Determining the Genetic Contribution of Stocked Walleye on the Wild Walleye Population in the Great Sacandaga Lake, New York

Addison Cain, Daniel Gatto, Hunter O'Dell, Chase Smith, Samuel Spraker, Alex Vogel, Brayden Ward, Emma Watermann*

Broadalbin-Perth High School, Broadalbin, NY 12025

This paper summarizes research evaluating the genetic contribution of hatchery-raised walleye to the wild walleye population in the Great Sacandaga Lake, New York. Collected data indicates that the hatchery fish are succeeding in the wild. Genetic analysis suggests that the wild fish population shows evidence of hatchery ancestry. Results reveal an average of 7.6% ancestry of the hatchery population in the wild population. Ranges from 0.7% to 68% hatchery ancestry were found in the wild population. Of the 75 wild-caught fish we sampled for this study, none of them were 100% hatchery-reared. In addition, genetic results suggest there may be more than one wild walleye population in the Great Sacandaga Lake. Populations of walleye could have been reproductively isolated over time due to the locations on the lake where they spawn. Computer generated models indicate that there may be enough genetic variation within the walleye to create two wild populations in the Great Sacandaga Lake.

Introduction

The Great Sacandaga Lake was created by the damming of the Sacandaga River to provide flood control in the Hudson Valley. It offers a variety of fishing opportunities for many different species of fish, including walleye (*Sander vitreus*). The lake is one of the largest in the Adirondack region, and because of its size, the natural population of walleye is plentiful. Walleye are a highly sought-after sport fish in New York State, especially in the Great Sacandaga Lake. Not only do they offer fishermen a great meal, but they are a challenge to catch as well.

Since 2012, the Great Sacandaga Lake Fisheries Federation (GSLFF) has stocked the lake with approximately 6,000 hatchery-reared juvenile walleye yearly. Stocking is an important management tool to increase and sustain highly pressured fish populations (*Penne, 2020*). The Broadalbin-Perth High School Science Research Class investigated if the stocked walleye are contributing to the population of the lake.

The questions that were explored include: 1. *What is the genetic contribution of stocked versus wild fish to the adult (harvestable) population?* 2. *Are the stocked walleye reproducing in the lake or are they experiencing a lower fitness than the natural population?* The results of this study could provide a directive for future stocking campaigns.

Figure 1. *The map of the Great Sacandaga Lake in Upstate New York*

*Addison Cain, Daniel Gatto, Hunter O'Dell, Chase Smith, Samuel Spraker, Alex Vogel, Brayden Ward, and Emma Watermann are members of the Broadalbin-Perth High School and participating in the school's science research course under the supervision of Mr. Brian Henry. The authors range from sophomores to seniors and plan to pursue science pathways in the future.

Figure 2. *Researchers netting one of 75 wild walleye from the Great Sacandaga Lake.*

Figure 3. *Caudal fin (tail) tissue sample taken from a caught walleye.*

Stocking can enhance recreational fishing, improve fishing populations, and keep bodies of water environmentally balanced (*Penne, 2020*). By providing data on whether the GSLFF stocking efforts are helping the fishery and improving the intangibles associated with it would be a huge benefit to the area. For example, the annual *Great Sacandaga Lake Walleye Challenge Ice Fishing Tournament* has brought in millions of dollars to local communities throughout the years. Understanding the genetics of the walleye population and whether the stocking program is making a difference would allow the GSLFF to modify or enhance its stocking efforts.

Method

Thirteen fishing trips were conducted between September 13, 2022 and October 23, 2022 on the Great Sacandaga Lake. Walleye were caught by trolling with standard fishing equipment using stick baits and worm harnesses. A total of 75 walleye were caught and tissue samples were obtained from each. A minimally invasive/non-lethal technique was used to collect fin clips. A small piece (5mm) of fin tissue was cut using scissors, from the caudal fin of each walleye caught. The fish were returned to the lake immediately after the sample was taken. The tissue samples were placed in 95% isopropyl alcohol and refrigerated for preservation purposes *(UCD-GVL, 2019)*.

Hatchery-reared walleye were received from Hickling's Fish Farm in Edmeston, New York. Hickling's Fish Farm has provided the walleye to the Great Sacandaga Lake Fisheries Federation for their annual stocking campaign.

Seventy-five tissue samples from the wild-caught fish and 35 tissue samples from the hatchery-reared fish were sent to West Virginia University for DNA analysis. Microsatellite testing was used to determine the genetic composition of the wild walleye samples and hatchery-reared walleye. Microsatellites are short segments of DNA that are repeated multiple times. They exist in individuals and can vary within a population. Microsatellites can be used to determine diversity within a species (*A. Johnson, personal communication, March 30, 2023*). The wild walleye samples were compared to the stocked walleye tissue samples to see if there are genetic similarities between the two populations. The results will help determine if some of the wild caught walleye are hybrids created by the stocked fish and individuals from the wild population.

Results

There is a likelihood that the hatchery fish are succeeding in the wild. This study indicated that the wild fish population shows evidence of hatchery ancestry. Results show an average of 7.6% ancestry of hatchery population in the wild population. Ranges from 0.7% to 68% hatchery ancestry were found in the wild population. Of the 75 wild-caught fish we sampled for this study, none of them were 100% hatchery reared.

An unexpected result from the collected data shows there may be more than one walleye population in the Great Sacandaga Lake. Populations of walleye could have been reproductively isolated over time due to the locations on the lake where they spawn. This phenomenon is commonly known as natal philopatry. Natal philopatry refers to the return of an animal to its place of birth to reproduce (*Nagle et al, 2023*).

This behavior can shape population genetics and may have created two populations of walleye in the lake with some genetic variation. Natal philopatry may provide local genetic adaptations, but it may also increase the probability of inbreeding and low genetic fitness that can compromise a population (*Salles et al, 2016*). Computer generated models indicate that there may be two wild walleye populations in the Great Sacandaga Lake (see Figure 4). The walleye populations spawn in specific locations on the lake which can keep their genome isolated from other populations, but the separate populations can occupy the same areas of the lake after their breeding season is over. In other words, the two populations are intermingled for most of the year, but separate when it is time to spawn.

The data also suggests that the wild population of effective reproducing walleye is relatively small in size. Factors such as sex ratios, inbreeding, and fluctuations in the number of walleye from generation to generation can influence the size. However, the collected data cannot provide a definitive explanation for the small effective population size (*A. Johnson, personal communication, March 30, 2023*).

Figure 4. *Structure plot to visualize ancestry of each walleye population, and contribution of the ancestry to each individual that was sampled. Orange represents the DNA of the hatchery fish, while the blue and purple represents the DNA from two wild populations.*

Discussion

Walleye populations in the Great Sacandaga Lake are influenced by various factors including available forage, habitat, interspecific competition, sport fishing, and stocking. These variables have shown both positive and negative impacts on walleye success rates in the Great Sacandaga Lake. Fish stocking helps improve fishing populations, increase recreational activity, and keep bodies of water environmentally balanced (*Penne, 2020*). The Great Sacandaga Lake Fisheries Federation walleye stocking campaign has shown to be working. Continued efforts to add more walleye to the lake through enhanced stocking efforts will only improve the population and strengthen the fishery.

The wild population in the Great Sacandaga Lake has a smaller effective population size. Results indicate that natal philopatry could impact genetic diversity in future generations. Subsequently, the walleye population may need to be managed by governing agencies. Continued collaboration with the New York State Department of Environmental Conservation, the Great Sacandaga Lake Advisory Council, and the Great Sacandaga Lake Fisheries Federation will be an essential practice to help monitor the walleye populations and to improve the GSL fishery.

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