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An angulate tortoise. *Chersina angulata*, photographed at Lang Elsie's Kraal Rest Camp in Bontebok National Park, Western Cape, South Africa. Note the undivided gular scute below the chin. **Photo © 2018 by Bernard Dupont**

featured species

Angulate Tortoise, *Chersina angulata* (Schweigger, 1812)

The Bowsprit Tortoise of Southern Africa

by M. A. Cohen

Endemic to coastal South Africa and Namibia, the angulate or bowsprit tortoise, *Chersina angulata*, is a monotypic genus with "two distinct evolutionary lineages associated with the southern and western regions of South Africa" (Hofmeyr, 2009). The biological term 'monotypic' indicates one type or representative and typically refers to a genus that has a single species. The distinct lineages and geographic variations of the angulate tortoise will be discussed in greater detail in the "Description" section of this article.

Scientifically described by the German naturalist August Friedrich Schweigger (1783–1821) in 1812, the angulate tortoise is also known commonly as the angulated tortoise, the bowsprit tortoise, the South African bowsprit tortoise, and is known locally as *rooipens* (Afrikaans vernacular for red-bellied tortoise) [Hofmeyr 2009].

The definition of the term bowsprit is as follows: a spar that extends forward from the prow (also called the bow) of a sailboat or a ship. In one of the common names of *C. angulata*, the word bowsprit refers to the stout, single gular scute protruding under the species' chin.

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The genus name *Chersina* derives from a Greek word root *chers-* meaning "dry land" and refers to a land tortoise, while the species name *angulata* derives from a Latin word root *angul-* that means "angled."

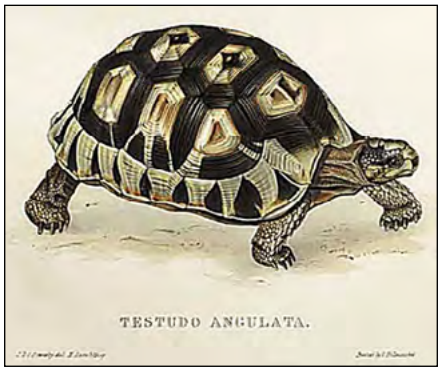
One of the most abundant species of tortoise in South Africa, the angulate tortoise inhabits a variety of ecoregions and climates ranging from semidesert biomes along the West Coast to Mediterranean climates in the southeast and temperate climates in the southwest (Hofmeyr, 2004).

Description

A small to medium-sized member of the tortoise family the Testudinidae, the angulate tortoise inhabits ecoregions generally described as coastal scrub within its southern Africa range.

Reaching a carapace length of 12 inches (30 centimeters) at maturity, *C. angulata* features a domed upper shell that is hingeless, elongated, and varies considerably in coloration (Chersina angulata).

Typically yellowish-brown to olive, the carapacial scutes have dark brown to black borders and a brown to black patch in the center of each vertebral and pleural scute. Marginal scutes have narrow, dark triangular markings near the front edge of each scute (Chersina angulata). The carapace frequently fades in coloration and patterning as the tortoise ages, with older tortoises often appearing uniformly yellowish-tan.



An image titled *Testudo angulata*, the original name of the species now known as *Chersina angulata*. Rendering by James De Carle Sowerby, published in *A Monograph of the Testudinata* by Thomas Bell (1832-1836). Public domain.

Yellow to reddish in background coloration, the angulate tortoise's plastron features a wide, dark, irregular stripe centered on its length. The species' "large, protruding undivided gular scute" is distinctive (Hofmeyr, 2009), and distinguishes it from all other species of South African tortoises.

Typically brown or black in color, the head of *C. angulata* may be yellow on the top with a moderately hooked jaw. Its forelimbs are olive to yellow; hindlimbs are dark on the outer surface and yellow on the inner (Chersina angulata).

Displaying pronounced sexual dimorphism, angulate tortoise males are typically larger than females with longer, thicker tails, deeply concave plastra, and larger gular projections (Chersina angulata). The carapace of the male angulate tortoise tends to be less domed than that of the female.

The species also inhabits islands off the coast of South Africa, including Dassen and Robben Islands off the southwest coast, where the population densities are comparatively high (Hofmeyr, 2009) .

Range and Habitat

Extending from southern and western South Africa northward into southwestern Namibia, the range of the angulate tortoise comprises four communities of flora and

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fauna known as biomes. About 90% of the species' range occurs in southern and western South Africa, while the remaining 10% is in Namibia.

According to M. D. Hofmeyr, the species lives in areas of "low annual rainfall (<100 to 600 millimeters)," which converts to less than 4 to 24 inches. Rainfall in the southernmost portions of the range may reach 1,000 millimeters (39 inches) in a given season. Summers vary in temperature from mild to hot. Rainfall varies from seasonal (winter only in Mediterranean ecoregions) to year-round (Hofmyer, 2009). With the exception of the Albany Thickets, these biomes are comparatively arid habitats.

The southern African biomes which *C. angulata* inhabits include Fynbos, Albany Thicket, Succulent Karoo, and Nama Karoo. The following are based on Hofmyer's brief descriptions of each biome in *Chelonian Research Monograph No. 5* published in 2009.

Fynbos
Based on an Afrikaans word meaning "fine-leaved," the term fynbos refers to a fire-prone shrubland that may be sparsely or densely vegetated. The dominant evergreen flowering shrubs of the fynbos, members of the heather family (Ericaceae), have small, needle-like or scale-like leaves. These shrubs and perennials are generally adapted to poor soils and arid conditions. The fynbos biome is also inhabited by many shrubs in the aster or daisy family (Asteraceae).

An exceptionally colorful angulate tortoise photographed in the Goegap Nature Reserve in Namakwaland, a semi-desert Succulent Karoo biome spanning Namibia and South Africa.
Photo © 2013 by Javier Ábalos Alvarez

Grass-like, perennial restios and other grasses add to the understory flora of the fynbos.

