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A Texas tortoise, *Gopherus berlandieri*, photographed in habitat in Texas. Photo © 2002 by Greg Lasley

featured species

Texas Tortoise, *Gopherus berlandieri* (Agassiz, 1857)

Berlandier's Tortoise

by M. A. Cohen

The state of Texas has some 30 native turtles, including species of sea turtle, box turtle, semi-aquatic turtle, snapping turtle and softshell turtle. The only species of terrestrial turtle (i.e., tortoise) native to Texas is the Berlandier's or Texas tortoise (*Gopherus berlandieri*), the smallest of the six recognized species of *Gopherus* tortoises.

A member of the Testudinidae family of tortoises, the Texas tortoise was formally described by Jean Louis Rodolphe Agassiz in 1857.

Jean-Louis Berlandier

A Belgian-French anthropologist, physician, and naturalist, Jean-Louis Berlandier was born before 1805 in the rural region between Fort de l'Écluse, France and Geneva, Switzerland. He studied botany and possibly pharmacology in Geneva, and his training in botany led to his being chosen to collect botanical specimens during an expedition to Mexico that landed in December 1826. After traveling extensively in the territory following his arrival, he became a physician, married a

article continues on page 2 ▶

CONTENTS

Berlandier's Tortoise (*Gopherus berlandieri*) by M. A. Cohen	1
Ravens vs. Tortoises: Protected Species Killing Endangered Species by Laurie Peterson	6
Climate Crisis Forecasts a Fragile Future for Wildflowers and Pollinators by Spoorthy Raman	8
Mike's Turtle Net Picks By Michael J. Connor, Ph.D.	10
In Memoriam: Dianne Huwaldt	11
CTTC Directory 2022	12
Forage Preferences and Feeding Patterns by Mark Massar	14
Classified Advertisements Nesting Sites to Accelerate Floreana Species Restoration Publication Confirms Fernanda as Fernandina Giant Tortoise	15
Meeting Schedule: July/August 2022	16

local lady, and settled in Matamoros in the state of Tamaulipas in 1829. Berlandier was one of the first scientists to conduct a biological survey of Mexico working for the Mexican government.

Berlandier continued to collect previously undescribed plants and animals in Mexico and Texas throughout his lifetime. His life ended when he drowned while trying to cross the San Fernando River near Matamoros in 1851 (Beolens, Watkins, & Grayson, 2011).

Berlandier catalogued in great detail the plants, animals, and ethnic groups of people endemic to the territory we now know as Texas and Mexico. He made significant contributions to the world's knowledge of the flora, fauna, and anthropology of this region.

Description

Berlandier's tortoise is a small- to medium-sized tortoise species. It is the most sexually dimorphic of the known *Gopherus* tortoises, meaning the males differ significantly in appearance from the females. Males in southeastern Texas tend to be larger than the species' average.

The species may reach a mature carapace length of 8.6-9.4 inches (22.0-24.0 centimeters). Its rugged carapace is brown to black in color and oval to oblong in shape. The top of the carapace is comparatively flattened. The species displays "growth rings," i.e., well-defined ridges on the carapacial scutes, and, from these ridges, one can estimate the age of younger individuals.

A Texas tortoise photographed in habitat in Tamaulipas, Mexico.
Photo © 2007 by William L. Farr

The centers of the carapacial scutes may be yellowish-orange in younger tortoises, and typically remain lighter in color than the background throughout the tortoise's life. The plastron of the species is typically yellow. The head of the species is wedge-shaped with a pointed snout. The skin of the head, tail and limbs is yellowish to brown. The irises of its eyes are often greenish-yellow.

The gender differentiation (known in biology as sexual dimorphism) between the *G. berlandieri* male and the female may begin to appear at a carapace length of 4 to 4.9 inches (10.5 to 12.5 centimeters) when the tortoise is as young as three to five years of age.

The male's carapace is somewhat longer and narrower than that of the female. Males display a concave plastron while the female's plastron is flat. The male's gular scutes are more prominent and characteristically forked than the female's gular. The male's mental glands (i.e., chin glands) are larger than those of the female, and his tail is longer and thicker than that of the female.

There are no recognized subspecies of *G. berlandieri*.

Range

The Texas tortoise is native to south-central Texas and northeastern Mexico. In Texas, *G. berlandieri* is found south of a line drawn across Texas through the cities of Del Rio, San Antonio, and Rockport. In northern Mexico, its range extends southward from the Rio Grande River through the eastern states of Coahuila, Nuevo León, Tamaulipas, and northeastern San Luis Potosí.

article continues on page 3 ▶

Habitat

G. berlandieri occupies a diverse array of habitats, ranging from semi-desert ecosystems in Mexico to the scrub forests, chaparral, and grasslands in subtropical south Texas. The species appears to prefer open scrub woodlands with sandy soils.

In Texas, *G. berlandieri* is found from sea level up to 660 feet (200 meters) of elevation. In Mexico, the species occurs from sea level to an elevation as high as 2,900 feet (884 meters).

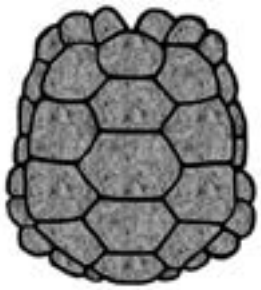
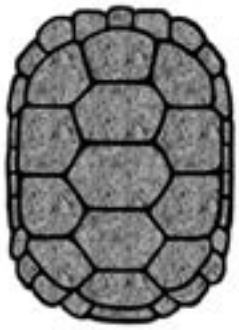
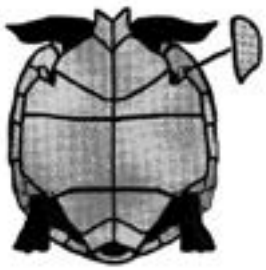
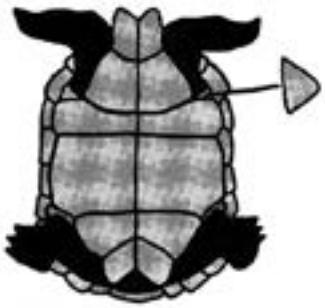
Although *G. berlandieri* belongs to the *Gopherus* genus of tortoises generally known for their ability to excavate sizable burrows, the Texas tortoise does not typically excavate the underground burrow that is characteristic of other members of its genus.

