



**Diversity of Vascular Plants on the Cliffs and Rocky Ridges of  
Sankalakhiri Range in Betong District, Yala Province**

**Jarearnsak Sae Wai**

**A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science in Botany  
Prince of Songkla University**

**2009**

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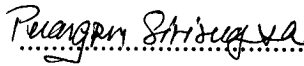
**Major Program** Botany

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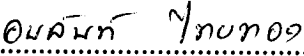
  
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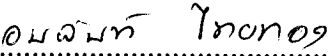
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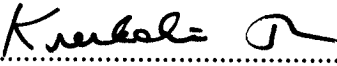
  
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Dean of Graduate School

ชื่อวิทยานิพนธ์	ความหลากหลายของพืชมีท่อลำเลียงบริเวณหน้าผาและสันเขาหินบน เทือกเขาสันกาลาคีรี ในเขตอำเภอเบตง จังหวัดยะลา
ผู้เขียน	นายเจริญศักดิ์ แซ่ไว่
สาขาวิชา	พฤกษศาสตร์
ปีการศึกษา	2552

### บทคัดย่อ

การศึกษาคความหลากหลายของพืชมีท่อลำเลียงบริเวณหน้าผา และสันเขาหินบน เทือกเขาสันกาลาคีรี ในเขตอำเภอเบตง จังหวัดยะลา ระหว่างเดือนตุลาคม 2548 ถึงเดือนกุมภาพันธ์ 2550 พบพืชมีท่อลำเลียงจำนวน 223 ชนิด ซึ่งประกอบด้วย ไโลโคไฟต์ 7 ชนิด เฟิร์น 41 ชนิด พืช เมล็ดเปลือก 3 ชนิด พืชใบเลี้ยงคู่ 113 ชนิด และพืชใบเลี้ยงเดี่ยว 59 ชนิด ในกลุ่มของพืชมีท่อลำเลียง ทั้งหมดนี้ พืชในวงศ์กล้วยไม้ จัดเป็นกลุ่มที่มีความหลากหลายและมีจำนวนชนิดมากที่สุด คือ 40 ชนิด ในการศึกษาพบว่ามีพืชที่คาดว่าอาจจะเป็นชนิดใหม่ของโลก 2 ชนิด ได้แก่ *Hoya* sp. และ *Dendrobium* sp. และพบพืชที่ยังไม่เคยมีรายงานในประเทศไทยมาก่อนจำนวน 16 ชนิด ได้แก่ *Syngamma minima* Holttum, *Anodendron axillare* Merr., *Willughbeia tenuiflora* Dyer ex Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC. var. *cordatus*, *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausen, *P. hanseniana* Clausen, *Coelogyne prasina* Ridl., *C. testacea* Lindl., *Dendrobium metrium* Kraenzl., *Epigeneium geminatum* (Blume) Summerh. และ *Geostachys penangensis* Ridl. นอกจากนี้ยังพบ พืชต่างถิ่นจำนวน 4 ชนิด ได้แก่ *Ageratum* sp., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clidemia hirta* D. Don และ *Lantana camara* L.

ในการศึกษานี้ได้จัดทำคำบรรยายลักษณะทางสัณฐานวิทยาของพืชมีท่อลำเลียง จำนวน 129 ชนิด พร้อมทั้งให้ข้อมูลสถานภาพของพืช (พบทั่วไป ไม่ได้พบทั่วไป หายาก) รวมถึง ข้อมูลต่างๆ ทางด้านนิเวศวิทยา ถิ่นอาศัย แหล่งที่พบ ขอบเขตการกระจายพันธุ์ และภาพถ่ายของพืช เหล่านี้ ตัวอย่างอ้างอิงทั้งหมดที่ศึกษาเก็บรักษาไว้ ณ พิพิธภัณฑ์พืชมหาวิทยาลัยสงขลานครินทร์ (PSU) พิพิธภัณฑ์พืชศาสตราจารย์กสิณ สุวตะพันธุ์ จุฬาลงกรณ์มหาวิทยาลัย (BCU) พิพิธภัณฑ์พืช กรุงเทพฯ (BK) หอพรรณไม้ กรมอุทยานแห่งชาติสัตว์ป่าและพันธุ์พืช (BKF) พิพิธภัณฑ์พืช มหาวิทยาลัยขอนแก่น (KKU) และพิพิธภัณฑ์พืชสวนพฤกษศาสตร์สมเด็จพระนางเจ้าสิริกิติ์ (QBG) นอกจากนี้ยังได้บรรยายลักษณะสังคมพืชบริเวณหน้าผา และบนสันเขาหินประเภทต่างๆ พร้อมด้วย ภาพประกอบ และได้อภิปรายถึงลักษณะความผันแปรขององค์ประกอบชนิดพรรณไม้ในสังคมพืชที่ พบบนสันเขาหินเหล่านี้



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<b>Author</b>	Mr. Jarearnsak Sae Wai
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## ABSTRACT

A study on the diversity of vascular plants on the cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province, was conducted from October 2005 to February 2007. A total of 223 vascular plant species were recorded. Seven species were lycophytes, 41 species were pterophytes, three species were gymnosperms, 113 species were dicots and 59 species were monocots. The most speciose family was Orchidaceae with 40 species. Two species of vascular plants are expected to be new to science, i.e. *Hoya* sp. and *Dendrobium* sp. and 16 species are new records for Thailand, i.e. *Syngramma minima* Holttum, *Anodendron axillare* Merr., *Willughbeia tenuiflora* Dyer ex Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC. var. *cordatus*, *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausen, *P. hanseniana* Clausen, *Coelogyne prasina* Ridl., *C. testacea* Lindl., *Dendrobium metrium* Kraenzl., *Epigeneium geminatum* (Blume) Summerh. and *Geostachys penangensis* Ridl. In addition, four alien species were recorded in the study area, i.e. *Ageratum* sp., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clidemia hirta* D. Don and *Lantana camara* L.

Descriptions of 129 vascular plant species and status of these taxa (common, uncommon, rare) together with ecological data, localities and distribution ranges of each species are presented as well as photographs. All voucher specimens have been deposited at the Prince of Songkla University Herbarium (PSU), with the duplicates sent to Chulalongkorn University Herbarium (BCU); Department of Agriculture Bangkok Herbarium (BK); The Forest Herbarium, Department of National Park Wildlife and Plant Conservation (BKF); Khon Kaen University Herbarium (KKU) and Queen Sirikit Botanic Garden Herbarium (QBG). The vegetation types in the study area are described and illustrated. The variations in floristic composition of the vegetation on these mountain ridges are also discussed.

## ACKNOWLEDGEMENTS

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Jarearnsak Sae Wai



# CONTENTS

	<b>Page</b>
Contents	vi
List of Tables	vii
List of Figures	viii
List of Plates	x
Chapter	
1. Introduction	1
Objectives	3
Literature review	4
2. Materials and Methods	9
Study area	9
Data collection	16
Laboratory study	17
Floristic and vegetation analyses	18
3. Results	19
Part I: Floristic study	19
Part II: Vegetation study	235
4. Discussion and Conclusion	251
Bibliography	262
Appendices	282
Colour Plates	299
Scientific Name Index	357
Vitae	362

## LIST OF TABLES

Table	Page
1 Location, geology, rock/soil pH, elevation and size of the study sites.	15
2 Number of families, genera and species in major groups of vascular plants found in the study sites.	19
3 Predominant families in each major group found in the study sites (excluding gymnosperms).	20
4 Number of families, genera and species in the study sites.	21
5 Number of species recorded in two different sub-vegetation types on quartzitic phyllite ridges.	21
6 Comparison of some different characters and sizes between <i>Hoya plicata</i> King & Gamble and <i>Hoya micrantha</i> Hook.f.	92
7 Comparison of some distinguished characters and phenological patterns between <i>Fagraea wallichiana</i> Benth. and <i>Fagraea fragrans</i> Roxb.	128
8 Altitudinal ranges of vascular plant species found in the study sties.	227
9 Distribution types of 129 vascular plant species found in the study sites.	228
10 Fruit types and fruit/seed maturity periods of 38 flowering plant species.	234



## LIST OF FIGURES

Figure	Page
1 Topographic map of Betong showing the elevations and the location of study sites.	11
2 Geological map of Betong showing the geological structure and the location of study sites.	12
3 Forest cover map of Betong showing the forest area and the location of study sites.	13
4 Mean monthly maximum-minimum temperatures in Betong district (data collected from January-December 2006).	14
5 Monthly rainfall during the study period, from Betong station (240202) (data from the Meteorology of Yala province, unpublished data) and number of rain days in each month of Betong district (data collected from January-December 2006).	14
6 Distances between the study sites (km).	15
7 The pie chart of habit/life form of vascular plant species found in the study sites.	22
8 Ten distribution patterns of 53 Malesian plant species found in the study sites.	229
9 Pie chart showing the distribution of rarity status.	230
10 Number of flowering species during each month of the year, the month of flowering was pooled over 2 years (2006-2007).	231
11 Patterns of peak flowering (type I-VI) and examples of plant species.	232
12 Frequency distribution of six patterns of peak flowering (type I-VI).	233
13 Vegetation on Gunung Silipid.	240
14 Vegetation on Khao Hin Ban Chantharat.	241
15 Vegetation on Khao Hin Ban Bo Num Ron.	242
16 Venn-Euler diagrams of the numbers of species found in the three different substrates (A) and among three quartzitic phyllite ridges (B).	246

LIST OF FIGURES (Continued)

Figure		Page
17	Cluster analysis dendrogram based on similarity of plant species composition and their abundance among study sites.	247
18	Periodicity of flowering of plants recorded from three different areas.	
	—◆— Present study (A);	
	—■— Pha Taem National Park (B), (source: Boonjaras, 2002);	
	—▲— Phu Hin Rong Kla National Park (C), (source: Sridith, 1989).	256



## LIST OF PLATES

Plate		Page
1	A-G. Gunung Silipid and its vegetation	300
2	A-F. Khao Hin Ban Chantharat and its vegetation	301
3	A-F. Khao Hin Ban Bo Num Ron and its vegetation	302
4	A-C. Khao Hin Ban Piyamit 2 and its vegetation	303
	D-F. Khao Hin Ban Ko Mo 4 and its vegetation	303
5	A-B. <i>Huperzia phlegmaria</i> (L.) Rothm.	304
	C-D. <i>Huperzia squarrosa</i> (G. Forst.) Trevis.	304
6	A-B. <i>Lycopodiella cernua</i> (L.) Pic. Serm.	305
	C-D. <i>Selaginella intermedia</i> (Blume) Spring	305
	E-F. <i>Selaginella siamensis</i> Hieron.	305
7	A-B. <i>Selaginella strigosa</i> Bedd.	306
	C-D. <i>Selaginella wallichii</i> (Hook. & Grev.) Spring	306
	E-F. <i>Syngramma minima</i> Holttum	306
8	A-B. <i>Taenitis blechnoides</i> (Willd.) Sw.	307
	C-D. <i>Asplenium affine</i> Sw.	307
	E-F. <i>Asplenium nidus</i> L. var. <i>nidus</i>	307
9	A-B. <i>Asplenium pellucidum</i> Lam.	308
	C-D. <i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn	308
	E-F. <i>Davallia heterophylla</i> Sm.	308
10	A-B. <i>Davallia pectinata</i> Sm.	309
	C-D. <i>Davallia repens</i> (L.f.) Kuhn	309
	E-F. <i>Davallia solida</i> (G. Forst.) Sw.	309
11	A-B. <i>Davallia trichomanoides</i> Blume var. <i>lorrainii</i> (Hance) Holttum	310
	C-D. <i>Lindsaea bouillodii</i> Christ	310
	E-F. <i>Pteridium aquilinum</i> (L.) Kuhn	310
12	A-B. <i>Cibotium barometz</i> J. Sm.	311
	C-D. <i>Dipteris conjugata</i> Reinw.	311
	E-F. <i>Dicranopteris linearis</i> (Burm.f.) Underw.	311

## LIST OF PLATES (Continued)

Plate		Page
13	A-B. <i>Crepidomanes minutum</i> (Blume) K. Iwats.	312
	C-D. <i>Hymenophyllum serrulatum</i> (C. Presl) C. Chr.	312
	E-F. <i>Oleandra pistillaris</i> (Sw.) C. Chr.	312
14	A-B. <i>Oleandra undulata</i> (Willd.) Ching	313
	C-D. <i>Drynaria rigidula</i> (Sw.) Bedd.	313
	E-F. <i>Drynaria sparsisora</i> (Desv.) T. Moore	313
15	A-B. <i>Pyrrosia adnascens</i> (Sw.) Ching	314
	C-D. <i>Selliguea heterocarpa</i> (Blume) Blume	314
	E-F. <i>Selliguea stenophylla</i> (Blume) Parris	314
16	A-B. <i>Pteris dalhousiae</i> Hook.	315
	C-D. <i>Schizaea dichotoma</i> (L.) Sm.	315
	E-F. <i>Schizaea digitata</i> (L.) Sw.	315
17	A-B. <i>Vittaria ensiformis</i> Sw.	316
	C-D. <i>Vittaria scolopendrina</i> (Bory) Schkuhr ex Thwaites	316
	E. <i>Gnetum gnemon</i> L. var. <i>tenerum</i> Markgr.	316
18	A-C. <i>Dacrydium elatum</i> (Roxb.) Wall. ex Hook.	317
	D-F. <i>Pyramidanthe prismatica</i> (Hook.f. & Thomson) J. Sinclair	317
19	A-B. <i>Alstonia rostrata</i> C.E.C. Fisch.	318
	C-D. <i>Anodendron axillare</i> Merr.	318
	E-F. <i>Willughbeia coriacea</i> Wall.	318
20	A-C. <i>Willughbeia tenuiflora</i> Dyer ex Hook.f.	319
	D-F. <i>Schefflera cephalotes</i> (C.B. Clarke) Harms	319
21	A-B. <i>Dischidia bengalensis</i> Colebr.	320
	C-E. <i>Dischidia fruticulosa</i> Ridl.	320
22	A-D. <i>Hoya imperialis</i> Lindl.	321
	E-F. <i>Hoya multiflora</i> Blume	321
22	A. <i>Hoya plicata</i> King & Gamble	322
	B-C. <i>Hoya rigida</i> Kerr	322
	D-F. <i>Hoya</i> sp.	322

## LIST OF PLATES (Continued)

Plate		Page
24	A-C. <i>Begonia sinuata</i> Wall. ex Meisn. var. <i>sinuata</i>	323
	D-F. <i>Begonia</i> sp.	323
25	A-B. <i>Cratoxylum maingayi</i> Dyer	324
	C-E. <i>Elaeocarpus pedunculatus</i> Wall. ex Mast.	324
26	A-B. <i>Rhododendron longiflorum</i> Lindl.	325
	C-I. <i>Vaccinium bancanum</i> Miq.	325
27	A-F. <i>Austrobuxus nitidus</i> Miq.	326
	G-H. <i>Archidendron contortum</i> (Mart.) I.C. Nielsen	326
28	A-B. <i>Callerya atropurpurea</i> (Wall.) Schot	327
	C-F. <i>Aeschynanthus radicans</i> Jack	327
29	A-D. <i>Didymocarpus citrinus</i> Ridl.	328
	E-F. <i>Didymocarpus corchorifolius</i> Wall ex A. DC.	328
30	A-C. <i>Didymocarpus cordatus</i> A. DC.	329
	D-F. <i>Henckelia bombycina</i> (Ridl.) A. Weber	329
31	A-C. <i>Henckelia inaequalis</i> (Ridl.) A. Weber	330
	D-F. <i>Paraboea elegans</i> (Ridl.) B.L. Burt	330
32	A-C. <i>Rhodoleia championii</i> Hook.f.	331
	D-F. <i>Fagraea acuminatissima</i> Merr.	331
33	A-D. <i>Fagraea wallichiana</i> Benth.	332
	E-F. <i>Dendrophthoe pentandra</i> (L.) Miq.	332
34	A-C. <i>Melastoma malabathricum</i> L. subsp. <i>malabathricum</i>	333
	D-F. <i>Oxyspora umbellulata</i> (Hook.f. ex Triana) J.F. Maxwell	333
35	A-C. <i>Pachycentria glauca</i> Triana subsp. <i>maingayi</i> (C.B. Clarke)	
	Clausing	334
	D. <i>Pachycentria hanseniana</i> Clausing	334
	E-F. <i>Pachycentria pulverulenta</i> (Jack) Clausing	334
36	A-C. <i>Sonerila griffithii</i> C.B. Clarke	335
	D-F. <i>Ficus deltoidea</i> Jack var. <i>deltoidea</i>	335

## LIST OF PLATES (Continued)

Plate		Page
37	A-C. <i>Ficus deltoidea</i> Jack var. <i>angustifolia</i> (Miq.) Corner	336
	D-G. <i>Ficus deltoidea</i> Jack var. <i>kunstleri</i> (King) Corner	336
38	A-E. <i>Ficus oleifolia</i> King subsp. <i>intermedia</i> (Corner) C.C. Berg	337
	F-H. <i>Rhodamnia cinerea</i> Jack var. <i>cinerea</i>	337
39	A-D. <i>Syzygium gratum</i> (Wight) S.N. Mitra var. <i>gratum</i>	338
	E. <i>Syzygium helferi</i> (Duthie) Chantar. & J. Parn.	338
	F. <i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry var. <i>parviflorum</i> (Craib) Chantar. & J. Parn.	338
40	A-B. <i>Syzygium syzygioides</i> (Miq.) Merr. & L.M. Perry	339
	C-E. <i>Syzygium</i> sp. 1	339
	F. <i>Syzygium</i> sp. 2	339
41	A-C. <i>Argostemma pictum</i> Wall.	340
	D. <i>Tarenna longifolia</i> (G. Don) Ridl.	340
	E-F. <i>Symplocos adenophylla</i> Wall. ex G. Don	340
42	A-F. <i>Anneslea fragrans</i> Wall.	341
	G. <i>Schima wallichii</i> (DC.) Korth.	341
43	A-C. <i>Acriopsis liliifolia</i> (J. Koenig) Ormerod	342
	D-F. <i>Bromheadia alticola</i> Ridl.	342
44	A-C. <i>Bromheadia finlaysoniana</i> (Lindl.) Miq.	343
	D-E. <i>Bromheadia truncata</i> Seidenf.	343
	F-H. <i>Bulbophyllum corolliferum</i> J.J. Sm.	343
45	A-C. <i>Bulbophyllum lilacinum</i> Ridl.	344
	D-F. <i>Bulbophyllum medusae</i> (Lindl.) Rchb.f.	344
46	A-C. <i>Bulbophyllum purpurascens</i> Teijsm. & Binn.	345
	D-G. <i>Bulbophyllum stenobulbon</i> E.C. Parish & Rchb.f.	345
47	A-C. <i>Coelogyne cumingii</i> Lindl.	346
	D-G. <i>Coelogyne prasina</i> Ridl.	346
48	A-D. <i>Coelogyne rochussenii</i> de Vriese	347
	E-G. <i>Coelogyne testacea</i> Lindl.	347

## LIST OF PLATES (Continued)

Plate		Page
49	A-B. <i>Coelogyne trinervis</i> Lindl.	348
	C-D. <i>Coelogyne velutina</i> de Vogel	348
	E-F. <i>Dendrobium acerosum</i> Lindl.	348
50	A-B. <i>Dendrobium bifarium</i> Lindl.	349
	C-D. <i>Dendrobium crumenatum</i> Sw.	349
	E-G. <i>Dendrobium farmeri</i> Paxton	349
51	A-B. <i>Dendrobium leonis</i> (Lindl.) Rchb.f.	350
	C-D. <i>Dendrobium metrium</i> Kraenzl.	350
	E-F. <i>Dendrobium pachyglossum</i> E.C. Parish & Rchb.f.	350
52	A-B. <i>Dendrobium sanguinolentum</i> Lindl.	351
	C-D. <i>Dendrobium tortile</i> Lindl.	351
	E-F. <i>Dendrobium</i> sp.	351
53	A-C. <i>Dienia ophrydis</i> (J. Koenig) Ormerod & Seidenf.	352
	D-G. <i>Dipodium pictum</i> (Lindl.) Rchb.f.	352
54	A-B. <i>Epigeneium geminatum</i> (Blume) Summerh.	353
	C-D. <i>Eria pulchella</i> Lindl.	353
	E-F. <i>Pholidota articulata</i> Lindl.	353
55	A-C. <i>Tainia penangiana</i> Hook.f.	354
	D-E. <i>Thrixspermum calceolus</i> (Lindl.) Rchb.f.	354
56	A-B. <i>Eulalia speciosa</i> Kuntze	355
	C-D. <i>Etlingera subterranea</i> (Holtum) R.M. Sm.	355
	E-G. <i>Geostachys holtumii</i> K. Larsen	355
57	A-C. <i>Geostachys penangensis</i> Ridl.	356
	D-G. <i>Globba pendula</i> Roxb.	356

# CHAPTER 1

## INTRODUCTION

Mountain ridges, cliffs and rocky outcrops are clearly distinct and unique habitats, their vegetation communities differ markedly from those of surrounding areas. Such habitats, under these edaphic and microclimatic conditions, are characteristically terrestrial/habitat islands. Moreover, mountain ridges, cliffs and rocky outcrops among tropical rain forests can be regarded as the xeric islands (Parmentier, 2003) and are often considered as models for studying ecology as well as biogeography (Porembski *et al.*, 1996). The isolated rocky outcrops in tropical Africa are well known as the “inselbergs” and the vegetation on the so called inselbergs have been studied by many botanists and ecologists (Barthlott *et al.*, 1996; Porembski *et al.*, 1997; Burke *et al.* 1998; Burke, 2002; Parmentier, 2003; Müller, 2007; Porembski, 2007), however, in tropical Asia this term and the vegetation has been scarcely known. In any case, the vegetation on non-limestone mountain ridges and rocky outcrops in Malesian region is usually recognised as the heath forest and also called kerangas (Whitmore, 1975; 1990; Davies and Kamariah, 1999). In conservation terms, heath forest systems should be given priority for habitat conservation due to its fragile ecosystem (Whitmore, 1990). In addition, there are several rare and endemic species apparently restricted to the heath forest ecosystems (van Steenis, 1971; Wong, 1998).

In Thailand, there are very few comprehensive studies on flora and plant vegetation on rocky outcrops. Most botanical works on rocky mountains have been concentrated on rare and threatened plants in limestone and sandstone habitats in the northern and northeastern parts of Thailand, there were some studies in Doi Chiangdao (Santisuk, 1998; Nanakorn, 2003; Chayamarit *et al.*, 2005), in Phu Kra Dung National Park (Koyama and Phengklai, 1989), in Phu Hin Rong Kla National Park (Sridith, 1989), in Pa Hin Ngam Forest Park (Suddee, 1995) and in Pha Taem National Park (Boonjaras, 2002). In contrast to the situation in Peninsular Thailand, there is very limited information about limestone as well as non-limestone flora.



The Peninsular Thailand lies on the northern part of Thai-Malay Peninsula, is one of the richest areas in diversity of habitat types and flora, it includes the transition zone between Indo-Chinese and Malesian floristic regions (Takhtajan, 1986). According to van Steenis (1950), 575 genera of flowering plants have their northern or southern range limits near Thai-Malaysian border, the boundary between this two floristic regions is, here, taken as Kangar-Pattani line (Whitmore, 1975), and this overlap should, then, be documented, thus adding value to the biodiversity of Peninsular Thailand. Topographically, there are three main mountain ranges running through the length of the peninsula, i.e. the Phuket, the Nakhon Si Thammarat and the Sankalakhiri (Pongsabutra, 1991). Moreover, there are many scattered limestone outcrops throughout the peninsula, while the high mountain ridges of these nearly continuous mountain ranges are mainly composed of granite. These areas serve as habitats for many rare and endemic plants. Therefore, they are very important for plant genetic resource conservation. Nowadays, scientific knowledge of biodiversity on rocky mountains in Peninsular Thailand is still limited, while many human activities causes a significant increase in extinction risk of native plant species. The study in order to get the account of the biodiversity, natural plant vegetation, rarity and endemism on isolated habitats is urgently needed at the moment, especially in Sankalakhiri range which is the natural border between Thailand and Malaysia, where was less explored in the past.

Betong is the southernmost district of Thailand, which located in Sankalakhiri range. It borders the Malaysian states of Kedah and Perak. Phytogeographically, it falls in the peninsular floristic region (Smitinand and Larsen, 1970), which connected to Perak sub-province of Peninsular Malaysia. The Perak sub-province is a special area of high diversity and endemism of plants, as it is the meeting point of different floristic elements, including the Burmese-Thai elements, the Sumatran elements and the Malayan elements (including endemic elements) (Ashton, 1992; Wong, 1998) and due to the fact that Betong district is next to the state of Perak, Malaysia, therefore the flora of this sub-province which belongs to the Malesian floristic region might continue to some parts of Peninsular Thailand, especially in Betong, the southern most frontier of Thailand. However, it is such a pity that there has been limited information concerning the flora and vegetation in this area. This

might due to the fact that the area of Betong and the adjacent areas are still unexplored. Previously, botanical surveys in this area were mainly made by Dr. A.F.G. Kerr in 1923 and 1925 (Jacobs, 1962). In the last decade, very few additional surveys were made by the staff of the Forest Herbarium, National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources, Bangkok. Some of these collections were reported to be newly recorded species for Thailand (Lindsay *et al.*, 2003; Saensouk *et al.*, 2003). It is, therefore, of interest in terms of diversity, biogeography and conservation to study the vascular flora in this area.

Betong's terrain is mostly mountainous and hilly area. Types of forest are mostly tropical lowland evergreen forest (hill dipterocarp forest) and lower montane forest according to Whitmore (1975). However, there are a few attractive isolated mountain ridges, the edaphic climax formations, which include both limestone and non-limestone areas, the non-limestone flora in the Peninsular Thailand was poorly known compared with the limestone flora. Furthermore, some of these mountain ridges are being destroyed. The habitat destruction, invasion by alien species and over exploitation are the main causes of biodiversity loss. Consequently, it is interested in a study of plant diversity on non-limestone mountain ridges, which has never been reported in Peninsular Thailand.

## OBJECTIVES

1. To investigate diversity of vascular plants on the cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province.
2. To obtain the details of morphology, ecology and geographical distribution of these vascular plants.
3. To study vegetation and compare the species composition of vascular plants between the study sites (floristic similarity).
4. To increase the number of reference plant collections in Thai Herbaria.

## LITERATURE REVIEW

### Botanical studies on rocky outcrops in tropical region

Most botanical works on rocky outcrops have been concentrated in tropical Africa and floristically best known is the vegetation of west African inselbergs. The information about flora, vegetation and their importance in the following works were mainly investigated from the rocky outcrops in tropical Africa and some studies in Australia:

Porembski *et al.* (1997) provided a general overview of plant communities on tropical inselbergs and stated that flora and vegetation of inselbergs in different geographical regions are clearly distinct. The most species-rich families of African inselbergs are Fabaceae, Scrophulariaceae and Lentibulariaceae, while the most species-rich families in South American inselbergs are Melastomataceae, Orchidaceae, Cactaceae and Bromeliaceae. The vegetation of Indian inselbergs is similar to the vegetation of African inselberg at the family and genus level.

Hunter and Clarke (1998) studied the flora and vegetation on granitic outcrops in eastern Australia, 28 plant communities and 671 vascular plant taxa were recorded. A high number of rare and threatened taxa have been found in these communities and many of which are restricted to the rocky outcrops.

Burke (2002) studied the plant communities on granite inselbergs and six dolerite dykes in the central Namib desert, the nine plant communities were recognised, these mentioned plant communities are reflected the diversity of habitats and the high conservation value of inselbergs among the desert landscape.

Parmentier (2003) investigated species composition of three inselbergs from continental Equatorial Guinea. The vegetation is dominated by monocotyledons (Orchidaceae, Cyperaceae and Poaceae). Interestingly, although the inselbergs are very close to each other, but they significantly differ in their vegetation and these could be explained by the insular property of inselberg vegetation surrounded by rain forest.

Müller (2007) studied on herbaceous vegetation of seasonally wet habitats on inselbergs and lateritic crusts in west and central Africa, plant communities were grouped into three large blocks, i.e. the communities of rock pools and shallow

depressions, mat vegetation and open pioneer communities. The spatial mosaics and the vegetation dynamics were also discussed.

In contrast, information about flora and vegetation of rocky outcrops or inselbergs in tropical Asian is very sparse. Botanical studies on limestone hills, mountain ridges and summits in the Peninsular Malaysia are as follows:

Chin (1977) documented 1,216 species of vascular plants from limestone hills in Peninsular Malaysia, there are 335 species characteristic of the limestone flora and about 254 species are confined to limestone habitats. The limestone vegetation was described and divided into nine subdivisions, i.e. base of hills, talus slopes, hill slopes to about 60° steepness, gullies and valleys, cliffs and near-vertical slopes, summits with considerable soil cover, summits with none or very little soil cover, coastal limestone and disturbed areas.

Stone (1981) reported the vegetation and flora of the summit region of Gunung Ulu Kali (Genting Highland), two vegetation types (i.e. upper montane forest and elfin-forest) and more than 460 species were recognised.

