CLIMATE CHANGE AND CONSERVATION IN THE PRAIRIE POTHOLE REGION: A HAPET UPDATE

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Because of their sensitivity to temperature and precipitation, wetlands in the Prairie Pothole Region (PPR) are predicted to undergo changes in number, wet area, and hydroperiod as a result of climate change. The Bismarck Habitat and Population Evaluation Team (HAPET) is in a unique position to address climate change effects on wetlands and wildlife in the PPR, as we have collected spatial data on ~43,000 wetland basins annually over the past 24 years. This period includes the second driest drought of the 20th century and the wettest period in the past 130, possibly 500, years. In addition, HAPET has an extensive library of data and models for waterfowl and other birds, including >1.3 million observations of waterfowl over the same 24-year period.

HAPET wetland data are a product of the Refuge program's annual Four-Square-Mile Survey for breeding waterfowl, which, in addition to assessing populations of breeding waterfowl, provides annual information on wet area of wetland basins at a spatial resolution of one meter. This long-term monitoring program is the foundation of the waterfowl "Thunderstorm Map" and a variety of other spatial planning tools (e.g., Figures 1-3).

The HAPET Office is assessing climate change and potential effects of climate change on wetlands and wildlife in the PPR on several fronts. Our efforts are being conducted with a variety of partners, including Region 3 HAPET, the Prairie Pothole Joint Venture, USFWS Division of Migratory Bird Management, USGS Northern Prairie Wildlife Research Center, USGS Fort Collins Science Center, USGS South Dakota Water Sciences Center, USGS Cryospheric Studies Center, and the Plains and Prairie Potholes LCC.

HAPET wetland data are the most extensive and complete record of wetness of prairie pothole wetlands anywhere and provide an excellent benchmark for assessing future changes to wetlands and wildlife in the Prairie Pothole Region.

Following are brief synopses of several of these projects:

Spatial and temporal variation in prairie pothole wetlands: distinguishing climate effects from natural variation

The HAPET office assessed spatial and temporal patterns in wet area of ~43,000 wetland basins sampled each May from 1988–2007 in the U.S. PPR. High variability in wetness (Figure 2) suggests that monitoring programs designed to detect changes in PPR wetlands due to climate change must be implemented over broad spatiotemporal scales and consider natural and anthropogenic factors that influence water levels as well as different wetland types to be able to distinguish directional change from natural variation. A paper describing this work has just been published in the peer-reviewed journal *Wetlands.*

Climate change and waterfowl conservation in the U.S. Prairie Pothole Region: reducing uncertainty and maintaining benefits

Scenario-based simulations suggest that wetlands in the central and western portions of PPR will become drier, with subsequent reductions in waterfowl carrying capacity and brood survival. Publications based on these scenarios suggest that conservation efforts be shifted east, where

Minor changes in climate can have major impacts on waterfowl-wetland relationships in the Prairie Pothole Region.

wetter conditions prevail. However, duck densities are lower in the eastern PPR, few wetlands and little grassland (which is essential for successful nesting) remain there, and land prices are higher. The HAPET office is analyzing May pond numbers collected across the entire PPR by the Division of Migratory Bird Management over a 37-year period to determine how well scenario-based simulations agree with actual numbers of wet ponds over time. May pond numbers in many strata have increased, and no strata showed significant declines. Our results suggest the need for caution in making substantial changes in priorities and successful conservation programs, as well as the need to rigorously assess indices of climate change and costs of conservation actions relative to benefits acquired. Two manuscripts describing this work are in preparation.

