FAUNA OF MALAYSIA

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WILDLIFE MANAGEMENT AND SUSTAINABILITY

PERHILITAN

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Foreword

I am glad to find that our researchers in Malaysia, from Peninsular Malaysia, Sabah, and Sarawak, are contributing to the writing of this book. This book is written based on diversity aspects of wildlife, management, and sustainability, and on integrating diverse species of flora and fauna in Malaysia. I believe that the scientific discoveries made through the collection and reporting of baseline data on flora and fauna have inspired all researchers including Malaysian and international researchers, to write this book. They had discovered more than they were looking for.

The publication throughout this book is the result of such collaborative work with 17 Malaysia agencies and bodies, and 8 international agencies such as the Department of Wildlife and National Parks (PERHILITAN) Peninsular Malaysia (PERHILITAN), the Sarawak Forestry Department, Malaysian Nuclear Agencies, and other national bodies such as UNIMAS, UMS, UM, UTHM, UKM, UniZA, UPM, USIM, and Cardiff University.

It thus gives me great pleasure to write the foreword to this informative books, which containing 25 chapters on various aspect of the diversity of wildlife related to management and sustainability throughout Malaysia. I congratulate all the authors for contributing to this informative book and I hope this books will be useful to all stakeholders and to those who remain connected through our reliance on conserving our wildlife.

YBhg Dato' Abdul Kadir Abu Hashim
Director General
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Preface

In 2020, Malaysia declared the complete extinction of the Sumatran rhinoceros (*Dicerorhinus sumatrensis*). As a tribute, this book has highlighted the front page of our lost iconic Sumatran rhino as a stark reminder for our future generations that time will judge us if we have done enough for our Malaysia wildlife.

This book also highlights the status, previous records, and general views of the Malaysian community about the extinction of the Sumatran rhino. In addition to the lessons learned from the extinction of this species, the content in this book also highlights the management and sustainability of other wildlife, consisting of flora and fauna found in Peninsular Malaysia and the Bornean islands of Sabah and Sarawak.

Serves as a guide for future generations of students, teachers, researchers, planners, managers, and also the public. The facts and figures are important for wildlife authorities to make informed decisions in order to sustain the wildlife existence and to prevent further extinction of large-sized species such as Malayan Tiger, Seladang, Sambar Deer, Tapir, Elephant, Siamang and Orangutans.

This book covers 25 manuscripts with a combination of diversity aspects of wildlife management and sustainability and integrating diverse species of flora and fauna such as gelam, local herbs, lichens. The fauna includes Sumatran rhinoceros, Proboscis monkey, Terrapin, Western tarsier and other species of non-human primates. In general, the chapter includes the legislation as well for forest manangement, managing human-wildlife conflict, and sustainable ecotourism development.

We hope the book series on fauna of Malaysia on wildlife management will be the major source of reference for students and teachers to understand the basic concepts and principles of ecology and environmental sustainability.

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8

DNA PROFILES OF LOCAL HERBS IN SARAWAK

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ABSTRACT

Many of the local herbs have commonly being used as folk medicines to treat among others; hepatitis, bronchitis, cough associated with pneumonia, jaundice, chest pain, snake bite, insect bite, rheumatism, anti-malaria and various stomach diseases. Some of these medicinal plants were shown to possess bioactive compounds against such as microbial activity, tumour activity, diabetic activity and diarrheal activity, which they have the potential to be explored in the production of novel drugs for pharmaceutical applications. Identification of the plants has been primarily based on morphology and similar looking plants may not be distinguished. A DNA profile can act as a signature for a particular plant species, whereby different species will have a different profile pattern. Hence, the profile can be used for identification and authentication of the plant species. Subsequently, it may be used as reference for pharmaceutical purposes. Variations within the plant species may also be detected by simply looking at the profile patterns. Three common local herbs, namely, *Elephantopus scaber*, *Ageratum conyzoides* and *Blumea balsamifera* are discussed. Their DNA profiles were generated using ISSR-PCR and RAPD-PCR.

