



BAKO — Biodiversity Between Land and the Sea

Edited by Mohd-Azlan, Suaidi & Das

Life from Headwaters to the Coast

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Biodiversity Between Land and the Sea

Edited by

Jayasilan Mohd-Azlan
Mohamad Kadim Suaidi
Indraneil Das


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Life from Headwaters to the Coast:

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Edited by Jayasilan Mohd-Azlan, Mohamad Kadim Suaidi and Indraneil Das

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Half-page: Sea Stack. Photo: Hans Hazebroek

Front cover: Silvered Langur. Photo: Chien C. Lee

Frontispiece: Sandstone gate at Telok Tajor. Photo: Hans Hazebroek

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CONTENTS

Foreword	vii
by YB Dato Sri Haji Abdul Karim Rahman Hamzah	

Preface	ix
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Introduction	1
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Introduction

General Section

Reminiscences of Bako.....	3
by Gathorne Cranbrook	

Geology and Geomorphology.....	5
by Hans Hazebroek	

Floral Accounts

The Vegetation	19
by Meekiong Kalu, Stephen Teo Ping, Mohd Effendi Wasli, Nursafinas Jelani, Mohd Akmal Mohd Raffi and Yazid Kalbi	

Two Endemic Herbs.....	25
by Wong Sin Yeng	

Carnivorous Plants.....	29
by Chien C. Lee	

Mushrooms	35
by Mohamad Hasnul Bolhassan, Mohd Haqim Mohd Haizar Nazry, Nur Atiqah Asiqin Sulaiman Khan, Mohamad Nurfazillah Mohamad Ramzie Faizal and Fatimah Daud	

Faunal Accounts

Mosquitoes.....	37
by Wong Siew Fui, Ichiro Miyagi, Takako Toma and Takao Okazawa	

Dragonflies and Damselflies	41
by Rory Dow and Graham T. Reels	

Butterflies.....	47
by Pang Sing Tyan, Ratnawati Razali and Wan Nurainie Wan Ismail	

Land Snail	53
by Mohd Zacaery Khalik and Mohammad Effendi Marzuki	

Crabs and Shrimps	57
by Jongkar Grinang	

Inland Fishes	60
by Kelvin K. P. Lim	

Amphibians	65
by Indraneil Das, Ramlah Zainudin, Pui Yong Min, Elvy Quatrin Deka and Taha Wahab	

Reptiles	69
by Indraneil Das, Pui Yong Min, Sabariman Hassan and Taha Wahab	

Birds.....	77
by Mohamad Fizl Sidq Ramji, Nurul Ashikeen Ab Razak, Ivana Berlinda Bilang, Rahah Mohd. Yakup, Isa Sait and Badiozaman Sulaiman	

Bats	91	Proboscis Monkey.....	114
by Faisal Ali Anwarali Khan, Muhd Amsyari Morni, Julius William-Dee, Norfarhana Mazlan, Wan Nur Syafinaz Wan Azman, Emy Ritta Jinggong, Nur Afiqah Aqilah Azhar, Roberta Chaya Tawie Tingga, Mohd Ridwan Abd Rahman and Isham Azhar		by Bolhan Budeng, Joan Bentrupperbäumer and David Gillieson	
Non-volant Small Mammals	95	Silvered Langur.....	117
by Faisal Ali Anwarali Khan, Julius William-Dee, Muhd Amsyari Morni, Nor Al-Shuhadah Sabarudin, Muhammad Amin Iman Azmi, Syamzuraini Zolkapley, Roberta Chaya Tawie Tingga, Mohd Ridwan Abd Rahman and Isham Azhar		by Bolhan Budeng, Joan Bentrupperbäumer and David Gillieson	
Large Mammals	99	Sunda Colugo.....	120
by Mohd-Azlan Jayasilan and Sally Soo Kaicheen		by Dzulhelmi Nasir and Nursyereen Mohd Nasir	
Species Highlights		Bearded Pig.....	123
Saltwater Crocodile.....	106	by Mohd-Azlan Jayasilan and Sally Soo Kaicheen	
by Engkamat Lading and Indraneil Das		Human Dimensions	
Bornean Green Pit-viper	111	Ecotourism.....	125
by Veronica Martin and Indraneil Das		by Arianti Atong, Abang Norizan Abang Median, Jalani Kelat and Suhaili Mokhtar	
		Contributor Affiliations.....	131

