RESEARCH ARTICLE
Open Access

Journal of Veterinary and Animal Sciences
ISSN (Print): 0971-0701, (Online): 2582-0605
https://doi.org/10.51966/jvas.2022.53.4.

Observational Study on Captive Indian star tortoise (*Geocheloneelegans)* in intra and interspecific enclosures

M. Aarthi*[1] L. Shakila[2]and N. Janani[3]
PG and Research Department of Zoology,
Ethiraj College for Women,
Chennai-600008, Tamilnadu, India.

Citation: Aarathi,M., Shakila,L. and Janani,N., 2022. Observational Study on Captive Indian star tortoise (*Geocheloneelegans)* in intra and interspecific enclosures. *J. Vet. Anim. Sci.* **53**(4):
DOI: https://doi.org/10.51966/jvas.2022.53.4.

Received: 02.04.2022 *Accepted: 24.05.2022* *Published: 31.12.2022*

Abstract

*Ethological studies in captivity play an important role in the conservation of animals. It also helps us to understand the human impact on fauna. On considering the behavioural aspects, birds and mammals have gained attention to some extent; but reptiles have not. Thisstudy attempts to focus on the behaviours of the Indian Star*tortoise*(Geocheloneelegans) in captivity. The study species were observed in intra and interspecific enclosures. State and event behaviours were indexed. Though there is no species variation among star tortoises, the change in the behavioural pattern is due to their habitat differences. Locomotion, fighting, feeding, retreat and conspecific contact was found to be high in intraspecific enclosure. Basking and lying in the water was high in interspecific enclosure. Fighting was not observed in the interspecific enclosure during the study period. The resting period of star tortoises in interspecific enclosure was less when compared to intraspecific enclosure. Herpetofauna is a key component of an ecosystem and updating our knowledge via these kinds of ethological studies will benefit us in conserving the species in captivity.*

Keywords: *Geocheloneelegans,star tortoises, ethological studies, animal behaviour*

The study of animals in captive conditions will help in a better way to conserve threatened species in their very own habitat or the wild. Activity pattern of animals is an essential part of their natural history. Knowing the activities of the species is crucial in designing conservation measures of that species (Allen, 1972; Broadhurst, 1963). It is such behavioural experiments that reveal much about the life history of the animals in its natural surroundings (Bellairs, 1969). Rearing of animals in captivity may change their behaviour which in turn manifests some managemental problems (Nair *et al*., 2008).

Every animal interacts with other animals during the course of its lifetime. The interactions between members of the same species are normally considered as social interactions or

1. *Research Scholar*
2. *Assistant Professor, PG and Research Department of Zoology*
3. *Research Scholar*

**Corresponding author: aarthi.4496@gmail.com Ph no: 9940245372*

intraspecific interactions. It is virtually impossible for an animal to remain unaffected in its relations with another. A Threat, avoidance behaviour often occurs between members of the same species. Aggressive behaviour rarely occurs during social interactions (McFarland, 1981). Individual performance of the species can be affected by abnormalbehaviour (Anil *et al.,* 1998). The social behaviour of turtles and tortoises are yet to be studied (Porter, 1972).

Behavioural ecology is not limited to the ecology movements, social interactions, foraging and escape from predators. Behavioural decisions ultimately influence individual fitness. They determine whether an individual will be able to compete within the social system of its own species (Zug *et al.,*2001).

In India, birds and mammals have received some attention in this regard; but other lesser life forms have not. In particular, reptiles are not the easiest of animals to focus on such studies. One such threatened Indian reptile is the star tortoise (*Geocheloneelegans)*. Previous studies on this species have focused on feeding behaviour, food preferences and factors which play an important role in feeding (Oftedal and Allen, 1996). The illegal trading on this species is a big business that has created negative impacts on wild populations, leading to biodiversity loss (Bush *et al*., 2014). Increased illegal activities lead to a steep decline in its population (Nijman and Shepherd, 2015). Captive propagation will help us to solve such problems. Understanding the husbandry and management problems of such species may help to manage and conserve these species in captivity (Vyas, 2006). Information is available only on feeding, breeding behaviours of star tortoises (Daniel 2002; Das, 1995, 2002). So the present study attempts to focus on all the behaviours of star tortoises in intra and interspecific enclosures.