Keywords: *Elephantopus scaber, Ageratum conyzoides, Blumea balsamifera,* ISSR-PCR, RAPD-PCR, DNA profiles, local herbs

INTRODUCTION

In various cultures worldwide, especially, in Asian countries, plants are being used in the traditional medicine since ancient time. Malaysia with its warm climate condition provides a hub for the growth of a diverse plant species, particularly, the plants with medicinal properties. *Elephantopus scaber* L, *Ageratum conyzoides* and *Blumea balsamifera* are among the plants which commonly used by the local people of Sarawak, East Malaysia in folk medicine. Medicinal plants as such are promising alternative medicine resources (Herbal Medicine) which have the potential to be developed as novel drugs for curing diseases as well as for pharmaceutical applications. All this while, identification of the plants has been primarily based on the morphology and it may not be accurate due to the environmental factors that may have effects on the growth and morphology of the plants (Viruel *et al.*, 2005). Two different plants may have a similar resemblance, however, they may have different active chemical compounds. The use of wrong plant in medicinal treatment may create different effects or the treatment may not be effective or may be fatal (Sekar *et al.*, 2007). Profiles generated using DNA markers may be used for accurate identifications.

DNA markers are reliable for informative polymorphisms as the genetic composition is unique for each species. Furthermore, the genetic composition is not affected by age, physiological conditions and environmental factors (Suslow *et al.*, 1999; Joshi *et al.*, 2004). Genomic DNA can be extracted from fresh or dried plants; hence the physical form of the plant sample does not restrict the detection (Joshi *et al.*,2004). Different species will have a different DNA banding pattern. Thus, it can act as a signature for a particular plant species which it can be utilised for identification and authentication of the plant. Subsequently, it can be utilised for future reference in pharmaceutical commercialisation of the medicinal plant. Level of variations within the plant species can also be detected by simply looking at the profile patterns. Thus, the DNA profiles of each fore-mentioned commonly found herb in Sarawak generated via Polymerase chain reaction (PCR)-based DNA marker system technique applying different microsatellite markers are presented along with other several aspects such as morphology, medicinal applications and bioactive compounds.

***Elephantopus scaber* Linn**

Elephantopus scaber L which belongs to the *Asteraceae* family is commonly known as prickly-leaved Elephant's foot or in Malay, Tutup bumi (Barnes & Chan, 1990). This common wild plant grows in shady places in tropical/subtropical conditions.It can easily be found by the roadsides, grass plots, grasslands, wasteland as well as in forest borders of altitude as high as 1500 m (Hammer & Johns, 1993; Ho *et al.*, 2009). Also, it can be cultivated in field (Hammer & Johns, 1993). This plant is a short, stiff and tufted herb which its stem can reaches up to 30 cm in height. The leaves of *E. scaber* L are variable in size and oblong shape (Barnes & Chan, 1990), generally grow at the base of the plant with white hairy like structure on top of the leaves and often very much notched on the margins (Barnes & Chan, 1990; Sankaranarayanan *et al.*, 2010). Its flowering heads formed in clusters at the terminal of the branches and usually enclosed by 3 leaf-like bracts (Sankaranarayanan *et al.*, 2010). The picture of this plant can be referred to Figure 1.

Figure 1: *Elephantopus scaber* L in Sarawak.

The roots, leaves and whole plant are commonly used in Asian countries such as China, India, Thailand, Japan, Indonesia and The Philippines to treat among others; hepatitis, bronchitis, cough associated with pneumonia, jaundice, chest pain, snake bite, insect bite, anti-malaria, diarrhea and various stomach diseases (But *et al.*, 1997; Singh *et al.*, 2005; Ichikawa *et al.*, 2006; Inta *et al.*, 2008). In Malaysia, decoction of *E.scaber* L root has been used to accelerate contraction of abdominal area and to prevent inflammation after birth (Ho *et al.*, 2009). Also, the whole plant is boiled with red bean to remove flatulence (Ong *et al.*, 1999). A number of studies have been conducted and major bioactivities of this plant based on its traditional applications were confirmed (Ho *et al.*, 2009).

Bioactive compounds of *E. scaber* L that were discovered include chromenes, benzofurans,cumarins, alkaloids, flavonoids,tannins, deoxyelephantopin, isodeoxyelephantopin and a germacranolide sesquiterpene lactone named scabertopin (But *et al.*, 1997; Quintero *et al.*, 1999; Liang *et al.*, 2002; Than *et al.*, 2005; Xu *et al.*, 2006; Mohan *et al.*, 2010). These bioactive compounds were reported to have anti-tumour activity (Quintero *et al.*, 1999; Rajkapoor *et al.*, 2002; Xu *et al.*, 2006) anti-microbial activity (Wiart *et al.*, 2002; Avani & Neeta, 2005), wound-healing property (Muthumani *et al.*, 2010), anti-diarrhoeal activity (Muthumani *et al.*, 2010), anti-inflammatory activities (Inta *et al.*, 2008), anti-diabetic activity (Dais *et al.*, 2009) as well as cardio tonic activity (Muthumani *et al.*, 2010). The consumption of *E. scaber* L products was also shown to help in preventing or treating some cardiovascular disorders such as thrombosis (Sankaranarayanan *et al.*, 2010).

