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An Aldabra giant tortoise, *Aldabrachelys gigantea* ssp. *gigantea*, photographed in habitat. Photograph © 2008 by Brieuc Fertard

featured species

Aldabra Giant Tortoise, *Aldabrachelys gigantea* (Schweigger, 1812)

The Giant Tortoise of the Aldabra Atoll by M. A. Cohen

One of only two living species of giant tortoise, the Aldabra giant tortoise is endemic to the Aldabra Atoll, a raised, ring-shaped coral atoll in the western Indian Ocean that encloses a large shallow lagoon.

Consisting of four main islands, this remote atoll is 373 miles (600 kilometers) west of the coast of East Africa and 253 miles (407 kilometers) northwest of the northern tip of the island of Madagascar.

The largest of the islands comprising the Seychelles archipelago, the **land** area of Aldabra is 22 miles (35 kilometers) x 9 miles (15 kilometers). The "total protected area" of the atoll is 988 square miles (2559 square kilometers) and includes "the lagoon, land and marine protected area" (Welcome to Aldabra, n.d.).

The United Nations Educational, Scientific and Cultural Organization designated the Aldabra Atoll as a World Heritage Site in 1982, thus protecting it from human influence. The largest population of giant tortoises on Earth, estimated at various times to be between 100,000 and 152,000 individuals, inhabits this remarkable landform (Aldabra Atoll, n.d.).

The 21st-century estimate of the number of Aldabra giant tortoises is that the population is stable at 100,000 animals, about five times

article continues on page 2 ▶

CONTENTS

The Giant Tortoise of the Aldabra Atoll by M. A. Cohen	1
Understanding Reptile Intelligence Can Aid Conservation and Safeguard Ecosystems	6
The Turtle's Garden: Brown-eyed Evening Primrose (*Chylismia claviformis*)	8
Mike's Turtle Net Picks By Michael J. Connor, Ph.D.	10
Classified Advertisements; DTRNA 50th Anniversary Celebration	11
Saving the Giants: How Satellite Technology is Transforming Giant Tortoise Conservation	
Florida Rule to Protect Diamondback Terrapins From Recreational Crab Traps	13
Lawsuit Filed to Protect Imperiled Alligator Snapping Turtles	14
Meeting Schedule: March/April 2023	15

that of the Galápagos giant tortoise population inhabiting the Galápagos Archipelago in the Pacific Ocean (Burt and Mitchell, 2018).

First formally described by the German naturalist August Friedrich Schweigger (1783–1821) in 1812 using the name *Testudo gigantea* in his description. The taxonomic (classification) history of the Aldabra giant tortoise is extensive, having been given nearly 40 different scientific names since Schweigger's original description in 1812.

Debates among taxonomists and conservation biologists regarding the correct terminology for the species took place over the following two centuries. During this time, taxonomists assigned the Aldabra giant tortoise to several genera, including *Testudo*, *Geochelone*, and *Dipsochelys*. They gave the tortoise a multitude of species names throughout those two centuries.

In 2013 the International Commission of Zoological Nomenclature finally established the name *Aldabrachelys gigantea* as the 'official' name of the species. Currently, the scientific community accepts this name as valid (Aldabra Giant Tortoise, n.d.).

The four islands comprising the Aldabra atoll feature an abundance of biological diversity including more than 400 species and subspecies of flora and fauna.

Giant Tortoise History in the Indian Ocean

According to Eric Palkovacs and his co-authors, fossil evidence suggests that historically giant tortoises existed on all continents except Australia and Antarctica, including most of the islands in the Indian Ocean. As time passed, human settlers on these continents and most of these islands hunted the giant tortoises to extinction.

Currently, "...giant tortoises have survived only on oceanic islands, including the Galápagos Archipelago in the Pacific Ocean and a host of islands in the western Indian Ocean, including Aldabra, the Comoros [Islands], and the granitic Seychelles [Islands]."

Evolutionary studies strongly suggest that the giant tortoises in the western Indian Ocean evolved from a "common ancestor" species endemic to Madagascar, reaching the adjacent islands by floating on the prevailing ocean currents (Palkovacs et al., 2002).

Description

The Aldabra giant tortoise is the second largest living tortoise, only the Galápagos giant tortoise is larger.

The adult Aldabra male is massive, potentially attaining a carapace length of 48 inches (122 centimeters) and weighing up to 770 pounds (350 kilograms). The average carapace length of the adult male is 47 inches (119 centimeters), and his average weight is 550 pounds (250 kilograms).

The adult female *A. gigantea* is typically smaller than the male, averaging 35 inches (90 centimeters) in length and weighing 330 pounds (150 kilograms) [Aldabra Giant Tortoise, n.d.; Aldabra Giant Tortoise - Aldabrachelys gigantea, 2018].

Hatchlings and juveniles have a glossy black carapace. The color of the adult's high-domed carapace typically ranges from light brown to black, and its plastron is brownish-gray. The head, tail, and limbs of

An Aldabra giant tortoise stretching its long neck to reach some fresh water and drinking "in the typical way of Aldabra tortoises, through the nostrils." Photo © 2008 by Brieuc-Fertard

article continues on page 3 ▶

the Aldabra giant tortoise are gray to brown. The scale-covered legs of the species are thickset and often described as elephant-like.

