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COMMUNICATION

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THE AMPHIBIAN DIVERSITY OF SELECTED AGROECOSYSTEMS IN THE SOUTHERN WESTERN GHATS, INDIA

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Abstract: A study was conducted to evaluate amphibian diversity in selected agroecosystems of central Kerala within the southern Western Ghats of India, from January to May 2017. A total of 10 anurans were recorded from cashew plantation, coconut plantation, homegarden and rubber plantation using a combination of quadrat sampling and visual encounter survey. We recorded three species endemic to the Western Ghats: *Minervarya keralensis*, *Pseudophilautus wynaadensis* and *Indosylvirana urbis* from these agroecosystems. *Pseudophilautus wynaadensis* is a threatened species with Endangered status as per the IUCN Red List. The present study shows a strong relationship between the types of agroecosystems and abundance of different amphibian species. This study highlights the potential of agroecosystems within and adjacent to the Western Ghats mountains to act as important abodes to conserve generalist species of amphibians and to provide a suitable habitat for threatened and endemic species.

Keywords: Endangered, *Minervarya keralensis*, frog, *Indosylvirana urbis*, *Pseudophilautus wynaadensis*, threatened species, Thrissur.

Malayalam Abstract:

മദ്ധ്യകേരളത്തിലെ വിവിധ കാർഷിക ആവാസവ്യവസ്ഥകളിലുള്ള ഉഭയജീവികളുടെ വൈവിധ്യം കണ്ടെത്തുന്നതിനായി ജനുവരി 2017 മുതൽ മെയ് 2017 വരെ നീണ്ടുനിന്ന ഒരു പഠനം നടത്തുകയുണ്ടായി. കശുമാവ് തോട്ടം, തെങ്ങിൻതോട്ടം, പൂർണ്ണ കശുമാവ് തുടങ്ങിയ കാർഷിക ആവാസവ്യവസ്ഥകളിൽ പലതരത്തിലുള്ള പഠന രീതികൾ പ്രയോഗിച്ച്, 10 വിവിധ ഇനം തവളകളെ കണ്ടെത്തുവാൻ കഴിഞ്ഞു. പശ്ചിമഘട്ടത്തിലെ തദ്ദേശീയ ഇനങ്ങളായ കേരള ചിലച്ചൻ (*Minervarya keralensis*), വയനാടൻ കരിയിലത്തവള (*Pseudophilautus wynaadensis*), നാട്ടു മണവാട്ടിത്തവള (*Indosylvirana urbis*) എന്നീ ഇനങ്ങളെയും പ്രസ്തുത പഠനത്തിന്റെ ഭാഗമായി കാർഷിക ആവാസവ്യവസ്ഥകളിൽ നിന്നും രേഖപ്പെടുത്തുവാനായി സാധിച്ചു. ഇതിൽ തന്നെ വയനാടൻ കരിയിലത്തവള (*Pseudophilautus wynaadensis*) IUCNന്റെ ചുവപ്പ് പട്ടിക പ്രകാരം അത്യധികം വംശനാശഭീഷണി നേരിടുന്ന (Endangered) ഗണത്തിൽപ്പെടുന്നതാണ്. തിരഞ്ഞെടുക്കപ്പെട്ട കാർഷിക ആവാസവ്യവസ്ഥകളും ഉഭയജീവികളുടെ സമൃദ്ധിയും തമ്മിൽ അഭേദ്യ ബന്ധം ഉണ്ടെന്നു ഈ പഠനം ചൂണ്ടിക്കാണിക്കുന്നു. വംശനാശഭീഷണി നേരിടുന്നതും തദ്ദേശീയവുമായ ഉഭയജീവികളുടെ സംരക്ഷണത്തിൽ പശ്ചിമഘട്ടത്തോട് ചേർന്നു കിടക്കുന്ന കാർഷിക ആവാസവ്യവസ്ഥകൾക്കുള്ള പങ്ക് ഈ പഠനത്തിലൂടെ വ്യക്തമാവുന്നു.