Instead, *G. berlandieri* scrapes the soil surface with its gular, forelimbs and the sides of its shell to clear away large rocks and debris, creating a pallet in which to rest. This surface depression is often located under a shrub or beside a stand of prickly pear (*Opuntia*) cactus. The pallet is rather shallow; the record depth for a pallet is just 4 inches (10 centimeters) (Texas Tortoise n.d.).

A Texas tortoise typically has several separate pallets within its home range, returning to them repeatedly in the course of its foraging activities.

G. berlandieri will utilize an existing burrow excavated by a badger or an armadillo if it is an appropriate size (Ernst and Lovich 2009). If soil conditions are favorable for digging, the tortoise may occasionally excavate its own burrow. Where soil conditions are unfavorable for burrowing, it will seek shelter underneath debris, rocks or tree stumps, often creating a pallet as previously described.

Differentiating the Texas tortoise and the desert tortoise

Texas tortoise (*Gopherus berlandieri*)	Desert tortoise (*Gopherus agassizii*)
The head of the Texas tortoise is wedge-shaped.	The head of the desert tortoise is rounded in shape.
	
The carapace of the Texas tortoise.	The carapace of the desert tortoise.
	
The plastron of the Texas tortoise showing an enlarged axillary scute.	The plastron of the desert tortoise showing an enlarged axillary scute.

These illustrations were originally published in the article "Tortoise ID" by A. H. Brame and D. J. Peerson in the September/October 1969 issue of the *International Turtle and Tortoise Society Journal*.

Foods and Feeding

Berlandier's tortoise is primarily herbivorous, consuming wild grasses, violets, asters and other plant materials native to its range. It has a preference for, and a symbiotic relationship with *Opuntia basilaris*, the common name of which is the prickly pear cactus.

The tortoise feeds on the pads, stems, flowers and fruit of *Opuntia*. The pads are known to botany as cladodes or cladophylls. Texas tortoises consume the cladodes when the pads are young because younger cladodes contain a high percentage of water (up to 94%). These younger pads are softer, having a thinner skin and fewer spines than more mature pads, so they are easier for the tortoise to consume. Ripe, dark-red fruit, which has a water content of about 84.5%, is preferred to green (unripe) fruit.

There are at least nine species of *Opuntia* cactus that are native to

article continues on page 4 ▶

the state of Texas. The Texas state legislature has declared the prickly pear cactus (*Opuntia basilaris*) to be the official state plant of Texas. The prickly pear cactus is often called the "symbol of the Rio Grande Valley," one of the regions in Texas to which Berlandier's tortoise is native.

The pallet on which the tortoise rests is often situated at the base of a prickly pear cactus. Seeds of *Opuntia* that pass through the digestive tract of a tortoise germinate at a higher rate than seeds are not ingested by the tortoise (Rose and Judd 1982). The nitrogenous component in the tortoise's feces provides nitrogen, a plant nutrient essential for the seedlings' growth.

G. berlandieri also occasionally consumes snails, insects, fecal matter of other tortoises and that of rabbits, and animal bones, based on field observations and analysis of the species' fecal pellets (Ernst and Lovich 2009).

A Texas tortoise with his head retracted showing his large, distinctively forked gular scutes, photographed in habitat near Nuevo León, Mexico. **Photo © 2021 by Carlos G. Velazco-Macias**

Activity Cycles

In the warmest portions of its range, Berlandier's tortoise may be active throughout the year. Typically, though, it will be less active during both the hottest and the coldest periods of the year.

The species is diurnal, meaning it usually has two activity periods daily. For most of the year, the species' activity occurs in the morning and the late afternoon, avoiding the midday heat. In fall, however, the tortoise may be active only at midday.

Estivation, prolonged dormancy or torpor, will occur during periods of extreme heat and/or drought. When estivating, tortoises will retreat into dense vegetation, seeking shaded areas under shrubs or cacti in order to escape the heat.

Brumation, periods of dormancy in reptiles during low temperatures, has not been well-documented in the Texas tortoise. However, several researchers report that they observed ***no*** active tortoises during their fieldwork between December and February, even though temperatures were mild (Ernst and Lovich 2009).

Mating and Reproduction

Research indicates that female Berlandier's tortoises may need to attain a carapace length of 6–6.5 inches (15.5–16.5 centimeters) — about 10 years of age — before they produce shelled eggs (Rose and Judd 1982). Some research indicates that the mean age of reproductive maturity for the species is 13.3 years (Berlandier's Tortoise n.d.). The mating season in Texas occurs from June to September, reaching its peak in late summer. The mating season in Mexico has not been well-studied.

The nesting season of the species generally occurs from April through July. Clutch size is typically one to three eggs, although reports of five- to seven-egg clutches exist. Female Berlandier's tortoises produce one or two clutches per nesting season, excavating shallow nests only 3 inches deep (Texas Tortoise n.d.). The incubation term for eggs is generally 90 to 120 days. The species has the slowest growth rate of any *Gopherus* species (Berlandier's Tortoise n.d.).

Genetically speaking, *G. berlandieri* is closely related to *G. agassizii,* the Mojave desert tortoise. In captivity, mating between the two species has resulted in the production of hybrid offspring. However, in the wild such hybridization would not occur since the ranges of the two species do not overlap.

Some chelonian biologists surmise that *G. berlandieri* may be a subspecies of *G. agassizii* based on the close biological relationship between the two species. More research is necessary to confirm this possibility (Ernst and Lovich 2009).

Longevity

Texas tortoises grow most rapidly during their first few years of life. They will typically grow to about 50% of their adult carapace length during their first year. Growth slows somewhat through the third to fifth years. At a carapace length of about 5 inches (13 centimeters) in the sixth year, growth slows significantly and subsequently remains relatively constant at about 5% per year.

Lifespan in the wild is unknown. In captivity, both male and female Texas tortoises have lived for 52 years (Ernst and Lovich 2009).

Threats and Predators

By far, the greatest threat to the Texas tortoise is posed by human activities such as vehicular traffic on roadways and habitat conversion and destruction largely due to agriculture. Road mortality, entanglement in fencing, and wildfires in south Texas impede population stability and contribute to habitat destruction (Ernst and Lovich 2009).

