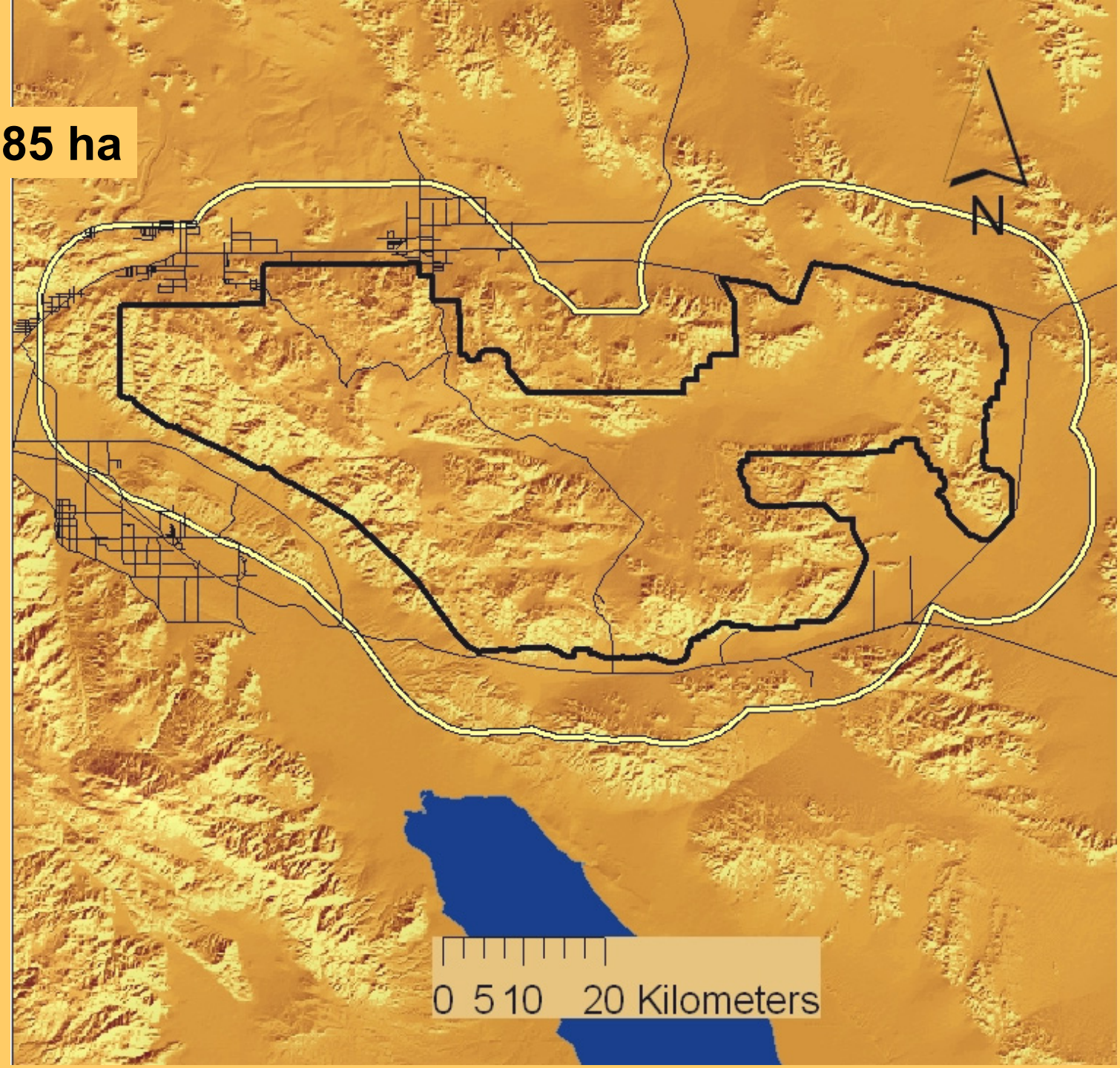
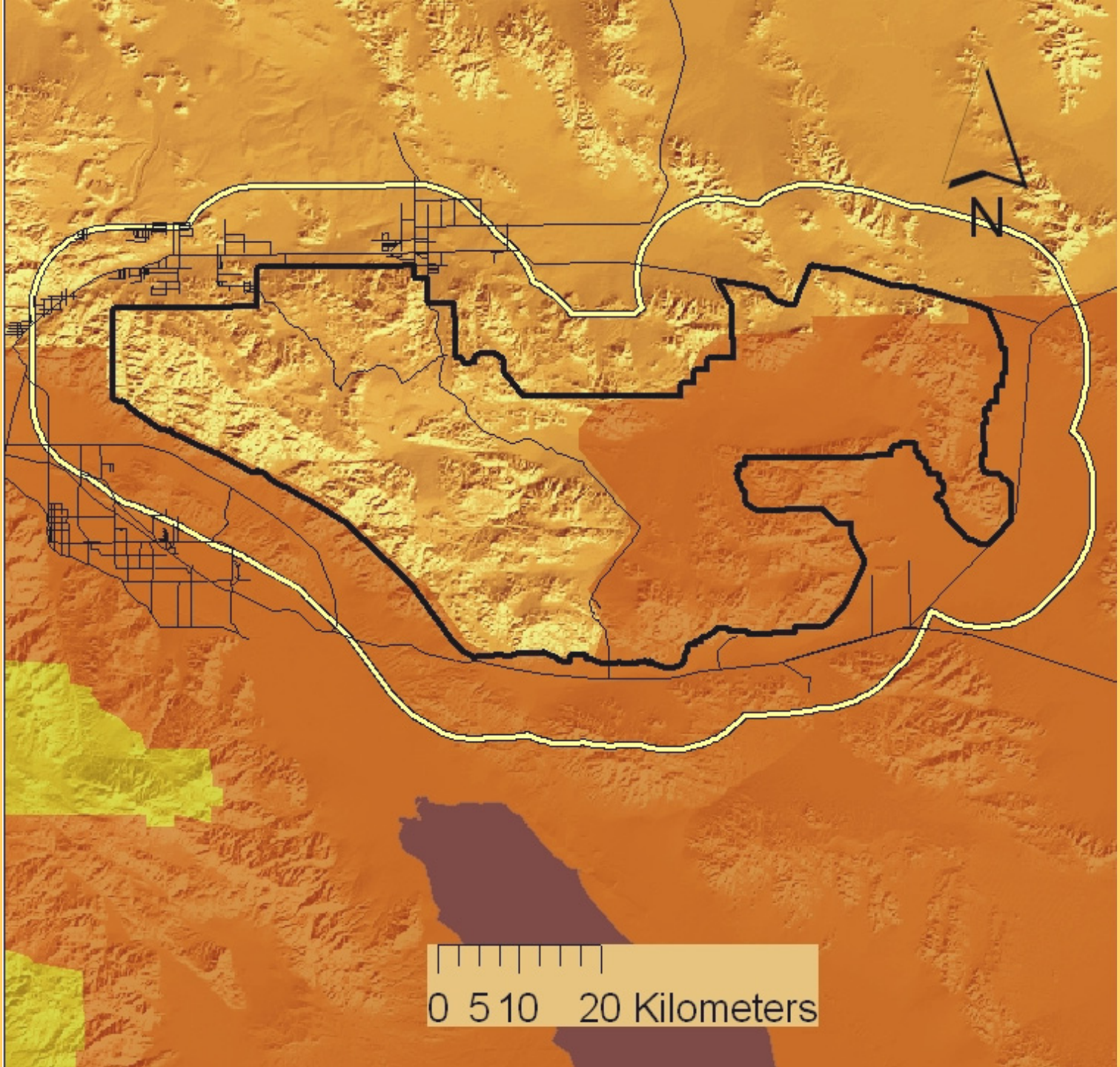
Assessing species sensitivity to climate change in a projected "hot spot"

Cameron Barrows, Ph.D.
University of California at Riverside's
Center for Conservation Biology

