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: 9,500

Research Project Topic:

The nesting bee and wasp communities of Nachusa Grasslands bison wallows

Research Project Purpose:

To document the bee and wasp species found nesting in bison wallows, identify the attributes of the wallow microhabitat that influence nesting community composition, and to compare the nesting communities between wallow and non-wallow habitats.

Research Project Outcomes to date:

Documenting the bee and wasp species found nesting in bison wallows.

Since the early sampling for this project in the late summer of 2020 the bison wallows of Nachusa Grasslands have proven to be incredibly diverse in terms of their nesting bee and wasp communities. Every year of sampling has uncovered new species to the preserve, rare species that have not been recorded in Illinois for many years, and endless information on the natural history of Nachusa's bee and wasp species. Much of these details will be included within Laura Rericha-Anchors unpublished monograph on the bees of the region and my unpublished article on the natural history of *Nomada banksi.* Attached is the current species list of bees and wasps recorded from Nachusa's bison wallows. As of 2023 we have recorded at the very least 115 bee and wasp species utilizing the bison wallow microhabitat. The list is still slowly increasing as more specimens become identified and as more sampling takes place.

Bison wallow bee and wasp species list: See email attachment and list also provided at end of document.

Identify the attributes of the wallow microhabitat that influence nesting community composition.

We found a strong relationship between wallow area and species richness. We also found there to be no significant relationship between soil bulk density and species richness. Much of this work still needs to be analyzed before this data can be published.

See attachments at end of document.

Compare the nesting communities between wallow and non-wallow habitats.

We first compared differences in the physical attributes between wallow and non-wallow habitats. We chose to use the metrics of soil bulk density, soil surface/"cell depth" temperatures, and soil texture because of their known importance in bee and wasp nesting biology. We found there was a significant difference between the soil bulk density and soil surface temperature between the two habitats. (see plots). We have yet to analyze how these metrics explain the variation in community composition between wallow and non-wallow nesting habitats.

See attachments at end of document.

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:

Funds were used to purchase emergence traps, insect specimen drawers, pinning supplies, and other equipment pertinent to the collection and preservation of insects. Funds were also used to pay for soil samples to be processed for texture analysis. Lastly funds were used to cover travel expenses for several trips across the 2022 field season.

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

Our project has benefited the work and goals of Nachusa Grasslands by identifying a key landscape feature on the preserve that is connected to the life histories of 115 different bee and wasp's species. Our work investigates a poorly understood area of grassland restoration ecology: the relationship between a newly re-introduced megafaunal herbivore and communities of insect pollinators and predators (bees and wasps). We show that bees and wasps are indirectly interacting with bison by utilizing the landscape features left behind by their wallowing behavior. Through this research we have been able to gain a fuller understanding of the diversity of bees and wasps found at Nachusa Grasslands, how this ecologically crucial group of insects responds to a reintroduced mammal, and have also identified an area of research that deserves much more investigation.

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

Our findings show that a more complex and heterogenous landscape of nesting microhabitats may be important in maintaining bee and wasp diversity. Current restoration efforts focused on pollinators are typically focused on re-establishing floral diversity but fall short in not considering re-establishing nesting habitats. Our work shows that the disturbance of bison modifies the landscape in metrics that are known to be important in the nest site selection of ground nesting bees and wasps (soil bulk density, soil surface temperature) and therefore, creates a more heterogenous landscape of nesting microhabitats for nest founding bees and wasps to select nest sites from. More specifically, our research shows that areas of large bare ground at Nachusa Grassland support a large diversity of nesting bees and wasps. This knowledge can be applied in areas where bison reintroduction is not possible by creating landscape features similar to wallows. This line of thought represents an entire new field of research that can be used to ask questions and gain insight on how to support bee and wasp diversity, especially in areas with species of concern.