As with so many chelonian species, habitat fragmentation resulting from

article continues on page 5 ▶

roads and railways, crop agriculture, and residential and other types of development have negative impacts on the biodiversity within an ecoregion (Guerra 2020).

Historically, collection for the pet trade seriously depleted wild populations. Texas enacted legislation fully protecting the remaining wild tortoises, but unfortunately enforcement of the state regulations is described as "weak" (Berlandier's Tortoise n.d.).

Intensive crop agriculture destroys the natural habitat of the Texas tortoise as well as fragmenting populations. It is estimated that 90% of tortoise habitat in the Rio Grande Valley has been destroyed by modern agricultural practices.

A Texas tortoise, *Gopherus berlandieri*, photographed on gypsum dunes (*dunas de yeso*) in the Cuatro Cienégas valley in the state of Coahuila, Mexico. **Photo © 2015 by the *Comisión Mexicana de Filmaciones***

Interestingly, ***managed*** cattle grazing can actually benefit wild Texas tortoises. By controlling the growth of brush, light grazing by cattle favors the grasses and *Opuntia* on which the tortoises feed, increasing the supply of quality foods available for tortoises and other wildlife.

Emerging disease threats exist in wild populations of *G. berlandieri*. Upper respiratory tract disease caused by *Mycoplasma agassizii*, the bacterial disease that has had a disastrous impact on populations of the Mojave desert tortoise, was detected in the Texas tortoise by Amanda Guthrie and her team of researchers in 2013.

A communicable fungal disease caused by the organism *Fusarium semitectum* has been identified as the cause of lesions on the carapacial scutes of Texas tortoises. The lesions range from "localized whitish blemishes to complete degradation of the external portion of the scute" (Rose et al. 2001). Fortunately, "there is no evidence of mortality associated with infection" by the shell disease (Ernst and Lovich 2009).

Predators of eggs and young tortoises include various mammals such as skunks, raccoons, foxes, coyotes, bobcats, and pumas. Coyotes and bobcats likely prey on adult tortoises. Various snakes and fire ants also prey on the young (Ernst and Lovich 2009).

Conservation

G. berlandieri was designated by the state of Texas as a threatened species in 1981 because of habitat loss and over-collection for the commercial pet trade. The species is currently listed by the Convention on International Trade in Endangered Species Protection Status as Appendix II.

The Texas tortoise is listed as a species of "least concern" by the International Union for the Conservation of Nature (IUCN) on its Red List of Threatened Species, implying that its populations are stable. However, the last assessment of the species' status by the IUCN was conducted in 1996 – 26 years ago. The situation of the Texas tortoise has deteriorated significantly in the intervening years because of the threats described in the previous section.

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Ravens vs. Tortoises: Protected species killing endangered species

Story and photographs by Laurie Pearson, Marine Corps Logistics Base, Barstow, California

The Environmental Division is tasked with carefully balancing one protected species against one endangered species with another aboard Marine Corps Logistics Base (MCLB), Barstow, California.

The Desert Tortoise was added to the Federal Endangered Species List, as a threatened species, in 1990, due to a rapidly declining population. Their population dropped nearly 95 percent throughout their range. Ravens, on the other hand, are protected under the Migratory Bird Treaty Act, which is an international treaty between Canada, the United States of America and Mexico which was put into place in 1906. Here in the High Desert, these two species are essentially at war and the Desert Tortoise is sorely losing that battle.

A Mojave Desert Tortoise, *Gopherus agassizii*, rests near some beaver-tail cactus flowers, aboard Marine Corps Logistics Base Barstow, CA, April 15, 2019. Public domain.

"Here in the Mojave Desert, the U.S. Fish and Wildlife Service noticed that as the Desert Tortoises were declining, less and less juvenile tortoises were being observed during surveys, there is a direct correlation to an increase in raven population," said Cody Leslie, natural resource specialist for the base. "When I say direct correlation,' I mean that as the tortoises are decreasing in population, the ravens have increased by as much as 1,500 percent. That's a huge increase."

Historically, the raven population was limited in the desert due to location of food, water and natural nesting sites, such as cliff faces and Joshua trees, he explained.

"Ravens are predatory birds, with no natural enemies or predators in this area," he said.

With the increase in humans in the desert, several things changed, impacting these two species of animals. When Highways 15 and 40 were built, and power lines put in place, corridors were created offering exponentially higher numbers of places for ravens to nest.

"As humans subsidize the desert, via towns, roads, landfills, agriculture, rest areas and waste at specific sites, like food trash," he said, "it gave the ravens a way to thrive in the desert."

Ravens are both predatory and opportunistic birds, which typically eat small animals, eggs of other birds, and reptiles.

"By adding power lines alone, we created nesting sites throughout the entire range of the Mojave Desert Tortoise habitat," Leslie said. "They now are in an elevated position, with a 360-degree view and are able to see any threat, as well as any prey in the vicinity."

Although ravens are typically found everywhere, there were larger populations in areas such as the Sierra Mountains and the coastal mountains, where habitats and water are more prevalent. Humans have disrupted that balance, and now high elevation nesting options, and atypical water sources, such as sprinklers leaving puddles and man-made ponds, are now available.

"The Mojave Desert Tortoise [MDT] range from southern Utah, west of the Colorado River, down to El Centro area," Leslie explained. "East of the Colorado River, there is another species called the Sonoran Desert Tortoise. Some areas within each range are considered Critical Habitat, meaning it is prime territory for MDT to flourish and recover, and hopefully thrive."

The MCLB Barstow area belongs to the Ord-Rodman Critical Habitat Unit, which is shared with Marine Corps Air Ground Combat Center 29 Palms.

"One problem is that we've isolated our tortoise population by creating highways, which they can't cross effectively," Leslie said.

In some cases, such as when bases are looking to expand, those isolated tortoises may have to be translocated or moved to an area ideal for their survival. Before translocation can be conducted, Environmental staff must track the tortoises and even conduct blood work.

"Some tortoises have a mycoplasma making them more susceptible to Upper Respiratory Tract Disease," Leslie said. "Captive tortoises are more likely to develop URTD than wild tortoises. So, that's why they can never be released back out into the wild. They can even get tortoise

article continues on page 7 ▶

ticks, shell lesions, and even a version of the herpes virus."

