**PROJECT SUMMARY**

**Overview:**

Understanding the consequences of contemporary trophic downgrading and the ensuing loss of biodiversity and ecosystem function is a pressing environmental issue. Yet, such large-scale changes in ecological systems have occurred in the recent past. For example, about 13,000  
years ago, most species of large-bodied mammals were extirpated in the Americas. While scientists have hotly debated the cause of the megafauna extinction for decades, only a handful of studies have moved the debate forward. Here, we propose to do just that: we will examine the consequences of the loss of tens of millions of large-bodied mammals on the structure and functioning of ecosystems in the Americas. We will characterize patterns of abundance, distribution, diet and morphology in the surviving mammals both before and after the extinction event. Abundance and distribution can be determined using occurrence information from fossil database compilations, morphology and size can be determined by measuring fossil limbs and molars, and diet by using stable isotope analysis. These data will be integrated with reconstructions of vegetative communities using pollen databases and the effects modeled in an earth system climate model. Our study establishes an important ecological baseline for the understanding of contemporary trophic downgrading by characterizing how terrestrial ecosystems were influenced by humans at the very beginning of the Anthropocene; some 13,000 years ago.

**Intellectual Merit :**

Elucidating the role these animals played, and how their extinction changed overall mammalian community structure and function, vegetation composition and abundance, and even the cycling  
of biogeochemicals can help us understand the likely consequences of contemporary biodiversity loss. Today, the majority of large-bodied mammals around the globe are either listed as vulnerable  
or endangered. A major focus of conservation biology is geared towards developing an understanding of how their loss may impact contemporary ecosystems. Yet, this experiment has already occurred: the imperiled apex predators of today were only meso-carnivores at the terminal Pleistocene. Thus, a historic perspective can provide information of considerable value to conservation biologists.

**Broader Impacts :**

The broader impacts of our research include 1) training and mentoring of graduate and undergraduate students in interdisciplinary, team science approaches, 2) outreach efforts targeted especially  
to incorporating underrepresented students into our research project, facilitated by UNM’s  
status as a minority serving institution, 3) the development of a course in Ecology of the Past, which will be taught in alternative years, 4) Enhancing scientific infrastructure by  
working with the Texas Memorial Museum to identify unsorted fossil materials and by providing images and data for dissemination, 5) a broad array of public outreach activities, including giving public talks and interviews, participation in the development of a Deep Time exhibit  
at the Smithsonian featuring the interaction between mega-herbivores and climate, participation in the ?Scientist is in? forum at the Smithsonian, and support of a ’BioBlog’, an outreach  
effort developed by the senior investigator, which brings together undergraduate and graduate students weekly to develop and hone writing about science and to constructively critique the writing of others.