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A Study on Herpetofaunal Assemblages in the Rain Forests of Western Ghats, Karnataka, India

S.R.Ganesh*[1], S.R.Chandra Mouli[2] and S.L.Edward[3]

[1&2] Division of Wildlife Biology, A.V.C. College, Mayiladuthurai, Tamil Nadu, India.

[3] Venkatraman Nagar, Korattur, Chennai - 600 080.

Abstract

We assessed the structure of herpetofaunal assemblage in the rain forests of Karnataka, India covering four different districts, all of which fall under the bio-diversity hotspot of Western Ghats, India. The study sites were categorized according to geographical location (i.e., latitude) and according to the intensity of anthropogenic pressures. The microhabitat availability, preference and utilization by each species were studied. We find a considerable variation in species-composition in each site which contributes to the rich local and regional diversity. The turn over of taxa among various sites proves the specificity and uniqueness of microhabitat needs of different species of the herpetofauna.

Keywords: herpetofauna, endemism, niche, anthropogenic pressure, diversity, community, dominance

INTRODUCTION

In the past, many detailed works on the herpetofauna have been done in the South Western Ghats, India constituting the hill ranges of Nilgiris, Anaimalais, High Wavys and Tirunelveli hills. Notable among them are the reports on the herpetofauna of Western Ghats by Inger *et al.* (1987), Bhupathy and Kannan(1997) and Ishwar *et al.* (1999) which throw light on the complex structure and assemblage of herpetofaunal community in different parts of Western Ghats. More recently studies about the same were also conducted extensively in the North-Western Ghats above Goa gap, in Maharashtra. (Ashok Captain Pers. Comm.). General accounts on the herpetofauna of India have been given by Das (2002) and Daniels (2004). But, no detailed work was carried out so far in the Karnataka part of Western Ghats, India and this paper describes a study from the Karnataka State to fill up this lacuna. It gives an analysis of target taxa (herpetofauna) composition and its variations across many study sites of Karnataka State, India, its usage of niches in the rain forest habitats, dispersal abilities, its limitations in colonizing altered habitats and also the effect of topography on its turn over.

STUDY SITES

Seven study sites were selected keeping in mind attributes like differences in latitudinal positioning, difference in altitudinal range and differences in the intensity of anthropogenic pressures (Tables 1 and 2) (Fig. 1).

VEGETATION

The whole geographic region, encompassing all the study sites, nestles in the coastal belt of Karnataka, in the Western Ghats. The forests here are typical rain forests, with trees reaching giddy heights before branching, tall trunk-boles supported by enormous buttresses and abundant lianas forming the quintessential multi-storied structure. Ground vegetation is dense and herbaceous with thick leaf litter. The undergrowth is lush, succulent and often upto 10 feet in height. The emergent layer is formed mainly of *Dipterocarpus* sp., *Hopea parviflora*, *Callophyllum tomentosum*, *Artocarpus* sp., *Cinnamomum* sp. *and Ficus* sp. There are numerous streams and small water falls that criss-cross the forests. In some places the water supply is perennial and in others, it is mainly seasonal. Average annual rainfall is between 4000 to 8000 mm.

METHODS

The survey method involved extensive surveys and careful visual inspection of all study sites and noting

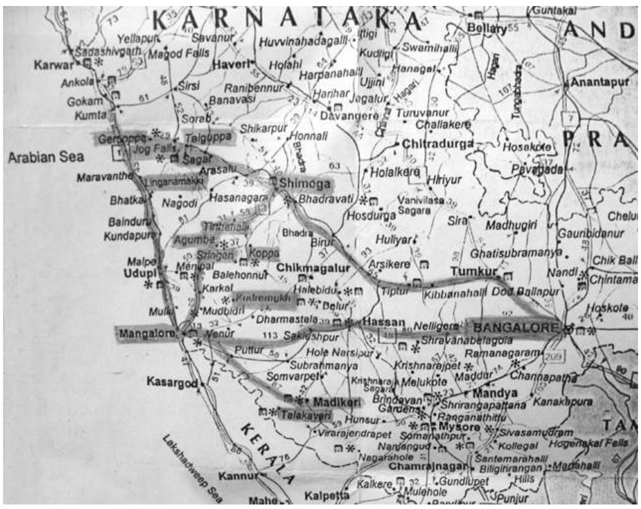

Figure 1. Map showing the of Study Sites in Karnataka, a Southern State of India

* Corresponding author
email: *snakeranglerr@gmail.com*

Table 1. Districts selected for herpetofaunal surveys in the Karnataka State, India.

