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Gopherus berlandieri (Agassiz 1857) –
Texas Tortoise, Berlandier's Tortoise, Galapago Tamaulipas

IVANA MALI, ROSS O. COUVILLON, AND MICHAEL R.J. FORSTNER

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***Gopherus berlandieri* (Agassiz 1857) – Texas Tortoise, Berlandier's Tortoise, Galapago Tamaulipas**

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SUMMARY. – The Texas Tortoise, *Gopherus berlandieri* (family Testudinidae), is a small, terrestrial tortoise native to southern Texas in the United States and northeastern Mexico. It is the smallest living member of its genus, with adults beginning to display secondary sexual characteristics at around 13 cm in shell length and typically growing no larger than 24 cm in maximum shell length. The species has a moderately domed, rounded shell that is usually brown to tan in adults, whereas juveniles are darker with yellow centers on each scute. Males and females are readily distinguished by various secondary sexual characteristics – males possess a more concave plastron, longer tails, and a longer gular projection than females. The species lays up to three clutches per year, each consisting of 1–5 elongate eggs that average approximately 4.2 cm in length and 3.4 cm in width, with eggs often distributed among multiple nests. This tortoise inhabits subtropical dry shrublands, particularly thornscrub (chaparral) ecosystems, and is also found on elevated coastal hills (lomas) and remnant riparian habitats. It is herbivorous and consumes a variety of grasses, forbs, and prickly pear cactus. The species is diurnal and has an annual activity period from approximately April to November. It is less active during the extreme heat of summer and enters a period of relative inactivity during colder months. *Gopherus berlandieri* has federal-level protection in Mexico and state-level protection in Texas in the United States. Nevertheless, threats to this species such as habitat loss, habitat fragmentation, and road mortality impact its populations. The effects of disease and invasive species on this tortoise are not well understood and deserve more attention. Much more is known about the status of populations in the United States as compared to Mexico. Efforts to better monitor this species in both Mexico and the United States are necessary to provide a more complete assessment of its status.

DISTRIBUTION. – Mexico, USA. Occurs across southern Texas in the USA and across much of Tamaulipas and Nuevo Leon, eastern Coahuila, northern Veracruz, and eastern San Luis Potosi in Mexico.

SYNONYMY. – *Testudo tuberculata* Berlandier 1850 (junior homonym and *nomen oblitum*; not *Testudo tuberculata* Pennant in Schoepff 1801); *Testudo bicolor* Berlandier 1850 (*nomen oblitum*); *Xerobates berlandieri* Agassiz 1857; *Testudo berlandieri*; *Xerobates gopher berlandieri*; *Gopherus berlandieri*; *Gopherus polyphemus berlandieri*; *Scaptochelys berlandieri*; *Testudo minima* Berlandier in Bour 2017 (*nomen nudum*).

SUBSPECIES. – None recognized.

STATUS. – IUCN 2026 Red List: Near Threatened (NT A2c+4c; in press); Previously: Near Threatened (NT; 2011); CITES: Appendix II, as Testudinidae spp. (1977); Texas: Threatened.

Taxonomy. — The Texas Tortoise, *Gopherus berlandieri*, was described by Louis Agassiz (1857) as *Xerobates berlandieri*. At the suggestion of Spencer Fullerton Baird, the eponym honors the contributions of Jean Louis Berlandier, a French naturalist who spent 26 years investigating the natural history of Mexico and Texas and worked on the Mexican Boundary Commission between 1828–1834 (Bour 2017). The specimens used to describe the species likely originated from Berlandier's collections near the Río Grande del Norte of extreme

southern Texas. Five syntypes are located at the Smithsonian National Museum of Natural History (formerly United States National Museum): USNM 59, 60, 75, 222511, and 222512 (summarized in Iverson 2022). The type locality was given by Agassiz as “southern Texas and Mexico” and later restricted to “Brownsville, Cameron County, Texas, USA” by Smith and Taylor (1950). The species was retained in *Xerobates* until it was referred to *Testudo* by Cope (1880) and to *Gopherus* by Stejneger (1893) (see Auffenberg and Franz 1978; TTWG 2025).



Figure 1. Adult female Texas Tortoise, *Gopherus berlandieri*, from Jim Hogg County, Texas, USA. Photo by Ross O. Couvillon.

The taxonomy of *G. berlandieri* remains stable, and taxonomic changes regarding its generic allocation have not affected its status as a distinct species. Similarly, the genus has experienced changes related to its fossil taxa (Reynoso and Montellano-Ballesteros 2004; TEWG 2015), but none of the proposed changes modify the understood relationships among extant taxa. We note a persistent error among synonymy versions which erroneously cite Berlandier (1850) and Strauch (1862), often not including the latter citation at all. We have reviewed delineation of the fossil taxon *G. auffenbergi* and consider the matter unresolved, choosing to follow Vlasco (2018) in retaining the taxon as distinct, pending formal review of the rediscovered holotype.

A phylogeographic study of genetic variation in microsatellites across the range of *G. berlandieri* in Texas found only weak differentiation of northern versus southern populations of the species (Fujii and Forstner 2010).

Description. — *Gopherus berlandieri* is the smallest extant species in the genus *Gopherus*. Judd and McQueen (1980) reported a maximum straight-line carapace length (SCL) of 21.9 cm from a male, but Rose and Judd (2014) reported a larger male at 23.8 cm SCL and the largest female as 21 cm SCL. Bury and Smith (1986) reported that males ranged in mass from 800 to 2,350 g, whereas females ranged from 850 to 1,800 g. The mean size at hatching is 4.2 cm SCL and weight 24.3 g (Judd and McQueen 1980).



Figure 2. Adult female *Gopherus berlandieri* from Jim Hogg County, Texas, USA. Photos by Ross O. Couvillon.



Figure 3. Male (top) and female (bottom) adult *Gopherus berlandieri* from Jim Hogg County, Texas, USA. The enlarged mental glands under the mandible and pronounced gular projection are typical of adult males. Photos by Ross O. Couvillon.

Gopherus berlandieri has a rounded to slightly oblong carapace, which is moderately domed but flatter compared to the larger congeners. Broader-shelled individuals within local populations are known; this seems an extension of the generally broader shell to length that distinguishes this species from the desert tortoises *G. morafkai*, *G. agassizii*, and *G. evgoodei*. The carapace is highest at the third vertebral scute. The carapace is typical of testudinids, with five vertebral scutes, four pairs of costal scutes, usually eleven pairs of marginal scutes, and an anterior nuchal scute. Concentric annuli on scutes form during seasonal growth cycles. While normally a single ring develops annually, their reliability in aging



Figure 4. Male *Gopherus berlandieri* from Texas showing the prominently enlarged mental glands under the mandible. Photo by Francis L. Rose.

an individual decreases with age due to the narrowing of growth rings (Hellgren et al. 2000). The growth ring details are lost on older individuals, which often have smooth shells.

