



BAKO — Biodiversity Between Land and the Sea

Edited by Mohd-Azlan, Suaidi & Das

Life from Headwaters  
to the Coast

# BAKO

## 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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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

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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*



# TWO ENDEMIC HERBS

*Wong Sin Yeng*

*Bakoa* P.C.Boyce & S.Y.Wong is a genus endemic to Bako National Park. The genus is monotypic with one species, *Bakoa lucens* (Bogner) and was described by P.C.Boyce and S.Y.Wong in 2008.



**Fig. 1.** *Bakoa lucens*.

***Bakoa*** P.C. Boyce & S.Y. Wong (Fig. 1)

Typus: *Bakoa lucens* (Bogner) P.C. Boyce & S.Y. Wong

Small rheophytic herbs. *Stem* condensed. *Leaves* several to many together; petiole sheathing only at the extreme base, thence extended into a very narrowly triangular marcescent ligular portion; blade very narrowly elongate-elliptic, rather coriaceous; midrib abaxially prominent with 4–6 very fine but well-differentiated (darker than surrounding tissue) primary lateral veins on each side, these hardly differentiated in thickness from the secondary venation and diverging at c. 30°; secondary veins adaxially more or less obscure, abaxially fine and rather faint, running to a thicker marginal vein; tertiary venation forming an inconspicuous tessellate reticulum abaxially. *Inflorescence* solitary to three together on a single shoot; peduncle erect to arching at anthesis with the spathe slightly downturned and the spathe opening ventral, declinate post anthesis and during fruiting. *Spathe* weakly nodding; more or less oblanceolate, hardly constricted, with a long apiculate tip. *Spadix* adnate to the spathe in the lower  $\frac{1}{2}$  -  $\frac{2}{3}$ ; female zone completely adnate to the spathe on the dorsal side; ovary depressed globose and weakly

## TWO ENDEMIC HERBS

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angular, placentation basal, ovules orthotropous, long-beaked; stigma sessile, narrower than the ovary, button-like, papillate; interpistillar staminodes absent from the female zone; sterile interstice somewhat thicker than the female zone, dorsally adnate to the spathe, composed of large truncate mostly irregularly polygonal staminodes, these also distributed up the dorsal side of the male zone to the spadix apex; male zone subcylindric-ellipsoid, apically narrowly acute and sterile, basally adnate to the spathe on the dorsal side, mostly with only the ventral-most stamens (those exposed by gaping spathe limb) fertile, sometimes more extensively fertile, but always sterile on the dorsal side; stamens crowded, truncate, dumbbell-shaped to irregularly rectangular from above, often with the connective irregularly broadened on one side; thecae each opening through a conspicuous, broad-rimmed pore. *Fruiting spathe* persistent, at fruit maturity very swiftly drying and thence by reflexing of the spadix the spathe recurving and opening basally and also tearing at the peduncle insertion to expose the fruits, at the same time spathe limb remaining distally convolute and still clasping the spadix appendix remains; fruiting peduncle initially declinate, later twisting through 180° and becoming arching-erect; berry depressed globular; seed ellipsoid, micropyle blunt, testa slightly ribbed.

*Distribution:* Malesia: endemic to Bako National Park.

*Habitat:* Lithophytic in forest, and rheophytic near streams or waterfalls, c. 30 m alt.

*Notes:* The combination of a spadix more than half adnate to the spathe, fertile male flowers mostly restricted to a small zone coincidental with the area exposed by the gaping spathe during anthesis, a fully persistent spathe becoming wholly marcescent at fruiting and seeds with a blunt micropyle borne on a basal placenta is unique in the Schismatoglottideae.

Field observations on *Bakoa lucens* were carried out at Tajor Waterfall, Bako National Park, Sarawak. The plants grew in the oligotrophic water system, on sandstone bedding with at least 60° slopes. The inflorescences of *B. lucens* took ca. 5 weeks to reach maturity. The natural pollinator of *B. lucens* was determined as flies of the genus *Colocasiomyia*. The entire pollination process is worked by two different phases of odour released during pistillate and staminate anthesis with the intrinsic spathe movement to regulate the pollinator behaviour.

*Etymology:* *Bakoa* is named for Bako National Park, Kuching Division. Established in 1957, Bako is Sarawak's oldest national park and despite its comparatively small size, is an extraordinarily beautiful and rich reserve for plants and animals.

*Hanguana bakoensis* is a newly described species from Bako National Park, Sarawak, Malaysia Borneo.

