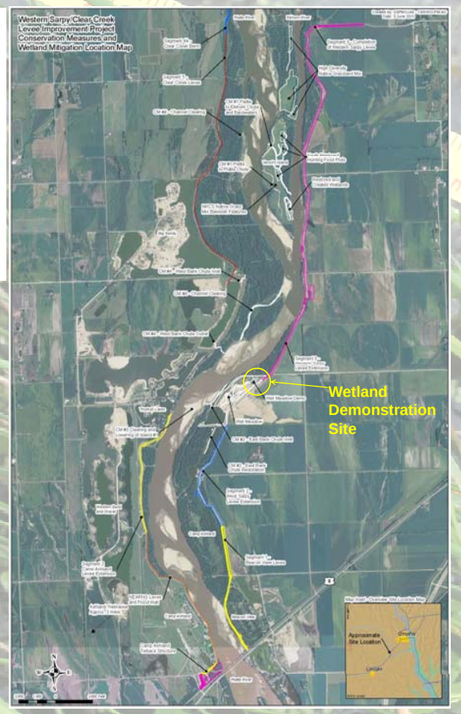
An Experimental Approach to Wet Meadow Design in the Lower Platte River Corridor

John Shelman and Mike Gilbert, U.S. Army Corps of Engineers, Omaha District

ABSTRACT

The Western Sarpy/Clear Creek (WSCC) project is a Flood Risk Management Project that was conducted under the Corps of Engineers (Corps) General Investigation authority. Project sponsors included: the Papio-Missouri, Lower Platte North and Lower Platte South Natural Resource Districts. Through consultation with the Fish and Wildlife Service (FWS) and the Nebraska Game and Parks Commission (NGPC), it was determined that approximately eight acres of wetlands would be directly impacted from fill during levee construction. Additionally, it was concluded that the project would constrict the Platte River and decrease the frequency of the rivers interaction with the floodplain. Reduced flooding outside the river banks would prevent an unquantifiable number of wetlands from forming in the future. Consequently, the Corps was required to mitigate all impacts by constructing 40 acres of wetlands, of which 32 acres were to be wet meadows. The wetlands would be temporarily to seasonally flooded and emulate nearby reference wet meadows within the Platte River valley.

PROJECT LOCATION



The project is located within the lower Platte River valley approximately 30 minutes west of Omaha, Nebraska. The Platte River forms in western Nebraska at the confluence of the North Platte and South Platte Rivers. The river is approximately 310 miles long and along with its tributaries drains approximately 90,000 square miles of the Great Plains.

In addition to wetland mitigation, numerous conservation measures were also constructed to avoid harm to federally listed birds and fish within the project area. These features consisted of chute, backwater and emergent sandbar creation. Constriction of the river would reduce the amount of shallow water habitat and emerged sandbars.

PLATTE RIVER WET MEADOWS

Platte River wet meadows by definition are graminoid systems with a temporarily flooded or seasonally flooded water regime. This community occurs in nearly-level floodplains, often in bands surrounding marshy channels. Soils are poorly drained silty and clay loams formed in alluvium. Vegetation under a native setting consists of prairie cordgrass (*Spartina pectinata*) and sedges (*Carex* spp.) as dominants. Typically these areas support a high species diversity of hydrophytic and transitional grasses and forbs. These systems occur both as depressions maintained by precipitation and as flow through systems within the floodplain mosaic.

EXPERIMENTAL DESIGN AND GOALS

In developing wet meadow design criteria, nearby relatively undisturbed wet meadows were tested and documented in terms of soil profiles, vegetation composition and soil chemistry. Topsoil borrow sites emulated these characteristics and were composed of similar textural and chemical properties. Top soil depths for the wet meadow creation site were 12”-18”, consistent with the profiles at the reference sites and as documented by a review of local soil survey information. Grading of the site was on an elevation gradient of four feet between 1,064’ to 1,068’ MSL at a slope of 1:40.

EXPERIMENTAL DESIGN AND GOALS (CONT.)

