

# Investigating the Effect of Birth Date on Yellow Perch Mortality via Otolith Analysis



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## Background

### Our Objective

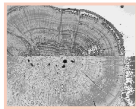
The goal of this research was to determine the relationship between a fish's date of hatch and its growth rate and ability to survive through the summer. Fish that hatch early in the season are thought to have the best access to habitat and food, therefore growing more quickly and increasing their likelihood of survival. Otolith analysis was used to determine whether this was occurring in a population of Yellow Perch in the Chippewa River.

### Why Yellow Perch?

Much research has been done on lake populations of Yellow Perch, particularly in the Great Lakes. River populations are less understood, and we sought to gather more information about their population dynamics.

### What Is an Otolith?

Otoliths are structures in the fish's brain cavity that resemble ear bones, but are actually calcium deposits. They gain a "growth ring" for each day of the fish's life, somewhat analogous to the annual rings in a tree. Otolith analysis is a proven method for evaluating the age of fish. When placed under a microscope, the growth rings can be counted to determine an accurate age of the fish.



## Methods

### Fish Capture

- Young-of-the-year Yellow Perch (*Perca flavescens*) were collected via seine nets and electrofishing equipment from the Lower Chippewa River in Dunn County.



- The fish were collected once on June 6, 2012 and again on August 20, 2012. Fish length and mass were measured and recorded.

### Otolith Removal, Imaging, and Counting

- Otoliths were extracted using forceps and a dissecting microscope.
- Otoliths were mounted to microscope slides using super glue.



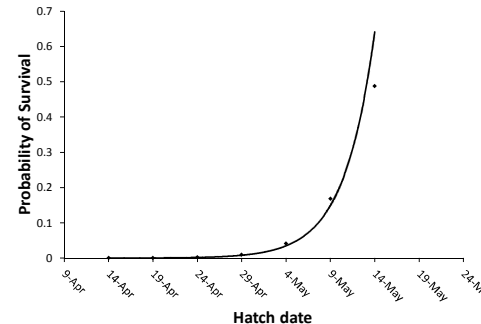
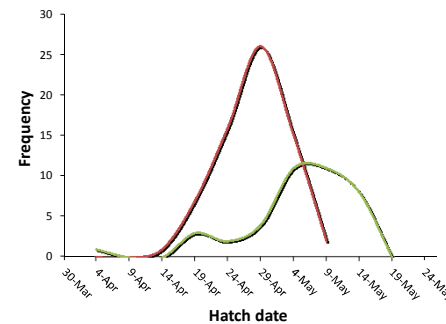
- The otolith was polished using fine grain sand paper until growth rings were clearly visible.



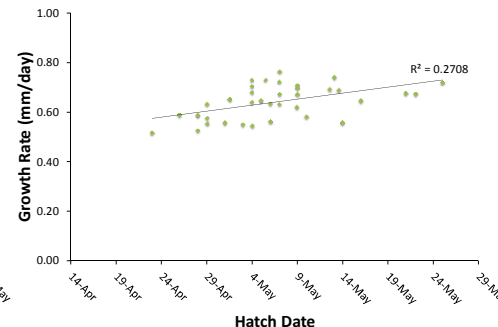
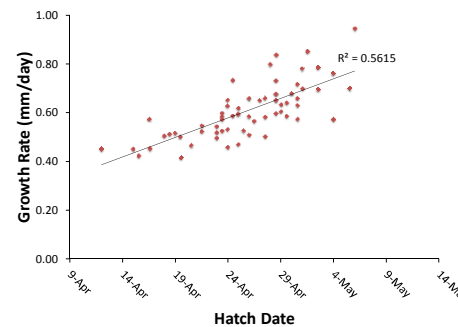
- Otoliths were imaged at 20x and 40x magnification using a microscope camera and SPOT imaging software.
- Rings were counted either using images or under oil at 1000x magnification.

## Results

- Survival through the summer was not shown to be statistically independent of birthdate by the chi-squared test ( $p < .001$ ).
- Frequency distributions show a major shift in the proportions in each birthdate class between June and August (Figure 4).
- Mean date of hatch for the June sample was April 26, while the mean hatch date for the August sample was May 3. Thus, the fish that survived through the summer were born, on average, a week later in the season.
- The survivorship curve generated from the mathematical modeling showed a strong relationship between the date of birth and the probability of survival.
- Fish born on May 14 were more than 50 times as likely to survive through the summer as those born on May 4.



Frequency distributions and survivorship curve of yellow perch related to hatch dates. The frequency distributions show a marked shift in the hatch date of fish that survived through the summer. Red represents fish caught in June ( $n=100$ ) while green represents fish caught in August ( $n=57$ ).



Growth rate in Yellow Perch as a function of age in early (left) and late summer (right). In early summer, oldest perch exhibited daily growth rates approximately twice the rate of the youngest fish. By the end of the summer, the difference in daily growth rate between young and old perch was negligible.

## Data Analysis

### Survivorship Analysis

- Hatch dates were determined for each fish by subtracting its number of otolith rings from the date of capture.
- Fish were then grouped into 5-day age classes and frequency distributions were created for both the June and August samples.
- A Chi-squared test was done to determine whether birth date was independent of survival into August.
- Statistical modeling as outlined by Good et al (2001) was used to generate survival probabilities for each birth date class.

### Growth Rate Analysis

- Growth rate was determined by dividing the length of each fish at capture by its otolith ring count.
- Growth rates were plotted for the June and August samples and modeled using linear regression.

## Conclusions

The shift in the birthdate distributions shows a higher proportion of August fish being born late in the hatching season. This leads us to believe that there may have been an advantage to being born at a later date. The chi-squared test revealed that birthdate and survivability were not independent, providing more evidence for a link between hatch time and ability to live through the summer. Further evidence is given by the steep slope of the survivorship curve.

There are a few possible explanations for the apparent advantage of late hatch date. One, termed the "swamp effect," relates hatch time with predation risk. Early-emerging fish have been shown to have much lower chance of survival compared to mid-to-late-emerging fish (Brännäs 1995). The early-hatching fish are the first ones exposed to hungry predators, and the relatively low number of other prey makes them prime targets. We believe the swamp effect could have been a major contributor to the survivorship pattern we saw. There could have been few perch emerging in late April, resulting in very low probability of survival for each fish, while the majority hatched in early-to-mid May, providing strength in numbers.

## Acknowledgements

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## References

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