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Author Details: M.S. SYAMILI is an Assistant Professor and works primarily on herpetofauna and birds. P.O. Nameer is a Professor and his research interest include the taxonomy, biogeography and ecology of the vertebrates except fishes.

Author Contribution: Both the authors contributed equally to the field work, morphometric data collection, analysis and manuscript preparation.

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INTRODUCTION

Amphibians are important predator and prey species in both aquatic and terrestrial habitats, especially in the tropics where the diversity and abundance of taxa are high. According to Whiles et al. (2006) loss of one species is akin to loss of two species in the case of amphibians. Baillie et al. (2004) stated that among the vertebrates of the world, amphibians are the most threatened taxa and have the highest proportion of species on the verge of extinction. The most pervasive threats to amphibians are habitat loss and habitat degradation.

For the amphibians of the Western Ghats the species accumulation curve has not yet reached a plateau (Aravind et al. 2004). According to Nameer et al. (2015) & Das (2015) 90% of amphibians in Kerala are endemic to the Western Ghats and 33% belong to various threatened categories. Generally, protected area networks are considered as the corner stone of biodiversity conservation efforts. Perfecto & Vandermeer (2008) commented that conservation strategies which focus on tropical forests while ignoring the multiple land uses in which they are embedded are failed strategies. According to Nair (2008), agroforests can be considered as potential oases for disappearing species, even though they cannot substitute for natural forests. Wanger et al. (2009) assessed the herpetological diversity in cacao agroforests of Southeast Asia, where they observed that

certain habitat features like increase in leaf litter favour the richness and abundance of disturbance-tolerant species. Bionda et al. (2011) worked on the amphibians of various agroecosystems in Argentina and found that there are species which take advantage of the hydrology and hydroperiod of agroecosystems for their survival. Not all agroecosystems contribute equally towards conservation.

Hence, for a realistic conservation strategy one should evaluate the conservation value of these multiple land use systems such as agroecosystems. The present study is expected to shed light on the amphibian diversity and richness in agroecosystems of Kerala.

STUDY AREA

The study was conducted in the selected agroecosystems in Thrissur District, southern Western Ghats, Kerala (10.53–10.55 °N & 76.27–76.28°E, 20–70 m). The chosen agroecosystems include, cashew plantation, coconut plantation, homegarden and rubber plantation (Fig. 1). The study area chosen mostly comes within the main campus of the Kerala Agricultural University, in Kerala, southern India. The campus has a total area of 391.44ha and is located very close to the Peechi-Vazhani Wildlife Sanctuary. The major habitats include gardens, botanical garden, plantations of rubber,

