The Friends of Nachusa Grasslands
2022 Scientific Research Project Grant Report
Due June 30, 2023

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. Donors and prospective researchers often read these reports after they are posted.

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, 2023.
5. The subject of the e-mail should be "2022 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.

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2022 grant amount: $3,400 (3rd of 3 years, total of $10,500)

Research Project Topic: Quantifying prescribed fire and assessing the impacts of landscape and management activities on small mammal populations

Research Project Purpose: The objective of this research was to combine data on management activities and landscape dimensions with a decade of small mammal trapping data to fully evaluate the complex interactions between small mammals and the environment. To accomplish this task, I continued management of a long-term small mammal trapping project established in 2013, collected and analyzed drone imagery, and an in the process of conducting statistical analysis to understand how management and other variables impact small mammal populations at 19 sites across the preserve.

Research Project Outcomes to date:
During the period of this grant, we had 1,038 captures composed of 425 individuals of eight different species during small mammal trapping. One highlight was the capture of

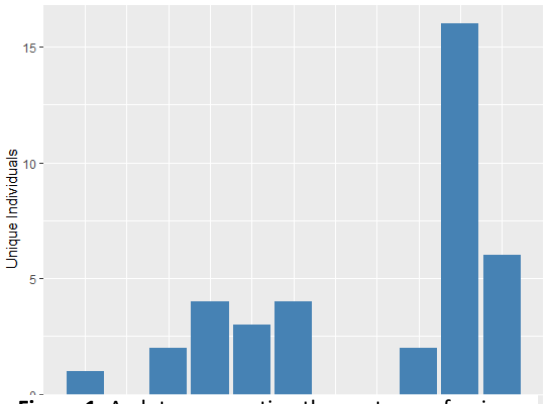

Figure 1: A plot representing the captures of unique individual meadow jumping mice by year of trapping. Captures spiked significantly in 2022 and remain high in the beginning of 2023

18 individual meadow jumping mice (*Zapus hudsonius*). Prior to 2021, we had only captured 14 individuals over nine years, so this represents a significant increase, and may represent a "boom" period for this species (Fig. 1).

Using the digitized prescribed fire history records we produced, we analyzed captures of these small mammals according to the amount of land that was burned within 100 meters of the trapping grid to understand how small mammals might respond to broader context of prescribed fire. For example, if one of our sites was not burned, but a significant amount of nearby area was, the mammals at our site may still respond to that burn.

Our results showed that deer mice (*Peromyscus maniculatus*) and prairie voles (*Microtus ochrogaster*) both had significant responses to the amount of prescribed fire nearby, and that even at unburned sites, these responses would occur if a large area nearby had been burned (Fig. 2).

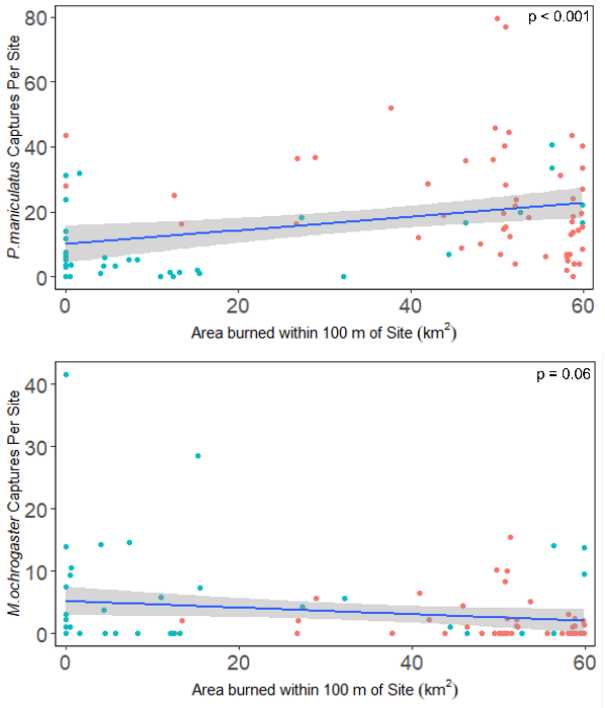

Figure 2: The relationship between two small mammal species and prescribed fire. Deer mouse abundance had a significant positive association with prescribed fire, while prairie vole abundance had a slight negative association. Burned plots are shown in red, while unburned plots are shown in blue.

