



University of Nevada, Reno

The Impacts of Land Use and Climate Change on Mojave Desert Tortoise Gene Flow Dynamics and Corridor Functionality

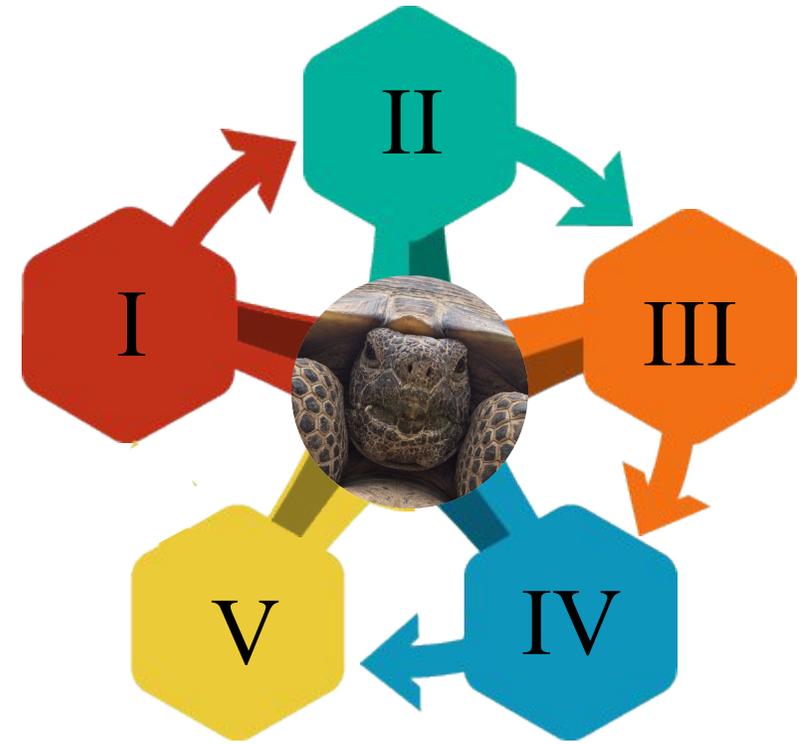
Progress to date

Kenneth Nussear, Anjana Parandhaman, Nathan Byer, Scott Bassett, Douglas Boyle, Marjorie Matocq, Todd Esque, Amy Vandergast, Thomas Dilts, Scott Wright, Derek Friend, and Jill S. Heaton



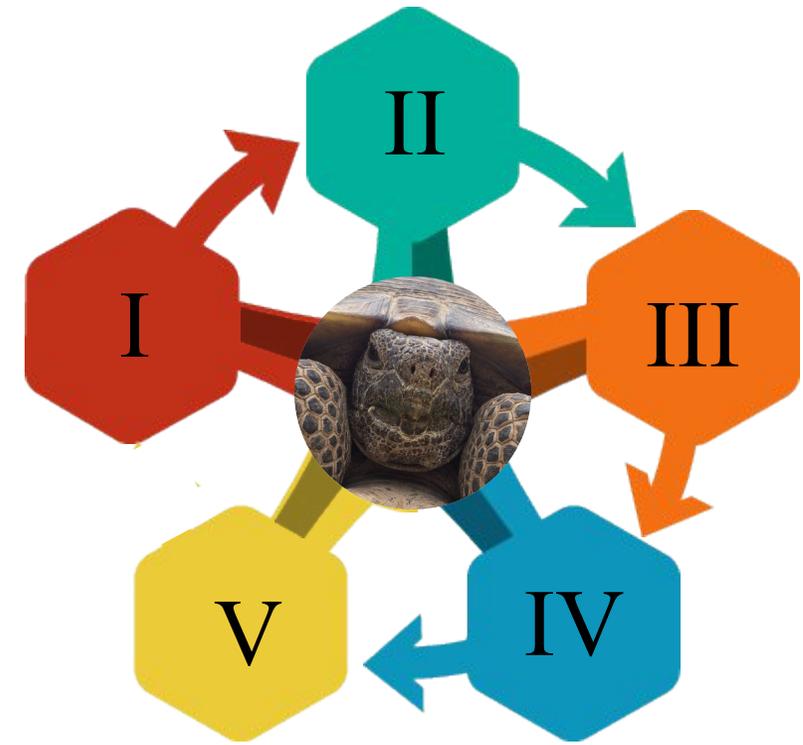
Objectives

- Evaluate how land use and climate change will impact Mojave Desert Tortoise gene flow and corridor functionality within the context of multi-species interactions and landscape connectivity



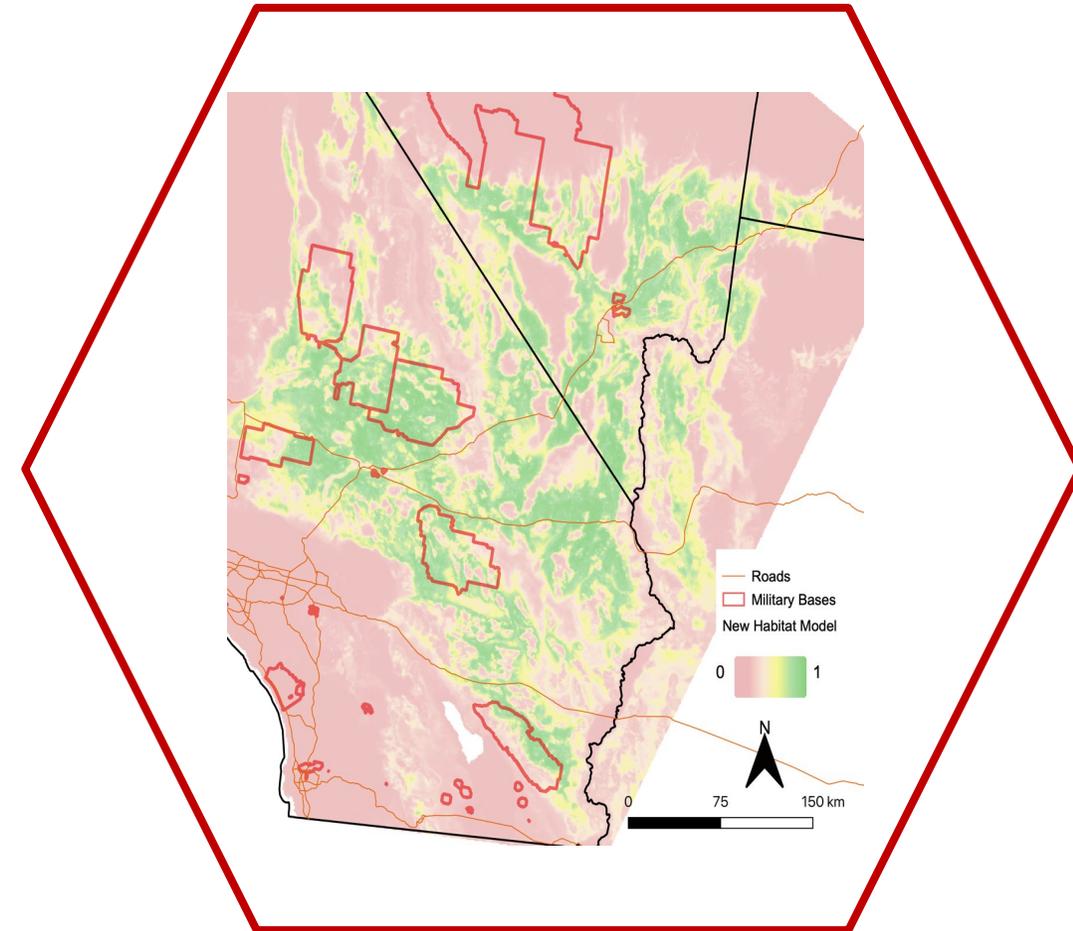
Phases

- I. Realized Desert Tortoise Habitat Model
- II. Desert Tortoise Landscape Corridor Functionality
- III. Desert Tortoise Genetic Connectivity and Diversity
- IV. Umbrella Species Assessment
- V. Management and Strategic Partner Recommendations



Phase I

- Create "realized" desert tortoise habitat models by combining an updated present-day desert tortoise habitat model with current land use footprints, and extending our models into future habitat projections by forecasting habitat under future climate and land use scenarios.



