



Short Communication

Testing the phylogenetic affinities of Southeast Asia's rarest geckos: Flap-legged geckos (*Luperosaurus*), Flying geckos (*Ptychozoon*) and their relationship to the pan-Asian genus *Gekko*

Rafe M. Brown^{a,*}, Cameron D. Siler^a, Indraneil Das^b, Yong Min^b

^a Biodiversity Institute and Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, KS 66045-7561, USA

^b Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

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ABSTRACT

Some of Southeast Asia's most poorly known vertebrates include forest lizards that are rarely seen by field biologists. Arguably the most enigmatic of forest lizards from the Indo Australian archipelago are the Flap-legged geckos and the Flying geckos of the genera *Luperosaurus* and *Ptychozoon*. As new species have accumulated, several have been noted for their bizarre combination of morphological characteristics, seemingly intermediate between these genera and the pan-Asian gecko genus *Gekko*. We used the first multilocus phylogeny for these taxa to estimate their relationships, with particular attention to the phylogenetic placement of the morphologically intermediate taxa *Ptychozoon rhacophorus*, *Luperosaurus iskandari*, and *L. gulat*. Surprisingly, our results demonstrate that *Luperosaurus* is more closely related to *Lepidodactylus* and *Pseudogekko* than it is to *Gekko* but that some species currently classified as *Luperosaurus* are nested within *Gekko*. The Flying Gecko genus *Ptychozoon* is also nested within *Gekko*, suggesting that higher-level taxonomic revision of the generic boundaries within Southeast Asian gekkonines will be a priority for the immediate future.

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1. Introduction

The conservation crisis facing Southeast Asian biodiversity (Brooks et al., 2002; Sodhi et al., 2004) is a problem not only of underestimation of species diversity in the face of catastrophic habitat loss and degradation, but also a frustratingly slow accumulation of knowledge concerning the evolutionary process that produced the region's staggering levels of vertebrate diversity (Lomolino et al., 2010; Woodruff, 2010). An understanding of the evolutionary processes that produced the region's land vertebrate diversity has been slow to precipitate for several reasons. These include a lack of comprehensive biodiversity surveys in many inaccessible forests of Southeast Asia (e.g., Lim et al., 2008; Brown and Diesmos, 2009), the slow pace of subsequent taxonomic work, logistical and legal obstacles to field work, and a dearth of well sampled robust phylogenies with which to infer stable evolutionary classifications and determine the content of higher taxonomic entities. At the same time, the pace of Asian forest destruction has been higher than anywhere else on the planet (Bawa et al., 1990; Whitmore and Sayer, 1992; Sodhi et al., 2004).

We initiated this study to understand the evolutionary relationships of some of Southeast Asia's most rare and enigmatic groups of land vertebrates, the "Flap-legged" and "Parachute" geckos (or "Flying" geckos) of the genera *Luperosaurus* and *Ptychozoon*. With a few exceptions, most species are poorly known forest obligates that seldom are encountered by field biologists (Russell, 1979; Brown et al., 1997, 2000; Brown and Diesmos, 2000; Ota et al., 1996; Das et al., 2008). This situation is taken to the extreme in the case of the genus *Luperosaurus*, in which the entire genus (13 or 14 species) is known from fewer than 30 specimens, with roughly half of these species represented only by one or two specimens in research collections (Ota et al., 1996; Brown and Diesmos, 2000; Brown et al., 2000, 2007, 2010, 2011; Das et al., 2008). Collections are made rarely and unpredictably, such as when high canopy species are dislodged from their perches during strong storms (Brown et al., 1997, 2000; Das et al., 2008).

Two fundamental questions of taxonomy and classification have persisted with respect to these rare forest species. First, a variety of authors have debated the systematic affinities and content of these genera, particularly with respect to the remaining, morphologically generalized gekkonines of Southeast Asia: e.g., members of the genera *Gehyra*, *Hemidactylus*, *Hemiphyllodactylus*, *Lepidodactylus*, *Pseudogekko* and *Gekko* (Boulenger, 1885; Taylor, 1922; Wermuth, 1965; Kluge, 1968; Brown and Alcala, 1978; Russell, 1979; Brown et al., 2000). Second, reliable and stable

* Corresponding author. Address: Biodiversity Research Center, 1345 Jayhawk Blvd., Lawrence, KS 66045, USA. Fax: +1 785 864 5335.

E-mail addresses: rafe@ku.edu (R.M. Brown), idas@ibec.unimas.my (I. Das).