Generally, adults are dark brown in color, grading to a lighter chestnut, while juveniles and young adults are darker; hatchlings are nearly black with yellow centers on each scute. Coloration normally fades as individuals grow and age, and some are seen to retain light centers on scutes or even radiating rays of lighter color. The normal aging adult is almost uniformly brown or tan. Occasionally large adults with very dark carapace colors are seen, as are a few individuals that could be considered reddish brown. The plastron is most typically yellowish to flat off-white, but occasionally darker brown, normally with darker marginal patches, and does not typically show as much color variation as the carapace.

Mature individuals are sexually dimorphic. The plastron is flat in females but strongly concave in males. The gular scutes form a forward projection, which is especially pronounced in males. Males regularly use their gular projection in combat with other males and in courtship of females. Males have a longer and thicker tail than females, which positions the male cloaca posterior to the shell margin when fully extended. The mental glands beneath the lower jaw are larger in males, and the difference is most notable during the breeding season.



Figure 5. Adult *Gopherus berlandieri* from Cameron County, Texas, USA, showing carapacial color variation. A smoothed carapace is a sign of a long-lived individual (right). Photos by Ross O. Couvillon.



Figure 6. Young Texas Tortoise, *Gopherus berlandieri*, from Jim Hogg County, Texas, USA. Photo by Ross O. Couvillon.

These glands are presumed to be involved in pheromone production related to mating and courtship, but could also be involved in social signaling. Scent-based communication via mental glands remains poorly studied.

The species has a smaller and more wedge-shaped head than other *Gopherus*, but has a similar keratinous beak. Like all *Gopherus*, the limbs are derived for their function in terrestrial locomotion and digging. The forelimbs are flattened, sometimes referred to as spatulate, with strong claws and enlarged scutes. The hindlimbs are much more cylindrical and might be considered elephantine, with smaller surface scutes and dramatically shorter claws. The coloration of the limbs change with age from darker brown-black toward lighter tan colors.

Many individuals have shell abnormalities caused by keratinizing fungal infections (e.g., *Fusarium* sp.). The infections often begin with a chalky, white residue on the carapace or plastron. Such infections can develop to the point of causing eroded shell areas or flaky scute surfaces. Overall, infections can lead to a tortoise whose phenotypic presentation is much affected, such as whitened shell surfaces that can be pitted or eroded over time. At present, the prevalence, transmission, and long-term demographic consequences of these infections remain poorly understood (but see Current Research below).

The karyotype consists of 52 chromosomes (26 macrochromosomes and 26 microchromosomes) and is similar to that of *G. agassizii* (Killebrew and McKown 1978).

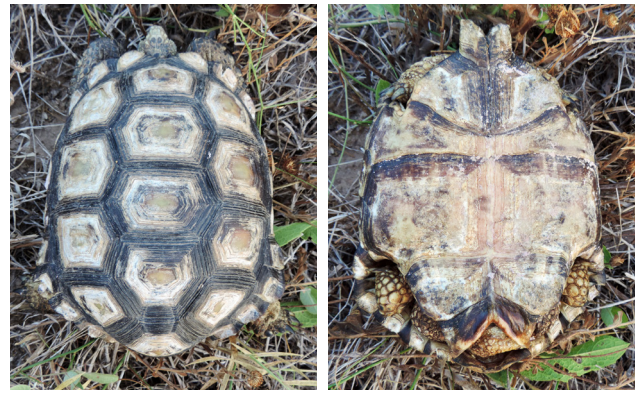


Figure 7. White patches on the shell of this adult male *Gopherus berlandieri* are indicative of a keratinizing fungus. The fungus can affect the entire shell in some individuals. Photos by Ross O. Couvillon.

Distribution. — *Gopherus berlandieri* is distributed in southeastern Texas, USA, and northeastern Mexico in eastern Coahuila, northern and eastern Nuevo León, most of Tamaulipas, northernmost Veracruz, and northernmost San Luis Potosí (Rose and Judd 1989; Iverson 1992; TTWG 2025). Recently, occurrences in Mexico have been expanded to include Zacatecas (Lemos-Espinal et al. 2026), similar to a report by Coghill et al. (2011) which also noted occurrences to the southwest; but these records are at unusually high elevations and may represent translocations. Overall, the abiotic features defining the species' distribution appear to be the Gulf of Mexico to the east and higher continental elevations to the north and west. Tortoises have been found at elevations from 884 m in Coahuila (Rose and Judd 1982, 1989) to as high as 2,115 m in Zacatecas (Lemos-Espinal et al. 2026). The species is normally found at less than 200 m in Texas, but individuals are occasionally detected at ca. 400 m in the western portions of its distribution in Texas. Individuals are detected with some regularity north and west of Del Rio (300–472 m respectively) and we consider those to be consistent enough over the past five decades to represent actual occurrence and not anthropogenic translocations (Dixon 2013; Forstner, pers. obs.).

In Texas, the species is distributed primarily in the southeastern region bounded in the north by a line from the cities of Del Rio to San Antonio to Rockport. There is uncertainty whether tortoises found further northeast along the Texas coast and records further west of Del Rio



Figure 8. Post-hatchling *Gopherus berlandieri* in the wild near Corpus Christi, Texas, USA. Photos by Benjamin Schwartz.

