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Completion Report

**Winter Creel Survey Report
for
Leech Lake
2010-2011**

by

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Walker Area Fisheries Office

Completion Report

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Leech Lake
2010-2011**

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TABLE OF CONTENTS

TABLE OF CONTENTS	3
INTRODUCTION.....	5
STUDY AREA.....	6
METHODS	7
Survey Design.....	7
Scheduling.....	7
Field procedure	8
Estimation of Angling Pressure and Catch Statistics.....	8
RESULTS & DISCUSSION	9
Angling Pressure.....	9
Catch and Harvest.....	10
FUTURE CONSIDERATIONS & MANAGEMENT IMPLCATIONS	12
ACKNOWLEDGEMENTS	13
LITERATURE CITED	13

TABLES.....16

Table 1. Sampling probabilities (P) used to determine winter creel survey schedules on Leech Lake, 2010-2011.17

Table 2. Mean party size and trip length by angler types in the Leech Lake winter fishery, December 15, 2010 to March 15, 2011.18

Table 3. Fishing pressure and standard error (angler-hours) by angler and day types, in the 2010-2011 Leech Lake winter fishery.19

Table 4. Historic creel survey estimates of the Leech Lake winter fishery, 1965-2011.20

Table 5. Species targeted by fishing parties in the 2010-2011 Leech Lake winter fishery.21

Table 6. Catch estimates for the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses. Regarding northern pike, spear angler catch refers to the encounters and release is the estimated number of pike passed on for a harvest opportunity.22

Table 7. Yield estimates (lbs) and mean weights of harvested fish for the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses.23

Table 8. Estimates of catch and harvest rates of selected species for all anglers in the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses. For darkhouse anglers, catch rate represents total encounters and release rate is the estimated rate at which harvest opportunities were passed.24

Table 10. Percent of all angling parties (top) and targeting angling parties (bottom) who harvested a given number of fish in the 2010-2011 Leech Lake winter fishery..26

Table 11. Length-frequency distribution (%) of commonly harvested and released fish for the 2010-2011 Leech Lake winter fishery.....27

FIGURES.....28

Figure 1. Creel survey sampling clusters (circles) and stations (dots) on Leech Lake, Minnesota. Public access points are denoted by a “P”. Stations not included in clusters were determined in 2009 to have low winter use and consequently were not sampled.29

Figure 2. Total fishing pressure (angler-hours) in the Leech Lake fishery, 1965-2010. Summer creel surveys were completed in the year noted. Winter surveys typically began during December of the year noted and ended March of the following spring, though start and end dates of winter surveys were influenced by varying ice conditions among years.30

Figure 3. Total sportfish harvest (lbs x 1,000) of select species from Leech Lake, 1965-2010. Horizontal lines denote upper harvest thresholds established by MN DNR (MN DNR 1997).31

INTRODUCTION

In 1983, the Minnesota Department of Natural Resources increased its commitment to managing Leech Lake and other large walleye lakes by establishing the Large Lake Monitoring Program (LLP). For Leech Lake, this program includes annual collection, analysis, and reporting of fish population data for monitoring long-term population trends, the development of management recommendations, and public outreach (Wingate and Schupp 1984).

In conjunction with annual fish surveys, angler use and harvest information is collected using creel surveys. Surveys are typically conducted two consecutive years out of every six and are used to estimate catch, harvest, and pressure statistics of the recreational fishery. Yield estimates are compared to safe harvest targets prescribed in Special Publication No. 151 (MDNR 1997). If yield estimates in a large lake routinely exceed established safe target harvest levels and the population exhibits signs of biological stress (Gangl and Pereira 2003) more restrictive harvest regulations would be considered to prevent significant declines in the fishery.

While Leech Lake is well known among anglers as an exceptional multi-species fishery, most anglers target and harvest walleye *Sander vitreus*. During the 1998-99 open water seasons, anglers averaged 1.2 million angler hours and harvested 174,000 pounds of walleye per year (Sledge, 1999, 2000). However, several consecutive years without a large walleye year class caused declines in overall walleye abundance and an unbalanced population size structure; this in turn produced historically low levels of angler effort and walleye harvest during the 2004-2005 open water seasons (Rivers 2005, 2006). These changes to the walleye fishery, as well as changes in the yellow perch population, coincided with high walleye and yellow perch harvest in the late 1990's, expanding populations of double-crested cormorants during the early 2000's, expanding invasive aquatic species such as rusty crayfish, and the introduction of Eurasian watermilfoil. In response, an aggressive management plan was developed and implemented to improve fishing quality while benefiting the long-term sustainability of Leech Lake. Regarding the walleye population, management actions included protecting the spawning stock of adult walleye, increasing overall abundance, improving the population size structure, and establishing two strong year classes during 2005-2010. Strategies adopted to achieve these goals included a reduced bag and protected slot limit for walleye (PSL: 18-26" protected, four fish in possession, one longer than 26" allowed in possession) to reduce exploitation of walleye brood stock, double-crested cormorant control, and experimental stockings of marked walleye fry to evaluate natural reproduction. The overall goal of this plan was to quickly improve the quality of walleye fishing on Leech Lake. In light of a substantial positive response of the walleye population to the implemented management actions (Schultz 2010b), the MN DNR scheduled creel surveys in 2008 and 2009 preceding the normally scheduled surveys during 2010 and 2011 to further assess how improvements in the walleye population transcend to the recreational fishery.

STUDY AREA

Leech Lake (DOW # 11-0203; Lake Class 26, Schupp 1992) is located in northern Cass County, Minnesota and is within the Chippewa National Forest and the Leech Lake Indian Reservation. The lake is the third-largest entirely within State boundaries and has approximately 112,000 surface acres. In its original state, Leech Lake covered about 106,000 acres. A dam constructed on the Leech River in 1884 raised the lake level approximately two feet and increased the surface area to the present state (Wilcox 1979).

Leech Lake is located in three glacial zones and has an irregular shape with many large and small bays (Figure 1). Leech Lake varies considerably from a morphological perspective. Some large bays, such as Steamboat and Boy, display highly eutrophic water characteristics whereas other large bays, such as Walker and Kabekona, have properties more congruent with oligotrophic lakes. The main portion of the lake, like most large Minnesota walleye lakes, is windswept and mesotrophic. Previous estimates of shoreline miles have varied, but using remote sensing technology, the estimate is 201 miles. Approximately 23 percent of the shoreline consists of a gravel-rubble-boulder mixture, nearly all of which is used by spawning walleye (Wilcox 1979).

The diversity of the Leech Lake shoreline and substrate, as well as its extensive littoral zone, provides excellent spawning and nursery habitats for a number of species, including Percids and Esocids which dominate the fish community. Walleye, northern pike *Esox lucius* and muskellunge *E. masquinongy* are the principal predators and are located throughout the lake. Although most fish species are found in every portion of the lake, the largest walleye and muskellunge concentrations exist in the mesotrophic areas. Northern pike are most common in eutrophic bays supporting large areas of dense vegetation. Yellow perch *Perca flavescens* are abundant throughout the lake and are the primary forage for walleye and northern pike. Cisco *Coregonus artedii* and lake whitefish *C. clupeaformis* are an important forage base for muskellunge and trophy northern pike (Engstrom-Heg et al. 1986) and are typically found in the mesotrophic and oligotrophic areas. Other species present in the lake include: white sucker *Catostomus commersoni*, burbot *Lota lota*, rock bass *Ambloplites rupestris*, bowfin *Amia calva*, shorthead redhorse *Moxostoma macrolepidotum*, bullheads *Ameiurus spp.*, pumpkinseed *Lepomis gibbosus*, bluegill *L. macrochirus*, largemouth bass *Micropterus salmoides*, smallmouth bass *M. dolomieu*, and black crappie *Pomoxis nigromaculatus*.

Previous summer and winter creel surveys completed on Leech Lake include Schupp (1972), Gustafson (1985, 1986), Haukos (1992, 1993), Sledge (1999, 2000), Rivers (2005, 2006), Schultz (2009, 2010), and Vondra and Schultz (2011). Historically, winter creel surveys have been infrequently completed on Leech Lake during the normal two out of six year creel cycle because winter angling pressure and harvest is relatively light compared to summer estimates. To date, winter surveys have been added to periodically assess large-scale changes to the winter fishery.

