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International Journal of Life Sciences (ISSN: 2277-193x) (Scientific Journal Impact Factor: 6.106)

UGC Approved-A Peer Reviewed Quarterly Journal



Full Length Research Paper

Diversity, Richness and Threats to Frog Species in and around College of Forestry Sirsi Uttara Kannada.

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ARTICLE DETAILS

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Key words:

Species, Diversity,
Richness, Species,
Threats, Abundance

ABSTRACT

The amphibians of the Western Ghats exhibit a remarkable diversity and uniqueness, playing vital roles in both terrestrial and wetland ecosystems. They serve as crucial components of food chains, contribute to energy flow, participate in nutrient cycling, and serve as excellent indicators of environmental degradation. Additionally, they play a significant role in controlling insect pests as bio-monitors. Against this backdrop, our study aimed to investigate the species composition, diversity, richness, and threats to frog species in the vicinity of the College of Forestry, Sirsi. A total of 18 frog species from five different families were documented through three distinct methods: visual encounter surveys, road walks, and acoustical sampling. Among these families, the Dicroglossidae family exhibited the highest number of frog species. Species diversity was quantified using the Shannon diversity index, resulting in an observed value of 2.41, with *Pseudophilautus amboli* having the highest abundance value (0.1506). Notably, *Hydrophylax bahuvistara* and *Hoplobatrachus tigerinus* are major species that face a high risk of road kill due to their mating behaviour during the rainy season. Our findings underscore the importance of these amphibians in the Western Ghats ecosystem and the need for conservation efforts, particularly for species vulnerable to road mortality during their critical mating periods. Understanding the diversity and threats to these amphibians can contribute to more effective conservation strategies and the preservation of the unique biodiversity of this region.

1. Introduction

Amphibians are the first vertebrate animals to have two completely different life stages, one as tadpoles that generally occur in water and other as adults dwelling more on land (Duellman and Trueb 1994). Frogs, toads, caecilians and salamanders together constitute amphibians. Among the known 6639 species of amphibians in the world (Frost, 2010) nearly one third are threatened with extinction (IUCN, 2009; Hamer and McDonnell, 2008). Amphibians are vital components of a healthy environment, Semi-permeable skin, an amniotic eggs and biphasic life style make them particularly vulnerable to changes and contamination of their habitats on land and in water. Presence of a good population of amphibians in a region is indication of a healthy environment (Gururaja et al., 2008). Amphibians play major role in ecosystem functioning, as prey and predator, especially as consumers of pest insects. They are also food for snakes, birds and small mammals. They have great therapeutical value, be in development of painkillers (Bufotonin, Epibatidine, etc.) or antimicrobials (refer to detailed review by Erspamer, 1994) or regenerating limbs (Tseng et al., 2010).

The amphibian fauna of India comprising of caecilians, frogs and toads and salamanders is extremely diverse (Dinesh et al., 2009) and has high-level endemism in the Western Ghats and Eastern Himalayas (Inger, 1999; Biju and Bossuyt, 2003; Roelant et al., 2004; Aravind et al., 2004). India harbours 311 species of amphibians belonging to all the extant orders, namely Caudata, Anura and Gymnophiona, while the Western Ghats harbours 161 species of which 138 are frogs and toads (Anura) and 23 are caecilians (Gymnophiona) belonging to 11 families and 30 genera. An overview of biodiversity and ecology of hill streams of the Western Ghats has been reviewed by Subramanian (2010). In this paper, we review the

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Received: 13-June-2025; Sent for Review on: 18-June-2025; Draft sent to Author for corrections: 28-June-2025; Accepted on: 04-July-2025; Online Available from 07-July-2025

DOI: [10.13140/RG.2.2.26766.47684](https://doi.org/10.13140/RG.2.2.26766.47684)

