



CAPTIVE BEHAVIOUR STUDY OF BIG FOUR INDIAN SNAKES

Psychology

Sagayaraj K*

Sagayaraj K, M.sc., Counseling Psychology, Chettinad Academy Of Research and Education (Deemed to be University) Kanchipuram Dist., Kelambakkam, Tamil Nadu - 603 103, India. *Corresponding Author

ABSTRACT

Background : Living snakes are found on every continent except Antarctica, and on smaller land masses, while sea snakes are widespread through the Indian and Pacific Oceans. Most species are nonvenomous, and the venomous types use it primarily to kill and subdue prey rather than for self-defence. Some possess venom potent enough to cause painful injuries or death to humans. Nonvenomous snakes either swallow their prey while it's alive or kill by constriction. Venomous snakes occur throughout many regions of the world and are a threat to public health, especially in the rural tropics where they are most abundant. Out of more than 3000 species of snakes in the world, some 600 are venomous and over 200 are considered to be medically important. In India, the snakes considered as the most common venomous snakes are the Spectacled Cobra (*Naja naja*), Common Krait (*Bungarus caeruleus*), Russell's Viper (*Daboia russelii*) and Saw-scaled Viper (*Echis carinatus*). They are often referred to as the 'Big Four'.

Aim : Captive study is the easiest way to get some baseline information on this cryptic species behavioural ecology as well as to increase life history data such as mating time and behaviour, nesting details, clutch size, incubation time. Observation study on different animals draws out the important and characteristic of that species in both captive and wild so these kind of behavioural studies are important in terms of conservation and protection of all species. The main aim of this study is to observe and draw an ethogram of the *ex-situ* behavioural pattern of the big four Indian snakes over a course of three months (Oct 2015 to Dec 2015). This study was conducted to contribute to the existing literature on behaviour of Big Four Indian Snakes.

Result : Based on the direct observation method a behavioural ethogram comprising six parameters and sixteen behavioural events were studied. Diet analysis was also done to investigate healthy digestion and growth rate of the species.

KEYWORDS

INTRODUCTION :

Ethology is a scientific study of animal behaviour; usually focus on behaviour under natural conditions and viewing behaviour as an evolutionary adaptive trait. An understanding of animal behaviour is essential for developing tools required for the management of a species. Behavioural ecology provides basic data that can be used by conservationists to develop appropriate management strategies for populations (Singh & Kaumanns 2005)⁽¹⁾. Most reptiles, for example, use diverse behaviours to maintain preferred temperatures (Pough *et al.*, 2001)⁽²⁾. Thus, the inclusion of behavioural studies in conservation biology might offer a different perspective on the threats they face. Despite that most ethological research initially focused on mammals, birds, and fish (Burghardt & Milostan 1995)⁽³⁾, a growing number of studies have evaluated activity and behaviour patterns also in snakes (Vitt *et al.*, 2014)⁽⁴⁾.

Several studies have been published regarding the natural history, distribution and behaviour of snakes (Whitaker 1978⁽⁵⁾, Daniel 2002⁽⁶⁾, Das 2002⁽⁷⁾, Whitaker & Captain 2004⁽⁸⁾, De silva 1990⁽⁹⁾) but the detailed behavioural studies still need to done on certain species. The big four snakes are highly venomous and causes more death rates in India and so understanding their behaviour is essential.

There are more than 297 species of snakes found in India out of which 60 are highly venomous. The King Cobra found in India is one of the largest venomous snake in the world. The big four member of highly toxic snakes in India are Spectacled Cobra, Common Krait, Russell's Viper, Saw-scaled Viper. In India there are four renowned snake parks are actively involving in husbandry care of exotic snakes; They are Katraj Snake Park in pune (Recently named as Rajiv Gandhi Zoo), Parassinikkadavu Snake Park in Kannur (Kerala), Bannerghatta Snake Park in Bangalore (Karnataka) and Guindy Snake Park in Chennai (Tamilndau). Chennai Snake Park is a NGO and India's first reptile park covers 1 acre of Gunday National Park and having more than 39 reptiles including 23 different species of snakes. The park has published several Books, Journals and Newsletters over the past forty years. To understand the natural behaviour of common Indian snakes it was a systematic attempt cataloguing of the big four snakes behavioural patterns in captivity. Specifically, the objectives of this study was to construct an ethogram for snakes and describe the *ex-situ* activity patterns during the post-monsoon season.

