PLATTE RIVER WHOOPING CRANE MAINTENANCE TRUST, INC.

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10 October 2000

David Carlson
US Fish & Wildlife Service
203 W Second St
Grand Island NE 68801

Re: Cooperative Agreement No. 1448-60181-00-J518

Greetings, Dave:

Enclosed is a copy of a draft study plan for the project entitled "Evaluating the development and effectiveness of wet meadow restorations in the central Platte River valley" (FWS Cooperative Agreement No. 1448-60181-00-J518). As requested, the Trust is providing names of the following potential expert reviewers for the study plan:

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If you have any questions or need more information, please feel free to contact me. Thank you.

Sincerely,

Paul J. Currier
Executive Director

Draft Study Plan—10 October 2000

Evaluating the development and effectiveness of wet meadow restorations in the central Platte River valley

Cooperative Agreement 1448-60181-00-J518 between the U.S. Fish and Wildlife Service and the Platte River Whooping Crane Maintenance Trust

Introduction

Riparian wet meadows are essential to habitat conservation and restoration efforts on the central Platte River. The meadows, and the wetlands within them, are important foraging habitats for numerous species of migratory birds—including sandhill cranes (*Grus canadensis*) and the endangered whooping cranes (*Grus americana*)—providing foods that are necessary for successful migration and nesting (U.S. Fish and Wildlife Service 1997).

Native wet meadows on the Platte River are a mosaic of prairie and wetland plant communities that usually occur within 1-2 miles of the river channel and that have a hydrologic connection with the river. Although wet meadows are generally flat, alluvial deposition and erosion have created a "corrugated" topography of linear, sinuous sloughs as well as sand ridges. This topography results in an undulating pattern of hydric and mesic plant communities that is very attractive to wildlife. While topographic relief typically is less than 3 m, wet meadow plant communities are highly diverse, ranging from emergent aquatic (e.g., bulrush [*Scirpus* spp.], arrowhead [*Sagittaria latifolia*]) in the bottom of the sloughs, to mesic tallgrass prairie (e.g., big bluestem [*Andropogon gerardii*], Maximillian's sunflower [*Helianthus maximillianus*]), to upland sandhills prairie (e.g., prairie sandreed [*Calamovilfa longifolia*], sand lovegrass [*Eragrostis trichodes*]) on the tops of the ridges. The high diversity of wet meadows (up to 300 species within the plant community alone) makes them resilient in the face of major disturbances such as floods or droughts.

Despite their importance to the integrity of the ecosystem, wet meadow habitats along the central Platte River have undergone dramatic change and serious degradation. As a result of diversion and regulation of the Platte River's flow, primarily for irrigated agriculture and hydroelectric power generation, much less water is available from the Platte River to support the native meadows. This has caused drying of many wetlands and has allowed meadows to be leveled and converted to crop land. Because of this and other forms of habitat alteration, at least 75% of the Platte's native meadows have disappeared (Sidle et al. 1989, U.S. Fish and Wildlife Service 1997). Wet meadows are even rarer, comprising less than 5% of the acres).

The National Audubon Society has completed two restorations at its Lillian Annette Rowe Sanctuary, a low diversity restoration planted in 1995 (80 acres) and a high diversity restoration planted in 1998 (30 acres; seed was provided by the Trust). Audubon did not incorporate wetland construction into either of its restoration projects.

The Central Platte Natural Resources District is currently sponsoring three demonstration projects to test "alternative" methods for enhancing wet meadows along the Platte River (Central Platte Natural Resources District et al. 1998). The projects are testing a variety of surface water application techniques in combination with deepening existing slough or depression wetlands. Except for one, however, all these demonstration projects are being implemented in degraded meadows rather than highly disturbed crop fields. Similar surface water application techniques have been tested in the past by the Platte River Trust, the U.S. Fish and Wildlife Service, and others and have met with very limited success. The Central Platte NRD demonstration projects are still being evaluated.