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current status of amphibian research in the Western Ghats and assess the gaps in our knowledge and provide solution for the conservation of amphibians in this global biodiversity hotspot. Indian amphibian fauna belong to 3 orders, 14 families, 54 genera and 311 species (277- Anura, 33-Gymnophiona, 1-Caudata). The Western Ghats harbours 161 species of which 137 are Anurans (frogs and toads) and 24 are Gymnophiona (caecilians) belonging to 11 families and 30 genera (Table 1). The families Micrixalidae, Nasikabatrachidae and Ranixalidae are exclusive to the Western Ghats represented by only one genus, whereas, the Family Nyctibatrachidae is endemic to both Western Ghats and Sri Lanka with genus *Nyctibatrachus* endemic to the Western Ghats and genus *Lankanectus* to Sri Lanka. The amphibians of the Western Ghats are very diverse and unique, with nearly 87 percent (138 species) of the 158 species are endemic to this region, which is highest for any group of animal in the Western Ghats. Most of the endemic species have restricted distribution, confined to the rainforests of the Western Ghats. The anuran genera, which are endemic, include - *Ghatophryne*, *Xanthophryne*, *Micrixalus*, *Melanobatrachus*, *Ramanella*, *Nasikabatrachus*, *Nyctibatrachus*, *Indirana*, *Ghatixalus* and *Raorchestes*. Among gymnophiona, the endemic genera include *Indotyphlus* and *Uraeotyphlu*. Three families viz., *Dicroglossidae*, *Rhacophoridae* and *Nyctibatrachidae* form 50 percent of the total species richness in the Western Ghats. The recent discovery of new frog, *Nasikabatrachus sahyadrensis* belongs to new family *Nasikabatrachidae*, is believed to be a living fossil. This Gondwana relict frog is more closely related to species found in the Seychelles Islands in the Indian Ocean. The endemic torrent toads *Ghatophryne ornata* and *Ghatophryne rubigina* are found only in hillstreams between Nilgiris and Kudremukh. The high level of endemism in the Western Ghats might have caused because of discontinuity in the chain of mountains which limits the dispersal (Vasudevan *et al.*, 2006) thus promoting local endemism (Bossuyt *et al.*, 2004) both in terms of 'out-of-India' and 'in-to-India' hypothesis (Bossuyt and Milinkovitch, 2001; Boclaer *et al.*, 2006). With the above stated background, our study was carried out to calculate the density and abundance of Frogs as percentage compositions of the different families and to analyze the species diversity indices in our campus

2. Material and methods

2.1 Study Area

College of Forestry, Sirsi campus is located at a Elevation of 600m above MSL, having Coordinates 14.61°95'N 74.83°54'E. It receives an average annual rainfall of about 2000-2500mm. Campus consists of total 14ha of land, comprising fragmented habitats, tree lots, wet lands and paddy fields. The forest around campus comprises mainly of degraded forests, moist deciduous and dry deciduous forests as well as *Acacia* plantations. This small campus is housing a many endangered flora and fauna towards having biodiversity rich environment for this study.



2.2 Methodology

The data collection process for this study involves Visual Encounter Surveys (VES), which entail thorough habitat surveys and visual estimations of amphibians. VES provides both quantitative and qualitative data on species richness and was formalized by Campbell and Christman in 1982 [Campbell and Christman, 1982]. Acoustical sampling is employed to identify amphibian species through their distinct calls, especially during night-time breeding periods. Frog calls are recorded, digitized, and analysed for species presence [Smith *et al.*, 2006]. Road walks are conducted to search for amphibians and reptiles across various habitats, with amphibian surveys occurring at night and reptile observations happening opportunistically [Jones *et al.*, 2010]. Diurnal forms are collected between dawn and midday, and experts are consulted for species identification. Diversity indices are calculated using the Shannon-Wieners formula [Magurran, 2004]. Data is collected through checklists of observed frogs, and essential tools for frog counting include notebooks, pens, mobile devices, Nikon cameras, and field guides [Wells, 1993].

3. Results

The study recorded a total of 18 frog species across five different families using three distinct survey methods: visual encounter surveys, road walks, and acoustical sampling. The analysis of species diversity was conducted using the Shannon diversity index, yielding an observed value of 2.41. Among the families, the *Dicroglossidae* family exhibited the highest abundance, representing 44.44% of the total frog population, followed by *Rhacophoridae* at 22.22%. Within the families, *Dicroglossidae* had the maximum number of frog species, with eight identified species, followed by *Rhacophoridae* (4 species), *Microhylidae* (2 species), *Ranidae* (2 species), and *Bufonidae* (2 species).