METHODS

Survey Design

The 2010-2011 Leech Lake winter creel survey utilized a stratified, random, two-stage completed trip survey design using unequal sampling probabilities (Pollock et al. 1994) from 15 December 2010 through 15 March 2011. This design has been used on Upper Red Lake since the fishery re-opened in 2006 (T. Standera, MN DNR, personal communication) and for several years on Mille Lacs Lake (T. Jones, MN DNR, personal communication). This survey is a departure from the incomplete trip, roving creel survey methods previously used. The change in methods was primarily due to safety concerns. Increased clerk safety and the higher frequency of completed trip interviews are gained, though the total number of interviews obtained is reduced.

The creel survey was stratified as follows:

- Time period: estimates of angling effort and harvest were reported by two 6-week time periods.
- Day type: weekdays and weekend/holidays.
- Angler type: day trip anglers, sleeper house anglers, and darkhouse anglers (speakers).

A total of 18 access sites around Leech Lake were sampled among two creel clerks in the survey (Figure 1); Grand Vu and Pine Points were combined into one sampling location. Each clerk was assigned three clusters. Unequal probabilities were assigned to each access site based on Saturday fish house counts conducted by the Walker Area Fisheries office at each access location throughout the 2009-2010 winter (MN DNR, unpublished data). Locations sampled represented the greatest amount of consistent use by winter anglers throughout the fishing season; locations either known or observed to have relatively low and/or intermittent use were excluded.

Probabilities were re-calculated at the end of January, 2011 based on first-period observations to maintain pace with changing ice and travel conditions that in turn influenced angler use (Table 1).

Scheduling

Two creel clerks were employed to conduct the survey. Clerks worked the 8-hour shifts per pay period from December 15, 2010 through March 15, 2011. Equal probabilities for assigned to the early and late-day time periods (shifts) for each clerks. Work shifts were outlined as follows:

- A. December 15, 2010 – Jan 31, 2011
 - a. Angling hours: 8:00 AM to 10:00 PM (14 hours)
 - b. Early shift: 8:00 AM to 3:00 PM (7 hours)
 - c. Late shift: 3:00 PM to 10:00 PM (7 hours)

- B. Feb 1 - March 15, 2011 (N = anticipated 30 days)
 - a. Angling hours: 7:00 AM to 9:00 PM (14 hours)
 - b. Early shift: 7:00 AM to 2:00 PM (7 hours)
 - c. Late shift: 2:00 PM to 9:00 PM (7 hours)

To avoid sampling overlap among shifts which would skew sampling effort, clerks were instructed to travel to/from sampling locations during the last half-hour of the early shift and the first half hour of the late shift. One shift and sampling cluster was randomly selected for each

scheduled work day in the survey. Clerks worked all weekend days and three weekdays each week. State holidays (n=4) were not surveyed because of union contracts. Two weekdays were randomly selected as days off for each clerk during each week.

Each shift was partitioned into three time blocks of 2.33 hours each. The number of access site visits per shift was determined by the assigned access site probabilities. The access site visited in each time block was randomly selected. Travel time between access sites varied and was incorporated into the 2.33-h sampling block.

The annual International Eelpout Festival held in Walker Bay was avoided entirely in the scheduling. These clusters were removed from random assignment during the event because attempting to sample it would cause significant inflation in fishing pressure while contributing little to total winter harvest.

Field procedure

Clerks took a position on the ice road that enabled them to view all vehicles traveling toward shore on that road. Clerks approached all vehicles returning to shore and determined if the angling party had concluded their fishing trip. If so, the clerk asked for their participation in an interview. Clerks recorded their respective arrival and departure times for each sampling location as well as the total number of parties that completed their fishing trip at that location during the time sampled. Vehicles that did not stop to be interviewed were tallied. This number was multiplied by the proportion of vehicles interviewed that indicated they were incomplete trips and fishing. This proportion was then added to the number of completed interviews at that respective location and time block for a total adjusted landing count.

During the creel survey interview clerks recorded the following: access location; party size; angler type; time fishing began and the interview time; species sought; total number and approximate lengths of fish released; total number and exact lengths, where possible, of harvested fish; and home zip code from one party member. For spearers, clerks asked about the number and approximate sizes of northern pike “passed”, where the angler chose not to attempt harvest with a spear. These fish were treated as “released” fish in data analyses. Thus, catch for spearers represents total encounters and released represents fish passed by the angler.

Estimation of Angling Pressure and Catch Statistics

All estimates of fishing pressure, catch, and harvest were generated using the Creel Application Software (CAS) (Soupir and Brown 2002).

Adjusted counts of completed trips per access site were multiplied by the average daily trip length and then divided by the assigned access site probability to produce an instantaneous count of the number of angler parties fishing during the respective time block (P. Radomski, MN DNR, personal communication). The mean number of angling parties estimated for each time block was expanded to the entire 14-h fishing day to produce a daily instantaneous estimate of fishing pressure. The mean number of anglers per party and length of trip data collected during the creel survey interview were used to expand day trip, sleeper, and darkhouse trips into angler hours of fishing pressure. A mean daily pressure estimate by angler type and day type was derived from

the total days sampled within a stratum and expanded to the total number of days in that stratum to produce an overall estimate of fishing pressure.

Within each stratum, harvest rates and release rates were multiplied by hours fished to estimate numbers of fish harvested and released for each species. Length-weight relationships developed from the historical Leech Lake data set were applied to the length-frequency distribution of harvested fish, by species, to produce a total harvest estimate.

RESULTS & DISCUSSION

Angling Pressure

A total of 470 day trip, 40 sleeper house, and 26 spearfisher parties were interviewed from December 15, 2010 through March 15, 2011 (Table 2). The estimated total angling pressure on Leech Lake during the winter fishing season was 357,404 angler-hours (Table 3; Figure 2). This was the highest total observed since winter creel surveys were first conducted in 1965-1966, and represents a three-fold increase in winter fishing pressure since 2004-2005 (Table 4). Most anglers targeted yellow perch (Table 5). Increased accessibility via plowed roads in the Sucker Bay area in conjunction with media reports of good fishing (D. Schultz, personal communication), particularly for perch, are the likely causes for the considerable increase in winter fishing effort. For perspective, winter fishing pressure on Leech Lake during this survey was 3.20 hours/acre; this compares to 3.92 hours/acre on Lake Winnibigoshish during 2007-2008 (Albert 2008) and 14.3 hours/acre on Mille Lacs Lake during 2009-2010 (Jensen 2010), historically two of Minnesota's most prominent winter fisheries.

The wheeled, sleeper-type fish house has enabled winter anglers to fish in the relative comfort of home while retaining a high degree of mobility. This type of fish house has become much more prevalent in recent years, particularly on the large "destination" winter walleye fisheries of Minnesota, such as Mille Lacs, Lake of the Woods and Upper Red Lake. Since there is no feasible way to determine exactly how much time sleeper house anglers spend fishing verses sleeping or engaging in other activities, their trip lengths were recorded as the total amount of time spent on the lake during that given trip. Given the popularity of Rattle Reel[®]-type devices which allow anglers to fish while they are asleep, this accounting of trip lengths for sleeper house anglers is reasonable.

In contrast to Upper Red Lake where sleeper houses tend to account for the majority of winter fishing pressure (Habratt 2011), they constituted a minor component of winter pressure on Leech Lake at this time. However, it is anticipated that sleeper houses will continue to increase as a significant component of the winter fishery as their popularity continues to grow.

Estimated darkhouse (spear) fishing pressure in 2010-2011 was 9,850 angler-hours, about one-half of estimates garnered since 1984. This estimate was presumed to be low as zero darkhouse interviews were completed during Feb 1-Feb 28 despite spearfishing occurring. Considerable travel time required by the clerk to survey at Oak Point Resort where the majority of spearfishing occurs confounded this issue. A rough correction using the daily effort estimated during the first stratum, by day type (Table 3; 186.93 darkhouse hours/day on weekends; 212.74 darkhouse

hours/day on weekdays) times the number of days spearing could occur in February (n=9 for weekends; n = 19 for weekdays) produces an approximation of 5,724 additional hours of darkhouse effort, with a summed total of 15,574 angler-hours of darkhouse effort. This is near previous estimates (1984, 1990, and 1991) and seems reasonable. Similarly adjusting spear-fisher harvest by multiplying 5,724 hours x 0.116 fish/hour harvested by spearkers during Dec 15-Jan 31 suggests an additional 664 northern pike (1,729 pounds) were harvested. The adjusted totals are denoted by an “^a” in the tables of this report. The adjusted estimates are near or below historical observations, suggesting little change in the spear fishery since 1984.

