

**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: Luke Fannin

Address: 408A

Phone: 330.715.3045

Current

E-mail:

luke.d.fannin.gr@dartmouth.edu

2023 grant amount: \$1,644.00

Research Project Topic: Bison Foraging Ecology; Bison Foraging Performance

Research Project Purpose: The current project has three main objectives:

- 1.) To investigate how the structural traits of grasses— fiber content, fracture toughness, and phytolith (silica content) covary as a function of the photosynthetic pathway utilized (C3 or C4 photosynthesizing); and (2) degree of herbivory pressure by bison (enclosure vs. non-enclosure plots).
- 2.) Quantify the siliceous component of bison diets via an analysis of fecal silica to understand the seasonal nature of bison silica ingestion and its relationship to grass silica levels.
- 3.) Quantify seasonal differences in bison chewing efficiency (via measuring fecal particulate size) to determine how variation in grass silica and toughness influence bison digestive performance.

- 4.) Utilize DNA metabarcoding methodologies to determine the types/species of plants consumed by bison across the grass season, linking such patterns to differences in silica uptake and chewing efficiency.

Research Project Outcomes to date:

We have extracted silica from bison dung across the grass-growing season, as well as quantified bison chewing performance via fecal particulate size. Currently, we are extracting silica from the plant tissues collected from previous field seasons. We have collected a number of fracture toughness values from Nachusa plants within the bison diets. This year (2024), we have started a DNA metabarcoding project, collecting and preserving bison dung for DNA sequencing. We plan to return in September 2024 to collect another round of bison dung. We hope to have DNA metabarcoding results in winter 2025 (sequencing in Fall 2024).

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:

Received funds served three primary roles; (1) they helped the applicant with both travel and meal costs for studying at Nachusa Grasslands during sample collection; (2) they were used for purchasing sample collection implements (e.g., plastic sample bags, desiccant, collection tubes); and (3) for purchasing sample collection kits for later DNA metabarcoding work from bison dung.

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

Silica is known to increase plant resiliency to various abiotic and biotic stresses (e.g., drought, microbial infection, etc.); thus, understanding the factors structuring silica levels in native grassland plants will aid in predicting their potential responses to climatic and biotic changes in the ecosystem in the future.

Our work is beginning to elucidate the role of bison herbivory in grassland seasonal silica cycling dynamics, perhaps another benefit of returning native grazers back to restored prairie ecosystems.

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

Our silica extraction protocol will produce a library of morphologically-distinct phytoliths (i.e., phyto-library) in the diets of Nachusa bison. Likewise, our DNA metabarcoding data will provide lists of plant taxa in the diets of Nachusa bison across the grass-growing season. Such information can be used to identify the plant species composing the Nachusa bison diets, allowing for further understanding of how the bison are structuring the plant community composition at Nachusa through their herbivory.

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

Presented our work at the 2024 Nachusa Science Symposium.

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.)

We anticipate publishing our continuing work at Nachusa in either *Functional Ecology*, *The American Naturalist*, or *Journal of Animal Ecology*. We anticipate beginning to publish one such article in 2025.

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

Work on this project is continuing through summer 2024, where LDF plans to return to collect more plant and bison dung samples in September.

As a follow-up, I would like to do a planting experiment, where I raise Nachusa plants to soil with added silica that has been subject to bison-like stomach/digestive conditions. My question is whether the act of silica moving through a bison digestive system improves its later uptake by plants after being contributed to the surrounding soil via dung inputs.

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

I am incredibly impressed and inspired by the committed work of both the Friends and the research scientists at Nachusa Grasslands. I found the grant application process straightforward and easy to navigate, and I plan to apply again in the future.