PROJECT TITLE: Evaluation of treatments to mitigate negative plant-soil feedbacks and improve reconstruction seeding success at Kulm Wetland Management District

FY Requested	FY Funded
2014	2014

Project Proposal

NWR: KULM WETLAND MANAGEMENT DISTRICT

RFP ID: 62630-175-2013

Project Type:	Focus:	Scale:
Research	Abiotic Factor/Ecological Process	Station

- [x] Staff Biologist?
- [x] This proposal has station support?
- [x] FWS protocols were followed regarding data managment?
- [x] This proposal supports a priority in a CCP/ HMP or other refuge plan

Objectives supported from the Kulm Habitat Management Plan (HMP):Objective 1.4 Fee-title Waterfowl Production Areas (WPAs) – During the next 15 years, target 80% of all habitat management activities on 142 WPAs located in 1A [n = 81], 1B [n = 57], 2A, 2B [n = 3], 3A, and 3B [n = 1] landscapes supporting ≥25 duck pairs per square mile and ≥40% grass cover within a 10.4 km2 area surrounding each WPA to provide diverse, heterogeneous nesting habitat for waterfowl that promotes an average of ≥15-20% nest success while meeting the habitat requirements of ROCs such as grasshopper sparrow, clay-colored sparrow, bobolink, black tern, marbled godwit, and northern harrier.Objective 2.4 – Reconstructed Prairie – During the next 15 years, maintain ≥75% pristine native plant composition and diversity representative of stable plant communities on ecological sites by retaining >75% of the species included in the seed mixture on all established (typically 5-7 years after initial seeding) reconstructed prairie tracts on WPAs located in 1A to 3B landscapes using active management to provide attractive heterogeneous nesting habitat for waterfowl and other ROCs while contributing to BIDEH within the mixed-grass prairie ecosystem.And supports information needed to further develop the Region 6 FY14 priority:Develop “Phase II--Crisis in the Prairies” strategic communication campaign on the value of the prairies to gain public support, attract national attention, and work collaboratively with our partners on prairie conservation efforts.And the I&M priority identified in the 7-year plan:AM 1.3 From FY13-FY14, the I&M Initiative will identify and support existing and new AM projects ongoing across the Refuge System, help them be successful, explore possible metrics for tracking achievement of management objectives, explore ways of reporting accomplishments to different audiences, and seek to learn as much as possible from their experiences.

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☐ This proposal supports a "Top Region 6 Priority"

PROJECT DESCRIPTION

Because of the scarcity of research on (Plant-Soil Feedback) PSF mitigation in reconstruction settings, this project will take inspiration from agronomy for possible mitigation strategies. Forging cross-disciplinary links (Simberloff et al. 2013) can provide important insight into current ecological problems such as aboveground-belowground linkage, invasion, and reconstruction. Agronomic soil biota management techniques (e.g., fungal and bacterial inoculation and/or fungicide/bactericide application) will be adapted and applied as reconstruction treatments for PSF mitigation. This project will test one-time treatments that are meant to be applied during the initial stages of reconstruction to mitigate PSFs and promote the establishment of native species. Therefore, the purpose of this project is aimed at improving the success of native plant reconstruction in Kulm Wetland Management District by evaluating easily applied soil treatments to mitigate negative PSFs and increase native plant establishment. Treatments are designed to manipulate the soil microbial community in a manner that is expected increase the establishment of native plants by diminishing the negative effects of the resident soil microbial community and increasing the presence of beneficial microbes.

OBJECTIVES

The objective of this study is to apply plant-soil feedback mitigation treatments during native plant reconstruction to evaluate the effectiveness of treatments on increasing native plant establishment and overall site reconstruction success.

DESIGN AND METHODS

Mitigation treatmentsMitigation treatments for plant-soil feedbacks include augmentation or reduction of the soil microbial community (Table 1). Augmentation of the soil microbial community will be achieved with inoculation with fungi or beneficial bacteria. Fungal inoculum has been applied in reconstruction resulting in decreased weed performance (Johnson 1998, Rowe et al. 2007) and increased native plant performance (Allen and Allen 1988, Johnson 1998, Rowe et al. 2007); although the performance of natives can be species-specific (Allen and Allen 1988, Rowe et al. 2007). Beneficial bacteria inoculant has been applied in agriculture settings (Dominguez-Nunez et al. 2012) and during reconstruction to increase target plant performance (Carillo-Garcia et al. 2000). These treatments will be applied individually and not be factorially combined. Reduction of the soil microbial community will be achieved with application of biocides (Table 1). Fungicides are commonly applied in agronomic systems and have been used in reconstruction settings to decrease soil fungus and increase native forb performance (McCain et al. 2011). Unfortunately, there is no commercially available product that is strictly a soil bactericide. However, combination products bactericide/fungicides are available and may help alter negative bacterial plant-soil feedbacks.

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Treatment application Treatments will be applied by hand with a hand-held sprayer after the fields are seeded with native species by refuge staff. All treatments will be applied following the manufacture's recommended rates (Table 1). Treatments will be applied in the spring immediately following seeding. Total research area will be 10 m × 10 m plots in each field. Each plot will be divided into 25, 2m × 2m squares (Figure 1) and each square will be randomly assigned a treatment. Treatments will be applied to 2 m × 2 m size plots and measurements will be taken in the center 1 m × 1 m square to minimize edge effects. Data collection Non-destructive techniques will be used to evaluate the effect of the treatments on reconstruction success. At the end of the first growing season and the beginning and end of the second growing season (Table 2), field sites will be visited and the following data will be recorded in each of the 25 treatment areas: plant density and cover by species, average plant height, and the number of reproductive individuals.

