



<http://dx.doi.org/10.11646/zootaxa.3620.3.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:03B8D237-7C7D-4E79-A020-4305ACF119B7>

Taxonomy of the super-cryptic *Hyperolius nasutus* group of long reed frogs of Africa (Anura: Hyperoliidae), with descriptions of six new species

A. CHANNING^{1,11}, A. HILLERS^{2,3}, S. LÖTTERS⁴, M.-O. RÖDEL², S. SCHICK⁴, W. CONRADIE⁵, D. RÖDDER⁶, V. MERCURIO², P. WAGNER⁷, J.M. DEHLING⁸, L.H. DU PREEZ⁹, J. KIELGAST¹⁰ & M. BURGER¹

¹Biodiversity and Conservation Biology Department, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa

²Museum für Naturkunde, Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin, Herpetology, Invalidenstr. 43, 10115 Berlin, Germany

³Across the River – a Transboundary Peace Park for Sierra Leone and Liberia, The Royal Society for the Protection of Birds, 164 Dama Road, Kenema, Sierra Leone

⁴Trier University, Biogeography Department, Universitätsring 15, 54295 Trier, Germany

⁵Port Elizabeth Museum (Bayworld), P.O. Box 13147, Humewood, Port Elizabeth 6013, South Africa

⁶Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, D-53113 Bonn, Germany

⁷Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19085, USA

⁸Institut für Integrierte Naturwissenschaften, Abteilung Biologie, Universität Koblenz-Landau, Universitätsstraße 1, 56070 Koblenz, Germany

⁹School of Environmental, Sciences and Development, North-West University, Private Bag X6001, Potchefstroom 2531, South Africa

¹⁰Natural History Museum of Denmark, University of Copenhagen, Universitetsparken 15, 2100 Copenhagen, Denmark

¹¹Corresponding author. E-mail: achanning@uwc.ac.za

Table of contents

Abstract	302
Introduction	302
Material and methods	303
Results	306
Taxonomy	310
<i>Hyperolius acuticeps</i> Ahl, 1931	310
<i>Hyperolius adspersus</i> Peters, 1877	314
<i>Hyperolius benguellensis</i> (Bocage, 1893)	317
<i>Hyperolius dartavellei</i> Laurent, 1943	319
<i>Hyperolius friedemanni</i> sp. nov. Mercurio & Rödel	320
<i>Hyperolius howelli</i> sp. nov. Du Preez & Channing	322
<i>Hyperolius igbettensis</i> Schiøtz, 1963	324
<i>Hyperolius inyangae</i> sp. nov. Channing	326
<i>Hyperolius jacobsoni</i> sp. nov. Channing	327
<i>Hyperolius lamottei</i> Laurent, 1958	329
<i>Hyperolius lupiroensis</i> sp. nov. Channing	330
<i>Hyperolius nasicus</i> Laurent, 1943	333
<i>Hyperolius nasutus</i> Günther, 1865	334
<i>Hyperolius poweri</i> Loveridge, 1938	335
<i>Hyperolius rwandae</i> sp. nov. Dehling, Sinsch, Rödel & Channing	337
<i>Hyperolius viridis</i> Schiøtz, 1975	339
Incertae sedis	341
Species distribution model	341
Discussion	341
Acknowledgements	343
References	343

Abstract

Specimens from across the range of the *Hyperolius nasutus* species group were sequenced for two mitochondrial genes and one nuclear gene. Advertisement calls were recorded from the same specimens where possible, and morphological characters were compared. Bayesian inference and maximum likelihood produced a tree indicating 16 clades. The clades show little or no overlap in combinations of 16S sequence difference, shared *tyr* haplotypes, advertisement call parameters, snout profiles and webbing. On the basis of these data we recognise *H. acuticeps*, *H. adspersus*, *H. benguellensis*, *H. dartevellei*, *H. igbettensis*, *H. nasutus*, *H. nasicus*, *H. poweri*, *H. viridis* and describe six new species: *Hyperolius friedemanni* **sp. nov.** Mercurio & Rödel, *Hyperolius howelli* **sp. nov.** Du Preez & Channing, *Hyperolius inyangae* **sp. nov.** Channing, *Hyperolius jacobsoni* **sp. nov.** Channing, *Hyperolius rwandae* **sp. nov.** Dehling, Sinsch, Rödel & Channing, and *Hyperolius lupiroensis* **sp. nov.** Channing. *Hyperolius lamottei* is confirmed to be outside the *H. nasutus* group clade. *Hyperolius granulatus*, *H. oxyrhynchus*, *H. punctulatus* and *H. sagitta* are assigned as junior synonyms. As our results are based on a small number of specimens, these hypotheses await testing with larger sample sizes and more characters. A species distribution model suggests where outlier populations might be found.