Field Sampling

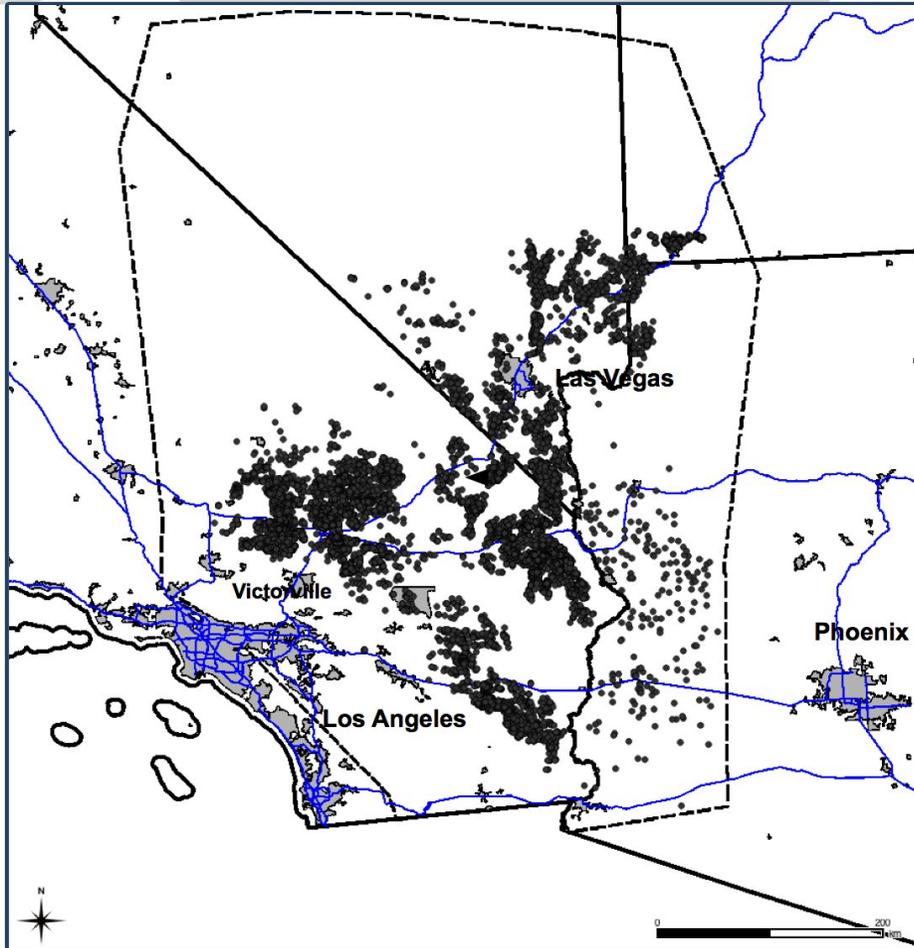
Phase I



Expanded Dataset of Tortoise Locality data

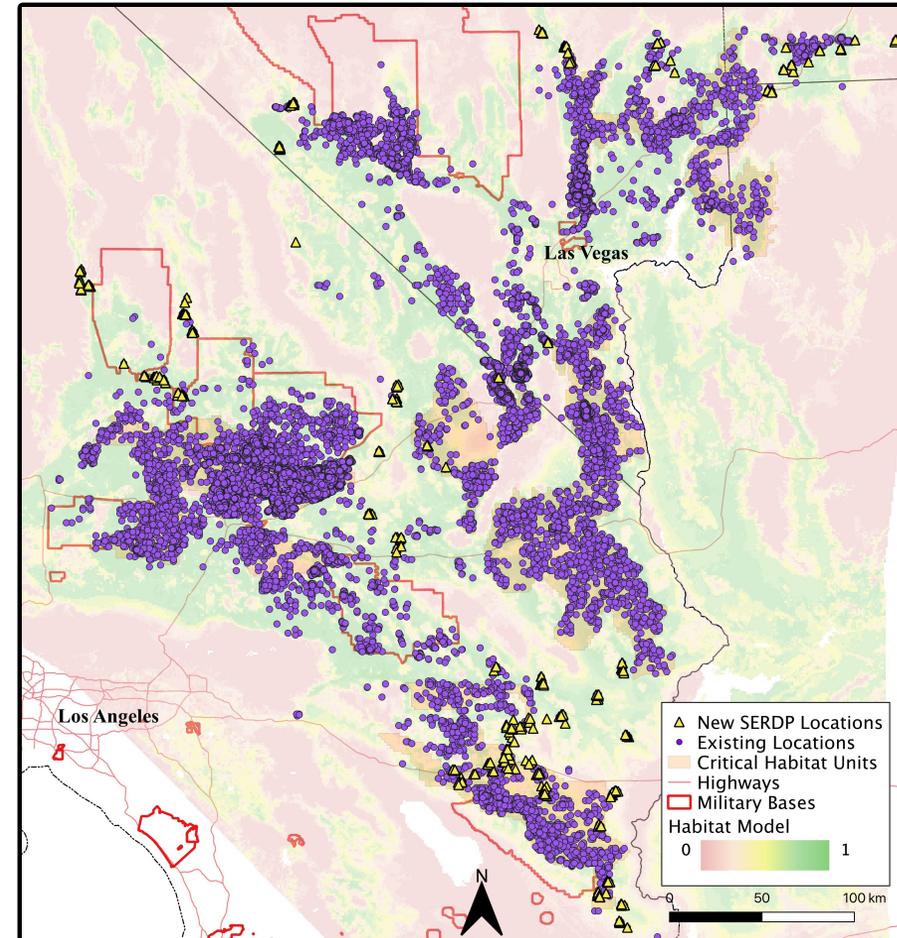
Phase I

2009



15,311

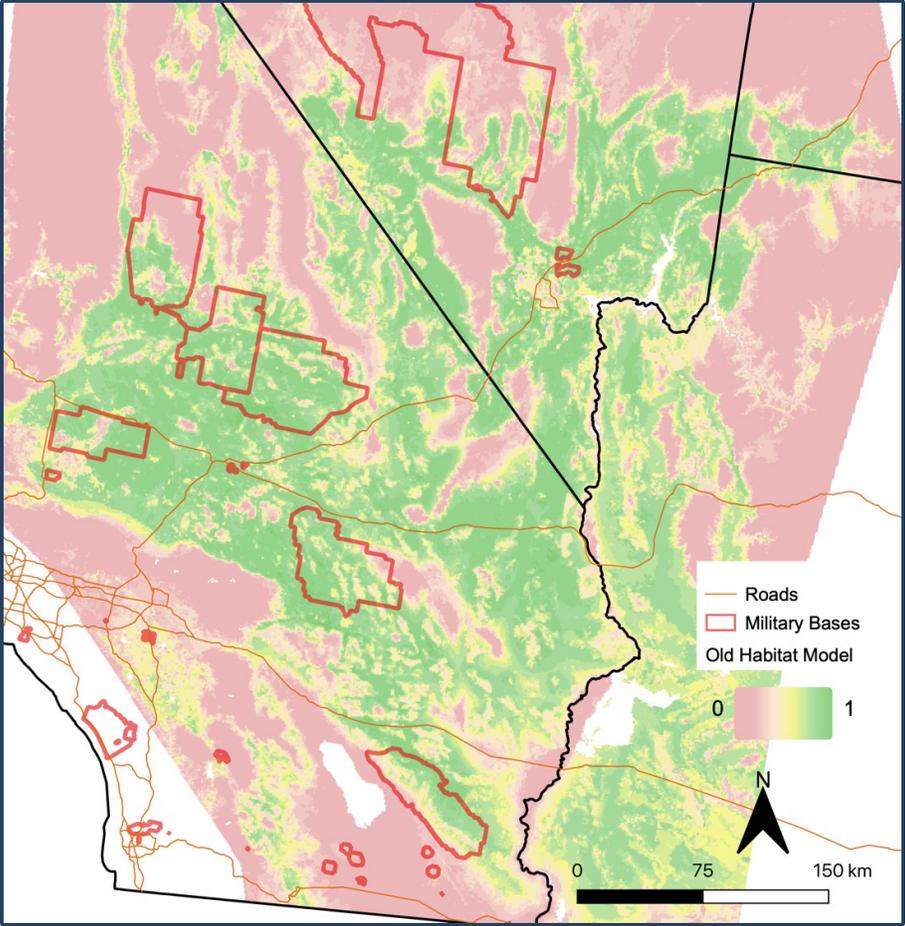
2020



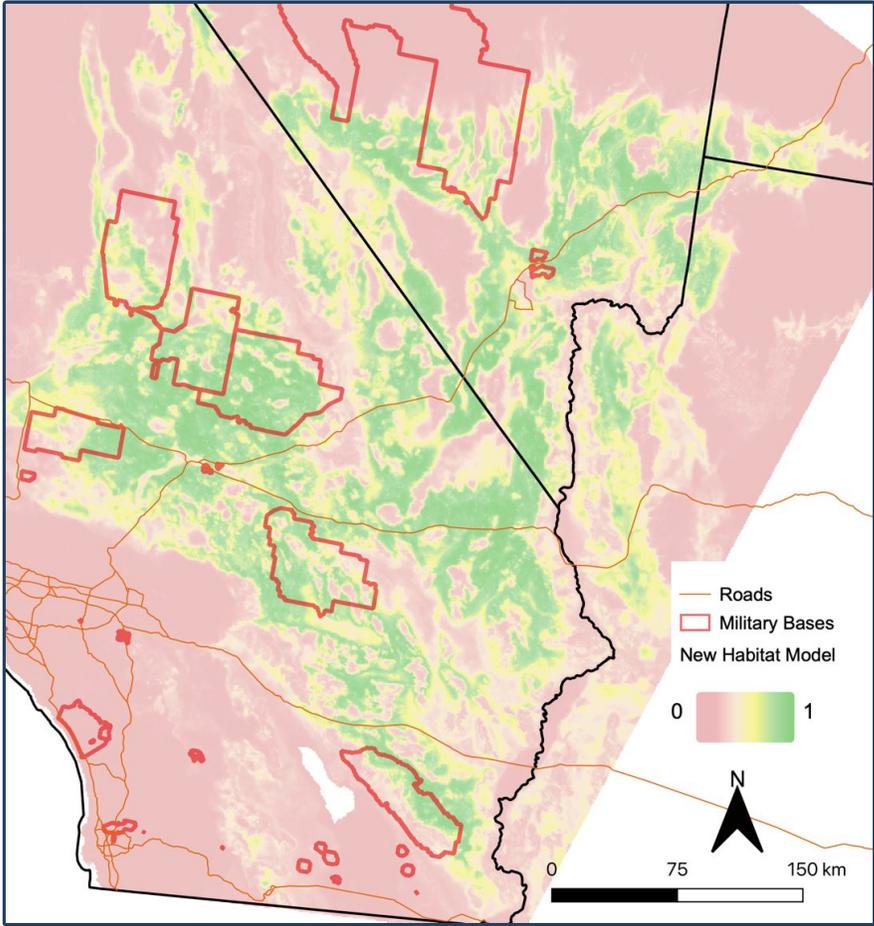
253,360

Habitat Modeling

Phase I



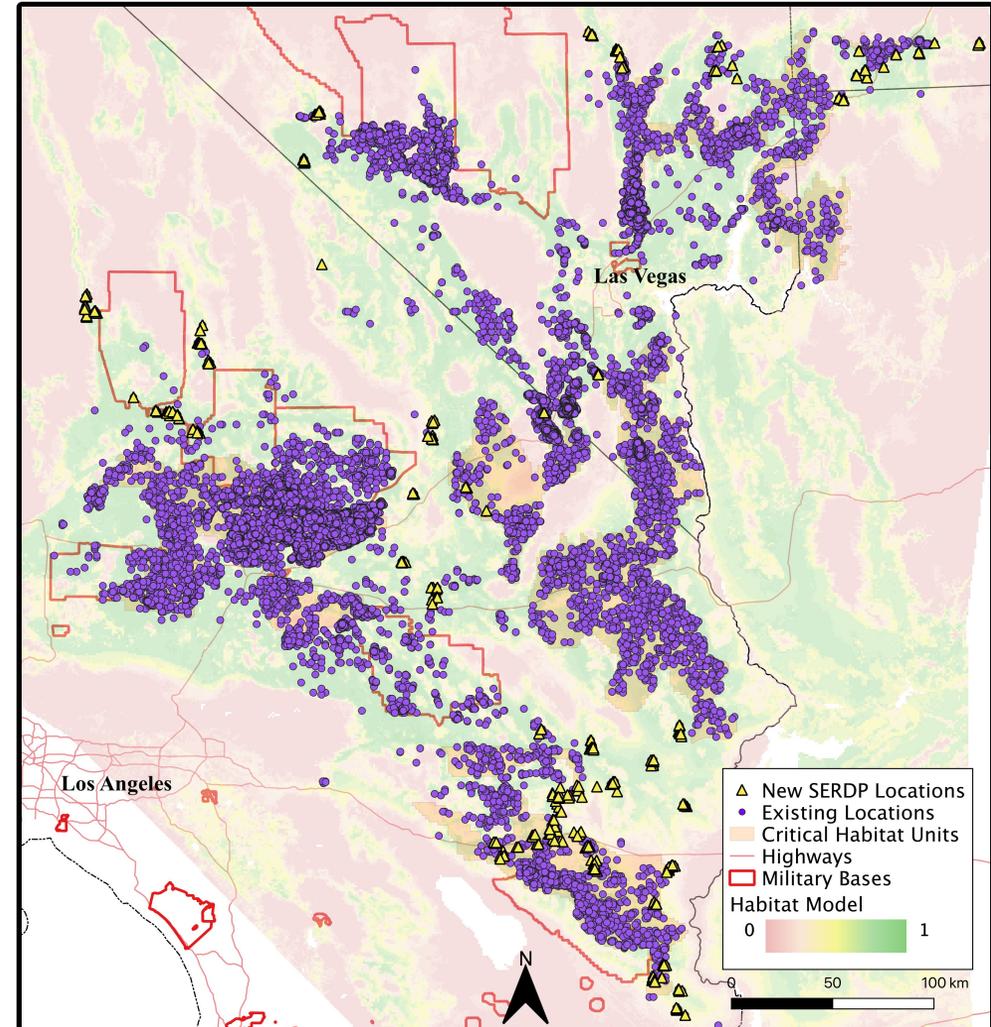
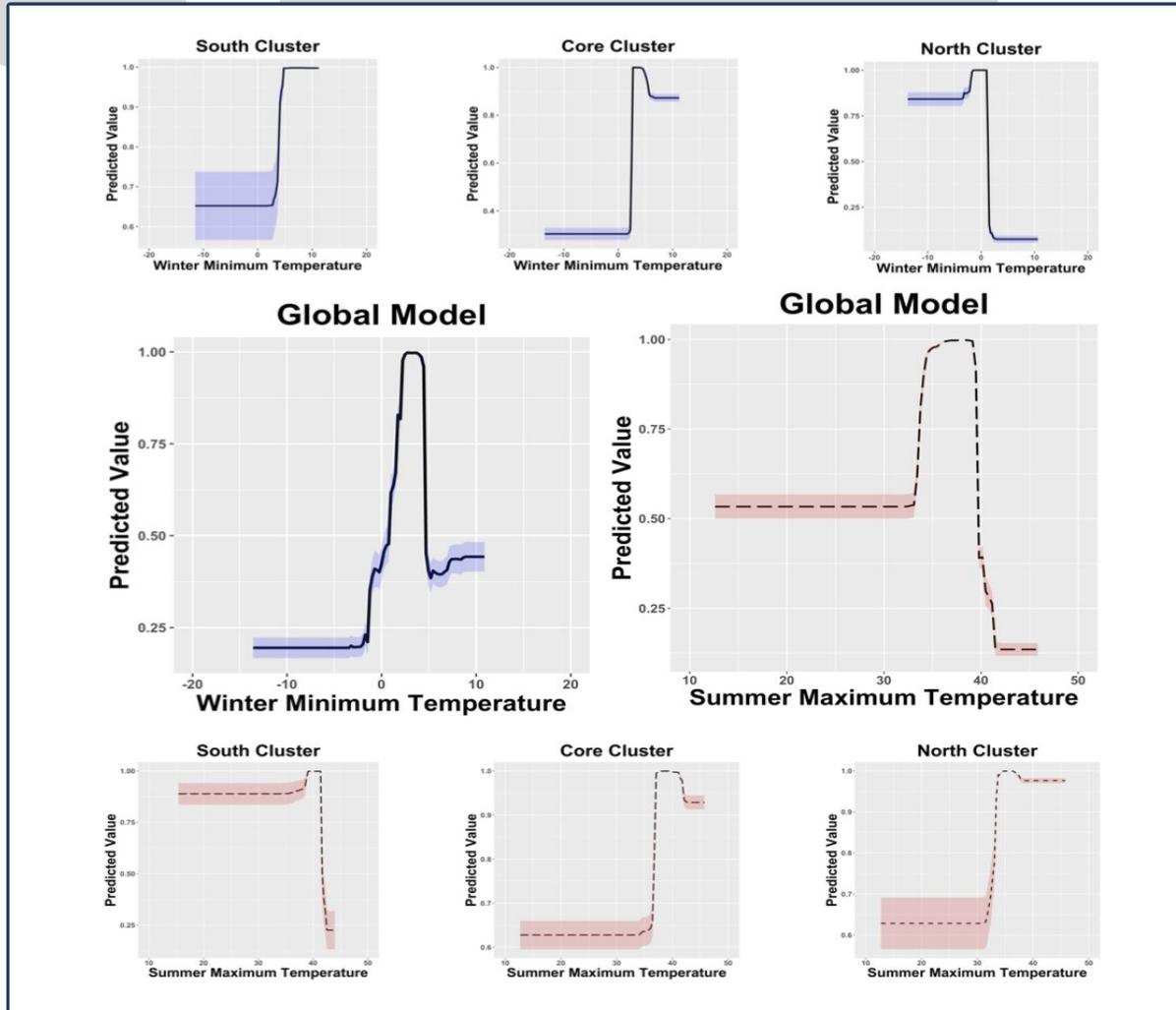
Nusear et al. 2009