Indicators of wet meadow function and restoration success

Hydrology is likely the single aspect of the physical environment that has the most pervasive influence on wet meadow function. It is the fundamental underlying factor that determines the type and character of a wetland. Without surface or shallow ground water, a wetland simply would not be a wetland (U.S. Army Corps of Engineers 1987). Hydrology, together with the substrate (e.g., soil), influences the type of plant community that develops on a wetland, which in turn influences the animal communities that utilize this important habitat. Besides simply having water, the seasonal pattern of this surface and subsurface water through time, called the hydroperiod, can vary greatly among wetland types (Mitsch and Gosselink 2000). For example, the wet meadows and lowland grasslands of the Platte River in central Nebraska have a hydroperiod characterized by shallow standing water or saturated soils in the spring, followed by declining water levels throughout the growing season (Wesche et al. 1994). In late summer, water levels range from 1-2 m below the surface, but periodic summer thunderstorms occasionally raise the water level to near or above the surface for short periods. Within these wet meadows and lowland grasslands, the topographic position determines the water table depth as the landscape repeatedly alternates from swale to ridge above the water table. Topographic relief can vary as much as 3 m from the bottom of a swale to an adjacent ridge but typically varies about 1 m in most areas.

When the Platte River Trust reclaims crop fields, a portion of the topography that was removed is restored, and this should create a variety of sites with different surface and ground water depths, which in turn should create a variety of wetland plant and animal communities. If historic river flows were present, the restored sloughs could approximate the depth found in the remaining native meadows and habitat quality because of their sensitivity to water chemistry, substrate composition, and plant community structure (Resh et al. 1996, Karr and Chu 1998). Within the Platte River system, wetland invertebrate communities strongly reflect the hydrologic regime also, and they represent concentrated areas of high productivity and biodiversity within a meadow (Goldowitz and Whiles 1999, Whiles et al. 1999, Alexander and Whiles 2000, Whiles and Goldowitz 2000). Although colonization by aquatic invertebrates can proceed relatively rapidly within natural systems (Mackay 1992), little is known about the development of these communities in the constructed wetlands within meadow restorations in the Platte.

Invertebrates inhabiting wet meadows encompass a wide range of functional groups, life-history strategies, and habitat preferences. In addition, they are sensitive to microhabitat changes, play an important role in nutrient cycling, and are critical food resources for a wide variety of other meadow species. Since they comprise a vital component of grassland and wetland ecosystems and may be useful in measuring habitat quality and the success of restoration projects (Noss 1990), information on invertebrate community structure and colonization rates in restored areas is needed to understand the development and effectiveness of wet meadow restoration projects.

Wet meadows in the Platte River valley also contain a variety of aquatic vertebrate communities that collectively contribute to nutrient cycling, productivity, and biodiversity of the meadow system. In addition, amphibian and fish communities may be important food resources for migratory birds. Initial research has shown that the composition of amphibian and fish communities of Platte River wetlands is strongly related to hydroperiod (Whiles and Goldowitz 1998, Goldowitz and Whiles 1999). Within the meadow system, a mosaic of wetlands with varying hydrologic regimes maintains a high diversity of the fish and amphibian communities (Whiles and Goldowitz 1998, Goldowitz and Whiles 1999). Because of their sensitivity to hydrologic fluctuations, amphibians and fishes should be excellent indicators of habitat quality when evaluating the effectiveness of wet meadow restoration projects.

In the Platte River valley, wet meadow restoration techniques have been developed based, in large part, on trial and error combined with lessons from prior experience. Currently, new restoration projects are being undertaken every year and also may be expanded as part of a Platte River Cooperative Recovery Implementation Program (1997). However, the effectiveness of restoring wet meadows on the Platte has received limited study (Pfeiffer 1999). Information about the relationships between the physical environment and biotic communities (e.g., how processes like hydrologic flux maintain the integrity of wet meadow functions like invertebrate production), along with systematic evaluation of the success of restored wet meadows, are needed to determine whether restoration efforts are effectively meeting habitat conservation goals.

percent of time that water levels are at or above a given level without regard to time sequence. These data will provide information on the magnitude, timing, frequency, and duration of water-level changes at the native and restored sites.