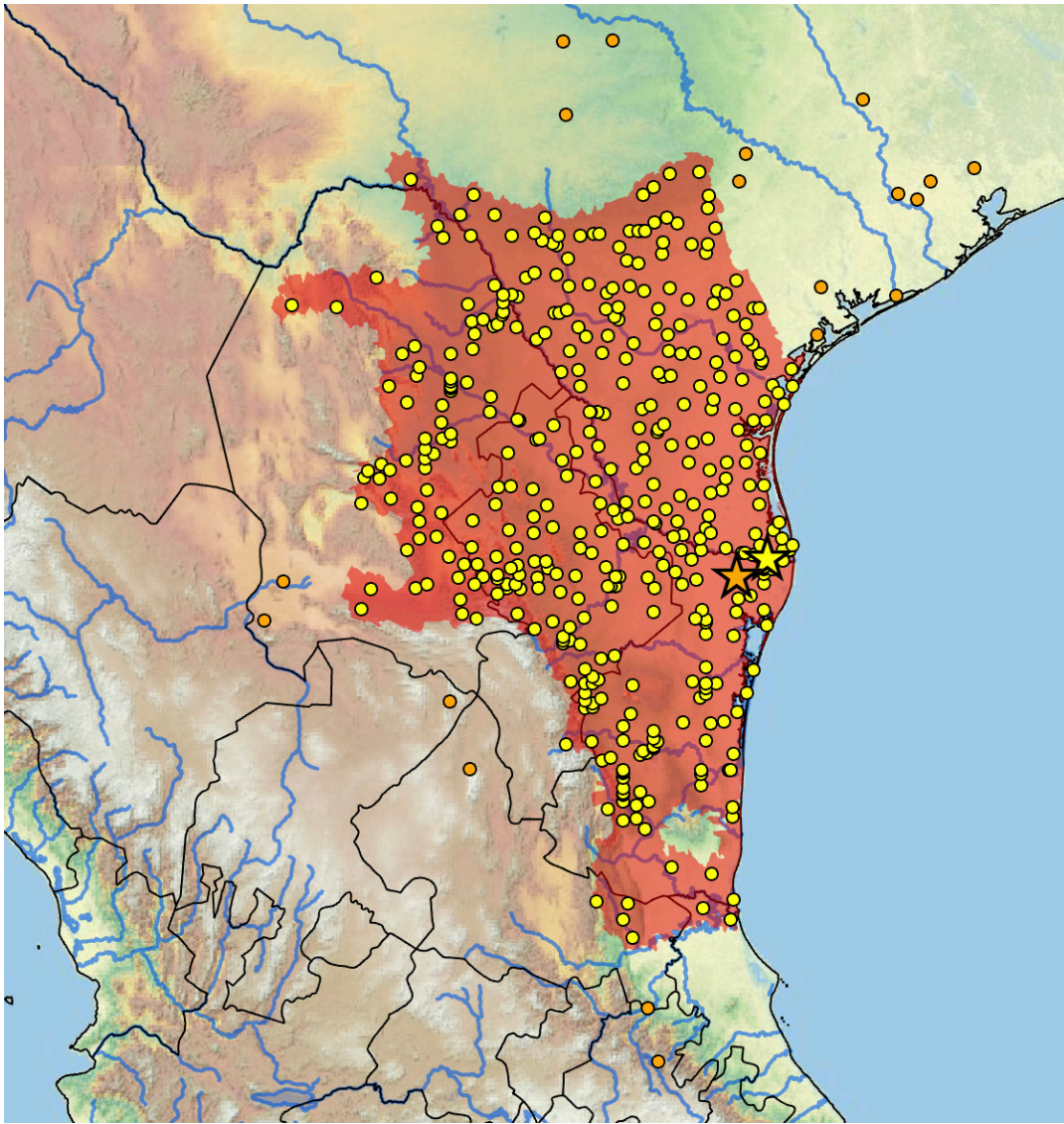


Figure 9. Estimated historical indigenous distribution of *Gopherus berlandieri* in Texas, USA, and Mexico. Yellow dots = museum and current and historical occurrence records of presumed native populations based on literature and online records (TTWG 2025; in prep.); orange dots = presumed translocated or introduced non-native records; yellow star = restricted type locality for *Xerobates berlandieri* Agassiz 1857; orange star = estimated type locality for *Testudo tuberculata* Berlandier 1850 and *Testudo bicolor* Berlandier 1850 (*nomina oblita*). Colored shading = estimated historical indigenous range. Distribution is based on fine-scaled GIS-defined level 12 HUCs (hydrologic unit compartments) constructed around localities and then adding HUCs that connect point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs, based on TTWG (2025) and adjusted based on subsequent data (TTWG, in prep.) and from the authors. Map by Chelonian Research Foundation.

are the result of anthropogenic translocations, but we assume they are. Such human transport is clearly the case for many isolated records to the north and east of the species' contiguous distribution (Dixon 2013). Habitat suitability modeling based on positive occurrence localities in Texas identified minimum temperature of the coldest month and precipitation seasonality as the two most important environmental variables (Parandhaman et al. 2026). Areas of high habitat suitability were identified in the southernmost and northwestern portions of the species' distribution in Texas (Parandhaman et al. 2026).

The species is one that is often held in captivity by enthusiasts. This is, in part, a consequence of only state

protected status in the USA. This can result in the release, either intentional or unintentional escapes, of individuals to the wild outside their native range in Texas and beyond. Individuals have even been found in the wild in California (Bury and Luckenbach 1976). We also note that reports of *G. berlandieri* outside its native range often coincides with the recovery of other exotic tortoises escaped from captivity (Forstner, pers. obs.).

Habitat and Ecology. — *Gopherus berlandieri* occupies the subtropical dry shrublands of Texas and northern Mexico most often referred to as chaparral. The distribution of *G. berlandieri* coincides with the Tamaulipan Biotic Province (Blair 1950). In Mexico, the region

is sometimes referred to as the Mezquital Tamaulipeco, or Tamaulipan mezquital. This is a region defined by the colloquial “thornscrub”, with diverse communities of trees, shrubs, grasses, and herbaceous vegetation in its undisturbed state. Many of these areas are becoming dominated by Honey Mesquite (*Prosopis glandulosa*) or vast monocultures of Prickly Pear Cactus (e.g., *Opuntia engelmannii*) after land clearing or other anthropogenic disturbances. Within the few remaining stands of native thornscrub, the ground is normally open among a mix of shrubs and grasses providing relatively easy passage for tortoises. These habitats grade into more xeric shrub and tree assemblies westward into the areas adjacent to the Chihuahuan desert habitats.

Gopherus berlandieri also occurs in coastal areas. It occupies “lomas” or hills formed from windblown clay dunes that rise above the water level within shallow bays of the coastline that forms the eastern boundary of its distribution. Along and near the coast where lomas occur, this species will utilize grassland loma habitat in greater proportion to what is available, evergreen and non-loma grasslands in proportion to availability, and avoids all other habitat types such as woodlands and shrublands (Moeller et al. 2025a). The species also occurs within the few remaining intact riparian habitat patches that once represented extensive woodland and palm forest (Sabal Palm [*Sabal palmetto*]) habitats along the Río Grande/Río Bravo del Norte. The attendant changes in geology from sand and lomas inland to rocky outcrops and caliche, as well as an east-west precipitation gradient, provide an expected wide array of vegetation communities utilized by the species.

Diet. — The species is a herbivore, but can be considered a facultative generalist as it consumes a wide array of plant resources by region. Ernst and Lovich (2009) reported a wide array of grasses (e.g., genera *Aristida*, *Bucheloe*, *Cenchrus*) and forbs (e.g., genera *Aster*, *Evolvulus*, *Viola*) are consumed. Compared to its availability, Prickly Pear Cactus is eaten more often than expected, whereas grasses are eaten less frequently (Scalise 2011). When seasonally available, the fruits from Prickly Pear Cactus are sought, as these are both nutritious and have high water content (Rose and Judd 2014). Tortoises can promote recruitment through endozoochorous seed dispersal, as *Opuntia* seeds that pass through their digestive tract have higher germination rates (Rose and Judd 1982). Feeding on the feces of other animals, including that from other tortoises, as well as on dried bones, has been reported (Auffenberg and Weaver 1969, Mares 1971). Rose and Judd (2014) also noted snails, or at the very least their shells, appear to be ingested seasonally by female tortoises, potentially choosing this prey item for supplemental calcium. Fragments from animals ranging from mammalian hair to arthropods and mollusks (snails as above) were also found in fecal analyses (Scalise 2011). We do not know if tortoises seek out such protein

sources or if these are simply opportunistically taken during normal foraging. Juveniles consume more forbs and less grasses than adults (Scalise 2011).

