

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-7

Study No.: 230723

Title: Effects of exploitation and fisheries management on genetic diversity of fish stocks in inland and Great Lake waters of Michigan.

Period Covered: October 1, 2005 to September 30, 2006

Study Objectives: (1) To use molecular markers and population genetics theory to investigate genetic stock relationships and status of indigenous fish species of importance in Michigan, (2) to estimate the effects of past and proposed management on population and meta-population levels of genetic diversity.

Summary: Research is ongoing in each of several topical areas, all related to historical and contemporary factors affecting the genetic diversity of fisheries in Michigan waters. Studies involve numerous native species of economic importance that are intensively managed. This project seeks to provide information to better understand how recent management practices have impacted the genetic diversity of Michigan's fisheries. Review of available literature conclusively shows that historically, Michigan's fisheries were composed of taxonomically diverse fish assemblages. Most species were also genetically quite diverse as the result of admixture events whereby fishes that were geographically isolated into glacial refugia mixed following the retreat of glacial ice. All available literature suggests that humans have left an indelible, and mostly negative mark on the genetic architecture on Michigan's fishes. Management efforts have contributed to community and species declines in genetic diversity. Each job addresses issues of importance to fish species in Michigan.

Findings: Jobs 2–7 were scheduled for 2005–06, and progress is reported below.

Job 2. Title: Evaluation of Black Lake sturgeon.—We used microsatellite markers to determine parentage for the Black Lake population of lake sturgeon based on genetic determination of parentage. We estimated that polygyny and polyandry were common with males and females mating with an average of 3.10 and 1.93 mates, respectively. Despite recent reductions in population size, we did not observe evidence of inbreeding. We also observed a considerable amount of variance in reproductive success among both males and females. On average individuals whose offspring migrated downstream during a more constrained time period produced fewer offspring than those individuals whose offspring migrated downstream over a more protracted time period. While we did not observe a significant correlation between body size and reproductive success, we did observe a significant relationship between the number of mates an individual had and the number of offspring produced. Our results suggest that individuals increase their reproductive success by distributing their gametes among multiple mates and spawning during multiple or more protracted periods of time. Estimates of the effective number of breeders were 44% and 47% of the census number of breeders when N_b was estimated from parentage data and temporal changes in allele frequencies respectively. The relatively high ratio of effective to census population size (N_b/N) based on samplings obtained from the larval drift has implications for different supplementation scenarios. For example, managers will never be able to achieve a high N_b/N ratio, and concomitantly high levels of genetic diversity in progeny stocked by direct spawning of adults.

Job 3. Title: Examine levels of walleye stock structure.—Publication of the research conducted and reported during 2005 is ongoing. A publication for the Journal of Great Lakes Research is being prepared that details results of all data collected and reported on over the last several years.

Job 4. Title: Determine hatchery impacts of steelhead and harvest rates.—Publication of the research conducted and reported during 2005 is ongoing. Publications in the Journals Aquaculture and North American Journal of Fisheries Management are being prepared that details results of all data collected and reported on over the last several years.

Job 5. Title: Assess status of Lake Superior coaster brook trout.—Publication of the research conducted and reported during 2005 is ongoing. A publication for the Journal of Great Lakes Research is being prepared that details results of all data collected and reported on over the last several years.

Job 6. Title: Collect and evaluate Esocid data and develop genetics hatchery management plan.—

Potential introgression between Northern and Great Lakes muskellunge—Previously, based on baseline samples from Lake St. Clair (N=69) and Thornapple Lake (N=67), we found that Great Lakes muskellunge and Northern muskellunge were genetically distinct and could be easily identified using microsatellite loci. Based on genotypes and statistical assignment tests we were able to genotype individuals and assign individual fish as either Northern or Great Lakes muskellunge with very high accuracy (99.3% correct classification).

Over a 3-year period (2003-2005), muskellunge were collected by Michigan DNR biologists below a dam on the Huron River in Southeastern Michigan. Fish were within the Lake Erie drainage and had access to the Great Lakes. Based on morphology, the fish did not appear to be Great Lakes muskellunge. Given that Northern muskellunge had been routinely stocked in reservoirs above dams on tributary rivers to the Great Lakes, including on the Huron River, these fish could have plausibly been either subspecies.

In 2003, 21 muskellunge were sampled below the dam and all were determined to be northern musky (i.e., of hatchery origin). In 2004 18 musky were sampled and 16 or 18 were found to be northern musky while 2 were Great Lakes muskellunge. During 2005 21 muskellunge were screened. Twenty were found to be northern musky and one was a musky-northern pike hybrid. The muskellunge alleles in the hybrid were with high probability northern muskellunge suggesting that the introgression occurred by directed crossing and not naturally in Lake St. Clair. Implications of stocking genetically differentiated forms in close proximity to valued natural populations in the Great Lakes are of concern. We are working with DNR biologists to collect additional samples of muskellunge from drainages with connectivity to the Great Lakes and where hatchery supplementation of northern muskellunge has occurred.

Job 7. Title: Prepare annual progress report.—Findings from the first years activities are communicated in this document and to Michigan DNR and regional fisheries biologists via oral communications at meetings, professional meetings, and written reports. This annual progress report was prepared as scheduled.

Prepared by: Kim T. Scribner

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