Habitat Use by Lake Sturgeon (*Acipenser fulvescens)* Using Acoustics and Stable Isotopes

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Introduction

- Lake Sturgeon are a long-lived, migratory fish species native to the Great Lakes region that were extirpated from the St. Louis River during the early 1900s. Beginning in the 1980s, Minnesota and Wisconsin DNRs initiated intensive restocking efforts in the lower river.
- Despite these intensive efforts, there has only been limited evidence for successful natural reproduction. Understanding habitat use by Lake Sturgeon is an important step to address the potential environmental factors, including legacy contaminants, that are potentially limiting the recovery of Lake Sturgeon in the lower St. Louis River.
- Therefore, our goal was to use both physical (acoustic tags) and chemical (carbon and nitrogen stable isotopes) tracers to characterize habitat use, movements and diets of Lake Sturgeon.

Methods

- Lake Sturgeon were captured and implanted with an acoustic tag. Pelvic fin clips were taken for stable isotope analysis.

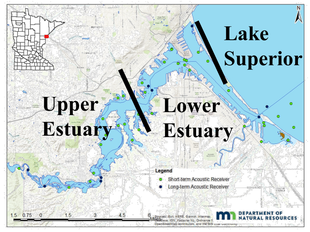


Figure. Map of the St. Louis River Estuary including the location of short and long-term hydroacoustic receiver deployments.

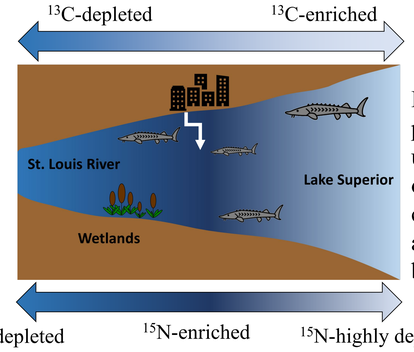


Figure. Graphical abstract of possible Lake Sturgeon habitat use in this study. There is an output of city effluent that creates a unique ^{15}N-enriched area in the lower estuary, noted by the white arrow.



Figure. a Walking back to the shoreline for biometric assessment. **b** Preparing the Lake Sturgeon for acoustic tag implantation. **c** Lake Sturgeon are surgically fit with an acoustic tag on the ventral side **d** Surgical site is sutured. **e** Healed incision (red arrow).

Results

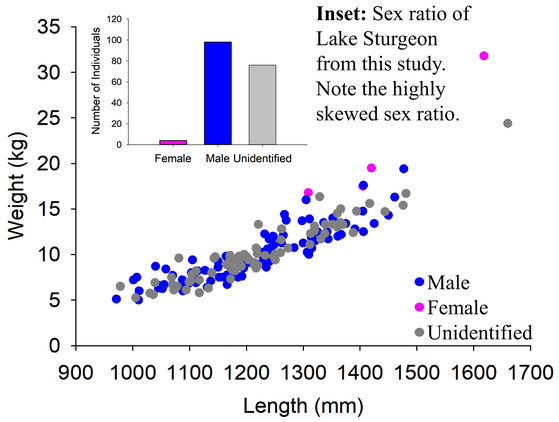


Figure. Length:Weight relationship, count of female (n=4), male (n=98) and unidentified (n=76) individual Lake Sturgeon from this study. There is a highly skewed sex ratio between males and females. Unidentified individual fish were not able to be sexed by field crews

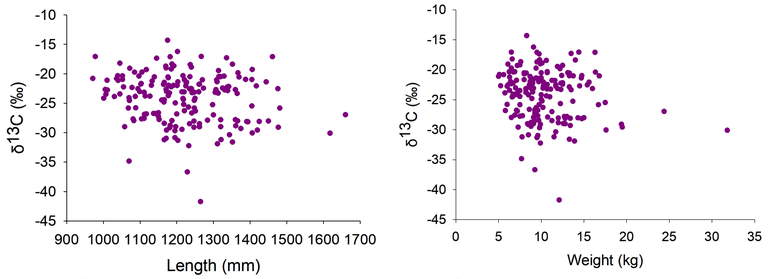


Figure. δ^{13}C values in comparison to length (left) and weight (right). Points represent individual fish from both 2016 and 2017. There is no apparent relationship or pattern.

