WATERBIRD PLAN

SECTION 4

2017 and 2005 Principal Author:
Neal Niemuth

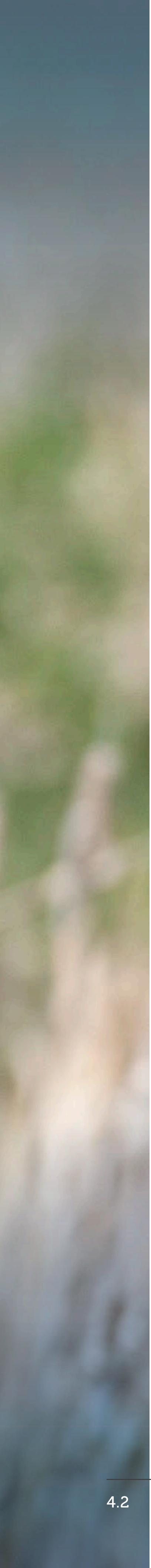

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Photo: Neal & MJ Mishler

BACKGROUND AND CONTEXT

Importance of the Prairie Pothole Region to Continental Waterbird Populations

The myriad wetlands that make the Prairie Pothole Region (PPR) valuable to waterfowl also make it valuable to waterbirds, and the PPR harbors a large proportion of the total population and includes much of the breeding range for many North American waterbird species (Figure 1; Sauer et al. 2014). Information on many waterbird populations is poor relative to waterfowl, but it is estimated that the proportion of the continental breeding population found in the PPR is > 60% for Franklin's Gull; > 50% for Pied-billed Grebe, American Bittern, Sora, American Coot, and Black Tern; and approximately 30% for American White Pelican and California Gull (Table 1; Niemuth et al. 2003). High populations and numbers of waterbird species signify the critical importance of the PPR to continental waterbird conservation.

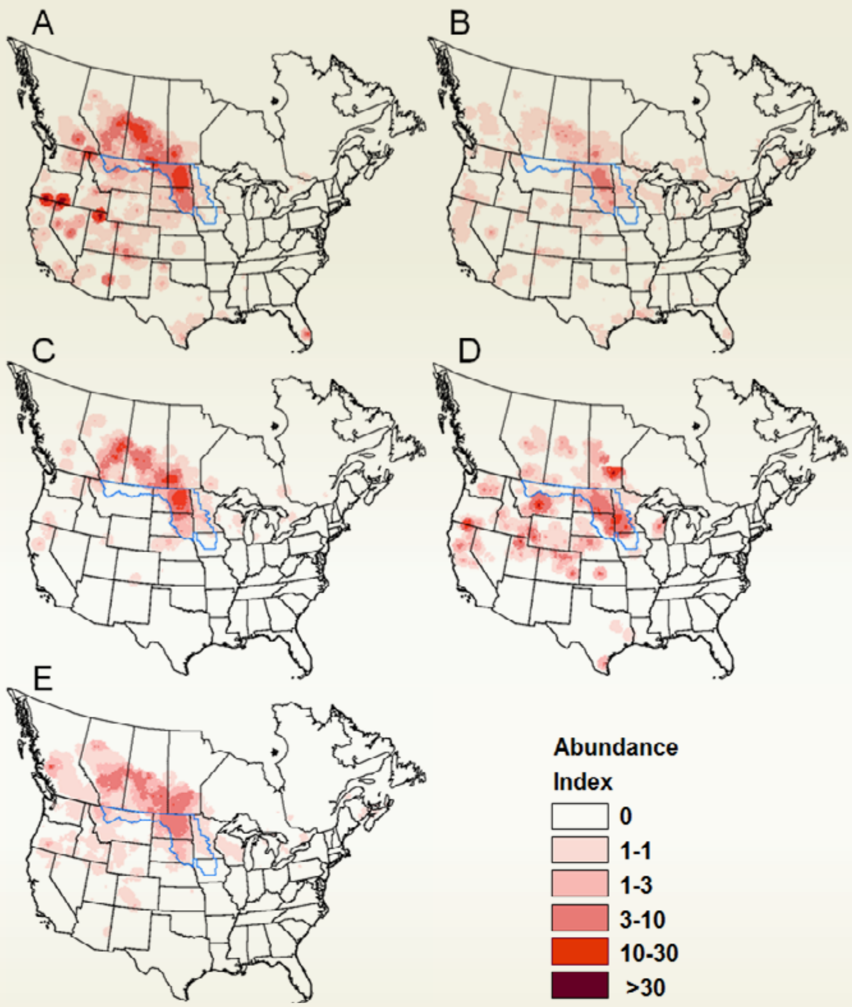

Figure 1. Summer distribution and density of (A) American Coot, (B) Pied-billed Grebe, (C) Black Tern, (D) American White Pelican, and (E) Sora, 2008-2012, as detected by North American Breeding Bird Survey (Sauer et al. 2014). Blue outline indicates Prairie Pothole Joint Venture boundary

Table 1. **Estimated percent of continental population breeding in BCR 11, breeding status, breeding distribution, and conservation priority ratings of waterbird species in BCR 11 (Beyersbergen et al. 2004); population trend estimates for BCR 11 and the North American survey area for 1966-2013 (Sauer et al. 2014). Trends marked "NA" indicate that data are not available or are poorly estimated due to small sample size.**

