



## WETLAND AND AQUATIC ECOSYSTEM STUDIES

### Northern Prairie Wildlife Research Center Jamestown, North Dakota

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Northern Prairie Wildlife Research Center (NPWRC) has a long history of conducting high-quality, comprehensive wetlands research in the Great Plains and elsewhere in the United States and Canada. The primary thrust of the NPWRC wetland science program is directed toward developing an ecological understanding of processes that influence wetland functions and values. New policies and directives mandate that many federal programs and land management agencies, and the private sector consider the necessity to maintain or restore the integrity of natural systems using sound science. Improving our scientific understanding of wetland processes is critical to accomplishing this goal because it will allow the development of ecologically based techniques to restore and manage aquatic resources to ensure sustainable productivity, environmental health, and biological diversity. This will increase the probability of successful management and reduce long-term maintenance management costs. Scientists within the NPWRC wetland science program also recognize that decisions uniformly made at the Federal level years ago are now made with outside collaboration. This is evidenced by the active participation of citizens in advisory committees and the proliferation of stakeholder groups and land trusts across the country. Thus, the need for information on the consequences of decisions expands beyond traditional decision-makers, and increased efforts are required to provide information in an applied and understandable manner to diverse stakeholders.

### CURRENT RESEARCH

**COTTONWOOD LAKE STUDY AREA** — NPWRC and the Water Resources Division of the U. S. Geological Survey, in partnership with the U. S. Bureau of Reclamation, the U. S. Fish and Wildlife Service, and various universities, are conducting a long-term investigation of the hydrology, the impact of hydrology on water chemistry and hydroperiod, and the combined influence of hydrology, hydroperiod, and chemistry on wetland flora and fauna of a prairie wetland complex. A primary goal of this effort is to quantify and develop an understanding of factors influencing patterns of temporal and spatial variability in prairie wetland ecosystems. This study has been ongoing since 1967 and has resulted in over 80 scientific papers, theses, and abstracts.

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**WETLAND MANAGEMENT ON NATIONAL WILDLIFE REFUGES** —

Center biologists work closely with U. S. Fish and Wildlife Service staff on wetland management issues on National Wildlife Refuge (NWR) system lands. NPWRC is currently conducting a series of related research studies and providing technical assistance examining NWR biological programs and management actions in support of U. S. Fish and Wildlife Service's Comprehensive Conservation Planning efforts. Additional studies are conducted on various topics to improve the capability of refuge managers to manage wetland resources on NWRs. Contact: [murray\\_laubhan@usgs.gov](mailto:murray_laubhan@usgs.gov)

**WETLAND MONITORING ON TRIBAL LANDS** — Center biologists are assisting staff of the Spirit Lake Nation's Tribal Environmental Protection Agency (EPA) Office in developing and implementing a biological assessment system to monitor the condition of wetlands on tribal lands. This effort includes classroom and field workshops on biological monitoring techniques for Tribal EPA staff. Additionally, Center biologists provide onsite assistance to select wetlands to monitor, and implement the biological assessments of plant, invertebrate, and amphibian communities of tribal wetlands. Contact: [ned\\_euliss@usgs.gov](mailto:ned_euliss@usgs.gov)

**FLOOD STORAGE CAPACITY OF RESTORABLE WETLANDS** — Flooding along the Red River of the North has caused enormous economic losses and inflicted serious social hardships in North Dakota, Minnesota, and Canada. The extremely flat topography of the Red River Valley (RRV) precludes many conventional practices such as flood control reservoirs. Further, soils in the RRV are very fertile and it may not be economically feasible to implement many alternative measures to detain floodwater within the RRV because economic incentives will continue to favor agricultural production. Although still an important area for agricultural production, the upper watershed has been targeted for a variety of conservation practices that currently provide some degree of floodwater protection. In this study, we will develop a methodology to define flood storage capacity of wetlands in the upper watershed of the RRV and develop a Geographical Information System database with spatial data layers that identify drained wetlands that could be targeted for restoration. This information will then be used to model the flood storage capacity of restorable wetlands under different land use and climate scenarios. *Contact:* [robert\\_gleason@usgs.gov](mailto:robert_gleason@usgs.gov)



