



## Wetland restoration for carbon sequestration in Prairie Canada

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**Short title:** Wetland restoration for carbon sequestration in Prairie Canada

**Key Message:** Wetland restoration in Prairie Canada could substantially contribute to the mitigation and sequestration of GHG emissions. In Alberta, a carbon offset system is already in place and work continues to have wetlands included in that system. Ideally similar systems will be developed across Canada.

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**Reviewer:** Rhonda L. McDougal

### What is the problem?

Agricultural development and intensification since the 1900s has dramatically reduced the extent and function of wetlands across prairie Canada. In many areas of Manitoba, Saskatchewan and Alberta wetland loss exceeds 70 per cent, making prairie wetlands one of the most threatened ecosystems in North America. Wetland conversion continues in this region largely because of limited understanding and acceptance of the benefits that wetlands provide (i.e. water, air, biodiversity, flood control, recreation). This has resulted in a lack of incentives for landowners to retain natural wetlands and/or restore lost or degraded wetlands.

### Which ecosystem services were examined and how?

Increasing atmospheric concentrations of greenhouse gases and associated climate impacts has stimulated interest in the potential to address GHG emissions by restoring prairie wetlands. Recent studies of prairie wetland systems have independently quantified greenhouse gas fluxes and changes in soil organic carbon. The research led by DUC was the first to combine these factors to determine the net GHG balance of prairie wetlands.

The research focused on 62 wetland basins distributed across Alberta, Saskatchewan, and Manitoba. Wetland hydrology was included as a key covariate with seasonal, semi permanent and permanent wetlands being monitored. The study design paired reference wetlands (never drained or cultivated) with two restored wetlands (where hydrologic function was restored). Nine wetlands were also intensively monitored to determine the cumulative fluxes of GHG. In addition to

GHG fluxes, we also monitored water quality at all sites and collected soil cores to determine the soil organic carbon stored in these wetlands. This enabled us to determine some of the environmental drivers of GHG emissions in these systems.

The study revealed that restoring prairie wetlands produces a positive net GHG balance of 3.25 Mg CO<sub>2</sub> equivalents ha<sup>-1</sup>yr (Badiou et al. submitted). Given significant historic and ongoing wetland loss, wetland restoration in Prairie Canada could contribute substantially to mitigation of GHG emissions. For example, the Prairie Habitat Joint Venture of the North American Waterfowl Management Plan identifies the need to restore 112,600 hectares of wetlands across the three Canadian Prairie Provinces over a twenty-five year period. If this goal was achieved the annual sequestration rate would be about 366,000 Mg CO<sub>2</sub> equivalents yr (Prairie Habitat Joint Venture 2008). Over the estimated sequestration period of 33 years, achieving this goal would remove approximately 12 million Mg CO<sub>2</sub> equivalents. This research also demonstrates the dramatic impact that wetlands drainage can have on wetland carbon stores. Approximately 89 Mg of SOC/ha (or 326 Mg of CO<sub>2</sub> eq/ha) is lost when seasonal, semi-permanent, and permanent wetlands are drained (Badiou et al. submitted). This loss is further enhanced if the drained wetland basin is converted to cropland.

#### **What inputs in terms of personnel, skills, resources was necessary for this analysis?**

The research involved a multiagency (ENGO, University and Government) team of wetland scientists, waterfowl biologists, soil scientists, and economists. The core research team included four researchers, one each from DUC, the University of Saskatchewan, Manitoba Water Stewardship and the Canadian Wildlife Service of Environment Canada. The overall research team included eight researchers and five graduate students. Support of private landowners was central to the project. The five year study was funded by federal and provincial Governments, universities and DUC.

#### **How was this information used to change local and regional policy?**

Results have been used in a number of ways. First, the results highlight the opportunity for wetland conservation and restoration to mitigate GHG emissions. Secondly, it has led to the development of a policy instrument. A Wetlands Restoration Protocol is currently being developed in Alberta to provide a market-based incentive to landowners to restore wetlands. The protocol meets the criteria of the Alberta Offset System and supports Alberta's climate change mitigation objectives. Establishing a market-based incentive for wetland conservation and restoration has the added benefit of providing numerous environmental co-benefits including nutrient abatement, increased biodiversity, and flood and drought mitigation. Incentives are an important component of effective wetland policy and the offset system provides the regulatory backstop to advance this type of incentive to private landowners.

The success of the Prairie Canada project has sparked a follow-up study focused on assessing the net GHG balance of restored mineral wetlands in Southern Ontario. This study will also include a focus on the sensitivity of net GHG fluxes to changing climate by combining modeling and laboratory based manipulations of climatic

variables. This will provide critical insights into the impacts of climate change on the long term viability of wetland restoration as an offset for GHG emissions.

### **References**

Badiou, P.H.J., R.M. McDougal, D. Pennock, and R. Clark (submitted) Greenhouse Gas Emissions and Carbon Sequestration Potential in Restored Wetlands of the Canadian Prairie Pothole Region. *Wetland Ecology and Management* (submitted August 2010, in review).

Prairie Habitat Joint Venture 2008. Prairie Habitat Joint Venture Implementation Plan 2007-2012. Report of the Prairie Habitat Joint Venture. Environment Canada, Edmonton, AB. 34pp. (*Revised May 2009*).