The neck of the Aldabra tortoise is exceptionally long compared to other tortoise species. Its elongated neck enables the tortoise to reach shrubbery three feet (one meter) above the ground to eat the nutritious leaves and low-hanging fruit. Its long neck allows the tortoise to drink from micro-pools of fresh water that collect in rock formations after rainfall. Its flattened snout enables the tortoise to drink by suctioning fresh water from shallow puddles through its nostrils.

The male Aldabra giant tortoise has a concave plastron and the female plastron is flat. The tail of the male is longer and thicker than the female tail.

Subspecies

Chelonian science recognizes four subspecies of Aldabra giant tortoise, one of which is extinct. These subspecies are as follows:

1. ***Aldabrachelys gigantea gigantea*, the Aldabra giant tortoise** from the Aldabra atoll;

2. ***A. g arnoldi*, Arnold's giant tortoise or the Seychelles Saddle-backed giant tortoise** from the Seychelles island of Mahé;

3. ***A. g. daudinii*, Daudin's giant tortoise** formerly from the island of Mahé, was hunted to extinction between 1830 and 1850; and

4. ***A. g. hololissa*, Seychelles giant tortoise**, from the islands of Cerf, Cousine, Frégate, Mahé, Praslin, Round, and Silhouette (Yates, 2019).

Range and Habitat

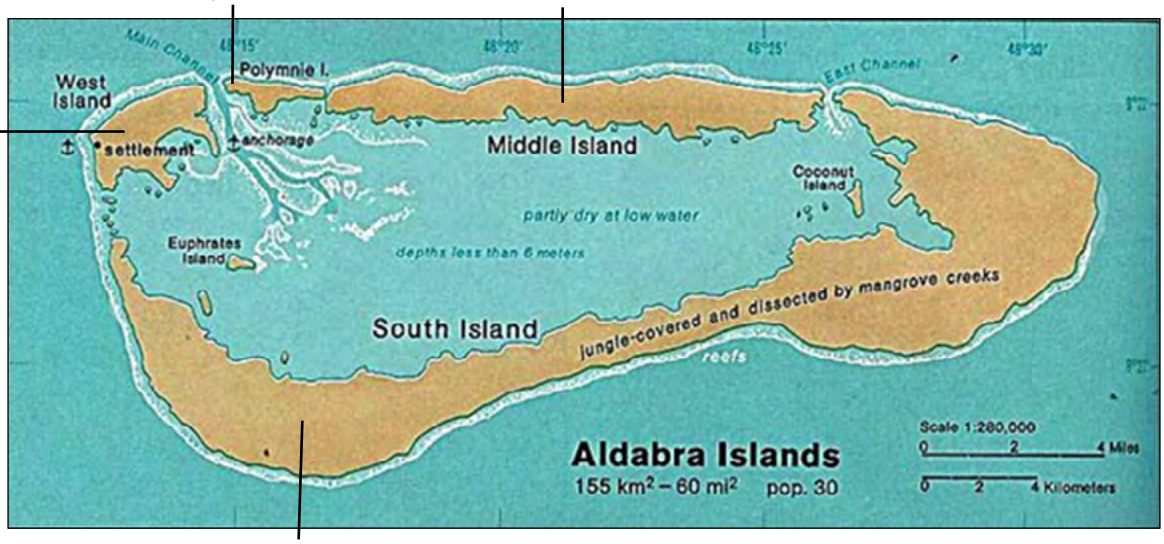
The native habitat of *A. gigantea* is the Aldabra atoll, where it inhabits coastal dunes, beaches, grasslands, scrub forests, and mangrove swamps. The largest populations of tortoises occur in regions of mixed scrub vegetation and flat grassland areas known as "platins." The term "tortoise turf" aptly describes these platins, as the grazing herds of giant tortoises keep the grasses and herbs cropped short.

Some 20 species of grasses and forbs (herbaceous plants other than grasses) comprise the "tortoise turf" grazing areas. These plants bear their seeds low on the plant–not near the top–so seeds sprout and grow undamaged, thus replenishing this unusual plant community (Aldabra Giant Tortoise - Aldabrachelys gigantea, 2018). Because the tortoises do not harm their roots, the perennials among the grasses and herbs continually re-sprout and provide new forage for the grazers.

The peak of population density for *A. gigantea* occurred in the 1970s at ±150,000 tortoises. As Lovich and Gibbons note, "... the collective tortoise biomass was the highest of any grazing animal in the world, including hoofed mammal herds" that inhabit national parks in Africa (Lovich & Gibbons, 2021; Aldabra Giant Tortoise, n.d.).

The inhospitable climate and terrain of the atoll force all resident wildlife to adapt to adversity. Extremes in

The Aldabra Atoll



The Seychelles Archipelago comprises some 115 islands. The Aldabra Atoll, one of the Seychelles' Outer Islands group, is the largest raised coral atoll in the world.

The four primary islands comprising the Aldabra Atoll. The shallow, salt-water lagoon in the center of the atoll is less than 20 feet (6 meters) deep at high water. The atoll is uninhabited by humans except for a research station on Picard Island run by the Seychelles Islands Foundation. A small crew of scientists staffs the research station and conducts studies of the atoll's remarkable biodiversity. Image taken from the Perry-Castañeda Library (PCL), originally from the CIA Indian Ocean Atlas. Public domain.

article continues on page 4 ▶

Head shot of an Aldabra giant tortoise. Photo © 2017 by Martin Wettges

temperature and amount of rainfall are routine on the atoll. Researchers have detected shifts toward higher temperatures and longer periods of drought.