The other mountain summits in the Peninsular Malaysia such as Cameron Highland, Fraser's Hill, Gunung Jerai, Taiping Hill, etc., these mountain peaks, sandstone plateau and quartzite areas are in effect island habitats and serve as habitats for many rare and endemic plant species (Wong, 1998).

The botanical studies on rocky mountains in the northern and north eastern of Thailand are as follows:

During August to September 1988, the Thai-Japanese botanical expedition was undertaken by the cooperation between Thai and Japanese botanists. The botanical expedition was made in Phu Kradueng National Park. About 13,000 sheets and 130 living plants were mainly collected from the summit plateau of Phu Kradueng National Park (sandstone) (Koyama and Phengklai, 1989).

Sridith (1989) studied the flowering plants on rock platform of Phu Hin Rong Kla National Park (sandstone). Eighty eight species were recorded, including 54 species of dicotyledons and 34 species of monocotyledons. The most species-rich family was Orchidaceae.

Suddee (1995) studied the flowering plants in the Pa Hin Ngam Forest Park (sandstone). One hundred and forty one species of dicotyledons were recorded. The richest family in number of genera and species was Fabaceae.

Santisuk (1998) investigated the vegetation and flora of Doi Chiangdao (limestone). The enumeration of the threatened plants of Doi Chiangdao and the information on their fragile habitat were provided. Eighty nine species of rare and endemic seed plant species in the montane zone were reported.

Boonjaras (2002) studied the flowering plants in Pha Taem National Park (sandstone). One hundred and seven species were recognised, including 74 species of dicotyledons and 33 species of monocotyledons. The top three species rich-families were Orchidaceae, Fabaceae and Scrophulariaceae. There were six endemic species recorded in the area.

Nanakorn (2003) surveyed and collected the rare plants from Doi Chiang Dao, three hundred herbarium specimens were deposited at the Queen Sirikit Botanic Garden Herbarium (QBG) and additional living plant collections of some rare and endangered species were collected and planted in the nursery of Queen Sirikit Botanic Garden.

Recently, Chayamarit *et al.* (2005) published the Flora of Doi Chaingdao. The information about flora and vegetation of Doi Chaingdao were presented. The species lists of plants were provided, including 93 species of rare and endemic species.

### **Floristic inventories and botanical studies in Peninsular Thailand**

In 1930, F.W. Foxworthy an American botanist worked in Peninsular Malaysia surveyed and collected the plant specimens from the southern part of Peninsular Thailand. Mainly based on the dominant species of Dipterocarpaceae, Foxworthy (1979) stated that the plant species composition in the forests of two southernmost provinces of Thailand (Yala and Narathiwat) is similar to that of the Peninsular Malaysia.

Congdon (1982) studied the vegetation of Tarutao National Park, Satun province. Ten vegetation types including the limestone vegetation and scrub forest on the top of mountains were enumerated together with a vegetation map of the islands. A

total of 869 species were recognised, among these 105 species were found on limestone.

Maxwell (1986) documented 596 species and 128 families of vascular plants from Ko Hong Hill in Hat Yai district, Songkhla province. Many plant specimens were partly collected from sandstone habitats and deposited at Prince of Songkla University Herbarium (PSU).

Ramsri (1986) studied vascular plants at Gahrome Falls, Khao Luang National Park. Eighty one families, 174 genera and 220 species were recorded.

In 1990, the Thai-Danish botanical expedition was partly undertaken from limestone habitats in Surat Thani, Trang, Songkhla and Yala provinces. This botanical expedition was reported by Larsen (1992).

Sirirugsa *et al.* (1999) studied the diversity of vascular plants at Ton Nga Chang Wildlife Sanctuary. A total of 905 species, 444 genera and 129 families were recorded and the vegetation types were classified into seven types based on habitat types.

Niyomdham *et al.* (2000) reported three plant community types at Hala-Bala wildlife Sanctuary in Yala and Narathiwat provinces, i.e. tropical lowland rainforest, lower montane rainforest and vegetation over limestone hill. The stunt shrubs and trees found on limestone hills belong mainly to the families Ericaceae and Podocarpaceae (Ericaceae and *Dacrydium* community). There are several species of orchids and ferns, and in addition *Nepenthes* spp. are commonly found.

Sridith (2002) studied the remnant of vegetation on a coastal sandbar in Songkhla Province. Ninety eight plant species were recorded. Vegetation profiles of study plots at Ban Ta-ling Chan village, Chana district were provided.

Laongpol (2003) studied the flora and vegetation along the coast in Narathiwat province. One hundred and fifty seven species of vascular plants were recorded. Ten plant communities were recognised, these plant communities were grouped into three types of vegetation, i.e. dune grassland vegetation, dune scrub vegetation and dune woodland vegetation.

Leeratiwong and Jornead (2003) studied the diversity of vascular plants in Sriphangnga National Park, Phangnga. Five hundred and forty three species were reported and the distribution of each species also was provided.



### Previous accounts of botanical studies in Betong

Dr. A.F.G. Kerr is one of the few botanists who surveyed and collected the plant collections from Betong in 1923 and 1925. Sixty nine specimens were collected, as recorded in detail by Jacob (1962).

Maknoi (2000) studied Zingiberaceae in Thai-Malaysian border. Nineteen species of Zingiberaceae were collected from Betong. Of these, six species were reported to be new records for Thailand.

In the last decade, many plant specimens collected from Betong have been reported to be newly recorded for Thailand, e.g. *Polyalthia lateritia* J. Sinclair (Bunchalee and Chantaranothai, 2002), *Matonia pectinata* R. Br. (Lindsay *et al.*, 2003), etc. Many Malesian elements in Thailand have only been found in Betong district and they are also very rare species for Thailand, e.g. *Argostemma subcrassum* King (Sridith, 1999), *Alpinia scabra* (Blume) Baker (Saensouk *et al.*, 2003), etc.

According to Pooma *et al.* (2005) in an account of threatened plants in Thailand, many Malesian plants have only been found at Betong such as *Pomatocalpa kunstleri* (Hook.f.) J.J. Sm., *Shorea macroptera* Dyer, *Ridleyandra kerrii* A. Weber, *Dissochaeta conica* (Bakh.f.) Clausen, *Wightia borneensis* Hook.f., *Rhododendron jasminiflorum* Hook.f., *Disepalum pulchrum* (King) J. Sinclair, *Pinanga perakensis* Becc., *Breynia coronata* Hook.f., *Licuala scortechinii* Becc., *Alchornea villosa* Müll. Arg., *Medinilla clarkei* King and *Medinilla scortechinii* King.

From the literature review, it was found that the information of flora and vegetation on mountain ridges and rocky outcrops in the Peninsular Thailand is very scarce, especially in Betong. Therefore, it was expected that many rare, poorly known or undescribed species was to be found in this area.

## **CHAPTER 2**

### **MATERIALS AND METHODS**

#### **STUDY AREA**

##### **1. Location**

Betong district is situated in the southernmost province of Thailand, which located in Sankalakhiri range. It borders the Malaysian state of Kedah and Perak. The northern part is next to Than To district of Yala province and Chanae district of Narathiwat province is on its east border. The area lies approximately between latitudes 5° 36'-6° 00' N and longitudes 100° 59'-101° 30' E, which covers an area of 1,328 km<sup>2</sup> (Figs. 1-3), it is 140 km from Yala and 1,224 km from Bangkok.

##### **2. Topography and geology**

The topography of Betong is mostly mountainous and hilly area, varied in altitudes ranging from 140-1,535 meters above sea level (Fig. 1), the highest peak of Sankalakhiri range on Thai-Malaysian border is Gunung Ulu Titi Basah. There are a few small isolated rocky mountains scattered in the area, the approximate ranges of the areas of these rocky mountains are about 5 to 10 hectares. Their topographic features are characterised by the steep slopes, dome-shaped structure with the high cliffs. They rise abruptly from the surrounding area. The geology of the area mainly consists of two major types, i.e. Triassic granites and Devonian-Silurian metamorphic rocks (Betong and Yaha formations). There are very few middle Permian limestone outcrops (Ratburi group) near the town of Betong at Ban Ko Mo 4 (Fig. 2).

##### **3. Climate**

According to Köppen's classification system of climatic region analysis in Kottek *et al.* (2006), the climate of Betong belongs to the tropical rain forest (AF) climate. The precipitation in this area is under the influence of the southwest and northwest monsoons. The average annual rainfall is usually above 2,000 mm per year and there is no distinct dry season. Climatological data about study sites are available

from Betong district and the Meteorology of Yala province (Figs. 4-5). During the study period (January-December 2006), a total of 160 rain days were recorded and the heavy rainfalls occurred in the months of September and October. The relative humidity of Betong region is high throughout the year. The summits of study sites are usually fog-covered in the early morning throughout the year. However, the relative humidity may drop below 60 % on the exposed ridges and when winds. The monthly average maximum and minimum daily temperatures in the foothills range from 20 °C to 33 °C, but on the exposed areas of rocky ridges are drier and hotter than those shady conditions in surrounding area. The day temperatures can reach higher than 40 °C in sunny days, whereas at night and early morning, the temperatures may drop to 15 °C. The lowest temperatures are usually recorded in January and February, while the highest temperatures occur between March and April.

#### 4. Forest

Forest area of Betong is about 50 % of the total area, approximately 650 km<sup>2</sup> including two protected areas in the eastern part, i.e. Bang Lang National Park and Hala-Bala Wildlife Sanctuary. The other forest areas usually occur in high altitudes near Thai-Malaysian border and some scattered in isolated patches on steep slopes, mountain ridges and rocky outcrops (Fig. 3). According to Whitmore (1975), types of forest in Betong region are mostly tropical lowland evergreen forest (hill dipterocarp forest) and lower montane forest. The hill dipterocarp forest is dominated by *Shorea curtisii* Dyer ex King and the shaded palms, such as *Eugeissona triste* Griff., *Iguanura* spp. and *Pinangna* spp., which are typically found in Malayan type forest. The floristic composition of lower montane forest varies locally, it is usually dominated by *Dacrydium elatum* (Roxb.) Wall. ex Hook. (Podocarpaceae); *Lithocarpus* spp., *Quercus* spp. (Fagaceae); *Schima wallichii* (DC.) Korth. (Theaceae); *Rhododendron* spp. and *Vaccinium* spp. (Ericaceae) (Niyomdham *et al.*, 2000).

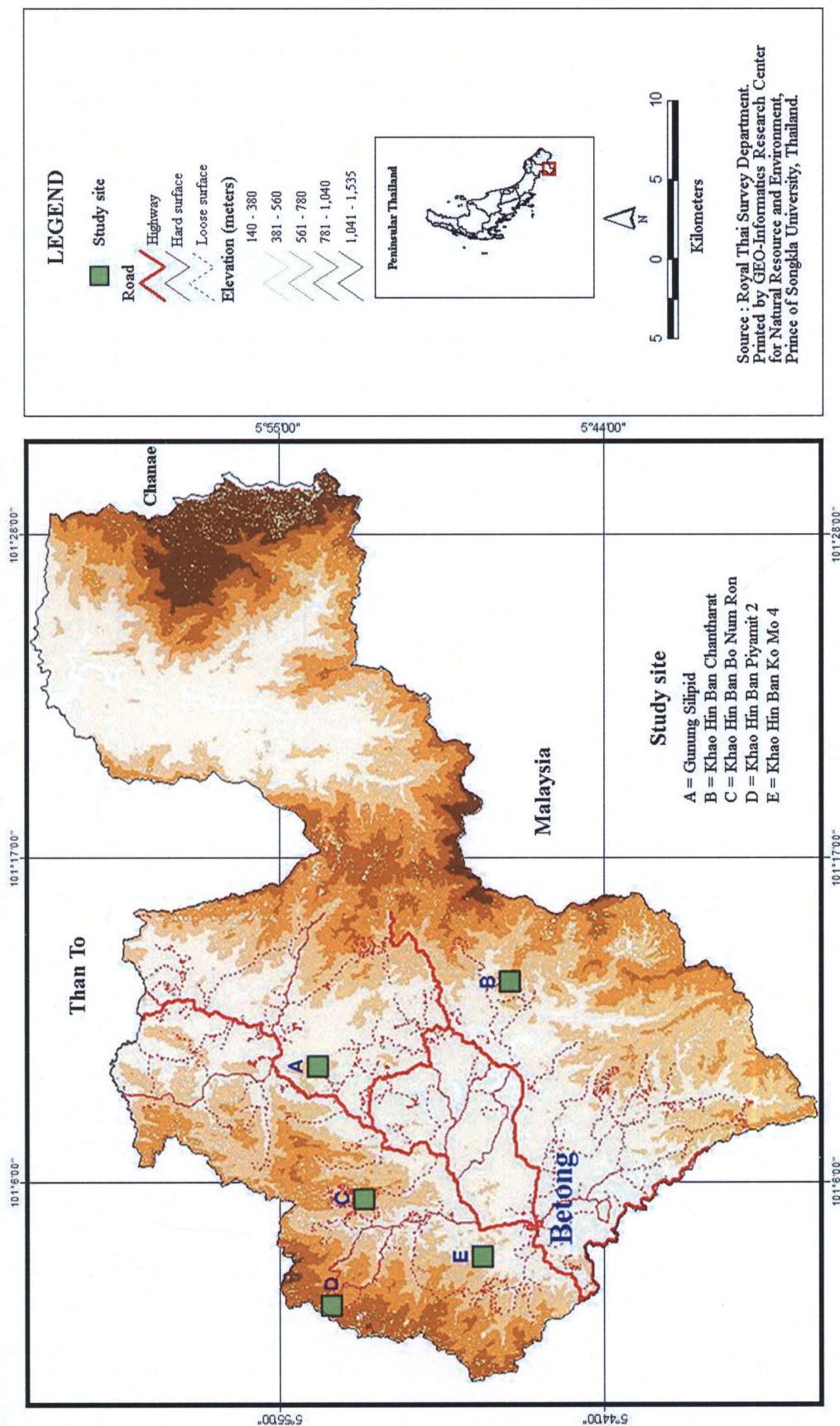


Figure 1. Topographic map of Betong showing the elevations and the location of study sites.



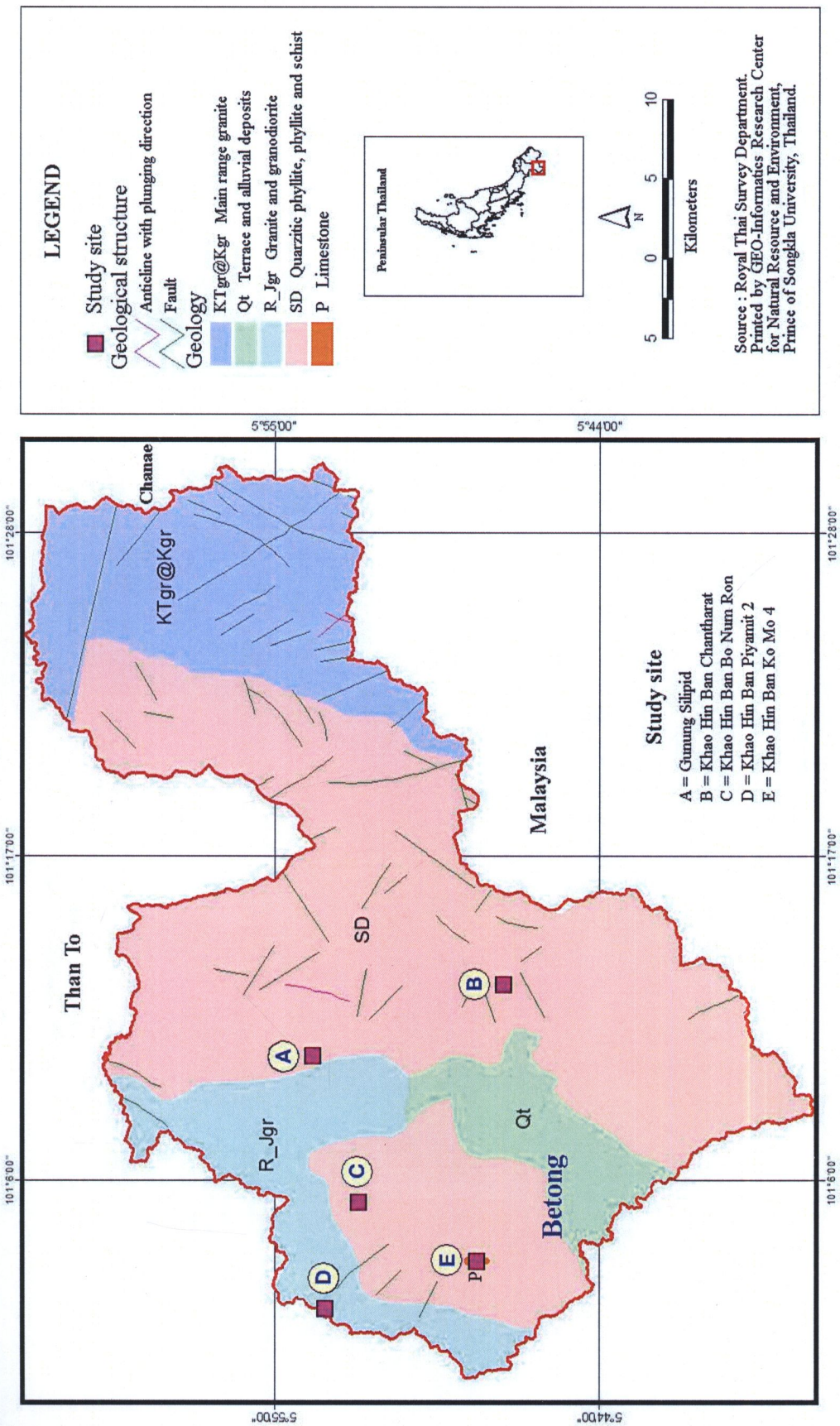


Figure 2. Geological map of Betong showing the geological structure and the location of study sites.

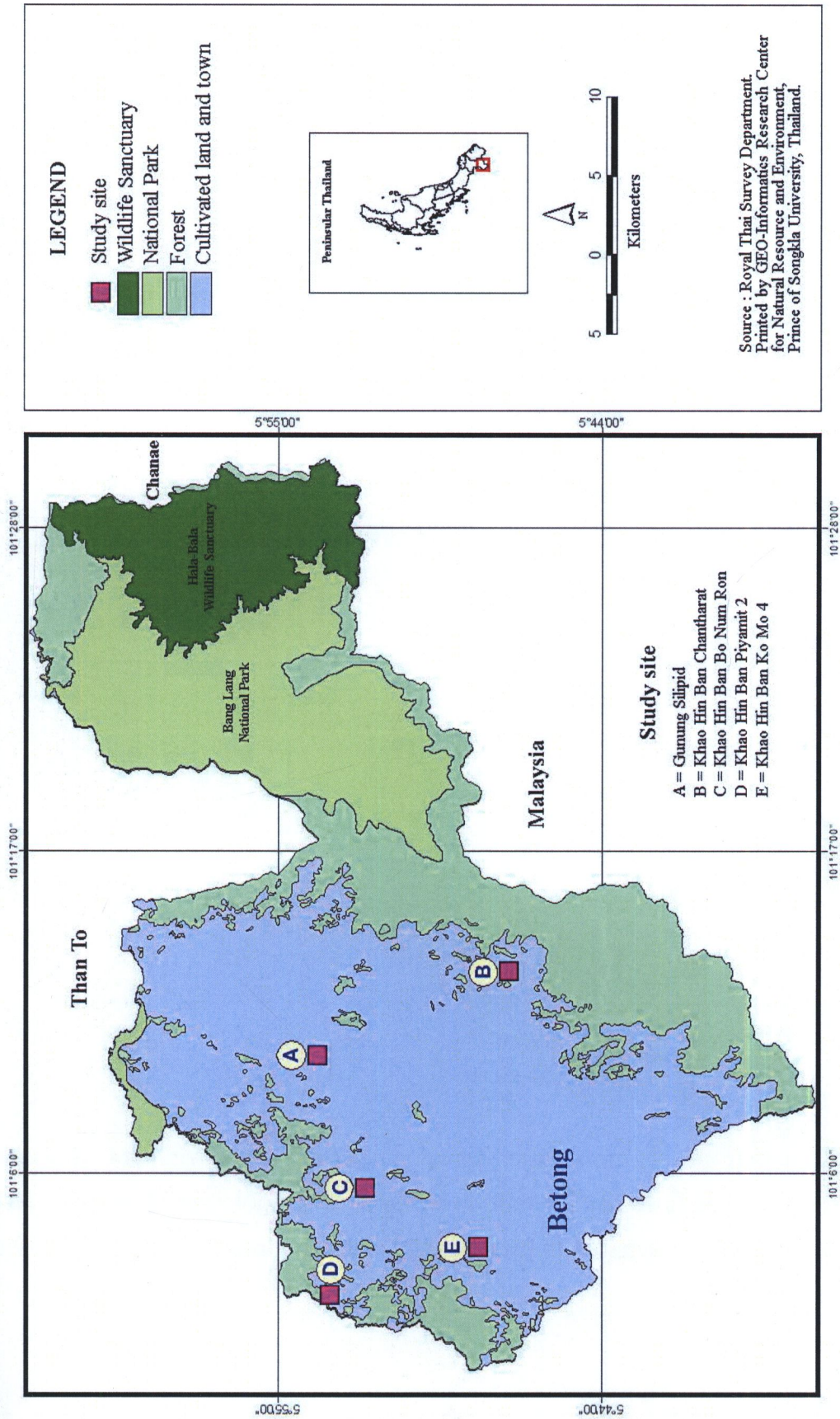
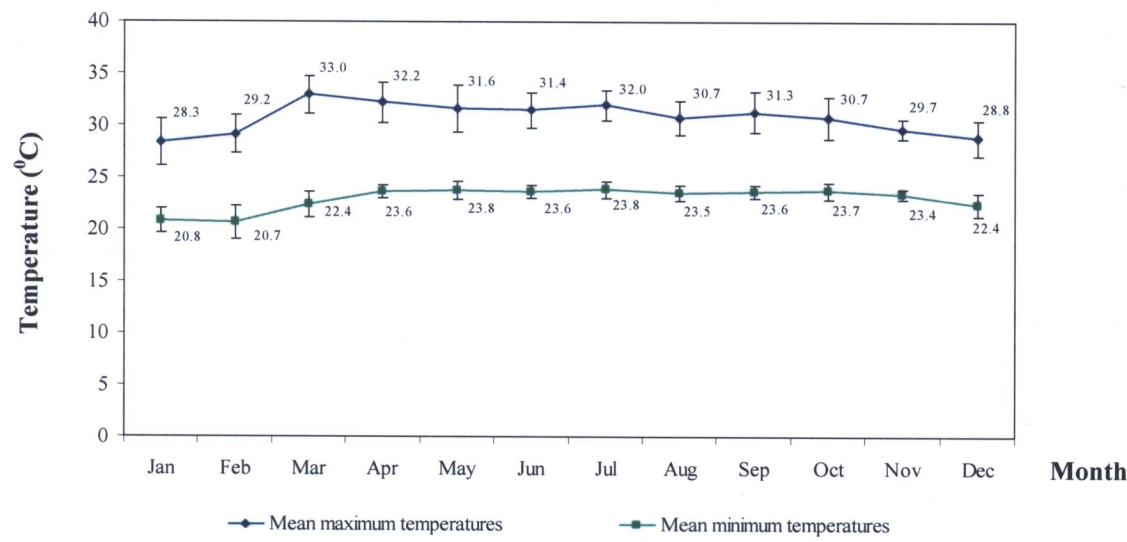
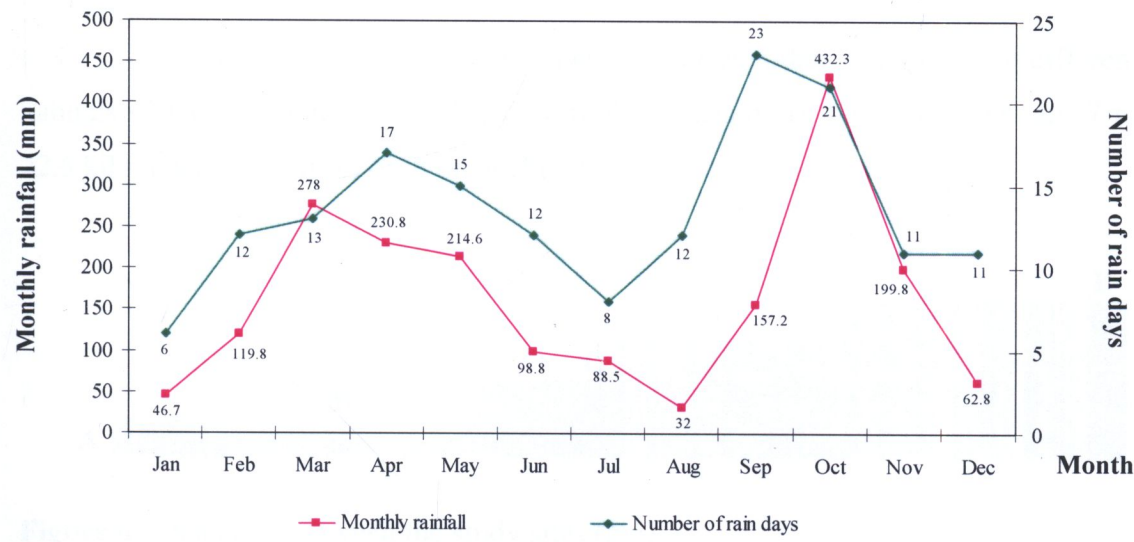


Figure 3. Forest cover map of Betong showing the forest area and the location of study sites.





**Figure 4.** Mean monthly maximum-minimum temperatures in Betong district (data collected from January-December 2006).



**Figure 5.** Monthly rainfall during the study period, from Betong station (240202) (data from the Meteorology of Yala province, unpublished data) and number of rain days in each month of Betong district (data collected from January-December 2006).



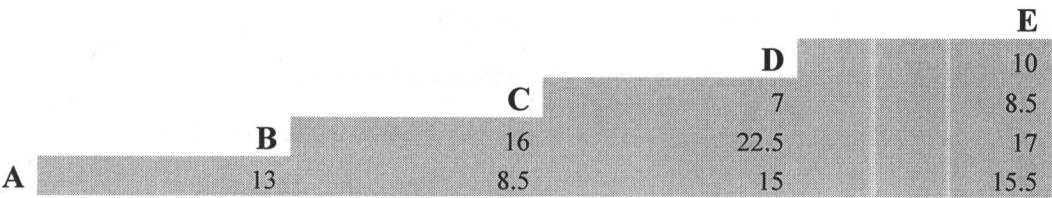
5. Study sites

Five isolated study sites were chosen including non-limestone and limestone areas in order to study diversity, plant species composition and floristic similarity (Table 1, Figs. 1-3).

**Table 1.** Location, geology, rock/soil pH, elevation and size of the study sites.

Study site	Geology	Rock/Soil pH	Elevation (m)	Approximate area (hectare)
A. Gunung Silipid 5° 53' N, 101° 09' E	Quarzitic phyllite	4.20-4.50	550-664	8
B. Khao Hin Ban Chantharat 5° 47' N, 101° 12' E	Quarzitic phyllite	4.13-5.50	600-700	10
C. Khao Hin Ban Bo Num Ron 5° 52' N, 101° 05' E	Quarzitic phyllite	3.80-5.07	600-675	5
D. Khao Hin Ban Piyamit 2 5° 53' N, 101° 01' E	Granite	4.05-4.75	850-1,050	5
E. Khao Hin Ban Ko Mo 4 5° 48' N, 101° 03' E	Limestone	7.57-7.81	450-550	5

The five study sites are isolated from each other by a matrix of different habitats (lowland evegreen forest and/or rubber plantation), the study sites are 7 to 22.5 kilometers apart from each other (Fig. 6).



**Figure 6.** Distances between the study sites (km).

## DATA COLLECTION

### 1. Exploration and plant collection

Surveying and collecting were conducted in the study sites at monthly or bimonthly intervals from October 2005 to February 2007. Most plant taxa were collected and made in the form of herbarium specimens (including both dry and spirit specimens), but some species (lacking key characters, e.g. flower, fruit, fertile segment, etc.) were only observed and noted. Ecological data, habitats, habit and some diagnostic characters of each specimen, such as color, smell, etc. were noted and photographs were taken in the field. Specimen processing followed the directions specified in “The Herbarium Handbook” (Foreman and Bridson, 1998).

### 2. Vegetation data collection

The photographs of all study sites (A-E) were taken showing the structure of vegetation. The abundance of each species was registered in each study site in order to investigate floristic similarity among study sites.

The abundance of each species was estimated by eye in terms of percent cover as described by Kent and Coker (1992). The numerical scores based on the subjective scales were recorded as follows:

5 = highly abundant (76-100% cover)

4 = abundant (51-75% cover)

3 = common (26-50% cover)

2 = few (6-25% cover)

1 = scarce (1-5% cover)

0 = absent

## LABORATORY STUDY

The collected specimens were identified by using both keys and descriptions from available taxonomic literatures (see citations) and compared with identified herbarium specimens from Prince of Songkla University Herbarium (PSU).

The specimens were studied in detail of morphology under a stereomicroscope such as indumentum, flower and fruit characters. Some small morphological characters such as size and shape of seeds/spores, etc. were observed and measured under a light microscope.

