

# The Effects of Angling Pressure on Northern Pike Size Structure

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A number of conditions within a lake system can affect northern pike (*Esox lucius*) size structure. Of these conditions, the amount of angling pressure may have the biggest effect on the size structure of northern pike in Minnesota lake systems. In this study, five private and five public lakes were chosen near Bemidji, Minnesota. Each lake was fished for twenty angling hours using live northern hog suckers (*Hypentelium nigricans*) or golden shiners (*Notemigonus crysoleucas*). Total length (mm) and weight (kg) were measured for each northern pike caught. The number of fish houses that were on the lake during each angling event was used as an estimate of angling pressure. In private lakes northern pike had higher densities in the 500, 600, 800 mm class sizes. Between public and private lakes there was a significant difference in average ice house density (p-value = 0.004) but not in average mean of northern pike length (p-value = 0.27).

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## Introduction

Northern pike (*Esox lucius*) are a popular game species in parts of the United States, Canada, and Europe. In Minnesota, northern pike are the most widespread targeted game species (Paukert et al. 2001). In Wisconsin, fifty-eight percent of anglers target northern pike (Paukert et al. 2001). They are a popular sport fish in this region of the world because they are abundant and exciting to catch.

Because of the popularity of northern pike, the size structure can be altered by angling pressure. Most recreational fisheries are selective of morphological traits and exploitation rates can be substantial to a northern pike population (Matsumura et al. 2011). Larger northern pike are more appealing to anglers and therefore more vulnerable to being caught, resulting in larger northern pike being harvested more than the smaller fish. In a study conducted by Pierce and Tomcko (2003), they concluded from their low population estimates and turnover ratios, that larger less productive fish were susceptible to angler harvest. Because of this increased susceptibility, a decrease in size structure of the northern pike occurred. In Minnesota, northern pike of 500 mm total length (TL) or larger are more susceptible to all forms of angling (Pierce and Tomcko 2003). Detailed knowledge related to the influence

angling pressure influence has on the size structure of northern pike would help management produce trophy northern pike in Minnesota lakes.

The objectives of this study were to 1) test for a difference between northern pike size structure in public and private lakes and 2) to determine if angling pressure has influenced the size structure in smaller Minnesota lakes. It is hypothesized that private lakes near Bemidji will have less angling pressure resulting in a decrease in the size structure of northern pike because of high population densities and slow growth.

## Methods

Ten lakes were included in this study and split into two categories, five public lakes which have a boat launch and five private lakes which do not have a boat launch. Each of the lakes were chosen using the Minnesota Department of Natural Resources (DNR) lake finder website based on lake characteristics (Table 1). Records of previous lake surveys were reviewed showing a steady northern pike population. Each lake was fished for a total of 20 hours, over three separate fishing events.

Table 1 – Lake characteristics for lake included in the study during the 2013-2014 ice fishing season.

Lake	Lake ID	County	Private or Public	Distance from Bemidj (km)	Surface area (ha)	Maximum depth (m)
Beltrami	04-0135-00	Beltrami	Public	16.2	292.2	15.2
Julia	04-0166-00	Beltrami	Public	24.9	182.1	13.1
North Twin	04-0063-00	Beltrami	Public	31	131.7	17.9
Sandy	04-0124-00	Beltrami	Public	33.7	105.7	9.7
Plantangenet	29-0156-00	Hubbard	Public	10.9	1024.2	19.8
Bass	04-0139-00	Beltrami	Private	35.2	44.5	28.3
Black	04-0157-00	Beltrami	Private	22.2	99.5	12.8
Carter	04-0056-00	Beltrami	Private	31.5	12.1	21
Nelson	04-0057-00	Beltrami	Private	32.8	11.7	9.1
Silver	04-0172-00	Beltrami	Private	39.1	29.1	13.7

Two different methods were used to choose fishing locations on individual lakes. The first method was to use knowledge from past experience fishing for northern pike. To account for all northern pike sizes, several habitats in each lake were included for sample locations. Habitats included points, drop offs, flats, bays, vegetation, and depths between 1.8 to 7.6 m. The second method for choosing locations was to use depth charts and vegetation maps found on the MNDNR Lakefinder<sup>1</sup> website to gain knowledge about the habitat structure for each lake. Once out on a lake a vexliar FL-18 was used to choose fishing locations based on the above criteria. Two methods of fishing were used to collect the data, the first method being tip-ups rigged with a golden shiner (*Notemigonus crysoleucas*) or a northern hog sucker (*Hypentelium nigricans*). The amount of tip-ups used varied from two to six per fishing event. The second method of fishing was an ugly stick ice-fishing pole rigged with an artificial lure such as a slender spoon or the same live bait as the tip-ups. Jigging or dead-stick methods were then used to attract fish to the bait. A folding measuring tape was used to measure fish TL in mm. Fish were then weighed in kg using a digital scale.