The average maximum summer temperature is 90°F (30°C), and the average minimum winter temperature is 72°F (22°C) on the atoll (Farrow, 1971). Rainfall on Aldabra is seasonal: the average annual rainfall totals 38 inches (975 millimeters) per year and falls primarily during the northwestern monsoon from December through April.

Meteorological studies of Aldabra rainfall conducted from 2004 to 2012 detected a disturbing decline of 0.25 (6.6 mm) per year in annual rainfall total (Walton et al., 2019).

The largest of the four main atoll islands, Grande Terre, harbors the highest concentration of giant tortoises. Sizable numbers of giant tortoises occur on Malabar and Picard Islands. No tortoises live on the smallest of the main islands, Polymnie.

Foods and Feeding

While *A. gigantea* is primarily herbivorous, it is actually an opportunistic omnivore, feeding on grasses, forbs, woody plants, small invertebrates, and occasionally carrion. There is comparatively little fresh water available for drinking in their habitat, so the tortoises rely on their food for the hydration they need to survive.

The Aldabra giant tortoise can survive without food and water for long periods of time, perhaps as long as six months. The species will knock over smaller trees and shrubs to access nutritious leaves (Aldabra tortoise, 2016).

The activity levels of the Aldabra giant tortoise are seasonal, with less activity during hotter, drier periods and more activity as the cooler, wetter monsoon season arrives when there is more to eat and drink.

The species tends to bask and feed in the early morning, retreating to shaded forest areas, caves, and swamps to cool off during the midday heat. They will wallow in mud to escape the annoyance of mosquitoes when resting. Often there will be additional foraging activity in the late afternoon and early evening preceding the night's sleep. The species may sleep as many as 18 out of 24 hours (Aldabra Tortoise, 2016).

Seed dispersal is a significant contribution that *A. gigantea* makes to its ecosystem. Because the gape of the tortoise's jaws is so large, it swallows fruits whole and does not damage the seeds by crushing or chewing the fruit. Transit time through the animal's gut is typically 17 to 21 days, after which the tortoise deposits the undamaged seeds in a fertile pile of dung.

Jonathan
the Aldabran Giant Tortoise

At approximately 190 years old, Jonathan is believed to be the world's oldest living land animal. Jonathan lives on the grounds of Plantation House, the residence of the Governor of St. Helena, a remote island that is a British overseas territory in the South Atlantic Ocean. For an extensive and well-illustrated article about this remarkable tortoise, click this link: Jonathan the Tortoise.

The tortoise will likely move a couple of miles (several kilometers) from the fruit-bearing shrub or tree as its food moves through its digestive system. It deposits droppings, including undamaged seeds, far from the parent plants. The fertilizer within the droppings provides vital plant nutrients when the seedlings germinate (Aldabra Giant Tortoise, n.d.).

Reproduction

A. gigantea typically reaches reproductive maturity between 20 and 30 years old when they reach approximately half their fully mature size. The reproductive rate of the species is comparatively low.

Their mating activity occurs only when the tortoises are active from February through May. Nesting occurs from April through August, and females may lay between four and 14 eggs. Incubation of the eggs takes 110 to 250 days.

Hatching occurs during the monsoon season from late September through December. However, only three to five hatchlings typically emerge from a clutch, the balance of the eggs being infertile. Females may produce a second clutch in the same season (Aldabra tortoise, 2016; Aldabra Giant Tortoise, n.d.; Ng, n.d.).

Rewilding

A comparatively new concept in conservation biology, "(r)ewilding aims to restore healthy ecosystems by creating wild, biodiverse spaces. It rebuilds ecosystems that have previously been modified by human disturbance" (The Benefits and Risks of Rewilding, 2021).

Giant tortoises benefit their environments by acting as ecosystem engineers, impacting their ecosystems in various ways, including seed dispersal, clearing pathways, and opening nesting areas in dense shrubbery.

article continues on page 5 ▶

Scientists in the Galápagos Islands are successfully conducting rewilding projects on several islands that once had populations of giant tortoises. Results of rewilding tortoises include the general restoration of healthy plant communities, an advantage to all endemic animals.

DNA studies confirm that *A. gigantea* is genetically similar to the extinct giant tortoise species that inhabited the Indian Ocean islands before extermination by human settlers. Ongoing rewilding projects are occurring on the island of Madagascar, the granitic (granite-based) Seychelles, and the Mascarene Islands in the Indian Ocean.

Threats

Predators that feed on the hatchling and juvenile *A. gigantea* include crabs, herons, and pied crows. As the tortoises mature, their size enables them to resist all predators except the humans that historically hunted them for food and their eggs (Geochelone gigantea, n.d.). Some poaching continues to threaten the species.

The average elevation of the four islands of the Aldabra atoll is only 26 feet (8 meters) above sea level, causing concern about the consequences of rising sea levels, changing weather patterns, and warming ocean temperatures resulting from climate change, all of which threaten the plants and animals of low-lying islands worldwide.

Marine plastic waste that washes up on the Aldabra atoll beaches "from as far away as Australia, India, China, and Malaysia" poses a threat to the atoll's endemic animals, including "birds, sea turtles, tortoises, and marine mammals" (Burt and Mitchell, 2018).

Conservation

There is "an unusually long history of organized conservation" concerning the Aldabra giant tortoise that goes back to the late 19th century when a group of esteemed scientists, including Charles Darwin, began working with local governments to establish legal protection for the species (Aldabra Giant Tortoise–Aldabrachelys gigantea, 2018).