District	Study period	Site Names	Latitude	Altitude Range
Dakshin Kannada	May 05	Kudremukh & Someshwara	13′N 74′E	High/Mid
Shimoga	Jun 06	Agumbe, Tirthahalli	13′N 75′E	Mid
Talakaveri	Jun 07	Talakaveri	12′N 75′E	High
Uttar Kannada	Jun 07	Gersoppa & Sharavathi	14′N 76′E	Low/Mid

* **Note** : The lat-long details does not refer to extent of study sites, but location of the headquarters of the respective districts.
In altitude: Low is < 450, mid is 450-750, high is > 750, m ASL.

Table 2. Habitat quality and human pressure levels in the study sites

Site name	Habitat quality	Human pressure level
Kudremukh	Pristine (relatively)	Low
Someshwara	Disturbed	Medium
Agumbe	Disturbed	Medium
Tirthahalli	Altered	High
Talakaveri	Pristine (relatively)	Low
Gersoppa	Disturbed	Medium
Sharavathi	Pristine (relatively)	Low

down species, microhabitat occupied, habitat quality and number of individuals of each species to know the species composition of herpetofaunal community in each study site. Details regarding important vegetation aspects and habitat quality were also noted in each study site. A species occupying several niche types and a niche type occupied by various species are tabulated accordingly and separately. Based on this, niche breadth was evaluated and then dispersal limitation and ability were ascertained. They were then inter-related. Based on these the "sensitive" species and their threshold level of tolerance to habitat disturbance and / or alteration were found out. Repeated visits were made to the various study sites at the same month of different years 2005-2007 (Table 1) to thoroughly search the entire area of cach study site.

RESULTS

A Site-Wise Species Checklist (An * indicates Endemic species) of herpetofauna recorded are given below

Kudremukh Division
(Period of Survey was May 2005)

Amphibians

1. *Ansonia ornata* *
2. *Micrixalus saxicola* *
3. *Polypedates maculatus*
4. *Rana curtipes* *
5. *Rana malabarica* *
6. *Rana temporalis*
7. *Indirana leithii* *

Reptiles

8. *Cnemaspis indica* *
9. *Calotes versicolor*
10. *Calotes rouxii* *
11. *Mabuya carinata*
12. *Mabuya macularia*
13. *Ristella beddomii* *
14. *Ahaetulla nasuta*
15. *Amphiesma beddomei* *

Endemism = 9 / 15.

Someshwara Division
(Period of Survey was May 05)

Amphibians

1. *Bufo melanostictus*
2. *Philautus leucorhinus**
3. *Philautus sp.*
4. *Indirana beddomii* *
5. *Minervarya sahyadris* *

Reptiles

6. *Geckoella deccanensis* *
7. *Calotes rouxii* *
8. *Mabuya macularia*
9. *Mabuya beddomii* *
10. *Amphiesma beddomei* *
11. *Boiga beddomei*

Endemism = 7 / 11.

Agumbe Division (Period of Survey was June 2006)

Amphibians

1. *Ichthyophis beddomei* *
2. *Ramanella montana* *
3. *Philautus temporalis**
4. *Philautus leucorhinus*
5. *Polypedates pseudocruciger* *
6. *Rana malabarica**
7. *Rana temporalis*
8. *Indirana leithii* *
9. *Indirana beddomii* *
10. *Limnonectes brevipalmata* *
11. *Nyctybatrachus sp. (juv.)*

Reptiles

12. *Melanochelys trijuga*
13. *Cnemaspis indica* *
14. *Calotes rouxii* *
15. *Mabuya macularia*
16. *Ristella beddomii* *
17. *Melanophidium punctatum* *
18. *Ptyas mucosus*
19. *Amphiesma beddomei* *
20. *Amphiesma monticola* *
21. *Ahaetulla nasuta*
22. *Bungarus caeruleus*
23. *Calliophis nigrescens* *
24. *Ophiophagus hannah*
25. *Hypnale hypnale*

