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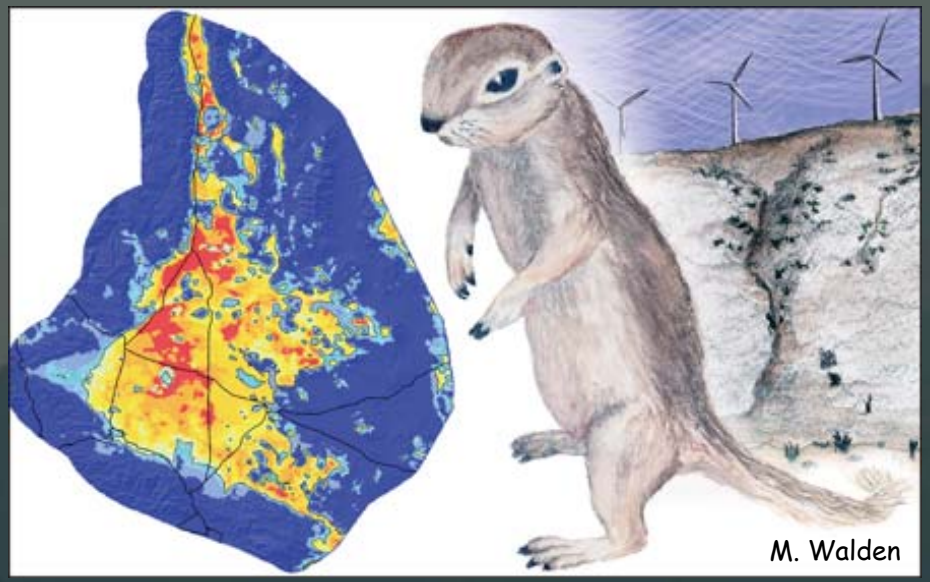
science for a changing world

Endangered Species, Climate Change, and Renewable Energy



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Objectives

Using the best available information……

Develop current & future (2030 & 2080) MGS habitat suitability models

Evaluate gains and losses of habitat and genetic diversity in response to climate change

Evaluate habitat connectivity

All in relation to renewable energy development

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MGS habitat Ft. Irwin, CA – K.K. Drake, USGS

Previously Identified Issues

Mohave Ground Squirrel

Restricted distribution
Extensive impacts –

- **Human development in the west Mojave Desert**
- **Direct habitat losses to road and construction mortalities**
- **Cumulative impacts of landscape level disturbances**
  - **off-highway vehicles use**
  - **agriculture**
  - **military operations**

Reduced populations and habitat connectivity of suitable habitat

1984 - Listed as Threatened under the CESA
2011 - a petition for federal listing of the species was deemed not warranted by the USFWS

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Niche modeling

“The niche relationships of the California Thrasher” Joseph Grinnell 1917

Biophysical Envelope

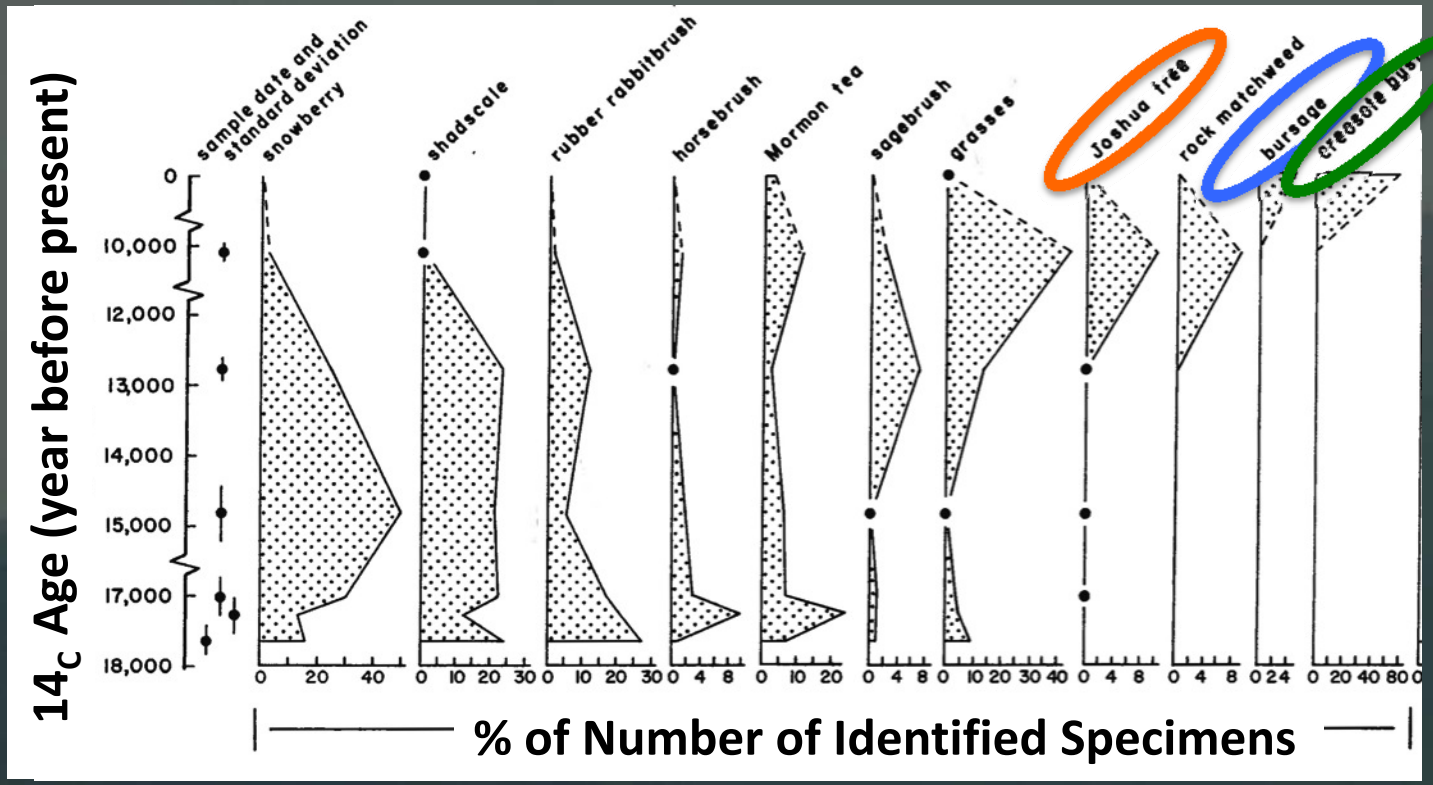
Biological –
Food, predators, competitors