DNA profiles generated were from several individual plant samples of three different districts of Sarawak, Malaysia, namely, Samarahan, Sematan and Tabuan Jaya. The genomic DNA of each sample was extracted from young leaves of the plant using extraction method with high percentage of sodium dodecyl sulfate (SDS) (Kikuchi *et al.*, 1998) with some modifications (Rosmawati *et al.*, 2013). The extracted genomic DNA was then subjected to ISSR-PCR which is a technique that uses microsatellites as a single primer PCR reaction targeting multiple genomic loci to amplify mainly the inter-simple sequence repeats motifs of different sizes (Reddy *et al.*, 2002). The microsatellite repeats used as primers can be in di, tri, tetra or penta nucleotides (Reddy *et al.*, 2002). It is a fast, simple, efficient technique and it has high reproducibility (Reddy *et al.*, 2002).

Furthermore, laboratory procedures can easily be applied to any plant species and it may reveal a much higher number of polymorphic fragments as the sequences of ISSR targets are abundant throughout the eukaryotic genome (Fang&Roose, 1997; Esselman *et al.*, 1999). Three different designed ISSR primers of di-nucleotide and one tri-nucleotide primer were applied in generating the DNA profiles (Rosmawati *et al.*, 2013). All the di-nucleotide primers were able to generate DNA profiles, whereas tri-nucleotide primer failed to generate DNA profile. This observation is probably due to the abundance of di-nucleotides present in this plant herb compared to the tri-nucleotides which are generally are less abundant in plants (Reddy *et al.*, 2002). In addition, ISSR primers with (CA), (GA), (CT), (AC), (TC) and (GA) repeats generally show higher polymorphism than primer with other di-, tri or tetra-nucleotide repeats (Reddy *et al.*, 2002). ISSR Primer 1 (Table 1) had successfully generated a total of five different amplicons for plant samples obtained from Kota Samarahan, whereas samples collected from Sematan and Tabuan Jaya both showed same DNA profile which three amplicons were detected (Figure 2). The size range of the amplicons was between 400 bp and 1,400 bp (Figure 2). Again, samples from Sematan and Tabuan Jaya shared same DNA profile pattern with only two amplicons produced with Primer 2 (Table 1).

However, a total of nine amplicons were observed in the profile of samples obtained from Kota Samarahan (Figure 3).

The size of the amplicons detected using this primer was in the range of between 300 bp 1,200 bp (Figure 3). Both profiles of samples from Kota Samarahan and Tabuan Jaya had the same profile with a total of nine amplicons generated using Primer 4 (Table 1) and samples from Sematan, in contrarily, showed a different pattern of profile with only three amplicons produced (Figure 4). Primer 4 had generated amplicons with the size range of between 300 bp and 1,200 bp and (Figure 4). Primer 3, however, failed to generate any DNA profiles for all the samples obtained from all locations.Different DNA profile patterns were observed for each ISSR primer used may indicate some level of variations within the plant species.The findings of ISSR study on eight natural *E. scaber* L populations from South China also indicated some variations within the plant species. The fragmented local environments as well as human disturbance suggested to play an important role in shaping the population structure of *E. scaber* L (Wang *et al.*, 2006) and variations within the plant species observed may be due to the mutation events (Reddy *et al.*, 2002).

Table 1: List of ISSR primers used.

