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Adult star tortoises, *Geochelone elegans*, enjoying their meal.

featured species

Indian star tortoise, *Geochelone elegans* (Schoepff, 1795)

The Indian Star Tortoise

text and photographs by Ralph Hoekstra

I have written this in the hope that what I have learned about the Indian star tortoise—*Geochelone elegans*—will increase their survival under captive conditions. What I have learned is based upon my personal experiences with these tortoises over many years. In that time I have had good fortune to watch over 50 hatchlings break out of their eggs.

Starting with a trio of what their original owner thought to be Sri Lankan star tortoises, my collection grew to four pairs of adults and eight juveniles purportedly originating from European breeding colonies. Also interspersed in this writing are items I gleaned out of some literature, either given to me by other enthusiasts or obtained on the internet. This narrative chronicles my adventures with these tortoises while, at the same time, hopes to pass on advice that I was given and what I, too, have found that works for me.

I also hope what you read here will help dispel what I have found to be untrue—that star tortoises have no personality, that they are just "pretty rocks," that they are too fragile and are difficult to breed.

The star tortoise complex

Before I go any further, I should state that my experience is from caring for what is categorized as the smaller Indian star tortoises. Although the star tortoise complex has no subspecies, there are many literature sources that describe three physically unique groupings of the Indian star tortoise.

Two of the recognized groups are to be found on the Indian Subcontinent, which includes Pakistan and

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a third on the island nation of Sri Lanka. The two groups from India are separated by size. Those found in Northwest India are the largest. (Choudhury and Bhupathy 1993). There is some anecdotal information that a large female was found to be 15 in (380 mm) in length and weighed 15 lbs (7 kg). W. Holmstrom). The average size of my females is just over 7 in (180 mm) and my males, just under 6 in (150 mm).

The size difference between the two groups found in India is considerable. There are other differences, namely, the age when attaining sexual maturity, the shell color, and the size of eggs. I have read that the individuals from Sri Lanka may attain a size comparable to the larger Indian variety.

However, the size of my original trio, thought to be Sri Lankans by their original owner, is right at the average size of my adults. The Sri Lankans that I have seen in other collections and in photographs have broader yellow stripes than those displayed by Indian stars.

Two Sri Lankan hybrid hatchlings photographed in February 2004.

The larger stars from Northern India are said to have a brownish background behind their yellow stripes. The ones found in the south are said to have a black background.

Nine adult star tortoises near the entrance to their outdoor house.

To complicate the classification by location even further, I recently I heard of the possibility of a fourth group within the same *Geochelone elegans* species, and that is a small family of star tortoises, possibly from Pakistan. Examples of this group may include those tortoises imported to the U.S. as being captive bred in Europe.

Indian star tortoises are a CITES Appendix II species and are no longer legally exported. Prior to the passage of the Indian Wildlife Protection Act of 1972, Star tortoises were heavily exploited for the pet trade.

I know of a group of very large star tortoises that were legally imported before that date. Assuming that they were adults in the 1960s, that would make them at least 60 years old. Some of the females are nearly 14 in (356 mm), and, because of their large size, they are kept with adult radiated tortoises. To date that group has produced no offspring.

Another experienced keeper had a group of these large star tortoises for several years in the hope of breeding them. She referred to them as "pretty rocks." Nothing she could do would initiate mating activity. Admittedly these are just two examples of breeding results with the animals imported in the 1960s. If other keepers had similar experiences, the star tortoise could have received the reputation as being hard to breed and very inactive.

As far as star tortoises being labeled "fragile," I have an opinion on that subject. In the early/mid 1990's a large number of hatchlings showed up in various U.S. markets. They were selling for around 250^{00}. At that price, there were a lot of willing buyers. What they bought were little guys that weren't very healthy. A lot

Patterning on the plastrons of two star tortoises.

of them already had bacterial infections probably due to being subjected to cold temperatures and other unhealthy conditions during their travels to the U.S. markets. I believe it to be a fair assumption that half of them died. Another factor to consider as to them being labeled fragile is that a lot of star tortoises hatch out in the winter months. Anxious sellers and buyers may agree to shipping these hatchlings when it is too cold to safely ship them.

My Star Tortoise Collection

As far as my adult stars, I concluded that I am the owner of the smaller tortoises from the southern part of the Indian Subcontinent. I base this on the following information. My females nested at four years of age upon attaining a size of 7 in (180 mm) and at a weight of around 2 lbs (1000 gm).

The other characteristic of my group that the literature ascribes to the smaller Indian Stars is egg size and clutch size. The eggs my females deposit weigh from 0.8 to 0.9 oz (22 to 26 gm). Eggs from the larger star tortoises from the north can weigh up to 1.3 oz (38 gm), (Smith et al., 1931). Clutch sizes from my females have ranged from two eggs to one of six eggs. The average clutch size is close to three eggs. My largest female nested five times last year, the oldest female has averaged two clutches over the last three years and the two youngest ones nested once last year for their first time.

I feel it is important to make this differentiation. The advice for caring for the larger stars may be different than what I have learned during my time with the smaller variety. With this disclaimer I can now proceed with my experiences.

The First Star Tortoises

In February 1997, while on a business trip to the Seattle area, I was fortunate enough to receive an offer to purchase a captive-bred trio of these beautiful tortoises consisting of a 12-year-old male and two four-year-old females. The male was 5.5 in (125 mm), one female was just under 7 in (175 mm) and the smaller one was just under 6.75 in (170 mm).

