

The background of the cover is a vibrant landscape. At the top, a blue sky is filled with large, white, fluffy clouds. Below the sky, a range of dark, forested mountains stretches across the horizon. In the middle ground, a lush green valley is filled with dense tropical vegetation. On the left side, a waterfall cascades over large, grey rocks. On the right side, a small village with colorful houses and a winding road is visible, partially obscured by a layer of white mist or low clouds that fills the lower portion of the image. The title 'BUNGO RANGE' is prominently displayed in the center, with 'BUNGO' in white and 'RANGE' in black, both in a large, bold, sans-serif font. The letters of 'RANGE' are filled with various images of tropical wildlife and plants.

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

EDITORS

GABRIEL TONGA NOWEG

FAISAL ALI ANWARALI KHAN

JONGKAR GRINANG

BUNGO RANGE

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EDITORS

GABRIEL TONGA NOWEG
FAISAL ALI ANWARALI KHAN
JONGKAR GRINANG

SUPPORTING EDITORS

CINDY PETER
RUNI SYLVESTER PUNGG
ANDREW ALEK TUEN

UNIVERSITI MALAYSIA SARAWAK

BUNGO RANGE

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Published in Malaysia by
UNIMAS Publisher,
Universiti Malaysia Sarawak,
94300 Kota Samarahan,
Sarawak, Malaysia.

Printed in Malaysia by

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

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FOREWORD

I am glad to note that this publication is another excellent milestone from Universiti Malaysia Sarawak through the Institute of Biodiversity and Environmental Conservation, in particular exploring and documenting the rich biodiversity and community in Sarawak. The biodiversity and environmental conservation is one of three niche areas of the university, which recognise the need to balance the biodiversity, habitats and human development. As such, the Research Innovation and Enterprise Centre, the university's centre responsible for research and innovation, has actively facilitated and supported research activities, and publications in various platforms available to scientific communities and the public.

I would like to thank staff of the Institute of Biodiversity and Environmental Conservation for continuously conducting good research and documenting crucial information that benefits many users including scientists across the region. It is well in line with the Institute's vision to become a leading center for research in tropical biodiversity and environmental conservation in Borneo and Southeast Asian region. I would like to congratulate the editors for their efforts in compiling and editing the data resulted from a multidisciplinary expedition in Bungo Range in December 2017 into a well indexed research book. I do believe that each article in this book serves its purpose as an important reference to academics, policy makers as well as public audiences. In particular, the findings would be a useful reference for the management plan of Bungo Range National Park that was gazetted on 26 February 2009.

To materialise the multidisciplinary expedition and the publication, the Institute had collaborated with various state agencies and local communities. Therefore, I am acknowledging their support and contribution (both financial and in-kind) to this project. They are Forest Department Sarawak, Sarawak Forestry Corporation,

Sarawak Biodiversity Centre, Sekolah Kebangsaan Tringgus, Pejabat Pendidikan Daerah Bau, Bau District Office, Bau District Council, Klinik Kesihatan Krokong, Bau District Police, Bau Fire and Rescue Station, Bau Hospital, and villagers from Tringgus settlement namely, Kg Bong, Kg Rotan and Kg Nguan. I hope similar collaborative efforts will be pursued in the near future to other protected areas in Sarawak.

To the authors, UNIMAS Publisher, and those who are involved in this publication, keep up with the good team spirit.

Finally, thank you for inviting me to pen my message in this great reading material.

Prof. Dr. Wan Hashim bin Wan Ibrahim
Deputy Vice Chancellor (Research and Innovation)
Universiti Malaysia Sarawak

PREFACE

This publication marks another significant output of the collaborative works between Universiti Malaysia Sarawak and Forest Department Sarawak on biodiversity study and conservation in the State.

In this book, the findings of multidisciplinary expedition to Bungo Range in December 2017 were compiled into 24 chapters covering biodiversity, environment and community under the theme “Bungo Range - Biodiversity and Community”. The theme signifies the importance of the pristine mountainous forest of the Bungo Range that supports rich species of flora and fauna, and the uniqueness of community and their customs as well as cultures. The involvement of academics, researchers and the villagers in the expedition has enhanced the exchange of knowledge, skill, and experience among the stakeholders, which are reflected in this book. In particular, the participation of the villagers in the expedition had indirectly conveyed the message of the Forest Department Sarawak on the importance of conserving the forest of Bungo Range and preserving local cultures. Ironically, the Bungo Range is becoming a popular tourism destination due to the outstanding sceneries such as mountains, waterfalls, reservoir, and the cultures (e. g., the last ring ladies). Indeed, this book will serve as a useful reading material for researchers, scientists and non-government organization in their research endeavour.

