

# Changes in the Minnesota Northern Pike Population Over the Past Thirty Years

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Northern pike *Esox lucius* are one of the most popular game fish in Minnesota. Many anglers have noticed that northern pike seemed to decrease in size throughout much of this state. Catch per unit of effort (CPUE) drives average weight for northern pike; within lakes, as CPUE goes up average weight decreases. Decreases in size has led the Minnesota Department of Natural Resources (MNDNR) to implement new regulations on northern pike. The MNDNR noticed that not all the state has this same problem with Northern Pike, and has broken down the state into three zones, with different protected slots and limits based on where the lake is located geographically within Minnesota. Results from this study indicate the north-central zone has seen a statistically significant increase in pike CPUE ( $\hat{Y} = -237.78 + 0.12X$ ;  $P < 0.01$ ). The other areas of Minnesota have not seen any statistically significant changes in northern pike population density. These steady populations are due to lack of fishing pressure plus the slow reproductive rates in these areas of the state. Having regulations based on yields is not as effective when regulating northern pike, because anglers are very selective and do not tend to keep smaller pike.

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## Introduction

The northern pike *Esox lucius* is a native predatory fish throughout the entire state of Minnesota. Northern pike are one of the most popular game fish for anglers in this state. Even though northern pike are very popular game fish, anglers release them at a 75% rate (Pierce et al. 1995). It is difficult to implement limits on northern pike since most anglers catch and release northern pike when they are caught. A fisheries management study showed anglers tend to be interested in catching larger pike and still there is a high rate of catch and release, which means length regulations should not be based on yields of northern pike that can be caught (Pierce et al. 1995). Having protective limits that are not based on yields makes it complicated to improve a population of northern pike.

The Minnesota Department of Natural Resources (MNDNR) have noticed many of the lakes in this state have high numbers of northern pike with a smaller average size. This abundance of smaller pike has adverse effects within the lake's ecosystem. When a lake has a high number of pike with a small size, yellow perch *Perca flavescens* populations generally decrease to unhealthy levels,

there is reduced effectiveness of walleye stocking, and panfish populations reduce in size.

Protecting larger northern pike is something that Minnesota has tried in the past, by having protected slot limits with the goal of increasing the average size of northern pike. There was a review of a temporary slot limit on twenty-two Minnesota lakes that took place between 1989 through 1998 (Pierce et al. 2010). These lakes had similar northern pike population dynamics and they were compared to data from the 1970s. Pierce et al. (2010) found that slot limits improved the size structure of northern pike populations but produced no consistent trends in relative abundance. Having lakes that have more large northern pike is something that would help increase tourism, increase desire for anglers to try to catch northern pike, and could help other fish species have healthier populations. Pierce et al. (2010) suggested length limits protected large northern pike and would produce lower yields of pike taken which could increase overall size.

The MNDNR has recognized that different areas of the state have different populations of northern pike. These differences across the state have compelled the MNDNR to change the northern pike fishing regulations for these lakes. They have

created three “Pike Zones” across Minnesota, and each zone has different regulations based on where the lake is geographically.

The three zones in Minnesota are the north-central, northeast and southern zone. In the north-central zone the MNDNR has found that many lakes have an unhealthy population of small pike. In this area of the state there is moderate to high fishing pressure, and pike grow rather slowly. This combination has created lakes with a small average size of northern pike throughout most of this zone. The MNDNR created regulations on pike that allow anglers to keep up to ten pike under twenty-two inches. Their goal is to remove the large number of small pike out of these lakes to increase the average size. The northeast zone has the lowest fishing pressure in the state, but pike still grow slow. The MNDNR believes the pike populations in these lakes is at a healthy level and their goal is to maintain those populations. The southern zone has the highest fishing pressure, but pike grow faster in this area than any other part of the state. The MNDNR has found limited numbers of pike in these lakes. The goal for this zone is to increase the abundance of northern pike. The objective of this research is to determine how abundance and average weight of northern pike have changed over the past thirty years, in each of the three Minnesota northern pike zones, respectively.

