Dedicated to Turtle & Tortoise Conservation, Preservation and Education Since 1964

California Turtle & Tortoise Club

the Tortuga Gazette

Volume 55, Number 6 • November/December 2019

Testudo graeca, the Mediterranean spur-thighed tortoise, photographed at Balcalı, Adana, Turkey. Photo © 2018 by Zeynel Cebeci. Source Wikimedia Commons; license: CC-BY-SA-4.0..

featured species

Mediterranean Spur-thighed Tortoise, *Testudo graeca* (Linnaeus 1758)

The Greek Tortoise Complex

by M. A. Cohen

Members of the genera *Testudo* and *Agrionemys*, the Mediterranean tortoise species are endemic to arid regions of Mediterranean Europe, North Africa, and portions of the Middle East. The Mediterranean species include the following:

- *Testudo graeca*, the spur-thighed tortoise;
- *Testudo hermanni*, Hermann's tortoise;
- *Agrionemys. horsfieldi*, the Russian tortoise;
- *Testudo kleinmanni*, the Egyptian tortoise; and
- *Testudo marginata*, the Marginated tortoise.

The *Testudo* and *Agrionemys* genera both belong to the land tortoise family, the Testudinidae, which consists of some 11 genera and 40 to 50 species, depending on the authority one consults.

Generally speaking, *T. graeca* is a small- to medium-sized tortoise found in "semi-dry grassland and brush areas" throughout its range (Turtles of the World, n.d.). All subspecies are primarily herbivorous, feeding on forbs (herbaceous flowering plants) and grasses regardless of the region they inhabit. At least one subspecies is somewhat omnivorous.

As the common name (spur-thighed tortoise) implies, all *T. graeca* subspecies have at least one conical tubercle (a small rounded projection) on the outer surface of each thigh, and some may have two or three tubercles per thigh. All subspecies lack keratinized tips on their tails. The males of each subspecies have longer, thicker tails than the females.

A cautionary note: Testudinid herpesvirus 3 (TeHV-3) is a growing threat to wild and captive populations of tortoises, and members of the genus *Testudo* seem particularly vulnerable to it. TeHV-3 causes an infection with extremely high mortality rates. If the tortoise does survive the infection, it becomes an "asymptomatic carrier" of the virus for the rest of its life (Science 2.0, 2015).

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T. graeca Subspecies

Although there are at least 20 published subspecies names currently in use, there is no consensus as to the validity of all these names. In addition, there are dozens of synonyms that have been used historically, creating even more taxonomic confusion.

While the taxonomy (classification) of *T. graeca* remains in flux, there is general agreement on at least three subspecies. Additionally, there is one member of the complex that some chelonian biologists regard as a *graeca* subspecies, while other biologists consider it to be a completely separate species.

Testudo graeca graeca

Testudo graeca graeca photographed at the Labenne Zoo in France. Photo © 2019 by Vorlod. Source: Wikimedia Commons; license: CC-BY-SA-4.0

Found in North Africa and southern Europe, *T. g. graeca* occurs in northern Morocco, Tunisia, Algeria and Libya, on the Pityusae Islands of the Balearic Islands, and in southern Spain (Ernst and Barbour, 1989). On the Mediterranean islands of Sardinia and Sicily and on mainland Italy, the subspecies exists, but has likely been introduced in these locations (Turtles of the World, n.d.).

T. g. graeca is sometimes called the Moorish spur-thighed tortoise, presumably because it inhabits North Africa and Spain, where the Muslim civilization known as the Moors flourished between the 8th and 15th centuries.

The carapacial color of *T. g. graeca* is typically cream, yellow or tan with brown or black markings. Its plastron is similarly light in color with highly contrasting, symmetrical dark markings. The head of this subspecies is usually dark. One of the smaller subspecies, *T. g. graeca* grows to 8 inches (20 centimeters) at maturity.

Testudo graeca ibera

There are differences of opinion among taxonomists about whether this taxon is a *graeca* subspecies or a completely separate species. In this article, the taxon is considered a subspecies, the conclusion of a study published in *Chelonian Conservation and Biology* in 2012.

Sometimes called the Asia Minor or Eurasian spur-thighed tortoise, *T. g. ibera* is native to northeast Greece and the northern Aegean islands, portions of the Balkan states, and parts of Turkey southward to Iran or Iraq (Pollock and Kanis, 2015).

Testudo graeca ibera. A wild juvenile tortoise photographed at the Bolata Reserve on the Black Sea coast of northeastern Bulgaria. Photo © 2012 by MrPanyGoff. Source: Wikimedia Commons; license: CC-BY-SA-3.0.

A larger subspecies, the Eurasian spur-thighed tortoise reaches up to 12 inches (30 centimeters) when mature. *T. g. ibera* displays considerable variation in the coloration of its carapace. Some individuals are nearly solid black, while others are tan with brown or ocher markings. The shape of its carapace is somewhat flatter and rounder than others in the *graeca* complex (Soler, Silvestre and Fernandez, 2009).