Linking prairie pothole basin wet area to future climate conditions

Before future wetland conditions across the PPR can be accurately modeled, factors influencing individual basin wetness must be better understood. Members of the HAPET office are preparing landcover, climate, soils, wetland, drainage, and topographic data as part of an analysis that will relate these variables to wet area of ~49,000 wetland basins sampled each May from 1987–2009 in the U.S. PPR. Our goal is to identify mechanisms influencing wet area and their relative contribution to changes in wet area. Projected climate data from down-scaled atmosphere-ocean general circulation models developed by USGS partners will then be fed into regression equations developed from this analysis to develop spatially explicit predictions of future wet area of wetland basins. Projections will be applied to species-habitat models predicting the distribution and density of wetland-dependent wildlife under future climatic conditions.

Modeling response of waterfowl to variable climatic conditions

Because waterfowl settling patterns and reproductive effort vary with water conditions, it is essential that models predicting waterfowl response to climate change explicitly consider the range of variation that is expected to be encountered in the future. HAPET's long-term database of spatial waterfowl observations is ideal for this purpose, as it includes observations from extremes of drought

and deluge. HAPET will be working with scientists from the Prairie Pothole Joint Venture and Northern Prairie Wildlife Research Center to parameterize models to better understand waterfowl response to potential changes in wet area of wetland basins.

Waterfowl conservation in a changing climate: modeling future populations

Using downscaled climate data provided by USGS partners and basin-specific water area estimates derived from HAPET models (above), we will apply waterfowl habitat models to predict the distribution and density of waterfowl in the future. These models can then be used in conjunction with data on land costs and land conversion risk to guide future conservation efforts and policy.

Modeling response of waterbirds to variable climatic conditions

Similar to waterfowl, the response of waterbirds such as terns, bitterns, and rails is likely non-stationary, with differing responses to wetland water regimes and availability under different water conditions (Figure 3). HAPET will georeference and combine Breeding Bird Survey data with HAPET's spatially explicit wetness layers to parameterize predictive models and better understand the response of waterbirds to varying amounts of water in wetland basins across time and space.

Waterbird conservation in a changing climate: modeling future populations

We will use downscaled climate data provided by USGS partners and basin-specific water area estimates derived from HAPET models to create water regime-specific landscape-level interpolations of water conditions. Projected wet areas of wetland basins will be linked to regression models predicting the distribution and density of waterbirds in the future. As with waterfowl, these projections can be used in conjunction with other information to guide future conservation efforts.

Figure 1. "Thunderstorm Map" based on waterfowl-wetland relationships shows number of duck pairs that can access land units in the Prairie Pothole Region of North Dakota, South Dakota, Iowa, Minnesota, and northeastern Montana.