Primer	Sequence	Nucleotide repeats
Primer 1	5' CACACACACACAAC 3'	di-nucleotide
Primer 2	5'CACACACACACAGG 3'	di-nucleotide
Primer 3	5'GTGGTGGTGGC3'	tri-nucleotide
Primer 4	5'GAGAGAGAGAGAGG 3'	di-nucleotide

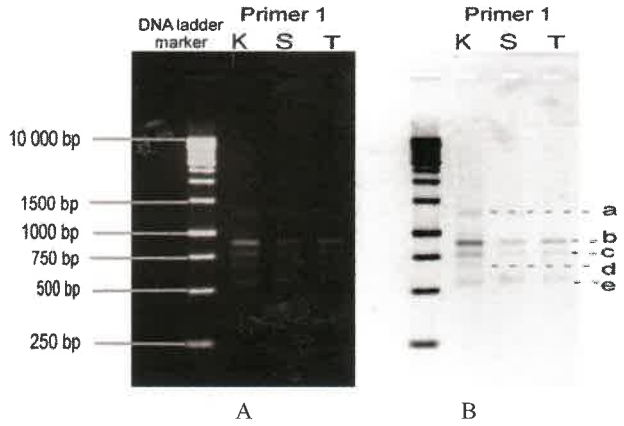

Figure 2:DNA profiles generated using ISSR primer 1. **A.** A 2% ethidium bromide stained agarose gel of DNA profiles. **B.** A reverse picture of the ethidium bromide stained gel picture of DNA profiles, Lanes: K - sample from Samarahan, S – sample from Sematan, and T – sample from Tabuan Jaya.

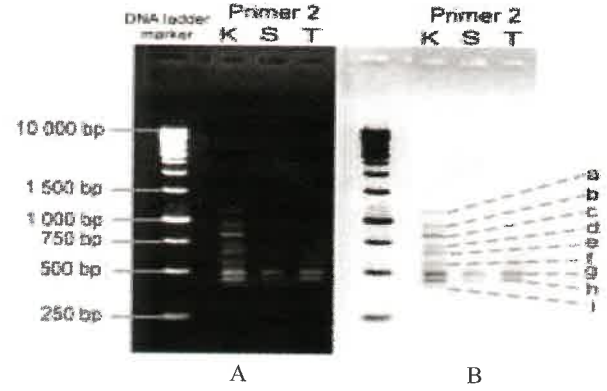

Figure 3:DNA profiles generated using ISSR primer 2. **A.** A 2% ethidium bromide stained agarose gel of DNA profiles. **B.** A reverse picture of the ethidium bromide stained gel picture of DNA profiles, Lanes: K - sample from Samarahan, S – sample from Sematan, and T – sample from Tabuan Jaya.

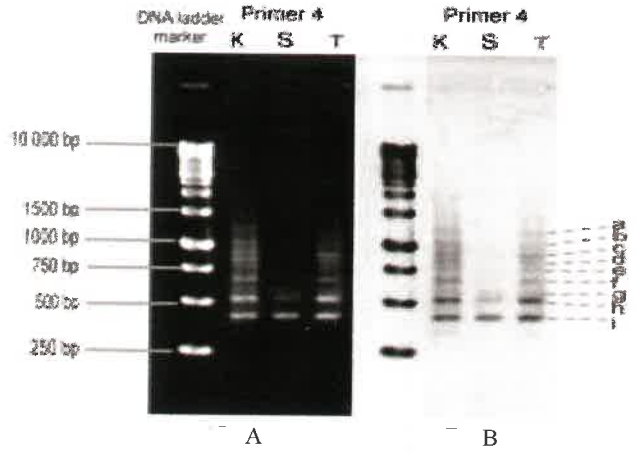

Figure 4:DNA profiles generated using ISSR primer 4. **A.** A 2% ethidium bromide stained agarose gel picture of DNA profiles. **B.** A reverse picture of the ethidium bromide stained gel picture of DNA profiles, Lanes: K - sample from Samarahan, S – sample from Sematan, and T – sample from Tabuan Jaya.

***Ageratum conyzoides* Linn**

Ageratum conyzoides L. is a plant that belongs to *Asteracea* family. It is a native plant in Central America and Caribbean and nowadays widespread in tropics and subtropics regions. Common names for *A. conyzoides* include goat weed, chick weed, tropical white weed, floss flower and to the locals in Malaysia it is known as "rumput tahi ayam". It is an annual branching plant which can grow up to 1 m in height (Shekhar & Anju, 2012). The flowers are white or bluish lavender in colour (Motooka *et al.*, 2003)

Figure 5 : *Ageratum conyzoides* L in Sarawak.

(Figure 5). It has a hairy stem. In some countries, *A. conyzoides* L is considered as weeds due to their growths that are highly abundant and difficult to control (Ming, 1999).

