STUDY PERFORMANCE REPORT

State: Michigan

Project No: F-80-R-2

Study No: 688

Title: Evaluation of alternative mechanisms underlying spatial genetic diversity of Lake Michigan steelhead: an assessment using molecular genetic markers

Period Covered: October 1, 2000 to September 30, 2001

Study Objectives: (1) To quantify the degree of genetic variation among naturalized populations of steelhead from drainages of Lake Michigan, (2) to estimate the effective breeding population size of summer and winter run hatchery strains used in supplementation programs in the state of Michigan, (3) to estimate the effective population size of naturalized populations in Michigan drainages, (4) to correlate inter-population differences in gene frequency with population differences in life history and morphology, (5) to utilize genetic data from naturalized and hatchery populations to test and explain current spatial patterns of genetic differentiation and to make predictions of future trends in levels of genetic diversity, and (6) to assess the feasibility of using gene frequency data in Mixed Stock Analysis for open-water Lake Michigan steelhead sport fisheries.

Summary: Steelhead *Oncorhynchus mykiss* represent one of the first directed introductions of non-indigenous fish into the Great Lakes. Introductions began in the late 1800's, and present distribution and abundance is maintained by recruitment both from widely dispersed naturalized populations and supplemental releases of hatchery-reared offspring from several steelhead strains. Recent increases in stocking levels and greater survival of hatchery juveniles is believed to have shifted basin-wide recruitment from predominantly natural to predominantly hatchery origin. Given that hatchery strains are derived from phylogeographically distinct native West Coast steelhead stocks, and that naturalized populations may have diverged, molecular genetic markers may be useful in distinguishing strains and populations. Genetic markers and novel statistical methods of analysis may prove valuable in assessment of the impacts management practices.

Job 5. Title: Assess the feasibility of using Mixed Stock Analysis (MSA) for open water steelhead fisheries in Lake Michigan.

Findings: This job was completed during the previous year. Based on findings of high accuracy and precision in strain assignment, we have received additional funding to proceed with actual Lake Michigan basin-wide assessments using MSA techniques and the baseline population and hatchery strain data collected under Job 1. We will add additional loci to our population and hatchery data base during the coming year. The final report will include a final summary of accuracy and precision of harvest derivations using simulated mixtures.

Job 6. Title: To assemble results of genetic characterizations of naturalized and supplemented stocks into a predictive model of present and future levels of genetic diversity for steelhead in the Lake Michigan Basin.

Findings: We have developed two computer programs that create population mixtures of individuals produced under different breeding conditions (e.g., hatchery mating schemes). One program is written in Visual Basic. This program is based on user-defined input for population allele frequency and degree of coancestry (as would be developed in release hatchery juveniles). Simulated individuals can interbreed or not. Simulations can be prepared over a series of generations to track changes in population gene frequencies and gene diversity. The second model is written using the Statistical Analysis System (SAS). The model was created to allow varying contributions of two source populations whose allele frequencies were known for a suite of bi-parentally inherited loci. Source populations could be altered to reflect the genetic diversity observed in hatchery and naturalized populations. Results of preliminary simulations suggest that the net change in genetic diversity over time is dependent on relative contributions of each source populations and their relative diversities.

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