Physical –
Temperature, precipitation, Soils

Weather versus climate

Past Changes in Mojave Desert Vegetation Through Time

Point of Rocks Site, Amargosa Desert

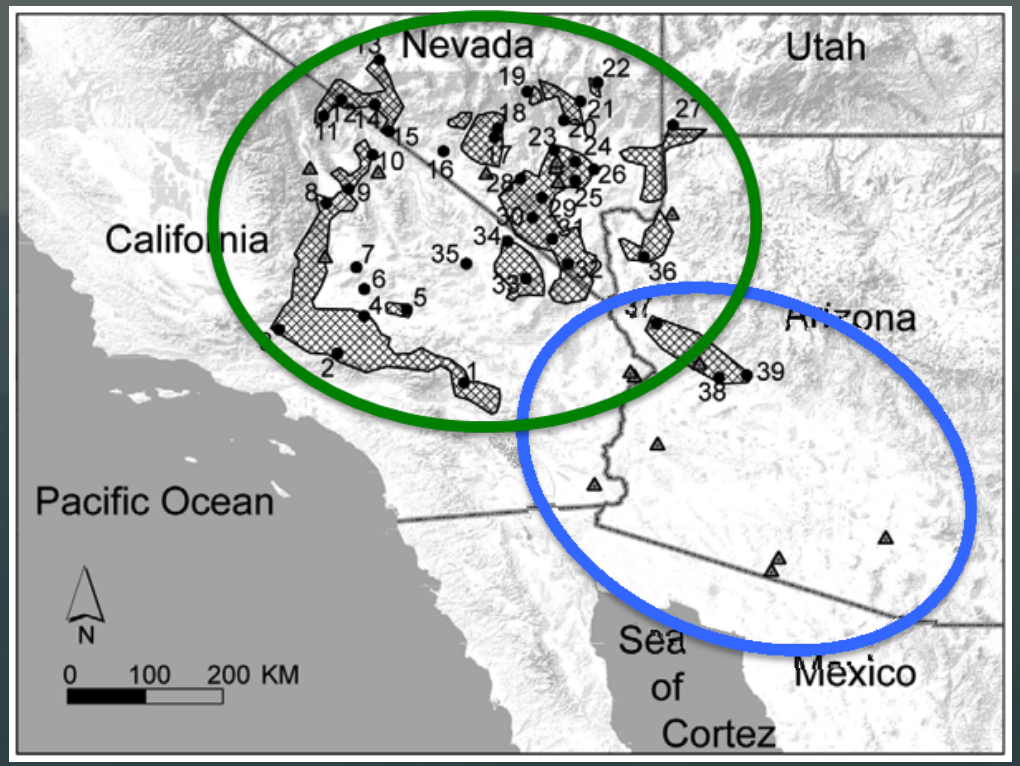


Spaulding 1990 40k years of change

Past Changes in Mojave Desert Vegetation Through Space

The compliment of plant and animal species found in the Mojave Desert today is the result of past changes in species distributions on a large scale.