DATA ANALYSIS/MODELS

We will use multivariate analysis of variance (MANOVA) in SAS version 9.3 (PROC GLM; SAS Institute, Cary, NC) to determine differences in plant density, plant cover, average plant height, and number of reproductive individuals among treatments and control for study site.

REVIEWERS:

Dr. Erin Espeland,Research Ecologist, USDA- ARS,Pest Management Research Unit 1500 N. Central AveSidney, MT, 59270(406) 433-9416Erin.espeland@ars.usda.gov

PARTNERS

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SOURCES OF SUPPORT:

Years Funding Requested: 2

Request From I&M Program:	$11,820.00
Contributed By Station:	$1,000.00
Contributed By Partners:	$11,000.00
Allocation Grand Total:	$23,820.00

Salary & Benefits:	$5,172.00
Equipment:	$650.00
Contracts:	$0.00
Travel:	$0.00
Other:	$5,998.00

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	Year 1		Year 2		Year 3	
Personnel 1:	Biological Technician	$2,586.00	Biological Technician	$2,586.00		
Personnel2:						
Personnel3:						
Salary and Benefits Sum:		$2,586.00		$2,586.00		
Equipment:		$550.00		$100.00		
Contracts:						
Travel:						
Other:	These funds will be transferred to SDSU under a Cooperative Agreement with the USFWS to cover costs for SDSU staff to assist with field work and cover principale investigator salary	$2,938.00	These funds will be transferred to SDSU under a Cooperative Agreement with the USFWS to cover costs for SDSU staff to assist with field work, cost to publish peer-reviewed article, and cover principale investigator salary	$3,060.00		
Project Cost IM:		$6,074.00		$5,746.00		$0.00
Station Contribution:		$500.00		$500.00		
Partner Contribution:	Dr. Lora Perkins, Assistant Professor of Range Ecology, Department of Natural Resource	$5,500.00	Dr. Lora Perkins, Assistant Professor of Range Ecology, Department of Natural Resource	$5,500.00		

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Management, South Dakota State University, Brookings, SD 57007, USADr. Troy Grovenburg, Assitant Professor of Wildlife Ecology, Department of Natural Resource Management, South Dakota State University, Brookings, SD 57007, USA		Management, South Dakota State University, Brookings, SD 57007, USADr. Troy Grovenburg, Assitant Professor of Wildlife Ecology, Department of Natural Resource Management, South Dakota State University, Brookings, SD 57007, USA	
Project Cost Totals:	$6,074.00	$5,746.00	$0.00
Allocation Totals	$12,074.00	$11,746.00	$0.00

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RFP ID: 62630-175-2013

	Year 4		Year 5	
Personnel 1:				
Personnel2:				
Personnel3:				
Salary and Benefits Sum:				
Equipment:				
Contracts:				
Travel:				
Other:				
Project Cost IM:		$0.00		$0.00
Station Contribution:				
Partner Contribution:				
Project Cost Totals:		$0.00		$0.00
Allocation Totals		$0.00		$0.00

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DATA MANAGEMENT:

Description of data entry, verification, editing and software.

The Biologist at Kulm WMD will act as the data steward and comply with the FWS policy on data resource management (274 FW 1) by complying with data management standards to ensure quality control procedures and security considerations while creating, maintaining, and storing data in accordance with FWS policies 274 FW 2 and 282 FW 4. Software used to store data for the project will include: 1) Program R, SAS, and/or SPSS Statistics 19, 2) Microsoft Excel spreadsheets, and 3) GIS spatial data in ArcMap 10.

Please describe metadata including the who, what, where, and when of the data.

Please describe data security and archiving. Provide the schedule and location for regularly backing up files.

STATUS AND RESULTS

ADDITIONAL INFORMATION:

LITERATURE CITED:

Abella, S. R., L. P. Chiquoine, and C. H. Vanier (2013). "Characterizing soil seed banks and relationships to plant communities." Plant Ecology 214(5): 703-715.Espeland, E. K., L. B. Perkins, and E. A. Leger (2010). "Comparison of Seed Bank Estimation Techniques Using Six Weed Species in Two Soil Types." Rangeland Ecology & Management 63(2): 243-247.Fahnestock, J. T., D. L. Larson, G. E. Plumb, and J. K. Detling (2003). "Effects of ungulates and prairie dogs on seed banks and vegetation in a North American mixed-grass prairie." Plant Ecology 167: 255-268.Gioria, M. and B. Osborne. (2010). “Similarities in the impact of three large invasive plant species on soil seed bank communities”. Biological Invasions 12:1671-1683.Johnson, R. G., and R. C. Anderson. 1986. The seed bank of a tallgrass prairie in Illinois. American Midland Naturalist 115:123-130.Kelton, J. A., A. J. Price, E. van Santen, K. S. Balkcom, F. J. Arriaga, and J. N. Shaw (2011). “Weed seed bank density and composition in a tillage and landscape variability study.” Communications in Biometry and Crop Science 6:21-30.McNicoll, M. B. and C. K. Augspurger (2010). "A Comparison of Vegetation and Seed Bank Community Structure in a Sand Prairie in Illinois, USA." American Midland Naturalist 164(1): 136-150.Morista, M. (1959). “Measuring of interspecific association and similarity between communities”. Memoirs of the Faculty of Science, Kyushu University, Series E. (Biology) 3:65-80.Orrock, J. L. and J. L. Hoisington-Lopez. (2009). “Mortality of exotic and native seeds in invaded and uninvaded habitats.” Acta Oecologica-International Journal of Ecology 35:758-762.Roberts, H. A. (1986). “Seed Persistence in Soil and Seasonal Emergence in Plant Species from Different Habitats.” Journal of Applied Ecology

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23:639-656.Robertson, S. G. and K. R. Hickman. (2012). “Aboveground plant community and seed bank composition along an invasion gradient.” Plant Ecology 213:1461-1475.