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A KEY TO THE FROGS OF SARAWAK

Robert F. Inger,* Harold K. Voris and Paul Walker*****

INTRODUCTION

At least 90 species of frogs and toads occur in the forests of Sarawak. As a number of these species have been described since the publication of a monograph on the Amphibia of Borneo (Inger 1966, Fieldiana: Zoology. Vol. 52), there exists no published key covering the entire fauna. That is one of the main reasons for the present article. Another is that the keys in the monograph were designed with specialists in mind and, consequently, do not easily serve the purposes of teachers, field biologists other than herpetologists, and interested lay persons.

We hope the key that follows will serve a variety of persons. It is designed for use with live or freshly killed frogs. Most ofthe features mentioned in the key can be seen with the naked eye. A few may require a handlens, but no part of the key depends on a microscope. As more than ninety per cent of the known frog fauna of Bornean forests occur in Sarawak, the key can be used throughout the island.

The key is divided into two very unequal portions. The first and larger part deals with the species found in the old native, relatively undisturbed forests. Species of amphibians are not uniformly distributed throughout all forest in Sarawak, as some are restricted to flat topography and some to hilly country. Little is known as yet about the ability of the native Bornean species to survive in logged forests or in old secondary growth. It is safe to say, however, that most of these amphibians cannot survive in areas that have been clear felled. Such areas, as well as kampong, towns, padi fields and other cultivated fields, are the province of a small group of frogs that are closely associated with and, indeed, dependenton man's activities to create suitable environments. These associates of man, which do not penetrate rain forest, are dealt with in the second, smaller part of the key, which can be used throughout Borneo as these species occur in all political divisions.

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A KEY TO THE FROGS OF SARAWAK

by

Robert F. Inger,* Harold K. Voris** and Paul Walker***

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Some general comments on the natural history of this fauna may be helpful. The forest-dwelling frogs of Sarawak (and of Borneo as a whole) are remarkably diverse. They run the gamut from tiny (head and body length 1.5 cm at maturity) to very large (maximum about 27.5 cm), from stocky to slender, from blackish or brown to green to yellow to red. They also exhibit a wide variety of life styles. All are active primarily at night and generally hide under leaves or debris during daylight hours. In fact, it seems that for Sarawak frogs the darker the better. They are most active, in terms of both feeding and breeding, on overcast nights and during the dark of the moon.

Sarawak frogs can be thought of as being distributed both horizontally through the forest and vertically through the vegetation. They are either primarily ground dwellers with narrow toe tips or tree dwellers with expanded, sticky toe pads. In terms of horizontal distribution Sarawak frogs fall into three groups: (1) Species that live out their lives along rivers and creeks, (2) those that live out their lives in the forest away from streams and (3) those that move back and forth between these two habitats.

These ecological groupings are not absolute. Consider species that live along streams. Some of them, for example, the river frog *Rana blythi* and the common river toad *Bufo asper*, spend their entire lives within a few metres of water's edge. Others, such as the small black and orange *Rana signata*, disperse away from streams into the forest as soon as they transform from tadpoles to froglets. There they feed and grow, but as they reach adult size they return to streams to spend the rest of their lives. Or, consider the species that live away from streams. Many, for example, the toad *Bufo divergens*, move to streams to breed, but as soon as their tadpoles change into toadlets they hop away to spend their lives far from streams except when breeding. On the other hand, there are also species, such as the tiny *Microhyla borneensis*, that breed in small rain pools on the forest floor and appear on stream banks only by accident. Even the arboreal and terrestrial categories are not completely separated, because some species that live in trees begin life as tadpoles in pools on the forest floor. When they transform into frogs, they are on the forest floor for a short while.

We can also see differences among species in breeding behavior. Some form rather large aggregations of many calling males and a few ripe females. This is true of the small, green, arboreal *Rana chalconota* and the small toad *Bufo divergens*. Others do not form aggregations, and instead a single male and a single ripe female meet to pair. This is the pattern in *Rana ibanorum* and *Bufo asper*.

Besides breeding in streams and pools on the forest floor, frogs also breed in tree holes or buttress cavities in which water has accumulated. These are the typical sites for egg laying of the tree frogs, *Rhacophorus harrissoni* and *Nyctixalus pictus*. The common form and position of a clutch of eggs for most frogs are as a single layer on the surface of water, whether in a stream or forest pool. But tree frogs of the genera *Rhacophorus* and *Polypedates* make a foam nest attached to vegetation usually 0.5–3 m above water. Several species probably attach their eggs to the underside of large rocks in swift currents (species of *Amolops*). At least one species, *Rana blythi*, deposits its eggs in a shallow, dish-shaped depression made by the male in gravel bars in midstream.