SERDP Global V1 2020

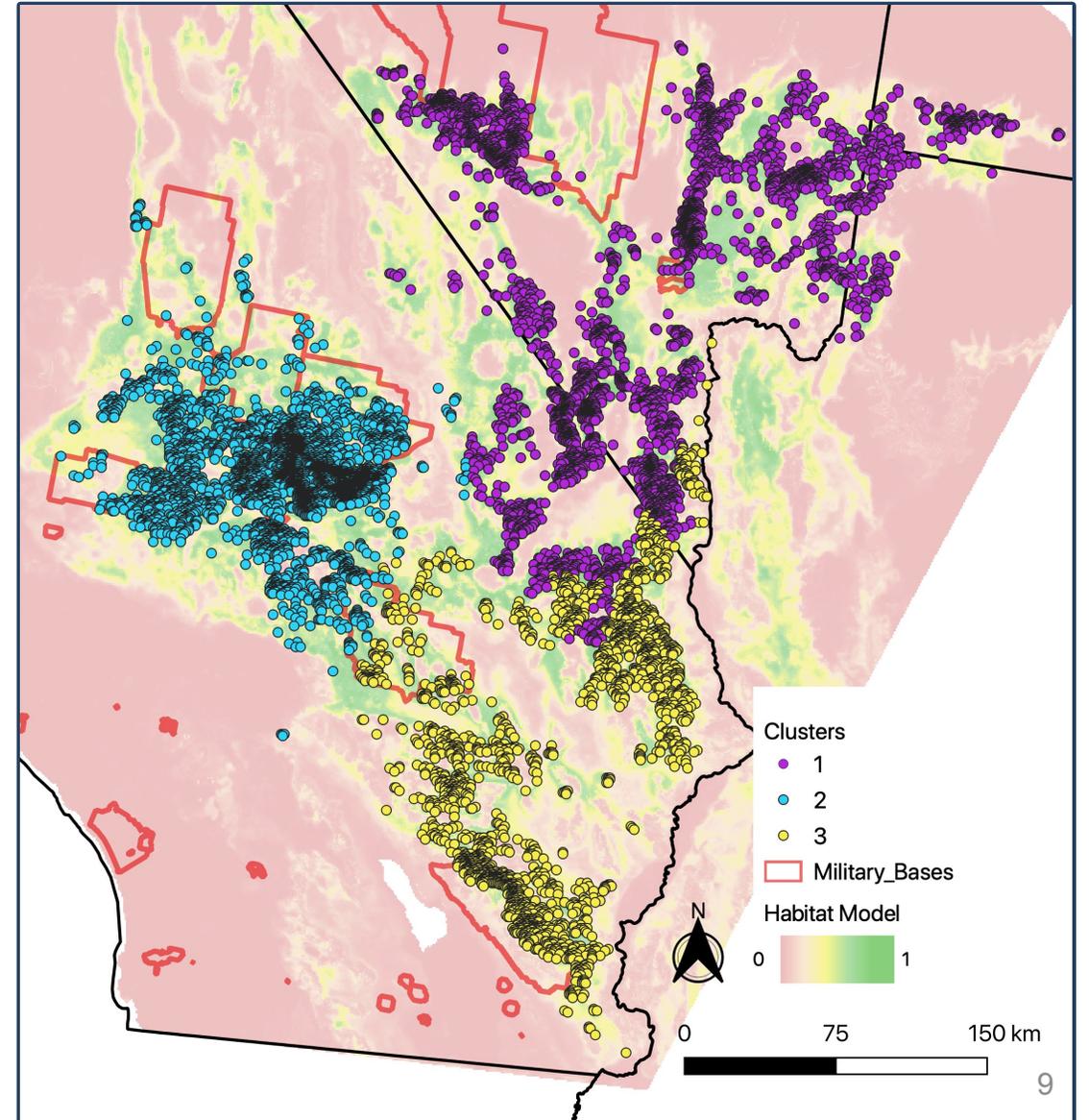
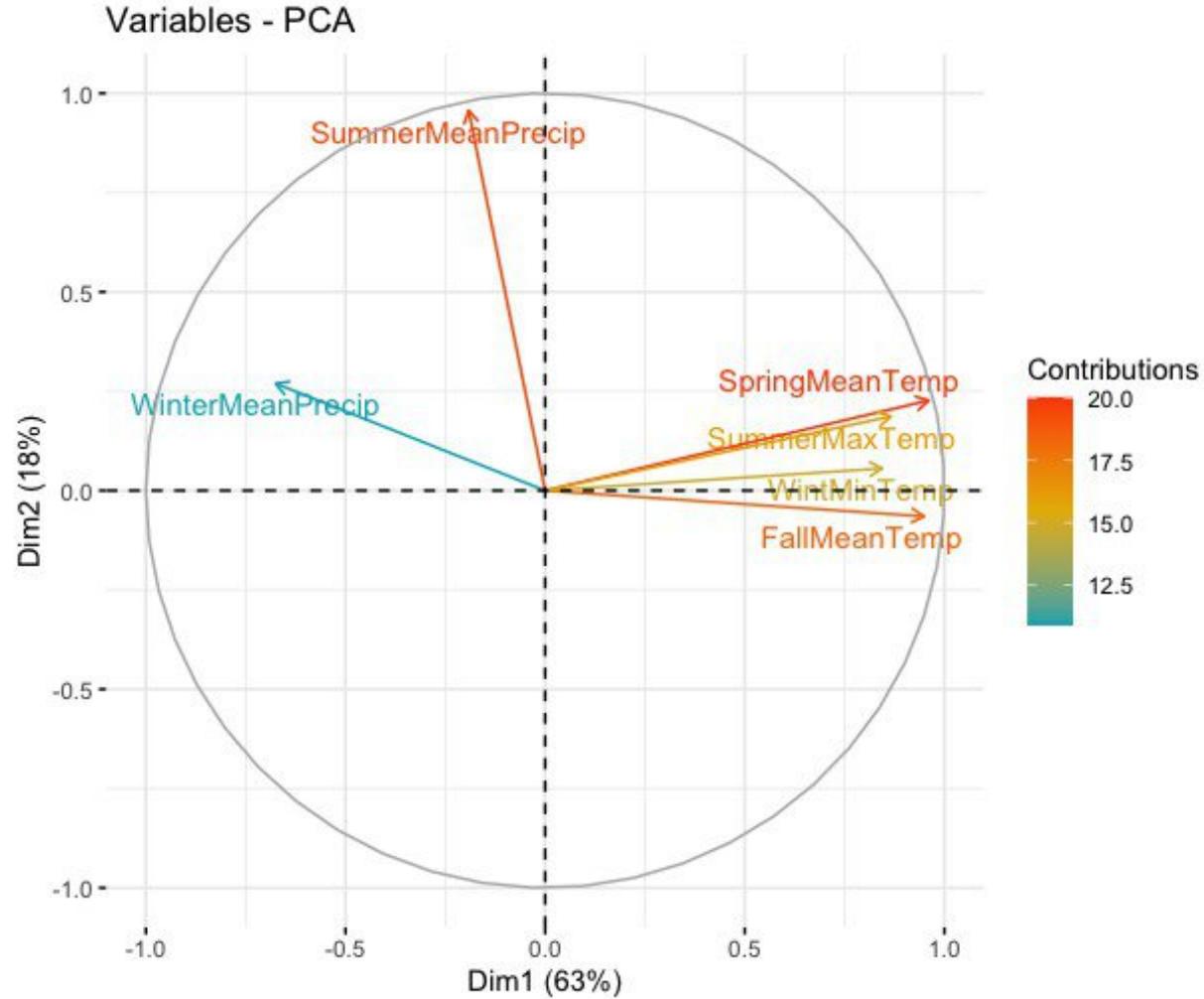
Regional Climate Influences

