Maintaining and Breeding Galapagos Tortoises

By Jerry D. Fife

A Galapagos tortoise enjoying the weekly flooding of the author's yard. Photo by Jerry Fife.

Background

In the 16th century, there were more than 250,000 Galapagos tortoises found on the volcanic islands that make up the Galapagos archipelago. Though the taxonomic status of the various races is not fully resolved, there are thirteen species of Galapagos tortoises recognized, with eleven species existing today in the wild. One species, the Pinta Island tortoise (*Chelonoides nigra abingdoni*) was down to a single remaining male nicknamed "Lonesome George", before his death on June 24th, 2012.

By the 1970s the number of Galapagos tortoises declined to a low of between 3,000-6,000. In 1965, breeding and release programs began and efforts were made to eliminate feral pigs, dogs, cats, rats and goats. Eggs were collected from nesting sites and hatchlings raised at breeding centers until they were large enough to survive in the wild. These conservation efforts have raised the estimated number of Galapagos tortoises to more than 19,000. While this is a tremendous gain it is still only a fraction of original populations.

There is also hope for the extinct Floreana Island species (*C. n. elephantopus*). A number of hybrid tortoises have been identified which have strong Floreana ancestry based on a comparison to DNA analysis of Floreana museum specimens. It is hoped that through selective breeding the Floreana

species will be restored.

While all this is exciting news for the future of these tortoises in the Galapagos Islands, the future is less exciting in the United States. Some of the zoo specimens were imported in the 1920s and as these founder stock begin to die, they cannot be replaced. Zoos may be hesitant to breed their tortoises for a variety of reasons such as lack of genetic diversity, possibility of having hybrid specimens, plus many zoos and private individuals that are actively trying to breed their tortoises are having poor success.

"Lonesome George" (right), was the last of the Pinta Island Galapagos tortoises. Photo by Jerry Fife.

At the 2010 Association of Zoos and Aquariums Taxon Advisory Group (AZATAG) meeting in San Diego, several zoo representatives, the TTPG and private sector breeders met informally to discuss the current status of Galapagos tortoises in the United States.

The group recognized that if breeding efforts are not instituted, the Galapagos tortoise will disappear from the U.S. as current specimens age and die. In addition, raising hatchlings has been problematic. Even if tortoises are not pure genetic stock, the knowledge gained from raising the hatchlings is critical to the future survival of Galapagos tortoises in the United States. It is also apparent that hybrids may be beneficial

in selective breeding projects to restoring the most threatened or even extinct species.

The TURTLE and TORTOISE PRESERVATION GROUP, through the efforts of James Badman and a proposed grant, is working to conduct DNA testing of Galapagos tortoises in the private sector. Most zoos have already conducted DNA testing of their tortoises, however re-testing of their tortoises has resulted in some reclassifications. Through efforts of the public and private sector, it is hoped that a partnership and exchange of information will take place to ensure genetic identity. In 2011, The Gladys Porter Zoo in Texas and the author were successful in breeding and hatching Galapagos tortoises. A zoo in South Carolina also unexpectedly had baby Galapagos tortoises hatch naturally out of the ground in their tortoise enclosure. I am not aware of any other zoos or individuals who were successful in hatching Galapagos tortoises in 2010. In 2011, the Oklahoma Zoo was successful and the author currently has eggs incubating.

TTPG members James Badman and Drew Rheinhardt drawing blood for DNA analysis. Photo by Jerry Fife.

Maintaining Galapagos Tortoises

The TTPG and many of its members are in the unique position of having raised hundreds and even thousands of various tortoises. This knowledge and experience benefits us in our ability to successfully rear hatchling Galapagos tortoises. Something as basic as allowing the hatchling tortoise to fully absorb the yolk sac may be something not understood by individuals or institutions with limited experience. I recently heard an example of a facility which successfully hatched an endangered tortoise with an enlarged large yolk sac and they were informed that the yolk sac should be cut off or tightly wrapped with a string and be allowed to drop off. If the yolk sac had been cut, off the tortoise likely would have died. Fortunately, they contacted a member of the TTPG and were informed they could leave the tortoise in the incubator or put it on some moist paper towels and that the yolk sac would be absorbed in a few days.

