UNIVERSITI PUTRA MALAYSIA

DIVERSITY OF LIMESTONE ORCHIDS IN CENTRAL AND NORTHERN PADAWAN, KUCHING, SARAWAK

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FS 2008 14

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MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

2008

DIVERSITY OF LIMESTONE ORCHIDS IN CENTRAL AND NORTHERN PADAWAN, KUCHING, SARAWAK

By

MICHAEL LIM YEE LIANG

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

Jan 2008

I certify that an Examination Committee has met on 11 January 2008 to conduct the final examination of Michael Lim Yee Liang on his Master of Science thesis entitled "Diversity of Limestone Orchids in Central and Northern Padawan, Kuching, Sarawak" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the degree of Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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Date: 19 February 2008

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

DIVERSITY OF LIMESTONE ORCHIDS IN CENTRAL AND NORTHERN PADAWAN, KUCHING, SARAWAK

By

MICHAEL LIM YEE LIANG

Jan 2008

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Sarawak is situated in the north-west of Borneo, which is the largest state in Malaysia. Limestone hills and mountains are a natural landmark in parts of Sarawak and Padawan Formation is the largest outcrop in Sarawak. Padawan area is located at the south-west part of Kuching District and limestone hills are mostly of the wet type. The favourable climate and various forms of microhabitat strongly enhance the richness and diversity in the composition of limestone orchids in Padawan, especially rare and endemic species. Nonetheless, the Padawan orchid is poorly known due to the very few specific literature made and most of the documentations in field have not been published. This study is an attempt to document the orchid diversity in limestone areas not covered in the previous study by Phoon (2004). From this study, a total of 94 taxa in 36 genera from 4 subfamilies of orchids on 14 limestone hills and one riverbank from northern to central part of Padawan Limestone Area were recorded and botanized. A total of 25 taxa and one genus are new records for Padawan Formation. Out of these, eight taxa are new records for Sarawak and one taxon is a new record for Malaysia. *Bulbophyllum reticulatum* and *Paphiopedilum stonei* are endemic to Sarawak; whilst, *B. longiflorum*, *B. reticulatum*, *Cleisostoma discolor*, *C. nieuwenhuisii*, *Dossinia marmorata*, *P. stonei*, *Phalaenopsis cochlearis***,** *Trichoglottis winkleri var. minor* and *Vanda scandens* are limestone endemic species. Discussions were based upon two main aspects: (i) floristic diversity significance, for analyzing species diversity and morphological diversity of Padawan orchids; and (ii) the geographical significance, for conferring the diversity patterns of Padawan limestone orchids distributed in different places and endemism. The Orchidaceae of Padawan principally comprised the Bornean element at the generic and species level given its geographical, geological, climatic and floristic proximity. Gunung Bekap, Gunung Mentawa and Gunung Timurang covered the most diverse amount of orchid species together with those rare and endangered species. Therefore, they have to be conserved broadly by implementing *in situ* conservation techniques.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

DIVERSITI ORKID BATU KAPUR DI BAHAGIAN TENGAH DAN UTARA PADAWAN, KUCHING, SARAWAK

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Sarawak terletak pada bahagian barat laut Borneo, yang merupakan negeri terbesar di Malaysia. Kawasan bukit dan gunung batu kapur adalah satu simbol semulajadi tempatan di bahagian Sarawak dan Formasi Padawan merupakan kawasan batu kapur yang paling besar di Sarawak. Kawasan Padawan terletak di bahagian barat daya Daerah Kuching dan bukit-bukau batu kapur yang terkandung dalam kawasan Padawan kebanyakannya ialah batu kapur basah. Iklim yang sesuai dan kewujudan pelbagai bentuk mikro-habitat banyak mendorong kepada kekayaan dan kepelbagaian komposisi orkid batu kapur di Padawan, terutamanya spesies yang jarang ditemui dan endemik. Walau bagaimanapun, orkid Padawan tidak banyak diketahui kerana hanya sedikit catatan spesifik yang dibuat dan kebanyakan dokumentasi di lapangan tidak diterbitkan. Kajian ini merupakan usaha bagi mendokumentasikan kepelbagaian orkid di kawasan batu kapur yang belum diterajui oleh Phoon (2004) pada kajian yang lepas. Daripada kajian ini, sebanyak 94 taksa orkid dalam 36 genera daripada empat subfamili yang terdapat pada 14 kawasan bukit batu kapur dan satu sungai dari bahagian utara hingga ke tengah Kawasan Batu Kapur Padawan telah direkod dan ditinjau. Sebanyak 25 taksa dan satu genus adalah rekod baru bagi Formasi Padawan. Lapan taksa daripada jumlah tersebut merupakan rekod baru bagi Sarawak dan salah satu taksa daripadanya adalah rekod baru bagi Malaysia. *Bulbophyllum reticulatum* and *Paphiopedilum stonei* ialah spesies endemik kepada Sarawak manakala *Bulbophyllum longiflorum*, *Bulbophyllum reticulatum*, *Cleisostoma discolor*, *Cleisostoma nieuwenhuisii*, *Dossinia marmorata*, *Paphiopedilum stonei*, *Phalaenopsis cochlearis*, *Trichoglottis winkleri var. minor* and *Vanda scandens* merupakan spesies endemik kepada kawasan batu kapur. Perbincangan mengenai dua aspek utama: (i) kepentingan kepelbagaian floristik, untuk menganalisis kepelbagaian spesies dan kepelbagaian morfologi bagi orkid Padawan; dan (ii) kepentingan geografi, untuk membincangkan corak kepelbagaian bagi orkid batu kapur Padawan bertaburan di tempat-tempat yang berlainan serta pasal endemik telah dilakukan. Famili orkid di Padawan kebanyakannya berasaskan elemen Bornean pada aras genus dan spesies dari segi hubungan geografi, geologi, iklim dan floristik. Gunung Bekap, Gunung Mentawa dan Gunung Timurang mengandungi kepelbagaian spesies