Catch and Harvest

An estimated 704,249 fish were caught in Leech Lake during the 2010-2011 winter creel season (Table 6), of which 246,541 were harvested (35% of total catch). Total catch was nearly as high as 2010 summer estimates and total harvest was similar to 2010 summer estimates (Vondra and Schultz 2011). The highest stratum-specific estimate of total fishing effort, catch, and harvest occurred during Feb 1- Mar 15.

Total yield during the 2010-2011 winter creel season was approximately 125,276 pounds of fish (1.12 lbs/acre; Table 7) and is considerably higher than previous surveys. The overall catch and harvest rates across all anglers were 2.124 and 0.704 fish/hour, respectively (Table 8). Basin-specific estimates of fishing effort, catch, and harvest are not reported here, but data were collected in a manner that would facilitate basin-specific calculations if needed.

Walleye

An estimated 8,449 walleye (9,776 pounds) were harvested during the 2010-2011 winter season at a rate of 0.032 walleye/hour across all anglers (Table 8). Walleye catch and harvest rates for anglers specifically targeting walleye were 0.323 fish/hour and 0.119 fish/hour, respectively (Table 9). The frequency of angling parties that harvested a limit of walleye was highest during Dec 15-Jan 31. (Table 10). Of total walleye harvested, only an estimated 155 (104 pounds) fish were consumed on the ice by sleeper houses. Combined with summer harvest, total walleye harvest for the 2010 fishing season was approximately 85,720 pounds, well below the safe harvest level (Figure 4).

The average harvested walleye weighed approximately 1.0 pounds (Table 7). Lengths of walleye caught ranged from 5-29 inches (Table 11). Creel clerks measured 202 harvested walleye and anglers reported lengths on another 440 released walleye. Based on length, most harvested walleye appear to be from the 2006-2008 year classes; most of the 2005 year class grew into the PSL (Schultz 2011).

Northern pike

An estimated 2,349 northern pike (6,524 pounds) were harvested at a rate of 0.006 fish/hour across all angler types (Table 4), both of which are below the historical averages. This is likely the product of most anglers seeking yellow perch, as a mere 4% of parties interviewed during the creel survey specifically targeted northern pike. No parties interviewed harvested a limit of northern pike (Table 10). Combined with summer harvest, total pike harvest for the 2010 fishing season was approximately 55,540 pounds, well below the safe harvest level (Figure 4).

Harvested northern pike averaged 2.7 pounds across the entire season (Table 7). Mean weight of harvested pike was similar among day-trip, sleeper, and darkhouse anglers (2.7, 2.9, and 2.6 pounds, respectively). While lengths of northern pike caught and/or encountered by anglers ranged from 12 to 34 inches, pike 20 to 27 inches were more likely to be harvested (Table 11); this is similar to summer creel surveys (Vondra and Schultz 2011).

Yellow perch

An estimated 224,963 yellow perch (95,701 pounds; 0.86 lbs/acre) were harvested during the 2010-2011 winter season. Approximately 90% of the total catch and harvest was comprised of yellow perch, implicating that the winter Leech Lake perch fishery has increased substantially in prominence. For perspective, harvest estimates from Lake Winnibigoshish and Mille Lacs Lake, two of Minnesota's most recognizable winter perch fisheries, were 1.12 lbs/acre (Albert 2008) and 0.17 lbs/acre (Jensen 2010), respectively.

Yellow perch were harvested at a rate of 0.643 fish/hour across all anglers during winter 2010-2011 (Table 4) and was within the historical range for winter observations on Leech Lake. However, total winter harvest was considerably higher than summer harvest during 2010 (65,000 pounds; Vondra and Schultz 2011). Combined, total harvest for the 2010 fishing season was approximately 160,000 pounds (Figure 4) and is substantially higher than the safe harvest level established by MN DNR (MN DNR 1997). Taking into consideration the population has recently recovered from historical lows (Schultz 2010b), the population should be closely monitored for indicators of over-exploitation.

Catch and harvest of yellow perch was highest during Feb 1 – Mar 15 (Tables 6 and 7) as were catch and harvest rates (Tables 8 and 9) and the frequencies of angling parties that harvested a limit of yellow perch (Table 10). Anglers reported catching yellow perch that ranged in length from less than 4 inches to 13 inches (Table 11). The average harvested yellow perch weighed 0.4 pounds (Table 7), and harvested yellow perch were usually 9.0 inches or longer (Table 11).

Bluegill/Pumpkinseed (sunfish)

An estimated 824 sunfish (430 pounds; bluegill and pumpkinseed combined) were harvested at a rate of 0.004 fish/hour across all anglers (Table 4). Catch and harvest statistics were highest during Feb 1 – Mar 15 (Table 6-8) and were entirely pursued by day trip anglers. Lengths of sunfish caught ranged from 4 to 10 inches, with harvested fish measuring 6 to 10 inches long (Table 11).

Burbot (eelpout)

An estimated 491 burbot (1,670 pounds) were harvested at a rate of 0.004 fish/hour across all anglers (Tables 6-8). Catch and harvest statistics were relatively static throughout the season (Table 8). Lengths of burbot caught ranged from 8 to 30 inches, with most harvested fish measuring 20 to 30 inches long (Table 11).

Cisco (tulibee)

An estimated 8,294 cisco (11,175 pounds) were harvested at a rate of 0.015 fish/hour across all anglers (Table 4). With exception of the 1992 winter creel survey that specifically targeted the winter cisco fishery, total catch and harvest were within the historical ranges previously observed. Based on annual fall gill net survey data, the cisco population is the most abundant it has been in nearly 20 years (Schultz 2011), and this would account for higher catch and harvest reported here. Lengths of cisco caught ranged from 10 to 22 inches, with most harvested fish measuring 14 inches and longer (Table 11).

FUTURE CONSIDERATIONS & MANAGEMENT IMPLCATIONS

Based on personal observation, we presume that winter ice and travel conditions had a significant influence on access site use and total fishing pressure during 2010-2011. Heavy snowfall during New Year's weekend slowed ice development in many parts of the lake and caused slush to occur in most locations; these conditions did not improve until March 2011. Ice conditions forced anglers to concentrate around accessible locations and may have reduced total fishing pressure. Anecdotal observations of Walker Fisheries staff suggest total pressure may have been higher during 2009-2010 when travel conditions were better. Furthermore, some accesses were assigned very low probabilities following Feb 1 revisions. Three interviews were obtained at low-use accesses, and these resulted in extremely high instantaneous estimates of use that, in turn, inflated total fishing pressure to approximately 660,000 angler-hours; these encounters were removed from the final analysis. Following communication with Bemidji Area Fisheries office staff who conducted the Upper Red Lake winter creel survey, future winter surveys on Leech Lake should consider more frequent revision of access probability distributions (eg. first day of each month) and a reduction and/or inclusion of access sites in response to angler travel patterns.

Regarding spear fishers, the adjustment in work shift hours on Feb 1 in response to changing daylight reduced the probability of contacting spear anglers. Communication with the clerk at the survey's conclusion indicate that the 45-min travel time from the access site (Oak Point Resort) to the Walker Fisheries office at the end of the day forced the clerk to leave the access early, thereby missing a number of interview opportunities. Future designs should consider some minor flexibility to the schedule (eg. 30-min at start or end of shift) that facilitates the opportunity for some of these interviews to be completed; that is, so the shift length is not the limiting factor on a frequent basis.

Total annual harvest of yellow perch for the 2010 season was well above the harvest threshold. Biological Performance Indicators (BPIs) similar to those used for walleye (Gangl and Pereira 2003) were recently compiled for yellow perch to the extent the data set allows (D. Schultz, unpublished data). These should be included in the ensuing annual Large Lake Assessment Reports and used, in part, to help guide yellow perch management decisions on Leech Lake, particularly as they pertain to harvest. Given the relatively new prominence of the winter perch fishery on Leech Lake, winter creel surveys should be included in future creel survey funding cycles.

