



## Mud-packing frog: A novel breeding behaviour and parental care in a stream dwelling new species of *Nyctibatrachus* (Amphibia, Anura, Nyctibatrachidae)

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### Abstract

Reproductive modes are diverse and unique in anurans. Selective pressures of evolution, ecology and environment are attributed to such diverse reproductive modes. Globally forty different reproductive modes in anurans have been described to date. The genus *Nyctibatrachus* has been recently revised and belongs to an ancient lineage of frog families in the Western Ghats of India. Species of this genus are known to exhibit mountain associated clade endemism and novel breeding behaviours. The purpose of this study is to present unique reproductive behaviour, oviposition and parental care in a new species *Nyctibatrachus kumbara* sp. nov. which is described in the paper. *Nyctibatrachus kumbara* sp. nov. is a medium sized stream dwelling frog. It is distinct from the congeners based on a suite of morphological characters and substantially divergent in DNA sequences of the mitochondrial 16S rRNA gene. Males exhibit parental care by mud packing the egg clutch. Such parental care has so far not been described from any other frog species worldwide. Besides this, we emphasize that three co-occurring congeneric species of *Nyctibatrachus*, namely *N. jog*, *N. kempholeyensis* and *Nyctibatrachus kumbara* sp. nov. from the study site differ in breeding behaviour, which could represent a case of reproductive character displacement. These three species are distinct in their size, call pattern, reproductive behaviour, maximum number of eggs in a clutch, oviposition and parental care, which was evident from the statistical analysis. The study throws light on the reproductive behaviour of *Nyctibatrachus kumbara* sp. nov. and associated species to understand the evolution and adaptation of reproductive modes of anurans in general, and *Nyctibatrachus* in particular from the Western Ghats.

**Key words:** Axillary amplexus, oviposition, Kathalekan, mud pack, *Myristica* swamps, reproductive character displacement, Western Ghats

### Introduction

Reproductive modes including oviposition sites, egg development, larval development sites, presence or absence of parental care and details of parental care are diverse among anurans (Jameson 1955; Toledo *et al.* 2012). Up until now, 40 anuran reproductive modes are known, which vary both inter and intra specifically (Morrison & Hero 2003; Gururaja 2010; Toledo *et al.* 2012). Intraspecific variation in reproductive mode is known in very few species (Haddad & Prado 2005), but interspecific variation is widespread. Such variations are usually attributed to evolutionary and ecological factors (Morrison & Hero 2003; Rice 2008). Reproductive character displacement (RCD) is one such evolutionary determinant that arises with the interactions between co-occurring congeneric (COCG) species and imposes directional selection on each species' reproductive characteristics (including mating signals or mating preferences), leading to divergence between COCG species in these characteristics and a related reduction in reproductive interfaces (Howard 1993; Rice 2008).

The family *Nyctibatrachidae* forms one of the three oldest frog families in the Indian subcontinent (Roelants *et al.* 2007), with genus *Nyctibatrachus* endemic to the Western Ghats and genus *Lankanectes* endemic to Sri Lanka.

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