Their owner knew I lived in Southern California and had experience raising tortoises. She wanted her tortoises to have a chance to live and reproduce in a sunny location. She had raised these torts from the time they were hatchlings. Living in the Northwest region of the United States, these tortoises had little chance to live outdoors. She kept them comfortably warm indoors in a medium-sized structure. She said that there was a lot of breeding activity, and she guessed that the females were gravid.

Before taking responsibility for their husbandry, I got some basic advice from her on how to keep them. She said to keep them warm! They come from India (or Sri Lanka) located on or near the equator. They need a heat gradient from at least 95°F (35°C) to a slightly cooler area when kept indoors.

Nesting star tortoise with her eggs.

She also said to do fecal examinations in order to check for parasites. Even in captivity under clean conditions, she said that they had parasites showing up in fecal exams. She also said that they need regular soakings for the purposes of hydration, defecating, and for passing urates.

I got them home and placed the three of them in the only suitable indoor structure I had. It was in my unheated garage. It was a 2 ft by 3 ft (0.6 m by 1 m) wooden house heated with a ceramic heater, and it had an 18 in (46 cm) fixture holding a UV fluorescent bulb.

Nesting

Within a few days of them being introduced to their new house, the larger of the two females started digging a nest. She soon discovered that 5 in (127 mm) of substrate was not enough to dig a proper nest. She "hit bottom" on several tries and decided that this was not a good site for a nest. I couldn't raise the level of the substrate for fear of getting her too close to the ceramic heat emitter. This house was not designed to be a permanent home for a trio of nesting stars. If nesting is to be done indoors, they will need at least 8 in (200 mm) of nesting material.

Another local Indian star owner recently solved a similar problem. She has a pair of three-year-old stars. At the time her female weighed 4 lbs (1.8 kg) and measured 8 in (200 mm). This female started to nest indoors in an enclosure that could not provide an adequate substrate depth for nesting. She moved the tortoise after she started her nest digging ritual and moved her to a tub. The tub had an eight-inch substrate made up of a mixture of planting mix and dampened sphagnum moss. The tortoise, being in her "nesting trance," kept on digging and nested successfully when moved to the tub. At least one of the eggs proved to be fertile.

Back to my personal account. On the next warm day I put my three new star tortoises out doors. The largest female chose a sunny spot on top of a dirt

Star tortoise nesting in the dark. A clip-on hood with a ceramic heat emitter provides warmth while she completes the nesting process.

mound a promptly dug a nest. These eggs were calcified over and were not viable. This female was gravid, but having no suitable place to nest, she retained the eggs. The weather became warmer in April, and I was able to put them outdoors in a pen that had a heated house.

In August the bigger of the two females nested again. She deposited three eggs and when finished doing this, she started to cover the nest site. She covered the mound with the dirt she had excavated. I thought she was finished and I could now get the eggs.

However, she wasn't done. Although the nest site was covered, she now started disguising the site. She did this by compacting the dirt—by beating it down with her rear limbs and then using her plastron as a "pile driver." I let her continue this process and when she moved from the nest I carefully removed the eggs.

Only one of her three eggs survived this punishment. One was broken, and another had a crack too large to repair. But one was good! It showed no signs of being calcified.

What I learned from this nesting was to move the female after she starts to back fill the nest and remove the eggs. I then put her back over the nest and let her continue the process. If it is a late season nest I help her out by filling the nest with some of the original soil plus planter mix. Since they quite often will pick out the same area to nest, the planter mix helps make the soil more pliable.

They begin their nesting in the late afternoon, and this process could continue until sundown. In the late fall and early winter the late afternoon temperature could get down to below 60°F (15°C) where I live. With benefit of the heat of the sun going away, and with temperatures going below 60°F, her strength will be diminished.

If she has completed depositing her eggs, I'll put her in her heated house where she can continue moving her rear legs as if still in the nesting trance. If she still is digging her nest and not through depositing her eggs, I'll put a clamp-on heat lamp fixture over her until she completes the nest and deposits the eggs. I reward all females who had a nesting with a fresh-picked hibiscus flower!

Incubating the Eggs

When I had my first egg to incubate I called an experienced star tortoise keeper to find out how to incubate it. He told me to incubate the egg in a plastic tub filled halfway with vermiculite with enough water added to equal the weight of the vermiculite—a 50/50 mixture of water and vermiculite by weight. I also weighed the egg and marked the top with an "X." As he instructed, I set the thermostat at 85°F (29°C). In a little over a week the egg showed signs of being fertile. A white circle appeared under the "X!" I found out in 120 days that this temperature setting produces all males.

In October the other female dug a nest in about the same spot. I found this out too late to move her after she deposited and positioned the eggs.

Newly-hatched star tortoise with its plump yolk sac visible.

One had a large, open crack making it useless to incubate. The remaining one went into the incubator at a slightly higher temperature setting of 86.5°F (30°C). In February of 1998 my second male hatched.

Hatchlings

I was tracking the weight of the hatchlings on a weekly basis. I became concerned that at eight weeks old the first hatchling stopped gaining weight. It went about six weeks without gaining weight. I called the person I got my adults from, and she said that I wasn't keeping it warm enough. The house that it was in had a heat source that "maxed" out at around 83°F (24°C). The hatchling needed a new home!

Hatchling star tortoise beside a U.S. quarter coin for scale.

I constructed a wooden, hinged top for a 15 gallon (57 liter) aquarium. By making it out of wood I was able to mount an 18 in (48 cm) fluorescent fixture in the back and a light fixture on one side to house a ceramic heat emitter. By locating the heat emitter on one end I was able to provide a heat gradient from 95°F (35°C) to 85°F (29°C) on the other end. I completed the new house in time to put the second hatchling in it soon after hatching. The first hatchling started to gain weight. The second hatchling always showed continual weight increases.