Joshua Tree



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Smith et al. 2011

Vicariance Factors

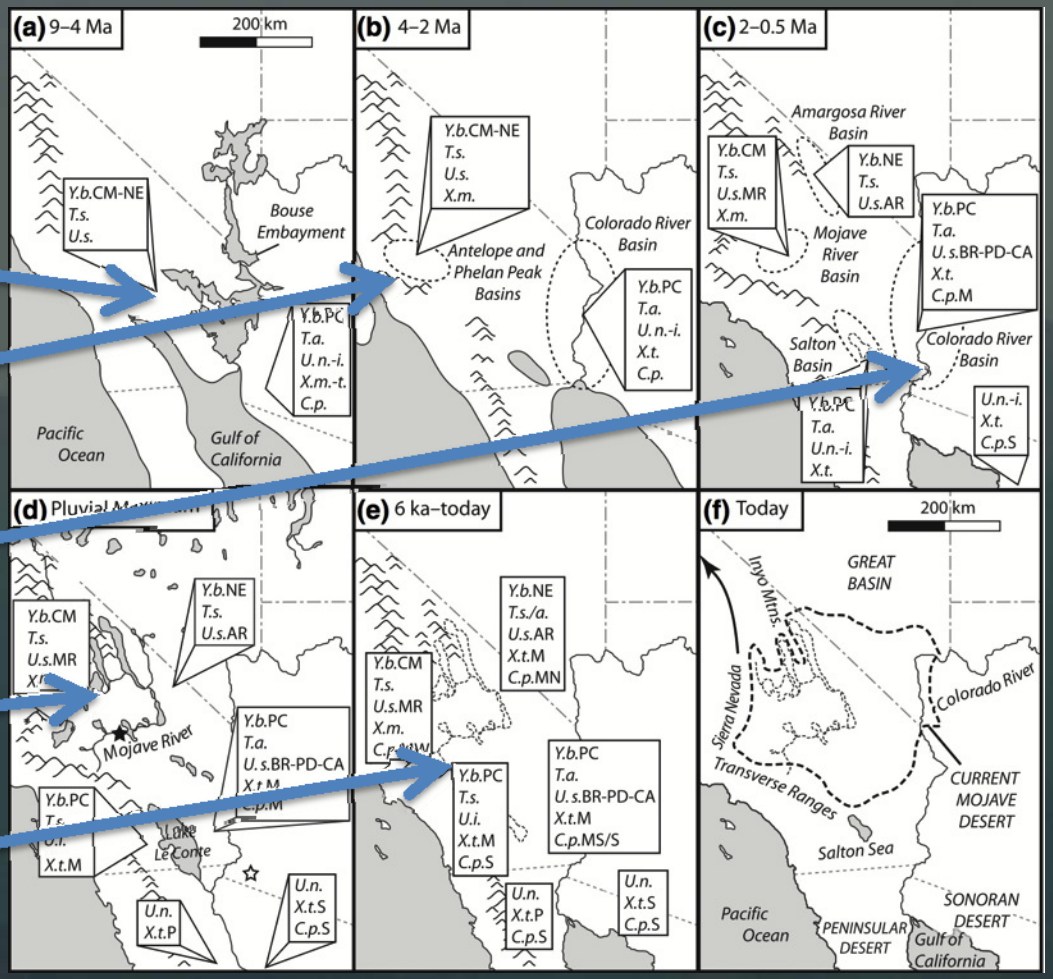
Bouse Embayment

Transverse Ranges & Basins

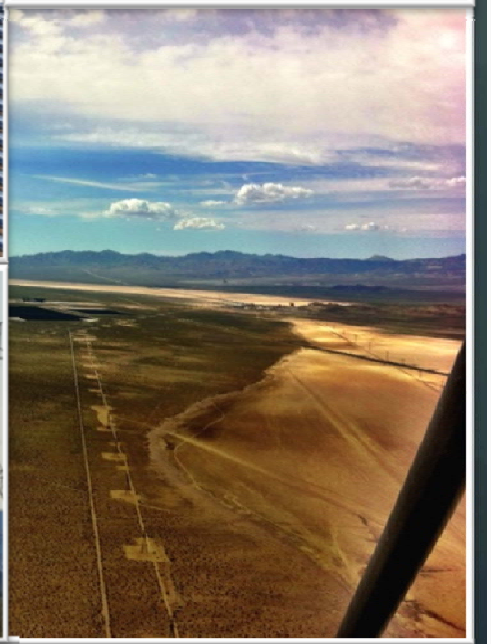
Colorado River

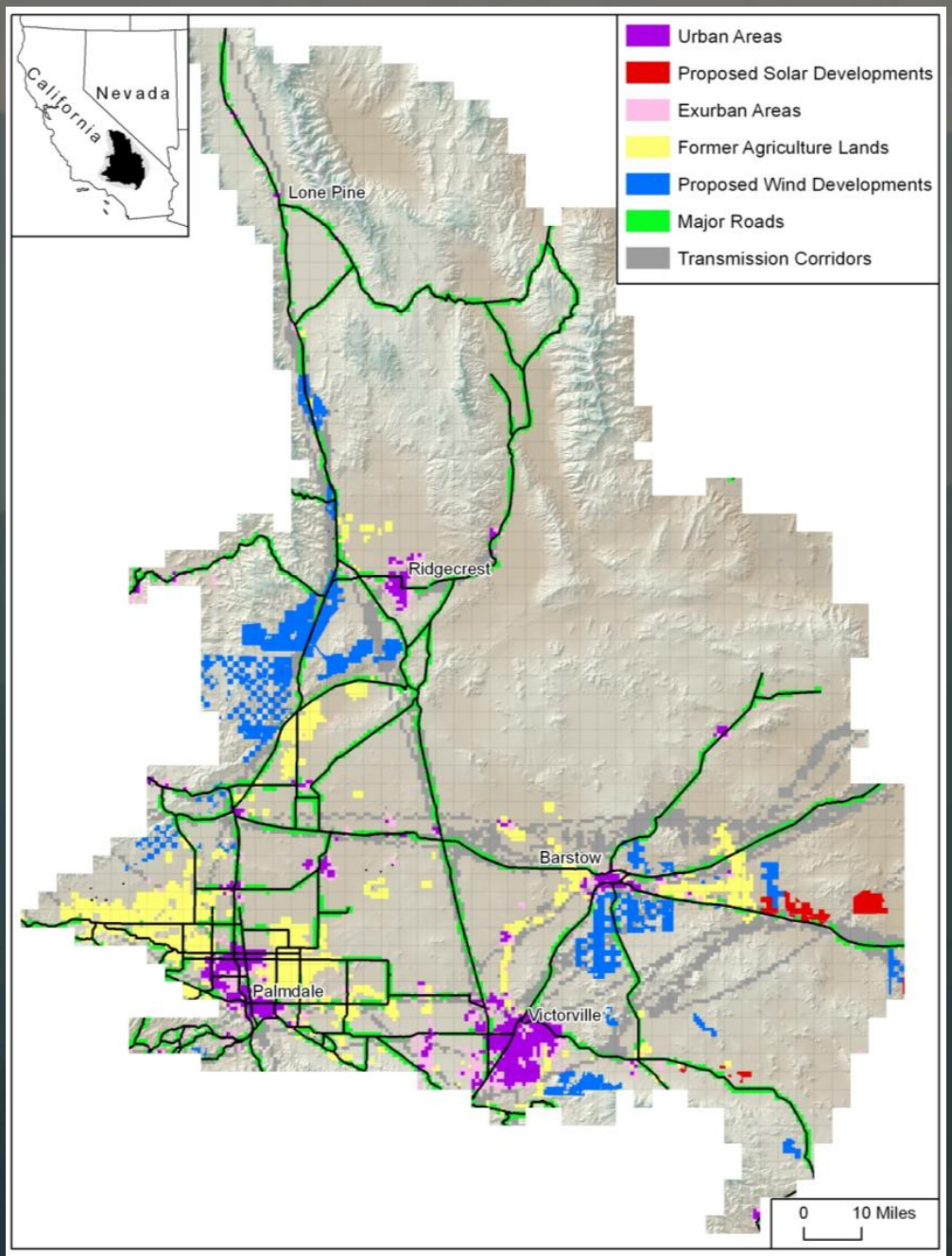
Pluvial Lakes

Mojave River



Vicariance Factors?





Utility Lines

Refuse/
Subsidies

Subsidized
Predators

Potential Habitat for the Mohave Ground Squirrel (*Xerospermophilus mohavensis*):

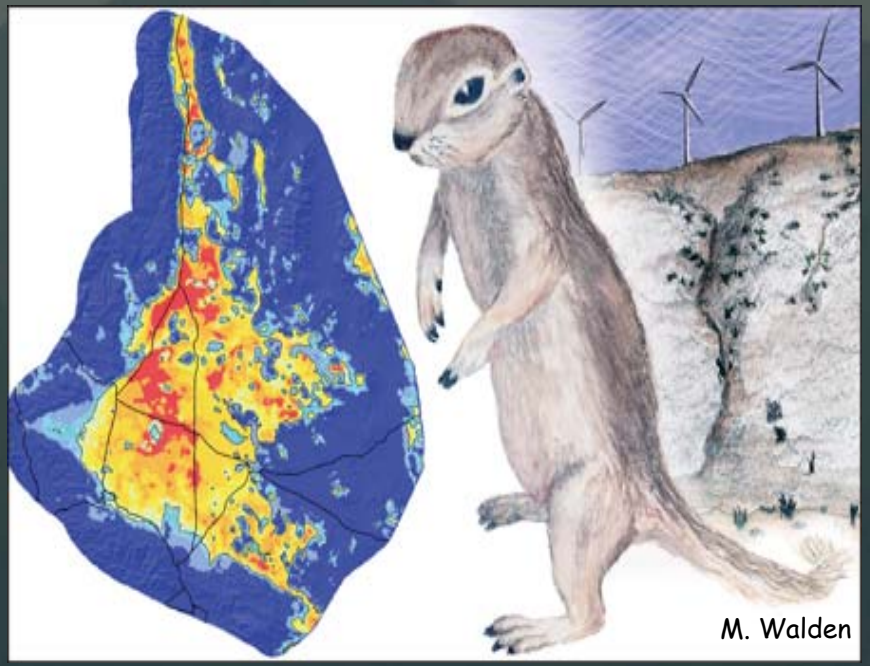
Is there room for all of us?

Modeling of habitat suitability:
Correlations between known squirrel locations and environmental factors

temperature, precipitation, soils,
plants, food, cover, predators, disease

Fluctuations vs Averages
daily, seasonal, interannual, decadal, millenial

Information available or not?



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Inman, et al. 2013. Featured Article. Endangered Species Research 20:1-18. doi: 10.3354/esr00487

Habitat Model

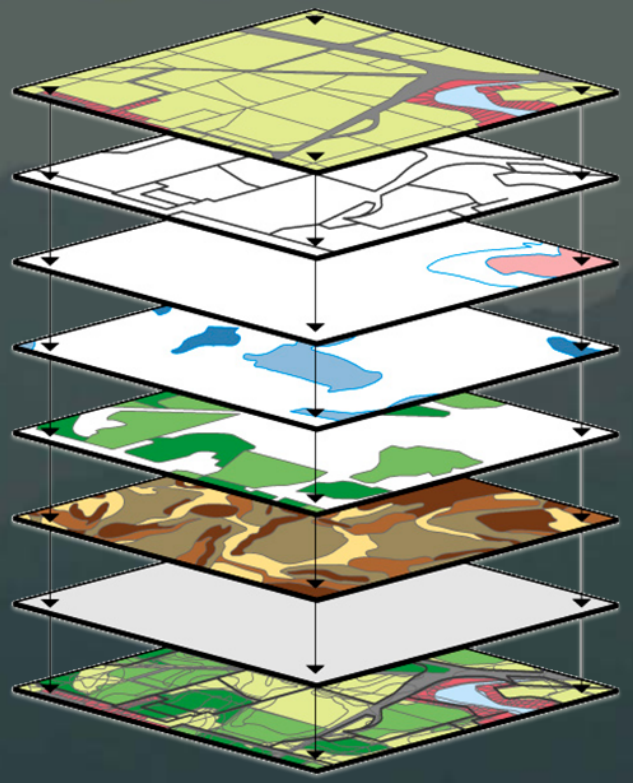
(Current conditions)

Environmental Layers

1 Surface texture,
2 Surface albedo
3 Mean winter climatic water deficit
4 Precipitation

Elevation??
Vegetation??

