

The Friends of Nachusa Grasslands
2023 Scientific Research Project Grant Report
Due June 30, 2024

Please answer the following questions with clearly written summaries to give Nachusa Friends' science committee members, officers, and board members a good idea of what you accomplished using your grant money. Unless you object to the Friends doing so, your report will be uploaded into the science section of the Friends' website: nachusagrasslands.org.

1. Please save this form to your desktop with a unique file name that includes "Friends 2022 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, 2024.
5. The subject of the e-mail should be "2023 Scientific Research Grant Report" and your last name.
6. If you have not completed your work, please submit this form anyway by the June 30 deadline and plan to contact Friends after your project is complete so that we may learn from and publicize the outcomes as appropriate.

Name: Bethanne Bruninga-Socular

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2023 grant amount: \$10,000

Research Project Topic: Monitoring Nachusa's wild bees: long-term trends and regional importance

Research Project Purpose:

In 2023, we aimed to continue our long-term native bee monitoring program at Nachusa, now in its 10th year. We also aimed to assess the role that Nachusa plays in maintaining native bee abundance and diversity in the region by comparing bee communities at Nachusa to those at a nearby prairie preserve. To address our first aim, we continued our long-term monitoring of Nachusa's native bees, with 2023 marking year 10 since we began our program. To address our second aim, we also collected data on native bee diversity and abundance at the Byron Forest Preserve in order to compare the bee communities at Nachusa and Byron.

Finally, we always aim to support the career growth of the technicians we hire to conduct our fieldwork. In 2023, our goal was to work with our technician, Gabriella Muller, to develop an

independent research project that she could conduct in conjunction with her data collection to address our research aims described above.

Research Project Outcomes to date:

Our field technician, Gabriella Muller, worked full-time at Nachusa from May 15 through August 11, 2023. She collected ~4,000 bee specimens from 19 restored and remnant sites at Nachusa, and four sites at Byron. These bees have been pinned, sorted to genus and morphogroup, and are currently with taxonomic experts for species identification. These bees will contribute to our long-term study of bee diversity and abundance at Nachusa Grasslands, as well as provide a comparison with the bee communities at Byron.

In addition, Gabby worked with us to design and carry out an independent research project. Studies of native bees in restored habitats focus overwhelmingly on total bee diversity and abundance (e.g., our long-term study at Nachusa) but comparatively little work has been done on specific plant-pollinator relationships in restored ecosystems. Gabby focused her research on species in the genus *Penstemon*, particularly *P. digitalis*, *P. pallidus*, and *P. hirsutus*, which are commonly used in tallgrass prairie restoration seed mixes. She identified floral neighborhoods of 2m x 2m plots at several sites at Nachusa, each defined by a focal *Penstemon* plant located in the center of the plot. She identified and counted every species of plant in the neighborhoods that was in bloom at the time of data collection. She then collected two types of pollinator data: 1) bee visits to the focal *Penstemon* individual in 10-minute observation periods, and 2) the sequence of plant individuals visited by foraging bees within the plot in separate 10-minute observation periods. With these data, she aims to describe the relative attractiveness of *Penstemon* compared to other flowering plants in the plots.

So far, our analysis of Gabby's data has found that, in general, bees foraging in the floral neighborhoods visit *Penstemon* less than expected when it is rare, and in proportion to its abundance when it is more common in its floral neighborhood. This is an efficient foraging strategy in the absence of strong preference, and suggests that plants of conservation interest might achieve higher pollination rates if planted in aggregations. Gabby is currently finishing her analysis of these data and has already begun drafting a manuscript for eventual publication.

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 bulk of our grant funds were spent on Gabby's wages for three months of full-time work in 2023. The remainder were spent on replacing much of our bee sampling equipment after 10 years of use, and minimal fees to support taxonomic identification of our bee specimens.