Common Name	Population in BCR 11 (%)	Colonial or Non-colonial	Breeding distribution	Priority	BCR trend (%/yr)	Continental trend (%/yr)
Common Loon	<1	N	Widespread	Low	NA	0.72
Pied-billed Grebe	>50	N	Widespread	Low	2.29*	0.31
Horned Grebe	10-24	N/C1	Widespread	High	-1.09	-1.61
Red-necked Grebe	<10	N/C	Widespread	Low	2.72*	1.12
Eared Grebe	~20	C/N	Widespread	Moderate	1.48	0.60
Western Grebe	<10	C	Widespread	High	NA	NA
Clark's Grebe	1-9	C	Local	Low	NA	NA
American White Pelican	~30	C	Widespread	Moderate	6.10*	5.06*
D.-crested Cormorant	~15	C	Widespread	Low[2]	5.06*	3.56
American Bittern	>50	N	Widespread	High	0.10	-0.64
Least Bittern	<10	N/C	Widespread	Moderate[3]	NA	0.00
Great Blue Heron	~5	C	Widespread	Moderate	0.42	0.28
Great Egret	<1	C	Peripheral	Low	NA	2.11*
Snowy Egret	<1	C	Peripheral	Low	NA	1.20
Cattle Egret	<1	C	Local	Low	NA	-1.52*
Little Blue Heron	<1	C	Peripheral	Low	NA	-1.52*
Tricolored Heron	<1	C	Peripheral	Low	NA	-0.27
Green Heron	<1	N/C	Widespread	Low	NA	-1.73*
Bl.-crowned Night-Heron	<10	C	Widespread	Moderate	-0.83	-0.62
Yel.-crowned Night-Heron	<1	C	Peripheral	Low	NA	-0.53
White-faced Ibis	<1	C	Local	Low	NA	4.86*
Yellow Rail	Unknown	N	Widespread	High	NA	NA
Black Rail	<1	N	Peripheral	Moderate	NA	NA
King Rail	10-24	N	Widespread	High	NA	-4.58*
Virginia Rail	<10	N	Widespread	Moderate	NA	NA
Sora	>50	N	Widespread	Low[4]	1.99*	0.97
Common Moorhen	10-24	N	Peripheral	Low[4]	NA	NA
American Coot	>50	N	Widespread	Low[4]	1.51	0.12
Sandhill Crane	<1	N	Widespread	Low[4]	8.00*	4.85*
Whooping Crane[4]	-------	N	-------	Listed	NA	NA
Franklin's Gull	~67	C	Widespread	High	-1.49	-3.96*
Bonaparte's Gull	Unknown	C/N	Peripheral	Low	NA	NA
Ring-billed Gull	>5	C	Widespread	Low[2]	0.30	1.77
California Gull	~30	C	Widespread	Low[2]	-1.12	-1.78
Herring Gull	~2	C	Peripheral	Low	NA	NA
Caspian Tern	<1	C	Local	Moderate	NA	-0.18
Common Tern	10-24	C	Widespread	Moderate	-4.27*	-1.44
Forster's Tern	8-10	C	Widespread	Low	0.37	-1.72
Least Tern	<2	C/N	Local	Listed	NA	-3.30
Black Tern	>50	C	Widespread	High	-1.18	-2.33*

[1]N/C: degree of coloniality varies; most typical behavior is listed first.

[2]May be of higher management concern due to problems associated with locally increasing populations.

[3]Federally listed in Canada.

[4]Does not breed in Region.

The North American Waterbird Conservation Plan (NAWCP; Kushlan et al. 2002), was developed to provide a continental perspective on the status of, and conservation efforts for, waterbirds in North America. The NAWCP covers 210 species of waterbirds in 23 families that spend at least part of the year in the NAWCP planning area, which includes the interests of 29 nations in North America, Central America, and surrounding pelagic zones. However, the NAWCP specifically addresses colonial and semi-colonial waterbirds only; solitary breeders were to be addressed in the second version of the NAWCP, which was planned but has not been completed. Some information about population status, monitoring, and conservation of solitary-breeding waterbirds is available on the NAWCP web page, but the material is limited and there do not appear to be plans to rectify the situation. This information gap is particularly significant to the PPR, where 38% of species are generally solitary breeders, as opposed to only 20% of waterbird species across the continent.

The Northern Prairie & Parkland Waterbird Conservation Plan (Beyersbergen et al. 2004) was developed to address waterbird conservation issues specific to the PPR. The Plan describes knowledge, biology, and conservation efforts for 40 waterbird species (Table 1) in the Plan area, which also includes the Canadian Peace Parklands (Figure 2).

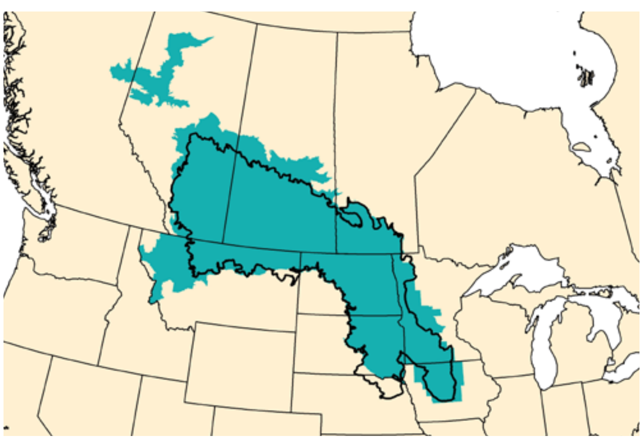

Figure 2. The Northern Prairie and Parkland Waterbird Conservation Region (green shading) consists of those areas covered by the Prairie Pothole Joint Venture (PPJV) in the United States and the Prairie Habitat Joint Venture (PHJV) in Canada and approximates Bird Conservation Region 11 (black outline) in north-central North America.

The overall goal of the Northern Prairie & Parkland Waterbird Conservation Plan is

"To provide guidelines for conservation that, when implemented, result in maintaining and managing healthy populations, distributions, and habitats of waterbirds throughout the Northern Prairie & Parkland Region of North America."

Waterbirds breeding in the PPR spend only a portion of their annual cycle there, and migration corridors, staging areas, and wintering grounds are also vital to waterbird conservation. Continental planning efforts must recognize and support conservation of linkages between different geographic regions, and regional plans should identify and address conservation issues within their respective boundaries.

Landscape Changes and Associated Implications to Waterbirds

Ecological functions are increasingly being lost in portions of the PPR as native habitat is altered or converted to other uses. Because agriculture is the primary land use in the PPR, many of the threats to the ecological integrity of the landscape are related to agricultural practices and programs. Threats can be direct, as in habitat loss from wetland drainage and conversion of grassland to cropland, or indirect, such as pesticide-induced loss of invertebrate populations necessary for growth and survival of birds.

Vast numbers of wetlands already have been converted to other uses in the PPR. Statewide estimates of number of wetlands lost through the 1980s are 89% for Iowa, 49% for North Dakota, 42% for Minnesota, 35% for South Dakota, and 27% for Montana (Dahl 1990). The percentage of surface area lost is smaller than the percentage of number of wetlands, as smaller wetlands, which are easier to drain, are generally drained first. In addition, consolidation of wetlands, where several small wetlands are drained into one larger wetland, is common (Anteau 2012). Loss of small wetlands can disrupt habitat connectivity and reduce diversity and function of wetland complexes (Anteau 2012). Wetland loss continues, especially drainage of wetlands in crop fields, which is particularly high during times of high commodity prices (Dahl 2011, Johnston 2013).

