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Nesting female Australian flatback turtle, *Natator depressus*, photographed in habitat in Bowen, Queensland, Australia. Photo © 2009 by Stephen Zozaya. Reprinted with permission from the photographer.

Turtle of the Month

Flatback Sea Turtle, *Natator depressus*

The Australian Flatback by M. A. Cohen

The Australian flatback is a member of the Cheloniidae, the superfamily of sea turtles, which is collectively the most endangered family of turtles on the planet. Least studied of the seven living sea turtle species, the Australian flatback turtle, *Natator depressus*, is unusual in several respects.

It is the only sea turtle that is endemic, i.e., restricted to a certain area (Flatback, n.d.). The Australian flatback is the only sea turtle that does not migrate extensive distances in the open ocean. Moreover, it does not venture into the deep ocean waters, but prefers the relatively shallow ocean waters near the Australian coast. It occasionally journeys to favored feeding grounds in southeast Asia.

Like the carapace of the leatherback turtle (*Dermochelys coriacea*), fleshy skin covers the carapace of the flatback turtle. Ordinarily, keratinized scutes cover the carapace of sea turtles species.

The species was first described by American ichthyologist/herpetologist Samuel W. Garman (1843-1927) in 1880. Originally Garman assigned the Australian flatback to the genus *Chelonia*, thinking it was a type of green turtle, and he gave it the name *C. depressa*.

Historically, there have been differences of opinion about how to classify the species. In 1908, Allan R. McCulloch thought he had discovered a new species of sea turtle, and he named it *Natator tessellates*. Notwithstanding, in 1913, D. B. Fry examined the skeletal material and life history stages of the species and reverted to the name *C. depressa*, but he made mistakes when preparing his museum specimens that went undiscovered for decades.

In the 1980s, Rainer Zangerl and Colin Limpus concluded, through independent studies, that the Australian flatback was a unique species and not a relative of *C. mydas* (Spotila, 2004).

The flatback was officially described as a separate species in 1988 (Flatback, n.d.). Consequently, it was assigned to the genus *Natator*, the name which was first given it by McCulloch in 1908. Its species name was modified and became *depressus*. This name is now accepted by the scientific community.

The word "natator" means "a swimmer," a fitting name for a sea turtle, the most pelagic of turtle species. The species name *depressus* means "flattened" and refers to the carapace of

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the Australian flatback, which is noticeably less domed than that of other sea turtle species.

A flatback hatchling makes its way from its nest to the ocean. Photo © 2010 by Purpleturtle57; source: CC-BY- SA-3.0

Identification

The Australian flatback is a medium-to-large sea turtle species that reaches a mature carapace length of 114.7 centimeters (45.2 inches) at maturity, averaging 90 centimeters (35. 4 inches). The average weight of adults is 73 kilograms (161 pounds) (Arkive, n.d.). Adult females are larger than adult males; the females have smaller tails than the longer, thicker tails of the males (Ernst, et al., n.d.).

The adult flatback turtle possesses a relatively flat carapace that is oval in shape, and olive to gray to pale green in coloration. Fleshy hide that is somewhat "slimy" to the touch covers its carapace (Ernst, et al, n.d.). The carapace narrows at both the front and rear of the oval, and its edges are slightly upturned.

The plastron of the flatback is cream-colored to pale yellow. The head and neck are olive-gray above and pale yellow below, while the flippers of the adult flatback are olive-gray on the top and cream-colored on the underside (Spotila, 2004).

Hatchling flatback turtles are the largest of any sea turtle species, increasing their chances of survival. The average carapace length at hatching is 6.1 centimeters (2.4 inches), with an average weight is 43 grams (1.5 ounces). The hatchling carapace is gray with each scute outlined in black. The edges of the carapace and the plastron of the hatchling are white (Arkive, n.d).

Range

N. depressus inhabits the continental shelf of tropical northern and eastern Australia, from the Kimberley region in the state of Western Australia, across the Northern Territory to the Torres Strait between the Cape York Peninsula and Papua New Guinea. Cape York Peninsula is on the northern tip of the state of Queensland. The flatback turtle also inhabits coastal regions off eastern Queensland. The species is found in the Torres Strait area on the coast of Papua New Guinea, and occasionally on the Great Barrier Reef.

The Australian flatback has the most limited range of any species of sea turtle. As a result of its restricted range, the species is less endangered than other sea turtle species that travel greater distances in the open ocean. This does not mean that the species is not threatened by external pressures. See the section on conservation for more information.

Following nesting, females sometimes migrate hundreds of miles to favored feeding grounds in the Arafura Sea of Indonesia. Nesting female flatbacks tagged in Australia have been recaptured in feeding grounds over 800 miles from the nesting beach.

Feeding

Omnivorous in its feeding habits, *N. depressus* consumes a variety of marine invertebrates, including bryozoans, jellyfish, molluscs, sea cucumbers, sea pens, shrimp, and others (Spotila, 2004). The species also consumes seagrasses and soft corals (GBIF, n.d.). This diet renders its flesh less palatable to humans than that of herbivorous sea turtles, so humans rarely take flatback turtles for food (Ernst et al., n.d.).