Albany Thickets
Dense, comparatively lush woodland regions located in the Albany region of the Eastern Cape of South Africa, the Albany thickets offer milder, more humid microclimates than other angulate tortoise biomes.

On the hot, open plains of the Albany thickets, the flora consists of sparse, semi-succulent and thorny species that tend to be fire-prone. Mountain and river valleys offer some respite from the summer heat, their succulent, thorny vegetation growing more densely with an understory of small-scale succulents and ground-dwelling creeping species. Tending to favor the more open plains, angulate tortoises are less likely to occupy the densest thickets.

Succulent Karoo
According to the World Wildlife Fund for Nature, the Succulent Karoo ecoregion of South Africa and Namibia is a biodiversity hotspot with the greatest amount of succulent-plant diversity in the entire world. Approximately one-third of the world's 10,000 succulent species grow in the shrublands of the Succulent Karoo. Intermingled with succulents of all sizes are annuals, grasses, and geophytes (plants growing from bulbs, corms, rhizomes, etc.,) [Hofmeyr, 2009]

Precipitation occurs mainly in winter in the Succulent Karoo, and extended droughts are rare. Rainfall is augmented by dew and heavy fog, both of which regularly form over this biome (Cowling).

Nama Karoo
An ecoregion of harsh climatic extremes, the Nama Karoo, with its searing summers and freezing winters, lies primarily in South Africa but stretches into Namibia as well. The seasonal rainfall occurs between December and March, and droughts are common.

While trees and taller woody shrubs tend to exist adjacent to the region's watercourses, dwarf shrubs and grasses are the dominant flora in the Nama Karoo (Seymour).

Foods and Feeding

Omnivorous in its dietary preferences, *C. angulata* consumes flowering plants, grasses, herbs, mosses, mushrooms, insects, snails, and animal feces. As a "selective feeder," the diet of the angulate tortoise varies, changing with the season and the location (Hofmeyr, 2009).

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Reproduction

At 10 to 12 years of age, both *C. angulata* males and females reach reproductive maturity. Males typically pursue and nip at the legs of females during the courtship ritual. While it generally takes place from September through April, mating can occur throughout the year, and nesting usually happens in August (Chersina angulata).

Females normally lay one egg per clutch, laying from one to six clutches per season under favorable conditions [Hofmeyr, 2009].

Egg retention prior to nesting varies considerably, lasting anywhere from 23 to 214 days. Immediately following nesting, the female begins to develop another egg, in other words, "oviposition and ovulation (are) synchronized." Rainfall appears to be an environmental cue to begin nesting activity. As Hofmeyr observes, "this reproductive pattern is highly unusual for chelonians in Mediterranean climates" (Hofmeyr 2004).

Incubation varies from 94 to 198 days, and hatching occurs in early autumn (March-April in the southwestern Cape) [Hofmeyr, 2009].

The Two Lineages

While investigating the genetic differentiation within the widely distributed populations of angulate tortoises in southern Africa, biologists discovered two genealogical lineages. Differing in both genetic systems and habitat preferences, one lineage occurs in the southern portion of the range and the other, in the western portion of the range (Spitzweg, et al., 2020).

While the two lineages could be considered two subspecies, there is insufficient data on the geographic origins of the lineages to make the case for subspecies status. In the zone where the two lineages have contact, hybrids often occur (Spitzweg, et al., 2020).

An angulate tortoise, *Chersina angulata*, photographed in habitat at Bontebok National Park, Western Cape, South Africa. **Photo © 2016 by Bernard Du Pont**

Threats

C. angulata is comparatively common throughout its range in South Africa, but in Namibia the species is termed "peripheral" and receives legal protection (Hofmeyr, 2009).

Hunted for food since antiquity, the angulate tortoise is less widely exploited for both food and the pet trade today because of strong regulations (Hofmeyr, 2009).

Fire poses considerable danger to the species, largely because of fire-prone, alien, invasive plants that have encroached upon portions of its range. Because much of their range consists of sandy soils and gravelly or rocky substrates, tortoises often seek refuge from wildfires by burrowing into these soils and substrate media (Hofmeyr, 2009).

Conservation

The population of angulate tortoises in southern Africa is considered "stable." Listed as CITES Appendix II, *C angulata* is categorized by the IUCN as a species of "least concern" as of its RedList assessment in 2017.

The species is protected regionally by conservation ordinances and biodiversity laws in South Africa. In Namibia, *C. angulata* is legally protected (Hofmeyr & Keswick, 2018).

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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

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

Chelonian Research Institute Collection Moves to Ojai
Peter Pritchard's Chelonian Research Institute collection has found a new home at the Turtle Conservancy.

Your Turn Haaland and Biden!
Tortoise advocates plea for Secretary of Interior Haaland and President Biden to stop highway construction through significant desert tortoise habitat at Red Cliffs Reserve.

Galapagos Tortoise Hatchlings Found in Luggage
There was lots of coverage of this story of 185 hatchlings being found in a suitcase at a Galapagos airport.

Suwannee Alligator Snapping Turtle Proposed for ESA Listing
The USFWS has proposed listing the Suwannee alligator snapping turtle (*Macrochelys suwanniensis*) as a threatened species under the Endangered Species Act.

Video - Roti Island Snake-necked Turtle Hatchlings
Zoo Knoxville video of three snake-necked turtles that hatched in mid-April from eggs zookeepers found in their Roti Island turtle enclosure.

Video – Lion Chasing Turtle
A small but feisty helmeted turtle tackles a couple of drinking lions.

Sea Turtle Fossil Discovered in Pillar From Earthquake-damaged Church
The 35 million year old fossil remains of an *Eochelone* sea turtle were found inside a stone pillar during reconstruction of a church in Christchurch, New Zealand.