While it is primarily herbivorous, *T. g. ibera* is an omnivore, especially in the wild, consuming insects and mollusks as well as forbs and grasses.

Testudo graeca terrestris

Ranging through southern Turkey, Syria, Lebanon, Jordan, and westward from Israel to northern Egypt or Libya, *T. g. terrestris* is sometimes called the "Golden Greek tortoise" because its carapace is comparatively lighter in coloration than that of other *graeca*

T. g. terrestris, photographed at the Dibbeen Forest Reserve in northwest Jordan. Photo © 2013; source: Wikimedia Commons; license: CC-BY-SA-3.0.

subspecies. However, "Golden Greek" is a misnomer because this subspecies is not found in the nation of Greece

T. g. terrestris is sometimes called the Mesopotamian tortoise, referring to its occurrence in the region historically known as Mesopotamia, the territory of the Tigris-Euphrates River System.

Another small tortoise in the *graeca* complex, this subspecies grows to 8 inches (20 centimeters) at maturity.

Testudo graeca zarudnyi

Testudo graeca zarudnyi, photographed by Omid Mozaffari in 2006 in the Bidoieh Protected Area, Kerman, Iran, Islamic Republic of. Source: CalPhotos. Public domain.

Native to Iran, Afghanistan, Azerbaijan, and Pakistan, *T. g. zarudnyi* is sometimes called the Zarudnyi spur-thighed tortoise or the Iranian tortoise. Very rare in the wild, and even more so in captivity, *T. g. zarudnyi* is a larger subspecies that reaches up to 11 inches (27.5 centimeters) at maturity with an elongated, high-domed carapace and a single spur on each thigh. The head of the Iranian tortoise is typically plain gray in coloration.

T. g. zarudnyi appears to be the least studied member of the *graeca* complex, and very little general information exists about this rare subspecies.

Range and Habitat

The range of the *T. graeca* complex spans three continents, Asia, Africa, and Europe. According to the Red List of the International Union for the Conservation of Nature, the species is endemic to "Albania; Algeria; Armenia; Azerbaijan; Bulgaria; Egypt; Georgia; Greece; Iran, Islamic Republic of; Iraq; Israel; Jordan; Libya; Moldova; Morocco; North Macedonia; Romania; Russian Federation; Spain; Syrian Arab Republic; Tunisia; Turkey; Ukraine" (The IUCN Red List of Threatened Species, 1996).

A categorization widely-accepted by the scientific community is the division of the *graeca* complex into two groups, one from North Africa and southern Spain, and the other from Eurasia and the Middle East (Turtles of the World, n.d.).

Composed solely of *Testudo graeca graeca*, the North African/southern Spain group inhabits ecosystems from sea level to montane areas of some 6,000 feet (1,900 meters) of elevation in the Atlas Mountains. Often found in semi-dry grasslands, this subspecies also lives on coastal dunes, the margins of marshlands, brush-covered hillsides, and pine woods (Turtles of the World, n.d.).

The other *graeca* group, consisting of the Eurasian and Middle Eastern subspecies, populates ecosystems from sea level to 9,000 feet (2,700 meters) of elevation. These subspecies prefer steppes (dry, flat, unforested areas), and also inhabit coastal dunes, scrub thorn ecoregions, and dry woodlands (Turtles of the World, n.d.).

Dormancy

While *T. graeca* in the southern portions of the species' range estivate throughout the summer and do not brumate, in the colder northern portions of the range, they typically brumate until late March or early April.

Threats and Conservation

Once very popular in the European pet trade, thousands of spur-thighed tortoises were removed from the wild, causing the extinction of some local populations (Ernst and Barbour, 1989). Today conservation measures offer the species some protection.

Last assessed in 1996 by the IUCN, *T. graeca* was designated as "Vulnerable" to extinction. An annotation in the Red List indicates that the assessment "needs updating." Along with all other members of the Testudinidae family, *T. graeca* is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (The IUCN Red List of Threatened Species, 1996). ☯

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Dr. Kristin Berry Honored with Lifetime Achievement Award

Dr. Kristin Berry, founding and current board member of the Desert Tortoise Preserve Committee (DTPC), was honored with a Lifetime Achievement Award at the 17th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles on August 7th in Tucson, Arizona. The award was presented by Dr. Anders Rhodin, founder and director of the Chelonian Research Foundation. Collaborator and friend of Dr. Berry's, Dr. Taylor Edwards of the University of Arizona Genetics Core provided an introduction describing Dr. Berry as persistent, comprehensive in her work (publishing over 80 research papers), collaborative, professional and a pioneer. Excerpts from the introduction are provided below.

