates from the lower and upper shore are collectively referred to as “shorewide” estimates. Pressure, catch, and catch rates are determined for individual tributaries, and for the lower shore, upper shore, and shorewide. Anglers fishing in tributaries are considered “stream” anglers and anglers shore fishing in Lake Superior near the tributary mouths are considered “lake” anglers. The term “lake” refers to Lake Superior waters near tributary mouths and includes McQuade Harbor.

Separate estimates of catch and catch rate were made for Rainbow Trout 16 inches and greater and Rainbow Trout less than 16 inches to isolate the influence of juvenile steelhead from the analyses. Unless otherwise specified, estimates for Rainbow Trout are summarized and reported only for fish 16 inches or greater. References to a ‘long-term’ average in this report refer to the time period from 1992 to 2018.

Kamloops possess an adipose fin clip making them legal for anglers to harvest. No adipose-clipped steelhead stocked in the early 2000s should still exist in Lake Superior. Adipose-clipped steelhead (plus one other fin clipped) were stocked in the French and Lester rivers in 2018, and the first return of these

fish as adults should be in 2020 and 2021. The vast majority of unclipped steelhead caught before 2020 were produced in the wild, and some were products of MNDNR steelhead fry stocking. Some stocked steelhead, including captive broodstock from French River Coldwater Hatchery released back into Lake Superior, possess a maxillary clip that is often difficult for anglers to identify. These fish were reported by anglers as simply 'steelhead'. Maxillary clipped steelhead could influence the catch and catch-rate in the spring creel at the Knife River, which received all of the (maxillary clipped) steelhead stocked from 2003 to 2007. However, these fish are only rarely caught in the spring at the Knife River fish trap (Peterson 2018), and very few (if any) likely still exist in Lake Superior.

Unclipped Rainbow Trout (steelhead) are currently maintained as a catch-and-release-only fishery. Clipped Rainbow Trout (Kamloops or clipped steelhead) ≥ 16 inches are allowed to be harvested, however 25-40% of Kamloops caught each spring are voluntarily released. Most fish lengths reported in the creel surveys were estimated by anglers or measured by creel clerks prior to release. Individual fish weights were obtained using regression relationships derived from Knife River adult trap data. All other methods are summarized in Ostazeski (2004).

Angler population estimates were determined using a cumulative total of the number of 'new' anglers (not previously interviewed this spring) and 'recap' anglers (previously interviewed this spring) that were interviewed each day. 'New' or 'Recap' anglers were determined by asking the question "Have you previously been interviewed by a creel clerk this spring?" This question was not asked in 1992 to 1995 creel surveys, so estimates could not be determined before 1996. The Schnabel modification of the Lincoln-Petersen estimator was used to calculate daily estimates of angler abundance and its variance. Angler population estimates generally increase throughout the first half of the survey period, and then stabilize. Therefore, the average of the last nine estimates was used to calculate final angler population estimates and confidence intervals.

RESULTS

Fishing Pressure

The annual spring creel survey went from April 26 through May 21, 2018. A total of 1,144 interviews were collected shorewide. The majority (76%) of anglers interviewed in the annual spring creel were fishing in the lower shore, and most (86%) were fishing streams. The most interviews in the lower and upper shore were collected at the Sucker (186) and the Baptism (95) rivers, respectively. A total of 837 'new' (first time interviewed this year) anglers were interviewed in 2018.

Total angling pressure in 2018 was 28,235 angler-hours, which was slightly lower than the historic average (31,495 angler-hours) (Table 1, Figure 2). Most (73%) angling pressure was at lower shore rivers, which ranged from 4,131 angler-hours at the Sucker River to 522 angler-hours at Silver Creek. Angling pressure in the upper shore (7,656 angler-hours) was higher than the historic average (5,832 angler-hours), and ranged from 2,370 angler-hours at the Baptism River to 299 angler-hours at the Poplar

River. The Devil Track River experienced the highest angling pressure on record for the second year in a row (Table 2, Figure 3).

Rainbow Trout were by far the most sought after species in the spring 2018, and steelhead or Kamloops were the primary target species in 97% of all interviews (75% targeted steelhead, 22% targeted Kamloops). Other primary species targeted were Brook Trout at 2%, Coho Salmon at 1%, and four others at less than 1.0%. Nine percent of anglers listed steelhead as their secondary target species and 24% listed Kamloops as their secondary species. Other secondary species included Brook Trout at 8%, Coho Salmon at 4%, and three other species at <1%.

Catch, Catch-Rates and Harvest

Steelhead

An estimated 3,242 steelhead were caught in 2018, which was higher than the historic average (2,878). Catch in the lower shore (2,388) was slightly higher than the historic average (2,006), and catch in the upper shore (854) was similar to the historic average (871) (Figure 4). The highest catch in the lower shore was at the Sucker River (777), followed by the Knife River (456) and McQuade Harbor (250). The highest catch in the upper shore was at the Devil Track River (369), followed by the Baptism River (156) and Kadunce Creek (96). Eighteen steelhead 16 inches or larger were illegally harvested in 2018. Small steelhead (<16 inches) were reported at 12 creel stations; the estimated shorewide catch was 519, which was lower than the historic average (616) (Table 3). The average length of adult steelhead was 23.0 inches and average weight was 4.0 pounds (Table 4).

The shorewide catch-rate for steelhead was 0.115 fish per angler-hour (8.7 angler-hours per fish) which was better than the historic average (11.4 angler-hours per fish) (Figure 5). Catch-rates in the lower shore was 0.116 fish per angler-hour (8.6 angler-hours per fish) and upper shore was 0.112 fish per angler hour (8.9 angler-hours per fish), both were better than historic averages (Figure 6). The best catch-rates in the lower shore were at Silver Creek (0.212; 4.7 angler-hours per fish), the Sucker River (0.188; 5.3 angler-hours per fish), and the Knife River (0.136; 7.4 angler-hours per fish). The best catch-rates in the upper shore were at the Poplar River (0.295; 3.4 angler-hours per fish), the Devil Track River (0.178; 5.6 angler-hours per fish), and Kadunce Creek (0.168; 6.0 angler-hours per fish) (Table 3). Approximately 93% (3,002) of all steelhead were caught fishing in streams versus shore fishing Lake Superior. The shorewide catch-rate for steelhead in tributaries was 0.128 fish per angler-hour (7.8 angler-hours per fish) and in the lake was 0.034 fish per angler-hour (29.7 angler-hours per fish).

Kamloops

The estimated shorewide catch of Kamloops in the annual spring creel survey was 1,442, which was lower than the historic average (2,422). More Kamloops were caught in streams (788) than in the lake (654) (Figure 7). Catch in both the lower shore (1,371) and the upper shore (71) were lower than the historic averages (lower shore = 2,266; upper shore = 156) (Figure 8). In the lower shore, most

Kamloops were caught at McQuade/Talmadge River (464), the Sucker River (372), and the French River (255). In the upper shore, most Kamloops were caught at the Baptism River (23), the Poplar River (18), and the Devil Track River (17). No sub-legal sized Kamloops (<16 inches) were reported in 2018. Approximately 79% (1,207) of all legal sized Kamloops caught were harvested (Table 3). Averaged length was 24.0 inches and average weight was 4.9 pounds (Table 4).

The shorewide catch-rate for Kamloops was 0.051 fish per angler-hour (19.6 angler-hours per fish) (Figure 5). The catch-rate in the lower shore was 0.067 fish per angler-hour (14.9 angling-hours per fish), was slightly higher than the historic average (0.089; 11.3 angler-hours per fish). Catch-rates were best at McQuade Harbor/Talmadge River (0.175; 5.7 angler-hours per fish), the French River (0.136; 7.4 angler-hours per fish), and the Sucker River (0.090; 11.1 angler-hours per fish).