Loggerhead Sea Turtles May Use a Dynamic Thermal Corridor to Cross the Pacific
North Pacific Loggerhead sea turtles migrate enormous distances. Now biologists propose that they move along a "thermal corridor", a warm transport pathway that only opens intermittently.

Hybrid Sea Turtles in Northeast Brazil
Genetic analysis reveals that 30 to 40% of female hawksbills at some nesting sites in Brazil are hybrids resulting from cross-breeding with loggerheads.

Sea Turtle Saved From Fishermen's Tackle Again
A Loggerhead sea turtle named Eleonora was rescued for the second time in 3 years from being entangled in a fishing net.

West Coast Leatherback Sea Turtle Population Crashing
In less than 30 years, the number of western Pacific leatherbacks in the foraging population off of California has plummeted 80%.

Key Sea Turtle Research Paper
A Global Assessment of the Potential for Ocean-Driven Transport in Hatchling Sea Turtles.

Sea Turtle Newsletters
Latest **Indian Ocean Turtle Newsletter.**

African Sea Turtle Newsletter - Tribute to Peter Pritchard.

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!
https://www.facebook.com/CaliforniaTurtleandTortoiseClub

Earth Day: Rehabilitated sea turtle released in Florida Keys

MARATHON, Florida. (AP) — 22 April 2021 — Staff from the Florida Keys-based Turtle Hospital released a rehabilitated loggerhead sea turtle back to the ocean on Thursday to mark Earth Day.

Nicknamed "Sparb," the 125-pound (57-kilogram) subadult sea turtle was rescued in late January after being discovered floating offshore, unable to dive, with severe wounds and a missing front right flipper.

Typically, sea turtles admitted to the facility are named by their rescuers. Among Sparb's rescuers was a Keys resident who wished to honor her late husband, who had that nickname and lost his right leg.

When the endangered reptile arrived at the Turtle Hospital, it was in critical condition and was not expected to survive. Treatment included a whole blood transfusion, broad-spectrum antibiotics, extensive wound care, laser therapy, fluids, vitamins and a nourishing diet of fish and squid.

Beyond Earth Day, individuals can make a difference regarding the environment, Turtle Hospital manager Bette Zirkelbach said.

"We are at that sweet spot in time, there's an awareness," Zirkelbach said. "I really believe that today with awareness that every day is Earth Day.

The Turtle Hospital has been rescuing, rehabilitating and returning turtles to the wild for more than 35 years.

—Yahoo News press release

Galápagos Conservancy News

Final Phase of the Santa Fe Tortoise Repopulation Process Complete

— Galápagos Conservancy press release

2 March 2021 — On Friday, February 26, 191 juvenile tortoises of the *Chelonoidis hoodensis* (Española Island) species joined the population that has been introduced to Santa Fe Island since 2015 as part of the process implemented to achieve the ecological restoration of the entire island. After this final repopulation effort with the last 191 individuals from the Fausto Llerena breeding center in Santa Cruz, Santa Fe now has a population of 732 tortoises in total.

With this activity, the Galapagos National Park Directorate and Galápagos Conservancy completed the third phase of the Plan for the Introduction of Giant Tortoises to Santa Fe as a strategy to contribute to the process of their ecological restoration, which is part of the activities of the Giant Tortoise Restoration Initiative (GTRI).

Washington Tapia, Director of the GTRI, explained that the introduction of 31 sub-adult turtles carried out at the beginning of 2020 and the high survival rate of juveniles (99.8%), accelerated the process of establishing a breeding population on the island — which was essential to contribute effectively to the process of restoring the ecological integrity and biodiversity of Santa Fe.

Santa Fe Island

The 191 baby turtles hatched in the 2013–2014, 2014–2015 and 2015–2016 nesting seasons; their ages are between five and seven years old. Before being transferred to the island, they entered a 10–week quarantine period to eliminate the seeds contained in their digestive tract. In addition, they were dewormed, their health was checked and a microchip was placed on them that will allow them to be identified in the future.

A tree cactus (*Opuntia echios* var. *barringtonensis*) native to Santa Fe Island, Galápagos. The giant tortoises (*Chelonoidis hoodensis*) play a significant role in its seed dispersal which contributes to the revegetation of the island's native flora. **Photo © 2008 by me.**

The transfer was carried out by 22 rangers and scientists from the Park and Galápagos Conservancy, who traveled approximately three miles from the landing site to the release zone in the center of this nearly 10–square–mile island.

Release of tortoises on Santa Fe

Danny Rueda, director of the Galapagos National Park, explained that the island's ecological restoration process began in the 1970s with the eradication of goats, but in 2015 it took a new turn with the introduction of tortoises as an ecological analog of the original tortoise species on the island, which has been extinct for more than 150 years. That decision that was made after a comprehensive evaluation of the island showed that its main herbivore was missing, because the population of land iguanas here did not fulfill the same ecological role of tortoises — particularly in terms of seed dispersal.

Since its inception, the project has included a rigorous annual monitoring process, which has which has shown that tortoises have already dispersed over approximately 30% of the island's surface, and that there is no competition for resources among tortoises and iguanas. The tortoises are also actively contributing to seed dispersal, especially *Opuntia* cacti, which means they are fulfilling their important role as "ecosystem engineers" — an aspect that will continue to be documented through monitoring activities that will continue in the long term.

the Turtle's Garden
planting for chelonians
by M A Cohen

Echinacea purpurea, Coneflower

Close-up image of the eastern purple coneflower, *Echinacea purpurea*, showing its pink-purple outer petals and its spiny center disk flowers. Photo © 2019 by Jg44.89

Native to the northeastern and central United States, the coneflower belongs to the Asteraceae family of flowering plants, also known as the Compositae. Called the aster, composite, daisy, or sunflower family, the Asteraceae comprises some 23,600 recognized species with over 1,600 genera. This family is distributed worldwide, ranging from the heated tropics to cold arctic and alpine regions.