A description of each species was prepared based on specimens collected at non-limestone study sites (A-D). In addition, ecological data and geographical distribution of each species were retrieved from the literature.

For the plant name authors, other citations and abbreviation used in this thesis are followed Brummitt and Powell (1992) and according to the International Plant Names Index (IPNI) (The Plant Names Project, 1999). The terminology concerning the morphology of plants are followed Harris and Harris (2001).

All voucher specimens have been deposited at the Prince of Songkla University Herbarium (PSU), with at least three duplicates if possible sent to the other Thai Herbaria, i.e. Chulalongkorn University Herbarium (BCU); Department of Agriculture, Bangkok Herbarium (BK); The Forest Herbarium, Department of National Park Wildlife and Plant Conservation (BKF); Khon Kaen University Herbarium (KKU); Queen Sirikit Botanic Garden Herbarium (QBG) (abbreviation according to Index Herbariorum).

**Note:** Because the main aim was to study the poorly known non-limestone species, plants from the limestone site E were not described in detail. This site was only included in the vegetation study.

## FLORISTIC AND VEGETATION ANALYSES

Floristic richness of each non-limestone study site (A-D) was determined by directly counting the number of species, genera and families documented. The estimated species richness of each non-limestone study site as well as all non-limestone study sites were calculated using species-area curves.

Habit/lifeform and habitat classification methods were used to classify the vegetation on quartzitic phyllite ridges into subdivisions. The vegetation descriptions of all study sites (A-E) and the illustrations of some selected study sites (A-C) were prepared together with photographs.

Floristic similarity among study sites (A-E) was analysed according to plant species composition and their abundance. Cluster analysis was performed with PC-ORD software version 3.2 using the Sørensen distance measure and Ward's method for linking groups (McCune and Mefford, 1997).

## CHAPTER 3

### RESULTS

#### PART I: FLORISTIC STUDY

##### Floristic richness and taxonomic diversity

A total of 223 vascular plant species were recorded. Among these, seven species were lycophytes (3.1%), 41 species were pterophytes (18.4%), three species were gymnosperms (1.3%), 113 species were dicots (50.7%) and 59 species were monocots (26.5%) (Table 2). Species list is shown in Appendix 1. Sixteen species are new records for Thailand, i.e. *Syngamma minima* Holttum, *Anodendron axillare* Merr., *Willughbeia tenuiflora* Dyer ex Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC., *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausen, *P. hanseniana* Clausen, *Coelogyne prasina* Ridl. *C. testacea* Lindl., *Dendrobium metrium* Kraenzl., *Epigeneium geminatum* (Blume) Summerh. and *Geostachys penangensis* Ridl. There were 25 unidentified species, two species of which are expected to be new to science, i.e. *Hoya* sp. and *Dendrobium* sp. In addition, four alien species were found in the study area, i.e. *Ageratum* sp., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clidemia hirta* D. Don and *Lantana camara* L.

**Table 2.** Number of families, genera and species in major groups of vascular plants found in the study sites.

Plant groups	Families	Genera	Species
LYCOPHYTES	2	3	7
PTEROPHYTES	15	23	41
GYMNOSPERMS	2	2	3
ANGIOSPERMS	51	113	172
Dicots	43	81	113
Monocots	8	32	59
<b>TOTAL</b>	<b>70</b>	<b>141</b>	<b>223</b>

The plant families with the largest numbers of species in each major group are shown in Table 3. Selaginellaceae had the highest number of species among lycophytes (4 species, 13.3%), followed by Lycopodiaceae (3 species, 33.3%). Three families of pterophytes, namely Polypodiaceae (11 species, 10.8%), Davalliaceae (7 species, 36.8%) and Aspleniaceae (4 species, 10.8%) were among the most common ferns. The most species-rich families of dicots were Asclepiadaceae (10 species, 6.7%), followed by Rubiaceae (9 species, 1.5%), Melastomataceae (8 species, 11.4%), Myrtaceae (8 species, 7.1%), Gesneriaceae (7 species, 4.4%) and Moraceae (7 species, 6.4%), while the most predominant monocot families were Orchidaceae (40 species, 3.3%), Arecaceae (6 species, 4%) and Zingiberaceae (5 species, 2.5%), respectively.

**Table 3.** Predominant families in each major group found in the study sites (excluding gymnosperms).

Plant group	Study site				Total
	A	B	C	D	
<b>Lycophytes</b>					
Selaginellaceae	3	-	1	1	4/30 (13.3%)
Lycopodiaceae	2	1	-	1	3/9 (33.3%)
<b>Pterophytes</b>					
Polypodiaceae	5	5	4	8	11/102 (10.8%)
Davalliaceae	4	4	3	5	7/19 (36.8%)
Aspleniaceae	1	3	1	3	4/37 (10.8%)
<b>Dicots</b>					
Asclepiadaceae	2	4	2	5	10/150 (6.7%)
Rubiaceae	4	5	2	7	9/600 (1.5%)
Melastomataceae	6	5	5	6	8/70 (11.4%)
Myrtaceae	5	5	3	2	8/112 (7.1%)
Gesneriaceae	3	4	2	3	7/160 (4.4%)
Moraceae	2	3	3	4	7/110 (6.4%)
Apocynaceae	3	4	3	3	5/125 (4%)
Annonaceae	-	3	1	1	5/200 (2.5%)
<b>Monocots</b>					
Orchidaceae	20	26	14	14	40/1200 (3.3%)
Arecaceae	1	3	1	4	6/150 (4%)
Zingiberaceae	2	2	-	2	5/200 (2.5%)
Poaceae	3	2	2	1	3/600 (0.5%)

$$\% = \frac{\text{The number of species found in the study sites}}{\text{The approximately total number of species in Thailand}} \times 100$$

Species richness

The observed and estimated species richness of vascular plants in study sites are shown in Table 4. The observed and estimated species richness varied among sites, ranging from 74 to 127 species and 100 to 160 species, respectively. The total species richness of vascular plants in the study sites was estimated at least about 250 species.

**Table 4.** Number of families, genera and species in the study sites.

Study site	Richness (Observed)			Estimated species richness
	Family	Genus	Species	
A. Gunung Silipid	44	75	99	> 120
B. Khao Hin Ban Chantharat	48	96	127	> 160
C. Khao Hin Ban Bo Num Ron	39	62	74	> 100
D. Khao Hin Ban Piyamit 2	52	91	114	> 150
Total	70	141	223	> 250

The total species richness of vascular plants in woodland vegetation of all three quartzitic phyllite ridges (155 species) was about twice as high as that of grassland and scrub vegetation (82 species) (Table 5).

**Table 5.** Number of species recorded in two different sub-vegetation types on quartzitic phyllite ridges.

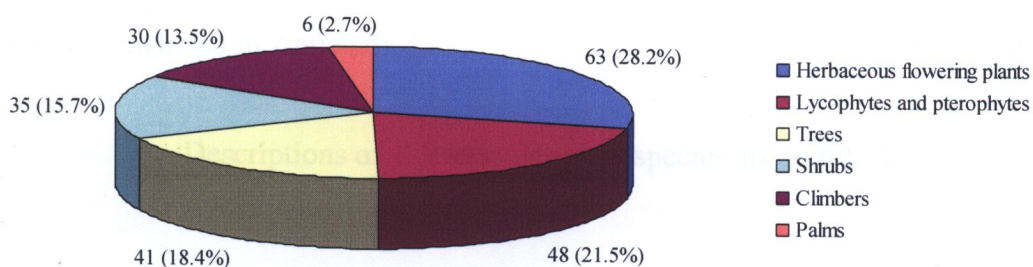
Study site	Species richness	
	Grassland and scrub vegetation	Woodland vegetation
A. Gunung Silipid	47	78
B. Khao Hin Ban Chantharat	55	116
C. Khao Hin Ban Bo Num Ron	44	53
Total	82	155

**Note:** See also details of sub-vegetation types in the vegetation study (Page 235-242).



### Plant habits/life forms

Among the 223 species of vascular plants that occurred in the study sites, the most abundant habit/life form was that of herbaceous flowering plants (63 species, 28.2%), followed by lycophytes and pterophytes (48 species, 21.5%), trees (41 species, 18.4%), shrubs (35 species, 15.7%), climbers (30 species, 13.5%), palms (6 species, 2.7%) (Fig. 7). Most herbaceous plants (including lycophytes and ferns), shrubs and climbers were lithophytes and/or facultative epiphytes, whereas most tree species were terrestrials. Additional three species were parasitic shrubs (Appendix 1).



**Figure 7.** The pie chart of habit/life form of vascular plant species found in the study sites.

### The abundance of plant species

The abundance of each plant species is shown in Appendix 1. The tree species with the highest value of relative abundance were *Syzygium gratum* (Wight) S.N. Mitra var. *gratum* (found in almost every study sites), and *Rhodoleia championii* Hook.f. (only found on Gunung Silipid). Some tree species occur with high or moderate numbers of individuals, i.e. *Tristaniaopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh., *Anneslea fragrans* Wall. and *Syzygium syzygioides* (Miq.) Merr & L.M. Perry. In shrubby plants, the species with the highest value of relative abundance were *Vaccinium bancanum* Miq. and *Melastoma malabathricum* L. subsp. *malabathricum*. Among herbaceous plants, the species with the highest value of relative abundance were *Eulalia speciosa* Kuntze, *Dicranopteris linearis* (Burm.f.) Underw., *Pteridium aquilinum* (L.) Kuhn, *Oleandra pistillaris* (Sw.) C. Chr., *O. undulata* (Willd.) Ching and *Coelogyne cumingii* Lindl.

**Species descriptions**

Four hundred and twenty two specimens were collected representing 129 species, 73 genera and 40 families. The full morphological descriptions, status of these taxa (common, uncommon, rare) as well as ecological data, localities and distribution range of each species together with the photographs were provided.

**Note:** Ninety four plant species found in the study sites could not be described in full detail because some of the collections were damaged during the study and inadequate (lacking key characters such as flowers, fruit or fertile segments). They were, however, included in Appendix 1.

Descriptions of 129 vascular plant species are as follows:

## LYCOPHYTES

### LYCOPODIACEAE

**1. *Huperzia phlegmaria* (L.) Rothm., Feddes Repert. Spec. Nov. Regni Veg. 54: 62. 1944.—***Lycopodium phlegmaria* L., Sp. Pl. 2: 1101. 1753; Tagawa & K. Iwats. in Fl. Thailand 3(1): 10. 1979; J.L. Tsai & W.C. Shieh in Fl. Taiwan 1: 39. 1994. **Plate 5A-B.**

Epiphyte or lithophyte. **Stems** pendulous or sometimes erect (when young), terete, dichotomously and regularly branched, up to 50 cm or more long, 1-2 mm in diam.; roots forming a basal tuft. **Leaves** coriaceous, rigid, spirally arranged or pseudowhorled, spreading, lanceolate to narrowly triangular or subdeltoid, 5-13 by 2-4 mm, green or yellowish green, glossy, glabrous, 1-veined, apex acute to subacuminate, base truncate or rounded, subsessile, margin entire. **Strobili** distinct, terminal, slender, dichotomously branched, 5-20 cm long, 0.5-1 mm in diam.; sporophylls persistent, adpressed, triangular-ovate, 1-1.5 by 0.5-1 mm, apex acute, base broad, sessile, margin entire. **Sporangia** axillary, solitary, with a very short stalk, reniform, 0.6-0.7 mm in diam. **Spores** homosporous, numerous in each sporangium, tetrahedral, trilete, subglobular, 25-30  $\mu$ m in diam.

**Thailand.**— NORTHERN: Lampang; NORTH-EASTERN: Loei, Nong Khai; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi; PENINSULAR: Chumphon, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Phatthalung, Satun, Yala.

**Distribution.**— India, Southern Japan to Southeast Asia.

**Ecology.**— On moist cliffs or on mossy rocks in shady areas of the quartzitic phyllite ridges at 550-700 m alt., and also found on tree trunks in lowland evergreen forest and rubber plantation. Uncommon.

**Vernacular.**— Chong Nang Khli (ช้องนางคลี) (Southwestern); Klet Nakkharat (เกล็ดนาคราช) (Northeastern); Raya (ระย้า) (Peninsular); Yom Doi (ยมโดย) (Central).

**Specimens examined.**— BETONG: *J. Wai* 191 (PSU), 879 (PSU); NAKHON SI THAMMARAT: *W. Ramsri* 13 (PSU).

**2. *Huperzia squarrosa*** (G. Forst.) Trevis., Atti Soc. Ital. Sci. Nat. 17(2): 247. 1874.— *Lycopodium squarrosum* G. Forst., Fl. Ins. Austr.: 479. 1786; Tagawa & K. Iwats. in Fl. Thailand 3(1): 9. 1979; J.L. Tsai & W.C. Shieh in Fl. Taiwan 1: 43. 1994. **Plate 5C-D.**

Epiphyte or lithophyte. **Stems** pendulous or sometimes erect (when young), terete, dichotomously and regularly branched, up to 60 cm or more long, 3-5 mm in diam. **Leaves** coriaceous, rigid, densely and spirally arranged, spreading, slightly twisted and recurved, linear-lanceolate, 7-14 by 1-2 mm, pale to dark green, glossy, glabrous, 1-veined, apex acuminate, base broad, sessile, margin entire. **Strobili** (the apical fertile portions) indistinct, terminal, slender, ca. 4.5 cm long, 0.5-0.7 mm in diam.; sporophylls persistent, almost similar to leaves, coriaceous, linear-lanceolate or narrowly triangular-ovate, 4-6 by ca. 1 mm, apex acute, base broad, sessile, margin entire. **Sporangia** axillary, solitary, with a very short stalk, reniform, ca. 1 mm in diam. **Spores** homosporous, numerous in each sporangium, tetrahedral, trilete, subglobular, 20-30  $\mu$ m in diam.

**Thailand.**— NORTHERN: Phitsanulok; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Yala.

**Distribution.**— Madagascar, Tropics and subtropics of Asia and Oceania.

**Ecology.**— On moist mossy cliffs in shady areas of the granitic ridges at 850-900 m alt., and also found on tree trunks in evergreen lowland forest. Uncommon.

**Vernacular.**— Chong Nang Khli (ช้องนางคลี) (Northern); Hang Khang (หางค่าง) (Peninsular).

**Specimen examined.**— BETONG: *J. Wai* 916 (PSU).

**3. *Lycopodiella cernua* (L.) Pic. Serm.,** *Webbia* 23: 166. 1968.— *Lycopodium cernuum* L., *Sp. Pl.* 2: 1103. 1753; Tagawa & K. Iwats. in *Fl. Thailand* 3(1): 12. 1979; J.L. Tsai & W.C. Shieh in *Fl. Taiwan* 1: 31, pl. 3. 1994. **Plate 6A-B.**

Terrestrial plant or rarely lithophyte. **Stems** terete, with indeterminate growth; main erect stems irregularly dichotomously branched (pseudomonopodial), densely covered with leaves (except on the lower part), up to 45 cm or more long, 2-3 mm in diam.; horizontal stems on substrate surface or subterranean, wide creeping. **Leaves** coriaceous, soft, spirally arranged or pseudowhorled, appressed in the lower part, spreading and incurved in the upper part, linear, 1-3 by ca. 0.5 mm, green or yellowish green, glabrous, 1-veined, apex acuminate, base broad, sessile, margin entire. **Strobili** terminal, solitary or rarely 2 at each apex of the fertile branches, pendulous, up to 8 mm long, ca. 2 mm in diam.; sporophylls ephemeral, imbricate, coriaceous, ovate, 10-15 by 0.7-10 mm, apex acuminate, base subpeltate, sessile, margin irregularly toothed. **Sporangia** solitary, at base of the adaxial surface of sporophylls, sessile, subglobular, ca. 0.5 mm in diam. **Spores** homosporous, numerous in each sporangium, tetrahedral, trilete, subglobular, 20-25  $\mu\text{m}$  in diam.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Tak, Phitsanulok; NORTH-EASTERN: Loei; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; PENINSULAR: Chumphon, Surat Thani, Nakhon Si Thammarat, Trang, Phatthalung, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Pantropics and subtropics throughout the world.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves in exposed areas of the quartzitic phyllite ridges at 600-650 m alt., and also found in lowland evergreen forest and rubber plantation. Common.

**Vernacular.**— Kut Khon (กูดชน) (Northern); Sam Roi Yot (สามร้อยยอด), Ya Rang Nok (หญ้ารังนก) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 712 (PSU), 883 (PSU); SATUN: *Hamilton & Congdon* 323 (PSU), *K. Larsen et al.* 41139 (PSU); SONGKHLA: *J.F. Maxwell* 85-758 (PSU), 86-854 (PSU), *H. Sitta* 1 (PSU).

## SELAGINELLACEAE

**4. *Selaginella intermedia*** (Blume) Spring, Bull. Acad. Roy. Sci. Bruxelles 10: 144. 1843; Tagawa & K. Iwats. in Fl. Thailand 3(1): 21. 1979.— *Lycopodium intermedium* Blume, Enum. Pl. Javae: 269. 1828.— *L. atroviride* Wall. ex Hook. & Grev., Icon. Filic. 1: t. 39. 1831. **Plate 6C-D.**

Terrestrial plant, 20-40 cm or more long. **Stems** creeping, becoming erect, terete or slightly flattened, 1-2.5 mm in diam., bearing rhizophores on lower part of stem; rhizophores ca. 1 mm in diam.; lateral branches regularly or irregularly dichotomously forked. **Leaves** dimorphic, spirally arranged in 4 complanated rows, 2 along both sides of branches and the other 2 along the upper, thin and papery in texture, brown to reddish brown or greenish, glossy, glabrous; leaves along lateral rows spreading almost at right angles to the stem, oblong-lanceolate, slightly falcate, 3-6 by 1-2.5 mm, 1-veined, with 2 lateral pseudoveins, apex acute, base obliquely rounded, sessile, margin translucent, minutely denticulate; those along dorsal rows imbricate (except on lower part of the stem), appressed, elliptic to elliptic-ovate, 1.5-4 by 0.5-2 mm, 1-veined, apex aristate, base rounded, sessile, margin translucent, dentate. **Strobili** terminal, tetragonous, slender, up to 2.5 cm long, 1.5-2 mm in diam., having two rows of megasporangia and two rows of microsporangia; sporophylls isomorphic, imbricate, ovate, ca. 1.5 by 0.5-1 mm, 1-veined, apex acuminate, base

rounded, sessile, margin dentate. *Sporangia* solitary in axil of sporophylls, stalked; megasporangia subglobular, ca. 0.7 mm in diam.; megaspores 4 in each megasporangium, tetrahedral, trilete, subglobular, ca. 0.3 mm in diam., rugose; microsporangia ovoid, ca. 0.7 by 0.5 mm; microspores numerous in each microsporangium, tetrahedral, trilete, subglobular, 20-25  $\mu$ m in diam., echinate.

**Thailand.**— NORTHERN: Lampang; NORTH-EASTERN: Loei; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Phatthalung, Trang, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— Indochina, Myanmar, Peninsular Malaysia, Sumatra, Java, Borneo and Sulawesi.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves in shady areas, usually found in the foothills of quartzitic phyllite ridges, and also found in lowland evergreen forest and rubber plantation, alt. 200-700 m. Common.

**Vernacular.**— Hi Moi Sao Kae (หิ๋มอยสาวแก่) (Northeastern).

**Specimens examined.**— BETONG: *J. Wai* 448 (PSU), 610 (BCU, PSU); SURAT THANI: *K. Larsen et al.* 40894 (PSU); PHATTHALUNG: *J.F. Maxwell* 86-752 (PSU); SONGKHLA: *Hamilton & Congdon* 359 (PSU), *J.F. Maxwell* 84-322 (PSU).

**5. *Selaginella siamensis*** Hieron., Bot. Tidsskr. 24: 113. 1901; Tagawa & K. Iwats. in Fl. Thailand 3(1): 18. 1979.— *S. reptans* Ridl. (non Sodirol), J. Straits Branch Roy. Asiat. Soc. 80: 155. 1919.— *S. riddleana* Kummerle, Magyar Bot. Lapok 26: 100. 1938. *Plate 6E-F*.

Lithophyte or terrestrial plant. *Stems* procumbent, terete, 1-2 mm in diam., growing indefinitely, rooting at apical part to form new plants; rhizophores ca. 0.5 mm

in diam.; lateral braches bipinnate, tripinnate or sometimes subdichotomously forked, triangular-ovate in outline. *Leaves* subisomorphic, spirally arranged in 4 complanated rows, 2 along both sides of branches and the other 2 along the upper, thin and papery in texture, light green or sometimes brownish, glabrous; leaves along lateral rows spreading at acute angles to the stem, slightly asymmetrically ovate to oblong-ovate, 1.5-3 by 0.5-2 mm, 1-veined, apex aristate, base rounded to cordate, sessile, margin ciliate; those along dorsal rows imbricate (except on the elongated main stem), appressed, similar to leaves along lateral rows or only slightly smaller in size. *Strobili* terminal, tetragonous, up to 4 mm long, 1.5-2.5 mm in diam., having two rows of megasporangia and two rows of microsporangia; sporophylls isomorphic, imbricate, ovate, 1-2 by 0.5-1 mm, 1-veined, apex aristate, base broad, sessile, margin ciliate. *Sporangia* solitary in axil of sporophylls, stalked; megasporangia subglobular, 0.7-0.8 mm in diam.; megaspores 4 in each megasporangium, tetrahedral, trilete, subglobular, 0.2-0.25 mm in diam., scabrate; microsporangia reniform to subglobular, 0.5-0.6 mm in diam.; microspores numerous in each microsporangium, tetrahedral, trilete, subglobular, 20-30  $\mu$ m in diam., scabrate.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Phitsanulok; NORTH-EASTERN: Loei; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Trat; PENINSULAR: Chumphon, Ranong, Phangnga, Nakhon Si Thammarat, Trang, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— Indochina.

**Ecology.**— On mossy rocks or on moist rocky or sandy heath soils, usually found in exposed and in partially shaded areas of quartzitic phyllite ridges, alt. 600-650 m. Uncommon.

**Vernacular.**— Phak Nok Yung (ผักนกกยุง) (Northeastern).

**Remarks.**— It is also expected to be found in the Peninsular Malaysia.



**Specimens examined.**— BETONG: *J. Wai* 654 (PSU), 817 (BCU, PSU).

**6. *Selaginella strigosa*** Bedd., Bull. Misc. Inform., Kew 1911: 192. 1911; Tagawa & K. Iwats. in Fl. Thailand 3(1): 26, fig. 2 (20-22). 1979. **Plate 7A-B.**

Lithophyte, up to 9 cm long. **Stems** pendulous or prostrate, terete, 0.2-0.3 mm in diam., bearing many rhizophores on lower part of stem; rhizophores 0.1-0.2 mm in diam.; lateral branches simple or few times forked. **Leaves** dimorphic, spirally arranged in 4 complanated rows, 2 along both sides of branches and the other 2 along the upper, thin and papery in texture, pale green or sometimes brownish, glossy, upper surface strigose or sometimes subglabrous; leaves along lateral rows spreading almost at right angles to the stem, slightly asymmetrically ovate, 1.5-3 by 1-2 mm, apex acute to acuminate, base obliquely rounded, sessile, margin ciliate, 1-veined; those along dorsal rows imbricate or not, appressed, elliptic-ovate, 1-2 by 0.5-1 mm, 1-veined, apex aristate, base obliquely rounded, sessile, margin ciliate. **Strobili** terminal, tetragonous, up to 1.2 cm long, 1-2 mm in diam., having two rows of megasporangia (occasionally with few to many microsporangia) and two rows of microsporangia or sometimes wholly microsporangiate; sporophylls isomorphic, imbricate, triangular-ovate, 1-2 by 0.2-0.5 mm, 1-veined, outer surface strigose or sometimes subglabrous, apex long acuminate, base rounded, sessile, margin ciliate. **Sporangia** solitary in axil of sporophylls, stalked; megasporangia subglobular, ca. 0.4 mm in diam.; megasporos 4 in each megasporangium, tetrahedral, trilete, subglobular, ca. 0.15 mm in diam., rugose; microsporangia ovoid, 0.3-0.4 by 0.2-0.3 mm; microspores numerous in each microsporangium, tetrahedral, trilete, subglobular, 20-25  $\mu$ m in diam., verrucate.

**Thailand.**— PENINSULAR: Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On moist mossy rocks in shady areas, usually found in the foothills of quartzitic phyllite ridges, alt. 550-600 m. Very rare.

**Vernacular.**—

**Specimen examined.**— BETONG: *J. Wai* 969 (BCU, PSU).

**7. *Selaginella wallichii*** (Hook. & Grev.) Spring in Fl. Bras. (Martius) 1(2): 124. 1840; Tagawa & K. Iwats. in Fl. Thailand 3(1): 20, fig. 2 (15-16). 1979.— *Lycopodium wallichii* Hook. & Grev., Bot. Misc. 2: 384. 1831. **Plate 7C-D.**

Terrestrial plant, up to 60 cm or more high. **Stems** erect, terete, 2-3 mm in diam., bearing many rhizophores on lower part of stem; rhizophores 1-2 mm in diam.; lateral branches pinnate, oblong-lanceolate to lanceolate in outline, 10-19 by 2.5-4.5 cm; pinnae of lateral branches oblong to oblong-lanceolate in outline, 8-25 by 3-6 mm. **Leaves** dimorphic, spirally arranged in 4 complanated rows, 2 along both sides of branches and the other 2 along the upper, thin and papery in texture, green, glossy, glabrous; leaves along lateral rows close together, spreading (except on the main erect stem distant, adpressed), oblong to oblong-lanceolate, slightly falcate, 2-3.5 by 1-1.5 mm, 1-veined, apex acute, base oblique, slightly auriculate at basiscopic side, sessile, margin entire, cartilaginous; those along dorsal rows imbricate (except on lower part of the stem), appressed, falcate-oblong, 0.5-1.5 by 0.2-0.5 mm, 1-veined, apex acuminate, base oblique, sessile, margin entire, cartilaginous. **Strobili** terminal, tetragonous, up to 2.5 cm or more long, 1-2 mm in diam., having two rows of megasporangia (occasionally with few to many microsporangia) and two rows of microsporangia; sporophylls isomorphic, imbricate, ovate, 1-1.5 by 0.5-0.8 mm, 1-veined, glabrous, apex acuminate, base rounded, sessile, margin entire. **Sporangia** solitary in axil of sporophylls, stalked; megasporangia subglobular, 0.4-0.6 mm in diam.; megasporos 4 in each megasporangium, tetrahedral, trilete, subglobular, 0.2-0.3 mm in diam., tuberculate; microsporangia ovoid, 0.3-0.4 by 0.2-0.3 mm; microspores numerous in each microsporangium, tetrahedral, trilete, subglobular, 25-30  $\mu$ m in diam., scabrate.

**Thailand.**— PENINSULAR: Ranong, Surat Thani, Nakhon Si Thammarat, Narathiwat, Yala.

**Distribution.**— Indochina, Myanmar, Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves in shady areas, usually found in the foothills of mountain ridges, and also found in lowland evergreen forest and rubber plantation, alt. 100-950 m. Uncommon.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 355 (BCU, PSU), 1096 (PSU), *J. Supapol* 226 (PSU); SURAT THANI: *K. Larsen et al.* 40895 (PSU); NARATHIWAT: *J.F. Maxwell* 87-261 (PSU).

## **PTEROPHYTES**

### **ADIANTACEAE**

**8. *Syngamma minima*** Holttum, Gard. Bull. Straits Settle. 4: 56. 1927; Holttum, Rev. Fl. Malaya 2: 585, fig. 345. 1954. *Plate 7E-F*.

Lithophyte. **Rhizome** short creeping, 1.5-3 mm in diam., bearing crowded fronds, densely covered with bristles; bristles stiff, multicellular, 0.5-1.5 mm long, dark brown to almost black, glossy. **Fronds** simple. **Stipe** not articulate to rhizome, grooved above, narrowly winged, 1-3 cm long, green or sometimes purplish brown, covered with minutely short bristles at the base. **Lamina** coriaceous, rigid, narrowly oblong to linear-oblong or spatulate, 1-7 by 0.2-0.5 cm, olive green, glabrous, apex rounded, base attenuate, margin crenate-denticulate, cartilaginous; midrib grooved above and prominent underneath, green or sometimes purplish brown; veins usually simple or once forked, anastomosing near the margin, slightly raised on the upper surface, sometimes inconspicuous especially in old fronds. **Sori** exindusiate, linear, elongated along the veins, extending about half-way to near the apical part of veins, 0.5-2 mm long; paraphyses with an enlarged terminal cell, reddish brown or red.

**Sporangia** subsessile, 0.15-0.2 mm in diam.; annulus vertical, interrupted. **Spores** trilete, tetrahedral, subglobular, 35-40  $\mu$ m in diam., rough, irregularly tuberculate.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On the cliffs in shady areas near the top of quartzitic phyllite ridges, alt. 650 m. Very rare.

**Vernacular.**—

**Remarks.**— *Syngamma minima* Holttum was previously known only from one locality on quartzite rocks near the summit of Gunung panti in South-East Johore of Malaysia (Holttum, 1954). This study demonstrates this species is new for Thailand.

