Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

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Project Title:

Impact of Grazing on Native Plants and Pollinators

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 465,456.98

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Other Non-State Funds: $ 0

Summary:

We will evaluate effects of grazing versus other management actions on native prairie plant communities, exotic grasses, and pollinator richness to help managers select appropriate tools to achieve their goals.

Name: Diane Larson

Sponsoring Organization: U.S. Geological Survey

Address: 1561 Lindig St
St. Paul MN 55108

Telephone Number: (651)649-5041

Email dlarson@usgs.gov

Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

MP: 0613-2-103-proposa
Budget: 0613-2-103-bud
Qual: 0613-2-103-qualifi
Map: 0613-2-103-map-Fi
Resolution:
List:

_____ Funding Priorities _____ Multiple Benefits _____ Outcomes _____ Knowledge Base

_____ Extent of Impact _____ Innovation _____ Scientific/Tech Basis _____ Urgency

Capacity Readiness Leverage Employment TOTAL

Project Title: Evaluating the Impact of Grazing Histories on Native Plant and Pollinator Diversity in Grasslands across Minnesota

I. PROJECT STATEMENT

Prairie landscapes need regular disturbance. Without disturbance most grasslands, prairies and some wetlands in Minnesota would rapidly transition into woodlands and forest. In pre-European settlement -times grazing by large herbivores, fires, and drought were the disturbances that maintained the prairies. Today these same forces are critical to maintaining a full range of community types, structures, and successional stages in the prairie landscape.

The Minnesota Prairie Conservation Plan calls for annual disturbance on 477,000 acres of prairies and grasslands. Over the last 30 years prescribed fire has gained acceptance as the primary tool for managing public grasslands. However, because prescribed fire is expensive, requires significant personnel numbers and time, can only be completed during small periods of time, and may have negative effects on some pollinators, land managers are limited in their ability to implement prescribed fire on enough acres to achieve this goal.

Recently, land managers have turned their attention to increased use of ungulates, namely cattle, to help achieve their grassland management goals. The Minnesota DNR has a stated goal of implementing conservation grazing on 50,000 acres of Wildlife Management Areas. And while conservation grazing holds promise for increasing disturbance on significant additional acreage, questions remain as to its effect on plant and pollinator community structure and diversity. This project strives to quantitatively address those questions.

Goals: The primary goal of this research project is to evaluate the effects of conservation grazing on key characteristics of tallgrass prairie habitat in Minnesota. We will assess the relative effects of grazing intensity and other management actions (e.g., prescribed fire, idling) on native plant species richness and diversity and on prevalence of invasive grasses. In addition, because pollinating insects are sensitive to both management and plant species composition, we will assess the direct and indirect effects of grazing and other management actions on pollinator species richness, including cleptoparasitic bees, the presence of which has been shown to indicate health of the insect community. The outcome of this research will inform federal, state, local and private land managers and help them select the most appropriate management tools to achieve their specific goals.

How we will achieve the goal: Management of tallgrass prairies, including by conservation grazing, has been practiced across the state for many decades. We will take advantage of this history to evaluate the relative effects of grazing, prescribed fire, and idling (i.e., no disturbance) on native plant species richness and composition, dominance of invasive grasses, and pollinator species richness. Covariates such as rates of nitrogen cycling, soil texture, and landscape characteristics, will also be considered. We have developed a preliminary structural equation model (see the figure) illustrating potential pathways of direct and indirect effects of management on key prairie characteristics; our research is designed to provide data to statistically evaluate this model.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Identify sites and collect management histories **Budget: $50,000**

Through partnership with The Nature Conservancy, we will identify at least 100 prairies with known histories and managers who are willing to participate in this study. Research has demonstrated that landscape characteristics are important determinants of pollinator site occupancy, so in addition to site-specific characteristics, surrounding land use will be identified using publicly-available GIS data.