FOREWORD

Sarawak retains some of the richest biodiversity in the world. It is home to many endemics and species of conservation importance. Some of the best examples can be found in the State's extensive network of protected areas. Many of us here in the Ministry continuously explore the exquisiteness of biodiversity in the hopes of harnessing and sharing of information with the general public, to appreciate such elements present in our protected areas. This book represents but a sample of the work done by academics in the realm of biodiversity from Universiti Malaysia Sarawak and experts from various other agencies. I would like to commend the efforts by these researchers who supported us in collecting information on the biodiversity in such species-rich areas as Bako, which forms the material for the book.



The work is also expected to be important for local communities, to enhance their understanding, appreciation and perhaps eventually, guide their use of such resources sustainably, acting as an interpretation tool to guide ecotourists and naturalists.

As will be evident to the readership, a variety of approaches have been taken by the authors of the volume. Sections, starting with reminiscences from the early days by the Earl of Cranbrook, and on geology and geomorphology, are divided along taxonomic and thematic lines. These include a general account of the tree flora and selected herbaceous flora, a review of carnivorous plants and one on the mushrooms. The faunal accounts include both invertebrates and vertebrates, ranging from mosquitoes to monkeys. A section highlights the biology of Bako's charismatic species, that attract so many tourists to the Park. Finally, the section on human dimensions round up the volume, with a chapter on ecotourism in Bako National Park.

FOREWORD

It is my hope that this book will contribute in a significant way by encouraging more people to appreciate nature, explore our biodiversity and win more supporters. I anticipate that this volume will be useful to stakeholders to whom we remain connected through our common views on biodiversity conservation for the future generation.



Yang Berhormat Dato Sri Haji Abdul Karim Rahman Hamzah
Minister of Tourism, Creative Industry, Performing Arts;
Minister of Youth, Sports & Entrepreneur Development Sarawak



LAND SNAILS

Mohd Zacaery Khalik and Mohammad Effendi Marzuki

Gastropods show high diversification of shell shapes and sculptures. In the tropics, gastropods could be encountered in a variety of habitats. Taxonomically, gastropods are classified in the phylum Mollusca, and have been estimated to contribute approximately 80% of the total species richness. In general, terrestrial gastropods come in three forms: (1) shelled snails, the constructed shell is used to accommodate the soft body; (2) reduced shell, known as semi-slugs, with visible external shell but not large enough for the soft body to fit in, or with internal minute shell which is not visible to the naked eye, and (3) true slugs, or those that have no shells.

Over the past few decades, the study on land snail diversity of Borneo has gained attention, which resulted in the description of numerous new species. J.J. Vermeulen, a Dutch malacologist, has significantly contributed to the knowledge on the diversity of minute land snails of Borneo. His work has resulted in the description of over a hundred species of land snails in Sabah and Sarawak. Marzuki and his colleagues in 2021 described 13 new species from Bau, Sarawak. Similarly, Khalik and colleagues in 2018 described nine new species of land snail of the genus *Georissa* from Sarawak. Ultimately, the continuous efforts in documenting land snail fauna of Borneo provide evidence of the outstanding diversity of the fauna in the region, far more than previously thought.

To date, the land snail fauna of non-karstic forests in Sarawak had been poorly investigated, exceptions being Lanjak Entimau, Gunung Penrissen and Gunung Santubong. The reason may be attributed to the low abundance of land snails at these areas as compared to karstic ones. High concentration of calcium carbonate at karst environments provides resources for land snails to construct their shells. In this chapter, we attempt to fill in the gap on the list of species that could be found at a non-karstic area, at Bako National Park and its adjacent regions.