Phase I

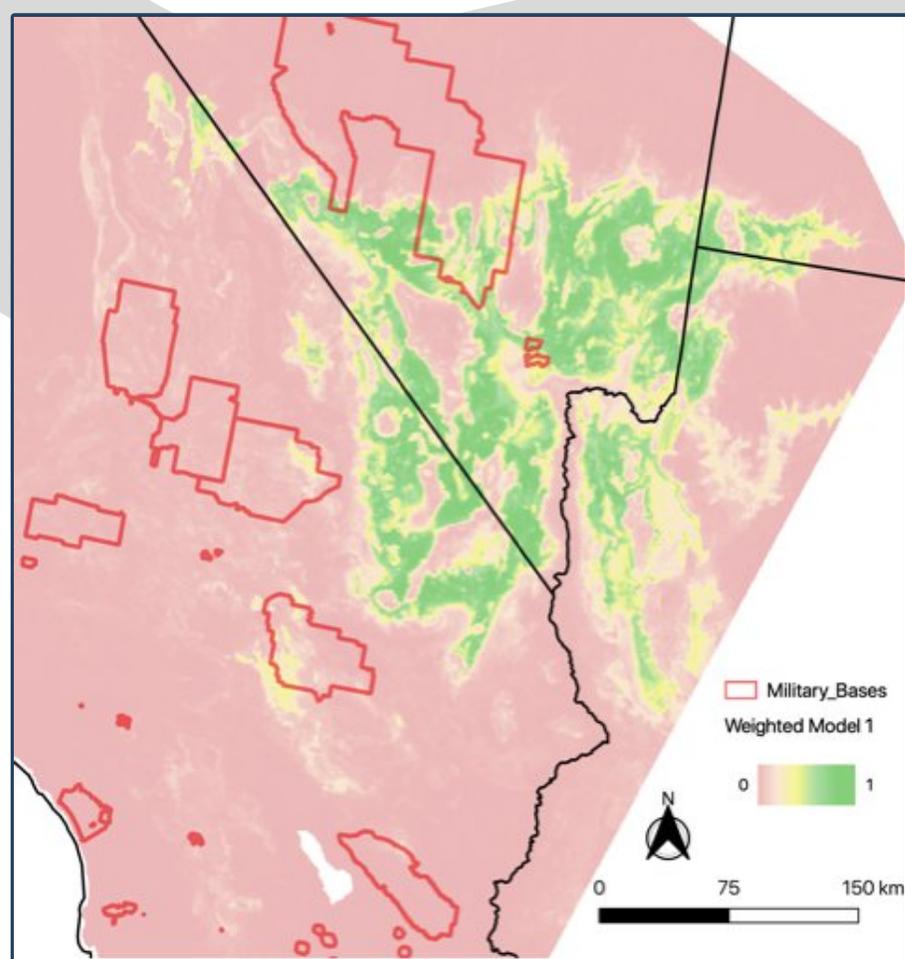


Regional Climate Influences

Phase I

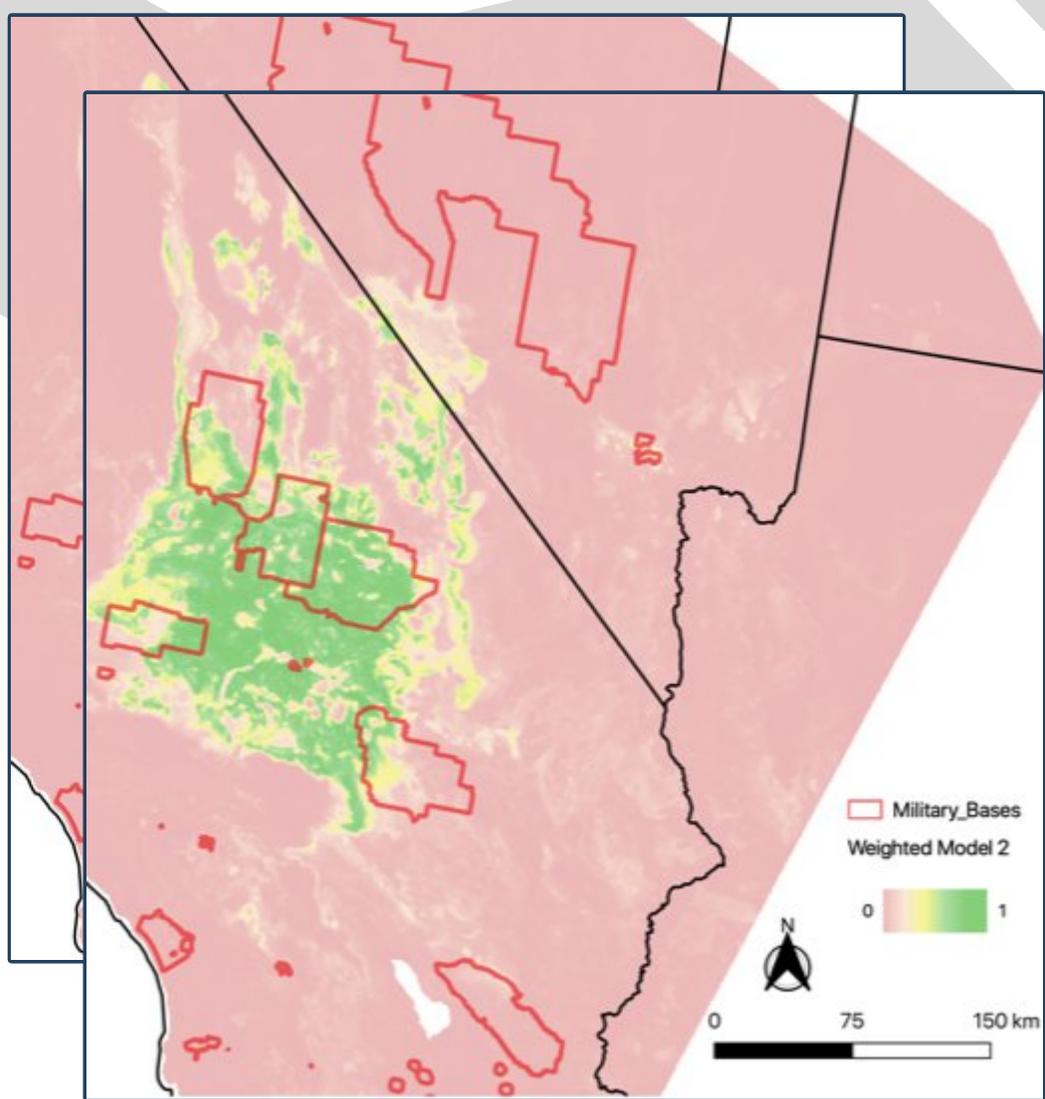


Phase I



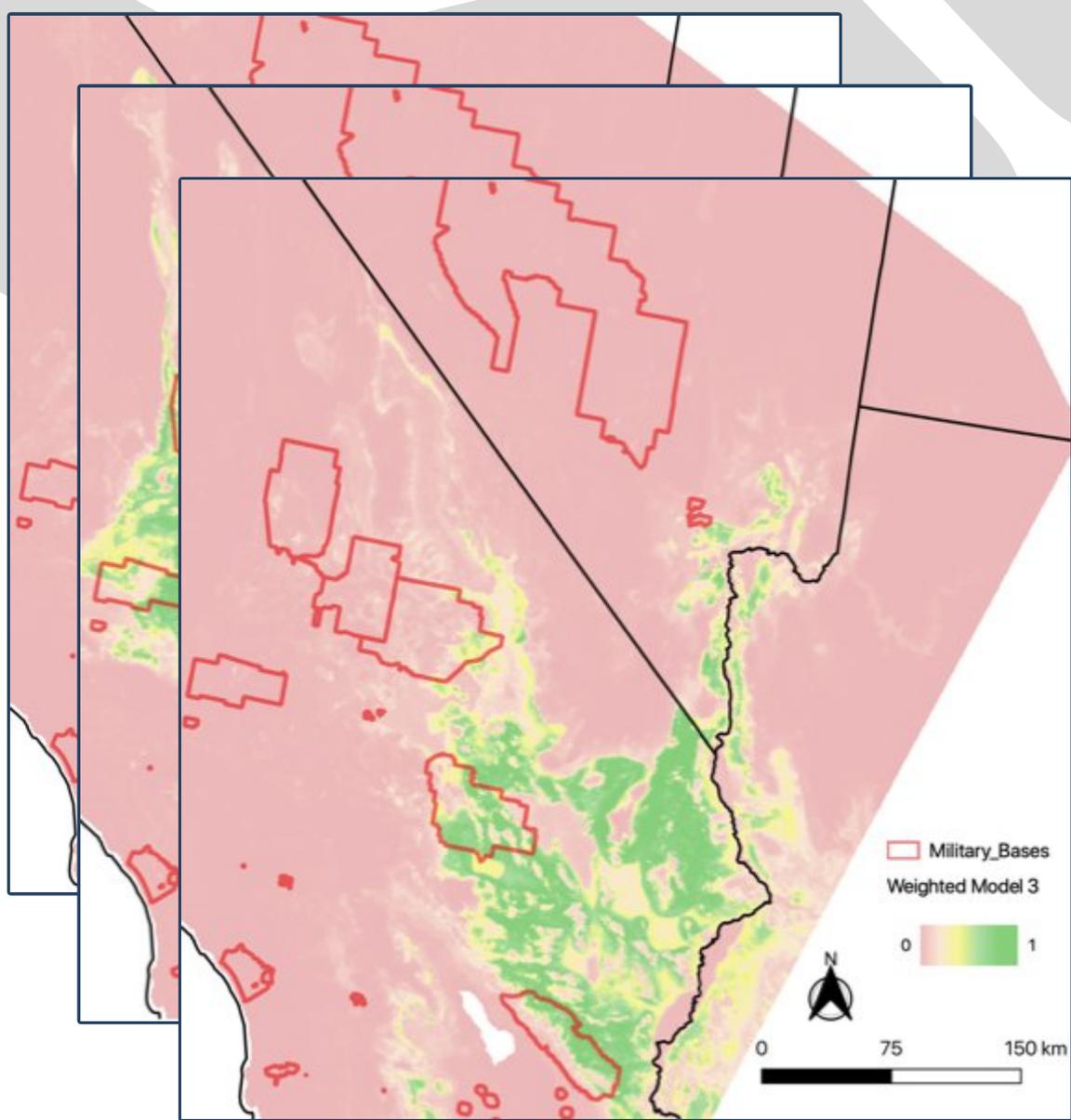