Due to its bad odour, it is not eaten by man. Nevertheless, the whole plant is used only for medicinal purposes and has a long history in folk medicine of varying countries. It is used in various parts of Africa, Asia and South Africa (Shekhar & Anju, 2012). The applications of the plant include in treating diarrhea, pneumonia, spasm, fever, to heal burns and wound (Ming, 1999). In Malaysia, it is used to treat dysentery, boil and poultries (Tropical Plant Database: *Ageratum conyzoides* 1996). It also has been used as a tea for diabetic patients and pneumonia (Ming, 1999).

A. conyzoides L is rich in polyoxygenated flavanoids which 21 of them were reported in the whole plant (Shekhar & Anju, 2012). Other range of bioactive compounds that were found in the plant includes chromenes, benzofurans, cumarins, alkaloids, flavanoids, tannins and isoflavone. These compounds were shown to possess antibacterial property such as against *Staphylococcus aureus*, *Klebsiella pneumonia* and *Basillus subtilus*, fungicidal property, antioxidant activity, wound healing property and antihyperglycaemic (Tropical Plant Database: *Ageratum conyzoides,* 1996; Okwori, 2007).

DNA profiles generated were from several individual plant samples of four different locations in Sarawak; Rantau Panjang, Samarahan, Matang and Kuching. The genomic DNA of each sample was extracted from the leaves of the plant using sodium dodecyl sulfate (SDS) with some modifications (Rosmawati &Siti Izyan, 2012). The extracted genomic DNA was then subjected to RAPD-PCR which is a method that based on the amplification of random DNA segments using single ten-base synthetic DNA arbitrary primers (Welsh, 1991). No prior knowledge of the organism's DNA sequences is required (Williams, 1990). It is a simple, rapid and sensitive technique that requires lower concentration of DNA samples (Williams, 1990). This technique has been successfully used for identification of plant species which include herbs and determination of the genetic variation level of plant species (Cheng, 2000; Li, *et al.*, 2004).Eight decamer RAPD primers (1st BASE Inc) were screened in the *A. conyzoides* L samples (Rosmawati& Siti Izyan, 2012). However, only one primer (OPB08) has successfully generated DNA profiles for all samples from the four locations. All the plant samples showed a similar DNA banding pattern which may indicated that there is no variation within the plant species despite different locations of the samples obtained. Three distinct amplicons were observed with the size range of between about 900 bp and about 1200 bp (Figure 6).

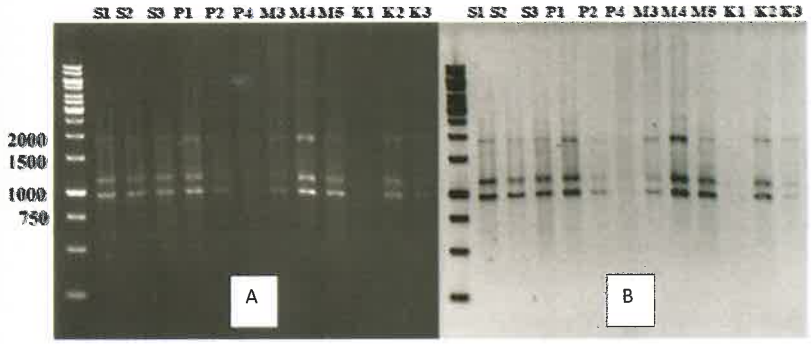

Figure 6: DNA profiles generated using RAPD primer OPA05. **A** . A 1.5% ethidium bromide stained agarose gel picture of DNA profiles. **B**. A reverse picture of the ethidium bromide stained gel picture of DNA profiles, Lanes: S - sample from Samarahan, P – sample from Rantau Panjang, and M – sample from Matang, K-sample from Kuching.

***Blumea balsimifera* D.C.**

Blumea balsamifera D. C. belongs to the family of *Asteracea*e that are commonly found on newly cleared land, gardens along the roadside, fields, lowland and mountainous regions. It sometimes grows at wet places at the river bank. It can be found in India, Myanmar, South China, Taiwan, Thailand, Malaysia, Indonesia and Philippines. This plant is a course, tall, erect and halfwoody which can grow between 1.5 to 3 meters in height. It is a strong aromatic herb and all parts of the plants are covered with a velvety texture. The leaves are elliptic to oblong-lanceolate in shape, 7 to 20 centimeters long, toothed at the margins, pointed blunt at the tip, and narrowed to the short petiole, which is often auricled or appendaged.The flowering heads are stalked and yellow in colour (Herbal Medicine).