In early June 2022, three separate surveys were conducted at Bako National Park, Kampung Sungei Bako and Kampung Selabat. These areas are located within ca. 5 km of the Park. During the surveys, conducted along established trails, living and dead snails (empty shells) were searched for by two persons for approximately 20 minutes, from habitats including leaf litter, rock and wood surfaces, and the surrounding vegetation of the dipterocarp

LAND SNAILS

forests. Living specimens and empty shells were collected, and subsequently identified. A total of 31 individuals of land snails, representing 12 species from five families and nine genera were recorded.

A single species had been formally recorded from Bako by Vermeulen in 1999, was *Leptopoma bourguignati*, from the family Cyclophoridae. This species has keeled periphery, white shell covered with scally-like periostracum and known for its pale-green mantle inside the shell. Interestingly, we managed to collect the same species and added three other species of cyclophorid snails to the list, which are *Leptopoma sericatum*, a rounded, silver-coloured snail with strongly sculpted spiral ribs, *Cyclophorus perdis borneensis*, a large-



Fig. 1. (a) *Leptopoma sericatum*; (b) *Cyclophorus perdis borneensis*; (c) *Opisthophorus biciliatus*; (d) *Everettia consul*; (e) *Vitrinula glutinosa*; (f) *Kaliella calculosa*.

shelled snail with light to dark brown coloured shell, and *Opisthophorus biciliatus*, a medium-sized and compressed-shelled snail with a sutural tube which turns upward, and dark brown in colour. *Opisthophorus biciliatus* shell is uniquely covered by double rows of hairy periostracum along the ultimate whorls.

Leptopoma bourguignati and *L. sericatum* were found foraging on small tree branches and leaves, while *O. biciliatus* was usually found on leaves of short shrubs near the ground, about a meter away from trails. *Cyclophorus perdix borneensis* was found foraging on the forest floor and in the leaf litter.

We found two species of minute land snails of the family Diplommatinidae. This group family comprises minute land snails known to be widely distributed, from karstic to non-karstic areas. *Diplommatina azlani* is a member of this group, found solely in non-karstic environments. This species possesses a striking red shell, with the tip darker than the rest of the shell. This species was formerly known to be restricted to the type locality of Santubong National Park. Another species is *Diplommatina concinna*, found in a variety of habitat types, while abundant in karst areas. It is best identified by its light orange colour, with strongly sculpted radial ribs.

Everettia consul is the sole species of the Dyakiidae collected during our surveys. It is known to possess a more elevated spire and has a larger shell compared to other members of the genus, and distinguished by its reddish glossy shell, with dark spots on its mantle. It was found on surfaces of Pandan leaf blades on our way to Arong Serait Waterfall at Kampung Selabat.

The family Ariophantidae comprises minute to large land snails that are widely distributed, from Madagascar to Australia. We found three species of these arboreal land snails at Bako. *Vitrinula glutinosa* is endemic to Sarawak, and has a reddish glossy shell, with angular periphery. *Hemiplecta densa* is a large land species and usually found creeping on leaves of trees and on rotten logs. It has a brown, more or less thick, wrinkled shell surface, with an almost keeled periphery. Another species is *Damayantia carinata*, a semi-slug, identified by its long and tapering tail, dorsum sharply keeled with disc-like shell completely covered by mantle.

The family Chronidae comprises minute land snails that use a wide range of microhabitats, from the leaf-litter to canopy tops. We found two species of the family: *Kaliella calculosa*, found creeping on leaves of trees and on Pandan blades, with its brittle, pale yellow glossy shell and a somewhat keeled periphery; and *Kaliella microconus*, encountered on leaf-litter, with its brown shell, which is trochoid in shape, shell surface spirally striated and with a keeled periphery.