There are several factors that have contributed to the decline in the Mojave Desert Tortoise population, in addition to those mentioned above.

"They live to approximately 80 to 100 years old," Leslie said. "It takes approximately 6 to 10 years for their shells to harden, making them easy prey for ravens. In addition, it can take 15 to 20 years for them to reach sexual maturity."

Females may breed with as many as six males at a time, so for each clutch of eggs, there may be up to six "baby-daddies." This provides genetic variations as a means to increase the potential survival of the species.

"Tortoises are slow-moving, long living creatures, slow to sexual maturity so they've adapted these techniques to promote genetic survival," Leslie explained. "This also means that these promiscuous tortoises may transmit such things as viral herpes at a surprising rate. The males also fight because it is competition based mating. So they may seriously injure one another."

The males have large horns [i.e., gular scutes – Editor's note] which they can use to flip other males onto their backs making them more vulnerable to the elements and predators.

A juvenile desert tortoise shell shows deadly impact of ravens to the tortoise population on base. Public domain.

The young and the weak, or compromised tortoises are not the only tortoises attacked by ravens now.

"Now we're even finding that they're even attacking the healthy adult tortoises," Leslie said. "They attacking and killing them via their shell access points. It's pretty gruesome. The Superior-Cronese Critical Habitat staff conducted a study using dummy adult tortoises. They used cameras on the dummies and observed raven predation. During the study, 43 percent of the adult-sized dummies were attacked by ravens. Nearly half of the adults are under attack. That's a lot."

Mojave Desert Tortoise aboard MCLB Barstow. Public domain.

On MCLB Barstow there are adult, breeding tortoises, but when surveys are conducted, Leslie and the others conducting the surveys have yet to find juveniles or hatchlings in several years. This is directly attributed to the out-of-control raven population. While living and working aboard the base, there are several things that employees and families can to do help decrease the raven impact.

"Ensure that all trash is disposed of in containers with lids and that those lids are closed," Leslie said. "Remove all food, to include pet food from areas accessible by birds. Also, remove any external water sources, such as bowls of water and leaking sprinklers from around the homes and offices. Report raven nests and activity to the Environmental Division, creating a work order at [760] 577-6220, and reporting it to me at [760] 577-6744."

One of the tactics that the Environmental Division is undertaking is called "Egg Oiling," which includes handheld and drone-based oiling of eggs in nests, using a silica-based oil. The oil coats the egg, clogging pores so that air can no longer penetrate the shell. The fetus no longer develops. However, the ravens continue to sit on the eggs, for the entire breeding season and do not continue to rebreed.

"Over time, we are reducing the number of breeding ravens," Leslie explained. "When the 2009 Raven Environmental Assessment was conducted, it was shown publicly that it does not have a detrimental impact on the overall raven population. It only manages to control populations in the Critical Mojave Desert Tortoise Habitat."

As an endangered species, humans are forbidden from harassing, collecting, or touching Mojave Desert Tortoises, and this is punishable by $50,000 fines and potential jail time. If someone sees a desert tortoise on base, there are a set list of actions that must be followed.

"If found on base, stop all work in the immediate vicinity," Leslie said. "Contact the Environmental Division, and assign a monitor to watch the tortoise until someone from Environmental has arrived."

If you have questions regarding ravens or the Mojave Desert Tortoise, contact Cody Leslie at [760] 577-6744.

This article was originally posted on the Defense Visual Information Distribution Service website on 13 May 2019. It is in the public domain.

Climate crisis forecasts a fragile future for wildflowers and pollinators

By Spoorthy Raman as published on Mongabay on 1 April 2022

- *A first-of-its-kind experimental study has found that climate change reduces the abundance of wildflowers and causes them to produce less nectar and fewer and lighter seeds.*
- *These changes also impact pollinating insects visiting the flowers: they have to visit more flowers, more frequently, to gather the required food.*
- *Fewer flowers imply reduced reproductive fitness in plants, as well as fewer food resources for invertebrates that rely on these plants for food, habitat and shelter.*
- *Overall, climate change may disturb the composition of wildflower species and their pollinators, impacting agricultural crop yields, researchers say.*

Think of climate change, and you'll probably picture devastating floods, raging wildfires, or parched earth. For the environmentally savvy, coral bleaching or masses of refugees may also make it to the list. Not many of us would think of the vibrant wildflowers in nearby meadows as victims of climate change. But the future of these pretty blooms could be gloomy in the face of a warming planet, suggests a recent study published in the journal *Frontiers in Plant Science*.

This first-of-its-kind study, conducted in the U.K., found that wildflowers across Northern Europe would likely see a steep decline in abundance — up to 40%. In the experimental study, the researchers simulated the warmer, wetter conditions predicted for the region due to climate change. Under this new scenario, some species of plants produced flowers with 60% less nectar and fewer or lighter seeds. Due to these changes, pollinating insects had to visit more flowers to gather the needed pollen and nectar, and visited each flower more frequently.

"Our results demonstrate that climate warming could have severe consequences for some species of wildflowers and their pollinators in agricultural systems, and shows that their community composition is likely to change in the future," said lead author Ellen D. Moss, a research associate at Newcastle University in the U.K.

While theoretical studies have predicted that climate change could accelerate pollinator losses and wildflower declines, Moss's study marks the first time scientists have put the theory to the test in an experimental setting. And previous climate change studies have focused on a small number of either plants or pollinating insects in a particular region, and not looked at the effects at a community level.

> "In California, which is experiencing increasingly hotter and drier winters due to climate change, studies have recorded a decline of wildflower species by 15% in 15 years."

"This study adds to the weight of evidence that pollinators are at risk from multiple stressors," said ecologist Jane Stout from Trinity College Dublin, who was not involved in the study. "They are losing places to feed and breed, and they are stressed by pesticides, disease and changes in climate."

To do this, the researchers sowed spring wheat and a few native wildflowers, which grow on wheat farms, in small agricultural plots in a North Yorkshire farm. They then heated some of these plots with infrared heaters to increase the soil temperature by 1.5° Celsius (2.7° Fahrenheit) and they increased the water supply by 40% to mimic the predicted wetter conditions from future climate change for Northern Europe. The non-heated plots acted as a control in their experiments to compare their results with.

