Energetic compensation – when declines in energy use from some species in a community are offset by gains from others – can render community-level function resilient to species’ fluctuations. When compensation is mediated by niche structure, it depends on the degree to which species are functionally substitutable. If species have different responses to changing conditions, shifting conditions may modulate the redundancy between species, rendering compensation variable over time.

Experiments on the rodent community near Portal, AZ have historically shown strong evidence of energetic compensation. After removal of kangaroo rats from experimental plots in 1977, smaller granivores displayed partial (~25%) compensation immediately, and near-complete compensation (~70%) following the establishment of the functionally analogous *Chaetodipus baileyi*. We explore whether compensation has persisted despite major transitions in the habitat and rodent community over the 40-year duration of the study.

Driven by a precipitous decline in *C. baileyi* over the past decade, energy use on experimental plots declined to ~40% of total energy use on control plots. This is a smaller shortfall in energy use than was first observed, but this is due to a sitewide increase in small granivore abundance rather than an increase in compensation. Shifting conditions may have made *C. baileyi* unable to continue to substitute for kangaroo rats, while persistent niche differences may prevent smaller species from compensating further despite increases in their abundance sitewide. These results highlight that energetic compensation in natural communities is a dynamic, contingent phenomenon that plays out over extended temporal scales – in this case, spanning decades.