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Cover

Bibron's coral snake (*Calliophis bibroni*)

Venomous. Endemic to Western Ghats. Grows to 2 ft. Feeds mainly on snakes. Lays eggs. Also see page 29.

Photo: K. Karthik

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Volume : VIII Issue 1

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CONTENTS

PAGE

HERPETOFAUNAL RICHNESS AND ITS CONSERVATION STATUS IN NARSINGHGARH WILDLIFE SANCTUARY, MADHYA PRADESH – Mukesh Ingle and Anil Sarsavan	1
A COMPARATIVE STUDY OF HERPETOFAUNA IN URBAN AND PERIPHERAL FOREST AREAS OF SOME PARTS OF SOUTHERN RAJASTHAN, INDIA – Vivek Sharma, Umesh Dutt, Rakesh Kumar Kumawat, Dinesh Meena, Divaker Yadav, Naresh Kumar Kumawat, Neha Sharma and Sharma, K. K.	10
HERPETOFAUNA OF JAISAMAND WILDLIFE SANCTUARY, RAJASTHAN – Satish Kumar Sharma	21
A PRELIMINARY STUDY ON TONGUE COLOURATION OF SOME INDIAN REPTILES – Satish Kumar Sharma and Vijay Kumar Koli	26
RECORD OF BIBRON'S CORAL SNAKE <i>CALLIOPHIS BIBRONI</i> (JAN, 1858) FROM KODAGU HILLS, WESTERN GHATS – K. Karthik	29
EGG-EATING BEHAVIOR OF A SPECTACLED COBRA <i>NAJA NAJA</i> – M.Rameshwaran	31
TERMITE HILL GECKO (<i>HEMIDACTYLUS TRIEDRUS</i>) PREDATION ON A JUVENILE BARK GECKO (<i>H. LESCHENAULTII</i>) – M. Rameshwaran	33
BREEDING NOTES ON BARK GECKO (<i>HEMIDACTYLUS LESCHENAULTII</i>) AND TERMITE-HILL GECKO (<i>H. TRIEDRUS</i>) FROM THOOTHUKUDI, TAMIL NADU – M.Rameshwaran	35
RANDOM HARVEST – B.Vijayaraghavan	39

CONTENTS

PAGE	
1	EDITORIAL
2	REVIEW ARTICLE
3	ORIGINAL ARTICLES
4	REVIEW
5	REVIEW
6	REVIEW
7	REVIEW
8	REVIEW
9	REVIEW
10	REVIEW
11	REVIEW
12	REVIEW
13	REVIEW
14	REVIEW
15	REVIEW
16	REVIEW
17	REVIEW
18	REVIEW
19	REVIEW
20	REVIEW
21	REVIEW
22	REVIEW
23	REVIEW
24	REVIEW
25	REVIEW
26	REVIEW
27	REVIEW
28	REVIEW
29	REVIEW
30	REVIEW
31	REVIEW
32	REVIEW
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35	REVIEW
36	REVIEW
37	REVIEW
38	REVIEW
39	REVIEW
40	REVIEW
41	REVIEW
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86	REVIEW
87	REVIEW
88	REVIEW
89	REVIEW
90	REVIEW
91	REVIEW
92	REVIEW
93	REVIEW
94	REVIEW
95	REVIEW
96	REVIEW
97	REVIEW
98	REVIEW
99	REVIEW
100	REVIEW

HERPETOFAUNAL RICHNESS AND ITS CONSERVATION STATUS IN NARSINGHGARH WILDLIFE SANCTUARY, MADHYA PRADESH

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Abstract

A herpetofaunal inventory based on field surveys, literature records and photographic records is presented for Narsinghgarh Wildlife Sanctuary (NWS) and its environs, situated in the Malwa Region of Madhya Pradesh, India. We list a total of nine species of amphibians and 34 species of reptiles from the area. The present study indicates that species count in Narsinghgarh Wildlife Sanctuary is likely to increase with additional surveys and systematic work. The observations include new locality records and natural history information on some species of amphibians and reptiles including *Fejervarya* cf. *syhadrensis*, *Eutropis dissimilis* and *Argyrogena fasciolata*. *Hemidactylus brookii* was observed expressing a modest degree of morphological and colour pattern variation. This represents the first such extensive checklist for the sanctuary and provides an initial baseline data of species for future research in this area.

Key words

Herpetofauna, Narsinghgarh Wildlife Sanctuary, Rajgarh, Malwa Region, Madhya Pradesh.

Introduction

Narsinghgarh Wildlife Sanctuary (23°35' - 23° 40' N - 77°02' - 77° 10' E) is situated in Rajgarh district (Malwa Region) of Madhya Pradesh at an elevation of 462 m. Spread over an area of 59.19 sq km. The forests of the Narsinghgarh Wildlife Sanctuary (NWS) are mainly denuded due to biological pressure and insufficient protection. The main attraction of sanctuary is the Chidikho lake which is spread over an area 22 hectares with a catchment area of 28 sq. km. This is surrounded by small hilly tracts and dense forest. The area has laterite formation due to weathering of the trap rocks. The soil formed by this process are lateritic and skeletal in nature.

The area of the sanctuary which is adjoining Rajasthan state has dry climate and the habitats are scrub forests and grass thickets. According to Champion and Seth (1968), the forests are classified as southern tropical dry deciduous forests which are further classified as follows: Group 5: Tropical Dry Deciduous forest, Sub group 5a: Southern Tropical Dry Deciduous Forest, degradation stage of deciduous forest, DS1: Dry Deciduous Scrub Forest, DS4: Dry Grass Land. The faunal composition of NWS presents the Deccan peninsular zone of Bio-geographic classification of India by Rodgers and Panwar (1988).

Methodology

The field methods involved basic exploration of the herpetofauna in the NWS. Herpetofaunal surveys were conducted at NWS from July to August 2012; we spent three weeks in the field. For this study, we used different field techniques (Noon et. al., 2006) including intensive crevice examination and belt-transect (6 m) method.

All the microhabitats (rock and boulders, dead and fallen logs, dense bushes and grass patches, rock and tree crevices and leaf litters) within transect were thoroughly checked (using flushing and beating, overturning stone and logs) for herpetofauna. Visual encounter surveys (Heyer et. al., 1994) were carried out throughout the sanctuary. It is the most effective method of surveying turtles in the various riverine habitats, amphibians along wetlands, and to survey xeric habitats for diurnal, non-fossorial lizards. Occasionally, diurnal snakes were encountered using this technique. Amphibian call surveys are an excellent way to determine the presence of frogs and toads. Some anuran species that are rarely seen are easily identified by call surveys. Road cruising was also carried out for identifying snake species in the Sanctuary. After rains, during day and night, this method is very effective. Opportunistic diurnal and nocturnal searches were also done along paths in forested and open areas (Thompson et. al., 1990). Randomized walk transects (Seber, 1979) were carried out at night and during the day across terrestrial habitat (forest patches, grassy meadows, paddy fields, and plantations area) and aquatic habitat (ponds and streams). In addition, the availability and extent of the microhabitat features was also recorded.

Identification of the reptilian species was done using the keys in Smith (1931, 1935, and 1943); Whitaker and Captain (2004) and Uetz *et al.* (2013). For amphibians, we followed the taxonomy of Dutta (1997) and Frost (2013).