Key words: *Hyperolius nasutus* group, new species, phylogeny, taxonomy, advertisement calls, biogeography, molecular genetics, morphology, species distribution model

Introduction

African reed frogs in the genus *Hyperolius* Rapp, 1842 are highly speciose, with 128 species currently recognised (Frost 2011). Many of them are brightly patterned and polymorphic (Schiøtz 1975, 1999), but all are poor in external diagnostic morphological characters, making it difficult to identify preserved material. Many of the original descriptions are not diagnostic which makes it difficult to assign names reliably. The advent of sound analysis that had become popular from the 1960s allowed the use of this non-morphological technique to identify *Hyperolius* species in the field (Schiøtz 1975, Köhler *et al.* 2005a, Dehling 2012). More recent phylogenetic studies have used DNA to help delimit *Hyperolius* species (Rödel *et al.* 2010, Schick *et al.* 2010, Conradie *et al.* 2012, Dehling 2012), and to even identify cryptic genera (Rödel *et al.* 2009). These studies are examples of an approach that has led to a huge increase in the number of amphibian species recognised worldwide (Köhler *et al.* 2005b). Mercurio (2011) provides illustrations and calls of some cryptic *Hyperolius* species.

Within *Hyperolius*, there are a number of proposed species groups (Schiøtz 1975). One of these, the long reed frogs in the *Hyperolius nasutus* group is widespread in sub-Saharan Africa. Recent molecular work revealed that these frogs are basal in a clade of some *Hyperolius* species (Rödel *et al.* 2009, Veith *et al.* 2009). Within this group many species have been described, and currently 15 species names are available (Amiet 2005). Channing *et al.* (2002) recognised three different advertisement call types across the range of the complex, and suggested that these represented three species (*H. nasutus*, *H. acuticeps*, *H. viridis*), with others regarded as *incertae sedis* as no calls were known for them. They proposed *H. lamottei* to be a junior synonym of *H. nasutus*, on the basis of a similar advertisement call. In addition they confirmed *H. viridis* as valid, based on calls and material from near Sumbawanga in Tanzania.

Schiøtz & Van Daele (2003) identified two species in north-western Zambia, using advertisement calls, which they referred to *H. nasutus* and *H. benguellensis*, in contrast to Channing *et al.* (2002) who had assigned two call types from the same locality to *H. acuticeps* and *H. nasutus*.

In Cameroon, two species were recognised by Amiet (2005), *H. adspersus* and *H. igbettensis*, which he distinguished using morphological features such as the snout shape and differences in webbing. There were also two species tentatively recognised in central Democratic Republic of Congo (hereafter DRC) (Schiøtz 2006a), *H. adspersus* and *H. nasicus* with a sharp snout tip.

Recently, Schiøtz (2006b) reviewed the state of the taxonomy of the group. He noted that the various characters used to separate the species often delimited different sets of specimens. His main conclusions were that *H. lamottei* was not part of the *H. nasutus* group, based on consistent call and colour pattern differences. He showed that the specimens that Channing *et al.* (2002) collected near Sumbawanga in Tanzania and identified as *H. viridis* (based on advertisement call), were actually not 'true' *H. viridis*, but other members of the *H. nasutus* group.

In the molecular hyperoliid phylogeny of Veith *et al.* (2009), having a limited sample size of long reed frogs at hand, three well supported lineages (of one specimen each) were evident, which the authors referred to as *H.*