

Ecology and Behavior of Reptilian Diversity in Nallamala Forest Region, Kurnool District, Andhra Pradesh

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Abstract Biodiversity is the variety among the living organisms, biological systems and biological processes found on earth. India contains about 8% of the world's biodiversity on 2% of the Earth's surface, making it one of the 12 mega diversity countries in the world. Acquiring knowledge of flora and fauna is of immense scientific and commercial importance. Nallamala Hills stretching across five districts across portions of Kurnool, Prakasam, Nalgonda, Guntur and Kadapa of the state of Andhra Pradesh is renowned for being rich in biodiversity. The vegetation is typically of southern tropical dry deciduous and southern tropical moist deciduous forest types intermingled with shrub. Though several research activities and surveys were made or undergoing in the area of study / project i.e. Nallamala forest (Kurnool region), Andhra Pradesh regarding the characterization, quantification of the species diversity, very little is known to public and which are confined to research area people only. Ecology and behavior of the spe-

cies diversity especially in relation to reptiles gives the impressive knowledge on the species diversity for the public / students even from the College / University level.

Keywords Biodiversity, Reptiles, Behavior, Nallamala forest, Kurnool.

Introduction

Biodiversity refers to the totality of species, populations, communities and ecosystems both wild and domesticated that constitute the life of any one area or of the entire planet. It is a hereditarily based variation at all levels of organization from the genes within a single local population to the species composing all or part of a local community and finally to the communities themselves that compose the living parts of multifarious ecosystems of the world. Most of the biodiversity of the Earth is located around Equator due to its high temperature and rainfall. Rainforests of Central and South America, Equatorial Africa and South East Asia house may diverse arrays of plants and animals. India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. India contains about 8% of the world's biodiversity on 2% of the Earth's surface, making it one of the 12 mega diversity countries in the world. This is based on the species richness and levels of endemism recorded in a wide range of taxa of both plants and animals.

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Obtaining knowledge of flora and fauna is of immense scientific and commercial importance. Region-wise consolidated fauna survey help us in understanding the biological wealth of the country and their distribution and status. Nallamala Hills stretching across five districts across portions of Kurnool, Prakasam, Nalgonda, Guntur and Kadapa of the state of Andhra Pradesh is renowned for being rich in biodiversity (Rao 1998). Nallamala (15°20'–16°31' N and 78°30'–80°10' E) is a group of low hill ranges in the central part of Eastern Ghats. From the Palnad basin in the North to the Tirupati basin in the South, the Nallamala runs a distance of 430 km with an average width of 30 km (Anon 1965). The altitude ranges from 200 to 950 m. An unbroken chain of rugged hills with precipitous cliffs encompassing an area of about 7640 km² forms the range. There are three types of soil : red, mixed varieties and black. The red and mixed varieties occur along the bases of Nallamala. The humus content is almost negligible as the black soil occurs in plains where cultivation is practiced (Krishnan 1956). The vegetation is typically of Southern tropical dry deciduous and Southern tropical moist deciduous forest types intermingled with shrub (Champion and Seth 1968). The climate is generally hot and dry with temperatures rising up to 43°C to 45°C during May and dips down to 8°C in December. Average rainfall in this region is between 900 and 1000 mm.

It is important to review and modify relevant environmental policies and in parallel develop strict regulatory frameworks to ensure that environmental and social impacts are minimized and mitigated (Webb et al. 2012). Concomitantly, the results of the protected area gap analysis should be integrated with national land use plans to limit conflicting land uses and maximize connectivity across conservation corridors. With the economic opportunities presented by increasing number of development projects in the country there is a need to include valuation of environmental services and biodiversity in development planning.

Ecosystem services have emerged as an integrated framework for managing ecosystems in an increasingly human dominated world (Harris et al. 2006, Lele et al. 2013). Defined as the benefits natural systems provide to humans, this nature for people paradigm has been increasingly adopted by governments

and nonprofit organizations to frame, plan and allocate resources (Posner et al. 2016). There is a notable division between those that see ecosystem function as something that can be quantified in monetary terms versus those that explicitly reject one dimensional valuation schema as being both impossible and undesirable (Pascual et al. 2017).

