Nonlinear Response of Prairie Pothole Landscapes to Climate Change and Land Management

Carter Johnson[1], Richard Adams[2], Phil Fay[3], Glenn R. Guntenspergen[4], Bruce V. Millett[1], and Richard Voldseth[5]
[1]South Dakota State University, Brookings, SD; [2]Oregon State University, Corvallis, OR; [3]Agricultural Research Service, Temple, TX; [4]University of Minnesota – Duluth, Superior, WI; [5]U.S. Forest Service, Grand Rapids, MN; U.S. Geological Survey, Reston, VA

This research project involves a multi-disciplinary, multi-institutional project that examines the possibility that the response of prairie wetland ecosystems to climate change may be nonlinear or threshold in nature.

Wetland ecosystems of the Prairie Pothole Region (PPR) in the northern Great Plains are extremely vulnerable to climate change. While aspects of this vulnerability have been examined in previous research, strongly suspected threshold responses of these wetlands to environmental drivers remain largely unstudied. The objective of this research project is to identify possible future climatic and land use conditions that could sharply reduce biodiversity in wetlands across the PPR.

A multi-step, integrated research framework will examine nonlinear responses through the use of a tested mathematical model (WETLANDSCAPE) that links upland and wetland processes at the landscape scale. Simulations will focus on critical environmental thresholds that control key ecosystem processes upon which most wetland biodiversity depends. Terrestrial (upland) conditions and their management will be incorporated explicitly as they influence the environment of wetlands down slope. The potential to use land management to mitigate for possible negative consequences of climate change on prairie wetland biodiversity will be examined using a land use decision model that embeds economic variables. This will allow quantification of the economic costs of land use alterations to achieve ecosystem goals.

A primary outcome of this research will be to inform the scientific and management community, and ultimately the public, of the existence of critical thresholds in the hydrologic environment of prairie wetlands which, if exceeded by future climate forcings, could produce major negative consequences for biodiversity. The possibility that amphibian and waterfowl numbers will greatly diminish in North America because of climate change in the PPR is of great concern among public and natural resource management agencies. This research will provide new understanding of the complex relationships among climate, wetland environment, and the habitat base for these and other elements of biodiversity. The research also will suggest the degree to which human adjustments (beyond reductions in greenhouse gases) such as land use changes can lessen the severity of impacts of climate change on natural ecosystems in the PPR. Finally, this study will provide preliminary information on the economic feasibility of alternative land use options and indicate the magnitude of required societal costs to achieve such outcomes.

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