



Desert Tortoise Population Monitoring



A desert tortoise next to the burrow it excavated in the sandy bank of a wash. Tortoises will also burrow down into dry sandy soil, often under shrubs. Notice the typical half-moon shape of the opening. (NPS / Stacy Manson)

Adapted to Desert Life...

What do desert tortoises (*Gopherus agassizii*) need to survive? It seems like the answer is "Not very much." Tortoises cope with extreme conditions in the Sonoran and Mojave Deserts by spending most of the year in suspended animation, hibernating in winter and estivating (the summer version of hibernating) in the hottest months. They can even go for months without drinking, using their bladders like canteens to store water.

Yet Declining Drastically

Although desert tortoises are adapted to extreme environments, climate change threatens their survival. One modeling study predicts that, with "moderate" climate warming (2°C increase in maximum July temperature, 50 mm decrease in annual precipitation), the amount of tortoise habitat at Joshua Tree National Park (JTNP) will shrink by 66 to 88 percent.

Beyond a changing climate, the main threats to tortoises in JTNP are roads and common ravens. As park visitation has doubled in the past decade, more tortoises have been killed by cars. Ravens, a significant predator on tortoise hatchlings, are growing in numbers throughout the region because they easily coexist with humans. Meanwhile, outside of JTNP and

other protected areas, tortoises have lost habitat to housing developments, solar energy development, roads, military base expansions, livestock grazing, wildland fires, and illegal cannabis farms.

To Help, Start by Counting Them

The U.S. Fish and Wildlife Service, which is charged with protecting and restoring endangered wildlife populations, has developed a Desert Tortoise Recovery Plan that establishes five Recovery Units across the species' range. Within these units are 17 Tortoise Conservation Areas (TCAs); Joshua Tree National Park is one of these.

Biologists from a variety of institutions have collaborated to monitor the park's tortoise population since 1978. Population monitoring does more than answer the question, "How many tortoises still live here?" It can reveal the number of males versus females, adults versus juveniles, and whether animals are generally healthy. Monitoring data combined with weather and vegetation data can reveal how climate change is affecting tortoises. Ultimately, population monitoring informs management decisions that, hopefully, will help desert tortoises persist.

Monitoring Methods

The most important tortoise monitoring technique is called “line distance sampling.” Biologists establish a transect usually 12 km long (a square, 3 km on a side) through an area of tortoise habitat. Two observers walk on either side of the line, scanning for tortoises. If they spot an animal, they measure it, determine the sex, and assess its general condition. They also note any dead tortoises found.

Tortoise radiotelemetry fieldwork complements line distance sampling. At the start of the monitoring process, a number of tortoises are tagged with small radio transmitters so they can be relocated using a directional antenna and radio receiver. Telemetry locates tortoises even when they are hidden in their burrows or under vegetation; biologists extrapolate from this information to predict how many tortoises are present but not detected by observers along the transect.

In JTNP, distance sampling for tortoises takes place between mid-March and mid-May when tortoises are most active, having emerged from hibernation to forage on spring wildflowers and look for mates. Park sample plots are areas with good tortoise habitat, typically scrublands dominated by creosote bush scrub and white bursage, but also Joshua tree woodlands and warm-season grasslands.



Juvenile tortoises like this one are very vulnerable to predation by common ravens (NPS / Daniel Elsbrock)

More Information

Lovich, J., Puffer, S., Cummings, K., Arundel, T., Vamstad, M., & Brundige, K. (2022). High female desert tortoise mortality in the western Sonoran Desert during California's epic 2012–2016 drought. *Endangered Species Research*, 50. doi.org/10.3354/esr01215

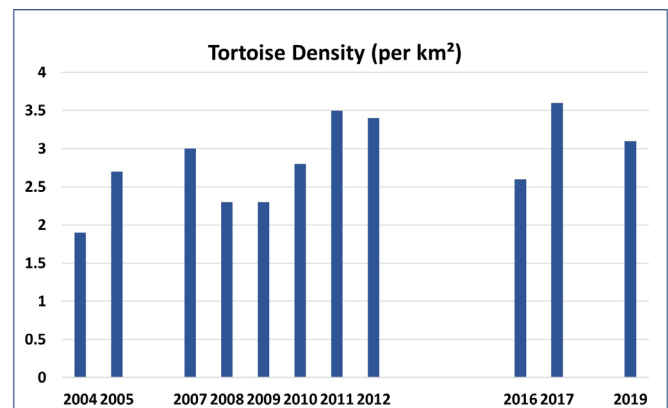
U.S. Fish and Wildlife Service. (2022). *Mojave desert tortoise (Gopherus agassizii) 5-Year review: Summary and evaluation*. Las Vegas, NV: USFWS. www.fws.gov/sites/default/files/documents/2022%20Mojave%20desert%20tortoise%205YR_FINAL.pdf

For general information about scientific research at Joshua Tree National Park: www.nps.gov/jotr/learn/nature/research.htm

Tortoise Populations Trends in JOTR

The key takeaways from tortoise monitoring in Joshua Tree National Park:

Tortoise populations continue to dwindle: Biologists counted as many as 30 tortoises per km² in some parts of the park three decades ago. Today there are fewer than four tortoises per km² in the park—barely enough to prevent the population from dwindling to extinction.



Transect-derived tortoise density estimates for sampled years in Joshua Tree National Park, 2004-2019 (NPS)

Droughts are deadly: The years between 2000 to 2021 were the driest the American Southwest has experienced in 1,200 years. A long-term study in the park's Pinto Basin found higher tortoise mortality during extended droughts, when the animals' main food source, spring wildflowers, is scarce. Many dead tortoises were found upright outside their burrows, not torn apart by predators, suggesting they died of starvation.

Female tortoises “hedge their bets”: A study conducted in the park's Cottonwood region found female tortoises consistently laid a normal (not reduced) number of eggs during the 2015-18 drought. This reproductive strategy is an (instinctive) gamble: if drought conditions lift, young tortoises will survive and sustain the population. The downside of the gamble: egg-laying draws on the female's water and energy reserves, and she may die; this study found more live male tortoises than females in the population.

Desert tortoises were listed as a federally threatened species more than three decades ago. Despite the protections that come with this status, populations have shrunk, not rebounded—a decrease of 37 percent from 2004 to 2014 throughout the species' range. If climate change continues as predicted and droughts become more frequent and severe, the desert tortoise may go extinct as deserts become uninhabitable for the species.