679,585 ha

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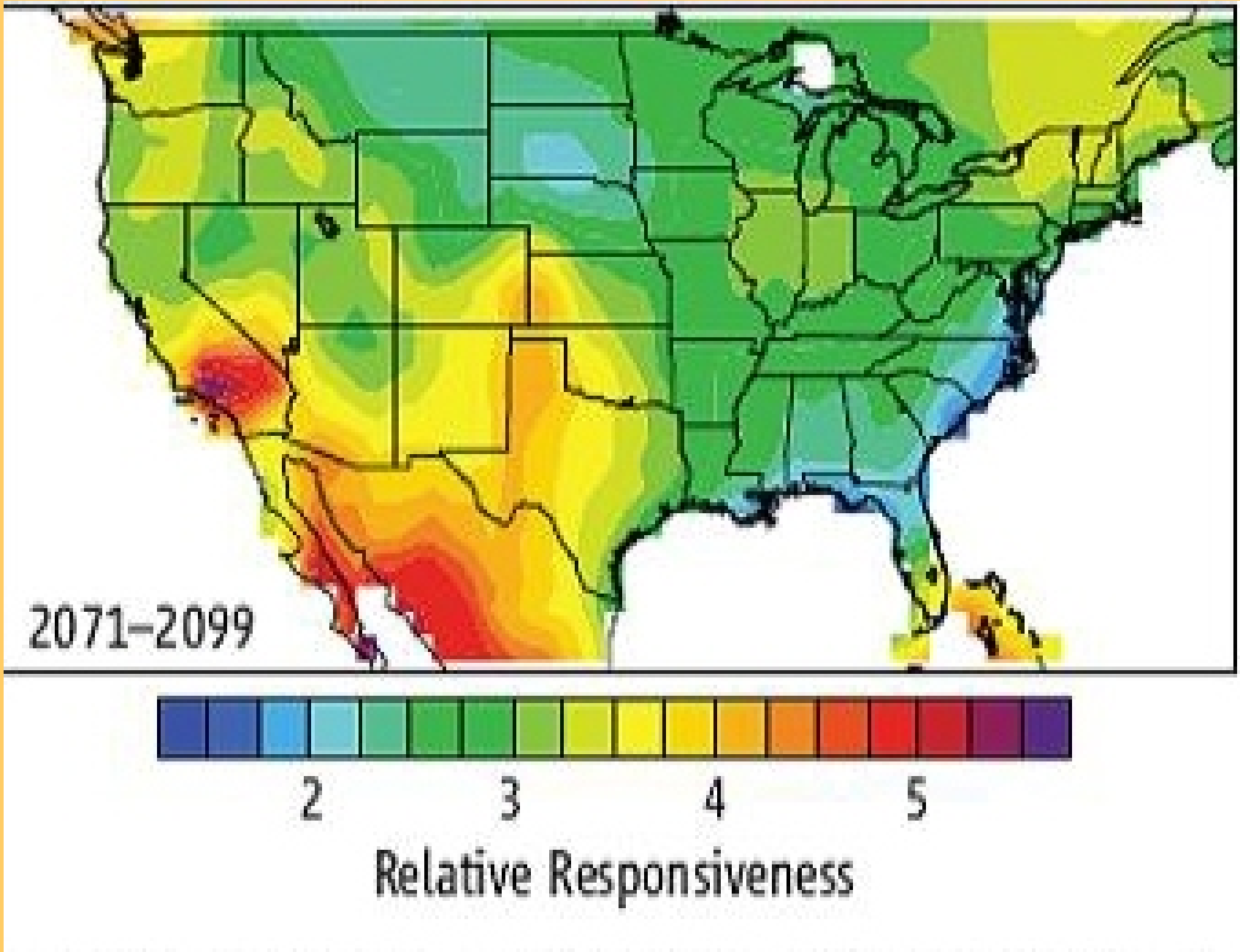
Kerr, RA (2008) Climate change hot spots mapped across the United States. Science 321: 909.



Reptile Species Included in the Climate change-Sensitivity Analyses

Species	Total
Desert Tortoise	**215**
Desert Horned Lizard	**40**
Blainville's Horned lizard	23
Desert Spiny Lizard	**47**
Western Fence Lizard	19
Chuckwalla	**44**
Mojave fringe-toed lizard	24
Sidewinder	34
Rosy Boa	32
Gopher Snake	**41**
Coachwhip	**52**

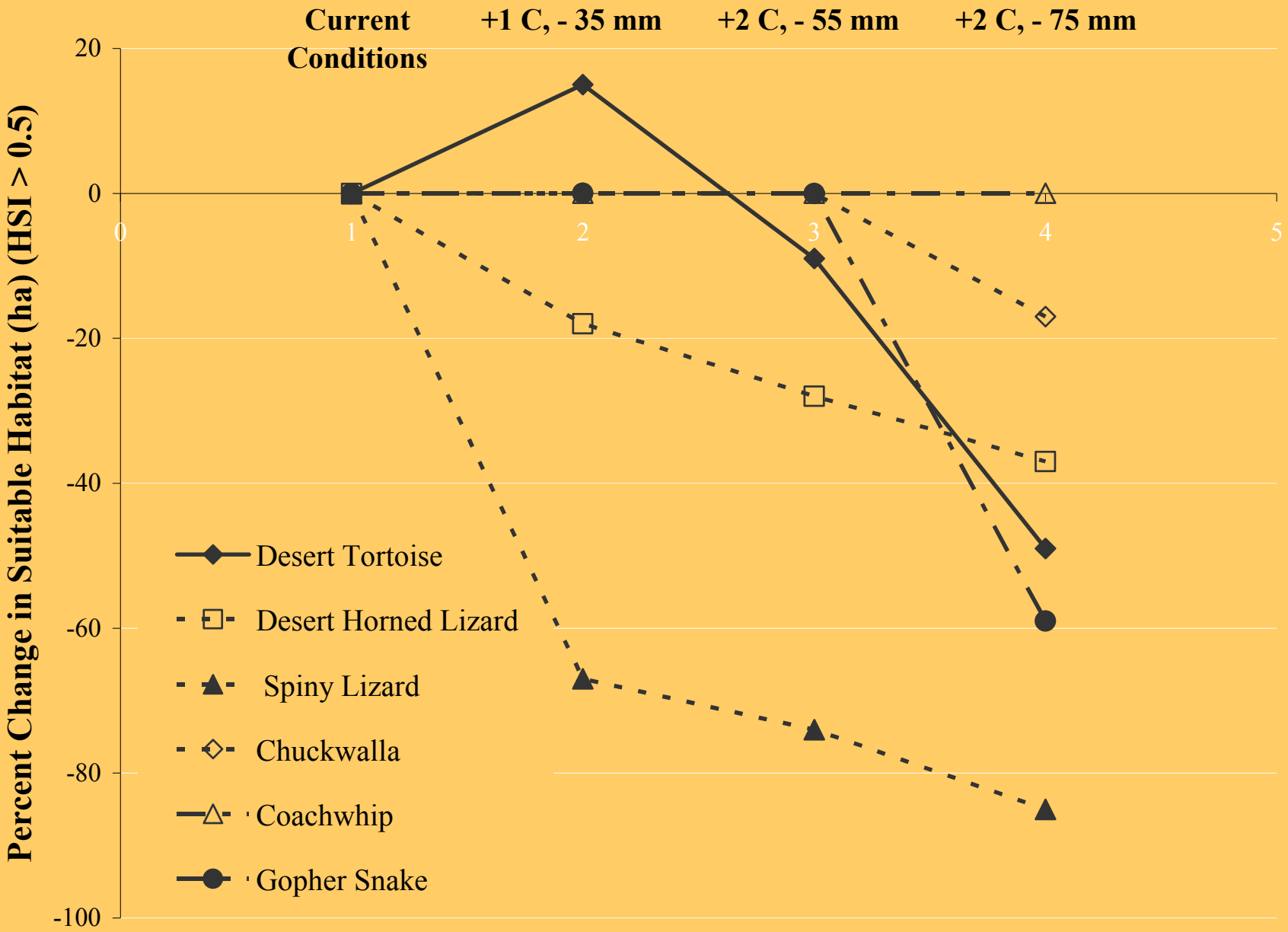
Partitioned Mahalanobis D^2 Niche Models

- Uses “presence” data, allowing access of a wide variety of data sources
- Model output includes a principle components-derived set of partitions equal to the number of independent variables used in the model, that when added together constitute the “full model”.
- Model output includes HSI’s (scaled from 0-1) for each map cell which can then be mapped showing habitat suitability across the region of interest.
- Once the best “current climate” niche model is created, the underlying temperature-precipitation parameters can be adjusted to demonstrate the availability of suitable species-specific climate envelopes under varying climatic conditions.

Rotenberry, JT, Preston, KL, Knick, ST (2006) GIS-based niche modeling for mapping species’ habitat. Ecology 87:1458-1464.