Catch estimates for Kamloops at the Lester River (129) and French River (255) were lower than their historic averages (Lester, 476; French, 430). Catch-rates at the Lester River improved from 2015 (35.8 angler-hours per fish) through 2017 (8.6 angler-hours per fish), but declined again in 2018 (23.8 angler-hours per fish). Conversely, catch-rates at the French River have improved slightly from 10.4 angler-hours per fish in 2015 to 7.4 angler-hours per fish in 2018 (Table 3).

Brook Trout

An estimated 1,880 Brook Trout were caught in spring 2018, which was the highest reported catch of Brook Trout in the spring creel since 1992 (Figure 9). The shorewide catch-rate was 0.081 fish per angler-hour (12.4 angler-hours per fish), 0.050 (20.1 angler-hours per fish) in the lower shore and 0.147 (6.8 angler-hours per fish) in the upper shore. One male Brook Trout that measured 20.8 inches was legally harvested in the spring; no other Brook Trout were harvested in the spring creel. The pounds of Brook Trout harvested was likely overestimated by this one, big fish. Average length was 9.8 inches and average weight was 0.8 pounds (Table 4).

Other Species

An estimated 19 Coho Salmon were caught during the annual spring creel survey with a shorewide catch-rate of 0.008 fish per angler-hour (1,229 angler-hours per fish); no salmon were reported in the upper shore. The average length was 14.5 inches and average weight was 0.96 pounds. All Coho salmon were harvested. Estimated catch of other species included Suckers (332; White and Longnose suckers), Brown Trout (40), Round Whitefish (35), Lake Whitefish (34), and Creek Chub (19) (Table 4).

Angler Population Estimates and Demographics

An estimated 1,660 anglers participated in the Lake Superior spring fishery in 2018, which was slightly higher than the historic average (1,643) (Figure 10). The majority (93%; 764) of all anglers interviewed were residents of Minnesota, 4% (32) were from Wisconsin, and <1% were from other states. Only 4% (34) of all anglers interviewed in 2018 were female, of which 31 were from Minnesota, two were from Wisconsin, and one was from Iowa (Table 5).

DISCUSSION

Most North Shore streams experienced average or above average fishing pressure in 2018 despite the late ice-out, relatively short duration of the steelhead spawning runs, and overlap of peak steelhead spawning runs and inland fishing opener. The number of anglers that fish North Shore streams in the spring has gradually increased since 1992, but has remained relatively stable over the last decade. Both the number of anglers that fish the North Shore and angling pressure each year is clearly influenced by sporadic changes in fishing conditions throughout the spring. Anglers and angling pressure are often highest in years that provide adequate fishing conditions with stable and consistent stream discharge and moderate to low turbidity throughout the spring creel season (e.g., 2016). Streams in the lower shore always experience more anglers and higher angling pressure than streams in the upper shore. Angling pressure in lower shore was lower than average in 2018, but still within the range observed over the last two decades. Angling pressure was above average in the upper shore, and the Devil Track River experienced the highest angling pressure since 1992 for the second year in a row.

Angling pressure at the French River was the lowest ever on record since 1992. Catch of Kamloops at French River in 2018 was lower than average, which would be somewhat expected given the low angling pressure in 2018. Although, fewer Kamloops were also captured during French River trap and seining operations in 2018 compared to previous years (Gottwald and Peterson 2018). Despite low angling pressure and catch, catch-rates for Kamloops at French River remained relatively high and anglers who fished there caught Kamloops at similar or higher rates than previous years. Angling pressure and catch of Kamloops at French River is expected to decline over time because Kamloops are no longer stocked in Minnesota waters of Lake Superior. However, the clipped steelhead program is expected to provide catch and harvest opportunities for Rainbow Trout in place of Kamloops.

Shorewide catch and catch-rates for steelhead have continued to improve over the last decade. Catch-rates in the upper shore has remained higher than lower shore rivers, and the upper shore catch-rate has now remained above 0.15 fish per angler-hour (6.6 hours per fish caught) in 16 of the last 21 years. Shorewide, the catch-rate of steelhead increased from the late 1990's until 2006. Since 2006, the shorewide catch-rate has remained consistently high but variable among years which could be an indication that steelhead abundances have reached (or are close to reaching) equilibrium with the available forage base and other predators in Lake Superior. Unlike many other limiting factors, such as prey availability or environmental conditions, stream habitat is something that can be addressed to improve steelhead populations. Poor spawning and rearing habitat in North Shore streams has long been a limitation to steelhead production (Smith and Moyle 1944). Future management strategies for steelhead will prioritize fish habitat restoration and enhancement, particularly spawning and nursery habitat in streams (Goldsworthy et al. 2017).

The catch-and-release regulation for steelhead has been in effect since August 1997. Regulation compliance has been good in recent years, however an estimated 35 steelhead were illegally harvested

in 2018. The catch-and-release regulation was discussed with the Lake Superior Advisory Group (LSAG) on February 15, 2015 during meetings to revise the 2006 Fisheries Management Plan for the Minnesota Waters of Lake Superior (Schreiner et al. 2006), and again on October 23, 2017 during a meeting to discuss results from the Steelhead Genetics Project. Overall, most on the LSAG supported continuation of the catch-and-release regulation. Compliance with the catch-and-release regulation will continue to be monitored in the spring creel survey, and increased enforcement action will be called for if compliance standards are not met in coming years.

Kamloops catch and catch-rates in 2018 were the second highest observed since 2013, but still remained below the historic average. Overall catch and catch-rates have decreased over time but have remained relatively consistent since 2006 with no marked increase nor decrease. Similar to previous years, the majority of Kamloops were caught in the lower shore, with few reported in the upper shore. Stocking locations explain most of the catch distribution of Kamloops in the spring creel survey. The low catch of Kamloops in recent years is a function of environmental and lake conditions, intra- or interspecific competition for resources (prey), and changes to the hatchery production and stocking protocols. Spring creel survey data shows that the angling pressure for Kamloops in the lake is very dependent on the daily lake conditions, whereas fishing is often not effective or limited with strong northeast winds and/or floating ice. Catch could be a function of competition for resources (prey) with steelhead or other predators in Lake Superior. Recent diet analyses found that Kamloops had a higher percentage of fish in their diet than previously estimated by Negus et al. (2008), which indicated that competition for prey with other predators in Lake Superior might be more than previously assumed (Negus and Hoffman 2013). However, this assumes that prey is limited (to some point) in Lake Superior. The survival of all fish species in Lake Superior, including Kamloops, is largely dictated by stream and lake conditions (e.g., water temperature) that fluctuate from year-to-year and are impossible to control.

Kamloops catch and catch-rates improved from 2015 to 2017, but declined in 2018. The MNDNR and some anglers were concerned that the low catch and catch rates between 2014 and 2016 were influenced by recent changes to the hatchery production and stocking protocols that potentially increased straying and/or decreased survival in Lake Superior. Although some straying of stocked Kamloops has occurred, increased reports of straying and decreased catch and catch-rates have become more apparent in recent years. The MNDNR has had reports of adipose clipped Rainbow Trout caught in the St. Mary's River in Michigan, the Brule River in Wisconsin, and rivers both on the upper North Shore of Minnesota and into Canada. Recent genetic analyses found that Kamloops are successfully spawning with steelhead in the wild, both in Minnesota waters and other jurisdictions (Miller et al. *in prep*). Straying of Kamloops beyond the Lester and French rivers is a concern shared by MNDNR, agencies in other jurisdictions, and anglers. Particularly concerning is the impact of introgression of Kamloops genes into naturalized steelhead populations. Negus (1999) found poorer survival of eggs from Kamloops x steelhead crosses compared to steelhead x steelhead crosses in the hatchery and concluded that when

Kamloops spawn with steelhead, steelhead gametes are essentially wasted. In the stream environment, Kamloops can successfully spawn with steelhead in the wild and produce juvenile hybrids (Close 1999; Miller et al. *in prep*). However, Miller et al. (2004) found that juvenile hybrids survive significantly less well compared to juvenile steelhead in the stream environment. Cumulative relative survival of cross types combining hatch rates from Negus (1999) and juvenile survival from Miller et al (2004) indicates a 42-70% reduction in survival to age-1 of a hybrid compared to a STT x STT cross (Miller et al. 2004). If hybrids survived to reproduce, genetic introgression could occur which would further increase the chance for introgression and decrease the fitness of wild steelhead populations. Continued stocking of Kamloops will negatively influence the fitness and increase the risk of extinction of wild steelhead through non-introgressive hybridization (Page et al. 2011). Kamloops are no longer stocked in Minnesota waters of Lake Superior, therefore catch of Kamloops will continue to decline in coming years.