**CARBON SEQUESTRATION AND PRAIRIE WETLANDS** — There is growing public concern over the management of global greenhouse carbon because of its relation to global climate change. NPWRC and the U. S. Department of Agriculture are collaborating to study the potential of prairie pothole region wetlands to sequester atmospheric carbon. Results suggest that prior to European settlement, wetlands functioned as sinks for atmospheric carbon, but cultivation, the current principal land use, has changed wetlands from sinks to sources of atmospheric carbon. Our data suggest that greater amounts of atmospheric carbon can be stored in wetlands through restoration programs than on cropland even though the acreage of wetlands is much smaller. For more information, see the NPWRC fact sheet “Prairie Wetlands are Important for Carbon Storage”. *Contact:* [robert\\_gleason@usgs.gov](mailto:robert_gleason@usgs.gov)

**TRACE GAS EMISSIONS FROM FARMED AND NONFARMED WETLANDS** — One of the most important climate change issues is the increasing concentration of greenhouse gases (GHG) in the atmosphere. Over the past decade, nations have been developing strategies to reduce and stabilize atmospheric GHG. To offset future impacts of GHG emissions, decision makers have identified two broad approaches for controlling atmospheric carbon concentrations: (1) reduction of carbon emissions at their source (e.g., reduce burning of fossil fuels), and (2) enhanced carbon sequestration. As such, much effort has focused on identifying sinks and sources of GHGs around the world. NPWRC is conducting research to quantify trace-greenhouse gas (i.e., nitrous oxide [N<sub>2</sub>O], methane [CH<sub>4</sub>]) emissions from agricultural and restored wetlands. The overall goal of this effort is to gather baseline information on trace-gas emissions from farmed and nonfarmed wetlands that can be used to direct future research and implement market-driven solutions to climate change. Specific objectives of this work are to (1) develop a methodology to quantify trace-gas emissions from wetlands, and (2) evaluate differences in trace-gas emissions between farmed and non-farmed (i.e. restored) wetlands. *Contact:* [robert\\_gleason@usgs.gov](mailto:robert_gleason@usgs.gov)

**HABITAT MODELING** — Scientists at NPWRC are recognized leaders in the development of habitat models to facilitate sound wildlife management decisions. A notable example is the mallard productivity model, which is extensively used by the U. S. Fish and Wildlife Service, Ducks Unlimited, and the North American Waterfowl Management Plan as a management tool. The mallard model predicts fall recruitment of mallards based on input of upland habitat features, number of breeding pairs, and availability of wetlands in 4-mi<sup>2</sup> plots that are monitored by the U. S. Fish and Wildlife Service in the prairie pothole region. *Contact:* [robert\\_cox@usgs.gov](mailto:robert_cox@usgs.gov)

**HABITAT AND LANDSCAPE MODELS OF WETLAND BIRDS** — With partial support from the U. S. Fish and Wildlife Service and the Environmental Protection Agency, the Center is determining the breeding birds of wetlands in the northern Great Plains. Surveys were made on more than 500 wetlands in North and South Dakota during 1995 and 1996. Models will be developed to relate bird presence and abundance to landscape features and habitat features, such as wetland size, class, and emergent vegetation. *Contact:* [douglas\\_h\\_johnson@usgs.gov](mailto:douglas_h_johnson@usgs.gov)

## PREVIOUS WORK

**WETLAND CLASSIFICATION** — Scientists at NPWRC have provided national and international leadership in wetland classification. Both the classification systems for the prairie pothole region (Stewart and Kantrud 1971) and for the United States (Cowardin et al. 1979) were developed at the Center.

**WETLAND COMPLEXES** — The concept of wetland complexes (i.e., that breeding waterfowl require complexes composed of several wetland types to satisfy their requirements during the breeding season) was developed by NPWRC. This concept forms the basis for wetland management and restoration in the Great Plains and is the guiding principle behind Federal and State land purchase, easement, and management programs.