This research work is carried out to characterize the species of reptiles regarding their ecology and behavior found in the above said region, their habits, habitat. Though several research activities and surveys were made or undergoing in the area of study / project i.e. Nallamala forest (Kurnool region), Andhra Pradesh regarding the characterization, quantification of the species diversity, very little is known to public because they are confined to research area people only. Ecology and behavior of the species diversity of reptiles gives the impressive knowledge on the species diversity for the public / students even from the College / University level. Hence this work is selected which will have mass acceptance and appreciation.

(We express our deep felt gratitude to all the biologists, academicians for their effort to the earlier outcomes regarding this area of research and also the authorities of Forest Department of Andhra Pradesh State for encouraging various institutional persons (authenticated) to do research in the said region / area whereby we obtained the information provided in this study).

Materials and Methods

Direct method involving sampling area i.e. as mentioned above (Nallamala forest, Kurnool region, Andhra Pradesh) and also based on secondary data.

Results and Discussion

We made our study based on the method said above on reptilian diversity of the Nallamala Hills, especially along the tracts encompassed by Nagarjunasagar Srisailem Tiger Reserve (3568 km²) and Gundla Brahmeshwaram Wildlife Sanctuary (1198 km²). Except a few faunal surveys carried out by Zoological Survey of India (Murthy 1968, 1986, Sharma 1971,

Agarwal and Bhattacharya 1976) and by the Forest Department, no scientific documentation of mammalian fauna was done until recently. Ecology and behavior of 19 nos. species of reptiles, habits, habitats, is collected and made available in this research study.

Here are the findings of our study on the ecology and behavior, habits, habitats of the said 19 nos. species of reptiles:

1. Indian Cobra (Spectacled/Binocellate Cobra)

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Elapidae, Genus: *Naja*, Species: *naja*. Other species include: 1a. *Naja naja oxiana* (Eichwald) (Black cobra), 1b. *Naja naja kaouthia* (Monocellete cobra), Local names in different places of India: Hindi–Nag, Bengali–Naja gokkura, Tamil–Nalla pambu, Telugu–Nalla pamu.

It occurs in wild forests like Tropical rain forests–Terrestrial Biomes–Savanna or Grassland forest–Rain forest–Shrub forest and in cultivated areas. The Indian cobra feeds on rodents, lizards and frogs. When threatened the Indian cobra will assume its characteristic posture it will raise the front 1-3 times of its body size and elongate its long flexible neck ribs and loose skin to form its distinctive hood which resemble eyes. The Indian cobra eats rats and mice that carry disease and eat human food. Also cobra venom is potential source of medicine including anti cancer drugs and pain killers. This species is highly venomous and its bite can be lethal. It is often encountered by accidents and many people die each year from its bites. In Indian sub continent it is found almost anywhere mainly in the plains, open fields, holes of embankments, hollows of trees, old tenet mounts and ruin rock piles. Usually, not aggressive except under extreme provocation.

2. Indian common Krait

Phylum : Chordata, Class : Reptilia, Order: Squamata, Family: Elapidae, Genus : *Bungarus*, Species: *coerulus*. Local names in different places of India: Hindi–krait, Bengal–kalach. Tamil–Kattuviryan, Telugu–Katlapamu, Marathi–Manyar.

They usually occur in sandy soil, termite mounds, burrows of small rodents and piles of brick and rubble, as they are mainly snakes of the plains. Despite the fact that they are common in some parts of the country like coastal area of Tamil Nadu, one rarely sees them. Kraits are nocturnal and they hide during the day time in holes of field mice and rats. They are short fanged snakes with a bulldog clasp and extremely fast and active at night. When a male krait is introduced to a cage of captive specimens, a jerking dance often follows, at times ending in a serious fit of biting. Kraits mainly eat snakes, lizards and rodents. They are true cannibals and can even gulp small kraits from a captive group. Their favorite items include Stripped Keel backs and Olive Keel backs. Kraits are extremely venomous and their venom includes nerve paralysis as it is highly toxic. As it leaves no local symptoms, a patient should be cautiously observed for signs of paralysis and treated immediately with anti-venom.