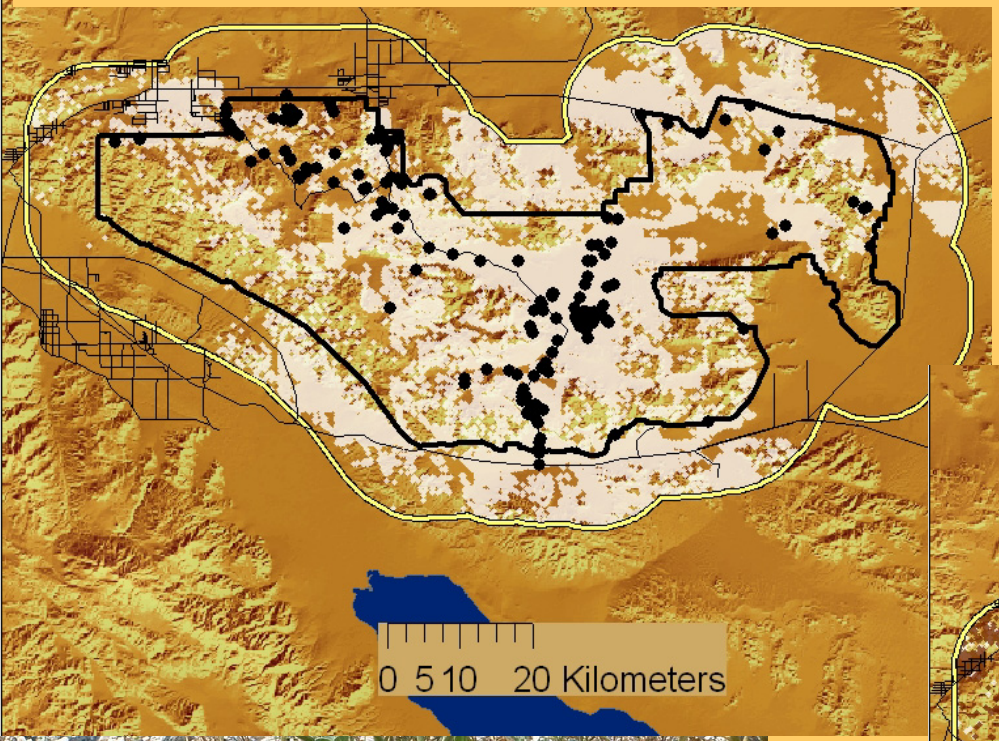
Model Variables

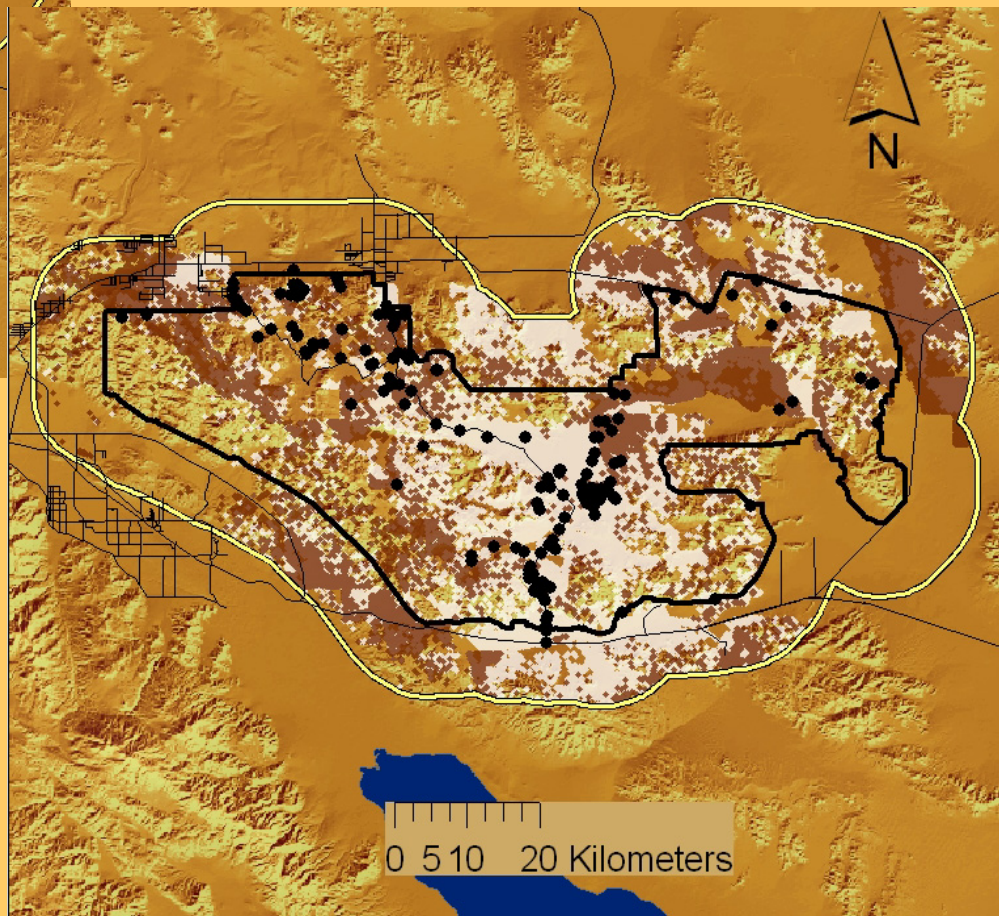
Independent Variable	Desert Tortoise	Desert Horned Lizard	Desert Spiny Lizard	Chuckwalla	Coachwhip	Gopher Snake
Rugged 3XD	X		X	X	X	X
Rugged 20X	X	X	X	X	X	X
Slope	X	X	X	X		
North Slope Aspect	X					X
East Slope Aspect	X					
Minimum Jan Temperature	X				X	
Maximum July Temperature	X	X	X	X	X	X
Mean Precipitation	X	X	X	X	X	X

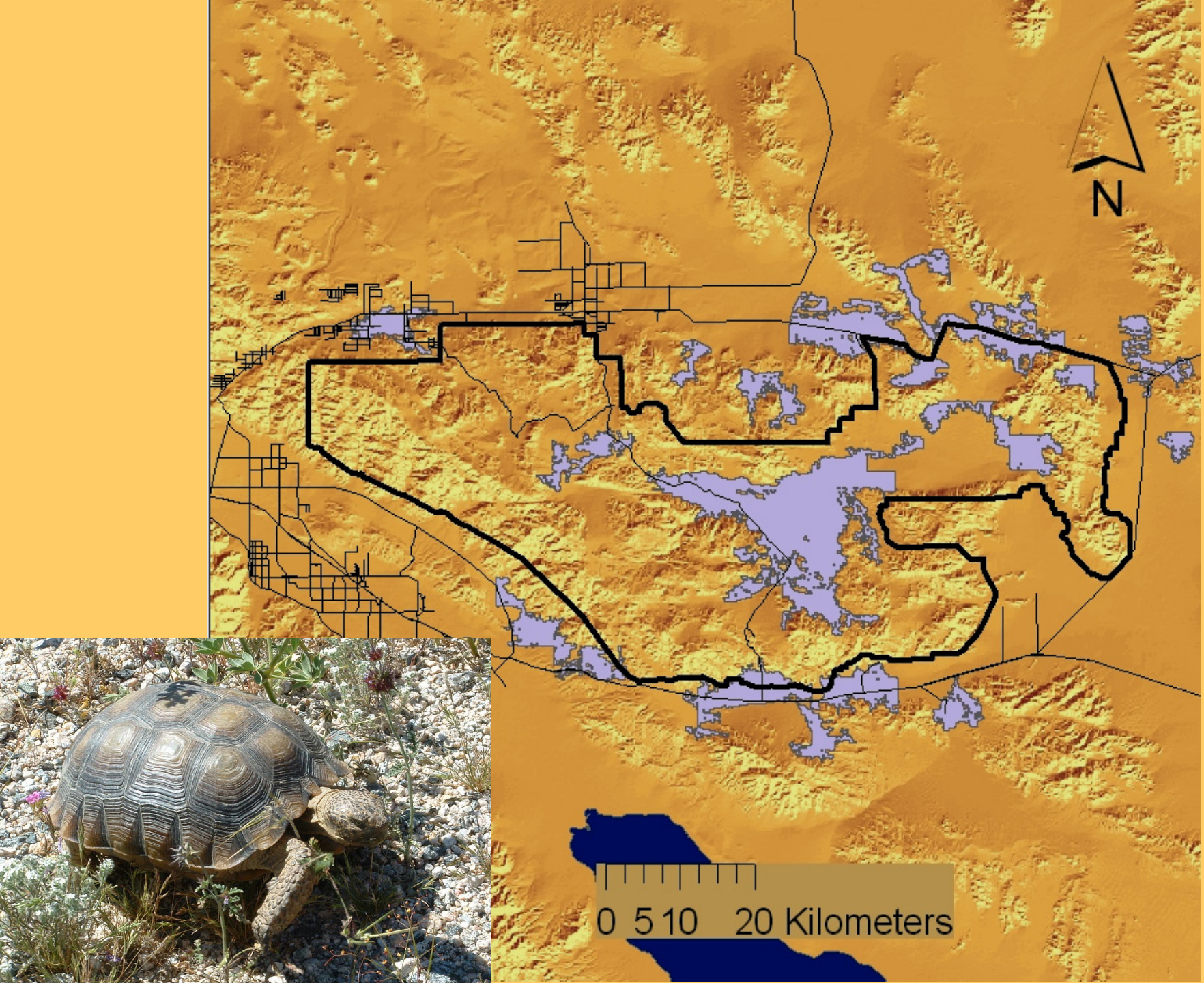

Current Conditions
+1 C, - 35 mm
+2 C, - 55 mm
+2 C, - 75 mm
Percent Change in Suitable Habitat (ha) (HSI > 0.5)
20
0
-20
-40
-60
-80
-100
0
1
2
3
4
5
Desert Tortoise
Desert Horned Lizard
Spiny Lizard
Chuckwalla
Coachwhip
Gopher Snake

