Zootaxa 2744: 39–52 (2011)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Phylogenetic relationships within the genus *Staurois* (Anura, Ranidae) based on 16S rRNA sequences

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Abstract

We estimate the phylogenetic relationships among all six recognized species of the genus *Staurois* based on 16S rRNA sequences (~522 bp) for 92 specimens from Borneo and the Philippines. Our preferred phylogenetic tree inferred from Maximum Parsimony and Bayesian methods reveal six major clades within the genus leading to recognition of *S. natator, S. nubilus, S. guttatus, S. tuberilinguis, S. parvus,* and *S. latopalmatus*. For species where multiple populations were assessed, we found high genetic variation that may eventually support the recognition of new species.

Key words: Amphibia, mitochondrial DNA, maximum parsimony, Bayesian analysis, phylogeny, genetic diversity

Introduction

Frogs of the genus *Staurois* (Ranidae) are found in clear, rocky, and swift streams in tropical rain forests of Southeast Asia (Inger & Stuebing 1997). Members of the genus have been recorded from Borneo (covering Kalimantan, Indonesia; Malaysia; and Brunei Darussalam) and the Philippines (Inger 1954, 1966; Alcala & Brown 1998; Iskandar & Colijn 2000).

Summarizing the work of previous taxonomists who focused on morphological characteristics, Frost *et al.* (2009) recognized five species under the genus of *Staurois*, including *S. natator, S. guttatus, S. tuberilinguis, S. parvus,* and *S. latopalmatus*. The type species *Staurois natator* (originally in the genus *Ixalus*) was described by Günther (1859) from the Mindanao, Philippines. The remaining described species are *S. guttatus, S. parvus, S. tuberilinguis,* and *S. latopalmatus* (Inger 1954, 1966; Iskandar & Colijn 2002; Frost *et al.* 2009). With the exception of *S. natator,* all are known only from Borneo. Van Kampen (1923) recognized four species of *Staurois*: *guttatus* (Borneo), *nubilus* (Palawan), *tuberilinguis* (Borneo), and *larutensis* (Borneo). He also recognized *Staurois latopalmatus* as a valid species of the genus *Simomantis,* following Boulenger (1918). However, Inger (1966) argued about the validity of the genus *Simomantis* and consequently placed *latopalmatus* in the genus *Staurois*. At the same time, he also excludes *Staurois larutensis* from the genus *Staurois*.

Staurois parvus was considered a synonym of *S. tuberilinguis* by Inger (1966) until Matsui *et al.* (2007) resurrected this species based on a combination of mitochondrial DNA data and recognition of morphological differences. However, *Staurois nubilus* remained in synonymy of *S. natator* (based on morphological characters of adults) despite having distinctly pigmented eggs, a character that distinguishes Bornean from Philippine populations (Inger 1966). Taylor (1920) considered *S. nubilus* a synonym of *S. natator* by appearance of feebly developed lingual papilla for some Palawan material, an opinion also shared by Inger (1954, 1966).

The ova of Bornean *natator* populations are blackish with small and slightly lighter vegetal hemisphere while those of Philippine populations (Palawan, Mindanao, and Leyte) are yellowish or orange. Pigmented ova are usually laid in places exposed to light, while non-pigmented clutches mostly in places protected from light (e.g. under

Accepted by M. Vences: 25 Nov. 2010; published: 19 Jan. 2011