Reproduction

The Australian flatback breeds and nests throughout its range off the coast of northern Australia as well as "patchily along the Great Barrier Reef" (Cogger, 1992). The Torres Strait region between Cape York Peninsula in Queensland and Papua New Guinea is the area with the greatest concentration of flatback nesting sites. The largest single flatback nesting colony occurs on Crab Island in

the northeastern Gulf of Carpentaria in Queensland (Spotila, 2004).

The nesting season varies by locality, and is likely linked to the local climate. On the southern Queensland coast, for example, flatbacks nest mainly between October and January, whereas on Crab Island in the Gulf of Carpentaria they nest year-round. In some areas, flatbacks nest from March to October during the dry season, while in others, the turtles nest from October to February during the rainy season (Spotila, 2004). Nesting typically takes place on undeveloped, isolated beaches.

Mating occurs in the shallow coastal waters of the continental shelf shortly before nesting. According to researchers, most nesting takes place in the early evening on the tops of sand dunes or on steep seaward slopes (Ernst et al., n.d.).

In proportion to its body size, the flatback lays the largest eggs of any sea turtle species (Spotila, 2004). A clutch typically consists of 50 to 70 eggs that are about the size of billiard balls, each egg weighing 70 to 80 grams (2.5 to 2.8 ounces). Females typically reproduce every two to four years, laying two to three clutches per season (Flatback, n.d.).

Incubation takes 48 to 66 days, depending on the temperature of the nest. According to Dr. James Spotila, "The pivotal temperature for sex determination is 29.5°C (85°F)" (Spotila, 2004). This is the temperature at which an equal ratio of males and females occurs among flatback hatchlings. Below this temperature, hatchlings are predominantly male, while above this temperature, hatchlings are predominantly female. Hatchlings typically emerge from the nest at night (Ernst et al., n.d.).

When they hatch, *N. depressus* hatchlings are roughly twice the size of green turtle (*Chelonia mydas*) hatchlings. Their size at hatching provides a distinct survival advantage to the flatback hatchlings. On many nesting beaches, they are less likely to become the prey of two species of ghost crabs (*Ocypode cordimana, O. ceratophthalma*) and silver gulls (*Larus novaehollandiae*) than the smaller green turtle hatchlings (Alderton, 1988).

The rate of hatchling survival is generally high on many isolated beaches, as high as 70 to 95%, with larger clutches generally having a higher survival rate (Spotila, 2004). However, many animals prey on flatback hatchlings once they emerge from their nests.

Once they reach the sea, flatback hatchlings and juveniles become the prey of various species of fish and sharks that patrol the shallow waters of the continental shelf awaiting the arrival of the hatchlings (GBIF, n.d.). Sea turtle biologists estimate that, in general, only one out of every 100 sea turtle hatchlings lives to maturity.

Predation and Conservation

Nest predators include the native dingoes (*Canis familiaris dingo*) and monitor lizards [goannas] (*Varanus gouldii, V. panoptes*), and the introduced red fox (*Vulpes vulpes*) (GBIF, n.d.). Many avian species prey on flatback hatchlings, including rufous night herons (*Nycticorax caledonicus*), Australian pelicans (*Pelecanus conspicullatus)* and numerous others (Spotila, 2004).

The primary predator of the adult flatback is the saltwater crocodile (*Crocodylus porosus*), which preys on the adult flatback over much of the turtle's nesting range (Flatback, n.d.). "Salties," as these crocodiles are sometimes called, will actually emerge from the sea to prey on nesting female flatbacks.

N. depressus is not endangered to the extent of other sea turtles, primarily because of its relatively limited range. However, humans and human activities pose the greatest threat to the Australian flatback. Coastal development and pollution pose increasing threats to flatbacks.

Accordingly, the Australian government lists the species as "Vulnerable," and "the Australian Marine Turtle Recovery Plan considers northern Australian flatback populations to be at significant risk from predation." The Australian government does protect nesting beaches, as well as protecting turtles at sea through the required use of Turtle Excluder Devices on many shrimp trawlers (Spotila, 2004). However, incidental capture in gill nets and other types of fishing gear also poses a risk to flatbacks in coastal waters.

The IUCN Red List finds that the species is "data deficient" but notes the need for an update to that finding. The flatback is in danger of extinction in coastal Western Australia, and faces imminent threats off the northern Kimberley coast due to industrial development (GBIF, n.d.). **Ω**

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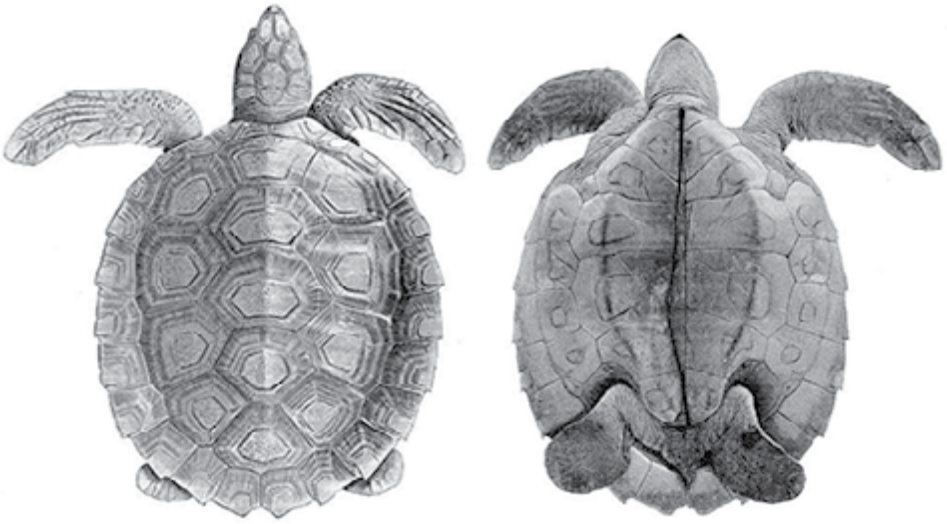

