Ecological interactions between American pikas and mountain goats in the La Sal mountains In partnership with the United States Forest Service

Discovery Pool Grant: Final Report ‘22-‘23

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Statement of research need and questions/aims addressed

The third season of fieldwork for my Ph.D. project was partially supported by the Discovery Pool grant in partnership with the US Forest Service. I am conducting a multi-level, field-based study to document potential ecological interactions between mountain goats and American pikas: two mammalian herbivores that are specialists in alpine habitats. There are no previous studies in the peer-reviewed literature on ecological interactions between mountain goats and pikas. Understanding these interactions will have important implications for the conservation of each species. Such data will be particularly useful for both pika conservation and agencies tasked with managing the land that introduced mountain goat herds inhabit.

The Specific Aims of my research are to:

1) Evaluate mountain goat use of pika-occupied talus habitat using GPS telemetry data from multiple subpopulations for habitat selection function analysis.

2) Compare forage utilization between goats and pikas. Test for evidence of competition or facilitation using a replicated three-plot semipermeable exclosure design. Additionally, test for ecosystem-level feedback loops in herbivore-plant interactions that might influence forage quality for both species around pika-inhabited talus slopes. I also added a DNA metabarcoding component to this aim to elucidate potential dietary overlap.

3) Assess risk-sensitive foraging by pikas by testing whether pika giving up distance varies with
(a) mountain goat pellet density, (b) vegetation coverage of soil, and (c) mountain goat visitation based on GPS data.

4) Review the ecological interactions between pikas and mountain goats, and the management options for both, in the context of conserving the biodiversity of alpine habitats of the Colorado Plateau.

Methodology

My team and I had a very efficient and successful field season this year. I worked with two field research technicians, Collette and Katelyn, who were supported by CNHA funding. Throughout the field season, we collected pika behavioral data (*Specific Aim 3*) and vegetation and goat sign data (*Specific Aim 3*). We collected over 200 observations for pika giving up distance; we now have a total of ~600 observations and will continue to augment to this dataset in the last season of fieldwork.

This was our first season collecting pika and goat scat to contribute to my collaboration with Princeton University in our analysis of plants in the diets of both species (*Specific Aim 2*). We used radio telemetry to track mountain goats in the north group of the La Sal mountains to collect scat samples from mountain goats (n=26) and sampled pika latrine sites regularly to collect scat samples from pikas (n=20). The samples were sent to Dr. Rob Pringle's lab at Princeton in September to be analyzed; we aim to have results as early as November.

At the end of August, my team and several volunteers clipped the vegetation in all of our experimental plots and sampled two soil samples at each site (*Specific Aim 2*). This fall, a laboratory technician (supported by CNHA funding) will dry, weigh, and compare the clipped vegetation from each site. This will serve as the first measurement of how grazing affected above-ground annual productivity, and a second year of samples/data will be gathered at the end of next summer. The soil samples will soon be sent to the Soil Lab at USU to be tested for soil nutrients such as nitrogen, phosphorous, sodium, and pH. Then, these values will be compared to last year's soil nutrient results.

To monitor visitation rates to our experimental plots by pikas and goats, we deployed two camera traps at each site and are streamlining our methods for processing them (*Specific Aim 2*). Specifically, we are working with Microsoft to develop an Artificial Intelligence model that is fine-tuned to detect pikas in camera trap photos. If successful, this AI model will greatly reduce the human portion of photo processing[1], which will help expedite results for this year and next year.

Finally, I have been working on the space-use analysis (*Specific Aim 1*) since last year. For this analysis, I need a digitized raster layer of talus habitat in the La Sal mountains, but such a layer is difficult to create (and many others have tried). However, after encountering some roadblocks, I have created a digitized talus layer and am pushing to complete this analysis by the end of spring 2024.

Personnel

- Mallory Sandoval Lambert. PhD candidate and Principal Investigator
- Collette Webb recently graduated with her Bachelor's degree in wildlife biology from Western Washington University. Collette was supported by funds from the Discovery Pool grant.
- Katelyn Sanchez recently graduated with her Bachelor's degree in Ecology and Conservation Biology from Texas A&M University. Katelyn was supported by funds from the Discovery Pool grant.
- Eliza Wesemann is a student at Utah Sate University and is helping me sort photos and vegetation. They are supported by funds from the Discovery Pool grant.
- Karli Weatherill is a student at Colorado Mesa University. She was supported by funds from the Saccomanno Institute Program for Biological Research fellowship and was co-mentored by Dr. Varner.
- Dr. Johanna Varner is a professor at Colorado Mesa University. Dr. Varner volunteered her time for field work several times throughout the summer and provided advice and guidance on study design.
- Yoni Argov works for the Moab BLM office as a wildlife biologist. Yoni volunteered and helped to collect mountain goat scat.
- Paul Frank is a desert tortoise biologist and Moab local. He volunteered to help clip vegetation in August.