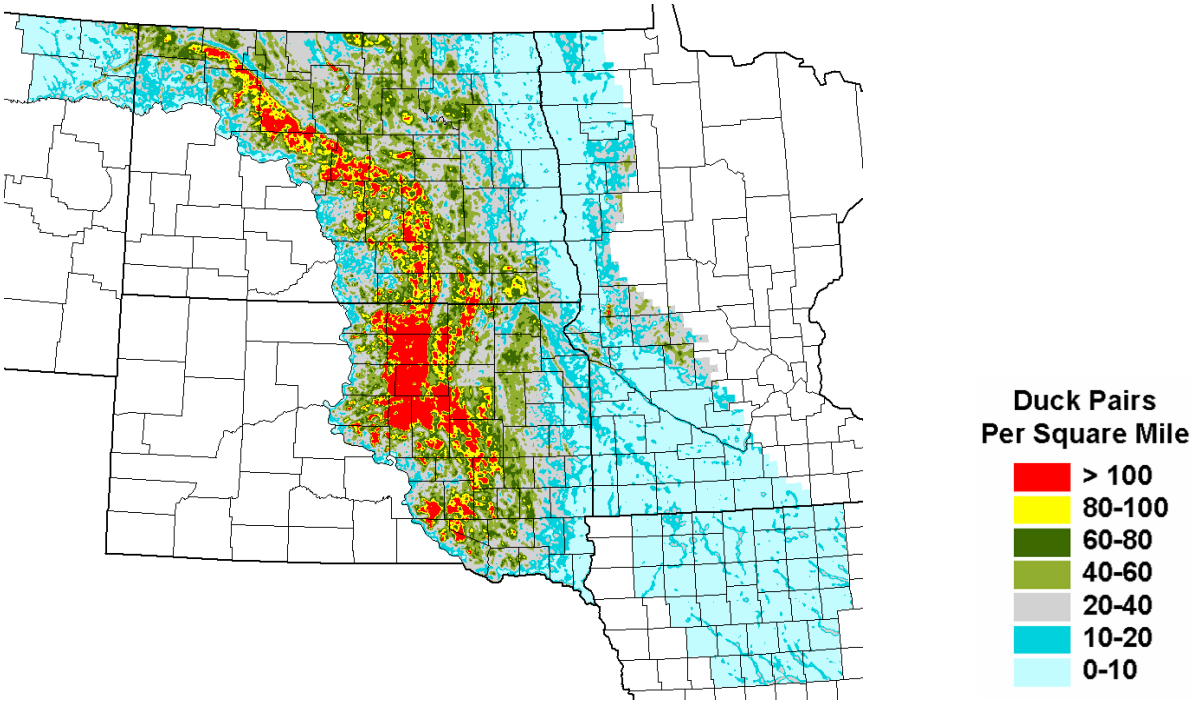

Figure 2. Wet area of temporary (Temp), seasonal (Seas), semipermanent (Semi), and lake wetlands in the U.S. Prairie Pothole Region of North Dakota and South Dakota varied among years, across space, and among water regimes over a 20-year period.

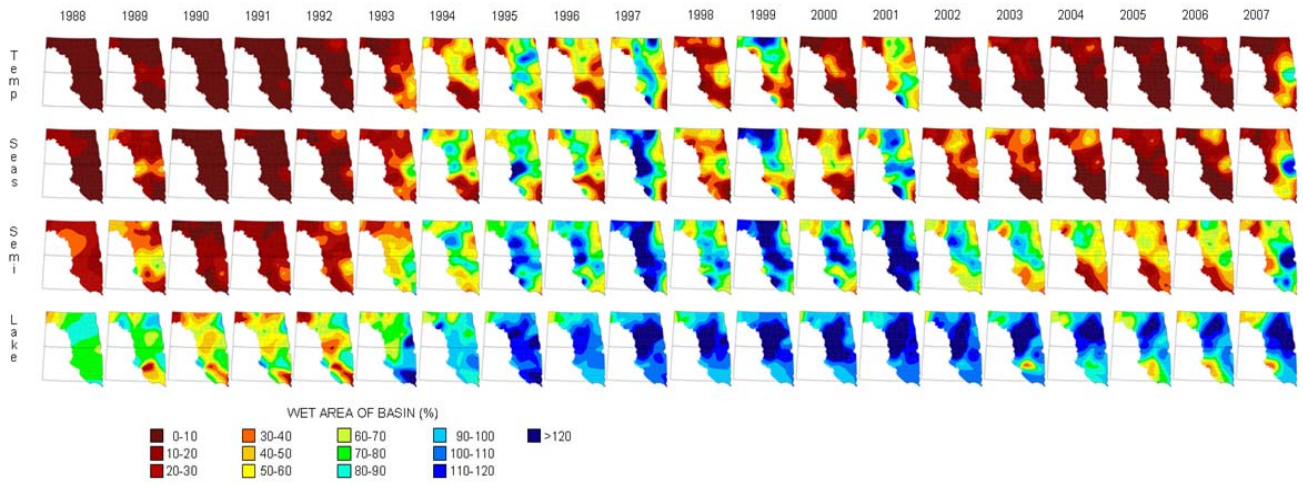

Figure 3. Modeled populations of Sora in the Prairie Pothole Region of North Dakota and Kidder County (inset) varied by more than a factor of four in a dry year (n = 0.6 million, top) and wet year (n = 2.8 million, bottom).