In addition to our work with small mammals, we also collected drone imagery of several sites at the preserve during the spring green-up period to compare the impacts of different burn treatments. We observed visible impacts of bison activity (wallows, bison trails) in the multispectral imagery (Fig. 3a). We also identified that green-up after a burn varied depending on the topography, with wetter, lowland areas appearing greener in the aerial imagery taken soon after a burn (Fig. 3b). In imagery comparing sites that were burned in the fall, spring, and not burned, visible differences were apparent, and the impacts of topography were once again clear. A low-lying area appeared much greener than a nearby area that was higher and less wet, despite the two being burned on the same day (Fig. 3c).

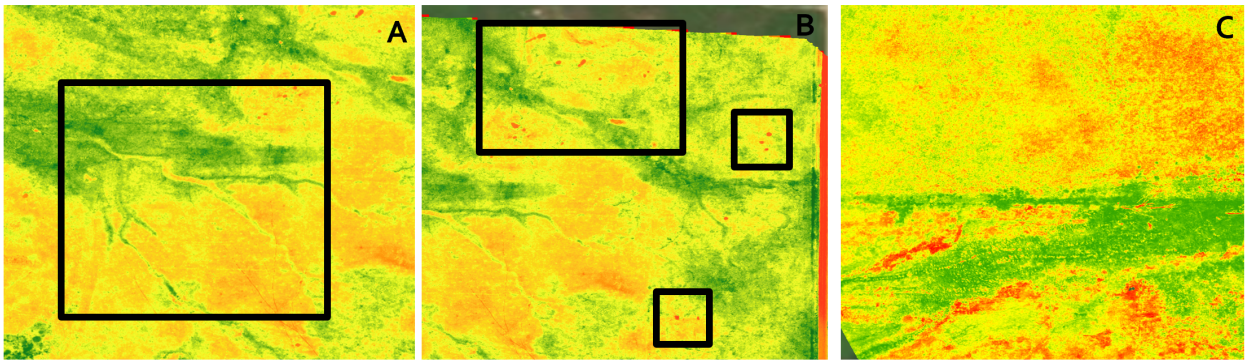

Figure 3: (A) Drone imagery showing stronger green signal in a lower-lying area during spring green-up. (B) Areas of bison wallowing leading to a lack of vegetation visible in multispectral drone imagery. (C) A comparison of two areas burned on the same day. The top area is higher-lying and sits above a nearby creek, while the bottom area is low-lying, wet, and sits directly adjacent to a creek and an area that recently had agricultural tiles removed.

Products include:

- 3 peer-reviewed manuscripts (including one first-author for the grant awardee)
- 7 oral presentations and 1 poster presentation at local, national, and international meetings
- Science communication via an interview with the Chicago Tribune, a blog post for the Friends of Nachusa Grasslands, and a blog post for The Applied Ecologist
- Continuation of a long-term small mammal trapping project for three years
- Continuing research that will be published in at least one additional paper and included in Erin Rowland-Schaefer's doctoral dissertation.

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:

Grant funds have been used to purchase required supplies for small mammal trapping, including peanut butter powder and oats for bait, passive integrated transponder (PIT) tags and syringes for marking animals, new scanners for scanning PIT tags, and other equipment for small mammal trapping. We were also able to purchase new fiberglass poles to replace damaged or worn poles to mark trapping sites, as well as iButtons and an iButton reader to help us study small mammal activity timing. Funds have also been used to pay for software licenses for technology to analyze drone imagery, to supplement pay for undergraduate student technicians, and to help provide for summer funds for Erin Rowland-Schaefer.

$1900 trapping supplies (bait, cotton batting, PIT tags)
$2500 trapping equipment (fiberglass poles, tagging and measuring equipment)
$500 software and trainings (drone license and analysis software)

$5600 pay for technicians, researcher stipend

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

One of the primary aims of this project is to gain a more sophisticated understanding of the far-reaching impacts of management activities. To this end, we have generated a number of datasets for use in our project that will also benefit others, such as digitized maps of the preserve's fire history and the footprint of other management activities (with additional support through a summer externship through TNC). These datasets will be published and shared widely for other researchers to use, and one such dataset was already published and described in a data paper, hopefully supporting the work of others in understanding prescribed fire impacts.

The focus species of our study, small mammals, can be key ecosystem indicators as central figures in tallgrass prairie food webs. By understanding how vegetation, management, time, and small mammals are related, managers at Nachusa can better predict their impacts on these species, and therefore the food web as a whole.

Another aim of this research is to refine the way we measure management activities such as prescribed fire or the reintroduction of bison, taking these factors from categorical (burned/unburned or bison present/absent) to continuous (How much area was burned? How much as bison using an area?) and using these more complex measurements to better study these tools. We hope that others can use the models we have developed for quantifying management activities in their work so that we can better capture the nuanced impacts of management work.

