

**The Friends of Nachusa Grasslands
2018 Scientific Research Project Grant Report
Due June 30, 2019**

1. Please save this form to your desktop with a unique file name that includes “Friends 2018 Science Grant Report” and your last name.
2. Complete the form using the headings in bold as your guide.
3. Save the file as a Word document or a PDF.
4. Attach the file to an e-mail, and send it to: nachusafriendsscience@gmail.com no later than June 30, 2019.
5. The subject of the e-mail should be “2018 Scientific Research Grant Report” and your last name.
6. After your research project is complete, please contact Friends so that we may learn from and publicize the outcomes as appropriate.

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2018 grant amount: \$1598

Please answer the following questions with 1- to 2- sentence summaries:

Research Project Topic: Native bees of restored tallgrass prairie: impacts of management actions on diversity and species abundances

Research Project Purpose: To describe the impact of management actions, specifically prescribed fire and bison grazing, on both the overall abundance and species richness of native bees, as well as the differential impacts on bees when grouped by their nesting substrate.

Research Project Outcomes to date: We have two manuscripts in draft form that will be submitted to journals soon (#2 is part of Sean Griffin’s PhD thesis, which he will defend this winter):

1) Bruninga-Socolar, Bethanne, S.R. Griffin, Z. Portman, & J. Gibbs. Spatiotemporal complexity of prescribed fire and grazing promotes wild bee diversity in tallgrass prairie.

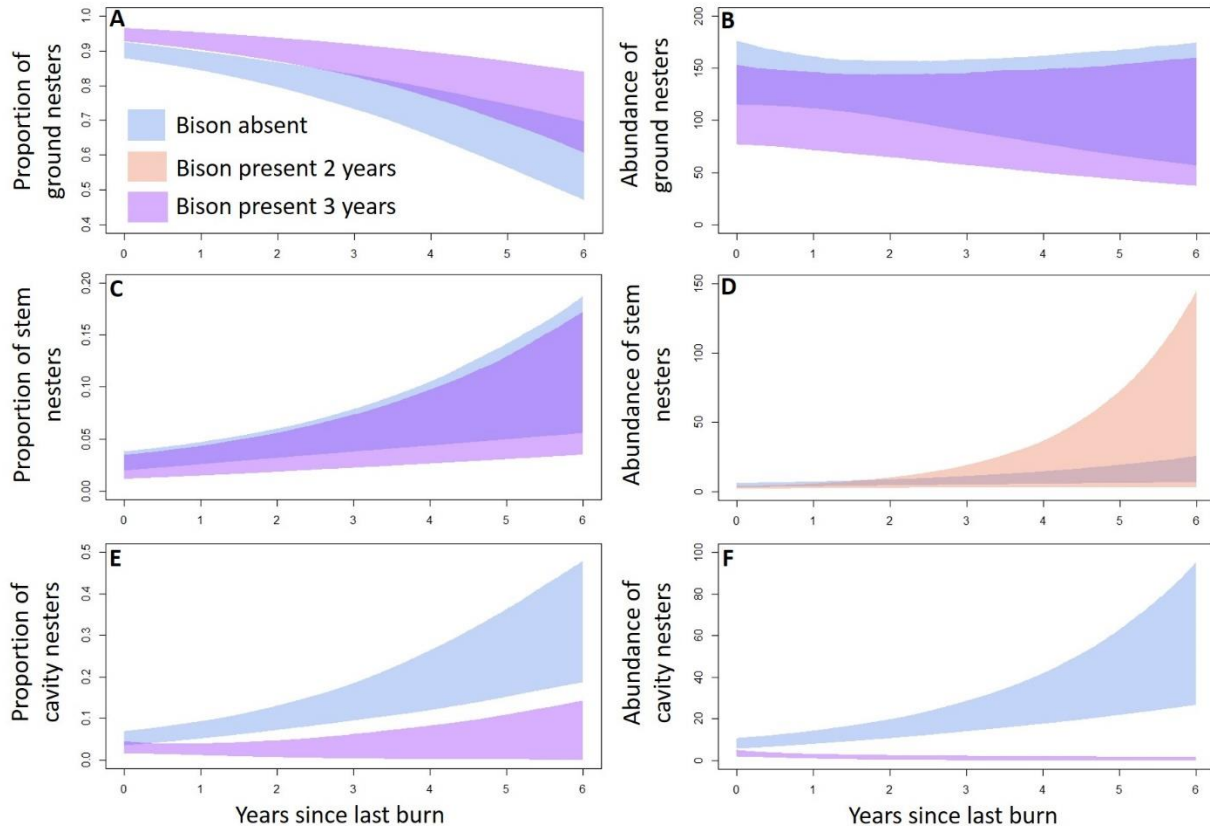
2) Griffin, Sean R., B. Bruninga-Socolar, J. Gibbs, & N.M. Haddad. Direct and indirect effects of restoration management on wild bee communities of a tallgrass prairie.

Describe how the grant funds you have received from the Friends of Nachusa Grasslands have been used in regard to the above topic, purpose, and/or outcomes: The 2018 Science Grant I received from the Friends has been used to finalize the taxonomic identifications of our bee specimens collected 2013-2017 at Nachusa. We have used the funds to mail specimens to Jason Gibbs at the University of Manitoba and to Laura Anchor at the Cook County Forest Preserve District. We have used the funds to

cover Jason Gibbs' fees for identifying specimens of the subgenus *Lasioglossum* (*Dialictus*) of which he is the global expert.

