***Overview:*** A primary goal of animal ecology is to understand how resources mediate the growth of consumer populations and the composition of communities. This requires connecting physiological processes operating within individual animals to population- and community-level dynamics. We propose to use longitudinal data to link seasonal variation in resource quality and quantity based on primary production to the diets and physiology of individual small mammals in a desert ecosystem. We will generate a low-dimensional representation of consumer foraging strategies with known constraints from mechanistic foraging models and an algorithmic mapping technique to quantify the fundamental foraging niche. This framework will be used to assess realized niches quantified by high-resolution empirical data on diet composition, forage quality, and measures of survival. Our framework thus couples a unique suite of empirical data with theory, allowing us to explore how climate-mediated shifts in resource landscapes impact consumer dynamics and community composition in rapidly changing ecosystems.

***Intellectual Merit:*** Our study will address three key questions: ***Q1) How does temporal variation in resource abundance and diversity influence individual- and population-level resource use in a desert mammal community?*** We will quantify resource selection by both primary and secondary consumers using a combination of fecal DNA metabarcoding and blood plasma stable isotope analysis. This will enable us to distinguish foraging specialists from generalists with a high degree of taxonomic resolution across a resource landscape that varies in resource quantity (i.e., biomass) and quality (e.g., nitrogen content, metabolite diversity). ***Q2) Do resources of different nutritional quality––nitrogen content, seed size, secondary metabolites, non-structural carbohydrates––correlate with consumer functional characteristics, including body condition, gut microbiome composition, and survival?*** Understanding how the nutritional quality of resources is related to physiologically mediated functional characteristics of consumers is a critical, but poorly resolved, step in linking resource availability to population and community dynamics. We will combine the data generated in Q1with direct measurements of forage quality to quantify their impact on consumer physiological characteristics, survival, and population size, providing unprecedented insights into how resource selection influences fitness. ***Q3) How do realized dietary niches map onto the fundamental foraging niche manifold, and are associated fitness consequences predictable?*** We will incorporate the empirical data from Q1-Q2into an interpretive framework based on complementary theoretical approaches: (*i*) a set of mechanistic foraging models that combine resource and consumer constraints in a fitness-maximization framework, and (*ii*) a diffusion mapping approach that allows assessment of empirical observations of rodent foraging relative to the nonlinear, multi-dimensional foraging strategies simulated by mechanistic models with known constraints. This framework will establish a representation of the fundamental foraging niche-space that is available to small mammals against which our observed foraging data from *Q1* can be compared, and from which consumer fitness can be predicted based on the relationships elucidated in *Q2*. These predictions will be used to explore how relevant climate change scenarios might influence the population and community dynamics of rodents in the desert southwest.

***Broader Impacts:*** Our field-based project lies at the interface of ecology, physiology, and theoretical biology. Our research plan includes a set of fully integrated hands-on and course-based learning opportunities for undergraduate students across multiple STEM disciplines. The research will engage three Ph.D. students and 6-10 undergraduates at two minority-majority universities with large Hispanic and Native American populations. Each spring we will also teach an open enrollment two-week field school at the UNM Sevilleta Field Station, where we aim to engage 10–20 undergraduates per year and introduce them to cutting-edge lab and field techniques in ecology and physiology. Postdoctoral scientists and graduate students will be involved in teaching and managing this course, and undergraduate students will be recruited from UNM, UCM, BU, and UW to take part in field and lab activities associated with our project, which we anticipate will produce publishable student-led research projects.