We would like to congratulate the editors, authors and those who contributed to the production of this book. We wish similar outputs shall be achieved from future collaborative work between Universiti Malaysia Sarawak and Forest Department Sarawak. Specifically, we would like to thank the community leaders and heads of department in Bau District for their support throughout the project. Yang Berhormat Miro Simuh for his strong supports of the expedition and launching of the event on 5th December 2017.

We hope this book serves the needs of the audiences either as academic reference or reading material in leisure time. Happy Reading!

Prof. Dr. Mohd Azlan Jayasilan

Director
Institute of Biodiversity and
Environmental Conservation
Universiti Malaysia Sarawak

Datu Hamden Haji Mohammad

Director
Forest Department Sarawak

INTRODUCTION

Sarawak government has voluntarily set aside more than 2.6 million hectares of lands and water bodies as conservation areas under the Heart of Borneo (HOB) Initiatives. The Sarawak's HOB area stretch from the north in Limbang Division to the south at Tanjung Datu that boundaries with Sabah, Brunei and Kalimantan, Indonesia. Of the total HOB area, approximately 441,000 hectares are totally protected area comprising national parks, wildlife sanctuaries and nature reserves. The southern part of the HOB contains 10 protected areas many of which are tourism hotspots such as Bako National Park, Kubah National Park, Gunung Gading National Park, Matang Wildlife Centre and Tanjung Datu National Park.

Bungo Range is located at 10° 16' latitude and 110° 9' longitude of the southern side of the HOB, about 500 meter above the sea level. The mountainous primary forest of the area was gazetted as Bungo Range National Park on 26th February 2009 covering 8,096 heactares (**Figure 1.1**). Bungo Range is an important water catchment area in the upstream of the Sarawak Kiri River and Sarawak Kanan River, where the Bengoh Dam is built to provide water supply for Kuching population. The southern end of the Bungo Range is the boundary of West Kalimantan, Indonesia.

In 2017, a multidisciplinary expedition to Bungo Range was conducted as one of the activities organized in conjunction with UNIMAS's Silver Jubilee Celebration. The Institute of Biodiversity and Environmental Conservation had led the expedition with the support of Forest Department Sarawak and other Institutes as well as Faculties within the university. The goal of the expedition was to increase the visibility of UNIMAS not just to the Tringgus community, but also to answer the call of the Sarawak government that wants to emphasise the implementation of Digital Biodiversity

in this state. The expedition was conducted for two weeks with the launching of the event held on 5th December 2017 at Tringgus settlement area.

Despite the earliest exploration in the area back to year 1880s, there is a lack of information pertaining to biodiversity and socio-economy, which are necessary to enhance biodiversity conservation, and boost local economic activities in the area. The expedition had produced substantial baseline data for the management of Bungo Range National Park, and highlight the area as a tourism destination, which eventually would benefit the local community in the area. The findings of the expedition are compiled herewith, comprising historical exploration in Bungo Range, water resource, aquatic biodiversity, floristics, mammals, birds, reptiles, amphibians, insects, and health and socio-economics of the locals. In summary, this book reported a total of 313 species of plants mainly orchids and zingers, and 298 species of wildlife among others are 105 birds, 39 mammals, 92 insects, 27 reptiles, 17 amphibians, and 59 aquatic lives. Additionally, the use of natural resources by local community in Tringgus is also presented in this book.

Because the expedition had only covered a small area of the southern section of the Bungo Range, gaps of information in this edition are expected, which suggest more explorations are needed in the near future. In this regard, the editors would like to acknowledge the contribution of the authors of each article in this edition. This edition may not stop here, and we wish to be working with you all again!

