EVALUATION OF WET MEADOW RESTORATIONS IN THE PLATTE RIVER VALLEY

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Abstract: The mission of the Platte River Whooping Crane Maintenance Trust is to protect and manage habitat in the Platte valley for whooping cranes (*Grus americana*), sandhill cranes (*Grus canadensis*), and other migratory birds. The plan for meeting this mission calls for the creation and maintenance of 11 habitat complexes distributed through the central Platte River valley. Each habitat complex is intended to consist of 1000 hectares of wet meadows and adjacent roost habitat of unvegetated river channel. Since approximately 75% of Platte valley wet meadows have been converted to crop land, there is not enough existing wet meadow habitat to meet the requirements of the habitat complex plan. Consequently, restoration of areas to wet meadow-type vegetation is necessary. Over the past 17 years, the Trust has attempted a variety of restoration techniques on 485 hectares of its lands. These restoration techniques fall into three basic categories: 1) low diversity (3-6 species) CRP-type grass plantings on former crop fields; 2) cleared riparian forests; and, most recently, 3) high diversity (100+ species) plantings on former crop fields, including land surface recontouring to create ridge and slough topography typical of native meadows. We are evaluating the restored areas to determine the relative success of the various techniques in creating vegetation that resembles the vegetation of native meadows. In spite of being done relatively recently (< 5 years) the high diversity plantings are already developing vegetation that more closely resembles native sites than either the low diversity plantings or the cleared forests, many of which are more than 10 years old. Based on these results, future restoration efforts should continue to focus on the high diversity technique.

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The "Big Bend" reach of the central Platte River valley (the 70-mile stretch from Overton to Chapman, Nebraska) has hemispherical significance as a staging area for migratory birds. The region is best known for the nearly 500,000 sandhill cranes (*Grus canadensis*) and several million ducks and geese that migrate annually through the region (Sidle et al. 1993). In total, approximately 300 species of birds use the woodlands, wet meadows, and river channel in the valley (Currier et al. 1985).

At the time of European settlement, the Platte River was characterized by having several wide braided channels with wet meadows adjacent to and between the channels. Trees were sparse and present as scattered clumps along some of the river banks. However, over the past century, the central Platte River valley has undergone a substantial transformation. Numerous dams and water diversions in Wyoming, Colorado, and western Nebraska have significantly reduced natural flows and sediment discharge. Peak discharge has declined nearly 70% and the river channel is only 10-70% of its 1865 width (O'Brien and Currier 1987). Once wide and treeless channels have been transformed to multiple, narrow channels with woody vegetation succeeding on stabilized sandbars (Sidle et al. 1989, MacDonald and Sidle 1992). Approximately 75% of native wet meadows associated with the river have been converted to crop land (Sidle et al. 1989).

The Platte River Whooping Crane Trust (the Trust) was created in 1979 with the mission of acquiring and protecting habitat for migratory birds, whooping cranes (*Grus americana*) in particular, in the central Platte valley. The habitat plan developed by the Trust calls for the protection of 1000 ha of habitat in each of the 11 bridge segments between Overton and Chapman. Land acquisition efforts have focused on river channel and native wet meadows, as these are limited in availability and are considered to be the most critical habitats for many species of migratory birds, including whooping cranes. However, in the process of buying these habitats, adjacent crop fields are often included. Consequently, crop land makes up 880 ha of the approximately 3,600 ha of land protected by the Trust to date. Many of these fields are marginally productive as crop land due to low fertility, high water tables, and/or high soil pH and are good candidates for wet meadow

restoration. Additionally, in some bridge segments, there are not enough existing wet meadows to meet the habitat goals.

To increase the availability of wet meadow habitat for migratory birds, the Trust and other conservation groups have begun efforts to restore areas to wet meadow-type vegetation. A variety of techniques were used for these restorations.

The earliest technique consisted of planting crop fields to low diversity (3-6 species) mix of native warm season grasses, primarily big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans* [*avenaceum*]), and switchgrass (*Panicum virgatum*). These were CRP-type (USDA Conservation Reserve Program) plantings, and no effort was made to introduce forbs or enhance the hydrology of the sites.

Starting in the early 1990's, the Trust began restoring crop fields by planting high diversity (100-200) species seed mixtures using locally harvested seeds. In some of these fields, a bulldozer was used to recontour the land surface to enhance the hydrology of the sites and create slough and ridge topography resembling that of native meadows.

The third restoration technique employed by the Trust involved reclaiming riparian areas by clearing cottonwood forests adjacent to the river to allow the development of grassland vegetation. The forests developed on stabilized river channel over the past 50 years as a result of reduced flows in the river since the completion of Kingsley dam in western Nebraska. Clearing these forests offered the potential to create wet meadows in the topographic position they would have originally occupied. None of these sites was seeded. Cleared areas were simply allowed to re-vegetate on their own.