In Malaysia, *Blumea balsamifera* leaves (Figure 7) are used as a lotion to treat beri-beri, lumbago, rheumatism, bathing a woman after childbirth, and skin conditions in children. The crushed leaves are applied to heal wounds and to stop bleeding, to treat stomachache and headache (Perry, 1980; Wiart, 2002). Also, the leaves are eaten with betel to ease the pain in the region of the heart (Perry, 1980).

Blumea balsamifera was shown to possess eleven flavanoids among others are quercetin, rhamnetin, luteolin, L-ascorbic acid and blumeatin. The findings suggested that flavanoid contents of different solvent extracts of the plant leaves were resposible for its anti-oxidant properties (Fazilatun, 2004). This plant was also shown to have two types of antioxidants, namely, butylated hydrotoluene (BHT) and butylated

hydroxyanisole (BHA) (Fazilatun *et al.*, 2002). Blumeatin was shown to help in protecting against liver injuries cause by CC14 and thioacetamide (Xu *et al.*, 1993). Essential oil of the leaves were shown to exhibit antifungal activity, antibacterial activity, partcularly, against *Staphylococcus aureus* which indicated the potential use as an antiseptic (Wang & Yu, 2018).

A B

Figure 7: A. *Blumea balsamifera* in Lundu. **B**. *Blumea balsamifera* in Samarahan

Leave samples of *Blumea balsamifera* collected from three divisions of Sarawak, Malaysia, namely, Samarahan, Matang and Lundu were used in generating the DNA profiles. As this plant was known to have high contain of phenolic compound (Fazilatun *et al.*, 2002), high polyvinylpyrolidone (PVP) extraction protocol by Kim *et al.* (1997) with some modifications was applied in extracting high quality of DNA (unpublish). The ISSR-PCR reactions performed were based on the procedure described by Yin *et al.*(2002) with some modifications (unpublish). All samples from all divisions exhibited the same pattern of DNA profile with a total of three amplicons (Figure 8). The smallest size of amplicon was observed to be 700 bp and the other two amplicons generated were above 1000 bp.

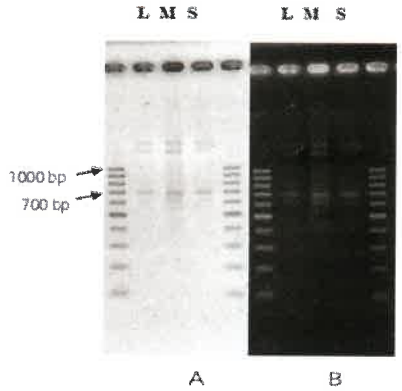

Figure 8: DNA profiles generated using ISSR Primer 1. **A.** A 1.5% ethidium bromide stained agarose gel picture of DNA profiles. B. A reverse picture of the ethidium bromide stained gel picture of DNA profiles, Lanes: S - sample from Samarahan, L – sample from Lundu and M – sample from Matang.

CONCLUSION

DNA profiles generated using ISSR-PCR approach for *Elephantopus scaber* L obtained from three districts in Sarawak (Samarahan, Sematan and Tabuan Jaya) showed two different DNA banding patterns which may indicate variation within the species. Whereas for *Blumea balsamifera,* asimilar ISSR-DNA profile was obtained for plants collected from Samarahan, Matang and Lundu, Sarawak. A total of three amplicons were observed with the smallest size of amplicon was 700 bp and the other two amplicons were above 1000 bp. *Ageratum conyzoides* L plants collected from Rantau Panjang, Samarahan, Matang and Kuching exhibited the same pattern of DNA profile with the total of three distinct amplicons (size range of between about 900 bp and about 1200 bp) when using RAPD primers.

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ABOUT EDITORS

Madinah Adrus is an academician of the Animal Resource Science and Management Programme at the Faculty of Resource Science and Technology, Universiti Malaysia Sarawak (UNIMAS), Malaysia. She has a Master of Science and doctorate in Zoology from UNIMAS and interested in wildlife parasitology (ecto and endo parasites) as a model of studies in order to contribute to a basic understanding of the way our biological world functions. She has experience in conducting research on host-parasites association relating their impact on human and ecosystems and has published several refereed journal and book chapters. She has also been an expert on parasitological analysis regarding ectoparasites on small mammals and endoparasites on non-human primates in Malaysia since her masters degree and Ph.D studies related to that area.