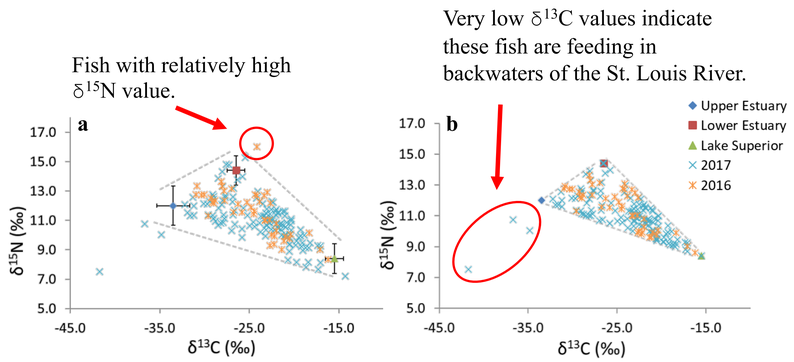


Figure. Mixing model biplot for source proportions of Lake Sturgeon diet from this study. **a** Raw data. **b** Mixing model allows a better fit for the data to make conclusions as to where Lake Sturgeon are feeding via isotopic signatures. Dotted line represents the convex hull bounded by the three diet sources. Error bars show plus or minus 1 standard deviation. Diet source data are from benthic macroinvertebrate stable isotope ratio data from those three habitats (Hoffman et al. 2020).

Results

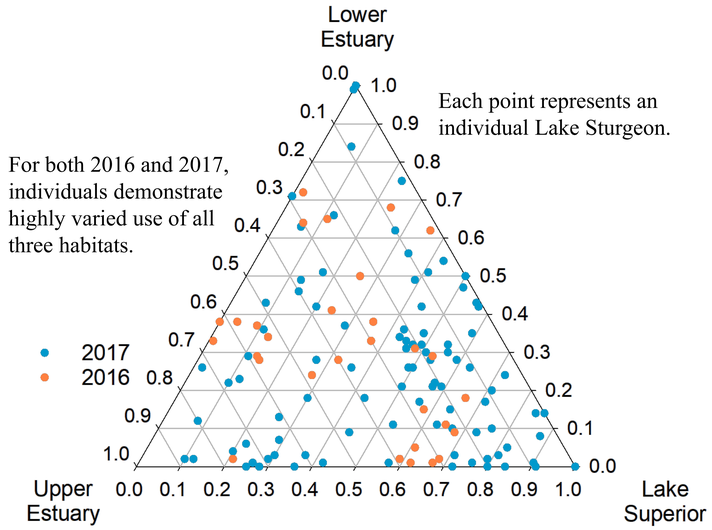


Figure. Three mixing component areas of diet sources in the St. Louis River estuary, (Upper Estuary, Lower Estuary and Lake Superior).

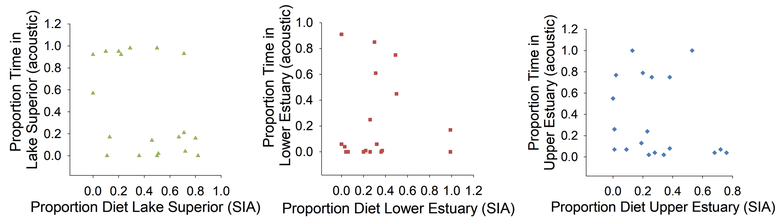


Figure. Diet proportions based on stable isotope analysis (SIA) compared to habitat use estimated as proportion days at large within each of the three areas based on acoustics. The correspondence is poor, indicating the habitat in which the individual was feeding prior to capture is not a good predictor of habitat use upon release.

Conclusions

- Stable isotope ratios revealed that captured Lake Sturgeon undertook a wide variety of foraging behaviors, routinely moving throughout the St. Louis River estuary and Lake Superior.
- Fin clips and acoustic tag data show disconnect between the habitat signals from isotope data (fin clips) and fish movement inferred from acoustics. This is consistent with the interpretation that individual movements vary widely.
- Refining our data analysis methods is necessary to better aid resource managers determine how habitat restoration will contribute to recovery.

References

Hoffman, J., Blazer, V.S., Walsh, H.H., Shaw, C.H., Braham, R. Mazik, P.M., 2020. Influence of demographics, exposure, and habitat use in an urban, coastal river on tumor prevalence in a demersal fish. Science of the Total Environment. 712. https://doi.org/10.1016/j.scitotenv.2020.136512

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