**Specimen examined.**— *J. Wai* 984 (PSU).

**9. *Taenitis blechnoides*** (Willd.) Sw., Syn. Fil. (Swartz): 24, 220. 1806; Holttum, Rev. Fl. Malaya 2: 586, fig. 346. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 186. 1985.— *Pteris blechnoides* Willd., Phytographia: 13, t. 9, fig. 3. 1794. **Plate 8A-B.**

Terrestrial or lithophytic plant. **Rhizome** creeping, 5-7 mm in diam., apical part densely covered with bristles; bristles stiff, multicellular, 1-2 mm long, dark brown to almost black, glossy. **Fronde**s pinnate. **Stipes** not articulate to rhizome, slender, terete, grooved, 12-55 cm long, glossy, upper part green, lower part purplish brown, covered with bristles at the base; rachis grooved above, glabrous. **Lamina** subcoriaceous to coriaceous, rigid, nearly rhombic in outline, 25-30 by 20-25 cm, glossy, glabrous, green to dark green above, pale green underneath; lateral pinnae 2-5 pairs, subopposite, sessile or on stalk to 8 mm long, not articulate to rachis, linear-lanceolate to linear-oblong, sometimes slightly falcate, 10-20 by 1.5-3 cm, apex acuminate, base

narrowly cuneate, sometimes oblique, margin slightly undulate, sometimes narrowly revolute, cartilaginous; costa grooved above, prominent underneath; veins anastomosing and forming oblique areoles without included veinlets, slightly raised on both surfaces or sometimes inconspicuous especially in old fronds. *Sori* exindusiate, elongated along a longitudinal band about half-way between costa and margin of pinna, 1-2 mm wide, rarely interrupted; paraphyses thickened upwards, 0.5-0.8 mm long. *Sporangia* oblong, 0.25-0.35 by 0.15-0.2 mm; stalk ca. 0.3 mm long; annulus vertical, interrupted. *Spores* trilete, tetrahedral, subtriangular or subglobular, 35-50  $\mu$ m in diam., slightly rough, with an equatorial flange.

**Thailand.**— NORTHERN: Phitsanulok; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phuket, Nakhon Si Thammarat, Phatthalung, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Sri Lanka, Southern India, Indochina and through Malaysia to Fiji.

**Ecology.**— On rocky or sandy heath soils with the decaying organic matter, occasional on the cliffs, usually in shady areas of quartzitic phyllite ridges, and also found in lowland evergreen forest and rubber plantation, from near sea level to 700 m alt. Common.

**Vernacular.**— Kut Prong (กูดปรอง) (Chanthaburi); Prong Nu (ปรองหนู) (Chumphon); Pa Hong Ti Ku (ปาโฮงตีกู) (Malay-Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 89 (PSU), 927 (PSU), 981 (PSU); NAKHON SI THAMMARAT: *J.F. Maxwell* 87-200 (PSU); PHATTHALUNG: *P. Panggul* 347 (PSU); SONGKHLA: *A. Tongphan* 8 (PSU), *J.F. Maxwell* 87-248 (PSU).

## ASPLENIACEAE

**10. *Asplenium affine*** Sw., J. Bot. (Schrader) 1800(2): 56. 1801; Tagawa & K. Iwats. in Fl. Thailand 3(2): 288. 1985.— *A. spathulinum* J. Sm. ex Hook., Sp. Fil. 3: 170. 1860; Holttum, Rev. Fl. Malaya 2: 439, fig. 257. 1954. **Plate 8C-D.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** short creeping, bearing a tuft of fronds, scaly at the apex; scales thin, clathrate, gradually narrowed towards apex, up to 12 by 1 mm, dark brown, glossy, margin entire, undulate, crisped or sometimes bearing appendages. **Fronds** bipinnate, tripinnatifid or subtripinnate. **Stipe** not articulate to rhizome, slender, grooved, 10-17 cm long, dark purplish to nearly black, glossy, minutely scaly or glabrescent, base covered with long pale brown scales especially when young; rachis grooved above, minutely scaly or glabrescent. **Lamina** chartaceous to subcoriaceous, subtriangular or oblong in outline, 25-35 by 12-20 cm, glossy, green to dark green above, pale green underneath, glabrescent, apex gradually acuminate; lateral pinnae 10-15 pairs, alternate, with stalks 2-6 mm long, not articulate to rachis, subtriangular or oblong in outline, apex gradually acuminate, base broadly cuneate, largest pinnae up to 12 by 4 cm; pinnules up to 10 pairs, subsessile or shortly stalked, spatulate, obovate or subquadrangular in outline, shallowly toothed to deeply lobed, apex rounded, base cuneate, the largest on lower pinnae up to 2.5 by 1.5 cm; veins 2-5 times forked, moderately conspicuous on both surfaces. **Sori** indusiate, linear or linear-oblong, elongated along the veins, not reaching the margin, up to 5 mm long; indusia thin, 0.4-0.5 mm wide, reflexed when mature. **Sporangia** 0.15-0.2 mm in diam.; stalk ca. 0.3 mm long; annulus vertical, interrupted. **Spores** monoletе, ellipsoid to ellipsoid-oblong, 30-40 by 20-25  $\mu$ m; perispore prominent, winged.

**Thailand.**— NORTHERN: Tak, Phitsanulok; NORTH-EASTERN: Loei; SOUTH-EASTERN: Prachin Buri; PENINSULAR: Phangnga, Yala.

**Distribution.**— Madagascar, Mascarene Islands, Sri Lanka, India, China, Cambodia, through Malaysia to Fiji.

**Ecology.**— On mossy rocks or on rocky or sandy heath soils with the litter of decaying leaves in shady areas of mountain ridges at 650-950 m alt., and also found on tree trunks in lowland evergreen forest. Uncommon.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 687 (PSU), 1092 (PSU).

**11. *Asplenium nidus* L. var. *nidus***, Sp. Pl. 2: 1079. 1753; Holttum, Rev. Fl. Malaya 2: 419. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 266. 1985; W.C. Shieh, De vol & C.M. Kuo in Fl. Taiwan 1: 457. 1994.— *Thamnopteris nidus* (L.) C. Presl, Epimel. Bot.: 68. 1849. **Plate 8E-F.**

Epiphyte or lithophyte. **Rhizome** short, erect or suberect, densely covered with a spongy mass of roots and humus, bearing crowded fronds at the top, scaly at the apex; scales thin, clathrate, up to 20 by 3 mm, dark brown to nearly black, glossy, margin bearing hair-like appendages. **Fronds** simple. **Stipe** not articulate to rhizome, stout, ca. 5 cm long, dark purplish to nearly black, brownish when dry, glossy, covered with scales at the base. **Lamina** coriaceous, narrowly oblong, spatulate or linear-elliptic, 100-140 by 10-15 cm, glossy, green to dark green above, pale green underneath, glabrous, apex acute, base attenuate, margin undulate; midrib moderately raised above and prominent underneath; veins often once forked near the midrib or sometimes simple, uniting to form a submarginal vein 0.5-1 mm from the margin. **Sori** indusiate, linear, elongated along the veins, extending from near the midrib half-way to the margin, 0.5-2.5 mm long; indusia thin, ca. 0.5 mm wide, reflexed when mature. **Sporangia** ca. 0.2 mm in diam.; stalk ca. 0.5 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid to ellipsoid-oblong, 30-50 by 25-30  $\mu$ m; perispore prominent, ridged.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang; NORTH-EASTERN: Loei, Nong Khai; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Saraburi; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Surat Thani, Krabi, Nakhon Si Thammarat, Yala.

**Distribution.**— Throughout the Paleotropics.

**Ecology.**— On moist rocks in shady areas of quartzitic phyllite ridges at 700 m alt., and usually found on trees in lowland evergreen forest, durian and rubber plantations. Common.

**Vernacular.**— Katae Tai Hin (กระแตไต่หิน) (Northeastern); Kaprok Hua Long (กระปรอกหัวหลง), Kaprok Hang Sing (กระปรอกหางสิงห์) (Southeastern); Khaluang Lang Lai (ข้าหลวงหลังลาย), Chong Nang (ช้องนาง), Hang Nok Yung (หางนกยูง) (Surat Thani); Hang Nok Wa (หางนกหว่า) (Yala).

**Specimens examined.**— BETONG: *J. Wai* 903 (PSU); KRABI: *J.F. Maxwell* 86-1009 (PSU).

**12. *Asplenium pellucidum*** Lam., *Encycl.* 2(1): 305. 1786; Holttum, *Rev. Fl. Malaya* 2: 428, fig. 246. 1954; Tagawa & K. Iwats. in *Fl. Thailand* 3(2): 282. 1985.— *A. hirtum* Kaulf., *Enum. Pl. Javae*: 169. 1824. **Plate 9A-B.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** short creeping, bearing a tuft of fronds, the apex densely covered with scales; scales clathrate, narrowed from base to long-tailed apex, up to 15 by 1 mm, dark brown to almost black, glossy, margin bearing appendages. **Fronds** pinnate. **Stipe** not articulate to rhizome, 1.5-3(-10) cm long, dark purplish brown to nearly black, glossy, shallowly grooved, scaly; rachis shallowly grooved above, scaly. **Lamina** chartaceous to subcoriaceous, oblong to linear-oblong or narrowly elliptic-oblong in outline, 22-100 by 3-15 cm, bright green above, pale green underneath, glabrescent, apex gradually acuminate; lateral pinnae 30-80 pairs, alternate or subopposite, sessile, not articulate to rachis, spreading almost at right angles to the rachis, oblong-lanceolate or subtriangular, except on the lower pinnae extremely reduced to a suborbicular shape, apex acute, obtuse or rounded, base broadly cuneate or truncate at auriculate acroscopic base, narrowly cuneate to truncate at basisopic base, margin usually shallowly serrate, largest pinnae up to 5 by 1 cm; veins 1-3 times forked, more or less



visible, raised above. **Sori** indusiate, linear to linear-oblong, elongated along the acroscopic branches of the veins, not reaching the margin, up to 6 mm long; indusia firm, brown, 0.5-0.8 mm wide, rolled back when mature. **Sporangia** 0.15-0.2 mm in diam.; stalk 0.2-0.5 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid to ellipsoid-oblong, 30-40 by 20-25  $\mu$ m; perispore prominent, winged.

**Thailand.**— NORTHERN: Tak; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi; PENINSULAR: Nakhon Si Thammarat, Phatthalung, Trang, Satun, Yala.

**Distribution.**— Paleotropics, from East-Africa to New Guinea.

**Ecology.**— Growing on trees, on rocks or sometimes on the litter of decaying leaves in partial shade of mountain ridges at 600-950 m alt., and also found in lowland evergreen forest and rubber plantation. Uncommon.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 298 (PSU), 531 (PSU), 673 (PSU), 836 (PSU), 861 (PSU), 965 (PSU); PHATTHALUNG: *J.F. Maxwell* 86-660.

## DAVALLIACEAE

**13. *Davallia denticulata*** (Burm.f.) Mett. ex Kuhn, *Filic. Afr.*: 27. 1868; Holttum, *Rev. Fl. Malaya* 2: 359, figs. 203, 206. 1954; Tagawa & K. Iwats. in *Fl. Thailand* 3(2): 160. 1985.— *Adiantum denticulatum* Burm.f., *Fl. Ind.*: 236. 1768.— *Davallia elegans* Sw., *J. Bot. (Schrader)* 1800(2): 87. 1801. **Plate 9C-D.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** long creeping, 3-8 mm in diam., densely covered with scales; scales peltate, narrowed from base to long-tailed apex, 4-7 by 0.3-0.8 mm, light brown to almost black, glossy, margin bearing

short spreading teeth. **Fron***ds* quadripinnatifid to quadripinnate. **Sti***pe* articulate to short phyllopodia, terete, grooved, 6.5-45 cm long, green or brown, glabrous; main rachis slightly flexuous, narrowly winged, glabrous. **Lami***na* firmly chartaceous to coriaceous, subtriangular or deltoid in outline, 13-85 by 10-80 cm, glossy, green above, pale green underneath, glabrous, apex gradually acuminate; lateral pinnae 5-20 pairs, alternate, with stalks to 3.5 cm or more long, not articulate to rachis, subtriangular in outline, apex gradually acuminate, base obliquely cuneate, largest pinnae up to 43 by 30 cm; pinnules up to 15 pairs, with stalks to 1 cm long, subtriangular or lanceolate in outline, apex gradually acuminate, base obliquely cuneate, the largest on the lower pinnae up to 17 by 12 cm; secondary pinnules up to 10 pairs, shortly stalked, subtriangular or ovate in outline, the upper ones narrower and subsessile, apex acute or obtuse, base obliquely cuneate; tertiary pinnules sessile or subsessile, subtriangular, ovate or oblong in outline, apex acute to rounded, base obliquely cuneate; lobes acute or obtuse, the lobes of the sterile lamina with shallowly crenate margins, fertile lamina more deeply lobed; veins conspicuous on lower surface; false veinlets present between the true veins. **Sori** indusiate, terminal on veinlets, placed at the margin of small oblique lobes; indusia tubular or cup-shaped, ca. 1 by 1 mm. **Sporangia** 0.15-0.2 mm in diam.; stalk 0.3-0.5 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid-oblong, 30-35 by 20-25  $\mu$ m, smooth, translucent.

**Thailand.**— NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chon Buri, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Yala.

**Distribution.**— Widely distributed in the Paleotropics.

**Ecology.**— On tree trunks and branches, sometimes on moist mossy rocks or on the litter of decaying leaves, in semi-exposed areas of mountain ridges, and also found on limestone hills, in durian, oil palm and rubber plantations, coastal heath and lowland evergreen forests, from sea level to 900 m alt. Common.

**Vernacular.**— Nakkharat (นาคธาร) (Central, Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 628 (PSU), 659 (PSU), 674 (PSU), 818 (PSU), 869 (PSU), 928 (PSU), 1098 (PSU); SURAT THANI: *Ch. Laongpol* 920 (PSU); KRABI: *Ch. Laongpol* 937 (PSU), *J. Supapol* 156 (PSU); SONGKHLA: *A. Augsonkitt & P. Phaisalchantasiri* 18 (PSU).

**14. *Davallia heterophylla*** Sm., Mém. Acad. Roy. Sci. (Turin) 5: 415. 1793.— *Humata heterophylla* (Sm.) Desv., Mém. Soc. Linn. Paris 6: 323. 1827; Holttum, Rev. Fl. Malaya 2: 366, fig. 211. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 168. 1985.  
**Plate 9E-F.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** slender, long creeping, 1.5-2.5 mm in diam., glaucous, densely covered with scales; scales peltate, spreading, narrowed from base to long-tailed apex, 4-5 by 0.5-0.7 mm, purplish brown or dark brown, glossy, margin toothed or sometimes becoming glabrous when old. **Fronds** simple, dimorphic, subcoriaceous to coriaceous, glossy. **Stipe** articulate to short phyllopodia, slightly laterally winged, up to 3.5 cm long, glabrous. **Sterile lamina** ovate, lanceolate or oblong-lanceolate, 2-12 by 1-4.5 cm, green or yellowish green, glabrous, apex acuminate or acute, base rounded to cuneate; veins once or twice forked, more or less conspicuous on the lower surface. **Fertile lamina** linear-lanceolate, 4-12 by 0.8-2.2 cm, shallowly to deeply lobed, usually lobed up to half-way to the midrib, apex bluntly acuminate or obtuse, base broadly to narrowly cuneate; lobes rounded or obtuse at apex, up to 1 by 0.5 cm, margin entire to crenate; veins once or twice forked, more or less conspicuous on the lower surface. **Sori** indusiate, submarginal, terminal on veinlets, 1-6 groups for each lobe; indusia attached by the sides a little above the base, lunate to semi-orbicular, 0.5-1 by 0.5-5 mm. **Sporangia** 0.15-0.2 mm in diam.; stalk up to 0.7 mm long; annulus vertical, interrupted. **Spores** monolet, ellipsoid-oblong, 30-35 by 20-25  $\mu$ m, tuberculate, translucent.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Songkhla, Narathiwat, Yala.

**Distribution.**— Malesia throughout to the Pacific and north to Indochina.

**Ecology.**— On tree trunks, on rocks or sometimes growing on the litter of decaying leaves, often found in mossy places in both semi-exposed and shady areas of quartzitic phyllite ridges, and also found in coastal heath and lowland evergreen forests, from sea level to 700 m alt. Uncommon.

**Vernacular.**— Plai Mon (ปลายมอน) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 352 (PSU), 728 (BCU, PSU), 860 (PSU); PHANGNGA: *Ch. Laongpol* 933 (PSU); KRABI: *Ch. Laongpol* 758 (PSU); SONGKHLA: *J.F. Maxwell* 85-603 (PSU).

**15. *Davallia pectinata* Sm.**, Mém. Acad. Roy. Sci. (Turin) 5: 415. 1793.— *Humata pectinata* (Sm.) Desv., Mém. Soc. Linn. Paris 6: 323. 1827; Holttum, Rev. Fl. Malaya 2: 369, fig. 214. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 167, fig. 12 (4). 1985; W.C. Shieh, De vol & T.Y. Yang in Fl. Taiwan 1: 192, pl. 78. 1994.— *Nephrodium gaimardiana* Gaudich., Voy. Uranie, Bot.: 335, t. 12, fig. 1. 1827.— *Humata gaimardiana* (Gaudich.) J. Sm., London J. Bot. 1: 425. 1842.— *Davallia parallela* Wall. ex Hook., Sp. Fil. 1: 153, t. 42 A. 1845.— *Humata parallela* (Wall. ex Hook.) Brack., U.S. Expl. Exped., Filic. 16: 229. 1854. **Plate 10A-B.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** slender, long creeping, 1-2.5 mm in diam., densely covered with scales; scales peltate, appressed, lanceolate or oblong-lanceolate, ca. 5 by 1 mm, dark brown with paler margins, glossy, apex acuminate, margin with very fine hairs, soon becoming glabrous. **Fronde** deeply pinnatifid. **Stipe** articulate to short phyllopodia, slender, terete, slightly adaxially winged, grooved, 1-9 cm long, sparsely scaly or becoming glabrous when old. **Lamina** coriaceous, triangular-ovate, narrowly deltoid, or oblong in outline, 4.5-

12 by 3-5.5 cm, glossy, green to dark green above, pale green underneath, glabrescent, apex gradually acuminate, lobed almost to the midrib; lobes spreading at right angles to the midrib, slightly curved, 3-6 mm wide in sterile lamina and 2-5 mm wide in fertile lamina, apex rounded or obtuse, margin entire or slightly crenulate in sterile lobes and crenulate in fertile lobes, the basal pair with a few basispic secondary lobes up to 7 by 4 mm; veins once or twice forked, in fertile lamina forked just below the sorus, conspicuous on the lower surface. **Sori** indusiate, submarginal, terminal on veinlets; indusia attached only by the base, semi-orbicular, 0.2-0.3 by 0.3-0.5 mm. **Sporangia** ca. 0.15 mm in diam.; stalk up to 0.25 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid-oblong, ca. 30 by 20  $\mu\text{m}$ , tuberculate, translucent.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Songkhla, Narathiwat, Yala.

**Distribution.**— Throughout the Malesian region and north to Indochina.

**Ecology.**— On moist mossy rocks or growing on the litter of decaying leaves in partial shade of quartzitic phyllite ridges, and also found on tree trunks in coastal heath and lowland evergreen forests, from sea level to 650 m alt. Uncommon.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 761 (PSU); KRABI: *Ch. Laongpol* 757 (PSU); SONGKHLA: *J.F. Maxwell* 85-198 (PSU).

**16. *Davallia repens* (L.f.) Kuhn (non Desv.),** *Filic. Decken.*: 26. 1867, nom. cons.— *Adiantum repens* L.f., *Suppl. Pl.*: 446. 1781.— *Davallia pedata* Sm., *Mém. Acad. Roy. Sci. (Turin)* 5: 415. 1793.— *Humata pedata* J. Sm., *J. Bot. (Hooker)* 3: 416. 1841.— *H. repens* (L.f.) J. Small ex Diels, *Nat. Pflanzenfam.* 1 (4): 209. 1899; Holttum, *Rev. Fl. Malaya* 2: 371, fig. 216. 1954; Tagawa & K. Iwats. in *Fl. Thailand* 3(2): 166. 1985; W.C. Shieh, De vol & T.Y. Yang in *Fl. Taiwan* 1: 195. 1994.—

*Davallia pinnatifida* Baker, J. Linn. Soc., Bot. 24: 257. 1887.— *Humata pinnatifida* (Baker) Bedd., Suppl. Ferns Brit. Ind.: 12. 1892.— *H. intermedia* C. Chr., Index Filic.: 353. 1905. **Plate 10C-D.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** slender, long creeping, 1-2.5 mm in diam., glaucous, densely covered with scales; scales peltate, appressed, lanceolate or oblong-lanceolate, 3-6 by 0.7-1 mm, dark brown to almost black with paler margins, glossy, apex acuminate, margin with very fine hairs, soon becoming glabrous. **Fronde** deeply pinnatifid to pinnate. **Stipe** articulate to short phyllopodia, slender, terete, slightly adaxially winged, grooved, 0.3-8.5 cm long, sparsely scaly or becoming glabrous when old. **Lamina** coriaceous, triangular-ovate, broadly to narrowly deltoid or subpentagonous in outline, 1.5-11.5 by 1.5-5.5 cm, glossy, green to dark green above, pale green underneath, glabrous above, sparsely scaly to glabrescent below, apex gradually acuminate to abruptly acute or obtuse, lobed almost to the midrib; lobes spreading at near right angles to the midrib, slightly curved, apex rounded or obtuse, margin entire or slightly crenulate in sterile lamina, more distinct crenulate or toothed in fertile lamina, the basal pair with many enlarged basiscopic secondary lobes up to 1.2 by 0.7 cm; veins conspicuous on the lower surface, once or twice forked, in fertile lamina forked just below the sorus. **Sori** marginal, terminal on veinlets; indusia attached only by the base, semi-orbicular or orbicular, 0.3-0.8 by 0.3-1 mm. **Sporangia** 0.15-0.2 mm in diam.; stalk up to 0.4 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid-oblong, 40-50 by 25-30  $\mu$ m, tuberculate, translucent.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Lampang, Phitsanulok; NORTH-EASTERN: Loei; SOUTH-WESTERN: Prachuap Khiri Khan; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Trang, Songkhla, Yala.

**Distribution.**— Widely distributed in the Paleotropics.

**Ecology.**— On tree trunks, on rocks or sometimes on the litter of decaying leaves, usually found in mossy places in both exposed and shady areas of mountain ridges, alt. 250-1,000 m. Uncommon.

**Vernacular.**— Kut Hom Bai Yoi (กุดห้อมไบย้อย) (Northern); Kut Thong (กุดทอง) (Northeastern); Nakkharat Tua Mia (นาคราชตัวเมีย) (Southeastern).

**Specimens examined.**— BETONG: *J. Wai* 211 (PSU), 302 (PSU), 453 (PSU), 684 (PSU), 729 (BCU, PSU), 777 (PSU); SONGKHLA: *G. Congdon* 704 (PSU), *J.F. Maxwell* 85-187 (PSU).

**17. *Davallia solida*** (G. Forst.) Sw., J. Bot. (Schrader) 1800(2): 87. 1801; Holttum, Rev. Fl. Malaya 2: 360, fig. 207. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 163. 1985; W.C. Shieh, De vol & T.Y. Yang in Fl. Taiwan 1: 190, pl. 76. 1994.— *Trichomanes solidum* G. Forst., Fl. Ins. Austr.: 86. 1786. **Plate 10E-F.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** stout, long creeping, 5-12 mm in diam., densely covered with scales; scales peltate, narrowed from base to acuminate apex, 3-6 by 0.5-1.5 mm, glossy, apical part pale brown, with densely spreading very fine silky pale brown or whitish hairs about 1 mm long, basal part dark brown to almost black; old part of rhizome covered with appressed persistent base of scales only. **Fronde**s tripinnate to quadripinnatifid. **Stipe** articulate to short phyllopodia, terete, grooved, 6-25 cm long, glabrescent; main rachis slightly flexuous, narrowly winged, glabrescent. **Lamina** subcoriaceous to coriaceous, subtriangular or deltoid in outline, 10-40 by 10-40 cm, glossy, green above, pale green underneath, reddish brown and covered with finely brownish hairs when young, soon becoming glabrous, apex gradually acuminate; lateral pinnae 6-15 pairs, alternate or subopposite, on stalks to 2.5 cm or more long, not articulate to rachis, subtriangular in outline, apex gradually acuminate, base obliquely cuneate, largest pinnae up to 25 by 20 cm; pinnules up to 10 pairs, with stalks to 1 cm long, subtriangular or lanceolate in outline, apex gradually acuminate, base obliquely cuneate, the largest on the lower pinnae up to 13 by 6.5 cm; secondary pinnules sessile or subsessile, subtriangular, lanceolate or

oblong in outline, apex acute or obtuse, base obliquely cuneate; lobes acute, the lobes of the sterile lamina with shallowly crenate margins, fertile lamina more deeply lobed; veins conspicuous on the lower surface; false veinlets absent. *Sori* terminal on veinlets, placed at the margin of small oblique lobes; indusia tubular or cup-shaped, 1-2 by 0.5-1 mm. *Sporangia* 0.15-0.2 mm in diam.; stalk up to 1 mm long; annulus vertical, interrupted. *Spores* monolet, ellipsoid-oblong, 35-40 by 25-30  $\mu$ m, smooth, translucent.

**Thailand.**— SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Songkhla, Yala.

**Distribution.**— Southern China, Taiwan, Indochina, Myanmar, Peninsular Malaysia, Borneo, Philippines and Polynesia.

**Ecology.**— On tree trunks, on mossy rocks or growing on the litter of decaying leaves, usually found in exposed areas of mountain ridges, and also found in coastal heath and lowland evergreen forests, from sea level to 1,000 m alt. Common.

**Vernacular.**— Phaya Nakkharat (พญาเนคราช) (Northern); Neraphusi (นระพูสี) (Northeastern); Wan Nakkharat (วันเนคราช) (Central, Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 291 (BCU, BKF, PSU), 328 (PSU), 374 (BCU, BKF, PSU), 417 (BCU, PSU), 660 (BCU, PSU), 816 (PSU); PHANGNGA: *Ch. Laongpol* 931 (PSU); SONGKHLA: *Ch. Laongpol* 557 (PSU), 983 (PSU), *Hamilton & Congdon* 435 (PSU), *J.F. Maxwell* 86-429 (PSU), 86-820 (PSU), *K. Larsen et al.* 41060 (PSU).



**18. *Davallia trichomanoides* Blume var. *lorrainii* (Hance) Holttum, Rev. Fl. Malaya 2: 361. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 163. 1985.— *D. lorrainii* Hance, Ann. Sci. Nat., Bot. 5: 254. 1866. **Plate 11A-B.****

Epiphyte, lithophyte or sometimes terrestrial plant. ***Rhizome*** long creeping, 2-5 mm in diam., densely covered with scales; scales peltate, spreading, abruptly narrowed above the base to form long-tailed apex, 5-7 by 0.5-1 mm, dark brown to almost black, margin bearing spreading tooth-like hairs about 0.3 mm long. ***Fronde*** tripinnate to quadripinnatifid. ***Stipe*** articulate to short phyllopodia, slender, terete, slightly grooved, 2.5-16.5 cm long, glabrous; main rachis slightly flexuous, flattened or slightly prominent above, narrowly winged, glabrous. ***Lamina*** firmly chartaceous to subcoriaceous, subpentagonous, deltoid or subtriangular in outline, 6.5-25 by 5-25 cm, pale green or yellowish green, glossy, glabrous, apex gradually acuminate; lateral pinnae 8-15 pairs, alternate or subopposite, shortly stalked, not articulate to rachis, triangular-ovate or oblong in outline, apex acuminate, acute to obtuse, base obliquely cuneate, largest pinnae up to 15 by 10 cm; pinnules up to 12 pairs, shortly stalked or sessile, lanceolate or oblong in outline, apex acuminate, acute to obtuse, base obliquely cuneate, the largest on the lower pinnae up to 7 by 3 cm; secondary pinnules sessile or sessile, subtriangular, triangular-ovate, lanceolate or oblong in outline, apex acute to obtuse, base obliquely cuneate; lobes unequally or equally bilobed, apex acute to obtuse, the lobes of the sterile lamina with shallowly crenate margins, fertile lamina more deeply lobed; veins usually inconspicuous; false veinlets absent. ***Sori*** terminal on veinlets, placed at the margin of small oblique lobes; indusia tubular or cup-shaped, 1-2 by 0.5-1 mm. ***Sporangia*** 0.2-0.3 mm in diam.; stalk up to 1.5 mm long; annulus vertical, interrupted. ***Spores*** monolet, ellipsoid-oblong, 40-50 by 30-35  $\mu\text{m}$ , smooth, translucent.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lamphun, Lampang, Tak, Phitsanulok; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chon Buri, Rayong, Chanthaburi; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Yala.

**Distribution.**— Indochina, Myanmar and throughout the Malesian region.

**Ecology.**— On mossy rocks or growing on the litter of decaying leaves in partial shade of mountain ridges, alt. 600-1,000 m. Uncommon.