Projected results

I am actively working on analyses, and I have several exciting preliminary results to share. Projected results differ depending on what ecological interaction hypothesis is happening (e.g., competition vs. facilitation vs. resource partitioning). I expect to need one more season of data

collection and field work in 2024 before wrapping up my dissertation and publications by the end of 2025.

Preliminary results: Grazing exclosures

This year, I have weighed the dry weight of the total biomass in each plot to compare total dry weight between 2022 and 2023. In 2022, a comparison of the dry weight of revealed no difference in biomass between plot types. Importantly, since the exclosures were set up this year, this result suggests that my plots are not systematically biased and that future differences in the dry weight of biomass will be due to herbivory.

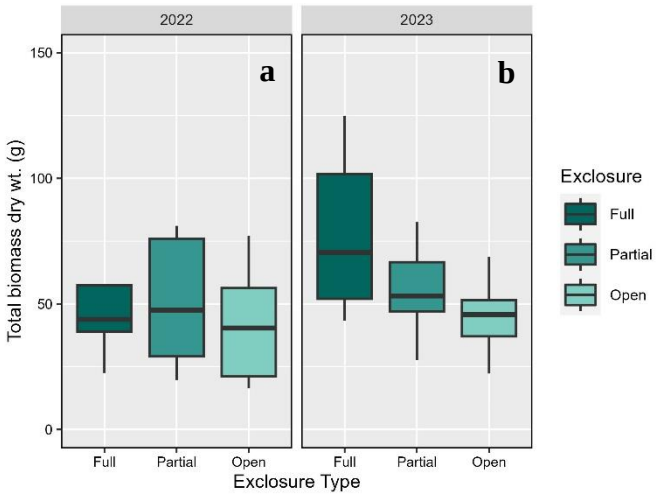

Figure 2. Total above-ground plant biomass (dry weight) in each exclosure type for years a) 2022 and b) 2023.

I recently weighed the biomass from plots in 2023 and was excited to see promising results. A pairwise t-test between the partial and full plots revealed that there is a statistically meaningful difference between the effects of all herbivores (goats and pikas included) vs. pikas only on aboveground biomass (t=2.8, p=0.02). Specifically, this result suggests that we are seeing an effect of herbivory in our experimental plots, and that herbivore effects differ between small and large herbivores. This is visualized in Figure 2, where 2022 (Fig. 2a) shows no clear pattern (i.e. no herbivory effect, or standing crop), whereas in 2023 (Fig 2b.) there is a clear trend in biomass between exclosure types (i.e. herbivory effects). This is very exciting and I look forward to disentangling the effects of large (i.e. mountain goats) vs. small herbivores (i.e. pikas) in the coming months. In the coming weeks, my laboratory technician, Eliza, will sort grasses and forbs collected from my grazing exclosure plots and record the dry weight of each vegetation class (grasses and forbs). This work will enable an additional layer of analysis as to the effects of differential herbivory/grazing on plant community composition.

Conclusions and application of research results to future educational or interpretive efforts

This summer, my field technicians and I worked hard and completed our goals for the third summer field season of my PhD. Having two technicians and accommodation in the field (a yurt) helped boost our effectiveness in the field compared to last year. The yurt made it easy to organize our field equipment each night in preparation for the following field day, it helped to keep our morale up when the weather was bad because it provided communal shelter, and it provided my technicians with safe housing on our days off. My technicians were amazingly productive this summer; I could not have done this season without them. For example, during the last and most important week of fieldwork I fell ill with COVID and was unable to help clip vegetation in my experimental plots. My technicians stepped up to the challenge and, with my indirect supervision and with the help of two volunteers, clipped all 30 plots in just four days. I would not have been able to hire such competent field crews without the competitive salaries that I could offer due to CNHA support.

I am still keeping the US Forest Service updated with the progress of my project and will share results as they become available in the near future. Additionally, I am communicating with several elementary and Jr. high teachers in the state to share my research with young students and to lead them in making their own observations about nature in their local communities.

Future research needs

My project has several research needs going forward. I will need funding next summer to 1) pay three technicians (two field technicians and one lab technician), 2) pay for a summer truck rental, and 3) help provide myself with a modest stipend for the summer. These requests are detailed in my 2023 Discovery Pool application.

Only one season of fieldwork remains for this project. Because this work is field-based and examines results on an annual scale, it takes several years to collect all of the data needed to produce statistically significant results. The preliminary results above clearly underscore the need for a fourth and final season of data collection, as do previous exclosure studies (e.g., Ranglack et al. 2013) that show that more than one year of grazing data yields stronger and more statistically powerful results.