"Many in the conservation community consider Dr. Berry to be the authority on *Gopherus agassizii* [Agassiz's desert tortoise]. She is arguably the most persistent advocate as her efforts have kept the plight of desert tortoise in the public eye for almost 50 years. Her career post graduate school has [been] almost entirely with the federal government, first employed by the Bureau of Land Management and since 1997...as a research biologist/ecologist with the U.S. Geological Survey. While still in [graduate] school...Dr. Berry was one of the [three] founders of the [Desert Tortoise] recovery group, later to become the Desert Tortoise Council...Already ahead of her time, in 1974, Dr. Berry, along with a group of concerned scientists, helped designate public land in the northwestern Mojave for the Desert Tortoise Natural Area. Land [was] purchased and restored specifically for desert tortoises and their environment through the Desert Tortoise Preserve Committee...[Dr. Berry] has not only contributed great scientific knowledge, but also effective conservation, the preservation of land, legal protection, and changes in policy."

Dr. Berry and DTPC President Ron Berger both attended the Symposium. They presented a talk entitled "Protection and Recovery of Agassiz's Desert Tortoise at the Desert Tortoise Research Natural Area and Adjacent Critical Habitat." ☯

Originally published in the DTPC newsletter *Tortoise Tracks* Edition 39: 3 (Fall 2019). Reprinted with permission.

'Deserve to Live': How a Hashtag Aims to Save Endangered Leatherback Sea Turtles: hashtag #saveleatherbacks —Turtle Island Restoration Network press release

15 October 2019—Pacific Leatherback Conservation Day falls on October 15 and this year, environmental activists are taking to social media to raise awareness of the rapidly declining species.

Less than 50 years ago, leatherback sea turtles—one of Earth's largest living reptiles—were thriving in the world's oceans. Today, the leatherback sea turtle is teetering on the edge of extinction. Global populations have decreased by 40 percent in the past three generations. The Eastern Pacific sub-population has been particularly hard hit, with a 97 percent decline in three generations.

The leatherback's decline is caused by unsustainable human activities:

- Illegal and legal harvest of eggs and meat kills remaining populations;
- Coastal development destroys nesting beaches;
- Plastic bags and balloons closely resembling jellyfish degrade the leatherback's foraging area;
- Drowning in commercial fisheries such as longlines or driftnets; and
- Entanglement in fishing line, plastic pollution, or ghost nets

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Leatherback hatchlings emerge from their nest on Eagle Beach, Aruba. Photo © 2008 by Elise Peterson. License: Creative Commons CC-BY-3.0.

Turtle Island Restoration Network is a leading advocate for leatherbacks:

- Closed the California longline fishery to prevent leatherback mortality;
- Organized the first Leatherback Survival Conference;
- Authored successful State law to have the Pacific leatherback listed as California's state marine reptile;
- Produced several award-winning leatherback documentaries; and
- Implemented the Pacific Leatherback Conservation Area.

With only 633 Eastern Pacific leatherback sea turtles left, scientists predict this iconic sea turtle could be extinct by 2040.

We can't let this happen.

Join the conversation today – tell us why you think leatherbacks deserve to live and tag #saveleatherbacks. Together, our voices make a difference. ☯

Neurological signals from the turtle's spinal cord surprise scientists

Faculty of Health and Medical Sciences | University of Copenhagen, Blegdamsvej, Denmark

Neurology—19 September 2019—With a study of the network between nerve and muscle cells in turtles, researchers from the University of Copenhagen have gained new insight into the way in which movements are generated and maintained. In the long term, the new knowledge may have an impact on the treatment of, for example, ALS and spinal cord injuries.

For most people, it is easy to put one leg in front of the other and keep walking. The ability to do it is second nature or, so to speak, in our bones. Quite literally.

'Most movements are actually generated in the spinal cord. Naturally, there is a conversation with high-ranking parts of the nervous system, such as the cerebrum, but there are also reflexes that simply stem from the back', says Associate Professor and Head of Research Rune W. Berg from the Department of Neuroscience at the University of Copenhagen.

He and his research group are behind a study of the network between nerve and muscle cells which has been published in the renowned scientific journal Nature Communications, and which provides completely new insight into the ways in which movements are generated and maintained.

Turtle Crawl

In the study, the research group used electrodes to study the spinal cord reflex of turtles when they scratched themselves with one hind leg. A reflex also found in dogs, cats and a number of other mammals.

Humans are likewise equipped with a variety of spinal reflexes. And although in terms of the evolution, we are rather distant from the turtle, scientists believe that many of the basic mechanisms are the same.

Thus, when the turtle rhythmically scratches itself using crawl movements from its hind leg, the fireworks of lightning quick neurological impulses that are set off inside the shell are not far from the mechanisms that also trigger our own muscles.

From Metronome to Network

So far, it has been a common assumption that the activation of muscle neurons originates from some sort of command centre that sends a signal to many cells at one time.

'Because the origin of movement has been difficult to find, it has long been assumed that it is a small core that sets the pace. Like some kind of metronome. But our data has shown that it may in fact be a large network', says Assistant Professor Henrik Lindén from the research group behind the study.

So far, it has been the common belief that a dense collection of a few cells triggers movement by sending the same signal to many other cells at the same time. Instead, research from the University of Copenhagen now shows that it is more likely a matter of a large, scattered network of cells, each of which only signals a few other cells.