A. gigantea is listed in CITES Appendix II, meaning no immediate threat of extinction exists but may arise without tight controls on trade. The Red List of the IUCN assessed the species as "vulnerable" in 1996 and notes that the assessment "needs updating" as of 2023.

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Aldabra giant tortoise photographed in habitat. Photo © 2021 by the Seychelles News Agency

Understanding reptile intelligence can aid conservation and safeguard ecosystems

Commentary by Deyatima Ghosh as published on Mongabay, 29 January 2023

- Reptile intelligence has long been considered inferior to that of birds and mammals. But recent studies in reptile cognition show reptiles have a profound understanding of their environment.
- Reptiles' understanding of their surroundings and their evolution of learning can play a part in biodiversity conservation and ecosystem service provisioning, especially on agricultural lands.
- This post is a commentary. The views expressed are those of the author, not necessarily Mongabay.

"Deep inside the skull of every one of us there is something like a brain of a crocodile."
– Carl Sagan, Cosmos

In science, reptiles have been considered to be of lower intelligence compared to birds and mammals. Dimwitted, even. But over the last decade, significant research has been out in reptile cognition, and the results have been truly exhilarating.

Mammals and birds are generally considered the intelligent class of animals. However, the basic brain structure in both these classes is similar to that of the reptilian brain, which diversified 280 million years ago. Reptiles and mammals are the only vertebrates to have a cerebral cortex with a clear, though simple, three-layered structure, similar to that of the mammalian allocortex. The reptilian ventral pallium gives rise to the dorsal ventricular ridge, which contributes to the complex cognitive abilities of birds. Although the reptilian cortex contains fewer subdivisions than mammals, the fundamental parts remain the same. It is subdivided into a medial cortex, better known as the hippocampus; a lateral cortex, equivalent to the mammalian piriform cortex; and a dorsal cortex which receives multimodal inputs (like the visual inputs in turtles).

Perhaps there is no reason to not acknowledge the cognitive abilities in reptiles, as, since they evolved, there has been enough time for further evolution of the cognitive mechanisms. Besides, the basic brain structure of reptiles should also share behavioral and morphological similarities with mammals and birds.

A tortoise eating daisies. Color discrimination in fruits and flowers has been widely studied in herbivorous reptiles like iguanas, tortoises, and turtles. Image © 2014 by Tambako The Jaguar

Charles Darwin, in his second book "The Descent of Man and Selection in Relation to Sex," mentions that other animals differ cognitively from humans only in degree but not in kind. In the reptilian brain, being of primitive, ancestral form, the structural and functional complexity may not be as sophisticated as those of birds or mammals. Hence the cognitive processes are fairly simple compared to the higher taxa.

Reptiles consist of three major orders — Chelonia, Crocodilia and Squamata — and all of them have a profound understanding of their environment. Over decades, scientists have been working towards understanding how they do what they do, and the results have often been surprising. Reptiles have excelled in learning about space and their surroundings, as well as about color and taste. Researchers have also observed social learning, eavesdropping on the warning sounds from other species, reversal learning, solving novel tasks and evidence of good memory.

Why should we care about reptile intelligence?

Although the information on reptile cognition is plentiful, we have, so far, not really considered reptile cognition as having any practical implications in solving real-life challenges. One such implication can be seen in conservation. For example, goannas and blue-tongued skinks in Australia face fatal risks upon consuming cane toads for their intolerance towards the Bufonidae toxin secreted by the toads. Training goannas and blue-tongued skinks with cane toad sausages laced with nausea-inducing chemicals caused aversion learning. When released in the wild, trained reptiles learned to avoid the cane toads. This learning and memory improved their survival rate.

Another possible implication is in preserving their ecological functioning. Most probably stemming from our ignorance, we have yet to considered the ecosystem functions they deliver. For example, reptiles

article continues on page 7 ▶

form a herald part of the agricultural community of biodiversity and are, to some extent, resistant to pesticides. Additionally, many of these farm-inhabiting reptiles are also insectivores which makes them relevant choices as bioregulators.

With our ever-increasing population, it is practically impossible to either prevent increased land claims by agriculture or to curb the amount of agricultural produce – agricultural land use can only increase in the coming years. What will be left of the biodiversity is what is bothering. However, the consequences are more than losing just a few counts of species. One of the major challenges with increasing crop production is the increase in loss in crop yield due to pest attacks. Several mitigating measures have been solicited over the past few decades ranging from chemical to cultural practices. With the detrimental impacts of pesticide on the ecosystem, crop health, human health, and biodiversity, the only option left is to use natural resources like natural enemies in regulating crop pests. The question here is, 'can cognition biology help in advancing pest management science?'

A quick overview of reptiles' cognitive abilities shows that they can discriminate between color, odor, shape and quantity. They can remember, decide and even follow social cues. For example, tortoises distinguish between yellow color over blue or white, a learning evolved for selecting carotenoid-rich food. Color discrimination in fruits and flowers has been widely studied in herbivorous reptiles like iguanas, tortoises, and turtles. Learning ability in reptiles can thus offer an opportunity to improve their ecosystem service provisioning.

Likewise, learning and remembering about refuge, which is "spatial cognition," can also benefit bioregulation. Reptiles can remember rewarding foraging patches. Further, being able to pick on social cues, lizards have been seen to observe bird movement to opportunistically locate fig trees which are a rich source of insects. Tortoises can follow social cues to learn their way around a barrier to obtain food. Reptiles exhibiting such behavioral flexibility allow us to examine such abilities through the lens of bioregulation. However, more refined experiments are needed, which are not only relevant for pest regulation but also relevant to the animal itself in the wild.