With +2° C , - 75 mm in precipitation

172,200 ha 69,600 ha – a 60% decrease



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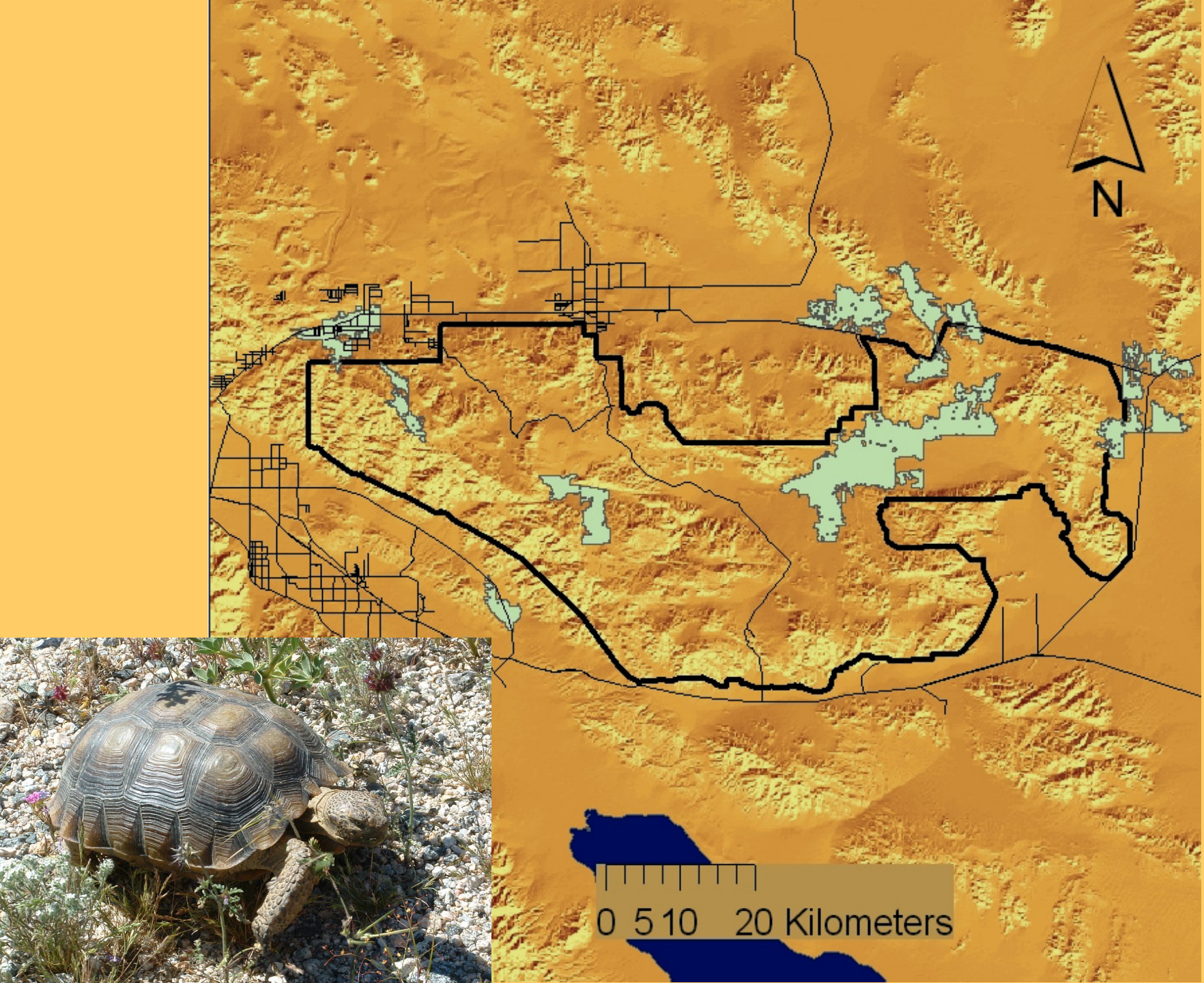
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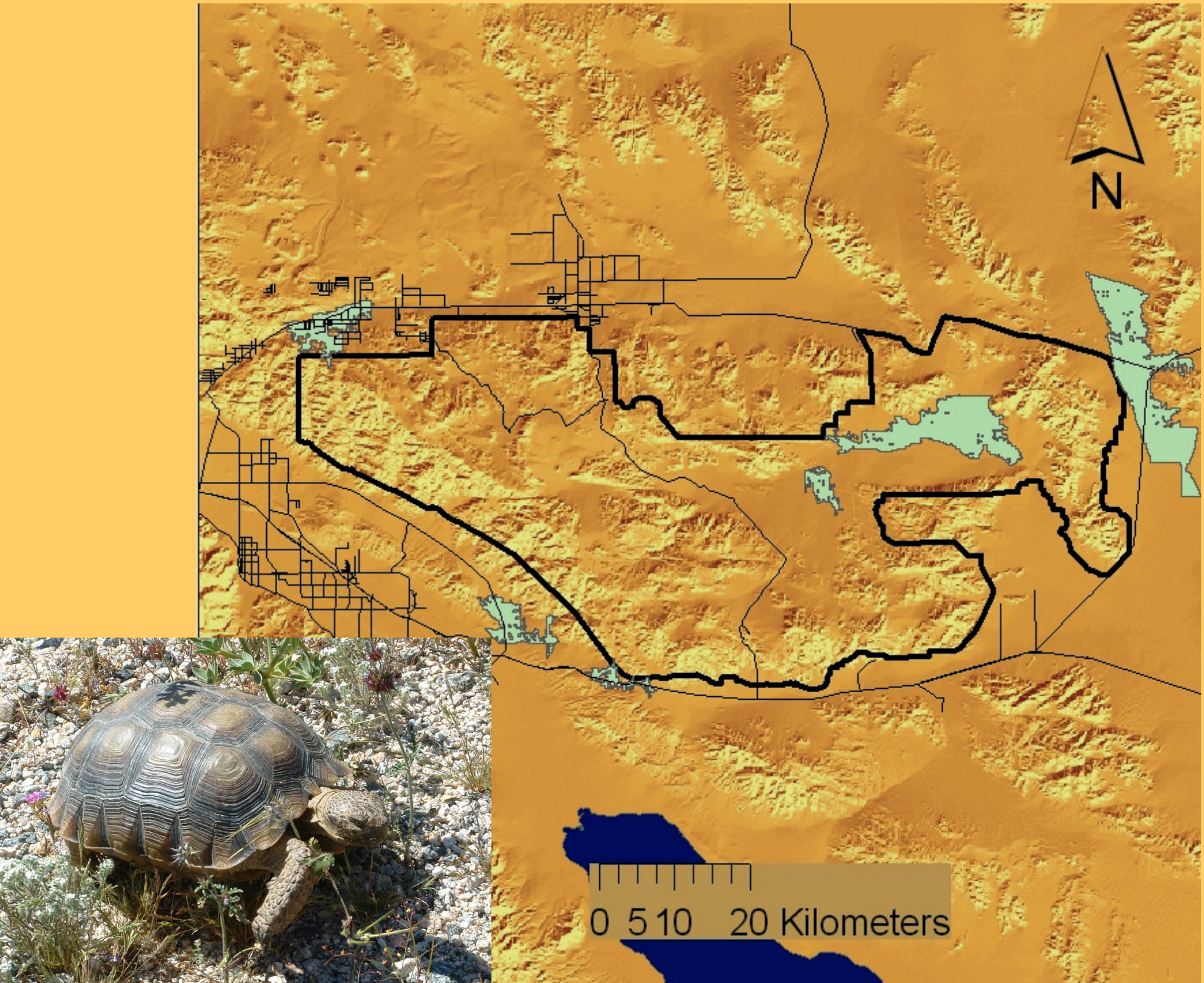
