STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-1

Study No.: 674 **Title:** Compilation of databases on Michigan lakes

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

Study Objective: To facilitate electronic access to previously collected data on Michigan lakes. In cooperation with Fisheries Division's Information Management Unit, expand the design of the Division's current data management system to enable access to multiple data sets on lakes. Prepare a master list of lake names and locations so that each lake can be uniquely identified and linked to appropriate databases, beginning with lakes at least 100 acres in area and having public access. Compile databases on Michigan lakes in electronic format in a manner that will make them accessible from relational databases and geographic information systems. Begin digitizing maps of lake depth contours.

Summary: A unique identification key, based on the county and lake number assigned by Humphrys and Green (1962), has now been assigned to 6,595 lakes ≥10 acres in area and also to 24,030 lakes from 0.1 to 9 acres in area. These numbers include several new lakes that have been created since the compilation by Humphrys and Green (1962); a few former lakes have now been flooded by new lakes and have been given a special coding. Under Job 3, additional data sets on Michigan lakes were assembled and converted to electronic format. These include names of 154 lakes with inland creel survey data and the report citation, Laarman's compilation of fish growth rate data (26,086 records), information on 147 Lake Survey Summary cards and about 200 Management Record cards on file here at the Institute for Fisheries Research. Unique lake keys were added or are being added to these lake data sets, providing a way to link the data using a relational database such as Access. Under Job 4, the total number of lake maps that have been digitized remains at seventeen. Attempts have been made to automatically prepare depth-contour maps from scanned images of lake maps using automatic line-detection software. However, it appears that a great deal of time must be spent cleaning up and preparing the scanned images for use by the software and also editing the vectors produced, so it is not yet clear how much time this approach saves over hand digitizing. Lake volume information from 412 Lake Volume Analysis cards has been entered into a spreadsheet. Under Job 5, a progress report has been written. Under Job 6, substantial progress has been made in linking lake databases to GIS layers. A point theme has been created in ArcView showing the location of 6,480 named lakes that have unique identification keys assigned. These keys have been assigned to corresponding lake polygons in a theme obtained from the Spatial Data Library of the Department of Natural Resources (DNR). In addition, some editing has been done to split or join polygons to better represent named lakes. Under Job 7, information from several sources is being prepared to develop models to predict walleye population characteristics. Initial work is focusing on approximately 700 lakes that are at least 50 acres in area and have public access sites.

Job 3. Title: <u>Assemble databases: format data; prepare metadata descriptions.</u>

Findings: The following is a cumulative list of databases that have been identified, converted to Excel spreadsheets or Access databases, and for which a unique lake identification key has been assigned to all (or most) of the lakes:

- Michigan lakes at least 10 acres in area (Humphrys and Green 1962); *N* = 6,595 lakes. This includes approximately fifty seven manmade lakes created after Humphrys and Green's compilation.
- Michigan lakes from 0.1 to 10 acres in area (Humphrys and Green 1962); *N* = 24,030 lakes.
- Michigan coldwater lakes (MDNR Fisheries Division 1976); *N* = 1,346 lakes.
- List of official Michigan lake names, obtained from the U.S. Geological Survey, Board of Geographic Names; *N* = 6,909. (A few of these names are lake groups, e.g., West Branch Lakes in Alger County.)
- Nutrient status of lakes with public access sites, at least 50 acres in area (Howard Wandell, Michigan Department of Environmental Quality, Land and Water Management Division, Lansing, personal communication); *N* = 697 lakes.
- Compilation of data on lake morphometry and water quality (Schneider 1975); *N* = 387 lakes.
- Lower Peninsula lakes sampled for fishes with large seines (Schneider 1981); *N* = 229 lakes.
- Atlas and gazetteer of Michigan lakes (Fusilier and Fusilier 1994); *N* = 297 lakes.
- Lakes in the Michigamme Project (Evans et al. 1991); *N* = 66 lakes.
- Watershed area and perimeter, and lake area and perimeter for natural lakes at least 100 acres in area (Marsh and Borton 1974); *N* = 831 individual lakes and 40 multi-lake groups.
- Names of Michigan lakes sampled as part of the U.S. Environmental Protection Agency's National Acid Precipitation Assessment Program (Kanciruk et al. 1986); *N* = 172.
- List of MDNR Status of the Fisheries Reports, *N* = 25 lakes (and 30 rivers).
- Public boat launch sites in Michigan (Ray Fahlsing, MDNR Parks and Recreation Division, personal communication); *N* = 919 inland lake sites (mostly on lakes 50 acres and larger).
- Names of inland lakes with creel survey data and a reference to the report containing the data (Lockwood 2000; Schneider and Lockwood 1979; and references therein); *N* = 154 lakes; *N* = 272 lake-year combinations.

