



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:

Bako. Biodiversity Between Land and the Sea

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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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



THE VEGETATION

*Meekiong Kalu, Stephen Teo Ping, Mohd Effendi Wasli,
Nursafinas Jelani, Mohd Akmal Mohd Raffi and Yazid Kalbi*

Bako National Park was gazetted as a protected area in 1957, making it Sarawak's oldest Park. With a coverage area of 2742 hectares and located at the tip of the sandstone peninsula of Muara Tebas, the vegetation of Bako is unique in many ways. The word "Bako" originates from the Malay "Bakau", a mangrove tree species that can be spotted along the Bako river on the way to the Park Headquarters. The term is also generally used by the local Malay fishing community to refer to the mangrove habitat in the area. The geological structures of the Park consist of a thick layer of tertiary sandstone, with a plateau-like formation. This uplifted layer gives the Park its distinctive appearance. Furthermore, the erosion process that took place over time has resulted in the formation of a picturesque coastline that is characterized by cliffs, rocky headlands with a shade of pink and red (the effect of iron deposition), a small bay with stretches of white sandy beaches, as well as sea arches and sea stacks with extraordinary structures. In addition, the majority of the Tertiary sandstone from which the soil is formed has gone through extensive weathering stages, resulting in nutrient deficiency. Clay deposits can be found distributed across the plateau. These clay deposits are often the result of the weathering of igneous rocks. Alluvial soils are rare on the plateau and happen in slender strips along the riparian zone. Muddy estuarine alluvium occurs seawards where mangrove vegetation is encountered

Being protected and situated within a biodiversity hotspot has made Bako National Park one of Sarawak's important habitats for plants. To date, its flora is represented by about 600 species of flowering plants, including 75 dicotyledonous and nine monocotyledonous families. It is anticipated that many new records and new species will be added in the future. The Park is home to several Bornean endemic genera, such as *Bakoa* (Araceae), *Upuna* (Dipterocarpaceae), *Whiteodendron* (Myrtaceae), *Schuermansiella* (Ochnaceae) and *Aetoxylon* (Thymelaeaceae), and also support a number of Bornean endemic species. For example, 23 out of the 50 species of dipterocarps recorded here are endemic to Borneo.

The Park displays a unique transition of vegetation. At the front, located between the sea and land, is mangrove vegetation, which forms broad belts fringing the sheltered bays and estuaries of Bako's large river. This important

vegetation act as the nucleus for biological activities and is a highly productive ecosystem. The unique rooting systems (comprising pneumatophores, knee roots and stilt roots) capture litter and other organic matter and serve as an anchorage for filamentous algae. The Park is among the best sites showing the stages of the succession of mangrove (zonation) by the almost pure stands of distinct mangrove species. For example, on the part of the beach on newly deposited mud at Teluk Asam and Teluk Delima, the vegetation consists of a near pure stand of the saltwater pioneer species, namely, *Sonneratia alba* (Perepat). Among other mangrove species recorded here are *Avicennia alba* (Api-api hitam), *Avicennia marina* (Api-api merah), *Rhizophora apiculata* (Bakau minyak), *Bruguiera sexangula* (Berus putih), *Bruguiera gymnorrhiza* (Tumu merah) and *Ceriops tagal* (Tengar).

The next vegetation type is what is referred to as beach vegetation. It develops in open areas of the bay, on undeveloped sandy soil above the high spring tide mark. Besides the sandy soils, it is characterized by the presence of specific plant species that can adapt to harsh conditions (erosive actions – sea waves, wind, direct sunlight, and saline environment). The creeping *Ipomoea pes-caprea* grows gregariously as a pioneer species and sometimes found under the shade of tall *Casuarina equisetifolia* (Rhu laut). In addition to the aforementioned trees, there are several other tree species in the area, including *Calophyllum inophyllum* (Bintangor), *Hibiscus tiliaceus* (Baru laut), *Millettia pinnata* (Mempari laut), *Pouteria obovata* (Nyatoh laut) and *Ardisia elliptica*, among others.