Activity and Movement. — *Gopherus berlandieri* is diurnal and exhibits seasonal differences in its activity and behavior. In Texas, the species is most active from May to November, with the greatest movements at external carapace temperatures ranging from 25 to 32°C (Kiel 2025). During its active season, it tends to delay activity until the body temperature is elevated (Rose et al. 1988). Tortoises undertake a prolonged warm-up period within shelters and do not emerge until body temperatures exceed 28°C, with only minimal basking following emergence (Voigt and Johnson 1976). Heat stress typically occurs at 37.5°C ambient temperature, while the critical thermal maximum is near 44°C (Judd and Rose 1977). Evaporative water loss increases with the ambient temperature and smaller tortoises tend to lose more water relative to their body mass in comparison to larger ones (Olson 1987). Summer aestivation is reported where aestivating tortoises maintain a lower body temperature than active tortoises (Voigt and Johnson 1976). During the inactive season, the species may enter brumation during the coldest months; however, the general areas of intensive use tend to remain stable throughout the year (Guerra et al. 2025). Overall, the species prefers areas with broad canopy cover heterogeneity and avoids extremely open or closed canopies (Kazmaier et al. 2001a; Guerra et al. 2025). With increasing temperatures during its active season, it tends to select thornscrub, which likely serves as a thermal refugium (Kiel 2025). This is also true for exceptionally cold seasons (Guerra et al. 2025).

Gopherus berlandieri demonstrates an apparent pattern of smaller home ranges on moist, coastal sites and larger home ranges on semiarid, inland sites. For an inland population, Kazmaier et al. (2002) reported the median home range (95% kernel density estimate) of males was 5.7 ha and 11.0 ha in grazed and ungrazed pastures, respectively, whereas for females it was 2.7 ha and 4.7 ha in grazed and ungrazed pastures, respectively. Mean home ranges (95% autocorrelated kernel density [95% AKDE]) for a different inland population were 24.2 ha for males, 3.1 ha for females, and 1.2 ha for juveniles (Couvillon, unpubl. data). For coastal populations, Kiel (2025) reported a mean home range (95% AKDE) size of 1.95 ha for males and 0.85 ha for females, Guerra et al. (2025) reported a mean home range (95% AKDE) size of 0.69 ha (sexes pooled), and Briggs (2016) reported a mean home range (95% minimum convex polygon) of 1.46 ha for males and 0.71 ha for females. Home range sizes vary across seasons and are generally smaller in the winter (Guerra et al. 2025; Kiel 2025).

During its active season, *G. berlandieri* has been reported to exhibit bimodal activity patterns, especially avoiding extreme midday temperatures (Rose and Judd



Figure 10. Typical habitats of *Gopherus berlandieri*. *Top left and Top right:* Mixed brush shrubland in Jim Hogg County, Texas, USA. *Bottom left:* Coastal loma in Cameron County, Texas, USA. Photos by Ross O. Couvillon. *Bottom right:* Oaks (*Quercus* sp.) clustered into mottes (pictured) or dispersed across the landscape can offer habitat in coastal grasslands. Photo by Frank W. Judd.

1975, 2014). Moeller et al. (2025b) conducted visual encounter transect surveys of captive individuals from June to September in a 2.4 ha enclosure containing 54 *G. berlandieri* and found the frequency of tortoises observed was not related to temperature, time of day, or their interaction; they suggested that surveys could be conducted at any time in daylight between 24 and 40°C. They acknowledged the inconsistency of their results with prior work (Auffenberg and Weaver 1969), so their conclusions about timing of surveys may be limited to certain populations or habitat contexts. As with many other tortoises, increased activity by *G. berlandieri* is noted after rainfall events.

Unlike other species of *Gopherus*, *G. berlandieri* does not excavate large burrows in which to retreat (Rose and Judd 2014). Instead, individuals dig a shallow pan or pallet with their front limbs, approximately one half their length. They exhibit some fidelity to individual pallets, but to a lesser degree than the fidelity other *Gopherus* have to their burrows (Couvillon, unpubl. data).

Reproduction. — *Gopherus berlandieri* is the most sexually dimorphic species of *Gopherus*. Males become

sexually mature at ca. 10.5 cm SCL, while females reach maturity at about 15.0 cm SCL (Rose and Judd 1982, 2014). Mittleman and Brown (1947) reported that sexes differed in ratios of head width to hind foot diameter and carapace length to width, but there were no differences in body depth. Given the size of the gular projection in males, combat plays a significant role in mating. Males have been reported trailing, biting, and ramming females, and such biting and ramming also occurs in male combat (Weaver 1970). While visual cues are certainly important over short distances, it has long been suspected that olfactory cues are important over longer distances, sourcing from the enlarged chin glands anteriorly and cloaca posteriorly (Weaver 1970). Females do not mate with males that are smaller than they are; the smallest male reported successfully mating was 16.3 cm SCL, and most were >17.5 cm (Rose and Judd 2014). This mating system is best characterized as female defense polygyny (Rose and Judd 2014).

Age at sexual maturity of females is ca. 13.3 yrs (Germano 1994), but Hellgren et al. (2000) concluded maturity could occur at 4–8 yrs and even earlier for individuals in



Figure 11. Inactive *Gopherus berlandieri* in pallets. At least part of the shell is usually exposed, though additional screening cover is provided by vegetation around and above the pallet site. Photos by Ross O. Couvillon.

captive conditions with abundant food access (Rose and Judd 2014). However, Rose and Judd (2014) considered 10 yrs necessary for females to reach maturity in the wild. Based on an average estimated age of maturity for *G. berlandieri* as 13.3 years (Germano 1994), the estimated generation time is ca. 30 years (Iverson 2024).

Courtship was observed most frequently from May to October, with intense courtship and copulation occurring from July through August (Rose and Judd 2014). Females annually produce up to three clutches of 1–5 (maximum 7) eggs that average approximately 4.2 cm in length and 3.4 cm in width but will distribute multiple eggs over several different nests (Judd and Rose 1989, Rose and Judd 2014). While most eggs are elliptical, this is the only *Gopherus* species showing great variation in egg shape from nearly spherical to definitely elongated (Rose and Judd 2014). Judd and Rose (1989) found that females retained shelled eggs for up to 39 days to partition the laying of a single clutch in time and space.

Egg mass ranges from 27 to 37 g, and clutch mass from 71 to 99 g (reviewed in Iverson et al. 2025). Relative clutch mass (clutch mass/gravid body mass) is estimated at 5.5–6.0% (Iverson et al. 2025). Early reports suggested that egg shells are flexible when laid to pass through the small carapace-xiphiplastron aperture (Paxson 1962). However, Rose and Judd (1991) disputed this claim and demonstrated that female Texas tortoises have the ability to move the plastron (via plastral hinge) and carapace to increase the space between pygal and xiphiplastron in order to pass hardened eggs.

Egg laying can occur as early as April, but the primary nesting season is in June and July, with a possible second peak in August and September (Garnt 1960; Auffenberg and Weaver 1969; Rose and Judd 2014). Despite some early reports that female *G. berlandieri* may exhibit nest guarding behavior (Strecker 1928), Rose and Judd (2014) dispute these interpretations, instead concluding

the species does not defend its nests and young and is not aggressive toward humans.