***Hanguana bakoensis*** Siti Nurfaizilah, Ahmad Sofiman & P. C. Boyce (Fig. 2) Typus. Malaysia, Sarawak, Bahagian Kuching, Bako N.P., Lintang Trail, 27 May 2007, Nadiyah I., Malcom D., Army K. & al. *S.100599* (holo- SAR!; iso- KEP, n.v.).



**Fig. 2.** *Hanguana bakoensis*.

Solitary to weakly clumping, herbaceous, glabrous, dioecious mesophyte to ca. 1 m tall, stem rhizomatous with terminal portion ascending, ca. 1.5 cm diam., older portions sub-woody, active portions covered with fibrous degraded leaf bases. Leaves up to 10 together, spreading, the longest leaves arching with the leaf tips touching the ground, bases imbricate, up to 90 cm long; leaf blade 1.5–4 cm wide, linear-lanceolate to very narrowly elliptic, somewhat leathery, both surfaces bluish-green when fresh, drying chartaceous and pale straw-coloured; pseudopetiole accounting for up to half the entire leaf length, although usually somewhat less, longitudinally folded inwards with the margins somewhat sharp, the lowermost

part of petiolar sheath margins erose-marcescent; leaf tip attenuate-mucronate; midrib prominently round-raised abaxially, especially in the lower part of the leaf blade, impressed adaxially and lesser venation obscure when fresh, midrib drying flush adaxially and all other venation minutely tessellate-striate in most specimens. Female and male inflorescences not observed, although based on very immature fruiting material inflorescence almost certainly erect at anthesis. Infructescence solitary, declinate, comprising 3–5 partial, thyrsoid or spicate infructescences plus a terminal spike, peduncle (lower non-flower bearing part) and scape (upper flower-bearing part) together up to 95 cm tall,

## TWO ENDEMIC HERBS

sub-microscopically puberulent, dark brown to greenish red, visible portion of peduncle up to 15 cm long but often shorter, start of scape marked by a foliaceous, fertile or sterile, narrowly lanceolate-elliptic bract up to 15 cm long, bract base clawed, tip aristate; partial infructescences each subtended by a bract similar to that marking the start of the scape, these diminishing in size distally along the infructescence, the smallest ca.  $8 \times 1.5$  mm; partial infructescences each comprising of 3 branches (exceptionally up to 5 in robust specimens, depauperate specimens with a single or paired branches), branches arising simultaneously from the axil of the subtending bract, median branch usually longer than lateral branches, 2–7 cm long ca. 1.5 mm thick, weakly angled, lateral branches approximately  $2/3$  the length of median branch, although branches subequal in distal-most partial infructescence. Male flowers not observed. *Female flowers* mainly in scattered groups of 2 to 3, lowermost flowers of each branch occasionally solitary, flowers mainly sessile, very occasionally pedicellate to ca. 0.5 mm, pale green, all flowers with an associated minute bracteole; *perianth* of 6 tepals, outermost ca.  $1 \times 1$  mm, ovate, weakly concave, in fruiting material reflexed from the mid-point, the tips recurved and touching the pedicel, inner tepals ca.  $2 \times 2$  mm, ovate, slightly concave; Staminodes minute, clavate, pale green. Ripe fruit compressed-globose, very weakly 3-lobed with a faint suture running from the pedicel to a point between the stigma lobes of the defining the fruit lobes, ca.  $5 \times 3.5$  mm initially glossy pale green, ripening glossy medium pink to magenta; stigma 3-lobed, lobes joined to form a clover-leaf, minute, impressed, ca. 1 mm diam., matte black. Seeds shallowly cupuliform, ca. 3.5 mm diam., 1 deep, smooth, glossy black, placenta waxy-oily, filling the depression in fresh seeds.

*Distribution:* Malaysian Borneo, Sarawak, endemic to Bako National Park.

*Ecology:* Kerangas and closed heath forest (virtually all collections, and Low, and Boyce, *pers. obs.*); mixed dipterocarp forest (*Fide S. 100599*), ca. 100 m asl.

*Notes.* *Hanguana bakoensis* is immediately distinguishable from *H. major* Airy Shaw and *H. bogneri* H.-J. Tillich & E. Sill, the other currently described Bornean forest species, by being glabrous, except for the sub-microscopically puberulent peduncle and scape, the narrow bluish-green leaves, and weakly 3-lobed fruits ripening medium pink to magenta. Sterile plants of *Dianella ensifolia* (Asphodelaceae), another Kerangas-favouring species common at Bako, look deceptively similar to *H. bakoensis* but may be readily distinguished by the minutely serrate leaf margins and the distal portion of the abaxial midrib.

## 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.