Our understanding of the cognitive abilities of reptiles is still incomplete and requires more research. Our idea of these animals being "sedentary, impassive creatures operating as instinctive machines" needs to be rapidly replaced for a fuller realization of the functional roles they play in sustaining our ecosystem. It is time we realize the importance of having these animals around us for their services to the ecosystem many of which remain unnoticed by us.

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Terminology

allocortex
one portion of the brain stem; the brain stem connects the brain with the spinal cord

pallium
a portion of the reptile brain that is not yet well-studied with regard to function

taxa
taxonomic groups (classifications) such as species or family

goanna
a carnivorous lizard of the *Varanus* genus (monitor lizards)

skink
a species of smooth-bodied lizard native to temperate and tropical regions of the world

carotenoid
a yellow, orange, or red organic and fat-soluble pigment produced by plants, animals, and algae

bioregulation
general definition: any biological process that regulates something; bioregulation often combines biology and chemistry in such fields of study as medicine and agriculture

Major Orders of Reptiles

Chelonia: turtles, tortoises

Crocodilia: crocodiles, alligators, gharials

Squamata: lizards, snakes, amphisbaenians (worm lizards); known collectively as scaled reptiles

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

Chylismia (=*Camissonia*) *claviformis*
Brown-eyed Evening Primrose

A single blossom of the brown-eyed evening primrose photographed in Anza-Borrego Desert State Park, San Diego County, CA. Photo © 2003 by Brent Miller

A species of native wildflower, *Chylismia claviformis*, the brown-eyed evening primrose, occurs in arid regions of western North America. Its genus name *Chylismia* derives from the Greek root word *chylos*, meaning "juice," presumably referring to the high water content of the plant. The species name *claviformis* derives from the Latin *clava-*, meaning "a club" and *-formis*, meaning "shape," referring to its club-shaped seed capsules.

The brown-eyed evening primrose is a source of high-quality nutrition for wild desert tortoises. The tortoises typically eat the leaves of the plant. These leaves are composed of ±10% protein, ±75% water, and ±2% potassium.

In a study conducted with juvenile Mojave desert tortoises (*Gopherus agassizii*) at the Fort Irwin Study Site in California, the brown-eyed evening primrose "accounted for nearly 50% of all bites taken even though it accounted for less than 5% of the biomass encountered" (Oftedal et al., 2002).

The basal rosette of leaves that gives rise to the clusters of flowers known in botany as inflorescences. Image was captured in San Bernardino County, CA. Photo © 2017 by Zoya Akulova

Initially assigned to the genus *Camissonia*, the brown-eyed evening primrose continues to appear under that name in some resources. Around 1969, taxonomists reassigned the species to *Chylismia* or *Oenothera*. *Oenothera claviformis* is a synonymous but less widely recognized name for the species. The species *C. claviformis* has 10 to 11 subspecies throughout its range.

The Evening Primrose belongs to the Onagraceae, the common name of which is the Willowherb family. The Evening Primrose family should not be confused with the Primrose family, Primulaceae, an entirely different plant family containing some toxic species.

The Evening Primrose family includes many wild and cultivated annuals and perennials, including fuchsia (*Fuchsia*), farewell-to-spring (*Clarkia*), evening primrose (*Oenothera*), and hummingbird trumpet (*Epilobium*).

Description

C. claviformis is usually an annual with a long taproot, although sometimes it grows as a perennial. The brown-eyed evening primrose is also known as browneyes and the brown-eyed primrose. These common names refer to appearance of its flowers. Four large white or yellow petals, up to 1.5 inches (3.8 centimeters) in length, comprise the blossoms borne singly or in groups on a tall stalk (known to botanists as an inflorescence). Each petal is reddish-brown to dark brown at its base, giving the flower a brown center.

C. claviformis grows as a basal rosette of leaves with a narrow lanceolate (oval) shape with smooth or toothed margins. Leaves are up to eight inches (20 centimeters) long and typically gray-green. Each leaf is pinnately lobed, meaning pairs of leaflets comprise the leaf. Rising above the ground-hugging rosette of leaves is an inflorescence ranging from 1 to 27 inches (2.5 to 68.5 centimeters) tall with nodding or upright flowers along the stalk.

Flowers open in the late afternoon or early evening to avoid the midday heat. The flowering season can run from February to June, depending on location. The reproductive structures of the flower, known in botany as the stamens and the stigma, are white, cream, or yellow and emerge from the center of the flower.

article continues on page 9 ▶

An inflorescence of the brown-eyed evening primrose photographed in Coachella Valley, CA. Photo © 2005 by Stan Shebs

The pollen and nectar of *C. claviformis* are valuable sources of nourishment for several desert insects. One species of bee, *Andrena rozeni*, is the primary pollinator of this plant and collects pollen exclusively from its flowers. Brown-eyed evening primrose also attracts butterflies and moths.

The seed capsules of the species are straight or curved, 0.3 to 1.5 inches (8 to 38 millimeters) in length, and wider at the top than at the base.

The Importance of High-PEP Plants

The brown-eyed evening primrose is a type of desert flora known collectively as high-PEP plants. "PEP" is an acronym for "potassium excretion potential." Plant materials with a high PEP index are critical to the diet of the wild desert tortoise.