Approximately, one hundred species ranging from FACU to OBL were applied at the recommended rate of one pound per acre and then applied at twice that rate on some cells to determine if seed density affected vegetation response. Hay obtained from a nearby wet meadow was applied as mulch to some of the plots. Some plots received shredded hay to test if mulch density had an affect. Some plots did not receive mulch. Experimental blocks with the various treatments and controls were randomly assigned along the elevation gradient to capture hydrology ranging from inundation to subirrigation. This design was intended to emulate the known hydrodynamics of Platte River wet meadows. The goal was to determine which treatments best respond at what elevation range for target community wetness and native floristic “quality”.

MONITORING AND DATA ANALYSIS

Point intercept sampling served as the primary method for quantifying vegetation response. The point intercept method is designed to sample within-plot variation and quantify changes in plant species composition and cover over time. Hydrological observations and qualitative vegetation descriptions are recorded in the spring while detailed vegetation point intercept sampling is conducted in late summer. Permanent photographic stations have been set up to monitor temporal change. Metrics of interest for each cell include: Floristic Quality Assessment Index (FQAI) and Prevalence Index (PI).

FQAI is a modified species richness index based on a species affinity to natural areas. The reference wet meadow FQAI was 11.3 +/- 2.4 standard error (se). The PI is a weighted average indicating sample “wetness” on a scale of 1 to 5. A value of “1” would indicate a community of obligate hydrophytes (OBL), while a value of “5” would indicate an upland plant community (UPL). The reference wet meadow PI was 2.2 +/- 0.6 se. Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS) Version 13.0. Descriptive statistics are provided in the results section for each of the principal metrics. In addition, the means of the PI and FQAI were compared to each treatment to test for significant differences.

RESULTS

Data are presented for the two principal criteria; wetness using the Prevalence Index (PI) and native richness using the Floristic Quality Assessment Index (FQAI). Initial statistical analyses involved descriptive statistics and a one way Analysis of Variance (ANOVA) across all treatments and elevations for both the PI and FQAI.

Descriptive Statistics

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Prevalence Index(PI)	1X Seed Rate	2.5	0.73	0.21	1.86	2.96	1.4	3.6
	1X Seed Rate/Shredded Hay	2.4	0.98	0.28	1.74	2.98	1.0	3.7
	2X Control	2.5	0.94	0.27	1.88	3.07	1.1	3.7
	2X Seed Rate	2.3	0.82	0.24	1.74	2.78	1.3	3.8
	2X Seed Rate/Unshredded Hay	2.4	0.92	0.27	1.77	2.94	1.1	3.4
	1X Control	2.6	0.91	0.26	2.02	3.17	1.3	3.5
	Shredded Hay	2.6	0.86	0.25	2.06	3.15	1.5	3.7
	Unshredded Hay	2.5	0.96	0.28	1.89	3.11	1.1	3.8
Floristic Quality Assessment Index(FQAI)	1X Seed Rate	4.4	2.18	0.63	2.99	5.78	1.7	9.0
	1X Seed Rate/Shredded Hay	4.9	2.54	0.73	3.28	6.51	0.3	9.5
	2X Control	4.3	2.96	0.85	2.40	6.16	0.0	8.1
	2X Seed Rate	5.7	3.34	0.97	3.56	7.82	1.0	11.1
	2X Seed Rate/Unshredded Hay	6.4	4.03	1.16	3.82	8.95	0.3	13.3
	1X Control	4.8	3.68	1.06	2.46	7.14	0.4	12.2
	Shredded Hay	4.4	3.76	1.08	2.02	6.80	0.0	11.2
	Unshredded Hay	5.9	3.86	1.11	3.48	8.39	1.3	12.8

n = 12 / treatment

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Prevalence Index(PI)	1065.5	1.48	0.31	0.08	1.31	1.64	1.0	2.0
	1066.0	1.44	0.23	0.06	1.32	1.57	1.1	1.9
	1066.5	2.24	0.49	0.12	1.98	2.50	1.4	3.2
	1067.0	2.90	0.44	0.11	2.67	3.14	2.3	3.5
	1067.5	3.22	0.39	0.10	3.01	3.43	2.6	3.8
	1068.0	3.33	0.47	0.12	3.08	3.58	2.0	3.8
	Total	2.43	0.87	0.09	2.26	2.61	1.0	3.8
Floristic Quality Assessment Index(FQAI)	1065.5	7.49	2.74	0.69	6.03	8.95	2.6	12.8
	1066.0	9.03	2.78	0.69	7.56	10.49	3.6	13.3
	1066.5	5.94	1.86	0.47	4.95	6.93	3.5	9.9
	1067.0	3.14	1.76	0.44	2.20	4.07	0.8	6.4
	1067.5	2.22	1.87	0.47	1.22	3.21	0.0	7.5
	1068.0	2.78	1.57	0.39	1.94	3.61	0.3	5.7
	Total	5.10	3.32	0.34	4.43	5.77	0.0	13.3

n = 16 / elevation

RESULTS (CONT.)