Outcome	**Completion**
1. Develop list of potential prairie sites in Minnesota, contact landowners and managers, obtain necessary permissions to survey on prairies, record management histories.	*March 2015*
2. Map participating tracts, develop sampling scheme, collect GIS layers (e.g., soil	*May 2015*

types, landcover)	

Activity 2: Assess relative effects of grazing and other management on native plant species richness and abundance of the invasive grasses Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*). **Budget: $207,728**

Using the study sites identified in Activity 1, we will relate plant species richness and abundance of invasive exotic grasses to management history and grazing intensity. A preliminary structural equation model (see figure) will be assessed and modified as needed to reflect data collected in the first and second years of the study. Results will be provided to managers and the general public in the form of a master's thesis, manuscript(s) in the published literature and a management-oriented fact sheet.

Outcome	**Completion**
1. Perform field surveys for plant species richness, cover of exotic grasses and soil N dynamics (some sites repeated to assess year-to-year variation)	*September 2015* *September 2016*
2. Develop and assess preliminary model of grazing effects on native plants	*May 2016*
3. Test preliminary model with second year's data; revise model as necessary	*December 2016*
4. Final report, manuscript(s) submitted	*June 2017*

Activity 3: Assess relative effects of grazing and other management on pollinator species richness **Budget: $207,728**

Using the study sites identified in Activity 1, we will relate pollinator species richness and presence of parasitic bees to management history and grazing intensity. A preliminary structural equation model (see figure) will be assessed and modified as needed to reflect data collected in the first and second years of the study. Results will be provided to managers and the general public in the form of manuscript(s) in the published literature and the fact sheet described in Activity 2.

Outcome	**Completion**
1. Perform field surveys for pollinators using pan traps and hand netting	*September 2015* *September 2016*
2. Identify insects collected during the field surveys	*December 2015* *December 2016*
2. Develop and assess preliminary model of grazing effects on pollinators	*May 2016*
3. Test preliminary model with second year's data; revise model as necessary	*December 2016*
4. Final report, manuscript(s) submitted	*June 2017*

III. PROJECT STRATEGY

A. Project Team/Partners: Diane Larson, Research Scientist, U.S. Geological Survey (research foci are invasive species and pollination mutualisms), will oversee research and co-advise graduate student. **Nicholas Jordan**, Professor in Agronomy and Plant Genetics (focus is sustainability of agricultural landscapes), will oversee funds within the University and co-advise graduate student. **Marissa Ahlering**, Prairie Ecologist, The Nature Conservancy (focus is grassland ecosystems), will lead study site selection and assist in field supervision and graduate student advising. **Sam Droege**, U.S. Geological Survey (foci are survey methods and taxonomy of hymenoptera) will oversee insect identification.

B. Timeline: Three years, with 2 years of funding due to July start. Site selection will begin as soon as funds are secured, July 2014. Field work will occur during 2015 and 2016 growing seasons, with insect identification and statistical analysis during the subsequent fall and winter. Final reports/manuscripts and the student's thesis will be completed by June 2017.

C. Long-term Strategy and Future Funding Needs: Our goal is to provide managers with a framework for deciding if and how conservation grazing will achieve their management goals for prairie plant and pollinator diversity. Both the fact sheet summarizing our results and the continued involvement of TNC with Minnesota land managers will ensure access to these results in the long-term. No future funding requests are anticipated.

2014 Detailed Project Budget

Project Title: *Evaluating the Impact of Grazing Histories on Native Plant and Pollinator Diversity in Grasslands Across Minnesota*

Personnel	Amount
Diane Larson (74% salary, 26% benefits) 21% FTE/year for 3 years	$90,882.00
University of Minnesota Master's Student ($21767 salary and $17330 fringe includes tuition, year-round for 3 years)	$117,291.00
Student research assistants, 1 at 50% FTE/year for 2 years,	$33,760.00
Contracts	
Polistes Foundation will provide expertise in insect and plant taxonomy and GIS support	$76,763.88
The Nature Conservancy will provide expertise on Minnesota prairies and coordination with land managers	
Marissa Ahlering (58% salary, 42% benefits) 15% FTE/year for 3 years	$39,710.10
Student services contractor, (50% FTE/year for 2 years)	$33,760.00
Equipment/Tools/Supplies	
Plot frames, markers, data sheets, reference material	$500.00
insect nets, survey supplies	$500.00
pins, boxes, glue for insect collections	$1,000.00
lab supplies for N extraction, soil texture	$2,074.00
U of M soil lab costs for nitrogen determinations	$12,000.00
Travel	
sampling plants, soil and insects at study sites, $123/day (motel + per diem), 3 people x 60 days/season x 2 seasons	$44,280.00
Larson and Ahlering travel for training and supervision of field crew, $123/day, 2 people x 7 days/season x 2 seasons	$3,936.00
Additional Budget Items	
field vehicle (USGS-owned) gas and maintenance	$5,000.00
Fact sheet publication and reproduction costs	$4,000.00
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$465,456.98