The genus name *Echinacea* derives from the Greek word root *echios-* meaning 'hedgehog,' referring to the brownish-orange, spiny, dome-shaped center disk of the coneflower (Brenzel, 2012).

Commonly called the coneflower, purple coneflower, snakeroot, scurvy root, Indian head, and hedgehog (Shadow, 2017), the herbaceous perennial coneflower grows easily in most regions of the United States, as well as many other locations worldwide.

A large planting of purple coneflower (*Echinacea purpurea*). Photo © 2009 by H. Zell

While the North American native *E. purpurea* blossom has pink-purple petals, developments by plant breeders include cultivars with petals of pure white through pink, lavender, yellow, orange, red, and various bi-color combinations. Double-flowering forms and other unique petal arrangements, as well as scented varieties, are some of the other cultivars that are commercially available.

Description

The native species has flowers with showy pink-purple petals and a domed, spiny center that resembles the center of a sunflower but is much smaller. Coneflower blossoms grow up to 5 inches (12 centimeters) in diameter atop slender stems 3 to 4 feet (1 to 1.2 meters) in length (Brenzel, 2012).

Growing some two to three feet (60 centimeters to 1 meter) tall, the coneflower plant has coarse-textured, narrow, lanceolate, medium- to dark-green leaves with sparse white hairs on the upper surface, and rough-textured stems (Stephenson). The coneflower generally blooms from June through August, but often starts blooming in spring in mild climates. It may continue to bloom until the first frost arrives (Brenzel, 2012).

E. purpurea is the native member of the genus and the species most frequently planted in perennial gardens. Furthermore, coneflower is attractive to pollinators such as bees, butterflies, predatory wasps, and pollinator flies (Reynolds, 2018). The species also attracts hummingbirds [Echinacea purpurea (Purple Coneflower)].

With many uses in the landscape, coneflower is a versatile, easy to grow, low mainte-

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nance perennial that fits well into many types of gardens, including naturalized, massed plantings, native meadow and wildflower gardens, and border plantings. Additionally, *E. purpurea* is an excellent, long-lasting fresh cut or dried flower (Echinacea purpurea).

Cultivation

Tolerating heat, drought, and humidity, *E. purpurea* has been popular in perennial gardens for over 200 years. Typically recommended is a full-sun location in the garden, but the species will tolerate part shade.

Tolerating a variety of soils, the coneflower will grow in poor soils, chalk, and clay or rocky soils, as long as soil drainage is good. Because the species has low to moderate water requirements, horticulturists recommend moderate watering practices in warmer areas for best appearance.

Echinacea purpurea 'White Swan' cultivar photographed by Hardyplants. Public domain.

Being a native North American prairie species, *E. purpurea* is easy to cultivate, providing the soil is well-drained and weeds do not outcompete it. With its long taproot, the coneflower is comparatively drought resistant (Reynolds, 2018).

Many horticulturists recommend dead-heading coneflower to improve its appearance. *E. purpurea* freely re-seeds if some seed heads are allowed to remain on the plant (Echinacea purpurea).

Furthermore, leaving spent flowers on the plant allows the seeds to mature and dry, thereby attracting finches and other birds that relish the seeds. Attracting birds to the garden is beneficial because the birds eat bugs as well as fertilizing the garden (Reynolds, 2018).

A double-flowered coneflower cultivar named 'Hot Papaya.'
Photo © 2018 by Zoya Akulova

As mentioned, the coneflower requires little to no maintenance once established. Because the species will derive sufficient growth nutrients from the garden soil, there is no need for supplemental fertilizer.

Comparatively resistant to pests and diseases, the coneflower is occasionally attacked by Japanese beetles or leaf spot disease. *E. purpurea* is also resistant to damage by deer.

Edibility

CAUTION: people with allergies to daisies, asters, sunflowers, and other flowers should avoid planting them or eating coneflower parts, which may trigger their allergies.

The leaves and the flower **petals** of the coneflower are edible, and these plant parts are consumed by persons that enjoy consuming wild foods and planting edible landscapes.

Tortoises and other herbivores are unlikely to have adverse reactions to the species. It is always wise to offer a small amount of a new plant to pets to check for a reaction. It is equally wise to feed only moderate amounts of leaves and flowers to pets as part of a varied diet.

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Turtles 'in horrible shape' with grim future due to rising sea levels

Expansive phylogenetic tree reveals clues about the animals' past, future

By David Colgan, UCLA Institute of the Environment and Sustainability

About 60% of the world's turtle species are considered threatened or endangered, making them one of the most vulnerable groups of animals on the planet.

A new study in the Proceedings of the National Academy of Sciences reveals new findings about turtles' evolution so far and the tough prospects they face for survival.

"Turtles are in horrible shape," said UCLA conservation geneticist Brad Shaffer, senior author of the paper. "There aren't very many species of turtles and tortoises to begin with, so we don't have many to lose."

The number of turtle species — around 360 — is tiny compared with the numbers of species of amphibians (over 8,200), mammals (6,400) and birds (10,000).

Human hunting of turtles for food and traditional medicine is by far the biggest current factor in their threatened status. But according to the paper, rising sea levels driven by climate change will be a much bigger problem in coming years and decades.

The crux of the paper is one of the most complete phylogenetic trees ever created for any major animal group. Phylogenetic trees — branching diagrams that show evolutionary relationships among organisms — include information on how species are interrelated and when they evolved into separate species. Documenting the timing and rate of when they speciated, or evolved into separate species, is crucial because it enables scientists to understand how past events may have influenced the winners and losers in the turtle family tree.

The researchers assembled the turtle tree by collecting and assembling DNA samples from hundreds of living species, and then analyzing the samples to determine similarities and differences among species. Next, they turned to fossil records for turtles to pinpoint when lineages evolved and declined.