## Methods

This study is broken down into three different studies, looking at northern pike populations in three different geographic zones in Minnesota. For each zone of Minnesota there needed to be a random sample of lakes. That random sample of lakes was done by finding the middle point of each zone and moving out circularly from that point. To find the middle point of the zones, Arc GIS pro was used to create lines from the corners of each zone. Where those lines intersected was considered the middle point. The northeastern zone is triangular, so I estimated the middle point of each side of the zone by looking at the decimal degrees on Arc GIS. I created lines from the middle of each side and the intersection of those lines was the middle point (Figure 1). After finding the middle point of each of the zones, I moved out circularly from the middle point and record data from the thirty closest lakes where at least one northern pike was sampled between 1990 and 2020. The year of sample, average weight, and CPUE (catch per unit effort; average number of pike per gill net), was recorded for each year where at least one northern pike was sampled.

Once the data was collected four graphs were created. The first graph compared CPUE (y-axis) and average weight (x-axis) for every lake surveyed. This graph showed the trend of how CPUE affects average weight of northern pike. The next three graphs compared CPUE (y-axis) and year of survey (x-axis), for each zone individually. Next a three-year rolling trendline was created for these three graphs. Then a standard linear regression test was run for each zone, looking at how the year of the sample affects CPUE for that zone.



**Figure 1.** These are the middle points for all three zones in Minnesota. The left picture is from the north central zone. The bottom right picture is the southern zone, and the top right picture is from the northeastern zone. The middle point for these zones are where the line intersect.

## Results

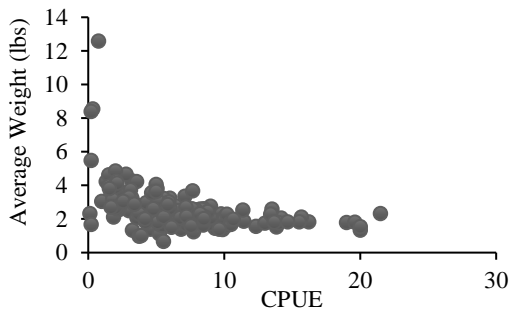
As CPUE increased average weight decreased which demonstrates how CPUE drives the average weight of northern pike (Figure 2). This trend was the same throughout the zones and shows that when studying northern pike populations, CPUE is the driving force in what the average weight will be. When looking at the three zones individually, CPUE will be the factor to look at and how those changes will drive how average weight has changed as well.

In the southern zone (Figure 3) there was a significant dip in pike numbers from around 2005 – 2010, but then it picked back up into similar numbers from before the decrease. Even though there was a decrease for around five years, overall, there was no significant change in CPUE for the southern zone in thirty years ( $P = 0.46$ ). The line with the three-year rolling average shows in 1993

the CPUE average was around four northern pike per gill net. The last point in 2020 also had a CPUE that was around four pike per gill net.

The data for the northeastern zone shows that northern pike populations have been at a steady level over the past thirty years (Figure 4). Although there was a significant spike in 1995, that spike was not seen any other years and does not affect the trend seen. The three-year rolling trendline moved less than it did when looking at the southern zone. There was no significant change in northern pike populations over the past thirty years ( $P = 0.18$ ).

For the north-central zone the data shows a clear trend that CPUE is rising in this area of Minnesota (Figure 5). When looking at the three-year rolling trendline there was a consistent increase in CPUE. There were significant increases in northern pike in the north central zone over the past thirty years ( $P = 0.002$ ). There was an average increase of 0.12 northern pike per gill net per year.

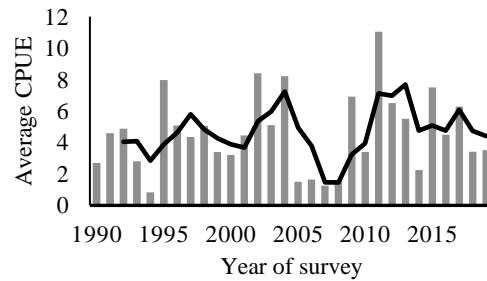


**Figure 2.** This is data from every lake surveyed over the past thirty years. Shows CPUE on the x axis and average weight on the y axis. Average weight is decreasing as CPUE increases.