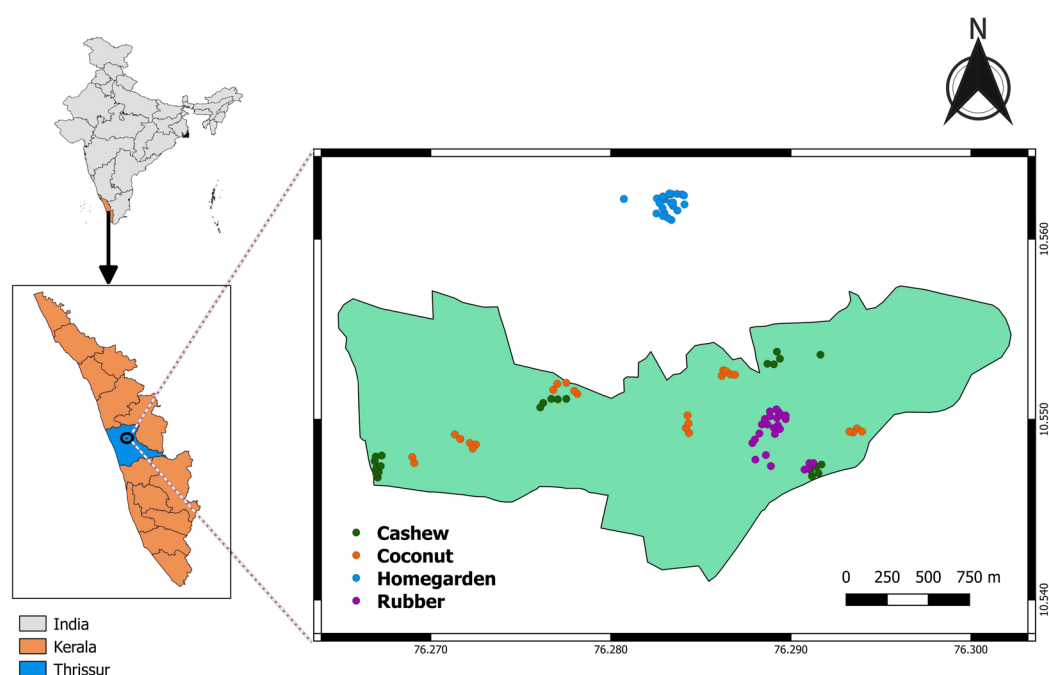


Figure 1. Location map of selected agroecosystems, Thrissur, Kerala

coconut, plantain, cacao, and orchards of mango, jackfruit, sapota and guava. The whole area must have been under the forests about one and a half century or so and was subsequently converted mostly into rubber plantations. Later the land was handed over to the Kerala Agricultural University (KAU) in 1971, and the KAU had developed these areas into the different land uses as is explained above. The 14-year mean minimum temperature is 23.3°C and 10-year mean maximum is 31.9°C. The area receives south-west and north-east monsoons, the greater portion of the rainfall, however is received from the south-west monsoon between June and September. The mean annual rainfall is 2,803.4mm. The mean number of rainy days per year is 112 days (KAU Weather Station 2014).

The study was conducted in four selected agroecosystems such as cashew plantation which is 16 years old and spreads over an area of 90 acres, a coconut plantation, which is about 35 years old and has an extent of 50 acres, a homegarden covering eight acres about 40 years old, and a rubber plantation with an extent of 60 acres and is about 67 years old.

METHODS

The study was conducted from January 2017 to May 2017. Quadrat sampling was the primary method adopted for the study and was supplemented with visual encounter survey.

Quadrat Sampling

One hundred quadrats each having a size of 10m × 10m were deployed in the study area randomly with a

minimum distance of 10m between two quadrats. The observations were taken between 19:00hr and 20:30hr. Two observers surveyed the quadrat from opposite corners approaching the center in a clockwise manner for thorough search of the ground-dwelling amphibians (Harikrishnan et al. 2012).

Visual Encounter Survey

Visual encounter survey was conducted in the study locations (Harikrishnan et al. 2012). This was done between 20:30–21:30 hr. LED torches and head lamps were used to spot the amphibians. During the survey, a range of possible microhabitats where the amphibians could be seen, such as rocks, marshes, fallen logs, tree holes, snags and water bodies were thoroughly examined.

RESULTS AND DISCUSSION

Amphibian diversity of selected agroecosystems

A total of 10 anurans belonging to five families were recorded from the selected agroecosystems of central Kerala (Table 1). This includes two species each from the families Microhylidae, Ranidae and Rhacophoridae, three species from Dicroglossidae and one species from Bufonidae. Dicroglossidae represented 30% of the amphibians encountered during the present study, however, these are commensal and generalist species. These include *Euphlyctis cyanophlyctis*, *Hoplobatrachus crassus* and *Minervarya keralensis*. According to Gururaja et al. (2007), anthropogenic changes in land use type, canopy cover and hydrological regimes support the presence of more generalist amphibian species.