During each fishing event, the numbers of permanent and portable icehouses were counted on the entire lake. The lakes were rotated between weekdays and weekends each time they were fished to account for different levels of pressure. The data was later transferred into excel for analysis. Two sample t-tests were used to determine if fish length, house density, and CPUE were different between public and private lakes.

## Results

During the 2013-2014 winter fishing season the distribution of northern pike on public and private lakes can be represented by a normal bell curve length frequency, with more fish in the 400, 500, 600, and 700 mm classes, and fewer fish in the 300, 800, and 900 mm classes for both lake systems (Figure 1). Private lakes however, had a higher number of northern pike captured than public lakes in the 500, 600, and 800 mm length classes (Figure 1).

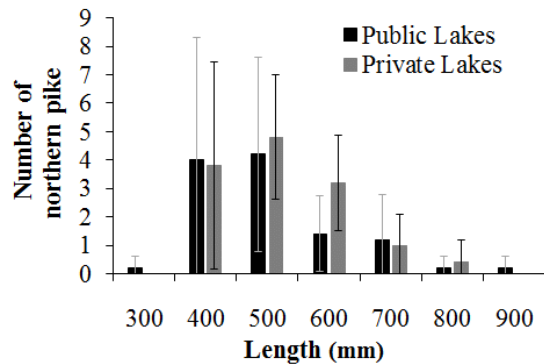


Figure 1- The length frequency for public and private lakes during the 2013-2014 ice fishing season with 95% CI.

Average mean northern pike total length was not significantly different between public and private lakes (p-value = 0.27, df = 8, t = -0.64), however, average ice house densities between the two lake systems did differ (p-value = 0.004, df = 8, t = 3.38, Figure 2).

The catch per unit effort (CPUE, fish/hour) of northern pike had no significant difference between public and private lakes (p-value = 0.21, df = 8, t = -0.83). CPUE has a larger 95% CI interval on public lakes than on private lakes (Figure 3).

<sup>1</sup> <http://www.dnr.state.mn.us/lakefind/index.html>

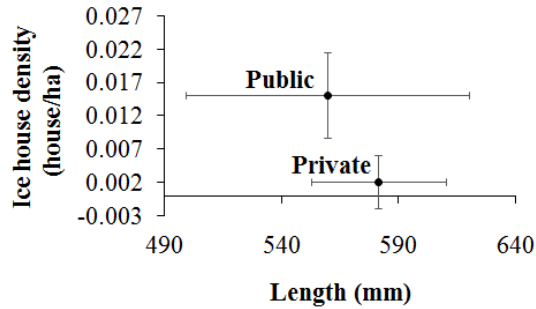


Figure 2- Comparison of average house density (house/ha) and average total length of northern pike (mm) with 95% CI for public and private lakes during the 2013-2014 ice fishing season.

The CPUE on public lakes stays steadier throughout the ice fishing season, whereas the private lakes start with a higher CPUE, then decrease slightly, before spiking again, and then falling again at the end of the season. CPUE did not differ throughout the course of the study in either public (p-value = 0.74, df = 3, 12, F = 0.42) or private (p-value = 0.83, df = 3, 12, F = 0.28) lakes during the 2013-2014 ice fishing season (Figure 4).

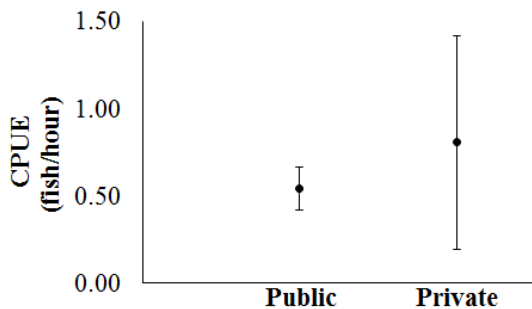


Figure 3- CPUE with 95% CI for public and private lakes during the 2013-2014 ice fishing season.