Both probably good predictors, but interfere with modeling future habitat



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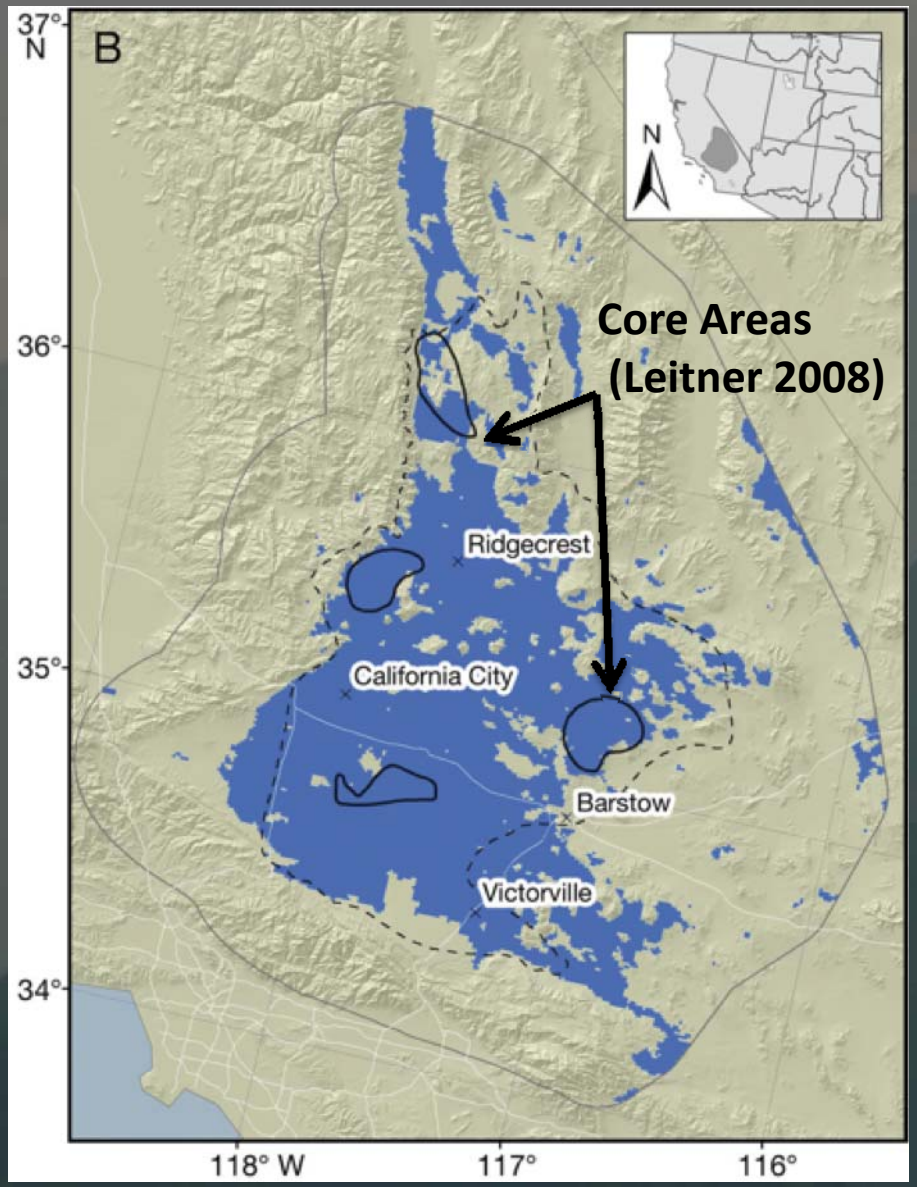

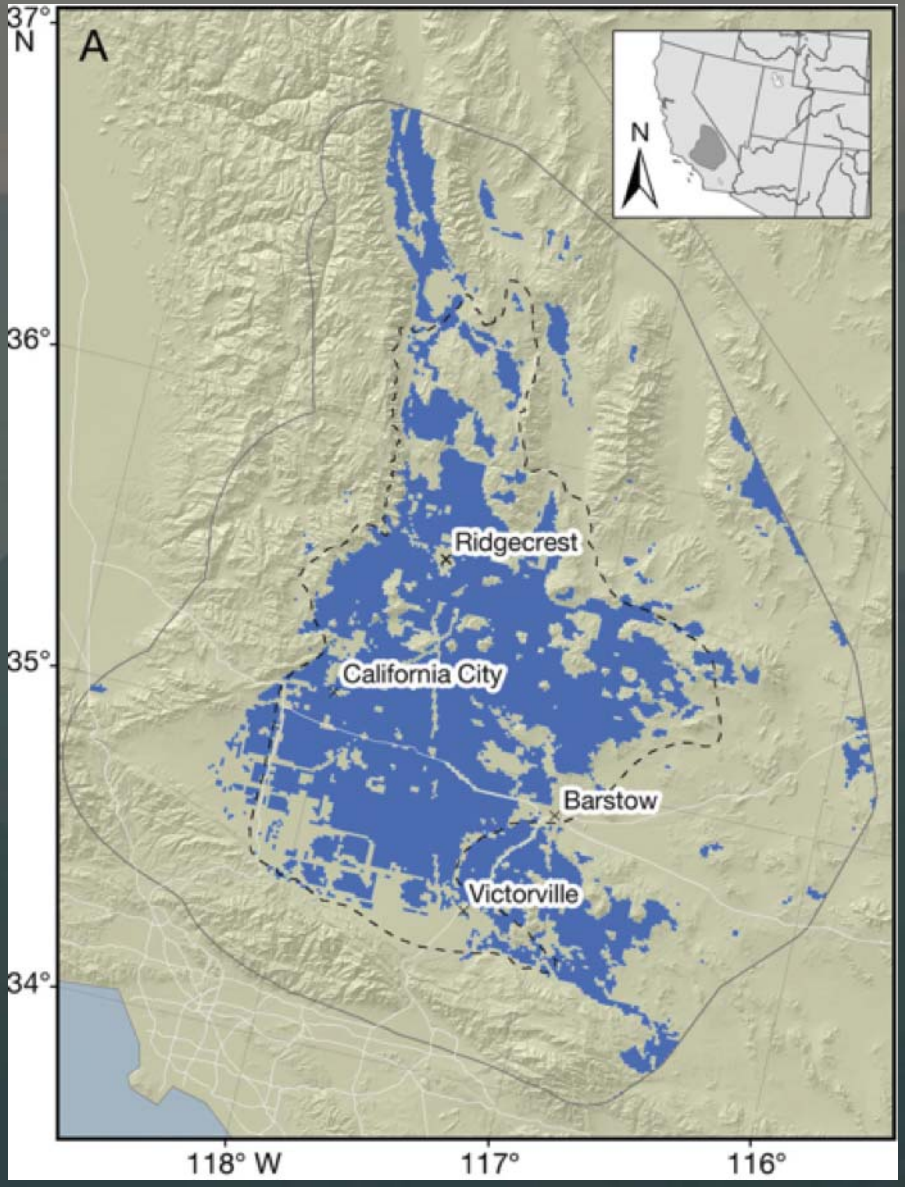

Historic Habitat Suitability
No Urban /Agricultural Impact

High Impact Scenario

Habitat Suitability Modeling Results

Present - 16% of historic habitat has been impacted by, or lost to, urbanization at present