Endemism = 15 / 25

Tirthahalli Division
(Period of Survey was June 2006)

Amphibians

1. *Bufo melanostictus*
2. *Ramanella montana* *
3. *Rana malabarica* *
4. *Rana curtipes* *

Reptiles

5. *Cnemaspis indica* *
6. *Calotes rouxii* *
7. *Mabuya beddomii* *
8. *Rhabdops olivaceus* *
9. *Coelognathus helena monticollaris* *
10. *Ptyas mucosus*
11. *Dendrelaphis pictus*
12. *Ahaetulla nasuta*
13. *Boiga ceylonensis*

Endemism = 8 / 13

Talakaveri Division
(Period of Survey was June 2007)

Amphibians

1. *Bufo melanostictus*
2. *Rana aurantiaca*
3. *Indirana beddomii* *
4. *Philautus charius* *
5. *Philautus temporalis* *
6. *Philautus leucorhinus*

Reptiles

7. *Cnemaspis sp*
8. *Cnemaspis indica* *
9. *Calotes versicolor*
10. *Calotes rouxii* *
11. *Calotes elliotti* *
12. *Calotes calotes*
13. *Calotes nemoricola* *
14. *Calotes grandisquamis* *
15. *Draco dussumieri* *
16. *Mabuya beddomii* *
17. *Oligodon taeniolatus*
18. *Ptyas mucosus*
19. *Amphiesma monticola**
20. *Trimeresurus malabaricus* *

Endemism = 12 / 20

Gersoppa Division
(Period of Survey was June 2007)

Amphibians

1. *Philautus leucorhinus*
2. *Indirana beddomii* *
3. *Nyctibatrachus beddomii* *
4. *Euphlyctis cyanophlyctis*
5. *Rana aurantiaca*
6. *Rana temporalis*
7. *Rana curtipes* *
8. *Indirana leithii* *

Reptiles

9. *Indotestudo travancorica* *
10. *Cnemaspis indica* *

11. *Cnemaspis littoralis*
12. *Hemidactylus leschenaulti*
13. *Cnemaspis tropidogaster*
14. *Calotes versicolor*
15. *Calotes rouxii* *
16. *Calotes ellioti* *
17. *Draco dussumieri* *
18. *Ristella beddomii**
19. *Mabuya beddomii* *
20. *Xenochrophis piscator*
21. *Amphiesma stolata*
22. *Dendrelaphis tristis*
23. *Naja naja*
24. *Hypnale hypnale*

Endemism = 11 / 24

Sharavathi Division (June 07)

Amphibians

1. *Ichtyophis beddomei* *
2. *Bufo beddomii* *
3. *Philautus temporalis**
4. *Philautus sp*
5. *Micrixalus fuscus* *
6. *Micrixalus saxicola* *
7. *Nyctibatrachus major**
8. *Nyctibatrachus humayuni**
9. *Rana tigerina*
10. *Indirana lepdodactylus* *
11. *Indirana beddomii* *

Reptiles

12. *Cnemaspis mysoriensis* *
13. *Calotes rouxii* *
14. *Ophisops leschenaultii*
15. *Amphiesma monticola* *
16. *Ahaetualla nasuta*
17. *Bungarus caerules*

Endemism = 12 / 17

Table 3. Species-composition and the percentage of endemism in each study site

Site	Endemism	Amphibia	Chelonia	Sauria	Serpentes
Kudremukh	9/15, 60%	7	NIL	6	2
Someshwara	7/11, 63%	5	NIL	4	2
Agumbe	15/25, 60%	11	1	4	9
Tirthahalli	8/13, 61%	4	NIL	3	6
Talakaveri	12/20, 60%	6	NIL	10	4
Gersoppa	11/24, 46%	8	1	10	5
Sharavathi	12/17, 70%	11	NIL	3	3

Note : Order wise classification for the Class Amphibia was not done because, entries in each order were very small. So it has been retained as a single entity.

Table 3 gives the species compositions and percentage of endemism of different study sites. The percentage of endemism was highest (70%) in Sharavathi study site.