The following databases have been identified, converted to Excel spreadsheets or Access databases, but lake identification keys have not yet been added:

- Public boat launch sites in Michigan (Ray Fahlsing, MDNR Parks and Recreation Division, personal communication); *N* = 89 Great Lakes sites, 5 Lake St. Clair sites, 294 river sites.
- Percy Laarman's compilation of fish growth rates, used to compute Michigan average growth rates; *N* = 26,086 records; many lakes.
- Lake Survey Summary cards from IFR files; *N* = 147 (currently adding more).
- Management Record cards from IFR files; *N* = about 200, with 974 management recommendations.
- List of MDNR Fisheries Research Reports, *N* = 2060.
- List of MDNR Fisheries Technical Reports, *N* = 204.
- List of MDNR Fisheries Management Reports, *N* = 12.
- List of MDNR Fisheries Special Reports, *N* = 7.

Formal metadata descriptions have not yet been prepared. However, descriptions of the variables have been added to some of the Access database tables.

Job 4. Title: Begin to digitize lake maps. Calculate lake volume and mean depth.

Findings: Digitizing lake depth contours by hand has been done for a total of seventeen (counties given in parentheses): Baseline (Livingston, Washtenaw), Big Portage (Livingston, Washtenaw), Black (Cheboygan, Presque Isle), Brevoort (Mackinac), Burt (Cheboygan), Cassidy (Washtenaw), Charlevoix (Charlevoix), Crystal (Benzie), Dead (Washtenaw), Dickerson (Montcalm), Fletcher Pond (Alpena, Montmorency), Ford (Washtenaw), Gogebic (Gogebic, Ontonagon), Higgins (Roscommon, Crawford), Houghton (Roscommon), Mullet (Cheboygan), Whitmore (Livingston, Washtenaw). This list includes nine of the eleven largest lakes in Michigan (Laarman 1976). For most of these lakes, the original map contains information on bottom types and aquatic vegetation (Taube et al. 1964). This information was captured and stored in separate data layers with the digital map.

Special software is being evaluated for converting scanned bitmap images of lake maps into vectors (Adobe Streamline) and then editing the vectors (Adobe Illustrator). This software does automatic line detection, but requires fairly clean bitmap images. It was hoped that this approach would appreciably reduce the effort in creating electronic versions of lake depth contours. However, on our scanned images, depth-contour lines contain breaks for depth labels, and depth-contour lines overlay patterns indicating bottom type (e.g., sand, marl, peat). Both of these features require editing the bitmap image prior to vectorizing or editing the vectors produced by the software, or both. From initial attempts, it appears that a relatively large amount of time (e.g., several hours) must be spent in pre- and post-processing, so it is not yet clear that this approach saves much time over hand digitizing.

Methods are being evaluated for calculating lake mean depth using the digitized contours. Spatial Analyst extension to ArcView can be used to overlay a grid and compute mean depth using the depth of each cell. Alternately, a formula can be used to calculate lake volume based on the area within each depth contour and the thickness of each contour interval. Lake volume information from 412 Lake Volume Analysis cards on file here at the Institute for Fisheries Research has been entered into a spreadsheet; some past errors in volume calculation have been detected.

Job 5. Title: Prepare report.

Findings: This performance report has been prepared.

Job 6. Title: Link databases to GIS lakes.

Findings: Substantial progress has been made in linking lake databases to GIS layers. Lake polygons were obtained from the DNR Spatial Data Library as an ArcView polygon theme. This theme contains about 70,000 polygons, including lakes, islands and very small water bodies. Some editing has been done to split or join polygons to better represent named lakes. A point theme has been created in ArcView showing the location of 6,480 named lakes that have unique identification keys assigned. These keys have also been assigned to the corresponding lake polygons. Using this unique code, databases can now be linked to points and lake polygons.

Job 7. Title: <u>Develop models to predict walleye population characteristics.</u>

Findings: Information from several sources is being assembled to develop models to predict walleye population characteristics. Initial work is focusing on approximately 700 lakes that are at least 50 acres in area and have public access sites. Information on walleye captured in netting surveys is being obtained from Fisheries Division's Fish Collection System. Additional information about lake and watershed characteristics is being compiled or is already available under Job 3.

Literature Cited:

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Date: September 30, 2000