Future - 10% more may be affected by renewable energy development in the near future.

Models illustrated that *MGS* habitat suitability is higher in areas slated for renewable energy development than in surrounding areas.

The information provided by the habitat suitability model can be used to:

Guide and develop sampling designs

Evaluate conservation corridors *and potential effects of climate change*

Inform development/conservation planning

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Future Climate

4 Emissions scenarios - Intergovernmental Panel on Climate Change (IPCC) Assessment Report -representing potential for global change in economic and human population growth, population demographics, consumption of fossil and alternative fuels, and technological development (IPCC 2001)

The A2 and B1 emissions scenarios (representing medium-high and low emissions, respectively) were coupled with the National Oceanic Atmospheric Administration (NOAA) Geo-physical Fluid Dynamics Laboratory (GFDL) CM 2.1 GCM to evaluate the potential influence of climate change on the distribution of habitat for the Mohave ground squirrel.

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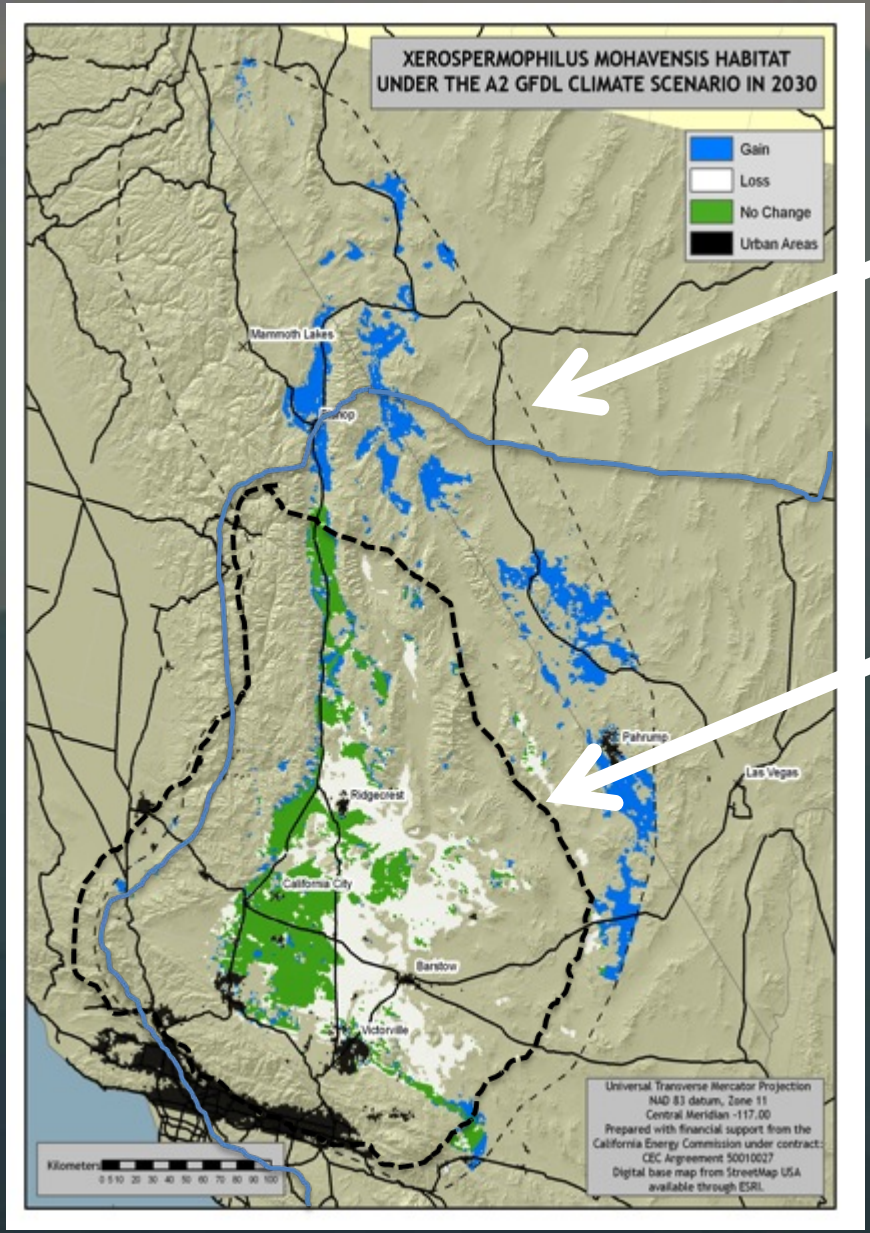
Study Areas - Climate Change & Habitat Modeling

Predicted MGS habitat distributions under present and future climate scenarios, extending to the north of the study area



Future
118,872 km²

Present
53,621 km²
(Chapter 2)