Additional hydrologic measurements will be obtained from wetlands within the study sites, to evaluate changes in surface water hydrology and wetland size during the study. We will identify a 20 m linear reach of slough at each native and restored site, install a staff gage in the deepest part of each slough, and establish three fixed transects at equal intervals across the 20 m reach of slough. Readings of staff gage height will be combined with measurements of wetted area and water depth profiles (from the transects), and regression analysis will be used to estimate wetted surface area and volume of each wetland. Staff gage heights then can be used to predict changes in wetland area and volume and compare surface water hydroperiods at native and restored sites.

Precipitation will be monitored at each site by a recording gage to help describe factors, in addition to the water table, that might influence hydroperiods, and to help explain weather related influences that might affect the overall restoration success. Most sites also will have a complete weather station located in a wet meadow $\leq$5 km from the site.

Plant Community Succession

The successional status of each restoration will be evaluated by comparing its current plant species composition with that of its potential natural community (PNC) (Winward 2000). PNCs for the Platte River wet meadows will be based on results of a study nearing completion (Henszey et al. 1998), where several native sites have been sampled for community composition. In this study, cluster analysis will be used to determine plant community composition from species sampled along a hydrologic gradient from the bottom of a slough to the top of an adjacent ridge. Once these potential native communities are determined, they will be assigned to areas within the restorations based on their topographic position in relation to the water table as a best estimate for the restoration PNCs. An appropriate number of randomly located transects will be permanently located within each community, and Daubenmire canopy coverage (Daubenmire 1959) will be estimated for each species. The following formula from Winward (2000) will be used to calculate a similarity index for each restored community:

$2w/(a+b)$, where

a = Sum of cover values measured in a similar native community

b = Sum of cover values measured in the restoration community

w = Sum of cover values common to both.

Thus, a similarity index, ranging from 0% for no species in common to 100% for all species in common with the same proportions for each species, can be used to evaluate the successional status of each restoration.

restored sites using one-way analysis of variance. Relationships between taxon richness and hydroperiod length will be analyzed using regression analysis.

Amphibian Communities

Amphibian communities in the native and restored wetlands will be monitored, during breeding and migration seasons, using drift fences and pitfall trap arrays (Gibbons and Semlitsch 1981). To monitor amphibian movements at each native and restored site, we will install trap arrays on both sides of each study wetland, parallel to each slough. Each drift fence will be 20 m long, constructed of aluminum flashing that is buried ~15 cm into the ground and extends ~40 cm above ground level. Pitfall traps, made from 5 gallon plastic buckets, will be buried to ground level at 10 m intervals along both sides of each drift fence.

During breeding and migration seasons, amphibians will be trapped continuously, i.e., traps will be kept open and monitored daily. All amphibians captured will be identified, measured, weighed, and then released. In addition, we will monitor reproductive activity, as evidenced by egg masses and larvae, by regular visual inspection and dip net sampling.

We will examine the relationship between length of hydroperiod and amphibian catch using polynomial regression analysis (a previous study revealed that relationships were non-linear [Whiles and Goldowitz 1998, Goldowitz and Whiles 1999]). Amphibian catches at native sites will be compared with restored wetlands using analysis of variance.

Fish Communities

Fish communities in the native and restored wetlands will be monitored monthly, whenever the sloughs are water-filled and ice-free. We will sample by electroshocking a single pass through each 20 m long study reach and collecting stunned fish with dip nets. All fish will be identified, measured, and released back into the wetland. Species richness, relative abundance, and catch per unit effort will be correlated with length of hydroperiod and compared between native and restored sites.