Hatchling Care

The care of hatchling Galapagos tortoises is similar to other tortoise species. Here in Arizona, hatchlings are raised indoors for their first four to six month at which point (if temperatures permit) they are moved to outdoor enclosures. Their indoor enclosure consists of fresh Bermuda grass clippings or moist peat moss covered with dry grass clippings. Full spectrum lighting is provided and temperatures are maintained between 75 and 90° F. Generally temperatures are maintained in the mid 80s F though temps may drop 5-10 degrees at night. The hatchling tortoise will burrow under the grass in the moist peat most of the day, but will emerge to eat and explore its environment. This moist micro-climate has been critical for proper shell growth and to help avoid pyramiding. In this indoor environment, with lights only a few inches above the top of the tortoise, the substrate will dry out quickly. Warm water should be added to the peat moss weekly to prevent it from drying. A moist hide box can also be utilized and may help the peat hold the moisture levels, however adequate temperatures must be maintained inside the hide box or the tortoise will not use it. The moist hide box may be made by placing a plastic shoe box upside down (with an entrance hole cut in the side) on top of the moist peat moss. If temperatures drop too low, the tortoise activity will decrease and it

may have a decreased appetite. Food is placed in the enclosure on top of the grass clippings. The diet may include the following:

Various greens (mustard greens, escarole, romaine lettuce, dandelion, kale, etc.)

Squash (zucchini, pumpkin)

Grass (bermuda, rye, alfalfa, blue grass, fescue, etc.)

Opuntia cactus (spineless prickly pear cactus)

Carrots, bell peppers, tomatoes, hibiscus leaves, grape leaves, mulberry tree leaves, etc.

Mazuri Tortoise Diet®

Water is provided by soaking the hatchling tortoise in slightly warm water once or twice a week. The water level should be below the head of the tortoise. The hatchling will often drink and then defecate. The tortoise will often eat aggressively after being soaked.

Hatchling tortoises grow fast. A hatchling Galapagos tortoise may double its weight and length within six months. A 2.5 inch hatchling will be four to five inches within six months and within three years will be over 15 inches and twenty pounds.

Juveniles and Adults

Outdoor enclosures are recommended for Galapagos tortoises when they are about six months old. Due to their rapid growth rates, one must be prepared long-term to feed and house a giant tortoise. Within a few years a Galapagos tortoise will be the size and weight of a typical adult African spurred tortoise.

In Phoenix, Arizona my tortoises are maintained outdoors year round. During the winter a heated hide is provided to keep temperatures above freezing. A 250 watt infrared bulb does the job. The heat light is located about two feet above the top of the tortoise and angled to direct heat across the entire shelter. The size of the hide box is increased every few years as the tortoises grow. The hide box may be made of wood, block or other material strong enough to hold the tortoises and the door is made with strips of plastic carpet protection runners. The tortoises can easily push through the plastic strips and seem to quickly learn to use their heated hides in the winter. During the summer, the tortoises may use the hide box but generally prefer to push into fountain grass, a bush, or under the cover of low branches of a tree.

A yard with bermuda grass or other vegetation is desirable. People often ask how much room is needed for Galapagos tortoises. The answer obviously varies as the tortoise grows, but perhaps the best answer is as much as possible. If there is insufficient area to maintain grass, the enclosure should be enlarged. There should be multiple hide areas, visual barriers and elevation changes allowing the tortoises to climb and exercise. I have seen my adult male flip on its back while trying to breed. The tortoise was able to use its legs and head to right itself. If a tortoise is maintained in a small enclosure where it mainly sits and eats, it is doubtful it would have had the strength to flip back over and perhaps may not have the strength to mount and breed a female.