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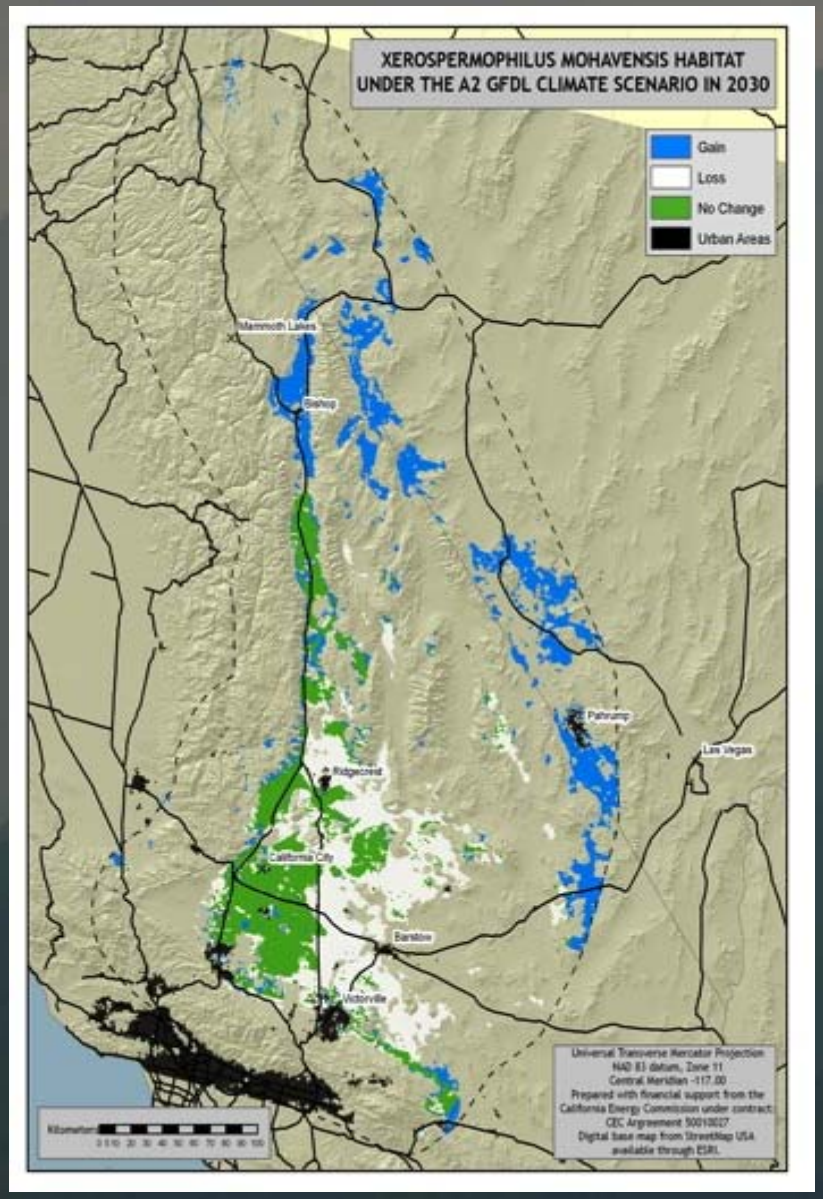
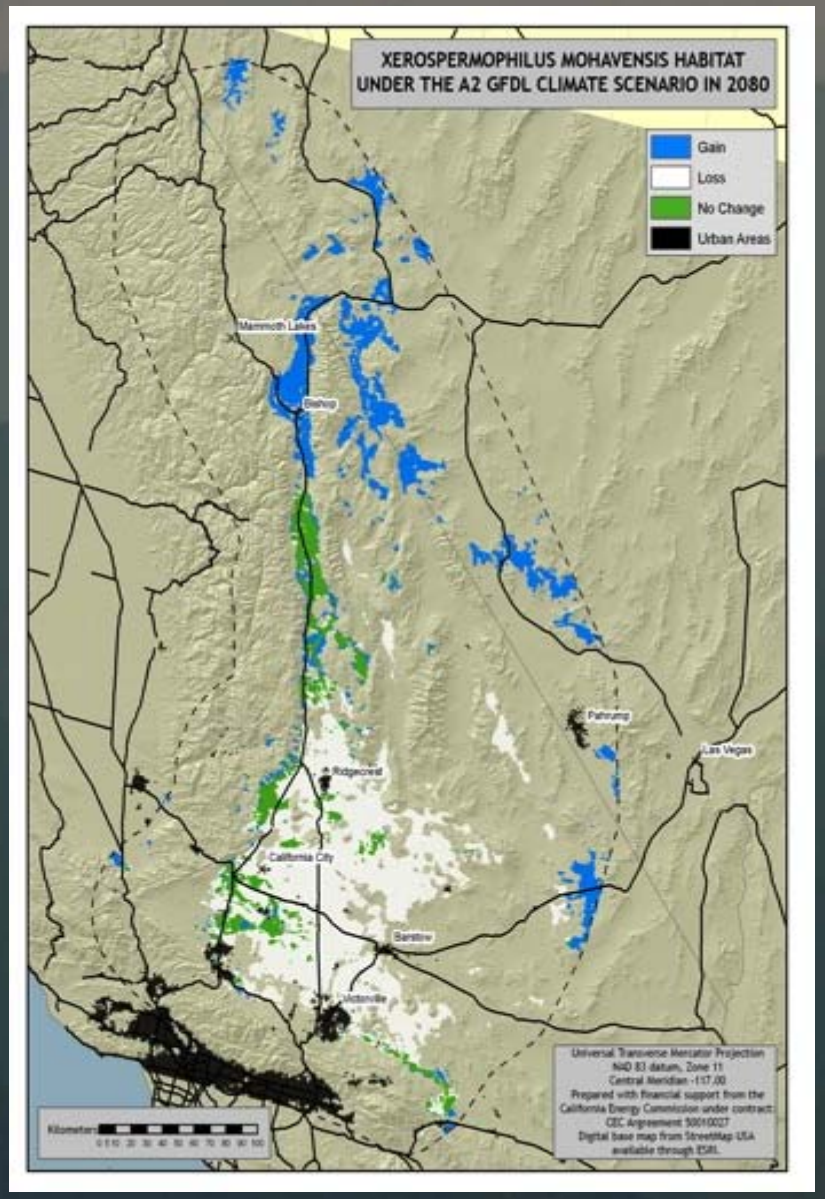
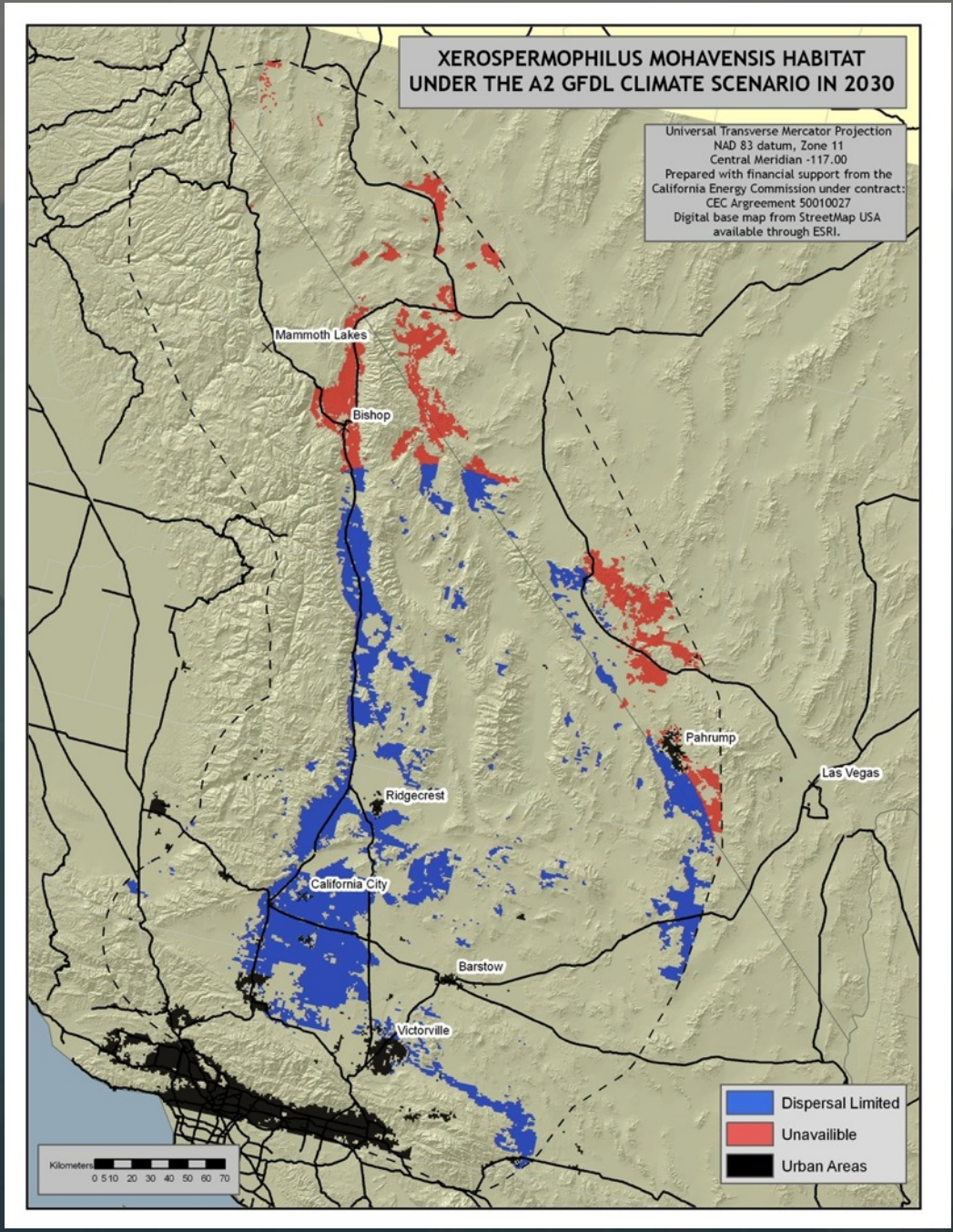
Impacts of Climate Change and Renewable Energy

