



WATER RESOURCES RESEARCH GRANT PROPOSAL

TITLE: ASSESSING THE EFFECTS OF LAND USE ON WETLAND QUALITY:
DEVELOPMENT OF BIOTIC INDICATORS

DURATION: September 1, 1996-August 30, 1997

FEDERAL-FUNDS REQUESTED \$50,672

NON-FEDERAL MATCH \$185,840

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STATEMENT OF CRITICAL REGIONAL & STATE WATER PROBLEMS

Interest in biological assessments of aquatic systems is growing with the recognition that physical and chemical assessments are inadequate for establishing standards that ensure ecosystem integrity and for detecting cumulative impacts from diverse land uses (Karr 1995). Over the past fifteen years, stream ecologists have demonstrated the effectiveness and feasibility of using biological indicators to assess aquatic system integrity (Davis and Simon 1995). Because of belated recognition of the importance of biotic indicators, water resource decision-makers lack the comprehensive information necessary to establish bioassessment criteria for stream systems. Data are even more scarce for other aquatic systems, including wetlands. The focus of wetland planning through Section 404 of the Clean Water Act has traditionally been to maximize functions. These functions are broadly considered to include stormwater retention, water quality improvement, and fisheries *and* wildlife production, among others. There has been little attention paid to the fact that in many intensively used landscapes, maximizing one of these functions likely diminishes the others of a system. Making decisions on how to avoid, minimize, or mitigate degradation to wetlands requires an understanding of how biological integrity relates to maximizing these functions. Since this information is lacking, wetlands and their associated watersheds are often reconfigured and altered so they bear limited resemblance to intact, natural systems. Assessing mitigation has been limited to documenting quantity rather than quality of restorations and creations (NRC 1992). Indices of biotic integrity (IBIs), similar to those developed for streams, need to be formulated for a variety of wetlands and tested for wetland assessment. Several agencies, including U.S. EPA, U.S. Geological Survey, and the Tennessee Valley Authority have indicated an interest in evaluating and implementing biological assessments of water resource integrity (Karr 1991).

Minnesota is an ideal place to pioneer wetland IBIs for several reasons: (1) the state has the authority to implement both state and federal wetland conservation mandates under the Wetland Conservation Act of 1991 (amended in 1996); (2) the Wetland Conservation Act explicitly states that maintaining biodiversity *is* a motivation for wetland protection; (3) Minnesota includes a diverse array of wetlands, extending from extensive peatlands and boreal wetlands, to prairie potholes, and large riverine floodplains and (4) Minnesota is diverse with respect to landscape context, with some portions of the state experiencing minimal past wetland loss and others with near total loss or impairment. We received funding from the Minnesota legislature in 1995 to explore the development of wetland IBIs. This work has focused on establishing reference sites and on the field collection of plant and animal composition data necessary for indicator development. Equally as important, we need to investigate how best to quantify land uses in the watershed of each site and to synthesize this information. The land use assessment component of IBIs have historically been simple, non-spatial measures (i.e., % agriculture in watershed). However, with improvements in geographic information system technology and increased digital data availability, spatial watershed assessments should be the basis for IBI development.

STATEMENT OF RESULTS OR BENEFITS

Biological assessment protocols will improve decision-makers' capabilities to determine how land use changes within watersheds affect the integrity of associated aquatic systems. Biological indicators are potentially more effective than chemical or physical indicators for screening overall degradation within watersheds, especially cumulative land use impacts. We plan to develop IBIs for eight kinds of wetlands in Minnesota. Four organismal groups will be tested for their effectiveness to serve as indicators. To evaluate the sensitivity of candidate indicators, the correspondence of biological measures to measures of land use degradation within the watershed will be established. Wetlands have been selected (15 for each kind of wetland) that vary in degree of land use degradation within the watershed. This project will establish protocols for quantifying watershed impacts with a Geographic Information System and for using this type of information to develop wetland IBIs. Land use measures derived from GIS should be a significant improvement over current approaches and thus advance indicator development for a variety of aquatic systems nationwide.

Integration of field ecological community data and watershed data will provide a comprehensive analysis of the influence of the surrounding landscape on the biological integrity of existing wetlands. This analysis will provide critical insights on how to sustain the biological integrity of both existing and mitigated wetlands. The results of this study will be disseminated to decision-makers throughout the state in the form of a draft manual by the Minnesota Board of Water and Soil Resources. The manual will describe how overall scores of biological integrity can be generated from field assessment data and how these data can be related to watershed condition (i.e., criteria). We plan to arrange independent field evaluations of the biological assessment protocols after the manual has been distributed. The Minnesota wetland IBI manual will likely be a national

model because it will include statewide coverage and because improved land use assessments will be used in indicator development.