Potassium, a mineral, is essential for the cells in the body to function. However, a high concentration of potassium is toxic to tortoises. When rainfall occurs, wild tortoises drink water to flush excess potassium from their bodies. "Without rainwater to drink, tortoises need to get water and protein from plants with a high potassium excretion potential (PEP), to avoid buildup of too much potassium" (Diet & Feeding–Desert Tortoises (Gopherus Agassizii) Fact Sheet, 2022).

In addition to *C. claviformis*, native and naturalized desert plants with high-PEP values include the following:

- Desert Indianwheat, *Plantago ovata* (naturalized);
- Desert Dandelion, *Malacothrix glabrata* (native);
- Yellow Desert Evening Primrose, *Oenothera primiveris* (native);
- Desert Pincushion, *Chaenactis fremontii* (native); and
- Redstem filaree, *Erodium cicutarium* (naturalized) [Oftedal et al., 2002].

Range

The brown-eyed evening primrose occurs as far north as southeastern Oregon, southwestern Idaho, eastern California, Nevada, Utah, Arizona, and New Mexico in the United States. Its range continues southward to northwestern Sonora and eastern Baja California in Mexico.

The species occurs in a broad range of elevations from 250 feet (76 meters) below sea level to 6,500 feet (1,981 meters) of elevation.

C. claviformis grows in coarse, sandy soils on rocky slopes and flatlands. The species often grows in washes and deposits of sand, gravel, and rocks formed by flowing water.

Ethnobotany

The Cahuilla Indians of Southern California consumed the leaves of *C. claviformis* as greens (Bean and Saubel, 1972).

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Portions of this article originally appeared in the *Tortuga Gazette* 48(4), July/August 2012.

Brown-eyed evening primrose in full bloom photographed in Death Valley, CA. Photo © 2008 by Stan Shebs

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

Desert Tortoise Conservation in Utah

Ann McLuckie reviewed Southern Utah's long history of tortoise study from Woodbury and Hardy to the present day.

Students Study Desert Tortoises and Climate Change

Cal State Fullerton students studying desert tortoises at the Deep Canyon Desert Research Center to monitor climate change impacts to their behavior and habitat.

Tick-borne Relapsing Fever in Desert Tortoise Habitat

Thesis probes ticks, tortoises and tick-borne relapsing fever in desert tortoise habitat.

Tortoises Rescued from Tortoise Rescue

A large number of tortoises needed rescuing from a defunct "rescue" in Joshua Tree.

French Tycoon Fined for Harming Hermann's Tortoises

Corsican real estate developer fined €150,000 for killing protected Hermann's tortoises, France's only native tortoise species.

How Long to Headstart?

Study measures 1 year survival of wood turtles headstarted for 1 or 2 years before being released.

Florida Requires Modified Crab Traps To Protect Diamondback Terrapins

New Florida rule aims to reduce diamondback terrapin drownings in crab traps.

Zoo Hatches Madagascar Big-heads

The Durrell Wildlife Conservation Trust hatched 6 critically endangered Madagascan big-headed turtles, *Erymnochelys madagascariensis*, from adults originally seized in Hong Kong.

Madagascar big-headed turtle photographed in habitat. Photo © 2016 by Cédric de Foucault

New Southern River Terrapin "Assurance Colony" in Cambodia

A third colony of critically endangered Southern river terrapin, *Batagur affinis*, has been established.

Feral Sliders in Germany

Abandoned red-eared sliders are breeding and possibly posing a threat to pond turtles in Germany.

State Animals of California

California's official state animals include desert tortoises and leatherback sea turtles.

Body Fat in Sea Turtles

Biologists use bioelectrical impedance analysis to assess body fat in green sea turtles.

UK and Ireland See Record Sea Turtle Strandings

A record fifteen sea turtles were founded stranded on UK and Ireland beaches this winter.

New Fossil Pleurodire From Egypt

First African Upper Cretaceous side-necked turtle, *Khargachelys caironensis*, excavated at Kharga Oasis.

New Fossil Turtle From New Mexico

A new Upper Cretaceous baenid turtle, *Edowa zuniensis*, from New Mexico described after being found in storage at the Arizona Museum of Natural History.

Tortoises As Dating Tools

Forget radiocarbon, TurtleChron aims to use carapace scute growth ring pattern chronology as a dating tool using shells from herpetological and museum collections.

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-Turtle-AndTortoise-list+subscribe@groups.io>.

CTTC On Facebook

For breaking news updates follow CTTC on Facebook!

You cannot get through a single day without having an impact on the world around you. What you do makes a difference, and you have to decide what kind of difference you want to make.

—*Dr. Jane Goodall (b. 1934), English primatologist and anthropologist*

Classified Advertisements

Classified advertisements run for one issue at 5^{00} for up to four lines. Ads are accepted at the discretion of the Editor. Classified ads are available to members and subscribers only and are run as a service to our members. California Turtle & Tortoise Club is not responsible for merchandise placed for sale in the *Tortuga Gazette*.

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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.

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

Celebration of the 50th Anniversary Desert Tortoise Research Natural Area Saturday, 25 March 2023

The Desert Tortoise Preserve Committee (DTPC) will celebrate the 50th Anniversary of the establishment of the Desert Tortoise Research Natural Area (DTRNA) on site on 25 March 2023 with an event featuring speakers, trail walks, and refreshments.

