A Guide to the Tadpoles of Borneo

Alexander Haas, Indraneil Das, Stefan T. Hertwig,
Pia Bublies, Reinhard Schulz-Schaeffer

tredition

Photo courtesy of © Lars Fehlandt

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Danum Valley canopy.

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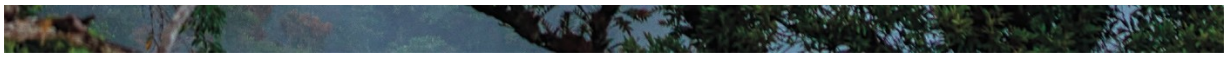

Ulu Temburong National Park, Brunei.
Photo courtesy of © Hanyrol H. Ahmad Sah.

WE WILL NEVER FORGET …

our first trip together in 2001 to the interior of Sarawak and the kind Kelabit people of the Bario Highlands. It was a joyful productive exploration of the beautiful forests of Bario. The morale was high, discussions on shared scientific interests were productive and soon showed that we should try doing a project together. Soon after, we applied to Volkswagen Foundation for a four-year project on an inventory of East Malaysian tadpoles. In the consecutive years, we conducted many field trips together and amassed data far beyond tadpoles. The idea of writing a book on tadpoles always lingered in our heads, fascinating and intimidating us at the same time. It was only after Stefan T. Hertwig, Pia Bublies, and Reinhard Schulz-Schaeffer had later strengthened our team that we started the book writing journey. The time was ripe for a summary of what had been achieved.

When thinking about writing a book on the tadpoles of Borneo, we found us confronted with some tricky questions. How can a book be written about a fauna that is incompletely known at the time of writing? How can we dare writing about the tadpoles of Borneo when many tadpoles have either not been discovered or not been described scientifically? Why would we try to assemble a book if current knowledge is so patchy? And why risk the

publication of a book that might be outdated by new discoveries and progress in taxonomy and systematics at the time of its release? These are only the biological and scientific questions raised by such a project. Many more questions concern the format: printed book, e-book, app for tablet PC? What would be the most useful and appealing format of such a publication in times of major changes in the markets. Who would use the book and how would it be used? What value in usability could we deliver?

The excellent previous work of colleagues certainly humbled us, for example Wen-hao Chou and Jun-yi Lin's *Tadpoles of Taiwan* and Marion Anstis' *Tadpoles and Frogs of Australia,* and Tsi Ming Leong's publications on Peninsular Malaysia tadpoles. At the same time, books such as *Frogs of Borneo* by Robert F. Inger, Robert B. Stuebing, T. Ulmar Grafe, and T. Maximilian Dehling inspired us with their book on frogs. The work and high standards of all theses authors encouraged us to fill a gap and experiment with our own ways to approach a publication on a localized tadpole fauna.

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Many years of field work in the beautiful rainforests of Sarawak and Sabah have enriched us with insights that we want to share. Many students, with their keen enthusiasm have convinced us that producing a publications that facilitates access to the exceptional and fascinating amphibian fauna of Borneo is an effort well spent. The faith of our major financial sponsor for this research project, the Volkswagen Foundation, certainly encouraged us to take this challenge. Last but not least, the numbers of visitors to our website on the frogs of Borneo (🌐 www.frogsofborneo.org) surprised us; we had not expected that attention. On this site, a few clicks lead the user to most of the Bornean species. Although incomplete in coverage and information for each species rather minimalistic, it has proven useful for many users. University students and general naturalists downloaded our imagery to build their personal pocket field guides. It convinced us that there is a need for simplicity among users.

🌐 www.frogsofborneo.org

Knowledge on amphibians and the tools of the trade are in constant change. That should not keep us from communicating the current status in the field in an accessible form. Our team of authors has proposed some new avenues in this book. For us it has been a joyful learning experience.

— Alexander Haas & Indraneil Das —


BRUNEI
SABAH
MALAYSIA
SARAWAK
KALIMANTAN
(INDONESIA)

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First and foremost, we would like to thank the Volkswagen Foundation for enabling us with a grant to initiate our research on Bornean tadpoles, organize a symposium at Universiti Malaysia Sarawak in 2009, and produce this book. Furthermore, we would like to express our sincere gratitude to our scientific institutions for providing us with the possibility to conduct this research, namely the Institute for Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak; the Center for Natural History, Universität Hamburg, Leibniz-Institute for the Analysis of Biodiversity Change, and the Natural History Museum Bern. The Burgergemeinde Bern and German Academic Exchange Program (DAAD) generously provided funds for field assistants and travel expenses. We also gratefully acknowledge the generous support of our collaborating

partners at the Universiti Sabah Malaysia, Charles Vairapppan and Kueh Boon-Hee.