Females excavate nests with their hind limbs, resulting in a ca. 2.5 cm neck that expands into a larger nest cavity (Rose and Judd 2014). Nesting is exclusively diurnal and the complete nesting sequence (digging, laying, and covering) takes about 4 hours. If nesting extends into the evening, a female will cease nesting and return the following day. Females urinate on nests during nesting, but the function of this behavior is not fully understood. Nests are usually located at the base of vegetation (e.g., cactus). The incubation period lasts approximately 105 days (range, 88–118), with eggs typically hatching from August to November (Judd and McQueen 1980; Rose and Judd 2014). Little is known about the sex determination of this tortoise, but we can reasonably assume temperature dependent sex determination Type Ia based on the data from *G. agassizii* and *G. polyphemus* (Krueger and Janzen 2022). Hatch rate of eggs is ca. 60% (Judd and McQueen 1980). Hatchlings up to one year of age grow ca. 0.06 mm SCL per day (Judd and McQueen 1980). Germano (1994) provided a general growth constant of 0.104, which is in the low range for the genus.

Longevity. — Both sexes can live over 50 years based on individuals held in captivity (Judd and McQueen 1982, Rose and Judd 1982, 1989). Anecdotally, some reports indicate that they can live beyond 70 years (e.g., TPWD, <https://texasortoise.org/texas-tortoise/>). Based on an age of maturity of 13.3 years and a generation time of 30 years, potential longevity can be estimated as ca. 74 years (Iverson 2024). However, Hellgren et al. (2000) suggested that overall longevity in the wild may be lower in this species than in closely related taxa, primarily due to lower annual survival rates of adult females.

Population Status. — Range-wide population assessments of *G. berlandieri* have not been undertaken, nor are there data enabling clear trend calculations for

this tortoise, although Mali and Forstner (in press) suspect ongoing population declines. *Gopherus berlandieri* has been examined using capture-mark-recapture studies and by population genetics in Texas. Unfortunately, these studies have not occurred in Mexico and population densities or demographics from there remain unavailable.

Relying on only USA data is an obstacle to adequate characterization of the species' global status. In Texas, Parandhaman et al. (2026) reported detecting just 7 individuals (4 of which were roadway mortalities) during more than 28,000 km of driving surveys within *G. berlandieri* habitat during their peak activity period. In contrast, Hamilton (1944) reported detecting 16 individuals in a 3–4 km stretch of highway in 1938. Although these two observations are not directly comparable, the scarcity of detections made recently is a serious concern if interpreted as representative of the species across its habitat in Texas.

Additional insights from Texas come from coastal (i.e., loma-associated) and inland (chapparal) habitat sites. For inland sites, population density estimates have been recorded at ca. 0.27 tortoises/ha (Hellgren et al. 2000; Kazmaier et al. 2001c); whereas coastal sites have demonstrated densities as much as 46–72 times higher than inland sites (Rose et al. 2011). Whether these densities are still present remains unstudied.

Mortality rates of juveniles have not been determined (Rose and Judd 2014), but Hellgren et al. (2000) considered only 5 of every 1000 hatchlings survive to age 20. Juvenile tortoises may represent 25% (Judd and Rose 1983) to 34% (Hellgren et al. 2000) of a population. Male bias in older age classes observed in southern Texas was attributed to lower survivorship of females, due to a combination of their vulnerability to predation and energetic costs of reproduction (Hellgren et al. 2000). In chelonians, it is typical that population stability is strongly dependent on adult survivorship remaining high considering the naturally low recruitment from hatchlings.

Hellgren et al. (2000) found the life history of an inland population of *G. berlandieri* differed from its congeners. Tortoises in the studied population matured at an earlier age, had smaller clutch sizes, and exhibited lower rates of female survival than other *Gopherus*. Hellgren et al. (2000) proposed this life history strategy was well suited to the fluctuating environmental conditions *G. berlandieri* experiences. There could be differences in the life history of populations occupying moist coastal and semiarid inland sites, but this remains unexplored.

Population genetic data derived from microsatellite allelic variation have also been provided for *G. berlandieri* samples collected across Texas, which indicate weak structure from north to south (Fujii and Forstner 2010). The genetic results were complicated by human translocations of tortoises, but no significant genetic structure was present in the Texas distribution that could not be explained from isolation by distance among the samples.

Renewed interest in this species is enabling new population genetic studies which seek to provide higher resolution geographic structure for tortoises collected in Texas to better understand historical demography and connectivity among remaining habitat fragments.

Threats to Survival. — *Gopherus berlandieri* has been and continues to face a wide range of threats broadly classified into: 1) habitat loss and degradation that cause not only habitat fragmentation but also direct mortality; 2) direct human uses; 3) non-native/invasive species; and 4) diseases (see Judd and Rose 2000; Rose and Judd 2014).

Habitat degradation and destruction, historically motivated for agriculture, appears to have had the greatest impact on tortoise populations. For the lower Rio Grande Valley of Texas, USA, over 95% of natural brushlands have been eliminated since the 1930s (Jahrsdoerfer and Leslie 1988; Tremblay et al. 2005), and 80% of remaining brushlands in Texas are unprotected and potentially threatened by clearance and/or development (Ramirez 1986; Rose and Judd 1989).

In the most recent comprehensive evaluation, Leslie (2016) updated earlier work and confirms 5% or less of the Tamaulipan Mixed Deciduous Thornscrub remains in the USA. Leslie (2016) also reported on the damage to the ecosystem done by border wall construction along the Rio Grande, noting the serious costs and difficulties faced by efforts toward restoring the original character of these anthropogenically altered habitats.

In Mexico, land use patterns changed from pastoral to more agricultural during the last decades of the 20th century. But within the Tamaulipan mezquital, changes from agricultural to woody vegetation regrowth are now documented for the recent decades (Bonilla-Moheno and Aide 2020).

More recently, oil and gas exploration within the Eagle Ford Shale has resulted in dramatic increases in roadways in a region of Texas characterized by lower overall disturbance prior to 2008. Since that time, the number of oilwell pads and the network of roadways for installation, maintenance, and distribution have grown exponentially (Parandhaman et al. 2026). Removal of habitat during construction has a larger footprint than the final oilwell pads, and the roadway networks support low traffic but are densely distributed.

Authorities have reviewed public roadways and evidence from other *Gopherus* populations to reach the conclusions that accidental mortality when crossing roads is frequent and may be a significant long-term threat (Gibbs and Shriver 2002; Rendón and Polaco 1996; Rose and Judd 2014). Roadway mortalities are exacerbated by vegetation management of the right-of-way. Vegetation mown short along roadways can attract tortoises, putting them closer to vehicular traffic or easily observed and captured by people. Invasive grasses (e.g., Buffelgrass [*Pennisetum ciliare*] and Guinea Grass [*Megathyrsus maximus*]) create



Figure 12. *Left:* An adult *Gopherus berlandieri* at risk of a vehicular strike as it walks down the tire rut of a two-track gravel road. Photo by Ross O. Couvillon. *Right:* An adult *Gopherus berlandieri* crossing a paved road in Texas. Photo by Akiko Fujii.

dense vertical rows along tire ruts of unimproved ranch roads, leading tortoises to travel within the tire locations of vehicular traffic (Briggs 2016).