Table 1. Species diversity of amphibians of selected agroecosystems of Thrissur District, Kerala

Common name	Scientific name	Family	Quadrat sampling	Visual encounter survey	IUCN status
Common Indian Toad	<i>Duttaphrynus melanostictus</i>	Bufonidae	1	1	LC
Skittering Frog	<i>Euphlyctis cyanophlyctis</i>	Dicroglossidae	1	0	LC
Jerdon's Bullfrog	<i>Hoplobatrachus crassus</i>	Dicroglossidae	1	0	LC
Kerala Warty Frog	<i>Minervarya keralensis</i>	Dicroglossidae	1	1	LC
Reddish Narrow-mouthed Frog	<i>Microhyla rubra</i>	Microhylidae	0	1	LC
Painted Frog	<i>Uperodon taprobanicus</i>	Microhylidae	0	1	LC
Fungoid Frog	<i>Hydrophylax malabaricus</i>	Ranidae	1	1	LC
Urban Golden-backed Frog	<i>Indosylvirana urbis</i>	Ranidae	1	0	NE
Common Indian Tree Frog	<i>Polypedates maculatus</i>	Rhacophoridae	0	1	LC
Jerdon's Bush Frog	<i>Pseudophilautus wynadensis</i>	Rhacophoridae	1	1	EN

EN - Endangered; LC - Least Concern; NE - Not Evaluated. 0 - Not encountered; 1 - Encountered

Table 2. Amphibian diversity and abundance from selected agroecosystems

Species	Cashew Plantation	Coconut Plantation	Home garden	Rubber Plantation	Total
<i>Duttaphrynus melanostictus</i>	1	0	0	6	7
<i>Euphylyctis cyanophlyctis</i>	0	0	0	5	
<i>Hoplobatrachus crassus</i>	0	0	0	14	
<i>Minervarya keralensis</i>	0	0	3	12	
<i>Microhyla rubra</i>	0	0	0	1	1
<i>Uperodon taprobanicus</i>	0	1	0	0	1
<i>Hydrophylax malabaricus</i>	0	0	0	1	1
<i>Indosylvirana urbis</i>	0	0	0	20	
<i>Polypedates maculatus</i>	0	3	0	0	3
<i>Pseudophilautus wynaadensis</i>	5	7	143	347	502
Total	6	11	146	406	569

Three species that are endemic to Western Ghats namely *Minervarya keralensis*, *Pseudophilautus wynaadensis* and *Indosylvirana urbis* were reported from the agroecosystems that were studied (Biju et al. 2004, 2014; Biju & Bossuyt 2009; Gururaja 2012; Das 2015;

Sanchez et al. 2018). *Pseudophilautus wynaadensis*, an Endangered species (Biju et al. 2004) was found to be present in all the agroecosystems surveyed during the present study (Table 2).

Rathod & Rathod (2013) reported highest diversity of amphibians from organic coffee plantations of Kodagu District where diversity of native rainforest trees was also high. Chemical contamination by the use of fertilizers and pesticides in the agricultural fields lead to incidence of abnormalities among common frog species as their breeding period coincides with the time of agrochemical application in the fields (Gurushankara et al. 2007; Kittusamy et al. 2014; Krishnamurthy et al. 2008). No abnormalities, however, were observed among the 569 individuals of amphibians recorded during the current study.

Quadrat sampling recorded only seven species from the study location. Though visual encounter survey also recorded seven species, it recorded three species that were not recorded through quadrat sampling (Table 1). It is potentially possible to obtain the complete species inventory of the sampled area when visual encounter survey is combined with another sampling technique (Eekhout 2010).

Duttaphrynus melanostictus (Schneider, 1799)