Dorsal (left) and ventral (right) views of a new species of sea turtle received by the Australian Museum in 1908. The 153-millimeter (6-inch) specimen is a juvenile was that examined and described by zoologist Allan Riverstone McCulloch who named the turtle *Natator tessallates*. McCulloch's description was published in *Records of the Australian Museum,* 7(2): 126–128, plates xxvi–xxvii [11 September 1908]. These images are photographs that were taken by H. Barnes, Junr.

Raine Island: the World's Largest Green Turtle Rookery by M. A. Cohen

The Great Barrier Reef, located off the eastern coast of Queensland, Australia, is the largest coral reef system in the world, extending over 2,300 kilometers (1,400 miles) to the south in the Coral Sea. This is about the length of the west coast of North America from Vancouver, Canada to the California-Mexico border. It comprises nearly 3,000 coral reef systems, 600 islands, 300 coral cays, and about 150 inshore mangrove islands. Moreover, it is the only living organism on the planet that is visible from space.

Green turtle, *Chelonia mydas,* surfacing for a breath of air near Lady Elliot Island in the Great Barrier Reef. Photo © 2008 by Holobionics. Source: Creative Commons; license CC-BY-SA-4.0.

The Great Barrier Reef (GBR) was designated as a World Heritage Site in 1981. Accordingly, the Great Barrier Reef Marine Park protects much of the Great Barrier Reef, limiting the negative impact of human activities such as commercial fishing and tourism.

The GBR is a biodiversity hotspot, home to 1,625 species of fish, 624 species of hard coral and six of the seven species of sea turtles. It is home to the dugong, an endangered sea mammal, as well as 30 species of whale and dolphin. 215 species of birds, both seabirds and shorebirds, inhabit the GBR, as well as 133 species of sharks and rays. Many other life forms inhabit the GBR, including jellyfish, molluscs, marine algae, sea pens and sponges (Great Barrier Reef, n.d.).

Climate change seriously impacts the Great Barrier Reef through coral bleaching, which is due to rising ocean temperatures. Consequently, scientists estimate that the Reef has lost over half of its coral cover in the past two decades.

The location of Raine Island is the eastern edge of the Great Barrier Reef. It is 620 kilometers (390 miles) north-northwest of Cairns, Queensland, Australia. It is a small island, occasionally called an islet, that is only 32 hectares (79 acres) in total area. Geologically, the island is a vegetated coral cay. The definition of a cay is "a small, flat marine island formed from coral materials or sand" (Allaby, 1994).

The cay received the name "Raine Island" since its shape is similar to that of a raindrop when viewed from above. Access to Raine Island is strictly limited to scientific studies and essential maintenance personnel only in order to protect the environment and wildlife of the island (Raine Island National Park, n.d.).

The Raine Island Rookery

The term "rookery" refers to a breeding colony of animals. The term is often used with reference to seabirds, but is also used for breeding colonies of marine mammals such as seals, as well as for breeding colonies of sea turtles.

Raine Island is the largest known green turtle rookery in the world. More female green turtles return annually to nest on Raine Island than to any other known site worldwide. Some 41,000 females may come ashore to nest on the island in a typical nesting season. During a high-density nesting season, that number could rise as high as 131, 000 females nesting (Raine Island National Park, n.d.).

Green turtles travel significant distances to nest on Raine Island. They migrate from northern Australia, Indonesia, New Caledonia, New Guinea and Vanuatu, migrating up to 2,600 kilometers (1,616 miles) to nest on the island (Raine Island National Park, n.d.).

The green turtle population on Raine Island fluctuates due to the El Niño–Southern Oscillation, a periodic change in ocean winds and surface temperatures in the eastern Pacific Ocean that affects tropical and subtropical areas.

The green turtle (*Chelonia mydas*), an ancient mariner with an extensive range spanning great distances and many tropical oceans, nests throughout its range. The green turtle rookery on Raine Island has been an active nesting site for at least 1,000 years, meaning it is the oldest known green turtle breeding colony in the world as well as the world's largest.

The Raine Island Beacon

Convicts constructed the Raine Island Beacon was on the eastern end of Raine Island in 1844, to assist navigators traveling north from Australia to Asia through the Outer Passage. Extending from the GBR through Torres Strait, the Outer Passage was infamous for shipwrecks. Accordingly, the beacon's builders actually used timber from one such shipwreck in the construction of the beacon.

It is the oldest European structure in northern tropical Australia. The beacon is 12 meters (39.4 feet) high with a 9-meter (30-foot) base diameter. It is visible for a distance of 13 nautical miles (15 miles).

