***Broader Impacts***

***Practical Training & Education:*** Our field-, lab-, and theory-based project is both diverse and approach while lying at the interface of ecology, physiology, and evolution, thus providing a wealth of opportunities for training undergraduate (UG) and graduate (GR) students in integrative biology through hands-on research experiences, while also supporting multiple postdoctoral researchers (PDs). Our project will principally take place on the Sevilleta NWR just south of UNM, which grants students immediate access to field-based ecological research. Both UNM and UC-Merced are minority-majority universities and certified Hispanic serving institutions, and UNM also has a large Native American population. First-generation UG students often struggle to find relevance and purpose in their classroom curriculum. At **UNM** our project will engage a minimum of 2–3 UG and 2 GR students in research each year and teach them practical field skills such as handling and processing small mammals, as well as identifying plants and arthropods. At **BU**, this award will directly support the course-based undergraduate research experiences (CURE) program, which directly enables students to gain practical experience deploying rapid DNA tests and developing data-science literacy—timely skillsets for a modern biomedical workforce spanning the environmental sciences, healthcare, and epidemiology (e.g., Feng et al. 2020). Specifically, the split-level (undergrad/grad) course ‘Conservation in the Genomics Age’ features an inquiry-based lab in which students collaborate with external collaborators to lead semester-long projects. The proposed CURE is scheduled for the first and third years of the award (Fall 2022 and 2024), when students will receive fecal samples and lead DNA metabarcoding analyses from sample preparation, to DNA sequencing, to bioinformatics, to reporting. The CURE pedagogy is an evidence-based strategy for enhancing access, inclusion, and diversity in STEM compared to traditional (often unpaid) mentored research internships (Bangera and Brownell 2014).

***Early-Career Research Engagement:*** In addition to providing research training and exposure to UG experience, this award will support 3 GS positions (1 at UNM, 1 at Brown, 1 at UC Merced) and 2 postdoctoral researchers (1 at UNM, 1 at Brown). At **UNM**, GS duties will involve […]. This project will directly support a postdoctoral scientist, who in addition to acquiring the skills described above will help manage a large field- and lab-intensive project, and mentor the undergraduate and graduate students the project will also support. At **BU** the GS will enroll in the described *Conservation in the Genomics Age* course (Fall 2022) and later serve as Teaching Assistant (Fall 2024). The grad TA will lead the publication of a paper on diet-microbiome linkages as proposed above, in collaboration with students from the CURE course. This plan to mentor students and aspiring educators to collaborate on publishing course-based research builds on PI Kartzinel’s strong track-record of publishing prior course-based research (Kartzinel et al. 2012, Kartzinel et al. 2015b). Kartzinel has demonstrated potential for success in sustaining this CURE program, since the students of a 2018 trial of this program generated all preliminary data presented in Kartzinel's CAREER award (DEB-XXXXX) and all rated their experience in the course ‘effective’ or ‘very effective.’ Overall this proposal will contribute to support three? early career researchers at Brown (a GS, PD, and PI). Both the PI and PD will present research results and co-author resulting publications, thereby enhancing their professional networks and visibility while contributing to the growth of data and understanding of process at an LTER. At **UCM** this award will support one GR researcher for 3 years, whose Ph.D. thesis will center on the development and investigation of both consumer foraging models as well as diffusion mapping techniques used to compare high-dimensional foraging strategies. The UCM GR student will lead the development and serve as first author on 2-3 manuscripts focused on applying consumer-resource models to small mammal communities and the utility of diffusion mapping to investigate behavioral niches, and present results at professional meetings during [Years 2 and 3]. The UCM GR will also gain teaching/mentoring experience by participating in annual meeting workshops (see below).

***Annual Meeting Educational Workshops:*** Annual PI/PD/GR/UG meetings will be held at UNM and the Sevilleta Field Station, and will allow research groups participating in different aspects of the project a chance to a) update, reconfigure, and assess progress on field, lab, and theoretical aspects of the project as well as to b) provide a means by which students and participants share basic ideas and state-of-the-art knowledge and techniques with regard to their respective fields and methods. For instance, at the annual meeting, we will set aside afternoons for short workshops, where project PDs/GRs run activities and seminars designed to introduce PDs/GRs/UGs (and PIs) to their own scientific specializations, capitalizing on the intersectionality (field/lab/theory) of this proposal. As such, GRs developing theoretical consumer models at UCM can learn about approaches used by PDs to estimate life-history characteristics in the field at UNM, or UGs helping in the field at UNM can learn from GRs engaged in DNA sequencing at BU. In this sense, project Annual Meetings will serve both to advance the states of each component of the proposed project as well as to facilitate student-led dissemination of methods, approaches, and theories.

***Sevilleta Field Course:*** The PIs will teach a new 6-day intensive field course in mid-May of each year of the project, which will be designed to expose undergraduates to cutting-edge field and lab-based research. This course will be offered to any biology major at UNM and incoming Sevilleta Research Experiences for Undergraduates (REU) students; we expect that it will attract ~10–20 students per year. The course will be organized into three sessions. The first three mornings will be spent at our field sites at the Sevilleta, where students will learn to identify plants and consumers (small mammals, grasshoppers, ants), collect plant and consumer tissues for stable isotope analysis and metabarcoding, operate the QMR, and quantify aboveground net primary production. After lunch, students will attend one lecture given by the PIs or their graduate students at the UNM Sevilleta field station, and then spend 2–3 hours in the field station laboratory learning data management and analysis skills as well as how to process plant and animal tissue samples for stable isotope analysis. With support from UNM and NSF (DBI-1429042), PI Newsome co-founded the UNM Center for Stable Isotopes (CSI), an interdisciplinary facility dedicated to enhancing research and training in the application of stable isotope analysis in the biological, geological, anthropological, and medical sciences (http://csi.unm.edu). The course will move to CSI for the final three days, which will provide students with hands-on training on how to operate and maintain isotope ratio mass spectrometers. In doing so, students will produce isotope data for the samples they collect during the field portion of the course, which they will learn how to analyze and interpret using mixing models and spatial metrics to quantify variation in resource use within and among desert consumers. CSI also provides grants for undergraduate and graduate projects to cover analytical costs, thus encouraging students to take on field and laboratory projects that may result in peer-reviewed publications or presentations.

***International Courses:*** Results of this study will also be incorporated into ecology courses taught in the U.S. and abroad, including a one-week short course taught by the PIs on stable isotope ecology to graduate students and faculty at the Centro Austral de Investigaciones Cientificas in La Serena, Chile where the PIs have an ongoing NSF-funded (LTREB) project in collaboration with Douglas Kelt (UC Davis) and Karin Maldonado (Universidad de Chile). Since 2009, PI Newsome has taught a dozen short courses in Latin American countries that have attracted >300 graduate students, postdoctoral researchers, and faculty. Relationships forged during these short courses have resulted in ~15 foreign graduate students coming to the U.S. to train in laboratories Newsome has been associated with. These interactions have also produced ~20 publications in peer-reviewed journals, but more importantly they have led to the transfer of knowledge and technology between the U.S. and Latin America, where the use of and analytical capability for stable isotope analysis is rapidly growing. PI Newsome also contributes to IsoCamp (isocamp.org), a two-week short course taught each summer at the University of Utah to an international group of graduate students and postdoctoral researchers.