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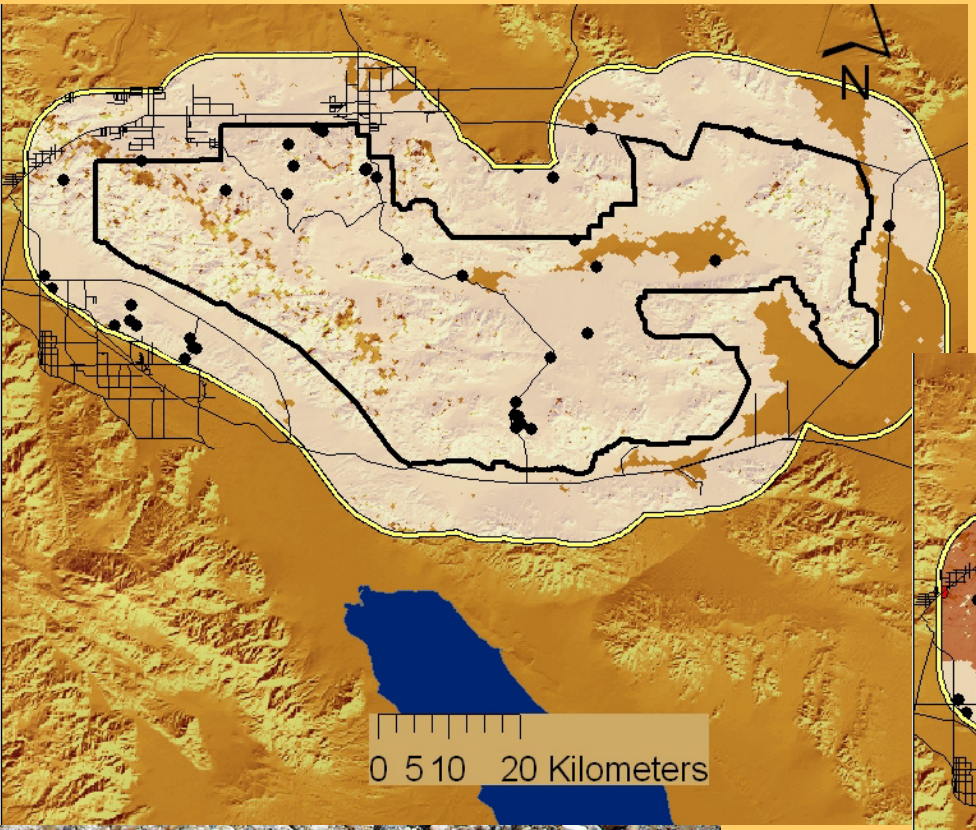
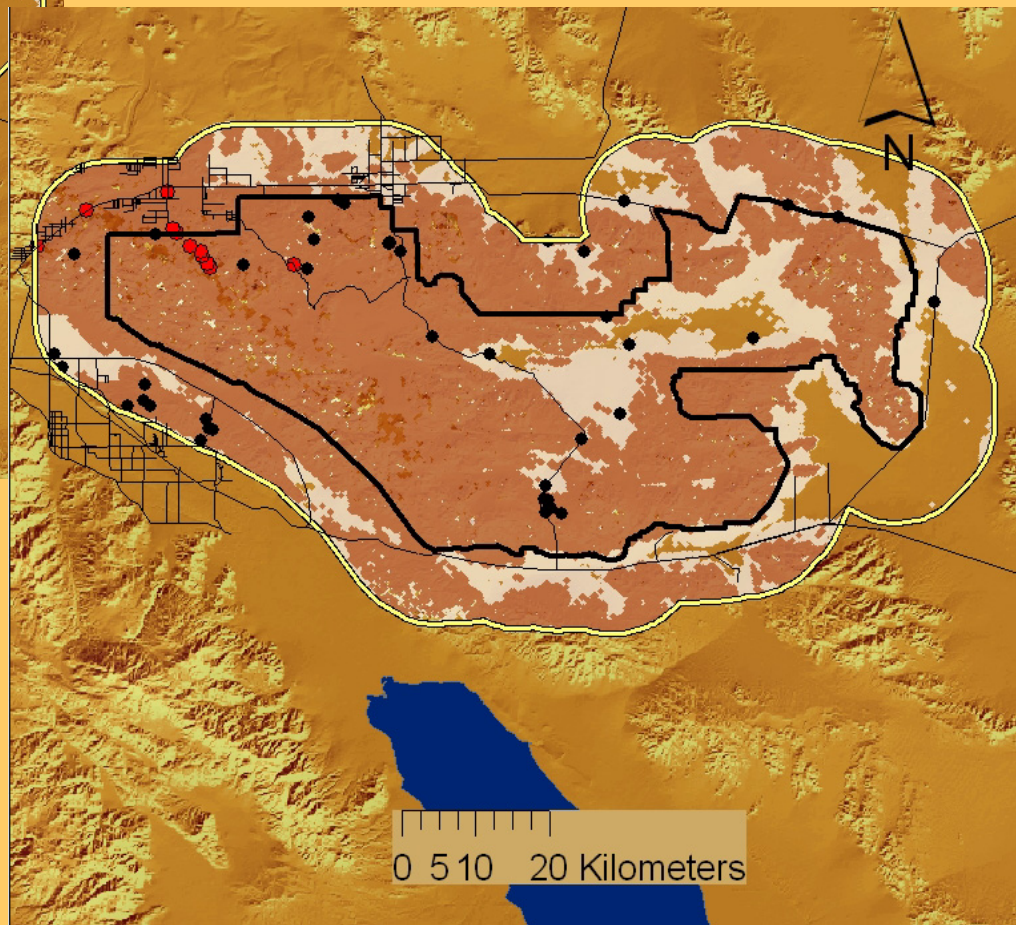
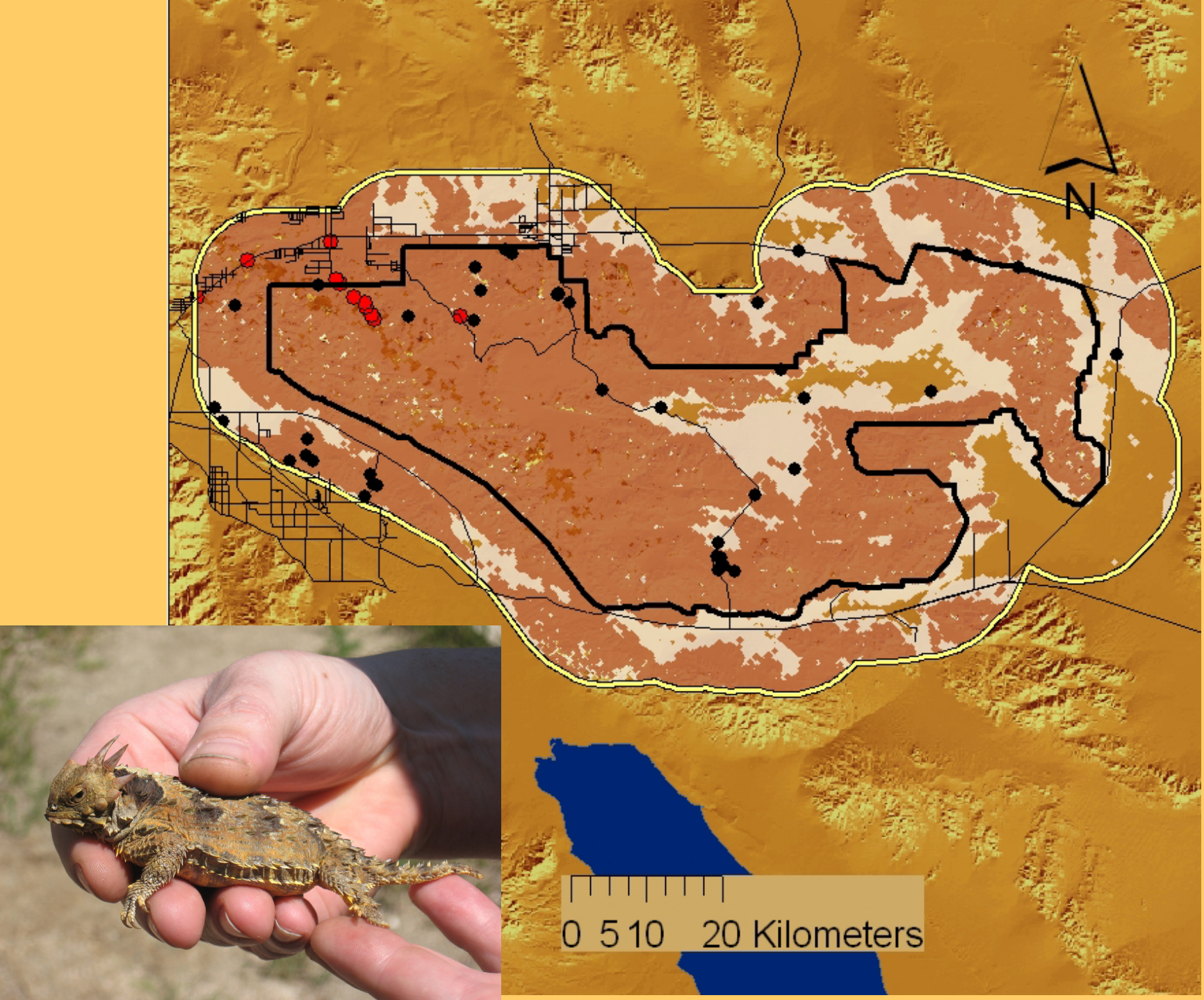
With +2° C , - 75 mm in precipitation