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

Since small mammals are so central to prairie food webs, understanding the drivers of their populations is critical for land managers. By understanding how management activities such as prescribed fires impact small mammals, managers may be able to predict the secondary effects on species of concern such as the Northern Harrier (*Circus hudsonius*). Furthermore, since small mammals are significant sources of seed removal and plant consumption, understanding their populations may help managers better plan for overseeding or planting of sensitive plant species.

By exploring alternative mechanisms of quantifying and understanding prescribed fire impacts, we hope to increase our understanding of the complex impacts of fire on prairie communities. With a more complex understanding of these processes, managers will be equipped to make more informed decision about management applications. The integration and exploration of new technologies help support the work of managers by providing new types of insight into their work.

Finally, by continuing to monitor small mammals through this project, we are continuing a rare long-term population monitoring project. This data will be incredibly valuable in the context of global climate change, and for managers to collaborate and compare with other tallgrass prairie preserves.

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

Oral Presentations (Invited*)

***2023 | Rowland-Schaefer, E.G.,** Jones, H.P. "The view from above: an assessment of the impacts of interactions between prescribed fire and bison on vegetation using drone imagery." Nachusa Science Symposium. Franklin Grove, IL.

2022 | Rowland-Schaefer, E.G., Jones, H.P. "On the ground and from above: a multi-scale analysis of the factors influencing small mammal populations in a restored tallgrass prairie." Ecological Society of America Annual Meeting, Montreal, Quebec, Canada.

2022 | Rowland-Schaefer, E.G., Jones, H.P. "A preliminary investigation of the landscape ecology of restored tallgrass prairie small mammals." American Society of Mammalogists Annual Meeting, Tuscon, AZ.

2022 | Rowland-Schaefer, E.G., Jones, H.P. "Landscape and habitat associations of prairie small mammals: a preliminary investigation." International Association for Landscape Ecology – North America Annual Meeting. Virtual

***2022 | Rowland-Schaefer, E.G.,** Jones, H.P. "Landscape and habitat associations of prairie small mammals: a preliminary investigation." Nachusa Science Symposium. Virtual.

2021 | Rowland, E.G., Bach, E.M., Kleiman, B.P., and Jones, H.P. "Beyond Burned and Unburned: A New Approach to Quantifying the Impacts of Prescribed Fire on Prairie Small Mammals." Midwest Ecology and Evolution Conference, Northern Illinois University. Virtual.

2021 | Rowland, E.G., Bach, E.M., Kleiman, B.P., and Jones, H.P. "Beyond Burned and Unburned: A New Approach to Quantifying the Impacts of Prescribed Fire on Prairie Small Mammals." Midwest Fish and Wildlife Conference, Milwaukee, MN. Virtual.

2020 | Rowland, E.G. "Seeing the Big Picture: Spatial Analysis and Landscape Ecology at Nachusa Grasslands." Northern Illinois University Department of Biological Sciences Seminar. Virtual.

Posters

2021 | Rowland, E.G., Bach, E.M., Kleiman, B.P., and Jones, H.P. "The View From Above: Spatial Trends in Prescribed Fire and Edge Proximity at Nachusa Grasslands." Nachusa Science Symposium. Virtual.

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.**)**

Guiden, P.W., A.M. Burke, J. Fliginger, **E.G. Rowland-Schaefer**, K. Savage, H.P. Jones. 2023. Reintroduced megaherbivores indirectly shape small-mammal responses to moonlight. *Ecology*: e3884

Rowland-Schaefer, E.G., E.M. Bach, B.P. Kleiman, and H.P. Jones. 2022. Mapping fire history and quantifying burned area through 35 years of prescribed fire history at an Illinois tallgrass prairie restoration site using GIS. *Ecological Solutions and Evidence*: 3(2): e12144

Guiden, P.W., N.A. Barber, R.C. Blackburn, A. Farrell, J. Fliginger, S.C. Hosler, R.B. King, M. Nelson, **E.G. Rowland**, K. Savage, J.P. Vanek, and H.P. Jones. 2021. Effects of management outweigh effects of plant diversity on restored animal communities in tallgrass prairies. *Proceedings of the National Academy of Sciences*: 118(5): e201542118.

What follow-up research work related to this project do you anticipate (if any)?
We anticipate that the small mammal trapping project will continue long-term and continue to produce interesting results. Data from this period of the project are still being analyzed, with plans to produce another manuscript that explores the interconnected relationships between land cover, management, plant communities, and small mammals, as well as a chapter of a dissertation from these results. We also hope to continue expanding the use of drones to assess the impacts of prescribed fire at Nachusa.

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