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LITERATURE CITED

- Albert, G. 2008. Angler creel surveys for the 2007 summer and 2007-2008 winter seasons, Lake Winnibigoshish and connected waters. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 814.
- Engstrom-Heg, R., R. T. Colesante, and G. A. Stillings. 1986. Prey selection by three esocid species and a hybrid esocid. Special Publication 15:189-194. American Fisheries Society, Bethesda, MD.
- Gangl, R. S. and D. L. Pereira. 2003. Biological performance indicators for evaluating exploitation of Minnesota's large-lake walleye fisheries. North American Journal of Fisheries Management 23:1303-1311.
- Gustafson, S. P. 1985. 1984 Leech Lake creel survey. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, St. Paul.
- Gustafson, S. P. 1986. 1985 Leech Lake creel survey. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, St. Paul.
- Habrat, M. 2011. East Upper Red Lake winter creel survey, December 15, 2010 – February 28, 2011. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 853.
- Haukos, N. A. 1992. 1991 summer creel survey and 1991-1992 winter creel survey for Leech Lake. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 2, Job 239.
- Haukos, N. A. 1993. 1992 summer creel survey and 1992 winter cisco survey for Leech Lake. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 2, Job 239.
- Jensen, E. 2010. Mille Lacs Lake creel survey report for open water season of 2010 and winter season of 2009-2010. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Jobs 836 & 858.

- MN DNR (Minnesota Department of Natural Resources) 1997. Potential, target, and current yields for Minnesota's large walleye lakes. Minnesota Department of Natural Resources, Section of Fisheries, Special Publication 151, St. Paul.
- Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler survey methods and their application in fisheries management. American Fisheries Society Special Publication 25, Bethesda, MD.
- Rivers, P. 2005. Leech Lake Summer and Winter Creel Surveys, May 15 to September 30, 2004. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 678.
- Rivers, P. 2006. Leech Lake Summer and Winter Creel Surveys, May 15 to September 30, 2005. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 714.
- Schultz, D. 2009. Summer creel survey report for Leech Lake, 2008. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 830.
- Schultz, D. 2010a. Summer creel survey report for Leech Lake, 2009. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 835.
- Schultz, D. 2010b. Leech Lake management plan, 2011-2015. Minnesota Department of Natural Resources, Section of Fisheries, St. Paul, MN.
- Schultz, D. 2011. Large lake sampling program assessment report for Leech Lake, 2010. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, F-29-R-29, Study 2.
- Schupp, D. H. 1972. The walleye fishery of Leech Lake, Minnesota. Minnesota Department of Natural Resources, Section of Fisheries, Investigational Report 317, St. Paul.
- Schupp, D. H. 1992. An ecological classification of Minnesota lakes with associated fish communities. Minnesota Department of Natural Resources, Section of Fisheries, Investigational Report 417, St. Paul, MN.
- Sledge, T. J. 1999. Leech Lake Creel Survey, May 9 to September 30, 1998. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 451.
- Sledge, T. J. 2000. Leech Lake Creel Survey, May 14 to September 30, 1999. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 479.

- Soupir, C. A. and M. L. Brown. 2002. Comprehensive evaluation and modification of the South Dakota angler creel program. Federal Aid to Sportfish Restoration Project F-15-R, Study 1575.
- Soupir, C. A., M. L. Brown, C. C. Stone, and J. P. Lott. 2006. Comparison of creel survey methods on Missouri River reservoirs. 2006. North American Journal of Fisheries Management 26:338-350.
- Vondra, B. and D. Schultz. 2011. Summer creel survey report for Leech Lake, 2010. Minnesota Department of Natural Resources, Section of Fisheries, Completion Report, Study 4, Job 854.
- Wilcox, D. E. 1979. The effect of various water level regimes on fish production in the Leech Lake reservoir, Cass County, Minnesota. Minnesota Department of Natural Resources, Section of Fisheries, St. Paul, MN.
- Wingate, P. J., and D. H. Schupp. 1984. Large lake sampling guide. Minnesota Department of Natural Resources, Section of Fisheries, Special Publication 140, St. Paul.

TABLES

Table 1. Sampling probabilities (P) used to determine winter creel survey schedules on Leech Lake, 2010-2011.

Clerk	Cluster	Access	Location	P		
				Dec 15-Jan 31	Feb 1-Mar 15	
1	1	1	New Leech Lake Campground	0.095	0.000	
		2	North Star Resort	0.248	0.060	
		3	Sucker Bay (PA)	0.021	0.000	
	2	1	1	Big Rock Resort	0.052	0.045
			2	Horseshoe Bay Resort	0.002	0.004
			3	Whipholt Beach (PA)	0.071	0.045
	3	1	1	Adventure North Resort	0.040	0.060
			2	Brindley's Harbor Resort	0.038	0.301
			3	Pine Point/Grand Vu resorts	0.433	0.515
	2	4	1	North Agency Bay	0.027	0.001
			2	East Agency Bay	0.022	0.001
			3	Stony Point Campground (PA)	0.110	0.138
5		1	1	Cochran's Bay	0.193	0.141
			2	Shingobee Island	0.155	0.044
			3	Walker City Park (PA)	0.072	0.056
6		1	1	Erickson's Landing (PA)	0.298	0.522
			2	Kabekona Bay	0.022	0.044
			3	Oak Point Resort	0.101	0.053

Table 2. Mean party size and trip length by angler types in the Leech Lake winter fishery, December 15, 2010 to March 15, 2011.

Day Trips						
Time period	Party size			Completed trip length		
	n	mean	se	n	mean	se
Dec 15 - Jan 30	220	2.36	0.39	220	4.30	0.78
Feb 1 - Mar 15	250	2.52	0.37	250	4.40	0.64
Totals	470	4.43	0.27	470	4.34	0.51

Sleeper Houses						
	Party size			Completed trip length		
	n	mean	se	n	mean	se
Dec 15 - Jan 30	22	3.38	1.08	22	28.48	9.33
Feb 1 - Mar 15	18	3.03	0.10	18	40.33	0.73
Totals	40	3.22	0.59	40	33.86	5.11

Darkhouse						
	Party size			Completed trip length		
	n	mean	se	n	mean	se
Dec 15 - Jan 30	26	2.01	0.30	26	5.10	0.54
Feb 1 - Mar 15	0	-	-	0	-	-
Totals	26	2.01	0.30	26	5.10	0.54

Table 3. Fishing pressure and standard error (angler-hours) by angler and day types, in the 2010-2011 Leech Lake winter fishery.

Time period	Days in Stratum	Days Sampled	Day trips (se)	Sleeper (se)	Darkhouse (se)	Total (se)
Weekend Days & Holidays						
Dec 15 - Jan 30	14	12	69,783 (25,369)	40,011 (20,172)	2,617 (1,838)	112,411 (32,844)
Feb 1 - Mar 15	13	12	61,082 (23,518)	10,926 (5,157)	1,682 ^a (-)	72,008 ^a (-)
Totals	27	24	130,864 (34,593)	50,938 (20,821)	4,299 (-)	
Weekdays						
Dec 15 - Jan 30	34	34	88,616 (22,595)	18,577 (11,537)	7,233 (4,030)	114,427 (25,456)
Feb 1 - Mar 15	30	30	52,313 (23,714)	6,245 (5,717)	4,042 ^a (-)	58,558 ^a (-)
Totals	64	64	140,930 (32,755)	24,822 (12,876)	11,275 (-)	
Day Types Combined						
Dec 15 - Jan 30	48	46	158,399 (33,973)	58,589 (23,238)	9,850 (4,429)	226,838 (41,555)
Feb 1 - Mar 15	43	42	113,395 (33,399)	17,171 (7,699)	5,724 ^a (-)	130,566 ^a (-)
Totals	91	88	271,794 (47,640)	75,760 (24,480)	15,547 (-)	363,101 (-)

^aAdjusted estimate due to zero darkhouse interviews during Feb-1 stratum.

Table 4. Historic creel survey estimates of the Leech Lake winter fishery, 1965-2011.