According to DTPC President Ron Berger, "... in 1973, the BLM published the boundaries of what became the DTRNA, as part of its management plan entitled, "Management of Recreational Vehicle Use" published by the U.S. Department of the Interior. This act was followed by fencing of the perimeter and posting signs to help direct OHV riders and others, including sheep grazers, to keep out of the area in order to protect the tortoise as well as the plants it needs to survive. The following year saw the establishment of your DTPC by Dr. [Kristin] Berry, Laura Stockton, and others.

DTPC is a nonprofit charitable organization established in 1974 to promote the welfare of the desert tortoise in the wild through land acquisition and management, scientific research, and educational outreach. The DTPC currently owns and manages over 29,991 acres of habitat for the desert tortoise and other sensitive species in the Mojave and Colorado deserts."

Additional details about this event will be published as they become available.

Saving the Giants: How Satellite Technology is Transforming Giant Tortoise Conservation

1 February 2023—The Galápagos Islands are a treasure trove of unique and endangered species, and the conservation of this wildlife is critical to the Islands' ecological integrity. Cutting-edge science and technology are advancing conservation efforts by giving scientists a better glimpse into the daily lives of animals in the Archipelago.

Satellite tracking is one of the technological tools being used to study and manage the iconic Giant Tortoises of the Galápagos Islands. Scientists can track the tortoises' movements and activities by attaching GPS devices to their shells, providing critical information for the conservation and management of these unique animals.

This technology allows scientists to study the Alcedo Volcano Giant Tortoises (*Chelonoidis vandenburghi*) of Isabela Island without having to stay on the volcano for extended periods. Satellite tracking data is critical to the proper management of this population and is used to answer key questions about the tortoises' movements and habitat use.

"These GPS devices measure around 3×3 inches (8x8 centimeters) and can be easily attached to the tortoises' shells. They are the latest in satellite tracking and monitoring technology and weigh only 200 grams (7 ounces), so they have no effect on the tortoises," said Washington Tapia, General Director of Galápagos Conservancy and its affiliate Conservando Galápagos.

Management actions, such as satellite tracking, are critical for Giant Tortoise conservation and restoration. The current population of Alcedo Volcano Giant Tortoises is estimated to be at least 10,000 and stable—making the volcano home to the largest tortoise population on the Islands. Thanks to successful management programs, such as the eradication of invasive goats and donkeys in 2006, vegetation is recovering and providing a permanent food source for the tortoises.

However, implementing and maintaining conservation measures for the Giant Tortoises that live on the remote and difficult-to-access Alcedo Volcano takes a significant amount of time and effort. Galápagos Conservancy is deeply grateful to those who make it possible to continue supporting these efforts to protect and restore the iconic Giant Tortoises of Galápagos.

—Galápagos Conservancy news release

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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

Florida Rule to Protect Diamondback Terrapins From Recreational Crab Traps to Take Effect Wednesday—Turtle Species Still Needs Protection From Commercial Fishery

Tallahassee, Florida—27 February 2023—A new rule aimed at protecting diamondback terrapin turtles from drowning in recreational blue crab traps will go into effect Wednesday, March 1.

The Florida Fish and Wildlife Conservation Commission (FWC) rule stems from nearly two years of advocacy and a petition filed by conservationists and turtle experts. But the commission has yet to consider badly needed protections in the commercial blue crab fishery.

Under the new rule, all recreational blue crab traps must have rigid entrances of no more than 2 inches by 6 inches or bycatch reduction devices, or "BRDs," of the same size.

When approving the recreational traps rule in 2021, the commission postponed consideration of similar requirements for the commercial blue crab fishery until commission staff completed a study of terrapin interactions with the fishery, despite abundant evidence that commercial crabbing also threatens terrapins. The commission website indicates this research is complete, but the agency has not revisited protective rules.

"It's a relief to know Florida's terrapins will get a reprieve from recreational blue crab traps, but the threat from commercial crab traps still looms large," said Elise Bennett, Florida director at the Center for Biological Diversity (CBD). "To protect our precious terrapins, the commission needs to finish what it started and revisit protections in the commercial fishery too."

"The conservation community recognizes that the single greatest action that the FWC can do would be to require the use of bycatch-reduction devices on all crab traps used in Florida waters," said George L. Heinrich, executive director of the Florida Turtle Conservation Trust (FTCT). "While requiring their use on recreational traps is a good step forward, it only begins to address the problem."

Diamondback terrapin, *Malaclemys terrapin*. "This species is the only terrestrial turtle with significant adaptions to coastal habitats." Photo © 2013 by J. D. Wilson

The commission's study of Florida's commercial blue crab fishery follows a large existing body of science on terrapin interactions with blue crab traps. In a 2020 statement, the Diamondback Terrapin Working Group (DTWG), an organization of academics, scientists, and regulators working to promote terrapin conservation, concluded that scientific data is "abundant and clear": Commercial and recreational blue crab traps threaten terrapin populations, and bycatch reduction devices effectively reduce terrapin deaths with minimal effect on crab catch.

Leading international turtle experts also urged Florida to require excluder devices on all crab traps in state waters based on the existing science. The experts emphasized that a fleet of blue crab traps is capable of removing enough individual terrapins to cause population declines—or wipe them out completely.

Diamondback terrapins, found along the Atlantic and Gulf coasts from Massachusetts to Texas, are the only turtles in the world that live exclusively in coastal estuaries. These estuaries are also home to blue crabs, which are trapped in crab pots by an active blue crab fishery.