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

2023 Nachusa Science Symposium - "Bison wallows: rekindling old relationships between the large and small….and more!"

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.**)**

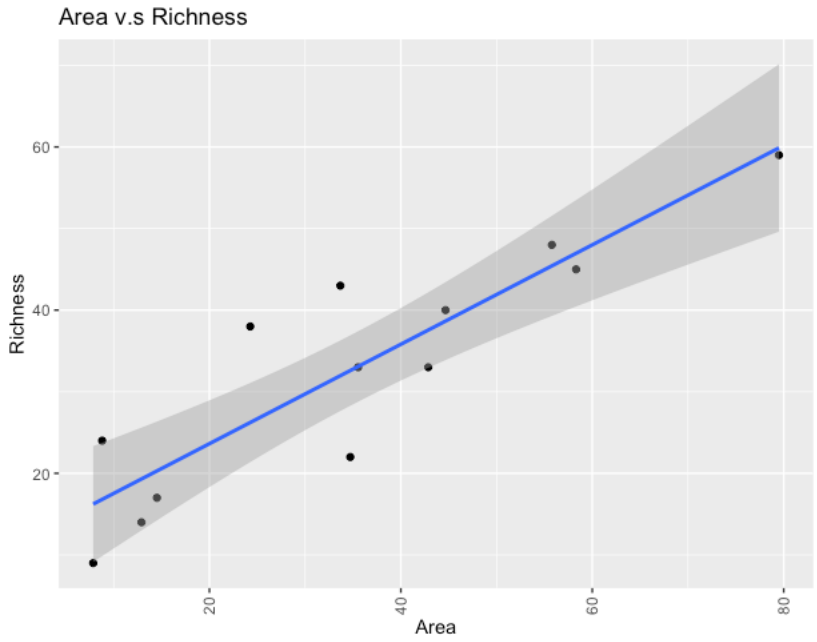
No, but I plan on doing so.

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

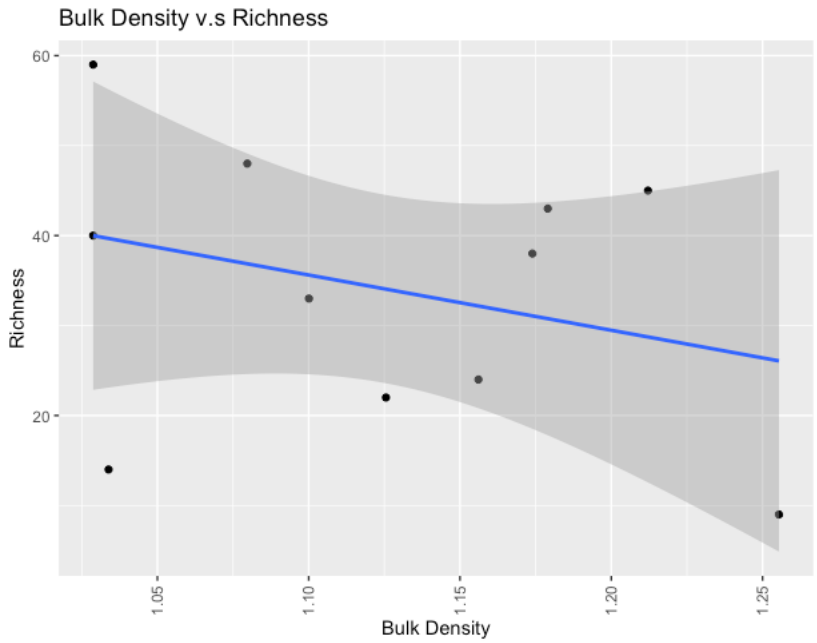
The wallows of Nachusa are a freshwater spring seeping forth new ideas for projects and discoveries. I will be returning in the fall of 2023 to monitor the large aggregation of *Andrena asteris* in the wallows of the Rolling Thunder unit. I will be making observations for my unpublished Natural History of *Nomada banksi* article. While completing the rest of my Ph.d work it will be difficult to follow up on the wallow work but once I become more free I have plenty of new projects that can build on the foundation that is the work shown above.

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

Area v.s Richness plot:



Bulk density v.s Richness plot:

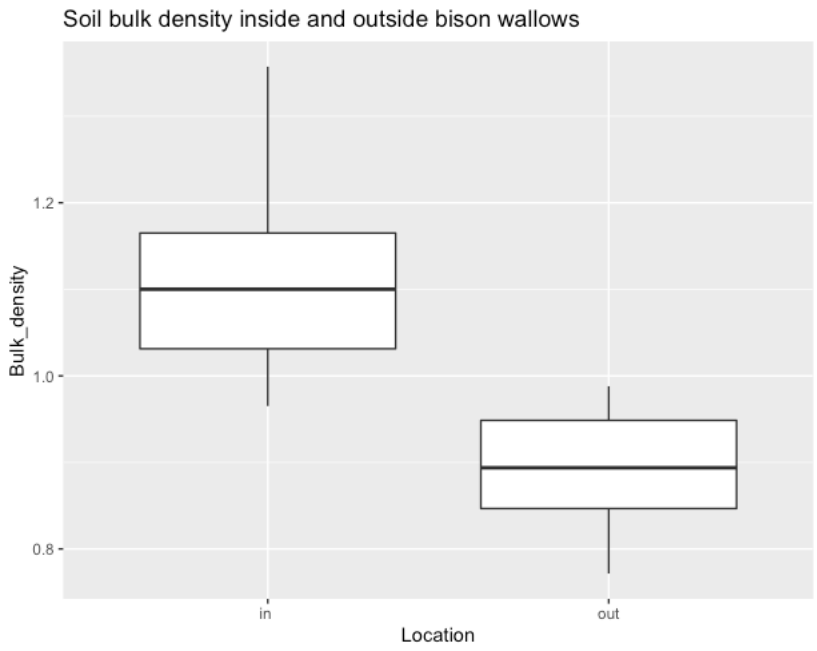


Linear model results for Area v.s Richness:

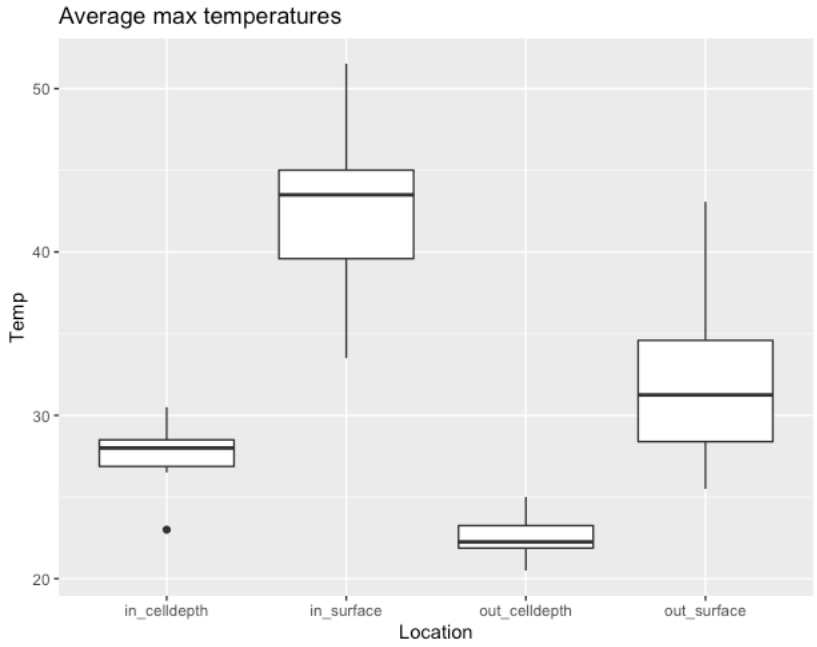
```
Call:
lm(formula = tot_rich.x ~ area, data = model1)

Residuals:
     Min       1Q   Median       3Q      Max
-10.5946  -4.5576  -0.8786   2.5739  11.7711

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 11.44644    3.84344   2.978   0.0126 *
area         0.60919    0.09479   6.427  4.9e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 7.068 on 11 degrees of freedom
Multiple R-squared:  0.7897,    Adjusted R-squared:  0.7706
F-statistic:  41.3 on 1 and 11 DF,  p-value: 4.898e-05
```

```
Call:
lm(formula = tot_rich.x ~ Bulk_density, data = model1)

Residuals:
     Min       1Q   Median       3Q      Max
-25.6772 -10.1101   0.0101  11.6863  19.0101

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)    103.16      70.37   1.466    0.177
Bulk_density   -61.40      62.42  -0.984    0.351

Residual standard error: 15.34 on 9 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.09707,   Adjusted R-squared:  -0.003258
F-statistic: 0.9675 on 1 and 9 DF,  p-value: 0.351
```

Bulk Density Plot:



Wallow temperature plot:



Attachment:

Nachusa wallow habitat bee and wasp species list

Species name: Family:
"1","Agapostemon splendens","Halictidae"
"2","Agapostemon virescens ","Halictidae"
"3","Agapostomen sericeus","Halictidae"
"4","Andrena asteris","Andrenidae"
"5","Andrena sp. ","Andrenidae"
"6","Astata unicolor ","Crabronidae"
"7","Augochlorella persimillis ","Halictidae"
"8","Augochloropsis metallica ","Halictidae"
"9","Bembecinus nanus","Crabronidae"
"10","Bembix americana spinolae","Crabronidae"
"11","Bembix belfragei","Crabronidae"
"12","Bembix sayi","Crabronidae"
"13","Bembix texana","Crabronidae"
"14","Bicyrtes quadrifasciata","Crabronidae"
"15","Bicyrtes ventralis","Crabronidae"
"16","Calliopsis andreniformis","Andrenidae"
"17","Calliopsis nebraskensis","Andrenidae"
"18","Cerceris bicornuta bicornuta","Crabronidae"
"19","Cerceris clypeata","Crabronidae"
"20","Cerceris echo atrata","Crabronidae"
"21","Cerceris echo echo","Crabronidae"
"22","Cerceris fumipennis ","Crabronidae"
"23","Cerceris rufinoda","Crabronidae"
"24","Cerceris rufopicta","Crabronidae"
"25","Cerceris sp. ","Crabronidae"
"26","Chlorion aerarium","Sphecidae"
"27","Chrysididae","Chrysididae"
"28","Coelioxys octodentata","Megachilidae"
"29","Coelioxys rufitarsis","Megachilidae"
"30","Colletes americanus","Colletidae"
"31","Colletes sp. ","Colletidae"
"32","Crossocerus sp. (Undetermined)","Crabronidae"
"33","Dasymutilla canella","Mutillidae"
"34","Dasymutilla nigripes","Mutillidae"
"35","Dasymutilla quadriguttata","Mutillidae"
"36","Dasymutilla scaevola","Mutillidae"
"37","Dasymutilla stevensii","Mutillidae"
"38","Dasymutilla ursus","Mutillidae"
"39","Dieunomia heteropoda","Halictidae"
"40","Ectemnius sp. (Undetermined)","Crabronidae"
"41","Epeolus ainslei","Apidae"
"42","Epeolus sp. ","Apidae"
"43","Epinysson cf. mellipes","Crabronidae"