**Vernacular.**— Nakkharat Klet Dam (นาคราชเกล็ดดำ) (General).

**Specimens examined.**— BETONG: *J. Wai* 169 (PSU), 303 (PSU), 820 (PSU), 961 (BCU, PSU).

## DENNSTAEDTIACEAE

**19. *Lindsaea bouillodii*** Christ, Notul. Syst. (Paris) 1(2): 59. 1909; K.U. Kramer in Fl. Males., Ser. 2, Pterid. 1(3): 204, fig. 21. 1971; Tagawa & K. Iwats. in Fl. Thailand 3(2): 135. 1985. *Plate 11C-D*.

Terrestrial or sometimes lithophytic plant. **Rhizome** short creeping, 2-3 mm in diam., covered with scales; scales stiff, linear-lanceolate, gradually narrowed from base to apex, up to 2 by 0.2 mm, brown to dark brown, glossy. **Fronds** bipinnate to tripinnate. **Stipe** not articulate to rhizome, slender, grooved, quadrangular, 25-32.5 cm long, dark purplish brown to nearly black, glossy, scaly at the base, upper part glabrescent; rachis grooved above, quadrangular, glabrescent. **Lamina** chartaceous, glossy, subtriangular or deltoid in outline, 20-28 by 15-20 cm, green to dark green above, pale green underneath, glabrous, apex gradually acuminate; lateral pinnae 5-11 pairs, alternate, shortly stalked, not articulate to rachis, oblong to linear-oblong, triangular-lanceolate or linear-lanceolate in outline, apex gradually acuminate, base obliquely cuneate, largest pinnae up to 11 by 5 cm; pinnules up to 15 pairs, sessile or shortly stalked, triangular-lanceolate, linear-oblong, obovate or obliquely flabellate in outline, usually shallowly lobed, sometimes deeply lobed, pinnatifid or pinnate, apex obtuse or rounded, base cuneate, the largest on lower pinnae pinnate, up to 2.5 by 1 cm; veins free except for the soral commissure, slightly raised. **Sori** submarginal, terminal on veinlets, elongated along the margin of lobes, interrupted by lobing;

indusia attached basally, opening outwardly, linear-oblong, oblong or sometimes semi-orbicular, 0.3-0.4 mm wide. *Sporangia* 0.1 mm in diam.; stalk ca. 0.2 mm long; annulus vertical, interrupted. *Spores* tetrahedral, trilete, subglobular, 20-25  $\mu$ m in diam., smooth or granulate.

**Thailand.**— PENINSULAR: Surat Thani, Krabi, Nakhon Si Thammarat, Yala.

**Distribution.**— Indochina and Malesian region.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or growing on moist cliffs, found in deep shade of mountain ridges, alt. 650-1,050 m. Uncommon.

**Vernacular.**—

**Specimens examined.**— *J. Wai* 447 (PSU), 735 (PSU).

**Note:** The genus *Lindsaea* Dryand. ex Sm. is sometimes placed in the family Lindsaeaceae.

**20. *Pteridium aquilinum*** (L.) Kuhn, Bot. Ost-Afrika 3(3): 11. 1879; Holttum, Rev. Fl. Malaya 2: 389, fig. 225. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(1): 125, fig. 9 (4-7). 1979; K.U. Kramer in Fam. & Gen. Vasc. Pl. (ed. K. Kubitzki) 1: 85. 1990; W.C. Shieh in Fl. Taiwan 1: 169. 1994.— *Pteris aquilina* L., Sp. Pl. 2: 1075. 1753.— *Pteridium esculentum* (G. Forst.) Nakai, Bot. Mag. (Tokyo) 39: 108. 1925; Holttum, Rev. Fl. Malaya 2: 390, fig. 226. 1954. **Plate 11E-F.**

Terrestrial or sometimes lithophytic plant. **Rhizome** underground, long creeping, 7-10 mm in diam., densely covered with hairs; hairs multicellular, fine, brown to dark brown, glossy. **Fronde**s tripinnate to quadripinnatifid. **Stipe** not articulate to rhizome, subquadrangular or terete, grooved, up to 1 m or more long, hypogaeal part

densely hairy, dark brown to almost black, aerial part glabrescent, greenish, yellowish or brown; rachis more or less finely hairy in groove above, sparsely hairy or glabrescent underneath. **Lamina** subcoriaceous, rigid, subtriangular or deltoid in outline, 32-70 by 30-60 cm, bright green or olive green above, paler underneath, apex gradually acuminate; lateral pinnae 10-15 pairs, opposite or subopposite, rarely alternate, on stalks to 5 cm long, not articulate to rachis, triangular or subtriangular in outline, apex gradually acuminate, largest pinnae up to 55 by 30 cm; pinnules up to 20 pairs, alternate, rarely subopposite or opposite, sessile or subsessile to shortly stalked, triangular-lanceolate or linear-oblong in outline, apex gradually acuminate, largest pinnules up to 55 by 30 cm; ultimate segments contiguous or widely spaced, oblong, triangular-oblong, usually slightly falcate, apex obtuse or rounded, margin narrowly revolute, densely hairy on lower surface; costae and costules grooved above, prominent and densely hairy underneath; veins free except for the soral commissure, usually once forked, slightly grooved on upper surface, raised on lower surface. **Sori** submarginal, terminal on veinlets, elongated along the margin of lobes; outer indusia thin, membranous, reflexed, margin fringed; inner indusia attached just below the receptacle, thinner and narrower than outer indusia, membranous, margin fringed. **Sporangia** 0.15-0.2 mm in diam.; stalk 0.3-0.5 mm long; annulus vertical, interrupted. **Spores** tetrahedral, trilete, subglobular, 25-50  $\mu$ m in diam., granulate.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lamphun, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Trat; PENINSULAR: Chumphon, Surat Thani, Nakhon Si Thammarat, Songkhla, Yala.

**Distribution.**— Cosmopolitan.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or growing in rock crevices, usually found in exposed areas of mountain ridges, and also found in coastal heath forest, cleared areas, roadsides and rubber plantation, from sea level to 1,000 m alt. Common.

**Vernacular.**— Kut Kia (กูดเกี้ย), Kut Kin (กูดกิน) (Northern); Chon (โชน), Chon Yai (โชนใหญ่), (Peninsular); Lue San (ลือซัน), Lue Sae Bue Sa (ลือแซบือซา) (Malay-Narathiwat).

**Remarks.**— The varieties of this species are not recognised in the present study, since the plant material is intermediate between *Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Agardh) R.M. Tryon and *P. aquilinum* (L.) Kuhn var. *yarrabense* Domin, the different characters of these two varieties, e.g. the segments and terminal lobes of pinnules, the indumentum of rachis, etc., those characters usually occurred in the same plant.

**Specimens examined.**— BETONG: *J. Wai* 327 (BCU, BKF, PSU), 652 (BCU, BKF, PSU); SONGKHLA: *J.F. Maxwell* 85-633 (PSU).

## DICKSONIACEAE

**21. *Cibotium barometz*** J. Sm., London J. Bot. 1: 437. 1842; Holttum, Rev. Fl. Malaya 2: 114, fig. 45. 1954; in Fl. Males., Ser. 2, Pterid. 1(2): 165, fig. 33a-c. 1963; Tagawa & K. Iwats. in Fl. Thailand 3(1): 109, fig. 6 (8-10). 1979; De vol & W.C. Shieh in Fl. Taiwan 1: 140, pl. 53. 1994. **Plate 12A-B.**

Terrestrial or lithophytic plant. **Rhizome** massive, prostrate or sometimes erect and forming a trunk, bearing fronds in a tuft at the apical part, 10-15 cm in diam., densely covered with hairs; hairs multicellular, up to 5 cm long, golden yellow or yellowish brown, glossy. **Fronds** up to 4 m long, deeply tripinnatifid. **Stipe** persistent, thick, terete, grooved, up to 2 m or more long, green or purplish black, glossy, densely hairy at the base, softly hairy throughout when young, the upper part usually becoming glabrous when old; main rachis slightly flexuous, green or brownish, softly hairy, usually glabrescent. **Lamina** firmly chartaceous, subtriangular, ovate, elliptic or oblong in outline, up to 2 by 1.5 m, glossy, green above, pale green and glaucous underneath, softly hairy throughout, usually becoming glabrous when old, apex gradually acuminate; lateral pinnae 10-20 pairs, alternate, on stalks to 5 cm or more

long, not articulate to rachis, oblong, triangular-oblong or lanceolate in outline, apex gradually acuminate, largest pinnae up to 70 by 25 cm; pinnules up to 30 pairs, deeply pinnatifid, the lower ones sessile or shortly stalked, narrowly lanceolate to linear-lanceolate in outline, apex gradually acuminate, base oblique, rounded, subtruncate or broadly cuneate, the largest on the lower pinnae up to 15 by 3 cm, lobed almost to costa, the upper ones shallowly lobed; ultimate segments oblong, slightly falcate, 3-18 by 2-6 mm, apex acute or obtuse, margin shallowly toothed; costae and costules raised on both surfaces, covered with softly hairs on lower surface; veins conspicuous, simple, once or twice forked. **Sori** terminal on usually unbranched veinlets protected by two indusia, 1-2 mm in diam.; outer indusia broad, semi-orbicular, 0.5-1 by 1.5-2 mm; inner indusia elongated, oblong, 1-1.5 by 0.5-1 mm; paraphyses numerous, 0.3-0.5 mm long. **Sporangia** 0.2-0.3 mm in diam.; stalk up to 0.3 mm long; annulus oblique, continuous. **Spores** tetrahedral, trilete, subtriangular, with equatorial ridge, 40-50  $\mu$ m in diam., smooth.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Phitsanulok; NORTH-EASTERN: Phetchabun, Loei; EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Yala.

**Distribution.**— Himalaya, Japan (Ryukyu islands), Southern China, Taiwan, Vietnam, Myanmar, Peninsular Malaysia, Sumatra and Java.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves, usually on the cliffs or growing in rock crevices, locally abundant in both exposed and shady areas of mountain ridges, and also found in lowland evergreen forest and rubber plantation, alt. 350-1,000 m. Common.

**Vernacular.**— Kut Phipa (กูดผีป่า), Kut Phan (กูดพาน) (Northern); Khon Kai Noi (خنไก่น้อย) (Northeastern); Hatsa Daeng (หัตถแดง) (Eastern); Laong Faifa (ละอองไฟฟ้า), Wan Kai Noi (ว่านไก่น้อย) (Central); Kut Sua (กูดเสือ), Pho Si (โพสี), Ninla Phosi (นิลโพสี) (Peninsular).

**Specimens examined.**— *J. Wai* 141 (PSU), 318 (PSU), 350 (PSU), 430 (PSU).

## DIPTERIDACEAE

**22. *Dipteris conjugata*** Reinw., Syll. Pl. Nov. 2: 3. 1824; Holttum, Rev. Fl. Malaya 2: 134, fig. 55. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 481, fig. 49 (1-2). 1989; De vol & W.C. Shieh in Fl. Taiwan 1: 465, pl. 180. 1994.— *D. horsfieldii* (R. Br. ex Hook.) Bedd., Ferns Brit. India: t. 321. 1869. **Plate 12C-D.**

Terrestrial or sometimes lithophytic plant. **Rhizome** underground, creeping, woody, ca. 1 cm in diam., densely covered with bristles; bristles stiff, up to 7 mm long, glossy, almost black. **Fronds** bipartite. **Stipe** not articulate to rhizome, terete or subquadrangular, grooved, up to 2 m or more long, green or yellowish, glabrous except at the base. **Lamina** subcoriaceous to coriaceous, upper surface glossy, green or yellowish green, lower surface paler, more or less glaucous, usually brownish or reddish brown and densely hairy in young fronds, glabrous when mature, nearly orbicular in outline, 40-45 by 45-50 cm or more variable in size, completely divided into two equal parts, each parts spreading, fan-shaped, divided more than half-way to the base into 4 unequal segments, each segments again once or twice lobed; ultimate segments narrowly subtriangular or triangular-oblong, sometimes more or less falcate, apex acuminate, margin serrate; main veins dichotomously branched, several times forked, moderately raised above, prominent below, the smaller veins anastomosing with free included veinlets, usually conspicuous. **Sori** exindusiate, scattered on lower surface, orbicular, 0.5-1 mm in diam. **Sporangia** 0.1-0.15 mm in diam., shortly stalked; annulus slightly oblique. **Spores** monoletе, ellipsoid-oblong or bean-shaped, 30-40 by 20-25  $\mu\text{m}$ , smooth, hyaline, translucent.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Yala.

**Distribution.**— Japan (Ryukyu Islands), Southern China, Taiwan, Vietnam, Cambodia, throughout Malesia to Australia (Queensland) and Southwestern Pacific (New Caledonia).

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves, rarely growing on bare rocks, usually common and locally abundant in both exposed and shady areas of mountain ridges at 400-1,000 m alt., and also occurring in deep shade of lower montane forest and sometimes in rubber plantation. Rare in Thailand.

**Vernacular.**— Bua chaek (บัวแฉก) (Peninsular).

**Remarks.**— The plants that grow in shady areas usually have rather longer stipe and larger lamina than those in exposed areas.

**Specimens examined.**— *J. Wai* 333 (PSU), 354 (PSU), 581 (BCU, PSU).

## GLEICHENIACEAE

**23. *Dicranopteris linearis*** (Burm.f.) Underw., Bull. Torrey Bot. Club 34(5): 250. 1907; Holttum in Fl. Males., Ser. 2, Pterid. 1(1): 33, figs. 12, 14f-i. 1959; Tagawa & K. Iwats. in Fl. Thailand 3(1): 55. 1979; De vol & W.C. Shieh in Fl. Taiwan 1: 91. 1994.— *Polypodium lineare* Burm.f., Fl. Ind. (N.L. Burman): 235, t. 67, fig. 2. 1768.— *Gleichenia linearis* (Burm.f.) C.B. Clarke, Trans. Linn. Soc. London, Bot. 1(7): 428. 1880; Holttum, Rev. Fl. Malaya 2: 68, fig. 16. 1954. **Plate 12E-F.**

Terrestrial or sometimes lithophytic plant. **Rhizome** slender, long creeping, 1-3 mm in diam., young part covered with hairs, becoming glabrous when old; hairs multicellular, basally branched, 1.5-2.5 mm long, reddish brown. **Fron**ds of indeterminate growth, erect or scandent. **Stipe** not articulate to rhizome, terete, 4.5-66.5 cm long, glossy, brown, glabrescent. **Lamina** few to several times, equally or slightly unequally, pseudodichotomously forked, sometimes once forked in young and stunted plants, usually with a pair of leafy accessory branches at the forks; dormant



apical bud densely hairy, protected by a pair of stipule-like leaflets; ultimate branches and accessory branches deeply pinnatifid, lobed almost to the costa, narrowly lanceolate to linear lanceolate in outline, 5-27 by 1.5-5.5 cm, apex gradually acuminate; ultimate segments at or near right angle to the costa, sparsely to densely covered with reddish brown hairs when young, linear to linear-oblong, 2-5 mm wide, apex obtuse, rounded or emarginate, margin entire, slightly revolute; texture firm, subcoriaceous to coriaceous, lower surface more or less glaucous, glabrescent; costa raised on both surfaces; costules slightly grooved above, prominent underneath, 2-5 (-7) mm apart; veins free, (1-)2-3 times forked, conspicuous. **Sori** exindusiate, solitary, near the costules, usually on an acroscopic branch of a secondary vein, each of 5-15 sporangium, orbicular, 0.5-1 mm in diam. **Sporangia** sessile, obovoid, 0.25-0.35 by 0.15-0.25 mm; annulus oblique, continuous. **Spores** trilete, tetrahedral, subtriangular, 25-30  $\mu$ m in diam., smooth, translucent.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Lampang; NORTH-EASTERN: Loei; SOUTH-EASTERN: Prachin Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phuket, Nakhon Si Thammarat, Trang, Songkhla, Narathiwat, Yala.

**Distribution.**— Tropical and subtropical Africa, Asia and Oceania.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves, sometimes growing in rock crevices, locally abundant in exposed areas of mountain ridges, and also found in cleared areas, often on the edges of lowland evergreen forest, secondary forest, rubber plantations and roadsides, from sea level to 1,000 m alt. Common.

**Vernacular.**— Ki Ku Ka Choei (กีกูกะเจ้ย) (Karen, Mae Hong Son); Kut Pit (กุดปัด) (Northern); Kut Muek (กุดหมึก) (Chiang Mai); Kut Taem (กุดแต่ม), Chon Lek (จั่นเหล็ก), Chon (โซน) (Peninsular); Kue Kae (กือแก), Rue Sae (รือแซ) (Malay-Narathiwat).

**Remarks.**— In the present study, the varieties in this species are not recognised, since it is rather difficult to distinguish them from each other and there is no strong evidence that this species should be divided into the infraspecific taxa.

**Specimens examined.**— BETONG: *J. Wai* 340 (BCU, PSU), 930 (BCU, PSU), 959 (BCU, BKF, PSU), 983 (PSU); SONGKHLA: *A. Tongphan* 27 (PSU), *Hamilton & Congdon* 1 (PSU).

### HYMENOPHYLLACEAE

**24. *Crepidomanes minutum*** (Blume) K. Iwats., J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 13(5): 524. 1985; Tagawa & K. Iwats. in Fl. Thailand 3(4): 613. 1989.— *Trichomanes minutum* Blume, Enum. Pl. Javae 2: 223. 1828; Holttum, Rev. Fl. Malaya 2: 96. 1954.— *T. parvulum* Blume (non Poir), Enum. Pl. Javae 2: 223. 1828.— *T. proliferum* Blume, Enum. Pl. Javae 2: 224. 1828; Holttum, Rev. Fl. Malaya 2: 97, fig. 33. 1954.— *T. saxifragoides* C. Presl, Hymenophyllaceae: 39. 1843.— *Gonocormus minutus* (Blume) Bosch, Hymenophyll. Javan.: 7, t. 3. 1861; J.L. Tsai & W.C. Shieh in Fl. Taiwan 1: 108, pl. 39. 1994.— *G. saxifragoides* (C. Presl) Bosch, Hymenophyll. Javan.: 9. 1861; Tagawa & K. Iwats. in Fl. Thailand 3(1): 80. 1979.— *G. teysmani* Bosch, Hymenophyll. Javan.: 10, t. 5. 1861.— *G. prolifer* (Blume) Prantl in Hymenophyllaceae (Presl): 51. 1875; Tagawa & K. Iwats. in Fl. Thailand 3(1): 81. 1979.— *G. siamensis* Tagawa & K. Iwats., Acta Phytotax. Geobot. 22: 99, fig. 3. 1967; Tagawa & K. Iwats. in Fl. Thailand 3(1): 81. 1979. **Plate 13A-B.**

Epiphytic, lithophytic or sometimes terrestrial plant. **Rhizome** slender, long creeping, 0.15-0.3 mm in diam., blackish, glossy, lacking roots, more or less covered with hairs; hairs dark brown, glossy, up to 1 mm long. **Fronds** irregularly dichotomously branched, pinnate to bipinnatifid, pale green to dark green, glossy, usually proliferous, new frond arising from bud at the axes of the older frond. **Stipes** not articulate to rhizome, slender, terete, up to 2.5 cm long, green, sparsely covered with brownish bristles. **Lamina** thin, membranous, translucent, often wider than long, flabellate, ovate or rarely oblong in outline, 3-12 by 5-10 mm; pinnae sessile or shortly

stalked, flabellate or ovate in outline, up to 10 by 5 mm; ultimate segments with a single veinlet, oblong, 0.3-0.7 mm wide, glabrous, apex obtuse, margin entire; veins raised on both surfaces, false veinlets absent. **Sori** solitary, terminal on veins, sunk at the apex of the ultimate segments; involucres tubular, winged, 0.8-1.5 by 0.7-1 mm, the mouth dilated, truncate, margin entire; receptacles extruded when mature. **Sporangia** sessile, 0.15-0.2 mm in diam.; annulus oblique, continuous. **Spores** trilete, tetrahedral, subglobular, 30-50  $\mu$ m in diam., densely papillate.

**Thailand.**— NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Prachuap Khiri Khan; SOUTH-EASTERN: Prachin Buri, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Trang, Narathiwat, Yala.

**Distribution.**— Throughout the Paleotropics.

**Ecology.**— On moist rocks, on mossy trees trunks, sometimes growing on the ground in mossy places and wet sandy banks of quartzitic phyllite ridges, alt. 650-700 m. Common.

**Vernacular.**—

**Specimen examined.**— BETONG: *J. Wai* 985 (PSU).

**25. Hymenophyllum serrulatum** (C. Presl) C. Chr., Index Filic.: 367. 1905; Holttum, Rev. Fl. Malaya 2: 78, fig. 19. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 611. 1989.— *Didymoglossum serrulatum* C. Presl, Hymenophyllaceae: 115. 1843.— *Meringium meyenianum* C. Presl, Hymenophyllaceae: 116. 1843; Tagawa & K. Iwats. in Fl. Thailand 3(1): 76. 1979. **Plate 13C-D.**

Epiphytic, lithophytic or terrestrial plant. **Rhizome** slender, long creeping, 0.15-0.3 mm in diam., blackish, glossy, young part hairy, old part glabrescent; hairs brown, glossy, up to 1.5 mm long. **Fronde** bipinnatifid to tripinnatifid, pale green to

dark green, glossy. **Stipes** not articulate to rhizome, slender, terete, up to 4 cm long, dark brown to nearly black, sparsely hairy or glabrescent; rachis winged, dark brown to nearly black, sparsely hairy or glabrescent. **Lamina** thin, membranous, translucent, oblong-lanceolate, elliptic-oblong or linear-oblong in outline, 3-7 by 1-2.5 cm; pinnae sessile, triangular-ovate, obovate or spatulate in outline, up to 1.5 by 1 cm, apex obtuse or rounded, base obliquely cuneate; ultimate segments of each pinnule with a single veinlet, oblong to linear-oblong, 0.5-1.5 mm wide, glabrous, apex rounded or obtuse, margin serrate; veins dark brown, raised on both surfaces, false veinlets absent. **Sori** solitary, terminal on veins, usually at the apex of basal acroscopic lobes in the upper part of fronds; involucre tubular or obconical, with bilabiate mouth, slightly winged, 2-2.5 by 0.7-1 mm, the lips as long as or slightly shorter than the tubular base, bluntly triangular or sometimes rounded, margin entire or slightly denticulate; receptacles extruded when mature. **Sporangia** sessile, 0.2-0.3 mm in diam.; annulus oblique, continuous. **Spores** trilete, tetrahedral, subglobular, 30-50  $\mu\text{m}$  in diam., densely papillate.

**Thailand.**— PENINSULAR: Ranong, Yala.

**Distribution.**— Throughout the Malesian region.

**Ecology.**— On moist mossy rocks, on mossy tree trunks, sometimes growing on the decaying organic matter or on wet sandy and mossy ground in shady areas of mountain ridges, alt. 650-1,000 m. Rare in Thailand.

**Vernacular.**—

**Specimen examined.**— BETONG: *J. Wai* 670 (BCU, BKF, PSU).

## OLEANDRACEAE

**26. *Oleandra pistillaris*** (Sw.) C. Chr., Index Filic., Suppl. Tertium pro Annis 1917-1933: 132. 1934; Holttum, Rev. Fl. Malaya 2: 386, fig. 224. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 182. 1985.— *Aspidium pistillare* Sw., J. Bot. (Schrader) 2: 30. 1801. **Plate 13E-F.**

Epiphytic, lithophytic or terrestrial plant. **Rhizome** long scandent, stiff, with erect or suberect shrub-like branches, forming bushes up to 3 m high, 4-10 mm in diam., densely covered with scales, glaucous under the scales; scales peltate, appressed, imbricate, lanceolate, 4-8 by 1-1.5 mm, dark brown to almost black with paler margins, glossy, apex acuminate, margin with very fine hairs, soon becoming glabrous; old part of rhizome covered with appressed persistent base of scales. **Fronde** simple, aggregated into pseudowhorls. **Phyllopodia** 1-5 mm long, scaly. **Stipe** articulate to phyllopodia, grooved above, 3-12 mm long, green, yellowish or purplish brown to dark brown, sparsely scaly when young, soon becoming glabrous. **Lamina** firmly chartaceous to coriaceous, narrowly oblong-ob lanceolate or linear-oblong, 8-50 by 1.3-5 cm, apex acuminate or caudate, base cuneate, margin undulate, upper surface green to dark green or yellowish green, usually becoming glabrous when old, glossy, lower surface paler and more or less hairy; midrib grooved above, prominent and hairy underneath, occasionally sparsely covered with scales at the basal portion; veins close, simple, once or twice forked. **Sori** in a single irregular row on each side of midrib, very near the midrib, superficial on simple veins or on an acroscopic branch of veins; indusia reniform, 0.7-1 by 1-1.5 mm. **Sporangia** 0.15-0.2 mm in diam.; stalk up to 0.5 mm long; annulus vertical, interrupted. **Spores** monoletе, ellipsoid, 35-50 by 25-35  $\mu$ m in diam., surface prominent, winged or ridged.

**Thailand.**— SOUTH-WESTERN: Prachuap Khiri Khan (Khao Luang); PENINSULAR: Nakhon Si Thammarat, Trang, Phatthalung, Songkhla, Yala.

**Distribution.**— Peninsular Malaysia, Java and Borneo.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or growing on mossy rocks, often locally abundant in both exposed and shady areas of mountain ridges at 600-1,000 m alt., also found on tree trunks in montane forest and on rocks along streamsides in lowland evergreen forest. Uncommon.

**Vernacular.**— Nakkharat (นาคราช) (Northern, Peninsular); Wan Nakkharat (วันนาคราช) (Northeastern, Peninsular); Phaya Ngu (พญาญู) (Northeastern); Nakho (นาหอ) (Malay-Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 47 (BCU, PSU), 304 (PSU), 378 (BCU, BKF, PSU), 503 (PSU), 897 (BCU, PSU); NAKHON SI THAMMARAT: *J.F. Maxwell* 85-495 (PSU); SONGKHLA: *J.F. Maxwell* 85-194 (PSU).

**27. *Oleandra undulata*** (Willd.) Ching, Lingnan Sci. J. 12(4): 565. 1933; Holttum, Rev. Fl. Malaya 2: 384, fig. 223. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 180. 1985.— *Polypodium undulatum* Willd., Sp. Pl., ed. 4., 5: 155. 1810.— *Oleandra cumingii* J. Sm., J. Bot. (Hooker) 3: 413. 1841.— *O. pubescens* Copel., Univ. Calif. Publ. Bot. 12(15): 397, t. 52A. 1931. **Plate 14A-B.**

Terrestrial or lithophytic plant. **Rhizome** long creeping, 2.5-4 mm in diam., densely covered with scales; scales peltate, appressed, imbricate, lanceolate, 3-6 by ca. 1 mm, dark brown to almost black with paler margins, glossy, apex acuminate, margin with very fine hairs. **Fronds** simple, remote. **Phyllopodia** erect, grooved, 1.5-8.5 cm long, densely covered with hairs and scaly when young, soon becoming glabrous. **Stipe** articulate to phyllopodia, slender, grooved above, 1.5-10 cm long, green or purplish brown to dark brown, densely hairy when young, glabrescent. **Lamina** firmly chartaceous to coriaceous, narrowly lanceolate or linear-oblong, 12-45 by 1.2-4 cm, apex acuminate or caudate, base attenuate or cuneate, margin undulate, upper surface green to dark green or yellowish green, glossy, glabrescent, lower surface paler and hairy; midrib flattened or slightly grooved above, prominent and hairy underneath, occasionally sparsely covered with scales at the basal portion; veins close, simple, once or twice forked. **Sori** usually in one regular row close to each side of midrib,

superficial on simple veins or on an acroscopic branch of veins; indusia reniform, 1-1.5 mm in diam., outer surface sparsely hairy. *Sporangia* 0.15-0.2 mm in diam.; stalk up to 0.6 mm long; annulus vertical, interrupted. *Spores* monolete, ellipsoid, 40-50 by 25-35  $\mu$ m in diam., surface prominent, winged or ridged.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Phrae; NORTH-EASTERN: Loei; EASTERN: Chaiyaphum; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Ranong, Phangnga, Krabi, Nakhon Si Thammarat, Yala.

**Distribution.**— Southern China, Myanmar and Peninsular Malaysia.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves, on moist mossy cliffs or sometimes growing in rocks crevices, often locally abundant in semi-exposed areas of mountain ridges, alt. 600-1,000 m. Uncommon.

**Vernacular.**— Nakkharat Bai Klue (นาคราชใบคลื่น) (General).

**Specimens examined.**— BETONG: *J. Wai* 142 (PSU), 345 (BCU, PSU), 415 (PSU), 476 (BKF, PSU), 606 (BKF, PSU); NAKHON SI THAMMARAT: *J.F. Maxwell* 87-227 (PSU).