For the second year in a row, the catch of Brook Trout in spring 2018 (1,880) was more than has been reported in the history of the spring creel survey. Brook Trout were the second most commonly caught species after Rainbow Trout, and have been reported in the spring creel survey every year since 1992. Though many Brook Trout are caught each year, very few anglers actively target them below barriers in the spring probably because shorewide catch and catch rates for Brook Trout are much lower than for steelhead at this time of year. Coaster Brook Trout rehabilitation is a management priority for the MNDNR, and regulation compliance is essential for this to occur. Compliance with the restrictive harvest regulation for Brook Trout (bag limit of 1, minimum size 20 inches) was good in spring 2018. The only Brook Trout that was harvested was above the legal length limit of 20 inches, and no other Brook Trout were reported by the creel clerks as illegally harvested.

Catch and fishing pressure for Coho Salmon remains sporadic and is largely dependent on the conditions of Lake Superior and year-class abundances. Coho Salmon caught in Minnesota waters are naturally-produced because the last Coho Salmon stockings in Lake Superior occurred in Michigan in 2006. Unlike streams in many other jurisdictions, streams on Minnesota's North Shore have less than ideal spawning conditions for fall spawning fish. Stream conditions on the North Shore in the fall are often characterized by low water levels, excessive ice formation, and lack of stream access due to gravel bars that block off access for fish from Lake Superior. Given these conditions, the vast majority of Coho Salmon caught in Minnesota waters are likely wild fish that migrated from other jurisdictions where stream habitat is more conducive for reproduction and survival of fall run fish (e.g., Wisconsin, Michigan, and Ontario, Canada).

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DEPARTMENT OF NATURAL RESOURCES

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
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2018

Completed by:
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4/2/2019
Area Supervisor \ Date

6/2/19
Regional Fisheries Approval \ Date

Table 1. Fishing pressure estimates (angler-hours) from the Lake Superior spring creel survey by shore zone, station and year.

Station	Station	Year											Mean	Range
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	1992-2018	1992-2018
Lower Shore	Lester River	5,315	10,476	9,892	6,644	4,928	3,588	2,580	3,699	7,293	4,955	3,051	5,896	2,580 - 10,476
	McQuade/Talmadge	--	--	1,399	2,996	3,938	2,407	1,340	1,659	5,453	3,612	2,657	2,829	1,340 - 5,453
	French River	2,456	6,068	6,505	3,206	3,015	3,544	3,080	2,409	6,014	3,678	1,868	4,069	1,868 - 8,544
	Sucker River	3,823	6,376	6,824	4,620	6,008	3,566	2,880	2,265	4,914	4,713	4,131	5,410	2,265 - 12,990
	Knife River	2,508	6,253	4,885	3,565	3,308	1,903	1,540	1,629	6,597	3,215	3,363	3,125	1,225 - 6,597
	Stewart River	3,991	3,957	4,079	5,782	1,557	1,885	1,280	1,653	3,385	3,658	2,620	2,448	720 - 5,782
	Silver Creek	1,256	1,230	930	1,996	818	131	312	577	582	529	522	814	131 - 1,996
	Gooseberry River	493	1,728	1,418	1,994	1,076	325	257	532	1,105	1,330	612	998	257 - 2,475
	Split Rock River	1,973	2,050	3,212	5,400	2,087	1,940	1,200	1,217	1,993	2,402	1,756	2,157	1,145 - 5,400
Upper Shore	Beaver River	362	481	776	824	820	304	233	473	436	685	346	617	233 - 1,159
	Baptism River	1,506	1,198	3,570	2,771	2,662	866	630	1,173	2,285	3,303	2,370	1,517	448 - 3,570
	Cross River	432	444	559	900	383	525	339	338	700	1,004	549	337	53 - 1,004
	Temperance River	472	651	434	488	170	630	83	359	370	494	319	354	77 - 788
	Poplar River	580	291	439	888	383	420	330	357	645	508	299	497	168 - 1,347
	Cascade River	767	346	675	488	905	296	309	438	846	601	307	519	194 - 939
	Devil Track River	818	447	1,264	1,050	1,163	857	677	1,355	1,421	1,841	2,066	725	75 - 2,066
	Kadunce Creek	502	581	259	746	500	642	770	448	1,420	1,030	570	488	79 - 1,420
	Brule River	796	800	1,059	1,283	1,206	963	767	539	1,410	1,015	829	791	207 - 1,505
Lower Shore		21,816	38,137	39,142	36,203	26,735	19,289	14,469	15,641	37,336	28,093	20,579	25,650	14,469 - 39,994
Upper Shore		6,235	5,238	9,035	9,438	8,192	5,503	4,138	5,479	9,533	10,480	7,656	5,832	3,046 - 10,480
Shorewide		28,051	43,375	48,177	45,641	34,927	24,792	18,607	21,120	46,868	38,573	28,235	31,495	18,607 - 48,177

Table 2. Fishing pressure estimates (angler-hours ± standard error [*SE*]) from the 2018 Lake Superior spring creel survey by shore zone and station.

Shore Zone	Station	Stream Pressure	*(SE)*	Lake Pressure	*(SE)*	Total Pressure	*(SE)*
Lower Shore	Lester River	2,823	*383*	228	*71*	3,051	*412*
	McQuade/Talmadge	457	*104*	2,200	*315*	2,657	*358*
	French River	0	*0*	1,868	*454*	1,868	*454*
	Sucker River	4,089	*522*	42	*29*	4,131	*524*
	Knife River	3,363	*1,002*	0	*0*	3,363	*1,002*
	Stewart River	2,395	*562*	225	*81*	2,620	*591*
	Silver Creek	522	*177*	0	*0*	522	*177*
	Gooseberry River	612	*155*	0	*0*	612	*155*
	Split Rock River	1,756	*377*	0	*0*	1,756	*377*
Upper Shore	Beaver River	293	*99*	53	*53*	346	*116*
	Baptism River	2,320	*551*	50	*50*	2,370	*565*
	Cross River	524	*166*	25	*25*	549	*170*
	Temperance River	266	*84*	53	*53*	319	*89*
	Poplar River	266	*158*	33	*33*	299	*178*
	Cascade River	246	*72*	61	*42*	307	*80*
	Devil Track River	2,066	*332*	0	*0*	2,066	*332*
	Kadunce Creek	542	*212*	29	*29*	570	*208*
	Brule River	829	*311*	0	*0*	829	*311*
Lower Shore		16,017	*1,396*	4,563	*564*	20,579	*1,526*
Upper Shore		7,352	*794*	305	*111*	7,656	*811*
Shorewide		23,368	*1,605*	4,867	*575*	28,235	*1,729*

Table 3. Rainbow Trout catch and catch-rate (fish per angler-hour) estimates in the 2018 Lake Superior spring creel survey by station.