One of the paper's major findings is that about 30 million years ago, the number of turtle species grew significantly, into the hundreds, encompassing the vast majority of species and lineages alive today. The phylogenetic tree helped the researchers determine the likely cause.

"One thing that happened about 30 to 35 million years ago is that the world got cold and dry. There was a big climate change," Shaffer said.

Water around the poles froze and ice caps expanded, causing sea levels to drop and exposing low-lying land that had previously been part of the submerged continental shelf surrounding most continents. Turtles settled that newly exposed land, and began breeding and differentiating in places like the Brahmaputra delta (in present day Bangladesh and India) and what is now the southeastern United States. Turtles that became isolated in those areas evolved and differentiated, and new species came into existence.

Diamondback terrapin, *Malaclemys terrapin*, one of the coastal species at risk from rising sea levels. Photo by Ltshears. Public domain.

Since then, the rate of speciation has been more stable, despite ice ages and other global changes over the millenia. Now, with sea levels projected to rise due to global warming, much of those habitats are expected to disappear or dramatically shrink within the next hundred years, which would deprive those species of their habitats, Shaffer said.

On top of that, coastal and waterfront areas are among the regions that have been most heavily developed and exploited by humans. As a result, species like the salt marsh specialist, the diamondback terrapin and map turtles — which have speciated

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in the coastal rivers of the eastern United States that drain into the Gulf of Mexico — have become endangered.

With turtles and other organisms, a major concern is the speed at which the climate is changing. Climate change has accelerated dramatically recently, leaving species little time to adapt — one reason Earth is experiencing the beginning of what is often referred to as the sixth major extinction, said University of Hawaii evolutionary biologist Robert Thomson, lead author of the paper..

"Geologically, it's likely to look more like a catastrophic meteor strike than one of these things that species slowly adapt to and recover from," Thomson said.

Foundational science such as the phylogenetic tree published today can help experts better understand how to deal with current problems, even in other scientific fields. The rapid development of COVID-19 vaccines, for example, used phylogenetic insights to identify newly evolved variants that may be more contagious or pathogenic.

For those studying turtles, the phylogenetic tree should help inform conservation efforts in a rapidly changing world.

Originally published on 8 February 2021 on the UCLA **Institute of the Environment and Sustainability** website. Reprinted with permission from author David Colgan.

The original article is entitled "A global phylogeny of turtles reveals a burst of climate-associated diversification on continental margins." The **abstract and references from the original article** are available on the Proceedings of the National Academy of Sciences website. The full PDF is also available for a fee.

Dear Sulcata Tortoise

By Matt Schumacher

When we pulled over suddenly
and I sprinted to save you
before you crossed the busy highway,
then brought you home in the back of our van,
I had no idea you were destined to attain
a greater weight than mine, and to outlive me.
I didn't know I could fall in love with a bulldozer,
a subsaharan African eating machine.
I didn't know the tortoise eye could mystify,
staring straight from the cretaceous,
that your war helmet would ceaselessly
patrol the yard on stubby legs,
part dinosaur, part toddler, ready to do
combat in your shield, carapace encasing
your back legs like a diaper. I didn't know
the other pets would get out of your way
as if they knew you would one day outgrow them.
I had no idea it could be so positively hypnotic
to assist you as you gorge yourself
on arugula and pumpkin,
to watch you luncheon on tufts
of dandelion and clover,
to see you look up at us
with a face like a child's drawing,
flapping your flipper-like arms when frustrated,
or sighing gently when asleep,
just like a human being.

Sulcata tortoise image by Dave Friend. Reprinted with his permission.

Matt Schumacher is a writer and sulcata tortoise keeper from Oregon. His poem is reprinted with his permission.

Court Upholds Protection for California's Western Joshua Trees

Judge Rejects Effort to Strip State Endangered Species Act Safeguards

— Center for Biological Diversity press release

Fresno, California — 22 February 2021 — A Fresno County Superior Court judge has rejected an effort by construction and real estate interests, along with the city of Hesperia, to strip away legal protections that currently apply to the imperiled western Joshua tree.

"This is a critical victory for these beautiful trees and their fragile desert ecosystem," said Brendan Cummings, the Center for Biological Diversity's conservation director and a Joshua Tree resident. "If Joshua trees are to survive the inhospitable climate we're giving them, the most important thing we must do is protect their habitat, and this decision ensures recent protections will remain in place."

On September 22, 2020, the California Fish and Game Commission unanimously voted to grant western Joshua trees candidate status under the California Endangered Species Act, giving them legal protection during a yearlong review to determine whether the species should be formally protected. The commission's protection decision came in response to a petition from the Center.

On October 21, 2020, a coalition of interests opposed to protection of the Joshua tree filed a lawsuit in Fresno County Superior Court seeking to overturn the commission's decision and moved to set aside the tree's candidate status. In her ruling last week rejecting the stay request, Judge Kristi Culver Kapetan found that "it is clear to the court that a stay would be against the public interest."

Sunset and moon rise in Joshua Tree National Park, California. A western Joshua tree (*Yucca brevifolia*) is in the foreground of this image which was captured in December 2010. Photo by National Park Service/Robb Hannawacker. Public domain.

In rejecting arguments that threats to the species are not immediate, the court found "that the Joshua tree is under a real, significant and immediate threat from development, fire, drought, and climate change."

The growing popularity of Joshua Tree National Park has spurred a building boom in Joshua Tree and adjacent communities, resulting in the widespread cutting down of the namesake trees to make way for vacation rentals and second homes. Recent state protection makes killing Joshua trees illegal absent special permits. Among the entities seeking to overturn state protection of western Joshua trees is the High Desert Association of Realtors.