The majority of south-central and extreme southern Texas remains as rural lands. These historically were large parcels (>200 ha), and this has been seen as beneficial to the tortoise populations within them. But threats related to these rural lands exist. Significant wire mesh fencing, particularly high fence installations (e.g., graduated net wire openings from 3 m down to ground level) result in mortalities of tortoises small enough to get caught in the mesh (Engeman et al. 2004). In some areas, tortoises are destroyed by ranch personnel as perceived predators of quail eggs (Rose and Judd 1989).

Humans directly utilize tortoises. While tortoises are eaten locally in Mexico, few tortoises are taken for consumption in Texas (Rose and Judd 2014). There has been some historical collection for the preparation of ornamental curios for sale in the tourist markets of Mexico (Rose and Judd 1989), but this seems to have stopped after passage and enforcement of NOM-059-SEMARNAT-2010, which is the Mexican regulatory standard making the tortoise a threatened animal in Mexico.

Historical exploitation of *G. berlandieri* for the pet trade has also occurred, with large numbers offered for sale in California and other markets during the 1960s and 1970s (E.V. Goode, pers. obs.). After tortoises gained protection within the USA under Texas law in 1967, tortoises were still sourced from Mexico (Rose and Judd 2014). Currently, the majority of direct use by humans is seemingly the opportunistic capture of individuals seeking a pet or erroneously believing that removing a tortoise from the roadside or public lands is a “rescue” of the individual. Many *G. berlandieri* are still kept as backyard garden pets in northeastern Mexico (E.V. Goode, pers. obs.). The annual increase in vacation travel to and from the Texas coast routinely results in the removal of many individual tortoises from wild populations.

Significant proportions of the distribution range of *G. berlandieri* in Texas and northern Mexico support introduced, non-native grasses that prevent growth of native vegetation. The issue is not only limited to non-protected, private ranches, as the introduced pasture grasses are known to escape intended areas. Long-term surveys spanning over a decade at the Palo Alto Battlefield National Historical Park (ca. 14 sq. km), a National Park Service unit located in southern Texas, have documented an increase in the prevalence of Guinea Grass on lomas over the years (Tuberville et al. 2026). These authors observed that tortoises were more likely to move from loma units with higher densities of the invasive grass to those with lower levels, and the overall abundance estimates of tortoises on this small park has dropped by 70%. Likewise, data on this invasive grass in Hawaii indicate that its fuel loading can contribute to altering the natural fire cycle, exacerbating wildfires when they occur (Ellsworth et al. 2013). However, it is also important to note that there has been a significant increase in development of the areas directly adjacent to the park (Mali and Forstner, pers. obs.), which suggests the likely cumulative effects of multiple stressors.

Gopherus berlandieri in all life history stages serves as an important food source for many native predators (Adams 2006, Legler and Vogt 2013, Cornaby et al. 2024). But, habitat disturbances, particularly prescribed fire and tilling, can remove or decrease cover which may increase predation rates (Cornaby et al. 2024). Tortoises are also likely to face threats from introduced Wild Boars (*Sus scrofa*), particularly endangering juveniles and nests. The presence of feral hogs is widely recognized as an extensive and growing problem throughout the state of Texas (Timmons et al. 2012). The Red Imported Fire Ant (*Solenopsis invicta*) could be an additional source of hatchling mortality. These ants have now spread to everywhere the tortoise is found in Texas (TDA 2021). Both of these potential sources of additive mortality should be better

characterized, with feral hog control efforts enabling gut content characterization or even fecal DNA diet testing.

Anticipated impacts from climate change are forecasted to affect southern Texas and northern Mexico in the coming decades. In general, models predict increasing drought frequency and intensity, coupled with fewer but more intense rainfall events (Nielsen-Gammon 2024). The outcomes of such climatic trends would fail to provide stable forage or habitat for the species and exacerbate the risks associated with intense wildfires. *Gopherus berlandieri* has temperature-dependent sex determination and oviposits in shallow excavated nest cavities. Temperature extremes are likely to be coincident with incubation periods, potentially impacting future sex ratios across populations. Survival of adults could be reduced as a result of increased thermal stress and increasingly severe and frequent droughts.

Diseases have been detected in wild populations (e.g., *Fusarium* sp. and *Mycoplasma* sp.) and represent relatively new areas of investigations (Moeller et al. 2025c). Previous reports include *G. berlandieri* susceptibility to western equine encephalitis in laboratory settings with 47% survival rate (Bowen 1977) and 28% prevalence of *Mycoplasma agassizii* in free ranging tortoises (Guthrie et al. 2013). The net impacts of these pathogens on wild populations remains unknown. Neck (1977) reported a case of cutaneous myiasis and evidence that bot flies can utilize previously injured skin of tortoises. While turtles in general are not prone to tumors, Zertuche-Pérez et al. (2026) reported a rhabdomyosarcoma in a captive *G. berlandieri* which is only the third such case in chelonians. This may be particularly important as the New World screwworm (*Cochliomyia hominivorax*) has been recently detected in south Texas.

Parasitism represents a poorly documented area of Texas tortoise research compared to other *Gopherus* species (McGuire et al. 2013; Huffman et al. 2018). Rose and Judd (2014) noted both hard and soft ticks associated with tortoises, but did not complete a formal study of prevalence. It is now confirmed that these ectoparasites do transfer known bacterial taxa to the tortoises when bitten (Medrano-Zapata 2024). Goff and Judd (1981) reported a large number of trombiculid mites, or chiggers (*Eutrombicula alfreddugesi*) attached on a wild adult female *G. berlandieri*.

Records for internal parasitism among wild *G. berlandieri* are likewise scarce. McAllister et al. (2008) reported roundworms (*Aleuris* sp.) in a specimen collected near Laredo, Texas, which provides a record from *G. berlandieri* explicitly after the reporting by Bouamer et al. (2001) and the initial work of Petter and Douglass (1976). There are reports for dense infestations of roundworms in this tortoise when held in captivity, and recent work seeking to repatriate captively held specimens (see below) has revealed captive tortoises are often affected.

Conservation Measures Taken. — The species is legally protected under Texas State law, which prohibits private or commercial uses. It remains the only *Gopherus* species that occurs in the USA that lacks federal protection. It has been listed on CITES Appendix II as Testudinidae spp. since 1977. The species has recently been officially reassessed for the IUCN Red List as Near Threatened (NT, A2c+4c) (Mali and Forstner, in press), although at the time of this writing it is still officially listed on the Red List as Least Concern (LC), based on an out-of-date assessment from 1996 (TFTSG 1996). It was also previously provisionally assessed as Near Threatened by the IUCN Tortoise and Freshwater Turtle Specialist Group in 2011 (Rhodin et al. 2018).

In Texas, secure populations of the species occur in the Laguna Atascosa National Wildlife Refuge (182 sq. km, IUCN cat. IV) and Welder Wildlife Refuge. There is a well-studied population on the Chaparral Wildlife Management Area (61 sq. km; Hellgren et al. 2000; Kazmaier et al. 2001a,b,c,d, 2002). This site experienced a fast-moving wildfire in 2008 that burned 95% of the landscape, illustrating that even protected areas can see dramatic changes. Studies remain underway to assess the short and longer-term impacts of the wildfire on tortoises.

