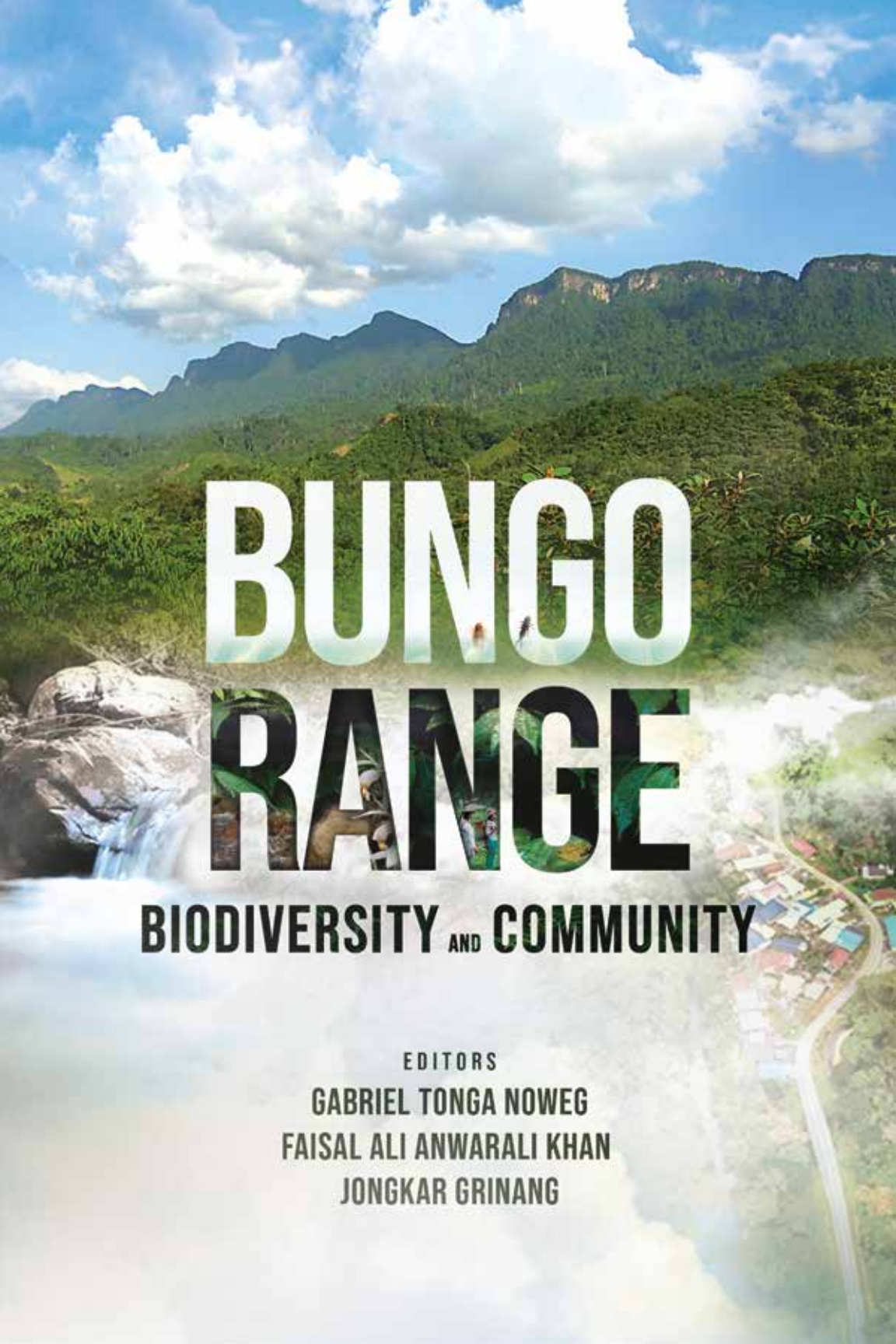

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FOREWORD

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 villages 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 strech 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 neccesary 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 spcies 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!