3. Saw scaled viper

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Viperidae, Genus: *Echis*, Species: *carinatus*, Local names in different places of India: English–Saw-scaled viper. Bengali–Foorsha, Gujarati–Fursa, Hindi–Fursa, Tamil–Suruttai viriyan.

They reside in the dry sandy or rock plains. They usually rest under rocks, behind barks, in thorny plants and other dry concealed places. Their favorite haunts include areas of laterite soil, boulders and light shrub jungle with small hills and open dry tracts. Mainly this viper is nocturnal and rarely makes a day-light appearance except possibly to bask in the sun after a cold, rainy night. This inconspicuous snake hides under rocks, bushes or in burrows during day time. They become very lively on humid or rainy nights and regular warm roads after dark. Saw scaled vipers get its English and Hindi names from the saw-edged keels of their lateral scales, which it rubs producing a ssshhh sound which is similar to the hissing noise produced by other snakes during violent breathing. They feed on lizards, mice, frogs, scorpions and few other arthropods. This species are plentiful throughout and are collected in large numbers in some areas like the Ratnagiri District of

Maharashtra for production of anti-venom at the Haffkin's Institute. Saw scaled vipers cause the largest number of venomous bites in the regions where they are very common. As this snake is fairly small, its bite is rarely fatal. Their venom is a strong blood coagulant, which after neutralizing the body's clotting agent, causes a bleeding tendency similar to hemophilia. The bite can be treated by way such as anti-venom, transfusions, vitamin-K and calcium carbonate.

4. Bamboo pit viper

Phylum: Chordata, Class: Reptilia, Order: *Squamata*, Family: *Viperidae*, Genus: *Trimeresurus*, Species: *gramineus*. Local names in different places of India: Indian tree viper, Bamboo snake, Indian green tree viper, Green tree viper, bamboo viper.

They generally prefer cool, thick vegetation near stream edges, bamboo and other dense jungle foliage. They are slow moving snakes and are active at night and sleep in the open by day. They protect themselves by camouflage. Although slow to defend themselves, they are capable of fast strikes and bites if injured or seriously troubled. They often vibrate their tail when frightened or cornered. Small ones feed on frogs and lizards. Larger ones tend to prefer rodents but seem to take frogs as well. As all Indian pit vipers are forest snakes the loss of dense forested areas, particularly the evergreen rain forests, is reducing the population of several species. Pit vipers are rather small and their venom is low in toxicity, hence their bites are rarely serious. Bites are common in some plantation areas, but the victims are generally only incapacitated for a day or two.

5. Russell's viper

Phylum: Chordata, Class: Reptilia, Order: *Squamata*, Family: *Viperidae*, Genus: *Vipera*, Species: *russellii*. Local names in different places of India: English-Chain Viper, Hindi-Parra, Chitti, Kaudia. Hindi names are variable and region specific. Marathi-Ghonas, Bengali-Chandroborra.

Russell's viper resides in the open areas of the hilly regions and plain shrub jungle bordering farm

lands. They are found in termite mounds and rat holes in very hot weather, but their preferred places are rock fissures, thick leaves, grass, thorn bushes and cacti. Pandanus bushes and Agave are their favorite abodes. This snake may seem to be sluggish, but when aggravated they are capable of very fast movements in short spurts. They may bite in defence and make a hissing sound. They are coy and timid, unlike cobras which are proficient at quick escape. Bites usually happen as a result of accidents in the plantation, estate and farms where farmers unknowingly put their feet or hands in dense bushes, or step on a viper. Young ones are wild in activity and can eat other snakes, lizards, mice, land crabs and sometimes even feed on scorpions and few arthropods. The adult vipers seem to be rodent-eaters, probably catching a bird. This species forms a main resource of the skin industry in South India. These are completely exterminated in some areas through enormous all season collection. Their venom is extremely toxic and the bite is one of the most lethal of all Indian snakes. So it should be urgently treated with ample anti-venom. This poisonous venom affects the blood and is used as medicine to check bleeding.