Materials and methods

Study species

The Indian star tortoise, *Geocheloneelegans* (Schoepff, 1795), Testudinidae, is aherbivorous reptile that is distributed in India, Pakistan and Sri Lanka (Iverson, 1992). They prefer dry lowland areas, scrub forests and grasslands. Adult females can have the length of up to 25 cm (10 inches), while males are usually less than 20 cm (8 inches) long. The most active growth happens in the first 10 years of life. Their average lifespan is about 30 years. However, some literature resources indicate that they can live up to 80 years in captivity. Adult specimens can weigh up to 6.6 kg. During the month of October – January breeding occurs. It lays up to 10 eggs that hatch after 2-6 months depending on temperature (Daniel, 2002; Das 2002 and Ganesh, 2015).

Study area

The study was carried out in the Chennai Snake Park, Guindy, Chennai, Tamil Nadu India. Theobservational study was conducted during the month ofOctober, 2019 in two differentenclosures for about 30 days.

Enclosure details

Enclosure I (startortoise enclosure/ intraspecific enclosure)

It measures about 11m x 12m x 4m. It was made of walls on all four sides; sides of the walls and roof were ironfenced. It consisted of 3 hiding places or retreat areas and a water trough.

Enclosure II (mixed spp. enclosure/ interspecific enclosure)

This enclosure depicted terrestrial ecosystem featuring some common reptiles and amphibians (star tortoises, green vine snakes, green iguanas, bronze back snakes, keelback snakes, trinket snakes, and frogs). Enclosure II measured about 14.5m x 8m x7.5m. It was made of walls on two sides and the other two sides were glass finished; and the roof was meshed to allow sun rays. It also consisted of a landscape fountain to provide water for animals and cactus for enrichment.

Observation methods

The Star tortoises were observed with the naked eye from a distance of 1m away from enclosure I and enclosure II respectively. The total observation period was 180 h; an equal

amount of time was spent in each enclosure, during the month of October. The time duration was noted in minutes, using the stopwatch and the frequency of activity was counted. Temperature and humidity were noted using a digital thermo hygrometer in sunlight and shady areas after one minute of exposure.The average temperature in sun and shade for enclosure I was noted as 28.8˚C and the average humidity was noted as 82.6%.For enclosure II, the average temperature in sun and shade was noted as 33.7˚C and 30.2˚C respectively. The average humidity in sun and shade was noted as 60.8 and 62.2% respectively. The activities noted during the present observation were divided into two categories: Long duration behaviour (States) and Short duration behaviour (Events). Long duration behaviours were locomotion, lying in the water, basking, feeding, fighting and resting (Fig 1, 2). Short duration behaviours were head movement, yawning, retreat behaviour, opening of the mouth, eye closed, limb stretch and conspecific contact.

Fig. 1. Feeding of Star tortoises

Fig. 2. Star tortoises lying in water

Results and discussion

The following behaviours were noted during the observational study namely locomotion, head movement, yawning, basking, retreat, feeding, opening of the mouth, eye closed, limb stretch, resting, conspecific interaction. The obtained results are summarized in the following tables 1 and 2.

The main focus of this study was to understand the behaviour of Star tortoise in intra and interspecific enclosure. In the interspecific enclosure, other species that were kept alongside were iguanas, bullfrogs, and keelback snakes. In nature, there is no scope for interspecific interaction between star tortoises and iguanas, as the latter is Native to Central America. As for the habitat associations in captivity, iguanas are arboreal; and frogs and keelbacks are mostly aquatic. The Area of both enclosures was almost equal, and each enclosure housed adult tortoises in equal number (n=2). But the frequency and duration of behaviour varied visibly. Previous research has suggested that the reptiles placed in the naturalistic environment exhibited more natural behaviour when compared to those with un-naturalistic settings and that naturalistic environment was less stressful for reptiles (Warwick *et al*., 1995).

In enclosure I (intraspecific enclosure) locomotion was found to be higher than in enclosure II (interspecific enclosure) (Table 1). This may due to the fact that the enclosure was occupied by other species and the enclosure consists of landscape fountain, water canal, and potted plants, such that it was suitable for all the species found inside. It was important that the enclosures be made to look like the animal's natural habitats (Reade and Waran, 1996). Though enclosure I had a water trough, the tortoises did not prefer to be in water; while star tortoises in enclosure II spent a long time in the water (Table 1). Star tortoise is a terrestrial species with a highly generalized preference (Moll, 1989; De Silva, 2003).

