



Texas Tortoise Monitoring at Palo Alto Battlefield National Historical Park: Results for 2025

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Crew member recording data on a Texas tortoise found during the 2025 Texas tortoise survey event at Palo Alto Battlefield. Image Credit NPS/GULN

Project Background and Methods

The Texas tortoise (*Gopherus berlandieri*; Figure 1) is a small, cryptic tortoise of south Texas and three states in Mexico that is threatened by widespread habitat loss and illegal collection. There is only one U.S. National Park unit where this species is commonly found, [Palo Alto Battlefield National Historical Park](#) (NHP) in Brownsville, Texas. The tortoises that live on the park do not face the same immediate threats as those occurring on unprotected lands, but even so, their abundance, health, and local movements require monitoring to support future management decisions.

The Texas tortoise monitoring project was established in 2008 by the [Gulf Coast Network](#), part of the [National Park Service's Inventory and Monitoring \(I&M\) Program](#). The goals of the Texas tortoise monitoring project are to:

1. track the tortoise's status in seven permanent, 4-hectare sampling units, in terms of catch per unit effort, movements, body condition, and the distribution of sizes and sexes captured, and
2. analyze cross-year trends in abundance and survivorship from mark-recapture data.



Figure 1. A Texas tortoise found during I&M surveys at Palo Alto Battlefield NHP. The drill holes on marginal scutes correspond to a unique number code that is used for identification upon recapture. This tortoise is a male, ID 326.

The Texas tortoise monitoring project is a long-term mark-recapture study, where field crews conduct standardized tortoise surveys once each year, always for the same amount of time and within the same seven survey units. The survey units are located on lomas, which are low ridges covered in thorny shrubs and mesquite trees, the tortoises' preferred habitat in coastal Texas (see Figure 2 for a schematic of a park loma and its adjacent habitats).

Sampling events occur over a three-day period each fall. All seven units are surveyed twice over this period, each time by a different team that dedicates eight person-hours of effort per unit, or about two hours for a four-person team. Repeat-surveys within a unit take place at the same time of day, 1-2 days apart. As team members encounter tortoises, they weigh them, measure their carapace dimensions,

photograph them, record their sex, and record a GPS location. For newly encountered individuals, they mark them by drilling holes in scutes according to a unique numeric code, to allow for identification upon recapture (Figure 1).

The park's Texas tortoises have been surveyed, marked, and measured like this at least once per year for 17 years; however, the total effort, survey areas, and written protocols have changed over time. The current protocol, Version 3.0, was published in 2018. Previous annual reports for this project as well as other information can be found in the Gulf Coast Network Texas Tortoise Monitoring Project on the [NPS DataStore](#) or the [network's website](#).

Trip Summary for 2025

The Gulf Coast Network completed its Fall 2025 Texas tortoise monitoring trip from December 8 to December 10. This was later than usual; surveys generally occur in late October or early November. Thirteen participants were split into two teams, each of which surveyed all seven units as required, for a total of 16 person-hours per unit.

Number of Tortoise Encounters and Recaptures

The Fall 2025 trip yielded 20 unique live tortoises, although two were found outside unit boundaries or survey times (Table 1). This amounted to 18 individuals found over 112 person-hours within time-and-area constrained surveys, or a catch-per-person-hour-effort of 0.16. This was the lowest yield since protocol version 3.0 was implemented in Fall 2018 (Figure 3).