Year	1965-1966	1984-1985	1990-1991	1991-1992	1992*	2004-2005	2010-2011 ¹
Angler-hours	8,418	22,279	55,889	81,829	19,788	114,932	347,554
Darkhouse hours	50,675	13,937	17,948	18,366	No est.	No est.	15,547 ^a
Total Pressure (hrs)	59,093	36,216	73,837	100,195	19,788	114,932	363,101
Number Harvested							
Walleye	246	1,388	4,010	6,420	-	2,555	8,294
Walleye (consumed)	-	-	-	-	-	-	155
Yellow perch	10,298	27,720	20,454	81,017	-	20,536	224,963
Northern pike	5,179	2,602	3,063	4,405	-	1,011	3,013 ^a
Cisco	1,034	57	1,760	2,090	46,225	29	8,801
Bluegill/Sunfish	-	-	-	-	-	1,551	824
Pounds Harvested							
Walleye	301	-	5,023	7,672	-	2,820	9,664
Walleye (consumed)	-	-	-	-	-	-	104
Yellow perch	5,149	-	9,247	27,150	-	7,734	95,701
Northern pike	20,004	-	6,540	12,479	-	3,323	8,253 ^a
Cisco	725	-	2,166	2,575	48,912	10	11,175
Bluegill/Sunfish	-	-	-	-	-	491	430
Harvest Rate (fish/hour) - All Anglers							
Walleye	0.029	0.062	0.117	0.070	-	0.022	0.032
Yellow perch	1.045	1.244	0.595	1.031	-	0.179	0.643
Northern pike	0.036	0.072	0.110	0.044	-	0.009	0.006
Cisco	0.720	0.002	0.050	0.021	2.336	0.000	0.015
Bluegill/Sunfish	-	-	-	-	-	0.014	0.004
Harvest Rate (fish/hour) - Targeting Anglers							
Walleye	-	-	-	-	-	0.043	0.119
Yellow perch	-	-	-	-	-	0.607	1.768
Northern pike	-	-	-	-	-	0.066	0.214
Cisco	-	-	-	-	-	0.000	9.062
Bluegill/Sunfish	-	-	-	-	-	1.773	1.120
Mean Weight (lbs) of Harvested Fish							
Walleye	1.23	-	1.25	1.20	-	1.10	1.02
Yellow perch	0.50	-	0.45	0.34	-	0.38	0.41
Northern pike	3.87	-	3.10	2.40	-	3.29	2.69
Cisco	0.71	-	1.23	1.23	1.06	0.33	1.27
Bluegill/Sunfish	-	-	-	-	-	0.32	0.35

*Specifically focused on cisco fishery

¹Walleye protected by 18-26" protected slot limit

^aSpear fisher effort and northern pike harvest during Feb 1 - Feb 28 was approximated based on average daily observations, by day type, during the Dec 15 - Jan 31 stratum.

Table 5. Species targeted by fishing parties in the 2010-2011 Leech Lake winter fishery.

Species Targeted	Day Trips							
	N interviews	Walleye	Northern pike	Yellow perch	Tulibee/cisco	Sunfish	Burbot	Other
Dec 15-Jan 31	220	162	1	127	0	0	2	3
Feb 1 - Mar 15	250	75	1	220	3	1	2	4
Total	470	237	2	347	3	1	4	7
Species Targeted	Sleeper Houses							
	N interviews	Walleye	Northern pike	Yellow perch	Tulibee/cisco	Sunfish	Burbot	Other
Dec 15-Jan 31	22	22	0	10	0	0	1	0
Feb 1 - Mar 15	18	14	0	9	0	0	0	0
Total	40	36	0	19	0	0	1	0
Species Targeted	Darkhouse							
	N interviews	Walleye	Northern pike	Yellow perch	Tulibee/cisco	Sunfish	Burbot	Other
Dec 15-Jan 31	26	1	26	1	0	0	0	0
Feb 1 - Mar 15	0	-	-	-	-	-	-	-
Total	26	1	26	1	0	0	0	0
Species Targeted	Percent of Total							
	N interviews	Walleye	Northern pike	Yellow perch	Tulibee/cisco	Sunfish	Burbot	Other
Overall	536	51%	5%	68%	1%	<1%	1%	1%

Table 6. Catch estimates for the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses. Regarding northern pike, spear angler catch refers to the encounters and release is the estimated number of pike passed on for a harvest opportunity.

<i>Number Caught (all anglers)</i>							
Species	Day Trips		Sleeper Houses		Speakers		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	2,270 (669)	593 (227)	-	108 (25)	3,156 (642)	-	6,127 (955)
Burbot	1,209 (489)	315 (150)	391 (251)	60 (-)	13 (17)	-	1,988 (570)
Sunfish spp.	211 (245)	1,368 (1,063)	31 (36)	-	-	-	1,610 (1,091)
Yellow perch	244,655 (61,337)	381,256 (131,404)	12,158 (7,267)	10,245 (5,496)	9,540 (822)	-	657,854 (142,619)
Walleye	15,552 (4,904)	4,326 (1,575)	3,398 (2,077)	598 (288)	372 (-)	-	24,246 (4,314)
Cisco	2,768 (1,418)	8,165 (7,990)	434 (302)	47 (25)	-	-	11,415 (8,120)
Overall	267,010 (63,756)	396,657 (135,890)	16,442 (8,892)	11,058 (5,561)	13,081 (1,097)	-	704,249 (147,431)

<i>Number Harvested (all anglers)</i>							
Species	Day Trips		Sleeper Houses		Speakers		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	970 (398)	232 (112)	-	9 (11)	1,138 (312)	664 ^a (-)	3,013 ^a (-)
Burbot	135 (77)	136 (75)	180 (138)	40 (-)	-	-	491 (175)
Sunfish spp.	106 (123)	688 (517)	31 (36)	-	-	-	824 (532)
Yellow perch	83,813 (24,230)	130,438 (45,388)	2,530 (1,572)	3,464 (1,830)	4,717 0	-	224,963 (50,903)
Walleye	5,454 (1,606)	1,512 (522)	1,040 (624)	195 (43)	248 (-)	-	8,449 (1,721)
Cisco	1,192 (993)	7,519 (7,708)	62 (71)	28 (18)	-	-	8,801 (7,772)
Overall	91,669 (25,247)	140,568 (48,841)	3,844 (2,386)	3,737 (1,856)	6,103 (312)	-	246,541 (-)

<i>Number Released (all anglers)</i>							
Species	Day Trips		Sleeper Houses		Speakers		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	1,300 (459)	361 (169)	-	99 (22)	2,018 (409)	-	3,777 (638)
Burbot	1,074 (487)	179 (110)	210 (122)	20 (-)	-	-	1,496 (515)
Sunfish spp.	106 (123)	680 (588)	-	-	-	-	786 (601)
Yellow perch	160,842 (38,814)	250,818 (87,175)	9,627 (6,015)	6,781 (3,721)	4,822 (822)	-	432,891 (93,757)
Walleye	10,098 (3,647)	2,815 (1,296)	2,358 (1,475)	403 (249)	124 (-)	-	15,797 (3,187)
Cisco	1,577 (725)	646 (341)	372 (298)	19 (22)	-	-	2,614 (855)
Overall	175,341 (40,136)	256,089 (88,626)	12,598 (6,858)	7,321 (3,761)	6,978 (1,040)	-	458,328 (95,451)

Table 7. Yield estimates (lbs) and mean weights of harvested fish for the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses.

<i>Total Harvest (lbs)</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	2,820 (1,827)	713 (424)	-	28 (32)	2,963 (1,842)	1,729 ^a (-)	8,253 ^a (-)
Burbot	428 (261)	681 (585)	417 (916)	145 (-)	-	-	1,670 (1,118)
Sunfish spp.	26 (-)	386 (111)	17 (22)	-	-	-	430 (113)
Yellow perch	35,101 (20,250)	56,175 (32,285)	819 (1,101)	1,393 (1,160)	2,212 (-)	-	95,701 (37,922)
Walleye	6,084 (3,303)	1,786 (785)	1,231 (1,613)	358 (193)	316 (-)	-	9,776 (3,530)
Cisco	1,343 (1,174)	9,755 (9,863)	33 (-)	45 (31)	-	-	11,175 (9,933)

<i>Mean Weight of Harvested Fish (lbs)</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	2.73 (2.03)	2.74 (4.11)	-	2.91 (4.82)	2.60 (1.78)	-	2.69 (1.58)
Burbot	3.17 (2.65)	3.81 (4.01)	2.31 (5.43)	3.63 (-)	-	-	3.65 (3.30)
Sunfish spp.	0.25 (-)	0.35 (0.38)	0.55 (0.95)	-	-	-	0.35 (0.36)
Yellow perch	0.43 (0.33)	0.39 (0.24)	0.32 (0.48)	0.40 (0.45)	0.47 (-)	-	0.41 (0.19)
Walleye	1.15 (0.68)	0.85 (0.85)	1.18 (1.74)	1.83 (1.16)	1.27 (-)	-	1.02 (0.56)
Cisco	1.12 (1.21)	1.30 (1.87)	0.53 (-)	1.57 (1.97)	-	-	1.27 (1.56)

Table 8. Estimates of catch and harvest rates of selected species for all anglers in the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses. For darkhouse anglers, catch rate represents total encounters and release rate is the estimated rate at which harvest opportunities were passed.