In a distinguished career spanning three decades, **Dato' Abdul Kadir bin Abu Hashim** commenced his service with the Department of Wildlife and National Parks (PERHILITAN) Peninsula Malaysia in April 1992. He has held various roles within PERHILITAN, including Research Officer, Chief of Taman Negara Pahang, Director of PERHILITAN State of Perak, and Chief of Enforcement Division before assuming the position of Director-General of PERHILITAN in August 2016.

He is an alumnus of the University Putra Malaysia, Serdang, Selangor, having obtained his Bachelor's degree in Forestry Management in 1990. In 2000, he completed his postgraduate studies, earning a Master of Science in Conservation and Biodiversity from The University of Leeds, United Kingdom. Over his extensive 30-year career, he has amassed a wealth of experience and expertise in the field of wildlife research, particularly specialising in research related to the Sumatran Rhino. Furthermore, he has been actively engaged in conducting wildlife inventories and joint enforcement operations with other enforcement agencies throughout Peninsular Malaysia.

One of his significant contributions to enforcement was as the catalyst for an unofficial joint enforcement operation with the Malaysian Armed Forces (ATM) known as Ops Jelai, commencing in 2006. This operation was aimed at curbing incursions by foreign nationals from Thailand, Vietnam, Cambodia, and Myanmar, who were frequently trespassing into our forests to steal valuable resources such as agarwood and engage in wanton wildlife poaching within our National Parks and Wildlife Reserves. Building on the successes of Ops Jelai, in January 2014, the official 1Malaysia Biodiversity Enforcement Operation Network (1MBEON) was launched in collaboration with the ATM to enhance enforcement efforts aimed at preventing encroachments and the illegal extraction of the nation's biodiversity treasures by foreign nationals within our National Parks.

On the 21 July 2019, Dato' Abdul Kadir Abu Hashim delivered his inaugural public lecture on wildlife conservation and management as Visiting Professor, Universiti Malaysia Terengganu. Recently in 2023, Dato' Abdul Kadir Abu Hashim was being

Muhamad Aidil Zahidin graduated with and MSc and BSc in Zoology from the Universiti Malaysia Terengganu (UMT) and the Universiti Malaysia Sarawak (UNIMAS). He has a keen research interest in human and non-human primates, especially in their biogeography, ecology and molecular genetics. His last work on Orang Asli's genetics allowed him to understand the extent of prehistoric migrations and the peopling of Southeast Asia. He has also been involved in scientific expeditions and published the findings in books, book chapters, indexed journals and a local magazine. Presently, he is a Ph.D. candidate at the Universiti Sains Malaysia (USM) Health Campus and researches molecular haematological disease.

Muhammad Abdul Latiff Abu Bakar is an Associate Professor at the Faculty of Applied Sciences and Technology (FAST) at Universiti Tun Hussein Onn Malaysia. He holds a PhD from UniversitiKebangsaan Malaysia (UKM) in the areas of primatology, conservation biology, and genetics. His current research focuses on Next Generation Sequencing, particularly metagenomics, mitogenomics, and eDNA for wildlife. Additionally, he is interested in the fields of ethnobiology and molecular ethnozoology, particularly in exploring the relationships between humans and wildlife in Malaysia.