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Conversion of grassland, particularly native prairie, to cropland in the region is extensive and ongoing as agricultural subsidies, new crop varieties, and altered climate enable planting of lands that were previously considered unsuitable for crop production (Stephens et al. 2008, Rashford et al. 2011, Lark et al. 2015). When crop prices are high, farmers are more likely to convert native habitat, including grassland and wetlands, to crop fields. However, agriculture can have a tremendous impact on land use even in the absence of direct market forces. For example, the U.S. Department of Agriculture's Conservation Reserve Program (CRP), which takes land out of production by paying farmers to plant grass on croplands for a contracted time period, paid farmers in North Dakota approximately $100 million per year during the late 1990s. CRP enrollment is particularly important in Minnesota and Iowa, where 68% and 41%, respectively, of grass cover in the PPR portion of each state was CRP in 2006 (Doherty et al. 2013). However, CRP enrollment has fallen dramatically in recent years (Table 2) due to reductions in available program acres and non-renewal of contracts during periods of high commodity prices. As CRP contracts expired in the Midwest between 2010 and 2013, only a small amount (~3%) of the land shifted into similar, non-CRP land-retirement or easement programs, with approximately 30% returning to primarily corn and soybean production (Morefield et al. 2016).

Wetlands in the U.S. presently receive some protection under the Swampbuster provision of the *Food Security Act of 1985* (a.k.a. Farm Bill) and its successors, which deny federal agricultural benefits to farmers who drain wetlands, although wetlands can be farmed in dry years. Swampbuster is important to wetland-dependent wildlife; however, protection under it is temporary, and may be lost as new Farm Bill legislation is enacted. Wetland protection also may be jeopardized by other government regulations and decisions. For example, the U.S. Supreme Court ruled that isolated, non-navigable, intrastate wetlands (such as those typical of the PPR) are no longer protected under Section 404 of the *Clean Water Act of 1972*, which prohibits the dredging or filling of any portion of the waters of the United States without a permit (van der Valk and Pederson 2003).

Table 2. State-wide acres of land enrolled in the USDA Conservation Reserve Program in 2006, acres enrolled in 2015, change in acres 2006-2015, and percent change 2006-2015. State-level data from http://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/Excel/statepayments8615.xls

State	2006 acres	2015 acres	Change (acres)	Change (%)
Iowa	1,958,883	1,484,593	-47,4290	-24.2
Minnesota	1,796,541	1,151,306	-64,5235	-35.9
Montana	3,481,533	1,499,179	-198,2354	-56.9
North Dakota	3,371,661	1,523,997	-184,7664	-54.8
South Dakota	1,515,227	926,266	-58,8961	-38.9
Total	12,123,845	6,585,341	-5,538,504	-45.7

Swampbuster is important to wetland-dependent wildlife; however, protection under it is temporary, and may be lost as new Farm Bill legislation is enacted.

Neal & MJ Mishler

Wetlands can be degraded even if they are not drained, as cultivation of wetland basins during dry years may reduce quality of wetland habitat during subsequent wet years when basins hold water. Marsh plants can survive several years of cultivation, but tillage of basins over extended periods can alter wetland plant community composition and reduce structure of wetland vegetation. In addition, wetlands in agricultural fields may have reduced numbers of invertebrates relative to wetlands in grasslands. Agriculture also has many less obvious, indirect effects that threaten the ecological integrity of the PPR, including siltation and fertilizer and herbicide inputs. Pesticides can decrease reproductive success as well as cause direct and indirect mortality of birds. Pesticides such as carbofuran, chlorpyrifos, and parathion can cause direct mortality of birds, kill invertebrates upon which many waterbirds feed, and contaminate food resources (Grue et al. 1986, Forsyth 1989). Use of neonicotinoid pesticides in the region is increasing, with considerable transport of neonicotinoids into wetlands (Main et al. 2014), resulting in many direct and indirect negative effects for wildlife (Gibbons et al. 2015).

Climate change will alter temperature, precipitation amounts and patterns, growing season, plant evapotranspiration, and a host of related factors such as snow cover, timing of migration, timing and duration of dormancy, species composition of native and agricultural systems, and urbanization, all of which could have dramatic impacts on many aspects of ecology in the PPR. The potential of climate change to reduce wetland water levels, wetland numbers, and waterbird populations has received considerable attention; however, analyses suggesting declines in wetlands over time (i.e., Poiani et al. 1991, Johnson et al. 2005, Johnson et al. 2010, Steen et al. 2016) were based on limited data and scenarios that "did not fully incorporate interacting or potentially overshadowing impacts of land use on wetland hydrology and ecology" (Anteau 2016). Long-term (1974-2013) trends suggest that, contrary to results of scenario-based models, actual May pond numbers in the PPR are stable or increasing and that indirect effects of climate change such as wetland drainage and land conversion may be greater threats to wildlife in the region than direct effects such as drying of wetlands (Niemuth et al. 2014). Increased precipitation and changes in precipitation due to climate change could actually reduce wetland quality for some waterbird species by flooding of emergent vegetation and reductions in nutrient release facilitated by seasonal drying of wetlands.

Exotic species are spreading within the region, including terrestrial species such as leafy spurge and spotted knapweed and wetland/riparian species such as reed canary grass, purple loosestrife and salt cedar. Many ecosystem functions are lost or altered as native species are displaced, nonnative species invade, and natural disturbances such as grazing and fire are altered (Collins and Wallace 1990).

Not all waterbird species have been negatively affected by human-induced landscape changes. Populations of some gull species have increased locally due to increased availability of food associated with humans. In addition, recent expansion of range into the PPR by several heron species may be a consequence of climate change.


Neal & MJ Mishler

Factors Limiting Waterbird Populations

Primary factors limiting waterbird populations in the PPJV administrative area are largely unknown. Advances in understanding limiting factors have not progressed quickly due to funding limitations, the difficulty of studying often-secretive species, large inter-annual fluctuations in population numbers and distribution, and low priority of waterbirds relative to many other species. Loss and degradation of wetland and upland habitats likely limit carrying capacity of the landscape. Carrying capacity may not decline linearly with wetland loss, as some waterbird species (e.g., Yellow Rail) key in on specific wetland types and several waterbird species respond to wetland complexes and structure of vegetation within wetlands (Kantrud and Stewart 1984, Johnson and Dinsmore 1986, Fairbairn and Dinsmore 2001, Naugle et al. 2001). Factors influencing nesting success, chick survival, and adult survival certainly vary among species, but are simply unknown or have only been studied in short, localized studies. It is likely that some of the factors and processes that affect waterfowl populations also affect waterbirds. For instance, composition of landscapes and predator communities might influence nesting success of waterbirds. However, colonial nesting, mobbing of potential predators, and over-water nesting of some waterbirds likely produce patterns of nesting success and survival that differ from waterfowl.

Given limited knowledge about factors limiting waterbird populations and the difficulty and expense of understanding limiting factors for these often-secretive species, it is important that research and resources be applied to clearly identified needs and questions. Overall, most waterbird populations in the PPR are doing well. Of the 40 waterbird species that occur, at least occasionally, in BCR 11, 18 species have trend information with trend credibility estimates (95% intervals). Of those, 6 had positive population trends and 1 had a negative population trend (Table 1). The remaining 11 species had trends not differentiated from stable. At the continental level, 31 species have trend information with trend credibility estimates (95% intervals). Of those, 4 had positive continental population trends and 6 had negative continental population trends (Table 1). The remaining 21 species had trends not differentiated from stable.