6. Common water snake

Phylum: Chordata, Class: Reptilia, Order: *Squamata*, Family: *Calubridae*, Genus: *Xenochropis*, Species: *piscator*. Local names in different places of India: English-Asiatic water snake, Hindi-Paani wala saap, Marathi-Davad.

Checkered keel back water snakes are found throughout India, up to 3,000m in the Himalayas. The darker forms are common in the streams of the higher hills in the Ghats and Himalayas. But their appearance and habits are similar. They usually live in lakes, ponds, wells, rivers, streams and flooded rice fields. Checkered keel backs are lively during day and night and hunt along the edges of ponds and rice fields, spending much time on land after dark. They flatten their head, extend the ribs of the neck and rear up, once excited. Because of this act, many mistake them for cobras. They bite readily when stepped on or caught, but soon become docile if handled properly. Young ones feed on tadpoles and water insects. As they grow larger, they intake fish, frogs and some-

times rodents and birds. They generally swallow their prey alive. Their long frog teeth in the back of the upper jaw hold and puncture frogs.

7. Vine snake

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Calubridae, Genus: *Ahaetulla*, Species: *nasutus*.

This snake is found throughout India, except in the Northwest and much of the Gangetic basin, upto 2,500 m above sea level. They can be seen in and around low bushes to trees, on the plains to large rain forest trees in the hills. They normally depend on their shape and color to get away exposure. Also, they can move at a fairly good speed. They open the mouth very wide and swell the body warningly, when aggravated. They are rear-fanged and usually hold its prey until the slightly toxic venom has killed it. At the time of breeding, these snakes group to gather in clusters and can be even seen in branches. Their diet mainly includes frogs, lizards, small birds and mice. On rare occasions, Vine snakes even feed on other snakes like the shield tail snake. Vine snakes are commonly found. It is greatly feared and almost always killed when seen. In many areas, it is unwisely believed that Vine snakes will nip at a person's eyes and peck them out.

8. Wolf snake

Phylum: Chordata, Class : Reptilia, Order: Squamata, Family: Calubridae, Genus: *Lycodon*, Species: *aulicus*.

Common Wolf Snakes are found throughout India, including the Andaman and Nicobar Islands up to over 2,000 m in the hills. They live in and around caves, stone piles, hollow trees, under bark and other dry, sheltered places. They easily survive in man-made mud, brick and cement caves because of abundant grub to feed on. They are strictly nocturnal and are never seen out during the day time. They are great climbers and can easily cling to fairly smooth walls and tree trunks. Initially they tend to bite with micro-ferocity, when handled. Sometimes a big bite can be quite painful. Their long front teeth can be sometime mistaken for fangs. Adult common wolf snakes prefer

skinks and geckos, though they also eat small lizards and frogs. They swallow their prey alive with the aid of their long front teeth which help in gripping it. The young have bolder and brighter patterns than the adults. They are often mistaken and killed as Kraits. Though found commonly, they are nowhere abundant.

9. Common sand boa

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Boidae, Genus: *Eryx*, Species: *conicus*.

They are common throughout India on the plains and low hills but rare or almost absent in most parts of Bengal and Assam. They thrive in sandy soil, rat burrows, brick piles and rocky areas are favored. Common sand boas are mainly nocturnal and hunt after dark for fresh rodent burrows with head and neck out of a hole, for a passing rodent. The common sand boas typically hide the head beneath the body when provoked. Though less of a digger than the Red sand boa, this snake also prefers sandy soils for effortless burrowing. The adults munch on rats, lizards, birds, frogs and toads. The young are bright replicas of their parents and somewhat resemble the saw scaled vipers. In some parts of India it is thoughtlessly believed that the bite or lick of this snake causes leprosy or a similar skin disease.