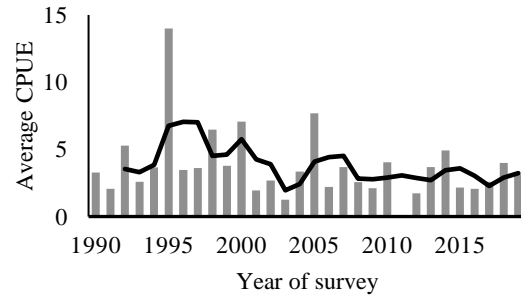
### Discussion

The first major finding was that CPUE drove average weight in all lakes for this study. As CPUE went up average weight would go down. This conclusion shows how northern pike population dynamics work, and how the population affects the size structure of these fish. Lakes with high population densities and reduced growth rates will result in poor size structure (Jacobson 1992). Lakes with high population densities tend to have smaller northern pike. This is seen in this study where lakes with a high CPUE have a low average weight. This trend is in line with the finding by Jacobson (1992) where slow growth rates combined with high mortality rates resulted in lakes dominated by small northern pike. In this study growth rates are not looked at, but one can assume that many of these lakes with very high CPUE and low average weight,

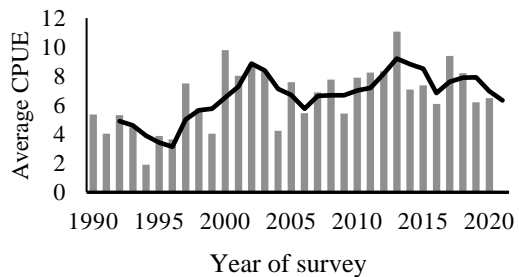
will have a slow growth rate, which impacts the size structure of northern pike.



**Figure 3.** This graph shows the changes in CPUE over the past thirty years in the southern zone of Minnesota. Each year has an average, which is the bars, then there is a three-year rolling trendline to show changes.



**Figure 4.** This graph shows the changes in CPUE over the past thirty years in the northeastern zone of Minnesota. Each year has an average which are the bars, then a three-year rolling trendline to show changes.



**Figure 5.** This graph shows the changes in CPUE over the past thirty years in the north-central zone of Minnesota. Each year has an average which are the bars, then a three-year rolling trendline to show changes.

Another finding that was observed, was that the north-central zone was the only zone that saw substantial changes in the population over the past thirty years. The southern zone and northeastern

zone, both changed throughout the thirty-year period, but those changes were not statically significant. For the southern zone there are many reasons why the northern pike population has stayed mainly steady. This area of Minnesota has a very high fishing pressure and pike tend to reproduce slowly. This combination leads to pike being pulled from these lakes once they reach a desirable size for anglers. Larger pike are taken from lakes approximately two to nine times more frequently than smaller pike (Pierce 2010). This selective nature anglers have leads to larger pike being kept while small pike tend to be released. For the northeastern zone fishing pressure is much less of a problem. This area of the state has the lowest fishing pressure, and northern pike reproduce naturally while growing at a fast rate. This has led to a healthy stable population of northern pike.

The north-central zone is where problems with northern pike are seen. Northern pike in this part of Minnesota are increasing at a rate of 0.12 pike per gill net per year. This increase in population density arises from; over harvesting of large pike, a lack of appropriately sized prey fish, and habitat that does not promote growth (MNDNR 2008). In the north central zone, all these problems are seen in these lakes, and this has harmed the population of northern pike. These problems have led to the increase in CPUE within the part of Minnesota, and many of these lakes being overrun by small northern pike.

Managing northern pike is a complex task that has many variables at play. The focus for creating a management plan should be to first remove the excess of small northern pike, while also limiting harvest of large pike. A major problem with managing pike populations is keeping large northern pike in the lakes in the face of heavy fishing pressure on the larger fish (MNDNR 2008). Since anglers are selective of which pike, they keep, finding a way to make anglers want to keep smaller pike should be a focus of the MNDNR. Finding different ways to prepare these fish, and teaching anglers how to remove the y bones could help increase the desire to keep small pike. Currently anglers release 75% of

the northern pike they catch which shows the selective nature of anglers (Pierce et al. 1995). Raising awareness of how large number of small pike can harm a lake also could help increase anglers' willingness to keep smaller pike. Lakes that are overrun by small pike have problems with smaller pan fish populations, walleye stocking, and depletion of perch populations. Breaking the state down into three zones is a good start to having a management plan that represents the lakes in that area better. Raising awareness about the harms of small pike, while having a protective slot of large pike, and higher yield limits on smaller pike will help curb this increase in small northern pike seen throughout much of Minnesota.

## References

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