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TROPICAL VERTEBRATES IN A CHANGING WORLD

DESCRIBING EAST MALAYSIAN TADPOLE DIVERSITY: STATUS AND RECOMMENDATIONS FOR STANDARDS AND PROCEDURES ASSOCIATED WITH LARVAL AMPHIBIAN DESCRIPTION AND DOCUMENTATION

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ABSTRACT

Our ad hoc survey of 130 books and monographs showed that almost 70% did not present any descriptive information on larval anurans, and when larval stages were included the quality of documentation often tended to be poor. The larval (or developmental) stages of 51 species of east Malaysian frogs still remain unknown. Modern methods and techniques have changed the way we treat larvae taxonomically, and we recommend their adoption in tadpole research. Notably, DNA barcoding allows for unequivocal matching with adult frogs, and digital color photography provides documentation of tadpole features of unprecedented quality, partly replacing traditional drawings. Both techniques are considered essential for the study of tadpoles. Tadpole measurements have now reached a high level of standardization and can be performed quickly, accurately, and easily with digital microscopes. Nevertheless, line drawings and SEM may still be valuable techniques when certain details need to be demonstrated.

Key words: Biodiversity, tadpole, inventory, morphology, barcoding, field techniques herpetology, Amphibia, Anura.

INTRODUCTION

General

Declines in amphibian numbers are a global phenomenon but are most widespread and catastrophic in the tropics (Wake & Vredenburg 2008). There is thus an urgent need for studies on all amphibian life stages in the tropics, where entire assemblages are being lost before any acquisition of knowledge of their ecological roles. However, most ecological community analyses address adults and their ecological needs and interactions, whereas larval stages are rarely included (Inger *et al.* 1986, Inger & Voris 1993, Eterovick 2003, Eterovick & Barros 2003, Kopp & Eterovick 2006). In taxon-based books (e.g., Duellman & Trueb 1986, Wells 2007), larval stages usually receive much less attention than adults. This is rather surprising, considering that the biphasic life cycle of anurans imposes dramatically different selec-

tive regimes on the aquatic larval stage, the metamorphic stage, and the terrestrial post-metamorphic stage (Wilbur & Collins 1973, Wassersug 1975, 1997; Harris 1999, Hentschel 1999, Rose 2005). Most herpetologists would agree that the tadpole stage is just as crucial as the adult stage for the persistence of the species at a specific locality and for its success and distribution, and may play a decisive role in speciation processes, particularly in tropical assemblages. However, this is not yet reflected in the quantity and depth of contemporary research efforts to record larval diversity and to analyze the specific ecology of this unique life stage.

The recent accelerating increase in species descriptions (based on adults), and thus in the number of known anuran species (AmphibiaWeb 2010, Frost 2010), makes clear that a huge backlog of work, both taxonomic and ecological, is accumulating for studies on larval forms for future workers. Even basic knowledge, such as information on tadpole diets, is patchy and not well understood (Altig *et al.* 2007). We think that the lack of state-of-the-art tadpole descriptions,

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