Biological Models for Waterbirds

Models are generalizations that can help managers understand relationships between species and habitat, with the end goal of increasing efficiency of conservation. Biological models for waterbirds vary among species, as well as with spatial and temporal scales. Waterbird habitat and behaviors vary throughout the year. Birds may use one habitat or area for courtship, another for nesting, another for brood-rearing, and still others for post-breeding molt and pre-migration staging. Availability of wetland habitat also may vary among years depending on precipitation. On a spatial scale, waterbird habitat may be characterized at nest site, wetland, wetland complex, and landscape scales, among others.

Colonial waterbirds may be subdivided according to the substrate that they choose for nesting. In general, these species may nest on floating vegetation platforms or islands, or in trees or tall shrubbery. With few exceptions, most species fall neatly into one of these categories. Species using the same nesting substrate often are found nesting in association with other colonial waterbirds. Species nesting on vegetation platforms in marshes include the Eared, Western, and Clark's Grebes; Black-crowned Night-Heron; White-faced Ibis; Franklin's Gull; and Forster's and Black Terns. The solitary nesting American Coot may be found nesting with these species. Among the island-nesting species, American White Pelicans; Double-crested Cormorants; California, Herring and Ring-billed Gulls; and Caspian and Common Terns often are found nesting together. Tree-nesting species include most of the herons and Double-crested Cormorants in some areas. Tree-nesting colonies may be composed of single species, or, especially in the southeastern portion of the BCR, many species. Non-colonial species may nest on floating platforms of vegetation, in emergent vegetation over water, or on the ground in drier sites such as sedge meadows, or even in dry upland vegetation. Cranes build a mound of vegetation that may be constructed in shallow water on or near the edge of a wetland. Waterbirds also can be categorized by their preference for a general type of wetland utilized for nesting during the breeding season in the PPR (Table 3; adapted from Beyersbergen et al. 2004).

Wetlands in Group A generally have extensive stands of emergent vegetation. These sites range from flooded sedge meadows to cattail or bulrush stands in deep water marshes and may be seasonal to permanent wetlands. Group B wetlands include mostly larger, permanent freshwater marshes with patches of emergent vegetation interspersed with open water. Wetlands in Group C have emergent vegetation (e.g., sedges, rushes, Phragmites) with extensive areas of open water. Some shallow-water marshes are included in this set, but the majority are deep-water marshes or lakes. Group D wetlands are typified by the presence of wooded areas that serve as nesting sites on islands, flooded stands of trees, or uplands near the wetland; some waterbirds using this group also will nest on barren sites. Finally, Group E includes wetlands or waterways with an island (vegetated or barren), sandbar, or exposed shoreline. Although these species are separated into general categories, habitat preferences will overlap across the region. Many wetlands have multiple vegetation zones based on basin substrate and water depth; distribution and structure of vegetation in a basin may change depending on variation in water levels. Maintaining appropriate interspersion of vegetation and wetland complexes is important because waterbirds may use multiple zones throughout the year or in different years.

Table 3. General waterbird habitat preferences based on amount of emergent vegetation, open water, and preferred nesting habitat.

GROUP				
A	**B**	**C**	**D**	**E**
Wetland with - much emergent vegetation - variable open water	Wetland with - emergent vegetation - partial open water	Wetland with - emergent vegetation - extensive open water	Wetland with - emergent vegetation - open water - nesting trees	Lake or River with - open water - barren ground - islands
American Bittern Least Bittern Black-crowned Night-Heron Yellow Rail Black Rail King Rail Virginia Rail Sora	Sandhill Crane Franklin's Gull Bonaparte's Gull Forster's Tern Black Tern	Common Loon Pied-billed Grebe Horned Grebe Red-necked Grebe Eared Grebe Western Grebe Clark's Grebe White-faced Ibis American Coot Common Moorhen	Great Blue Heron Great Egret Snowy Egret Tricolored Heron Little Blue Heron Cattle Egret Green Heron Yellow-crowned Night-Heron	American White Pelican Double-crested Cormorant Ring-billed Gull California Gull Herring Gull Caspian Tern Common Tern Least Tern

Waterbirds also select habitat on a broader spatial scale that encompasses characteristics of landscapes. Conservation planning at the landscape level is appropriate for several reasons. As mentioned previously, bird habitat selection is hierarchical and influenced by a variety of biotic and abiotic factors, with birds first selecting habitat at broad scales, then making fine-grained selections such as nest and foraging sites (Johnson 1980, Wiens 1989). Landscape-level conservation thus provides a broad habitat foundation within which birds can select habitat at a fine-grained scale. Landscape characteristics also are important from logistical and management standpoints. If habitat is purchased or otherwise selected for management based on landscape characteristics, local characteristics (e.g., vegetation composition and structure) within a patch can be modified relatively easily. But it is difficult to modify the landscape around a patch with suitable local characteristics if landscape characteristics are not suitable. For these reasons, most bird conservation initiatives (e.g., North American Waterfowl Management Plan, Partners In Flight, North American Bird Conservation Initiative) explicitly promote a landscape approach to bird conservation.

Habitat selection varies among species, but available information indicates that many waterbirds are

Casey Stemler

strongly influenced by proximity to other wetlands, presence of grassland/wetland complexes, and presence or absence of trees (Brown and Dinsmore 1986, Naugle et al. 1999, Fairbairn and Dinsmore 2001, Naugle et al. 2001, Niemuth et al. 2008). Obviously, fine-grained habitat characteristics also influence use of wetlands by waterbirds, but broad-scale features can be used to assess suitability of landscapes for waterbird conservation planning. For example, Black Terns in South Dakota were positively associated with total wetland area, area of semipermanent wetlands within a complex, and amount of grassland surrounding wetlands (Naugle et al. 2001). Analysis of BBS data from North Dakota and South Dakota indicates that Black Terns were positively associated with amount of seasonal wetland, semipermanent wetland, and grassland surrounding survey points and negatively associated with forest cover; detection was also influenced by geographic location and observer ability (Figure 3).

Development of spatially explicit habitat models throughout the PPJV administrative area is ongoing; existing models continue to be refined and new models are developed for additional species as appropriate data become available (Figure 4).