For two flowering seasons, 2014 and 2015, the researchers tracked the different plant species that grew in these plots, the number of flowers they produced, the volume of nectar in them, and the weight of the dried seeds resulting from the flowers. They also collected information about visiting insect pollinators, including their visiting patterns to both the experimental and untouched plots.

The study reported 25 plant species and 80 insect species in 2014, and 19 plant and 69 insect species in 2015. Higher temperatures and more precipitation didn't change what species were found in the plots, with the most abundant wildflowers being corn marigold (*Glebionis segetum*), cornflower (*Centaurea cyanus*), common field-speedwell (*Veronica persica*), shepherd's purse (*Capsella bursa-pastoris*), chickweed (*Stellaria media*) and red dead-nettle (*Lamium purpureum*).

Not only did wildlife abundance plunge by up to 40% in the heated plots, most of the plants in these plots also had fewer seeds in the seed heads, and the seeds weighed

article continues on page 9 ▶

much less than those in non-heated plots. The only exception was the generalist weed known as common field-speedwell. While it produced more and heavier seeds in the heated plots, its flowers secreted 65% less nectar, making it a less popular flower with pollinators.

"A key finding [of the study] is that not all wild plant species respond to experimental manipulation in the same way, and so the implications for plant communities, and their interactions with pollinators, are complex to predict," Stout said. Nevertheless, the general decrease in both the abundance and the number of seeds produced is of concern, she added, "because loss of floral resources in the landscape is already a major driver of pollinator decline."

The study also found marked changes in the feeding behavior of pollinators in the heated plots. Hoverflies, honeybees and bumblebees, which were the most abundant insects, visited more flowers, and increased the frequency of their visits to the same flower to collect the nectar and pollen they needed.

"Fewer flowers and less nectar mean less food for pollinators," Moss said, adding that such conditions may drive competition between pollinators and force them to choose less optimal flowers. "This could reduce their fitness and survival."

A gloomy future for the blooms

Worldwide, two in five plants, including wildflowers, are threatened with extinction due to land use change for agriculture, housing and construction. In California, which is experiencing increasingly hotter and drier winters due to climate change, studies have recorded a decline of wildflower species by 15% in 15 years. In the U.K., human activities have destroyed about 97% of wildflower meadows since the 1930s, threatening once commonly seen plants like wild strawberry (*Fragaria vesca*), harebell (*Campanula rotundifolia*), and ragged robin (*Silene flos-cuculi*).

A natural stand of wildflowers that sprouted following the Witch Creek Fire in 2007 in San Diego County, CA. Pictured are yellow-orange California poppies (*Escholscholzia californica*) and purple phacelia (*Phacelia* species). **Photo © 2008 by Chaparralian**

The loss of wildflowers also has a knock-on effect on thousands of insect species, including pollinators like bees and herbivores like aphids, grasshoppers and caterpillars. It also hits populations of natural pest controllers like spiders, ladybirds and lacewings that take shelter in the meadows. Studies show that, worldwide, a quarter of known bee species have not been seen since the 1990s, and loss of habitat is one of the primary reasons for the decline.

"[Climate change] risks crop pollination and our own food supply, but perhaps of more concern is the risk to wild plant pollination and our ecosystems and all the other benefits we get from them," Stout said.

Tackling climate change by rapidly decreasing emissions would save at least some of the blooms, but in the meantime, there are other steps that could prevent a catastrophic future for wildflowers.

"The main things that will improve ecosystem resilience in the context of wildflowers and pollinators is to improve habitat quantity, quality and connectivity," Moss said. "We need to leave more wild spaces for native plants and insects and try to connect these areas up so that these patches of high-quality habitat are not too small or too far apart."

Citations:

Moss, E. D., & Evans, D. M. (2022). Experimental climate warming reduces floral resources and alters insect visitation and wildflower seed set in a cereal agro-ecosystem. Frontiers in Plant Science. doi:10.3389/fpls.2022.826205

(2020). State of the World's Plants and Fungi 2020. Royal Botanic Gardens, Kew. doi:10.34885/172

Harrison, S. P., Gornish, E. S., & Copeland, S. (2015). Climate-driven diversity loss in a grassland community. Proceedings of the National Academy of Sciences, 112(28), 8672-8677. doi:10.1073/pnas.1502074112

Zattara, E. E., & Aizen, M. A. (2021). Worldwide occurrence records suggest a global decline in bee species richness. One Earth, 4(1), 114-123. doi:10.1016/j.oneear.2020.12.005

To read the original paper in *Frontiers in Plant Science* describing the study mentioned in this article, click: **Experimental climate warming reduces floral resources and alters insect visitation and wildflower seed set in a cereal agro-ecosystem**

Mike's Turtle Net Picks by Michael J. Connor, Ph.D.

A varied selection of recent articles, stories and sites on the Web that some of you may find as interesting as I did.
This list is also posted at tortoise.org/turtlenetpicks/turtlenetpicks.html

The Fernandina Giant Tortoise Is Not Extinct

Fernanda, the female *Chelonoidis phantasticus* discovered in 2019 on Fernandina Island in the Galapagos has now been officially described and her species declared "not extinct".

Albino Galapagos Giant Tortoise Makes Public Debut

Video of two *Chelonoidis porteri* hatchlings that hatched from eggs laid at Tropiquarium Zoo in Servion, Switzerland one of which is albino (video).

Joshua Tree National Park Desert Tortoises

Video of Wildlife Ecologist Michael Vamstad in action at Joshua Tree National Park.

CDFW Reviewing Desert Tortoise Uplisting

California is considering whether desert tortoises should be uplisted from threatened to endangered under the California Endangered Species Act. They encourage anyone who has observed desert tortoises to submit their observations before August 1.

Gopher Tortoise Status Under Review

USFWS will determine whether gopher tortoises in Florida, Georgia, South Carolina, and eastern Alabama should be listed as threatened or endangered under the federal Endangered Species Act by September 30, 2022.

Western Pond Turtle Conservation Paying Off in Washington

After being nearly extirpated from the state, Washington's western pond turtles are slowly recovering after 30 years of conservation.

