

## STUDY FINAL REPORT

State: Michigan

Project No.: F-80-R-7

Study No.: 230714

Title: Managing Michigan lakes: evaluating effects of watersheds and habitat perturbation on lake resources.

Period Covered: October 1, 2002–September 30, 2006

### Study Objective:

- 1) To evaluate the ability of the Fisheries Division Status and Trends Program to actually detect changes in the status of Michigan lakes over time.
- 2) To investigate the effects of habitat perturbation on lake biota.
- 3) To conduct workshops designed to improve dialog within the Division regarding implementation of the Status and Trends program, and integration of the program with research and management efforts.

**Summary:** To achieve Objective 1 we gathered existing monitoring data for fish length at age for two age classes of several common fish species in Michigan and Wisconsin. We then used a weighted mixed model to examine regional (statewide) temporal trends in mean length at age. Overall, 26 of 42 fish species x age class x state combinations were examined for temporal trends. Of these, only four combinations demonstrated significant regional temporal trends, with one being positive over time and three being negative over time. Further, we used a components of variance approach to partition the total variance in mean length at age into five components: (1) site-to-site (spatial) variation, (2) coherent (year-to-year) variation, (3) ephemeral temporal (site-by-year interaction) variation, (4) variation in site-specific trends, and (5) residual variation. We then used the variance estimates to inform a simulation model that investigated the statistical power to detect trends in mean length at age. These analyses demonstrated that partitioning of variance components differs among species and states, with important implications for the design of monitoring programs and their statistical power to detect regional temporal trends in fish length at age. To achieve Objective 2, we studied the effects of residential development of lake shorelines on littoral habitat, bluegill and black bass growth rates, and nesting success of black bass. To do so, we monitored several lakes in the Huron River watershed that were chosen because they shared similar natural features but represented a large gradient of residential shoreline development levels. Our analysis of relationships among shoreline development, littoral habitat, and fish populations documented habitat effects of shoreline development at both the local (site) and lake level. Most notably, the prevalence of coarse woody material was lower along developed shoreline segments, particularly in lakes with overall high residential development levels. We did not detect large effects of shoreline development on fish growth rates, but we found that black bass nesting success declined nearly two-fold with increasing lake dwelling density. With regards to Objective 3, we presented research findings, their implications for management, and ideas regarding future research to several Fisheries Division committees, engaged in regular planning sessions with Fisheries Division personnel, and sought additional opportunities for communicating findings to the Division as a whole. Finally, we provide a list of publications that resulted from this project and summarized our findings.

**Findings:** As findings will not be formally published through the Fisheries Division, this Final Report is submitted.

**Job 1: Title: Analyze existing data sets.**–The publication related to accomplishment of this job (Wagner et al., in press) is listed below under Job 7.

**Job 2: Title: Conduct fieldwork to investigate effects of habitat perturbation on lake biota.**

Findings of this job were published as Wagner et al. (2006). See list of publications under Job 7. In addition, Jubar (2004) was submitted as findings for Job 2 in 2004-05.

**Job 3: Title: Process field samples and analyze data.**—Publications resulting from completion of this job are the same as those listed under Job 2.

**Job 4: Title: Compare aquatic plant metrics.**—Results of Job 4 are published in Jabar (2004) and Cheruvilil et al. (2005).

**Job 5: Title: Conduct Division-wide workshops.**—We sought to link our research to current and future Fisheries Division efforts through a variety of formats. We provided presentations and discussion at several Basin Team meetings. We initiated an ongoing series of discussions with Fisheries Division researchers at the Institute for Fisheries Research regarding lake database development, monitoring, and research. We obtained funding to develop a landscape-based framework for lake classification and monitoring through analysis of a six-state database (including Michigan). Fisheries Division personnel participated in a workshop associated with the 6-state project. Finally, we published a collaborative manuscript that addresses statistical approaches available to state agencies to help improve monitoring programs (Wagner et al. 2006).

**Job 6: Title: Analyze 2002-2005 RIP data (if available).**—The status and trends data were not available in sufficient time to allow these analyses.

**Job 7: Title: Prepare annual reports and manuscripts.**—Annual reports were completed as scheduled. A list of manuscripts and a master's theses completed under this project are shown below. Jubar (2004) was previously submitted to SFR as an attachment to the 2004-05 progress report so it is not included with attachments to this 2005-06 progress report.

Cheruvilil, K. S., N. A. Nate, P. A. Soranno, and M. T. Bremigan. 2005. Lack of a unimodal relationship between fish growth and macrophyte cover in 45 north temperate lakes. *Archive fur Hydrobiologie* 162:193-215.

Wagner, T., M. T. Bremigan, K. S. Cheruvilil, P. A. Soranno, N. A. Nate, and J. E. Breck. In press. A multilevel modeling approach to assessing regional and local landscape features for lake classification and assessment of fish growth rates. *Environmental Monitoring and Assessment*.

Wagner, T., D. B. Hayes, and M. T. Bremigan. 2006. Accounting for multilevel data structures in fisheries data using mixed models. *Fisheries* 31:180-185.

Wagner, T., A. K. Jubar, and M. T. Bremigan. 2006. Can habitat alteration and spring angling explain largemouth bass nest success? *Transactions of the American Fisheries Society* 135:843–852.

**Job 8: Title: Prepare final report.**—This report was prepared.

**References**

Jubar, A. K. 2004. Quantifying effects of residential lakeshore development on littoral fishes and habitat: toward a framework for lake ecosystem conservation. Master's thesis. Department of Fisheries and Wildlife, Michigan State University, East Lansing.

**Prepared by: M. Bremigan, T. Wagner, A. Jubar, and P. Soranno**

**Date: September 30, 2006.**