In 1992 the Queensland Heritage Register listed the Beacon as a state heritage archaeological site. In 1988 one of several restoration projects was undertaken to shore up the beacon, which had suffered from undermining, weathering, and lightning strikes. Subsequently, the Australian government conducted repair and restoration projects to protect this heritage site from the damage by the elements. **Ω**

Raine Island Beacon, as photographed in 1983 by the Heritage branch staff of the Queensland Heritage Register

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Educating Hungry Ravens with 3D Printed Tortoise Shells by Hannah Rose Mendoza

You may not have noticed the declining number of desert tortoises in the Southwestern US in recent years, but it hasn't escaped the attention of a team of conservationists who have come up with a high-tech way to use 3D printed shells to educate their predators to leave them alone.

3D printed artificial carapace of a desert tortoise (*Gopherus agassizii*) in a desert environment.

The initial image that came to mind was of a series of slowly marching herbivores, lazily munching on vegetation while fending off areal attacks via lasers that had been fitted to their shells. Apparently, however, that is both impractical and unnecessary and so for some reason has not been fully explored as an option. In the meantime, the conservationists have been working to create a series of 3D printed decoy shells to fool the hungry ravens who are all too often targeting the youngest of these tortoises as their meal of choice.

The thing about ravens though is that they are surprisingly clever. So, instead of simply creating decoy shells to distract the ravens, they are using these artificial carapaces as part of a raven re-education program. The plan is to place these decoy shells after having sprayed them with a non-toxic substance that the ravens find highly unappealing. It shouldn't take too long for the ravens to realize that they are pecking at something awful smelling that doesn't yield any reward and they may begin to simply discount tortoise hunting as a worthwhile expenditure of energy.

The key here is that the ravens aren't harmed, there's no need to hunt them down or poison them, instead just fill them with a strong sense of doubt about the cost/benefit ratio of attempting to eat a small tortoise. It's the same sort of aversion therapy that I wish would work for cockroaches or talkative children, I'd rather not squish them, but instead have them convinced that they must be in the wrong place and leave.

The faux-shells were created as part of a collaboration between **Hardshell Labs** and **Autodesk** and are also equipped with sensors that track the ways in which the ravens interact with them to provide more data about the predator's behavior and to paint a picture of any improvements that need to be made. The initial phase of testing is underway, with three lures having been placed by conservation researcher William Boarman. He hopes to be able to conduct a larger scale test involving as many as 50 shells along with motion-triggered cameras to collect data about the predator interactions.

Boarman described the development of this unique approach to conservation and the contribution made by 3D printing:

"About 15 years ago, we used styrofoam models of juvenile tortoises that were nowhere near as authentic-looking as the 3D models are. Nearly 40% of those models were attacked by ravens, so we are confident the more realistic 3D ones will work. We are testing to see if other tortoise predators, such as coyotes and kit foxes, respond to the lures. If so, we could possibly use the models to train them with taste aversion not to eat tortoises. The applications [of this technology] to conservation are so broad they are only limited by conservationists' creativity."

Just how good are these fakes? Autodesk's Tatjana Dzambazova thinks fooling the ravens is a sure bet. She's showed them to colleagues and found that even when they know one of the shells they are looking at is fake, they can rarely distinguish which is which. This means the unsuspecting ravens are even less likely to spot the fake. Of course, there's always the chance that they will detect the trickery using other means, but Hardshell Labs is ready to respond to whatever the ravens might bring.

Tim Shields, the founder of Hardshell, described the type of information to be gathered as part of the perfection of these lures:

"We hope to use these lures to assess predation frequency by recording attacks (beak marks made in soft 'tissue' of the lure), videotape and photograph raven behavior as they approach and attack the lures, experiment with robotic versions adding the element of motion to the equation, and experiment with marking, trapping, and aversively training the birds. As we gain experience, we will probably find other combinations of predator and prey with whom this formula will work. We may ultimately be able to add an olfactory element by accurately 'scenting' the lures for species that identify prey both by sight and smell."

So, short of lasers, shell mines, and extensive training in the art of taekwondo, these clever fakes seem to be an excellent way to engage in a non-damaging bit of conservation. And even if the tortoises don't know it, their chances of survival are looking a whole lot better. Tell us your thoughts on this re-training system in the 3D Printed Tortoises forum over at 3DPB.com. **Ω**

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Hatchling desert tortoise (*Gopherus agassizii*), "a federally listed threatened species only found in the Mojave Desert. Young tortoises are especially prone to predators like dogs and ravens, whose numbers can increase around areas of human activity and structures." Photo from 2012 by K. Kristina Drake, Western Ecological Research Center, US Geological Survey. Source: Creative Commons; license CC0 1.0 Universal Public Domain Dedication.

Chicago Herpetological Society: Herpetology 2016

Abstracts of recently published herpetological papers prepared by the editorial staff of the CHS

Hawaiian Green Turtle Demographics

G. H. Balazs et al. [2015, Chelonian Conservation and Biology 14(2):119-129] summarize all existing data and knowledge of the demographic variables and their stochasticity[1] of Hawaiian green turtles (*Chelonia mydas*). The population numbers roughly 4,000 breeding females today, having rebounded from its near extinction in the early 1970s, with most of the nesting restricted to French Frigate Shoals in the remote and geologically ancient Northwestern Hawaiian Islands. A timeline is provided of the scientific monitoring for this population and associated data streams relating to morphometrics[2], maturity, nest dynamics, sex ratio, as well as population growth and viability.

