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BEHAVIOR OF THE DESERT TORTOISE
(Gopherus agassizii)

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Various species of desert tortoises have roamed the earth for at least 60 million years. Climatic changes that spelled extinction for the dinosaurs did not cause the same result for the desert tortoise. This exceptional creature adapted to the changes and survived.

BEHAVIOR

Burrowing

Burrows are crucial to the desert tortoise as they are ectotherms and therefore depend on external sources for body heat. First, tortoises use their burrows to protect them from the extremes of heat, cold, lack of moisture and too much moisture. Tortoises retreat to their burrows during the dry hot days in late spring and summer when water and food are unavailable. In the winter, the burrow serves as a warm site for winter hibernation. Finally, the tortoise also uses the burrow as protection from predators such as common ravens, coyotes, kit foxes, golden eagles, and greater roadrunners.

Tortoises build their burrows by scraping alternately with their "shovel-like" forelimbs

which are again used to push the dirt out when the hole is deep enough. These burrows vary considerably in length and type. The style of the burrow is dependant upon the region, soil type and vegetation in which it is found. In the eastern Mojave desert, burrows come in two forms. First, the deep winter dens in burrows in washes, some of which are 30 feet in length and second, shallower summer burrows three to nine feet in length in the flat areas. In areas with sandy-loamy soil, a burrow the length of a tortoise can be completed in just over an hour.

In Nevada tortoises have been observed using three different types of burrows; pallets or soil depressions with no soil cover, burrows the approximate width of a tortoise and at least as long as the tortoise, and large openings in rock or caliche which can accommodate several tortoises. Tortoise burrows are not kept, primarily for themselves. Burrows have been reported to be occupied by several commensal species including; western banded gecko, desert spiny lizard, zebra-tailed lizard, side-blotched lizard, whiptail lizard, desert iguana, night snake, gopher snake, rattlesnakes, coachwhip, burrowing owl, poorwill, desert woodrat, Merriam's kangaroo rat, pocket

mouse, canyon mouse, whitefooted mouse, white-tailed antelope squirrel, desert cottontail, black-tailed jackrabbit, kit fox, feral house cat, and various invertebrates including: tarantulas, black widow spiders, brown recluse spiders, and scorpions.

Each tortoise usually has more than one burrow. The number of burrows the tortoise uses may depend on age and sex, as well as on the season.

Daily and Seasonal Activity

Tortoises are ectotherms, depending on external sources for body heat, and they are also heterotherms, regulating their body temperature behaviorally. Seasonally, tortoises are active from early March to the end of October or early November, with the most active time being in the spring. Inactivity or hibernation occurs in the winter months when the tortoise retreat to their burrows. At this time, body temperature is lowered close to that of the air temperature in the burrow, approximately 40 to 60 degrees Fahrenheit, and the heart rate, respiration rate, and all bodily processes are slowed.

On a daily basis, the activity of the desert tortoise is highly dependant on the temperature.

Tortoises are active between temperatures of 65 to 105 degrees Fahrenheit. As a result, tortoises are active from mid-morning to mid-afternoon in the early spring, and as temperatures rise tortoises will emerge from their burrows earlier and return earlier to avoid the heat of midday. In later spring, tortoises also become active in the late afternoon. Once summer begins and daytime air and soil temperatures are over 90 degrees Fahrenheit and food supplies have dried, many tortoises become inactive, remaining underground for a large percentage of the time. Some will emerge in the early morning a few times a

week, to once in two or three weeks. Summer storms also draw tortoises out of their burrows as they emerge in order to drink, travel and eat.

Activity at night is rare although again if summer storms occur at night the tortoises may emerge from their burrows.

Tortoises have a home range in which it travels, feeds, sleeps, courts and has its burrows. Tortoises have a home range of 131 acres or more. Hatchlings restrict their activities to small home ranges associated with one or two burrows. Observed ranges appear to vary seasonally, growing larger even when forage is relatively abundant.

Foraging

Logically, tortoises forage in the early morning and late afternoon during their active periods. Their diet is mainly composed of small annual flowering plants and grasses which generally bloom from March to May and, depending on rainfall, in early fall. The genera of plants include; *Astragalus*, *Camissonia*, *Coreopsis*, *Cryptantha*, *Erodium*, *Euphorbia*, *Gilia*, *Lupinus*, *Malacothrix*, *Mentzelia*, *Phacelia* and *Plantago*. Species of annual grasses include; Six-weeks grama, Brome grass, Red brome, Red chess, Six-weeks fescue, and Schismus grass. Desert tortoises also feed on desert mallow, succulents (such as the cottonhop and beavertail cactus), and weeds that have been introduced in connection with livestock grazing. Tortoises feed on herbaceous perennial and annual wildflowers, such as wishbone bushes, lotus, loco weeds, spurges, blazing stars, lupines, Indian wheat, forget-me-nots, desert dandelions, gilies, phacelias, coreopsis, and many other species. They also eat annual and perennial grasses and fresh pads and buds of some species of cactus. They do not eat shrubs such as creosote bush and burro bush.

Succulents may be crucial to the tortoise at times as it may be the sole source of water and forage. The difficulty is that the caloric content of succulents is not high and therefore the tortoise requires large amounts. Annual weeds that are increasingly abundant in areas where grazing occurs pose a problem. As opposed to native vegetation, they do not provide the same moisture and nutritional value to the tortoise. In addition, they are abundant only in the spring and sometimes in the fall, while perennials are available continuously. Forage preferences seem to vary with geographic location and plant community composition but do not seem to be dependant on forage availability. Tortoises will consume dry plants but it is highly dependant on recent water intake. When given free access to water the desert tortoise can drink 40% of its body weight within the space of an hour or so. Tortoises can store this water in their bladders, where it can be reabsorbed. Fresh water from the bladder is clear and colorless and water that has been stored for some time is dark and concentrated. The desert tortoise can tolerate large imbalances in their water and energy budgets.

Reproduction

Tortoises often reach sexual maturity between 17 and 20 years of age. Considering the high mortality of young tortoises, few actually reach the age where reproduction is possible.

Courtship and mating does not have a defined season. It simply occurs when the opportunity presents itself and therefore has been observed in the spring, summer and fall. The male approaches the indifferent female who moves away. He trails her and bobs his head at her as is done in greeting. The frequency of the head bobs increases with duration. When she is caught, the male continues high-intensity head bobbing while circling her, usually in a

counterclockwise direction. The female may still try to move away, or avoid the male by circling around him, but once she stops, the male starts biting her head and forelimbs, and occasionally her carapace. He continues to circle to keep in front of her, and sometimes rams her gular projection with his while giving an open mouth threat. Finally she withdraws into her shell and remains in place. The male then moves behind, always ready to bite at her head, and mounts. Hissing and grunting sounds are produced though they are thought to be a product of copulatory effort, not auditory signals. Courting and mounting however does not necessarily mean that the male will copulate. In addition, not all tortoises within a population reproduce.

Females usually lay one or more clutches of one to twelve eggs between mid-April and mid-July. Smaller females will produce smaller sized clutches than larger sized females. Clutch size and the number of clutches produced can also depend on the food supply and how much food the tortoise has been able to obtain during the year or two prior to when the clutch is deposited.

Nest construction also occurs between mid-April and mid-July and preferably in the early morning or late afternoon, consistent with activity periods. The nest is dug by the female with its hind feet and is limited in size by the distance that the hind legs can extend. The nest is often constructed in association with the burrow; in the mound, in the mouth or even deep inside the tunnel. Maximum nest diameter and depth is approximately 14 inches (104 mm). Females drop the eggs in the nest, placing them with their hind legs and covering them carefully with the soil.

The eggs are elliptical to nearly spherical in shape and about 1.6 inches (40 mm) in length therefore resembling a ping pong ball in size

and shape. The average number of eggs in a clutch is 4 to 5. Hatching may occur within 70 to 120 days depending on the amount of warmth received. Intervals of longer than 180 days have been reported and some clutches may even over-winter underground and hatch in the spring.

Social Behavior

The social behavior of the desert tortoise is not well known but may be similar to that of the large, highly aggressive, polygynous lizards. Hierarchies among desert tortoises are believed to exist and are maintained through visual and chemical signals rather than through physical contact. Passive avoidance of larger, more dominant tortoises by subordinates may be a common feature of the social system and may have implications for relocation efforts.

When jousting among males occurs it follows a predictable pattern. After the initial meeting which involves stretching their necks and nodding, possibly even touching noses, the two males will circle each other with their heads bobbing. Sometimes they bite and make passes with their heads. Then they will step back and charge one another and meet head on with their heads partially withdrawn in their shells. Each tortoise rams at the other with their gular horn until the horns are sometimes butted together. The battle ends with either one of the tortoises walking away seemingly disinterested or one of them may get turned onto his back. The latter can be very serious for a tortoise if he cannot right himself as he may get cooked in his shell or die of suffocation from the weight on his lungs.