		Unclipped Steelhead						Clipped Rainbow Trout (Kamloops)					
		Catch			Catch-rate			Catch			Catch-rate		
			≥16			≥16			≥16			≥16	
Station		All	inches	(SE)	All	inches	(SE)	All	inches	(SE)	All	inches	(SE)
Lester	Harvested	0	0	0	0.000	0.000	0.000	119	119	38	0.039	0.039	0.012
River	Released	291	248	90	0.095	0.081	0.028	11	11	11	0.004	0.004	0.004
	Total	291	248	90	0.095	0.081	0.028	129	129	38	0.042	0.042	0.012
McQuade	Harvested	0	0	0	0.000	0.000	0.000	410	410	132	0.154	0.154	0.056
Harbor	Released	250	250	145	0.094	0.094	0.062	54	54	38	0.020	0.020	0.021
	Total	250	250	145	0.094	0.094	0.062	464	464	135	0.175	0.175	0.059
French	Harvested	0	0	0	0.000	0.000	0.000	234	234	67	0.125	0.125	0.019
River	Released	28	28	15	0.015	0.015	0.007	21	21	17	0.011	0.011	0.009
	Total	28	28	15	0.015	0.015	0.007	255	255	75	0.136	0.136	0.023
Sucker	Harvested	0	0	0	0.000	0.000	0.000	265	265	79	0.064	0.064	0.018
River	Released	827	777	247	0.200	0.188	0.055	108	108	41	0.026	0.026	0.010
	Total	827	777	247	0.200	0.188	0.055	372	372	103	0.090	0.090	0.022
Knife	Harvested	0	0	0	0.000	0.000	0.000	75	75	46	0.022	0.022	0.012
River	Released	568	456	164	0.169	0.136	0.026	9	9	9	0.003	0.003	0.003
	Total	568	456	164	0.169	0.136	0.026	9	9	9	0.003	0.003	0.003
Stewart	Harvested	18	18	16	0.007	0.007	0.006	38	38	21	0.014	0.014	0.013
River	Released	240	222	83	0.092	0.085	0.027	45	45	29	0.017	0.017	0.011
	Total	258	240	80	0.098	0.092	0.024	82	82	33	0.031	0.031	0.016
Silver	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
Creek	Released	138	111	62	0.265	0.212	0.100	0	0	0	0.000	0.000	0.000
	Total	138	111	62	0.265	0.212	0.100	0	0	0	0.000	0.000	0.000
Gooseberry	Harvested	0	0	0	0.000	0.000	0.000	25	25	19	0.040	0.040	0.030
River	Released	135	135	66	0.221	0.221	0.091	25	25	14	0.040	0.040	0.021
	Total	135	135	66	0.221	0.221	0.091	49	49	22	0.080	0.080	0.030
Split Rock	Harvested	0	0	0	0.000	0.000	0.000	10	10	10	0.006	0.006	0.006
River	Released	153	143	46	0.087	0.081	0.020	0	0	0	0.000	0.000	0.000
	Total	153	143	46	0.087	0.081	0.020	10	10	10	0.006	0.006	0.006
Lower Shore	Harvested	18	18	16	0.001	0.001	0.001	1,174	1,174	181	0.057	0.057	0.010
Total	Released	2,630	2,370	367	0.128	0.115	0.020	272	272	68	0.013	0.013	0.003
	Total	2,648	2,388	366	0.129	0.116	0.020	1,371	1,371	194	0.067	0.067	0.011

Table 3 continued. Rainbow Trout catch and catch-rate (fish per angler-hour) estimates in the 2018 Lake Superior spring creel survey by station.

		Unclipped Steelhead						Clipped Rainbow Trout (Kamloops)					
		Catch			Catch-rate			Catch			Catch-rate		
			≥16			≥16			≥16			≥16	
Station		All	inches	(SE)	All	inches	(SE)	All	inches	(SE)	All	inches	(SE)
Beaver	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	11	11	11	0.031	0.031	0.033	0	0	0	0.000	0.000	0.000
	Total	11	11	11	0.031	0.031	0.033	0	0	0	0.000	0.000	0.000
Baptism	Harvested	0	0	0	0.000	0.000	0.000	16	16	8	0.007	0.007	0.003
River	Released	156	156	85	0.066	0.066	0.033	8	8	8	0.003	0.003	0.003
	Total	156	156	85	0.066	0.066	0.033	23	23	11	0.010	0.010	0.004
Cross	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	18	18	18	0.032	0.032	0.033	0	0	0	0.000	0.000	0.000
	Total	18	18	18	0.032	0.032	0.033	0	0	0	0.000	0.000	0.000
Temperance	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	79	40	25	0.249	0.124	0.075	13	13	13	0.041	0.041	0.049
	Total	79	40	25	0.249	0.124	0.075	13	13	13	0.041	0.041	0.049
Poplar	Harvested	0	0	0	0.000	0.000	0.000	18	18	18	0.059	0.059	0.063
River	Released	106	88	73	0.354	0.295	0.173	0	0	0	0.000	0.000	0.000
	Total	106	88	73	0.354	0.295	0.173	18	18	18	0.059	0.059	0.063
Cascade	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	61	31	22	0.200	0.100	0.075	0	0	0	0.000	0.000	0.000
	Total	61	31	22	0.200	0.100	0.075	0	0	0	0.000	0.000	0.000
Devil Track	Harvested	17	0	0	0.008	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	486	369	139	0.235	0.178	0.061	17	17	17	0.008	0.008	0.008
	Total	503	369	139	0.243	0.178	0.061	17	17	17	0.008	0.008	0.008
Kadunce	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
Creek	Released	110	96	61	0.192	0.168	0.094	0	0	0	0.000	0.000	0.000
	Total	110	96	61	0.192	0.168	0.094	0	0	0	0.000	0.000	0.000
Brule	Harvested	0	0	0	0.000	0.000	0.000	0	0	0	0.000	0.000	0.000
River	Released	70	47	28	0.084	0.056	0.028	0	0	0	0.000	0.000	0.000
	Total	70	47	28	0.084	0.056	0.028	0	0	0	0.000	0.000	0.000
Upper Shore	Harvested	17	0	0	0.002	0.000	0.000	33	33	20	0.004	0.004	0.003
Total	Released	1,096	854	195	0.143	0.112	0.028	38	38	23	0.005	0.005	0.003
	Total	1,113	854	195	0.145	0.112	0.028	71	71	30	0.009	0.009	0.004
Shorewide	Harvested	35	18	16	0.001	0.001	0.001	1,207	1,207	182	0.043	0.043	0.007
Total	Released	3,726	3,224	415	0.132	0.114	0.016	309	309	72	0.011	0.011	0.003
	Total	3,761	3,242	415	0.133	0.115	0.016	1,442	1,442	196	0.051	0.051	0.008

Table 4. Yield, average length (inches) and average weight (pounds) of fish species caught in the 2018 Lake Superior spring creel survey.