Table 4. Frequency of occurrence of different species of herpetofauna and their niche utilization in different study sites.

S.No.	SPECIES (* - Endemism)	Niche utilized & no. of individuals	Occurrence ratio (out of 7 sites)
	Amphibians		
1.	*Ichthyophis beddomei**	Stream (2)	2:7
2.	*Ansonia ornata**	Stream(4)	1:7
3.	*Bufo melanostictus*	Leaf Litter (5)	4:7
4.	*Bufo beddomii**	Leaf Litter (3)	1:7
5.	*Ramanella montana**	Tree stumps (4)	2:7
6.	*Polypedates pseudocruciger**	Shrubs (1)	1:7
7.	*Polypedates maculates*	Shrubs(5)	1:7
8.	*Philautus temporalis*	Shrubs(9)	3:7
9.	*Philautus leucorhinus*	Shrub (8), Ground vegetation(6)	4:7
10.	*Philautus charius**	Shrub (3)	1:7
11.	*Philautus sp.*	Shrub (2)	2:7
12.	*Micrixalus fuscus**	Stream (12)	1:7
13.	*Micrixalus saxicola**	Stream (14)	2:7
14.	*Limnonectes brevipalmata**	Ground vegetation (1)	1:7
15.	*Euphlyctis cyanophlyctis*	Stream (12)	1:7
16.	*Rana tigerina*	Stream (2)	1:7

17.	*Rana malabarica**	Stream (5)	2:7
18.	*Rana aurantiaca*	Stream (17)	2:7
19.	*Rana temporalis*	Stream (11), Shrubs (4), Ground vegetation (16)	3:7
20.	*Rana curtipes**	Leaf litter (17), Stream (12)	3:7
21.	*Indirana beddomii**	Leaf litter (22), Stream (19)	5:7
22.	*Indirana leithii**	Stream (12), Leaf litter (16)	3:7
23.	*Indirana leptodactylus**	Stream (12), Leaf litter (9)	1:7
24.	*Minervarya sahyadris**	Leaf litter (3)	1:7
25.	*Nyctibatrachus major**	Stream (7)	1:7
26.	*Nyctibatrachus beddomii**	Stream (2)	1:7
27.	*Nyctibatrachus humayuni**	Stream (1)	1:7
28.	*Nyctibatrachus sp.*	Stream (1)	1:7
	Reptiles		
29.	*Melanochelys trijuga*	Road crossing (1)	1:7
30.	*Indotestudo travancorica**	Road crossing (1)	1:7
31.	*Hemidactylus leshenaultii*	Tree trunk (4)	1:7
32.	*Geckoella dekkanensis**	Road kill (1)	1:7
33.	*Cnemaspis indica**	Rocks (24), Tree trunk (12) Walls (14)	5:7
34.	*Cnemaspis littoralis*	Rocks (1), Stream (1)	1:7
35.	*Cnemaspis mysoriensis**	Stream (14)	1:7
36.	*Cnemaspis tropidogaster*	Tree trunk (9)	1:7
37.	*Cnemaspis sp.*	Rock (4)	1:7
38.	*Mabuya carinata*	Leaf litter (13)	1:7
39.	*Mabuya macularia*	Leaf litter (27)	3:7
40.	*Mabuya beddomii**	Leaf litter (35)	4:7
41.	*Ristella beddomii**	Stream (6)	3:7
42.	*Calotes versicolor*	Shrub (7)	3:7
43.	*Calotes calotes*	Tree trunk (1)	1:7
44.	*Calotes rouxii**	Tree trunk (32) Shrubs (19) Ground vegetation (12)	7:7
45.	*Calotes ellioti**	Shrub(2) Tree trunk (3)	2:7
46.	*Calotes nemoricola**	Tree trunk (1)	1:7
47.	*Calotes grandisquamis**	Tree trunk (1)	1:7
48.	*Draco dussumieri**	Tree trunk (21)	2:7
49.	*Ophisops leschenaultii*	Ground vegetation (2)	1:7
50.	*Melanophidium punctatum**	Leaf litter (1)	1:7
51.	*Oligodon taeniolatus*	Road crossing (1)	1:7
52.	*Coelognathus helena monticollaris**	Road kill (1)	1:7
53.	*Ptyas mucosus*	Ground vegetation (5)	2:7
54.	*Amphiesma beddomei**	Leaf litter(1) Stream (2) Under logs (2)	3:7
55.	*Amphiesma monticola**	Ground vegetation (1) Road kill (2)	3:7
56.	*Amphiesma stolata*	Road kill (1)	1:7
57.	*Xenochrophis piscator*	Stream (2)	2:7
58.	*Rhabdops olivaceus**	Stream (1)	1:7
59.	*Boiga beddomei*	Road kill(1) Shrubs (1)	1:7
60.	*Boiga ceylonensis*	Shrubs (1)	1:7
61.	*Dendrelaphis pictus*	Shrubs (1)	1:7
62.	*Dendrelaphis tristis*	Road kill (1)	1:7
63.	*Ahetulla nasuta*	Shrubs (7)	4:7
64.	*Bungarus caerules*	Road kill (1) Hole (1)	2:7
65.	*Calliophis nigrescens**	Leaf litter (1)	1:7
66.	*Naja naja*	Ground vegetation (1)	1:7
67.	*Ophiophagus hannah*	Ground vegetation (1)	1:7
68.	*Hypnale hypnale*	Leaf litter (1), Under Log (1)	2:7
69.	*Trimeresurus malabaricus**	Stream (4) Shrubs (1)	1:7