10. Common cat snake

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Calubridae, Genus: *Boiga*, Species: *trigonata*.

They are found throughout India, but mostly on plains. The Himalayan cat snake is found up to 3,000 m above sea level. In Tamil they are called palm leaf snakes, as it is found coiled up in the leaves of the Palmyra during the day time. They also like to stay in a cool place, among bushes, in that attached roofs or under the bark of trees. Cat snakes have cat-like protruding eyes and long feathery tongue which indicates that they are nocturnal. They are rear-fanged and have mild venom for paralyzing their prey. Usually they are inoffensive and when disturbed will coil firmly, rearing back and vibrating the tail. They mainly

feed on geckos and other lizards, but also eat mice and small birds.

11. Indian rock python

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Pythonidae, Genus: *Python*, Species: *molurus*.

These are scattered mostly throughout the India. Pythons are found in estuarine mangrove forests, arid shrub jungle and the cool dense rain forests up to 2000 m above sea level. Pythons can adapt in many types of environment but they require large undisturbed areas to hunt and hide in. They live in rocky clefts and caves, abandoned mammal burrows, hollow trees, dense water reed and mangrove thickets. They generally prefer a place near permanent water source. This species bask in the sun during the day time. At night, they hang around in search of prey or lie in wet near a water hole or a regular mammal pathway. Very large pythons seem unwilling to move far and often establish a territory and a preferred residence. After a heavy meal, they become lethargic and may rest for several days or even weeks during digestion. Pythons mainly feed on warm blooded prey ranging in size from mice and birds to jackal, civets and even deer and wild boar. They stalk prey silently, striking suddenly and tightening around the victim. Pythons do not crush their prey but hamper their respiration and heart beat. Pythons are extremely valuable predators on agricultural pests. The female may contract her body muscles rhythmically, thus incubating the clutch, affording temperature and humidity control and protection. Pythons are killed throughout their range for their fine skin ; thus, this beautiful species is now locally extinct in many areas. They are now partly protected by the Government of India and Python skin export is banned. In Kerala and Tamil Nadu, Poliyars and other tribal's eat Python meat and the fat is favored in many areas for supposed medical uses.

12. Rat snake

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Calubridae, Genus: *Ptyas*, Species: *mucosus*.

They are found throughout India, including the

Andaman and Nicobar Islands and 4,000 m above sea level. Termite mounds and rat holes are the favorite places. Generally they are versatile snakes and can adapt themselves to almost every environment. Their most wanted hunting grounds include high grass, rice fields and storage places. Being phenomenal rat eaters, these naturally occur more where rats dwell. And since rats are abundant where humans are, these snakes are plentifully found. They are diurnal and like other animals which live close to humans, tend to learn our activity cycles and avoid contact in its foray. They hiss, puff its throat and strike with force when threatened. They are harmless snakes, but their bite can be painful at times. They are mainly rodent eaters, but also feed on frogs, lizards, birds and even small snakes. They usually swallow the prey live or kill them by mechanically applying pressure of the jaws and body. In some regions their entire lot has been wiped out, resulting in an explosive increase in the rodent population. Many tribal groups survive on this industry ; but seasonal controls to allow breeding and studies on the level of cropping a persistent yield without the threat of extinction may afford them a livelihood without rigorous effect on agriculture.

13. Trinket snake

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Calubridae, Genus: *Elaphe*, Species: *helena*.

They are found throughout India. Green trinket snakes are found in the Andaman and the Mandarin trinket is found up to 4,000 m in the Himalayas. They generally live deep in termite mounds, rock piles and crevices during the hot weather, whereas in the cool season they emerge and are seen in leafy trees and bushes. They are active during day as well as at night. Generally trinket snakes are well mannered and calm when handled, but occasionally they swell their necks, rear back open-mouthed and make quick strikes at a provoker. In defense, they will sometimes vibrate their tails resembling one of the highly specialized rattle snakes in America. The adult trinket is mainly a rodent eater which kills its prey by constriction. On few occasions birds and their eggs are also eaten. As they prefer farmlands as well as forests, the rapid increase of cleared agricultural lands seems to have little ef-

fect. Though beautiful in appearance, they are not plentiful enough to be in demand by the skin trade. Trinket snakes are often wrongly considered as venomous even by snake-catching groups.

