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Morphological and molecular variation in *Tylototriton* (Caudata: Salamandridae) in Laos, with description of a new species

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Abstract

The salamandrid genus *Tylototriton* is poorly known in Laos, with one described species and unverified reports of two others. We undertook new fieldwork and obtained samples of *Tylototriton* at six localities across northern Laos during 2009–2013. Bayesian phylogenetic analysis of mitochondrial DNA, principal component analyses of 13 mensural characters, and qualitative morphological comparisons with samples from across the geographic range of *Tylototriton* were performed. Samples from Laos fell into four molecular and morphological groups, consisting of *T. notialis, T. panhai, T. anguliceps*, and a fourth lineage that is hypothesized here to be an undescribed species. *Tylototriton podichthys* **sp. nov.** is distinguished from its congeners by having distinct mitochondrial DNA haplotypes and in characteristics of the glandular skin on the head and body, shape of the rib nodules, and coloration of the body and limbs. This study expands the number of confirmed *Tylototriton* species in Laos from one to four, with the description of one species and extension of the ranges of *T. panhai* and *T. anguliceps* to Laos. An improved understanding of the geographic ranges of *T. podichthys* **sp. nov.** and *T. anguliceps* within Laos is needed.

Key words: Caudata, Laos, Southeast Asia, *Tylototriton shanjing*, *Tylototriton verrucosus*

Introduction

Little is known on the diversity and distribution of the Asian newt genus *Tylototriton* Anderson 1871 in Laos. The genus was only recently documented in the country with the description of *T. notialis* Stuart, Phimmachak, Sivongxay & Robichaud 2010 from Khammouan Province, central Laos. Additional records of the genus from the country (as *T. verrucosus verrucosus* or *T. shanjing*) have been cited only as voucher specimens (Matsui 2013; Nishikawa *et al*. 2013a; Le *et al.* 2015), or shown in photographs (Sparreboom 2014), with no descriptive information.

Many new species of *Tylototriton* have been described in very recent years (e.g., Nishikawa *et al*. 2013a,b; Nishikawa *et al*. 2014; Le *et al.* 2015). The genus is taxonomically difficult, and most newly described species have been differentiated on the basis of mitochondrial DNA sequence divergence, coloration in life, or size and shape differences (Stuart *et al.* 2010; Nishikawa *et al*. 2013a,b; Nishikawa *et al*. 2014; Le *et al.* 2015). Two of the most widely distributed species in the genus, *T. verrucosus* Anderson 1871 and *T. shanjing* Nussbaum, Brodie & Yang 1995 occur in parapatry (Nussbaum *et al.* 1995), and have shared mitochondrial genomes (Zhang *et al.* 2007), presumably from introgression, that further complicates the taxonomy of these taxa. There is consensus from previous analyses that the genus contains two major clades, corresponding to the subgenus *Tylototriton* Dubois & Raffaëlli 2009 (= *T. verrucosus* species group of Fei *et al.* 2005) and the subgenus *Yaotriton* Dubois & Raffaëlli 2009 (= *T. asperrimus* species group of Fei *et al.* 2005), but species boundaries within each of these clades have been disputed (e.g, Zhang *et al.* 2007; Yuan *et al.* 2011; Nishikawa *et al.* 2013b; Zhang *et al.* 2013; Sparreboom 2014; Nishikawa *et al.* 2015).

Asian newts, including the genus *Tylototriton*, are heavily exploited and traded internationally for traditional

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