**WETLAND SEDIMENTATION** — Drained wetland basins in agricultural fields in the Prairie pothole region receive heavy sedimentation from cultivated watersheds. Scientists from NPWRC led a team of scientists from the U.S. Environmental Protection Agency, National Research Council, U. S. Army Corps of Engineers, Humboldt State University (CA), and University of Minnesota in an interdisciplinary research project that examined the impact of siltation and sedimentation on wildlife, plants, aquatic invertebrates, and aquatic food webs. Center scientists also examined the spatial extent of sediment overburdens in drained, natural, and restored wetlands, and the influence of sediment overburden on recolonization potential of aquatic invertebrates and plants.



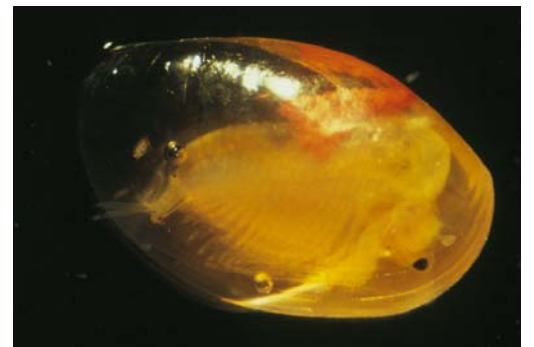
**WETLAND RESTORATION** — In collaboration with scientists from the U. S. Bureau of Reclamation, NPWRC led an evaluation of the success of wetlands restored as mitigation sites for Garrison Diversion. In addition, the Center conducted a comprehensive evaluation of restored wetlands in the prairie pothole region in collaboration with 18 federal, state, and private agencies/organizations.

**PLATTE RIVER WET MEADOWS** — As part of the Platte River Initiative, NPWRC biologists worked with the Platte River Whooping Crane Trust to examine the interactions among hydrology, soils, plant community, and invertebrate community of native wet meadows along the river. This study provides important baseline information for long-term management and monitoring of this threatened ecosystem. Additionally, breeding-bird use of natural and restored wet meadows along the Platte was evaluated. *Contact: jane\_austin@usgs.gov*

**MAJOR RIVER SYSTEMS** — NPWRC has conducted extensive research confirming that the riparian habitat needs of migratory waterbirds are met as part of comprehensive planning associated with allocation of water resources in the midcontinent region. The Platte River Ecology Study undertaken in coordination with studies by the U. S. Bureau of Reclamation and USGS identified habitat requirements of sandhill cranes and other waterbirds using riparian habitats along the Platte River, a key spring staging and breeding area for waterbirds. The information, contained in about 25 scientific publications prepared from this research, continues to be used by federal agencies, the courts, and others when addressing allocation of water resources in this highly developed river basin. Research conducted along the Mississippi River and rivers in the northern Great Plains also have identified important migratory waterbird habitat needs.

**WETLAND IDENTIFICATION AND DELINEATION USING INVERTEBRATES** — NPWRC has developed an innovative technique for positive identification and delineation of wetlands from recalcitrant invertebrate remains that can be used even when wetlands are dry and in agricultural production. Such wetlands are difficult to identify and delineate because they lack diagnostic vegetation and hydrology. The National Research Council's Wetlands Characterization Committee recommended this system as a faunal indicator of prairie wetlands in 1995.

**ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (EMAP)** — In partnership with the EPA, NPWRC developed an integrated, ecosystem-based approach to evaluate ecological indicators of ecosystem condition in the prairies. The work was focused on biological indicators, but also evaluated hydrological, geochemical, and soil indicators. Biological indicators included stress hormones, hydrophytes, wetland birds, waterfowl pair use and brood survival, invertebrates, aquatic invertebrate egg banks, and amphibians. Variables were measured at both landscape and basin scales.



**LANDSCAPE RESTORATION** — NPWRC in partnership with the Natural Resources Conservation Service's Wetland Institute (USDA) developed a decision support model for prioritizing wetland restoration in the northern Great Plains. The model provides 1) objective siting criteria for enrollment of land into the Wetland Reserve Program and 2) a GIS based landscape model to predict how wetland restoration can contribute to landscape function and integrity.

**LITTLE MISSOURI NATIONAL GRASSLAND** — Scientists at NPWRC worked with the U. S. Forest Service to evaluate the effects of water development in the grasslands of western North Dakota. The vast majority of the wetlands in this region have been deepened or dammed to increase their value as water sources for cattle and breeding habitat for waterfowl. The effects that this has had on other hydrological features of these wetlands and on the native flora and fauna typically associated with these naturally short-hydroperiod wetlands were determined.