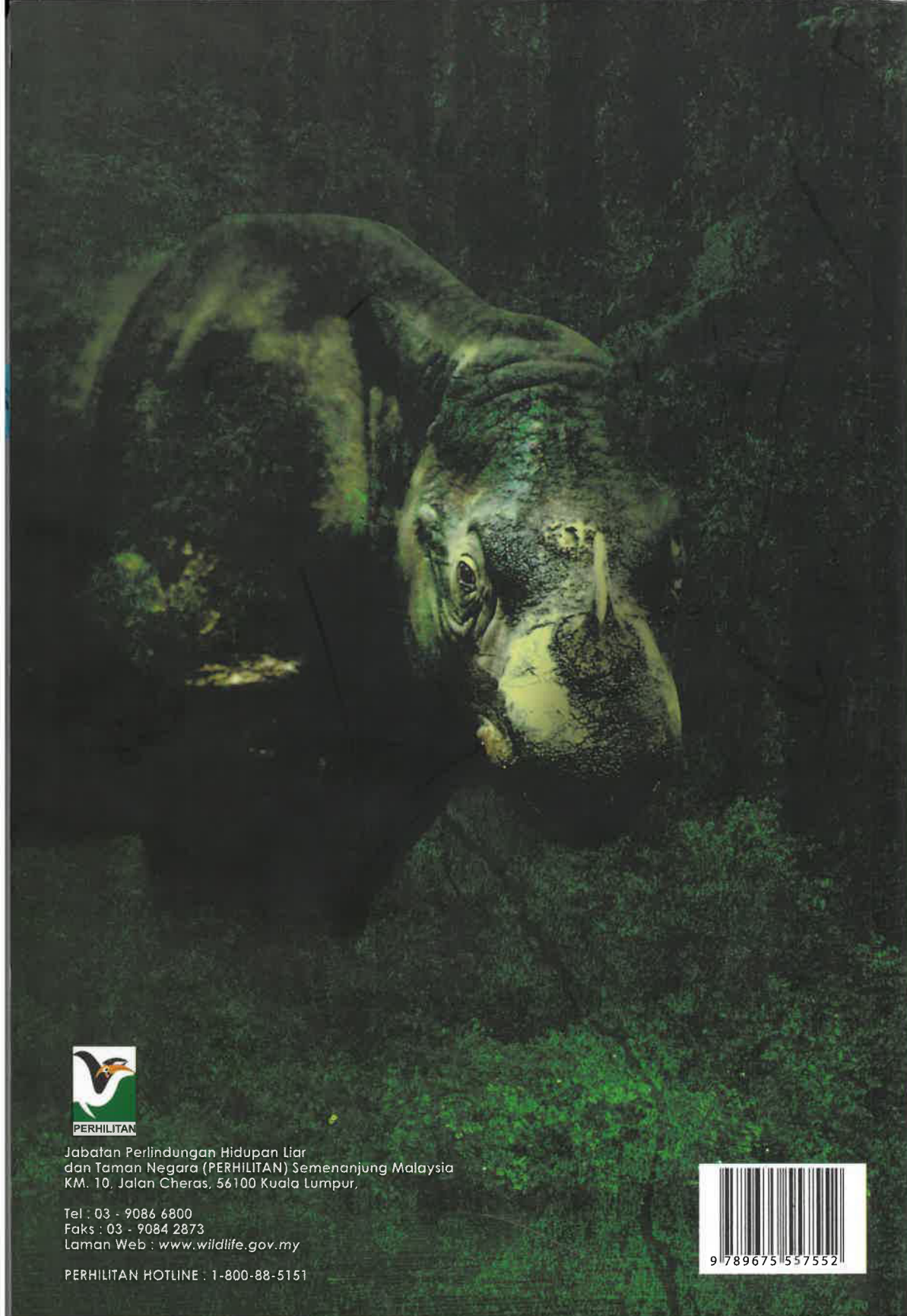
Mohd Tajuddin Abdullah graduated from the Institute Teknologi MARA with a diploma and pursued further studies at West Virginia University, where he earned an MSc in Wildlife Management. He then went on to the University of Queensland, where he earned a PhD in Zoology. He has nearly four decades of experience in the field, teaching, and supervising postdoctoral, PhD, MSc, and BSc research projects at UMT, UPM, and UNIMAS. He is also a fellow of the Academy of Science Malaysia and has been awarded the DIMP for his significant contributions to the discovery of knowledge that is useful to science and society. He won three National Book Awards in 2017, 2019, and 2021.

Summary

This book is a complete guide to the wildlife of Malaysia. It has contributions from 17 local and 8 international agencies. Learn about the diverse species of flora and fauna found in Peninsular Malaysia, Sabah, and Sarawak and the scientific discoveries made through the collection and reporting of baseline data. With 25 chapters covering topics such as wildlife management, sustainability, and legislation, this book serves as a guide for students, researchers, policymakers, and wildlife authorities to make informed decisions and prevent further extinction of large-sized species such as the Malaysian Tiger and Orang Utan.

This book also highlights the impact of human activities on wildlife, including the devastating extinction of the Sumatran Rhinoceros. A tribute to this lost iconic species, the book features the front page of the Sumatran Rhinoceros as a stern reminder for future generations to conserve Malaysia's wildlife. Through lessons learned from the extinction of this species, the book provides insights on sustainable ecotourism development, managing human-wildlife conflict, and habitat protection.

With a focus on diversity and sustainability, this informative book is a must-read for anyone interested in the conservation and preservation of Malaysia's unique and diverse wildlife. From gelam and local herbs to non-human primates, readers will learn about the wonders of Malaysia's flora and fauna and how to care for and protect these species for future generations.



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