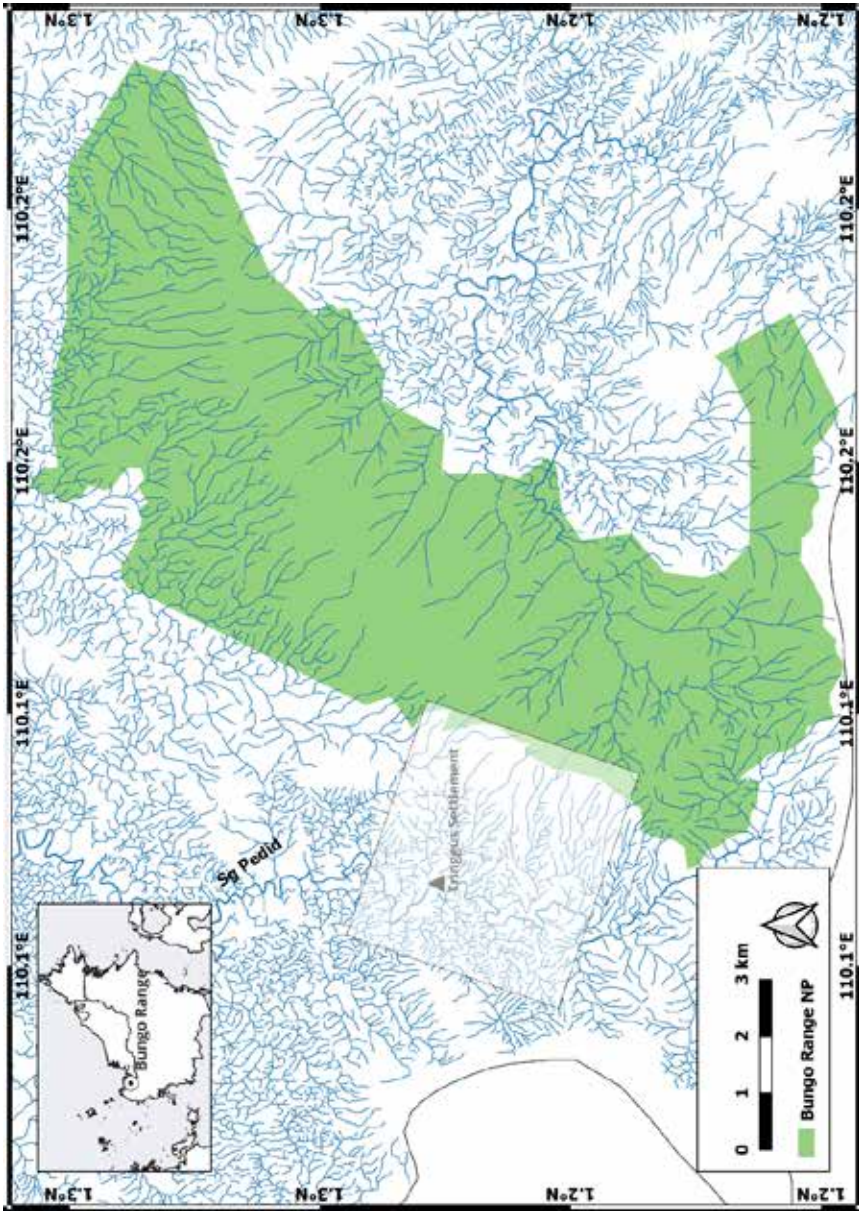


Figure 1.1. Map of Bungo Range National Park and the expedition area (shaded box).



THEME:
**GEOLOGICAL STUDY
AND ZOOLOGICAL
EXPLORATION**

HAPALINE (ARACEAE: ANGIOSPERM) OF BORNEO

Meekiong Kalu, Mohd Effendi Wasli, Hafsah Nahrawi and Zinnirah Shabdin

Tribe Caladieae comprises several genera, *Scaphispatha*, *Caladium*, *Jasarum*, *Xanthosoma*, *Chlorospatha*, *Syngonium*, and *Hapaline*. *Hapaline* is a genus of seven published species occurring from Myanmar to China (Yunnan) and south to western Sarawak. All species so far discovered are diminutive to moderate-sized, slender, tuberous or stoloniferous, clump-forming, terrestrial and seasonally dormant or (rarely) evergreen herbs (Boyce, 1996).

Hapaline is superficially similar to species of the genus *Typhonium* (tribe Areae), most notably in the sagittate leaves with prominently reticulate venation. In Borneo there are only three *Typhonium* species, all introduced and all associated exclusively with ruderal habitats whereas *Hapaline* is only found in natural forest. Elsewhere in the range of *Hapaline* (e.g., Thailand) there are strikingly similar species of *Typhonium* in natural habitats and confusion is possible between these and *Hapaline*. In these instances the floral characters to distinguish *Typhonium* include the naked spadix appendix (spadix appendix covered in synandrodies: *Hapaline*), the inflated, convolute lower spathe (lower spathe clasping the female flower zone: *Hapaline*), free male flowers (stamens fused into synandria: *Hapaline*) and the female flower zone free (fused to the abaxial lower spathe surface: *Hapaline*).