Results & Discussion

Through fieldwork in NWS altogether forty three species were recorded; which included nine species of amphibians- Order Anura (four families, eight genera) and thirty four species of reptiles-Order Testudines (one family, one genera, one species), suborder Sauria (five families, nine genera, fifteen species), suborder Serpents (six families, eighteen genera, eighteen species) were examined in the study area. Family Colubridae was dominant. *Duttaphrynus melanostictus*, *Hoplobatrachus tigerinus*, *Euphlyctis cyanophlyctis*, *Microhyla ornata* and *Fejervarya* sp. were the most common amphibian species and were spotted frequently almost throughout the study area. Five species of skink were observed during study period. *Eutropis carinata* and *Eutropis macularia* were abundant and, *Eutropis dissimilis*, *Lygosoma albopunctata*, *Lygosoma punctata* were less common, but not rare in the area. *Naja naja*, *Ptyas mucosa*, *Lycodon aulicus*, *Xenochrophis piscator* and *Argyrogena fasciolata* were commonly encountered throughout the study period. A road kill specimen of *Argyrogena fasciolata* was found during road survey. Interestingly, this specimen shows different hemipenial morphological characters; we are comparing it with other museum specimens. *Calotes versicolor*, *Hemidactylus brookii*, *Hemidactylus flaviviridis* were found both in the forest and also near human habitation. *Hemidactylus brookii* expresses a modest degree of morphological and colour pattern variation in this region. Some interesting new locality records also cover in this study viz. - *Hemidactylus triedrus*, *Lygosoma punctata*, *Eutropis dissimilis*, *Brachysaura minor*, *Ophisops jerdoni*, *Fejervarya syhadrensis*, *Sphaerotheca breviceps*, and *Ahaetulla nasuta*.

Table: 1. Checklist and status of amphibian & reptiles of Narsingharh Wildlife Sanctuary

Scientific Name	Common Name	Status (IWPA)	Status (IUCN)
AMPHIBIANS Frogs and Toads Family: Bufonidae			
<i>Duttaphrynus melanostictus</i>	Common Asian toad	Not listed	LC
<i>Duttaphrynus stomaticus</i>	Marbled toad	Not listed	LC
Family: Dicroglossidae			
<i>Euphlyctis cyanophlyctis</i>	Indian skipping frog	Sch. IV	LC
<i>Fejervarya cf. syhadrensis</i>	Syhadra cricket frog	Sch. IV	LC
<i>Hoplobatrachus tigerinus</i>	Indian bull frog	Sch. IV	LC
<i>Sphaerotheca breviceps</i>	Short-headed burrowing frog	Not listed	LC
Family: Microhylidae			
<i>Microhyla ornata</i>	Ornate narrow-mouthed frog	Not listed	LC
<i>Uperodon globulosus</i>	Marbled balloon frog	Not listed	LC
Family: Rachophoridae			
<i>Polypedates maculatus</i>	Common Indian tree frog	Not listed	LC
REPTILES Turtles Family: Troinychidae			
<i>Lissemys punctata</i>	Indian flapshell turtle	Sch. I	LC
Lizards Family: Agamidae			
<i>Brachysaura minor</i>	Lesser agama	Not listed	DD

<i>Calotes versicolor</i>	Indian garden lizard	Not listed	Not listed
<i>Psammophilus blanfordanus</i>	Blanford's rock agama	Not listed	Not listed
<i>Sitana ponticeriana</i>	Fan-throated lizard	Not listed	LC
Family: Gekkonidae			
<i>Hemidactylus brookii</i>	Brook's house gecko	Not listed	Not listed
<i>Hemidactylus flaviviridis</i>	Yellow-green house gecko	Not listed	Not listed
<i>Hemidactylus leschenaulti</i>	Bark gecko	Not listed	Not listed
<i>Hemidactylus triedrus</i>	Termite hill gecko	Not listed	Not listed
Family: Scincidae			
<i>Eutropis carinata</i>	Common keeled skink	Not listed	LC
<i>Eutropis dissimilis</i>	Striped grass skink	Not listed	Not listed
<i>Eutropis macularia</i>	Bronze grass skink	Not listed	Not listed
<i>Lygosoma albopunctata</i>	White-spotted supple skink	Not listed	Not listed
<i>Lygosoma punctata</i>	Spotted supple skink	Not listed	Not listed
Family: Lacertidae			
<i>Ophisops jerdoni</i>	Snake-eyed lacerta	Not listed	Not listed
Family: Varanidae			
<i>Varanus bengalensis</i>	Bengal monitor	Sch. I	LC
Snakes Family: Typhlopidae			
<i>Ramphotyphlops braminus</i>	Brahminy worm snake	Sch. IV	Not listed
<i>Grypotyphlops acutus</i>	Beaked worm snake	Sch. IV	Not listed
Family: Pythonidae			
<i>Python molurus</i>	Rock python	Sch. I	LR
Family: Boidae			

<i>Gongylophis conicus</i>	Common sand boa	Sch. IV	Not listed
<i>Eryx johnii</i>	Red sand boa	Sch. IV	Not listed
Family: Colubridae			
<i>Ahaetulla nasuta</i>	Common vine snake	Sch. IV	Not listed
<i>Amphiesma stolatum</i>	Striped keelback snake	Sch. IV	Not listed
<i>Argyrogena fasciolata</i>	Banded racer	Sch. IV	Not listed
<i>Boiga trigonata</i>	Common cat snake	Sch. IV	LC
<i>Coelognathus helena</i>	Common trinket snake	Sch. IV	Not listed
<i>Lycodon aulicus</i>	Common wolf snake	Sch. IV	Not listed
<i>Oligodon arnensis</i>	Common kukri snake	Sch. IV	Not listed
<i>Ptyas mucosa</i>	Indian rat snake	Sch. II	Not listed
<i>Xenochrophis piscator</i>	Checkred keelback	Sch. II	Not listed
Family: Elapidae			
<i>Bungarus caeruleus</i>	Common Indian krait	Sch. IV	Not listed
<i>Naja naja</i>	Spectacled cobra	Sch. II	Not listed
Family: Viperidae			
<i>Daboia russelii</i>	Russell's viper	Sch. II	LC
<i>Echis carinatus</i>	Saw-scaled viper	Sch. IV	Not listed

IWPA: Indian Wildlife Protection Act, IUCN: International Union for Conservation of Nature, LC: least concern, DD: data deficient, EN: endangered, LR: lower risk, Sch.: scheduled.

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A COMPARATIVE STUDY OF HERPETOFAUNA IN URBAN AND PERIPHERAL FOREST AREAS OF SOME PARTS OF SOUTHERN RAJASTHAN, INDIA

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The southern Rajasthan represents plateau, forest patches and scattered wetlands. Sirohi district is situated at the south-west part of Rajasthan between parallel of 24° 20' and 25° 17' North Latitude and 72° 16' and 73° 10' East Longitude. Sirohi is the third smallest district of Rajasthan province with an area of 5139 sq. km. (2009 sq. miles) with the great variety of soil texture and geographical variations. Sirohi district represents urban area of present study and the peripheral regions around the urban area of Sirohi district represents fragmented forest patches and wetlands. This characteristic feature provides us opportunity to compare trend of population distribution in urban and forest areas of a particular geographical region.