SCHEDULE

Pending completion and approval of this Study Plan, activities under this Cooperative Agreement will be scheduled as follows:

Year 1 (2000-'01): Site selection, sampling area & transect delineation
Installation of wells, recording & collecting instruments
Data collection—hydrology, vegetation, fauna
Sample processing & analysis—invertebrates

Table 1. Summary of total project budget.

budget category	USFWS	Platte River Trust	totals
salaries	$40,950	$45,372	$86,322
benefits	4,914	5,445	10,359
travel	6,000	2,000	8,000
equipment	0	0	0
supplies	1,000	2,000	3,000
other—anal/pub	1,136	1,000	2,136
totals	$54,000	$55,817	$109,817

Table 2. Budget breakdown for U.S. Fish & Wildlife Service contribution.

Budget category	Year 1	Year 2	Year 3	Category subtotal
salaries	$13,260	$13,650	14,040	$40,950
benefits	1,591	1,638	1,685	4,914
travel	2,000	2,000	2,000	6,000
equipment				0
supplies	400	400	200	1,000
other—anal/pub	150	150	836	1,136
totals	$17,401	$17,838	$18,761	$54,000

Table 3. Budget breakdown for Platte River Trust contribution.

Budget category	Year 1	Year 2	Year 3	Category subtotal
salaries	$15,124	$15,124	$15,124	$45,372
benefits	1,815	1,815	1,815	5,445
travel			2,000	2,000
equipment				0
supplies	1,700	150	150	2,000
other—anal/pub			1,000	1,000
totals	$18,639	$17,089	$20,089	$55,817

Henszey, R. J., K. Pfeiffer, J. Keough, and R. Swanson. 1998. Relationships between hydrology and biotic communities of riparian grasslands in the central Platte River flood plain. Study plan, U.S. Geological Survey, Northern Prairie Wildlife Research Center, Agreement No. 98CRAG1010. 12 pp.

Jansen, A. 1997. Terrestrial invertebrate community structure as an indicator of the success of a tropical rainforest restoration project. *Restoration Ecology* 5:115-124.

Karr, J. R. and E. W. Chu. 1998. *Restoring life in running waters: better biological monitoring*. Island Press, Covelo. 200 pp.

Mackay, R. J. 1992. Colonization by lotic macroinvertebrates: a review of processes and patterns. *Canadian Journal of Fisheries and Aquatic Sciences* 49:617-628.

Mitsch, W. J., and J. G. Gosselink. 2000. *Wetlands.* Third edition. John Wiley and Sons, Inc., New York. 920 pp.

Noss, R. F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* 4:355-364.

O'Leske, D. L., R. J. Robel, and K. E. Kemp. 1997. Sweepnet-collected invertebrate biomass from high- and low-input agricultural fields in Kansas. *Wildlife Society Bulletin* 25:133-138.

Pfeiffer, K. 1999. Evaluation of wet meadow restorations in the Platte River valley. Pp. 202-206 *in* J. Springer, ed. *Proceedings, 16th North American Prairie Conference.* University of Nebraska, Kearney.

Platte River Whooping Crane Maintenance Trust, Inc. 1998. *Habitat management, restoration, and acquisition plan for the Big Bend reach of the Platte River in central Nebraska.* Platte River Trust, Wood River. 70 pp + appendices.

Resh, V. H., M. J. Meyers, and M. J. Hannaford. 1996. Macroinvertebrates as biotic indicators of environmental quality. Pp. 647-667 *in* F. R. Hauer and G. A. Lamberti, eds. *Methods in stream ecology*. Academic Press, San Diego.

Sidle, J. G., E. D. Miller, and P. J. Currier. 1989. Changing habitats in the Platte River valley of Nebraska. *Prairie Naturalist* 21:91-104.

Simpson, E. H. 1949. Measurement of diversity. *Nature* (London) 163:688.

Turner, A. M. and J. C. Trexler. 1997. Sampling aquatic invertebrates from marshes:

Williams, K. S. 1993. Use of terrestrial arthropods to evaluate restored riparian woodlands. *Restoration Ecology* 1:107-116.

Winward, A. H. 2000. *Monitoring the vegetation resources in riparian areas.* General Technical Report RMRS-GTR-47. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 49 pp.