PhD Dissertation
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ABSTRACT

Modern ecologists have largely relied on short-term observational studies or bioclimatic modeling experiments to study how biological systems will respond to climate change. However, it is now clear that in order to get a more complete picture of the full range of responses to climate change, a long-term, or even deep-time perspective is required. The fossil record can provide the necessary data to understand these long-term responses. Here, in a series of 3 studies, I explore how late Neogene and Quaternary mammal assemblages have changed through time during intervals of climatic change. I also develop a novel method to estimate the body-mass of extinct proboscideans, data that will be used in the studies on temporal turnover. In the first study, I quantify taxonomic turnover in large mammalian herbivores in the Plio-Pleistocene of South Asia and the correspond changes in community structure. I test a model of climatically forced environmental species sorting to determine whether turnover is driven directly by changes in the environment. From 3.6 Ma to 0.6 Ma, two periods of pronounced faunal change are seen, one after 3 Ma, and the other after 2.58 Ma. The earlier turnover is driven largely by immigration events, while the latter involves a replacement of older species by newer immigrants. I found only partial support for the environmental species-sorting model, suggesting that factors other than the direct effects of climate on habitats is responsible for the turnovers seen. Furthermore, the taxonomic turnover is accompanied by a corresponding change in the structure of the herbivore assemblage whereby bovids become the more diverse members of this guild through time, while suids decrease in proportional representation. A slight increase in assemblage body-mass is also seen, especially in mammals weighing more than 100kg. Despite these periods of faunal change, a large proportion of the large herbivore guild remains remarkably stable through time. In the second study, I quantify the extinction of mammals in the Indian Subcontinent over the last 100,000 years. While these late Quaternary extinctions are better known from the rest of the world, India remains understudied in this context. Over this time period, only 4 species of mammal and 1 species of bird go extinct. The mammal extinctions represent 3.39% of all non-volant terrestrial mammals found in the Indian Peninsula, but 21.7% of ungulates and proboscideans. These extinctions are large-size biased, a characteristic of the megafaunal extinctions more commonly known from the Americas. However, the number of mammal species that go extinct is not different from what is expected under background conditions. The most significant finding is that despite almost 100,000 years of human colonization, very few species are seen to go extinct in the India suggesting that humans likely had very limited impacts on the biota in this region until very recently. Climate change is also insufficient to explain the low extinction magnitude since swings in regional precipitation regimes were commonplace during this period of time. In the final study, I explore the relationship between landscape topography and turnover in North American non-volant terrestrial mammals during the last de-glaciation. This period of time is characterized by large-scale biotic reorganization on the continent, but species did not shift their ranges uniformly. Species living in the montane west experienced smaller range shifts than species in the flatter east. Here, I test the hypothesis that turnover is inversely related to landscape topography. Using the FAUNMAP database, I quantified temporal turnover from 11 regions in North America, each with unique topography. Overall, temporal turnover shows a significant negative relationship with topographic variability. This can be explained by the short distances species have to move to reach favorable climates along an elevation gradient, and the presence of microclimatic refugia in mountainous regions, thus allowing species to persist through periods of intense climate change. These studies shed light on faunal change in understudied parts of the world, and illustrate how the landscape can provide resilience to communities.