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Pseudemys texana Baur 1893 –
Texas Cooter, Texas River Cooter

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Pseudemys texana Baur 1893 – Texas Cooter, Texas River Cooter

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SUMMARY. – The Texas Cooter, *Pseudemys texana* (family Emydidae), is a large-bodied, primarily herbivorous freshwater turtle endemic to central and south-central Texas, USA. Maximum recorded straight-line carapace length (SCL) is 29.4 cm for males and 34.4 cm for females. The species exhibits pronounced female-biased sexual dimorphism, rapid juvenile growth, and delayed maturity, characteristics typical of long-lived freshwater turtles. Males attain sexual maturity at approximately 15.4 cm SCL and about 4.4 years of age, whereas females mature at approximately 24.2 cm SCL and about 7.2 years of age. Nesting occurs primarily from late March through summer, with most activity concentrated in April through June. Females typically produce one to two clutches annually, although some individuals are capable of producing three clutches within a season. Clutch size ranges from 3 to 22 eggs, with most clutches containing approximately 8 to 10 eggs. Eggs average about 42 mm in length and 27 mm in width, and incubation periods generally range from 80 to 150 days depending on environmental conditions. Hatchlings are typically about 35 to 40 mm SCL at emergence and exhibit the bright green coloration and distinct yellow striping characteristic of juvenile river cooters. The species is strongly associated with rivers and spring-fed systems but also occurs in reservoirs, impoundments, canals, and stock ponds where aquatic vegetation is abundant. Life-history information is best known from long-term studies at Spring Lake in the San Marcos River headwaters and from surveys at Comal Springs–Landa Lake. These studies document high local abundance, nest-site fidelity, multiple clutching, and substantial spatial and demographic variation among populations. Recent mark-recapture studies and growth modeling have further quantified somatic growth patterns, maturity schedules, and population dynamics. *Pseudemys texana*, like its counterparts in the genus, has been documented attaining exceptionally high densities in spring-fed headwater systems. The species is currently assessed as Least Concern on the IUCN Red List, but localized threats include alteration of river flow regimes and shorelines, degradation of water quality, increasing recreational pressure and boat strikes, loss of nesting habitat, subsidized nest predation, commercial and pet-trade pressures affecting freshwater turtles in Texas, and emerging infectious diseases.

DISTRIBUTION. – USA. Endemic to Texas; occurs in the Brazos, Colorado (including the Concho, Llano, and San Saba), Guadalupe, San Antonio, and Nueces watersheds.

SYNONYMY. – *Pseudemys texana* Baur 1893, *Chrysemys texana*, *Pseudemys floridana texana*, *Pseudemys concinna texana*, *Chrysemys concinna texana*.

SUBSPECIES. – None recognized. The species was at times in the past considered a subspecies of either *Pseudemys floridana* or *Pseudemys concinna*.

Status. – IUCN 2026 Red List: Least Concern (LC; in press); Previously: Least Concern (LC; 2011); CITES: Not listed; Texas: Statewide harvest restrictions for freshwater turtles (2026).

Taxonomy. — Baur (1893) described the Texas Cooter, *Pseudemys texana*, based on a specimen (ANSP 246; Malnate 1971, Iverson 2022) from San Antonio, Texas. The generic name *Pseudemys* Gray, 1856, is derived from the Greek *pseudes* (false) and *emys* (freshwater turtle

or pond tortoise), while the specific epithet *texana* is a Latinized adjective meaning “of Texas,” referring to the region encompassing the type locality (TTWG 2025).

The name *Pseudemys concinna metterii* has at times been associated with the type material of *P. texana*, but



Figure 1. Adult Texas Cooter, *Pseudemys texana*, Cypress Bend Park, Guadalupe River, Comal Co., Texas, USA. Photo by Peter V. Lindeman.

current taxonomy treats *P. texana* as the valid name for the Texas populations (Bever 2009; Iverson 2022; TTWG 2025).

Pseudemys texana has remained recognized as a distinct taxon since its description, but has a history of being placed for a while in the genus *Chrysemys* and occasionally treated as a subspecies of either *Pseudemys concinna* or *P. floridana* (Conant 1958; Dixon 2013). Ward (1984) elevated the taxon to species rank. Phylogenetic work supports distinct lineages within *Pseudemys*, although results differ by marker choice and sampling. Based on two mitochondrial fragments, Jackson et al. (2012) found support for monophyly of *P. texana* with caution about broader taxonomic inferences, whereas Spinks et al. (2013) found complex, non-monophyletic

patterns within the genus based on mitochondrial and nuclear loci. Recent genome-scale phylogenomic work has produced a robust phylogeny for the world's turtles that recovers all 14 extant families, including Emydidae, as monophyletic and places the family within a broader reconstruction of turtle diversification (Thomson et al. 2021).

Current global checklists and the greater taxonomic community recognize *P. texana* as a valid species endemic to Texas (TTWG 2025). Despite mitochondrial non-monophyly in portions of the genus, *P. texana* remains distinguishable morphologically and geographically. No published study has assessed genetic structure across *P. texana* populations from the Brazos, Colorado, Guadalupe, and Nueces drainages; the drainage-level di-



Figure 2. Adult Texas Cooter, *Pseudemys texana*, South Llano River, Kimble Co., Texas, USA. Photos by Peter V. Lindeman.



Figure 3. Adult Texas Cooter, *Pseudemys texana*, South Llano River, Kimble Co., Texas, USA. Photo by Peter V. Lindeman.

vergence recently documented in its congener *P. gorzugi* (Vandeweghe et al. 2024) suggests comparable structure is plausible and remains an open question for this Texas endemic.

Description. — *Pseudemys texana* is a large emydid turtle exhibiting pronounced sexual dimorphism, with females attaining substantially larger body sizes than males. Maximum reported straight-line carapace lengths (SCL) are 29.4 cm for males and 34.4 cm for females (Munscher and Franklin, 2019; Siders et al. 2023; TTWG 2025). Body size varies geographically, with turtles from the South Llano River generally smaller than those inhabiting the spring-fed headwaters of the Comal and San Marcos river systems (Lindeman 2007; Munscher et al. 2019; Siders et al. 2023). In addition, females possess proportionally longer plastrons relative to shell length, whereas males are distinguished by elongated foreclaws, proportionally longer tails, and a cloacal opening positioned posterior to the rear margin of the carapace (Ernst and Lovich 2009; Lindeman 2007; Earls 2022; Siders et al. 2023).

The carapace of adult *P. texana* is typically olive to dark brown and marked with intricate yellow reticulations, whorls, or vermiculations, while the head, neck, and limbs bear conspicuous yellow striping. The species is distinguished from other members of the genus by its combination of a relatively low-profile, oval to pear-shaped carapace; intricate yellow reticulations, concentric whorls, and ocelli on the pleural and marginal scutes; and a distinctive head pattern consisting of a prominent postorbital stripe and broad vertical yellow bar behind the angle of the jaw. The second pleural scute typically bears five to six concentric yellow whorls with dark centers, a feature frequently cited as characteristic of the species. The upper jaw possesses a distinct medial notch flanked by tooth-

like cusps, and adults commonly develop longitudinal rugose striations on the pleural scutes. Adult males often become increasingly melanistic with age while retaining a reticulated shell pattern.

Pseudemys texana generally exhibits more extensive reticulated shell patterning, greater geographic variation in coloration, and a unique combination of head-stripping characters that distinguish it from congeners, particularly *P. gorzugi*, and populations historically assigned to *P. concinna*.

Hatchlings and small juveniles differ markedly from adults in coloration and pattern. Hatchlings are generally bright green to olive-green, with a nearly circular carapace bearing well-defined yellow to yellow-orange markings on each vertebral and pleural scute. The head, neck, limbs, and tail are marked with vivid yellow stripes that are often more contrasting than in adults. The plastron is yellow to yellow-orange and typically lacks extensive dark pigmentation. As growth proceeds, juvenile coloration gradually darkens, carapacial patterning becomes less distinct, and older individuals develop the darker olive-brown coloration characteristic of adults.

During a 10-year mark-recapture study at Comal Springs, Texas, 13 hatchlings measuring 35–45 mm straight-line carapace length were captured, indicating that individuals of this size occur within the population at or shortly after emergence (Munscher et al., unpubl. data).

In addition to the species' distinctive external morphology, *P. texana* possesses a diploid chromosome



Figure 4. Young juvenile Texas Cooter, *Pseudemys texana*, Texas, USA. Photos by James H. Harding.

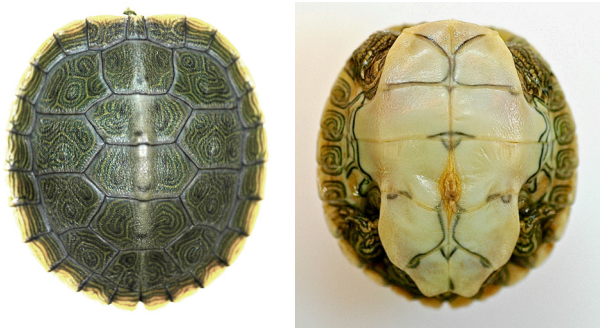


Figure 5. Hatchling Texas Cooter, *Pseudemys texana*, Texas, USA. Photos by Francis L. Rose.

number of 50 ($2n = 50$), including 26 macrochromosomes and 24 microchromosomes, a karyotype typical of many emydid turtles (Killebrew 1977).

Long-term mark-recapture studies indicate rapid juvenile growth followed by a marked decline in growth rate after maturity, resulting in asymptotic growth trajectories in older individuals rather than lifelong indeterminate growth (Rose et al. 2026). Morphological studies have also shown substantial ontogenetic and sexual dimorphism in cranial morphology, with body size, skeletal maturity, and individual variation contributing significantly to skull shape and proportions within the species (Lindeman 2007; Bever 2008, 2009; Ernst and Lovich 2009; Dixon 2013).

The skull of *P. texana* is lightly built, with extensive temporal and cheek emargination, large orbits, a short antorbital region, a short crista supraoccipitalis, and broad, complex triturating surfaces. The cranial bones remain thin even in the largest specimens and lack the heavy sculpturing seen in more robustly built turtles such as *Chelydra*. The dermal skull roof is typical of cryptodires, and cranial scutes are consistently absent (Bever 2008, 2009). During postnatal ontogeny, the skull more than quadruples in length, from approximately 13 mm to more than 50 mm, with the largest specimens, all female, reflecting the species' marked sexual size dimorphism (Ward 1984). Dermal bones attain their adult shape early, whereas the endochondral elements of the otic capsule and neurocranium mature more slowly. Skull shape changes little with growth, as most dimensions scale with negative allometry (Bever 2009). Proportionally large juvenile features, including the orbits, braincase, and optic capsule, persist into adulthood, while only the jaw triturating surfaces scale positively, becoming wider and more complex (Bever 2009). The adult skull therefore retains a strongly juvenile-like appearance.

The sexes follow similar growth trajectories, and adult females, though larger, are skeletally less mature than males, showing delayed closure of features such as the costoperipheral, otic, and ectepicondylar fontanelles (Bever 2009).

Distribution. — *Pseudemys texana* is endemic to Texas, USA. It occurs in the Brazos, Colorado (including

the Concho, Llano, and San Saba rivers), Guadalupe, San Antonio, and Nueces watersheds. The estimated historical indigenous area of occupancy (AOO) was ca. 102,815 sq. km, and the estimated historical indigenous extent of occurrence (EOO) was ca. 122,528 sq. km (TTWG 2025; Gordon et al., in press).

Across its range, the species is documented from low elevations near 2 m to upland river reaches approaching 777 m above sea level. Extralimital observations are best interpreted as human-mediated releases (pet releases or translocations) rather than established native populations. The absence of the species from the eastern Texas coastal plains should be noted, as it is in close proximity to the congeneric *P. concinna* complex, which reinforces historical isolation and *P. texana* as a distinct species.

Habitat and Ecology. — The Texas Cooter primarily inhabits rivers and larger streams, but also uses reservoirs, impoundments, cattle tanks, canals, and irrigation ditches, particularly where aquatic macrophytes and basking sites are abundant (Etchberger and Iverson 1990; Vermersch 1992; Ernst and Lovich 2009; Earls 2022). In spring-fed systems, turtles may aggregate at high densities in clear water with dense vegetation beds and silty substrates (Vermersch 1992; Munscher et al. 2019; Rose and Mali 2023).

At Spring Lake, *P. texana* occupies shallow water (<1 m) most frequently in summer and fall but shifted toward 1–3 m and >3 m depths in winter and spring, with depth use differing between the sexes (Osborne 2006). Together with the shared use of basking structures documented among *P. texana*, *Trachemys scripta elegans*, and *Graptemys pseudogeographica kohnii* in Waco Creek (Bardwell 2013), these observations suggest the potential for habitat partitioning among sympatric emydids, although formal quantification of depth partitioning among these taxa remains lacking. While habitat use and preference of *P. texana* is well known through long-term monitoring efforts in easily accessible and urbanized portions of its range (Munscher et al. 2019; Rose et al. 2020; Rose and Mali 2023), little is known about habitat preferences in less disturbed and more natural areas.

Diet. — The diet of *P. texana* is predominantly herbivorous, primarily composed of submerged aquatic macrophytes and algae, with a smaller invertebrate component that may be incidental or method-dependent in diet studies (Seaman 1997; Lindeman 2001, 2007; Fields et al. 2003; Piña 2012). At Spring Lake (including the San Marcos River headwaters), stomach-content studies documented plant-dominated diets and selective foraging on Carolina fanwort (*Cabomba caroliniana*), while the invasive exotic Hydrilla (*Hydrilla verticillata*) was an important food item where abundant (Seaman 1997; Fields et al. 2003).

As with congeners, juveniles may ingest proportionally more animal matter than adults before shifting toward

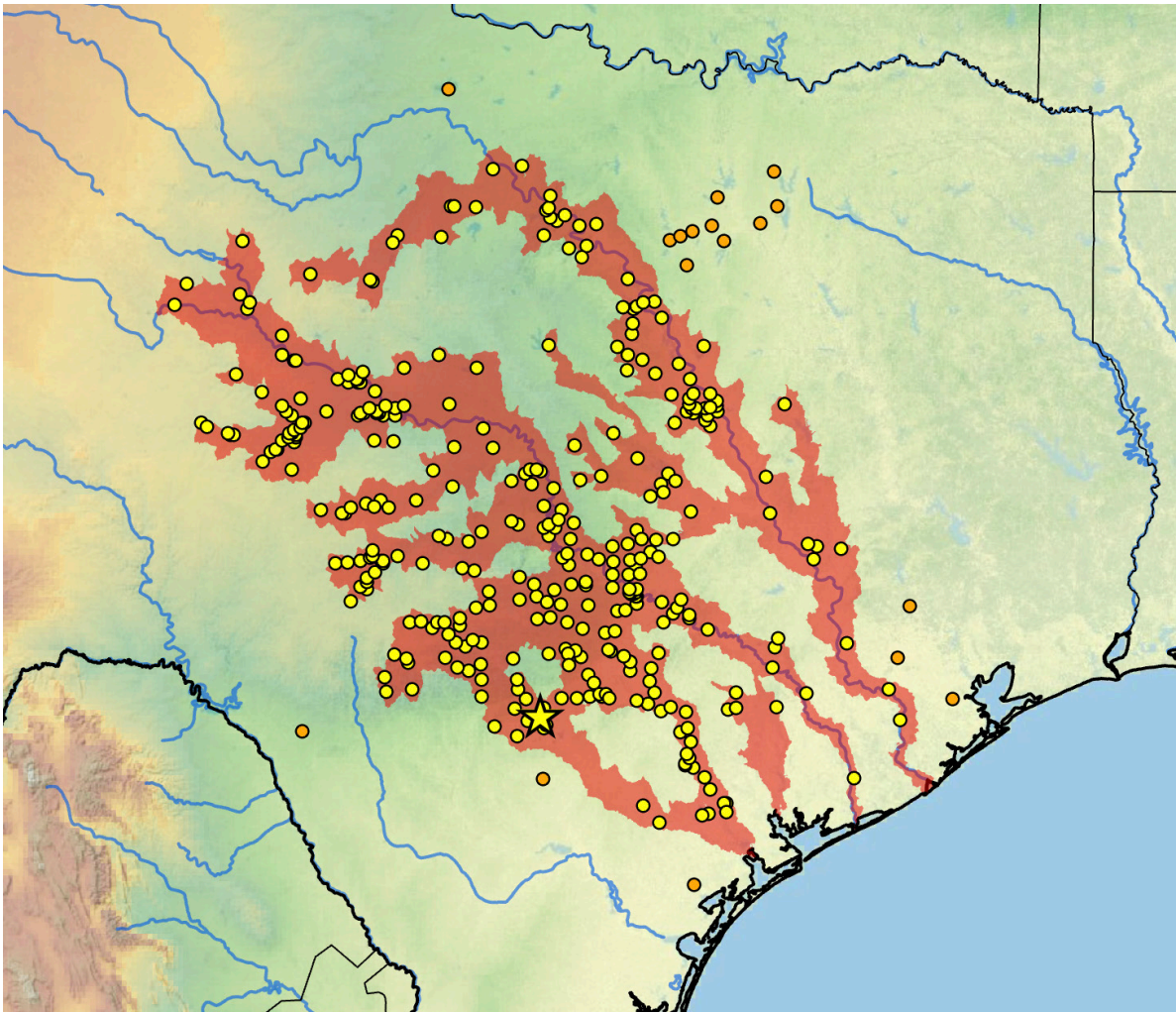


Figure 6. Estimated historical indigenous distribution of the Texas Cooter, *Pseudemys texana*, in Texas, USA. Yellow dots = museum and current and historical occurrence records of presumed native populations based on literature and online records (TTWG 2025); orange dots = presumed translocated or introduced non-native records; yellow star = type locality for *Pseudemys texana* Baur 1893. 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 from the authors. Map by Chelonian Research Foundation.

a more herbivorous diet with increasing size and age (McCauley and Bjorndal 1999; Bouchard and Bjorndal 2006). In the South Llano River, Lindeman (2007) documented higher than expected presence of animal taxa in the diet, but noted that this may have been a byproduct of assessment techniques.

Activity and Behavior. — *Pseudemys texana* is a predominantly diurnal, basking freshwater turtle whose activity and behavior are affected by season, thermal conditions, and habitat structure. Basking serves important thermoregulatory and physiological functions and typically occurs on emergent structures such as logs, fallen branches, shoreline banks, and low woody debris adjacent to aquatic vegetation beds (Ernst and Lovich 2009). Basking behavior is generally aggregative rather than agonistic. Individuals commonly bask in loose groups on shared structures where suitable sites are limited, with

little evidence of overt aggression or spatial exclusion, a pattern consistent with other large bodied *Pseudemys* species (Ernst and Lovich 2009).

Group basking may confer thermoregulatory advantages or reflect high local densities in favorable habitats, particularly in clear spring systems where visual detection is high and basking substrates are predictable (Bulté and Blouin-Demers 2010). Observations from Waco Creek demonstrated that *P. texana* frequently shared basking structures with *T. s. elegans* and *G. p. kohnii*, suggesting that basking site selection is influenced by both habitat availability and interactions with sympatric freshwater turtles (Bardwell 2013).

In non-spring-fed habitats, basking activity appears to be seasonally variable, with higher basking intensity during spring and early summer when water temperatures remain cooler and reproductive activity is elevated, and

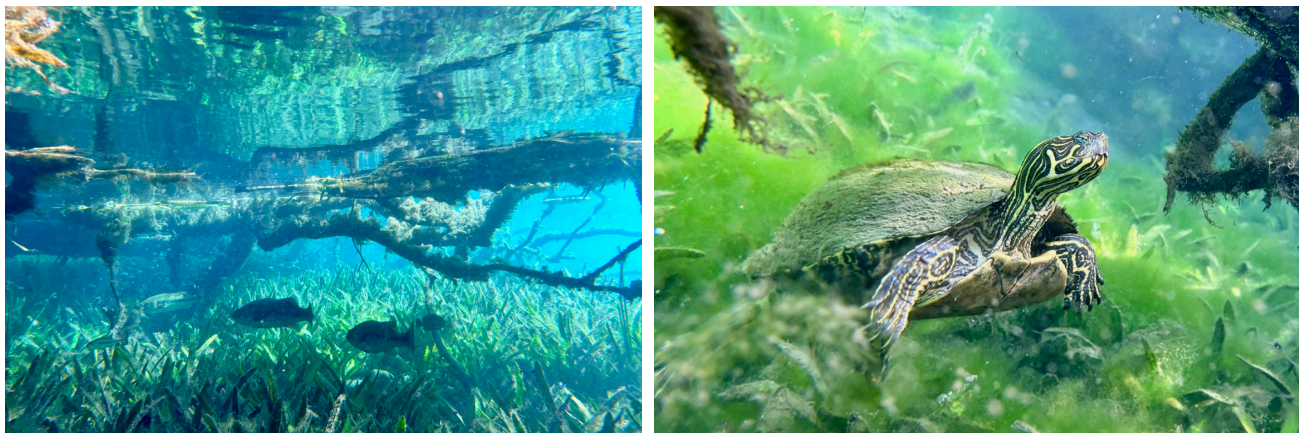


Figure 7. Underwater habitat used by *Pseudemys texana* at Comal Springs, New Braunfels, Texas. Photos by Ethan Owen.

reduced surface activity during periods of high summer water temperatures (Munscher, unpubl. data).

In spring-fed systems, where thermal regimes are relatively stable year-round, turtles may remain active either basking or at the surface for longer seasonal windows, and true winter dormancy is often reduced or absent (Ernst and Lovich 2009). Lindeman (2007) noted frequent basking and active foraging behavior throughout the warmer months in the South Llano River, suggesting that seasonal activity in riverine populations primarily reflects temperature and hydrologic variation rather than strict calendar constraints.

Responses to human presence vary with habitat context and the degree of exposure to disturbance. In relatively undisturbed river reaches, basking turtles often exhibit rapid flight responses, entering the water when approached at moderate distances. In contrast, turtles inhabiting heavily used spring systems and urbanized shorelines may exhibit reduced flight-initiation distances and greater tolerance for close human activity, likely reflecting habituation rather than innate behavioral differences (Polich and Barazowski 2016). Nevertheless, even in human dominated systems, sudden movements, boat traffic, or shoreline approach can elicit diving responses, potentially reducing basking opportunities in areas with intense recreational use (Ernst and Lovich 2009).

Age and Size at Maturity. — Traditional summaries indicate males mature at smaller sizes (≥ 9 cm SCL) and younger ages than females (ca. 22–24 cm SCL; Lindeman 2007). Recent growth-based modeling provides derived minimum ages and sizes at maturity of 4.4 years and 15.4 cm SCL for males, and 7.2 years and 24.2 cm SCL for females (Siders et al. 2023). Generation time for the species is estimated at about 15 yrs, based on female maturity at 7–8 yrs (Iverson 2024). Rose (pers. comm. to Iverson) reported longevity of at least 29 years; however, based on the longevity equation in Iverson (2024) for maturity at 7.2 years, longevity of *P. texana* would be estimated to be ca. 57–58 years.

Nesting Season and Clutch Frequency. — Long-term observations at the San Marcos headwaters show nesting from late March and April through summer, with multiple clutches within seasons (Rose 2011; Mali et al. 2014; Rose and Mali 2023). Mali (2010) noted that at least 30 individually monitored females produced a second clutch, confirming that multiple clutching occurs in the Spring Lake population. Rose (2011) documented 134 *P. texana* nesting events during the 2008 season at Spring Lake, finding that 82.8% of females nested once, 15.7% nested twice, and 1.5% nested three times, with an average inter-clutch interval of approximately 30 days between first and second clutches. During the 2009 season, 46% of nesting females produced a second clutch and a small number produced a third clutch (Mali et al. 2014), demonstrating annual variation in reproductive output. Larger females generally laid larger clutches and produced heavier, wider eggs, whereas mean egg mass, egg length, and egg width decreased in successive clutches laid within the same season, indicating reduced maternal investment later in the nesting season (Mali 2010; Mali et al. 2014).

Rose and Mali (2023) combined sequential annual datasets (2008–2010) from Spring Lake and found that many females nested repeatedly across years, confirming that multiple clutching is a regular component of the reproductive strategy of this population. Relative clutch mass (clutch mass/gravid female body mass) is estimated at 10.0–14.8% (Iverson et al. 2025), among the highest values for a cryptodiran turtle (Iverson and Greene 2022).

Nest-Site Selection and Survival. — Nesting data for *P. texana* are primarily available for anthropogenically altered nesting habitats at Spring Lake, primarily golf-course and managed shoreline settings. Thermal monitoring of nesting females showed that most nesting activity occurred during May, with 68.9% of monitored *P. texana* completing nests during that month. Most females emerged when water temperatures were between 22 and 26°C and ground-surface temperatures ranged from 20 to 35°C (Flores 2012).



Figure 8. Habitats used by *Pseudemys texana* in Texas. **A.** Guadalupe River at Monathalia; the species is commonly observed in this river, basking on the abundance of in-stream structures. **B.** Guadalupe River at Kerrville; this part of the river has abundant shoreline aquatic vegetation used for food and cover. **C.** San Marcos River at Prairie Lea; one of two spring-fed rivers in Texas where the species has large, well-documented populations. **D.** Blanco River in Wimberley; more of a limestone and clay-bottomed system. **E.** Landa Lake, headwaters of Comal Springs in New Braunfels. **F.** Slow-moving, clear water of the San Marcos River near Martindale. **G.** Moderately clear water, Guadalupe River system near Kendalia; the riparian zone contains both exposed rock for basking and overhanging trees for cover. **H.** Clear water with forested stream corridor and large rocks in the Blanco River near Fischer. Photo of Landa Lake (E) by Ethan Owen, all others by Jesse Meik.



Figure 9. Basking behavior by *Pseudemys texana* near La Costa, Medina County, Texas; also note the native Red-eared Slider, *Trachemys scripta elegans*, basking on the same log. Photos by Jesse Meik.

Washington (2008) monitored 122 nests across two nesting seasons (2006–2007) and documented substantial raccoon predation on unprotected nests (59% overall), with a large amount of predation occurring within two days of oviposition. Protected nests yielded live hatchlings in 46% of cases after excavation, while failures were associated with moisture extremes, ants, or incomplete development. Washington (2008) also documented nest-site selection relative to random points and reported nesting distances of 15–154 m from water (mean 84 m), with most nests in grass and under moderate canopy cover. Over a 20-year dataset from the same system, females exhibited nest-area fidelity within and among years, selecting nesting quadrants non-randomly (Rose et al. 2020).

Clutch and Egg Sizes. — Clutch size in *P. texana* is variable across populations. Preliminary data from the South Llano River indicated clutch sizes of 7–9 eggs (mean = 8.3 eggs) based on radiographed females, with egg dimensions averaging 42.2 mm in length and 27.0 mm in width (Lindeman 2001). Subsequent analyses from the same population reported a mean clutch size of 8.7 eggs (range = 4–16 eggs) and further documented variation in egg size and reproductive potential among females (Lindeman 2007). Studies from Spring Lake documented an overall clutch-size range of 3–22 eggs across multiple nesting seasons (Rose 2011; Mali et al. 2014).

In South Llano River samples, eggs averaged 41.9 mm in length (range = 36.7–44.7 mm) and 26.9 mm in width (range = 25.0–27.6 mm) (Lindeman 2007). Rose et al. (1996) further documented allometric relationships between egg dimensions and egg volume, demonstrating that *P. texana* produces the elongated eggs characteristic of River Cooters and providing predictive equations relating egg measurements to volume. Reproductive analyses from Spring Lake showed that mean egg mass, egg length, and egg width declined in successive clutches laid by the same female during a nesting season (Mali 2010; Mali et al. 2014).

Incubation Time. — Incubation duration is strongly influenced by temperature and moisture conditions and generally decreases as incubation temperature increases (Hennig 2020). Hatchlings emerge during late summer and autumn, with emergence timing varying among populations and environmental conditions. Incubation periods have been reported to range from approximately 80 to 150 days, depending on temperature and environmental conditions (Vermersch 1992; Kreuger and Janzen 2023).

Sex Determination. — Temperature-dependent sex determination is presumed to follow the TSD Ia pattern typical of emydid turtles, in which warmer incubation temperatures produce females and cooler temperatures produce males, with a pivotal temperature near 28°C (Ewert et al. 2004).

Predators. — *Pseudemys texana* adults are large and relatively heavy-bodied and are not generally depredated, but hatchlings are susceptible to many predators, and eggs in nests are particularly susceptible to depredation by Raccoons (*Procyon lotor*) and other predators, including Virginia Opossums (*Didelphis virginiana*), Skunks (*Mephitis* sp.), and Nine-banded Armadillos (*Dasypus novemcinctus*).

Parasites. — In addition to bacterial and viral pathogens, *P. texana* is known to host protozoan parasites. McAllister and Upton (1992) described a novel species of *Eimeria* from wild Texas River Cooters collected in north-central Texas, providing evidence of a specialized coccidian parasite associated with the species. Subsequent surveys in the Concho Valley documented three species of acanthocephalans (*Neoechinorhynchus emydis*, *N. emyditoides*, *N. pseudemydis*) in *P. texana*, with *N. emyditoides* occurring at a prevalence of 71%, along with several genera of intestinal nematodes (Easley 2022). These records establish *P. texana* as a host for a range of parasites, though their effects on individual condition and population dynamics have not been assessed.

Population Status. — The Texas Cooter is widely distributed within its endemic range and regarded as locally abundant in suitable habitats; however, quantitative population estimates remain localized to intensively studied sites affected by urbanization, recreation, and other anthropogenic factors.

Comal Springs–Landa Lake. — Intensive snorkel-based hand capture surveys conducted between 2012–2015 documented high abundance for *P. texana* within a 1.77-km spring-run segment of a heavily urbanized and reengineered section of Comal Springs–Landa Lake. Densities were found to be as high as ca. 230 individuals per hectare and an estimated 1,848–2,013 individuals in that spring system (Munscher et al. 2019). More recent analysis of the long-term (2012–2022) mark–recapture dataset from the same site indicated that adult *P. texana* began declining around 2015 and that juvenile detections were low throughout monitoring efforts and nearly absent after 2019, consistent with limitation of recruitment in this urbanized spring system with extensive shoreline armoring affecting nesting habitat availability (Munscher et al. in review).