Western Chicken Turtle Information Sought

Arkansas Game and Fish Commission is developing a western chicken turtle conservation plan and asks visitors and outdoors enthusiasts to report any sightings.

Red-crowned Roofed Turtles Released at Chambal Sanctuary

Nicely illustrated article covers TSA efforts to protect *Batagur kachuga* or the red-crowned roofed turtle on India's Chambal River.

New Fossil Kinosternid from Saskatchewan

A newly identified Late Cretaceous fossil turtle has been named *Leiochelys tokaryki*, in honor of Tim Tokaryk, former curator of palaeontology at the Royal Saskatchewan Museum.

Kemp's Ridley Sea Turtle Nests at Galveston Island

For the first time in 10 years, a Kemp's Ridley sea turtle nest was found on Galveston Island State Park beach.

Hawksbill Sea Turtle Navigation

New study shows that Hawksbill sea turtles often take a meandering, circuitous route to make relatively short migrations to isolated targets suggesting that they have a relatively crude "map sense" of the ocean.

Queensland Sea Turtles Hit by Extreme Rain Events and New Disease

The emergence of a new disease and sediment washed out from rivers during extreme rain that is reducing the quality and quantity of their food by smothering seagrass is hitting sea turtles along eastern Australia coasts.

Green Sea Turtle Demographic Changes During an Era of Seagrass Decline

In the face of 50 years of seagrass decline off Bermuda, green sea turtle (*Chelonia mydas*) foraging aggregates are smaller and now consists of more small turtles and fewer large turtles.

New SWOT Report Available State of the World's Sea Turtles

(SWOT) Report volume 17 is now available for free download.

More Than One in Five Reptiles Threatened with Extinction

International Union for Conservation of Nature (IUCN) study finds that 21% of all reptiles are threatened with extinction.

CTTC's Turtle and Tortoise Listserve

To talk with other turtle and tortoise fans in a friendly atmosphere join CTTC's Turtle and Tortoise list or send an email to: <CTTC-TurtleAndTortoise-list+-subscribe@groups.io>.

CTTC On Facebook

For breaking news updates follow CTTC on Facebook!

Hawksbill turtle, *Eretmochelys imbricata*. Photo © 2019 by Robert Suntay, Lamave Citizen Science Project

In Memoriam
Dianne Huwaldt

Tribute and photographs provided by Michael J. Connor, Ph.D.

Left to right: Anita De Leon, tribute author Dr. Michael J. Connor, and Dianne Huwaldt.

Sadly we lost California Turtle and Tortoise Club stalwart Dianne Huwaldt at the end of April after a long, heroic struggle with cancer.

Dianne became Vice president of CTTC Foothill Chapter in December 1996 and a year later was elected President of the Chapter. She remained President of Foothill Chapter for 13 years until December 2010. For much of that time she also acted as CTTC's liaison with the US Fish and Wildlife Service at Los Angeles International Airport placing confiscated turtles and tortoises. Dianne wrote a number of articles for the *Tortuga Gazette* and served as editor of the newsletter in 2006.

Dianne was a Veterinary Technician and each year ran Foothill Chapter's popular turtle and tortoise wellness and worming clinics.

She was friend to many and will be sorely missed.

RIP Dianne.

Dianne (left) and Foothill chapter member Linda Crawford on the CTTC Hawaiian Adventure island excursion in 2009.

◀ Foothill chapter's annual microchipping, worming, and wellness clinics were organized by Dianne with a local veterinarian in attendance. ▼

CTTC members from the Chino Valley and Foothill chapters.

2022 California Turtle & Tortoise Club Directory

Executive Board

Important: The Executive Board is strictly an administrative body for the corporate portion of CTTC, and does not handle animals or adoptions.
General information:
CTTCEBOfficers@tortoise.org
Chair: **John Kim**
Vice-chair: **Virginia Doepping**
Treasurer: **Javier Gonzalez**
Secretary: **Heather Ponek**
Meeting: Quarterly hybrid meetings held via Zoom and in-person at the Los Angeles County Arboretum, 301 No. Baldwin Ave., Arcadia, CA 91007. Next meeting: 9 July.

Chino Chapter

President: Lynda Misiak
Vice president: David Bowman
Secretary: Rachelle Buck
Adoptions: Jim Misiak
Meeting: In-person meetings on the third Friday of each month, 7:30 PM, at Chino Girl Scout House, 5007 Center St., Chino, CA 91710.

Foothill Chapter

President: Joanna Bolt
Secretary: Mardy Graves
Treasurer/Membership:
Jeanette Lea
Meeting: Information to be announced.

High Desert Chapter

President: Regene Fonville
Vice president: Toni Clegg
Secretary: Mary Dutro
Treasurer: Jose Zamudio
Meeting: Second Monday, 6:00 PM at Hillside Medical Building, 15247 11th Street, Victorville CA 92395.

Inland Empire Chapter

President: Monica Dirac
Vice president: Richard Roosman
Corresponding Secretary: Amy Taylor
Recording Secretary: Gerald Rezes
Treasurer: Robyn Kohr
Meeting: Hybrid meetings take place virtually via Zoom and in-person on the first Friday, 7:30 PM at "The Ark" Church of the Nazarenes in the Fellowship Hall in Young Hall, 1307 East Citrus Ave., Redlands, CA 92374.

Kern County Chapter

General information:
KernCTTC@tortoise.org
President/membership:
Heather Ponek
Vice president: Tim Brennan
Treasurer: Kathy Studer
Adoptions: Adoptions email
Meeting: In-person meetings on the second Monday, 6:30 PM at St. Philip of the Apostle Church, St. Ann's Room (East side of church), 7100 Stockdale Hwy (on the north side, between Ashe and Gosford), Bakersfield, CA 93309.

Low Desert Chapter

General Information:
Tony Vaninetti
Secretary: Marlies Dietrich
Adoptions: Bill Powers
Meeting: to be announced.

Orange County Chapter

General Information:
orangecounty@tortoise.org
President: **Sharon Paquette**
Vice president: **John Kim**
Secretary: **Joyce Keyak**
Treasurer/membership:
Virginia Doepping
Adoptions: Adoptions email
Meeting: First Friday every month at 7:30 PM at the First Christian Church of Orange, 1130 East Walnut Avenue, Orange, CA 92867.