	Yield			Average Length (inches)				Average Weight (pounds)			
Species	Number Caught	Number Harvested	Pounds Harvested	Harvested	Released	All	*(SE)*	Harvested	Released	All	*(SE)*
Brook Trout	1,880	8	51	20.8	9.7	9.8	*0.2*	6.4	0.8	0.8	*0.1*
Brown Trout	40	0	0	--	11.8	11.8	*2.1*	--	1.2	1.2	*0.4*
Coho Salmon	19	19	18	14.5	--	14.5	--	0.9	--	0.9	--
Creek Chub	19	0	0	--	3.3	3.3	*0.3*	--	0.1	0.1	*0.0*
Lake Whitefish	34	18	0	12.0	--	12.0	--	3.0	0.0	3.0	*0.0*
Kamloops (≥16")	1,442	1,207	6,011	24.1	23.7	24.0	*0.2*	5.0	4.9	5.0	*0.1*
Round Whitefish	35	0	0	--	8.0	8.0	--	--	1.0	1.0	*0.0*
Sucker species	332	0	0	--	14.8	14.8	*0.5*	--	1.3	1.3	*0.2*
Unclipped Steelhead (≥16")	3,242	18	57	21.5	23.1	23.0	*0.2*	3.2	4.0	4.0	*0.1*
Unclipped Steelhead (<16")	519	17	18	15.0	10.2	10.3	*0.5*	1.1	0.4	0.4	*0.1*

Table 5. The number of 'new' (first time interviewed in 2018) anglers who were interviewed in the 2018 Lake Superior spring creel survey by gender and state, including the percent of total interviews collected by state (Percent of Total).

State	Female	Male	Total	Percent of Total
Alaska	0	1	1	0.1%
Arizona	0	2	2	0.2%
California	0	1	1	0.1%
Connecticut	0	1	1	0.1%
Iowa	1	4	5	0.6%
Indiana	0	1	1	0.1%
Kansas	0	1	1	0.1%
Massachusetts	0	1	1	0.1%
Michigan	0	1	1	0.1%
Minnesota	31	733	764	93.2%
Missouri	0	1	1	0.1%
Montana	0	2	2	0.2%
North Dakota	0	4	4	0.5%
New Mexico	0	1	1	0.1%
South Dakota	0	1	1	0.1%
Washington	0	1	1	0.1%
Wisconsin	2	30	32	3.9%
Total	34	786	820	100.0%

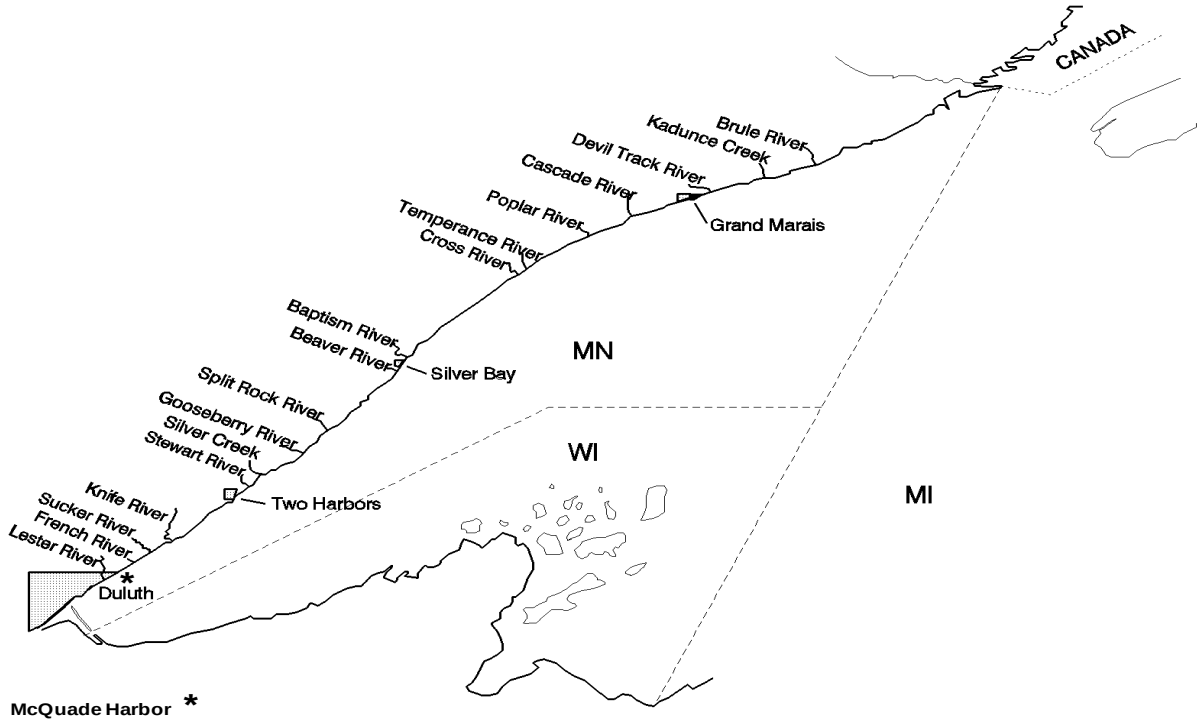

Figure 1. Sampling stations for the Lake Superior spring creel survey.

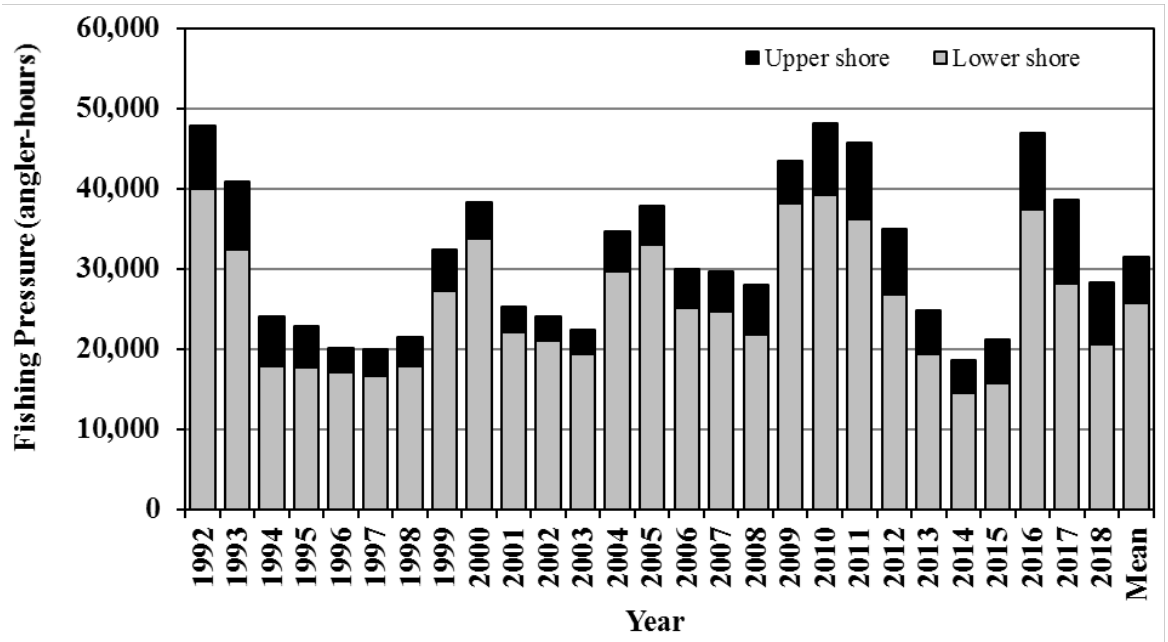

Figure 2. Fishing pressure (angler-hours) in the lower shore, upper shore, and shorewide from the Lake Superior spring creel survey by year, including the historic average (Mean) from 1992 to 2018.