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Ornate Box Turtles in Northwest Illinois

C. R. Tucker et al. [2015, Copeia 103(3):502-511] note that activity patterns of ectothermic[3] animals are affected by weather, time of day, and season, but quantifying these effects can be logistically challenging. An automated radio telemetry system was used to quantify ornate box turtle (*Terrepene ornata*) activity patterns for two years in northern Illinois. Continuously collected activity data were paired with meteorological data collected from the site to determine factors influencing turtle behavior. Temperature, relative humidity, rain, year, month, time of day, and reproductive status affected activity levels. Increased activity levels corresponded with rain events, and males were generally more active than females, especially during spring and late summer. Overall, turtles were less active during an uncharacteristically warm and dry year compared to a year with conditions that were closer to the long-term average. Bimodal daily activity patterns have been reported in more southerly populations, and this study found similar patterns near the species' northern range limit, indicating that thermal constraints may limit activity of this species across its range. Activity comparisons between a year with normal meteorological conditions and an abnormally warm and dry year provide insight to the effect that further onset of climate change may have on the activity of ornate box turtles.

Ornate box turtle, *Terrapene ornata ornata*. Photo © 2013 by Patrick Feller. Source: Creative Commons; license CC-BY-SA-2.0.

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Bangladesh Turtles and Tortoises

S. C. Rahman et al. [2015, Chelonian Conservation and Biology 14(2):130-135] note that the Chittagong Hill Tracts comprises an extensive expanse of hills located in the far southeast of Bangladesh, bordered by India and Myanmar. The Chittagong Hill Tracts cover more than 10% of the total land area of Bangladesh and lies within the Indo-Burma Biodiversity hotspot. Because of political instability and the generally remote nature of this region, it remains as the least explored area in Bangladesh. Very little is known about the chelonian fauna of the Chittagong Hill Tracts. The authors investigated the occurrence, conservation status, and exploitation of chelonians in the southern part of the Chittagong Hill Tracts, in Sangu-Matamuhuri Reserve Forest and adjacent areas, from 2011 to 2015. During the survey, they obtained specimen-based records of 8 species: Arakan forest turtle (*Heosemys depressa*), Asian brown tortoise (*Manouria emys*), keeled box turtle (*Cuora mouhotii*), elongated tortoise (*Indotestudo elongata*), Sylhet roofed turtle (*Pangshura sylhetensis*), Asian leaf turtle (*Cyclemys* sp.), Malayan softshell turtle (*Amyda ornata*), and Indian flapshell turtle (*Lissemys punctata*). The critically endangered *H. depressa* and the endangered *C. mouhotii* are recorded from Bangladesh for the first time, and the endangered *P. sylhetensis* is recorded from CHT for the first time. Two isolated populations of *M. emys* were documented in the Sangu-Matamuhri Reserve Forest. No evidence was found of large-scale, commercial turtle harvesting in the survey area. Subsistence hunting is probably the most immediate threat to chelonians in this region. With no intervention, subsistence hunting will likely cause large-scale local extirpation of extant, low density populations. Considering the species diversity and the opportunities for long-term conservation, the Chittagong Hill Tracts may be considered to be a priority site for these species in danger. To mitigate turtle hunting, the authors recommend a bottom-up, community-based conservation model, the foundation of which should be based on trust, traditional ecological knowledge, community participation, and ecological science.

Indian flapshell turtle, *Lissemys punctata*. Photo © 2008 by L. Shyamal; photographed at the Bannerghatta Rehabilitation Centre in Bangalore, Kamataka, India. Source: Wikimedia Commons; license CC-BY-SA-2.5.

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[1] **stocasticity:** lacking predictability; stocastic systems employ one or more variables to account for unpredictability or randomness.

[2] **morphometrics:** classification analysis of the forms of animals.

[3] **ectothermic:** an animal that depends on external sources to regulate its body heat; commonly termed "cold-blooded."

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.**

Road Threatens Red Cliff Desert Reserve
Politicians in St. George, Utah are plotting to build the "Northern Corridor" – a proposed road through Red Cliffs Reserve that would eliminate a good proportion of the desert tortoise habitat the preserve was supposed to protect.

China Sentences Radiated Tortoise Smugglers
In a welcome pro-conservation move, China sentenced seven people involved in an international ring smuggling radiated tortoises.

Antananarivo's Secret Tortoise Sanctuary
Only you and I (and the BBC) know about this top secret sanctuary for Madagascar's radiated tortoises...

Israel's Imperiled Tortoises
Overview of spur-thighed and Negev tortoises.

Peter Pritchard - The Movie
Tribute video honors Dr. Peter C. H. Pritchard, the world renowned author of *Living Turtles of the World*.

Unlucky Sea Turtle's Last Moments Documented in Video
While on a boat trip around the Galapagos Islands a tour guide filmed this amazing video of an orca tossing a sea turtle!

Breaking Bad and Fake Eggs
Police put GPS devices on barrels to try to track down the meth lab in Breaking Bad - inspiring conservationists to put GPS devices in fake sea turtle eggs to try to catch poachers.

Turtle Power: Hatching Together Is Good
Study shows green turtles hatching en masse from their nests "swamp" predators, allowing more individuals to reach the safety of the sea.

Mydas's Day
A day in the life of King Mydas, a green sea turtle living in the 400,000-gallon Gulf of Mexico exhibit at Audubon Aquarium.

Western Swamp Turtle Translocations
Two new colonies of Australia's endangered western swamp tortoise, *Pseudemydura umbrina*, are being established 250 km south of their known range.

Turtle Shell Evolution
New fossil study suggests that burrowing was a driver for the evolution of turtle shells.

Buried With Turtles
12,000 years ago an elaborate funeral was held for a Shaman. She was buried with 86 turtle shells.

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CTTC Meetings and Programs

Cen-Val: 8 September; 13 October

Chino Valley: 16 September; 21 October

Foothill: 23 September; 28 October

High Desert: 12 September; 10 October

Inland Empire: 2 September; 7 October

Kern County: 12 September; 10 October

Low Desert: 3 October

Orange County: 9 September; 14 October

Ridgecrest: 12 September; 10 October

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

Santa Clarita Branch: 17 September

Silicon Valley: 16 September; 21 October

TOOSLO (San Luis Obispo): 14 September; 12 October

TTCS (Long Beach): 16 September – Tom Roach; 21 October

Valley: 16 September; 21 October

Executive Board: 8 October. Meetings are held at the Los Angeles County Arboretum, Arcadia, CA.

Check your Chapter web site for the latest program information. Programs may be scheduled after the newsletter is published.

Chicago Herpetological Society: Herpetology 2016, continued

Desert Tortoise Thermal Environment

J. S. Mack et al (2015, J. Herpetology 49(3): 405-414) note that Agassiz's desert tortoise (*Gopherus agassizii*) spend >95% of their lives underground in cover sites that serve as thermal buffers from temperatures, which can fluctuate >40°C [104°F] on a daily and seasonal basis. They monitored temperatures at 30 tortoise cover sites within the Soda Mountains, San Bernardino County, California, from February 2004 to September 2006. Cover sites varied in type and structural characteristics, including opening height and width, soil cover depth over the opening, aspect, tunnel length and surficial geology. Analyses were focused on periods of extreme temperature: in summer between July 1 and September 1, and winter, between November 1 and February 15. With the use of multivariate regression tree analyses, it was found that cover-site temperatures were influenced largely by tunnel length and subsequently opening width and soil cover. Linear regression models further showed that increasing tunnel length increased temperature stability and dampened seasonal temperature extremes. Climate change models predict increased warming for southwestern North America. Cover sites that buffer temperature extremes and fluctuations will become increasingly important for survival of tortoises. In planning future translocation projects and conservation efforts, decision makers should consider habitats with terrain and underlying substrate that sustain cover sites with long tunnels and expanded openings for tortoises living under temperature extremes similar to those described here or as projected in the future. **Ω**

Originally published in the Chicago Herpetological Society *Bulletin* 50(3)54, 2016. Reprinted with permission from the Editor.

Adele the desert tortoise burrows beneath a fallen Joshua Tree in Joshua Tree National Park. Photo © 2015 by Kristen Lalumiere, National Park Service. Source: Creative Commons; license CC-BY-2.0

the Turtle's Garden

planting for chelonians
by M. A. Cohen

Mulberry: *Morus* species

Leaves and fruit of *Morus alba* (white mulberry). Photo © 2007 by Andre Abrahami. Source: Creative Commons, license CC-BY-SA-2.5.

Depending on the authority consulted, there are anywhere from 10 to 16 species of mulberry worldwide. Mulberry species, members of the genus *Morus*, hybridize freely, adding to the potential for confusion. Mulberry trees belong to the Moraceae family, commonly known as the mulberry or fig family.

Most mulberry species are native to the Asian subcontinent, but became naturalized in Europe and elsewhere centuries ago. American colonists introduced white mulberry, *M. alba*, which is native to China, to America for silkworm culture in the early colonial times. After its introduction, *M. alba* naturalized in the environment. Additionally, it hybridized freely with the American native *M. rubra* (red mulberry) (Mulberry, n.d.).

Several species of mulberry are commonly grown in California, according to California Rare Fruit Growers, Inc. These are *Morus alba* (white mulberry), *Morus nigra,* (black Mulberry), *Morus rubra* (red, or American mulberry) (Mulberry, n.d.). Hybrids between *M. alba* and *M. rubra* occur naturally. Plant breeders develop many cultivars (named varieties) for specific qualities such as fruit flavor or growth habit.

Male and Female Trees

Mulberries are either monoecious or dioecious. Monoecious species bear both male and female flowers on the same tree, while dioecious species bear male flowers and female flowers on separate trees.

Female trees and monoecious species are the fruit-bearing members of the genus. Female trees bear inconspicuous flowers called catkins, which are slender, pendulous clusters of flowers. These catkins give rise to the mulberry fruit.

