



## Taxonomic review of the tree frog genus *Rhacophorus* from the Western Ghats, India (Anura: Rhacophoridae), with description of ontogenetic colour changes and reproductive behaviour

S.D. BIJU<sup>1,2</sup>, RACHUNLIU G. KAMEI<sup>1</sup>, STEPHEN MAHONY<sup>1,3</sup>, ASHISH THOMAS<sup>1</sup>, SONALI GARG<sup>1</sup>, GARGI SIRCAR<sup>1</sup> & ROBIN SUYESH<sup>1</sup>

<sup>1</sup>Systematics Lab, Department of Environmental Studies, University of Delhi, Delhi 110 007, India

<sup>3</sup>School of Biology and Environmental Science, Science Centre (West), University College Dublin, Belfield, Dublin 4, Ireland

<sup>2</sup>Corresponding author: E-mail: [sdbiju.du@gmail.com](mailto:sdbiju.du@gmail.com)

### Abstract

A taxonomic revision of the Western Ghats species from the genus *Rhacophorus* is presented. Based on museum studies and new collections from localities spanning the known range of Western Ghats *Rhacophorus*, we review the four known species of this genus, their type specimens, current taxonomic status and their geographic distribution on the basis of morphological and molecular data. The holotypes of *Rhacophorus calcadensis*, *R. lateralis* and *R. malabaricus* are re-described. The previously unidentified holotype of *Rhacophorus malabaricus* is herein fixed. Descriptions of ontogenetic colour change (OCC) in the Western Ghats *Rhacophorus* are provided and we conjecture the taxonomic utility of OCC. Additionally we provide observations on nesting behaviour of each species, and report multiple male participation during amplexus, oviposition and foam nest construction in *R. lateralis* and *R. malabaricus*.

**Key words:** *Rhacophorus*, taxonomy, phylogeny, ontogenetic colour change, polyandry, Western Ghats, biodiversity, conservation

### Introduction

The Old World tree frog family Rhacophoridae Hoffman, consisting of 350 species in 16 genera, is one of the most diverse anuran families in the world (Frost 2013, AmphibiaWeb 2013). Within the genus *Rhacophorus* Kuhl & Van Hasselt (*sensu stricto*), 85 nominal species are currently recognised making it the most species-rich rhacophorid genus (Frost 2013; AmphibiaWeb 2013). The primary centre of *Rhacophorus* radiation is in the tropical and temperate zones of East and South East Asia (Inger 1999; Chan & Grismer 2010). In India, 14 *Rhacophorus* species have been reported though some of the species records from north and northeast India require taxonomic scrutiny (SDB, personal observation). The Western Ghats mountain range is considered a distinct biogeographic unit (Biju & Bossuyt 2003; Bossuyt *et al.* 2004, 2006; Roelants *et al.* 2004; Bocxlaer *et al.* 2009), and contains four species of *Rhacophorus* viz., *Rhacophorus calcadensis* Ahl, *R. lateralis* Boulenger, *R. malabaricus* Jerdon, and *R. pseudomalabaricus* Vasudevan & Dutta, that are endemic to this chain of mountains.

Polyandry is a taxonomically widespread behaviour and often the subject of intense debates (Jennions & Petrie 2000; Zeh & Zeh 2001). The generally understood benefits include: increased genetic variability amongst offspring (e.g., Yasui 1998; Gladstone 1979; Stacey 1982), insurance of high fertilisation rate (Byrne & Whiting 2008), insurance against male infertility (e.g., Sheldon 1994) or nest failure (Byrne & Keogh 2009), mitigating the risk of low sperm number (e.g., Bourne 1993), allowing females to select more compatible males and reducing incidence of inbreeding (Tregenza & Wedell 1998, 2002). Numerous reports and studies have demonstrated that polyandry is a relatively common behaviour for several rhacophorid species (e.g., Coe 1967, 1974; Wilson 1975; Halliday & Verrel 1984; Kasuya *et al.* 1987, 1996; Feng & Narins 1991; Fukuyama 1991; Jennions *et al.* 1992; Halliday 1998; Liao & Lua 2010), however this behaviour does not appear to have been previously documented for any of the Western Ghats species.