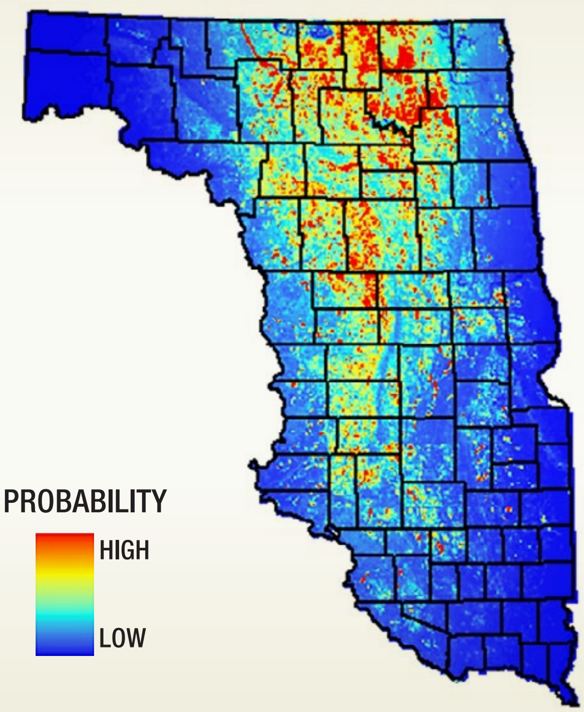

Figure 3. Estimated probability of detecting Black Tern in the Prairie Pothole Region of North Dakota and South Dakota in June of 1995. Model developed using georeferenced BBS data, digital National Wetlands Inventory data, and landcover information derived from Landsat Thematic Mapper imagery (Niemuth et al. 2005).

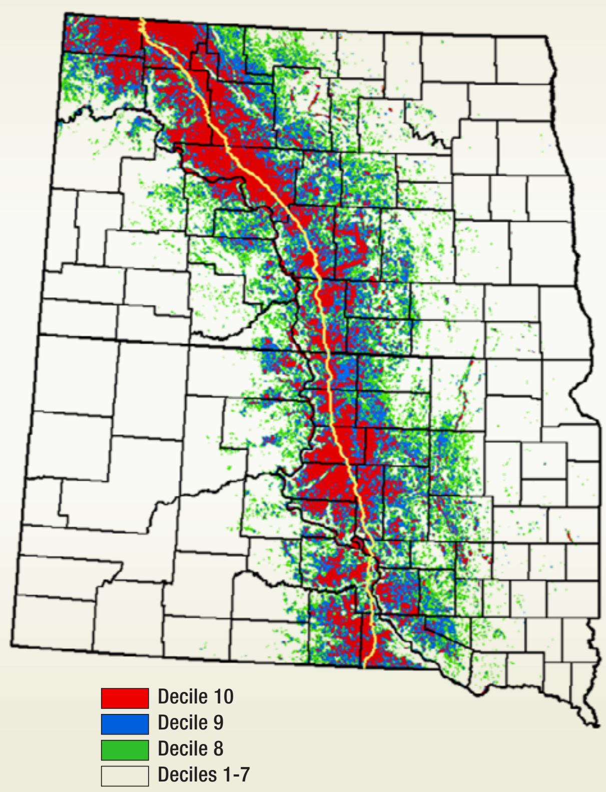

Figure 4. Whooping Crane habitat in North and South Dakota was identified and ranked by decile. The landscape was divided into equal-area units, each covering 10% of the analysis region. In this model, the top three deciles captured 78% of 427 independent, unbiased validation observations. The centerline of the migration corridor is shown in yellow.

Chuck Loesch

PAST TRENDS AND POPULATION DISTRIBUTIONS

Populations of many waterbird species are poorly understood and available population data are often imperfect. Nevertheless, available data indicate population declines for several species, which is a logical outcome of the extensive wetland and upland habitat loss that has taken place in much of the PPR. Whooping Crane and the interior population of the Least Tern are listed as endangered species in the U.S., and the Northern Prairie & Parkland Waterbird Conservation Plan identifies Western Grebe, Franklin's Gull, Black Tern, Horned Grebe, American Bittern, Yellow Rail, and King Rail as species of high concern (Table 1).

Wetland numbers in the PPR vary greatly across space and among years due to high inter-annual and regional variation in precipitation (Figure 5; Kantrud et al. 1989, Woodhouse and Overpeck 1998). Although the effect of wetland availability on breeding distribution and density of waterbirds is poorly known, limited information indicates that waterbirds are affected in a manner similar to waterfowl. Numbers of several waterbird species are positively correlated with number of May ponds (Figure 6; Niemuth and Solberg 2003), and changes in Black Tern populations in the prairie provinces of Canada are correlated with changes in Mallard populations, both of which vary with availability of wetlands (Peterjohn and Sauer 1997).

Fluctuations in waterbird numbers in response to wetland availability may be particularly important in the PPR, which is highly susceptible to drought and harbors a large proportion of the breeding populations of several species of waterbirds. Understanding the relationship between wetland numbers and waterbirds is likely as critical to the monitoring and management of waterbird populations in the PPR as it is for waterfowl. For example, if birds settle in different areas depending on water availability, apparent changes in local and regional populations may reflect wetland conditions instead of true population changes.