"It's a sad irony that the very real estate agents marketing the iconic beauty of Joshua trees are also leading the charge to kill them," said Cummings. "Fortunately, their misguided and selfish lawsuit was not successful."

The Fish and Game Commission is scheduled to make a final decision on listing the western Joshua tree as a threatened species by the end of the year. If the species wins permanent protection, state and local agencies will have to manage threats to them, including developing a recovery plan outlining a strategy to protect the species in the face of climate change and other threats.

Background

While the direct killing of western Joshua trees by developers is the most visible threat, climate change and fire are also pushing the species towards extinction. Recent studies show Joshua trees are dying off because of hotter, drier conditions, with very few younger trees becoming established. Even greater changes are projected over the coming

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decades. Scientists in 2019 projected that the Joshua tree will be largely gone from its namesake national park by the end of the century.

Prolonged droughts are projected to be more frequent and intense over the coming decades, shrinking the species' range and leading to more tree deaths. Higher elevations, where Joshua trees might survive increasing temperatures and drying conditions, are at risk of fire due to invasive non-native grasses.

Approximately 40% of the western Joshua tree's range in California is on private land, with only a tiny fraction protected from development. Current projections show that virtually all this habitat will be lost without stronger legal protections for the trees.

Joshua trees comprise two distinct species, the western Joshua tree (*Yucca brevifolia*) and the eastern Joshua tree (*Y. jaegeriana*). The two species occupy different areas of the desert, are genetically and morphologically distinguishable, and have different pollinating moths. Only the western species is currently protected under the California Endangered Species Act.

"Before state protections went into effect, developers were bulldozing Joshua trees by the thousands to build roads, powerlines, strip malls and vacation rentals," said Cummings. "If these beautiful plants are to have any hope of surviving in a warming world, we have to stop killing them. The California Endangered Species Act may be the only hope for saving these iconic symbols of the Mojave Desert."

The lawsuit was filed by the California Construction and Industrial Materials Association, California Business Properties Association, California Cattlemen's Association, California Farm Bureau Federation, California Manufacturers and Technology Association, High Desert Association of Realtors and the city of Hesperia. The Center and the solar company Terra-Gen separately intervened in the lawsuit to defend the commission's decision.

The case is California Business Properties Association v. California Fish and Game Commission, Case # 20CECG03125.

More Than 10,000 Sea Turtles Recorded During Largest Cold Stunning Event in U.S. History — Turtle Island Restoration Network news release

Galveston, Texas — 24 February 2021 — Right now Texas is experiencing the largest cold stunning event ever recorded in the United States. Cold stunning occurs when sea turtles are exposed to cold water for an extended period of time. Because they are reptiles and rely on external sources of heat to maintain their body temperatures, they experience a decrease in heart rate and circulation causing them to become lethargic and wash ashore.

So far this winter more than 10,000 cold stunned sea turtles — mostly endangered juvenile green sea turtles — have been recorded in Texas. This is more than double the 3,702 cold stunned turtles found in Texas during the winter of 2017–2018, during the previous largest cold stunning event in Texas since the Sea Turtle Stranding and Salvage Network (STSSN) was established in 1980.

Many organizations and individuals are helping with efforts to find, document, rehabilitate, and release cold stunned turtles on the Texas coast. Cold stunned sea turtles can be transported to a rehab facility, placed in a dry tub and evaluated for any other existing health concerns. They will be warmed up slowly and, when appropriate, placed in water and closely monitored by rehab staff. Once fully recovered, the turtles are released.

Anyone working or recreating in Texas bays, channels, and passes please be vigilant for cold stunned turtles and report any that they see by calling the Texas sea turtle rescue hotline at 1-866-TURTLE5 (1-866-887-8535).

Turtle Island Restoration Network has sponsored the sea turtle hotline for the Texas coast for more than a decade, and continues to raise awareness of the need to report any nesting, injured or deceased sea turtle to the hotline along the entire Texas coast.

Galápagos Conservancy News

185 Baby Galápagos Tortoises Seized from Illegal Traffickers

28 March 2012—On the afternoon of Sunday, March 28, Galápagos National Park (GNP) staff discovered 185 Critically Endangered tortoise hatchlings inside a suitcase bound for mainland Ecuador during a routine luggage inspection at Seymour Airport on Baltra Island. The tortoises were individually wrapped in plastic to limit their movement and subsequent detection, and at least 10 of the tortoises had died in the suitcase when they were discovered. Most of the young tortoises are estimated to be between 1–6 months of age, with some appearing to be newly hatched.

Galápagos Conservancy's Director of Conservation, Washington (Wacho) Tapia, believes that the tortoises were removed from tortoise nests on Santa Cruz Island. "The young tortoises were found in dreadful condition and appear to be extremely underweight. We are in the process of collecting important data, including size and weight, for each tortoise to better assess its health condition," said Tapia in a statement.

The surviving tortoise hatchlings have been placed in secure pens at the Giant Tortoise Breeding and Rearing Center on Santa Cruz Island that is managed by the Galápagos National Park Directorate (GNPD) and Galápagos Conservancy (GC), where they will be cared for under the close supervision of Park veterinarians and guardians.

Dr. James Gibbs, Vice President of Science and Conservation at GC, noted that the GNP and Ecuadorian authorities have been working diligently to prevent the illegal trafficking of Critically Endangered giant tortoises. While the pandemic has exacerbated the challenges, we congratulate Park staff for discovering the 185 hatchlings. GC scientists have inspected the hatchlings and are assisting in the care of the surviving babies, along with the Park team.

Juvenile giant tortoises at the Santa Cruz Tortoise Center. The surviving juvenile tortoises from the 28 March airport confiscation were taken to this location for rehabilitation. Photo © 2019 by Kimber Wukitsch / Galápagos Conservancy. Image provided for media use.