14. Indian chameleon

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Chamaeleonidae, Genus: *Chameleo*, Species: *zeylanicus*.

Local names in different places of India: Hindi–Girgit, Bengali–Bahuroop, Tamil–Pachchohnnan, Gujarati–Sarado. Arboreal in nature. It has a rare camouflaging quality, being able to change normal green body color frequently in response to light, heat, environment, emotion, Prefers wooded and semi desert areas.

15. Indian garden lizard

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Agamidae, Genus: *Calotes*, Species: *versicolor*.

Sun-loving lizard. Most often seen basking on shrubs, sometimes on wall or foraging ground. Most characteristic of dry, open shrub land and edges of cultivated fields. Scarce in dense forest, possibly absent in mountain grassland. Can change body coloration to a certain degree. Is capable of rotating each eye independently. If caught, will thrash and attempt to bite. Sleeps on vegetation at night. In captivity feeds on crickets, grasshoppers and beetles. Will lap up water sprinkled on leaves.

16. Roux's forest lizard

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Agamidae, Genus: *Calotes*, Species: *rouxii*.

In forest habitats ranging from moist evergreen to dry shrub or secondary forests. It is endemic to western India, where it can be found in many localities (Western Ghats of Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu and Eastern Ghats). It has been reported from the protected areas and reserve forests of Andhra Pradesh, Madhya Pradesh,

Maharashtra and Orissa. The species is generally widespread and common throughout its range. It can be found at elevations of 100–900 m (330–2,950 ft) above sea level.

17. Jerdon's snake eye

Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Lacertidae, Genus: *Ophiurus*, Species: *jerdoni*.

Terrestrial, lives in dry, rocky terrain in degraded and open forest. Very agile and fast moving often disappear with slight disturbance, feeds on small insects and spiders. Elsewhere India is found in outside Pakistan.

18. Indian star tortoise

Phylum: Chordata, Class: Reptilia, Order: Testudines, Family: Testudinidae, Genus: *Geochelone*, Species: *elegans*.

Inhabits in shrub forests and edged of deserts, agricultural fields, forests of teak, grassland and thorn shrubs. It is largely herbivorous, known to eat various species of plants, although also scavenge on animal matter. Indian star tortoise is a herbivore. It usually eats leaves, fruit, berries and flowers. Carrion is occasionally consumed in the wild. Young tortoises are born with butterfly or bow-shaped pattern on the shell which slowly transforms into stars as they grow. Indian star tortoise doesn't hibernate during the winter, but it decreases activity during the extremely hot and cold periods of year. Natural enemies of Indian star tortoises are birds of prey, snakes and humans.

19. Freshwater crocodile

Phylum: Chordata, Class: Reptilia, Order: Crocodylia, Family: Crocodylidae, Genus: *Crocodylus*, Species: *johnsoni*.

This species is shy and has a more slender snout and have slightly smaller teeth than the dangerous saltwater crocodile. Freshwater crocodiles will eat crustaceans, insects, spiders, fishes, frogs, turtles, lizards, snakes, birds and mammals. They can be cannibalistic with larger crocs preying on hatchlings.

Food may be obtained using the sit and wait method i.e. they wait for small animals to come within close range before snapping them up in a sideways motion. Larger prey may be ambushed. To aid digestion they may ingest small pebbles which help to grind up food in the gizzard. Freshwater crocodiles are largely nocturnal, meaning they are mainly active at night. They are mostly solitary animals, but may congregate in groups. A large male will often dominate over a congregation and assert dominance by biting subordinate males.

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