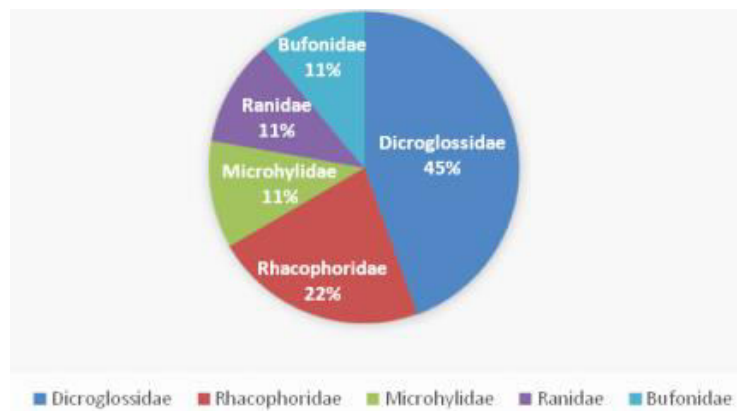


Fig.1. The family wise distribution of species in percentage

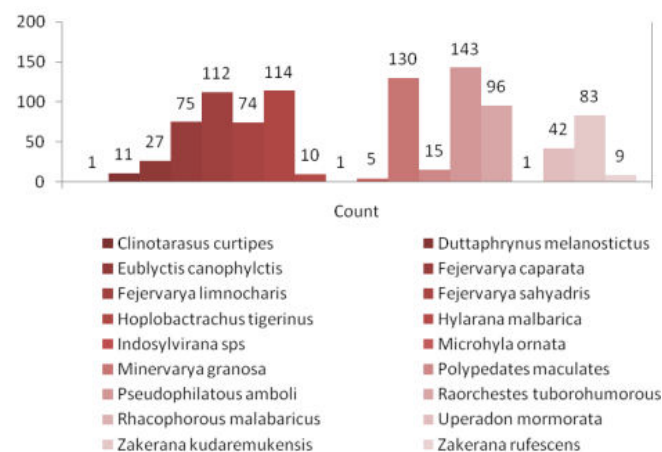


Fig.2.- The number of individuals observed in species

Table 1. The Percentage and number of species observed in different families

Sl no	Family	No of species	Species percentage
1	Dicroglossidae	8	44.4%
2	Rhacophoridae	4	22.2%
3	Microhylidae	2	11.1%
4	Ranidae	2	11.1%
5	Bufonidae	2	11.1%

4. Discussion

The findings of this study highlight the remarkable diversity of frog species in the College of Forestry's vicinity. The presence of 18 different species, many of which are likely to be endemic to the region, underscores the ecological significance of this area. Furthermore, the high species diversity value (Shannon diversity index of 2.41) indicates a well-balanced and diverse amphibian community within the study area. The dominance of the Dicroglossidae family, comprising 44.44% of the frog population, suggests that this family is particularly well-adapted to the local habitat. Their presence and abundance may be indicative of favorable environmental conditions within the study site, making it an area of interest for further research and conservation efforts.

The identified species, *Hydrophyl axbahuvistara* and *Hoplobatrachustigerinus*, facing an elevated risk of road kill during the rainy season due to their mating behavior, underscores the importance of understanding amphibian behaviour for conservation efforts. Strategies for mitigating road-related threats to these species should be considered, such as creating safe crossing areas or implementing speed restrictions during peak breeding seasons. Overall, this study serves as a valuable contribution to the understanding of local amphibian diversity and highlights the need for continued research and conservation efforts in this region. Conservation initiatives should focus on preserving the diverse amphibian species and their unique habitats to maintain ecological balance and ensure the long-term survival of these important members of the ecosystem.

Table 2: Checklist and their IUCN status of Frog species

Sl no	Scientific Name	Common name	Family	Habitat	IUCN status
1.	<i>Fejervaryasahyadris</i>	White lipped cricket frog	Dicroglasidae	Semi-aquatic, terrestrial sps	Endangered
2.	<i>Fejervaryacaparata</i>	Canara cricket frog	Dicroglassidae	Semi-aquatic,terrestrialsp	Endangered
3.	<i>Minervaryagranosa</i>	Mangalore cricket frog	Dicroglasidae	Semi-aquatic,terrestrial .grass land	Endangered
4.	<i>Raorchestestuberohumorous</i>	Kudaremkh bush frog	Rhacophoridae	Shrubs and low vegetations	Endangered
5	<i>Fejervaryalimnocharis</i>	Indian cricket frog	Dicroglasidae	Aquatic.terrestrial	Least concerned
6	<i>Eublyctiscanophylctis</i>	Dicroglassid frog	Dicroglasidae	Aquatic	Least concerned
7	<i>Hoplobatrachustigerinus</i>	Indian bull frog	Dicroglasidae	Fresh wetlands ,Aquatic habitats	Least concerned
8	<i>Microhylaornata</i>	Ant frog/black throated frog	Microhylidae	Grasses and leaf litters. subtropical forest	Least concerned
9	<i>Polypedates maculates</i>	Indian tree frog	Rhacophoridae	Arboreal	Least concerned
10	<i>Zakeranarufescense</i>	Reddish burrowing frog	Dicroglossidae	Tropical moist semi-evergreen forest	Least concerned
11	<i>Rhacophorousmalabaricus</i>	Malbar gliding frog	Rhacophoridae	Evergreen	Least concerned
12	<i>Duttaphrynusmelanostictus</i>	Asian common toad	Rhacophoridae	Lowland habitats	Least concerned
13	<i>Uperadonmormorata</i>	Narrow mouthed frog	Microhylidae	Semi evergreen	Endangered
14	<i>Clinotarasuscurtipes</i>	Bicoloured frog	Rhacophoridae	Evergreen forests	Near threatned
15	<i>Hylaranamalbarica</i>	Malbar fungoid frog	Ranidae	Forest floor and lower vegetation	Least concern
16	<i>Indosylviranasps</i>	Indian golden frog	Ranidae	Semic aquatic	Vulnurable
17	<i>Zakeranakudaremkensis</i>	Kudremukha cricket frog	Dicroglossidae	Tropical moist semi-evergreen forest	Least concerned
18	<i>Pseudophilatousamboli</i>	Amboli bush frog	Rhacophoridae	Shrubs and low vegetations	Least concerned