Male trees do not bear fruit, and are often called "fruitless" mulberries. Male trees do, however, produce flowers containing copious quantities of pollen that may induce allergy attacks in persons with pollen allergies, and may even trigger asthma in susceptible individuals. Consequently, some communities in the United States have banned the planting of male mulberry trees.

Leaves

Mulberries are deciduous trees, meaning they shed and regrow their leaves annually. Leaf color during the shedding process may range from muted yellow to bright yellow.

Mulberry leaves are relatively thin, and lobed or simple (unlobed) in shape. The leaf margin is blunt-toothed. The color of the leaves when the trees leaf out in spring is a light, bright green, and the leaves may vary considerably in both size and shape even on the same tree.

Mulberry leaves are edible and nutritious. Tortoises and other herbivorous reptiles readily accept mulberry leaves as part of their diet.

Fruit

Female and monoecious mulberry trees bear fruit of various colors, ranging from white to pink to red to purple, depending on the species and the stage of maturity. In appearance, the mulberry fruit resembles the blackberry (the genus *Rubus*). The mulberry is not, botanically speaking, a true berry, but rather a collective fruit (Mulberry, n.d.).

Mulberry fruit is edible and juicy, and the *Sunset Western Garden Book* describes it as sweet "but rather insipid," that is, flavorless (Brenzel, ed. 2012). Opinions differ on the best-tasting fruit, some saying *M. rubra,* red mulberry, which is native to the eastern and central United States, has better-flavored fruit, while others claim *M. nigra* (black mulberry), native to western Asia, tastes best. Moreover, many cultivars bear fruit that is superior in taste.

The fruit of the mulberry will stain hardscape (pavement, stepping-stones, etc.), as well as clothing and other fabrics with which it comes in contact. Accordingly, it is unwise to plant fruit-bearing mulberry trees near walkways. The ripe mulberry fruit is very attractive to birds.

Adding mulberry ***fruit*** for your turtle's diet depends on the species of turtle. Box turtles and forest tortoises, for whom fruit is a part of the natural diet, should have no problem with a moderate amount of mulberry fruit. Conversely, arid-region grazing tortoises such as desert tortoises (*Gopherus* species) should **not** eat mulberry fruit due to its high sugar content.

Mulberry culture

The mulberry tree needs full-sun exposure in order to thrive. Being a deep-rooted tree, it will not grow well in shallow soils. Once established, it is somewhat drought-tolerant, but looks best with regular watering. The tree is relatively wind-resistant, and it tolerates both pollution and a variety of soils.

White mulberry needs ample room to grow, as the upright form of the tree can reach a height of 15.24 meters (50 feet).

Mulberry trees are quite pest– and disease–resistant, although they can develop canker disease and dieback. Mulberries need a minimal amount of fertilizer. In California, mulberries usually need only nitrogen (Mulberry, n.d.).

"Weeping" mulberry

There are commercially available *M. alba* cultivars with a pendant growth habit. Weeping forms have branches that grow down rather than up, making harvesting leaves (and fruit) much easier. Weeping forms typically grow to a mature height of about 3.7 meters (12 feet). **Ω**

References

Brenzel, K. N. (Ed.). (2012). The New Sunset Western Garden Book. New York, NY: Time Home Entertainment Inc.

Mulberry. (n.d.). Retrieved July 7, 2016, from http://www.crfg.org/pubs/ff/mulberry.html

Santa Clarita Chapter Life Members

- Abigail DeSesa
- Donald Friese Family
- Frank Kaufman

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Every CTTC member on this mailing list has a MailChimp account that s/he can update as needed. When you receive your newsletter notification, there is a link at the bottom of the page titled "update your preferences." Simply click on this link to jump to your account page and update your email address and other information. Thank you!

Batagur (formerly *Callagur*) *borneoensis*, the painted river terrapin. Photo © 2008 by Jason Pratt. Source: Wikimedia Commons.

"... the current position of the California Department of Fish and Wildlife is that it is illegal to breed captive [desert] tortoises." [The Desert Tortoise Council's *Answering Questions* e-pub is currently offline in revision.]

"CTTC will not place desert tortoises (*Gopherus agassizii*) in situations where captive breeding may occur. CTTC works with California Department of Fish and Wildlife (CDFW) to place desert tortoises. Both CDFW and CTTC discourage the captive breeding of desert tortoises."

– **tortoise.org/cttc/adoption.html**

CTTC Membership

The California Turtle & Tortoise Club is a non-profit 501(c)(3) corporation. Contributions are tax deductible to the full extent of the law. Please pay by USA funds only (US bank check, money order, or International Postal Order. Your Chapter and renewal date (month/year) are printed on your address label. Mail your new or renewal membership/subscription to the Chapter of your choice.

Annual membership in the California Turtle & Tortoise Club and subscriptions to the *Tortuga Gazette* are handled through the CTTC Chapters. Members are free to join any Chapter. Many members in California choose to join a nearby Chapter to participate in Chapter meetings and other activities. Print membership forms from the **CTTC website** and mail to the Chapter of your choice.

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[2]Source: Photon International, Feb. 2011, Market survey on solar modules 2011.