Objectives:

1. To study the behavioural pattern of (*Naja naja*, *Bungarus caeruleus*,

Daboia russelii, *Echis carinatus*) in a captive environment over three month period.

2. To study diet and thermal regulation of all four species.

Method of study:

This study was an Ex-Situ Behavioural observation of (*Naja naja*, *Bungarus caeruleus*, *Daboia russelii*, *Echis carinatus*) for three months. A direct observation method without any interventions to the environment was done. Most enclosures were built very closely and covering up the small area so it is easy and convenient to observe them directly. It was done during the period of post monsoon period (October–December 2015).

Study Area description :

The snakes enclosures are designed with the small water pond and closed heat lamp for cooling and warming purposes. All the enclosures have sign boards giving information in both English and Tamil (Regional Language). The park temperature level changes according to Chennai ambient temperature and it was measured by OMRON digital thermometer, model MC-246. The Study period (Oct – Dec) is Northeast monsoon season (Post Monsoon season) in Chennai and there was heavy rainfall during this period. There was a massive flooding during 1st week of December, which had massive impact on Chennai city. The enclosure and the animals in the park were safe and secure during the heavy rainfall. The temperature details are noted in the Data sheets which were used to observe the behaviour of snakes. It ranges from 84.8 F (29.3°C) to 94.2 F (34.5°C).

To understand the natural behaviour of common Indian snakes it was systematic attempt cataloguing of the big four snakes behavioural patterns in captivity. Specifically, the objectives of my study were to construct an ethogram for snakes and describe the *ex-situ* activity patterns during the post-monsoon season.

Study enclosures & Ethogram

All the big four snakes were housed in glass-fronted enclosures. Spectacled cobra, Russell's viper and common krait enclosures are measuring ($l \times b \times h$) (1.50m×1.05m×1.20m) and saw-scaled viper enclosure is (0.75m×0.52m×0.60m) containing small water pond and heat lamp with small log for basking. There were 2 ♂ (male) and 1 ♀ (female) spectacled cobra; 3 ♂ and 3 ♀ common krait, 3 ♂ and 2 ♀ Saw-scaled viper and 1 ♂, 1 ♀ Russell's viper in the exhibit. (Table 1) All the snakes were observed during the day time and the hours of observation varies for each day. Totally all the big four snakes were observed for 60

hours (15 hours each species) (an hour in a day, 3 Species per day) during the study period. Focal animal sampling method (Altmann 1974¹⁰) was used to collect behavioural data. Altmann describes focal animal sampling as a method in which all occurrences of specified actions of an individual or a specified group of individuals are recorded during the sampling period. My observations suggested that the animals were became alert only when they are threatened physically and not by environmental disturbance. Their major behavioural activities were shown in the table 2.



Picture 1: Shows the snakes enclosure model at the study place

Table 1 : Number of species and Enclosures measurement

Name of the Species	Number of Male ♂	Number of Female ♀	Length of enclosure (l) m	Breadth of enclosure (b) m	Height of enclosure (h) m
Spectacled Cobra	3	1	1.50	1.05	1.20
Common Krait	3	3	0.75	0.52	0.60
Saw-Scaled Viper	3	2	1.50	1.05	1.20
Russell's Viper	0	1	1.50	1.05	1.20

Table 2 : Six behavioural parameters and sixteen behavioural events observed in all the big four snakes.

Behavioural Parameters	Behaviour	Description of Behaviour
Solitary	Sleep	Animal assumes species-specific position for sleeping, stays in one place and is not alert to any environmental changes.
	Rest	Animal stays in one place but may be roused easily by environmental changes.
	Urination	Animal urinates.
	Defecation	Animal defecates.
	Basking	The body is flattened onto the substrate and oriented at the right angles towards the heat source.
	Gape	The wide opening of the jaw; realigning the jaws.
	Travel	Animal moves from place to place.
Food Related	Drink	Animal consumes water or liquids found in its environment.
	Look for food	Animal searches the environment for food items.
Movement	Crawl	A slow forward movement with the body in contact with the substrate
	Slither	Slide unsteadily; go in an irregularly slipping motion.
	Head-Nod	A slow upward movement of the head followed by a rapid downward movement
Exploratory	Tongue Flick	The rapid movement of the tongue in and out of the mouth
	Turn Head	Movement of the head while the body in contact with the substrate.
Escape	Flee Patrol	One moves quickly away from the another animal or a predator (Running or crawling along the perimeter of the enclosure)
Off Exhibit	Off Exhibit	Animal is not visible in exhibit

No courtship or aggressive behaviour is observed and they never respond to the loud noises in the environment. Consumption of food was also not observed because most feedings were scheduled in the late evening when the park is closed. Most days Common Krait

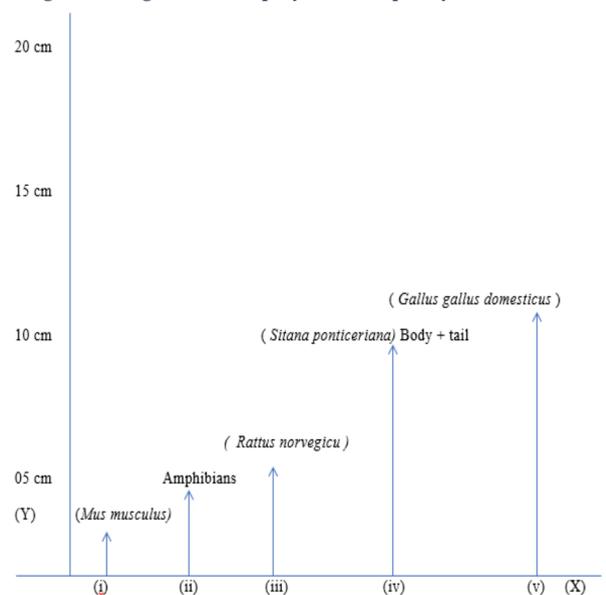
(*Bungarus caeruleus*), Russell's viper (*Daboia russelii*) and Saw-scaled Viper (*Echis carinatus*) were totally inactive because they are nocturnal (Active in the night) but Spectacled Cobra (*Naja naja*) was active even during the day. Spectacled Cobra (*Naja naja*) generally shy they may raise forebody (Some to more than half their body length) and Spread hood when threaten. Common kraits spent most of their time burrowing the sand and they totally off exhibit, and inactive during the day time. Saw-scaled Viper and Russell's viper are active only if it's necessary (Ex: exploring the food, basking & cooling the body). Picture 2 : Showing the Spectacled Cobra (*Naja naja*) raising the forebody and spreading the hood.



Diet Analysis : The diet of a species is key to its survival. An understanding of the diet of a species also provides us with information regarding the role it plays in its ecosystem. Numerous studies have attempted to identify factors that are important in the selection of a specie's diet (Pyke, 1984⁽¹¹⁾). All snakes are strictly carnivorous, eating small animals including lizards, frogs, other snakes, small mammals, birds, eggs, fish, snails, or insects (Mehrtens 1987⁽¹²⁾; Mertens 1961⁽¹³⁾; Behler et al.,1979⁽¹⁴⁾; Hsiang et al., 2015⁽¹⁵⁾) Because snakes cannot bite or tear their food to pieces, they must swallow their prey as a whole. The body size of a snake has a major influence on its eating habits. Smaller snakes eat smaller prey.

The snake's jaw is complex in structure. Contrary to the popular notion that snakes can dislocate their jaws, snakes have very flexible lower jaws, the two halves of which are not rigidly attached, and numerous other joints in their skull, allowing them to open their mouths wide enough to swallow their prey whole even if it is larger in diameter than the snake itself. Some snakes have a venomous bite, which they use to kill their prey before eating it. Many "non-venomous" snakes actually have toxic saliva with which they subdue the prey.

Diagram.1 Big four snakes prey sizes in captivity.



X Axis- Prey types:

- (i) (*Mus musculus*) – House mouse
 - (ii) Amphibians – Small frogs
 - (iii) (*Rattus norvegicus*) – Common Rat
 - (iv) (*Sitana ponticeriana*) – Fan throated lizard
 - (v) (*Gallus gallus domesticus*) – Small chicken
- Y Axis- Length of the prey in centimetres.

Method :

Faecal samples were collected from all the big four snakes to identify their diet content. All the snakes were fed regularly (once or twice a week) and enclosures were monitored in the morning for defecation. Different sets of samples were collected over a three months period. Small, closed plastic boxes of diameter 5cm and non-sterile latex gloves were used to collect and store the samples. Sample boxes were marked with all necessary details and were tested by adding normal water (H₂O) and a hair identification key was used to identify the types of hair present in the sample (Bahuguna *et al.*, 2010⁽¹⁶⁾). The primary diet of the big four in captivity was chicken, rodents, frogs, small lizards and fan throated lizards (*Sitana ponticeriana*) (For saw-scaled vipers). Except the saw-scaled vipers, all other snakes were primarily fed on chickens and rodents, so most samples contain hair and legs of those two. Since all the animals received the same diet, none of the snakes were marked and studied separately for diet analysis. Some samples were freshly taken in their semi-liquid state while others were collected in a dry, solid state. The enclosures were cleaned everyday by the keepers for maintenance purposes, so the uncollected samples were cleared out each day to avoid collecting the old samples. None of the big four snakes regurgitated in the past three months of observation, which shows that they are not under stress, the prey is not too large to swallow and that they had not been disturbed or mishandled by humans (Kaplan, 2000⁽¹⁷⁾). No Big four snakes in the captivity were dewormed, made to starve, or dehydrated during the observation period. Picture 3: showing the faecal analysis of common krait snake.

**RESULTS :**

The sixteen major behavioural patterns (Table 2) were observed in the big four Indian snakes. The proper diet, handling method indicates the healthy growth, non-regurgitation of the snakes which is most important in ex-situ breeding.

DISCUSSION:

Table 2 shows the captive behaviours and responses to the environment of big four snakes which has been reported for other snakes in the wild as well and synchronize with the other reptiles behaviour such as Rainbow skinks (*Carlia jarnoldae*) (Langkilde, 2003⁽¹⁸⁾), Scincid lizard (*Lampropholis guichenoti*). Snakes behaviour activity is not reported in depth in captive because of restricted environment. Unfortunately, the lack of behavioural data is Indian species does not allow for more appropriate comparisons. To the best of my knowledge, this is the first attempt made to draw an ethogram for “Big Four Indian Snakes in Captive”. Many studies have investigated the feeding habits and growth rates of different snake species (Barnard *et al.*, 1979⁽¹⁹⁾; Barnett & Schwaner, 1985⁽²⁰⁾; Forsman, 1996⁽²¹⁾; Scudder-Davis & Burghardt, 1996⁽²²⁾; Cundall & Greene, 2000⁽²³⁾; Schuett *et al.*, 2005⁽²⁴⁾) and they shed skin depending on their growth. The sampling results show healthy digestion of the species. Therefore feeding the smaller prey is essential and over feeding the animals should be avoid for the betterment of captive maintenance.

ACKNOWLEDGMENT:

I would like to thank Romulus Whitaker, founder of Chennai snake park trust and Vijayaraghavan, Chairman for giving me the opportunity to work on this project. I am grateful to Rajarathinam, Director and S.R.Ganesh, Herpetologist for supervising the study. I would like to extend my thanks to all the staffs of Chennai snake park

trust and Madras Crocodile bank trust for the continuous support throughout this study.

REFERENCES :

1. Singh, M., & Kaumanns, W. (2005). Behavioral studies: A necessity for wildlife management. *Current Science*, 89:1230–1236.
2. Pough, F.H., Andrews, R.M., Cadle, J.E., Crump, M.L., Sawitzky, A.H., & Wells, K.D. (2001). *Herpetology*, 2nd Ed. Prentice Hall: New Jersey.
3. Burghardt, G.M., & Milostan, M. (1995). *Ethological studies on reptiles and amphibians: Lessons for species survival*. pp 187-203, Sunny Press, NY.
4. Vitt J.L., & Caldwell, P.J. (2014). *Herpetology, An Introductory Biology of Amphibians and Reptiles*, 4th Ed. Elsevier, UK.
5. Whitaker, R (1978). *Common Indian snakes: A field guide*, Macmillan India. pp 154.
6. Daniel, J.C (2002). *The Book of Indian Reptiles and Amphibians*. Oxford university press, Mumbai.
7. Das, I (2002). *A photographic guide to the snakes and other reptiles of India*. New Holland publishers : UK, pp 144.
8. Whitaker, R & Captin, A. (2004). *Snakes of India: The Field Guide*. Draco Books, India.
9. De Silva (1990). *Colour guide to the snakes of srilanka*. R&A publishing, U.K. pp 130
10. Altmann, J. (1974). *Observational study of Behaviour : Sampling methods*. *Behaviour*, 49 (4), pp 227-267.
11. Pyke, G.H (1984). *Optimal foraging theory: A critical review*. *Annual Review of Ecology and Systematics* 15: 523–575.
12. Mehrtens J.M. (1987). *Living Snakes of the World in Colour*. New York: Sterling Publishers, pp 480.
13. Mertens, R (1961). "Lanthanotus: an important lizard in evolution". *Sarawak Museum Journal*, 10: 320–322.
14. Behler, J. L., & Wayne, K.F. (1979). *The Audubon Society Field Guide to Reptiles and Amphibians of North America* 2nd Ed. New York: pp. 581.
15. Hsiang, A.Y., Field, D.J., Webster, T.H., Behlke, A.D., Davis M.B., Racicot, R.A., Gauthier, J.A. (2015). *The origin of snakes: Revealing the ecology, behaviour, and evolutionary history of early snakes using genomics, phenomics, and the fossil record*. *BMC Evolutionary Biology* 15:87.
16. Bahuguna, A., Sahajpal, V., Goyal, S.P., S.K. Mukherjee, S.K., & Thakur, V (2010). *Species identification from guard hair of selected Indian mammals: A reference guide*. Wildlife Institute of India, Dehradun, India.
17. Kaplan, M (2000). "Herp care collection"- vomiting / Regurgitation in reptiles. Retrieved from <http://www.anapsid.org/vomiting.html>
18. Langkilde, T., Schwarzkopf, L., & Alford, R (2003). "An Ethogram for adult male rainbow skinks". *Herpetological Journal*, 13, pp. 141-148.
19. Barnard, S.M., Hollinger, T.G. & Romaine, T.A (1979) *Growth and food consumption in the corn snake, Elaphe guttata guttata (Serpentes Colubridae)*. *Copeia*, 4, 739-41.
20. Barnett, B & Schwaner, T. D (1985). *Growth in captive born tiger snakes (Notechis alter serventyi) from Chappell Island: implications for field and laboratory studies*. *Transactions And Proceedings of The Royal Society of South Australia*. 109, 31.
21. Forsman, A (1996). *An experimental test for food effects on head size allometry in juvenile snakes*. *Evolution*, 50: 2536-42.
22. scudder-davis, R. M. & Nurhardt, G. M (1996). *Ontogenetic changes in growth efficiency in laboratory-reared water snakes of the genus Nerodia*. *The Snake*, 27:75-84.
23. Cundall, D. & Greene, H. W. (2000). *Feeding in snakes*. In *Feeding: form, function and evolution in tetrapod vertebrates*. Schwenk, K. (Ed.). San Diego, CA. pp. 293–333.
24. Schuett, G. W.; Hardy Sr, D. L.; Earley, R. L. & Greene, H. W. (2005). *Does prey size induce head skeleton phenotypic plasticity during early ontogeny in the snake Boa constrictor*. *Journal of Zoology*, 267: 363-9.