Because of its large adult body size, *P. texana* accounts for a substantial proportion of turtle biomass within Comal Springs–Landa Lake. Analysis of long-term capture records from 2012–2022 produced an observed standing crop biomass estimate of 57.4 kg/ha (Munscher et al. in review). Observed biomass was highest during the mid-study period, peaking in 2014, and subsequently declined in parallel with reductions in estimated population size. These results suggest that changes in the ecological contribution of *P. texana* to the spring ecosystem may be greater than indicated by abundance estimates alone, because larger-bodied turtles disproportionately influence standing crop biomass.

Available data suggest that adult sex ratios are approximately balanced in *P. texana*. At Comal Springs, 323 males and 311 females were captured during a multi-year study, resulting in an observed sex ratio near 1:1, which is generally indicative of a stable and healthy population (McKnight et al. 2025; Munscher et al. 2019, in review). The authors also found that *P. texana* had high initial numbers of unsexed neonates (typically 10 or more per sampling event, but less than five per event after late 2017, and only eight neonates were detected since late 2018 (Munscher et al., in review). The lack of unsexed neonates and the lack of new adults indicate that recruitment failure was likely occurring in Comal Springs.

Spring Lake (San Marcos River Headwaters). — A long-term marking program at the 8-ha Spring Lake documented more than 2,000 marked individuals between 1995 and 2022, making it the longest-running demographic study of *P. texana* (Rose and Mali 2023; Rose et al. 2026). Additional visual survey work along a 9-km stretch of the San Marcos River estimated densities

of 9.5 adults and 2.1 juveniles per river-km (Bailey et al. 2014). Although population density and standing-crop biomass have not been quantified for Spring Lake using mark–recapture methods, the large number of marked turtles accumulated over nearly three decades indicates a substantial and persistent population within the San Marcos headwaters.

Colorado River Tributaries (Bull Creek). — A multi-year mark–recapture study (2016–2021) in Bull Creek, a tributary to Lake Austin in the Colorado River drainage (Travis County), found *P. texana* to be the numerically dominant native turtle (42.2% of captures) and reported a Chapman-modified Lincoln–Petersen point estimate of $n = 394$ for *P. texana* within the study reach (Munscher, unpubl. data). Adult sex ratios were strongly male-biased (2.29:1), with only 12 juvenile-classed individuals being captured in the 7-year study, which could be due to a lack of adequate nesting habitat around Lake Travis (Munscher, unpubl. data).

Recent hierarchical abundance modeling in the Guadalupe River Basin demonstrated spatial variation in detection probability and abundance among survey reaches, highlighting the importance of accounting for imperfect detection when assessing the global population status of *P. texana* (Lara 2025).

Threats to Survival. — Although the global conservation status of *P. texana* is still officially assessed as Least Concern on the IUCN Red List (van Dijk 2011; Gordon et al., in press), the following threats are of potential ongoing concern and are likely contributing to somewhat declining populations.

Habitat Alteration and Hydrology. — River modifications such as impoundments, shoreline armoring, channel alterations, and altered flow regimes are recurrent concerns for riverine turtles in Texas, especially in spring-fed systems where aquatic conditions may remain favorable while terrestrial nesting habitat is constrained (Vermersch 1992; Munscher et al., in review). While *P. texana* tends to inhabit spring-fed areas which remain relatively consistent in water level throughout the year, water quantity is a growing concern as aquifers are being depleted and water withdrawal has increased in support of growing cities and nearby communities.

Water Quality and Contaminants. — Nutrient enrichment and microbial contamination have been documented in spring systems within the range of *P. texana*, primarily from stormwater runoff via increased impervious surface cover and wastewater effluent (Flores et al. 2023). Increased frequency, intensity, and scouring associated with flash flood events, a well-documented hazard within the Texas Hill Country, could potentially affect *P. texana* through individual mortality, downstream displacement, nest inundation, or habitat degradation, though empirical documentation of these effects for the species is currently lacking. Flood impacts on freshwater turtle populations

have shown mixed results in other systems, with some species demonstrating demographic resilience, while others experienced short-term displacement and nest mortality (Jergenson et al. 2014; Gordon et al., in press). Additionally, increased upstream or upland activities, such as hydraulic fracking-based oil and gas exploration or large data centers that rely heavily on surface or sub-surface water resources, have the potential for large-scale unintended effluent releases into habitats occupied by the species, as well as groundwater depletion.

Direct Mortality and Recreation. — Boat strikes have been documented for *P. texana* and can disproportionately affect adult females, which are larger-bodied and more frequently encountered at the surface than males (Bassett and Forstner 2023). Terrestrial nesting migrations further expose females to elevated mortality risk in systems with high recreational intensity or limited upland access. High recreational intensity and shoreline development can constrain nesting habitat and increase terrestrial mortality risk, a mechanism implicated in declining adult populations at Comal Springs–Landa Lake (Munscher et al., in review). Additionally, gunshot mortality from wanton shooting and bycatch from sport fishing activities have been documented as direct stressors for the species (Gordon et al., in press).