In much of its Texas range, this tortoise occurs on large blocks of privately owned land where agriculture is limited and alternative land uses such as livestock grazing and recreational hunting can benefit tortoises. Certain managed grazing practices can favor these tortoises (Rose and Judd 1989). Kazmaier et al. (2001d) found no differences in a wide range of demographic parameters (e.g., relative abundance, age/size distribution, growth rates) between tortoises on ungrazed and moderately grazed areas. The control of woody brush encroachment, prescribed burns, and the overall maintenance of a heterogeneous vegetation community that is practiced to benefit game species, like White-Tailed Deer (*Odocoileus virginianus*) and Northern Bobwhite (*Colinus virginianus*), can also benefit tortoises (Couvillon 2017).

In Mexico, the species is federally listed as threatened, enabling protected status everywhere it occurs. It has habitat protections in both Federal and State level protected areas within Mexico. At the Federal level, the Área de Protección de Flora y Fauna Laguna Madre y Delta del Río Bravo (Tamaulipas) is more than 500,000 ha in total size, while the Parque Nacional Cumbres de Monterrey (Nuevo León) is even larger, but with less potential tortoise habitat. Also, within Nuevo León, the Área Natural Protegida Sierra de Picachos (Nuevo León) has recently expanded from ca. 75,000 to 175,000 ha and includes tortoise habitat in the lower elevations.

Conservation Measures Proposed. — Habitat protection for *G. berlandieri* remains incomplete across its range in the USA and Mexico. Although protected areas exist in both countries, the total area of protected sites

that currently support tortoise populations is unquantified. Consequently, a comprehensive inventory of protected areas containing tortoises in both nations is needed. Prioritization of future public land acquisitions that incorporate tortoise conservation objectives is also expected to bolster this species. In addition, native thornscrub habitats—the primary habitat for *G. berlandieri*—currently lack formal protections. Increasing public awareness of the ecological uniqueness and wildlife value of thornscrub ecosystems could encourage landowners and land stewards to adopt conservation-oriented management practices.

Effective land management strategies are also required to maintain and improve habitat quality. Collaboration among stakeholders and state management agencies could facilitate the development and testing of best management practices for optimal tortoise habitat, ultimately producing a framework applicable to a variety of habitat managers with different land use objectives. Such guidelines could then be implemented or evaluated alongside existing management activities. Implementation of land management practices should be coupled with long-term monitoring of tortoise populations. Coastal loma habitats should be protected from grazing. Brush clearance and tillage operations should include measures to avoid the direct mortality of tortoises. Control of invasive or problematic species represents another key management challenge. Many habitats in Texas contain invasive grasses, yet the extent of their impact on *G. berlandieri* remains poorly understood (but see Tuberville et al. 2026). While some management actions targeting invasive grasses are underway, research evaluating the effectiveness of these strategies and their outcomes for tortoise populations is lacking. Habitat restoration efforts could also benefit from clearer guidance that incorporates natural disturbance events (e.g., wildfires or flooding) into restoration planning. By assessing risks and balancing restoration efficiency with potential impacts on tortoises, land managers could better define optimal habitat conditions and management approaches.

Species-specific management actions are also necessary. Information on direct human utilization of the species, aside from the pet trade, is limited, and improved data on harvest or opportunistic collection would help clarify potential impacts. Repatriation programs represent a potentially valuable conservation tool, particularly because many tortoises are removed from the wild each year by well-intentioned but uninformed individuals. Developing, testing, and implementing protocols for safely returning these animals to wild populations could enable supplementation of existing populations or re-establishment of extirpated ones.

Efforts supported by Texas Parks and Wildlife Department have sought to obtain captive-held Texas Tortoises, waiving the potential for prosecution in events accepting the captives from the public. The most recent effort in Laredo, Texas (16 Aug 2025) accepted 180 individuals,

overwhelming expectations and predictions of captive tortoises held by the public. Similar attempts with less state support have occurred sporadically across the last four decades. The more recent effort is better developed and funded but will require continued investment and outreach to achieve a meaningful goal. Additionally, the large number of tortoises currently held by private individuals across Texas could eventually be leveraged for experimental or managed introductions in suitable areas outside the current range (i.e., northerly), particularly as climate change alters habitat suitability (Leslie 2016, Parandhaman et al. 2026).

Education and public awareness initiatives could significantly enhance conservation outcomes for the species. Wildlife officers in the USA often have broad responsibilities and limited time, which can make additional training on nongame species difficult; nevertheless, targeted professional development on tortoise conservation could improve awareness and enforcement. Public outreach presents an especially promising opportunity. Modern communication strategies—including social media, digital educational materials, and community outreach programs—could increase public engagement with the species and support conservation goals while strengthening relationships between management agencies and local communities. Road signage that communicates the detrimental impacts of removing tortoises encountered along roadways may also contribute to conservation outcomes. Since much of the private land holdings in Texas are considered working lands—areas actively managed for economic production—targeted outreach to ranch workers, energy industry personnel, land managers, and tourists could improve awareness and reduce human-related mortality.

Legal and policy frameworks also influence conservation effectiveness. In the USA, stronger standards and codes for species protection would likely depend on Federal recognition under the Endangered Species Act. At present, there is no national-level compliance or enforcement specifically directed toward this taxon in the USA, although Mexico provides such protections. Within Texas, state law protects the species, but greater awareness among wildlife officers and other personnel responsible for nongame resources would improve implementation and enforcement of these protections.

Economic incentives may further support conservation efforts. Much of the species' range in Texas consists of rural ranchlands that are increasingly subdivided into smaller parcels. Even small tracts can provide meaningful habitat if managed appropriately. Conservation incentive programs (e.g., wildlife tax valuation) tied to habitat management activities beneficial to *G. berlandieri*, could encourage private landowners to maintain or improve habitat conditions on their properties.

Several research priorities are essential for informed conservation planning. Taxonomic research using modern

genetic approaches may reveal population substructure within the species, potentially enabling more accurate population assessments and proper repatriation of captive tortoises. Long-term monitoring of population size, distribution, and trends is also critical, particularly in Mexico, where data are sparse. Coordinated range-wide surveys using standardized methods would improve global population estimates, while high-resolution population genomic studies could clarify patterns of migration and connectivity among remaining populations. Additional survey efforts in Mexican protected areas, including Cumbres de Monterrey National Park, Cerro de la Silla Natural Monument, and Sierra del Abra Tanchipa Biosphere Reserve, would be particularly valuable.

Research on life history and ecology remains a conservation need, especially in the area of disease ecology. Key concerns include keratinizing fungal infections caused by *Fusarium* sp. and respiratory diseases associated with *Mycoplasma* sp. Publication of modern microbial community analyses, including metagenomic assessments of microbial and viral communities, could improve understanding of pathogen distributions and threats across the species' range. Ongoing disease surveillance in Texas would benefit from the inclusion of comparable data from Mexico. Additional ecological research should examine the impacts of invasive grasses, woody plant encroachment, fencing, and habitat fragmentation on tortoise populations. For example, high fencing used in ranch management has been associated with initial increases in tortoise mortality during installation, but the long-term population-level consequences remain unclear (Rose and Judd 2014).