Describe how your project has benefited the work and goals of Nachusa Grasslands:

I am currently analyzing our 10 years of bee specimen data at Nachusa to describe the responses of individual bee species to restoration and management. Very few pollinator studies have been conducted for longer than 2-3 years because that is the typical cycle of most grant agencies. Bee communities are known to exhibit dramatic temporal turnover which we cannot yet attribute to specific causes. Thus, it is difficult in the literature to make broad inferences about changes in

bee communities over time in the absence of long-term studies. With 10 years of data, we hope to make progress in this area of research. Currently, I am analyzing each of the most abundant bee species and finding that they respond differently to restoration and management practices over time.

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

Our past publications and my current analysis of the common species at Nachusa all continue to tell a story that the spatial and temporal variation in restoration and management at Nachusa creates a dynamic, heterogenous landscape that promotes high native bee diversity and abundance.

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

Upcoming:

Ecological Society of America: August 5-9, 2024 at Long Beach, CA

Talk title: Solitary bee species vary in response to tallgrass prairie restoration and management
Presented as part of the session organized by Elizabeth Bach: "Integrating across the academic-practitioner divide: supporting basic and applied ecology researchers across their careers at Nachusa Grasslands"

Selected past presentations:

"If you build it, they will come": an evidence-based approach to habitat restoration for bees.
Biology Department Seminar Series, Susquehanna University, February 2024
Bees in restored tallgrass prairie: lessons learned from 8 years of fieldwork in Illinois. Department of Entomology Seminar Series, University of Minnesota. February 2021.
Restoration management influences functional composition change in a native bee community of restored tallgrass prairie. Society for Range Management Annual Meeting. February 2019

Have you submitted manuscripts to scientific journals? If so, which ones? If not, do you anticipate doing so? (Please send digital copies of published articles to the Friends so that we can learn from your work.)

Manuscripts in progress:

Muller G, Griffin SR, and Bruninga-Socolar B. (*in prep*) Bees use, but do not prefer, *Penstemon* spp. in a diverse floral community.
Bruninga-Socolar B, Griffin SR, Portman ZM, and Gibbs J. (*in prep*) Solitary bee species vary in response to tallgrass prairie restoration and management.

Past manuscripts:

Griffin SR, Bruninga-Socolar B, Gibbs J. (2021) Bee communities in restored prairies are structured by landscape and management, not local floral resources. *Basic and Applied Ecology* 50: 144-154.
Bruninga-Socolar B, Griffin SR, Portman ZM, and Gibbs J. (2021) Variation in prescribed fire and bison grazing supports multiple bee nesting groups in tallgrass prairie. *Restoration Ecology* e13507.
Griffin SR, Bruninga-Socolar B, Kerr MA, Gibbs J, and Winfree R. (2017) Wild bee community change over a 26-year chronosequence of restored tallgrass prairie. *Restoration Ecology* 25(4): 650-660.

What follow-up research work related to this project do you anticipate (if any)?

In addition to our current papers in prep, we have several other manuscripts in progress. First, past work by our former technicians, Josh Klostermann and Chan Dolan, is moving through analysis and writing as both of them have pursued graduate degrees in native bee and pollination research following their first field season at Nachusa in 2020. Second, I am eager to analyze our 10-year data set including the 2023 data set to look at changes in bee diversity, abundance, and community composition over this 10 year period, potentially as a consequence of regional climatic variation.

For future data collection, I am eager to continue our long-term data set by contributing to it every three years, resuming data collection again in 2026. I am also eager to conduct more small-scale projects similar to Gabby's 2023 project that investigate more specific plant-pollinator interactions at Nachusa. There is much to discover about the pollination ecology of specific plant species that are commonly used in tallgrass prairie restoration, with the potential to make recommendations for improving habitat restoration for native bees.

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

I am so grateful for this opportunity. Sean Griffin and I have both benefited enormously in our careers from the long relationship that we have been able to build with Nachusa and with the Friends of Nachusa. We are extremely grateful as well that Nachusa has supported our efforts to provide career growth opportunities for our technicians by creating a welcoming and supportive atmosphere each summer.