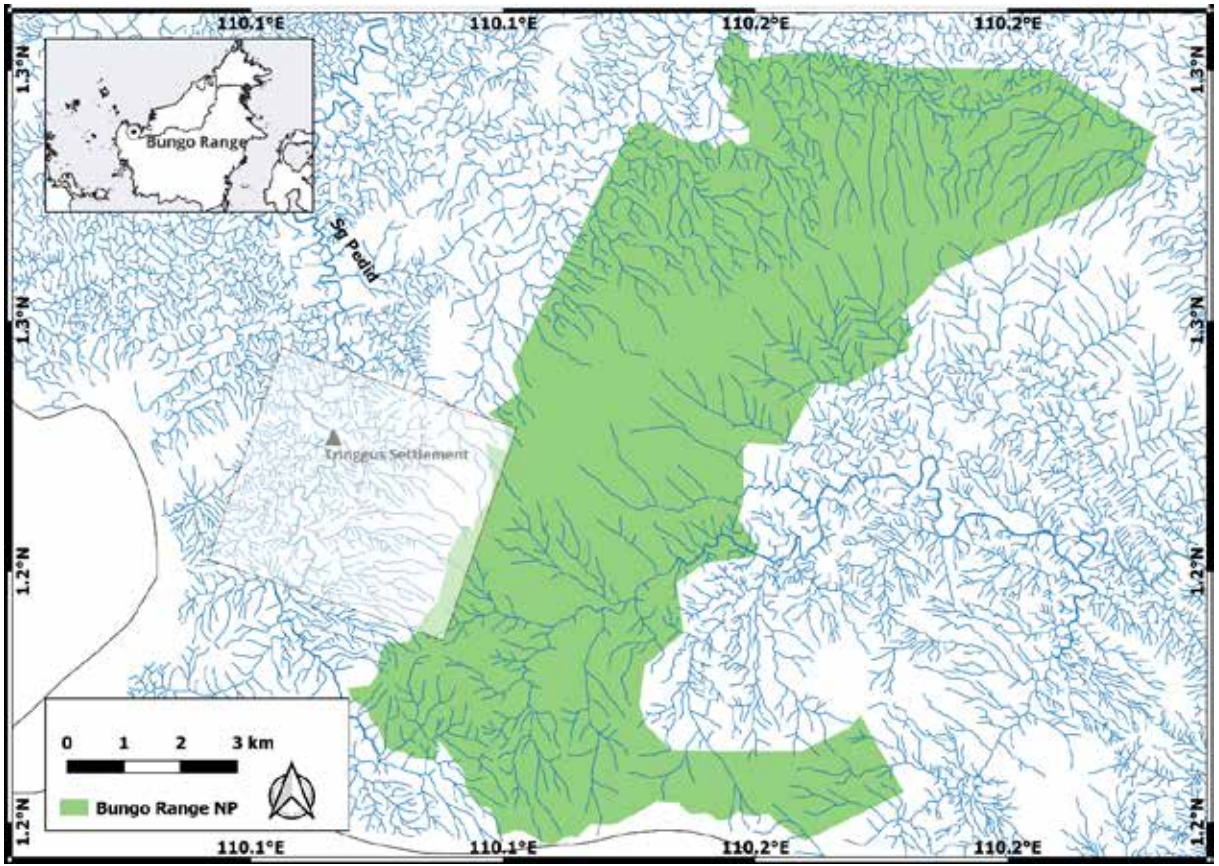

Figure 1.1. Map of Bungo Range National Park and the expedition area (shaded box).

BURKHOLDERIA SPECIES FROM SELECTED VILLAGES IN BUNGO RANGE

Yuwana Podin, Lua Viana Pangau, Dorathy Jampi

The genus *Burkholderia* is a Gram-negative bacilli bacteria comprises over 100 subspecies residing a diverse ecological niches. *Burkholderia* species have been reported as plant pathogens while others are recognized as plant commensals or even potential bioremediation agents by degrading environmental pollutants.

Despite the positive roles of some of the bacteria for plants, some species have the ability to cause infections in humans and animals. For instance *Burkholderia pseudomallei* which causes melioidosis and *Burkholderia mallei* causes glanders, are both pathogenic and potentially fatal to humans and animals. In addition, *Burkholderia cepacia* has been reported to cause opportunistic infections in individuals suffering from cystic fibrosis and chronic granulomatous disease.

The distribution of the members of the *Burkholderia* species in the environment is dynamic, influenced by a wide range of factors. Soil water content, either due to a nearby waterbody or rainfall, has been shown to influence the presence of the bacteria with higher recovery rate from moist soil. In addition, higher presence of *Burkholderia* species in the soil is also dependent on human activities including construction or excavation, agriculture, use of fertilizers, and animal rearing which also have direct and indirect impacts on the ecology and soil distribution of the genus *Burkholderia* particularly *B. pseudomallei*.

Soil texture also influences the prevalence of the microorganisms in the soil although variations in conditions were observed different members of the *Burkholderia* species. Other parameters correlated with the abundance of the *Burkholderia* species in the soil include pH, salinity, nitrate, and iron content where they mostly are associated with the use of fertilizer and agricultural activities. The distribution of *Burkholderia* species in the environment is also influenced by vegetation where certain species have been shown to colonize roots and aerial parts of specific grasses.