To test whether it was a matter of small command units or a large network, the researchers compared the relatively quiet rhythm of the turtle's movement with the rapid neurological impulses from the spine.

To the surprise of the research group, the measurements showed no evidence of correlation – and thus no evidence that the neurological signals in multiple cells should have originated from the same source, which would indeed have been the case if it had been a command center that signaled to multiple cells at the same time.

Instead, the researchers now believe that neurological signals originate from a major, scattered network of cells, each of which sends signals to only a few other cells. A result which the group has subsequently replicated in computer models of a simulated, simple nervous system.

Potential for ALS and Spinal Cord Injuries

With these results, researchers have come a step closer to precisely understanding where and how movements are actually generated.

'If we do not know enough about the network and how it works, we grope a bit in the dark when it comes to treatment. Conversely, once we gain insight into the principles behind the distribution of the network, and which cell types are important, we can better put the treatment of neurological disorders on the right track', says Rune W. Berg.

Amongst others, he emphasizes neurological disorders such as ALS as well as spinal cord injuries, for example from traffic accidents, as areas where increased knowledge about the spinal nervous system can lead to advances in treatment in the long term.

Likewise, new insights from basic research into the neurons of the spinal cord may benefit other parts of the neurology, for example in connection with cot death, which is associated with defects in brain stem activity.

Now, the next step for the research group is to continue the mapping of the scattered neurological network with optical measurements that allow them to track the activity simultaneously over a larger area. ☯

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

Lavatera maritima ≈ *Malva subovata*
Tree Mallow

Being a member of the Mallow family, the Malvaceae, the tree mallow is one of a notable group of plants that includes the tropical hibiscus (*Hibiscus rosa-sinensis*), the flowering maple (*Abutilon* hybrids), the desert mallow (*Sphaeralcea ambigua*), the Rose of Sharon (*Hibiscus syriacus*), and other mallow species previously profiled in this column.

As a native of the western Mediterranean region, the tree mallow thrives in Mediterranean climates worldwide, including that in Southern California, given the proper growing conditions and care. *L. maritima*, sometimes called "sea mallow," is native to the coastal Mediterranean region. *Maritima* is based on the Latin *maritimus* from the root word *mare*, meaning the sea. The tree mallow tolerates seaside conditions such as salt air and wind (Inland Valley Garden Planner, n.d.).

Some botanists and websites refer to this species using the synonym *Malva subovata*. However, this terminology has yet to be widely adopted, particularly in the commercial nursery trade. This column will use the name *L. maritima* under which the plant is commonly available.

Sometimes the species is sold as *L. m.* 'Bicolor' or *L. bicolor*. This name refers to a cultivar with a blossom that features petals with highly contrasting coloration (Hinsley. 2008).

Lavatera maritima in full bloom. Photo © 2012 by Consultaplantas, captured at the *Jardín Botánico de Barcelona* in Spain. Source: Wikimedia Commons; license: CC-BY-SA-4.0.

Description

A medium-sized, evergreen shrub, the tree mallow rapidly reaches a height of 6 to 10 feet (1.8 to 3 meters) with a spread of 8 to 12 feet (2.4 to 3.7 meters). Because its growth is so fast, it is comparatively short-lived and typically lasts about five years. However, this trait makes the shrub a good, fast-filling hedge or background shrub for a perennial bed.

Drought-tolerant once established, tree mallow, with its gray-green, maple-like, tomentose (downy) leaves and large, showy flowers, is an attractive addition to the low-maintenance landscape. This shrub is drought-deciduous, meaning it will lose some or all of its leaves without supplemental water during periods of prolonged drought or extremely high heat (Inland Valley Garden Planner, n.d.).

With a diameter of 2 to 3 inches (5 to 8 centimeters), tree mallow flowers feature five pale pink petals that have deep lavender to purple centers and veining. Flowering occurs from spring through fall and is most abundant in summer. In mild regions blossoms may appear throughout the year. A light pruning following the first bloom of the season will encourage more flowering and keeps the shrub compact (Gardenia.net, n.d.).

Close-up of the blossoms, buds, and leaves of the Tree Mallow, *Lavatera maritima*, sometimes sold as. *Lavatera bicolor*. Photo © 2011 by Peter A. Mansfield. Source: Wikimedia Commons; license CC-BY-3.0.

Care

Tree mallow thrives in light, sandy soil that is moderately fertile and has good drainage (Gardenia.net, n.d.). The species will not tolerate a waterlogged planting site.

Except in hot, arid locations, *L. maritima* thrives in full sun. In intense desert heat, tree mallow requires "partial to full shade" (Brenzel, 2012).

While it requires consistent watering to become established in the landscape, the tree mallow will need moderate to occasional watering once established. During periods of intense heat, or if it is planted in a container, tree mallow will require more water than it would if planted in the landscape. Supplemental water will not be necessary during the rainy season unless rains fail to arrive.