orkid yang terluas serta spesies yang mengalami risiko kepupusan dan jarang dijumpai. Justeru, ketiga-tiga gunung tersebut perlu dipulihara secara menyeluruh dengan perlaksanaan teknik pemuliharaan *in situ*.

ACKNOWLEDGEMENTS

Praise and thanks be to God in the highest.

First of all, the author would like to express the deepest appreciation to his supervisor, Assoc. Prof. Dr. Rusea Go for her appropriate suggestions, continuous guidance, unselfishly encouragement, invaluable advice and earnest concern, who also assisted to edit this paper and share her vast taxonomical and botanical understanding all over this study.

Secondly, the author's thanks goes to Dr. Faridah Qamaruz Zaman as internal co-supervisor, not only made watchful corrections for the author during the inspection of this work, but also aiding and advising the author whenever he met difficulties throughout this study; and The Deputy Manager of Sarawak Forest Research Centre, Mr. Julaihi Abdullah, as external co-supervisor, who had provided the author the transportation comprehensively to execute and complete the collections of specimens in the field as well as given priceless effort and explanation in compiling this paper.

Members of the Sarawak Forest Research Centre also helped in the study, especially in guiding the field works and providing the essential and relevant information no matter inside or outside the field. The author wishes to acknowledge the hard work and proficiency of Madam Lucy, Madam Runi, Mr. Chan, Mr. Awang, Mr. Atak, Mr. Dino and those whose name are forgotten.

The author should like to acknowledge the sponsorship of Yayasan Sarawak Tunku Abdul Rahman Scholarship (YBSTAR) during the period of this study.

The author would like to thank Dr. Philip Cribb, Dr. John Beaman, Dr. Ruth Kiew and Dr. Jaap Vermeulen for their sincere guidelines and assistance in identifying a number of the specimens.

The honest gratitude is expressed too to the following authorities: Sarawak Research Centre Herbarium (SAR), Singapore Herbarium (SING), Universiti Putra Malaysia Biological Herbarium (UPM), University Malaya Herbarium (KLU), Universiti Kebangsaan Malaysia Herbarium, Bangi (UKMB), State Library of Sarawak, Malaysian Meteorological Department of Kuala Lumpur, Malaysian Meteorological Service of Petaling Jaya and Mineral and Geoscience Department of Kuala Lumpur. They had supplied direction in examination of the herbaria specimens as well as provided significant data.

Without the truthful helping hands from lab assistants: Kak Latifah, En. Azman and En. Arif, together with the supports and cheerfulness from his seniors: Phoon, Claysius,

Qutub, Joe, Wendy, Yet Han, Lea Yen, Loh Ming and Tang, the author might not be able to accomplish and conclude his study.

Perhaps most importantly, the author feels grateful for having his most beloved parents, brother, and all his friends especially Sin Ling, Meng Han, Jap Meng, Alvin, Swee Chiang, Leslie and Lip Nam. They are undeniable in giving him the courage, prayer, moral support and accompanying him most of the times since the project study started.

Last of all, the author would like to show appreciation for those who might not particularly named.