Figure 24.1. Animal droppings have been associated with higher nitrate content and higher presence of *B. pseudomallei*

The main objective of this study is to assess the prevalence of *Burkholderia* species including the pathogenic *B. pseudomallei* in the Bengoh community. This predominantly Bidayuh Jagoi community resides in the Bungo Range in three villages namely Kampung Bong, Kampung Rabak Rotan and Kampung Matan Nguan with a population size of about 800. It was observed that there were subsistent farms

and poultry rearing around the villages. There is also a stream nearby and drains around the villages. Land clearing was also observed for the purpose of farming and construction.

Figure 24.2. Collection of soil sample next to a puddle of water.

Soil samples were collected from various types of land-use including farms, drains, newly excavated earth, and areas around the houses that gave consent. The collected soils were subjected to bacterial culture in selective media where the bacterial isolates were tested for *Burkholderia* species identification using a technique called polymerase chain reaction. The bacterial isolates that were tested positive for *Burkholderia* species were then subjected to confirmation test for *B. pseudomallei*.

Burkholderia species being soil bacteria, were found in abundance from the samples collected, particularly the ones closer to waterbody or puddles. Due to the rainy season during the sampling period, the soil surface was moist and in some instances, waterlogged. Such condition has led to accumulation of bacteria on the soil 10 to 30 centimetres below the surface. Also found were isolates belonging to the *Ralstonia* species which are commonly found within the same environmental of *Burkholderia* species, and were previously categorized as the same genus as *Burkholderia.* It would be interesting in the future to ascertain the *Burkholderia* species population of the village in relation to the different weather and the ever-changing landscape of the village due to human activities. Genomic analysis of the bacterial isolates are underway to compare their characteristics to those found elsewhere.

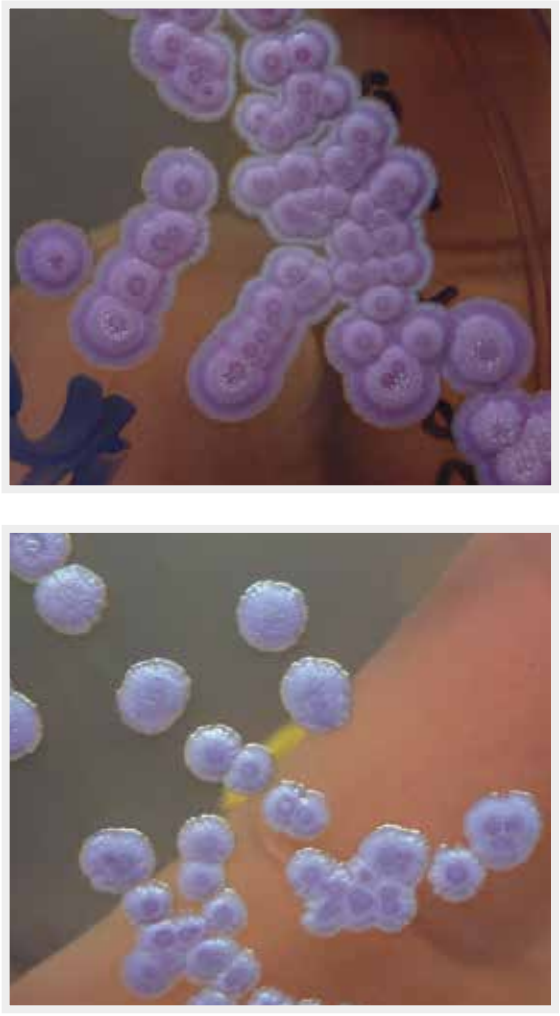

Figure 24.3. Colonies of *Burkholderia* species grown on Ashdown agar.

In addition to conducting environmental sampling around the village vicinity, as part of our effort in creating awareness, the villagers were given health education about melioidosis and other infectious diseases in general. They were also informed about the various modes of transmission of *B. pseudomallei* which causes melioidosis. Brochures about the disease were disseminated to households that we outreached to, many of whom have not heard of melioidosis.

While this expedition opened paths for future scientific discoveries in the field of molecular microbiology and transmission of infectious diseases, it also exhibits the importance of continuous health education among members of rural or semi-rural communities as part of a larger initiative in informing public health. It is important too for research translation to occur where scientific discoveries are translated into meaningful and practical actions that the communities involved can be part of.

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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 serves as a useful reference for the development and management of Bungo Range National Park, and the communities living surrounding the area.

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