2024 Sport Fish Restoration Project Award Nomination– Research and Surveys

Project Title: Niche Overlap, Diets, and Consumption of Muskellunge and Other Piscivores in Minnesota Lakes

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Overview and Need

Muskellunge, Northern Pike, Walleye, and Largemouth Bass are recreationally popular piscivorous top-predators found in many aquatic ecosystems throughout the United States. Inherent in their status as piscivorous top-predators is the potential for interspecific competition, a particular concern for fisheries managers when considering stocking efforts or regulation changes. In Minnesota, specifically, Muskellunge stocking to supplement native populations, or stocking to expand angling opportunities to new Muskellunge lakes, has resulted in significant interest from the public and fisheries managers about potential negative effects of Muskellunge on other fish populations.

Research Methods and Results

Two complimentary projects have recently been completed to help inform the critical need to better understand the interaction between Muskellunge, other top predators, and their prey. The objectives of the studies were to quantify diets and niche overlap of Muskellunge and these other predator species, and apply bioenergetics modeling to estimate how much food, and how much of each prey species, is consumed by Muskellunge populations compared to the other predator populations.

To accomplish the objectives, seasonal diets were quantified in 12 lakes by directly examining stomach contents of Muskellunge, Walleye, Northern Pike, and Largemouth Bass. Second, stable isotope analysis was conducted in 17 lakes to provide additional diet information and determine niche size and trophic position. Diet information was then combined with mark-recapture population estimates for each predator in three lakes, to determine how much of each prey species was consumed by each predator population. These research projects required a tremendous amount of field work and collaboration with other DNR staff and with external collaborators. Technical and field assistance was provided by area fisheries personnel and exemplified an effective and productive collaboration between DNR management and research staff. Additionally, faculty (Andy Hafs, Bemidji State University; Kyle Zimmer, University of St. Thomas), graduate students (Kamden Glade, Bemidji State University), and undergraduates led and assisted with lab and field work resulting in multiple additional publications.

The results of the diet component revealed that Yellow Perch and various centrarchids were important prey items across all lakes for Muskellunge, Northern Pike, and Walleye, while crayfish and other aquatic invertebrates were critical for Largemouth Bass. Muskellunge had low levels of dietary overlap with other predators, while Northern Pike and Walleye had relatively high levels of dietary overlap. Diet overlap tended to be lower among all species when Cisco were present. Stable isotope analysis indicated that Northern Pike had the lowest trophic position across lakes, followed by Largemouth Bass, with Muskellunge and Walleye having similarly high values. Walleye and Muskellunge used the least littoral carbon, Northern Pike intermediate, and Largemouth Bass the highest proportion of littoral carbon. Walleye and Muskellunge had the smallest niche size, Northern Pike intermediate, and Largemouth Bass the largest trophic niche. Largemouth Bass and Northern Pike overlap more onto each other's niches

than they do Walleye, Northern Pike overlap more onto the niche of Largemouth Bass than they do Muskellunge or Walleye, while Muskellunge and Walleye do not significantly overlap with the other species.

Despite very different geographic locations in Minnesota, population estimates were remarkably consistent between each of the three lakes, where Largemouth Bass were the most abundant (47-50% of the total predator population), followed by Northern Pike (31-34%), Walleye (17-18%), and Muskellunge (1-4%). Of all the food eaten by these top predators in each lake, Northern Pike populations consumed the most (38-50%), followed by Largemouth Bass (23-29%), Walleye (15-23%) and Muskellunge (6-16%). Walleye and Northern Pike consumed mostly Yellow Perch and centrarchids in each lake, while also consuming a large amount of Cisco in North Star Lake, the only lake in the bioenergetics study where this pelagic prey species was present. Largemouth Bass consumed primarily crayfish in all three lakes, followed by Yellow Perch and centrarchids. Muskellunge consumed considerably different prey than the other predators, where the biomass consumed was mostly made up of esocids and benthic fish (e.g., bullheads and White Sucker).

Benefits to Fisheries Management and Anglers

Using this work and prior studies (Knapp et al. 2012, Herwig et al. 2022), the MNDNR has concluded that Muskellunge management and stocking in appropriate lakes can provide diverse angling opportunities for trophy fish without jeopardizing populations of other predators, panfish species, and forage fishes. We are now able to directly address concerns of some anglers that their preferred angling targets, generally walleye, bluegill, and black crappie, are not negatively affected by Muskellunge populations.

Overall, the results of this work will benefit and better inform the public (i.e., anglers and lakeshore owners), DNR fisheries staff, and policy makers about the ecological role and prey demands of Muskellunge, Walleye, Northern Pike, and Largemouth Bass. It will also be useful for fisheries managers when considering stocking plans or possible regulation changes for any of these top predators in lakes throughout Minnesota or other areas of the United States.

These research studies have excelled at disseminating this information through completed publications (3), publications in prep (5), professional conference presentations (21), public presentations (13), radio interviews (2), podcasts (8), magazine articles (5) and multiple areas on the MN DNR website.

References

Herwig, B.R., K.D. Zimmer & D.F. Staples (2022) Using stable isotope data to quantify niche overlap and diets of muskellunge, northern pike, and walleye in a deep Minnesota lake. Ecology of Freshwater Fish, 31, 60-71. DOI: 10.1111/eff.12608.

Knapp, M. L., S. W. Mero, D. J. Bohlander, D. F. Staples, and J. A. Younk. 2012. Fish community responses to the introduction of muskellunge into Minnesota lakes. North American Journal of Fisheries Management 32:191-202.

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