L. maritima adapts well to pruning, and may be lightly pruned for size and shape as needed throughout its growing season. Horticulturists recommend a hard pruning in late winter or early spring prior to flowering to promote dense growth and prolific bloom.

Pollinators and other beneficial wildlife are attracted to the flowers of tree mallow, including hummingbirds, bees, and butterflies.

Edibility

Very little information is published regarding the edibility of *L. maritima*. According to a risk assessment by the Institute of Pacific Islands Forestry, tree mallow shows ***no*** evidence of toxicity to either animals or people, presents no allergy risk, and it is palatable to grazing animals (Pacific Island Ecosystems at Risk [PIER], 2008). ☯

Tree mallow blossom with a visiting pollinator, a bee. Photo © 2015 by Junkyardsparkle. Public domain..

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◀ As the sun rises on her day yard, Tammy, a desert tortoise (*Gopherus agassizii*), is out basking. A "hitch-hiking" Western fence lizard (*Sceloporus occidentalis*) sees Tammy's carapace as a basking platform, while Tammy seems oblivious to the lizard. Photograph © 2019 by Karen Berry.

▶ Stonewall the desert tortoise (*Gopherus agassizii*) snoozing in the sun, using a concrete ledge as his "pillow." Photograph © 2019 by Karen Berry.

ARCHELON—The Sea Turtle Protection Society of Greece

Founded in 1983, ARCHELON, the Sea Turtle Protection Society of Greece, is dedicated to the protection of "sea turtles and their habitats in Greece through monitoring and research, developing and implementing management plans, habitat restoration, raising public awareness, and rehabilitating sick and injured turtles," according to the **ARCHELON website**.

Based in Athens, Greece, ARCHELON partners with other conservation-oriented groups on various projects, and it operates a Rescue Center in Glyfada (near Athens) at which sick and injured sea turtles are rehabilitated with the goal of release into the wild. The organization conducts surveys and collects data, participates in habitat management, and operates both permanent and seasonal "information stations" around Greece to raise public awareness of the importance of sea turtles.

Through its programs for tagging and applying satellite-transmitters, ARCHELON monitors the movements of sea turtles throughout the Mediterranean Sea and beyond.

As it is with many conservation organizations, ARCHELON relies on volunteers and donations for many of its projects. The following is a recent press release (1 October 2019) describing some of the Society's work.

Archelon the turtle

The largest turtle ever known to exist, *Archelon* lived in the late Cretaceous period (100.5–66 million years ago). A marine species, known locations for *Archelon* fossils are South Dakota and Wyoming in the USA. The name *Archelon* derives from root words meaning "ruling turtle." Based on fossil evidence, paleontologists estimate the size of *Archelon* to be 15 feet (460 centimeters) from nose to tail with a weight of 4,900 pounds (2,200 kilograms).

Double release and triple joy, this time together with our Life Euroturtles partners!

Two rescued female loggerhead sea turtles returned to their natural habitat, the sea, after a stay of about 10 months in ARCHELON's Sea Turtle Rescue Centre. The event took place on Thursday 26/9/2019 and marks the happy outcome of a lengthy rescue effort in both cases. "Aphrodite" was found with a deliberate head injury in Ermioni, in November last year and was directly transported to the Rescue Centre. "Katerina" was found with a deliberate head injury in Halkidiki, also in November last year. This turtle was given first aid by Prof. A. Komninou at the Veterinary School of Thessaloniki University and consequently was transported to the Rescue Centre for treatment.

Loggerhead sea turtle, *Caretta caretta*. Photo © 2006 by ukanda. Source: Wikimedia Commons; license: CC-BY-2.0.

So, double release, but triple joy as the whole Life-Euroturtles team attended this event. ARCHELON was hosting the annual meeting of the project and partners from Cyprus, Italy, Slovenia, Croatia and Malta were in Glyfada during most of last week. The Life-Euroturtles project aims to improve connections and synergism on key conservation aspects among 6 EU countries, which are amongst the most important countries for the conservation of sea turtles in the Mediterranean. All participants were looking forward to the event of the rescued turtles release.

"We find it extremely useful to meet and exchange on the implementation of our commonly agreed activities" says Drasco Holcer, the Euroturtles Coordinator from the Croatian Natural History Museum. "Many loggerheads nest in Greece but feed and spend a lot of time in the Adriatic Sea and other parts of the Mediterranean, together with us and our fishermen. The threats of the sea turtles at sea are common in all countries" he added. Representatives of the European Commission, more specifically from Executive Agency for Small and Medium-sized Enterprises, who are supervising Life projects, also joined the meeting in Glyfada.

It is also a fact that with the latest improvements at the Rescue Centre, ARCHELON's staff and volunteers have been able to put up with the increased number of arrivals of sea turtles deliberately injured in the head. "These cases take a long time to reach rehabilitation. Last winter, until the recent extensions, there was no space available at the Centre to admit new cases" says Eirini Kassimati, biologist MSc, who is ARCHELON's rescue/rehabilitation officer.