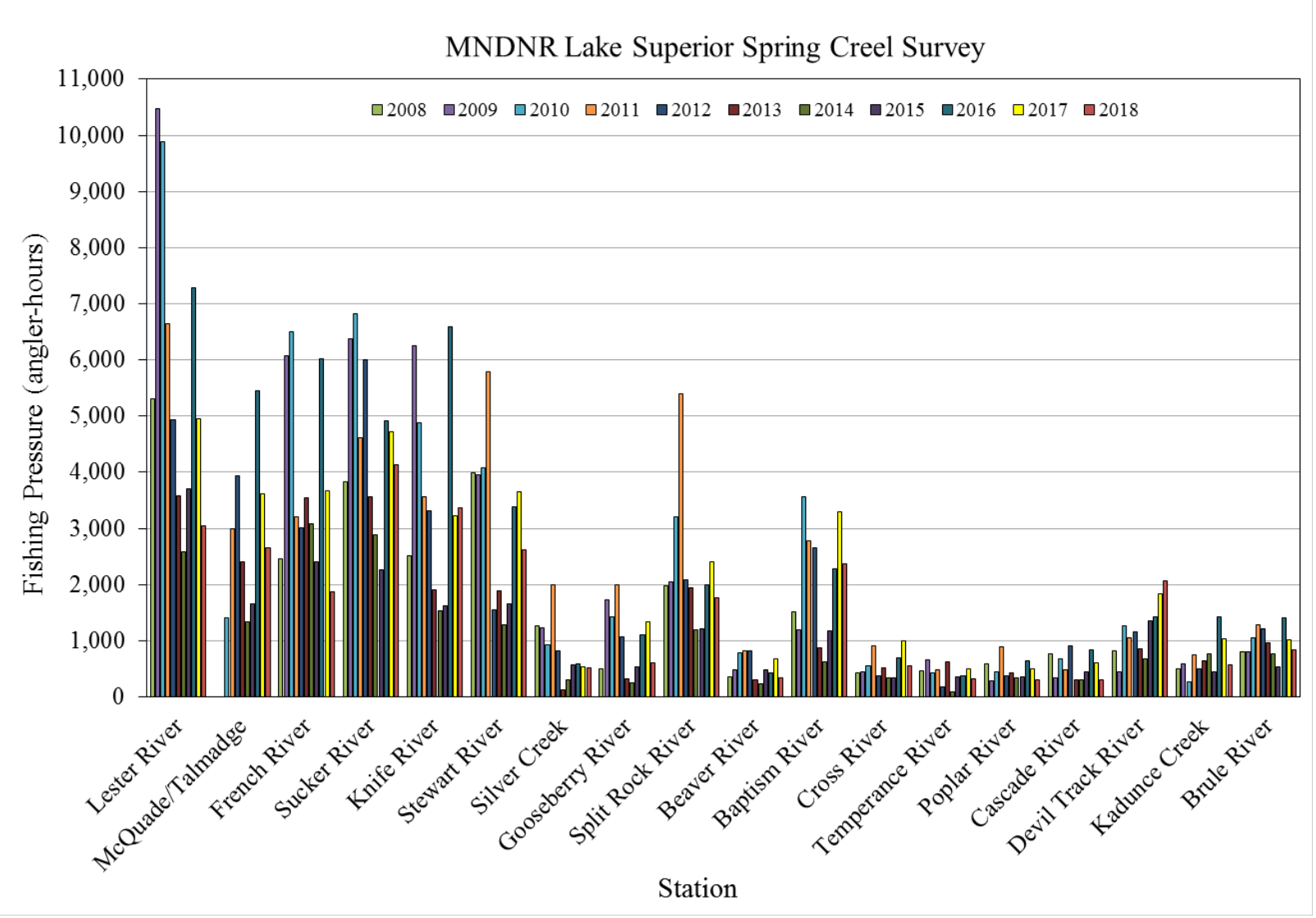

Figure 3. Fishing pressure (angler-hours) by station in the Lake Superior spring creel survey from 2008 to 2018.

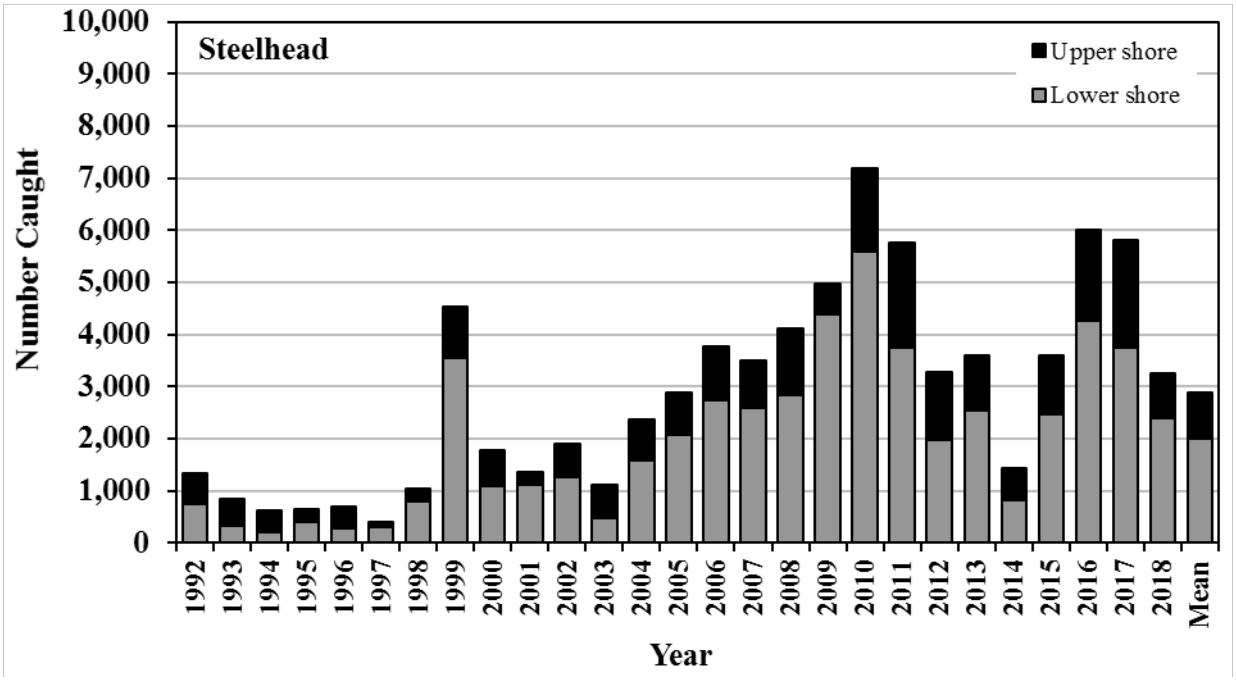

Figure 4. Number of steelhead ≥ 16 inches caught in the lower shore, upper shore, and shorewide from the Lake Superior spring creel survey by year, including the historic average (Mean) from 1992 to 2018.