Local Models

Phase I

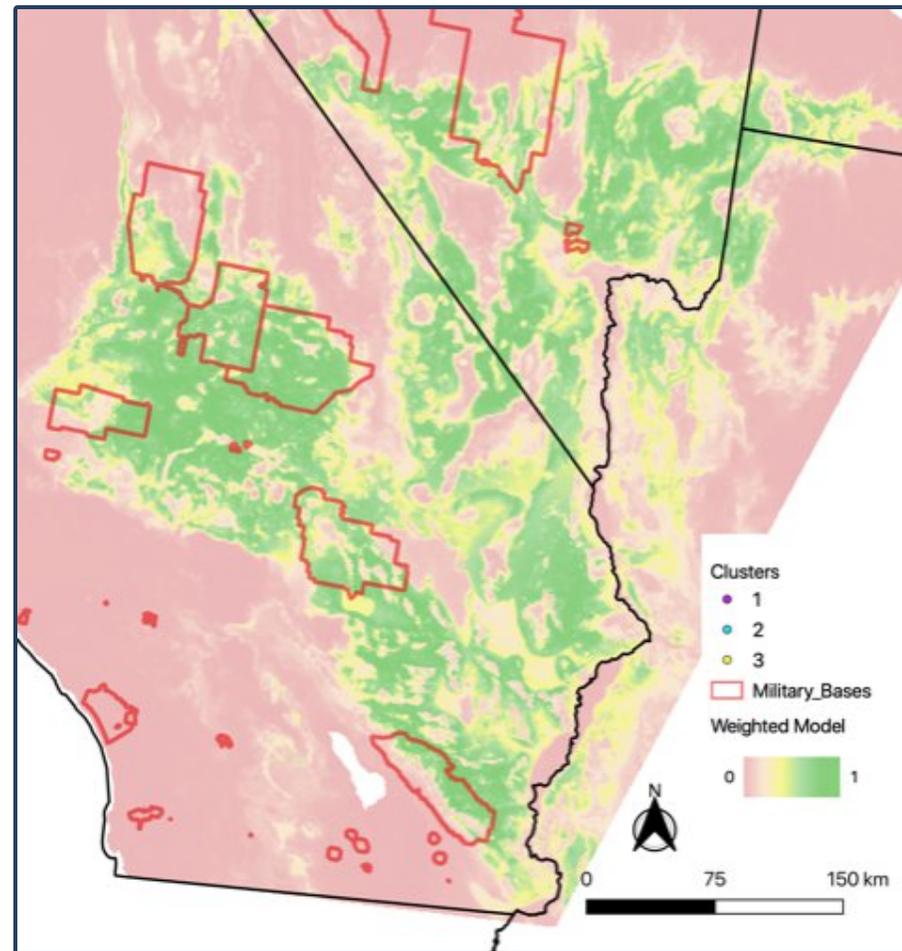


Local Models

Phase I

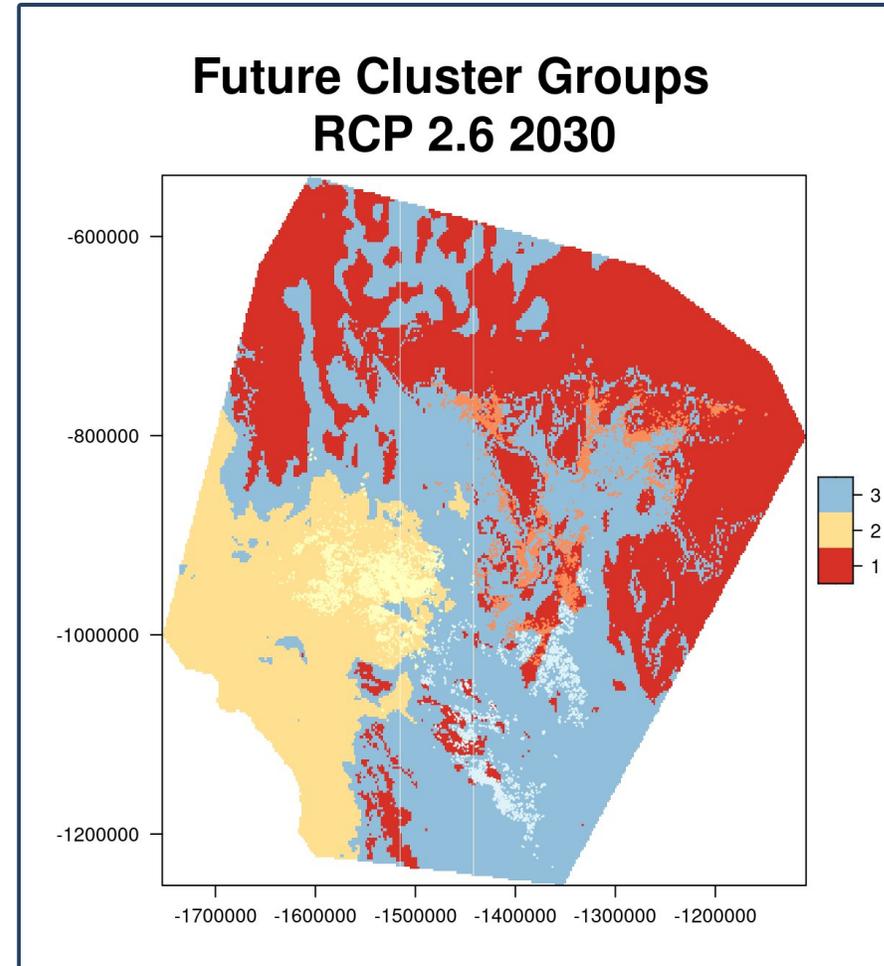
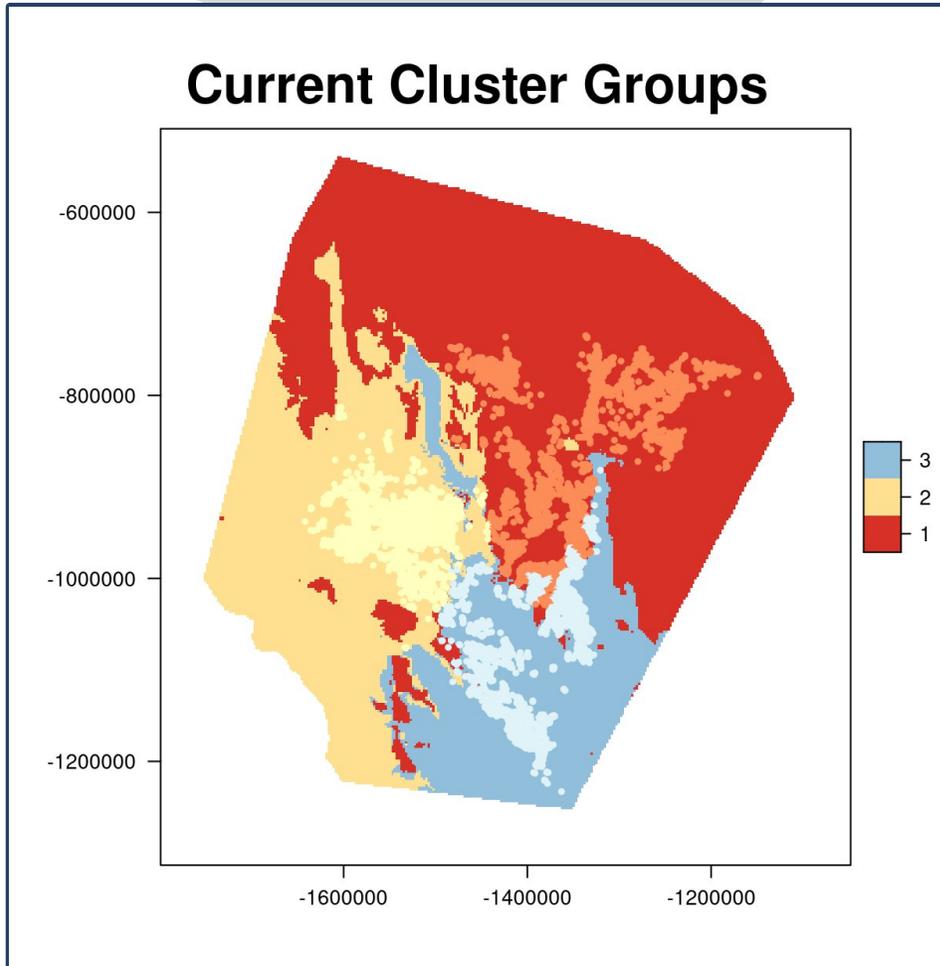