The area under investigation is the part of Sirohi district administratively known as Sheoganj (Tehsil) located at the Northern boundary of this district. It's situated at the geographical location of 25° 9' 0" N 73° 4' 0" E; 260 m asl. The average annual rain fall is 460.1 mm and temperature goes down to 6° C in winters and rises 45° C in summers. The biodiversity is unique in this area because of specific geographical and climatic conditions. The configuration of the land is hilly and rugged with high altitude. The climate of the region is quite pleasant with subtropical features and characterized by distinct winter, summer and rainy season.

According to geological aspects Sirohi is categorized as Sandamata Complex (Tectono thermally reworked basement). Sirohi lineament bounds the western most outcrops of the deformed, metamorphosed rocks of Aravalli mountain ranges and also with eastern limit of the un-deformed, platform sequence called the Marwar supergroup (Roy and Jakhar, 2002).

Most of the earlier studies from this part have focused on higher vertebrates, and very little has been described about the herpetofaunal diversity from this part of Rajasthan (Sharma, 1995; Sharma, 1997; Sharma, 2001; Sharma, 2003; Sharma, 2007; Sharma and Mehra, 2007; Shalini and Pandey, 2007; Bhatanagar and Mathur, 2009; Bhatanagar *et al.*, 2010; Yaseen *et al.*, 2011; Sharma *et al.*, 2012a, b, c).

The trend of occurrence of faunal diversity in urban area with reference to nearby forest patches was studied in two sites around the urban parts of Sheoganj (study site A). Kambeshwar Mahadev is a temple in Sirohi district near Sheoganj representing non-urban habitat dominated by semi arid type of climatic conditions. The second non-urban study site was Jawai dam near Sumerpur town in Pali District of Rajasthan state in India. Dam was built by Maharaja Umaid Singh of Jodhpur in 1957. This is the biggest dam in the western Rajasthan. The dam has capacity of 7887.5 million cubic feet and covers an area of 102,315 acres (414.05 km²) of cultivable command area. Its height is about 61.25 feet (18.67 m). Sei dam and Kalibor dam are the feeder dams of the Jawai dam. Besides being a winter paradise for migratory birds, it is the main water supply source for Jodhpur city and parts of Pali district. If there is sufficient water in dam, then some villages of Jalore district and Pali district get water for irrigation from Jawai dam, which was main aim in making this dam.

Methodology

For the assessment of herpetofaunal diversity at these three study sites namely Sheoganj (urban), Kameshwer Mahadev Temple and area nearby Jawai Dam (forest covers) were selected to achieve the objectives. Random surveys were carried out for assessment of herpetofaunal diversity of the study area. Surveys were carried out in both day and night to find out activity pattern in reference of diurnal as well as nocturnal species. Surveys were conducted to classify microhabitats and distribution of herpetofaunal species according to microhabitats. Herpetofauna species were identified using standard diagnostic keys (Chanda, 2002; Daniel 2002; Das, 2002; Whitaker and Captin, 2004; Daniels, 2005). Survey methods included mainly Ad hoc Search (Random survey) Method along with Visual Encounter

and Transect Methods. Point Count Method was also used for assessment of the population of organism of interest.

Microhabitats: Areas under investigation were classified in following microhabitats for the convenience of the study.

Wetland / Marsh (WM): All ponds, lakes, ditches, roadside water logged areas (temporary and permanent) were classified as wetlands or marshy areas type of microhabitats.

Agricultural Fields (AF): Areas where agricultural practices were going on.

Forest Areas (FA): Fragmented forest patch near Sirohi district.

Urbanized Areas (UA): All areas near by human settlements were categorized as urbanized microhabitats. This type also included residential as well as industrial areas.

Population statuses of observed organisms were grouped in different categories as MC: Most Common; C: Common; NC: Not Common and R: Rare on the basis of their population occurred during various field surveys by different methodologies.

Several diversity measures are available for assessment of species diversity in an area. Species abundance relations were also assessed in form of Evenness indices, more specifically similarity Measures namely “Jaccard Index” and “Sorenson Index” were also assessed for different sites for comparing the similarities of occurred diversity in all mentioned three study site A (Sheoganj); B (Kameshwer Mahadev) and C (Jawai Dam).

Jaccard Index: $C_j = j / (a+b-j)$

where

j = the number of species common to both sites

a = the number of species in site a and

b = the number of species in site b

Sorenson Index: $C_s = 2j / (a+b)$

where

j = the number of species common to both sites

a = the number of species in site a and

b = the number of species in site b

Results

During the present study a total of 31 species of herpetofauna inhabiting various habitats of Sirohi district were recorded from the observed sites with the population status of these herpetofaunal species were also observed. Out of these 31 species, 8 species belonging to class Amphibia and 23 species belongs to class Reptilia (Table 1). During present study, it was observed that Sheoganj (Sirohi) supports a good diversity of Amphibians as well as Reptiles.

Site-wise Distribution and Population Status of Observed Species:

Study Site A: Sheoganj: Overall 26 species of herpetofauna were documented from Sheoganj site. Out of these 26 species the population abundance found as 2 species as Most Common; 10 species as Common; 7 species as Not Common and 7 species found as Rare.

Study Site B: Kambeshwar Mahadev: Overall 23 species of herpetofauna were documented from Kambeshwar Mahadev site. Out of these 23 species were population abundance was observed as 12 species as Common; 4 species as Not Common and 7 species found as Rare. Not a single species were categorized as Most Common.

Study Site C: Jawai Dam: Overall 28 species of herpetofauna were documented from Jawai Dam site. Out of these 28 species population abundance criteria indicated as 6 species as Most Common; 11 species as Common; 5 species as Not Common and 6 species found as Rare.

Similarity or Evenness Status among various study sites: To assess the similarity or evenness of species occurrence among studied different sites A (Sheoganj); B (Kambeshwar Mahadev) and C (Jawai Dam) the biodiversity indices "Jaccard Index" and Sorenson Index" were assessed for assessment of species diversity in study area.

	Jaccard Index			
	$C_j = j / (a+b-j)$			
Sorenson Index $C_s = 2j / (a+b)$		Site A	Site B	Site C
	Site A	-	0.689	0.862
	Site B	0.816	-	0.645
	Site C	0.925	0.784	-

Conclusion

During our study we came across certain threats direct as well as indirect to the herpetofaunal diversity of the study area. The major reason is the increasing urbanization which leads to habitat loss for several species. Local inhabitants and near-by area people (Jodhpur, Pali, Sirohi etc.) are largely dependent on the Jawai Dam for daily uses as well as for the irrigation purposes. During the low water level conditions, certain farmers encroach on the catchments areas for agriculture. These areas are the feeding and breeding grounds of various species in general and *C. platuris* mainly. This leads to sharp decline in the population of herpetofaunal species.

A recent increasing threat identified as human – wildlife conflict, is a secondary impact of urbanization. This is the main cause of population decline of certain snake and crocodile species. People usually kill the snakes whenever they encounter due to fear or misbeliefs. Peoples sometimes kill juvenile crocodiles trapped in their fishing nets.