Housing the Adult Tortoises

I now had to get serious with building a suitable structure for housing the adults indoors during the cold months of November through March. I also decided that the stars deserved a better outdoors location.

The time to create both the indoor and outdoors projects became available when I retired from my work in May 1998. I built a new house for their outdoors use first. It is "barn-shaped," made up of Styrofoam

During cold weather (November through March), my star tortoises live indoors in this three-level custom-built housing unit.

sandwiched in between ¼-inch plywood for insulation. Its floor size is approximately 3 ft by 3 ft (1 m by 1 m). In the peak it has a fluorescent fixture to use when the weather doesn't allow them to go outdoors. It also has a light fixture in which I installed a ceramic heat emitter.

I planted their pen with perennial rye grass, except for 4 by 7 ft (1.2 by 2.1 m) oval dirt area. I planted tall grasses in this dirt area to give them shade from the sun and also a place to nest. I put some large plant saucers in their pen to act as water dishes. I like the ones from Walmart that have sloped sides. So they now had a place to live until October. This gave me time to plan and build their winter quarters.

This structure was to go into my garage to replace six smaller structures. I wanted it to be around 3 ft (1 m) deep and 7 ft (1.8 m) wide. I wanted to be able to view each level and to provide for air circulation. The design requirements evolved to specify it being insulated, having three levels, with each level capable of being partitioned. I wanted each level to have separate heating controls with enough heat sources to reach 95°F (35°C). At least one of the levels would have to provide for an 8 in (20 cm) nesting area. Of course, each level was to have a fluorescent fixture to provide light and a UV source for vitamin D_3 absorption. I also added a requirement for small wattage halogen lighting.

This concept was put into a set of drawings and I began its construction. It took a lot longer than I had planned. It was still incomplete in December 1998 when the two original females showed signs of wanting to nest: each was climbing their walls and each other, a good sign that they wanted to get rid of their eggs.

Their new structure was about 80% complete. I hurriedly filled one section of the bottom level with an 8 in (20 cm) mixture of dampened potting soil, peat moss and sand. I jury-rigged temporary walls to keep them from escaping and turned on the heat. Each female nested the same day. This time I was able to move them after they nested and all the eggs were saved from being stomped on. These eggs were weighed and since there were more than one, I numbered them. I cranked up the incubator to 89°F (31°C) in the hope of producing females. It worked!

Hand feeding an adult female star tortoise a slice of cooked sweet potato.

My collection increased with the purchase of a male who had survived bad husbandry. His left side didn't develop correctly and is "C"-shaped. Other than being misshaped he is a very healthy little guy. My next acquisition was an adult pair I bought from a local keeper who wanted to concentrate on a single species. I also bought a pair which became available when their owner died in an accident. Finally I obtained a fourth male to even up my collection of adults at four pairs.

Feeding and Activity Routines

A typical week finds me going to a local farmer's market to buy fresh greens for all of my tortoises. I buy escarole, endive, and romaine lettuces. The greens I buy include dandelions, mizuna*, mustards, collards, and turnip tops. I also pick out a week's supply of sweet potatoes that I give them cooked and sliced as an appetizer. I chop the lettuces and greens fine for the smaller tortoises and a little larger for the bigger tortoises. I mix them and bag them up in plastic bags, seven of each size for a week's worth of feeding.

When I open the door to the house of the adults to let them get at their morning meal of greens, I have to be prepared to hand feed them their ration of sliced, cooked sweet potatoes. It becomes a real challenge when four or more of them insist on being the first to get this treat. Some insist on being hand-fed.

It's also a challenge to make sure that this treat is evenly distributed. Not all of them charge the door. Some wake up and begin the day on a more leisurely basis. For them I place their treats under the greens placed on a paper plate in their house. After this feeding frenzy, they settle into their routines.

Two of the males seem to share "sentry" duties and march around the perimeter of the enclosure. One of them greets every visitor by making a direct route to the "intruder." A drink out of one of the water dishes or a soak in it is another one of their morning routines. This activity is followed by them

*Mizuna: an oriental vegetable in the cabbage family used as a salad green

finding a place to soak up some sun, or hide from it on hot days. Around noon they once again get hungry, and most of them will browse on grasses. I also offer them some fruit and tomato leftovers from my lunch. I dust their food with calcium, reptile vitamins and minerals. When indoors, I use a supplement that has vitamin D_3.

Stars being diurnal (having two daily periods of activity), they will once again start looking for food in the late afternoon. I think this is a great feature of these tortoises. They become active after most of my other tortoises have retired for the day. When I was still working, I could look forward to coming home and seeing activity in their pen.

Temperature Requirements

I'd like now to discuss the question of their temperature requirements. I use 60°F (15°C) as their minimum outdoor temperature need. In spring, when outdoor temperatures exceed that temperature, I will place them in their outdoors compound. Conversely, in the late fall, when daytime temperatures fall below 60°F (15°C), I'll bring them in to their indoors home. I think that this limit provides them with a margin of safety. I have read accounts that temperatures in India may drop into the 50°F to 59°F (10°C to 15°C) and that these cold temperatures may last up to four months. The star tortoises will seek out shelter and wait for the warmth to return. (Whether this period of inactivity is actually aestivation has not been verified.) What the accounts also don't state is the size of the tortoises. Maybe the larger stars can safely withstand 50°F (10°C), but I would not want to risk it.

Male star tortoise bred by the author and purchased by CTTC member Diana Gatti, who says the tortoise is her best breeder.