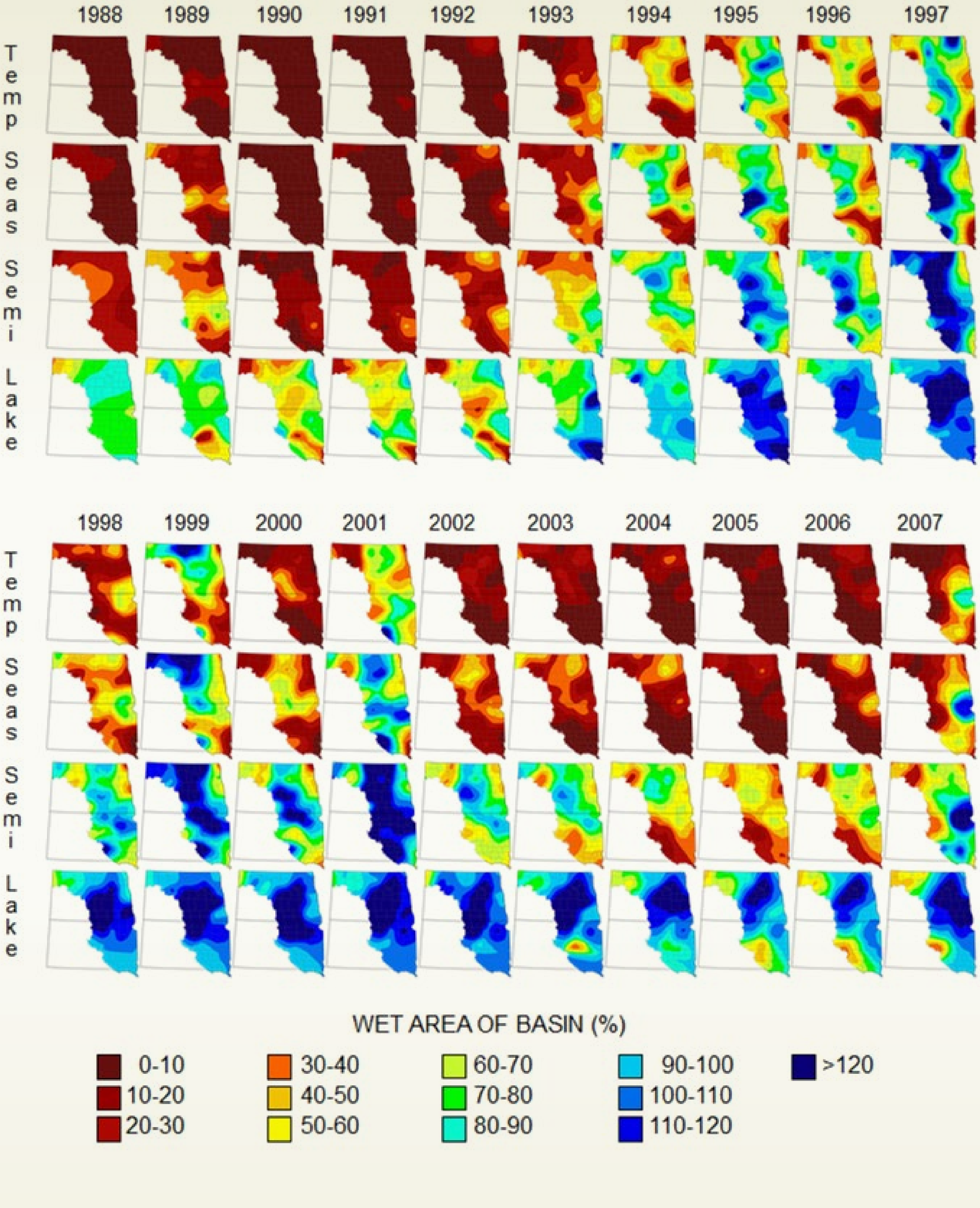

Figure 5. Interpolated wet area (%) of temporary (Temp), seasonal (Seas), semipermanent (Semi), and lake wetland basins varied spatially and temporally within and among wetland water regimes in the Prairie Pothole Region of North Dakota and South Dakota, 1988-2007 (Niemuth et al. 2010).

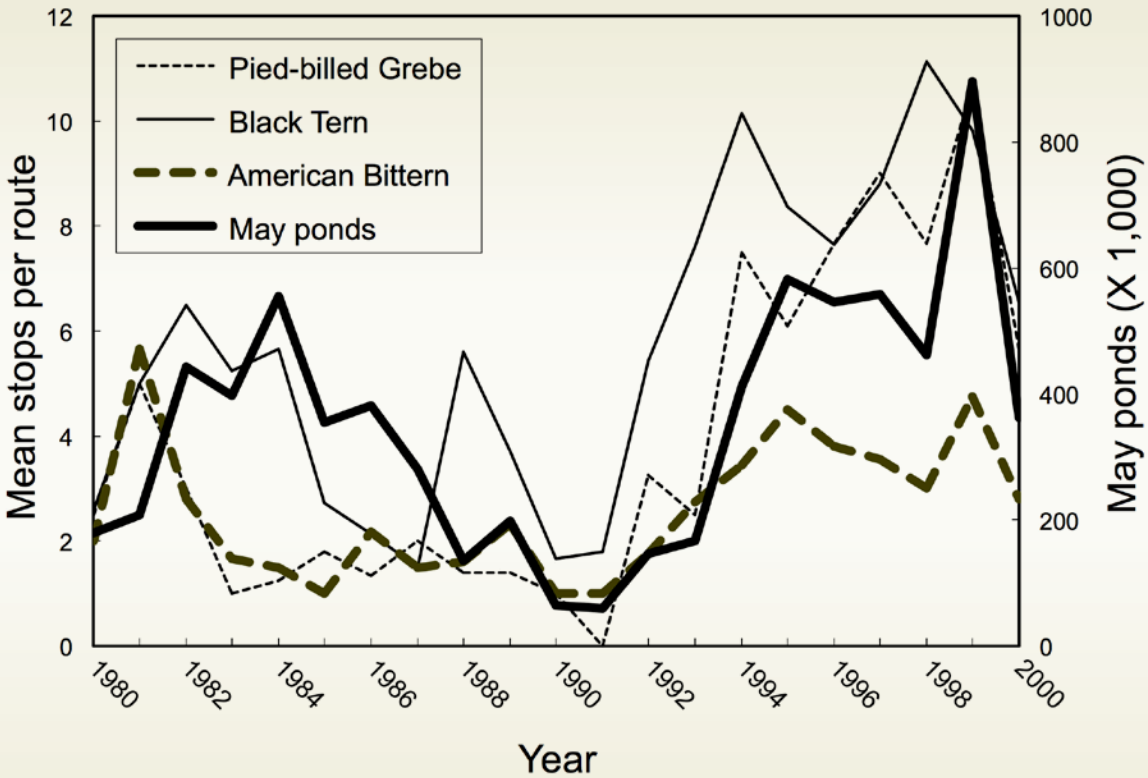

Figure 6. Relationship between wetland numbers and detection of Pied-billed Grebe, Black Tern, and American Bittern in north-central North Dakota, 1980-2000.

BIOLOGICAL FOUNDATION

Healthy wetland complexes are the biological foundation of waterbird conservation in the PPJV administrative area and are influenced by a multitude of factors. For example, changes in water availability can alter habitat and influence local distribution and behavior of waterbirds. Temporal variation in water levels creates the "reservoir effect," which influences productivity of wetlands and, potentially, their suitability for waterbirds. Changes in water levels also encourage horizontal zonation of emergent vegetation, which is important to many species of waterbirds. Population movements, foraging tactics, breeding seasonality, prey availability, susceptibility to predation, foraging sociality, competition, nest site selection, and nest site tenacity of waterbirds all can be influenced by water availability, although effect varies with species and location. Ultimately, altered behavior, prey availability, and susceptibility to predation can affect local reproductive success and population size. Effects of water availability on waterbirds also may be influenced by water availability in other regions.

Other local conditions such as land use can also influence a wetland's ability to support waterbirds. Agricultural practices can affect the prey base, turbidity, and vegetation characteristics of a wetland, all of which will affect the wetland's ability to support waterbirds. It is important to note that the biological foundation is always changing, both in terms of habitat and changing climate conditions (e.g., loss of wetlands, altered water regimes due to extended wet periods, altered composition of waterbird communities, consolidation of wetlands).