390,950 ha 246,150 ha – a 37% decrease



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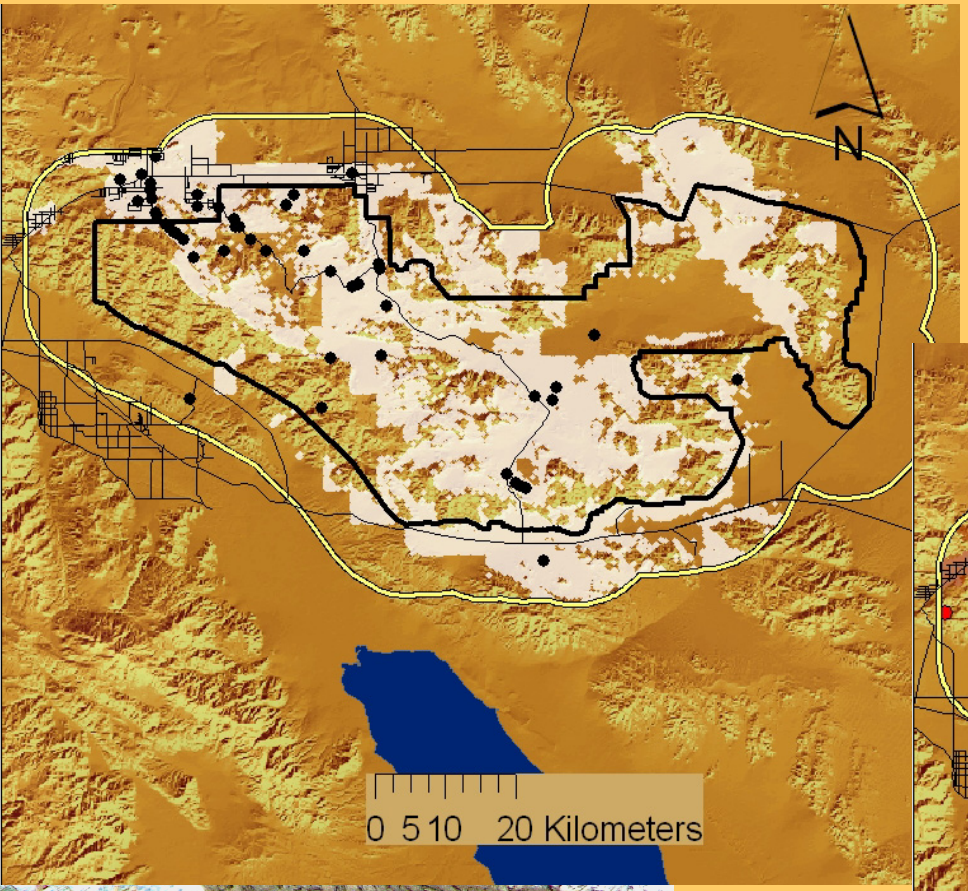
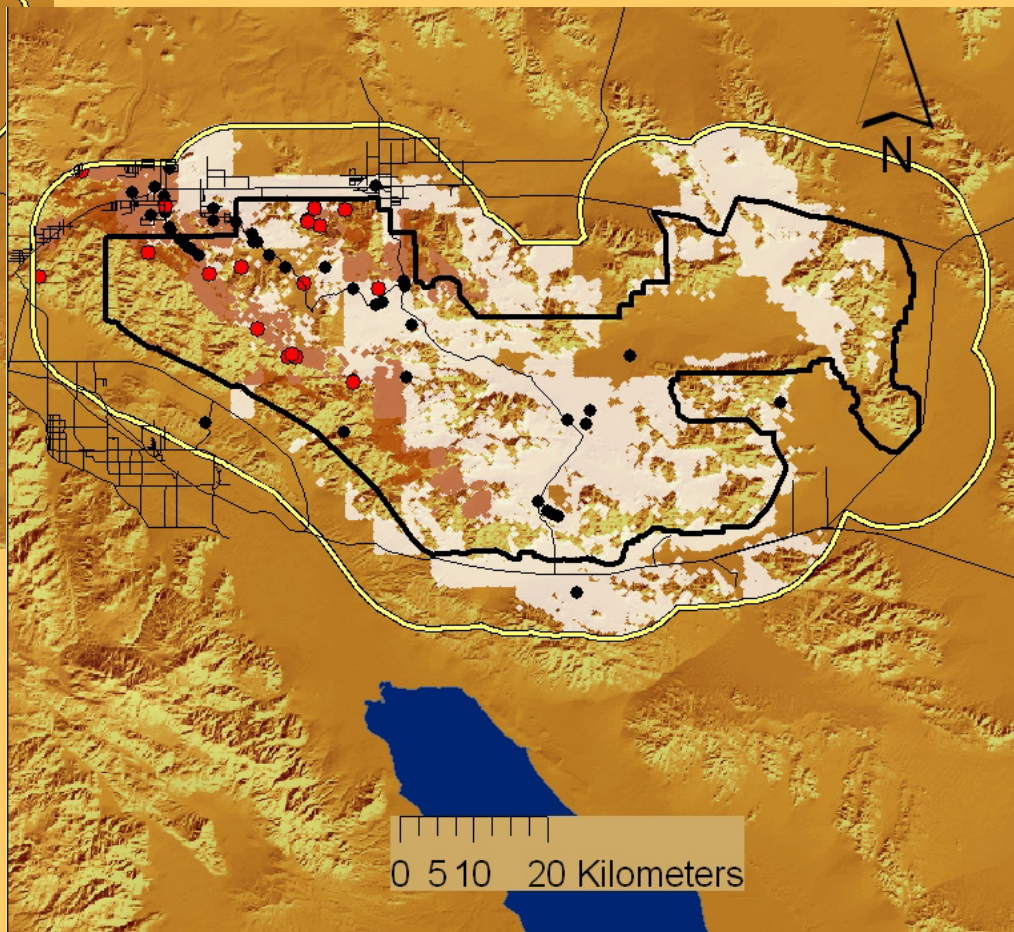
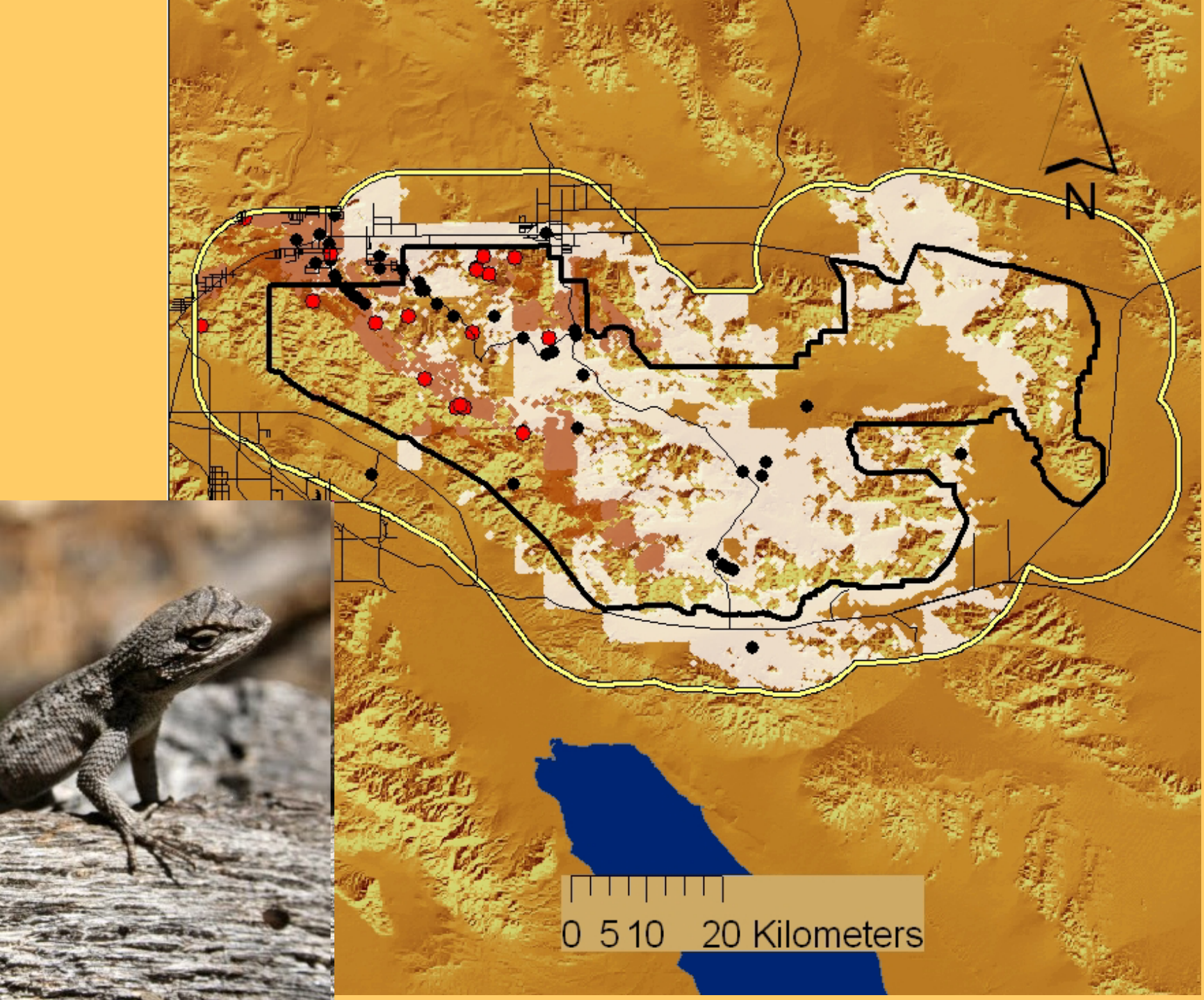
With +2° C , - 75 mm in precipitation