During the present study, Common Indian Toad

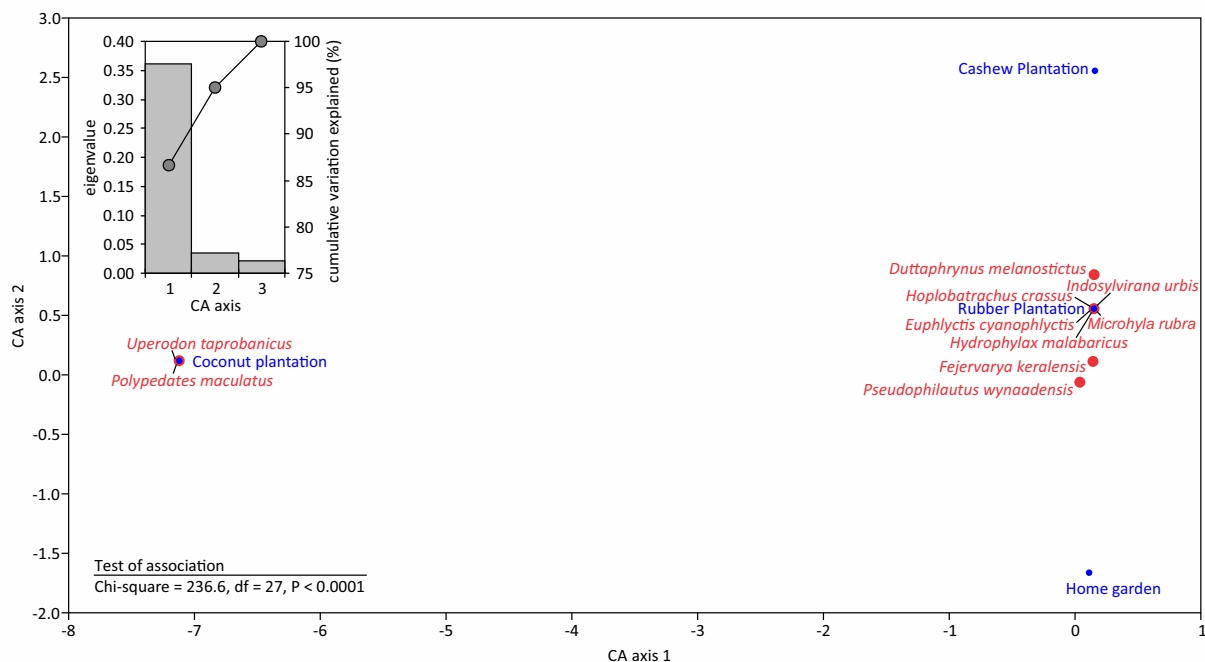


Figure 2. Correspondence analysis (CA) depicting the association between the agroecosystems and the abundance of different amphibian species. Note that *Hoplobatrachus crassus*, *Hydrophylax malabaricus*, *Euphylyctis cyanophlyctis*, *Indosylvirana urbis* and *Microhyla rubra* overlap with the rubber plantation. Test of association and scree plot of percentage variation explained by each CA axis are shown in the inset.

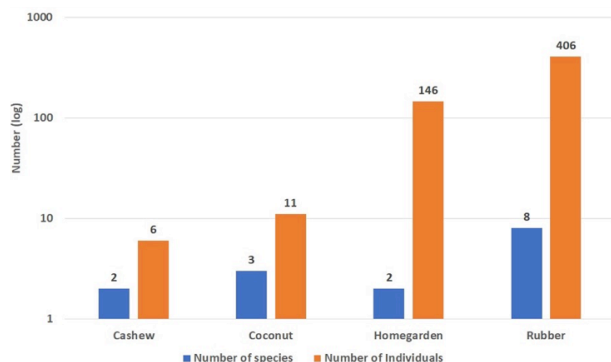


Figure 3. Species richness and abundance of amphibians of selected agroecosystems in southern Western Ghats, India
S = species richness ; N = number of individuals

(Image 1) was encountered from cashew and rubber plantations. It was also sighted in different colour morphs (Images 1A–D) and all individuals were adults.

Euphlyctis cyanophlyctis (Schneider, 1799)

Skittering Frog (Image 2) was sighted only at the pond in the rubber plantation. In this case also only adult individuals were sighted.

Hoplobatrachus crassus (Jerdon, 1853)

Jerdon's Bullfrog (Image 3) is another species which was detected only at the pond within the rubber plantation. The individuals sighted included both adults and juveniles. *Hoplobatrachus crassus* as well as *Euphlyctis cyanophlyctis* are species that prefer water bodies, thus justifying their presence at the pond.

