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## Mitochondrial DNA reveals a new species of parachuting frog (Rhacophoridae: *Rhacophorus*) from Sumatra

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### Abstract

The Indonesian island of Sumatra contains several endemic species of parachuting frog of the genus *Rhacophorus*. Most of these are known from small type series collected from only a few localities, and consequently, many Sumatran *Rhacophorus* species are poorly understood. Using mitochondrial DNA (mtDNA), we investigated relationships among a group of *Rhacophorus* species from southern Sumatra. Our molecular analysis was based on a fragment of the 16S ribosomal subunit gene (16S) and included data derived from type specimens of two species endemic to Sumatra: *R. barisani* and *R. catamitus*. Our analyses of these data reveal that the only known female specimen of *R. catamitus* possesses a divergent 16S sequence compared to male specimens (8.82%; uncorrected “p” distance). Based on phylogenetic reconstructions, we found that this female specimen belongs to an unnamed taxon related to *R. margaritifera* from Java. Consequently, we remove the specimen from *R. catamitus* and describe it as *R. bengkuluenis* sp. nov., a medium-sized slender tree frog with extensive brown hand webbing. We identified additional specimens referable to the new species using mtDNA and morphology. These specimens originate from low to intermediate elevations (ca. 600–1600 m) in the provinces of Bengkulu and Lampung, suggesting that *R. bengkuluenis* is widely distributed across the southwestern versant of the Bukit Barisan.

**Key words:** Rhacophoridae, Indonesia, Sundaland, 16S, flying frog, new species, composite taxon

### Introduction

The genus *Rhacophorus* (Anura: Rhacophoridae) is distributed throughout south-eastern Asia and currently contains 85 nominal species (Frost 2014). Members of the genus are foam-nest building tree frogs that occur from India and Sri Lanka, eastward to eastern China and Japan, and southward to the Philippines, Malaysia and Indonesia. Often referred to as parachuting frogs (Harvey *et al.* 2002), several species have extensive hand and foot webbing that they use for parachuting or gliding. Over 50% of the known parachuting frog species occur on landmasses of the Sunda Continental Shelf (Inger & Tan 1996; Iskandar & Colijn 2000; Harvey *et al.* 2002). Within this continental shelf, the Malay Peninsula and Borneo possess relatively well-studied assemblages of *Rhacophorus* (e.g., Inger 1966; Inger & Stuebing 1997; Malkmus *et al.* 2002; Dehling 2008; Hertwig *et al.* 2013). However, elsewhere in Sundaland parachuting frogs have been poorly examined (see Iskandar 1998; Harvey *et al.* 2002). In particular, the large Indonesian island of Sumatra has rarely been sampled and as such fewer amphibian species have been reported from this island than from neighbouring regions of the Sunda Shelf (Inger 1999). Sumatra is home to 10 *Rhacophorus* species, some with distributions extending outside of the island (*R. nigropalmatus*, *R. pardalis* and *R. prominans*) and others that are thought to be endemic (*R. achantharrhena*, *R. barisani*, *R. bifasciatus*, *R. catamitus*, *R. modestus*, *R. poecilonotus*, and *R. pseudacutirostris*). A recently described

members (i.e., those that occur above 1000 m asl) of this assemblage (*R. barisani*, *R. bifasciatus*, *R. catamitus*, *R. modestus*, and *R. poecilnotus*) are known from the latitude of Padang southward. Thus, further study of inadequately sampled montane areas of northern Sumatra should yield many new species belonging to this charismatic genus of tree frogs.

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## APPENDIX.

Specimens Examined (institutional abbreviations are BMNH = The Natural History Museum, London, United Kingdom; FMNH = Field Museum of Natural History, Chicago, Illinois, USA; MZB = Muzeum Zoologicum Bogoriense, Bogor, Java, Indonesia; NHMB = Naturhistorisches Museum Basel, Basel, Switzerland; RMBR = Raffles Museum of Biodiversity Research field series, Singapore; UTA, The University of Texas at Arlington, Arlington, Texas, USA; ZMA = Zoölogisch Museum Amsterdam [now housed at Naturalis Biodiversity Center, Leiden, Netherlands], ZRC = Zoological Reference Collection, National University of Singapore, Singapore).

- Kurixalus appendiculatus* (46): Malaysia (FMNH 230995–231039), Indonesia: Sumatra: Indragiri (NHMB 1187; holotype of *Rhacophorus phyllopygus*)
- Kurixalus bisacculus* (9): Vietnam (FMNH 255654–255662)
- Kurixalus baliogaster* (8): Vietnam (FMNH 254342–254349)
- Philautus macroscelis* (13): Malaysia: Sabah (FMNH 250967–250979)
- Philautus hosii* (7): Malaysia (FMNH 240945–240951)
- Polypedates colletti* (5): No locality data (FMNH 242764–242767)
- Polypedates leucomystax* (49): Singapore (RMBR uncatalogued; field nos. JWS 563–572, 574, 576–585, 587–606, 609–610, 612–629)
- Rhacophorus angulirostris* (12): Malaysia: Sabah (FMNH 239179, 239181–239184, 250956–250958, 250960–250965)
- Rhacophorus achantharrhena* (5): Indonesia: Sumatra: Bengkulu (UTA A-53961, UTA A-53963–53966; type series)
- Rhacophorus baluensis* (8): Malaysia: Sabah (FMNH 239220, 239221, 239224, 239227, 235957–235958, 250966)
- Rhacophorus barisani* (11): Indonesia: Sumatra: Bengkulu (UTA A-53971–53980; type series, MZB.Amph 16308)
- Rhacophorus bifasciatus* (2): Indonesia: Sumatra (ZMA 5872, 5873)
- Rhacophorus bipunctatus* (18): Malaysia (FMNH 189995), Malaysia: Pahang (FMNH 216436, 216437), Thailand (FMNH 128289, 128290, 178310–178312, 187509–187514, 187516, 187517, 189996, 189997)
- Rhacophorus calcaneus* (25): Vietnam (FMNH 253384–253408)
- Rhacophorus catamitus*: Indonesia: Sumatra: Sumatera Selatan (UTA A-53981–94, 53996–98, 54017–18), Indonesia: Sumatra: Bengkulu (UTA A-54002–54004; type series)
- Rhacophorus cyanopunctatus* (47): Malaysia: Sarawak (FMNH 221749, 221750), Malaysia: Sabah (FMNH 136316, 137990–137992, 139347, 146199, 146200, 147422–147424, 147887–147890, 147892, 147893, 147895–147899, 147900, 157308–157325, 157757–157759, 158013)
- Rhacophorus dulitensis* (32): Malaysia: Sabah (FMNH 231389–231413, 235741–235746, 240956–240957, 245880–245887), Malaysia: Sarawak (BMNH 92.6.3.15, holotype)
- Rhacophorus fasciatus* (2): Malaysia: Sarawak (FMNH 157114, 221751)
- Rhacophorus gauni* (38): Malaysia: Sabah (FMNH 245888–245925)
- Rhacophorus harrissoni* (21): Malaysia: Sarawak (FMNH 137941–137948, 145633, 146203–146204, 147707–147710, 157154–157160)
- Rhacophorus kajau* (5): No locality data (FMNH 234996–235001)
- Rhacophorus margaritifer* (70): Indonesia: Java (ZRC 1.6767–1.6830, UTA A-54005–10)
- Rhacophorus modestus* (3): Indonesia: Sumatra (BMNH 1947.2.7.76, 1947.2.7.77, 1973.1351)