Local Models



Weighted Model

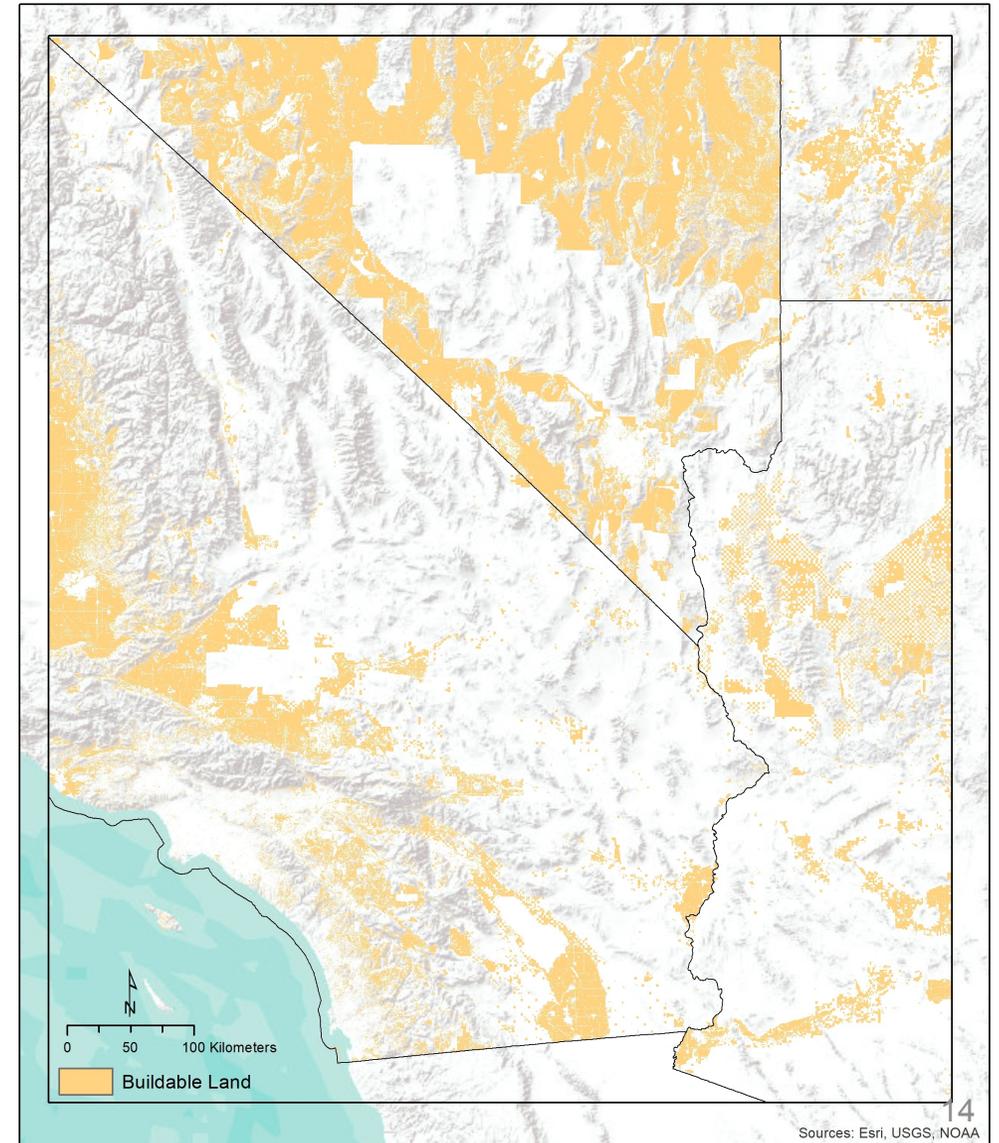
Phase I



Phase I

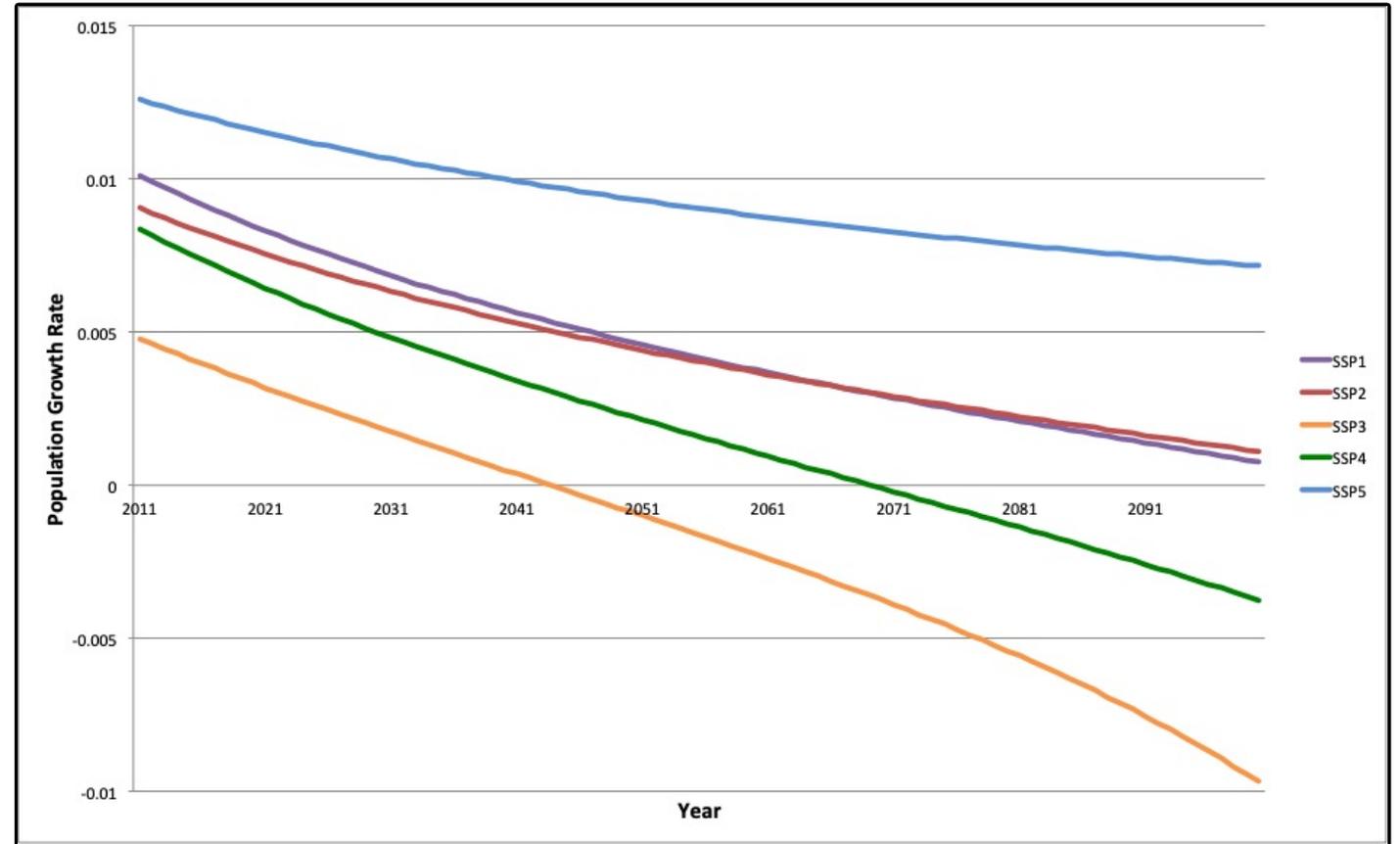
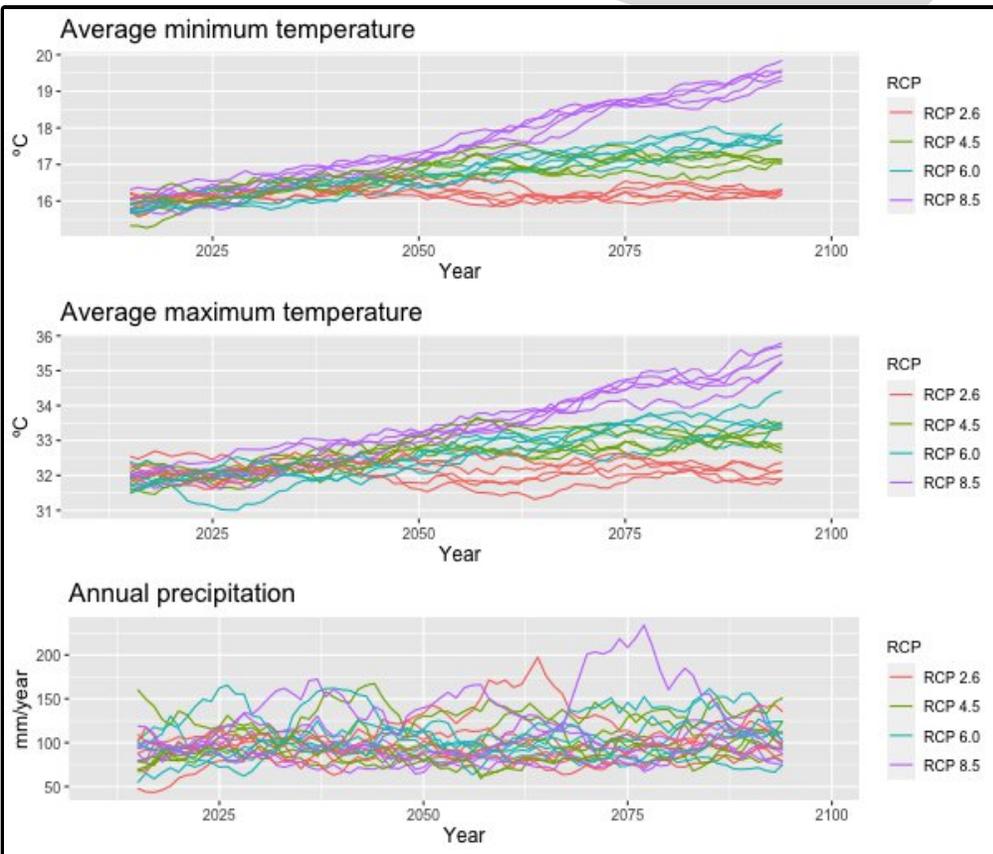
Buildable Lands

- Slope less than 20%
- Non-urban lands
- Not open water or a wetland
- Private land or land owned by the U.S. Bureau of Land Management in the State of Nevada.
- Land not designated with a conservation or preservation category



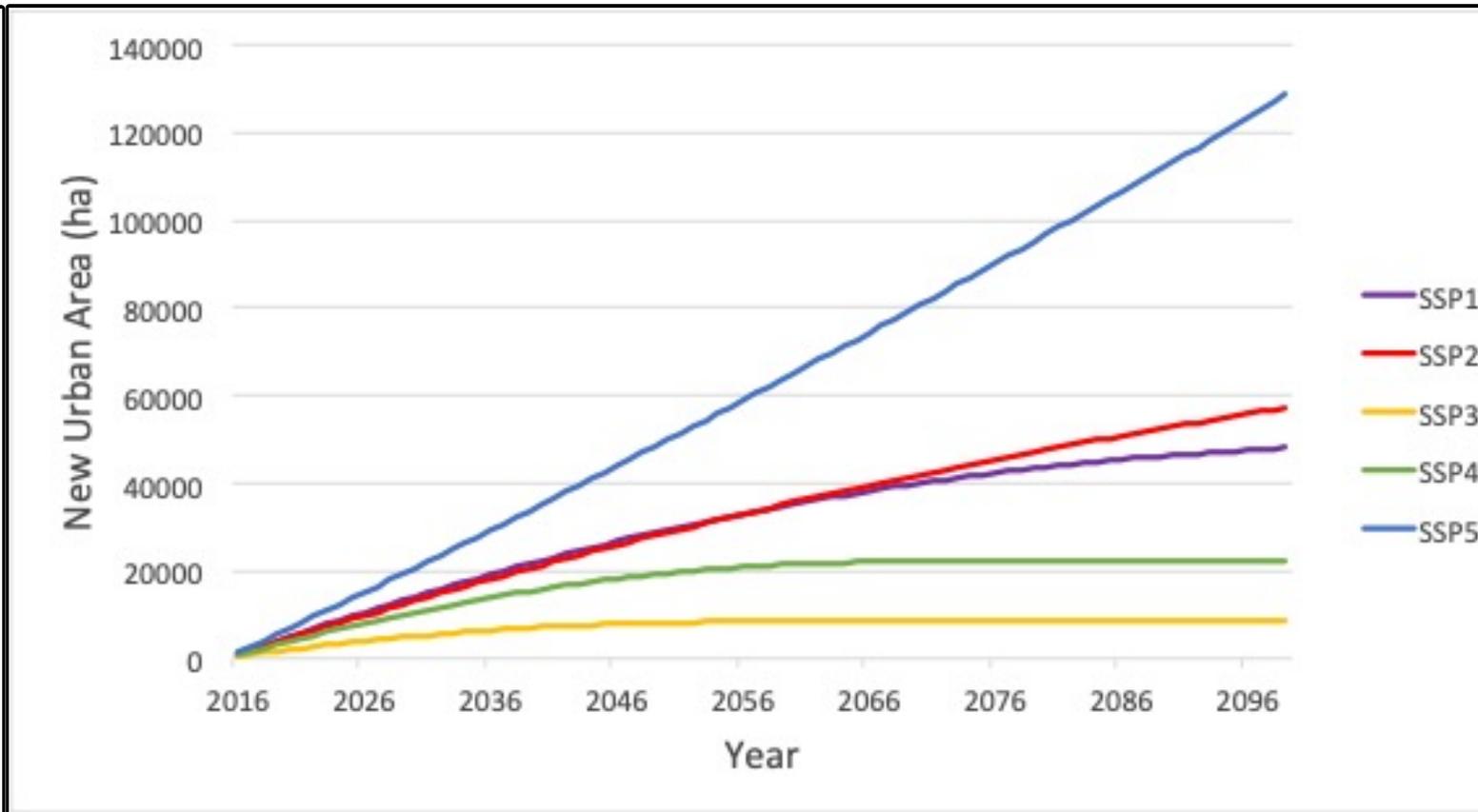
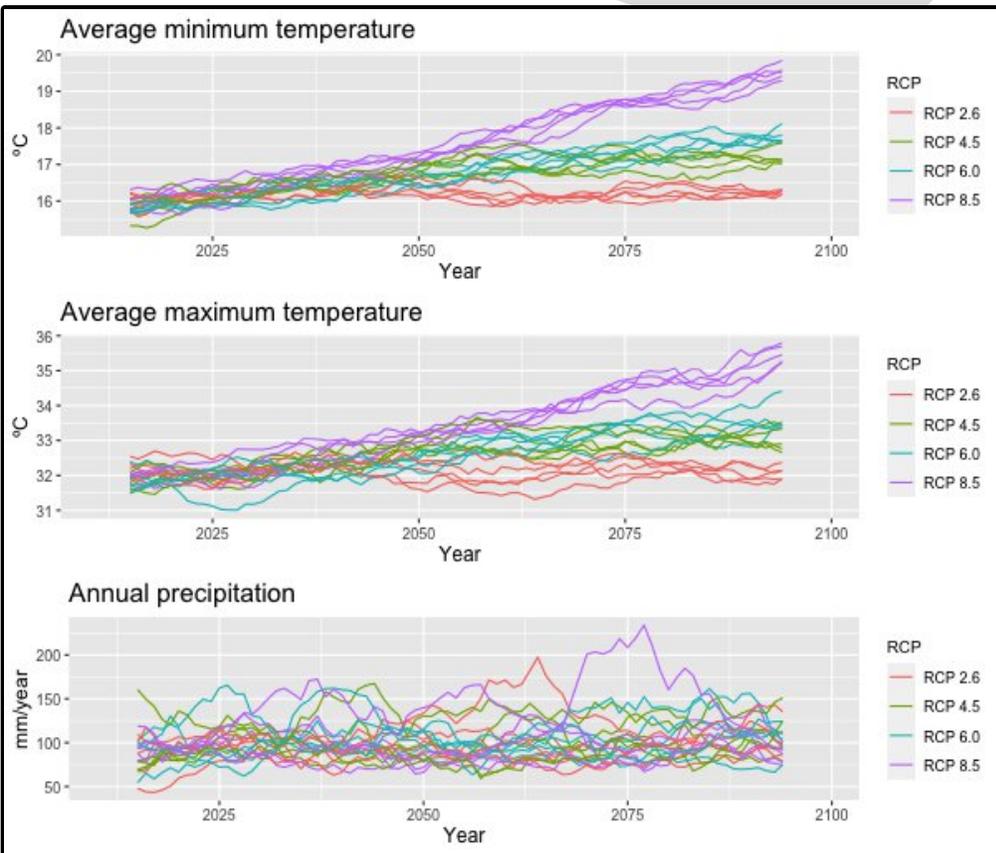
Future Climate Change and Population Growth Scenarios (human)

Phase I



Future Climate Change and Population Growth Scenarios (human)