In order to ensure that future restorations come as close as possible to mimicking native meadows, we are evaluating the 3 techniques used to date. This paper represents the first systematic effort to evaluate the relative success of these techniques in creating vegetation that resembles the vegetation of native wet meadows. Preliminary analysis of the data is presented here.

METHODS

Study Areas

We chose 14 native wet meadow areas to serve as reference sites to compare to the restorations. The restorations were divided into 3 groups according to the techniques used to create them. There were 7 low diversity plantings, 11 high diversity plantings, and 4 reclaimed riparian sites. Permanent 200-m long transects were established on each site. Transects were set up so that they cut across the gradient of sloughs and ridges in each site and the proportion of slough, mesic prairie, and sand ridge areas were roughly equivalent in the native reference meadows and the restorations. Cover values were estimated at 10-m intervals along each transect using a 0.1-m^2 quadrat (Daubenmire 1959). Each transect was sampled in June 1997 and again in June 1998.

Data Analysis

For purposes of analysis, plant species were grouped into 8 categories: warm season native grasses, cool season native grasses, cool season exotic grasses, sedges & rushes, conservative prairie forbs (species that are present only on high quality native meadows and are very sensitive to management practices), other prairie forbs, wetland forbs, and exotic forbs (Table 1). Cover values of each category of each restoration technique were compared to the reference sites using ANOVA. Differences in means were examined with Student-Newman-Keuls Test at a significance level of $P < 0.05$.

RESULTS AND DISCUSSION

Native Platte River wet meadows are characterized topographically by being relatively flat, but with series of sinuous, linear sloughs aligned roughly parallel to the river with adjacent areas of mesic prairie and/or sand ridges. Plant communities range from emergent aquatic vegetation in the bottoms of the deepest sloughs to Sandhills prairie on the highest ridges. Overall, reference meadows are dominated by warm season grasses and sedges & rushes. Cool season native grasses and conservative prairie forbs are relatively uncommon. Exotic species account for just over 10% of the vegetation on these sites. On average, a good quality native meadow will contain between 120 and 150 species of native plants.

Low Diversity Plantings

Compared to native reference meadows, low diversity plantings had significantly greater cover of exotic cool season grasses and exotic forbs and significantly less cover of sedges & rushes and wetland forbs (Table 2).

When the low diversity plantings were being done, it was hoped that many additional plant species would colonize the sites from adjacent native meadows. So far, it appears that only a few of the most aggressive species are capable of doing so, and some of these plantings are approaching 20 years old. Species richness of these sites remains very low with

Table 1. Vegetation categories and the most common species in each category. Names follow the Atlas of the Flora of the Great Plains (Barkley 1977).

Categories	Common Name	Scientific Name
Warm Season Native Grasses	big bluestem	*Andropogon gerardii*
	Indian grass	*Sorghastrum nutans (avenaceum)*
	switchgrass	*Panicum virgatum*
	prairie cordgrass	*Spartina pectinata*
	rice cutgrass	*Leersia orizoides*
Cool Season Native Grasses	slender wheatgrass	*Agropyron caninum*
	northern reedgrass	*Calamagrostis inexpansa*
	prairie wedgegrass	*Sphenopolis obtusata*
	Canada wild rye	*Elymus canadensis*
Cool Season Exotic Grasses	smooth brome	*Bromus inermis*
	redtop	*Agrostis stolonifera*
	Kentucky bluegrass	*Poa pratensis*
Sedges and Rushes	water sedge	*Carex aquatilis*
	broom sedge	*Carex scoparia*
	darkgreen bulrush	*Scirpus atrovirens*
	Torrey's rush	*Juncus torreyi*
	path rush	*Juncus tenuis*
Conservative Prairie Forbs	wholeleaf rosinweed	*Silphium integrifolium*
	purple prairie clover	*Petalostemum purpurea*
	Canada milkvetch	*Astragalus canadensis*
	tall blazingstar	*Liatris pycnostachya*
Other Prairie Forbs	white aster	*Aster ericoides*
	wild licorice	*Glycyrrhiza lepidota*
	black-eyed susan	*Rudbeckia hirta*
	pale-spike lobelia	*Lobelia spicata*
	prairie goldenrod	*Solidago missouriensis*
Wetland Forbs	boneset	*Eupatorium perfoliatum*
	sneezeweed	*Helenium autumnale*
	tufted loosestrife	*Lysimachia thyrsiflora*
	winged loosestrife	*Lythrum alatum*
	water parsnip	*Sium suave*
Exotic Forbs	white sweet clover	*Melilotus alba*
	curly dock	*Rumex crispus*
	red clover	*Trifolium pratense*

less than 30 species The low diversity plantings are also highly vulnerable to invasion by undesirable exotic plants, particularly smooth brome (*Bromus inermis*) and redtop (*Agrostis stolonifera*). This is most likely a result of the patchy nature of warm season grass plantings, which provides ample open space for the exotic grasses to exploit.