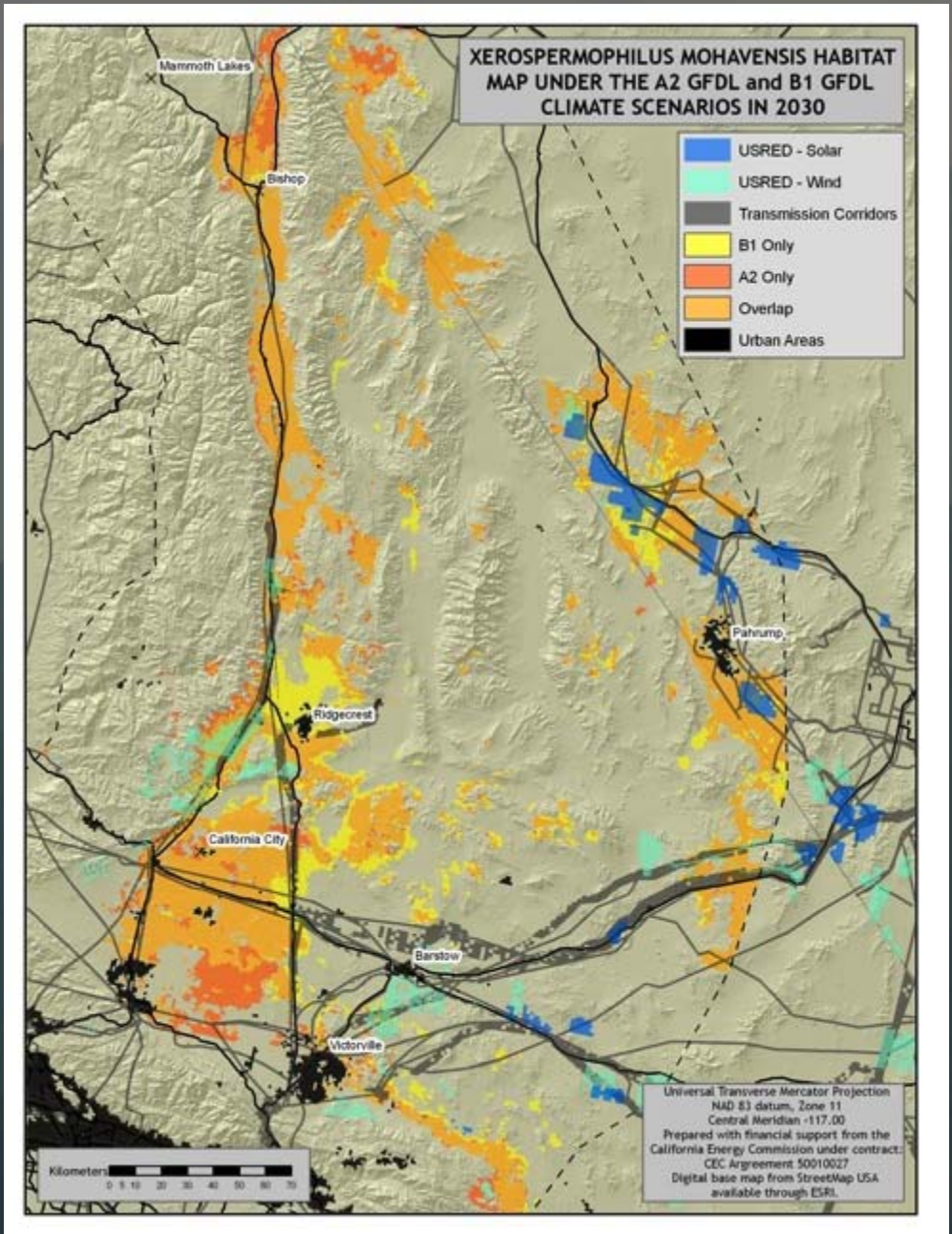




Limitations Due to Dispersal ability?



Mohave ground squirrel (*Xerospermophilus mohavensis*) habitat under the GFDL A2 (red) and B1 (yellow) climate scenarios with overlap (orange) in 2030. Solar (dark blue) and wind (light blue) USRED is shown along with transmission corridors (grey).