Minervarya keralensis (Sanchez et al. 2018)

Kerala Warty Frog (Images 4A–B) was detected from the homegarden and from the pond within the rubber plantations. Only adult individuals were sighted for this species. This species was formerly under the genus *Fejervarya*, but now is under the new genus *Minervarya* (Sanchez et al. 2018).

Microhyla rubra (Jerdon, 1854)

Reddish Narrow-mouthed Frog (Image 5) was sighted from the premises of the pond in the rubber plantation during visual encounter survey. Interestingly, all the individuals recorded were juveniles of very small size.



Image 1. Common Indian Toad *Duttaphrynus melanostictus*. (A, B, C & D are different colour morphs)



Image 2. Skittering Frog *Euphlyctis cyanophlyctis*.



Image 3. Jerdon's Bull Frog *Hoplobatrachus crassus*.



Image 4. Kerala Warty Frog *Minervarya keralensis*.
(A & B are different morphs)



Image 5. Reddish Narrow-mouthed Frog *Microhyla rubra*.



Image 6. Fungoid Frog *Hydrophylax malabaricus*.



Image 7. Urban Golden-backed Frog *Indosylvirana urbis*.

***Uperodon taprobanicus* (Parker, 1934)**

Painted Frog was spotted from a tree hole within the coconut plantation. This species was sighted only once during the study period.

***Hydrophylax malabaricus* (Tschudi, 1838)**

Fungoid frog (Image 6) was detected only from the rubber plantation. It was found in the moist areas of the

plantation.

***Indosylvirana urbis* (Biju et al., 2014)**

Urban Golden-backed Frog (Image 7) was found on the rocky patches near the pond within the rubber plantation.



Image 8. Common Indian Tree Frog *Polypedates maculatus*.

Polypedates maculatus (Gray, 1834)

Common Indian Tree Frog (Image 8) is one of the most common tree frogs in Kerala. During the visual encounter survey, a male and female of the species were recorded from the coconut plantation. After the first summer shower in May, one additional individual was also observed from the coconut plantation.

Pseudophilautus wynaadensis (Jerdon, 1853)

Jerdon's Bush Frog (Image 9) was the most common frog during the present study and was recorded from all the agroecosystems selected for the present study. We observed four colour morphs of the species during the study period (Image 9A–D). All the 25 quadrats in the homegarden detected the presence of this species. The highest count of the species was from rubber plantation where there were 30–40 individuals on a single herb of *Rauwolfia tetraphylla* near a moist area, due to a leakage in the irrigation pipeline that passed through the rubber plantation.

It may be noted that all the amphibians sighted within the rubber plantations were either located in a pond in the rubber plantation or from artificially wet areas.

Association between the agroecosystems and abundance of amphibians

The null hypothesis is that there is no association between the type of agroecosystem and abundance of different amphibian species. The Chi-square test (Chi-square = 236.6, df = 27, $P < 0.0001$) suggested that there is a strong association between the type of agroecosystem and abundance of different amphibian species (Fig. 2). Correspondence analysis was performed to understand the association between selected agroecosystems and amphibian abundance.



Image 9. Jerdon's Bush Frog *Pseudophilautus wynaadensis* (A, B, C & D are different colour morphs).

Polypedatus maculatus and *Uperodon taprobanicus* were only present in coconut plantation and this agroecosystem was not preferred by other species of amphibians encountered in the study (Fig. 2). All other species of amphibians preferred rubber plantation. *Hoplobatrachus crassus*, *Hydrophylax malabaricus*, *Euphlyctis cyanophlyctis*, *Indosylvirana urbis* and *Microhyla rubra* were exclusively present in the rubber plantation, while *Minervarya keralensis* and *Pseudophilautus wynaadensis* also preferred homegardens at some level, while *Duttaphrynus melanostictus* showed a preference to the cashew plantation (Fig. 2).