The distribution trend of herpetofaunal species in urban and the surrounding patches of forest areas have shown that many herpetofaunal species have now started showing their inclination or preference to urban areas. Although it was surprising initially because there was a general assumption that species that originated in nature would prefer to live in the wild but the observations shows a totally different trend. It could be due to better availability of food, shelter and lesser chance of predation in urban areas as compared to open fields of forest areas.

The difficulty in this trend is men-wildlife conflict. To counter this there is urgent need of awareness activities and habitat restoration in the wild.

Recommendations for Conservation

It is suggested that efforts should be made to protect the natural habitats of herpetofauna by spreading awareness and habitat protection along with habitat restoration. The myths about the herpetofauna to human removed by educate the local inhabitants and by awareness programmes.

Table 1: Status of herpetofauna, their distribution with reference to site and microhabitat

S. No	Scientific Name	Common Name	Microhabitat	Site A	Site B	Site C	IUCN** National/ Global Status
Amphibians							
Family Dicoglossidae							
1	<i>Euphlyctis cyanophlyctis</i>	Indian skittering frog	WM/AF/UA	C	R	MC	LRnt / DD/ N
2	<i>Hoplobatrachus tigerinus</i>	Indian bull frog	WM/UA	C	-	C	VU/ DD/ A1d
3	<i>Fejervarya cf. limnocharis</i>	Paddy field frog	WM/AF/FA/ UA	MC	C	MC	VU/ DD/ A1a,c
4	<i>Sphaerotheca breviceps</i>	Short headed burrowing frog	WM	NC	-	C	-
Family Bufonidae							
5	<i>Duttaphrynus melanostictus</i>	Common Asian toad	WM/AF/FA/ UA	C	R	MC	VU/ DD/ A1a,b,c
6	<i>Bufo stomaticus</i>	Marbled toad	WM/AF/FA/ UA	C	C	MC	LRnt/ DD/ N
Family Microhylidae							
7	<i>Microhyla ornata</i>	Ornate narrow mouthed frog	WM/AF	NC	-	C	LR1c/ DD/ N

8	<i>Uperodon systoma</i>	Marbled balloon frog	WM	-	-	R	LRnt/ DD/ N
Reptiles							
Family Trionychidae							
9	<i>Lissemys punctata</i>	Indian mud or flap- shell turtle	WM/FA	R	-	C	LRnt/ N
Family Testudinidae							
10	<i>Geochelone elegans</i>	Indian star tortoise	FA/UA	NC	R	R	VU/ N/ A1a,c,d
Family Crocodylidae							
11	<i>Crocodylus palaustris</i>	Fresh water crocodile	WM	R	-	C	VU/ N/ B1, 2a,b,c,d,e
Family Gekkonidae							
12	<i>Hemidactylus flaviviridis</i>	Northern house gecko	FA/UA	MC	C	C	LR1c/ N
13	<i>Hemidactylus brookii</i>	Brook's gecko	FA/UA	C	C	C	LR1c/ N
Family Agamidae							
14	<i>Calotes versicolor</i>	Common garden lizard	AF/FA/UA	C	C	C	LRnt/ N
15	<i>Sitana ponticeriana</i>	Fan-throated lizard	AF/FA/UA	C	C	-	LR1c/ N

Family Scicidae							
16	<i>Eutropis macularia</i>	Bronzed grass skink	AF/FA/UA	C	NC	NC	LRic/ N
17	<i>Eutropis carinata</i>	Keeled grass skink	AF/FA/UA	R	C	NC	LRic/ N
18	<i>Lygosoma punctatum</i>	Dotted garden skink	AF/FA/UA	R	C	R	LRic/ N
Family Varanidae							
19	<i>Varanus bengalensis</i>	Indian monitor lizard	WM/AF/FA/UA	NC	NC	C	VU/ N/ A1a,c,d
Family Typhlopidae							
20	<i>Ramphotyphlops braminus</i>	Brahminy worm snake	WM/AF/FA/UA	C	C	C	LRnt/ N
Family Boidae							
21	<i>Gongylophis conicus</i>	Common sand boa	WM/AF/FA/UA	NC	C	NC	LRnt/ N
22	<i>Eryx johnii</i>	Red sand boa	WM/AF/FA/UA	NC	C	NC	LRic/ N
23	<i>Python molurus</i>	Indian rock python	FA	-	R	-	LRnt/ N
Family Colubridae							
24	<i>Ptyas mucosus</i>	Common rat snake	WM/AF/FA/UA	NC	NC	C	-
25	<i>Lycodon aulicus</i>	Common wolf snake	WM/AF/FA/UA	-	R	R	LRic/ N
26	<i>Xenochrophis piscator</i>	Checkered keelback	WM/AF/UA	R	-	MC	LRic/ N
27	<i>Boiga trigonata</i>	Common cat snake	WM/AF/FA/UA	R	NC	NC	LRic/ N

Family Elapidae							
28	<i>Bungarus caeruleus</i>	Common Indian krait	FA	-	-	R	LRnt/ N
29	<i>Naja naja</i>	Indian cobra	WM/AF/FA/UA	C	C	MC	LRnt/ N
Family Viperidae							
30	<i>Daboia russelii</i>	Russell's viper	WM/AF/FA/UA	R	R	R	LRnt/ N
31	<i>Echis carinatus</i>	Saw-scaled viper	WM/AF/FA/UA	-	R	-	LRnt

Status Observed: MC: Most Common; C: Common; NC: Not Common; and R: Rare

Microhabitats: WM: Wetland / Marsh; AF: Agricultural Field; FA: Forest Area and UA: Urbanized Area

**Source: IUCN 2000

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HERPETOFAUNA OF JAISAMAND WILDLIFE SANCTUARY, RAJASTHAN

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Jaisamand Wildlife Sanctuary is situated in the southern Aravallis in Udaipur district, Rajasthan. The Jaisamand Lake, within the sanctuary is one of the largest man-made fresh water lakes in the world, built three centuries ago in 1691 A.D. by Maharana Jai Singh of Mewar. The lake measures 14 km in length and 9 km in width, with a circumference of 88 km, covering an area of 21 sq km. The sanctuary covers an area of 52.0 sq km. It has dry deciduous forest with trees such as *Anogeissus pendula* being the predominant species. The terrain is hilly and criss-crossed by a number of seasonal nullahs that go dry in summer. The Sanctuary was visited many times from 1986 to 2012 to document its herpetofauna. All the habitats like water bodies, denser areas, grasslands, anicuts and old buildings were surveyed. During rainy season, Udaipur-Salumbar and Jaisamand-Jagat roads were visited frequently to record the trampled amphibian and reptiles on the border roads. Some scientific studies have been made by Sharma (1994 a,b,c; 95 a,b,c,d; 2012 a,b) to study the herpetofauna of southern Aravallis landscape in general but little information is available on the herpetofauna of Jaisamand Sanctuary (Sharma 2012 a,b). Hence, the present paper lists the amphibians and reptiles observed within this sanctuary.