Important Connectivity areas

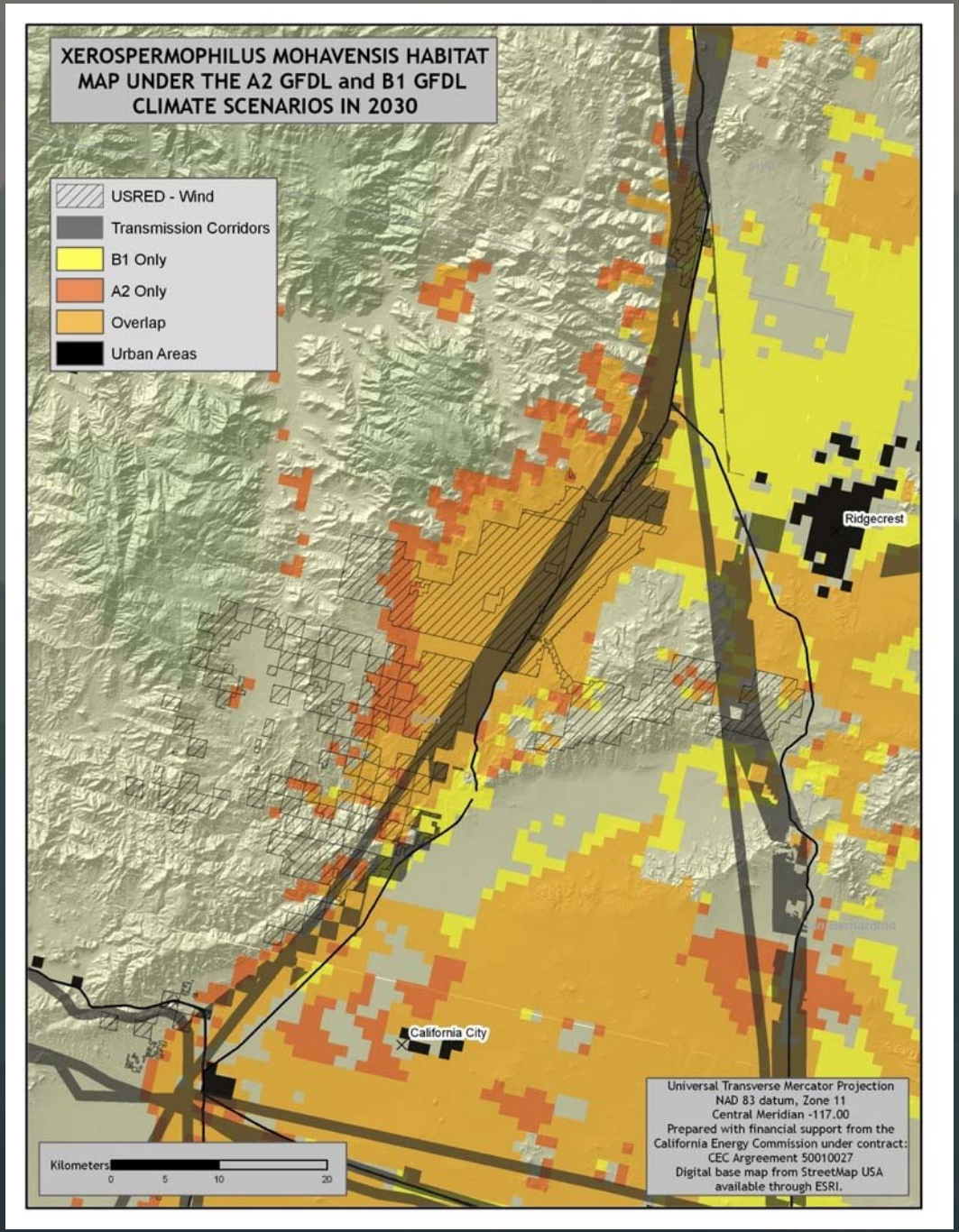
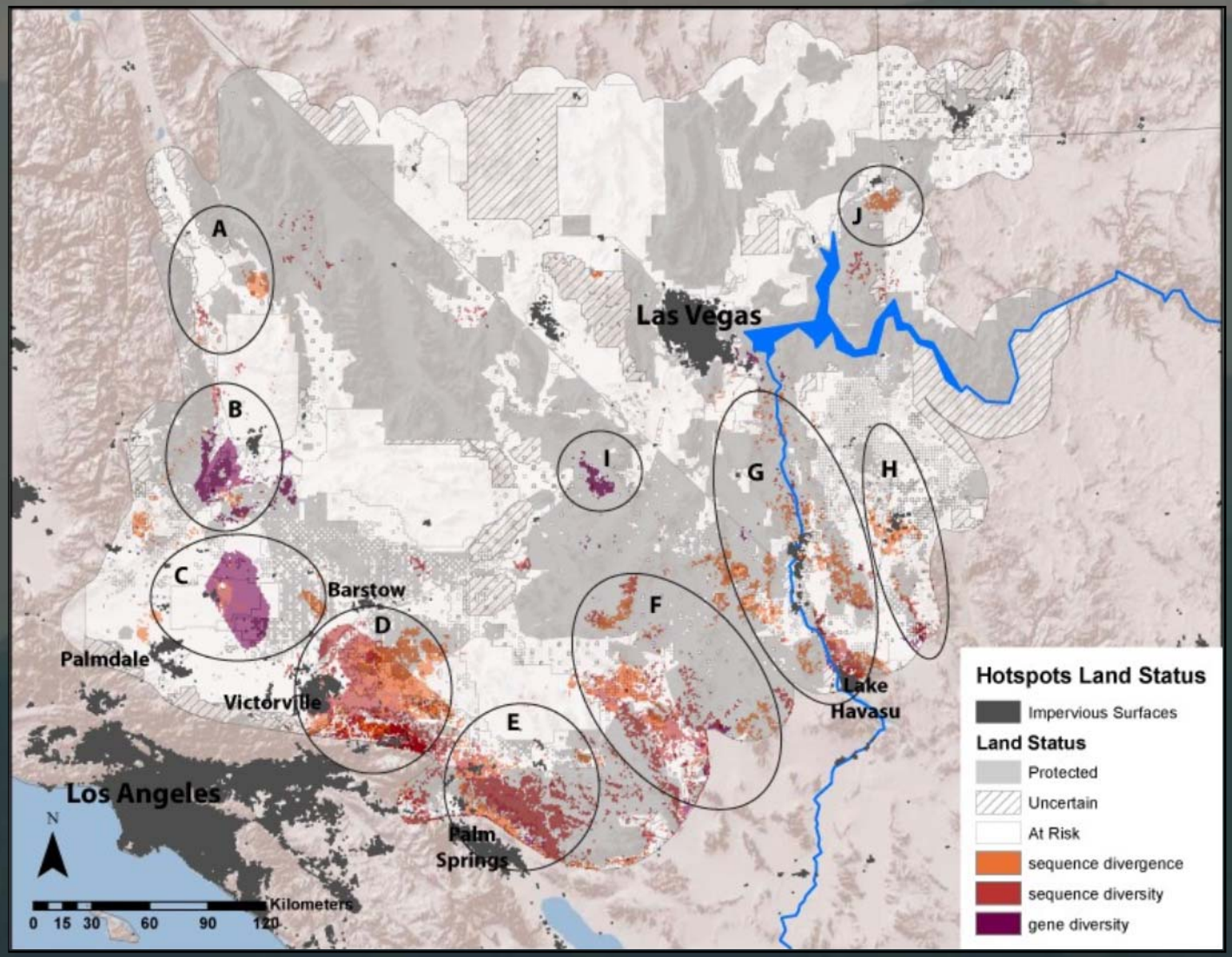


Figure 17: Mohave ground squirrel (*Xerospermophilus mohavensis*) habitat under the GFDL A2 (red) and B1 (yellow) climate scenarios with overlap (orange) in 2080. Wind (hashed) USRED is shown along with transmission corridors (grey).

Summary

- Created a habitat model for current conditions estimating current anthropogenic impacts
- Constructed to enable inclusion of future climate forecasting to predict future habitat
- Identified key areas of habitat loss and connectivity
- Provides information for future planning efforts for USRED

Multi-species genetic considerations



Vandergast et al. 2013

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