Phase I

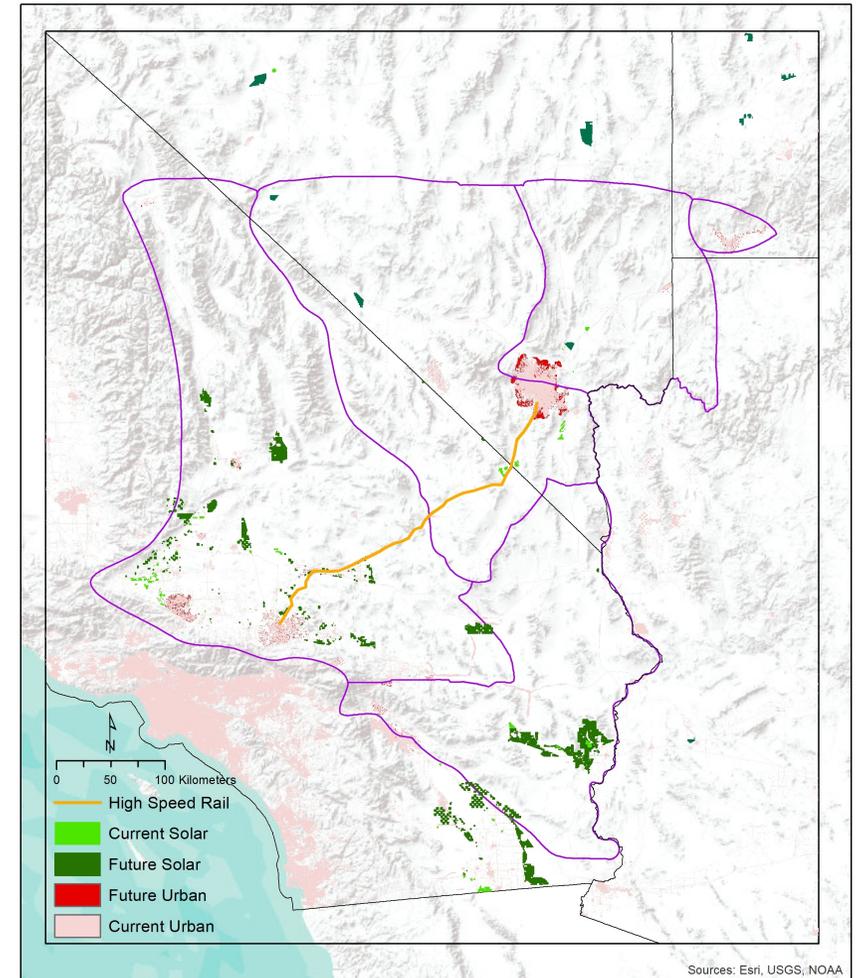


Phase I

Future Population Growth Scenarios

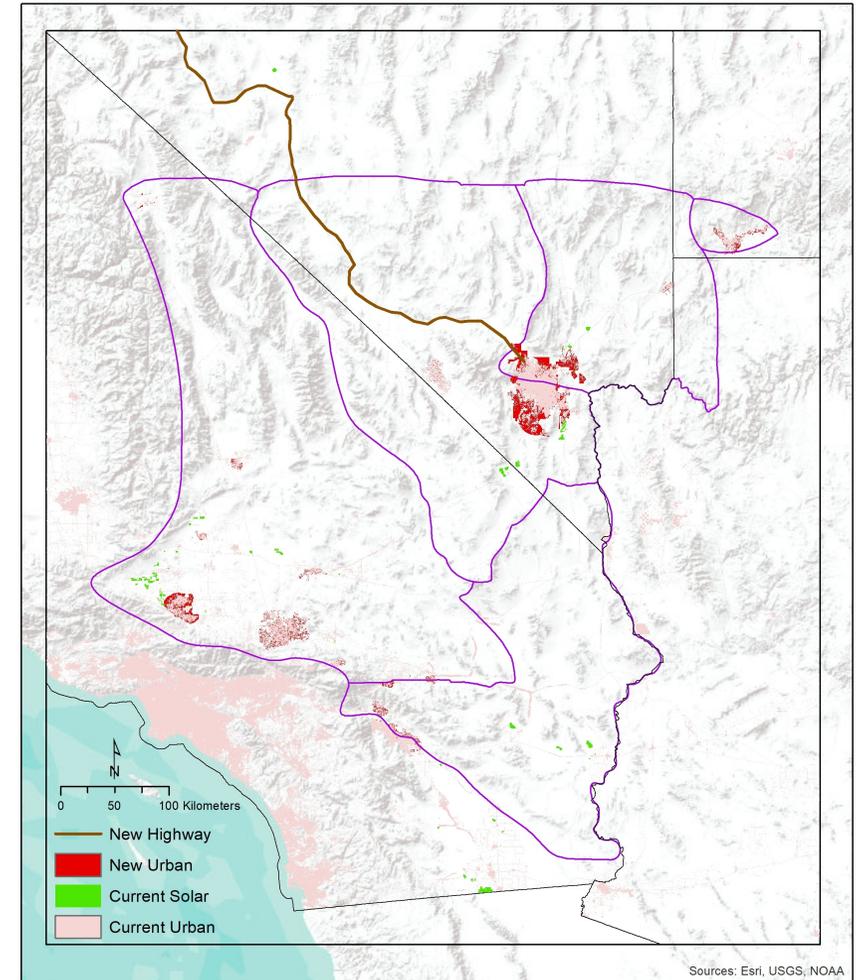
SSP1 Future

- Seeking to provide a reduction in greenhouse gas emissions from human sources, the western states initiate a campaign to **encourage renewable energy generation** at the consumer scale. New housing developments are required to include solar energy generation at the household level where each new house or large residential complex incorporates solar technology on the rooftop and excess energy production is sold back to large energy companies. Energy companies support the endeavor and residential energy generation is sold to commercial, industrial and historic residential sectors. New residential buildings and houses incorporate low energy consumption appliances and technology along with battery storage facilities on site. Emissions rates follow those projected under **RCP 2.6**.



Phase I

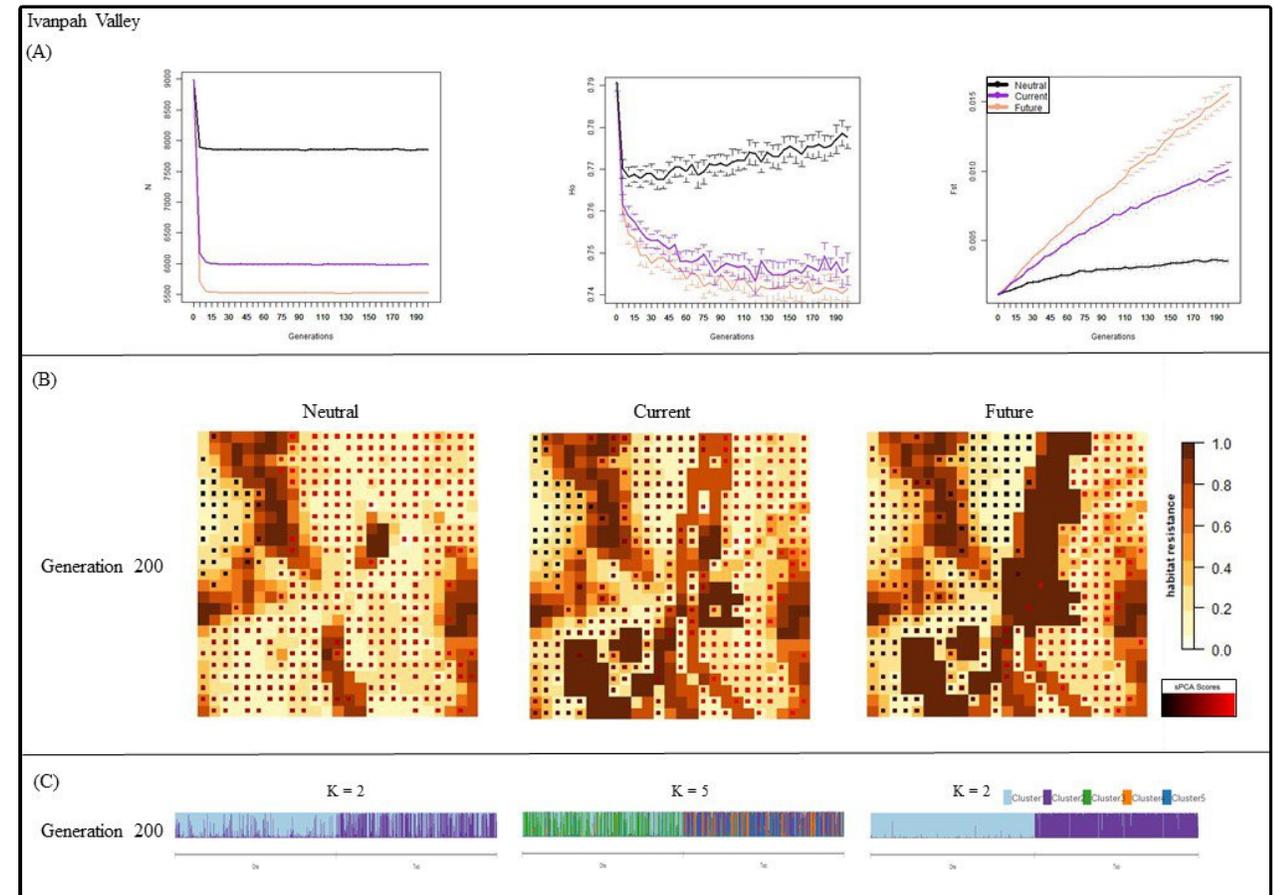
- **SSP5 Future**
- With a doubling of food demand worldwide comes a commitment to relax energy consumption restrictions. High levels of fossil fuels are consumed and energy production avoids renewable sources. In all, energy demand triples. Emissions rates follow **RCP 8.5**.
- **Regional population increases at a high rate.** Little effort is made to curb a population increase resulting in the regional population increases from 3.1 million to 7.1 million people. **A road extension to northern Nevada occurs.**



