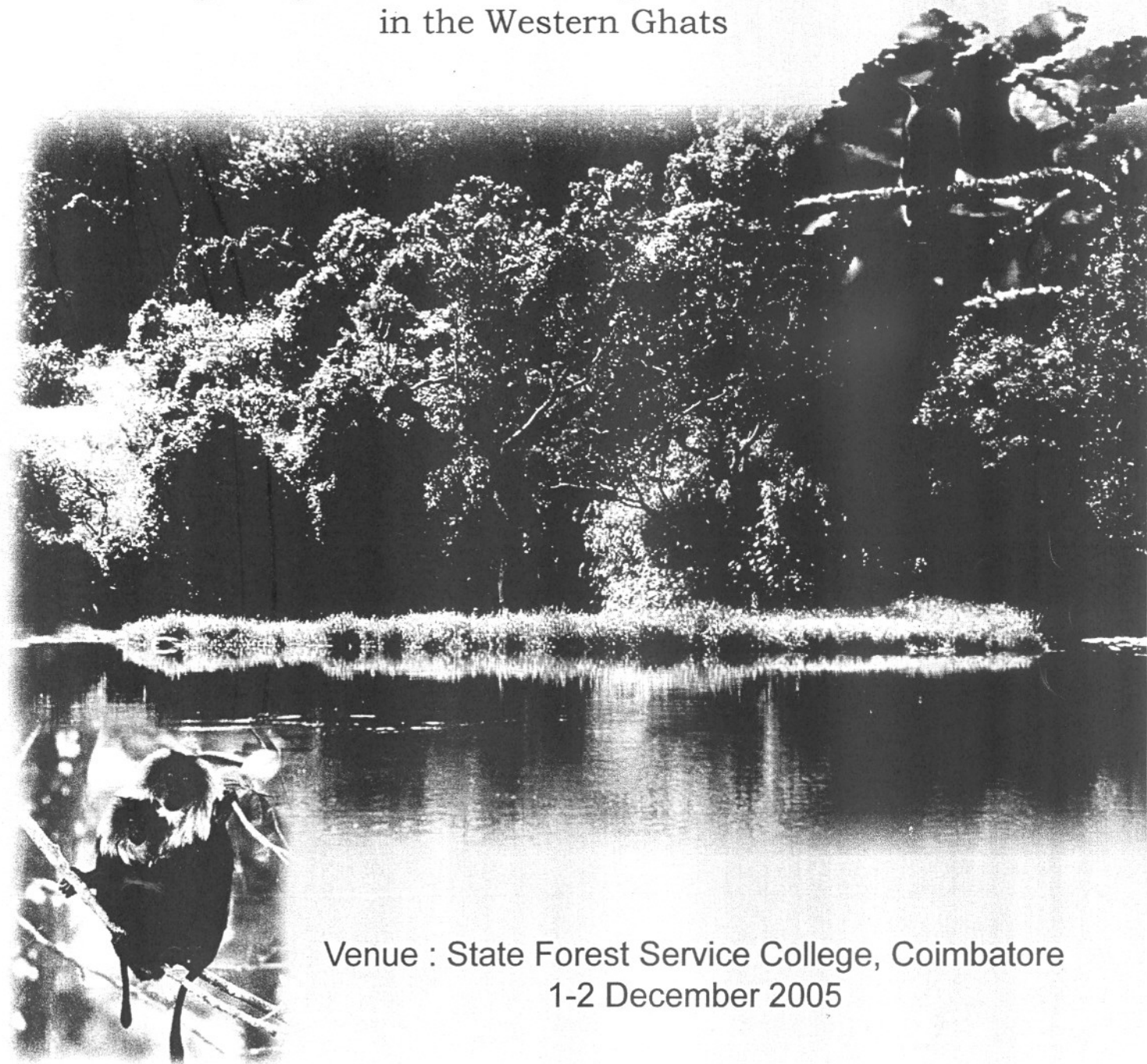


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INTEGRATED APPROACHES TO MINIMISE AMBIGUITIES IN ANURAN DESCRIPTION

Gururaja K.V. and Ramachandra T.V.

*Energy and Wetlands Research Group Centre for Ecological Sciences
Indian Institute of Science, Bangalore.*

The Western Ghats and Sri Lanka, among the hottest hotspots of biodiversity, are being in more focus on amphibian studies, especially after the report of discovery of about 200 old world tree frogs from these two regions. Eventually, these regions became amphibian hotspots of the globe, surpassing Borneo, Madagascar etc. The evidence of decline in amphibian global population fuelled amphibian research in the past two decades, which has led to the description of new species and also to controversies associated with the approaches in describing a new species.