"44","Epinysson sp. (Undetermined)","Crabronidae"
"45","Halictus confusus ","Halictidae"
"46","Halictus ligatus","Halictidae"
"47","Halictus parallelus","Halictidae"
"48","Halictus rubicundus ","Halictidae"
"49","Holcopasites calliopsidis","Apidae"
"50","Hoplisoides costalis","Crabronidae"
"51","Hoplisoides nebulosus nebulosus","Crabronidae"
"52","Hoplisoides placidus pergandei","Crabronidae"
"53","Hoplisoides sp. (Undetermined)","Crabronidae"
"54","Hoplissodes nebulosus nebulosus","Crabronidae"
"55","Larropsis distincta","Crabronidae"
"56","Lasioglossum (Dialictus) sp.","Halictidae"
"57","Lasioglossum (Dialictus) vierecki","Halictidae"
"58","Lasioglossum albipenne","Halictidae"
"59","Lasioglossum anomalum","Halictidae"
"60","Lasioglossum ellisiae","Halictidae"
"61","Lasioglossum hitchensi","Halictidae"
"62","Lasioglossum leucocomum","Halictidae"
"63","Lasioglossum pectorale","Halictidae"
"64","Lasioglossum pilosum","Halictidae"
"65","Lasioglossum platyparium ","Halictidae"
"66","Lyroda subita","Crabronidae"
"67","Megachile addenda","Megachilidae"
"68","Megachile latimanus","Megachilidae"
"69","Melissodes druriellus","Apidae"
"70","Melissodes sp.","Apidae"
"71","Myrmosula parvula","Myrmosidae"
"72","Nomada australis","Apidae"
"73","Nomada banksi","Apidae"
"74","Nomada erigeronis","Apidae"
"75","Nomada placida","Apidae"
"76","Nomada sp.","Apidae"
"77","Nomada vegana","Apidae"
"78","Oryttus gracilis","Crabronidae"
"79","Oxybelus cressonii","Crabronidae"
"80","Oxybelus emarginatus","Crabronidae"
"81","Oxybelus uniglumis","Crabronidae"
"82","Perdita halictoides","Andrenidae"
"83","Philanthus gibbosus","Crabronidae"
"84","Philanthus lepidus","Crabronidae"
"85","Philanthus politus","Crabronidae"
"86","Philanthus sanbornii ","Crabronidae"
"87","Pompilidae","Pompilidae"
"88","Protandrena bancrofti ","Andrenidae"
"89","Protandrena cockerelli","Andrenidae"
"90","Psenini","Crabronidae"
"91","Pseudomethoca cf. propinqua/sanbornii","Mutillidae"
"92","Pseudomethoca frigida","Mutillidae"
"93","Pseudomethoca simillima","Mutillidae"
"94","Pseudopanurgus albitarsis","Andrenidae"
"95","Pseudopanurgus sp.","Andrenidae"
"96","Psuedomethoca sp.","Mutillidae"
"97","Scoliidae","Scoliidae"
"98","Sphecodes (Sphecodium) sp.","Halictidae"
"99","Sphecodes atlantis","Halictidae"
"100","Sphecodes davisii","Halictidae"
"101","Sphecodes illinoensis","Halictidae"
"102","Sphecodes mandibularis ","Halictidae"
"103","Sphecodes near galerus ","Halictidae"
"104","Sphecodes sp.","Halictidae"
"105","Tachysphex cf. brullii group","Crabronidae"
"106","Tachysphex cf. terminatus group","Crabronidae"
"107","Tachytes parvus","Crabronidae"
"108","Tachytes sp. ","Crabronidae"
"109","Timulla vagans","Mutillidae"
"110","Tiphiidae","Tiphiidae"
"111","Triepeolus distinctus ","Apidae"
"112","Triepeolus helianthi","Apidae"
"113","Triepeolus pectoralis","Apidae"
"114","Triepeolus remigatus","Apidae"
"115","Triepeolus sp.","Apidae"