Amphibia	
Anura	
Bufonidae	
Common Indian toad (<i>Duttaphrynus melanostictus</i>)	+++
Marbled toad (<i>D. stomaticus</i>)	++
Dicroglossidae	
Indian bull frog (<i>Hoplobatrachus tigerinus</i>)	+++

Indian cricket frog (<i>Fejervarya cf. limnocharis</i>)	+++
Skipping frog (<i>Euphlyctis cyanophlyctis</i>)	++++
Indian burrowing frog (<i>Sphaerotheca breviceps</i>)	+++
Microhylidae	
Ornate microhylid (<i>Microhyla ornata</i>)	+++
Marbled balloon frog (<i>Uperodon systema</i>)	++
Reptilia	
Crocodylia	
Mugger or marsh crocodile (<i>Crocodylus palustris</i>)	+++
Testudines	
Trionycidae	
Indian flap-shell turtle (<i>Lissemys punctata</i>)	+
Geoemydidae	
Roofed terrapin (<i>Pangshura tectum</i>)	+
Testudinidae	
Star tortoise (<i>Geochelone elegans</i>)	+
Squamata	
Gekkonidae	
Northern house gecko (<i>Hemidactylus flaviviridis</i>)	++++
Termite gecko (<i>H. triedrus</i>)	++
Brook's gecko (<i>H. cf. brooki</i>)	++
Fat-tailed gecko (<i>Eublepharis macularius</i>)	+
Agamidae	
Common garden lizard (<i>Calotes versicolor</i>)	++++
Fan-throated lizard (<i>Sitana ponticeriana</i>)	++
Chameleonidae	
Indian chameleon (<i>Chamaeleo zeylanicus</i>)	+
Scincidae	
Keeled grass skink (<i>Eutropis carinata</i>)	+++
Varanidae	
Indian monitor (<i>Varanus bengalensis</i>)	+++

Typhlopidae	
Common worm Snake (<i>Ramphotyphlops braminus</i>)	+
Pythonidae	
Indian python (<i>Python molurus</i>)	+
Boidae	
Common sand boa (<i>Gongylophis conicus</i>)	++
Red sand boa (<i>Eryx johnii</i>)	++
Colubridae	
Common wolf snake (<i>Lycodon aulicus</i>)	++
Shaw's wolf snake (<i>L. striatus</i>)	+
Variiegated kukri snake (<i>Oligodon taeniolatus</i>)	+
Common kukri snake (<i>O. arnensis</i>)	+
Common trinket snake (<i>Coelagnathus helena helena</i>)	+++
Common rat snake (<i>Ptyas mucosus</i>)	+
Common bronzeback tree snake (<i>Dandrelaphis tristis</i>)	+
Indian cat snake (<i>Boiga trigonata</i>)	+
Dumeril's black-headed snake (<i>Sibynophis subpunctatus</i>)	+
Natricidae	
Checkered keelback (<i>Xenochrophis piscator</i>)	++++
Buff-striped keelback (<i>Amphiesma stolatum</i>)	+
Green keelback (<i>Macropisthodon plumbicolor</i>)	+
Elapidae	
Indian cobra (<i>Naja naja</i>)	+++
Common krait (<i>Bungarus caeruleus</i>)	++
Viperidae	
Russell's viper (<i>Daboia russelii</i>)	++
Saw-scaled viper (<i>Echis carinatus</i>)	++

+ = Rare (Seen 1-5 times)

++ = Less Common (Seen 6-10 times)

+++ = Common (Seen 11-20 times)

++++ = Very Common (Seen more than 21 times)

Marshes in the downstream of the lake harbour cricket frogs in huge numbers. These frogs are common in green carpet of grasses and sedges during and after rains. Skipping frogs are very common in every waterhole of the Sanctuary. Many frogs and reptiles could be found inside the Canal of Jaisamand lake passing through western outskirts of the Sanctuary. Toads, microhylids and burrowing frogs are found during the rains.

Marsh crocodiles inhabit the series of "islands" that are present inside the lake which provide suitable basking place. House geckos are common on walls of various historical buildings.

Fan-throated lizard is present in the dry open parts such as Kurabad, Bambora, Kun and Bhinder of the sanctuary. Skinks are common under leaf litter and around stony areas. Monitor lizards are found mostly in undisturbed areas.

Slender racer snake is quite rare in Rajasthan but this species is frequently visible in this sanctuary during rainy and summer season. Indian star tortoise is relatively rare in and around the Sanctuary, but when one moves towards Bhinder and Mavali villages, presence of this tortoise increases in number.

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A PRELIMINARY STUDY ON TONGUE COLOURATION OF SOME INDIAN SNAKES AND MONITOR LIZARD

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Snakes and monitor lizards have elongate and forked tongue, which performs many special functions such as smell and taste. Tip of the tongue is used in smell while forked tongue facilitate to identify the direction from which smell comes. Sensing from head side using tongue and from following trails using chemical signals is termed as “tropotaxis” (Schwenk 1994). Forked tongue also increases surface for chemical perception. Similarly, tongue-flicking helps in sampling chemicals for vomerolfactory analysis (Cooper 1994, Gove 2010), done largely at the Jacobson’s organ present at the roof of the mouth.

Besides these, here we describe tongue colouration that has largely escaped attention from researchers so far. For this, we maintain a record of tongue colours of different snakes and monitor lizard which were rescued by forest department from various places between 2005 and 2012.

A total of 15 species of snakes and monitor lizard were observed to record tongue colouration (Table 1). In this preliminary study only some individuals, all live adults from Rajasthan were observed for noting the tongue colouration. No individuals that were moulting or those that were colour-mutants (leucistic, melanistic) were involved. Broadly, four types of colour patterns were observed from this study i.e. bluish, pinkish, pinkish with bluish tip and chocolaty brown. Bluish tongue was found in six species, pinkish tongue in five species, pinkish with bluish tipped tongue in three species and chocolaty brown tongue in one species respectively.

Table 1. Tongue colouration of fourteen species of Indian reptiles

S. no.	Species	Tongue colouration
1	Green keelback <i>Macropisthodon plumbicolor</i>	Pinkish, tip bluish
2	Common rat snake <i>Ptyas mucosus</i>	Bluish
3	Isabelline whip snake <i>Ahaetulla nasuta</i>	Whitish-pink
4	Checkered beelback <i>Xenochropis piscator</i>	Bluish
5	Shaw's wolf snake <i>Lycodon striatus</i>	Pinkish
6	Striped keelback <i>Amphiema stolata</i>	Proximal part pinkish and distal bluish
7	Russell's viper <i>Daboia russelii</i>	Bluish
8	Common sand boa <i>Eryx conicus</i>	Bluish
9	Red sand boa <i>Eryx johni</i>	Brown
10	Indian trinket <i>Coelognathus helena helena</i>	Bluish
11	Common wolf snake <i>Lycodon aulicus</i>	Pinkish
12	Common tree snake <i>Dendrelaphis tristis</i>	Bluish
13	Black-headed snake <i>Sibynophis subpunctatus</i>	Pinkish
14	Indian python <i>Python molurus</i>	Pinkish
15	Indian monitor lizard <i>Varanus bengalensis</i>	Proximal part pinkish and distal bluish

Extensive studies are required to reveal any possible correlation between colouration and physiological function of tongues.