<i>Catch Rate (fish/hour) - All Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	0.015 (0.036)	0.005 (0.009)	-	0.006 (-)	0.320 (0.264)	-	0.014 (0.015)
Burbot	0.006 (0.012)	0.010 (0.010)	0.007 (-)	0.003 (-)	0.001 (0.002)	-	0.008 (0.007)
Sunfish spp.	0.001 (0.001)	0.011 (0.009)	0.001 (0.001)	-	-	-	0.006 (0.004)
Yellow perch	1.755 (0.991)	2.681 (1.594)	0.208 (0.131)	0.597 (0.447)	0.968 (0.443)	-	2.004 (0.771)
Walleye	0.094 (0.051)	0.058 (0.049)	0.058 (0.014)	0.035 (0.032)	0.038 (-)	-	0.070 (0.029)
Cisco	0.013 (0.007)	0.031 (0.033)	0.007 (0.013)	0.003 (0.003)	-	-	0.021 (0.015)
Overall	1.885 (1.047)	2.798 (1.661)	0.281 (0.302)	0.644 (0.475)	1.328 (0.865)	-	2.124 (0.811)

<i>Harvest Rate (fish/hour) - All Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	0.006 (-)	0.004 (0.004)	-	0.001 (0.002)	0.116 (0.117)	-	0.006 (0.002)
Burbot	0.001 (<0.001)	0.007 (0.007)	0.003 (0.002)	0.002 (-)	-	-	0.004 (0.003)
Sunfish spp.	<0.001 (0.001)	0.008 (0.008)	0.001 (0.001)	-	-	-	0.004 (0.004)
Yellow perch	0.608 (0.360)	0.822 (0.500)	0.043 (-)	0.202 (0.166)	0.479 (0.215)	-	0.643 (0.252)
Walleye	0.037 (0.021)	0.033 (0.035)	0.018 (-)	0.011 (0.007)	0.025 (-)	-	0.032 (0.017)
Cisco	0.006 (0.004)	0.026 (0.030)	0.001 (-)	0.002 (-)	-	-	0.015 (0.014)
Overall	0.658 (0.383)	0.900 (0.547)	0.066 (0.015)	0.218 (0.174)	0.620 (0.363)	-	0.704 (0.274)

<i>Release Rate (fish/hour) - All Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	0.009 (0.028)	0.001 (0.004)	-	0.006 (-)	0.205 (0.146)	-	0.008 (0.011)
Burbot	0.006 (0.012)	0.004 (-)	0.004 (-)	0.001 (-)	0.001 (0.002)	-	0.004 (0.003)
Sunfish spp.	<0.001 (0.001)	0.002 (0.002)	-	-	-	-	0.001 (0.001)
Yellow perch	1.147 (0.602)	1.859 (1.121)	0.164 (0.171)	0.395 (0.283)	0.490 (0.235)	-	1.361 (0.526)
Walleye	0.057 (0.072)	0.025 (0.017)	0.040 (0.028)	0.023 (0.024)	0.013 (-)	-	0.038 (0.024)
Cisco	0.007 (0.004)	0.005 (0.005)	0.006 (0.014)	0.001 (0.003)	-	-	0.006 (0.003)
Overall	1.228 (0.707)	1.898 (1.144)	0.215 (0.266)	0.426 (0.302)	0.708 (0.505)	-	1.420 (0.558)

Table 9. Estimates of catch and harvest rates of selected species for targeting anglers in the 2010-2011 Leech Lake winter fishery. Standard errors are in parentheses. For darkhouse anglers, catch rate represents total encounters and release rate is the estimated rate at which harvest opportunities were passed.

<i>Catch Rate (fish/hour) - Targeting Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	-	0.197 (-)	-	-	0.789 (0.200)	-	0.702 (0.487)
Burbot	1.373 (-)	0.156 (-)	-	-	-	-	0.655 (-)
Sunfish spp.	-	3.040 (-)	-	-	-	-	3.040 (-)
Yellow perch	4.678 (0.502)	7.600 (0.695)	1.366 (0.013)	2.983 (1.089)	2.747 (-)	-	5.638 (1.433)
Walleye	0.450 (0.109)	0.240 (0.081)	0.087 (0.016)	0.104 (0.010)	0.290 (-)	-	0.323 (0.121)
Cisco	-	9.360 (6.725)	-	-	-	-	9.360 (15.540)

<i>Harvest Rate (fish/hour) - Targeting Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	-	0.197 (0.444)	-	-	0.225 (0.160)	-	0.214 (0.084)
Burbot	0.000 (-)	0.000 (-)	-	-	-	-	0.000 (-)
Sunfish spp.	-	1.120 (1.058)	-	-	-	-	1.120 (-)
Yellow perch	1.367 (0.102)	2.463 (0.135)	0.284 (0.182)	0.987 (0.331)	2.747 (-)	-	1.768 (0.348)
Walleye	0.152 (0.032)	0.116 (0.068)	0.033 (0.039)	0.036 (0.115)	0.194 (-)	-	0.119 (0.040)
Cisco	-	9.062 (1.895)	-	-	-	-	9.062 (14.989)

<i>Release Rate (fish/hour) - Targeting Anglers</i>							
Species	Day Trips		Sleeper Houses		Darkhouse		Combined
	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Dec 15 - Jan 31	Feb 1 - Mar 15	Season
Northern pike	-	0.000 (-)	-	-	0.563 (0.176)	-	0.488 (0.426)
Burbot	1.373 (-)	0.156 (-)	-	-	-	-	0.655 (-)
Sunfish spp.	-	1.920 (-)	-	-	-	-	1.920 (-)
Yellow perch	3.311 (0.324)	5.137 (0.566)	1.083 (0.001)	1.996 (0.829)	0.000 (-)	-	3.871 (1.215)
Walleye	0.298 (0.096)	0.123 (0.059)	0.054 (0.011)	0.068 (0.008)	0.097 (-)	-	0.204 (0.105)
Cisco	-	0.298 (0.238)	-	-	-	-	0.298 (0.551)

Table 10. Percent of all angling parties (top) and targeting angling parties (bottom) who harvested a given number of fish in the 2010-2011 Leech Lake winter fishery.

Species/stratum	N	Number Harvested per Angler (%)						
Northern pike		0	0.1-0.9	1.0-1.9	2.0-2.9	3		
Dec 15 - Jan 31	268	91.4	5.2	3.0	0.4	0.0		
Feb 1 - Mar 15	269	96.7	3.0	0.4	0.0	0.0		
Yellow perch		0	0.1-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20	
Dec 15 - Jan 31	268	60.9	27.1	1.9	1.5	0.0	8.7	
Feb 1 - Mar 15	269	23.6	27.0	13.7	6.8	9.1	19.8	
Walleye		0	0.1-0.9	1.0-1.99	2.0-2.99	3.0-3.99	4	
Dec 15 - Jan 31	268	77.2	9.3	9.7	1.9	1.5	0.4	
Feb 1 - Mar 15	269	84.4	11.2	3.4	0.4	0.7	0.0	
Tulibee/cisco		0	0.1-9.9	10.0-19.9	20.0-29.9	30.0-39.9	40.0-49.9	50
Dec 15 - Jan 31	268	98.1	1.9	0.0	0.0	0.0	0.0	0.0
Feb 1 - Mar 15	269	91.8	7.8	0.0	0.0	0.0	0.4	0.0

Species/stratum	N	Number Harvested per Targeting Angler (%)						
Northern pike		0	0.1-0.9	1.0-1.9	2.0-2.9	3		
Dec 15 - Jan 31	27	63.0	11.1	22.2	3.7	0.0		
Feb 1 - Mar 15	1	0.0	100.0	0.0	0.0	0.0		
Yellow perch		0	0.1-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20	
Dec 15 - Jan 31	136	37.5	40.4	3.7	2.9	0.0	15.4	
Feb 1 - Mar 15	224	17.0	27.7	15.6	7.6	10.7	21.4	
Walleye		0	0.1-0.9	1.0-1.99	2.0-2.99	3.0-3.99	4	
Dec 15 - Jan 31	185	68.1	13.0	13.5	2.7	2.2	0.5	
Feb 1 - Mar 15	89	73.0	18.0	5.6	1.1	2.3	0.0	
Tulibee/cisco		0	0.1-9.9	10.0-19.9	20.0-29.9	30.0-39.9	40.0-49.9	50
Dec 15 - Jan 31	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb 1 - Mar 15	3	0.0	66.7	0.0	0.0	0.0	33.3	0.0

Table 11. Length-frequency distribution (%) of commonly harvested and released fish for the 2010-2011 Leech Lake winter fishery.