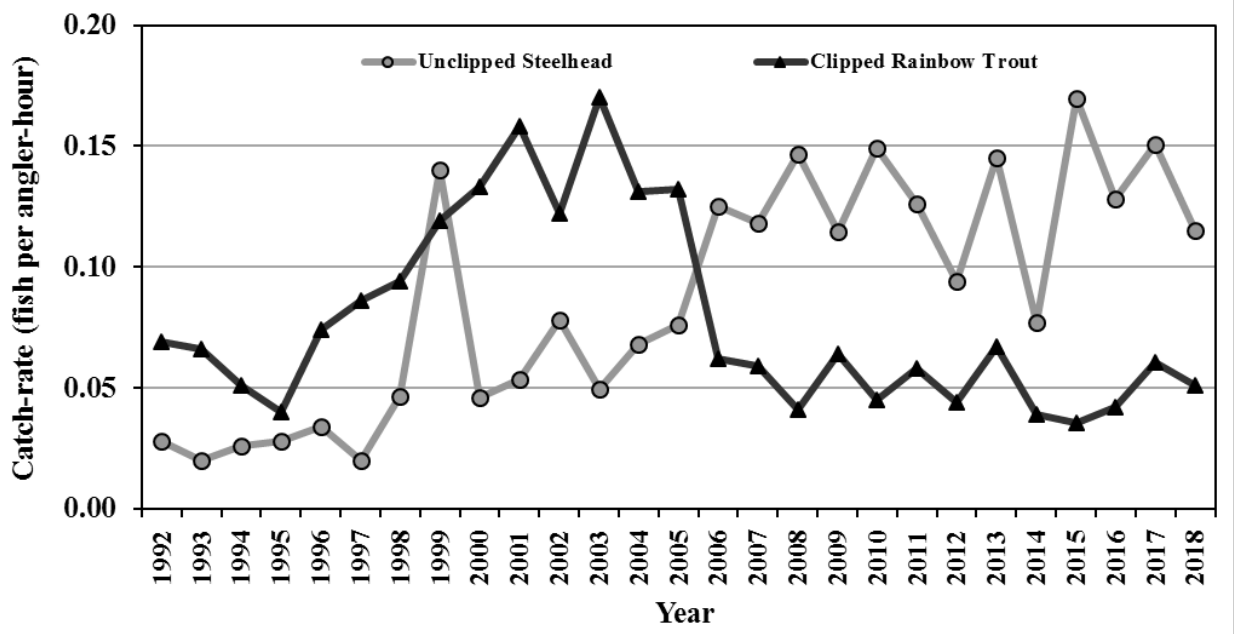

Figure 5. Shorewide catch-rate (fish per angler-hour) of steelhead and clipped Rainbow Trout (Kamloops and clipped steelhead) ≥ 16 inches from the Lake Superior spring creel survey by year.

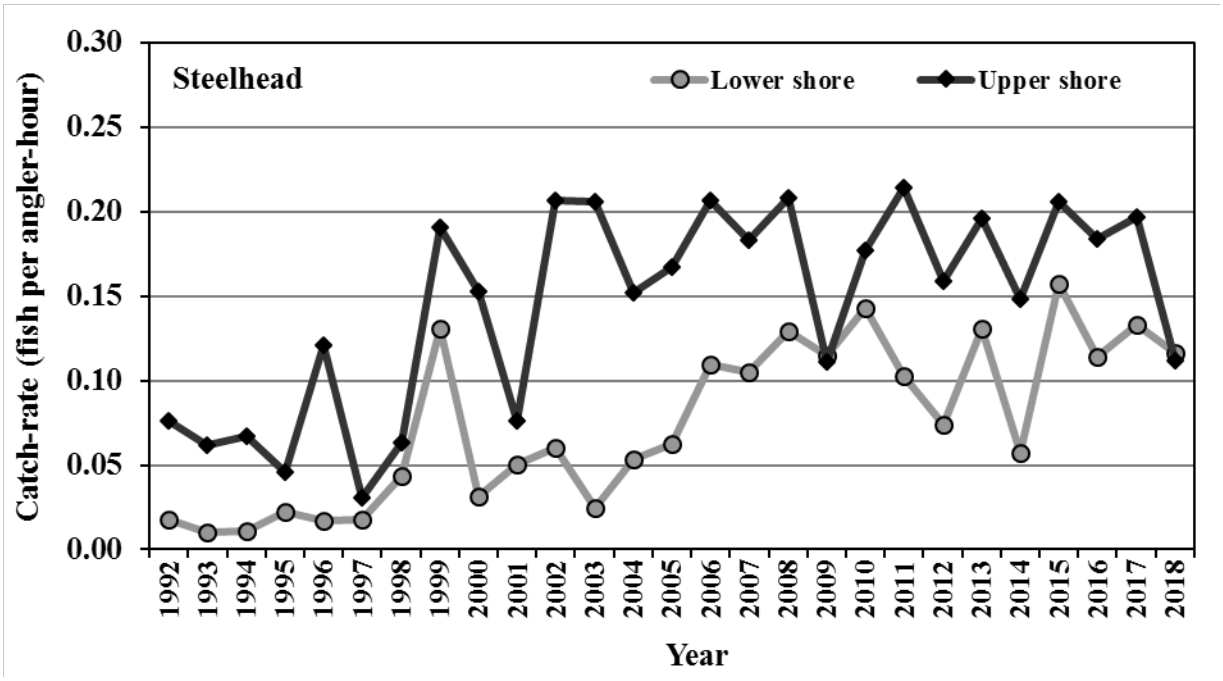

Figure 6. Catch-rate (fish per angler-hour) of steelhead ≥ 16 inches from the Lake Superior spring creel survey in the lower shore and upper shore by year.

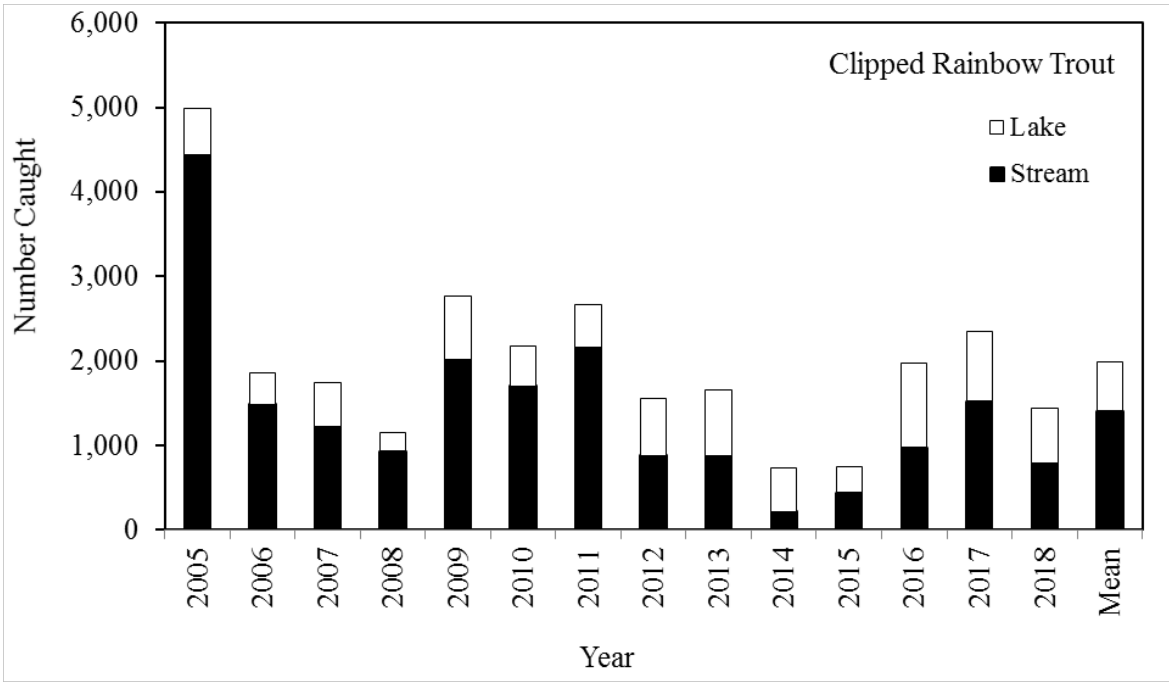

Figure 7. The number of clipped Rainbow Trout (Kamloops) ≥16 inches caught in the lake and stream, including the average (Mean) from 2005 to 2018.