The diet of juveniles and adults is similar to hatchlings, however since they have access to grass and vegetation for grazing, they do not require as much supplemental food. During the spring laying season, I supplement daily with carrots, squash, or prickly pear cactus. In the summer, the tortoises eat a lot of Mesquite beans which grow on the trees in their enclosures. I often supplement their diet during the winter with alfalfa or Bermuda grass hay. I plant a small section of winter rye, however it is not sufficient to feed three large tortoises. The tortoises will actively eat the dry hay. Appetites may decrease with the cooler winter temperatures, however they still eat daily.

My tortoises do not have a permanent source of water for drinking or soaking. During the summer, I flood irrigate the grass with water weekly. The tortoises will drink and may soak for a couple hours, however the water quickly percolates into the soil. I will also run the hose in a low area of the yard periodically for the tortoises to drink and I frequently spray the tortoises with the hose during the summer.

By providing a heated hide in the winter, my tortoises have dealt with winter lows of 18 degrees and by providing shade, and spraying the tortoises with water in the summer, they have easily handled hot summer temperatures which have reached 122° F. Galapagos tortoise are very hardy and can easily handle temperature from 50-110° F with little more than food and shelter. Galapagos tortoises may handle brief freezing temperatures, however if temperatures will be at or below freezing for very long, they must be provided heat. On the rare occasion when my tortoise have not used their

Galapagos tortoises enjoying a snack of large carrots. Photo by Jerry Fife.

heated hide, I have used a heat mat and a large dog pillow to provide protection from freezing night temperatures.

The main problem seen in captive-raised Galapagos tortoises is fluid retention or swelling of the neck and limbs. The cause of this has been blamed on lack of iodine, exercise, protein, Vitamin A or proper hydration. Perhaps all or none of these play a part and the cause for swelling in one tortoise may be different than that seen in another tortoise. A visit to a veterinarian may help in identifying or at least eliminating certain factors, however this is an area where there is still much to learn.

Breeding Galapagos Tortoises

My Galapagos tortoises began breeding activity at 12 or 13 years old, though the females did not lay eggs until they were 18 years old.

Having raised two Galapagos tortoises from hatchlings, I soon discovered I had two females and began a search for a male. Like many reptile species, Galapagos tortoises are temperature sex determinant (TSD) meaning that the sex of the hatchling is determined by the incubation temperature of the egg. All the Galapagos tortoises in the private sector were coming from one main source and they apparently were incubating all the eggs the same and producing only females.

My tortoises were 12 years old when I finally found a male. The male I obtained on a breeding loan was one year older but several inches smaller than my two females. Within a year, breeding activity began, though it would be five years before the tortoises laid their first clutch of eggs. I suspect this was related to the size of the male. The male began breeding when it was smaller than the females, however I don't believe it was successful in mating until it was several inches larger than the females. When I obtained my first fertile eggs, the females were 28 inches and the male 31 inches in length.

During their first year laying, each female laid two clutches of eggs, which ranged in size from 5 to 10 eggs. The first three clutches of eggs were infertile but the final clutch of five eggs, laid in May, had four fertile eggs. During the current year, one tortoise has laid one clutch of four eggs and three of the eggs appear fertile. It is hoped that the fertility rate will greatly increase during the second and future years of egg production.

The three main issues with breeding Galapagos tortoises are: 1. finding both sexes, 2. having a male that shows no interest in breeding, and 3. infertile eggs.

There is currently a shortage of adult male Galapagos tortoises and many people with adult females have been unable to pair up their females. Some private breeders report their males show no interest in breeding. They have tried separations without success. This issue has been resolved successfully by introducing an active breeding male into the group. At the Charles Darwin Station, an actively breeding male introduced into a group with a male that showed no interest in breeding did spur more breeding interest. Adding an extra male to a breeding group, however, is difficult to achieve due to the current lack of adult males.

Mating Galapagos tortoises. Photo by Jerry Fife.

A female Galapagos tortoise moistening the nest area with urine. Photo by Jerry Fife.

The other problem is infertility. I am aware of zoos and private breeders with multiple males which actively breed, however they never obtain fertile eggs. The reason for this is unclear however poor fertility has been a common issue.