Growth Rates in Captivity

Star tortoise hatchlings raised in captivity show almost startling growth rates. Mine have started life weighing in as little as (0.3 oz) 9 gm, while the average is close to (0.5 oz) 15 gm. I use an electronic diet scale to track their progress. The scale registers both ounces and grams. I prefer to use grams for the granularity that system provides.

Weights at the one-year mark have ranged between (2.6 oz) 75 gm for males and (3.5 oz) 110 gm for females. At two years of age, their weight would double to around 5.2 to 8.8 oz (150 to 250 gm). At three years old, their weight would again double to 10.6 to 17.6 oz (300 to 500 gm). It is their fourth year when their growth rate is awesome when it again doubles to 21.2 oz (600 gm) for males and 35.2 oz (1000 gm) for females. Their growth in years five and up proceeds at a much slower rate, if at all. Again this data is based upon my group of adult star tortoises and their hatchlings.

The star tortoises that I have that came from breeding colonies in Europe have not come close to achieving these growth rates. I have a beautiful male with very wide stripes and a huge tail. When I got him he was 4.375 in (110 mm) and 9 oz (267 gm). His measurements today are the same.

Another group of seven that I am caring for have been in the U.S. for over a year. They average 4.5 in (115 mm) and 10.5 oz (300 gm). They have very narrow stripes. This group's growth has been minimal if at all. One wonders whether they are dwarfs. I have seen the males mounting the females. Has the stress of shipping set their growth back? Or are they following the typical growth rate of star tortoises in the wild? In any case, I am sure that those who bought them in the hope of having a breeding group have been disappointed.

11 Indian star hatchlings in their indoor enclosure.

Illness

I have had some setbacks while caring for these tortoises. It seems that no matter how careful you are with them, you will incur problems. Weather conditions can change while they are outdoors, and, if you are not around to put them in where it is warm, they can get a cold. The symptoms will be a runny nose and a rasping noise when they breathe. If untreated this can lead to serious illnesses.

An untreated tor-

Front view of the hatchling terrarium with the top raised; accessories include ceramic heat fixture, a fluorescent light fixture, thermometers, and a humidity gauge.

toise, if not separated from the others, will infect them. Then you will have a bigger problem to deal with. When I find a tortoise that I suspect has a cold, I separate it from the others. I put it in a heated isolation area where I can observe it. I weigh it and compare its weight to my records of it. A loss of 10 percent from its last weight is a definite warning sign. If it is lethargic and doesn't readily eat any of its favorite foods, it is time to worry. When these symptoms appear—runny/bubbly nose, lethargy, and lack of appetite—it is a certainty that the tortoise is ill. Living in Southern California I have access to competent veterinary care. I always have the tortoise examined by a vet to get a diagnosis and a course of treatment.

Dealing with Pyramiding (Raised Scutes)

My Indian stars demonstrated continuous growth during their first four years of life and achieved sexual maturity at that age. While this is a positive trait, it can also cause pyramiding of their carapaces. One husbandry technique to avoid this problem that is being used for other species, is to feed them once every two days. But, by doing this with Indian stars, they would be deprived of the nourishment they need every day during their primary growth years, i.e., years one through four. By greatly limiting their food intake, you might have a smaller tortoise with a smooth carapace after four years but it would have missed its best growth years. The method I used to raise Indian stars, Burmese stars (*Geochelone platynota*), and Radiated tortoises (*Astrochelys radiata*) is under high humidity conditions. (Note: the conditions I am about to describe here do ***not*** apply to Desert tortoises!)

I use 2 to 3 in (5 to 8 cm) of dampened substrate made up of a 50/50 mixture of peat moss and coir (coconut husk fiber). As suggested by Dr. Paul Gibbons of the Turtle Conservancy, I now cover the substrate with a layer of rice hulls that acts as an insulating material, and is also safer than the substrate if ingested.

I raise them in a 20-gallon terrarium with a hinged, wooden top. Attached to the top are a fluorescent tube fixture in the center and a heat-controlled ceramic heat emitter at one end. I plant a Pothos indoor plant in the end away from the heat source and near where I feed them. Their appropriately-sized water dish is in the center and their hide box is near the heat source.

Thermometers are used on either end of the terrarium to monitor temperature gradients. A humidity gauge is used to try to keep the humidity levels at about 60%.

I used this method recently to raise a 6-week old Radiated tortoise for two years, and it left with a smooth carapace!

Seven hatchling stars having a meal of finely-chopped greens.

Afterword

In 2006, when I downsized my tortoise collection, I sent my remaining Indian stars to a good friend where, as of this date, they are living a great life. They are being kept indoors in a large and interesting pen. Most, if not all, of my hatchlings have become adults, and are continuing to increase the numbers of this species. ♧

References

Choudhury, B. and Bhupathy, S. (1993). Turtle trade in India, a study of tortoise and fresh water turtles. TRAFFIC–India, 50 pp.

McCloud, K. (2008). A Photographic Identification Guide to Star-Patterned Tortoises. Identification Guides for Wildlife Law Enforcement, No.12. USFWS, National Fish and Wildlife Forensics Laboratory, Ashland, OR.

Smith, M. (1931). The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia, Vol. I. Loricata and Testudines. London: Taylor and Francis.

Ralph Hoekstra is past president of the Turtle and Tortoise Care Society (Long Beach) chapter of the California Turtle and Tortoise Club. He has been a tortoise enthusiast for 40 years and has kept most of the tortoise species that are, or were, in the pet trade.

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The secret to turtle hibernation: Butt-breathing

by Jacqueline Litzgus, Professor, Department of Biology, Laurentian University, Greater Sudbury, Ontario, Canada

To breathe or not to breathe, that is the question.