Harvest, Use, and Trade. — While *P. texana* is not typically highlighted as a primary commercial harvest species, statewide patterns of freshwater turtle trade and harvest management affect co-occurring taxa and can influence enforcement and market dynamics. Analyses of the Texas turtle trade documented extensive trade in native and exotic species and emphasized the risk of overexploitation of long-lived turtles (Ceballos and Fitzgerald 2004). Subsequent assessments of harvest regulation efficacy concluded that long-term sustainable harvest is unlikely under management regimes that leave most water bodies unprotected, motivating the need for broader restrictions (Brown et al. 2011).

Predation. — Nest predation by Raccoons can be intense in anthropogenic landscapes. For example, at Spring Lake, unprotected nests experienced 59% Raccoon predation across monitored seasons, with much of the predation occurring soon after oviposition (Washington 2008). Urbanization and subsidized mesopredator populations can amplify these pressures and contribute to recruitment limitations (Washington 2008; Munscher et al., in review).

Infectious Disease Risk. — Turtles can serve as hosts or vectors for pathogens. At Spring Lake, culture and molecular methods detected *Salmonella enterica* in multiple turtle species, including *P. texana*, highlighting the pathogen's presence even within headwater systems (Gaertner et al. 2008). Temporal analyses in the same ecosystem demonstrated links between precipitation and runoff events and *Salmonella* dynamics (Gaertner et al.

2009). Additionally, a novel group of negative-sense RNA viruses associated with epizootics in freshwater turtles in Florida has been described (Turtle frausvirus 1), with clinical signs including neurological disease and mucosal ulcerations; notably, the virus has been documented infecting Florida *Pseudemys* congeners (*P. nelsoni* and *P. peninsularis*), elevating the potential spillover risk to *P. texana* should the pathogen expand its geographic range (Waltzek et al. 2022).

Conservation Measures Taken. — *Pseudemys texana* occurs within a variety of protected lands, including state parks and other managed areas, and was listed as Least Concern (LC) on the IUCN Red List in 2011 (van Dijk 2011). It persists in both protected and unprotected river systems, and has recently been reassessed as Least Concern on the IUCN Red List (Gordon et al., in press).

In some cases, such as Comal Springs–Landa Lake, the headwaters of the Comal River are protected due to four endangered species that are present, including the Fountain Darter (*Etheostoma fonticola*), the Comal Springs Riffle Beetle (*Heterelmis comalensis*), the Comal Springs Drypoid Beetle (*Stygoparnus comalensis*), and the Peck's Cave Amphipod (*Stygobromus pecki*), but the shoreline has been extensively modified, so protection does not necessarily equate with conservation of *P. texana*. The Texas Cooter population in Landa Lake is declining due to this habitat alteration and limitation (Munscher et al., in review). Texas-wide regulatory changes restricting, and later prohibiting, commercial harvest of freshwater turtles provide indirect conservation benefit by reducing market-driven collection pressure on aquatic turtle assemblages (Brown et al. 2011).

Conservation Measures Proposed. — Life-history studies at other sites in addition to those detailed above are sorely needed, given that headspring impoundments represent an unnatural and tiny portion of the species range. Given the species' dependence on terrestrial nesting habitat and connectivity, conservation priorities include: maintaining environmental flows and water quality in river and spring systems; protecting and restoring nesting habitat and terrestrial corridors adjacent to aquatic habitats; mitigating road and recreational mortality during nesting migrations; and implementing long-term monitoring to detect recruitment limitations and demographic shifts (Washington 2008; Munscher et al. 2019; Munscher et al., in review).

At important *P. texana* population centers where suitable nesting habitat is limited, or females must traverse heavily disturbed areas, such as Comal Springs (Munscher et al. 2019; Munscher et al., in review), strategically placed artificial nesting islands (e.g., Biohaven Islands as developed in Australia; <https://1millionturtles.com/biohaven-islands>) could also be evaluated as a possible means of providing secure nesting habitat in aquatic areas

and potentially reducing hazardous overland movements by gravid females.

Captive Husbandry. — The species occurs in the pet trade and has historically been included within broader Texas turtle trade dynamics (Ceballos and Fitzgerald 2004). As with other large emydids, captive care requires substantial aquatic space, basking opportunities, and a diet emphasizing aquatic vegetation (Ernst and Lovich 2009). Though captive breeding is not currently a conservation tool for the species, breeding programs have been successfully implemented for other aquatic turtle species facing similar stressors (Burke 2015; Mullin et al. 2023).

Current Research. — Current and recent research on *P. texana* has emphasized: 1) population ecology and assemblage context in urbanized spring-fed systems (Munscher et al. 2019; Munscher et al., in review), 2) reproductive phenology and nesting demography at Spring Lake (Rose and Mali 2023), and 3) growth and maturity modeling from long-term mark–recapture datasets (Siders et al. 2023). Additional ongoing work in Texas creek systems (e.g., Bull Creek) is expanding quantitative baselines for abundance, sex ratios, and growth outside major spring runs (Munscher, unpubl. data).

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