GC, which has been supporting the Park for more than three decades, is working closely with authorities to devise strategic tactics to increase security and monitoring efforts around the natural tortoise nesting sites across Galápagos — to prevent further trafficking attempts.

Many species of Galapagos giant tortoises are highly endangered due to past exploitation, with a current population size of only 10–15% of its historical number. A total of 15 Galápagos giant tortoise species are endemic to the archipelago, of which six are Critically Endangered (including the Santa Cruz tortoise species), and three are Extinct.

GC and the GNP have collaborated closely on the Giant Tortoise Restoration Initiative for the past decade to rewild populations of giant tortoises to their historical numbers and distribution across the Galapagos Archipelago.

— Galápagos Conservancy news release

Founded in 1985, the **Fausto Llerena Tortoise Center on Santa Cruz Island** is a breeding and rearing facility devoted to raising Galápagos tortoises. The goal of the Santa Cruz Tortoise Center's work is to rewild juvenile tortoises on various Galápagos Islands on which the giant tortoise populations have declined or gone extinct.

Typically, tortoise eggs or hatchlings are collected from natural nests and brought to the Center to grow in a predator-resistant environment until they are large enough to have a reasonable chance of survival in the wild.

After release, the tortoises will contribute to the "ecological restoration" of the islands on which giant tortoises once flourished.

— Based on information from the Galápagos Conservancy website

Turtle Conservation Hits the SPOT in North Cyprus

By James Fair as posted on Mongabay.com on 24 March 2021

▶ Green and loggerhead turtle nest counts have increased by 162% and 46% respectively in less than two decades on North Cyprus in the Mediterranean.

▶ The increase has been achieved through preventing nests being raided by dogs and foxes, and protecting the beaches from tourism development.

▶ Conservation begun by enthusiasts in 1983 is now organized by a local NGO, the Society for the Protection of Turtles (SPOT), in collaboration with scientists from the University of Exeter in the U.K. and the local Department of Environmental Protection.

▶ Many issues still impact the recovery of turtle populations: loggerheads are killed in fishing nets, while both species are affected by plastic pollution in a variety of ways.

Green turtle (*Chelonia mydas*) hatchling emerging from its egg on Ascension Island in the southern Atlantic Ocean.
Photo © 2015 by Stefan Hunt

In May, female turtles will start emerging from the Mediterranean onto the shores of Turkey, Greece and Libya, as well as onto islands such as Cyprus, Crete and Sicily. They will crawl laboriously up the beaches to dig their nests and lay their eggs, continuing an annual miracle of evolution that has been taking place for more than 200 million years.

On North Cyprus last year, just over 2,400 nests were recorded, an all-time high, and 10 times more than the number counted during the first proper survey carried out in 1988. Bucking many global wildlife trends, green (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*) numbers in the Mediterranean (the only two species that breed there) are on the rise.

"Numbers have increased a lot because of the protection [we give them]," says Kutlay Keço, chairman of the North Cyprus Society for the Protection of Turtles (SPOT). "It's the best project in the whole of the Mediterranean, if not the whole world."

Keço, who fought in the civil war that resulted in the partition of the island in 1974 and the creation of what is now the Turkish Republic of Northern Cyprus, helped to found SPOT in 1983. He and other founders monitored beaches for nesting females but they knew they needed professional conservation expertise if they were to protect their turtles properly.

Then, as now, North Cyprus was only officially recognized as an independent state by the Turkish government; the U.N. considers it to be part of the Republic of Cyprus. This made it harder to persuade international scientists to visit. As the name suggests, it forms the northern part of the island, and it's tiny, covering just 3,355 square kilometers (1,295 square miles), roughly the size of Rhode Island, the smallest state in the U.S.

In 1992, Annette Broderick — now a professor of marine conservation at the University of Exeter and the co-coordinator of its Marine Turtle Research Group, then studying at Glasgow — came as part of an expedition numbering a dozen or so students.

"I remember explaining to other people on the plane why we were going out there, and they — and these were Turkish Cypriot people — were saying, 'Turtles, I'm not sure we've got turtles,'" she says. "I was thinking, 'Oh gosh, I really hope you do.' But that was the level of awareness then."

Luckily, Cyprus did have turtles, but they weren't doing well. On that first visit, Broderick saw nest after nest that had been scavenged by dogs and foxes, so protecting them with cages has been one of the most essential conservation actions. Today, an army of volunteers patrols all the main nesting beaches on a daily or (in the case of one, Alagadi) nightly basis during the six-month nesting season to make sure they find and secure as many nests as possible.

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It has also helped that, especially for green turtles, exploitation for their meat has ceased to be an issue in recent decades. This has helped numbers rebound all over the world.

Finally, North Cyprus, because of its unique political status, was lagging behind other Mediterranean countries in developing its tourism industry in the early 1990s. Conservationists said the key beaches needed to be left as they were, and this protection agenda has been broadly embraced by the North Cyprus government.

Loggerhead turtle (*Caretta caretta*) hatchlings. USFWS Northeast Region. Public domain.

From a regional perspective, North Cyprus is especially important for green turtles. Ronnas and Alagadi beaches are the second and fifth respectively most important nesting sites in the Mediterranean. A new paper due to be published soon in the journal Animal Conservation, authored by Broderick and colleagues from Exeter as well as local SPOT scientists, will show that green turtle nest counts on North Cyprus have increased by 162% since 1993, and loggerheads by 46%.

But for Broderick, there is something else that marks out the conservation work they are doing.

"It is a shining example of how to do research," she says. "We've got females that we tagged in 1992 that are still breeding, so we are unravelling some of the life history traits of sea turtles we didn't know before. If you are trying to predict what will happen to a population, it's so important to understand basic things such as how long they live for."

Much of this is made possible by the mainly international volunteers (though this is changing) who come to North Cyprus every nesting season to work.