157,872 ha **23,028 ha – a 85% decrease**



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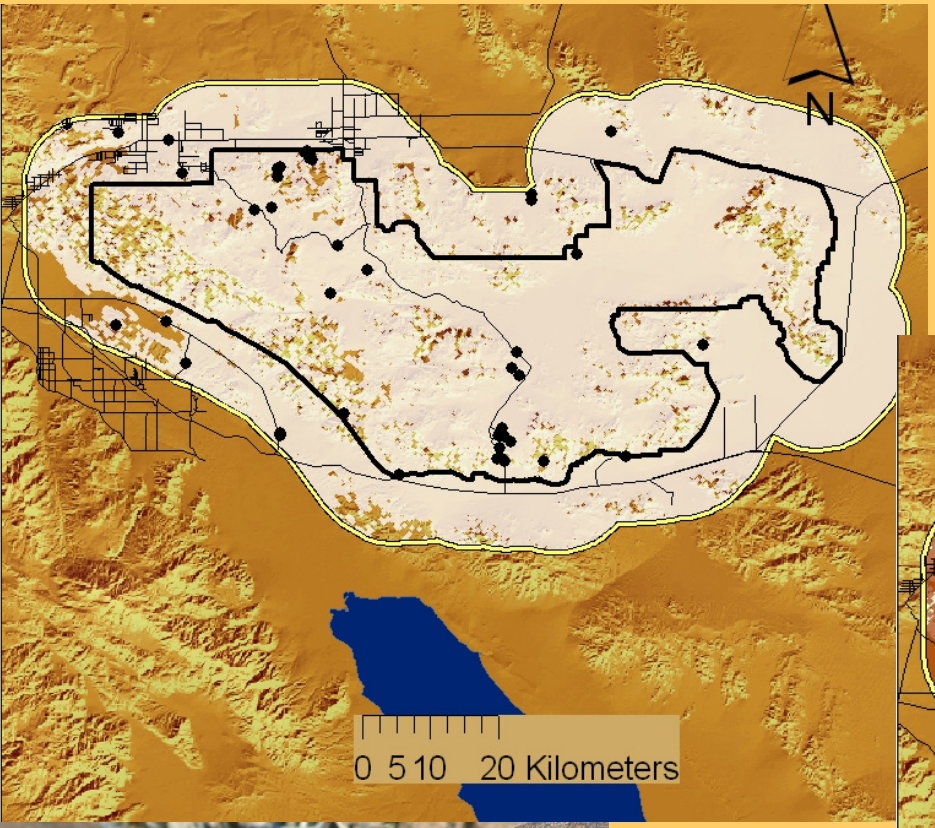
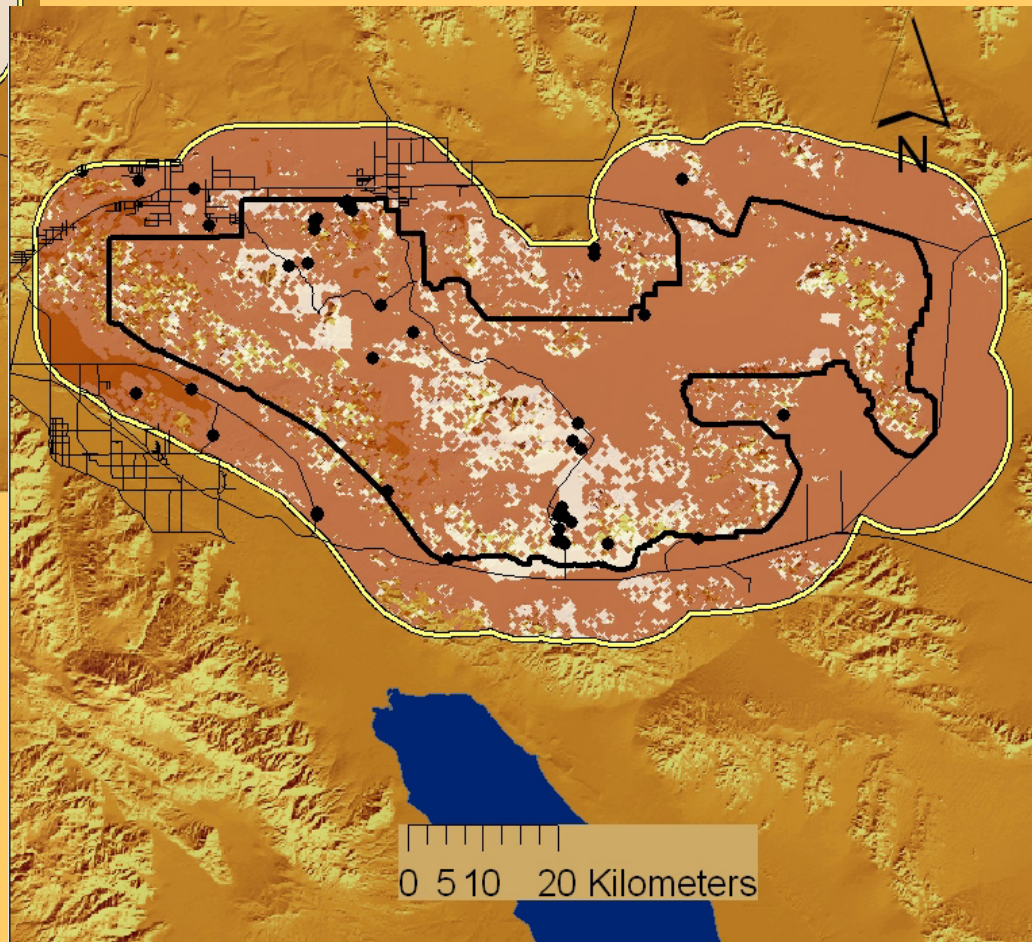
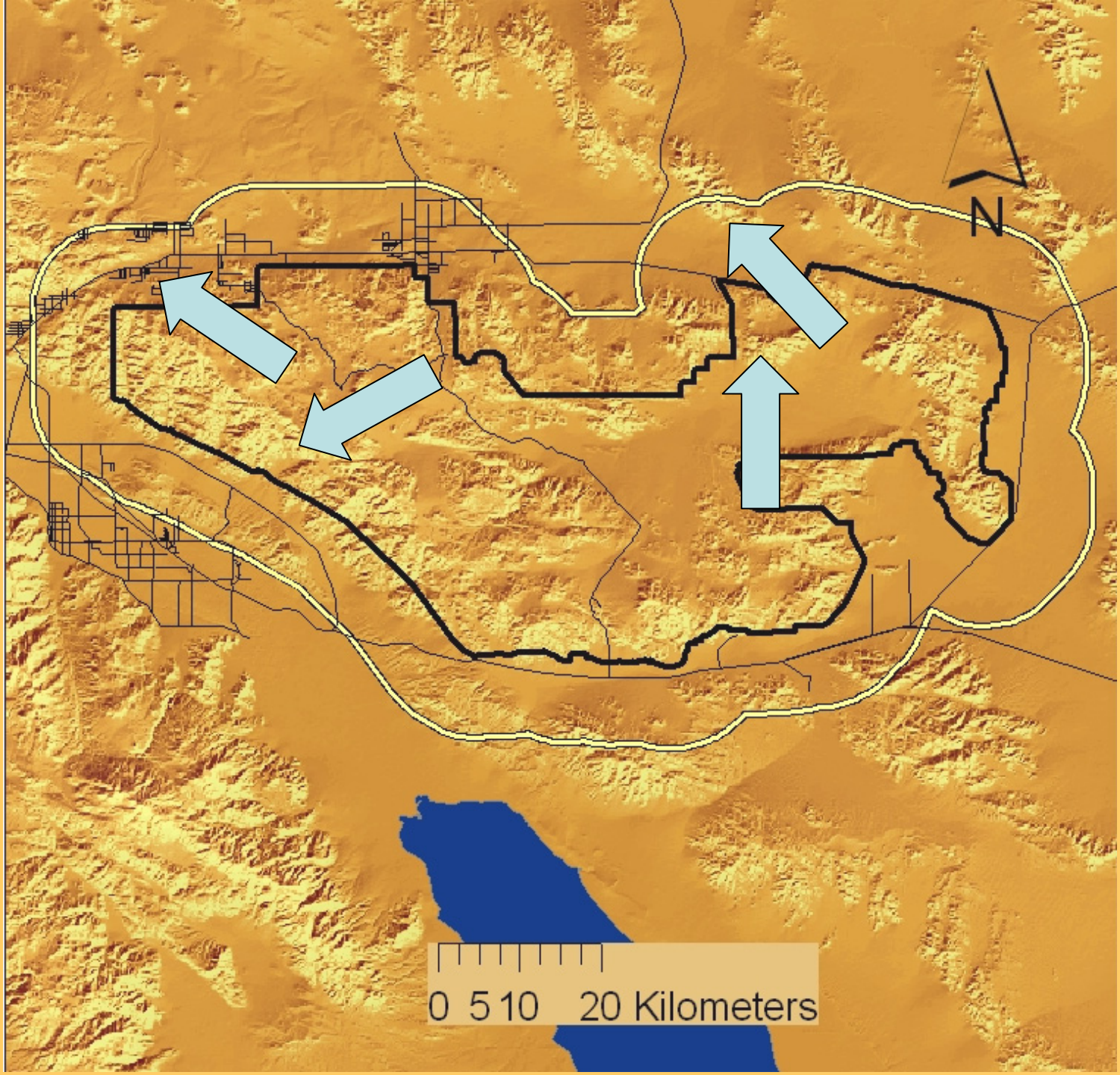
With +2° C , - 75 mm in precipitation

