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A phylogenetic analysis of the southern African gecko genus *Afroedura* Loveridge (Squamata: Gekkonidae), with the description of nine new species from Limpopo and Mpumalanga provinces of South Africa

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Abstract

A molecular phylogeny of the largely rupicolous geckos of the gekkonid genus *Afroedura* is presented based on a combination of mitochondrial and nuclear gene sequence data. Previously recognized species groups are only partly recovered, with *A. pondolia* retrieved as very distantly related to the congeners to which it was previously considered allied. *Afroedura hawequensis* forms a monotypic group that is sister to all other species, which are allocated to the *A. nivaria*, *A. transvaalica*, *A. africana*, *A. multiporis*, *A. marleyi*, and *A. langi* groups. The taxonomic status of species occurring in the former Transvaal province of South Africa (now Limpopo and Mpumalanga provinces) is reviewed based on morphological and molecular evidence. *Afroedura rupestris* **sp. nov.** is described in the *A. multiporis* group, *A. maripi* **sp. nov.**, *A. pongola* **sp. nov.**, and *A. rondavelica* **sp. nov.**, are described in the *A. marleyi* group, and *A. broadleyi* **sp. nov.**, *A. granitica* **sp. nov.**, *A. leoloensis* **sp. nov.**, *A. pienaari* **sp. nov.**, and *A. waterbergensis* **sp. nov.** are described in the *A. langi* group. In addition, *A. haackei*, *A. namaquensis*, and *A. tirasensis*, are all raised to specific status. The description of nine new species highlights Limpopo and Mpumalanga provinces as previously unrecognized centers of diversity for the genus *Afroedura*. A key to the species of *Afroedura* is provided.

Key words: *Afroedura*, *Afroedura broadleyi* **sp. nov.**, *Afroedura granitica* **sp. nov.**, *Afroedura leoloensis* **sp. nov.**, *Afroedura maripi* **sp. nov.**, *Afroedura pienaari* **sp. nov.**, *Afroedura pongola* **sp. nov.**, *Afroedura rondavelica* **sp. nov.**, *Afroedura rupestris* **sp. nov.**, *Afroedura waterbergensis* **sp. nov.**, South Africa, molecular phylogenetics, description, taxonomy, biogeography

Introduction

Southern Africa supports one of the most diverse gecko-faunas in the world and recent phylogenetic studies (Bauer & Lamb 2005; Lamb & Bauer 2006; Gamble *et al.* 2012) have verified the monophyly of a large clade of chiefly southern African gekkonid geckos that includes the highly speciose genus *Pachydactylus* Wiegmann and its satellite genera, *Colopus* Peters, *Chondrodactylus* Peters, *Elasmodactylus* Boulenger, and *Rhoptropus* Peters. These taxa have long been hypothesized as close relatives, on the grounds of shared features of digital morphology, most notably hyperphalangy of the first digit of both manus and pes (Haacke 1968, 1976; Russell 1972, 1976; Joger 1985; Bauer 1990). In this instance, this putative synapomorphy of these geckos has been validated by independent (molecular) data. However, the presumed sister group relationship of the North African/Mediterranean *Tarentola* Gray, to the *Pachydactylus* group, also based on shared hyperphalangy, has been falsified and this genus is now known to belong to a different gekkotan family, the Phyllodactylidae (Gamble *et al.* 2008). Rather, a multi-gene phylogenetic analysis of nearly all gekkotan genera (Gamble *et al.* 2012) reveals that the *Pachydactylus* group is part of a more inclusive clade of Afro-Malagasy gekkonids. The closest relatives of the *Pachydactylus* group include not only genera characterized by broad toepads—the clade *Geckolepis* Grandidier (*Blaesodactylus* Boettger, *Homopholis* Boulenger) (Greenbaum *et al.* 2007), but also taxa with so-called leaf-toed digital morphologies, i.e., *Goggia* Bauer, Good & Branch and *Afroedura* Loveridge, demonstrating the plasticity of digital morphology within gekkotans as a whole (Gamble *et al.* 2012). Although these latter two African leaf-toed genera share some features in common (Bauer 1990), existing data suggest a closer relationship of *Afroedura* to the *Geckolepis* + *Blaesodactylus* + *Homopholis* clade (Gamble *et al.* 2012).

Afroedura species are typically distinctly dorsoventrally flattened and usually occupy rock cracks and crevices, although *A. loveridgei* is arboreal and the facultative use of arboreal and/or edificarian habitats has been reported in *A. marleyi*, *A. haackei*, and *A. pondolia* (Hewit 1937; Bruton & Haacke 1980; Onderstall 1984; Alexander 1990; Bauer 2014f,h,i). Like many rupicolous taxa, their distributions are highly disjunct, being dependent on the availability of suitable substrates. The majority of the species occur in eastern southern Africa, with a single species in Angola and extreme northern Namibia (Loveridge 1944; Branch 1998), another, with several subspecies from Little Namaqualand to central Namibia (Haacke 1965), and one species in the Cape Fold Mountains of the southwestern Western Cape (Mouton & Mostert 1985). In the northeast of the range two additional species extend north of the Limpopo, one in Mozambique, the other in Zimbabwe (Visser 1984; Branch 1998).

Until the advent of molecular phylogenetic analyses, the relationships of *Afroedura* had been particularly

of the species in this paper, only *A. langi*, *A. multiporis*, *A. haackei*, and peripherally *A. transvaalica* and *A. marleyi* had been known from Limpopo and Mpumalanga themselves. Although the species described herein were known to South African workers since first being identified by Jacobsen (1990, 1992a), without formal description, they have been omitted from most faunal works (e.g., Branch 1998; Bates *et al.* 2014). This has resulted in an artificial underestimation of the true diversity of the genus in northeastern South Africa. As nearly all of the new species have highly restricted ranges it is likely that the conservation status of some will be in the higher threat categories following IUCN assessment criteria.

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