Table. 3 . Species richness and diversity of Frog species

Sl. No	Species name	Count	Ni/N	LN	Hi
1	<i>Clinotarasuscurtipes</i>	1	0.001053741	-6.855408799	0.007223824
2	<i>Duttaphrynusmelanostictus</i>	11	0.011591149	-4.457513526	0.051667702
3	<i>Eublyctiscanophylctis</i>	27	0.028451001	-3.559571933	0.101273385
4	<i>Fejervaryacaparata</i>	75	0.079030558	-2.537920685	0.200573289
5	<i>Fejervaryalimnocharis</i>	112	0.118018967	-2.136909927	0.252195903
6	<i>Fejervaryasahyadris</i>	74	0.077976818	-2.551343705	0.198945663
7	<i>Hoplobatrachustigerinus</i>	114	0.120126449	-2.11921035	0.254573214
8	<i>Hylaranamalbarica</i>	10	0.010537408	-4.552823706	0.04797496
9	<i>Indosylviranasps</i>	1	0.001053741	-6.855408799	0.007223824
10	<i>Microhyla ornate</i>	5	0.005268704	-5.245970886	0.027639467
11	<i>Minervaryagranosa</i>	130	0.136986301	-1.987874348	0.272311555
12	<i>Polypedates maculates</i>	15	0.015806112	-4.147358598	0.065553613
13	<i>Pseudophilatous amboli</i>	143	0.150684932	-1.892564168	0.285180902
14	<i>Raorchestestuborohumorous</i>	96	0.101159115	-2.291060607	0.231761663
15	<i>Rhacophorousmalabaricus</i>	1	0.001053741	-6.855408799	0.007223824
16	<i>Uperadonmormorata</i>	42	0.044257113	-3.11773918	0.137982134
17	<i>Zakeranakudaremkensis</i>	83	0.087460485	-2.436568191	0.213103435
18	<i>Zakeranarufescens</i>	9	0.009483667	-4.658184221	0.044176668
Total		949	1	-68.25884043	2.406585024

5. Conclusion

This study focuses on the diverse frog species found in and around the College of Forestry, Sirsi. The area boasts a comparatively good number of frog species, many of which are critically endangered and endemic to the Western Ghats, underscoring the importance of their conservation (Myers et al., 2004). Three methods, including visual encounter surveys, road walks, and acoustical sampling, identified 18 frog species across five families, with *Dicroglossidae* having the highest number (AmphibiaWeb). The study calculated species diversity using the Shannon diversity index (Magurran, 2004), resulting in a value of 2.41, with *Pseudophilatous amboli* being the most abundant (0.1506). Notably, *Hydrophylaxbahuvistara* and *Hoplobatrachustigerinus* face high risks of road kill during rainy season mating behaviour. Habitat destruction is a major threat to frog diversity, emphasizing the importance of habitat conservation (Blaustein and Kiesecker, 2002). The study also highlights the need for awareness programs to promote herpetofauna conservation, mitigate human-animal interactions, and address snakebite management (Williams et al., 2008). Additionally, 16 snake species were observed in human habitation areas, with Russell's viper posing the highest human-snake conflict risk. Lack

of awareness was a key factor in snake fatalities, underscoring the necessity for educational initiatives (Nath et al., 2011). This research provides valuable baseline data for amphibian conservation in arid zones and emphasizes the significance of herpetofauna in ecological balance (Rödger et al., 2009).

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