Climate Change Effects on a Keystone Fauna

Bill Tietje-Cooperative Extension Specialist, Dept. of ESPM, UC Berkeley and Barry Sinervo-Professor, Dept. of Ecology and Evolutionary Biology, UC Santa Cruz

"Climate Change: the major biodiversity threat of our time"

Introduction

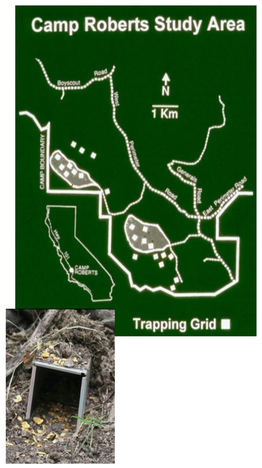
A multi-disciplinary team of scientists address woodrat (aka packrat; *Neotoma* spp.) responses to climate warming. Analyses of (1) paleo (ancient) climate and desert woodrat midden data, and (2) current long-term dusky-footed woodrat demographic data will predict climate warming effects on the woodrat, a keystone vertebrate in woodland and forestland. The objectives are to discover physiological causes of climate change effects on reproduction and survival, predict future demographic and range changes, and test models with range shifts and extinctions known from paleo climate and paleo midden data.

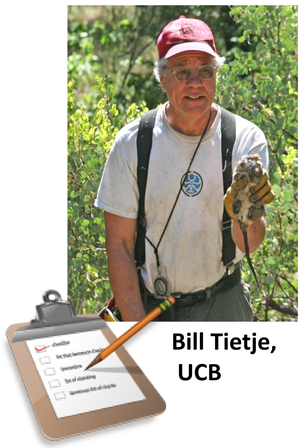
Paleo Data

Due to information scientists have collected from middens, paleo distributions and extinctions of the desert woodrats are perhaps the best known of any vertebrate. Examined middens date from the late Quaternary Period (40,000 to 5,000 years BP). Analyses of these shifts can yield insights into likely woodrat responses to *contemporary* anthropogenic warming.

Middens contain the preserved remains of desert woodrat feces and tidbits from the surrounding area.

Midden information from Smith and Betancourt 1998, 2006.





Bill Tietje, UCB

Field Data

Current field data for climate-change analyses includes capture-recapture data from the live trapping of small mammals each spring and fall since 1993 in a remote area of the Camp Roberts National Guard post. The data set comprises nearly 62,000 capture records across several El Niño/La Niña Southern Oscillations. Approximately half of the captures are of the dusky-footed woodrat, the species of interest here.

Photo by R.E. Larsen

The long-term data set provides demographic histories, including reproductive output (juveniles/adult female) and seasonal survival across two decades of measurement. During successive La Niña years, woodrats lose weight and reproduction is nearly curtailed, perhaps due to the woodrat's decreased ability to digest dietary toxins, which appears to be temperature related. Population numbers are lowest during these times.

Analysis Process

- Use the 20-year data set to determine the effects of temperature and precipitation on woodrat physiology, and thereby on population demographic attributes (e.g., birth/death rates).
- To link woodrat demographic attributes to climate-warming effects, use Population Viability Analysis (PVA). PVA brings together species demographic variability and environmental variability to predict whether a population will be self-sustaining over the long term.
- Test models with desert woodrat paleo (ancestral) range shifts under paleo climate conditions. If models accurately hind cast paleo distributions, they will accurately future cast climate impacts.

Barry Sinervo, UCSC

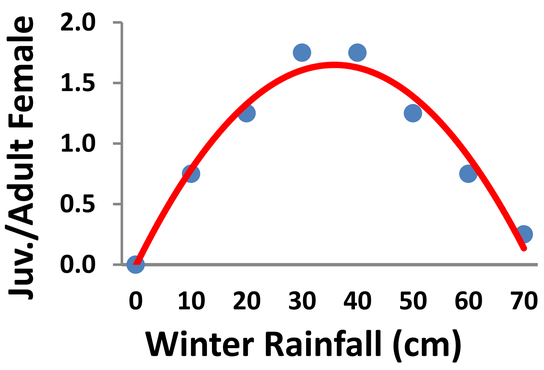


Fig. Relationship between woodrat reproductive output and winter \rainfall (estimated).

Anticipated Outreach

- Policy Brief
- *California Agriculture Journal* article

- Journal Publication