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LIST OF ABBREVIATIONS

asl.	Above sea level
c.	Approximately
cm	Centimeter
G.	Gunung (Hill)
ha	Hectare
km	Kilometer
Kpg.	Kampung (Village)
m	Meter
mm	Milimeter
^{o}C	Degree Celsius
pers. comm.	Personal communication
Sg.	Sungai (River)
sq km	Square kilometer
—	To
x	Times

LIST OF COLOUR PLATES

CHAPTER I

INTRODUCTION

The orchid family (Orchidaceae) is a very large group of plants mainly distributed in tropical and subtropical regions. Some of its members also thrive in temperate areas and even extend to alpine and artic regions. The plants of various forms produce many pretty and attractive flowers that have enjoyed world wide fame (Horng, 1975) .The third largest island in the world, Borneo, is a center of diversity of orchid, which consists of 10% of the world's orchids, equivalent to 2500-3000 orchid species. However, only 30-40% is endemic to Borneo Island (Lamb, 1991).

The word "orchid" is a derivation of the Greek *orchis*, meaning *testis*, in reference to the testiculate bulbs or tubers with which the particular plants of those Mediterranean regions were furnished (Reinikka, 1972). Orchids are commonly divided into only two groups, despite all their apparent differences. Those that grow on the ground are called "terrestrials." They are earth dwellers, which sink their roots into the soil and shoot up like ordinary plants (Martin, 1974). About half of the world's total species are terrestrial, but most of the remainder, all tropical or subtropical, is "epiphyte". Epiphytes grow in elevated positions on trees and rock cliffs. They do not take food from the tree on which they grow, but merely use it as a platform for exposure to the sun.

Sarawak is one of the most important centers of plant diversity in the world and also the largest state in Malaysia with an area of approximately 124,449sq km, which accounts for about 37.5% of Malaysia in terms of size. Limestone areas in Sarawak are widespread and rich in orchid species. There are only 40 genera of orchids endemic to limestone although 150 genera and around 901 species are found in Sabah and Sarawak (Wood and Cribb, 1994). However, not many specific studies have been carried out on limestone orchids especially in Padawan, Kuching, Sarawak. In addition, no specimens had been collected before this study, even though there are many rare and endemic orchids in the limestone areas at Padawan. The main factors hindering botanizing in these areas are the dangers of rock climbing, poisonous insects and snakes, as well as difficulties of assessment in limestone forests. Furthermore, the numbers of plant taxonomists in Malaysia are extremely inadequate as we are now having less than 10 taxonomists actively working on our mega biodiversity (The News Strait Times, 2002). Hence, this study aims to acquire more knowledge and baseline species data on the diversity of limestone orchids in Padawan.

Limestone habitats have been rapidly disturbed due to the uncontrolled human activities such as traditional farming system and agriculture practices, uncontrolled logging activities, non-stop quarrying activities and illegal collections of orchids. These will bring negative impacts and finally may cause extinction of the orchids. As a precaution, conservation on limestone orchids must be emphasized continuously.

To date, less than 10% of the total limestone hills in Padawan have been botanized (area where botanical work has been carried out) and studied comprehensively.

OBJECTIVES

The objectives of this study are:

1. To investigate diversity of limestone orchids in selected hills in Padawan Limestone, Sarawak, in terms of species number, towards proper and scientific documentation.
2. To reevaluate macro-morphological characters of the collected limestone orchids, adding to the existing taxonomic data and identification keys.
3. To investigate diversity of limestone endemic species and Sarawak endemic and endangered species in Padawan Limestone Area.

CHAPTER II

LITERATURE REVIEW

Sarawak, Kuching and Padawan

Sarawak is situated in the north-west of Borneo, between 0°50’ to 5°10’N latitude and 109°35’ to 115°40’E longitude, borders Brunei, Sabah and Kalimantan, Indonesia. It is the largest state of Malaysia covering an area of 124,450 sq km with a coastline 720 km in length which accounts for about 37.5% of the area of Malaysia. Its highest point is Gunung Murud, 2,438 m, and it also has the longest river in Malaysia, Batang Rajang, which stretches over 640 km (Chin, 1997).

Sarawak is a tropical area with an equatorial climate. It is hot and humid throughout the year with mean daily temperatures ranging from 23^{o}C during the early hours of the morning to 32^{o}C during the day. It experiences two monsoonal changes. The West Coast East Monsoon, which usually occurs between November to February, brings with it heavy rainfall. The South West Monsoon is usually less wet. Except for monsoonal changes, the climate remains fairly stable throughout the year. Sarawak, with an average rainfall varying between 330 cm to 460 cm for the greater part of the country, is an expansive network of rivers, rainforests, mangroves, swamp forests, mountains and has the world’s oldest limestone caves (Burgers *et al.*, 1991; Julaihi, 2001).