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Many people contributed to our project. We needed support and assistance in the field, specimens had to be processed, tadpoles had to be barcoded, phylogenetically analyzed, and described. Some students produced Bachelor’s or Master’s Theses on tadpoles and frogs of Sarawak and Sabah as part of our project and moved on to make their own careers. First of all, our gratitude goes to Pui Yong Min

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Ledlenser kindly provided some samples of their LED torches for field testing. Yeo Siew Teck (Cat City Holidays) provided valuable logistics support over the years. Nele

Johannsen skillfully developed and contributed a sketched rainforest scenery (p. 46f) that shows where tadpoles live .

The authors hold copyrights for all photos in this book, except for several photos that were kindly provided by other photographers and are marked alongside with the photo. Especially Chien Lee, Hanyrol H. Ahmad, Lars Fehlandt, Pui Yong Min, Nikolay A. Poyarkov, Arne Schulze, and Wencke Krings. Marion Beeck gave some time-saving InDesign tips. We very much appreciate all their contributions!

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Two species of *Abavorana* have been described, *A. luctuosa* and, recently, *A. decorata.* At present, the limited genetic data available does not allow a definitive identification of this remarkable specimen from Lambir Hills National Park.

GENERAL SCOPE

Biodiversity research aims to uncover and understand the full biological richness of a given area. Southeast Asia includes several hotspots of biodiversity that are paralleled in species richness only by the Amazon river basin and adjacent regions in South America. One of the Asian hotspots is Sundaland, a shallow continental shelf on which Borneo, Sumatra, and Peninsula Malaysia are located (p. 26). Today's islands of Sundaland have been interconnected repeatedly during periods of low sea levels at former times.

The biodiversity of Southeast Asia has been vastly underestimated in the past and researchers are only beginning to comprehend the true richness of this region. Borneo is the largest island of Sundaland and plays a crucial role in the recording and understanding of the evolution of biodiversity in this region. In the past 20 years many species of frogs have been discovered on the island of Borneo. Some of these new species have been split from known taxa, acknowledging that known species had been complexes of several, closely related and morphologically similar, but genetically and ecologically distinct species. Progress is fast. A text like this can become outdated shortly after publication.

In this book we focus on species that we encountered in our own work in Sarawak and Sabah. For many known species, however, tadpoles have not been documented. The current list of Bornean frog species follows below (p. 18). Many more are likely to be described in the decades to come. It is unavoidable that the scientific information available for species and species' tadpoles (imagery, ecology) differs significantly. Some species are well known, widespread, and commonly found, others are restricted to certain areas, sometimes known only from their respective type localities and rarely seen. Our species accounts necessarily reflect that and are snapshots in an evolving field.

Feihyla kajau

While adults frogs live in numerous terrestrial habitats and niches, tadpoles are the larval aquatic stage in the biphasic life-cycle of frogs. The body shape, anatomy, and ecological requirements are completely different from the terrestrial frog. The tadpole eventually undergoes a metamorphosis to transform into a froglet. Metamorphosis is the process of physical transition from the aquatic larva to the terrestrial adult. The biology of tadpoles is just as fascinating as the biology of frogs and has been central in our own research. We believe that rather few publications have given tadpoles

the attention they deserve. Clearly, understanding the ecology of tadpoles is essential for any conservation efforts. If an area does not provide proper habitats for tadpoles, there will be no frogs either! For the naturalist, ecologist or surveyor, tadpoles are an important indicator of the presence of a reproductively active population of that species.

After metamorphosis, the froglets leave the water and move to their different species-specific terrestrial habitats. Frogs occupy a large number of ecological niches, ranging from burrows in the forest floor to the canopy of the rainforests. This variety of living conditions is reflected by the adaptations of their body. Species that perch on shrubs or trees have slender bodies and long legs, while ground-dwellers often show a stocky body and short but strong legs.

All amphibian species from Borneo (and indeed from all over the world) have been described largely, if not entirely, on the basis of adult specimens, because frogs are found more often in the field than their larval stages. Tradition in herpetological research is another reason for the focus on adults and the neglect in tadpole research. Knowledge of tadpole descriptions has thus seriously lagged behind. Although many larval descriptions of species occurring on the island of Borneo have been published, we still lack information on the larval forms of many species. Larval descriptions currently available are sometimes derived from non-Bornean populations that may eventually prove to be non-conspecifics. Several familiar species have been shown