Northern Prairie Wetlands and Climate Change
Drought and Ducks on the Prairies

Importanc e of north ern prairie wetlands

The Prairie Pothole Region (PPR) (Fig. 1) contains 5-8 million small wetlands and is one of the most ecologically valuable freshwater resources of the Nation. These wetlands provide abundant ecosystem services, including groundwater recharge, water for agriculture, water purification, and recreation. The PPR is best known as the "duck factory" of North America. By some estimates, this region produces over 50% of the ducks in North America.

Is the climate of the PPR changing?

Climate records indicate that the strong west-east moisture gradient across the PPR steepened during the 20th century, with weather stations in the west becoming drier and stations in the east becoming wetter. The greatest drying occurred in the Canadian Prairies.

Possible future climates

Climatologists forecast increased drought in the PPR under most climate scenarios. Air temperatures in northern and central parts of the PPR may warm 3-6°C by the end of this century. Longer growing seasons, milder winters, earlier springs, and warmer and drier summers are expected.

Linking climate and wetlands

Wetlands in the PPR are likely to be affected by forecasted changes in climate but the magnitude of the impact is uncertain. Climate drives hydrology which controls key wetland processes and services.

Scientists from the U.S. Geological Survey, South Dakota State University, and the University of Montana initiated a study to examine the potential vulnerability of PPR wetlands to changes in temperature and precipitation hypothesized by global climate change models. A simulation model (WETSIM) was used to examine the response of semi-permanent wetlands to climate change.

Model simulations determined that a warmer climate of only a few degrees Centigrade increased evaporation, shortened wetland hydro period, increased drought frequency and duration, and produced less favorable vegetation conditions in semi-permanent wetlands for most of the PPR compared to historic conditions. Unfavorable wetland conditions developed more often in the historically drier western portions of the PPR under a simulated warmer climate.

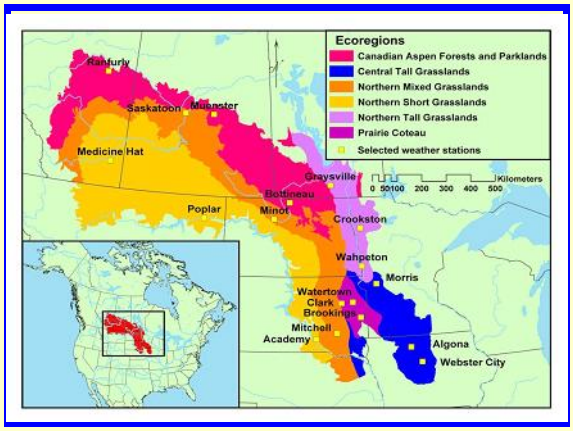

Figure 1. Location of the Prairie Pothole Region and its ecoregions in North America.

Climate Change may pose a long term threat to Prairie Pothole wetlands

- Climatologists forecast increased potential for drought over the next 100 years for the PPR
- The west-east moisture gradient across the PPR has steepened in the 20th century
- Wetland simulation models demonstrate that warmer temperatures produce less favorable semi-permanent wetland vegetation conditions for most portions of the PPR
- Model simulations using modest changes in temperature and precipitation corresponding to conservative climate change scenarios result in eastward shifts in the location of wet wetlands
- Ongoing efforts by conservation groups to protect wetlands and improve waterfowl nesting cover in the PPR's historic "duck factory" should be maximized to increase duck production when wet years do occur. Restoration of wetlands in the eastern portion of the PPR could help diminish the effects of increased drought in a drier west.

Prairie wet land in north-central South Dakota

Prairie wetlands und er future climatic con ditions

Climate scenarios employing modest changes in air temperature and precipitation result in geographic shifts in the location of the most favorable water and vegetation cover conditions associated with semi-permanent wetlands across the PPR (Fig. 2). When precipitation was increased enough to compensate for the greater evaporative demand of the warmer climate (+20%), location of the most productive semi-permanent wetland conditions remained relatively stable geographically. However, when precipitation was decreased or held at historic levels, conditions in nearly all of the PPR became too dry to maintain optimum water and cover conditions in semi-permanent wetlands. These results imply that the climatically drier portions of the PPR, including the historic duck factory, would be especially vulnerable to climate warming because they would become critically dry in most years.

Outlook for waterfowl populations

The geographic shifts simulated by these models suggest that waterfowl populations might be affected in a warmer and drier climate because semi-permanent wetlands that used to provide breeding habitat will be too dry most of the time.

Climate change poses a conservation challenge because the highest wetland densities occur where effects of climate change are predicted to be most severe. Ongoing efforts by conservation groups to protect wetlands and improve nesting cover in the west, however, should be continued to maximize population rebound when wet years do occur. The eastern fringe of the PPR is unlikely to compensate for habitat losses farther west because >95% of wetlands in the east have been drained for crop production. Still, restoration of wetlands and upland nesting habitat in the east, where the climate may become more favorable for waterfowl production could diminish some of the effects of increased drought in the west.

FUTURE WORK

We have expanded our research to investigate the potential for changes in upland land management to ameliorate impacts of climate change on prairie wetlands. Additional work is also underway to address the potential impacts of climate change on more ephemeral wetland types using a new model "WETLANDSCAPE".

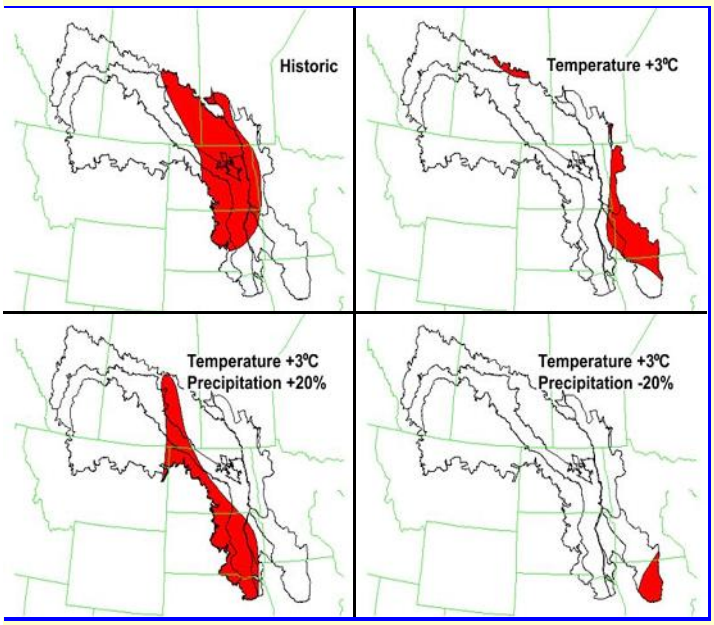

Figure 2. Model simulations that locate the most favorable wetland conditions for breeding waterfowl under historic and alternative future climates (Johnson et al. 2005).

For More Inform ation

Johnso n, W.C., B.V. Millett, T. Gilman ov, R.V. Voldseth, G.R. Guntenspergen, and D.E. Naugle. 200 5. Vulnerability of Northern Prairie wetlands to climate change. BioScience 55:863-872.

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Mallard ducks (*Anas platyrhynchos*).

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