Amphibian abundance and richness was found to be higher in rubber plantation followed by homegarden (Fig. 3). This higher amphibian diversity and abundance in the rubber plantation could be an artifact because of the presence of a pond as well as the presence of a couple of wet areas due to anthropogenic interventions, in the rubber plantations. This could also explain the presence of species such as *Euphlyctis cyanophlyctis*, *Hoplobatrachus crassus*, *Indosylvirana urbis*, and *Microhyla rubra* only from the rubber plantation, even during the summer months. According to Neckel-Oliveira & Gascon (2006), presence of an aquatic habitat is crucial for the existence of certain species of amphibians.

Rathod & Rathod (2013) explained that an open canopy can increase the temperature and evaporation and decrease the persistence of moist areas. This can be one reason for fewer encounters with amphibians from coconut plantation and cashew plantation.

CONCLUSION

Protected areas cover 18% of the Earth's land area and 8% of Kerala's geographical area, and they are considered to be corner stones of biodiversity conservation. It is a fact that most of these protected areas are virtual islands embedded within a matrix of multiple land uses. A large proportion of biodiversity coexists with humans in their managed ecosystems, which can hold minimum viable populations of rare and endangered native fauna and flora. The potential of such landscapes in conserving native biodiversity is still untapped. The present study showed that agroecosystems have not only the potential to conserve generalist species, but also help to provide suitable habitat for some threatened and endemic species of amphibians.

