

How long can Desert Tortoises, *Gopherus agassizii*, hide in their burrows from climate change?



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HOURS OF ACTIVITY VS HOURS OF RESTRICTION

- Ectotherm survival depends on a *delicate* balance between hours available for activity and hours of restriction
 - Hours of restriction – surface temperatures above operative temperatures
 - Critical Thermal Maximums (CTM) = 41.3 °C
- Reduction in hours of activity may leave tortoises unable to meet all of their crucial biological needs
 - Past a tipping point for survival.



CLIMATE CHANGE

- **Southwestern United States disproportionately subjected to trends in rising temperatures and increased aridity**
- **Global Circulation Models (GCM)**
 - **Projected temperature increase of 3.5–4°C within the next 60–90 years**
- **Predicted to affect distribution and survival of desert tortoise**

IMPACTS OF CLIMATE CHANGE ON DESERT TORTOISE

- Thermal constraints on activity and microhabitat utilization
 - Spend up to **>98%** of their annual activity cycle below ground due to harsh desert conditions and **<2%** of time active at the surface.
- Environmental Sex Determination
 - Limit production of male hatchlings

POSSIBLE RESPONSES?

*None

*Extirpation/extinction

*Evolution

–wider threshold temperature for sex determination

*Adaptation

- shift elevation range upward
- shift geographic range
- shift nesting season
- change nest depth/location



IMPORTANCE

- Desert species already struggling to survive in the harsh desert conditions where climate change is predicted to have its most **severe** impact
- Respond quickly enough to a rapidly warming climate?
 - evolution would have to occur at a rate that is $>10,000$ faster
- Habitat fragmentation limits ability to track climatic niches.

DATA COLLECTION

- Study site located in the the southernmost boundary of Joshua Tree National Park in the Sonoran Desert of California.
- Data loggers designed to mimic thermal dynamics of desert tortoises
 - Collected air temps every 15 minutes under current conditions
- Data loggers placed in various tortoise microhabitats; in and under bushes, trees and under rock shelters and burrows



PERCENT OF OBSERVATIONS ABOVE CTM

CLIMATE	MINIMUM	MAXIMUM	MEAN
CURRENT CONDITIONS (2016-2017)	0%	9.1401%	2.576%
FUTURE CONDITIONS (+4 °C)	0%	13.3041%	6.449%

CONCLUSION

Future climatic conditions that further restrict hours available to tortoises for above ground activity will have a potentially major impact on their surface activity and possibly their survival rates

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