Mixed dipterocarp forests (MDF) are found in areas where loamy soils are present or organic material has built up over sandy soils (such as on hills in the plateau). Here, species diversity is at its highest, with dipterocarps dominating and the forest configuration more complex. The dominant trees, usually of large diameter and reaching the uppermost layer of the forest canopy (emergent layer), are mainly from the family Dipterocarpaceae, including species such as *Anisoptera grossivenia* (Mersawa kunyit), *Dipterocarpus borneensis* (Keruing sindor), *Dryobalanops beccarii* (Kapur keladan), *Shorea bracteolata* (Meranti pa'ang), *Hopea beccariana* (Chengal pasir) and *Shorea scabrifolia* (Meranti lop). The second layer or main canopy is dominated by representatives of the families Euphorbiaceae, Fabaceae, Fagaceae, Loganiaceae, Moraceae and Sapindaceae. The understory layer is dominated by species such as *Garcinia eugenifolia* (Kandis), *Garcinia prainiana* (Cerapu), *Palaquium calophyllum* (Nyatoh durian), *Strombosia ceylanica* (Belian landak), *Vatica pedicellata* (Resak) and *Diospyros buxifolia* (Kayu malam).

One of the fascinating vegetation found in Bako is the Kerangas forest (including the pandang vegetation). Kerangas is from an Iban word which

VEGETATION

means land that cannot support rice-growing, attributed to the poor fertility of the podzolic soil. The soils derived from sandstone are impoverished in phosphorous and nitrate, possess a low water-holding capability and furthermore, are strongly acidic. The severe challenges faced by Kerangas vegetation tend to support a high number of plants from certain plant groups. Here, some plant species can adapt to such a harsh environment by absorbing nutrition through special mechanisms, chiefly, the carnivorous or insectivorous plants which trap insects to supplement their nitrogenous nutrient requirements (e.g., *Nepenthes*, *Drosera* and *Utricularia*) [see also a chapter on Carnivorous Plants]. These include myrmecophytes (such as *Dischidia rafflesiana*, *Phymatodes sinuosa*, *Myrmecodia tuberosa* and *Hydnophytum formicarum*). The deficiency of phosphorous and extreme warmness made some plant species produce/reduce leaf size as a strategy to ease water loss, as seen in *Baeckea frutescens* (Cucur atap) and *Dacrydium beccarii* (Sempilor) and some plants such as *Johannesteijsmannia altifrons* (Palma ekor buaya) have developed massive leaves.

Bako National Park's Kerangas forests have been subjected to both human and natural disturbances in the past before it's gazettement. These events



Fig. 1. *Baeckea frutescens* has reduced leaf size, a strategy to ease water-loss in extreme conditions of Kerangas forests.



Fig. 2. *Eleiodoxa conferta* ('Asam Paya'), the predominant palm species in swamp forests.



Fig. 3. *Hydnophytum formicarum*, a common species in Kerangas forests, is recognised for its medicinal value.



Fig. 4. *Johannesteijmannia altifrons* ('Palma Ekor Buaya'), identifiable from its massive leaves, is a protected species in Sarawak.

frequently occur, which affect regeneration. Different degradation levels are often used to classify the different subtypes of Kerangas. Some places in the Park are severely affected, being converted to scrubland or 'Padang', which are bare and open and often covered by the fern, *Dicranopteris linearis* (Resam). Endemic plants are also constrained to the subtype of Kerangas at the locality, among them, *Tristaniopsis beccarii* (Selunsur merah), *Elaeocarpus chrysophyllum* (Sangkurat), *Hopea kerangasensis* (Luis kerangas) and *Kokoona litorallis* var. *bakoensis* (Bajan).