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**RECORD OF BIBRON'S CORAL SNAKE
CALLIOPHIS BIBRONI (JAN, 1858)
FROM KODAGU HILLS, WESTERN GHATS**

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Bibron's coral snake *Calliophis bibroni* (Jan, 1858) is a rare venomous snake endemic to the Western Ghats of India (Molur & Walker, 1998). Very little information exists on this species (Whitaker & Captain, 2004) and only recently has this species been found after a long time and redescribed with many additional materials originating from several localities across the Western Ghats (Deepak et al., 2010; Gowrishankar & Ganesh, 2009). Precise localities of this species include: Travancore, Anaimalais, Nilgiris, Wayanad, Calicut, Kannur, Coorg, Chikmagalur and Shimoga hills (Deepak et al., 2010). In this note, I report on my recent finding of this species in Kodagu.

On 23rd Nov. 2013, at around 9:00 hrs., a live adult Bibron's coral snake (see cover photo) was sighted on the ground in our coffee estate in Kodagu (12°23.74'N 75°92.43'E; 950 m asl). Kodagu is a hill district present in southwestern Karnataka, abutting northern Kerala. The average annual rainfall varies between 100 and 600 cm and is largely from southwest monsoon during June-August. Diurnal temperature ranges between 15°C and 28°C. The altitude varies from 400 to 1600 m. As regards the habitat type, wet evergreen forests occur on the western slopes and drier deciduous forests occur on the leeward, eastern slopes.

The snake was nearly 45 cm long, and was deep cherry red with 31 wide black bands on body and 8 more similar ones on the tail. The red colour was mixed with grey on the back, but was not so along the snake's flanks and the belly. The underside was spotted with black. Since it is a venomous snake and no antivenom exists for bites of this species, the snake was not handled to get detailed scale counts, but after a few clear record shots, was released alive in a nearby forest patch away from human presence. Please see cover photograph.

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EGG-EATING BEHAVIOR OF A SPECTACLED COBRA *NAJA NAJA*

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Feeding behaviour of the spectacled cobra (*Naja naja*) is relatively well-documented (Whitaker, 1978, Whitaker and Captain, 2008; Das, 2002; Daniel, 2002). It is consensually considered that this species feeds on rodents, frogs and toads, small birds, lizards, other snakes and fishes. According to Daniel (2002) it is an inveterate egg-stealer and the eggs are swallowed whole and digested in about 48 hours. In this note, I present my observations on the egg-eating behavior in the spectacled cobra.

On 17th April 2012 at 07:25 hrs, I was summoned to rescue a spectacled cobra from a poultry farm. On arriving at the spot, I observed an adult spectacled cobra in the poultry shed, with bulged belly and noticed a dead hen nearby. Four full eggs could be made out inside the snake. Since the snake was within building premises, surrounded by human habitation, it was rescued for translocation to an uninhabited nearby forest area. During the course of rescue, the snake regurgitated all the four eggs. While regurgitating, the narrower side of the egg came out first and the incident took 4 minutes to complete.

I then recorded the snake's and the eggs' measurements. The snake's snout to vent length was 102 cm, tail length was 21.5 cm, (totaling to 123.5 cm) and weighed about 454.5 g. It's head length was 37 mm and width 25 mm. The eggs measured 54 mm in length, 38 mm width (mid portion), and about 43 g in weight. Upon comparing the egg's width and the cobra's head width, it could be inferred

that the snake had eaten a prey of over 2.2 times its head size and the total mass of the food item (4 eggs) was one tenth the snake's own weight.

As regards the snake's egg-eating habits that are rather poorly documented, my observations corroborate that of Daniel (2002), namely, that the eggs are swallowed whole. This is the case with other egg-eating snakes also except the Indian egg-eater (*Elachistodon westermanni*) which slices open the shell in its gullet and swallows the contents and spits out the shell fragments.

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I am very grateful to the local people for informing me upon seeing the snake mentioned here. I thank Dr. P. Kannan, Asst. Prof., Govt. Arts College, Ooty for his comments and valuable suggestions on this manuscript and also the officers and staff of the Chennai Snake Park for their encouragement and guidance.

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**TERMITE HILL GECKO (*HEMIDACTYLUS TRIEDRUS*)
PREDATION ON A JUVENILE BARK GECKO
(*H. LESCHENAULTII*)**

M. Rameshwaran

Wildlife Association of Rajapalayam

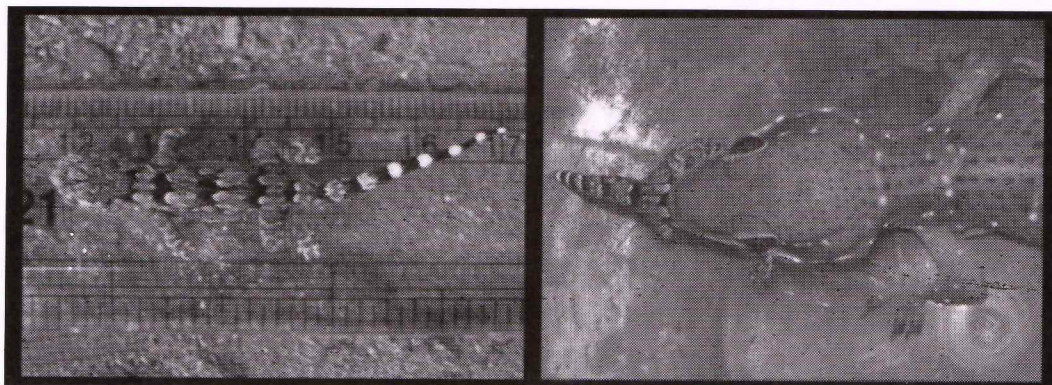
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The termite-hill gecko *Hemidactylus triedrus* (Daudin, 1802) is a widespread, nocturnal, terrestrial lizard usually found in termite hills, inhabiting the open forests and scrublands of the Indian subcontinent (Das, 2002; Daniel, 2002; Smith, 1935). According to Das (2002) the diet comprises termites and also crickets, grasshoppers, spiders and beetles, and known to congregate on termitaria with swarming termites. Smith (1935) quotes Deraniyagala's record of a pair dug up in a termite hillock near Colombo, and that termites appear to be its favourite food. In this note, I present my observations on termite-hill gecko feeding on young bark geckoes.

On 21st September 2008 at 11:20 hrs I observed an adult female termite-hill gecko measuring 145 mm (65 mm snout to vent, tail 80 mm long) suddenly pouncing on a juvenile bark gecko (*Hemidactylus leschenaultii*) measuring 57 mm (30 mm snout to vent, tail 27 mm long). The termite hill gecko grabbed the bark gecko by mid trunk, then aligned it parallel to its own body and started eating it head-first. The feeding happened within two minutes. After two more minutes it caught another juvenile bark gecko (probably the first lizard's sibling) and swallowed in much the same way.

A juvenile bark gecko *Hemidactylus leschenaultii* (live sibling of those that were eaten) and the termite-hill gecko *H. triedrus* seen here eating a young bark gecko.



According to Das (2002) the bark gecko is a known predator of the Asian house gecko (*H. frenatus*). The spotted rock gecko's (*H. maculatus*) diet comprises insects and other geckos, while Daniel (2002) mentions the northern house gecko's (*H. flaviviridis*) prey are insects including caterpillars (except toxic ones) and that the lizard is occasionally cannibalistic, eating individuals of its own species. My observation confirms that the termite hill gecko sometime preys on other geckoes.