LAND SNAILS

Our survey in Bako National Park and its surrounding areas resulted in the addition of 10 new record of land snails and a semi-slug (see Checklist). Further malacological work is recommended to produce a more comprehensive list of land snails of Bako.

Checklist

Land snails recorded at Bako National Park and surrounding areas.
Current: 1 August 2022.

Order Stylommatophora		
Superfamily Helicarionidae		
Family Ariophantidae		
<i>Vitrinula glutinosa</i> (Metcalf, 1851)		(3 specimens, new record)
<i>Hemiplecta densa</i> (H. Adams & Reeve, 1850)		(1 specimen, new record)
<i>Damayantia carinata</i> Collinge, 1901		(1 specimen, new record)
Superfamily Trochomorpoidea		
Family Dyakiidae		
<i>Everettia consul</i> (Pfeiffer, 1854)		(1 specimen, new record)
Family Chronidae		
<i>Kaliella calculosa</i> (Gould, 1852)		(6 specimens, new record)
<i>Kaliella microconus</i> (Mousson, 1865)		(3 specimens, new record)
Order Architaenioglossa		
Superfamily Cyclophoroidea		
Family Diplommatinidae		
<i>Diplommatina azlani</i> Marzuki, 2019		(2 specimens, new record)
<i>Diplommatina concinna</i> H. Adams, 1872		(6 specimens, new record)
Family Cyclophoridae		
<i>Leptopoma bourguignati</i> Issel, 1874		(2 specimens)
<i>Leptopoma sericatum</i> (Pfeiffer, 1851)		(1 specimen, new record)
<i>Cyclophorus perdux borneensis</i> (Metcalf, 1851)		(2 specimens, new record)
<i>Opisthophorus biciliatus</i> (Mousson, 1849)		(3 specimens, new record)

BAKO NATIONAL PARK

This work takes the readers through a journey through several unique ecosystems within Bako National Park, highlighting many inhabitants on the way, from humble insects, such as mosquitoes and dragonflies, to the charismatic species, including the Proboscis Monkey and a rich assemblage of shorebirds that draw tourists by the thousands to the Park.

Bako is rich in biodiversity and accessible throughout the year via a short boat ride to the Park headquarters. From this vantage point, an eager tourist will be able to easily access the various habitats represented, including mixed dipterocarp forests, mangrove forests, cliff forest, beach forests, Kerangas, as well as mudflats, each with its unique biodiversity. The Park is also home to several endemic species, as well as species of conservation importance, upon which substantial ecotourism activities are based.

Bako National Park's rich ecosystems are presented through images and text accounts in this volume, which is based on field research, that reiterates their value for naturalists, tourists, as well as researchers. This book aims to enlighten stakeholders and present information on species biology and distribution to nature enthusiasts.

The chapter on geology and geomorphology sets the scene for the book. The wildlife aspects cover species from an array of taxa that includes plants and invertebrates, to fishes, herpetofauna, birds and mammals, rounded up with the ecotourism potential of the Park.

Research in Bako National Park was possible thanks to the generosity of various government agencies through research grants to Universiti Malaysia Sarawak. The project is aimed at assessing the area's biotic diversity, examine anthropogenic elements, and finally, to develop an applicable environmental model for ecotourism.



The Editors



Jayasilan Mohd-Azlan (left) earned his doctoral degree from Charles Darwin University for his work on mangrove avifauna of Australia. He is currently the Director of the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak.

Mohamad Kadim Suaidi (middle) is the Vice Chancellor of Universiti Malaysia Sarawak since 2013, and hails from Kampung Bako. He is passionate about community engagement and sustainable development in relation to biodiversity conservation. The university's visibility and recognition at the global stage is one of his main achievements.

Indraneil Das (right) received his doctoral degree from the University of Oxford, and was a Fulbright Fellow at the Museum of Comparative Zoology, Harvard University. Currently, he is Professor at the Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak.