STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-1

Study No.: 681

Title: Development of multi-lake management strategies for Michigan's inland lakes

Period Covered: October 1, 1999 - September 30, 2000

Study Objective: Develop a classification system for management of Michigan's inland lakes by determining how and why fish communities - and their response to management practices - vary among lakes (i.e., intersystem variability), along abiotic (e.g., longitudinal) and biotic (e.g., productivity) gradients, as well as across years (i.e., interannual variability).

Summary: The process of assembling fish population assessment and GIS data began during the summer of 2000 under the direction of PhD student Nancy Nate. Summaries of fish growth were entered for a subset of Michigan Lakes. Limitations in existing information were identified and the focus of the historic fisheries assessment analysis shifted from recruitment to growth. Also, a working group was formed of individuals from throughout the state, interested in these data and in lake classification efforts.

Job 1. Title: Assemble fish population assessment data.

Findings: Areas where existing information limited our understanding of variability in pertinent fish population parameters were identified. For example, due to variability in sampling procedures, analysis of recruitment across multiple lakes was limited given that estimates of relative abundance were not easily comparable. The primary research focus shifted from an analysis of recruitment dynamics to an analysis of trends in growth across environmental gradients and years. Because growth data were not available electronically, data entry of historic growth summaries for 1960-99 began during the summer of 2000 and will continue into the next year. It was decided that initial data entry efforts would focus on 697 lakes with matching limnological information. Available data from the Fish Collection System for years 1994-99 were summarized and integrated with the historic growth summary database.

Pertinent literature relating to growth, recruitment, and mechanisms that shape fish populations has been assembled. A research study proposal has been drafted and is currently in review.

Job 2. Title: Assemble abiotic, biotic, and meteorological data.

Findings: Dr. Jim Breck, Fisheries Division, provided a file containing limnological data for 697 Michigan lakes. These data were originally obtained from the Michigan Department of Environmental Quality, Land and Water Management Division and are also available through the U.S. EPA STORET system. We began exploring the spatial distribution of these lakes and have determined that this subset will provide an appropriate starting point for linking with and modeling fisheries population dynamics.

We have obtained digital geographic data through the DNR Spatial Data Library web-site and have begun the process of building a GIS database for the previously mentioned subset of Michigan lakes. Ecoregion, connectivity, landscape position, hydrologic setting, lake surface area, fetch, littoral area and watershed area will be measured, identified, or estimated from GIS coverages. Lake depth contours for a smaller subset will be digitized to verify mean depth

measurements previously estimated and available in the limnological data set. Climate data will be obtained from the National Climatological Data Center (NCDC).

Job 5. Title: <u>Conduct research to assess bluegill recruitment.</u>

Findings: Research on bluegill recruitment represents a portion of a larger research project evaluating the indirect effects of selective removal of Eurasian watermilfoil (*Myriophyllum spicatum*; using the herbicide Sonar®) on largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) populations. Two MS graduate students have been involved. Ray Valley focused on young-of-year bluegill and largemouth bass. He determined that age-0 largemouth bass growth was positively correlated with availability of age-0 bluegill. In turn, availability of bluegill prey was highly variable among lakes; yet surprisingly, did not vary predictably with macrophyte abundance. Ray recently completed his MS thesis and is currently working for the US Forest Service in Minnesota. Steve Hanson will complete his MS degree in about 1 year. He is evaluating the effects of Eurasian watermilfoil control on adult largemouth bass growth and consumption of bluegill.

Job 6. <u>Participate in assessment and inventory committee.</u>

Findings: I continued to participate in the Resource Inventory and Assessment Committee. My research and extension activities related to lake management and classification have benefited from my participation in this committee.

Additional Extension Efforts
Our Eurasian watermilfoil research group (Dr. Pat Soranno, and graduate students Kendra Spence Cheruvelil, Steve Hanson, and Ray Valley) was involved in several outreach efforts. We created two posters that were displayed at Ag Expo and Natural Resources Expo on MSU's campus. Also, I presented a 45 minute seminar to the fall meeting of the Michigan Chapter of the North American Lake Management Society (McNalms), summarizing our research findings to date. I also summarized our research findings to the MDNR committee that addresses habitat issues in Michigan lakes.

Since June, 2000 I have served as secretary for McNalms.

Job 7. <u>Expand research into related areas.</u>

Findings: *Proposals*:

Soranno, P.A., M.T. Bremigan, J.E. Breck, and M.J. Wiley. A hierarchical landscape-based classification systm to predict biological integrity of reference lakes. US Environmental Protection Agency. Funding denied.

Bremigan, M.T., P.A. Soranno, J.E. Breck, and J.C. Schneider. Classifying Michigan lakes through integration of fish assemblage and water quality aspects of lake integrity. Submitted to Fisheries Division, MDNR. Funding denied.

Dr. Pat Soranno and I have formed a working committee of individuals interested in lake management and classification in Michigan. Committee members represent agencies (Fisheries Division, Department of Environmental Quality, Michigan Natural Features Inventory) and universities (Michigan State University, University of Michigan). Nancy Nate (PhD student on this project) and I are collaborating with Dr. Soranno, her PhD student, Kendra Spence Cheruvelil, and Dr. Jim Breck, Fisheries Division, to build a comprehensive database for

Michigan lakes. We continued to seek funding to:1) determine the extent to which aspects of lake biological integrity (e.g., fish growth, nutrient concentrations, species composition, and habitat conditions) are related, and 2) determine the extent to which aspects of integrity vary predictably among lakes according to landscape characteristics ranging in spatial scale from very broad (e.g., ecoregion) to local (e.g., lake size).

Job 8. <u>Prepare annual reports and publications</u>.

Findings: This annual progress report was prepared as scheduled.

Manuscript published

Nate, N. A., M. A. Bozek, M. J. Hansen, S. W. Hewett. 2000. Variation in walleye abundance with lake size and recruitment source. North American Journal of Fisheries Management 20: 107-114.

Manuscript in review

Nate, N. A., M. A. Bozek, M. J. Hansen, S. W. Hewett. (*accepted pending minor revision*). Variation of adult walleye abundance in relation to recruitment and limnological variables in northern Wisconsin lakes. North American Journal of Fisheries Management.

Valley, R.D. and M.T. Bremigan. The effects of Eurasian watermilfoil, and its management, on largemouth bass recruitment. Submitted to the *Journal of Aquatic Plant Management*, July 2000.

Manuscripts in preparation

Cheruvelil, K.S., M.T. Bremigan, S.H. Hanson, K.L. Rogers, P.A. Soranno and R.D. Valley. Whole-lake response to treatment with the herbicide, Sonar® in Bass Lake, MI.

Garvey, J.E., R.A. Stein, R.A. Wright, and M.T. Bremigan. Assessing how largemouth bass populations respond to complex food-web interactions: searching for general mechanisms across environmental gradients.

Nate, N. A., M. A. Bozek, C. W. Ramm, M. J. Hansen, M.T. Bremigan, S. W. Hewett,. Predicting walleye presence from physical and biological features of northern Wisconsin lakes.

Valley, R.D. and M.T. Bremigan. The effects of macrophyte structural heterogeneity and fish prey availability on age-0 largemouth bass foraging and growth. To be submitted to *Transactions of the American Fisheries Society* in November, 2000.

Posters

Bremigan, M.T., K. S. Cheruvelil, S. M. Hanson, J. D. Madsen, P. A. Soranno and R. D. Valley. 2000. The indirect effects of Eurasian watermilfoil herbicide control. Agricultural Expo and Outdoor Expo, Michigan State University, East Lansing, MI.

Bremigan, M.T., K. S. Cheruvelil, S. M. Hanson, P. A. Soranno, and R. D. Valley. 2000. Aquatic plants and their management in lakes. Agricultural Expo and Outdoor Explo, Michigan State University, East Lansing, MI.

Valley, R.D. and M.T. Bremigan. 2000. The structure-altering effects of invasive macrophytes and their potential influences on largemouth bass recruitment: implications for management. American Fisheries Society Annual Meeting, St Louis, MO.

Presentations

Bremigan, M.T. and P. A. Soranno. 2000. The indirect effects of the herbicide Sonar® on lake food webs, Michigan Chapter of the North American Lake Management Society, Lansing, MI.

Nate, N. A., M. A. Bozek, M. J. Hansen, and S. W. Hewett. 2000. Predicting walleye presence in northern Wisconsin lakes. American Fisheries Society Annual Meeting, St. Louis, MO.

Valley, R.D. and M.T. Bremigan 1999. Largemouth bass recruitment: effects of prey abundance and macrophyte assemblages. Midwest Fish and Wildlife Conference, Chicago, IL.

Valley, R.D. and M.T. Bremigan. 2000. The effects of Eurasian watermilfoil, and its management, on largemouth bass recruitment. Aquatic Plant Management Society Annual Meeting, San Diego, CA.

Prepared by: Mary Bremigan
Date: September 30, 2000