Measures of Performance

Measuring the performance of conservation actions on waterbird populations will be difficult given the limited information available on most waterbird species in the PPJV administrative area. Wildlife populations are often assessed in terms of presence/absence, density, long-term population size, and demographic performance, with the cost of assessment typically increasing in the same order. Except for a few isolated cases (e.g., monitoring of the American White Pelican colony at Chase Lake NWR), information on reproductive success of waterbirds in the PPJV administrative area will be lacking or limited. Targeted surveys will provide information on presence/absence and density of waterbirds, and, over time, these surveys will provide insight into long-term population size. However, such surveys provide limited insight into the mechanisms behind population dynamics, as well as how populations within the survey area relate to populations outside the survey area. For all these reasons, it will be important to focus monitoring, conservation, and assessment efforts on priority species, questions, and landscapes.

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Assumptions and Key Uncertainties

Given the paucity of information about waterbirds in the PPR, many assumptions necessarily have been made in developing planning tools for waterbirds. As more information is gathered to increase understanding and aid conservation of waterbirds in the PPR, the following key assumptions should be re-evaluated. First, we have assumed that waterbirds enjoy substantial benefits from waterfowl conservation activities in the Region, which is supported in part by preliminary analyses by the HAPET office. Priority waterfowl areas, defined as those areas accessible to > 60 pairs of upland-nesting ducks, cover 57% of North Dakota and South Dakota and contained 68% of predicted Black Tern populations, which is an improvement over the 57% one would expect by chance. Acquisition of easements for conservation, which primarily targets areas of high waterfowl densities, therefore also benefits Black Terns (Figure 7). However, the response to waterfowl conservation actions will vary among waterbird species, which have diverse habitat requirements. Finally, the assumption that landscapes are the appropriate scale for conservation planning should be evaluated. This may be particularly important given the value of wetland/upland complexes to waterbirds and the dynamic nature of the PPR.

Research Needs

Reliable, comprehensive population information that incorporates wetland availability and landscape context is the foremost information need identified in the NPPWCP. Specific, high priority research and information needs pertinent to the PPJV administrative area include:

» Accurate distribution, abundance, and population trend data for all species, particularly non-colonial waterbirds.

» An understanding of habitat requirements at local and landscape levels for all waterbirds with emphasis on priority species.

» An understanding of factors affecting survival and productivity.

» Knowledge of the response of different waterbirds to various management treatments.

The plan recommends a landscape approach to help integrate conservation planning for waterbirds with conservation planning for other species, particularly extensive, ongoing waterfowl conservation efforts. Priority recommendations for implementation of the plan include:

» Completion of region-wide wetland inventory, to be updated at regular intervals.

» Completion of region-wide upland habitat inventory, to be updated at regular intervals.

» Initiation of standardized, region-wide surveys for colonial and non-colonial species.

» Development of statistically sound, defensible estimates of distribution, abundance, and population trends for all waterbird species.

» Understanding habitat requirements at local and landscape levels for all waterbirds.

» Development of region-wide spatially explicit habitat models for waterbirds.

Since development of the NPPWCP, additional information needs that have been identified include:

- **Development of an understanding of the effects of neonicotinoid insecticides on wetland invertebrates and food chains.**
- **Understanding effects of wetland consolidation on waterbird populations and communities.**
- **Understanding effects of changes of the Farm Bill on land use and wetland conversion and their effects on waterbirds.**
- **Understanding the effects of tile drainage on wetlands and waterbird populations.**

As mentioned previously, spatially explicit habitat models have been developed for some species to guide waterbird conservation planning in the PPJV administrative area. However, the low numbers and cryptic nature of some species (e.g., Yellow Rail) hamper data collection and development of rigorous models. Implementation of standardized, region-wide surveys will provide a georeferenced species database that will serve as the foundation for development of additional spatial planning tools. Other decision support tools for waterbird conservation, such as assessments of risk of wetland drainage, will be developed in conjunction with ongoing waterfowl conservation efforts.

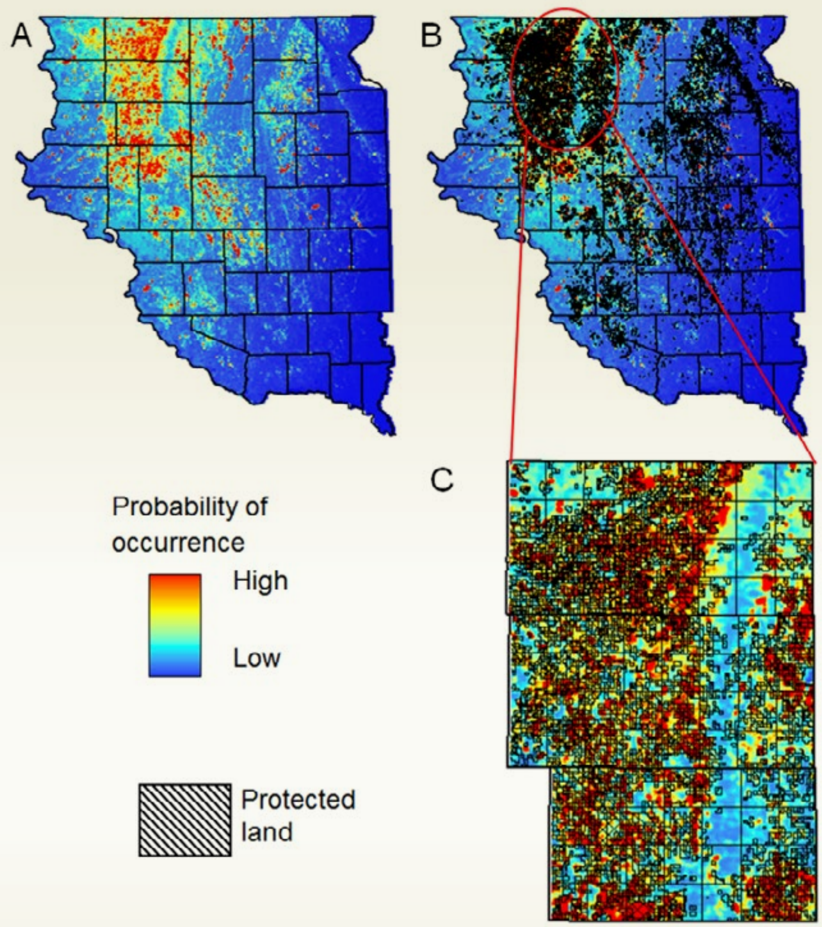

Figure 7. Predicted probability of occurrence of Black Tern in the Prairie Pothole Region of South Dakota (A); protected lands (national wildlife refuges, waterfowl production areas, grassland easements, and wetland easements) in relation to predicted black tern occurrence (B); and protected lands in relation to predicted Black Tern occurrence in McPherson, Edmunds, and Faulk Counties, South Dakota (C).