Number Harvested (H) and Released (R)												
TL (inches)	Northern pike		Burbot		Sunfish spp.		Yellow perch		Walleye ¹		Cisco/ Whitefish	
	H	R	H	R	H	R	H	R	H	R	H	R
<4.00												
4.00-4.99						4		496				
5.00-5.99								2,146		5		
6.00-6.99					5	13	1	4,176		16		
7.00-7.99					2		548	3,625		76		
8.00-8.99				1	3		302	1,146				
9.00-9.99							1,801	208		25		
10.00-10.99				1	7		3,090	143	2	70	1	1
11.00-11.99							34		6	6	2	1
12.00-12.99		1		2			93	51	24	54	6	27
13.00-13.99							1		14	10	8	6
14.00-14.99	1		1	3					30	6	15	5
15.00-15.99	2	6		1					87	34	12	5
16.00-16.99				1					12	7	3	2
17.00-17.99									22	3	12	
18.00-18.99		13		11					1	7		
19.00-19.99	2	6								15		
20.00-20.99	4	12	2	7					1	16	1	2
21.00-21.99	2									19		
22.00-22.99	11	6	2	1					1	44	10	
23.00-23.99	3	9	1	2						5		
24.00-24.99	5	4	1							7		
25.00-25.99	3	7	4	2					1	8		
26.00-26.99	2	5		1						4		
27.00-27.99	3		1	3						2		
28.00-28.99	1	3	1							1		
29.00-29.99									1			
30.00-30.99	1	4	2									
31.00-31.99												
32.00-32.99	1											
33.00-33.99												
34.00-34.99		2										
35.00-35.99												
≥ 36.00												
Total (N)	41	78	15	36	17	17	5,870	11,991	202	440	70	49

¹Bold font denotes walleye protected by length limit.

FIGURES

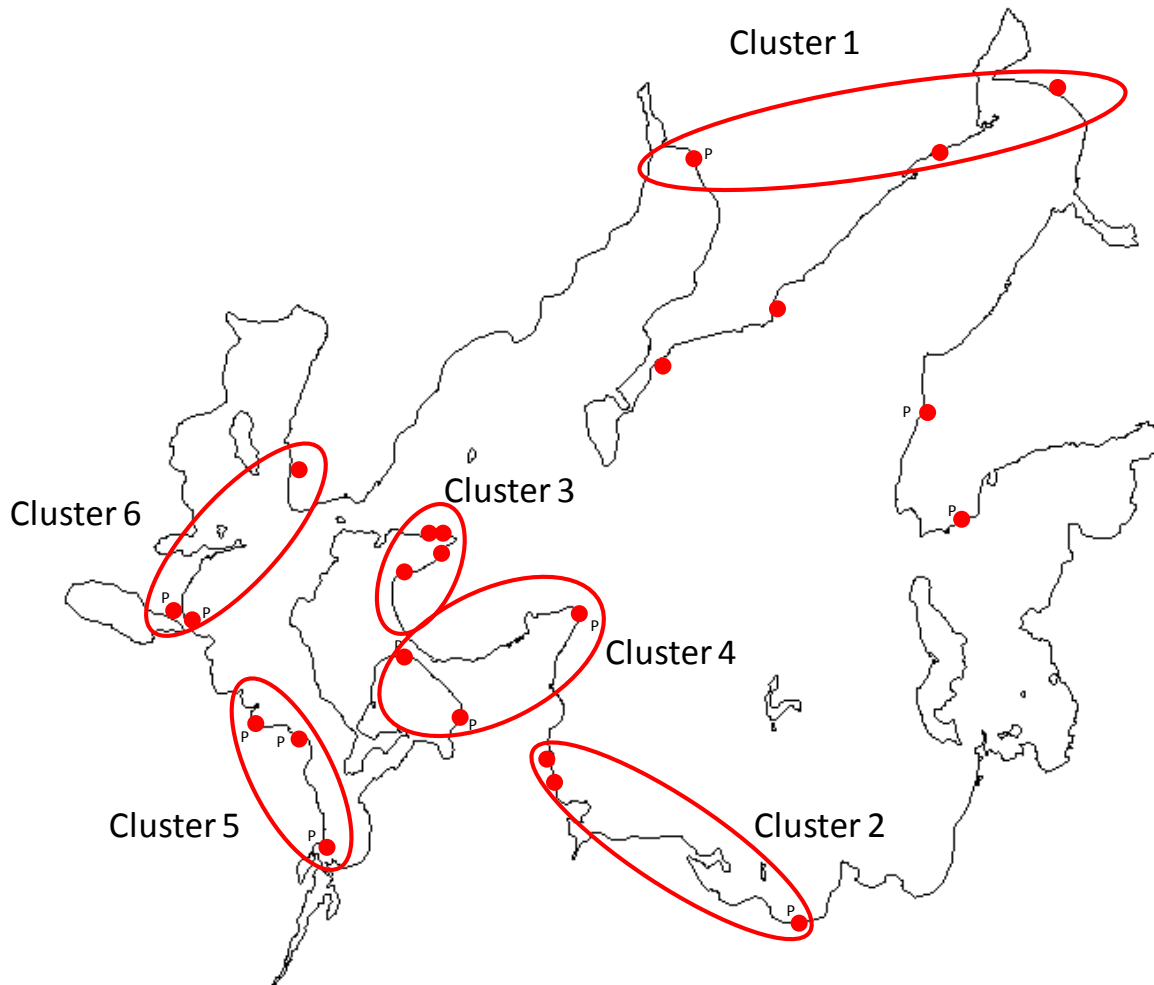


Figure 1. Creel survey sampling clusters (circles) and stations (dots) on Leech Lake, Minnesota. Public access points are denoted by a “P”. Stations not included in clusters were determined in 2009 to have low winter use and consequently were not sampled.

