Breeding Galapagos Tortoises, *Geochelone nigra*: Common Factors at The Phoenix Zoo and The Philadelphia Zoo

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**Abstract:** Key factors in Galapagos tortoise, *Geochelone nigra*, captive propagation at the Phoenix and Philadelphia zoos appear to include appropriate herd composition, connected warm weather and cold weather facilities, periodic separation of males from females, separation from other tortoise species during breeding efforts, and a high plane of nutrition.

**Key Words:** *Geochelone nigra*, tortoise, captive propagation, Galapagos tortoise, Aldabra tortoise, *Geochelone gigantea*.

Although Galapagos tortoise, *Geochelone nigra*, captive propagation is becoming more common in the private sector, it still remains a rare occurrence in North American zoos. Current research on the genetics of Galapagos tortoises may be the basis of recommendations for moving tortoises to different zoos to develop genetically compatible breeding groups. Unfortunately, unless more institutions are successful breeding these tortoises, it is likely that implementing these recommendations will not result in the desired offspring. The Philadelphia Zoo is the only northeastern zoo that has successfully bred Galapagos tortoises within the past 20yr. Its adult herd consists of 1.2 animals, including a female born at the Bermuda Zoo in the 1950’s. The Phoenix Zoo, located much farther south, has reproduced Galapagos tortoises several times over the past decade and its current adult herd includes 1.1 animals. Both zoos also display Aldabra tortoises, *Geochelone gigantea*, and perhaps the rediscovered Seychelles tortoises, with their Galapagos tortoise herd. There are a few key factors in the captive husbandry of these two herds that are worth considering to improve the reproductive success in Galapagos tortoises at other institutions.

1) Appropriate herd composition: Genetically incompatible subspecies of Galapagos tortoises may have slightly altered breeding patterns and seasonality, poor fertility, and low survival rates of fertilized eggs and hatchlings. If there are too many females for the male to cover, the male may copulate so frequently that semen produced may be of insufficient quantity and density of viable sperm. Some tortoise species, such as the yellowfoot tortoise, *Geochelone denticulata*, appear to propagate more successfully with multiple males of the same species present in a herd and male combat appears to stimulate copulation. The male Galapagos tortoises at the Phoenix and Philadelphia zoos, do not appear to need the presence of another male of that species to evoke appropriate mating behaviors. Although males of other giant tortoise species are present and may be an important stimulus, true combat between the species has not been observed. Galapagos tortoises have a complex social structure and it is apparent that some tortoises just do not get along. Tortoise managers have to admit that mutual attraction is a necessary aspect of tortoise romance. It is most often the female who is discriminating since some male Galapagos tortoises have been seen breeding with rocks and logs, as mentioned below. A final consideration of herd composition relates to the size of the enclosures available. Many zoos keep their giant tortoises indoors for 9mo or more out of the year, and in fairly small enclosures. Access to larger enclosures that provide visual barriers and hiding places for the tortoises is important for breeding many species of tortoises.
2) Both the Phoenix and Philadelphia zoos have cold weather housing adjacent to warm weather housing so the tortoises can walk in and out at their own accord. They do so on a daily basis when the weather is appropriate and get access to natural sunlight for several months of the year. If the sky is clear and sunny, the tortoises may be seen wandering around, eating and basking on days in the mid-60°F. They are herded into the warm barns or indoor housing at the end of the day. Many other zoos have “winter” and “summer” enclosures that are so far apart that the tortoises must be loaded onto trucks and driven back and forth. Once the tortoise is moved, it is in the new enclosure for several weeks to months. The stress of major moves such as these can interfere with the reproductive cycle of these tortoises, especially females, and inhibit normal follicular maturation and oogenesis. If a tortoise undergoes a major move, such as transfer to another zoo, it may not resume normal reproductive cycling for 2-5yr. This can profoundly impact the future management of Galapagos tortoises in zoos. Any move made for genetic management may take at least 5yr to determine if it came to fruition. This sort of waiting period will seem interminable to the public relations department and other functionaries in a zoo who are used to mammal projects where a birth may be expected within 1yr of a successful introduction. It also means that Galapagos tortoise managers must take an extraordinarily long view of their projects and leave a detailed explanation of the reasoning for their actions that is easy for their successors to understand.

3) The Phoenix and Philadelphia zoos have the ability to separate males from females for extended periods. This can happen at any time of the year but is most commonly done during the late fall, winter, and early spring. “Absence makes the heart grow fonder” and that males are more focused on their breeding efforts when they are reintroduced to the females. Periodic resting of the herd may improve the semen quality of the males and make each mating that much more potent! It is noteworthy that the Philadelphia Zoo has not bred Galapagos tortoises since their holding space became occupied by an injured male tortoise and they cannot separate their sexes during cold weather.

4) The Phoenix and Philadelphia zoos have the ability to separate Galapagos tortoises from Aldabra tortoises during breeding season, typically late spring, summer, and early fall. Male tortoises do not discriminate sex partners and may breed with other species and even inanimate objects such as appropriately shaped rocks and other objects. By restricting their breeding efforts only to their own species, the males are more likely to transfer high quality semen than if they are indiscriminately “sowing wild oats”.

5) The Phoenix and Philadelphia zoos both have a high plane of nutrition offered throughout the year. The Phoenix zoo tortoises have *ad libitum* access to fresh grass and alfalfa hay throughout the year. Freshly harvested cactus pads, *Opuntia ficus-indica*, among other species, are offered regularly along with fresh produce. The Philadelphia Zoo uses Walkabout Mix™ for Giant Tortoises which provides a balanced intake of nutrients throughout the year, even when they are allowed outside to graze (Wright and others 1997). Malnutrition may underlie the reproductive failures of many giant tortoise programs. Many of these animals have been in captivity and fed substandard diets for decades. It may take several years for a tortoise to recover from malnutrition once it starts to consume a well-balanced diet with appropriate levels of energy, protein, fiber, vitamins, and minerals. Until the tortoise is fully recovered, it is unlikely to successfully breed.

Galapagos tortoises and the other giant tortoises are the longest-lived vertebrate species managed by zoos. They are much more complex and demanding animals than any zoo professional suspected during the early 20th century, and it is only now that serious attention is being given to improving their plight in captivity. There is a poignancy to this realization as the Galapagos Islands were once considered the epitome of a successful ongoing conservation effort without the need for *ex situ* refugium population of any of its species in zoos. Unfortunately, recent political unrest over fishing...
rights and an oil spill that wreaked havoc on some marine ecosystems, have pointed out the vulnerability of these precious islands, and zoo managers need to rethink how they are managing their Galapagos tortoise herds so that captive propagation becomes a common fact rather than a noteworthy event.

REFERENCES