## POLYPODIACEAE

**28. *Drynaria rigidula*** (Sw.) Bedd., Ferns Brit. India: t. 314. 1869; Holttum, Rev. Fl. Malaya 2: 183, fig. 90. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 550, pl. IV5. 1989.— *Polypodium rigidulum* Sw., J. Bot. (Schrader) 2: 26. 1801. **Plate 14C-D.**

Epiphyte or lithophyte. **Rhizome** stout and fleshy, creeping, 4-8 mm in diam., densely covered with scales; scales peltate, narrowed from base to long-tailed apex, 4-5 by ca. 1 mm, pale to dark brown, glossy, margin fimbriate. **Fronde**s dimorphic. **Nest-leaves** subcoriaceous to coriaceous, sessile, erect, imbricate, ovate-lanceolate in

outline, 20-23 by 10-11 cm, brown, glossy, apex acute, base rounded, lobed up to half-way to the midrib; lobes subtriangular, 1-2.5 by 0.5-2 cm, apex acute to rounded, margin subentire to serrate, glabrescent; midrib and costae prominent on both surfaces, usually covered with soft downy hairs; veins anastomosing with few included free veinlets. **Foliage-leaves** pinnate; stipe not articulate to rhizome, terete, up to 17 cm long, purplish brown to purplish black, bearing many small appendages (undeveloped pinnae), usually covered with soft downy hairs; rachis terete, 52-83 cm long, covered with soft downy hairs; lamina subcoriaceous to coriaceous, oblong in outline, 70-90 by 20-30 cm; lateral pinnae sessile to shortly stalked, about 30 pairs, linear-oblong or linear-lanceolate, slightly falcate, 13-24 by 0.7-2.6 cm, yellowish green or green, glossy, apex gradually long acuminate, base cuneate to attenuate, margin serrate or subentire; costa articulate to rachis, prominent on both surfaces, purplish brown to purplish black; veins anastomosing, raised on both surfaces, main veins ca. 3 mm apart, areoles between main veins with few included free veinlets. **Sori** exindusiate, one between adjacent main veins, usually at half-way from margin to costa or rather nearer the costa than the margin, raised on upper surface, orbicular, 1-2 mm in diam., 2-5 mm apart. **Sporangia** ca. 0.15 mm in diam.; stalk up to 0.5 mm long; annulus vertical, interrupted. **Spores** monoletе, obliquely ellipsoid-oblong or bean-shaped, 40-50 by 25-30  $\mu\text{m}$ , spinulose, translucent.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Tak, Phitsanulok; NORTH-EASTERN: Loei; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi; PENINSULAR: Surat Thani, Krabi, Phatthalung, Satun, Songkhla, Yala.

**Distribution.**— Indochina, Myanmar, Malesia, tropical Australia and Polynesia.

**Ecology.**— On rocks or on tree trunks, often found on exposed rocks on mountain ridges, and also found in shady areas in lowland evergreen forest and rubber plantation, alt. 200-1,000 m. Common.



**Vernacular.**— Kra Prok Lek (กระปรอกเล็ก), Kra Prok Hua Hin (กระปรอกหัวหิน) (Chanthaburi); Kut Thang (กูดถึง) (Chiang Mai); Kut Fuei (กูดเฟื้อย), Kut Mai (กูดไม้), Kut Om (กูดอ้อม), Kut Hang Ma (กูดหางม้า) (Northern).

**Specimens examined.**— BETONG: *J. Wai* 636 (PSU), 663 (PSU); SATUN: *G. Condon* 809 (PSU); SONGKHLA: *J.F. Maxwell* 84-526 (PSU).

**29. *Drynaria sparsisora*** (Desv.) T. Moore, Index Filic.: 348. 1862; Holttum, Rev. Fl. Malaya 2: 183, fig. 89. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 544. 1989.— *Polypodium sparsisorum* Desv., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 5: 315. 1811.— *P. linnei* Bory, Ann. Sci. Nat. (Paris) 5: 464. 1825.— *Drynaria linnei* (Bory) Bedd., Ferns Brit. India: t. 315. 1869. **Plate 14E-F.**

Epiphyte or lithophyte. **Rhizome** stout and fleshy, creeping, 1-2 cm in diam., densely covered with scales; scales peltate, ovate, abruptly narrowed above base, 2-5 by 1-2 mm, dark brown to almost black with paler margins, glossy, apex long acuminate, margin fimbriate; old part of rhizome covered with appressed persistent base of scales. **Fronde**s dimorphic. **Nest-leaves** coriaceous, sessile, erect, imbricate, ovate in outline, 22-26 by 22-23 cm, brown, glossy, apex obtuse, base rounded, lobed up to half-way to the midrib; lobes subtriangular to oblong-subtriangular, 1.5-4 by 2.5-3.5 cm, apex obtuse to rounded, margin entire; midrib and costae prominent on both surfaces; veins anastomosing with few included free veinlets. **Foliage-leaves** deeply pinnatifid; stipe not articulate to rhizome, terete, narrowly winged, 18-23 cm long, purplish brown to purplish black, glabrous; lamina coriaceous, oblong in outline, 45-52 by 25-35 cm, light to dark green, glossy, glabrous, lobed to 3-15 mm from the midrib; midrib raised on both surfaces; lobes oblong-lanceolate, slightly falcate, 8-18 by 2.5-5 cm, apex long acuminate, margin entire; veins anastomosing, raised on both surfaces, main veins 2-10 mm apart, areoles between main veins with few included free veinlets. **Sori** exindusiate, irregularly in 2 rows between adjacent main veins, often with others interspersed, orbicular, 1-1.5 mm in diam. **Sporangia** 0.15-0.2 mm in diam.; stalk up to 0.4 mm long; annulus vertical, interrupted. **Spores** monoletе, obliquely ellipsoid-oblong or bean-shaped, 40-50 by 25-30  $\mu$ m, smooth, translucent.

**Thailand.**— EASTERN: Chaiyaphum; SOUTH-EASTERN: Prachin Buri, Chanthaburi, Trat; PENINSULAR: Ranong, Phangnga, Phuket, Phatthalung, Trang, Satun, Narathiwat, Yala.

**Distribution.**— Malesian region, through Polynesia to tropical Australia.

**Ecology.**— On rocks in both exposed and shady areas of mountain ridges, and also commonly found on trees in lowland evergreen forest and rubber plantation, from sea level to 1,000 m alt. Common.

**Vernacular.**— Kut Hok (กูดฮอก) (Northern); Wan Ngu Kwak (ว่านงูควัก), Wao (ว่าว) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 88 (PSU), 586 (PSU); PHATTHALUNG: *A. Tongphan* 19 (PSU).

**30. *Pyrrosia adnascens*** (Sw.) Ching, Bull. Chin. Bot. Soc. 1(1): 45. 1935; Holttum, Rev. Fl. Malaya 2: 144, fig. 60. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 496. 1989; W.C. Shieh, De vol & C.M. Kuo in Fl. Taiwan 1: 513. 1994. — *Polypodium adnascens* Sw., Syn. Fil. 25: 220, t. 2, fig. 2. 1806.— *Niphobolus adnascens* Kaulf., Enum. Filic.: 124. 1824.— *Cyclophorus adnascens* (Sw.) Desv., Berlin. Mag. 5: 300. 1811. **Plate 15A-B.**

Epiphyte or lithophyte. **Rhizome** slender, long creeping, branched, 1-2 mm in diam., densely covered with scales; scales peltate, appressed, ovate or lanceolate, 2-4 by 0.5-1 mm, dark brown to almost black in the central part with paler margins, glossy, apex long acuminate, margin fimbriate. **Fronds** simple, dimorphic or sometimes hardly dimorphic, stipe articulate to short phyllopodia, grooved, narrowly winged, stellate hairy or becoming glabrous when old; lamina thick and fleshy, coriaceous, upper surface stellate hairy or glabrescent and glossy when old, lower surface densely stellate hairy; midrib grooved above, prominent underneath; veins inconspicuous. **Sterile fronds:** stipe 0.5-2.5(-7) cm long; lamina oblong-ob lanceolate,

spatulate, linear-oblong or linear-elliptic, 5-8.5(-13.5) by 0.5-1 cm, apex rounded, obtuse or emarginate, base attenuate. **Fertile fronds** usually much longer and narrower than sterile fronds; stipe 2-8.5 cm long; lamina linear, 7.5-17 by 0.3-0.7 mm, apex acute, obtuse, rounded or emarginate, base attenuate, margin of fertile part recurved when dry. **Sori** exindusiate, close, scattered on the apical half of lamina, densely covered with stellate hairs when young, orbicular, up to ca. 1 mm in diam. **Sporangia** ca. 0.2 mm in diam.; stalk up to 0.35 mm long; annulus vertical, interrupted. **Spores** monolete, obliquely ellipsoid-oblong or bean-shaped, 50-65 by 35-40  $\mu\text{m}$ , irregularly verrucose, translucent.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Tak, Phitsanulok; NORTH-EASTERN: Loei, Nong Khai, Mukdahan, Khon Kaen; EASTERN: Chaiyaphum, Nakhon Ratchasima, Buri Ram; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Saraburi, Nakhon Nayok; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Phatthalung, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Widely distributed in tropical Asia and Polynesia.

**Ecology.**— On rocks in exposed areas of mountain ridges at 600-1,000 m alt., and also found on trees in coastal heath and lowland evergreen forests. Common.

**Vernacular.**— Phak Pik Kai (ผักปิกไค้) (Northern).

**Remarks.**— *Pyrrosia adnascens* (Sw.) Ching might be conspecific with *Pyrrosia lanceolata* (L.) Farw., *P. nuda* (Giesenh.) Ching and *P. varia* (Kaulf.) Farw., since their morphological characters are very similar, except for their sizes and indumentum. Generally, the sizes and indumentum characters are often highly variable and offer no taxonomic value. In any case, more evidences and the taxonomic revision of this genus are needed.

**Specimens examined.**— BETONG: *J. Wai* 204 (BCU, BKF, PSU), 431 (PSU), 473 (PSU); SURAT THANI: *Ch. Laongpol* 719 (PSU); PHUKET: *J.F. Maxwell* 87-1030 (PSU); KRABI: *Ch. Laongpol* 936 (PSU); NAKHON SI THAMMARAT: *W. Ramsri* 87 (PSU); SATUN: *J.F. Maxwell* 87-380 (PSU); SONGKHLA: *Ch. Laongpol* 556 (PSU), 984 (PSU), *J.F. Maxwell* 84-152 (PSU), 86-455 (PSU).

**31. *Selliguea heterocarpa*** (Blume) Blume, Enum. Pl. Javae: 125, t. 52, fig. 1. 1828; Holttum, Rev. Fl. Malaya 2: 157, fig. 69. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 563, fig. 56 (10-11). 1989.— *Polypodium heterocarpum* Blume, Fl. Javae: 167, t. 75. 1829. **Plate 15C-D.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** long creeping, 1.5-3 mm in diam., densely covered with scales; scales peltate, stiff, abruptly narrowed above the base to long-tailed apex, 8-12 by 0.4-0.8 mm, dark brown, glossy, margin of basal part toothed. **Fronde** simple. **Stipe** articulate to short phyllopodia, slender, grooved, slightly adaxially winged, terete, 1-26 cm long, green, yellowish brown when dry, glabrescent. **Lamina** coriaceous, glossy, ovate, lanceolate or oblong-lanceolate, 2.5-21.5 by 1.5-7 cm, green to dark green above, paler underneath, glabrous, apex acute or acuminate, sometimes obtuse to rounded, base cuneate to rounded, margin entire or undulate; midrib and lateral main veins raised on both surfaces, veinlets inconspicuous, anastomosing with included free veinlets. **Sori** exindusiate, in a single row between adjacent lateral main veins, more or less interrupted or continuous, not reaching midrib or margin, shallowly immersed and slightly raised on upper surface, oblong to linear or sometimes orbicular, 1.5-17 by 1.5-2 mm. **Sporangia** 0.15-0.2 mm in diam.; stalk up to 0.7 mm long; annulus vertical, interrupted. **Spores** monolet, obliquely ellipsoid-oblong or bean-shaped, 40-55 by 25-30  $\mu$ m, tuberculate, translucent.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Phatthalung, Satun, Songkhla, Yala.

**Distribution.**— Indochina, Peninsular Malaysia, Sumatra, Java, Borneo and Philippines.

**Ecology.**— On mossy rocks or mossy tree trunks, sometimes growing on the litter of decaying leaves, locally abundant in shady areas of quartzitic phyllite ridges, and also found in lowland evergreen forest, alt. 150-700 m. Uncommon.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 212 (PSU), 578 (PSU), 727 (BCU, BKF, PSU); PHATTHALUNG: *J.F. Maxwell* 86-664 (PSU), 86-751 (PSU), *P. Panggul* 344 (PSU); SONGKHLA: *A. Tongphan* 23 (PSU), *J.F. Maxwell* 85-188 (PSU).

**32. *Selliguea stenophylla*** (Blume) Parris, Pl. Mt. Kinabalu 151. 1992; Boonkerd, S. Linds., D.J. Middleton & Suddee, Thai Forest Bull., Bot. 32: 10. 2004.— *Polypodium stenophyllum* Blume, Enum. Pl. Javae 2: 124. 1828.— *Pleopeltis stenophylla* (Blume) T. Moore; Index Filic. LXXVII. 1857.— *Crypsinus stenophyllus* (Blume) Holttum, Rev. Fl. Malaya 2: 199, fig. 101. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(4): 557. 1989. **Plate 15E-F.**

Epiphyte, lithophyte or sometimes terrestrial plant. **Rhizome** long creeping, 1.5-3 mm in diam., densely covered with scales; scales peltate, gradually narrowed from base to acuminate apex, 4-5 by 0.8-1 mm, dark brown in the central part with creamy or pale brown margins, glossy. **Fronds** simple or occasionally bifurcate. **Stipe** articulate to short phyllopodia, slender, grooved, slightly adaxially winged, terete, 1-3 cm long, purplish brown to purplish black, glabrescent. **Lamina** coriaceous, glossy, linear-elliptic or linear-lanceolate, 12-17 by 1.2-1.6 cm, green to dark green above, paler underneath, glabrous, sterile lamina usually shorter than fertile lamina, apex acute or obtuse, base attenuate, margin narrowly revolute; midrib slightly grooved above, prominent underneath, lateral main veins more or less conspicuous on lower surface, veinlets inconspicuous, anastomosing with included free veinlets. **Sori**

exindusiate, one between adjacent lateral main veins, in a single row in each side of midrib, usually in apical  $\frac{1}{4}$ - $\frac{1}{2}$  of the fertile fronds, nearer the margin than the midrib, deeply immersed in cavities and raised on upper surface, orbicular, 1.5-2.5 mm in diam. **Sporangia** 0.2-0.25 mm in diam.; stalk up to 1 mm long; annulus vertical, interrupted. **Spores** monolete, obliquely ellipsoid-oblong or bean-shaped, 50-60 by 30-40  $\mu$ m, smooth, translucent.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Borneo and Philippines.

**Ecology.**— On moist mossy rocks or on mossy tree trunks, sometimes growing on the litter of decaying leaves, found in semi-exposed or partially shaded areas of mountain ridges at 650-950 m alt. Very rare in Thailand.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 316 (BCU, PSU), 737 (PSU).

## PTERIDACEAE

**33. *Pteris dalhousiae*** Hook., Sp. Fil. 2: 170, t. 121 A. 1858; Holttum, Rev. Fl. Malaya 2: 401. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 231. 1985. **Plate 16A-B.**

Terrestrial or lithophytic plant. **Rhizome** short, erect, apical part densely covered with scales; scales narrowly linear, 4-5 by 0.05-0.1 mm, dark brown to nearly black, glossy, margin thin, crisped, pale brown. **Fronds** bipinnatisect to tripinnatisect. **Stipe** not articulate to rhizome, slender, subquadangular or terete, grooved, 25-40 cm long, dark purplish brown to nearly black, glossy, scaly at the base; rachis grooved above, slightly adaxially winged, glabrous. **Lamina** chartaceous, glossy, triangular-ovate in outline, 30-35 by 25-30 cm, green to dark green above, pale green underneath,

glabrous, apex acuminate, base broad, rounded; lateral pinnae 4-5 pairs, subopposite, sessile or on stalk to 1.5 cm long, not articulate to rachis, triangular-falcate in outline, bearing 4-5 basiscopic pinnules and often with a few acroscopic pinnules, apex acuminate, base oblique, the largest pinnae up to 25 by 10 cm; pinnules sessile, the largest on the lower pinnae bearing a few secondary basiscopic lobes (secondary pinnules) or sometimes with a acroscopic lobe, triangular-falcate in outline, up to 20 by 7 cm; lobes linear-lanceolate, slightly falcate, 4-13 by 0.5-0.8 cm, apex gradually acuminate, margin serrate, the lobes of apical lamina widely spaced and connected by a broad wing; costa slightly grooved above, with wings throughout, prominent underneath; costules slightly raised above, prominent on lower surface; veins free except for the soral commissure, usually once or twice forked, rarely simple. **Sori** linear, continuous along the margin of lobes; false indusia transparent, 0.3-0.4 mm wide; paraphyses ca. 0.3 mm long, with usually enlarged  $\pm$  capitate-glandular terminal cell. **Sporangia** oblong, ca. 0.2 by 0.1 mm; stalk 0.1-0.2 mm long; annulus vertical, interrupted. **Spores** tetrahedral, trilete, subtriangular or subglobular, 25-30  $\mu$ m in diam., striate-rugulate.

**Thailand.**— SOUTH-EASTERN: Chanthaburi; PENINSULAR: Surat Thani, Songkhla, Yala.

**Distribution.**— Cambodia, Peninsular Malaysia, Sumatra and Java.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or on mossy cliffs in deep shade of mountain ridges, alt. 600-950 m. Uncommon.

**Vernacular.**—

**Specimen examined.**— BETONG: *J. Wai* 859 (PSU).

## SCHIZAEACEAE

**34. *Schizaea dichotoma*** (L.) Sm., Mém. Acad. Roy. Sci. (Turin) 5: 422, t. 9, fig. 9. 1793; Holttum, Rev. Fl. Malaya 2: 50. 1954; in Fl. Males., Ser. 2, Pterid. 1(1): 41, figs. 1, 2, 4a-d. 1959; Tagawa & K. Iwats. in Fl. Thailand 3(1): 57. 1979; De vol & W.C. Shieh in Fl. Taiwan 1: 86, pl. 30. 1994.— *Acrostichum dichotomum* L., Sp. Pl. 2: 1068. 1753. **Plate 16C-D.**

Terrestrial plant. **Rhizome** underground, short creeping, young part hairy; hairs thin, flattened, articulate, 2-3 mm long, pale brown, glossy. **Fronde**s repeatedly dichotomously branched. **Stipe** erect, slender, grooved, narrowly winged except for the basal part, 8-35 cm long, green, underground part brownish, glabrescent. **Lamina** reduced to a narrow wing on each side of the axis, fan-shaped in outline, 4-15 by 5-10 cm, green, glossy, glabrescent; ultimate segments ca. 1 mm wide. **Sorophores** in pinnate groups, terminal on ultimate segments, 3-8 pairs, 1.5-4 mm long, margin hairy. **Sporangia** in 2 rows, attached to the sides of an abaxial ridge and protected by the reflexed margins of the sorophore, sessile, ellipsoid-ovoid, ca. 0.3 by 0.2 mm; annulus subapical. **Spores** monolet, ellipsoid-oblong, 40-50 by 25-35  $\mu$ m, granulate.

**Thailand.**— EASTERN: Nakhon Ratchasima; SOUTH-EASTERN: Chon Buri, Trat; PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Throughout the Paleotropics.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves in partial shade of mountain ridges, and also found in rubber plantation, coastal heath and lowland evergreen forests, from sea level to 1,000 m alt. Common.

**Vernacular.**— Tan Klom (ตานกล่อม), Tan Phrao (ตานพร้าว), Tan San (ตานसान), Wan Dok Din (วันดอกดิน) (Peninsular); Ya Hang Ma Ba (หย้าหางหมาบ้า) (Southeastern); Misa Rima (มีชารีมา), Purasae (ปูรานแซ) (Malay-Peninsular).



**Specimens examined.**— BETONG: *J. Wai* 579 (PSU), 656 (PSU), 936 (PSU); SATUN: *P. Pattarakulpisutti et al.* 93 (PSU); SONGKHLA: *Ch. Laongpol et al.* 1 (PSU), *K. Sridith* 271 (PSU), *P. Ritthisunthorn* 65 (PSU), *P. Sirirugsa* 1161 (PSU), 1181 (PSU); NARATHIWAT: *J.F. Maxwell* 87-498 (PSU).

**35. *Schizaea digitata* (L.) Sw.,** Syn. Fil. 150, 380, t. 4, fig. 1. 1806; Holttum, Rev. Fl. Malaya 2: 51. 1954; in Fl. Males., Ser. 2, Pterid. 1(1): 41, fig. 3a-e. 1959; Tagawa & K. Iwats. in Fl. Thailand 3(1): 58. 1979; De vol & W.C. Shieh in Fl. Taiwan 1: 86, pl. 31. 1994.— *Acrostichum digitatum* L., Sp. Pl. 2: 1068. 1753. **Plate 16E-F.**

Terrestrial plant. **Rhizome** underground, very short, creeping or suberect, bearing crowded fronds, apex hairy; hairs thin, flattened, articulate, 1.5-2 mm long, brown, glossy. **Fronds** simple, erect, grass-like when sterile, winged except for the basal part, linear, more or less twisted, 10-40 by 0.1-0.3 cm, green, glossy, base slender, triquetrous, lower surface covered with minutely glandular hairs or glabrescent; midrib slightly grooved above, prominent underneath. **Sorophores** 5-12, in pseudodigitate groups at the apex of fertile fronds, 0.5-4.5 cm long, margin entire. **Sporangia** in 4 rows, densely covering the abaxial surface and protected by the reflexed margins of the sorophore, sessile, ellipsoid-ovoid, ca. 0.3 by 0.2 mm; annulus subapical. **Spores** monolete, ellipsoid-oblong, 40-50 by 25-30  $\mu$ m, obliquely striate.

**Thailand.**— SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Tropical Asia.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves in partial shade of mountain ridges, and also found in rubber plantation, coastal heath and lowland evergreen forests, from sea level to 1,000 m alt. Common.

**Vernacular.**— Tan Bit (ตานบิต), Tan Sai (ตานทราย) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 81 (PSU), 711 (PSU); SATUN: *P. Pattarakulpisutti et al.* 94 (PSU); SONGKHLA: *J.F. Maxwell* 85-114 (PSU); NARATHIWAT: *J.F. Maxwell* 87-513 (PSU).

## VITTARIACEAE

**36. *Vittaria ensiformis*** Sw., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 2: 134, t. 7, fig. 1. 1799; Holttum, Rev. Fl. Malaya 2: 613, fig. 359. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 223. 1985. **Plate 17A-B.**

Epiphyte or lithophyte. **Rhizome** short creeping, apex densely covered with scales; scales clathrate, linear-lanceolate, 4-7 by 0.2-0.5 mm, dark brown to almost black, glossy, apex long acuminate, margin minutely toothed. **Fronde**s simple, sessile, coriaceous, glossy, glabrescent, green to dark green above, pale green underneath, usually red or reddish brown when young, linear, sometimes slightly falcate 5-45 by 0.2-1 cm, apex acute, base narrow, margin entire, sometimes revolute; midrib faint or sometimes only distinct at the base; veins indistinct. **Sori** elongated, immersed in deep grooves almost at margin (submarginal); paraphyses with darkened obconical terminal cell, 0.4-0.5 mm long. **Sporangia** 0.15-0.2 mm in diam.; stalk apically widened, 0.1-0.3 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid-oblong, 45-60 by 25-30  $\mu$ m, smooth, hyaline, translucent.

**Thailand.**— SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Phuket, Krabi, Nakhon Si Thammarat, Trang, Phatthalung, Satun, Songkhla, Pattani, Yala.

**Distribution.**— Widely distributed in the Paleotropics.

**Ecology.**— On tree trunks or on moist mossy rocks, found in both semi-exposed and shady areas of mountain ridges, and also found in rubber plantation, coastal heath and lowland evergreen forests, from sea level to 700 m alt. Common.

**Vernacular.**— Kut Pik Kai (กูดปีกไก่), Wan Hang Hua Laman (ว่านหางห้ว  
ละมาน) (Pattani).

**Specimens examined.**— BETONG: *J. Wai* 353 (PSU), 420 (PSU), 655 (BCU, PSU); PHATTHALUNG: *J.F. Maxwell* 86-663 (PSU), *P. Panggul* 349 (PSU); SATUN: *G. Congdon* 683 (PSU), 839 (PSU), *J.F. Maxwell* 86-936 (PSU), *P. Pattarakulpisutti et al.* 95 (PSU); SONGKHLA: *A. Tongphan* 21 (PSU), *J.F. Maxwell* 84-216 (PSU).

**37. *Vittaria scolopendrina*** (Bory) Schkuhr ex Thwaites, Enum. Pl. Zeyl.: 381. 1864; Holttum, Rev. Fl. Malaya 2: 611. 1954; Tagawa & K. Iwats. in Fl. Thailand 3(2): 228. 1985.— *Pteris scolopendrina* Bory, Voy. Iles Afrique 2: 323. 1804. **Plate 17C-D.**

Epiphyte or lithophyte. **Rhizome** short creeping, 2-4 mm in diam., apex densely scaly; scales clathrate, linear-lanceolate, 3-7 by 0.2-0.5 mm, dark brown to almost black, glossy, apex long acuminate, margin minutely toothed. **Fronde**s simple, sessile, coriaceous, glossy, green to dark green above, pale green underneath, linear-elliptic or linear-oblong, sometimes slightly falcate, 20-90 by 1-6 cm, apex gradually acute or sometimes cleft, base narrow, margin slightly undulate, usually tightly wavy in young plants; midrib raised above, slightly grooved underneath except for the base; veins slightly raised above and usually faint beneath. **Sori** elongated, immersed in shallow grooves just within the margin, 1-2 mm wide; paraphyses with darkened obconical terminal cell, 0.4-0.5 mm long. **Sporangia** 0.15-0.2 mm in diam.; stalk apically widened, 0.1-0.3 mm long; annulus vertical, interrupted. **Spores** monolete, ellipsoid-oblong, 45-50 by 25-30  $\mu$ m, smooth, hyaline or yellowish, translucent.

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Satun, Yala.

**Distribution.**— Widely distributed in the Paleotropics.

**Ecology.**— On tree trunks or on moist mossy cliffs, usually found in shady areas of mountain ridges at 650-950 m alt. Uncommon.

**Vernacular.**— Thu Rang (ทุ้ง) (Nakhon Si Thammarat).

**Specimens examined.**— BETONG: *J. Wai* 206 (PSU), 1091 (PSU).

## **GYMNOSPERMS**

### **GNETACEAE**

**38. *Gnetum gnemon* L. var. *tenerum* Markgr.**, Bull. Jard. Bot. Buitenzorg, ser. 3, 10: 444. 1930; Phengklai in Fl. Thailand 2(3): 206, fig. 24. 1975. **Plate 17E.**

Shrub 2-3 m high. **Bark** greyish brown; wood cream or yellowish. **Leaves** simple, opposite, glabrous; petiole slightly winged, 5-10 mm long; blade thinly coriaceous, elliptic to elliptic-oblong, ovate or lanceolate, 7-14 by 2.5-5.5 cm, green to dark green on upper surface, pale green underneath, apex acuminate or cuspidate, base cuneate or attenuate, margin entire or slightly undulate; midrib flattened or slightly impressed above, raised underneath. **Strobili** axillary, simple or few-branched, cylindrical, 1-2 cm long, ca. 2 mm in diam.; involucral collars ca. 1 mm high raised from their base (nodes); peduncle 5-10 mm long; male strobili with 6-10 involucral collars, each collar containing numerous fertile male structures and 5-6 rudimentary ovules; female strobili with 5-9 involucral collars, each collar with 3-5 fertile ovules plus numerous rudimentary male structures; ovules ovoid. **Seeds** not seen.

**Thailand.**— PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Yala.

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— On mountain ridges, often found in lowland evergreen forest and secondary forest, from sea level to 950 m alt. Common. Pollination in October-December.

**Vernacular.**— Khliang (เขลียง), Rian Kae (เรียนแก) (Nakhon Si Thammarat); Phak Kariang (ผักกะเหรียง) (Chumphon); Phak Miang (ผักเมี่ยง), Miang (เหมียง) (Phangnga); Phak Liang (ผักเหลียง) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 314 (BCU, BKF, PSU), 925 (PSU), 1093 (PSU); NAKHON SI THAMMARAT: *M. Newman* 56 (PSU).