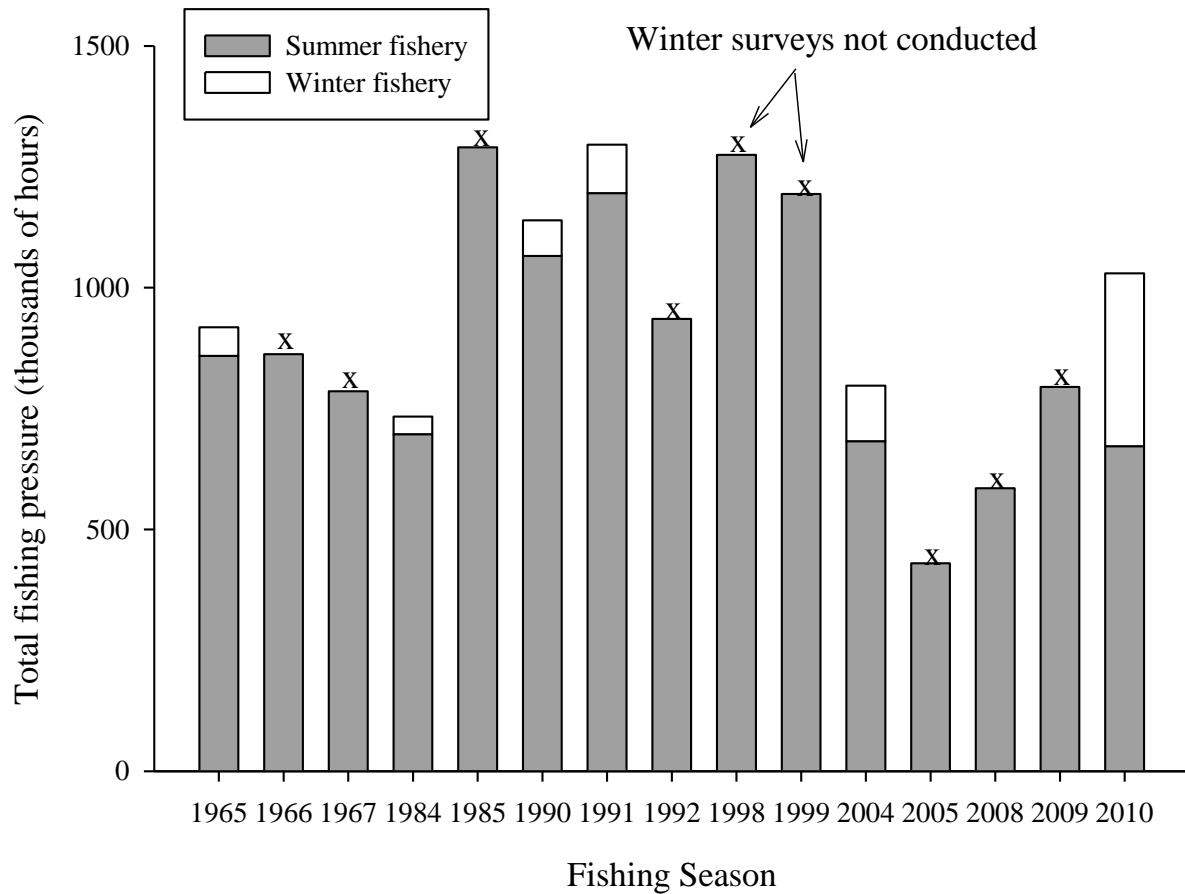


Figure 2. Total fishing pressure (angler-hours) in the Leech Lake fishery, 1965-2010. Summer creel surveys were completed in the year noted. Winter surveys typically began during December of the year noted and ended March of the following spring, though start and end dates of winter surveys were influenced by varying ice conditions among years.

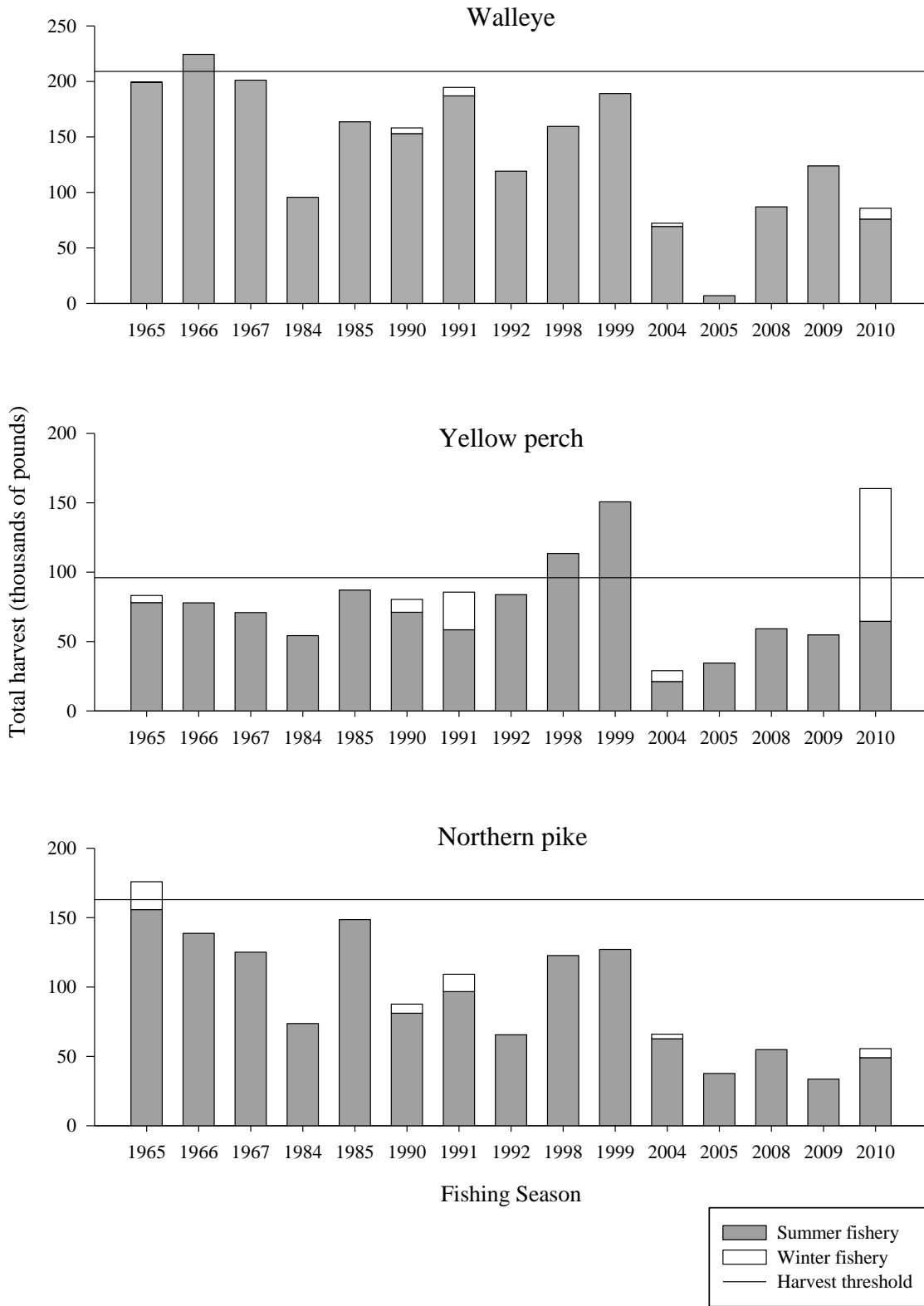


Figure 3. Total sportfish harvest (lbs x 1,000) of select species from Leech Lake, 1965-2010. Horizontal lines denote upper harvest thresholds established by MN DNR (MN DNR 1997).



**Minnesota Department of Natural Resources
Section of Fisheries**



Creel Survey Summary for Leech Lake, Minnesota

Fish Management Area: Walker

Year Surveyed: 15 December 2010 - 15 March 2011

Angling Pressure

Angler-hours	363,101
Angler-hours/acre	3.20
Anglers/party	Day Trips: 4.43; Sleeper: 3.22; Darkhouse: 2.01
Mean Trip Length (h)	Day Trips: 4.34; Sleeper: 33.86; Darkhouse: 5.10

Catch (number)

Harvest (number)

Harvest (pounds)

Species	Catch (number)		Harvest (number)		Harvest (pounds)	
	Total N	N/acre	Total N	N/acre	Total lbs.	lbs./acre
Bullhead spp.						
Northern pike	6,127	0.055	3,013	0.027	8,253	0.074
Muskellunge						
Burbot	1,988	0.018	491	0.004	1,670	0.015
Rock bass						
Sunfish spp.	1,610	0.014	824	0.007	430	0.004
Smallmouth bass						
Largemouth bass						
Black crappie						
Yellow perch	657,854	5.895	224,963	2.016	95,701	0.858
Walleye	24,246	0.217	8,449	0.076	9,776	0.088
Cisco	11,415	0.102	8,801	0.079	11,175	0.100
All species	704,249	6.311	246,541	2.209	127,005	1.138

Catch Rate (fish/hour)

Harvest Rate (fish/hour)

Species	Catch Rate (fish/hour)		Harvest Rate (fish/hour)	
	Angler Type		Angler Type	
	All	Targeting	All	Targeting
Bullhead spp.				
Northern pike	0.014	0.702	0.006	0.214
Muskellunge				
Burbot	0.008	0.655	0.004	0.000
Rock bass				
Sunfish spp.	0.006	3.040	0.004	1.120
Smallmouth bass				
Largemouth bass				
Black crappie				
Yellow perch	2.004	5.638	0.643	1.768
Walleye	0.070	0.323	0.032	0.119
Cisco	0.021	9.360	0.015	9.062
All/Targeted Any	2.124	-	0.704	-

Creel Survey Summary for Leech Lake, Minnesota

Length Frequency Summary for Harvested (measured) Fish (inch groups)

Species	0.0-4.9	5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21.0-24.9	25.0-29.9	≥30.0
Bullhead spp.								
Northern pike				3	6	21	9	2
Muskellunge								
Burbot				1	2	4	6	2
Rock bass								
Sunfish spp.		10	7					
Smallmouth bass								
Largemouth bass								
Black crappie								
Yellow perch		851	5018	1				
Walleye			32	143	24	1	2	
Cisco			9	38	13	10		

Comments:

Citation: D.Schultz and B. Vondra. 2011. Winter creel survey for Leech Lake, 2011. Minnesota Department of Natural Resources, Section of Fisheries, Study 4, Job 855.