Two *Hapaline* species occur on Borneo: *H. appendiculata* Ridl. (Ridley, 1908), described from Kampung Puak, Bau, Kuching Division, Sarawak, where it is associated with Karst limestone, but extending as far east as the Belaga drainages (Kapit Division), where it occurs on basalt, and shale-obligated *H. celatrix* P.C. Boyce, described from

Brunei, but also occurring in adjacent Miri and Limbang Divisions, Sarawak (Boyce & Wong, 2008). Active fieldwork by the author has located a significant population of *H. appendiculata* at Tringgus, Bau.

Hapaline appendiculata Ridl., J. Straits Branch Roy. Asiat. Soc. 49 (1908 ('1907')) 47; Bogner, Pl. Syst. Evol. 144 (1984): 62 (1984); Boyce, Kew Bull. 51(1) (1996) 63-82 (1996). **Type:** Sarawak, Kuching Division, Puak, Sept. 1890, *Ridley 12411* (holotype SING!; isotype K!). **Figure 8.1.**

Slender, tuberous, perennial herb up to 25 cm tall. **Stem:** tuberous, ± cylindric, c. 1.5 x 1 cm; plants frequently producing two to five slender (c. 3 mm diam.) stolons to 30 cm long, these rooting terminally and forming additional tubers. **Roots** c. 0.25–0.33 mm in diam., mostly spreading through the leaf litter-soil interface. **Leaf** prophyll linear, up to 9 x c. 4 mm, acute; cataphylls oblong-lanceolate to linear triangular or triangular, up to 10 cm x 5 mm, attenuate to acute, prophyll and cataphylls at first membranous and pale green, soon darkening and drying papery; petiole 2.5–18 cm x 1–2 mm; leaf blade ovate to hastate or subsagittate, 10–21 x 3.5–8.5 cm, thinly coriaceous or coriaceous, even on the same plant, pale to dark green, occasionally with various greyish to pale green blotchy or/or cloudy markings adaxially, abaxial surface much paler, sometimes suffused reddish purple in which case primary mid-vein and primary lateral veins on abaxial surface purple-red, margins smooth, apex acute to acuminate, posterior lobes rounded to subacute, divergent to almost parallel, sometimes ± absent. **Inflorescence** (1)2–4 together held level with or below the leaves; peduncle 4–25 cm x 0.25–0.5 mm; spathe 2–7 cm long; spathe limb elliptic, 1.6–2.6 cm x 5–7 mm, apex acute to briefly attenuate, base decurrent into lower spathe; lower spathe margins clasping the ovaries, 4–8 x c. 1.5 mm; spadix 2.5–3.5 cm x 0.25–1 mm, free portion cylindric, up to 14 mm long, tapering apically into a greatly attenuated appendix to 9 mm long composed of connate synandrodes. **Flowers** synandria irregularly elongate in plan view, 2–3 x 0.5–1 mm; ovaries bottle-shaped, 1.5 x 0.7

mm, two or three in a single row aligned longitudinally along the spadix axis; stigma capitate, c. 0.2 mm in diam., papillose; style very short. **Infructescence** carried on declinate to reflexed peduncle, enclosed by the persistent lower spathe, 2 cm x 4 mm, few-berried; berries more or less globular, ripening pale green, c. 4 mm in diam, stigmatic remains persistent, not prominent. **Seed** ellipsoid, c. 3 x 2 mm, glossy pale brown with a conspicuous white oily raphe.

Distribution: Endemic to Sarawak with four collections to date, these only from Kuching Division (three collections) and Kapit Division (one collection).

Other specimens seen: SARAWAK. Kuching Division: Krokong, Kampung Tringgus, Sungai Bong, 01° 15' 22.8"; 110° 05' 53.9", 4 March 2005, *P.Boyce, Jeland & Jepom AR-1017* (SAR, UNIMAS); Bau, Bidi, 6 Dec. 1905, *Hewitt 476* (SING!). Kapit Division: Belaga, Long Linau, near Punan Lusong to Long Jakah, 8 Sept. 1978, *Burt & Woods 11477* (E!).

