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Genetic differentiation among species of the genus *Thermophis* Malnate (Serpentes, Colubridae) and comments on *T. shangrila*

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Abstract

The genus *Thermophis* includes the two species, *T. baileyi* and *T. zhaoermii*, which differ morphologically, geographically and molecularly. Recently, a third *Thermophis* species was described from Shangri-La, northern Yunnan Province, China, and named *T. shangrila*. The new species was based on morphological and genetic data derived from three specimens. However, the morphological features used to delimit this species seem vague, because they may fall within the range of intraspecific variation of *T. zhaoermii*. Furthermore, the reported genetic differences in nuclear data are questionable. They likely resulted from a misinterpretation probably due to alignment/analytical flaws or sample/sequence mix-up. Here, we used partial sequences of three mitochondrial (*COI*, *ND4*, *cytb*) genes and one nuclear (*c-mos*) gene to analyse the genetic variation between and within species of *Thermophis*. We inferred the phylogeny using Bayesian Inference and Maximum Likelihood approaches and present additional morphological data that contribute to the knowledge on intraspecific variation in the genus. Our results indicate lacking robustness in the distinguishing morphological features and in the genetic differentiation of *T. shangrila* and highlight the need for more detailed morphological and molecular studies from a substantially larger sample.

Key words: *Thermophis baileyi*, *Thermophis zhaoermii*, *Thermophis shangrila*, intraspecific variation, Hengduan Shan

Introduction

The Asian colubrid genus *Thermophis* comprises three species, namely *T. baileyi* (Wall 1907), *T. zhaoermii* Guo, Liu, Feng & He, 2008 and *T. shangrila* Peng, Lu, Huang, Guo & Zhang, 2014. While the Xizang hot-spring keel-back (*T. baileyi*) is endemic to Tibet with a restricted distribution along the central part of the Yarlung River valley (Hofmann *et al.* 2014) the Sichuan hot-spring keel-back (*T. zhaoermii*) has only been recorded from the type locality in Litang County, Garzê Prefecture, Sichuan Province (Guo *et al.* 2009; Hofmann 2012; Fig. 1), although, a wider distribution of *T. zhaoermii* in Sichuan and also in the northern parts of Yunnan has been suggested (Dorge *et al.* 2007). The two species are allopatric, separated by the Hengduan mountain ranges (HMR) that follow a north-south orientation at the eastern margin of the Himalayan-Tibetan orogen (HTO).

The genus *Thermophis* has received considerable scientific attention not only due to its uncertain phylogenetic position, but also because of its distribution at elevations up to 4,900 m a.s.l. and its strong preference for hot-spring habitats (Dorge *et al.* 2007). Moreover, *T. baileyi* is accepted as one of the few suitable reptilian proxies to help unravel the timing of the HTO uplift (Hofmann 2012; Hofmann *et al.* 2014). Given the small population sizes, a limited and, in the case of *T. zhaoermii*, a poorly known geographic distribution, and the increasing habitat destruction due to the harnessing of hot-spring areas for geothermal energy, the two species are considered as "Near Threatened" (*T. baileyi*) and "Endangered" (*T. zhaoermii*), respectively, by the IUCN Red List (The IUCN Red List of Threatened Species. Version 2015.1).