Desert Tortoise Landscape Corridor Functionality

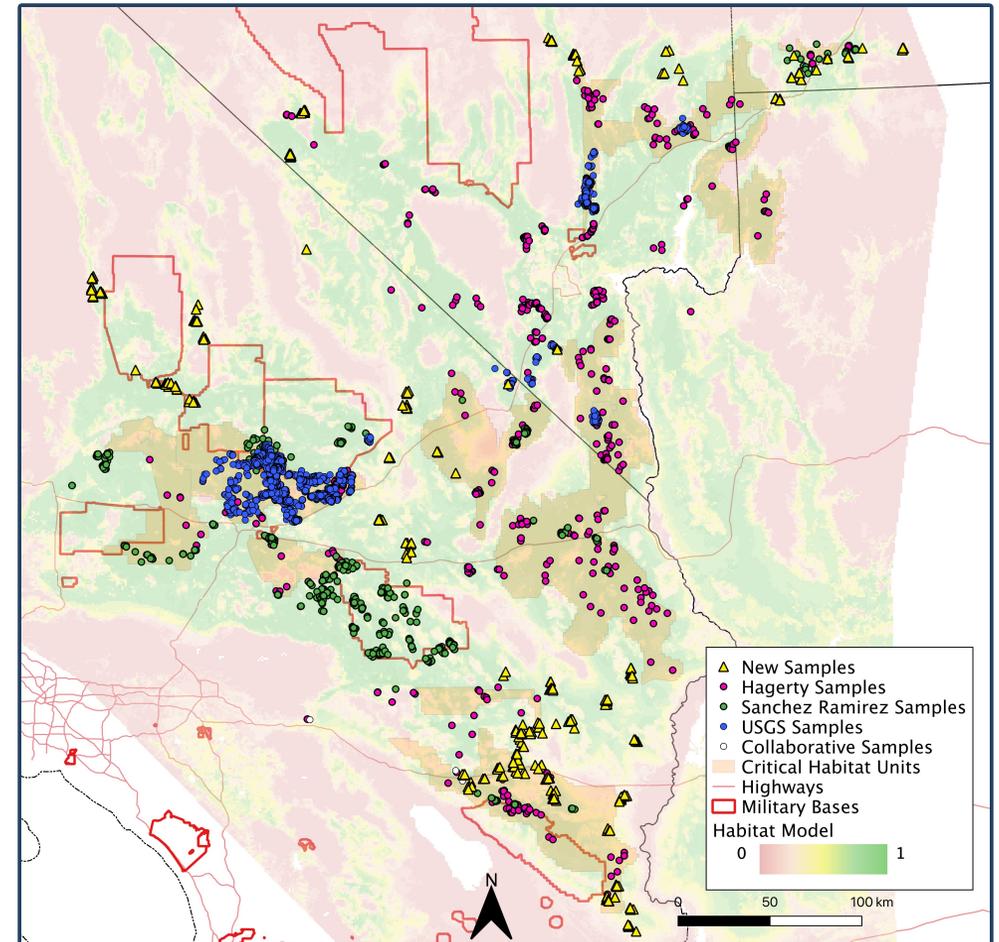
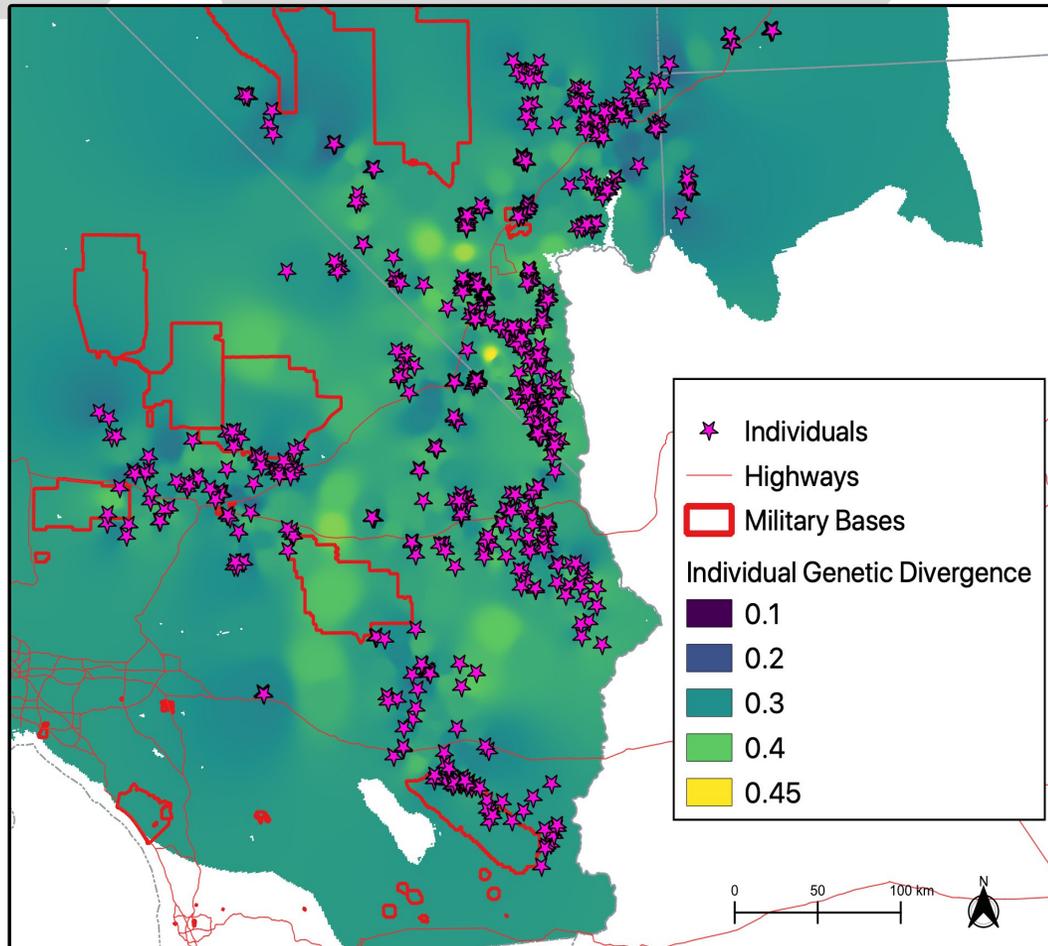
Phase II

- This phase will explore the current barriers to connectivity with respect to current and future land use status and underlying habitat suitability
- These will be based on the final outputs from Phase I once complete



Desert Tortoise Genetic Connectivity and Diversity

Phase III

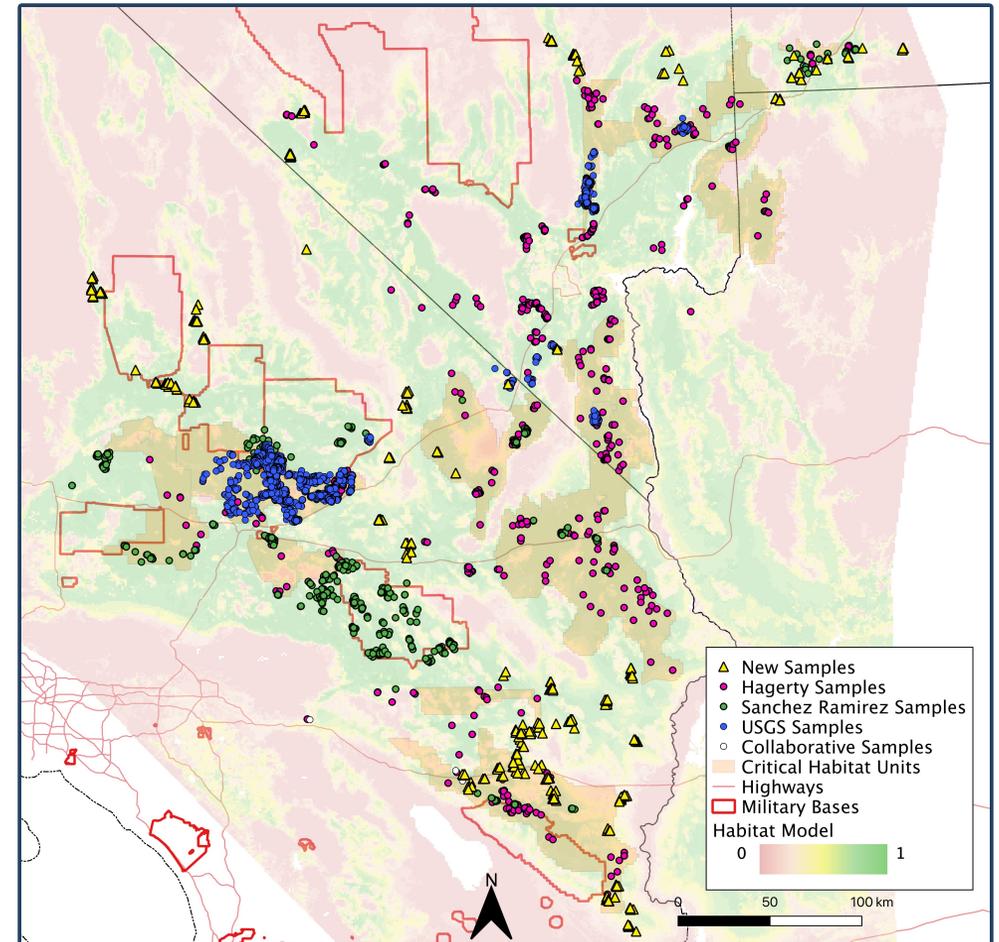


Progress To Date

Phase III

We will use single nucleotide polymorphisms (SNP's)

- Samples - Currently have 951
- Currently performing DNA extractions
- Final Samples to be gathered spring 2021
- Will analyze (N_e , H_o , F_{ST} , and F_{IS})
- Connectivity will be assessed using asymmetric rates of dispersal, kinship, and spatial autocorrelation in genetic distances

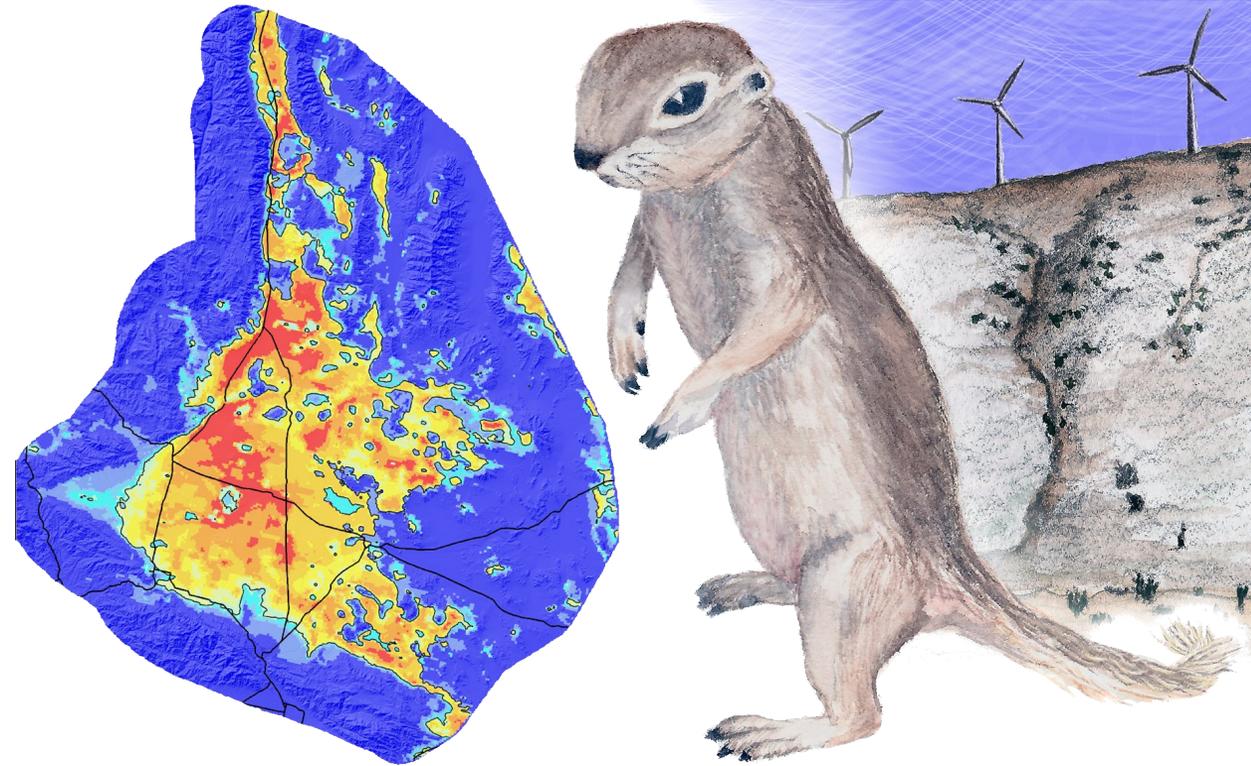


Umbrella Species Assessment

Phase IV

The desert tortoise has been called an umbrella species for other wide-spread Mojave Desert state and federally protected and important species.

1. Identify wide-spread, Mojave Desert species important to individual and collective [military] installations,
2. assess their inclusion in our analyses based upon existing distribution and habitat knowledge, and
3. evaluate their level of protection under a desert tortoise "umbrella"



Umbrella Species Assessment

Phase IV

Model Category	Type	Mammal	Bird	Herp	Plant	Invert	All taxa	Type Sum
USGS models	Mojave	5	0	9	1	1	15	
DRECP/Clark County	Mojave	3	5	0	2	0	10	
Clark County endemic	Mojave	0	0	1	11	0	12	
DRECP endemic	Mojave	4	1	1	15	0	21	59
Clark County only	regional	5	5	3	9	1	23	
DRECP only	regional	2	10	0	12	0	24	47

Phase V

- Military installations will contain populations, habitat, and corridors that are important for the continued and future persistence of the desert tortoise, although the role of individual installations will vary.
- An assessment of each installation will identify existing and lost DT habitat, corridor and gene flow connections within and among surrounding and nearby landscapes across present and future scenarios.
- Identify strategic partners identified by space and topic.
- Produce a matrix of opportunities and constraints to meeting conservation objectives between and among entities in relation to the desert tortoise and species that fall under its umbrella

Objectives

- Evaluate how land use and climate change will impact Mojave Desert Tortoise gene flow and corridor functionality within the context of multi-species interactions and landscape connectivity

