STUDY FINAL REPORT

State: Michigan

Project No.: F-80-R-3

Study No.: 475

Title: Development and Implementation of conservation genetic Initiatives for Michigan inland and Great Lakes fisheries

Period Covered: April 1, 1998 - September 30, 2002

Study Objectives: (1) to develop genetic guidelines and policies governing broodstock and hatchery production and release for the Fisheries Broodstock Committee of the Michigan Department of Natural Resources, (2) to assess levels of genetic diversity in Lake Sturgeon and other threatened species in Michigan Great Lakes and inland waters and to assist in the implementation of genetics guidelines to aid in species restoration efforts, (3) to collect, analyze, and interpret demographic and genetic data bases for Great Lakes sport fisheries to assist in efforts to establish the extent of interaction of hatchery supplemented fisheries to natural reproduction, (4) to collect, analyze, and interpret demographic and genetic data bases for Great Lakes sport fisheries to assist in efforts to identify areas of endemism and of high genetic diversity which could serve as species conservation areas or management zones.

Summary: Management of fisheries resources has often been directed towards goals of maintaining total fish numbers. However, there is a need to reconcile goals of meeting and maintaining specific criteria of population numbers with long-term goals of restoring and maintaining sustainable fisheries biodiversity. Management efforts shold be based on biologically sound criteria founded on a greater fundamental understanding of the complexity of historical fish diversity and the genetic diversity of extant populations. Further, long-term fisheries management goals should include directives to maintain genetic diversity (and inferentially evolutionary adaptability). As such, issues related to transportation of stocks and the choice of donor stocks to use in supplementation should be based on fundamental genetic principles.

Over the course of this study we have visited all hatcheries and interactions have taken place with all individuals responsible for each domestic broodstock and anadromous species gamete takes. All records have been reviewed. We have examined each strain of each salmonid species in domestic culture genetically. We have examined geographic populations of each of several species that naturally occur throughout the Great Lakes in Michigan waters. Recommendations reported herein are based on these data and information from managers. Reporting also consists of fisheries genetic papers, reports, and talks made at local, regional and national levels that are based on data and experiences with data from Michigan Department of Natural Resources data and policies. An attached appendix describes the breadth of contribution in these areas.

Findings: This final report was prepared, including Jobs 6, 7, and 9, which were scheduled for 2001-02. All jobs are reported on below.

Job 1. Title: Review background information concerning historical broodstock and hatchery operations for all species and strains currently in production in the state of Michigan. Review existing Michigan DNR broodstock management plan which presently covers the underlying principals and practices of hatchery operations, and of releases.–Each hatchery has been visited, some on multiple occasions. Hatchery records have been collated for all species and strains of salmonids in domestic culture. Fisheries Division of the Michigan Department of

Natural Resources has changed all gamete take operations and various aspects of culture practices to accommodate recommendations offered in document provided under each job and based on discussions and oral presentations with Fisheries Division personnel. See also Appendix 1 for details regarding aspects of written or oral communications of research and service-related activities.

Job 2. Title: Write general guidelines and policy governing genetic broodstock and hatchery management for the Broodstock Committee of the Michigan Department of Natural Resources.–See attached document

Scribner, K.T. Genetic section of the Michigan DNR Broodstock Management Plan.

Job 3. Title: Write genetic guidelines regarding the status of existing broodstock strains and establish guidelines for future assessment of potential replacement strains and for supplementation of existing strains.–See attached document

Scribner, K.T. Recommendations for egg and milt takes from a genetics perspective.

Job 4. Title: Write genetic guidelines for the Lake Sturgeon Recovery Team pertaining to aspects of egg and milt takes for hatchery production and release.–see attached report

Scribner, K.T. Genetic guidelines for lake sturgeon gamete takes in the state of Michigan.

Job 5. Title: Work with hatchery biologist and support staff working with salmonid production (coho salmon, chinook salmon and steelhead) to identify aspects of hatchery operations which could be improved to enhance the genetic diversity of supplemental fisheries.– Records have been collated for all species and strains of salmonids that are spawned at weirs in Michigan waters. Fisheries Division of the Michigan Department of Natural Resources has changed all gamete take operations and various aspects of culture practices to accommodate recommendations offered in document provided under each job and based on discussions and oral presentations with Fisheries Division personnel. See also Appendix 1 for details regarding aspects of written or oral communications of research and service-related activities.

Job 6. Title: Conduct surveys of genetic diversity in naturalized and supplemental salmonid fisheries. Continue background assessment to characterize levels of genetic variation.–See attached reports

Scribner, K.T. and K. Bennett. Genetic evaluation of Michigan DNR broodstock management practices for domestic strains of brook trout and lake trout.

Scribner, K.T. and J. Warrillow. Genetic evaluation of U.S.F.W.S. domestic strains of rainbow trout stocked in the state of Michigan and empirical examination of the origin of Pine River rainbow trout.

Scribner, K.T. and J. Warrillow. Genetic evaluation of Michigan DNR broodstock management practices for domestic strains of brown trout.

Job 7. Title: Genetic model for Lake Michigan salmonid fisheries. Use preliminary background data to begin to model future trends in genetic diversity of introduced and native salmonids.–We have developed several 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. A second program is also developed in Visual Basic. This program allow user-specific input about different breeding and stocking strategies and the effects on overall genetic diversity, how diversity is partitioned, and on effective population size. This program is designed to integrate with existing data bases on location-specific stocking and on gamete-take practices.

Two additional programs, also written in Visual Basic are designed to utilize genetic data to assign individuals to population of origin on the basis of genotype and the likelihood of observing the genotype in each of a series of putative populations of origin. One program (MLE) provides estimates of confidence in individual assignment decisions using Bayesian formulations. The second program (GA) utilizes a Genetic Algorithm to select optimal multi-locus combinations that maximize classification accuracy.

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