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 2023-2024

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Statement of research need and questions/aims addressed

The fourth and final 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 this summer were 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 my research under this third aim to elucidate the plants in the diets of both species.

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 productive field season this year. I worked with three field research technicians, Ellie, James, and Moth, 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 a record 636 observations for pika giving up distance, we now have a total of ~1,200 observations, I am currently cleaning this data and preparing it for analysis in Specific Aim 3. This was our second 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=27) and sampled pika latrine sites regularly to collect scat samples from pikas (n=24). The samples were sent to Dr. Rob Pringle's lab at Princeton in September to be analyzed. A few weeks ago, I received preliminary results for the 2023 samples from Princeton and am working to sort and analyze those the rest of this semester. I will forward these results to CNHA and the USFS. At the end of August, my team and I clipped the vegetation in all of our experimental plots and sampled two soil samples at each site (*Specific Aim 2*). A laboratory technician has begun the process of drying, weighing, and comparing the clipped vegetation from each site. This will serve as the second measurement of grazing-affected above-ground annual productivity. 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, they will then be compared to the previous two years' soil nutrient results. To monitor visitation rates to our experimental plots by pikas and goats, we deployed two camera traps at each site, a laboratory technician is processing them (*Specific*

Aim 2).

Personnel

- Mallory Sandoval Lambert. PhD candidate and principal investigator
- Ellie Kaiser graduated with her Bachelor's degree in wildlife biology from California Polytechnic State University. Ellie was supported by funds from the Discovery Pool grant.
- James Irza-Leggat recently graduated with his Bachelor's degree in Environmental Science from University of Vermont. This was James' first wildlife technician position! James was supported by funds from the Discovery Pool grant.
- Moth Deppe graduated with his Bachelor's degree in Biology from Northern Arizona University. Moth 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 and the Rocky Mountain Goat Alliance.
- Karli Weatherill is a student at Colorado Mesa University. She was supported by funds from the Saccomanno InstituteProgram for Biological Research fellowship.

Preliminary results: using data from collared mountain goats to assess spatial overlap between mountain goats and pikas.

I am excited to be wrapping up the first chapter (*Specific Aim 1*) of my dissertation, where I analyzed mountain goat GPS collar data to assess spatial overlap between mountain goat space-use and pika habitat at the talus edge. I used a Resource Selection Function (RSF) to compare resources at mountain goat used GPS points with randomly generated, available points within mountain goat home ranges. To understand whether mountain goats are selecting or avoiding pika habitat, I included a variable for distance to pika habitat in the model. I also included variables that previous studies have been shown to be important for mountain goat resource selection, they include: distance-to-escape terrain, biomass, slope angle, elevation, and heat load.

Mountain goats avoided distance to pika habitat (β=-0.46, *P*=0.001). In other words, mountain goats selected for areas near to pika habitat and avoided areas which were farther from pika habitat (Fig. 1). This demonstrates that spatial overlap exists between mountain goat space-use and pika habitat, establishing a basis for potential interactions between the two species.

Additionally, mountain goats avoided distance to escape terrain (β=-1.01, *P*=0.001), selected for elevation (β=0.81, *P*=0.001) and forage biomass (β=0.50, *P*=0.001), and they neither selected nor avoided slope (β=0.03, *P*=0.54) or heat load (β=0.06, *P*=0.11).

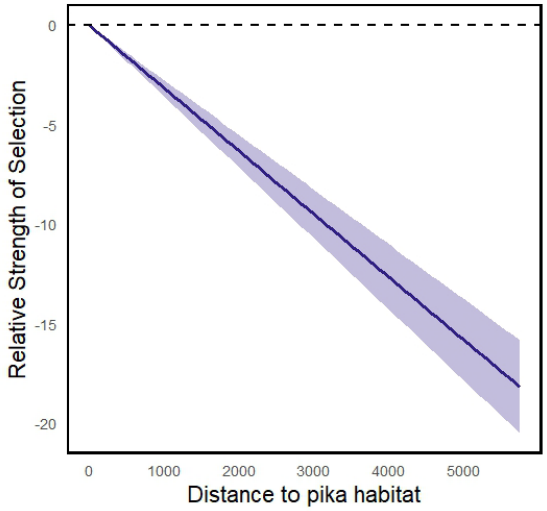

Figure 1. Relative Selection Strength (RSS) for distance to pika habitat by mountain goats within their home ranges in the La Sal mountains during the summers of 2020-2022. Mountain goats selected for areas near to pika habitat and avoided those far from pika habitat.

