The Friends of Nachusa Grasslands
2021 Scientific Research Project Grant Report
Due June 30, 2022

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2021 grant amount: $450.00

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

Research Project Topic: This project is titled: Functional Ecology of competing photosynthetic pathways in a North American Tall-Grass Prairie. Our project focuses on the ecological and functional roles of silica within tall-grass prairie ecosystems and the role silica plays within plant-animal co-evolution in the context of bison herbivory.

Research Project Purpose: Our project has three defined research goals:

1.) To investigate how the structural traits of grass plants – 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 feces to understand the seasonal nature of bison silica ingestion and its relationship to grass silica levels.

3.) Understand the ecosystem dynamics of silica cycling in the Nachusa ecosystem through plant uptake and herbivore deposition in the soil (dung “bioactive silica”)

Research Project Outcomes to date:

Our lab work from samples collected in 2021 is currently underway and we expect to present initial results to the Friends at the end of 2022 or early 2023.

The silica extraction method that we are currently running on the Nachusa Bison samples collected in 2021 was recently accepted for publication (June 2022) in *Methods in Ecology and Evolution* (no pdf link yet, but we will forward). We field tested this method on another captive bison population in Maine for the paper and found promising results; thus, we expect that such a method holds immense future promise for understanding the silica ingestion patterns of the Nachusa bison.

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 plant presses, in order to create an index of voucher specimens for the current project.

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 silica extraction protocol also will produce a library of phytoliths found within bison dung (see below). This library will then be used to understand the types of plants being included in Nachusa bison diets across seasons, informing conservation and management practices.

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. Such a library can be used to identify the plant species composing the Nachusa bison diets during various seasons, 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:

Nachusa Grasslands Blog:

Fannin LD (2021). 'Grass-eating and the Nachusa bison – Do plants fight back?'. Nachusa Grasslands Blog. https://www.nachusagrasslands.org/nachusa-blog/grass-eating-and-the-nachusa-bison-do-plants-fight-back

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 *Frontiers in Plant Science*. We anticipate beginning to publish one such article in either 2023 or 2024.

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

Work on this project is continuing through summer 2022, where LDF plans to return to collect more plant and bison dung samples.

Future follow-up work includes utilizing a portable mechanical tester for quantifying fracture toughness in fresh grasses, along with further sample collections for silica extraction.

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.