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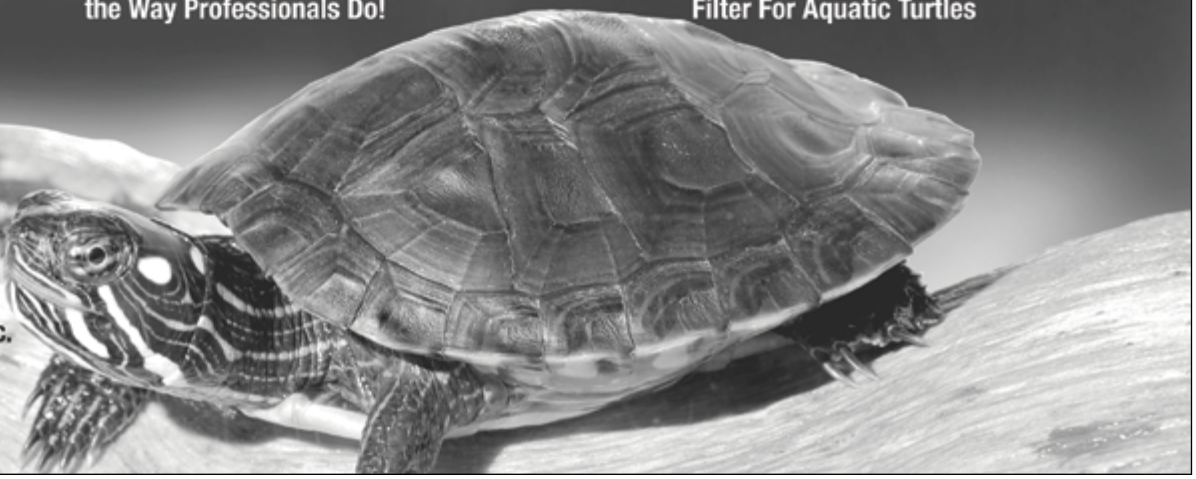

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3650 Sacramento Dr.
San Luis Obispo, CA 93401
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the *Tortuga Gazette*
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Turtle of the Month
Australian Flatback Turtle
Natator depressus

2016 CTTC Show Schedule

17 September – TOOSLO (San Luis Obispo) show at the Veterans' Memorial Building, 801 Grand Ave., San Luis Obispo, CA. 10 AM to 3 PM.

CTTC Online: tortoise.org
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Lawsuit Launched to Protect Blue Whales, Other Endangered Animals From Offshore Fracking in California

Federal Government Authorized Fracks From Oil Platforms Without Analyzing Threats to Rare Whales, Sea Otters, Turtles, Birds or Fish

Santa Barbara, California—17 August 2016—The Center for Biological Diversity today filed a notice of intent to sue the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement for approving fracking in federal waters off the California coast without evaluating the dangers to blue whales, sea otters, and other threatened and endangered wildlife.

"Every offshore frack puts California's wonderful coastal wildlife at risk from toxic chemicals or another deadly oil spill," said Kristen Monsell, a Center attorney. "It's disturbing to see the federal government ignore its legal responsibility to carefully consider the dangers of offshore fracking and prolonged drilling to whales, sea otters and other species already struggling to survive."

The bureaus decided to allow offshore fracking in May, after releasing a cursory environmental assessment of the practice. The federal assessment acknowledged potential threats to imperiled wildlife, including toxic risks to sea turtles and seabirds from fracking chemicals and the danger that fracking support vessels could run over sea turtles and whales. A recent study by Oregon State University researchers cites collision with ships as a reason blue whales have not recovered.

The federal assessment also admitted that offshore fracking will prolong offshore oil and gas activities, extending the life of aging infrastructure and increasing the risk of yet more oil spills. A coastal pipeline that ruptured last year near Santa Barbara spilled more than 140,000 gallons of crude, killing hundreds of marine mammals and birds.

But the bureaus failed to consult with the expert wildlife agencies on the risks these activities pose to threatened and endangered coastal wildlife as required by the Endangered Species Act.

The Center's notice seeks to compel the bureaus to suspend approval of all offshore fracking and other well stimulations off California's coast until completion of a comprehensive analysis of the impacts on imperiled species under Section 7 of the Endangered Species Act.

Image of a Blue Whale's tail fluke with the Santa Barbara Channel Islands in the background. Photo captured by Shulman in 2007. Public domain.

At least 10 fracking chemicals used in offshore fracking in California could kill or harm a broad variety of marine species, including sea otters and fish, Center scientists have found. The California Council on Science and Technology has identified some common fracking chemicals to be among the most toxic in the world to marine animals.

Oil platforms in the Santa Barbara Channel have federal permission to dump up to 9 billion gallons of produced water per year — including fracking chemicals — into the ocean.

The federal environmental assessment was issued as part of a legal settlement resolving a prior Center lawsuit over the federal government's approval of fracking from offshore platforms in the wildlife-rich Santa Barbara Channel without complying with the National Environmental Policy Act.

Today's 60-day notice of intent to sue is required before a lawsuit can be filed to compel the bureaus to comply with the Endangered Species Act for their new decision to authorize offshore fracking.

"Offshore fracking doesn't belong off the California coast, and the federal government certainly has no right to let the oil industry frack in these waters without fully analyzing the risks this toxic technique poses to imperiled marine animals," Monsell said. **Ω**

— Center for Biological Diversity press release