What would happen if you were submerged in a pond where the water temperature hovered just above freezing and the surface was capped by a lid of ice for 100 days?

Well, obviously you'd die.

And that's because you're not as cool as a turtle. And by cool I don't just mean amazing, I mean literally cool, as in cold. Plus, you can't breathe through your butt.

But turtles can, which is just one of the many reasons that turtles are truly awesome.

Cold weather slow down

As an ectotherm—an animal that relies on an external source of heat—a turtle's body temperature tracks that of its environment. If the pond water is 1°C [33.8°F], so is the turtle's body.

But turtles have lungs and they breathe air. So, how is it possible for them to survive in a frigid pond with a lid of ice that prevents them from coming up for air? The answer lies in the relationship between body temperature and metabolism.

A cold turtle in cold water has a slow metabolism. The colder it gets, the slower its metabolism, which translates into lower energy and oxygen demands.

When turtles hibernate, they rely on stored energy and uptake oxygen from the pond water by moving it across body surfaces that are flush with blood vessels. In this way, they can get enough oxygen to support their minimal needs without using their lungs. Turtles have one area that is especially well vascularized— their butts.

See, I wasn't kidding, turtles really can breathe through their butts. (The technical term is cloacal respiration.)

Not frozen, just cold

We are not turtles. We are endotherms—expensive metabolic heat furnaces—that need to constantly fuel our bodies with food to generate body heat and maintain a constant temperature to stay alive and well.

When it's cold out, we pile on clothes to trap metabolic heat and stay warm. We could never pick up enough oxygen across our vascularized surfaces, other than our lungs, to supply the high demand of our metabolic furnaces.

"Turtles will bask in the sun to warm up and ease their crampy muscles." Male midland painted turtle (*Chrysemys picta dorsalis*) basking in Algonquin Provincial Park, Ontario, Canada. Photo © 2011 by Matt Keevil. Source: Creative Commons; license: CC-BY-SA-3.0.

For humans, a change in body temperature is generally a sign of illness, that something is wrong. When a turtle's body temperature changes, it's simply because the environment has become warmer or colder.

But even ectotherms have their limits. With very few exceptions (e.g., box turtles), adult turtles cannot survive freezing temperatures; they cannot survive having ice crystals in their bodies. This is why freshwater turtles hibernate in water, where their body temperatures remain relatively stable and will not go below freezing.

Water acts as a temperature buffer; it has a high specific heat, which means it takes a lot of energy to change water temperature. Pond water temperatures remain quite stable over the winter and an ectotherm sitting in that water will have a similarly stable body temperature. Air, on the other hand, has a low specific heat so its temperature fluctuates, and gets too cold for turtle survival.

Crampy muscles

An ice-covered pond presents two problems for turtles: they can't surface to take a breath, and little new oxygen gets into the water. On top of that, there are other critters in the pond consuming the oxygen that was produced by aquatic plants during the summer.

Over the winter, as the oxygen is used up, the pond becomes hypoxic (low oxygen content) or anoxic (depleted of oxygen). Some turtles can handle water with low oxygen content —others cannot.

Snapping turtles and painted turtles tolerate this stressful situation by switching their metabolism to one that doesn't require oxygen. This ability is amazing, but can be dangerous, even lethal, if it goes on for too long, because acids build up in their tissues as a result of this metabolic switch.

But how long is "too long"? Both snapping turtles and painted turtles can survive forced submergence at cold water temperatures in the lab for well over 100 days. Painted turtles are the kings of anoxia-tolerance. They mobilize calcium from their shells to neutralize the acid, in much the same way we take calcium-containing antacids for heartburn.

In the spring, when anaerobic turtles emerge from hibernation, they are basically one big muscle cramp. It's like when you go for a hard run —your body switches to anaerobic metabolism, lactic acid builds up and

you get a cramp. The turtles are desperate to bask in the sun to increase their body temperature, to fire up their metabolism and eliminate these acidic by-products.

And it's hard to move when they're that crampy, making them vulnerable to predators and other hazards. Spring emergence can be a dangerous time for these lethargic turtles.

Cold weather turtle tracking

Field biologists tend to do their research during the spring and summer, when animals are most active. But in Ontario, where the winters are long, many turtle species are inactive for half of their lives.

Understanding what they do and need during winter is essential to their conservation and habitat protection, especially given that two-thirds of turtle species are at risk of extinction.

My research group has monitored several species of freshwater turtles during their hibernation. We attach tiny devices to the turtles' shells that measure temperature and allow us to follow them under the ice.

We've found that all species choose to hibernate in wetland locations that hover just above freezing, that they move around under the ice, hibernate in groups and return to the same places winter after winter.

Despite all this work, we still know so little about this part of turtles' lives.

So, I do what any committed biologist would do: I send my students out to do field research at -25°C [-13°F]. We are not restricted to fair-weather biology here.

Besides, there is unparalleled beauty in a Canadian winter landscape, especially when you envision all of those awesome turtles beneath the ice, breathing through their butts. ♧

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Update your email address through your MailChimp account by clicking the "Update Your Preferences" link on your newsletter notice. Or email your changes and corrections to **tgdistribution@tortoise.org**

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**

Temperature-dependent Sex Determination in the Española Giant Tortoise | Biologists studying temperature-dependent sex determination in Galápagos tortoises from Española (*Chelonoidis hoodensis*) also found sexual dimorphism in the hatchlings – male hatchlings had more large dorsal scales on their tails than did females.

Video - Spider Tortoises at Fort Worth Zoo | Watch Madagascar spider tortoises at the Fort Worth Zoo with Seamus Ehrhard.