Kevin Barnes

IMPLEMENTATION FRAMEWORK

Given the voluntary nature of joint ventures and present lack of support for waterbird conservation, it is difficult to identify specific roles and assign duties for more than a few tasks. The Habitat and Population Evaluation Team (HAPET) offices in Bismarck, North Dakota and Fergus Falls, Minnesota will be responsible for development of spatial planning tools for waterbirds. As additional spatial planning tools become available, the HAPET offices will be better able to (1) quantify the extent of waterbird habitat conservation that has occurred because of waterfowl conservation efforts; (2) identify priority waterbird conservation areas that are presently unprotected and have potential to be protected through waterfowl conservation efforts; and, (3) identify priority waterbird conservation areas that are presently unprotected and need waterbird-specific programs and funding for conservation.

We assume that ongoing waterfowl conservation efforts will continue to have benefits for waterbirds. Acquisition of wetland and grassland easements will likely continue to be the primary focus of conservation actions, followed closely by restoration and enhancement projects. Given the large amount of privately owned land in the PPR, private lands programs are invaluable. Matching funds provided by state and nongovernment partners will continue to be critical for securing NAWCA grants, which provide the primary funding mechanism for wetland creations and restorations that benefit waterbirds.

OVERALL GOALS AND OBJECTIVES

Highest priority conservation issues affecting waterbirds in the PPR are:

- Loss and degradation of wetland habitats, which directly affects all waterbird species throughout the PPJV administrative area.
- Loss and degradation of upland habitats surrounding wetlands, which directly affects most waterbird species throughout the PPJV administrative area.

Because of limited information on population sizes for waterbirds in the PPR, population goals were not set in the Northern Prairie & Parkland Waterbird Conservation Plan. For colonial species where fairly accurate population estimates exist, the plan identified refining estimates and setting a "no-net loss" of population size as a reasonable first step. For species identified as potentially over-abundant, management strategies should ensure these species are not detrimental to the environment or other bird species using similar habitats. The next step the plan identified is accurate and range-wide surveys of existing and potential colonial breeding sites within the PPR to refine population estimates. For species lacking concrete population estimates, the plan recommended determining population trends. This focus would cover most non-colonial species. The baseline for all species should be "no net loss." For species where numbers are extremely low and the PPR has a high level of responsibility, the plan identified better population estimates and increased populations as goals. In some cases, local populations of Double-crested Cormorant and some gull species may need to be lowered to reduce depredation of Piping Plover eggs and young and also to reduce conflicts with humans.

Protection Objectives

The first protection objective for waterbird conservation in the PPJV administrative area is protection of existing wetlands and grassland. Areas to be conserved can be prioritized through application of spatially explicit habitat models; risk assessment (i.e., risk of conversion) should also be included in the prioritization process. Retention and development of wildlife-friendly agriculture programs (e.g., "Swampbuster" provision in the Farm Bill) will have a major impact on waterbird conservation in the PPR by helping preserve the existing wetland and upland habitat base. Specifically addressing waterbird conservation issues in the PPR necessitates that limited resources directed toward waterbird conservation are strategically applied by considering spatial distribution of priority species and dynamics of annual water conditions.

Restoration Objectives

Because deep-water wetlands are less likely to be drained, shallow wetlands, including fens, wet meadows, and sedge meadows should be highest priority for restoration. Restoration of uplands surrounding wetlands is also important, as some waterbird species use uplands for foraging and nesting, and grassy uplands improve water quality and suitability of wetlands for waterbirds.

Chuck Loesch

Enhancement Objectives

Development of biological models will help identify key components of waterbird habitats. Application of spatially explicit models and their composite data layers will help identify areas where key components (e.g., certain wetland types or complexes, grassland) are missing. These components can then be selectively restored or added to enhance the area for waterbirds.

For some species and objectives, small, focused monitoring projects may be appropriate.

MONITORING AND ADAPTIVE MANAGEMENT

Waterbird monitoring in the PPR is presently limited to the North American Breeding Bird Survey (BBS) and a few localized, short-term surveys. BBS data likely provide an index that is useful for tracking populations of some common species of waterbirds (e.g., Sora, Black Tern), but the design of the BBS limits detection of nocturnal and rare species. Habitat along BBS routes is often thought to be non-representative of the broader landscape, but analysis of NWI data in the PPR of North Dakota and South Dakota indicates that the BBS accurately represents area of temporary and seasonal wetlands, adequately represents area of semipermanent wetlands, but significantly under-represents area of permanent wetlands and lakes (Niemuth et al. 2007).

A standardized survey protocol and a sampling design framework have been developed for monitoring secretive marshbirds (Johnson et al. 2009, Conway 2011). Given the large amount of privately owned land in the PPR and logistical issues associated with pre-dawn travel in wetlands, a broad-scale marshbird monitoring effort will likely require that some, if not many, surveys are conducted from roadsides. Understanding how marshbird presence and detection are influenced by proximity to roads is critical to interpreting data from roadside surveys; preliminary data (Terry Shaffer, personal communication) from studies conducted in 2008-2009 by researchers at Northern Prairie Wildlife Research Center indicate that occupancy of wetlands was not affected by proximity to roads for any of the six species (American Bittern, Black Tern, Least Bittern, Pied-billed Grebe, Sora, and Virginia Rail) under consideration. However, detection of Black Tern, Sora, and Virginia Rail was slightly higher from roads than at off-road sites. Overall, roadside surveying does not appear to be a serious problem for marshbird monitoring in the PPR.

Development of a regional waterbird monitoring program has been considered a high priority for the PPR, as it can provide information on distribution, density, and long-term numbers of priority waterbird species. However, information gained from the survey, derivative products, and resultant improvements in conservation efficiency must be weighed against the significant cost of collecting the data relative to current understanding of waterbird population trends obtained from BBS data. For some species and objectives, small, focused monitoring projects may be appropriate.

Development of a regional waterbird monitoring program has been considered a high priority for the PPR, as it can provide information on distribution, density, and long-term numbers of priority waterbird species.

PROGRAM DELIVERY, COORDINATION, AND TIMETABLE

Given the voluntary nature of joint ventures and present lack of support for waterbird conservation, it is difficult to identify specific roles and assign duties for more than a few tasks. In the U.S., the Habitat and Population Evaluation Team (HAPET) offices in Bismarck, North Dakota and Fergus Falls, Minnesota will be responsible for development of spatial planning tools and evaluation and implementation of regional waterbird surveys. We will coordinate PPR-wide efforts with Prairie Habitat Joint Venture partners (e.g., Bird Studies Canada) and strive to step down continental goals to the regional/joint venture level as time and funding allows us to specifically address waterbird conservation goals and objectives.

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