Basking (thermoregulation) was found to be high in interspecific enclosure and it may be due to the fact that the enclosure had received only limited sun rays and so they preferred to be

Table 1. Duration comparison of state behaviours in 180 hours

State behaviours	Intraspecific enclosure (minutes)	Interspecific enclosure (minutes)
Locomotion	89	26
Lying in water	0	36
Basking	23	38
Feeding	31	25
Fighting	10	0
Resting	56	54

Table 2. Duration comparison of event behaviours in 180 hours

Event behaviours	Intraspecific enclosure(minutes)	Interspecific enclosure (minutes)
Head movement	76	78
Yawning	4	1
Retreat behaviour	30	25
Opening of mouth	1	5
Eye closed	2	45
Limb stretch	3	4
Conspecific contact	35	23

in sun-lit place for longer duration.In the other enclosure only star tortoises were present and so they preferred to bask when needed (Table 1). Ambient temperature (max and min) played an important role in the activity of animals (Vyas, 2006) and approximately 60% of the enclosure should have shade or filtered sunlight provided by plants or shade cloth (Boyer and Boyer, 1994).

An understanding of the diet of a species also provides information on the role it plays in the ecosystem. Numerous studies have attempted to identify factors that were important in the choice of diet (Boyer and Boyer, 1994). The tortoises were fed regularly on chopped vegetables and spinach. Plant material constituted an important part of their diet, while omnivore and opportunistic feeding have also been recorded(Nandu andArora, 2017).Feeding was found to be high in the enclosure I (Table 1). Being the only species present, they consumed the maximum food. But in the interspecific enclosure, the food was kept for both star tortoises and Iguanas together. Iguanas being fast-moving animals, they eat fast when compared to Startortoises. The Iguanas consumed ample food in a shorter time compared to tortoises. Star tortoises were found to feed on earthworms that were fed to the frogs in the enclosure. This clearly indicated that these tortoises were not strictly herbivorous. The literature states their consumption on small insects and faecal matter of larger vertebrates, as well as some invertebrates present in the plant matter (involuntarily), that form minor parts of their diet (Pyke, 1984). Das (1995) mentioned that the star tortoise was largely herbivorous in nature, but in captivity it is known to eat animal matter. This perhaps applies only to captive specimens deprived of a complete natural diet (Whitaker, 1974). Fighting was observed only in the intraspecific enclosure (Table 1). It might be due to territorial behaviour, even though the enclosure is spacious and well-enriched / furnished, they both prefer to occupy the same place in the enclosure. Fighting composed of the vigorous dashing of heads and stretching the limbs. Stretch marks of the fighting were photographed. However, fighting was never seen in the interspecific enclosure during the observation period. This may be due to the fact that resource availability and the necessity of the species were not the same in both the enclosures. Retreat behaviour was also high in the intraspecific enclosure, likely because of more fighting, chasing and advancements by these individuals (Table 2). When maintaining a group of tortoises in captivity, visual barriers such as logs, rocks, and vegetation were important to allow tortoises to occasionally retreat from one another (Boyer and Boyer, 1994).

Conspecific contact was high in enclosure I because only star tortoises were present (Table 2). This was much lower in enclosure II. Less resting time was noted in enclosure II than enclosure I (Table 1). In addition to the above-mentioned behaviours, head moment, yawning, the opening of the mouth, eye closed, limb stretched were also observed (Table 2).

Conclusion

Captive housing of animals fortifies the species from external threats. Captivity also provides the possibility to study all the behaviour of study species in depth. Both intraspecific and interspecific housings improve its social and physical complexity. Conspecific interaction helps the animals in achieving their behavioural needs. Further, this study infers that the study species, Indian star tortoises (G*. elegans*) exhibited normal behaviour in both the enclosures anddoes not show agonistic interaction with other species that were present in the mixed species enclosure. Deduction in data also revealed that the resting period of the star tortoise in the interspecific enclosure was comparably lower than the intraspecific enclosure. Both intra and interspecific housing of animals protect the species from external threat; adopting such methods may help us to conserve species in large scale. Maintaining animals in interspecific enclosure is advantageous both economically and practically. Hence, this method can be suggested to protect this species. However, further studies are required to validate this conclusion.

Acknowledgement

We express our deep sense of gratitude to Dr. S. Paulraj, Executive Chairman,Dr. M. Arumugam, Director of Research and Training and Director,R. Rajarathinam, for permitting us to carry out the research work at Chennai Snake Park. Wealso extend our sincere and profound gratitude to Dr. S. R. Ganesh, Scientist and Deputy Director, Chennai Snake Park for supporting and guiding us throughout our work.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Anil, L., Rajagopalan, T. G. and Anil, S. S. 1998. Effect of stocking density in growing pigs.Behaviour pattern. *J. Vet. Anim. Sci.* **29**:16-18.

Allen, T. B. 1972. *The marvels of animal behavior*. National Geographic Society,United States, 422p.

Bellairs, A.D.A. 1969.*The life of Reptiles*: (Vol 2). Weidenfield and Nicolson, London, 51p.

Boyer, D. M. and Boyer, T. H. 1994. Tortoise care. *Bulletin of the Association of Reptilian and Amphibian Veterinarians*. **4**(1):16-28.

Broadhurst, P.L. 1963.*The science of animal behaviour.* Penguin Books, London, 142p.

Bush, E. R., Baker, S. E. and Macdonald, D. W. 2014. Global trade in exotic pets 2006–2012. *Conserv. Bio*.**28**(3):663-676.

Daniel, J.C. 2002. *The Book of Indian Reptiles and Amphibians* (Bombay Natural History Society). Oxford University Press, Oxford, United Kingdom, 170p.

Das, I. 1995. *Turtles and tortoises of India*. Oxford University Press, Oxford, United Kingdom, 179p.

Das, I. 2002. *A Photographic Guide to Snakes and Other Reptiles of India*. New HollandPublishers Ltd., London, 144p.

De Silva, A. 2003. *The Biology and Status of the Star Tortoise, (GeocheloneElegansSchoepf 1795) in Sri Lanka*. Protected Area Management and Wildlife Conservation Project, Ministry of Environmental and Natural Resources, Sri Lanka, 100p.

Ganesh, S. R. 2015. *An Illustrated Guide to Common Indian Amphibians and Reptiles.* Chennai Snake Park Trust, Chennai, 89p.

Iverson, J. B. 1992. *A revised checklist with distribution maps of the turtles of the world*.

Published by the author Richmond, Indiana, 248p.

McFarland, D.1981. *Oxford companion to animal behaviour*. Oxford University Press, United Kingdom, 47p.

Moll, E. O. 1989. *Geocheloneelegans,* Indian Star Tortoise.In: The Conservation Biology of

Tortoise. Swingland and M.W Klemens (eds). *Occ. Pap.* IUCN/SSC No.**5**: 113-114.

Nair, C. R., Mathew, J., Shyama, K., Saseendran, P. C., Anil, K. S. and Kannan, A. 2008. Memory and hierarchical behaviour in mice, rats and guinea pigs*. J. Vet. Anim. Sci.* **39**:49-52*.*

Nandu, V.S and Arora, B. M. 2017. Study on the Foraging Behaviour and Diet Preferences ofIndian StarTortoises (*Geocheloneelegans*) in Chinnar Wildlife Sanctuary, Kerala, India. *J. Zool. Sci.***5**(1):58-69.

Nijman, Vand Shepherd, C. R. 2015. Analysis of a decade of trade of tortoises and freshwaterturtles in Bangkok, Thailand. *Biodiversity and conservation*. **24**(2):309-318.

Oftedal, O. T. and Allen, M. E. 1996. Nutrition as a major facet of reptile conservation.*Zoo Biol*. **15**(5):491-497.

Porter, K. R. 1972. *Herpetology*. W. B. Saunders, Philadelphia, 110p.

Pyke, G. H. 1984. Optimal foraging theory: a critical review. *Annu. Rev. Ecol. Syst.* **15**(1):523-575.

Reade, L. S. and Waran, N. K. 1996. The modern zoo: How do people perceive zooanimals? *Appl. Anim. Behav. Sci*. **47**(1-2):109-118.

Vyas, R. 2006. The Indian star tortoise *Geocheloneelegans* status in the protected areas of Gujarat and in Indian zoos. *Zoos Pr. J.***21**:2220-2222.

Warwick, C., Frye, F. L. and Murphy, J. B. 1995. *Health and welfare of captive reptiles*.Chapman and Hall, London, 113p.

Whitaker, R. 1974. Feeding habits of the Star Tortoise. *J. Bombay Nat. Hist. Soc*.**71**(1):147-148.

Zug, G. R., Vitt, L. J. and Caldwell, J. P. 2001. *Herpetology: an introductory biology ofamphibians and reptiles*. Academic press,Cambridge, Massachusetts, 214p. ■