Treatments

There was *no significant* relationship of the PI and FQAI to treatments. Lack of significance for treatments may be due to the small sample size. Also, more time was needed for expression of plant community characteristics or other uncontrollable factors.

PI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.400	7	.200	.251	.970
Within Groups	70.016	88	.796		
Total	71.416	95			

FQAI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	54.068	7	7.724	.687	.683
Within Groups	990.041	88	11.250		
Total	1044.109	95			

Elevation

The relationship of elevation to PI and FQAI using one-way ANOVA indicated *significant* relationships for both indices.

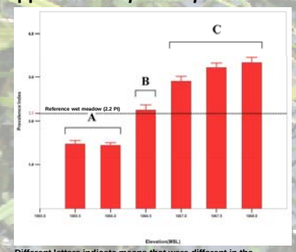
PI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	57.115	5	11.423	71.883	.000
Within Groups	14.302	90	.159		
Total	71.416	95			

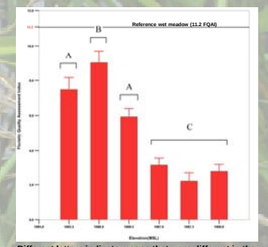
FQAI

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	629.852	5	125.970	27.368	.000
Within Groups	414.257	90	4.603		
Total	1044.109	95			

A post-hoc analyses were conducted using the Tukey-Kramer HSD. Means that were different are presented in the following figures. A distinct trend of the PI and FQAI along the gradient was easily observed. Visual inspection indicated more of a similarity when compared to the reference site between elevations of 1066.0’ and 1067.0’ MSL. A target elevation of 1065.5’ to 1067.0’ MSL seemed to be the ecotone between the target *Carex* spp. and the *Spartina pectinata* dominated communities.



Different letters indicate means that were different in the Tukey-Kramer HSD post-hoc tests.



Different letters indicate means that were different in the Tukey-Kramer HSD post-hoc tests.

DISCUSSION

It was also determined that doubling the seeding rate did not affect wetness or diversity. Using the wet meadow hay as mulch did contribute to the quantity and quality of hydrophytes present. Species present in the hay and not in the seed mix emerged at the site. It did not appear that the density of the hay (shredding) had a positive impact on vegetation response. Initially the goal was to monitor the experimental wetland for three years prior to drawing conclusions to incorporate in the design of the 32 acre wet meadow mitigation area. However, Funds received from the American Recovery Reinvestment Act accelerated construction on the WSCC project, including mitigation features. Following only two years of monitoring the fluctuation of groundwater was determined to be between 1065.5’ to 1067’ MSL. The wetland would be constructed within this elevation range and would incorporate micro and macrotopographic features to increase vegetative diversity in response to varying hydrology regimes. Seed mixes were modified to incorporate wetness tolerance range.

IMPLICATIONS TO RESTORATION PRACTICIONERS

- Completing experimental work in advance of implementing a larger project allowed for refinement in target elevations and treatments.
- The experimental site is three growing seasons ahead of the 32 acre site. Trends observed in the experimental area may allow for adaptive management of the larger site.
- Invasive species deflecting from the target graminoid system have increased in abundance over the sampling seasons. This trend will continue for both areas. Purple loosestrife, cottonwood and willow control will require major efforts for long term control.
- Wet meadows are among the more difficult plant communities to restore or create. Elevations of 6” +/- can affect target plant communities. It is recommended that multiple elevations are incorporated in project design to account for temporal inundation/saturation dynamics.
- This data can be used to help identify restoration targets, inform restoration strategies, and evaluate restoration success within the Lower Platte River Corridor.

Authors: John Shelman, Environmental Resource Specialist, USACE, Johnathan.A.Shelman@usace.army.mil and Mike Gilbert, Wetlands Biologist, USACE, Michael.C.Gilbert@usace.army.mil