Acknowledgements

I thank Tamil Nadu Forest Department, Thoothukudi District for encouraging my work on herpetofauna. I am very grateful to Mr. S. Mohammed Zakkaria (Snake Rescuer) for helping me with my observations of these geckoes. I thank Chennai Snake Park for encouragement and guidance.

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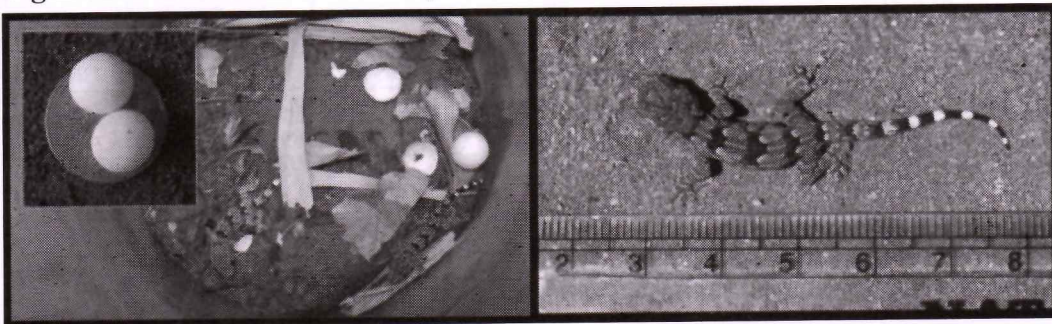
BREEDING NOTES ON BARK GECKO (*HEMIDACTYLUS LESCHENAULTII*) AND TERMITE-HILL GECKO (*H. TRIEDRUS*) FROM THOOTHUKUDI, TAMIL NADU

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On 01.08.2008 at 09:25 hrs, in Thoothukudi District, Tamil Nadu (8°46'09.15" N 78°08'06.78" E) a gravid bark gecko (*Hemidactylus leschenaultii*) was noticed near a fence thatched with coconut leaf, close to a human habitation. On 19.09.2008 at 00:55 hrs near the same place, a gravid termite hill gecko (*H. triedrus*) was noticed in a motor room near a land under cultivation. These geckoes were watched over a day. Next day (02.08.2008 at 08:15 hrs and 21.09.2008 at 10:25 hrs) the geckos laid two eggs. The geckos were released back in their exact habitats. The eggs were, oval in shape, the hard shell was white in colour. Morphometric measurements of the egg were collected (Table 1). The eggs were kept in a 5 liter plastic container with good aeration and with dry river sand so as to create an environment conducive to proper incubation. The temperature range was 27-30° C. The eggs were continuously monitored to know the incubation period. After 50 days, the eggs of both the species were found broken and hatchlings were seen and these were climbing on the wall of the plastic containers. After taking measurements (Figs. 1 & 2, Table 1) the young ones were immediately released in suitable habitats.

Figure 1. Bark Gecko *Hemidactylus leschenaultii* eggs and hatchlings



Figures 2. Termite hill gecko *Hemidactylus triedrus* eggs and hatchlings

Table 1. Breeding data of two sympatric *Hemidactylus* geckos

Details on Geckos and Eggs	Observation	Bark gecko (<i>H. leschenaultii</i>)	Termite hill gecko (<i>H. triedrus</i>)
Adult Female	Date	01.08.2008	19.09.2008
	Time (hrs)	09:25	00:55
	Habitat	In-between fence thatched with coconut leaves. New Harbour, Thoothukudi district, Tamil Nadu.	Thatched roof of a motor room in cultivation land. Kodaangi Patti, Vilathikulam Taluk, Thoothukudi district, Tamil Nadu.
	Snout-vent length (mm)	72	65
	Tail length (mm)	58	80
	Total length (mm)	130	145
Eggs	Date of egg laying	02.08.2008	21.09.2008
	Time of egg laying (hrs)	08:15	10:25
	Clutch size	2	2
	Length of egg (mm)	11	11
	Eggs parameters	Oval in shape, hard shell and white in colour	Oval in shape, hard shell and white in colour
	Hatching date	21.09.2008	21.11.2008
	Hatching time (hrs)	10:30	10:00
	Hatched young ones	2	2
	Incubation (days)	50	61
Hatchlings	Snout-vent length (mm)	30	24
	Tail length (mm)	27	27
	Total length (mm)	57	51

Daniel (2002) says that bark gecko *Hemidactylus leschenaultii* breeds between April and July and the eggs hatch after 32 days. Das (2002), states that this gecko laid eggs in March. In the present study the incubation period was 50 days and month also varied from Daniel (2002) and Das (2002). According to earlier studies and the present observations, geckos in general have an extended period of breeding season between March and August.

With regard to the breeding records of termite hill gecko *Hemidactylus triedrus* Daniel (2002), explains that breeding habits have not been recorded in India. My observation confirms the breeding record of this species mentioned by Das (2002).

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I am thankful to Tamil Nadu Forest Department, Thoothukudi District for encouraging my work on herpetofauna. I am very grateful to Mr. S. Mohammed Zakkaria (Snake Rescuer) for his help in field work. I thank Dr. P. Kannan, Asst. Prof. Govt. Arts College Ooty, for his comments and valuable suggestions on this manuscript. I thank officers and staff of the Chennai Snake Park, for their encouragement and guidance.

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RANDOM HARVEST

More on the cock-headed snake

In *Random Harvest* in *Cobra* vol. V Issue I (Jan.- June 2011), I had referred to a belief in parts of Kerala about a large cock-headed snake and the possibility of this being a mis-identification of the king cobra while in a stage of incomplete moulting with part of the dead skin projecting from the head.

I recently came across another reference to this in Logan's *Malabar Manual* (1887). William Logan, a member of the Indian Civil Service, was the collector of Malabar district in the erstwhile Madras Presidency. He was the author of the celebrated *Malabar Manual* giving an extensive account of the district's history, geographical features, natural history, social and religious customs and so on. While dealing with the district's fauna, unfortunately in a somewhat discursive manner, Logan writes, "[The tribal] tells us a wonderful story of a snake which chased him here, and declares it had wattles like a cock on its head of a brilliant scarlet! Most probably the snake was the mountain cobra (*Ophiophagus elaps*) which is given to be aggressive." The specific name '*elaps*' is the obsolete one for the king cobra, now '*hannah*'.

* * * * *

New pitviper from Sikkim

In a research paper by Hajun Pan *et al.* in the *Asian Herpetological Research*, vol. 4, issue 2, a new species of pit viper named *Protobothrops himalayanus* has been described. As its name suggests, it inhabits high mountainous areas in the eastern parts of the Himalayas, including northern Sikkim in India, Haa Valley in western Bhutan and southern Tibet in China. This is reported to be a predominantly terrestrial snake like others of its kind. It is also a large snake growing to more than a meter and a half in length. It is reported to be a colourful one sporting a dark brown head with reddish-brown eye streaks, an olive coloured body, with distinct black-edged red- brown transverse bands across and golden brownish eyes.

This brings up the total number of Indian snakes listed so far to 288 as against 278 mentioned in the checklist in the 2nd edition (2008) of Whitaker & Captain's *Snakes of India*.