Agumbe and Sharavathi had more amphibian species (11 species, each). Chelonia were recorded in Agumbe and Gersoppa only. Saurian and Serpentes species were more in Talakaveri and Gersoppa study sites. Agumbe had the highest number of species of serpents.

Frequency of occurrences of each species and their occurrence ratios are given in Table 4 in order to show the niche availability, preference and utilization by our target species and the occurrence of each species in all the study sites. The most 'utilized' niches were stream and leaf litters (Table 5).

Table 5. Total number of species occurring and number of species restricted only to a particular niche in the study area

Niche name	No. of species occupying	restricted only to a particular niche
Stream	23	16
Ground vegetation	9	5
Rocks	2	1
Leaf litter	12	6
Shrubs	7	4
Tree trunk	8	5
Others	4	0

Note: Road crossings and road kills are omitted in this table because it may not be feasible to find the 'niche occupied' by these creatures under such circumstances.

It was noted in our study that certain ecologically similar species, when favored by anthropogenic alterations and/or disturbance show a positive response to that habitat change and cluster together to constitute a 'Guild'. Such guilds are comprised of some genera that are characteristically similar in niche utilization (Table 6).

Table 6. Hepatofaunal guilds in the study sites

Guild name	Comprising genera
Stream side guild	*Ichtyophis, Ansonia, Rana, Micrixalus, Nyctibatrachus, Ristella, Amphiesma* and *Trimeresurus*
Leaf litter Guild	*Indirana, Mabuya, Melanophidium, Calliophis* and *Hypnale,*
Shrub layer Guild	*Philautus, Ahaetualla* and *Dendrelaphis*
Tree trunk Guild	*Cnemaspis, Hemidactylus, Calotes* and *Draco*

Note: Though some habitat generalists occur in more than one guild, it is appropriate to place a genus only in one guild, based on the number of individuals sighted, falling in any particular niche, present in its corresponding guild. We have omitted some commensally genera like *Naja, Ptyas* etc., because; they are eclectic in their habitat selection.

DISCUSSION

Thus, we have recorded 69 species of 40 genera out of which 38 species are endemic, in the seven study sites. Ecological factors and the ability of a species to adapt to changes in the environment seemed to be the major deciding factors that affected the species' presence in each study site, as there are differences in the study sites, in terms of anthropogenic pressure intensity and this will in turn 'test' whether a species can exist there or not in a particular place.