The reason for lack of success in breeding Galapagos tortoises could be many. One institution reported a cool period increased fertility of adults. At another facility, a former zoo keeper reported feeding rats prior to egg laying improved their success. One zoo keeper believes that separating the males and females is critical to success. He observed my tortoise set-up and was convinced that even though my tortoise are not physically separated, that they experience a natural separation due to the large area, vegetation, and physical barriers at my facility.

My tortoises experience a natural cool season in Arizona, I have never offered animal protein, but they do eat Mesquite beans which grow in their enclosures. I only have one male, so while having multiple males may be helpful, it is not necessary for successful breeding.

It is difficult to know what is the reason for my success, however varied diet, a large area with physical barriers, slopes providing natural separation and physical exercise for strong tortoises may play a role. My tortoises are active during moderate temperatures and the male is particularly active in roaming the yard. The tortoises graze and are provided some supplementary food, however they are not overweight and actively roam the yard looking for food, shelter, grazing, and exhibiting natural behavior. They may go days or weeks without interacting or may all be together. Galapagos tortoises do establish a hierarchy and when first introduced or after long periods of separation may show some aggression.

Nesting

Galapagos tortoises dig a narrow hole as deep as their back legs will allow. My tortoises often dig test holes for a week or more before actually laying eggs. They follow the same routine, beginning to dig a couple hours before dark and laying eggs at dusk or after dark. The entire egg laying process generally takes about five hours. Due to the numerous test holes, I soon learned that if the tortoise filled the hole with urine that this was a good sign that it was actually going to lay eggs. The urine softens the soil and creates two mud piles as the tortoise excavates its nest. By the time the nest is ready, the urine has been fully absorbed in the soil around the nest. The tortoise will lay between four and fifteen eggs and then begin the slow process of covering the nest. This whole process is generally not complete until after 9 or 10 p.m. at night. The female does such a good job covering the nest that unless observed, it may be difficult to know where eggs were laid. Due to my rocky soil, I often assist the female by digging out large rocks and cutting roots which may prevent her from completing her task.

The timing of the Galapagos tortoise nesting has made finding nests quite simple. A quick check of the tortoises prior to dark will identify any nesting females. My tortoises lay eggs in spring, generally from February to May.

The egg travels to the bottom of the nest on a mucus sleeve. Photo by Jerry Fife.

Galapagos tortoise eggs are TSD, therefore eggs are incubated in the low 80s F to produce mostly males and the upper 80s F to produce females. Eggs are incubated on moist peat moss and hatch in four to five months.

Conclusion

Galapagos tortoises are very personable and do quite well in captivity if given adequate space and proper temperatures. They are listed by the US Fish and Wildlife Service as Endangered Species and require a federal Captive Born Wildlife (CBW) permit to cross state lines. Captive-hatched specimens purchased instate do not require permits, however anyone purchasing an endangered species out-of-state must be sure that both the buyer and seller have a current CBW.

There is still much to learn about breeding Galapagos tortoises and raising hatchlings to prevent the fluid retention seen in some captive-raised specimens, but generally their health issues are minimal. Due to their large size they are not a species for everyone, however if you live in a climate where they can be housed outdoors, they are a rewarding species to maintain.

The nest is difficult to see after the process is complete. Photo by Jerry Fife.

A healthy and beautiful Galapagos tortoise hatchling. Photo by Jerry Fife.

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He has produced hatchlings of all five species both indoors using artificial incubation and out of the ground in his outdoor enclosures.

Jerry has traveled to the Caribbean, Mexico, the Galapagos Islands, Ethiopia, Fiji, Indonesia, and Central America as he works on writing projects. He is the author of many articles and the following books:

IGUANAS of the WORLD

LEOPARD TORTOISES: The Natural History, Captive Care and Breeding of *Stigmochelys pardalis* (with his brother, tortoise breeder, Richard Fife)

STAR TORTOISES: The Natural History, Captive Care, and Breeding of *Geochelone elegans* and *Geochelone platynota*