And work they do — anyone who thinks they've come for a relaxing sojourn in the sun will be in for a rude shock. On Alagadi, in order to ensure you identify every female coming up to lay eggs, says SPOT board member Robin Snape, you need a team of 10–15 people to be working continually through the night. If there's no moon (they don't use torches so as not to disturb the turtles), you're effectively looking for them in the pitch dark.

"You're just looking for changes in the texture on the sand where the tracks are," says Snape, who has lived in North Cyprus since he came as a volunteer in the early 2000s, and is now married to a local conservationist, Damla Beton.

These difficulties are compounded by the fact that a female will only lay eggs for roughly every three nesting attempts. "You have to learn to follow the track round," Snape says. "The turtle's dug here, but then it's moved to here, but these digging activities can't be the nest, it must be the last one before it left the beach. All this requires a lot of training."

Volunteers must also learn to differentiate between a green and loggerhead's tracks; the former move their rear flippers in unison, leaving a symmetrical track, the latter do it one after the other, leaving an asymmetrical one.

While the beaches are safe from development, there are still some very serious issues impacting the recovery of both species. Loggerheads get accidentally caught and drown in fishing nets, but the scale of this problem is not fully understood. Snape and others are trying to work with fishers to reduce the problem.

North Cyprus also has a terrible problem with waste plastic and other trash, most of which is carried to its shores from anywhere between Turkey and Egypt.

The magnitude of the pollution has to be seen to be believed,

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says Ceren Barlas, who has worked for SPOT in various capacities since first volunteering for the project as a 17–year-old high school student in 2003.

"We get anything from little plastic spoons to huge fridges wash up on our shores," Barlas says. "Ronnas Beach is very hard to get to, and therefore not cleaned much, and lots of the plastic just remains there, layers upon layers of it."

Nesting females will often give up digging if they encounter a big piece of plastic in the sand, while newly hatched baby turtles that are coming up through the sand might find their passage physically blocked. "We once found a piece of plastic packaging with a hole in it. A hatchling was trying to get through the hole, and it got stuck and died," Barlas says.

Last summer, Barlas managed the beach-cleaning program for SPOT. They carried out 12 beach cleanups, each one taking up to three hours and involving an average of 25–30 volunteers, and they removed more than three metric tons of trash. They try to get schoolchildren to join as much as possible as a way of engaging the younger generation.

"We always have a little session before and after the clean, just five minutes talking to them about how the plastic affects the turtles, and then do a turtle release too to show them in action," Barlas says.

Barlas is two years into a Ph.D. studying the impact of microplastics — fragments less than 5 millimeters, or a fifth of an inch, in length — on the temperature of the sand. It's important for two reasons: first, turtle gender is determined by temperature, and the warmer the sand in which the eggs incubate, the more females will hatch. Second, climate change is expected to raise temperatures over time, so the question of whether plastic pollution is doing the same has added importance. "We don't know if they are having an impact, no studies have been done on this," Barlas says.

Pandemic lockdowns across the world created particular problems for turtle conservation in North Cyprus. Historically, SPOT has relied on biology students from abroad to do the essential nesting-season monitoring and nest protection. Many of them come for weeks on end, and they pay a contribution that covers their costs. But last summer, this wasn't possible, and SPOT turned to locals to fill the void.

From a local population of 300,000 people, they recruited 300 volunteers. This was great for raising awareness about turtle conservation locally, but there were downsides. First, most were unable to commit to working more than a week or two, making it hard to maintain a pool of trained people, while SPOT decided not to charge them as they do international students. This meant they had to raise money for basic operating costs in another way: a crowd-funding campaign raised the equivalent of nearly $33,000.

Annette Broderick says she feels they may not have done enough up until now to involve local people, and the necessity of doing it last year produced fantastic results. The question now is, "how do we continue to foster that involvement but keep the funding going?"

There is much local pride in the island's turtles. Tarik Bozalan runs the Caretta restaurant on Akdeniz Beach and has long tried to educate visitors to not disturb nesting females. He also organizes his own beach cleanups with university students and social clubs. "When I opened the restaurant 15 years ago, there were only 20 to 25 nests a year," he says. "Now, there's up to 350." Last year, SPOT awarded Bozalan its "Caretta" flag in recognition of his efforts.

Most days on Alagadi Beach during the height of the nesting season, vacationers can witness the volunteers excavating nests where the turtles are hatching. This is done to increase survival rates, because dogs and foxes will snap up any stragglers they find, and it also raises funds through voluntary donations.

The hatchlings are held back, then released into the sea once night falls to begin their perilous odyssey. Despite this intervention, an often-quoted figure of the marine turtle's biology is that only an estimated one in 1,000 will reach adulthood to breed. Those on North Cyprus, at least, have better odds than most.

1995 postage stamp from the Republic of Azerbaijan depicting a loggerhead turtle. Public domain.

Meetings and Programs

Click on your Chapter's website link for the latest program information. Programs may be scheduled after newsletter publication.

Chino Valley
Meeting dates to be determined due to CoVid-19 restrictions.

Foothill
Contact chapter for meeting information.

High Desert
10 May; 11 June - meeting place Hillcrest Medical Bldg. in Victorville until further notice.

Inland Empire
7 May; 4 June via Zoom.

Kern County
10 May; 11 June via Zoom.

Low Desert
Paused in-person meetings until it is safe to gather.

Orange County
14 May; 11 June: Joint meetings with Care Society via Zoom.

Ridgecrest
10 May; 11 June outdoors at the Maturango Museum.

Santa Barbara-Ventura
Contact the chapter for meeting information.

Santa Clarita
Meeting information to be announced.

TOOSLO (San Luis Obispo)
Paused activities due to pandemic restrictions.

TTCS (Long Beach)
14 May; 11 June: Joint meetings with Orange County via Zoom.

Valley
21 May; 18 June via Zoom.

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