## PODOCARPACEAE

**39. *Dacrydium elatum*** (Roxb.) Wall. ex Hook., London J. Bot. 2: 144, pl. 2. 1843; Hook.f., Fl. Brit. India 5: 648. 1888; Ridl., Fl. Malay Penins. 5: 279, fig. 227. 1925; Corner, Wayside Trees Mal. 1-2: 721, pl. 223-224. 1940; H. Keng in Tree Fl. Malaya 1: 45, fig. 1d. 1972; Phengklai in Fl. Thailand 2(3): 197, fig. 16. 1975.— *Juniperus elatus* Roxb., Fl. Ind. 3: 838. 1832.— *Corneria elata* (Roxb.) A.V. Bobrov & Melikyan, Bot. Zhurn. (Moscow & Leningrad) 85(7): 62. 2000. **Plate 18A-C.**

Medium to large tree, up to 25 m high; crown dome-shaped, often much branched and usually with weeping branchlets. **Bark** shallowly fissured or irregularly scaly and flaking, reddish brown or dark brown, often with whitish grey blotches. **Leaves** spirally arranged, dimorphic; juvenile leaves spreading, acicular or linear-lanceolate, 4-angled, slightly incurved, 1-10 by 0.3-0.4 mm; adult leaves appressed, imbricate, scale-like, stiff, awl-shaped, 1.5-3 by 0.3-1 mm. **Male cone** terminal on branch ends, cylindrical, 2-5 mm long, 1-1.2 mm in diam.; microsporophylls numerous. **Female cone** terminal on branch ends, bearing only one fertile bract; ovule 1. **Seed** solitary, sessile, ovoid, 4-5 by 2-3 mm,  $\frac{1}{3}$  of base covered with epimatium (pseudopericarp); epimatium broadly rounded, red and fleshy when ripe.

**Thailand.**— NORTHERN: Phitsanulok; NORTH-EASTERN: Phetchabun, Loei; EASTERN: Nakhon Ratchasima, Chaiyaphum; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Trat; PENINSULAR: Narathiwat, Yala.

**Distribution.**— India, Myanmar, Cambodia and throughout Malesia.

**Ecology.**— On mountain ridges, often locally abundant in lower montane forest, alt. 900-1,500 m. Uncommon. Seed maturity in November-December.

**Vernacular.**— Chuang Pha (จวงผา), Sam Phan Pi (สามพันปี), Phaya Mai (พญาไม้) (Northeastern); Hang Ma (หางหมา) (Loei, Chaiyaphum); Phaya Ma Kham Pom (พญามะขามป้อม), Son Soi (สนสร้อย) (Southeastern); Son (สน) (Yala, Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 451 (BCU, BKF, PSU), 528 (BKF, PSU).

## ANGIOSPERMS

### *DICOTS*

#### ANNONACEAE

**40. *Pyramidanthe prismatica*** (Hook.f. & Thomson) J. Sinclair, Gard. Bull. Singapore 14: 362. 1955; Kochummen in Tree Fl. Malaya 1: 64. 1972.— *Melodorum prismaticum* Hook.f. & Thomson, Fl. Ind. 1: 121. 1855; in Fl. Brit. India (J.D. Hooker) 1: 81. 1872; Ridl., Fl. Malay Penins. 1: 87. 1922. **Plate 18D-F.**

Woody climber. **Bark** fissured, dark grey, usually with whitish grey blotches; young branches and shoots pubescent. **Leaves** simple, alternate, reddish brown when dry; petiole 8-15 mm long, pubescent; blade coriaceous, oblong or oblanceolate, 4-12 by 2-4.5 cm, upper surface shining, green to dark green, glabrous, lower surface paler, glaucous, sparsely minute-setose to finely pubescent or glabrous in old leaves, apex acuminate or rarely retuse, base rounded, margin entire; midrib impressed above and prominent underneath, pubescent, secondary veins 10-20 pairs, intramarginal veins present. **Flowers** solitary, axillary or terminal; bracts 1-3, triangular-rounded, 1-2 by 1-3 mm, pubescent; pedicels 5-11 mm long, pubescent. **Sepals** valvate, connate into a 3-angled disc, persistent, 8-9 mm in diam., pale green, pubescent outside. **Petals** 6, in 2 row, valvate, thick, connivent; outer petals narrowly triangular-lanceolate, ca. 4

by 1.2 cm, yellow-orange, pubescent; inner petals triangular-ovate, ca. 1 by 0.5 cm, yellow, glabrous. **Stamens** numerous, 1-2.5 mm long, glabrous; connective appendages pentagonal, orbicular, triangular or quadrangular; anthers opening with longitudinal slits, 1-1.5 mm long. **Apocarpus carpels** 10-13 per flower, 2.5-3 mm long; ovary superior, cylindrical-oblong, ca. 2 mm long, placentation marginal; outside of placental line hairy, hairs arranged on one side of ovary; ovules 14-20; stigma and style ca. 1 mm long; stigma bilobed, curly and warty; style very short. **Fruit** aggregate, with persistent calyx; monocarpis ellipsoid, slightly rough (tuberculate), 1.7-3.5 by 0.6-1.7 cm, pubescent; stipes 1-2.2 cm long, subglabrous to sparsely pubescent. **Seeds** 3-20 per monocarp, slightly flattened, elliptic-oblong, 9-11 by 6-7 mm, dark brown, glossy.

**Thailand.**— PENINSULAR: Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— On exposed quartzitic phyllite ridges, alt. 600-700 m. Common in forests of Malaysia, in Borneo found on sandstone hills and kerangas forest. Very rare in Thailand. Flowering and fruiting all year round, more flowers in July-August.

**Vernacular.**— Plao (แปล) (Yala).

**Specimens examined.**— BETONG: *J. Wai* 312 (BKF, PSU), 497 (BKF, PSU), 515 (PSU), 1109 (PSU); MALAYSIA (Kelantan): *A. Latiff et al.* ALM 1817 (PSU).

## APOCYNACEAE

**41. *Alstonia rostrata*** C.E.C. Fisch., Bull. Misc. Inform., Kew 1929: 315. 1929; P.T. Li, Leeuwenb. & D.J. Middleton in Fl. China 16: 155. 1995; D.J. Middleton in Fl. Thailand 7(1): 45. 1999; in Fl. Males., Ser. 1, Seed Pl. 18: 53, fig. 9. 2007.— *Winchia calophylla* A. DC. in Prodr. (DC.) 8: 326. 1844; Hook.f., Fl. Brit. India 3: 630. 1882; Kerr, Fl. Siam. 2: 439. 1939.— *W. glaucescens* K. Schum., Nat. Pflanzenfam. 4(2): 125. 1895.— *Alstonia glaucescens* (K. Schum.) Monach. in Pacific Sci. 3: 144. 1949.— *A. undulifolia* Kochummen & K.M. Wong, Blumea 29(2): 513. 1984. **Plate 19A-B.**

Tree or shrubby tree up to 15 m high; latex white. **Bark** blackish brown or grey; branchlets glabrous. **Leaves** simple, arranged in whorls of 3-4; petiole 0.7-2 cm long, glabrous; blade coriaceous, oblong, elliptic or obovate, 3.5-11.5 by 1-4.5 cm, upper surface shining, light to dark green, lower surface paler, glabrous on both surfaces, apex acuminate, truncate or emarginate, base cuneate, margin undulate; midrib impressed above when dry and prominent underneath, glabrous, secondary veins 30-45 pairs. **Inflorescences** terminal, paniculate cymes, many-flowered, 2-3.5 cm long; peduncle 0.5-2 cm long, glabrous; bracts and bracteoles minute, ovate or triangular, ca. 0.5 mm long, glabrous. **Flowers** 5-merous (excluding gynoecium); pedicels 1.5-2.5 mm long, glabrous. **Calyx** lobes ovate, 0.5-1 mm long, reddish purple or greenish, apex rounded, margin ciliate. **Corolla** salverform, creamy white; tube cylindrical, 4-5 mm long, glabrous outside, pubescent inside except at the base of tube; lobes overlapping to the left in bud, oblong, ca. 2 by 1.5 mm, inner surface pubescent, outer surface minutely pubescent, apex rounded. **Stamens** 5, inserted around the middle of corolla tube; filaments ca. 1 mm long; anthers lanceolate or narrowly triangular, ca. 1 mm long. **Disk** absent. **Ovary** partly inferior, ca. 1 mm long, 2-locular; ovules numerous per locule; style very short; stigma head bifid. **Follicle** solitary, linear, ca. 17 by 0.9 cm, glabrous. **Seeds** numerous, flattened, oblong, ca. 7 by 2 mm, glabrous, ends rounded; longest cilia 1-1.5 cm long, brown.



**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Lampang, Phrae, Phitsanulok; NORTH-EASTERN: Chaiyaphum; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Satun, Songkhla, Yala.

**Distribution.**— China, Vietnam, Myanmar, Peninsular Malaysia and Sumatra.

**Ecology.**— On exposed quartzitic phyllite ridges, and also found on sandstone hills, in lowland evergreen and secondary forests, alt. 300-700 m. Uncommon. Flowering in April-June, fruiting in July-August.

**Vernacular.**— Nong Khao (น่องขาว) (Mae Hong Son).

**Specimens examined.**— BETONG: *J. Wai* 653 (BKF, PSU), 705 (BKF, PSU), 821 (PSU); SONGKHLA: *J.F. Maxwell* 85-528 (PSU).

**42. *Anodendron axillare*** Merr., Philipp. J. Sci., C 7: 331. 1912; D.J. Middleton, *Blumea* 41(1): 42, fig. 1. 1993; in *Fl. Males.*, Ser. 1, Seed Pl. 18: 136, fig. 29. 2007.

**Plate 19C-D.**

Climber with white latex; branches slender, blackish brown or dark grey; branchlets rust-coloured to brown, terete, glabrous. **Leaves** simple, opposite; petiole 0.3-1 cm long, glabrous; blade subcoriaceous, oblong or elliptic, 3-7.7 by 0.6-2.7 cm, glabrous, upper surface shining, light green to dark green, lower surface paler, minutely punctate (sometimes indistinct), apex acuminate or abruptly caudate, base cuneate, margin entire; midrib flattened or impressed above when dry and prominent underneath, glabrous, secondary veins 7-13 pairs. **Inflorescences** terminal or axillary, corymbose-paniculate cymes, 3-13-flowered, 2-4 cm long; peduncle 0.5-2.3 cm long, glabrous; bracts and bracteoles minute, ovate or triangular, ca. 1 mm long, glabrous, bracteoles 2 per flower. **Flowers** fragrant, 5-merous (excluding gynoecium), sessile to subsessile; pedicels 0-1 mm long. **Calyx** lobes ovate or triangular, ca. 1 mm long, reddish, glabrous, apex acute. **Corolla** salverform; tube cylindrical, 4-5 mm long, reddish, glabrous outside, villous inside; lobes overlapping to the right and twisting to

the left in bud, mature lobes twisted, narrowly oblong-falcate, 5-7 mm long, inner surface creamy or yellowish, villous, outer surface reddish, glabrous, apex asymmetrical, truncate with acute or short acuminate tip. **Stamens** 5, inserted near base of corolla tube; filaments very short; anthers narrowly triangular, ca. 1 mm long, apex mucronate, base sagittate. **Disk** cup-shaped, 5 crenate, 0.4-0.5 mm high. **Ovaries** 2, superior, 0.3-0.4 mm long; ovules numerous; style united, very short; stigma head conical-cylindrical, bilobed, ca. 1 mm long. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Borneo and Philippines.

**Ecology.**— On semi-exposed rocky ridges, alt. 650-950 m. Very rare in Thailand. Flowering in January-March.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand.

**Specimens examined.**— BETONG: *J. Wai* 570 (BCU, BKF, PSU), 598 (BCU, BKF, PSU).

**43. *Willughbeia coriacea*** Wall., Pl. Asiat. Rar. 3: 45. 1832; Hook.f., Fl. Brit. India 3: 623. 1882; Ridl., Fl. Malay Penins. 2: 323. 1923; D.J. Middleton, Blumea 38(1): 8. 1993; in Fl. Thailand 7(1): 19. 1999; in Fl. Males., Ser. 1, Seed Pl. 18: 425. 2007.— *W. firma* Blume, Mus. Bot. 1: 154. 1850; Hook.f., Fl. Brit. India 3: 624. 1882; Ridl., Fl. Malay Penins. 2: 323, fig. 105. 1923; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 224. 1965. **Plate 19E-F.**

Climber with white latex; branches and branchlets quadrangular, blackish brown, lenticellate. **Leaves** simple, opposite; petiole 0.5-1.5 cm long, glabrous; blade coriaceous, oblong, elliptic or lanceolate, 6-13 by 2-5 cm, upper surface shining,

green to dark green, lower surface pale green, glabrous on both surfaces, apex acuminate, base cuneate, margin entire; midrib impressed above when dry and prominent underneath, glabrous, secondary veins 12-20 pairs. **Inflorescences** axillary cymes, short and dense, many-flowered, sessile to subsessile; peduncle 0-2 mm long; bracts and bracteoles narrowly triangular or oblong to oblong-linear, apex acuminate or acute, margin ciliate in apical part or sometimes subglabrous (especially when dry), bracts 3-4 mm long, bracteoles 1-2 mm long. **Flowers** fragrant, 5-merous (excluding gynoecium), sessile to subsessile; pedicels 0-2 mm long. **Calyx** lobes oblong or ovate, 1-1.5 by 0.5-0.8 mm, greenish, apex rounded, margin ciliate. **Corolla** salverform, creamy white or yellowish; tube cylindrical, dilated in the middle, (3.5-)4-5(-6) mm long, glabrous outside, pubescent around stamens inside; lobes overlapping to the left in bud, mature lobes narrowly oblong, (3-)5-6 mm long, apex rounded, margin ciliate. **Stamens** 5, inserted around the middle of corolla tube, at 1.5-2 mm from base; filaments ca. 1 mm long; anthers ovate-lanceolate, ca. 1 mm long, apex acute or mucronate, base slightly cordate. **Ovary** partly inferior, ca. 1 mm long, 1-locular; ovules numerous; style 1-1.5 mm long; stigma head conical or ovoid, ca. 1 mm long, pubescent. **Berry** obovoid. **Seeds** not seen.

**Thailand.**— PENINSULAR: Surat Thani, Krabi, Nakhon Si Thammarat, Pattani, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java and Borneo.

**Ecology.**— On rocky or sandy heath soils in partial shade of rocky ridges, and also found in lowland evergreen forest, alt. 200-950 m. Uncommon. Flowering and fruiting in May-October, more flowers in July-August.

**Vernacular.**— Khui (คุย) (Peninsular); A Ka Kue Lo (อาภาเกื้อเลาะ) (Malay-Pattani); Gutta Garoo (กัตตาการู) (Malay-Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 243 (BKF, PSU), 839 (BCU, BKF, PSU); NAKHON SI THAMMARAT: *W. Ramsri* 102 (PSU).

**44. *Willughbeia tenuiflora*** Dyer ex Hook.f., Fl. Brit. India 3: 625. 1882; Ridl., Fl. Malay Penins. 2: 325. 1923; D.J. Middleton, Blumea 38(1): 18. 1993; in Fl. Males., Ser. 1, Seed Pl. 18: 435. 2007. **Plate 20A-C.**

Climber with white latex; branches and branchlets terete to subquadrangular, lenticellate; branches blackish brown, glabrous; branchlets rust-coloured to brownish, pubescent. **Leaves** simple, opposite; petiole 1-1.7 cm long, glabrous or rarely subglabrous (sparsely puberulent); blade coriaceous, oblong, rarely elliptic or obovate, 5-12 by 1.5-5.5 cm, upper surface shining, light green or yellowish green, lower surface paler, glabrous on both surfaces, apex acuminate, abruptly caudate, rarely obtuse or retuse, base cuneate, margin entire or undulate; midrib impressed above when dry and prominent underneath, glabrous or rarely subglabrous (sparsely puberulent), secondary veins 20-30 pairs. **Inflorescences** axillary, paniculate cymes, many-flowered, up to 10 cm long; peduncle 3-10 mm long, pubescent; bracts and bracteoles ovate or oblong, pubescent, apex rounded or acute, bracts at the base of flower pedicels, 2-2.5 mm long, bracteoles on flower pedicels, 1-2 mm long, pubescent. **Flowers** fragrant, 5-merous (excluding gynoecium); pedicels 2-4 mm long, pubescent. **Calyx** lobes ovate or oblong, 1.5-2 by 1-1.5 mm, reddish brown or greenish, pubescent, apex rounded or acute. **Corolla** salverform; tube cylindrical, dilated at the base, 12-14 mm long, yellowish or reddish, glabrous outside, villous inside except on the lower part of tube, around the stamens inside glabrous; lobes overlapping to the left in bud, mature lobes narrowly oblong and slightly falcate, (12-)15-21 by 3-4 mm, white, apex rounded or acute, margin sparsely ciliate. **Stamens** 5, inserted at 2-3 mm from base; filaments ca. 1 mm long, pubescent at the base; anthers ovate-lanceolate, ca. 1.5 mm long, apex mucronulate, base slightly cordate. **Ovary** partly inferior, 1.5-2 mm long, 1-locular; ovules numerous; style ca. 0.1 mm long; stigma head conical or ovoid, ca. 1.5 mm long, puberulent. **Berry** pear-shaped, 13-15 by 10-12 cm. **Seeds** oblong, 2.2-2.5 by 1.2-1.5 cm and 1-1.3 cm thick.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Singapore and Sumatra.

**Ecology.**— On exposed quartzitic phyllite ridges, alt. 600-700 m. Very rare in Thailand. Flowering and fruiting in November-May, more flowers in April.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand and differs from its close ally, *Willughbeia grandiflora* Dyer ex Hook.f. in having very short style (stigma subsessile) and the texture of leaves not glaucescent.

**Specimens examined.**— BETONG: *J. Wai* 501 (BKF, PSU), 668 (PSU), 681 (BCU, BKF, PSU).

**Additional specimen examined.**— *Willughbeia grandiflora* Dyer ex Hook.f.; NARATHIWAT: *J.F. Maxwell* 87-588 (PSU).

## ARALIACEAE

**45. *Schefflera cephalotes*** (C.B. Clarke) Harms in Nat. Pflanzenfam. (Engler & Prantl) 3(8): 36. 1894; Ridl., Fl. Malay Penins. 1: 875. 1922; B.C. Stone in Tree Fl. Malaya 3: 31. 1978.— *Heptapleurum cephalotes* C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 731. 1879. **Plate 20D-F.**

Shrubby tree or tree, up to 15 m high. **Bark** greyish brown; branchlets stout, terete, often with prominent leaf scars, lenticellate, greyish brown. **Stipules** distinct, intrapetiolar, connate within petiole into a ligule. **Leaves** spirally arranged, palmately compound, digitate; petiole terete, up to 30 cm or more long, stellate hairy or glabrescent, base clasping the stem; leaflets 6-10; petiolule 2.5-4.5 cm long, covered with golden brown stellate hairs or glabrescent; blade rigid, coriaceous, obovate to oblong-ob lanceolate, 10-17.5 by 4-6 cm, acuminate-cuspidate, acute or obtuse, sometimes emarginate, base cuneate, margin entire, upper surface shining, green, glabrescent, underneath paler, densely covered with golden reddish brown stellate hairs; midrib raised above, strongly prominent underneath, secondary veins 10-20

pairs. **Inflorescences** terminal, consists of numerous heads arranged within panicles, densely covered with golden brown stellate hairs, 30-40 cm long; peduncles 5-12 cm long; rachis 25-30 cm long; heads globular, 1.2-1.5 cm in diam. (living), on stalks to 1 cm long. **Flowers** sessile. **Calyx** tube adnate to ovary; lobes reduced to a ring, rim-like, entire. **Petals** 8, valvate, connate into a cap, 2-3 mm in diam., light reddish brown, densely stellate hairy outside, glabrous inside. **Stamens** 8, glabrous; filaments 1-1.5 mm long, light green; anthers oblong-ovate or oblong, 1-1.2 by 0.7-0.8 mm, deep purple. **Disk** fleshy, slightly convex. **Ovary** inferior, obconical, 3.5-4 by 2-3 mm, 8-locular, placentation axile, with a single ovule per locule; stigma sessile. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Singapore and Borneo.

**Ecology.**— In open vegetation on quartzitic phyllite ridges, alt. 650-700 m. Very rare. Flowering in March-May, fruiting in July-October.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 689 (BKF, PSU), 738 (PSU).

## ASCLEPIADACEAE

**46. *Dischidia bengalensis*** Colebr., Trans. Linn. Soc. London 12: 357, t. 15. 1818; Hook.f., Fl. Brit. India 4: 50. 1883; Ridl., Fl. Malay Penins. 2: 405. 1923; Craib in Fl. Siam. 3(1): 43. 1951; M.R. Hend., Malay. Wild Fls., Dicots.: 300. 1959; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 263. 1965; Rintz, Blumea 26(1): 97, fig. 17. 1980; P.T. Li, M.G. Gilbert & W.D. Stevens in Fl. China 16: 236. 1995.— *D. spatulata* Blume, Bijdr. Fl. Ned. Ind. 16: 1060. 1826.— *D. cuneifolia* Wall., Pl. Asiat. Rar. 2: 36. 1831.— *D. littoralis* Schltr., Nachtr. Fl. Deutsch. Sudsee: 359. 1905.— *D. loeseneriana* Schltr., Beih. Bot. Centralbl. 34(2): 10. 1916. **Plate 21A-B.**

Climber with white latex. **Stems** and branches creeping or twining, slender, with nodal roots, 1.5-3 mm in diam., greenish, glabrous; internodes 5.5-8 cm long. **Leaves** simple, opposite, glabrous, subsessile; petiole 1-2 mm long; blade thick and fleshy, linear-oblong to elliptic-oblong or sometimes narrowly oblanceolate, 14-20 by 2-8 mm, olive green or whitish green, glabrous, apex emarginate, truncate or rounded, base cuneate or rounded, margin entire; midrib inconspicuous. **Inflorescences** extra-axillary; pseudoumbels 1-2-flowered, sessile; bracts triangular or ovate, 0.3-0.4 by 0.3-0.5 mm, outer surface pubescent, apex acute, margin ciliate. **Flowers** 5-merous (excluding gynoecium); pedicels 0.5-1 mm long, glabrous. **Calyx** lobes ovate, 0.5-1 mm long, subglabrous or glabrous, apex acute, margin ciliate or glabrous. **Corolla** broadly urceolate, creamy white, glabrous; tube 1.5-2 mm long; lobes ovate, 1-1.5 mm long, glabrous, apex acute, thickened. **Gynostegium** conical, ca. 1.5 by 1.5 mm, creamy white; corona segments stalked, with 2 recurved lobes, ca. 1 mm long, hyaline; anther wings ca. 0.5 mm long, yellowish white; pollinium ascending corpusculum fusiform, 0.15-0.2 mm long, reddish; translators triangular, 0.15-0.2 mm long, hyaline; pollinia obovoid, 0.2-0.3 mm long. **Ovaries** 2, superior, 0.5-0.6 mm long; ovules numerous; style united, very short; stigma head thick, conical-subquadrangular. **Fruit** and **Seeds** not seen.

**Thailand.**— Throughout the country.

**Distribution.**— India, Indochina, Myanmar, Peninsular Malaysia, Sumatra, Java, Borneo and New Guinea.

**Ecology.**— On tree trunks or on rocks in both semi-exposed and shady areas of rocky mountains, and also found in coastal heath and lowland evergreen forests, from sea level to 1,000 m alt. Common. Flowering in March-May.

**Vernacular.**— Thao Wan Duan (เถาวัลย์ดวน) (Prachuap Khiri Khan); Thao Hua Duan (เถาหัวดวน) (Surat Thani); O Lop (อ้อลบ) (Trang).

**Remarks.**— In descriptions of this species, the corolla throat is pilose inside (Ridley, 1923; Rintz, 1980), but the specimens from this study, the corolla throat is entirely glabrous.

**Specimens examined.**— BETONG: *J. Wai* 682 (PSU); SATUN: *P. Pattarakulpisutti et al.* 85 (PSU); SONGKHLA: *J.F. Maxwell* 84-204 (PSU), 86-459 (PSU), *P. Sirirugsa* 873 (PSU).

**47. *Dischidia fruticulosa*** Ridl., J. Straits Branch Roy. Asiat. Soc. 79: 96. 1918; Ridl., Fl. Malay Penins. 2: 408. 1923; Rintz, Blumea 26(1): 101, fig. 24. 1980. **Plate 21C-E.**

Climber with white latex. **Stems** and branches slender, 0.5-3.5 mm in diam., greenish, glabrous; young parts pubescent; internodes 0.5-5.5 cm long. **Leaves** simple, alternate and opposite on the same plant; petiole 3-8 mm long; blade thick and fleshy, elliptic, ovate or obovate, 3-6 by 1.2-2.3 cm, light to dark olive green, glabrous, apex acute or acuminate, base cuneate or attenuate, margin finely serrate; midrib inconspicuous. **Inflorescences** extra-axillary or terminal; pseudoumbels 1-11-flowered, sessile or subsessile; peduncle 0-5 mm long, glabrous; bracts triangular, 0.3-0.5 by 0.3-0.7 mm, glabrous, apex acute or acuminate, margin finely serrate or entire. **Flowers** 5-merous (excluding gynoeceium); pedicels 0.5-1 mm long, glabrous. **Calyx** lobes ovate, 0.7-0.8 mm long, glabrous, apex acute or rounded, margin finely serrate. **Corolla** narrowly urceolate; tube cylindrical, base dilated, 2.5-3 mm long, creamy white, outer surface glabrous, throat pilose inside, pinkish; lobes ovate, 0.7-0.8 mm long, pinkish, apex acute, outer surface glabrous, base of lobes densely pilose inside. **Gynostegium** conical, ca. 1 by 1 mm, creamy white; corona segments stalked, with a sagittate apex and 2 reflexed lobes, 5-6 mm long, hyaline; anther wings ca. 0.5 mm long, creamy white; pollinium ascending corpusculum fusiform, ca. 0.2 mm long, reddish; translators triangular, ca. 0.1 mm long, hyaline; pollinia obovoid, 0.2-0.25 mm long. **Ovaries** 2, superior, 0.6-0.7 mm long; ovules numerous; style united, very short; stigma head thick, conical-subquadrangular. **Follicles** cylindrical, terete, ca. 4.2 by 0.2 cm (young fruit), glabrous. **Seeds** with coma.



**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On tree trunks and branches, found in shady areas of quartzitic phyllite ridge, alt. 650-700 m. Very rare. Flowering in February-August.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand. In this study, the plant materials are slightly different from the description of Rinzt (1980) in some aspects, i.e. the length of peduncle is shorter and the corolla lobes are only pilose on the base of corolla lobes. However, It is treated here as *Dischidia fruticulosa* Ridl., since those characters are very highly variable. Only few plant specimens were collected from this study. Therefore, more collections are required.

**Specimens examined.**— BETONG: *J. Wai* 704 (PSU), 835 (PSU).

**48. *Hoya imperialis*** Lindl., Edwards's Bot. Reg. 33: sub t. 68. 1846; Hook.f., Fl. Brit. India 4: 59. 1883; Ridl., Fl. Malay Penins. 2: 399. 1923; Rintz, Malayan Nat. J. 30(3-4): 501, fig. 18. 1978. **Plate 22A-D.**

Climber with white latex. **Stems** and branches scandent, stout, 0.5-1.5 cm in diam., brownish grey, pubescent except on very old parts; internodes 5-25 cm long. **Leaves** simple, opposite; petiole stout, 1-1.5 cm long, pubescent; blade coriaceous, rigid, thick and fleshy, oblanceolate to elliptic-oblong, 5-15 by 2-5 cm, upper surface shining, light to dark green, lower surface paler, apex shortly acuminate and usually reflexed, base rounded or cuneate, margin entire or undulate, narrowly revolute, ciliate; midrib impressed above when dry and prominent underneath, pubescent on both surfaces, secondary veins 19-23 pairs. **Inflorescences** extra-axillary or sometimes terminal, sub-pendulous; pseudoumbels convex, 1-19-flowered, pubescent; peduncle stout, 5-12 cm long, 4-5 mm in diam.; bracts triangular, 1-3 by 2-5 mm, outer surface

pubescent. **Flowers** 5-merous (excluding gynoecium), lasting 2-3 weeks; pedicels uniform, 6.5-7 cm long, with scattered glands below the receptacle. **Calyx** 2-2.5 cm in diam., pale green, outer surface pubescent, with scattered glands, inner surface glabrous; lobes ovate, 7-10 by 6-8 mm, apex  $\pm$  acute, margin ciliate. **Corolla** fleshy, rotate-campanulate, spreading in star-shape when fully open, 7-9 cm in diam.; tube 1-1.5 cm long, inner surface creamy white, between lobes reddish purple, finely pubescent, outer surface pale yellow to pale green, sparsely scattered with reddish purple glands, glabrous; lobes ovate, 2.5-3 by 2-2.5 cm, inner surface dark red or reddish purple, outer surface pale yellow to pale green, with scattered reddish purple glands, glabrous on both surfaces, apex acute, margin recurved, ciliate. **Corona** massive, ca. 2 cm in diam., creamy white, outside glabrous, with very short pubescent stalk; coronal scales ovoid, ca. 10 by 4.5 mm, raised from corolla ca. 1.2 cm high, inner angle  $\pm$  acute, outer angle retuse; inner lobe with a conical process or a spine-like appendage, inside solid with densely soft spongy-like tissue around the stigma head; outer lobe blunt, upcurved, inside hollow and pubescent to pilose-villous; anther appendages covering the receptive area of stigma, creamy white; anther wings rigid, ca. 3.5 mm long, yellowish white; pollinium ascending corpusculum slightly rounded-subquadrangular, ca. 0.5 mm in diam., brownish black; translators ca. 0.3 mm long, hyaline; pollinia winged, obliquely oblong, 2-2.5 by 0.5-0.7 mm, yellow. **Ovaries** 2, superior, 5-7 mm long, pale green, glabrous; ovules numerous; style united, very short; stigma head conical-subquadrangular, 8-9 by ca. 6 mm, creamy white. **Fruit** and **seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— On thin layer decaying organic matter over the rocky base in exposed areas of quartzitic phyllite ridge at 650 m alt., and also found on tree trunks in mangrove and lowland evergreen forests (outside Thailand). Very rare in Thailand. Flowering in October-April. Floral visitors were mainly honey bees, ants and moths.

mm, white with pale orange tips, with scattered reddish purple glands, inner surface pubescent, outer surface glabrous, apex acute, margin reflexed or recurved, ciliate. **Corona** stalked, ca. 1.2 cm in diam., white, glabrous; coronal scales, suberect, fusiform-narrowly rhomboid, ca. 10 by 2 mm, raised from corolla ca. 8 mm high, inner and outer angle acuminate; inner lobe erect; outer lobe strongly reflexed; anther appendages covering the receptive area of stigma, deep purple; anther wings rigid, ca. 2 mm long, creamy white; pollinium ascending corpusculum ovoid, 0.2-0.3 mm long, reddish brown; translators ca. 0.15 mm long, hyaline; pollinia winged, narrowly oblong, ca. 1 by 0.2 mm, yellow. **Ovaries** 2, superior, ca. 2.5 mm long; ovules numerous; style united, very short; stigma head conical, narrowly subquadrangular, ca. 5 by 2.5 mm. **Follicle** with a persistent calyx, linear-cylindrical, terete, 15-19 by 0.5-0.7 cm. **Seeds** compressed, lanceolate-oblong, ca. 4 by 1-1.5 mm; coma ca. 4 cm long.

