STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** T-10-T-5

Study No.: 237001 **Title:** Development of lake spatial information and tools for aquatic life conservation

Period Covered: October 1, 2014 to September 30, 2015

Study Objective: The goal of this project is to provide geospatial databases, tools, and models to assist in developing management plans to implement the Michigan Wildlife Action Plan (MWAP). This goal will be addressed by meeting the following objectives:

Objective 1. To continue the development of an ecological database containing information on the aquatic habitats of the Great Lakes.

Objective 2. To conduct ecological classification of nearshore and offshore Great Lakes habitats in Lakes Huron, Superior and Ontario, and compare with existing classifications of nearshore zones and streams.

Objective 3. Continue development of a spatial database of lake habitats using landscape and local variables that can be used to characterize lake types and the patterns of fish assemblages in inland lakes.

Objective 4. Support the preparation of river ecological assessments through development of spatial databases and GIS tools. These documents facilitate several priority actions and conservation needs.

Objective 5. To determine suitable indices of relative habitat quality for sensitive life stages of important non-game species.

Objective 6. To develop GIS-based decision support projects to facilitate evaluation of potential impacts to non-game wildlife habitat from a variety of pressures.

Objective 7. To develop and deliver educational programs for end-users on the use of Great Lakes GIS (GLGIS) use for science inquiry and decision support.

Objective 8. To develop and implement long-term, Internet-based strategies for project maintenance and distribution.

Summary: Ecological units were created for coastal, nearshore, and offshore areas of the Great Lakes based on depth, water temperature, and mechanical energy. MaxEnt species distribution models were revised for aquatic Species of Greatest Conservation Need (SGCN). These models were then used to identify important natural habitat characteristics associated with each species and to identify habitat suitability for all SGCN species in all lakes and stream reaches in Michigan. Additional species data were acquired and processed for the Great Lakes. Work continued on developing web-based tools for viewing, overlaying, and retrieving Great Lakes and inland habitat data and occurrences of species of greatest conservation need. Journal articles describing development of tributary watersheds for the Great Lakes and development of Great Lakes classification were drafted. A manuscript documenting Great Lakes GIS databases and spatial framework was published.

Findings: Jobs 1–10 were scheduled for 2014-15, and progress is reported below.

Job 1. Develop ecological units.–Variables describing depth, thermal regime, and mechanical energy were used to develop an aquatic ecological classification for waters of the Great Lakes. The classification is developed across aquatic zones including coastal (0-3 meters), nearshore (3-30 meters), and offshore (>30 meters) areas for all five lakes. The nearshore and offshore zones were divided into shallow and deep categories. We calculated cumulative degree-days above zero in the coastal zone using surface temperatures, and in the nearshore and offshore zones using the mean water column temperature of the upper 20 meters. Mechanical energy was described using relative exposure index in the nearshore and coastal areas and dominate spring circulation patterns in the offshore zone. We developed classification thresholds for each of these variables using information from the literature and from a team of Great Lakes' experts.

Job 2. Determine indices of relative habitat quality.–MaxEnt species distribution models were revised for SGCN including 37 lake and stream fish species, 12 mussels species, and 2 aquatic insect species with at least 10 stream/river occurrence records. Model output was used to create statewide maps for each SGCN species showing habitat suitability for all lakes and stream reaches in Michigan. MDNR nearshore fish community data were acquired, processed, and quality checked for use in determining habitat quality in the Great Lakes.

Job 3. Provide support to the lake classification and assessment project for inland lakes and ponds.–No additional support was needed for the lake classification and assessment project in fiscal year 2014-15.

Job 4. Digitize lake contour maps and calculate morphometric variables.–No lake maps were digitized in fiscal year 2014-15.

Job 5. Link information on geographic distribution of fish species and other data to the NHD.–The current MDEQ dams layer was linked to the NHD 1:24,000 layer. We modified trout and salmon regulations, which are linked to the NHD 1:24,000 layer in support of coldwater protection efforts. Land use, land cover, population data, road density, and geology summaries were developed for all tributary watersheds in the Great Lakes basin from the NHD 1:100,000 layer. We created an upstream barrier representation on the NHD 1:24,000 layer for minnow regulation communication and enforcement that involve fish health issues. Finally, we created fish disease regulation maps that incorporated the first upstream barrier on NHD 1:24,000 network.

Job 6. Provide GIS and database support for river ecological assessments.–We have continued to develop a spatial framework in support of the MWAP, including the development of a stream/lake connectivity layer and addition of catchment summaries (e.g. climate change predictions) as new data become available.

Job 7. Develop GIS-based decision support projects.–Work continued on developing web-based tools for viewing, overlaying, and retrieving Great Lakes and inland habitat data and occurrences and assessments of SGCN. We have been working with a set of beta testers to get feedback on the design and utility of the Great Lakes Decision Support Tool.

Job 8. Develop and deliver educational programs for end-users.–Four presentations were developed and given to end-users explaining how to use Great Lakes and inland aquatic habitat viewers.

Job 9. Develop and implement long-term, Internet-based strategies for project maintenance and distribution.–Several meetings were held to discuss long-term internet based options for maintaining and distributing data with the University of Michigan. Work continued on a website

that will serve as the data portal for inland and Great Lakes data, classifications, and conservation assessment and planning tools.

Job 10. Title: Write annual reports and journal publications.–This annual report was written as scheduled. Journal articles describing development of tributary watersheds for the Great Lakes and development of Great Lakes classification were drafted. A manuscript documenting Great Lakes GIS databases and spatial framework was published. In addition, a study summary was prepared (Attachment 1).

Wang, L., C. M. Riseng, L. A. Mason, K. E. Wehrly, E. S. Rutherford, J. E. McKenna, C. Castiglione, L. B. Johnson, D. M. Infante, S. Sowa, M. Robertson, J. Schaeffer, M. Khoury, J. Gaiot, T. Hollenhorst, C. Brooks, and M. Coscarelli. 2015. A spatial classification and database for management, research, and policy making: The Great Lakes aquatic habitat framework. Journal of Great Lakes Research 41(2):584-596.

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