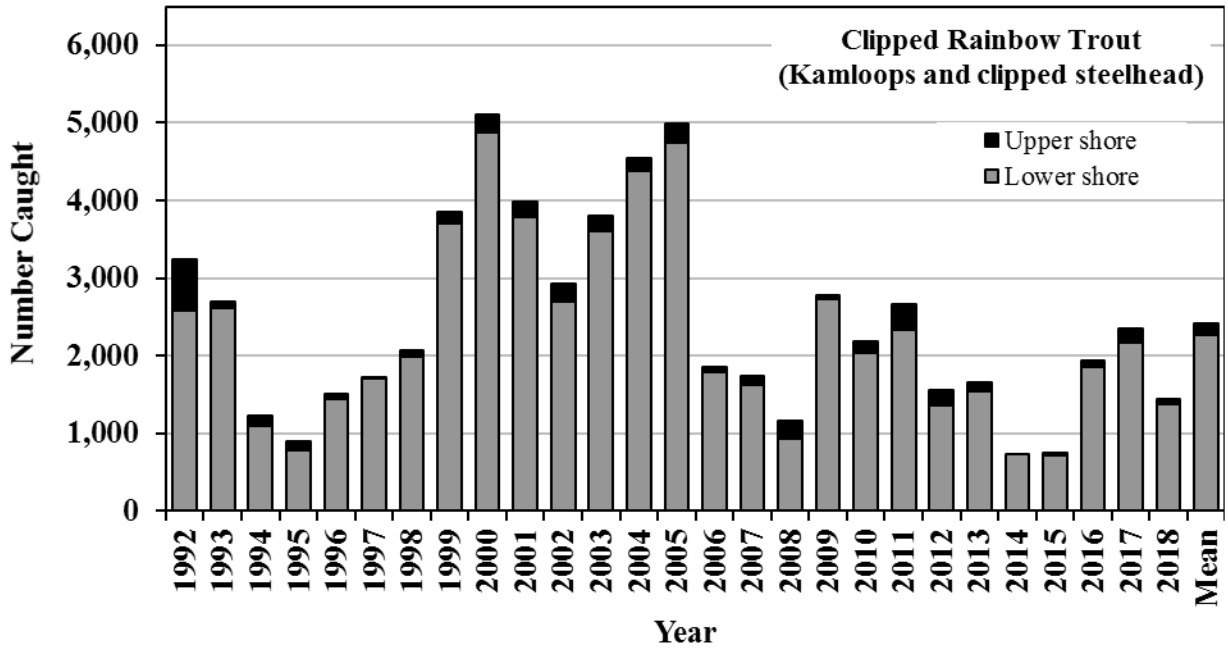

Figure 8. Number of clipped Rainbow Trout (Kamloops and clipped steelhead) ≥ 16 inches caught in the lower shore, upper shore, and shorewide from the Lake Superior spring creel survey by year, including the historic average (Mean) from 1992 to 2018.

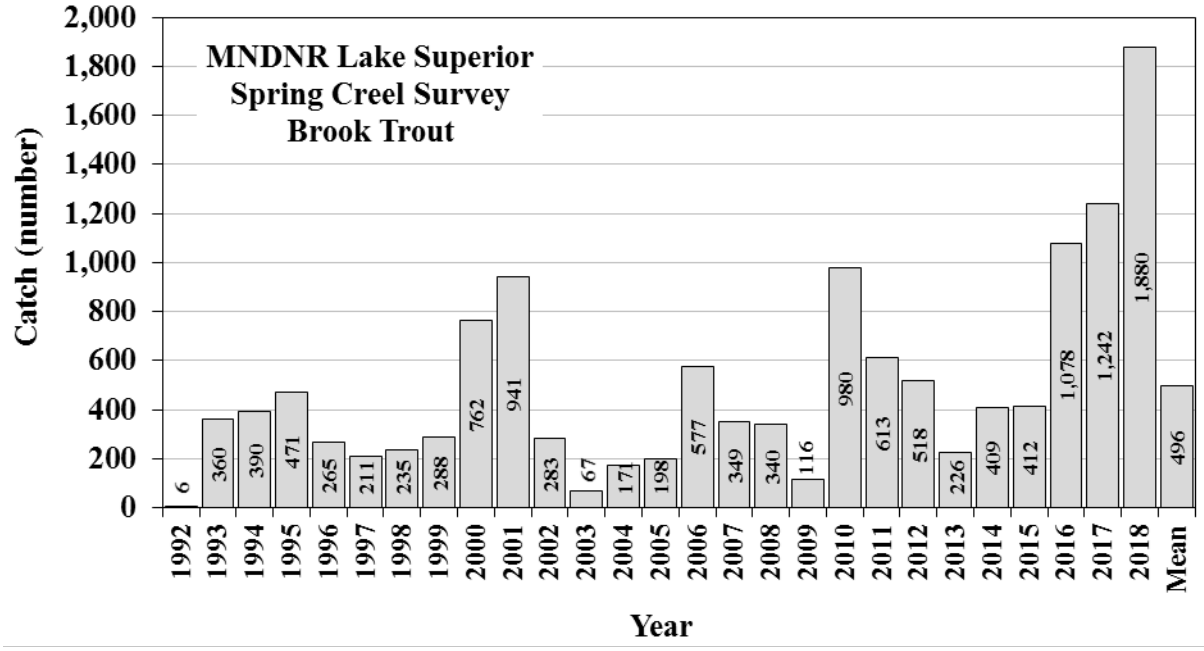

Figure 9. Number of Brook Trout caught by year during the Lake Superior spring creel survey by year, including the historic mean (Mean) from 1992 to 2018.

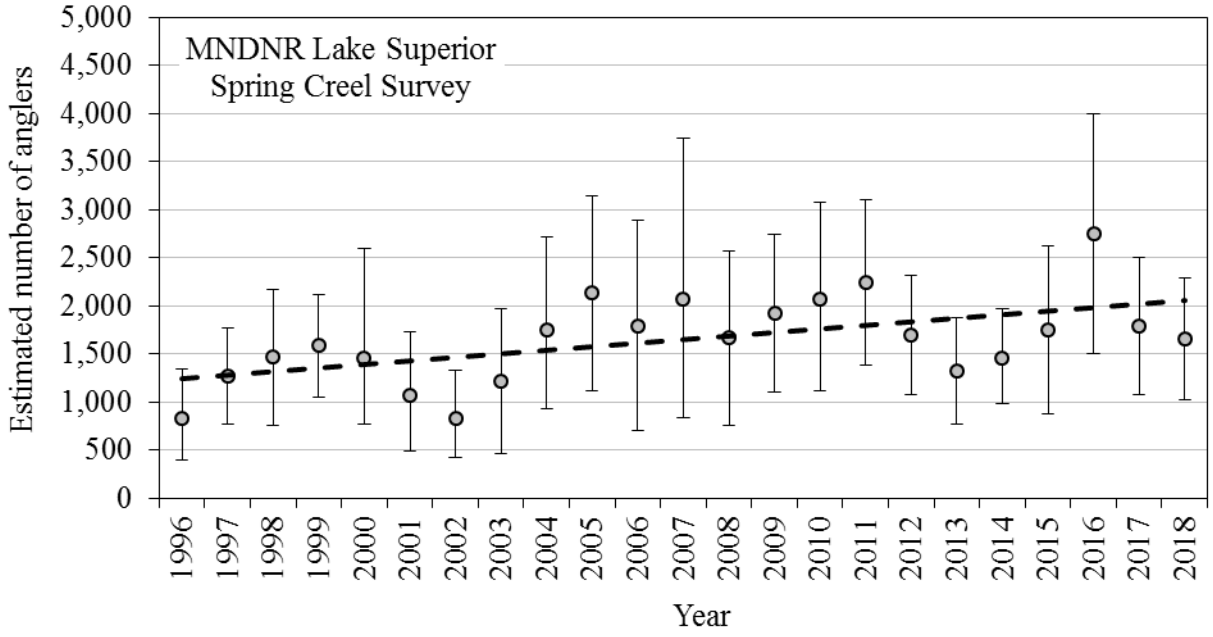

Figure 10. The estimated number of anglers that have participated in the Lake Superior spring fishery by year from 1996 to 2018. The dashed line shows the linear trendline for all years.