Video - Sexual Dimorphism in Red-bellied Turtles | Video explains the science behind why male and female turtles are different sizes.

Genetic Variation in *Manouria emys* | Biologists have published the first comparison of genetic and morphological variation in *Manouria emys*, the fourth largest tortoise species.

Green Sea Turtle Sex Ratios Altered by Climate Change | Rising beach temperatures have driven one of Australia's green sea turtle nesting colonies to produce largely females for the last 20 years.

Who's Your Daddy Little Loggerhead? | Researchers identified the paternity of 989 loggerhead sea turtle hatchlings from 51 nests on Sanibel Island in Florida and found they were the offspring of 126 distinct males!

Off-road Vehicles at Cape Hatteras National Seashore | Economic analysis shows the benefits of restricting vehicles on the beach considerably outweigh the costs of enforcing the restriction.

Video – A Green Sea Turtle Named Ellie | Wonderful youtube TED talk from biologist Brendan Godley.

Video – Treadmills for Hatchling Sea Turtles | Hatchling sea turtles have more stamina than graduate students! :)

Appeals Court Backs Environmentalists Fighting Swordfish Fishery Expansion | A Ninth Circuit Court of Appeals panel agreed with the Turtle Island Restoration Network that the NMFS acted improperly when it increased the allowable take of Hawaii sea turtles by the longline swordfish fishery.

New Fossil Turtle From Algora, Spain | A recently discovered fossil turtle, *Algorachelus peregrinus*, may have migrated from Africa to Spain some 95 million years ago.

New Publications

- **African Sea Turtle Newsletter.**
- **Abstracts of the 2018 International Sea Turtle Symposium.**
- **Latest issue of Herpetological Conservation and Biology.**

CTTC On Facebook | For breaking news updates, visit and "like" us on Facebook!

Young Midland painted turtle (*Chrysemys picta dorsalis*) with a Canadian dollar for scale. Photographed in Ottawa, Ontario, Canada. Photo © 2010 by D. Gordon E. Robertson. Source: Wikimedia Commons; license CC-BY-SA-3.0.

2017 Donations to non-profit organizations	
Tortoise Group	$10,000
Turtle Survival Alliance	10,000
Kerulos Center	7,500
Turtle Rescue Long Island	5,000
Desert Tortoise Council	5,000
The Living Desert	2,500
Lewis Center for Educational Research	2,500
Judy Roger's Memorial Tortoise Habitat	2,500
American Tortoise Rescue	2,500
Gopher Tortoise Council	2,500
Hundred Acre Hollows	2,500
Desert Tortoise Preserve Committee	2,500
Turtle & Tortoise Preservation Group	2,500
San Diego Turtle & Tortoise Society	1,500
Southwestern Herpetological Society	1,500
Central Texas Tortoise Rescue	1,500
Rio Grande Turtle & Tortoise Club	1,500
Center for Biological Diversity	1,500
Central Mississippi Turtle Rescue	1,500
CTTC Chapters: $1,500 each x 13	19,500
Grand Total of Holiday Giving 2017	**$86,000**

From the Chair...by Abigail DeSesa

First Annual Holiday Giving: 2017 Donations

Donations are the life blood of every non-profit or charitable organization, allowing them to fulfill their stated missions. CTTC is no exception. A wonderful woman named Marcella Blechman gave the CTTC the phenomenal ability to not only fulfill our missions, but assist others with theirs, by paying her generosity forward to fellow organizations supporting chelonians in need.

At the end of 2017, the California Turtle & Tortoise Club, Executive Board, gave out donations in its First Annual Holiday Giving. Nineteen outside organizations received a total of $66,500.

The following requirements had to be met to be considered for a donation from the California Turtle & Tortoise Club Executive Board.

- Recommend by an Executive Board Member
- Chelonian Related
- Current Charitable 501(c)3 Non-profit Organization
- Established and Reputable

Additionally, the Executive Board distributed a total $19,500 to its thirteen Chapters in good standing; each received $1,500. Future donations to outside organizations, as well as distributions to our chapters, will be determined by these requirements, in addition to how well the California Turtle & Tortoise Club Executive Board's Investment Portfolio performs. The Investment Portfolio was created out of the Marcella Blechman Estate Donation received in the Fall of 2016.

As a Member, if you would like to recommend an organization that fits these requirements, please contact your Chapter's Executive Board Delegate for submission no later than July 1st annually. After vetting of the recommended organizations, the entire California Turtle &Tortoise Club Executive Board will vote on each organization and the amount they will receive, at the annual October meeting. The Annual Holiday Giving is subject to the annual performance of the Investment Portfolio.

Congratulations to the nineteen organizations that received donations in the First Annual Holiday Giving for the contributions they bring to the chelonian world.

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

Pelargonium species (Geranium)

Pelargonium grandiflorum 'Angeleyes', Angeleyes regal geranium. Photo © 2008 by Gothika. Source: Creative Commons; licenses: CC-BY-SA-4.0,3.0,2.5,2.0,1.0.

Botanically speaking, *Pelargonium* and *Geranium* are two distinct genera within the Geraniaceae (cranesbill or storksbill) family. However, in ordinary usage, gardeners refer to members of the genus *Pelargonium* by the common name "geranium," as in ivy geranium and scented geranium. This article will employ the commonly-used terminology while recognizing that a differing botanical vocabulary exists.

Comprising flowering perennials, shrubs, and succulents, most members of the genus *Pelargonium* are native to southern Africa. Evergreen ornamentals with diverse leaf forms, flower colors, and fragrances, geraniums are among the most popular plants grown in temperate and tropical regions worldwide.