Preliminary results: Grazing exclosures

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). However, I have weighed the dry weight of the total biomass in each plot to compare total dry weight between 2022, 2023, and 2024. The 2022 data represents standing crop, or baseline biomass across all sites and plots, while 2023 and 2024 represent the first and second year of the treatment, respectively.

A pairwise t-test between the partial and full plots revealed that there is no statistical difference in biomass between the two plot types (t=0.9, p=0.34). However, there is a statistical difference in biomass between open and full plots (t=2.5, p=0.02). It is interesting that the trends in aboveground biomass differ between 2023 and 2024 (Fig. 2). In 2023 (Fig 2b.) there is a clear trend in biomass between all exclosure types, however, in 2024 (Fig 2c) this trend is less pronounced, especially between the full and the partial plots. This could mean one of several things: 1) that there is an abiotic factor that is causing inter-annual variation in aboveground biomass (e.g. differences in snow depth and duration), 2) perhaps pikas did not graze in partial plots as much as they did in 2023, or 3) it could suggest that pikas have a negligible impact on aboveground biomass and large herbivores, including mountain goats, are responsible for a substantial portion of the reduction in biomass.

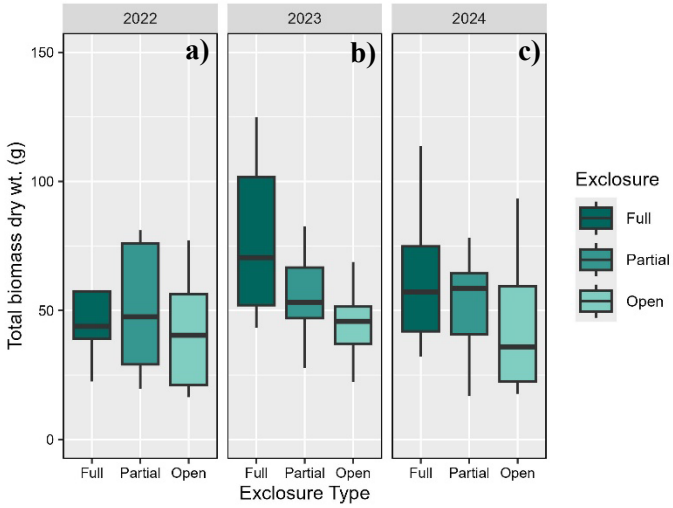

Figure 2. Three box plots displaying total dry weight of biomass in each exclosure type for years a) 2022, b) 2023, and c) 2024.

I look forward to disentangling the effects of large vs. small herbivores in the coming months, specifically, I am excited to analyze these data at the plant community level to disentangle how grazing by large vs. small herbivores impacts grasses and forbs. Additional next steps are to calculate mountain goat and pika visitation rates to grazing exclosures and complete the fecal DNA metabarcoding analysis of plants in the diets of both species. Together, these analyses will help elucidate the type of interaction that exists between pikas and mountain goats in the La Sal mountains.

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

This summer was productive and rewarding. I am grateful to the CNHA for supporting my project over the last three years. Without financial support from the Discovery Pool grant, completing the fieldwork portion of my dissertation would have been even more challenging. I will continue to update the US Forest Service on the progress of my dissertation. I am currently writing the mountain goat space-use chapter of my dissertation for publication, I hope to submit it to a scientific journal by May 2025. 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.