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period	$ -	*Indicate: Secured or Pending*
In-kind services during project period		
Salary for Sam Droege, 2 weeks/year for 2 years, $3400 salary + 32% fringe/ 2-week period	$8,976.00	Secured

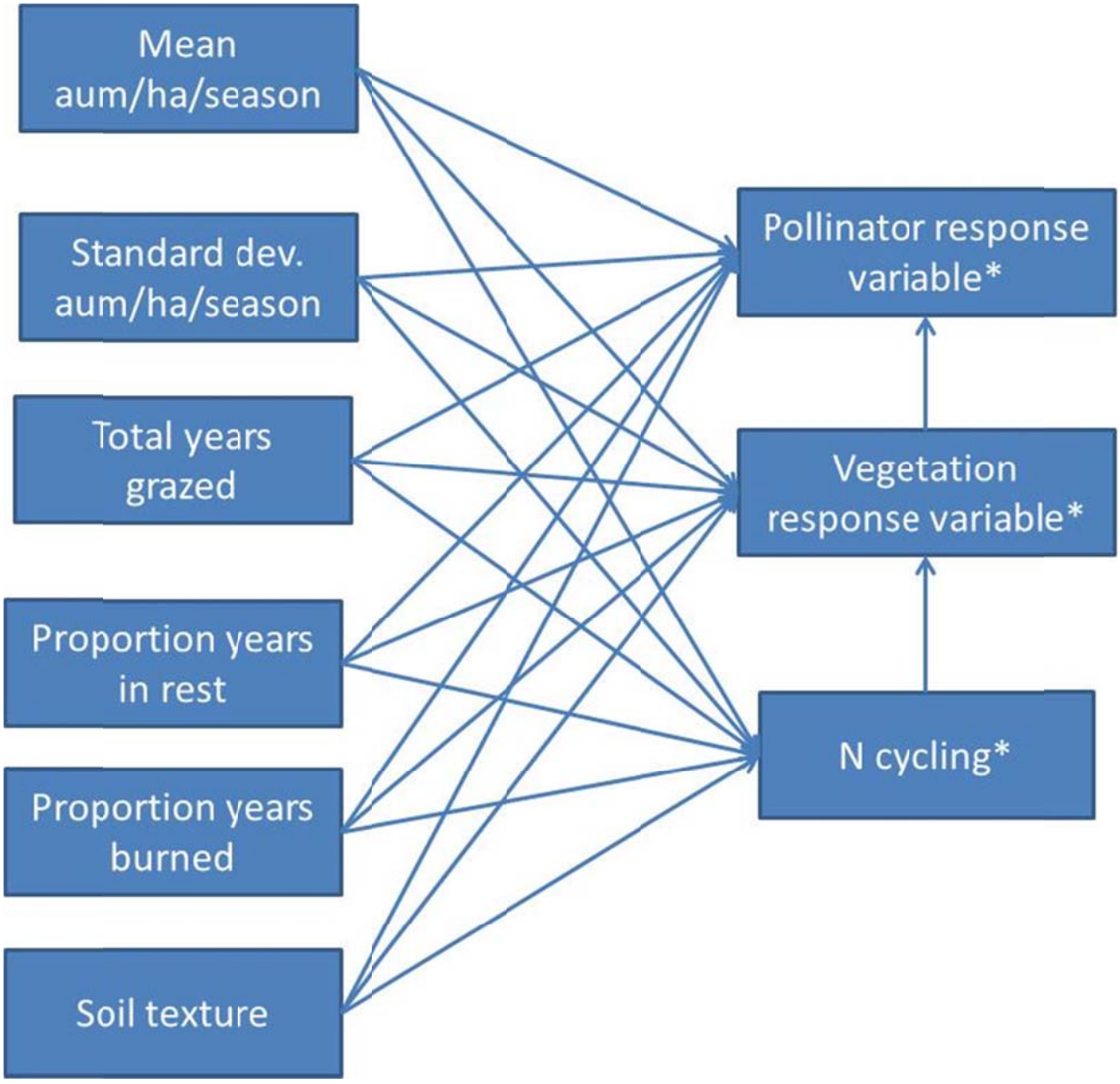

Figure 1. Hypothesized model for effects of grazing and burning on vegetation and pollinators. Each arrow represents a hypothesized causal pathway that affects the response variable.