Niche breadth and dispersal ability / limitation

Preference of different species to different microhabitats are given in Table 4. From table 4 it can be inferred that, *Calotes rouxii* is the most abundant and the most niche-insensitive species, occurring in all study sites and ubiquitous to micro habitat availability. It is seen most often in gallery forests, secondary degraded forests and in disturbed forests. Despite being endemic, it is quite successful and capable of colonizing disturbed habitats, which are unsuitable for some other 'sensitive' species. Thus this species seems to have a very low dispersal limitation. In amphibians, it is *Indirana beddomii* that shares many of the traits with *Calotes rouxii*, occurring in 5 out of 7 sites, and occupying a wide variety of niches.

The most sensitive and rare species are those that exhibit very narrow niche breadth and very narrow geographic range. Based on these two covariates, the following "sensitive" species were identified; they are *Ichthophis beddomei*, *Indotestudo travancorica*, *Calotes nemoricola*, *Calotes grandisquamis*, *Melanophidium punctatum* and *Rhabdops olivaceus.* These species were recorded from a single locality and that too only a single individual was sighted. Oddly enough of all these 'rare' or 'sensitive' species were actually recorded from disturbed or altered habitats! Not even one was recorded from pristine habitats, except one (of the two) sightings of *Ichtyophis beddomei*. The aforesaid species were sighted in Areca nut and Coffee plantations! *Indotestudo travancorica* was sighted crossing the road, sandwiched by forests. This paradoxical situation may be presumably attributed to the differences in detection probabilities in a plantation (where it is high) than that of the pristine rain forest (where it is low). This means, areas of low and high abundance may actually be areas of low and high detection (Mackenzie and Kendall, 2002; Mackenzie *et al.* 2003, 2004a, b, 2005a,b; Mackenzie, 2005). However, we assume that the detection probability as 1. i.e., we assume that we do not 'miss' the presence of a species as every care was taken to search thoroughly. In other words, non-detection of a species implies its apparent absence as far as the present study is concerned.

Niche utilization, overlap and the concept of guild formation

Further more, table 5 indicates that Stream is the place where there is very high occupancy of niches / microhabitats by the target taxa. In streams, 23 species coexist and among them 16 species (i.e., 69%) are confined only to it. Consequently there are more possibilities of creatures to share the niches and exhibit high degree of niche overlap. It can also be noted that the species-composition in such a diverse niche is varied, thus explaining the diversity or species richness of the place and the co-existence of all such species in low individual densities. This trend shows higher degree of species richness and lower degree of dominance by a particular species.

Leaf litter closely follows the stream and is similar to it in almost all of the above discussed aspects. As 12 species occur confluent in leaf litter and 6 species (i.e. 50%) of it is restricted only to it, the important role played by leaf litter as a potential niche for the various target taxa is indicated. Next, in the descending order of niche utilization comes the ground vegetation, tree trunk, shrubs and rocks. Tree trunks were the most preferred or utilized niche by many of the Agamid lizards. An incredible 100 % sighting of all *Draco dussimueri* was on tree trunks. Apart from this, the rare and scarcely sighted two endemic Agamids, *Calotes nemoricola* and *Calotes grandisquamis* were sighted on tree trunks. Though the number of individuals recorded is too less (i.e., only one) for both these lizards to emphatically say that these Agamids prefer Tree trunks, the low species richness in altered habitat types such as Coffee estate, where these lizards were sighted, indicates that though these altered habitats (Coffee estates) support less diverse taxa, they are important to these agamid lizards. Therefore obviously such altered habitats are dominated by agamid lizards. For example, the encounter rate of one such dominant species (*Draco dussumieri*) in Gersoppa, a patch of disturbed forest was an incredible 7.8 lizards per kilometer. In fact 18 out of 21 individuals of this species sighted overall in all of our study sites, were in Gersoppa. Similarly, Talakaveri division showed a very high diversity in agamid lizards and so was dominated by it, in its herpetofaunal assemblage.