Socioeconomic research is equally important, given that the species occurs primarily on rural ranchlands rather than agricultural fields. Livestock ranching has historically coexisted with tortoise populations without documented negative impacts, provided appropriate stocking density and grazing management is adhered to (Kazmaier et al. 2001c). However, modern mechanized practices, large-scale land conversions, and intensive agriculture may present new threats. Collaborative research with landowners and stakeholders could identify management practices that minimize impacts on tortoises while maintaining economic productivity.

Further research should address broader threats, including habitat conversion, roadway impacts, and landscape fragmentation. Geographic information science approaches could quantify rates of habitat change across the species' range and identify regions experiencing particularly rapid transformation. Road mortality studies could help estimate population declines associated with vehicular traffic and serve as a proxy for fragmentation effects.

Additionally, evaluations of conservation and restoration actions coupled with comprehensive conservation planning is currently lacking for *G. berlandieri*. Unlike several other *Gopherus*, this species does not yet have

a formal action or recovery plan outlining conservation priorities. Developing such a plan would provide a structured framework for coordinated management efforts. Area-based management planning may also be necessary because habitat disturbances and anthropogenic impacts vary considerably across the species' range. Regional conservation strategies informed by land-use forecasts could help identify areas with differing threat levels and management priorities. Although regulated harvest or trade is not recommended, management strategies addressing opportunistic collection by individuals should remain a priority for state wildlife agencies. The outcomes of all conservation and restoration actions should be evaluated to inform best practices.

Finally, long-term monitoring programs are needed to track conservation outcomes. Some sites already maintain multi-decadal datasets on tortoise populations, and expanding those monitoring efforts by revisiting historically studied locations may provide valuable insights into population trends over longer timescales. Comprehensive assembly of unpublished or "gray literature" datasets from past research would further strengthen these assessments. Monitoring should also address informal harvest trends, the presence of the species in the pet trade, and habitat changes across the distribution. Together, these monitoring efforts would provide the data necessary to evaluate conservation strategies and guide adaptive management for *G. berlandieri*.

Captive Husbandry. — Guidelines for the care of inadvertent captives of *G. berlandieri* are not available as they are for *G. agassizii* (McKeown et al. 1993; Johnson et al. 2001). Such guidelines can be seen to "legitimize" captive care of the species despite legal protections. *Gopherus berlandieri* is protected under State law in Texas and Federal laws in Mexico and should not be held in captivity. Though the species cannot be held by private citizens within their range, it is routinely kept. Additionally, wildlife rehabilitators have a need for accurate care information, and translocations may become a more formalized conservation strategy for the species. Thus, their care in captivity remains relevant to conservation stewardship.

The following outline of care is appropriate to areas within the existing natural distribution of the species; however, these guidelines are not likely applicable north of San Antonio, Texas, as the species is not adapted to the lower winter temperatures in regions north of its native distribution. Historically, specimens of *G. berlandieri* have not acclimated well to captive environments outside their native range, and should in general not be kept *ex-situ* beyond their range (E.V. Goode, pers. obs.).

Considering many individuals in captivity were opportunistically collected along roadways, the people caring for them are likely not proficient in proper reptile husbandry. Possible inadequacies in care include poor

management of diet, UV exposure, temperature regime, and humidity. Such shortcomings can contribute to metabolic bone disease, growth deformities, and overall poor body conditions. Key to their successful maintenance is a strong focus on nutrition, hydration, and environmental conditions that match their native range.

The species needs to be able to achieve basking temperatures (warmer than ambient daytime exposures) and ambient temperatures that are between 25–32°C daily (Kiel 2025). While these temperatures are exceeded routinely, even daily in its native habitats, the microclimate choices the species makes enable it to stay within these safe temperature boundaries. The species requires UVB lighting for successful calcium metabolism, and if the species is held indoors this requires appropriate artificial UVB sources with routine bulb replacement (normally 6–12 month replacement cycle).

Both indoor and outdoor maintenance must not permit overly wet conditions. Sandy loam or non-ingestible substrates with good drainage, and maintenance of overall low humidity are key. Tortoises should be offered sufficient room for daily movement with access to various hiding spots. The elements of an outdoor tortoise enclosure will determine how capable captives are at enduring the cold temperatures of winter. Enclosures offering sufficient vegetation cover and retreats will mostly allow tortoises to overwinter outdoors (presuming the location is within the species' native distribution). This is especially so if underground hiding spots are available, which would offer similar conditions as those found in the Southern Plains Woodrat (*Neotoma micropus*) middens these tortoises will naturally use. For such underground refuges, well-draining soil is crucial. Tortoises offered free roam of their caregiver's backyard will have fewer options for choosing an appropriate site during cold weather, especially if the yard's vegetation is well manicured. In either situation, tortoises will need to be further protected from near-freezing temperatures, especially in the latter case. This may require bringing tortoises indoors into temporary holdings during periods of near freezing weather, particularly when a warm day is followed by extreme drop in temperature.

If individuals are held outside of the subtropical climate characteristic of the natural range of *G. berlandieri*, indoor winter accommodations will be essential and potentially necessary for the entire season. Failing to do so can result in individuals surviving a freeze event but suffering paralysis as a result of the spinal cord freezing in exposed areas of the carapacial dome. If overwintered inside, careful attention to hydration and humidity are required to prevent desiccation. These individuals may be reticent to feed during this period.

This species requires high-fiber, low-protein forage. Leafy greens, native grasses or forbs, including cactus fruits or pads, should make up the majority of the diet.

Supplemental calcium (calcium carbonate) dusting of foods will benefit juveniles as they grow, but is also important for adults. Seemingly innocuous human greens, such as spinach or beet greens, are oxalate-rich and should be avoided. Finally, fresh water filled to a shallow depth (enough to submerge the plastron) can be provided and should be kept clean and changed daily.

Individuals in captivity should never be released to the wild by individuals. Captive individuals can obtain and maintain diseases dangerous to the wild populations. Often small enclosures can result in intestinal parasite reinforcement cycles as the contaminated feces recycle increasing parasite loads into the tortoise. Any ill or diseased tortoise should receive care from a qualified veterinarian.

Current Research. — This species continues to be understudied in comparison to other *Gopherus*, or other taxa that are as susceptible to decline. While it remains the only *Gopherus* that lacks Federal protection in the USA, it is also seeing renewed research efforts in Texas. Shawn McCracken (Texas A&M University, Corpus Christi) is leading investigations concerning *Fusarium* sp. prevalence, population genomics, and current population abundance. His group recently evaluated the presence and potential pathology of *Mycoplasma* sp. in Texas. This pathogen has had strong negative effects in *G. agassizii* but has generally not been quantified among *G. berlandieri*. Current and planned long-term studies are examining population connectivity, particularly the effects of roadways on tortoise movement and high fencing that is impassable to tortoises and may pose substantial thermal risks in southern Texas. There will be potential to integrate new population genomic results with landscape changes, such as habitat loss or degradation (e.g., spread of invasive grasses). Finally, Texas Tortoises surrendered by the public (see Conservation Measures section) are being assessed and then, if suitable, will be placed into soft release enclosures within habitat and monitored, before their intended return to the wild.

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