High Diversity Plantings

Compared to native reference meadows, the high diversity plantings had significantly greater cover of warm season native grasses, cool season native grasses and significantly less cover of sedges & rushes and wetland forbs (Table 2). Many of the sedges, rushes, and other wetland species are present in the restoration, but they occur in low numbers. They simply seem to develop at a much slower rate than the mesic prairie species. For example, broom sedge (*Carex scoparia*), an abundant species in native meadows that has been planted in many of the high

Table 2. Mean percent cover of vegetation categories. Similar letters indicate no significant difference (P>.05) between treatments.

Category	Native	High Divers.	Low Divers.	Riparian
Warm Season Grass	21.5a	33.9b	17.8a	16.0a
Cool Season Native	1.3a	8.3b	1.9a	1.9a
Cool Season Exotic	7.8a	2.0a	28.2b	8.3a
Sedges & Rushes	25.6a	4.9b	2.0b	21.1a
Conservative Forbs	1.0a	9.0b	2.0a	0.0a
Prairie Forbs	13.9a	18.7a	11.5a	11.3a
Wetland Forbs	5.6a	1.2b	0.6b	2.7ab
Exotic Forbs	3.1a	4.6a	12.5b	6.8a

diversity restorations, has never been observed in any of the sites prior to the third year after planting. Once it does appear, it increases steadily in abundance.

Many of the conservative prairie forbs have limited distributions and small populations in the Platte valley. They occur primarily on a handful sites that were not subject to abusive management practices in the past. The relative abundance of conservative prairie species in the high diversity restorations compared to native sites is simply the result of a concerted effort to harvest seed from these species with the intent of establishing new and larger populations of them.

Plant species richness of the high diversity sites is equivalent to that of the native reference meadows (120-150 species).

Reclaimed Riparian Areas

None of the vegetation categories in the riparian areas was significantly different in cover values from those of the reference sites (Table 2). However, species richness of these areas was very low (< 50 species) compared to either native meadows or high diversity restorations. What appears to have happened on these sites is that a few plant species typical of wet meadows (such as water sedge [*Carex aquatilis*], prairie cordgrass [*Spartina pectinata*], and tufted loosestrife [*Lysimachia thyrsiflora*]) were present as scattered patches within the woodlands. Once the overstory trees were removed, these plants rapidly expanded and now dominate the sites. Unlike native reference meadows, reclaimed riparian areas also have a high degree of shrub cover, primarily rough-leaved dogwood (*Cornus drummondii*) and false indigo [indigobush] (*Amorpha fruticosa*), that have proven difficult to control.

CONCLUSIONS

Preliminary analysis of the data collected in this study indicates the high diversity planting technique offers the best potential for wet meadow restorations. The high diversity restorations have been completed more recently, and have had less time to develop than either the low diversity plantings or the reclaimed riparian areas. In spite of that fact, the high diversity restorations have already developed vegetation that more closely resembles native wet meadows than either of the other to restoration types.

Reclaiming riparian areas by removing trees offers some potential as an acceptable wet meadow restoration technique if an effective means of controlling shrubs can be developed. However, it may be necessary to seed these areas once the trees are removed to improve the diversity of the wet meadow plant community that will eventually develop there.

The low diversity grass planting technique offers the least value for wet meadow restoration. This technique is not recommended for future wet meadow restorations in the Platte River valley.

LITERATURE CITED

Barkley, T. M. 1977. Atlas of the flora of the Great Plains. Iowa State University Press, Ames, Iowa, USA.

Currier, P. J., G. R. Lingle, and J. G. VanDerwalker. 1985. Migratory bird habitat on the Platte and North Platte Rivers in Nebraska. The High

Pressure Press, Marquette, Nebraska, USA.

Daubenmire, R. F. 1959. Canopy coverage method of vegetation analysis. Northwest Science 33:43-64.

MacDonald, P. M., and J. G. Sidle. 1992. Habitat changes above and below water projects on the North Platte and South Platte Rivers in Nebraska. Prairie Naturalist 24:149-158.

O'Brien, J. R., and P. J. Currier. 1987. Channel morphology and riparian vegetation changes in the Big Bend Reach of the Platte River in Nebraska and minimum streamflow criteria for channel maintenance, Platte River Trust Report.

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

———, H. G. Nagel, R. Clark, C. Gilbert, D. Stewart, K. Wilburn, and M. Orr. 1993. Aerial thermal imaging of sandhill cranes on the Platte River, Nebraska. Remote Sensing of the Environment 43:333-341.