STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-4

Study No.: 701 **Title:** Decision-support tools for managing fisheries of inland lakes

Period Covered: October 1, 2002 to September 30, 2003

Study Objective: To prepare reviews of the characteristics of Michigan's inland lakes and of fisheries management of selected species in inland lakes, and to develop decision-support tools to help manage fisheries on inland lakes. One critical set of tools to be developed is methods for allocating fish among multiple fisheries that occur in the same lake, given a safe harvest level. Another objective of this study is to develop tools that help fisheries managers compare the status and potential of specific lakes and fisheries.

Summary: According to the study schedule, Jobs 3, 4, and 5 were active this year. No progress was made on Job 3, developing methods for allocating fish among multiple fisheries that occur in the same lake.

Findings: Jobs 3, 4, and 5 were scheduled for 2002-03, and progress is reported below.

Job 3. Title: Develop models for allocating fish among multiple fisheries.–Because of other assignments, due in part to several retirements, no progress was made in developing methods for allocating fish among multiple fisheries that occur in the same lake.

Job 4. Title: Develop additional decision-support tools.–Development continued on several database tables and geographic information system (GIS) files that will be used to build decision-support tools for natural resource managers. Metadata was prepared for many database tables and GIS files.

Database records for recently published documents were added to the table of Fisheries Division reports. Companion tables were prepared to allow searching for reports by author, keyword (including fish species), and lake. Another companion table was prepared containing abstracts for 396 research reports. These tables will permit development of GIS tools that allow a user to click on a lake and see a list of the reports that mention that lake and the abstracts for those reports.

Digitized lake maps were used in computing lake volume and mean depth. Mean depth is an important characteristic for understanding hydrologic residence time and other aspects of lake ecology.

One other piece of information that can be very helpful in understanding and managing a lake is depth to the thermocline (depth at which water temperature is changing most rapidly with increasing depth). If depth to the thermocline can be estimated, and if maximum depth is known, then one can predict whether or not a lake will be thermally stratified in summer. A lake is expected to be stratified during the summer if the maximum depth exceeds the estimated depth to the thermocline. A lake that does not stratify in the summer is not likely to support self-sustaining populations of trout or other coldwater species.

An algorithm was used to estimate lake fetch for all lake polygons. The algorithm determines the longest unobstructed line across a lake, and the length and azimuth of this line. The length of this line is one estimate of fetch (Kalff 2002). Longest unobstructed straight line was calculated for all 70,000 lake polygons in the current GIS shape file for Michigan lakes and ponds.

Ragotzkie (1978) developed an equation to estimate mean depth of the thermocline (D_{th}, in meters) based on lake fetch (F, in kilometers).

$$D_{th} = 4\sqrt{F}$$

This equation is based on measurements of the thermal structure of 18 lakes in Wisconsin and central Canada during spring and summer. Lakes ranged in fetch size from 0.1 to over 20 km; and thermocline depths ranged from about 1 to 19 m (about 3 to 62 ft). No effect of lake orientation was evident, he reports. Ragotzkie (1978, p. 17) said that the estimated depths were accurate "within a meter or so" for deep lakes. This equation was used to estimate the mean depth to thermocline for all 70,000 lake polygons in our current GIS shape file for Michigan lakes and ponds. The length and direction of the longest unobstructed straight line and the estimated mean depth to thermocline have been added to the attribute table for lake polygons.

Job 5. Title: Write progress report.–This progress report has been prepared.

Literature Cited:

Kalff, J. 2002. Limnology: inland water ecosystems. Prentice Hall, Upper Saddle River, New Jersey.

Ragotzkie, R. A. 1978. Heat budget of lakes. Chapter 1, pages 1-19 in A. Lerman (editor). Lakes: chemistry, geology, physics. Springer-Verlag, New York, New York.

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