*Response variables

Pollinator response variable: pollinator species richness, presence of parasitic trophic level

Vegetation response variables: FQI, species richness/diversity/evenness, total exotic cover, cover of smooth brome and Kentucky bluegrass

N cycling: nitrogen mineralization rate, net nitrification

Project Manager Biographical Sketch: Diane L. Larson

Educational Background
B.A. (Environmental, Population, and Organismic Biology) University of Colorado, Boulder, 1978
M.A. (Environmental, Population, and Organismic Biology) University of Colorado, Boulder, 1984
Ph.D. (Biology) University of Illinois, Chicago, 1991

Current Position
Research Wildlife Biologist, U.S. Geological Survey, Northern Prairie Wildlife Research Center, 1991-
Adjunct Associate Professor, Dept. of Ecology, Evolution and Behavior, University of Minnesota, St. Paul, Minnesota, 1998-
Adjunct Professor, Dept. of Horticultural Science, University of Minnesota, St. Paul, Minnesota, July 2008-

Recent Relevant Research Funding
Pollination webs to guide management of rare and invasive species in a changing climate; Diane Larson and Sam Droege; 2010-2013, $277.5K; U.S. Geological Survey Park Oriented Biological Support Program and U.S. Geological Survey Invasive Species Program.

Restoration methods to minimize Canada thistle (*Cirsium arvense*) infestation; Diane Larson: 2004 – 2007; continued 2009-2010, $360K, U.S. Geological Survey and U.S. Fish and Wildlife joint funding; U.S. Geological Survey Science Support Program.

Effects of removal of Canada thistle on pollination networks and pollinator species richness; Diane Larson, Sam Droege (USGS), Milton Haar (National Park Service). U.S. Geological Survey Park Oriented Biological Support Program, January 6, 2012.

Relevant Publications in the Peer-reviewed Literature
Larson, D.L., JB Bright, P. Drobney, J.L. Larson, N. Palaia, P.A. Rabie, S. Vacek, and D. Wells. 2013. Using prairie restoration to curtail invasion by Canada thistle: the importance of limiting similarity and seed mix richness. Biological Invasions DOI **10.1007/s10530-013-0432-0**.
Jordan, Nicholas R, Laura Aldrich-Wolfe, Sheri C. Huerd, Diane L. Larson, and Gary Muehlbauer. In press. Soil-occupancy effects of invasive and native grassland plant species on composition and diversity of mycorrhizal associations. Invasive Plant Science and Management.
Larson, D.L., JB Bright, P. Drobney, J.L. Larson, N. Palaia, P.A. Rabie, S. Vacek, and D. Wells. 2011. Effects of planting methods and seed mix richness on the early stages of tallgrass prairie restoration. Biological Conservation, 144: 3127-3139.
Larson, D.L. and J.L. Larson. 2010. Control of one invasive plant species allows exotic grasses to become dominant in northern Great Plains grasslands. Biological Conservation 143: 1901-1910.
Larson, D.L., R.A. Royer and M.R. Royer. 2006. Insect visitation and pollen deposition in an invaded prairie plant community. Biological Conservation 130: 148-159.
Larson, D.L. 2008. Invasive Plant and Pollinator Interactions. Endangered Species Bulletin 33 (3): 46-49.

Organization
The U.S. Geological Survey (USGS) is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information. The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. The Northern Prairie Wildlife Research Center (NPWRC) conducts integrated research to fulfill the Department of the Interior's responsibilities to the Nation's natural resources. The NPWRC develops and disseminates scientific information needed to understand, conserve, and wisely manage the Nation's biological resources.