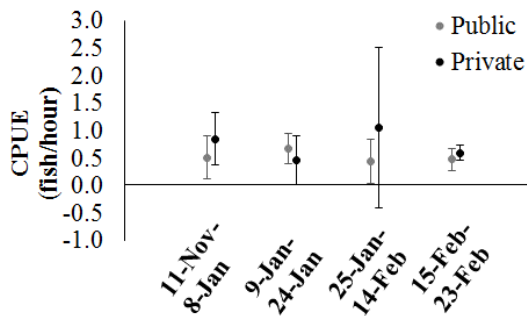


Figure 4- The number of fish caught and CPUE throughout the 2013-2014 ice fishing season with 95% CI.

## Discussion

During this study there was no significant difference in total length of northern pike in public and private lake systems. A non-detectable difference in total length between the two types of lake systems may be due to higher harvesting rates of larger fish during the dark house spearing and summer angling seasons. Pierce and Cook (2000) found that fish larger than 508 mm had an average population estimate of 0.89 fish/ha with an estimated 11% of these fish being harvested during the spearing season. Fish larger than 609 mm had an average population estimate of 0.20 fish/ha with an estimated 27% of fish being harvested by spearing. There are not many large fish within a population of northern pike and spearing harvests a very large portion of these fish. Summer angling harvests even more of the larger northern pike than winter spearing. Pierce and Cook (2000) found that summer angling is capable of harvesting 30% of the fish larger than 508 mm and 47% of the fish larger than 609 mm within a single season. Winter dark house spearing and summer angling, two sources not accounted for in this study, harvest large amounts of fish out of public and private lakes, possibly influencing northern pike size structure in both lake systems.

Results from this study provide evidence to suggest angling catch rate will be relatively similar on both public and private lakes. However, confidence interval widths demonstrate that CPUE on private lakes can greatly fluctuate. CPUE can be a way to measure fish abundance; if catch rates are high, population density should be high (Pierce and Tomcko 2011). On private lakes in this study the CPUE was variable indicating the density of northern pike could also have differed. Changes in density of a northern pike population could influence the size structure of a population in some private lakes. Having a higher population density could produce a greater abundance of smaller northern pike while a small population density could produce larger northern pike in private lakes.

Past research has suggested that angling pressure changes significantly between summer and winter angling. Margenau et al. (2003) reported that during winter an average of 31% of fishing effort was directed towards northern pike compared to only 12% during the summer. There are several reasons why northern pike experience greater fishing pressure in the winter than in the summer months. Anglers may be targeting northern pike more in the winter as a food source, or when other species, such as muskellunge (*Esox masquinongy*) seasons are closed (Margenau et al. 2003). Northern pike certainly experience more

angling pressure at different times of the year especially during the winter. During this study angling pressure which was measured through average house density per (ha) was significantly different between public and private lakes.

Differences in surface area between public and private lakes may have influenced the size structure of northern pike in this study. Logistical limitations of the study design resulted in a group of study lakes in which all public lakes were larger than the largest private lake. Previous research found that small northern pike grew faster in shallow lakes composed mainly of littoral area, while large deep lakes are more likely to produce trophy northern pike (Jacobson 1992). Even though there was significantly less angling pressure on private lakes in this study, it is possible that depth and surface area influences could have counteracted expected angling pressure effects.

Heavy snowfall early and bitter cold temperatures late in the season likely resulted in lower ice house densities over the course of this study than in years with more favorable conditions. Reduced angling pressure during years of harsh weather should have direct influences on the size structure of northern pike. Assuming northern pike populations can quickly respond to changes in angling pressure, differences in northern pike size structure between public and private lakes would be minimized in years with harsh weather.

Management of northern pike can be time consuming and difficult, but understanding how angling pressure effects the size structure of northern pike is crucial. A major hurdle is that there are a number of interacting factors that affect northern pike growth (Pierce 2012). Information provided by this study should help fishery managers better understand the effects of angling pressure improving the selection of laws and regulations aimed at creating quality size structure of northern pike in public and private lakes.

### **Acknowledgements**

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