Description

Woody perennials that often have succulent leaves and stems, geraniums reach mature heights of 1 to 4 feet (0.3 to 1.2 meters), usually with an equal spread, depending on the specific variety.

Because of the adaptability of species geraniums, hundreds of varieties exist, and plant breeders continue to develop many cultivars ("cultivated varieties" or hybrids). Horticulturists select and propagate new cultivars based on various desirable characteristics, such as growth habit, flower color, leaf color, flower abundance, fragrance, pest and disease resistance, and other qualities.

Encompassing characteristics such as shape, height, spread, appearance, and the like, growth habits vary widely among the commercially available geraniums. Upright, spreading, and trailing geraniums are utilized as bedding and landscape plants as well as container plants.

The somewhat asymmetrical, five-petaled geranium flowers grow in clusters, and occur in a wide range of solid colors, including white, pink, salmon, lavender, orange, red, maroon, purple, and black (yes, black!). Bicolored and multicolored blossoms in various color combinations are also available commercially.

From tomentose (woolly) to leathery (smooth), the foliage surface texture of the geranium differs according to variety. The shape of the leaf is generally palmate (fan-shaped), and the leaf margin may have deep or shallow lobes. Leaf color ranges from a solid green to a green background accented with bands of colors such as maroon, yellow, and white.

Culture

Thriving outdoors in warm, sunny regions where nights are cool and winters are mild, geraniums are moderately drought- and heat-tolerant but will only take minor episodes of frost. When geraniums are grown in more extreme climates, a brightly-lit indoor location might be a better choice for cultivating geranium varieties.

In any location, plants require average to regular watering for best performance. Because moisture on geraniums' leaves and flowers promotes fungal diseases, water early in the day so the plant dries before nightfall or use a soaker hose. Because they do not like "wet feet," geraniums require well-drained soil.

In loamy soil, geraniums need a moderate program of supplementary fertilizing; in sandy soil, plants will benefit from applications of all-purpose fertilizer every 2 to 3 weeks when actively growing.

Whether planted in the garden or in containers, remove faded flowers consistently for abundant bloom production, a procedure known as deadheading. Tip-pinching, selectively pruning the tips of growing branches, promotes compact growth, especially in younger plants.

Blossoms and leaves of the rose-scented geranium, *Pelargonium graveolens*, which bears aromatic foliage. Photo © 2005 by Eric Hunt. Source: Creative Commons; license: CC BY-SA 2.5.

Geraniums in containers often perform best when they are somewhat pot-bound. Because nutrients leach out of the soil when watering containerized plants, most species require regular applications of fertilizer to grow well.

Propagation

Propagation of geraniums from cuttings is simple. An added benefit of making cuttings is promoting more compact growth of stems, making for a more attractive plant.

Whenever possible, choose vigorous, healthy stems without flowers for preparing the softwood cuttings. Using a sharp knife, scalpel, or single-edge razor blade, cut 2 to 3 inches (5 to 8 centimeters) of tip growth just below a node, the place on the stem from which the leaves emerge.

Remove leaves from the lowest 1 or 2 nodes to anchor the cuttings in the soil. Dip the bottoms of the cuttings in rooting hormone, plant the cuttings in loose potting soil, and place in a warm, brightly-lit location. Keep the potting soil evenly moist but not soggy while the cuttings are forming their roots.

Formation of roots should begin in 1 to 4 weeks. New growth emerging from cuttings indicates that the rooting process has succeeded, and cuttings are ready for repotting into larger containers.

Edibility of Scented Geraniums

While some gardening authorities question of the edibility of geraniums, there is general agreement that the leaves and flowers of scented geraniums are edible. Producing scented oils within their leaves, the foliage of scented geraniums holds the most intense fragrance, while the flowers are milder versions of the leaf scents. Foliage scents include almond, apple, chocolate, cinnamon, ginger, lemon, lime, mint, nutmeg, rose, and strawberry, among others. In human cuisine, scented geraniums are consumed cooked or raw, and they also add flavor to cakes, cookies, ice creams, jellies, sorbets, and teas, as well as honeys and sugars.

Meetings and Programs

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

Cen-Val
8 March; 12 April

Chino Valley
16 March; 20 April

Foothill
23 March; 27 April

High Desert
12 March; 9 April

Inland Empire
2 March; 6 April

Kern County
12 March; 9 April

Low Desert
2 April

Orange County
9 March; 13 April

Ridgecrest
12 March; 9 April

Santa Barbara-Ventura
Contact the chapter for meeting information.

Santa Clarita
17 March

TOOSLO (San Luis Obispo)
14 March; 11 April

TTCS (Long Beach)
16 March: Don Fisher, creator of lifelike turtle statues and planters; 20 April

Valley
16 March; 20 April

Executive Board
14 April. Meetings take place at the Los Angeles County Arboretum, Arcadia, CA.

Other Household Uses of Scented Geraniums

In addition to use for cut-flower arrangements, scented geraniums are often dried for use in potpourri. Using steam distillation, concentrated essential oils are extracted from scented geraniums for use in aromatherapy and other alternative healing treatments.

As with any unfamiliar product, it is wise to consult a medical professional prior to using a new phytochemical, particularly for those with allergies or other sensitivities. ♧

References

Barash, C. (1993). Edible Flowers. 1st ed. Golden, CO: Fulcrum Publishing, pp.197-200.

Brenzel, K. (2012). The New Sunset Western Garden Book. 9th ed. New York, NY: Time Home Entertainment Inc., pp.487-489.