Ecology: Lowland evergreen moist valley forest on shales and basalt. Only recorded altitude c. 150 m asl (Tringgus). Both Bornean *Hapaline* are associated with shale and basalt whereas all other *Hapaline* species (all extra-Bornean) are restricted to karst limestone.

Notes: Based on the paucity of collections, *H. appendiculata* appears to be one of the rarest aroids in Borneo. However, considering its diminutive size, the periodically dormant nature of the plant and the fact that aroids have received scant attention from field workers since Ridley's time, it is equally possible that it is simply overlooked during fieldwork. It is worth noting that the Kuching and Kapit collections of *H. appendiculata* are 340 km apart with much of the intervening forest botanically unexplored.

Hapaline appendiculata differs from *H. celatrix* by its seasonally dormant habit, thinly coriaceous leaves and greatly elongated sterile appendix. The habitat of *H. celatrix* is briefly seasonally-dry riverine forest on shale. Both known localities of *H. celatrix* are more exposed (higher light levels) and presumably less humid for at least part of each day than the habitats of *H. appendiculata*. In neither locality is *H. celatrix* abundant.

Developing (submature) infructescences of *H. appendiculata* consist of the persistent lower spathe and associated fruit. The spathe limb, and all spent portions of the spadix are already shed, and the lower spathe partially envelops the developing fruits, which are turned to present the stigma uppermost. As the fruits continue to grow their increase in size forces open the lower spathe. It was observed that while younger infructescences often have two, rarely even three berries, none of the later stage infructescences have more than one. Once the fruit has reached full maturity the spathe quite suddenly reflexes, in a matter of a few minutes, to ‘display’ the ripe berry. At this point the pericarp also rapidly turns from opaque green to semi-transparent white, allowing the large bright green seed to be visible. It was noticed that once the spathe reflexed the berry became only loosely attached to the spadix, dislodging at a touch. The pericarp of fallen fruits is readily damaged, and sticky once so (Wong & Boyce, 2012).

Key to the two species of *Hapaline* in Borneo

- 1a. Spadix sterile apex greatly elongated, exceeding spathe limb; foliage thinly coriaceous..... *H. appendiculata*
- 1b. Spadix sterile apex not greatly elongated, not exceeding spathe limb; foliage thickly coriaceous..... *H. celatrix*



Figure 8.1. *Hapaline appendiculata* Ridl. A, A typical population at Tringus. B, C, Inflorescence, note the greatly elongated appendix comprised of fused synandrodes.

References

- Bogner, J. (1984). On *Hapaline appendiculata* and *Phymatarum borneense*, two rare Araceae from Borneo. *Plant Syst. Evol.*, 44: 59-66.
- Boyce, P. C. (1996). *Hapaline* (Araceae: Aroideae: Caladieae). *Kew Bull.*, 51: 63-82.
- Boyce, P. C. & Wong, S. Y. (2008). *Hapaline celatrix* (Araceae: Caladieae) – A new record for Sarawak, Malaysian Borneo. *Gardens' Bull. Sing.*, 60: 31-36
- Ridley, H. N. (1908 '1907'). New or rare Malayan plants. III. *J. Straits Branch Roy. Asiat. Soc.*, 49: 11-52.
- Wong, S. Y. & Boyce, P. C. (2012). Infructescences of *Hapaline appendiculata*. *Newslett. Int. Aroid Soc.*, 34: 16-17.

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

This book highlights the significant findings from the Multidisciplinary Expedition in Bungo Range conducted on 5-10 December 2017. The expedition was organized by the Institute of Biodiversity and Environmental Conservation, UNIMAS with support from the Forest Department Sarawak. This volume is illustrated in 24 chapters covering the historical exploration of Bungo Range, a geological feature of the mountain, water resources, aquatic biodiversity, floristics, mammals, birds, reptiles, amphibians, insects, and health and socio-economics of the Tringgus community. It is reported herewith in the book that there are a total of 313 species of plants mainly orchids and zingers, and 298 species of wildlife, among them 105 birds, 39 mammals, 92 insects, 27 reptiles, 17 amphibians, and 59 aquatic lives. Additionally, the use of natural resources by the local community in Tringgus is also presented. This book can serve as a useful reference for the development and management of Bungo Range National Park, and the communities living surrounding the area.