* * * * *

The benefits from frog fungus

Globally, several hundreds of amphibian species have been declining over the past 40 years due to the chytrid fungus *Batrachochytridium dendrobatidis*, laments an article featured in *Down to Earth* of Nov.16-30 2013. The fungus, which releases a toxin, has deadly effects on the frog. The yet-to-be identified toxin impairs the frog's immunity, slowly resulting in its death. But, the good news is that the same toxin has been found to be capable of inhibiting the growth of various cells, including the mammalian cancerous cell line, which indicates its potential use in medicine.

* * * * *

Cane toad update

In an article that appeared in *The Hindu* of 4th July 2013, quoting a study by scientists from the Charles Darwin Univ., Australia, it is said that the exotic cane toad (*Rhinella marina*) population in Australia is endangering the Australian dwarf freshwater crocodile (*Crocodylus johnsoni*) more and more. This is the only fresh water crocodile found in Australia. As is well known, the cane toads which are native to Central and South America are toxic when consumed. Many Australian fauna, including the crocodiles, die after eating these toads. *Crocodylus johnsoni* attains only about 2.5 to 3 m maximum length, which is roughly half the size of

freshwater crocodiles elsewhere. Being a rather small species of crocodile, it is more vulnerable to the cane toad's toxin.

The cane toad was introduced into Australia from Hawaii to control scarab beetle in the 1930s. The toads have, since then, begun spreading prolifically throughout northwestern Australia, at the rate of some 50 km per year. Population surveys of *C. johnsoni* repeatedly report a marked decline every year which is largely attributed to the cane toad.

* * * * *

Abdominal pain : a typical symptom of Sri Lankan Russell's viper bites

In literature on snakebite, acute abdominal pain is often mentioned as a typical symptom of bite by the common krait (*Bungarus caeruleus*). This is of particular significance since bites by the common krait usually happen while the victim is asleep at night and there are few clues for the identification of the snake responsible. But, now a paper by Senanayake Kularatne *et al.* published in *PLoS ONE* of 26 Feb. 2014 states that bites by the Sri Lankan population of Russell's viper (*Daboia russelii*) also produce extensive abdominal pain. So much so, the presence of abdominal pain could mean that the snake is either a krait or a Russell's viper. But, Russell's viper bite, unlike krait bite also produces pain at bite site, local swelling, blood clot, kidney failure and weak and rapid pulse. Additionally, bites from the Sri Lankan population of Russell's viper are known to cause mild nerve paralysis. These features can be used to distinguish between krait bite and Russell's viper (Sri Lankan population) bite notwithstanding that acute abdominal pain is common to both.

It is now increasingly realized that the present practice of using Indian polyvalent antivenom against Sri Lankan Russell's viper bites is not fully effective. The study also points out that, as the initiation of antivenom administration relies on clinical and laboratory evidence of envenoming, the non-availability of early predictors of Russell's viper systemic envenoming delays the antivenom administration.

The team evaluated the clinical profile of Russell's viper bite victims in hospitals in Sri Lanka. The team studied 55 bite victims who produced the responsible vipers, and also 154 suspected Russell's viper bite victims and found that while blood clot, kidney failure, nerve paralysis and local swelling were prevalent in the patients, as already known, significantly abdominal pain was also present in 80%

of patients, appearing anywhere between 5 minutes and 4 hours after the bite. The team found that the severity of the abdominal pain was correlated to blood clot and paralysis.

The study comes out with a caveat that abdominal pain must be considered in conjunction with other symptoms to distinguish Russell's viper bite from krait bites in Sri Lanka.

* * * * *

Recent studies on Indian skinks

A new molecular study on Indian skinks of the genus *Lygosoma* by Anirudhdha Datta-Roy *et al.* from the Indian Inst. of Science, reported in the April 2014 issue of *Journal of Genetics* reveals interesting insights into the evolutionary history of these skinks. The study shows that the phylogeny of *Lygosoma* and its related forms from tropical Asia and Africa suggest an endemic Indian radiation, that is, a distinct cluster of closely-related skinks restricted to India. The study points out that this endemic Indian radiation is likely to be derived from Southeast Asian forms as the peninsular Indian endemic *Lygosoma pruthi* was not part of the Indian radiation, but within South East Asian taxa. *Lygosoma pruthi* is a very poorly known skink that was originally described by R.C. Sharma of the ZSI in 1977 from the Chitteri hills, in the Eastern Ghats of Tamilnadu. The team also found that the African skink genera *Mochlus* and *Lepidothyris* were nested deep inside the *Lygosoma* radiation which leads one to question their generic validity. Additionally, their study also questions the validity of the Asian genus *Riopa*. Based on genetic studies to the extent the taxa have been sampled.

Another recent molecular study titled "The high level classification of skinks" published in *Zootaxa* by Blair Hedges from Pennsylvania Univ., USA, spanning several skinks all over the globe indicates the presence of new families within what was traditionally treated as skinks, family Scincidae. He named a new family Ristellidae, for a group of endemic skinks, genus *Ristella* from the Western Ghats of India, and genus *Lankascincus* from the wet zone of central Srilanka. These skinks are called 'cat skinks' because of their unique possession of retractile claws like that of a cat.

* * * * *

Studies on the structure of multiple fangs

In a recent paper titled “3D reconstruction of fang replacement in the venomous snakes *Dendroaspis jamensoni* (Elapidae) and *Bitis arietans* (Viperidae)” by Zoltan Nagy *et al.* published in *Salamandra*, vol. 49, issue 2, an illustrated account on multiple fang structure including osteological details have appeared. The paper discusses aspects of fang structure variation and fang configuration when multiple fangs occur. i.e., presence of one or two ‘reserve fangs’ alongside the main functional fang. Specifically, the paper addresses questions such as identification of functional and reserve fangs based on fang-socket position, when and how a functional fang is replaced by a new fang, what is the ontogeny or development stages of fang replacement process and what happens to the functional fang in its late stages. Colour-stained micro CT-scan images of skull explaining the relative positions of the main functional and the reserve fangs is a major achievement of the study. By comparing the study on 3-dimensional fang configuration between two species, the Jamenson’s mamba (*Dendroaspis jamensoni*), an elapid and the puff adder (*Bitis arietans*), a viper, the study illustrates the differences in short-fixed elapid fang (proteroglyph) structure and, in contrast, the long, cursive viper fang (solenoglyph) structure.

– B. Vijayaraghavan

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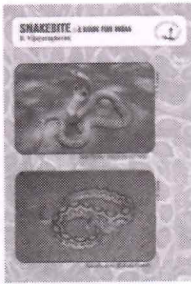
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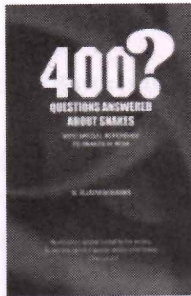
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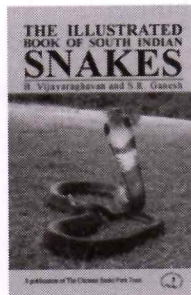
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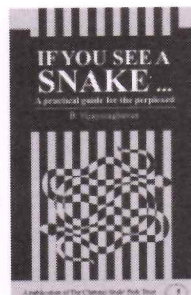
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