Ridgecrest Chapter

President: Robert Parker
Vice president: Sue Parker
Adoptions: Montynne Yates
Meeting: Second Monday, 7:30 PM outdoors at Maturango Museum, 100 East Las Flores Ave., Ridgecrest, CA 93555. There are no meetings in July or August.

Santa Barbara-Ventura Chapter

General information:
SB.Ventura@tortoise.org
President: **Trent Barnhart**
Vice president: **Sue Alvarez**
Treasurer: **Vel Muskat**
Secretary: **Chuck Alvarez**
Meeting: Contact the Chapter for meeting information.

Santa Clarita Chapter

General Information: Abigail DeSesa
President: **George Ordway**
Treasurer/membership/adoptions:
Abigail DeSesa
Secretary: **Jennifer Fields**
Meeting: Information to be announced.

TOOSLO (San Luis Obispo) Chapter

President: Brandon Froelicher
Vice president: Brian Kusko
Treasurer: Diane O'Leary
Meeting: The chapter has paused its activities until further notice due to the pandemic.

Turtle & Tortoise Care Society Chapter

President: John Kim
Vice president: **Casey Quinn**
Secretary/Treasurer:
Yolanda Keh
Adoptions: Adoptions Inquiries
Meeting: Third Saturday, 7:30 PM at St. Gregory's Episcopal Church, 6201 East Willow Street, Long Beach, Ca. 90815.

Valley Chapter

President: Bob Hazard
Treasurer: Karen Berry
Adoptions: Valley Adoption Team
Meeting: In-person or virtual meetings via Zoom are held on the third Friday of every month at 7:30 PM depending on scheduling. In-person meetings take place at Woodland Hills Christian Church, 5920 Shoup Ave., Woodland Hills 91367-3327.

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California Turtle & Tortoise Club

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A CRITICALLY ENDANGERED TORTOISE ENJOYS ZOO MED GRASSLAND TORTOISE FOOD

The Radiated Tortoise *(Astrochelys radiata)* is the 6th rarest tortoise in the world, and the heroes at Turtle Survival Alliance (TSA) are fighting for its future. As a non-profit, the TSA relies on support from the community. Zoo Med has pledged to donate pallets of their Natural Grassland Tortoise Food to TSA's Madagascar location 3 times a year. This food prevents shell and spinal growth deformities by matching the nutrient profile and high fiber content of a wild tortoise diet.

Join Zoo Med in supporting the TSA's conservation efforts; visit their website to learn more and how to contribute: turtlesurvival.org

TSA
turtle survival alliance

Back in the Day: Summer 2006

Forage Preferences and Feeding Patterns

by Mark Massar, Desert Tortoise Preserve Committee

One of the original ways biologists collected information on Desert Tortoise (*Gopherus agassizii*) diet was by examining tortoise scat. However, scat analysis is very inaccurate because certain species, such as grasses, pass through the digestive tract more readily than others (i.e., herbaceous plants).

Acmispon brachycarpus, formerly known as *Lotus humistratus*, a favorite food of Mojave desert tortoises. Common names for this plant include foothill deervetch and short-podded lotus. **Photo © 2021 by charlescrussell**

Instead, biologists use bite counts, which involve observing a particular tortoise (with binoculars) from dawn to dusk, tediously counting every bite the animal takes and recording the plant species eaten. Based on tens of thousands of bite counts from various tortoises across the Mojave Desert, a clearer picture of the diet of wild Desert Tortoises has emerged.

Tortoises are strict vegetarians. In general their food consists of winter annuals, summer annuals, herbaceous perennials, grasses, and, to a lesser extent, cacti. Tortoises do not eat desert shrubs such as the ubiquitous creosote bush (*Larrea tridentata*). Tortoises are very selective about the plants they prefer.

The specific plants that tortoises prefer are often rather rare in the environment. Tortoises will make deliberate searches in order to find them, often following specific pathways from one plant to another, and bypassing other, more common and seemingly less palatable plants.

The majority of the diet of Desert Tortoises consists of just a few plant species. Plants in the legume family make up the greatest percentage of their diet, with lotus (*Lotus humistratus*) and astragalus (*Astragalus didymocarpus* and *A. layneae*) being the most important species, especially in the eastern Mojave. Surprisingly, tortoises do not prefer the more common annual species, such as Desert Dandelions (*Malacothrix glabrata*) and Alkali Goldfields (*Lasthenia species*), although these species can carpet the desert in a sea of color following wet winters.

As it turns out, there is a good reason why tortoises are particular in their food choices. Most desert plants contain high levels of potassium. Because an accumulation of potassium in the body is lethal, potassium is regularly excreted from the body using a process that is, unfortunately, water intensive. Obviously desert tortoises need to be experts at water conservation, so they select the few desert plants in their environment that have relatively low concentrations of potassium and relatively high levels of water and protein. Desert tortoises prefer fresh, green, succulent annuals over dried vegetation. In the western Mojave Desert, fresh annuals are available mainly in the spring following the winter rains.

In the eastern Mojave Desert and the Colorado Desert, rains come not only in the winter but also in the summer. This gives tortoises living there two opportunities to eat fresh green plants. During droughts, tortoises generally become less active, staying mostly underground in their burrows and caves.

An alarming trend in the Mojave Desert is the spread of non-native annual plants. This spread is changing the desert is many ways that are jeopardizing the future of the Desert Tortoise. Non-native annuals are replacing many of the native preferred annuals.

Non-native annuals make up a very small percentage of the tortoises' diet, although in some places they now make up more than 90% of the annual-plant biomass. Also, alien annuals promote the spread of wildfires, which in turn creates conditions favorable for the increased spread of alien annuals.

Although the situation appears dire, land managers are beginning to explore options of controlling the spread of alien annuals and reseeding areas with the native annuals that tortoises prefer.

Originally published in the *Tortoise Tracks* newsletter of the Desert Tortoise Preserve Committee, 26(2), Summer 2006.

Reprinted in the CTTC *Tortuga Gazette* 44(4), July/August 2008.

Astragalus didymocarpus var *didymocarpus,* dwarf white milkvetch, a food plant favored by the Mojave desert tortoise. Photo by Alex Heyman. Public domain.