424,560 ha 351,100 ha – a 17% decrease



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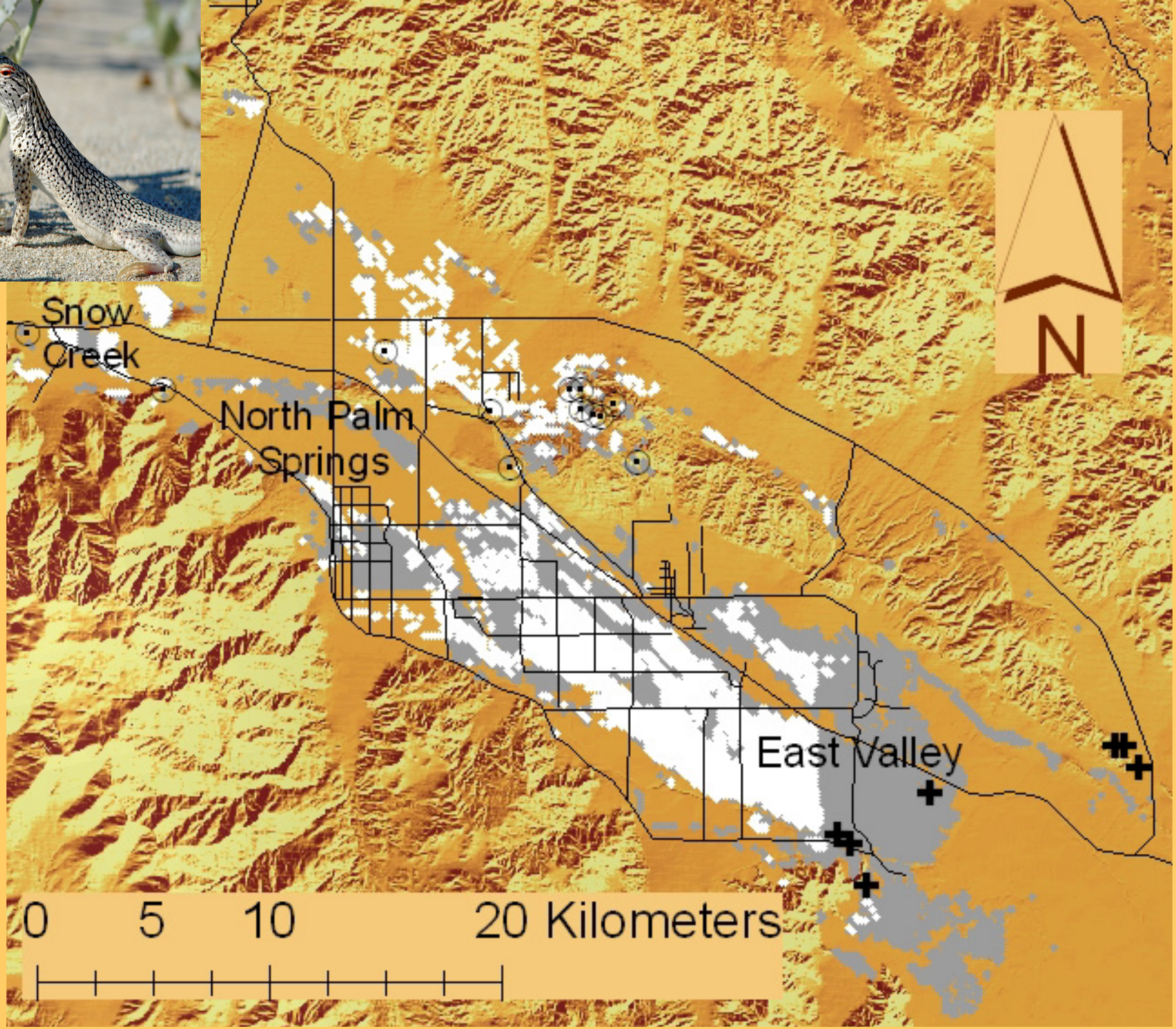
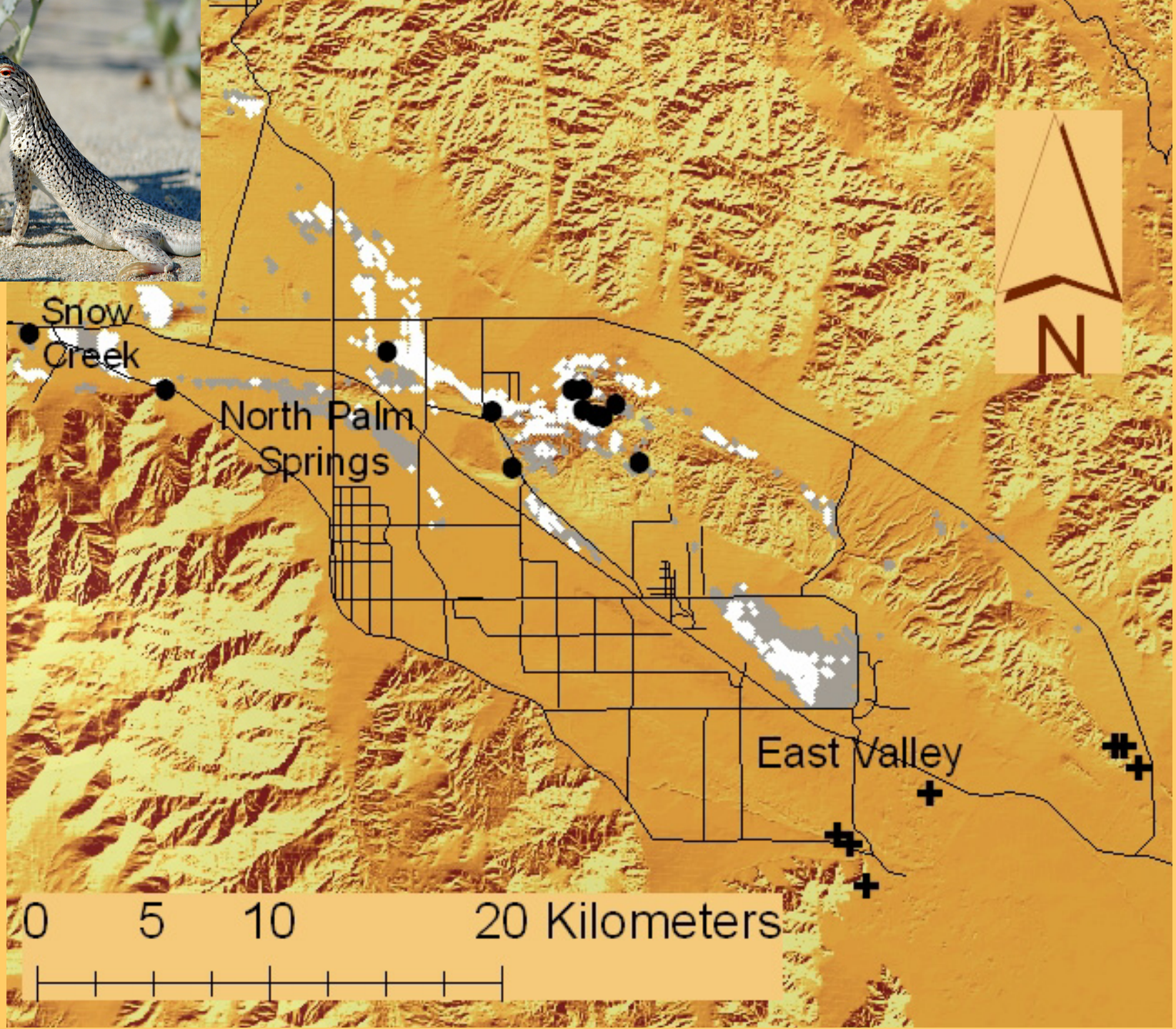
Outcomes

- **Each species' model responded uniquely to shifts in climate change.**
- **Most of the modeled species' models showed some resilience to the most extreme climate change predicted for this region. However only abiotic variables were considered here……..**
- **Small-bodied lizards' models showed the most sensitivity (loss of suitable habitat) at milder levels of climate change.**
- **Models for large-bodied reptiles, especially those with distributions that extend to sea level, showed the most resilience to climate change.**
- **The large topographic diversity of JTNP and its surrounding landscape appears to create climatic refugia.**
- **The models identified areas and linkages outside the Park boundary that add important suitable habitat to help ensure the persistence of populations.**
- **The modeled levels of change point to a need for better resource monitoring.**


Snow
Creek
North Palm
Springs
East Valley
N
0 5 10 20 Kilometers


Snow Creek
North Palm Springs
East Valley
N
0 5 10 20 Kilometers

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