Effects of Vegetation

In our study, it was noted that the arboreal community of the herpetofauna was favored by moderate to less densely spaced trees in a rain forest. In Gersoppa, for example, 9 individuals of *Draco dussumieri* were sighted in a single day, where the trees were not so densely packed. The average spacing between trees was 2.5 m. But the trees must be huge and matured ones. Age old trees with enormous buttresses support a good deal or arboreal community. Several individuals of *Cnemaspis sp* and *Draco dussumieri* were sighted not singly but in pairs / parties, on trees that measured 15 ft or more at perimeter around the buttress, at ground level. The least and the highest of buttress perimeter values ranged between 9 ft and 26 ft. The most arboreal of the agamids, *Draco dussumieri* as indicated by its dermal ornamentation, the patagium, actually glides between trees. To facilitate this gliding habit, trees must be adequately spaced apart. Also that if trees are adequately spaced apart, the canopy becomes less contiguous, permitting a reasonable level of sunlight penetration into lower storey. This favors the sun loving agamids which bask in a typical posture on the bare vertical tree trunks.

On the other hand in some stream side surveys, it was seen that high canopy contiguity and limited light penetration favored the amphibians, helping them to remain moist and thus active during day time too. Thus the probability of sightings and therefore the density of stream side community were higher. This was same also in case of the semi-fossorial, leaf litter dwelling species, which showed a positive response to canopy contiguity. However, a unique problem arises here if we take into account, the vegetative phenology of the trees. If there is to be more leaf litter, there must be more leaf fall. But if there is more leaf fall, there will be low canopy cover. This controversial statement can be set right if we consider the high productivity rate in a tropical rain forest. With constant rainfall and sunshine in the emergent layer, the canopy will produce profusely and also that with rich soil flora and bacterial load the degradation of older leaf litter will happen quickly. Thus, these are the habitat complexion parameters that influence the species composition and structure of herpetofaunal assemblage in the present study area.

Effects of topography, relief features and geographic range boundaries

Of all our study sites, Agumbe and Gersoppa were the most bio-diverse or species-supportive, with 25 species occurring in them. But Agumbe has 60% endemism, while Gersoppa has only 46% endemism (least of all study sites). This can be partly due to the low altitude, despite being covered by rain forests, in that site, which may be responsible for the influx of a vast array of commensally species / habitat generalists. Agumbe on the other hand, though having equal intensity of human pressures like Gersoppa, is situated in higher elevation and enjoys less chance of colonizing by the commensally species from the plains. Agumbe is also unique in its species composition, as it had the highest number of snake species (i.e. 9).

But Sharavathi must be considered as the most ecologically important study site, as it exhibits the highest degree of endemism (70%), closely followed by Someshwara (63%). The same 'altitude' seemed to be playing a different game here. The reason for this can be the difference in habitat types: Someshwara is one of the last remaining stretches of low land rain forests left, and Sharavathi is near Jog, the highest water falls in India. Relative differences in human pressure may be another reason behind this. However, no emphatic evidence could be produced from our report as ours is a short term work and more detailed, long term studies need to be undertaken to explain the above differences in herpetofaunal endemicity.

Effect of Sample size

The single individual records and generally less number of individuals recorded for a species, greatly hinder one from authentically concluding the findings. However, considering the rarity of some species, like that of *Rhabdops olivaceus* which very well deserves dedication of a separate publication regarding its sighting record and other accompanying abnormalities of scientific interest, this low sample size is a thing to bear with. But the unexplainable absence of some 'expected species' in their respective typical localities and unequal or biased search efficiency in such circumstances are major shortcomings in this work.

Taxonomic uncertainties

A major disadvantage was the variations in taxonomic resolution. While it is always healthier to taxonomically ascertain an individual upto species level, not always can this be possible in the field. More so if one considers the larval and intermediary stages of frogs that are difficult enough even to identify upto genus or family level. Even the adults of some genera like *Philautus* and *Cnemaspis* pose a problem in this regard.

CONCLUSION

After this study, we conclude that there is a marked difference in the species richness, abundance and composition of the target taxa (herpetofauna) across the many study sites of the present study. It was found out that many endemic species are recorded from a single locality records and this contributes greatly to the local diversity. Also that the study sites are reasonably decent in their faunal content as the estimated percentage of endemism ranges between a healthy 60% - 72% in six out of seven study sites, well above from the "poor" category mark. The turn over of taxa was governed by factors like latitude, altitude and intensity of anthropogenic pressures. We also tested the niche utilization of various species. The niche used was in some cases shared by a multitude of ecologically similar species, either due to the want of substrate, or food or micro-climatic necessities or all of these. It was found that in places where there is less human pressure, the forest supported richer community and when disturbed or altered by man made pressures, there is a loss in richness and this apparent absence of competitive species paves way for one adaptive species to emerge successfully as the dominant species in such sites. Thus the more number of individuals of any particular species and less number of different species indicate a disturbed or altered habitat. Low endemism percentage values are often due to such reasons. Thus this study implies the intricate assemblages of herpetofauna in the study sites and the damages caused to it due to the 'loss' of certain 'sensitive' species owing to human pressures. Therefore, for a good herpetofaunal community, the habitat must be complex enough to accommodate and fulfill the needs of the diverse species encompassed within.