All of the above having been said, our last thought is with the two rescued sea turtles who start a new journey and the tens of volunteers who took care of them during their stay! Good luck to all of you, as well as to our Life Euroturtles partners! ☯

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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**

Thelma the Travelling Tortoise

Between August 2000 and August 2002, a Sonoran desert tortoise named Thelma trekked 23 miles from Saguaro National Park to the Santa Rita Mountains and then came back again.

David Morafka Award

The Desert Tortoise Council is accepting applications for its annual David J. Morafka Research Award.

PARC Inventory and Monitoring Guide

PARC's *Inventory and Monitoring: Recommended Techniques for Reptiles and Amphibians, with application to the United States and Canada* is now available for free download.

Long-Term Turtle Declines: Protected Is a Verb, Not an Outcome

Long-term monitoring of spotted turtle populations reveals their ability to persist for long periods of time despite having little recruitment and a declining population trajectory and underlines the importance of active management within protected areas.

Florida Turtle Traffickers Busted

Florida's Fish and Wildlife Commission charged 2 men with poaching and confiscated large numbers of turtles and shells.

Don't Kiss Your Turtle!

The Center for Disease Control reports 13 cases of turtle-related *Salmonella* infection this year. Please remember to wash your hands before and after handling any turtle or tortoise

Green Sea Turtle Shape Can Help Identify Genetic Lineage

Important new study opens new possibilities to explore ecological and evolutionary hypotheses in turtles with wide morphological variation and broad geographic distribution range.

Online Sea Turtle Necropsy Lectures

Important NOAA educational resource for people participating in sea turtle postmortems. These are very informative videos that are definitely not for the squeamish.

Dorian Wiped Out 8,000 Turtle Nests in Florida

Surveys conducted at the Archie Carr National Wildlife Refuge in Melbourne Beach shows that Hurricane Dorian washed away 45% of green sea turtle nests. Sea turtle species that nest and hatch earlier in the season were less impacted.

Jurassic Turtle Fossil Shows Signs of Being Crushed by a Dinosaur

Road works in the Jura Mountains in Switzerland uncovered a fossil Thalassochelydian turtle that may have been stomped by a dinosaur some 50-200 million years ago.

CTTC's Turtle And Tortoise Listserve

CTTC's Turtle and Tortoise list has now moved to io.groups. If you want to talk with other turtle and tortoise fans in a friendly atmosphere just send an email to: **<CTTC-TurtleAndTortoise-list+subscribe@groups.io>**

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Speedy, a desert tortoise (*Gopherus agassizii*), enjoying a tropical hibiscus blossom (*Hibiscus rosa-sinensis*). Photograph © 2018 by Karen Berry.

Galápagos Conservancy News

Giant Tortoise Restoration Initiative: 99.9% of Tortoises Repopulated to Santa Fe Island are in Good Health

10 September 2019—According to the preliminary monitoring results from the Santa Fe Island Ecological Restoration Plan, 99.9% of the tortoises released on the island over the past four years have survived and are in good health. This project is part of the Giant Tortoise Restoration Initiative (GTRI), a collaborative effort between the Galápagos National Park and Galápagos Conservancy.

Of the 549 individuals released on Santa Fe since 2015, only four have died to date, which is presumed to be due to natural predation by Galápagos hawks.

"These young tortoises fulfill their role as engineers of the ecosystem, as we can clearly see tortoise paths in approximately 30% of the surface of the island. It has also been proven that they are actively contributing to seed dispersal, especially of *Opuntia* cactus," said Jorge Carrión, director of the Galápagos National Park.

Washington Tapia, Director of the Giant Tortoise Restoration Initiative, noted that "this will help improve the population dynamics of cacti whose population is currently made up mainly of adults and subadults; a situation that represents a risk for the future of that species."

As part of this effort, GTRI team members installed a network of 60 cameras on Santa Fe to record images of tortoise activity, as well as changes in the vegetation of the 20 permanent plots established to measure their long-term effects.

Click **Tortoise release** to watch a video of the 2015 reintroduction of Santa Fe Galápagos tortoises to the island. ☯

—Galápagos Conservancy press release

Meetings and Programs

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

Chino Valley: 15 November; NO MEETING in December

Foothill: **25 November**: Laura Brewer from Prehistoric Pets; **16 December**: Annual Christmas Party/Potluck [NOTE DATE CHANGES]

High Desert: 11 November; 9 December

Inland Empire: 1 November; 6 December

Kern County: 11 November; 9 December

Low Desert: 2 December

Orange County: 8 November; 13 December

Ridgecrest: 11 November; 9 December

Santa Barbara-Ventura: Contact the chapter for meeting information.

Santa Clarita: 16 November: Annual Holiday Potluck and Bingo Party

TOOSLO (San Luis Obispo): 19 November; 17 December

TTCS (Long Beach): 15 November; 20 December

Valley: 15 November; 20 December

Executive Board: TBA January 2020. Meetings take place at the Los Angeles County Arboretum in Arcadia, CA.