Baited blue crab traps are known to trap and drown terrapins, while commercial fleets of traps can steadily remove individual turtles until a population can't sustain itself. Abandoned or lost traps, also called ghost traps, can capture terrapins by the dozen. Experts agree that blue crab traps pose the greatest threat to the diamondback terrapin's existence.

Background

Diamondback terrapins are known for stunning diamond-patterned shells and speckled skin. They live in coastal marshes and other estuarine habitats, where they primarily feed on snails, clams, mussels and small crabs. The terrapin is potentially a keystone species in salt marshes and mangroves, helping to maintain their ecological health.

There are currently seven recognized subspecies of diamondback terrapin, and Florida is home to five, three of which only live there. Florida also has the most coastal habitat of all the states in the species' range.

The International Union for Conservation of Nature's Red List ranks the diamondback terrapin's global status as vulnerable and describes its population trend as decreasing. Threats include habitat destruction and degradation, crab-pot mortality, sea-level rise caused by climate change, pollution, boat strikes, collection for commercial and personal purposes, and inadequate regulatory measures to address these threats.

In January 2020 the CBD, FTCT, and DTWG filed a petition asking Florida's wildlife commission to require bycatch reduction devices on all recreational and commercial blue crab traps in state waters. When affixed to crab-pot entrance funnels, these small, inexpensive devices prevent most terrapins from entering the pot while having little to no effect on crab haul.

—Center for Biological Diversity press release

CTTC Valley Chapter
Turtle & Tortoise Show
Saturday, May 20, 2023
11:00 AM ~ 4:00 PM
Woodland Hills Christian Church
5920 Shoup Avenue, Woodland Hills, CA 91367

- Live turtles and tortoises
- Information on adoptions, care, and conservation
- Tortuga Gift Shop
- Raffle
- 'Ask the Vet' booth

For more information, contact:

Show Chair: Karen Berry
theflyingturtle1953@gmail.com

Co-Chair: Cristina Perovich
cribetti@gmail.com

ADMISSION FEES

Adults	$3.00	Children under 5	FREE
Seniors 60+	2.00	Active Military & Veterans	FREE
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In honor of Armed Services Day, we are offering free admission to our active military, veterans, and first responders.

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Lawsuit Filed to Protect Imperiled Alligator Snapping Turtles

Largest North American Freshwater Turtles Threatened by Habitat Destruction, Trapping Across Midwest, Southeast

St. Petersburg, Florida—7 March 2023— The Center for Biological Diversity (CBD) sued the U.S. Fish and Wildlife Service today to force it to ensure protections for 12 plants and animals under the Endangered Species Act, including the alligator snapping turtle and Suwannee alligator snapping turtle.

Today's lawsuit seeks final protections for the gargantuan turtles, which are threatened by habitat degradation, trapping, entanglement in fishing gear, nest predation from predators like raccoons, and climate change.

"The Service must follow through with its proposal to protect these fierce and imperiled turtles," said Elise Bennett, Florida director at the CBD. "These incredible creatures lose ground in the fight against extinction each day that protections are delayed. The Endangered Species Act works, but only once those protections are in place."

Following a 2012 Endangered Species Act listing petition and legal victory from the Center, the agency proposed protecting the Suwannee alligator snapping turtle as a threatened species in April 2021, and the alligator snapping turtle as a threatened species in November 2021. Despite finding these imperiled turtles deserve protection under the Act, the agency failed to finalize those protections for more than a year, leading to today's litigation.

Species background

Alligator snapping turtles are enormous, prehistoric-looking reptiles that can grow to 200 pounds and can live almost 100 years. These slow-moving, largely sedentary behemoths spend so much of their time sitting on river bottoms waiting for food that algae grows thick on their shells. They use a wormlike lure on their tongues to capture prey. The turtles have no natural enemies.

However, their populations have declined by up to 95% over much of their historic range due to overharvesting and unchecked habitat degradation. The turtles are also easy prey for hunters that feed thriving world markets for the exhibition and consumption of the turtles.

Early in the 20th century alligator snapping turtles were plentiful in U.S. river systems draining into the Gulf of Mexico, from the waterways and lakes of the upper Midwest to the swamps and bayous of Florida, Louisiana and Texas. But recent population surveys show the turtles are now likely extirpated in Iowa, Illinois, Kentucky, Missouri and Tennessee.

Historically, the alligator snapping turtle was considered a single species, but more recent study supported splitting off the genetically distinct Suwannee alligator snapping turtle as a new species. The Suwannee snapper is found in its namesake Suwannee River basin in southern Georgia and northern Florida.

—Center for Biological Diversity press release

Meeting Schedule: March/April 2023

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

Chino Valley
March 17; April 21

Foothill
March 10; April 14

High Desert
March 13; April 10

Inland Empire
March 3; April 7

Kern County
March 13; April 10

Low Desert
Meeting information to be announced.

Orange County
March 3; April 7

Ridgecrest
March 13; April 10

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)
March 18; April 22

Valley
March 17; April 21

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Membership in the CTTC and subscriptions to the *Tortuga Gazette* are handled through the CTTC Chapters. The Chapters also manage membership renewals (see postal addresses to the right).

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

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

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

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

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Memberships and Renewals

Each chapter handles its own memberships and renewals.

There are three options for membership renewal:

1. Send a check to the mailing address of your chapter. In the panel below, you will find the current membership fees and the mailing addresses for each chapter.
2. Renew your membership in person at your chapter's meeting.
3. Some chapters have PayPal accounts that enable their members to renew memberships online.