Review of the genus *Philautus* in 2001, provided a comprehensive account on the genus, which has heralded a competition among researchers from Sri Lanka and Western Ghats' on *Philautus* diversity. Amphibian diversity studies were also supplemented with the new discoveries of caecilians and other ranids in the Western Ghats. Such taxonomic oriented research activities in these regions, though is a positive development from conservation point of view, but has led to controversies due to ambiguous ecological status of some species. This has serious consequences in the conservation and management of Western Ghats, which necessitates an immediate step to arrive at a protocol in describing a new species. This paper while documenting the integration of many disciplines and emphasises the need for arriving at a consensus before assigning 'new status' to a species and ascertaining its ecological status.

In the Western Ghats, since 2000, 18 new species of amphibians belonging to two extant orders, namely anura and gymnophiona have been described mainly on the basis of morphology and morphometry (Mor). Recent advances in technology have provided sophistication in analysis and interpretation of molecular data (Mol), acoustics/vocalization (Voc) and osteology (Ost) to describe a new species. Table 1 compares methods used by researchers to describe a new species in the Western Ghats. Recent description from Sri Lanka and Western Ghats indicates fragmented approaches in describing a species even today despite availability of better methods. However, most of the species have been described incompletely as there are limitation in traditional as

well as in newer methods. Relative merits and demerits of these methods are listed in Table 2. This necessitates integrated approaches involving morphological, molecular and acoustical analysis along with natural history and osteology in species description.

The case of so called 'extinct' frog taxa *Philautus leucorhinus*, Lichtenstein, Weinland and von Martens 1856 from Sri Lanka highlights the need for integrating molecular and morphological approaches, supplemented by osteological, acoustical and developmental analysis in species description. In this case, except morphometry, all relative information like vocalization, reproductive behaviour and molecular data are either obscure or not available, creating unnecessary confusion among conservation biologists on the exact status of the species.

Table 1. Amphibian species described from the Western Ghats with various methods.

Species	Mor	Mol	Voc	Nat	Ost	Key
Microhylidae						
<i>Microhyla sholigari</i>	+	-	-	-	-	-
Nasikabatrachidae						
<i>Nasikabatrachus sahyadrensis</i>	+	+	-	-*	+	-
Ranidae						
<i>Minervarya sahyadris</i>	+	+	-	-	-	-
<i>Nyctibatrachus hussaini</i>	+	-	-	-	-	+
<i>Nyctibatrachus petraeus</i>	+	-	-*	+	-	-
<i>Philautus bobingeri</i>	+	-	-	-*	-	-
<i>Philautus graminirupes</i>	+	-	-	-*	-	-
<i>Philautus griet</i>	+	+	-	-	-	-
<i>Philautus luteolus</i>	+	-	+	-	-	-
<i>Philautus nerostagona</i>	+	-	-	-*	-	-
<i>Philautus ponmudi</i>	+	-	-	-	-	-
<i>Philautus tuberochumerus</i>	+	-	+	-	+	-
<i>Rhacophorus pseudomalabaricus</i>	+	-	-	-*	-	-
Caeciliidae						
<i>Gegeneophis nadkarnii</i>	+	-	NA	-	-	-
<i>Gegeneophis madhavai</i>	+	-	NA	-	-	-
<i>Gegeneophis danieli</i>	+	-	NA	-	-	-
<i>Gegeneophis seshachari</i>	+	-	NA	-	-	-
<i>Indotyphlus maharashtraensis</i>	+	-	NA	-	-	+

Note: + presence, - absence, -* partial, NA – Not applicable;

Mor: Morphology/Morphometry; Mol: Molecular analysis; Voc: Vocalization/Acoustical analysis; Nat: Natural history - Reproductive behaviour/developmental biology; Ost: Osteology/Skeletal morphology; Key: Identification keys

Apart from the mandatory requirement of vouchering a type specimen to national museum with the information on place, date of collection, collector name and ecological notes, it is essential to standardise the protocol integrating all the aforesaid methods with keys to assign 'new taxon' while describing a species. This would eliminate the lacunae associated with the traditional as well as advanced methods. Morphological and molecular will complement each, while other methods like acoustics, natural history and osteology would supplement the description, resulting in a comprehensive description of the species. This would certainly eliminate the controversies associated in describing anuran species.