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Causes and Prevention of URTD in Grazing Tortoises

by Dr. Todd Driggers, Avian and Exotic Animal Clinic of Arizona, Mesa, AZ

This article is based on a presentation at the General Meeting of the National Turtle & Tortoise Society (Phoenix, AZ) held on June 28, 1996.

Dr. Driggers is a graduate of Purdue University. He completed an internship with Dr. Elliot Jacobson of the University of Florida , and with Dr. Doug Mader of Long Beach, California. He worked in Indianapolis as an exotic and avian veterinarian. he also worked at the Lincoln Park Zoo and is a published author.

Known Species of Tortoises that are Affected by URTD

- *Testudo graeca*
- *Testudo hermanni*
- *Testudo (=Agrionemys) horsfieldii*
- *Gopherus agassizii*
- *Gopherus polyphemus*
- *Geochelone (=Stigmochelys) pardalis*
- *Geochelone (=Centrochelys) sulcata*
- *Geochelone (=Astrochelys) radiata*
- *Geochelone elegans*

All tortoises can be considered as having the potential to contract and spread the disease.

The bacteria which causes URTD (Upper Respiratory Tract Disease) in desert tortoises was discovered by Dr. Jacobson during testing at the University of Florida. Symptoms of URTD in tortoises include a runny nose,and bulging eyes. Desert tortoises in the Mojave [Desert] and in Utah have declined due to this disease and inefficient hibernation. But desert tortoises are not the only ones affected by URTD—it can affect any grazing tortoise including Leopard (*Geochelone pardalis*), Radiated (*Geochelone radiata*), Indian Star (*Geochelone elegans*), African spurred (*Geochelone sulcata*), Russian (*Testudo horsfieldii*), and gopher tortoises (*Gopherus polyphemus*). Captivity predisposes these animals to disease. Until 1990–1991, attempts at demonstrating or incriminating a causal agent were unsuccessful. Because of negative findings and failure to incriminate a specific bacteria, a virus was considered as a possible cause. In studies conducted on captive desert tortoises, a bacterial organism, *Pasteurella testudinis*, was isolated and incriminated as a possible cause. However, *P. testudinis* has also been isolated from healthy tortoises and the significance of this organism remains unknown. In the 1970s, desert tortoises with signs of the disease were observed on the Beaver Dam Slope of Utah, a site where many captive tortoises were being released.

In 1988, desert tortoises at the Desert Tortoise Natural Area (DTNA), Kern County, California were seen with clinical signs of illness similar to that of captive desert tortoises. Signs included a mild to severe nasal discharge, puffy eyelids, eyes recessed into the orbits, dullness to the skin and scutes, weight loss, and either waking up during hibernation or inability to hibernate. Based on these clinical signs, Upper Respiratory Disease Syndrome (URDS) was used to character this syndrome.

Symptoms of URTD

- Mild to severe nasal discharge
- Bulging eyes
- Reddened asymmetric choana [Ed. note: the hindmost internal openings of the nasal passages in the roof of the mouth]
- Anorexia and weight loss
- Waking up during hibernation or will not hibernate

Surveys of the DTNA in 1989 and 1990 revealed that many tortoises were ill with the disease, and shells of many tortoises indicated a major die-off was underway. Research on long-term study plots with marked tortoises showed that more than 70% of adult tortoises of adult tortoises died between 1988 and 1992. Other surveys indicate that wild desert tortoises with URDS are also widespread in the west-

Distribution of URTD

- Entire range of the desert tortoise, including Mojave and Sonoran Deserts
- Most likely caused by captive tortoises being released back into the wild
- Causes in captive tortoises are multifactorial and yet completely understood

ern Mojave Desert of California, around Las Vegas Valley in Nevada, and on the Beaver Sam Slope of Utah and Arizona.

In May 1989, with a contract from the U.S. Bureau of Land Management (BLM), studies on the desert tortoises ill with URDS were initiated in an attempt to elucidate the responsible pathogens. During the course of these studies, the pathology of the disease was better understood and findings indicated that the upper respiratory tract was the major site of involvement. Based on these findings, the disease was determined to be a chronic upper respiratory tract disease and the acronym URTD was used. Today, URTD more appropriately designated this disease this illness and should replace URDS.

Microbiologic investigations with URTD failed to incriminate a virus as a potential causal agent. *Pasteurella testudinis* was isolated from most of the ill tortoises examined and a previously unidentified *Mycoplasma* was also isolated from ill tortoises. Electron microscopic studies confirmed the presence of *Mycoplasma* on the surface membranes of the upper respiratory tract of desert tortoises ill with URTD.

In 1992, research was conducted on transmission of the disease. The findings support the contention that *Mycoplasma* is the most like cause of URTD. A causal relationship of between *Mycoplasma* and URTD has been established. Still,

Free-ranging Agassiz's desert tortoise (*Gopherus agassizii*) photographed in the Mojave Desert by staff from the Pacific Southwest Region US Fish and Wildlife Service. Public domain.

