



A survey of morphological variation in adult *Meristogenys amoropalamus* (Amphibia, Anura, Ranidae), with a description of a new cryptic species

TOMOHIKO SHIMADA^{1,2}, MASAFUMI MATSUI^{2,5}, PAUL YAMBUN³ & AHMAD SUDIN⁴

¹Department of Science, Faculty of Education, Aichi University of Education, Kariya, Aichi 448-8542, Japan

²Graduate School of Human and Environmental Studies, Kyoto University, Sakyo, Kyoto 606-8501, Japan

³Research and Education Division, Sabah Parks, P. O. Box 10626, Kota Kinabalu 88806, Sabah, Malaysia

⁴Institute for Tropical Biology and Conservation, University Malaysia Sabah, Kota Kinabalu 88999, Sabah, Malaysia

⁵Corresponding author. E-mail: fumi@zoo.zool.kyoto-u.ac.jp

Abstract

Previous analyses of molecular and larval morphology have suggested that *Meristogenys amoropalamus* is composed of two cryptic species, but no diagnostic characters of their adult morphology have been reported. Here, we compared adult characters of these two species and found that they differed in iris colour (yellowish-green and sandy brown), tympanum size and relative limb length. Based on the results of analysis of DNA sequences of the type specimens and a discriminant analysis using 18 morphological variables, we conclude that the lineage with green irises is the true *M. amoropalamus*, and that the lineage with sandy brown irises is a new species, *M. dyscritus* sp. nov. In northern Sabah, *M. dyscritus* is distributed in altitudes lower than those of *M. amoropalamus*, but the distributional ranges of their larvae overlap in some streams. *Meristogenys amoropalamus* has larger and lighter-coloured ova, smaller clutch sizes and a more interstitial larval life than *M. dyscritus*. These differences suggest that *M. amoropalamus* has a more cryptic life during its larval period than *M. dyscritus*.

Key words: trade-off of reproductive traits, iris color, Borneo, cryptic species, *Meristogenys*

Introduction

In many phylogenetically related species of frogs, tadpoles are more difficult to separate than adults (Inger & Stuebing, 2005), but the reverse is true in some species such as *Bufo japonicus* and *B. torrenticola* (Matsui, 1976). The Bornean endemic ranid genus *Meristogenys* represents one such unusual case (Inger & Stuebing, 2005). Larvae of this genus are specialised for a life in strong currents, with a large mouth on the underside of the snout and a large abdominal sucker covering the abdomen. In contrast to adults, which usually have few notable inter-specific differences in external morphology, these larvae possess many taxonomically useful characters, such as their labial tooth row formula (LTRF), jaw sheath shape, and presence or absence of surface projections and dermal glands (Shimada *et al.*, 2007a).

This tendency is obvious in the two cryptic forms found in *Meristogenys amoropalamus* sensu lato. Shimada *et al.* (2007a, 2008) found two larval forms (morphotypes 1 and 3-a) in *M. amoropalamus* sensu lato that were differentiated by mitochondrial (mt) and nuclear DNA (nuDNA) sequence characters. These two forms were considered to represent distinct species, but no taxonomic decision was made because they were not easily differentiated by adult morphology and no evidence existed to determine which of the two forms is the true *M. amoropalamus*.

To resolve this taxonomic problem, we searched for diagnostic morphological characters that distinguish adult specimens. We also studied sequences of DNA fragments from the type specimens of *M. amoropalamus* and compared them with the larval sequences. Based on our results, we describe a new species and discuss the distribution and reproductive traits of the new form compared to those of *M. amoropalamus*.