Describe how your project has benefited the work and goals of Nachusa Grasslands: Very little is known about how to restore native bee communities and how native bee communities respond to restoration techniques focused on other taxa. In our first paper published on Nachusa bees (Griffin et al. 2016 *Restoration Ecology*), we determined that basic, plant-based restoration of diverse tallgrass prairie restored native bee communities to abundances and diversity similar to those in remnant prairie. With the addition of bison to the preserve in 2014, we began collecting data on native bees in sites with and without bison, and sites along a gradient of time since prescribed fire. We are using these data to ask how ongoing management of restored prairie impacts the bee community. I am leading a paper that we expect to submit to a scientific journal by the end of the summer. In this paper, we divide the bee community based on nesting substrate; i.e. we group bee species by whether they nest in the ground, in stems, or in cavities. We then model the abundance of each group of bees as a function of bison presence/absence and time since the last burn at our sites. I have found that nesting substrate mediates bee response to bison grazing and prescribed fire: the nesting groups respond differently to bison grazing and prescribed fire. Both grazing and fire impact the availability of bee nests by altering the vegetation structure of prairies and how much bare ground is visible to bees searching for nest sites. The bee groups respond complementarily, suggesting that a mosaic of grazing and prescribed fire, both spatial and temporal, supports bee diversity in tallgrass prairie. This is likely consistent with the historic ecology of tallgrass prairie in which daily and seasonal bison movement and wildfire or Native American prescribed fires created spatiotemporal complexity in the prairie.

I am including one figure from my draft paper that I hope is a useful visualization of the summary of my main finding above. Each nesting group of bees is a row in the figure consisting of a pair of plots. The first plot shows the relationship between the *proportion* of that nesting group of bees out of the total bee community and management variables, while the second plot shows the relationship between the *abundance* of that nesting group and the management variables. The colors represent a breakdown of bison presence/absence, where blue shows results from sites where bison are absent and purple shows results from sites where bison have been present for three years. Orange shows results from sites where bison have been present for two years, and is only included in one panel because the 95% credible interval for the bison-present-for-three-years category was so large as to be uninterpretable.



What I hope this graph illustrates is that the ground nesting category (top two panels) responds differently to prescribed fire than the other two nesting categories. Ground nesters are the most abundant bee group (89% of our total data set), followed by cavity nesters (6%), and stem nesters (3%). The two more rare nesting categories of bees respond in the opposite pattern compared to ground nesters. If we only look at the dominant group (plot A), we would conclude that extremely frequent fire + bison grazing is most beneficial to the bee community. But since stem nesters and cavity nesters respond differently to fire and grazing, preserving refuges of prairie each year that are not grazed or burned is important for conservation of the total diversity of the bee community. In particular, note that the cavity nesters group (which includes bumble bees) greatly prefers sites without any bison grazing (plots E & F) although they are agnostic towards fire frequency.

The main conclusion from my results, i.e. the importance of maintaining spatial and temporal variation in management, is already best practice in restoration management. My results provide evidence for the efficacy of this practice when applied specifically to native bees, an understudied group that is essential for the sustainability and long-term success of tallgrass prairie restoration.

Describe how your findings can be applied to challenges in management practices for restoration effectiveness and species of concern: My research provides evidence

that diverse native bee communities are supported by spatiotemporal variation in grazing and burning practices. Very little is known about bee species of concern, although some bumble bee species are beginning to be more understood. Bumble bees are cavity nesters, nesting in large, usually pre-made cavities such as under bunchgrasses or in old rodent burrows. My research analyzing the response of cavity nesters to restoration management practices thus provides some insight for managers who may wish to manage their prairie specifically for bumble bees.

Please list presentations/posters you have given on your research:

Bruninga-Socolar, B., S.R. Griffin, J. Gibbs. Restoration management influences functional composition change in a native bee community of restored tallgrass prairie. Society for Range Management (SRM) Annual Meeting. Minneapolis, MN. Feb. 12, 2019. (*Invited presentation* – Conservation & Monitoring of Native Pollinators Symposium)

Bruninga-Socolar, B., S.R. Griffin, J. Gibbs. Restoration management influences functional composition change in a native bee community of restored tallgrass prairie. Nachusa Grasslands Science Symposium. Franklin Grove, IL. Oct. 20, 2018

Bruninga-Socolar, B., S.R. Griffin, J. Gibbs. Restoration management influences functional composition change in a native bee community of restored tallgrass prairie. Ecological Society of America (ESA) Annual Meeting. Portland, OR. Aug. 9, 2017

Have you submitted manuscripts to scientific journals? If so, which ones? If not, do you anticipate doing so? (Please keep us informed on publications.)

I tried to get my manuscript ready for submission in time for this grant report, but that didn't happen! I expect to submit my paper (#1 on the first page under "Research Project Outcomes" and described on the previous page) by the end of the summer.

Optional: Offer suggestions for improving the application and award process for future Friends of Nachusa Grasslands Scientific Research Grants:

No suggestions. I have always found the process smooth. Thank you for supporting our research since 2015!