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REFERENCES

Bupathy, S. and Kannan, P. 1997. *Status of Agamid Lizards in the Western Ghats, Tamil Nadu, India*. Technical Report no. 5. Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Daniels, R.J.R. 2004. *Amphibians of Peninsular India*. Univ. Press., Hyderabad

Das, I. 2002. *A photographic guide to snakes and other reptiles of India*. New Holland Publications, London.

Inger, R.F., Shaffer, H.B., Koshy, M. and Bakde, R. 1987. Ecological structure of a Herpetological assemblage in South India. *Amphibia - Reptilia*. 8: 189-202. E.J.Brill, Leiden.

Ishwar, N.M., Chellam, R., Kumar, A. and Noon, B.R. 1999. *The response of agamid lizards to the rain forest fragmentation in the Southern Western Ghats, India*. Wildlife Conservaion & Society, 1,2. Sage Publications, New Delhi / Thousand Oaks / London.

MacKenzie, D.I. 2005. Was it there? Dealing with imperfect detection for species presence/absence data. *Aus. NZ. J. Stat.*, 47: 65-74.

MacKenzie, D.I. and Kendall, W.L. 2002. How should detection probability be incorporated into estimates of relative abundance. *Ecology.* 83: 2387-2393.

MacKenzie, D.I., Nichols, J.D., Hines, J.E., Knutson, M.G. and Franklin, A.D. 2003. Estimating site occupancy, colonization and local extinction when a species is detected imperfectly. *Ecology.* 84: 2200-2207

MacKenzie, D.I., Bailey, L.L. and Nichols, J.D. 2004a. Investigating species co-occurrence patterns when species are detected imperfectly. *J. Anim. Ecol.*, 73: 546-555.

MacKenzie, D.I., Royle, J.A. Brown, J.A. and Nichols, J.D. 2004b. Occupancy estimation and modeling for rare and elusive populations. Pages 149-172 in W.L. Thompson (ed), Sampling Rare or Elusive Species. Island Press, Washington, D.C.

MacKenzie, D.I., Nichols, J.D., Royle, J.A., Pollock, K.H., Hines, J.E. and Bailey, L.L. 2005a. *Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence* Elsevier, San Diego, USA.

MacKenzie, D.I., Nichols, J.D., Sutton, N., Kawanishi, K. and Bailey, L.L. 2005b. Improving inferences in population studies of rare species that are detected imperfectly. *Ecology.* 86: 1101-1113.

Pendelton, G.W. 1995. Sampling strategies, detection probabilities and Independence of Counts on the use of point counts. *USDA Forest Service. Gen. Tech. Rep.* PSW-GTR-149.

Roux, J. 1928. Reptiles et Amphibiens de I'lnde meridionale. *Ann. Rev. Ecol. Syst*. 4: 53-57.

Smith, M.A. 1935. *Fauna of British India, including Ceylon and Burma Vol-II Sauria.*, Taylor & Francis, London.

Smith, M.A. 1943. *Fauna of British India, including Ceylon and Burma. Vol-III Serpentes*, Taylor & Francis, London.

Swihart, R.K., Lusk, J.J., Duchlamp, J.E., Rickzilla, C.E. and Moore, J.E. 2006. The roles of landscape context, niche breadth and range boundaries in predicting species responses to habitat alteration. *Diversity Distrib*. 12: 277-287.

Whitekar, R. and Captain, A. 2004. *Snakes of India the Field Guide*. Draco Books, Chengelpat, India.

Whitmore, T.C. 1990. *An introduction to tropical Rain forests*. Clarden Press, Oxford.