Pasteurella and other bacteria may affect the severity of the disease.

A blood test has been developed at the University of Florida to determine exposure status of tortoises to *Mycoplasma*. Preliminary studies are very promising in that this test may ultimately be useful in assessing conditions of tortoises.

Predisposing factors such as poor nutrition (resulting from habitat degradation), drought, and release of captive desert tortoises ill with URTD into the wild are also more than likely involved. The whole issue of releasing an ill pet desert tortoise into the wild needs to be publicized because this practice should not continue. Transmission studies have clearly demonstrated the infectious nature of URTD. Thus it is safe to assume that captive tortoises that are ill can transmit this disease to both captive and free-ranging clinically healthy tortoises.

Transmission of URTD

- Bacteria transmitted by respiratory secretions, although other means of contracting the bacteria are possible
- Disease is considered infectious
- Poor nutrition and loss of habitat also play a role in the expression and severity of the disease [in free-ranging tortoises].

Primary Causes of URTD

- Humidity is too high (non-desert)
- Over-watering of grazing grass
- Misting sprinklers
- Housing with infected tortoises
- Immunocompromized/stressed tortoise
- Malnutrition

Until recently, no antibiotics or combination of antibiotics have been efficacious for treating tortoises ill with URTD. With evidence that *Mycoplasma* is the etiological agent of URTD and that *Pasteurella testudinis* and other gram negative bacteria may contribute to the severity of the disease, antibiotic therapy with enrofloxacin [Baytril®] at 5 mg/kg of body weight every other day for 10 treatments is considered the therapy of choice. In addition, injectable enrofloxacin should be diluted 1:10 in sterile saline and a small quantity (up to 0.5 cc) should be flushed up both nostrils of the affected tortoise utilizing a syringe and attached catheter of appropriate diameter. Flushing should continue daily for one month (at least until the rhinitis has abated). Since enrofloxacin is very irritating to mucous membranes surround the eyes, it is important to avoid contact of enrofloxacin with those tissues. It is important to maintain tortoises at an optimum environmental temperature during the course of treatment. While antibiotic therapy may result in clinical improvement and complete regression of clinical signs, this does not mean that this tortoise will be free of disease thereafter. Turtles may remain carriers of *Mycoplasma* for life with recurrence of the disease at some point in time in the future.

Results of clinical trials with these new drugs and drug combinations for treating tortoises ill with URTD are extremely promising for captive tortoises. Unfortunately, the situation for ill free-ranging tortoises is not as promising. Since the disease is more than likely multifactorial, schemes for managing URTD in free-ranging populations are going to be difficult to develop and implement. Minimally, tortoise hobbyists and veterinarians can make a major contribution by getting the word out that captive tortoises should not be released into the wild. More than likely this practice has contributed to the spread of URTD in wild populations.

Preventive Action

- Remove tortoises before watering their grazing area.
- Flood irrigate if it is not possible to remove the tortoises.
- Wait until water has completely soaked in before returning animals to the area.
- Do not soak tortoises frequently.
- Practice good husbandry.
- Quarantine affected animals.
- Test tortoises with runny noses for disease.
- Test fecal samples.
- DO NOT MIX SPECIES.
- Handle affected tortoises last.

— Article concludes on page 14, column 1.

The following points should be remembered with regard to grazing tortoises and URTD:

▶ URTD is a chronic infectious disease affecting not only desert tortoises but other tortoise species as well.

▶ Scientific evidence supports the belief that *Mycoplasma* is the infective agent responsible for URTD.

▶ URTD is a transmissible disease. Because of this, tortoises showing clinical signs of illness should be isolated from healthy tortoises.

▶ Different species of tortoises should NOT be kept together in captivity, since foreign pathogens may be introduced into new hosts.

▶ Although antibiotic treatment may result in complete remission of clinical signs, tortoises may still develop the disease at a future date.

▶ Ill or formerly ill desert tortoises should never be released into the wild. Release of captive tortoises may have been responsible for disease outbreaks in the Mojave Desert.* ☯

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Originally published in the National Turtle & Tortoise Society's newsletter *The Carapace*, July/August 1996 (Volume XII, Number 4).

* [Editor's note: For this very reason, professionals and non-professionals alike generally believe that *NO* formerly captive tortoise should *ever* be released into the wild.]

I only have a minute.

Sixty seconds in it.

Forced upon me, I did not choose it,

But I know that I must use it.

Give account if I abuse it.

Suffer, if I lose it.

Only a tiny little minute,

But eternity is in it.

poem written by Dr. Benjamin Mays and quoted by the Honorable Elijah E. Cummings (1951–2019), American legislator

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Chino Valley Chapter: P. O. Box 1753, Chino, CA 91708–1753

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

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

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

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

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California Turtle & Tortoise Club
Post Office Box 7300
Van Nuys, CA 91409–7300