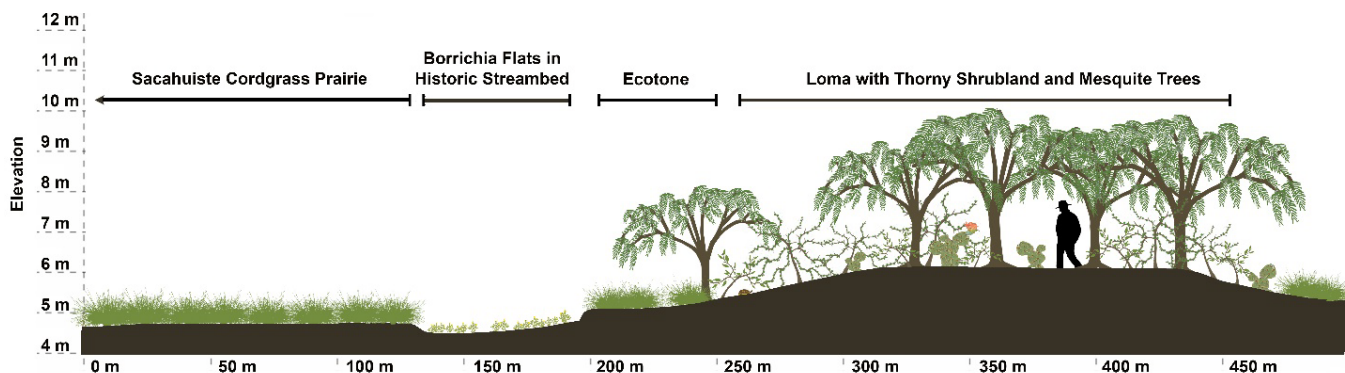


Figure 2. A schematic of a loma and other major habitats at Palo Alto Battlefield NHP. The park has wide expanses of sacahuiste prairie (*Spartina spartinae*) with intermittent old streambeds containing sea ox-eye daisy (*Borrichia frutescens*). Near these old streambeds, the ground elevation gently rises into a ridge, or loma, typically covered in woody shrubs, prickly pear (*Opuntia engelmannii*) and mesquite trees (*Prosopis glandulosa*). Lomas and their ecotones are the main habitats of Texas tortoises in the park.

Table 1. Live, unique tortoises found both in and out of surveys. Each individual tortoise was only counted only once, even if it was seen during both surveys. Total counts of individuals were then summed for all seven units, for a combined tally of tortoises across both teams. The total includes a separate tally of newly marked individuals for 2025 ("new"), in addition to the combined total that also counts tortoises recaptured from previous years. The table does not include the three dead tortoises found during surveys; two of the dead tortoises were marked, and the other was unmarked.

Grouping	Female	Male	Juvenile	Total
Tortoises found during surveys in the seven focal units	11	6	1	18 (4 new)
Tortoises found outside survey boundaries or survey times	0	2	0	2 (1 new)
Total number of tortoises found on trip	11	8	1	20 (5 new)

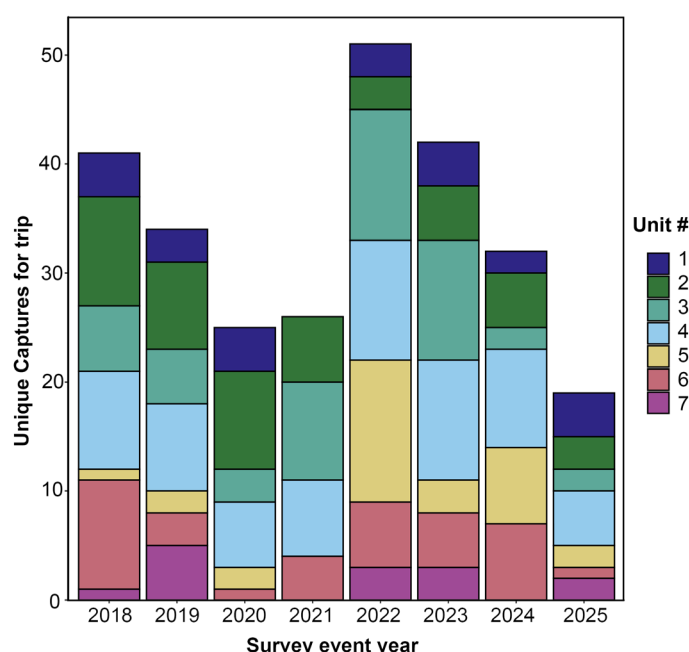


Figure 3. Tortoise encounters within each unit (colored portions within each bar) for each survey trip since Fall 2018.

Five tortoises were newly marked during the trip, with the trip's final new ID being 366. Four of these new tortoises were found during surveys, and one was found after survey time had ended. This is a low number of newly marked tortoises as compared with recent surveys, yet it still makes up a sizable fraction of the total captures, at 25%.

This study has routinely documented new, adult individuals during annual surveys, with an overall average of 7.4 per trip since 2018. Some of these tortoises were likely recent juveniles that recruited in-place, but the majority were larger, older tortoises. The regularity of mature, new entrants into the study suggest that tortoises are somewhat transient. Even with small home ranges, some animals likely slip in or out of survey units from trip to trip.

Regarding recapture rates and detectability, four of the 18 unique live tortoises (22%) were captured by both survey teams, excluding out of time or out of

bounds encounters. Although a 22% shared capture rate is high relative to most recent survey events, it is lower than would be preferred for mark-recapture studies. The tendency for low within-trip recaptures, with only 1-2 days between events, likely reflects the inherent difficulty of locating this small, cryptic species within densely vegetated loma habitats of the park. For comparison:

- The Fall 2024 trip recorded 32 unique live tortoises, with three individuals captured by both teams (9% shared captures).
- The Fall 2023 trip recorded 42 unique live tortoises, with nine shared captures (21%).
- Across the five trips prior to 2023, shared capture percentages were 18%, 19%, 0%, 6%, and 17%.

Distribution of Encounters Across Survey Units

The 18 tortoises found during survey events were distributed unevenly among units (Figure 4). The greatest yields were in units 1 and 4, with five and four tortoise encounters, respectively. Units 2, 3, 5 and 7 had two individuals each. Unit 6, traditionally yielding several tortoises per event, delivered only one individual (Figures 3 and 4). Newly marked tortoises were widely distributed across the park, occurring in units 1, 2, 5 and 7.

It is not fully understood why some units have lower yields than others, but potential causes include differences in plant communities on the lomas, past agricultural impacts, connectivity with other upland areas, and the degree of invasion by the non-native Guinea grass (*Urochloa maxima*).

Environmental Conditions and Change Over Time

Since monitoring began at Palo Alto Battlefield NHP, tortoise yields have fluctuated from one year to the next. This has remained true across the eight events since the most recent protocol was implemented in Fall 2018 (Figure 3). Although the primary cause remains unclear, several

environmental variables are likely to play a role. These include temperature, precipitation, and vegetation density as a response to seasonal rainfall. Temperature has a more instantaneous impact, where animals become inactive or increasingly sheltered when too hot or cold. Meanwhile, vegetation density changes more slowly, but when it does, this impacts the quality and quantity of forage as well as overall tortoise detectability. The park's plant productivity and response to precipitation is measured using the Enhanced Vegetation Index (EVI), which is based on spectral signatures of 'vegetation greenness', recorded in 16-day averages of satellite imagery (MODIS/Terra satellite;

MOD13Q1.016). In comparison to past survey years, this year's survey was colder and had lower plant productivity than average, likely associated with recent drought (Figure 5).

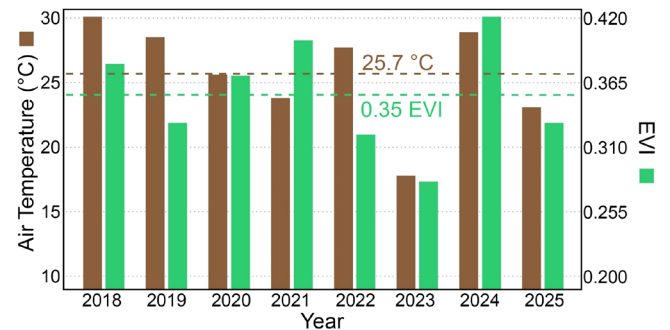


Figure 5. Environmental conditions during Texas tortoise monitoring surveys from 2018 to 2025. Air temperature is measured as the average recorded during all surveys within a trip. The EVI or Enhanced Vegetation Index is an average of 'vegetation greenness' for the three most recent 16-day intervals prior to and including the monitoring trip. Labeled, dotted lines are cross-year averages.

Notable Events and Observations

GPS-transmitter Study of 14 Tortoises

The 2025 trip was primarily focused on routine Texas tortoise surveys in the seven primary survey units. Field crews had an additional objective on this trip, however, which was adding GPS-transmitters to a total of 14 tortoises. The ATS-brand transmitters were provided by Kurt Buhlmann, a founder and long-term participant in the Texas tortoise monitoring project from the University of Georgia, and his collaborator Luke Pearson from the U.S. Fish and Wildlife Service.

The GPS-transmitters were mounted on tortoises during two week-long trips in 2025. The first trip was in November 2025, when seven tortoises were affixed with transmitters. The second trip was embedded in the December 2025 survey, when seven more tortoises were affixed with transmitters. All transmitters were set to record tortoise locations and air temperatures once per hour for 24 hours per day. Data uploads through a cellular network were set at once per day or as available based on battery condition (charged through attached solar panels). Standard radio-telemetry tags (ATS R1680) were added to each tortoise at the same time as the GPS transmitters, to facilitate tortoise relocation at the end of the study. As of April 2026, all 14 transmitters had uploaded data, and collaborator Heather Gaya had already used these data to create intriguing visualizations of tortoise movements over the past several months. Examples of these data

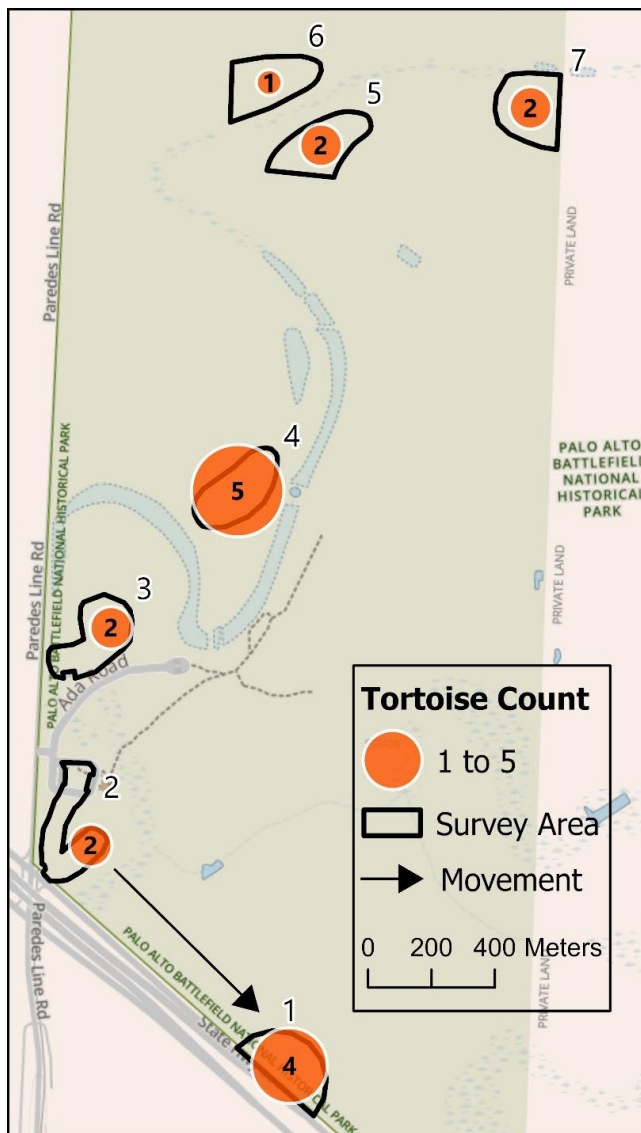


Figure 4. Encounters per survey unit at Palo Alto Battlefield NHP in 2025. Survey units are labeled at upper right. Orange circle sizes correspond to the count of tortoises found in that unit; the count is also written inside the circle. Arrowed line shows long distance movement (> 212 meters [695.6 feet]) between a tortoise encounter on the current trip and its previous encounter.

visualizations, as well as other information on the GPS-transmitter tortoises, are in the 2025 Supplementary Materials Document.

Notable Observations of Wildlife and Plants During Fieldwork

During each tortoise survey event, participants may write down wildlife or plant sightings or record other observations that seem interesting or unusual. These observations are informal and do not have a direct bearing on tortoise monitoring data, but they may provide informative or at least entertaining context to survey reports. Notable species observed by crew members in 2025 are listed below.

Native

- Eastern Cottontail Rabbit (*Sylvilagus floridanus*)
- Southern Plains Woodrat (*Neotoma micropus*)
- Nine-Banded Armadillo (*Dasypus novemcinctus*)
- Javelina (*Dicotyles tajacu*)
- Indigo Snake (*Drymarchon melanurus erebennus*)
- Western Diamondback Rattlesnake (*Crotalus atrox*)
- Texas Nipple-cactus (*Mammillaria prolifera* var. *texana*; Figure 6)

Non-Native

- Feral Hog (*Sus scrofa*)
- Nilgai (*Boselaphus tragocamelus*); [Click here for the Inventory and Assessment Program's new article](#) about the park's Nilgai inventory.



Figure 6. Texas nipple cactus, a new addition to the park species list at Palo Alto Battlefield NHP. It was found for the first time during the 2025 Texas tortoise survey event.

Updates on Park Activities and Projects

During and after fieldwork in December 2025, I&M staff learned of several activities or projects by park staff and their partners that have relevance to the park's Texas tortoise population and long-term monitoring. First, there was a major breach in the boundary fence with the neighboring ranch in spring/summer 2025, and over 100 cattle entered the park property. The cattle were present on the park for up to six months, and their ultimate removal in August 2025 required a helicopter and ground support. This was not the first occasion of cattle breaching the fence in the past several years, but this event was unique for its size and likely impacts to park vegetation. The park worked with the neighboring rancher to get the fence repaired to prevent future cattle re-entry.

Second, in fall 2025, the park was in the process of implementing a new brush clearing project with the U.S. Fish and Wildlife Service (USFWS), supported by the Peregrine Fund. The project aimed to remove honey mesquite (*Prosopis glandulosa*) and huisache (*Vachellia farnesiana*) trees that were encroaching into the cordgrass prairie, with the shared goals of improving habitat for Aplomodo falcons (*Falco femoralis septentrionalis*) and maintaining an open battlefield viewshed for the park. The USFWS project lead was Johanthan Moczygemba. The work was slated to begin in September 2025 but was delayed due to the government shutdown. At that time, staff from the Gulf Coast I&M Network provided input on the spatial boundaries of the brush removal project to minimize impacts on I&M survey units and known Texas tortoise home ranges. The brush clearing work was completed in January 2026, with apparent minimal impacts on lomas or loma ecotones.

Third, the park started trapping feral hogs in spring 2025, and they had successfully culled several hogs by the end of May 2025. Crew members from the Gulf Coast Network have recorded major hog damage to several of the park's resaca and ponds (e.g. Figure 7), so this work is expected to benefit park habitats. Hogs have also been considered a direct threat to Texas tortoises in the park, for their potential to eat adult tortoises, juveniles or eggs.

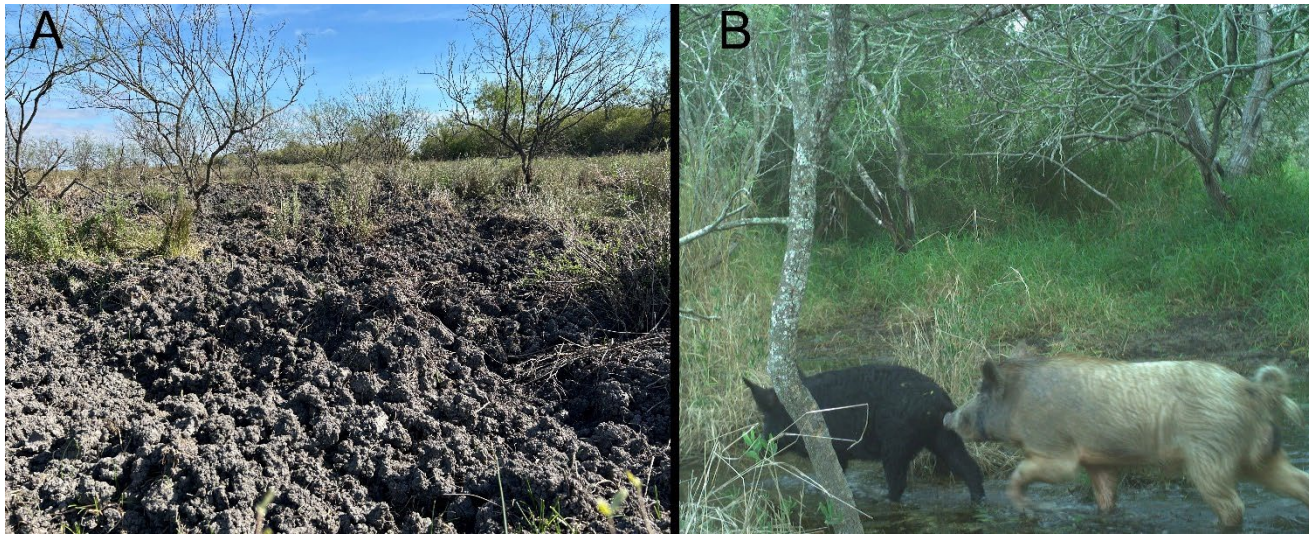


Figure 7. Recent evidence of feral hogs at Palo Alto Battlefield NHP. (A) Feral hog damage to the dried pond bed just southeast of the Visitor Center, recorded in December 2025; (B) Feral hogs in a resaca bed in the northern end of the park, as photographed by trail cameras during the park's [Nilgai Inventory in 2021](#).

Conclusions and Next Steps

The Gulf Coast Network has conducted surveys for the Texas tortoise mark/recapture monitoring project at least once per year since 2008, with methods and survey units standardized in 2014 and within-trip effort increased in 2018. The December 2025 event was notable for its low capture rate as compared to previous years, with only 18 tortoises encountered during surveys. This event was also unusual for taking place in December as opposed to October or November, due to the 2025 governmental shutdown. Tortoise activity patterns are known to change at the onset of the winter season, and this may have influenced results. For the upcoming 2026 event and subsequent surveys, crew leaders will prioritize completing fieldwork in late October or early November, to remain consistent with most previous events.

The park is known to maintain a sizable population of tortoises; however, a recently-published trend analyses has revealed a decline in the park's Texas tortoise population over time, with certain areas of the park showing greater losses than others (Tuberville et al. 2026). This new trend analysis, which includes management recommendations, was led by Tracey Tuberville and other partners from the University of Georgia, with active collaboration from I&M staff. Continued long-term monitoring is important to understand whether this declining

trajectory will continue and how external pressures are impacting this iconic south Texas species, both now and into the future.

Supporting Materials

Supplementary materials for this report are available in the NPS datastore, as are all previous project briefs. The two focal supporting materials for the 2025 summary include:

- **2025 Supplementary Materials Document** (NPS internal downloads only).

Carlson J.E. and J. Bracewell. 2026. Supplementary Materials to Texas Tortoise Monitoring at Palo Alto Battlefield National Historical Park: Results for 2025. Gulf Coast I&M Network, Lafayette, LA
<https://irma.nps.gov/DataStore/Reference/Profile/2318220>

- **The newly published trend analysis of the Texas tortoise population at Palo Alto Battlefield NHP.**

Tuberville, T. D., H. E. Gaya, J. E. Carlson, J. Bracewell, and K. A. Buhlmann. 2026. Population dynamics, survival, and movements of Texas tortoises in a national park in southern Texas. *Journal of Wildlife Management* 90:e70197. <https://doi.org/10.1002/jwmg.70197>