REFERENCES

- Aravind, N.A., R.U. Shaanker & K.N. Ganeshaiah (2004). Croak, croak, croak: are there more frogs to be discovered in the Western Ghats? *Current Science* 86(11): 1471–1472.
- Baillie, J., C. Hilton-Taylor & S.N. Stuart [eds.]. (2004). 2004 IUCN Red List of Threatened Species: A Global Species Assessment. Thanet Press Ltd., Margate, UK, 195p.
- Biju, S.D. & F. Bossuyt (2009). Systematics and phylogeny of *Philautus* Gistel, 1848 (Anura, Rhacophoridae) in the Western Ghats of India, with descriptions of 12 new species. *Zoological Journal of the Linnean Society* 155(2): 374–444; <http://doi.org/10.1111/j.1096-3642.2008.00466.x>
- Biju, S.D., G.D. Buddhe, S. Dutta, K. Vasudevan, C. Srinivasulu & S.P. Vijayakumar (2004). *Pseudophilautus wynaadensis* (errata version published in 2016). The IUCN Red List of Threatened Species 2004. Downloaded on 16 March 2018; <http://doi.org/10.2305/IUCN.UK.2004.RLTS.T58937A11859437.en>
- Biju, S.D., S. Garg, S. Mahony, N. Wijayathilaka, G. Senevirathne & M. Meegaskumbura (2014). DNA barcoding, phylogeny and systematics of Golden-backed Frogs (Hylarana, Ranidae) of the Western Ghats-Sri Lanka biodiversity hotspot, with the description of seven new species. *Contributions to Zoology* 83(4): 269–335.
- Bionda, C.D.L., I.E. di Tada & R.C. Lajmanovich (2011). Composition of amphibian assemblages in agroecosystems from the central region of Argentina. *Russian Journal of Herpetology* 18(2): 93–98.
- Das, S. (2015). A checklist of amphibians of the Kerala State. *Journal of Threatened Taxa* 7(13): 8023–8035; <http://doi.org/10.11609/JoTT.2003.7.13.8023-8035>
- Eekhout, X. (2010). Sampling amphibians and reptiles, pp. 530–557. In: *Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories*. National Focal Point to The Global Taxonomy Initiative, Belgium.
- Gururaja, K.V. (2012). *Pictorial Guide to Frogs and Toads of the Western Ghats*. Gubbi Labs LLP.
- Gururaja, K.V., K.P. Dinesh, M.J. Palot, C. Radhakrishnan & T.V. Ramachandra (2007). A new species of *Philautus* Gistel (Amphibia: Anura: Rhacophoridae) from southern Western Ghats, India. *Zootaxa* 1621: 1–16.
- Gurushankara, H.P., S.V. Krishnamurthy & V. Vasudev (2007). Morphological abnormalities in natural populations of common frogs inhabiting agroecosystems of central Western Ghats. *Applied Herpetology* 4(1): <http://doi.org/39-4510.1163/157075407779766651>
- Harikrishnan, S., S. Chandramouli & K. Vasudevan (2012). A survey of herpetofauna on Long Island, Andaman and Nicobar Islands, India. *Herpetological Bulletin* 119: 19.
- Kittusamy, G., C. Kandaswamy, N. Kandan & M. Subramanian (2014). Pesticide residues in two frog species in a paddy agroecosystem in Palakkad district, Kerala, India. *Bulletin of Environmental Contamination and Toxicology* 93(6): 728–734; <http://doi.org/10.1007/s00128-014-1351-1>
- Krishnamurthy, S.V., D. Meenakumari, H.P. Gurushankara & V. Vasudev (2008). Nitrate-induced morphological anomalies in the tadpoles of *Nyctibatrachus major* and *Fejervarya limnocharis* (Anura: Ranidae). *Turkish Journal of Zoology* 32(3): 239–244.
- Nair, P.R. (2008). Agroecosystem management in the 21st century: it is time for a paradigm shift. *Journal of Tropical Agriculture* 46: 1–12.
- Nameer, P.O., J. Praveen, A. Bijukumar, M.J. Palot, S. Das & R. Raghavan (2015). A checklist of vertebrates of the Kerala State. *Journal of Threatened Taxa* 7(13): 7961–7970; <http://doi.org/10.11609/jott.1999.7.13.7961-7970>
- Neckel-Oliveira, S. & C. Gascon (2006). Abundance, body size and movement patterns of a tropical treefrog in continuous and fragmented forests in the Brazilian Amazon. *Biological Conservation* 128(3): 308–315; <http://doi.org/10.1016/j.biocon.2005.09.037>
- Perfecto, I. & J. Vandermeer (2008). Biodiversity conservation in tropical agroecosystems. *Annals of New York Academy of Science* 1134(1): 173–200; <http://dx.doi.org/10.1196/annals.1439.011>
- Rathod, S. & P. Rathod (2013). CEPF Western Ghats Special Series: Amphibian communities in three different coffee plantation regimes in the Western Ghats, India. *Journal of Threatened Taxa* 5(9): 4404–4413; <http://doi.org/10.11609/JoTT.o3054.4404-13>
- Sanchez, E., S.D. Biju, M.M. Islam, M. Hasan, A. Ohler, M. Vences & A. Kurabayashi (2018). Phylogeny and classification of fejevryan frogs (Anura: Dicroglossidae). *SALAMANDRA* 54(2): 109–116.
- Wanger, T.C., A. Saro, D.T. Iskandar, B.W. Brook, N.S. Sodhi, Y. Clough & T. Tschardt (2009). Conservation value of cacao agroforestry for amphibians and reptiles in Southeast Asia: combining correlative models with follow-up field experiments. *Journal of Applied Ecology* 46(4): 823–832; <http://doi.org/10.1111/j.1365-2664.2009.01663.x>
- Whiles, M.R., K.R. Lips, C.M. Pringle, S.S. Kilham, R.J. Bixby, R. Brenes, S. Connelly, J.C. Colon-Gaud, M. Hunte-Brown, A.D. Huryn & C. Montgomery (2006). The effects of amphibian population decline on the structure and function of Neotropical stream ecosystems. *Frontiers in Ecology and Environment* 4(1): 27–34; [http://doi.org/10.1890/1540-9295\(2006\)004\[0027:TEOAPD\]2.0.CO;2](http://doi.org/10.1890/1540-9295(2006)004[0027:TEOAPD]2.0.CO;2)





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