DIVERSITY OF LIMESTONE ORCHIDS IN PADAWAN, SARAWAK

By

PHOON SOOK NGOH

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

September 2004
DEDICATION

This thesis is dedicated to my supervisors, Assoc. Prof. Dr. Rusea Go, Dr. Faridah Qamaruz Zaman and Assoc. Prof. Dr. Saleh Kadzimin. Much of the results and discussions in this thesis would be but uncut diamonds without their expertise.

I also dedicated this thesis to my beloved family. There is no way to overstate the importance of their love and support.
DIVERSITY OF LIMESTONE ORCHIDS IN PADAWAN, SARAWAK

By

PHOON SOOK NGOH

September 2004

Chairman: Associate Professor Rusea Go, Ph.D.

Faculty: Science and Environmental Studies

Padawan Formation is the largest outcrop in Sarawak. However, little botanical work has been done. Many of the collections are unpublished. Therefore, the orchid flora in Padawan is poorly known. Nine limestone hills and two rivers in the northern part of Padawan Formation have been botanized in this study. A total of 148 taxa in 47 genera from 3 subfamilies were recorded. A total of 43 taxa and 10 genera are new records for Padawan. Bulbophyllum reticulatum, Cleisostoma discolor, Dendrobium truncatum, Dossinia marmorata, and Paphiopedilum stonei are recognised as endemic species of limestone area; whilst, Bulbophyllum reticulatum, and Paphiopedilum stonei are recognised as endemic species in Sarawak. There are three outstanding features of the Orchidaceae of Padawan: (i) consists of Asian and Papuasia elements at the generic level and Bornean element at the species level; (ii) morphological diversity, a prima fascia indication of the rich floristic composition of the limestone area; and (iii) small size of genus, species in small populations. Gunung Bekap, Gunung Mangan and Gunung Timurang, stand out for in-situ conservation because they comprise the most diverse
orchid species. They are also home to endangered and rare species like *Dossinia marmorata*, *Paphiopedilum lowii* and *Paphiopedilum stonei*. 
Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

DIVERSITI ORKID BATU KAPUR DI PADAWAN, SARAWAK

Oleh

PHOON SOOK NGOH

September 2004

Pengerusi: Professor Madya Rusea Go, Ph.D.

Fakulti: Sains dan Pengajian Alam Sekitar

gunung yang paling sesuai untuk pemuliharaan in situ sebab ketiga-tiga gunung ini mempunyai kepelbagaian spesies orkid yang paling luas. Ketiga-tiga gunung ini juga mempunyai spesies yang dalam bahaya kepupusan seperti Dossinia marmorata, Paphiopedilum lowii and Paphiopedilum stonei.
ACKNOWLEDGEMENT

I would like to express my deep appreciation to:

My supervisor, Assoc. Prof. Dr. Rusea Go:
Thank you so much for your understanding and wise counsels.

My co-supervisors, Assoc. Prof. Dr. Saleh Kadzimin and Dr. Faridah Qamaruz Zaman:
Thank you for careful corrections and I really appreciate your input and comments.

The Malaysian Government departments
Malaysian Agriculture Department Kuala Lumpur, Sarawak Forestry Research Centre,
Mineral and Geoscience Department Kuala Lumpur, Mineral and Geoscience Department
Kuching, Statistics Department Sarawak, Malaysian Meteorological Department Kuala
Lumpur and Library of Sultan Abdul Samad, UPM:
Thank you so much for your helping hand.

The Herbaria
Herbarium of Sarawak Research Centre (SAR), Herbarium of Universiti Kebangsaan
Malaysia (UKMB), Herbarium of Universiti Malaya (KLU), Herbarium of FRIM (KEP)
and Herbarium of Singapore (SING):
Thanks for giving me so much guidance in checking the herbaria specimens.

Mr André Schuiteman:
Thank you so much for the excellent discussion guide.

Dr. Jaap J. Vermeulen, Dr. Edward de Vogel, Dr. Philip Cribb, Dr. John Beaman, Mr.
Tony Lamb, Dr. Finn N Rasmussen and Dr. Hanne N. Rasmussen:
Thanks for invaluable opinions and suggestions.

Kak Pak and Abang Man:
Thank you for being such a wonderful assistant in the Biology herbarium.

My fellow buddies in Biology Herbarium, UPM
Joe, Q-tub, Clay, Yet Han, Wendy, Lea Yen, Tang, Mike, Christina:
Thank you for the fun times in herbarium.

Drina and Choon Kit:
A special salute to both of you. Thanks for your prayer and love. Cheer for faithful
friendship.

My family:
Next to God’s grace, all of you are the best gifts to me. Thanks for loving me as who I
am.
I certify that an Examination Committee met on 17th September 2004 to conduct the final examination of Phoon Sook Ngoh on her Master of Science thesis entitled “Diversity of Limestone Orchid in Padawan, Sarawak” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

**Rusea Go, Ph.D.**
Associate Professor
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia
(Chairman)

**Examiner 1, Ph.D.**
Professor
Faculty
Universiti
(Member)

**Examiner 2, Ph.D.**
Professor
Faculty
Universiti
(Member)

**Independent Examiner, Ph.D.**
Professor
Faculty
Universiti
(Independent Examiner)

__________________________________
GULAM RUSUL RAHMAT ALI, Ph.D.
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia
Date:
This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisor Committee are as follows:

**Rusea Go, Ph.D.**
Associate Professor
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia
(Chairman)

**Faridah Qamaruz Zaman, Ph.D.**
Doctor
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia
(Member)

**Saleh Kazimin, Ph.D.**
Associate Professor
Faculty of Agriculture,
Universiti Putra Malaysia
(Member)

____________________________________

**AINI IDERIS, Ph.D.**
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:
DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_________________________
PHOON SOOK NGOH

Date:
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEDICATION</td>
<td>ii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>vii</td>
</tr>
<tr>
<td>APPROVAL</td>
<td>viii</td>
</tr>
<tr>
<td>DECLARATION</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF PLATES</td>
<td>xix</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xxiii</td>
</tr>
</tbody>
</table>

## CHAPTER

### I INTRODUCTION

1

### II LITERATURE REVIEW

- Classification of Sarawak Orchids
  3
- Diversity and Limestone Endemic
  4
- Legislative Protection and Conservation of Sarawak Orchids
  8
- Threats in Padawan Formation
  16

### III LOCALITY AND METHODS

- Sarawak and Padawan
  18
- Present Status of Knowledge on Sarawak Orchid
  23
- Area Covered
  25
- Field Collections
  26
- Herbarium Techniques
  27
- Conservation Approaches
  28
- Species Identification and Enumeration
  28

### IV RESULTS

- Orchid Diversity in Padawan Formation
  32
- Conservation Approaches for Padawan Orchids
  43
- Classification of Padawan Orchid Genera
  44
- Artificial key to the Subfamilies, Genera and Species of Orchidaceae in Padawan
  45
  - Artificial key to the subfamilies of Padawan Orchids
    46
  - Artificial key to Genera in Subfamily Orchidioideae
    46
  - Artificial key to Genera in Subfamily Epidendroideae
    47
- Taxa Enumeration
  51
V  DISCUSSION
   Analysis of the Compositions  291
   Geological Significance  299
   Conservation for Padawan Orchids  303

VI  CONCLUSION AND RECOMMENDATIONS  307
   In-situ Conservation  310
   Ex-situ Conservation  311

REFERENCES  314
APPENDICES  317
BIODATA OF THE AUTHOR  423