Linch, J. (1984). How to Grow and Use Scented Geraniums. [online] Mother Earth News. Available at: https://www.motherearthnews.com/organic-gardening/scented-geraniums-zmaz84jazloeck

WebMD. (n.d.). Rose Geranium Oil. [online] Available at: https://www.webmd.com/vitamins-supplements/ingredientmono-153-rose%20geranium%20oil.aspx?activeingredientid=153&activeingredientname=rose%20geranium%20oil

Request for Information and Photos for an Article about Max and Lillian Greene

Max and Lillian Greene raised a variety of tortoises at their home near Ojai, in Meiners Oaks, CA. They called their place "Turtletown," sometimes spelled "Turtle Town." Many of us CTTC members visited Turtletown and were treated to talks by Lillian and a tour of their collection. I am hoping that some members might have taken photographs while visiting Turtletown, and if so, would you be willing to share copies of them? Any photographs will receive full photo credit in the article.

I would also like to receive any recollections or anecdotes you might have of your visit for a future article in the *Gazette*.

The Greenes started their involvement with tortoises when Max retired. Lillian kept Turtletown going by herself after his death in 1993 until she died in 1999.

Please send your responses directly to Ralph Hoekstra via email at **rhoekstra@aol.com** ♧

CTTC Foothill Chapter: Upcoming Events

April 27, 2018 at 7:00 PM: Annual Plant Auction

This is a Club fundraising event, so that we may continue our mission of rescue, adoption, care and education/outreach programs to the public. This auction and all our meetings are open to the public. Parking and admission are free. Refreshments will be provided! This is a great event for both members of our Club and our plant-loving friends and neighbors. Please visit us at **www.tortoise.org/foothill/**

Donations: (Wide Variety of Plants and Trees) Steve List, Head of the Horticulture Department at Sylmar High School • Armstrong Centers • Sunland Water Gardens (Aquatic Turtles) • Members also provide their specialty homegrown plants.

June 22, 2018 at 7:00 PM: Annual Health Clinic and Silent Auction

Health clinic includes **de-worming** and **micro-chipping** for turtles and tortoises
De-worming fee: $10^{00} • Micro-chipping fee: $25^{00}
Free veterinarian check-up provided by Dr. Fees

Silent auction: come join the festivities with fellow Club members, friends and neighbors to continue our mission and support of our "shelled friends!" Silent auction donations come from restaurants, businesses, stores, gift cards, and include specially selected items.

Foothill Chapter Meeting Location: Los Angeles County Arboretum (Palm Room), 301 North Baldwin Avenue, Arcadia, CA. 91007
Contact: Robin Robb, Foothill Chapter president (951) 359-3003; **sgrpilot@hotmail.com**

Florida Fish & Wildlife Conservation Commission monitoring sea turtles, manatees during cold weather

As Florida's residents and visitors manage the current cold-weather conditions, the state's unique and treasured fish and wildlife species may need some extra care as well. The Florida Fish and Wildlife Conservation Commission (FWC) is prepared and ready to prioritize this critical mission.

"We are committed to conserving our natural resources, and are staged and ready in strategic areas throughout the state," said FWC Executive Director Eric Sutton. "Our team of FWC staff, partners and volunteers are monitoring the status of marine species affected most by the cold, and are prepared in case rescues are needed."

Sea turtles are one species that can be affected by cold weather. When the water temperatures drop, stunned sea turtles may float listlessly in the water on or near shore. Although these turtles may appear to be dead, they are often still alive. It is important to report these turtles to the FWC Wildlife Alert Hotline as soon as possible [888-404-FWCC (3922)].

"Our staff, partners and permitted volunteers are already working to rescue sea turtles in northwest Florida. Nearly 100 turtles have been rescued so far. We are also monitoring the Mosquito Lagoon and other areas of the state to see if sea turtles are being impacted there," said Kipp Frohlich, director of FWC's Division of Habitat and Species Conservation.

The Florida manatee is another species that can be impacted by extreme cold weather. When water temperatures drop, manatees gather in warm-water habitats such as discharge canals at power plants and natural springs. The FWC asks that boaters be extra vigilant in watching for manatees in shallow waters near the coast, both inland and coastal, and obey all posted manatee speed zone signs.

"Aggregated animals should not be disturbed, as this could cause them to leave the warm-water sites that help them cope with cold temperatures."

Sustaining adequate winter habitat for manatees remains a statewide conservation goal.

—FWC press release posted 3 January 2018

2018 Show Schedule

5 May: Turtle & Tortoise Care Society MiniShow
El Dorado Nature Center, 7550 E. Spring St., Long Beach, CA 90815; 10 AM–3 PM.

19 May: Valley Chapter Annual Show
Woodland Hills Christian Church, 5920 Shoup Ave., Woodland Hills, CA 91367; 11 AM–4 PM.

Adult female Indian star tortoise (*Geochelone elegans*). Photo by Ralph Hoekstra

Classified Advertisements

Classified advertisements run for one issue at 5^{00} for up to four lines, or 30^{00} for ¼ page. Ads are accepted at the discretion of the Editor. 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*.

Please make your check payable to the **California Turtle & Tortoise Club**.

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**.

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

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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.

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}**

Chapter Postal Mail Addresses

Cen-Val Chapter: P. O. Box 16418, Fresno, CA 93755-6418

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

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

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

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

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

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

Orange County Chapter: P. O. Box 11124, Santa Ana, CA 9271

Ridgecrest Chapter: P. O. Box 1272, Ridgecrest, CA 9355

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

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

TOOSLO Chapter: P. O. Box 14222, San Luis Obispo, CA 93406

Turtle & Tortoise Care Society Chapter: P. O. Box 15965, Long Beach, CA 90815-0965

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

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