



## WATER RESOURCES RESEARCH GRANT PROPOSAL

**Project ID:** MI2561

**Title:** Building a Landscape Context for Lake Ecological Processes

**Focus Categories:** Ecology, None

**Keywords:** Ecosystems

**Start Date:** 04/01/2001

**End Date:** 01/01/2003

**Federal Funds:** \$15,000

**Non-Federal Matching Funds:** \$56,538

**Congressional District:** 8

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**Abstract**

Research objectives and outcomes: To better understand the wide diversity of lake ecosystems, and to improve how we manage them, we propose that lake ecosystems must be viewed within a matrix of landscape features that are hierarchically organized into three dominant spatial scales, such that higher levels constrain the possible outcomes of lower levels. At the highest level, the regional scale captures the dominant signature of climatic and geomorphological forces. At the next level, the sub-regional scale characterizes hydrological connections among lakes and their landscapes that determine transport of materials and movement of species. At the finest spatial scale, local features of lakes and their catchments mediate climatic forcing of biotic processes and transport of materials from land to water. We have three primary objectives in our proposed research project. First, we will build a hierarchical landscape-context model, using classification and regression tree analysis, which organizes lakes into groups according to the three spatial scales of landscape context. Second, we will quantify the ecological relevance of the landscape-context lake groups by determining whether the groups predict a wide range of important abiotic and biotic lake response variables (lake water chemistry, trophic status and fish growth rates). Third, we will determine how land use differences among lakes within landscape-context groups drive lake response variables.

Our research will define the underlying variability among lakes that is driven by non-human drivers such as landscape context. As a result, we will achieve a better understanding of how land use change affects lake integrity than is currently possible with simplistic models that are highly variable and of limited use to managers. In so doing, we will be developing databases of considerable use to natural resource agencies throughout the state. In addition, because our model is based on digital map data that are available for large geographic regions, we will produce classification tools that can be used to assign a lake to a group, based on its landscape context, without the need to sample the lake itself. Thus, it will be relatively straightforward to extend our modeling approach to broader spatial sales. Our approach should help resolve the dilemma that managers must manage on local scales (individual lakes) while recognizing that lakes are

strongly influenced by processes occurring at much larger spatial scales (landscape context). Finally, our approach provides a common dialog for water quality, land use, and fisheries managers, each charged with a limited management mission.

Schedule: In year 1, we will build the landscape-context database. These data will be obtained directly from GIS coverages from the Michigan Department of Natural Resources (MDNR) Spatial Data library, or derived from existing coverages through manipulation and digital processing. We are also building a database of internal lake variables (data provided by the Department of Environmental Quality (DEQ), and MDNR - Fisheries Division) that will be used to test the landscape-context classification system. In year 2, we will conduct the statistical analyses to develop the classification system, transfer the databases to state natural resource agencies, and prepare peer-reviewed publications.

Linkages: Our research has clear linkages to many programs ongoing both at Michigan State University, and within the state's natural resource agencies. Both the DNR and DEQ will benefit from the databases that will be created as a result of this research. We hope in the future that the data that we create will be made available to the public through web-based technology, which both DEQ and MDNR plan to develop. In addition, the classification system that we will develop will provide helpful guidance to the MDNR-Fisheries Division's efforts to establish a program for resource inventory and assessment. At MSU, our research is complementary to other efforts examining land use change in the state of Michigan, and the effect on important natural resources within the state. These projects include the NASA-funded Upper Great Lakes RESAC project (Regional Earth Science Applications Center), and the Land Use Enterprise Zone that is being initiated at MSU this year.