In scattered Kerangas forest areas, as in Paya Jelutung and in between Bukit Dai and Bukit Gondol of the Park, where there is water logging, organic material accumulates due to the anaerobic condition as well as acidic conditions (pH frequently below 4) prevail, flat swampy alluvium areas are to be encountered. The peat swamp vegetation has a similar structure as mixed

VEGETATION

dipterocarp forest but differs in plant species composition. Some of these are obligatory and survive well in swampy conditions, for example, *Jackiopsis ornata* (Selumar), *Donax canniformis* (Bemban ai), *Eleiodoxa conferta* (Asam paya), and *Durio carinatus* (Durian paya). Many others are facultative, as they can also survive outside of swampy conditions. Comparing to the mixed dipterocarp forests, the emergent species here are from the Malvaceae (*Neesia malayana*, *Coelostegia borneensis*), Moraceae (*Artocarpus elasticus*), Apocynaceae (*Dyera polyphylla*) and Dipterocarpaceae (*Dipterocarpus costata*, *Dipterocarpus geniculata*). The ground flora is rather densely compared to the mixed dipterocarp forests, with many palms, pandans and sedges.

The rocky and exposed coastal cliffs, as represented in Bako, are rare in Sarawak, as most of the coastal areas of the State have sandy beaches or mangrove vegetation. This narrow zone vegetation at the base of Bako's cliff is of great interest. Dominated by small shrubs, herbaceous and *Pandanus* (possibly *Pandanus odorifer*), most species are well adapted to this area's extreme environmental conditions, such as with thick leathery leaves that resist



Fig. 5. *Shorea maxwelliana*, one of most common *Meranti* in the Bako's mixed dipterocarp forests and Kerangas.



Fig. 6. *Sonneratia* and *Avicenia*, the two common tree genera in the mangrove forests of Bako National Park.

drought and salt spray. Few interesting plants are recorded here such as *Cycas rumphii* (Paku laut), *Rhododendron brookeanum* (Tassak) and *Ficus deltoidea* (Tangkai beritu). Two insectivorous plants, *Nepenthes albomarginata* and *N. reinwardtiana* can be spotted here. The former is commonly found with rosette habit on the rocky pockets, and the latter are found as epiphytes, clinging to branches.

The plant life at Bako National Park has been naturally structured in a multitude of distinct patterns, the Park a home to at least six different types of significant vegetation, each of which hosts an exceptionally high number of plant and animal species. The entirety of the Park is located on poor soil and subject to harsh climatic conditions, which have contributed to the evolution of unique adaptations. Since it is gazetted as a Totally Protected Area, conservation of the extraordinarily high number of endemic lineages will be assured protection, and remain both a natural treasure in the State of Sarawak, as well as a heritage site for people from all over the world.



Fig. 7. *Vatica pedicellata* ('Resak'), a small plant with fragrant flowers.

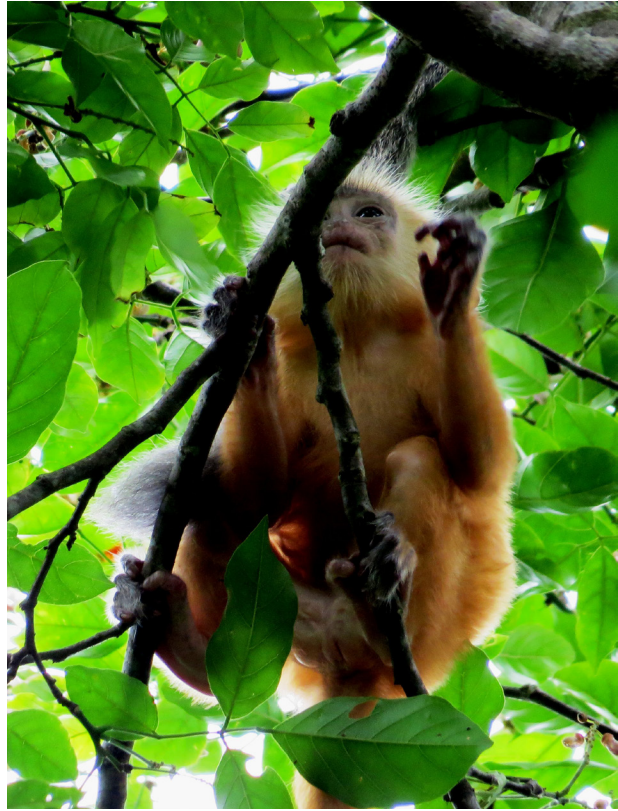


Fig. 8. A juvenile silverleaf langur feeding on the fruits of *Millettia pinnata*.

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.