Galápagos Conservancy News

New Breeding Center Nesting Sites to Accelerate Floreana Species Restoration

3 June 2022 — Galápagos National Park rangers, volunteers, and staff from Galápagos Conservancy have begun preparing additional nesting sites at the Fausto Llerena Giant Tortoise Breeding Center on Santa Cruz Island to accelerate the progress of the restoration of the extinct Floreana Giant Tortoise, part of a comprehensive initiative to restore the island to its original state, Project Floreana.

The breeding program was launched in 2017, two years after a Galápagos National Park Directorate-Galápagos Conservancy expedition discovered 19 tortoises on Wolf Volcano with partial ancestry to the species, which has been extinct since the mid-19th century due to exploitation by whalers and hunting by the first settlers in the 18th and 19th centuries.

"Once the nesting areas in the pens are ready, we will work with the reproductive groups of tortoises, made up of one male and two or three females, for the restoration of tortoises of the Floreana Island species," said Jorge Carrión, Director of Conservation Galápagos Conservancy.

Since 1965, when the Breeding Center in Santa Cruz was created, this place has been key to restoring giant tortoise populations in Galápagos. Here begins the life of new baby tortoises that remain in the Breeding Center for approximately five years until they are physically prepared to live in their natural habitat.

All these efforts are part of *Iniciativa Galápagos*, which seeks to restore tortoise populations to their historical distribution and numbers in Galápagos, including on islands where tortoises have become extinct like Floreana.

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Please send ad fee to: CTTC Tortuga Gazette, attn Treasurer, P. O. Box 7300, Van Nuys, CA 91409-7300. Mail fee with ad copy to the *Tortuga Gazette* mailing address; OR, mail fee to the postal address above, and email the ad copy to the Gazette Editor

FOR SALE: Young Leopard tortoises for sale. Approximate age is 6 months. 75^{00} each. Contact Richard Roosman: richardinwalnutpark@msn.com

Publication Confirms Fernanda as Fernandina Giant Tortoise

9 June 2022 — The highly anticipated scientific paper just published in the journal *Communications Biology* by a multinational group of scientists, including Galápagos Conservancy's Vice President of Science and Conservation Dr. James Gibbs and General Director Washington Tapia, confirms that Fernanda, the lone female tortoise discovered on Fernandina Island in 2019, is a Fernandina Giant Tortoise of the species *Chelonoidis phantasticus*.

DNA analysis in early 2021 by researchers from Yale University and the University of Newcastle had previously declared the same conclusion, but this new evaluation highlights Fernanda's genetic uniqueness and examines her species' genetic relationship to other Galápagos Giant Tortoises.

The team of researchers compared the genomes of the two known specimens of the species — Fernanda and one collected on Fernandina Island in 1906 — with a dataset of genomes from each of the Archipelago's 12 living and one extinct Giant Tortoise lineages.

The study's results confirmed that Fernanda and the specimen collected in 1906 are from the same lineage. These two individuals, representing one lineage, are genetically distinct from all other tortoises in Galápagos.

While Fernanda is again confirmed as the last known member of her species, recent expeditions to Fernandina Island have failed to locate another living member of the species. In the next few months, Galápagos Conservancy and Galápagos National Park will return to Fernandina island and, with helicopter support, explore areas inaccessible on foot in a last bid to search for a mate for Fernanda.

Fernanda is both a symbol of hope and a call to action for conservation in Galápagos. Her simple existence after over 100 years of presumed extinction is incredible. Her story will turn into tragedy if it follows the same trajectory as Lonesome George, the last Pinta Giant Tortoise who died in 2012.

Whether Fernanda is the "endling" of her species or not, she represents an exciting discovery that engenders hope that even long-unseen species may yet survive.

Click *Communications Biology* for the complete article on Fernanda published by Princeton University.

— Galápagos Conservancy press releases

Meeting Schedule: July/August 2022

Click on your Chapter's website link for the latest program information which is posted as it becomes available.

Chino Valley
15 July; 19 August

Foothill
Meeting information to be announced.

High Desert
11 July; 8 August

Inland Empire
1 July; 5 August

Kern County
11 July; 8 August

Low Desert
Meeting information to be announced.

Orange County
1 July; 5 August

Ridgecrest
NO meetings in July or August.

Santa Barbara-Ventura
Meeting information to be announced.

Santa Clarita
Meeting information to be announced.

TOOSLO (San Luis Obispo)
Contact the chapter for meeting information.

TTCS (Long Beach)
16 July; 20 August

Valley
15 July; 19 August

California Turtle & Tortoise Club: a Society Dedicated to Turtle & Tortoise Preservation, Conservation and Education since 1964. Promoting and Facilitating the Care, Rehoming, and Adoption of Native and Nonnative Turtles and Tortoises.

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Many members choose to join a nearby Chapter to participate in Chapter meetings and other activities. Print membership forms from the CTTC website.

Your Chapter and your renewal date (month/year) are displayed on your newsletter notification. Mail your new or renewal membership/subscription to the Chapter of your choice.

Membership fees

- Student membership $15.00
- Individual membership $25.00
- Family membership $35.00
- Life membership $500.00

CTTC Postal Mailing Addresses

Chino Valley Chapter
P.O. Box 1753, Chino, CA 91708-1753

Foothill Chapter
P.O. Box 51002, Pasadena, CA 91115-1002

High Desert Chapter
P.O. Box 163, Victorville, CA 92393

Inland Empire Chapter
P.O. Box 2371, San Bernardino, CA 92406-2371

Kern County Chapter
P.O. Box 81772, Bakersfield, CA 93380-1772

Low Desert Chapter
P.O. Box 4156, Palm Desert, CA 92261

Orange County Chapter
P.O. Box 11124, Santa Ana, CA 92711

Ridgecrest Chapter
P.O. Box 1272, Ridgecrest, CA 93555

Santa Barbara-Ventura Chapter
P.O. Box 3086, Camarillo, CA 93011-3086

Santa Clarita Chapter
P.O. Box 4012, Castaic, CA 91310

TOOSLO Chapter
P.O. Box 763, Grover Beach, CA 93483

Turtle & Tortoise Care Society Chapter
P.O. Box 15952, Long Beach, CA 90815

Valley Chapter
P.O. Box 7364, Van Nuys, CA 91409-7364

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