**COMPETITION BETWEEN DUCKLINGS AND MINNOWS** — Raising minnows to supply bait for the sport-fishing industry is nearly a \$250,000 per year enterprise in the northern Great Plains. The Center worked collaboratively with the Minnesota Department of Natural Resources, North Dakota State University, and South Dakota State University to evaluate the impact of fathead minnows on weight gain and survival of mallard ducklings. There is concern among wetland managers that using wetlands to culture fish may impact migratory birds. Findings indicated that fathead minnows prey heavily on aquatic invertebrates and can significantly lower food availability to waterfowl, especially ducklings. Mallard ducklings reared in experimental wetlands with low numbers of aquatic invertebrates had lower growth and survival than those reared in wetlands with high numbers of invertebrates.

**SYMPOSIA AND WORKSHOPS** — Technology transfer is critical for effective natural resource management. The Center is a leader in the dissemination of wetland information through symposia, workshops, and other forms of information exchange. Notable examples include a wetland symposium, *Prairie Ecosystems: Wetland Ecology, Management, and Restoration* in 1993; a symposium in 1985 that led to the development of *Northern Prairie Wetlands* (NPWRC scientists and collaborators authored 5 of 12 chapters), the most comprehensive textbook available on the ecology of prairie wetlands; a workshop for the National Academy of Science's Wetlands Characterization Committee in 1994, and a workshop in 1995 to develop final drafts for a National and a Great Plains version of the Hydrogeomorphic Functional Assessment method for wetlands that will be used by the U. S. Department of Agriculture to assess minimal effects and develop mitigation strategies.

## RELATED INFORMATION

**RESEARCH FACILITIES** — NPWRC maintains state-of-the-art laboratory facilities, a 20-cell experimental pond facility, a modern GIS/Remote Sensing Laboratory, and manages two well-established, long-term wetland study areas. The Cottonwood Lake Study Area is an interdisciplinary, multi-agency research project and is the most intensively studied (at an ecosystem level) wetland complex in North America. The Center also maintains a modern research facility on the 2,650-acre Woodworth Waterfowl Production Area, a site dedicated to research and an area of intensive wetlands and uplands research over the past 30 years. In addition, the Center maintains an extensive library and houses the third-largest herbarium in North Dakota.

**COLLABORATORS AND NETWORKING** — NPWRC operates within an extensive network of natural resources science groups, with collaborators from other federal agencies, state offices, and universities. At present, significant portions of the Center's wetland program are supported by sources outside the USGS. Our research program is broad, comprehensive, and is primarily directed towards Department of Interior needs, but also addresses the needs of other clients.

**PUBLICATIONS** — Although wetland research has operated with a modest staff, nearly 300 scientific publications on wetlands have been produced since the late 1960's. The current thinking on prairie wetlands in the Great Plains and the current management of those wetlands is largely a result of research conducted at the Center. Ongoing wetland research projects at NPWRC are responsive to the needs of federal, state, and private wetland managers.

**CONSULTATIONS** — NPWRC staff members have served as the government's primary expert witnesses on biological issues on wetland-related litigations and continues to provide a primary source of scientific expertise on wetland ecology, including use by migratory birds. Consultations are regularly requested by other agencies and the public to provide information on federal farm and wetland legislation to Congress, provide information needed for the preparation of environmental impact statements, for agency planning, and other purposes.

**SCIENTIFIC OUTREACH** — NPWRC worked with cooperators to serve on the World-Wide Web annotated bibliographies pertaining to wetland restoration (<http://www.npwrc.usgs.gov/resource/literatr/wetresto/wetresto.htm>) and to riparian systems (<http://www.npwrc.usgs.gov/resource/literatr/riparian/riparian.htm>). Originally developed by the Midcontinent Ecological Science Center and the Idaho office of the Bureau of Land Management, respectively, the restoration and riparian databases were augmented and developed for Web access by the Center. The wetland restoration bibliography is a "living bibliography," to which users can contribute by providing new references directly to the Web site. Numerous other wetland-related resources can also be found on the Center's website (<http://www.npwrc.usgs.gov/>).

**FOR FURTHER INFORMATION:**

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