**Thailand.**— SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Phangnga, Narathiwat, Yala.

**Distribution.**— China, Laos, Vietnam, Myanmar, Philippines, Peninsular Malaysia, Sumatra, Java, Borneo and Sulawesi.

**Ecology.**— On mossy rocks in partial shade of mountain ridges at 650-950 m alt., and also found on tree trunks in coastal heath and lowland evergreen forests. Uncommon. Flowering and fruiting all year round, more flowers in rainy season.

**Vernacular.**— Kluai Mai Fan Ngu (กล้วยไม้พันธุ์) (Central).

**Remarks.**— The present plant collections differ from the other collections of *Hoya multiflora* Blume in having more coriaceous and thicker leaves.

**Specimens examined.**— BETONG: *J. Wai* 511 (PSU), 567 (PSU), 645 (PSU), 917 (PSU); PHANGNGA: *Ph. Buathong* 006 (PSU).

**50. *Hoya plicata*** King & Gamble, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74: 578. 1907; Ridl., Fl. Malay Penins. 2: 402. 1923. **Plate 23A.**

Climber with white latex. **Stems** and branches slender with nodal and adventitious roots, 1-5 mm in diam., brownish grey or greenish, glabrous; internodes 2-15 cm long. **Leaves** simple, opposite or occasionally in whorls of 3, glabrous; petiole 7-15 mm long; blade coriaceous, thick and fleshy, oblong-elliptic or sometimes lanceolate, 7-12 by 2.2-4 cm, green to dark green above, paler underneath, apex acuminate, base cuneate, margin shallowly crenate or entire, slightly revolute; midrib and secondary veins usually inconspicuous. **Inflorescences** axillary or terminal, pendulous; pseudoumbels concave, 7-24-flowered; peduncle 4.5-11 cm long, greenish, glabrous; bracts triangular, 0.5-1 by 1-1.5 mm, outer surface glabrous or papillate. **Flowers** 5-merous (excluding gynoecium); pedicels various in length, 1-3.5 cm long, with scattered reddish purple glands, glabrous or sparsely papillate. **Calyx** 4-5 mm in diam., reddish purple to deep purple, outer surface minutely papillate; lobes broadly ovate, 1-1.5 by 1-1.5 mm, apex acute. **Corolla** rigid, spreading in star shape and reflexed when fully open, 1.2-1.3 cm in diam., creamy white to pale orange with tinged pinkish; tube ca. 3 mm long, around and below the corona insertion elevated, 5-angled, sericeous to pilose-villous; lobes recurved, ovate, ca. 5 by 4 mm, inner surface minutely puberulous (seem to be glabrous without optic help), outer surface glabrous, apex acute. **Corona** ca. 6 mm in diam., glabrous; coronal scales, slightly suberect, elliptic-ovate, 3-3.5 by 1-1.5 mm, raised from corolla 2-2.5 mm high, inner angle  $\pm$  acuminate, reddish purple or pinkish white, outer angle rounded to emarginate, creamy white to pale orange; anther appendages covering the receptive area of stigma, white; anther wings rigid, ca. 1 mm long, reddish purple or pinkish; pollinium ascending corpusculum cylindrical-oblong, ca. 0.2 by 0.1 mm, reddish brown; translators winged, triangular, ca. 0.15 mm long, hyaline; pollinia winged, obliquely oblong, ca. 0.6 by 0.15 mm, yellow. **Ovaries** 2, superior, ca. 2 mm long; ovules numerous; style united, very short; stigma head conical, subquadrangular, ca. 1.2 by 1-1.2 mm. **Fruit** and **seeds** not seen.

**Thailand.**—PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On tree trunks and branches or on mossy cliffs, found in partial shade of granitic ridge, alt. 950 m. Very rare. Flowering almost all year round, more flowers in April.

**Vernacular.**—

**Remarks.**— According to Rinzt (1978), *Hoya plicata* King & Gamble was treated as a synonym of *Hoya micrantha* Hook.f., but these Thai plant materials matched well with the original description of *H. plicata* King & Gamble. Moreover, the comparison between this doubtful species represented by the present plant materials and *H. micrantha* Hook.f. represented by *K. Sridith & J. Wai* 826 (PSU), the results showed that some characters and sizes are different (Table 6), it is noticed that *H. plicata* King & Gamble may be a polyploid species of this complex *Hoya* group (including *Hoya revoluta* Wight). Furthermore, they do not overlap in distribution, i.e. *H. micrantha* Hook.f. has been recorded from lowland forests in Myanmar (Tenasserim and Mergui) and upper west region of peninsular Thailand, whereas *H. plicata* King & Gamble has been recorded from mountain forests at high altitudes in Peninsular Malaysia. Nevertheless, additional field surveys, population studies and chromosomal data of this complex group are strongly needed to clarify the variation among this complex group.

**Specimens examined.**— BETONG: *J. Wai* 221 (PSU), 591 (PSU), 600 (PSU), 855 (PSU).

**Additional specimen examined.**— *Hoya micrantha* Hook.f.; RANONG: *K. Sridith & J. Wai* 826 (PSU).

**Table 6.** Comparison of some different characters and sizes between *Hoya plicata* King & Gamble and *Hoya micrantha* Hook.f.

Character	<i>Hoya plicata</i> King & Gamble	<i>Hoya micrantha</i> Hook.f.
1. Peduncle and pedicels	stout	slender
2. Calyx lobe shape (width/length ratio)	broadly ovate 1:1	ovate 1:1.5
3. Corolla tube length	3-4 mm long	1.5-2 mm long
4. Corolla lobe length	ca. 5 by 4 mm	3-4 by 2-3 mm
5. Inner surface of corolla lobes	minutely puberulous (seem to be glabrous)	pubescent (conspicuous)
6. Coronal scales	3-3.5 by 1-1.5 mm	ca. 2.5 by 1 mm
7. Ovaries	ca. 2 mm long	1-1.5 mm long

**51. *Hoya rigida*** Kerr, Bull. Misc. Inform., Kew 1939: 463. 1939; in Fl. Siam. 3(1): 42. 1951. **Plate 23B-C.**

Climber with white latex. **Stems** and branches stout with adventitious roots, 4-10 mm in diam., brownish, glabrous. **Leaves** simple, opposite, glabrous; petiole stout, 1.5-2.2 cm long; blade coriaceous, thick and fleshy, ovate-lanceolate or lanceolate, 16-27 by 4.5-9 cm, upper surface green to dark green, lower surface pale green, densely punctate, apex acuminate, base rounded, margin entire or sometimes undulate, slightly revolute; main veins 3 from base, conspicuous and prominent when dry. **Inflorescences** axillary, horizontal or semi-pendulous; pseudoumbels convex, 35-50-flowered, glabrous; peduncle 5-10 cm long; bracts triangular, 0.25-0.5 by 0.25-1 mm, outer surface papillate or sometimes glabrous. **Flowers** 5-merous (excluding gynoeceium); pedicels uniform, 2.7-3.2 cm long, with scattered reddish purple glands. **Calyx** 6-7 mm in diam., outer surface papillate; lobes lanceolate, triangular or rarely ovate, 2.5-3 by 1-1.5 mm, apex acute. **Corolla** rigid, spreading in star shape and reflexed when fully open, 2-2.2 cm in diam., inner surface creamy white, puberulous, outer surface creamy white, with scattered reddish purple glands, glabrous; tube 2.5-3 mm long, around and below the corona insertion glabrous; lobes recurved, ovate, 8-9 by 5-6 mm, apex acute or shortly acuminate. **Corona** star-shaped,  $\pm$  horizontal, 9-10 mm in diam., glabrous; coronal scales elliptic, 4-4.5 by 2-2.5 mm, raised from corolla

2-2.5 mm high, inner angle  $\pm$  acuminate, pinkish, outer angle acute, creamy white; anther appendages covering the receptive area of stigma, yellowish white; anther wings rigid, ca. 2 mm long, yellowish white; pollinium ascending corpusculum subquadrangular-oblong, 0.25-0.3 by ca. 0.15 mm, reddish brown; translators ca. 0.1 mm long, hyaline; pollinia winged, obliquely oblong, ca. 0.7 by 0.25 mm, yellow. **Ovaries** 2, superior, ca. 2 mm long; ovules numerous; style united, very short; stigma head conical, subquadrangular, ca. 1.5 by 2 mm. **Fruit** and **seeds** not seen.

**Thailand.**— EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Trat, Chanthaburi; PENINSULAR: Nakhon Si Thammarat, Pattani, Yala.

**Distribution.**— Endemic (?).

**Ecology.**— On tree trunks and branches or on the cliffs, found in semi-exposed areas of granitic ridge, alt. 900 m. Uncommon. Flowering in March-April.

**Vernacular.**— Thao Roi Pla (เถาร้อยปลา) (Trat); Lin Khwai (ลิ้นควาย) (Pattani).

**Remarks.**— This species is also expected to be found in the Peninsular Malaysia. In the previous key to species of *Hoya parasitica* complex in Thailand, the sepals are longer than the corolla tubes and more than 4.5 mm long (Kidyue *et al.*, 2005), but the specimens from this present study, the sepals are as long as the corolla tubes. However, these quantitative characters are highly variable.

**Specimen examined.**— BETONG: J. Wai 629 (PSU).

**52. Hoya sp.****Plate 23D-F.**

Climber with white latex. **Stems** scandent, stout, up to 1 cm in diam.; branches and branchlets slender, brownish grey, glabrous; young parts finely pubescent; internodes 1.5-20 cm long. **Leaves** simple, alternate and opposite on the same plant; petiole 5-12 mm long, glabrous or subglabrous; blade thinly coriaceous, elliptic-oblong or lanceolate, 6.5-13 by 2.5-4.8 cm, upper surface green to dark green, lower surface pale green, glabrous on both surfaces, apex acuminate or cuspidate, base cuneate, margin entire or undulate; midrib impressed above when dry and prominent underneath, glabrous, secondary veins 6-10 pairs. **Inflorescences** axillary or terminal, pendulous; pseudoumbels bearing a succession of flowers, usually solitary or rarely 2-flowered; peduncle 1-5 cm long, glabrous; bracts broadly triangular, 0.25-0.5 by 0.5-1 mm, glabrous, margin ciliate or sometimes glabrous. **Flowers** 5-merous (excluding gynoecium); pedicels 1.5-2 cm long, glabrous. **Calyx** ca. 4 mm in diam., pale green; lobes ovate, ca. 1.5 by 1-1.5 mm, apex acute or rounded, margin ciliate. **Corolla** thin, spreading, campanulate, 3-4.5(-5) cm in diam.; tube 1.5-2 cm long, glabrous, inner surface creamy white, base of tube around the corona reddish purple or pinkish, around and below the corona insertion pubescent, outer surface creamy white, with scattered reddish purple glands; lobes strongly recurved, broadly triangular, 6-8 by 18-22 mm, creamy white, glabrous, outer surface with scattered reddish purple glands, apex acuminate. **Corona** radiate, ca. 1.2 cm in diam., glabrous; coronal scales lanceolate, 5-6 by 2.5-3 mm, raised from corolla ca. 5 mm high, inner angle  $\pm$  acuminate, outer angle obtuse or rounded; inner lobe erect, laterally compressed, margin recurved, reddish purple with a deep purple stripe; outer lobe blunt, slightly upcurved, yellowish white or pinkish tinged, inside hollow; anther appendages covering the receptive area of stigma, creamy white or pinkish white; anther wings rigid, ca. 4 mm long, yellowish white; pollinium ascending corpusculum compressed-ovoid or oblong, 0.2-0.3 by 0.1-0.15 mm, reddish brown; translators ca. 0.2 mm long, hyaline; pollinia winged, obliquely oblong, 0.7-0.8 by 0.25-0.3 mm, yellow. **Ovaries** superior, ca. 2.5 mm long; ovules numerous; style united, very short; stigma head conical-subquadrangular, ca. 2.5 by 1.5-2 mm. **Fruit** and **seeds** not seen.



**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Known only from this study.

**Ecology.**— On tree trunks and branches, on mossy cliffs or growing in rock crevices, found in shady areas of quartzitic phyllite ridge, alt. 650-700 m. Very rare. Flowering all year round, more flowers in May and October.

**Vernacular.**—

**Remarks.**— This unidentified *Hoya* species belonging to the section *Physostelma* (Wight) Schltr. with bell-shaped corolla is somewhat similar to *Hoya campanulata* Blume in various aspects, i.e. thinly coriaceous, elliptic-oblong, glabrous leaves and having campanulate flowers. However, this species differs from *H. campanulata* Blume in having distinctly recurved corolla lobes, the inner lobe of coronal scales is much higher than outer lobe, while inner and outer lobes of coronal scales in the latter species are equal in length. Moreover, this species also has much shorter outer lobe of coronal scales than the latter. All these morphological characters are significantly different from the other *Hoya* species, it is convinced that these specimens collected may represent a new species. Nevertheless, additional collections and population studies of this unidentified species are strongly needed to clarify its variation within species and also among closely related species together with their distribution.

**Specimens examined.**— BETONG: *J. Wai* 207 (PSU), 337 (BCU, PSU), 496 (PSU), 582 (PSU), 725 (BCU, PSU).

## BEGONIACEAE

**53. *Begonia sinuata*** Wall. ex Meisn. var. ***sinuata***, Ber. Verh. Naturf. Ges. Freiburg. 2: 42. 1836; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 650. 1879; Ridl., Fl. Malay Penins. 1: 856. 1922; M.R. Hend., Malay. Wild Fls., Dicots.: 163, fig. 155. 1959; Kiew, Begonias Peninsular Malaysia: 58. 2005.— *B. clivalis* Ridl., J. Straits Branch Roy. Asiat. Soc. 54: 43. 1910; Fl. Malay Penins. 1: 857. 1922. **Plate 24A-C.**

Small herb, monoecious, with succulent tuberous rhizome; tuber fleshy, without hairs, ovoid or subglobular, 3-5 mm in diam., creamy or pale brown. **Stems** erect, unbranched, terete, short, succulent, densely covered with stellate hairs, 1- or 2-leaved. **Stipules** triangular or triangular-lanceolate, 1-2 by 0.5-1 mm, outer surface covered with stellate hairs, apex acute. **Leaves** simple, alternate; petiole 1-10 mm long, reddish purple or greenish, densely covered with stellate hairs; blade bright green or dark green above, green or reddish purple underneath, membranous when dry, broadly ovate, orbicular or reniform, 1.5-13 by 1.5-13 cm, covered with stellate hairs, apex obtuse or rounded, base cordate, margin shallowly and irregularly toothed; venation palmate-pinnate, basal veins 7 or 9, impressed above, densely covered with stellate hairs and prominent underneath. **Inflorescences** terminal or sometimes arising from the base of leaf blades, erect, paniculate cymes, with many male and a few female flowers, 4-10 cm long; peduncle reddish purple, 1.5-6.5 cm long, covered with stellate hairs; bracts persistent, ovate to lanceolate or oblong-lanceolate, 2-5.5 by 1-2.5 mm, greenish or reddish, 3- or 5-veined, outer surface covered with stellate hairs, apex acute or obtuse. **Male flowers** pink or pinkish white; pedicels reddish purple, pinkish or sometimes greenish, 5-12 mm long, sparsely covered with minutely glandular hairs or sometimes subglabrous; tepals 4, spreading, slightly concave, glabrous; outer two tepals ovate, elliptic, suborbicular or sometimes obovate, 4.5-5.5 by 4-5 mm, 7- or 9-veined, apex rounded; inner two tepals narrowly obovate or elliptic-oblong, 4.5-5.5 by 2-2.5 mm, 3- or 5-veined, apex rounded or sometimes obtuse. **Stamens** 18-27, cluster globular, ca. 1.5 mm in diam., yellow; stalk ca. 1 mm long; filaments 0.2-0.3 mm long; anthers opening by slits, obovoid, 0.4-0.75 by 0.3-0.6 mm, apex truncate. **Female flowers** pink or pinkish white; pedicels reddish purple, pinkish or sometimes

greenish, 4-8 mm long, sparsely covered with minutely glandular hairs or sometimes subglabrous; tepals 5, spreading, sometimes slightly concave, glabrous; outer two tepals elliptic, 4.5-6 by 3-4 mm, 6-9-veined, apex rounded; inner tepals smaller than the outer tepals, obovate to elliptic-obovate, 4.5-6 by 1.5-3 mm, 3-6-veined, apex rounded or sometimes obtuse. **Ovary** inferior, 3-winged, 3-5.5 by 4.5-7.5 mm, edges of wings covered with minutely glandular hairs, 2-locular, each locule with 2 axile placentas; ovules numerous per locule; styles and stigmas yellow, 2-2.5 mm long, styles 2, connate at the base, stigmas binate, U-shaped, papillose. **Capsule** 3-winged, 5-7 by 7-8 mm, edges of wings covered with minutely glandular hairs. **Seeds** numerous, oblong or oblong-ovoid, 0.15-0.2 by 0.1-0.15 mm, brown; testa cells reticulate.

**Thailand.**— SOUTH-EASTERN: Chon Buri, Chanthaburi; PENINSULAR: Ranong, Phangnga, Nakhon Si Thammarat, Trang, Satun, Songkhla, Yala.

**Distribution.**— Vietnam, Cambodia, Myanmar and Peninsular Malaysia.

**Ecology.**— On moist mossy cliffs or on moist rocky or sandy heath soils with the decaying organic matter, found in both semi-exposed and shady areas, usually growing along the streams in the foothills of rocky mountain at 600-950 m alt., and also found in lowland evergreen forest. Common. Flowering in July-November, fruiting in September-January.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 277 (PSU), 294 (BKF, PSU), 826 (PSU), 881 (PSU); PHANGNGA: *V. Chamchumroon* 2115 (PSU); TRANG: *K. Larsen et al.* 41339 (PSU); SATUN: *Dim* 5 (PSU), *J.F. Maxwell* 85-846 (PSU), *K. Larsen et al.* 41181 (PSU), 42376 (PSU); SONGKHLA: *J.F. Maxwell* 84-114 (PSU).

**54. Begonia sp.****Plate 24D-F.**

Small herb, monoecious, with succulent tuberous rhizome; tuber fleshy, without hairs, subglobular or sometimes elongated, 2-5 mm in diam., creamy or pale brown. **Stems** erect, unbranched, terete, short, succulent, densely covered with straight, somewhat appressed hairs (sericeous), 1- or 2-leaved. **Stipules** narrowly triangular, 1.5-2.5 by 0.3-0.7 mm, hairy outside, apex acute. **Leaves** simple, alternate; petiole 1-3 cm long, reddish purple or greenish, densely hairy; blade bright green, membranous when dry, broadly ovate, 4-10 by 4-8 cm, covered with sparsely appressed hairs, more densely so on veins, apex acute or obtuse, base cordate, margin shallowly and irregularly toothed; venation palmate-pinnate, basal veins 7 or 9, impressed above, prominent underneath. **Inflorescences** terminal, erect, paniculate cymes, with many male and a few female flowers, 8-14 cm long; peduncle reddish purple, 5-10.5 cm long, sparsely hairy or subglabrous; bracts caducous, oblong-lanceolate to lanceolate or triangular, 1-2 by 0.3-0.5 mm, 1-veined, sparsely hairy or subglabrous outside, apex acute. **Male flowers** pink or pinkish white; pedicels greenish, reddish purple or pinkish, 4-10 mm long, glabrous or very sparsely covered with minutely glandular hairs; tepals 4, spreading, slightly concave, glabrous; outer two tepals ovate or elliptic-ovate, 5-5.5 by 3.5-4 mm, 6-8-veined, apex bluntly acute; inner two tepals elliptic, elliptic-oblong or oblanceolate, 4-4.5 by 1.5-2.5 mm, 3-veined, apex rounded or obtuse. **Stamens** ca. 36, cluster globular, ca. 1.5 mm in diam., yellow; stalk ca. 1 mm long; filaments 0.2-0.35 mm long; anthers opening by slits, obovoid, 0.4-0.8 by 0.3-0.5 mm, apex emarginated or truncate. **Female flowers** pink or pinkish white; pedicels greenish, reddish purple or pinkish, 4-9 mm long, glabrous or very sparsely covered with minutely glandular hairs; tepals (4-)5, spreading, sometimes slightly concave, glabrous; outer two tepals elliptic or elliptic-ovate, 5.5-6 by 3.5-4 mm, 5- or 7-veined, apex obtuse; inner tepals smaller than the outer tepals, elliptic-oblong or oblanceolate, 4-5.5 by 1-2.5 mm, 3- or 5-veined, apex rounded or obtuse. **Ovary** inferior, 3-winged, 3.5-6 by 5-7 mm, edges of wings glabrous or very sparsely covered with minutely glandular hairs, 2-locular, each locule with 2 axile placentas; ovules numerous per locule; styles and stigmas yellow, 2-3 mm long, styles 2, connate at the base, stigmas binate, U-shaped, papillose. **Capsule** 3-winged, ca. 7 by

8.5 mm, edges of wings glabrous or subglabrous. **Seeds** numerous, oblong or oblong-ovoid, 0.25-0.3 by 0.1-0.15 mm, brown; testa cells reticulate.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Known only from this study.

**Ecology.**— On moist mossy cliffs or on moist rocky or sandy heath soils with the decaying organic matter, usually found in deeply shade along small streams in the foothills of the quartzitic phyllite ridges at 600-650 m alt., and also found in lowland evergreen forest. Uncommon. Flowering in August-January, fruiting in September-February.

**Vernacular.**—

**Remarks.**— This unidentified species is closely related to *Begonia sinuata* Wall. ex Meisn. var. *sinuata*, but it typically differs from the latter species in having caducous bracts and sericeous indumentum.

**Specimens examined.**— BETONG: *J. Wai* 11 (PSU), 895 (BCU, BKF, PSU).

## CLUSIACEAE

**55. *Cratoxylum maingayi*** Dyer in Fl. Brit. India (J. D. Hooker) 1: 258. 1874; Ridl., Fl. Malay Penins. 1: 154. 1922; Corner, Wayside Trees Mal. 1: 327. 1940; Kochummen in Tree Fl. Malaya 2: 251, fig. 1c. 1973; N. Robson in Fl. Males., Ser. 1, Spermat. 8: 9, fig. 6m-o. 1974. **Plate 25A-B.**

Tree or shrubby tree up to 10 m high, deciduous or partly deciduous. **Bark** narrowly fissured, greyish brown; branchlets subquadrangular when young, becoming terete with age, brown or reddish brown, glabrous; interpetiolar scar interrupted; young leaves and shoots reddish purple. **Leaves** simple, opposite; petiole narrowly

winged, 2-6 mm long, glabrous; blade chartaceous to subcoriaceous, with numerous pellucid or dark glands, elliptic to elliptic-oblong, 2.5-10.5 by 1-4.5 cm, glabrous, upper surface shining, green or yellowish green, lower surface paler, apex acuminate to rounded, base cuneate, margin entire; midrib impressed above, prominent underneath, secondary veins 6-12 pairs. **Inflorescences** of 1-6-flowered cymes in lower axis of young shoots. **Flowers** 5-merous (excluding androecium and gynoecium), 1.5-2 cm in diam.; pedicels 3-8 mm long, glabrous. **Sepals** rather thick and fleshy, greenish with pinkish tips, elliptic-ovate to lanceolate, with dark linear glands (when dry), 5-6 by 2.5-3 mm, glabrous, apex acute to rounded. **Petals** pinkish white, with a few small brown glands, obovate to oblanceolate, 12-15 by 4-5.5 mm, apex rounded or emarginate, base narrowly clawed, margin ciliate in the upper half; petal scales triangular-ovate or ovate, ca. 2 mm long, apex acute to rounded, truncate or emarginate, margin slightly toothed. **Stamen fascicles** 3, 7-8 mm long, with 7-16 stamens per fascicle; filaments united for ca.  $\frac{2}{3}$  of their length; anthers dorsifixed, suborbicular, 0.3-0.4 mm in diam.; anther glands usually present. **Staminodal fascicles** fleshy, trigonous, ligulate, falcate-ovoid, 1.2-1.5 by 0.5-0.8 mm. **Ovary** superior, 2-3 mm long, glabrous, 3-locular, placentation axile; ovules 5-6 per locule, oblong, flattened, 0.4-0.5 by 0.2-0.25 mm; styles 3, 5-7 mm long, glabrous; stigmas capitate, ca. 0.3 mm in diam., papillose. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Trang, Songkhla, Narathiwat, Yala.

**Distribution.**— Vietnam, Cambodia, Myanmar, Peninsular Malaysia, Singapore, Sumatra and Borneo.

**Ecology.**— On exposed ridges, and also found on hill slopes in secondary and lowland evergreen forests, alt. 300-950 m. Locally common. Flowering in February-April.

**Vernacular.**— Tao (แต้ว) (Nakhon Si Thammarat, Trang); Tao (ต้าว) (Narathiwat); Tao Kha (แต้วคา) (Yala).

**Specimens examined.**— BETONG: *J. Wai* 605 (BCU, BKF, PSU), 617 (BCU, BKF, PSU).

## ELAEOCARPACEAE

**56. *Elaeocarpus pedunculatus*** Wall. ex Mast. in Fl. Brit. India (J.D. Hooker) 1: 408. 1874; Ridl., Fl. Malay Penins. 1: 316. 1922; Corner, Wayside Trees Mal. 1: 640. 1940; Ng, Tree Fl. Malaya 4: 92. 1989. **Plate 25C-E.**

Tree up to 15 m high. **Bark** brown, usually with whitish grey blotches; branchlets terete, often with prominent leaf scars, greyish or brown. **Leaves** simple, spirally arranged, buds and young leaves resin-coated; petiole adaxially grooved and narrowly winged, 1-3.5 cm long, very sparsely hairy, soon becoming glabrous; blade coriaceous, elliptic to oblanceolate, 4.5-12 by 2.5-4.5 cm, bluntly mucronate to acute or sometimes obtuse, base cuneate, margin shallowly serrate, cartilaginous, marginal teeth conspicuous, upper surface shining, green to dark green, underneath paler, old leaves turning bright red or orange in colour before falling; midrib very sparsely hairy, soon glabrous, flattened or slightly raised above, prominent underneath, secondary veins 7-10 pairs, slightly raised above, prominent underneath, usually with domatia in veins axils on lower surface, reticulation usually conspicuous. **Stipules** in pairs, minute, triangular-ovate, sparsely hairy, becoming glabrous, usually resin-coated. **Inflorescences** mostly from the axis of the fallen leaves, racemose, 7-12-flowered, 3.5-7 cm long; peduncle 1-2.5 cm long, usually sparsely pubescent, soon glabrous; peduncular bracts minute, triangular-ovate, usually glabrescent and resin-coated, very early caducous; rachis pubescent; floral bracts very early caducous, concave, obovate-subulate, 2-2.5 by 1-1.5 mm, pubescent, apex acute or acuminate. **Flowers** fragrant, pendulous, 5-merous (excluding androecium and gynoecium); pedicels 5-7 mm long, creamy to pale brown, densely pubescent. **Sepals** thick, slightly incurved, lanceolate, 5-6 by 1.5-1.8 mm, creamy to pale brown, outer surface pubescent, inner surface with a median keel (prominent midrib), glabrous, apex acute. **Petals** slightly incurved, oblong when flattened, 6-6.5 by 2-3 mm, creamy to pale brown, densely pubescent outside, with a basally hairy ridge inside, apex broad, with

7-10 fimbriae about  $\frac{1}{4}$  of the petal length, margin rolled inward. **Stamens** ca. 20; filaments 1-1.5 mm long, pubescent; anthers linear-oblong, outer lobe with a recurved acute apex, 2-2.5 mm long, pubescent. **Disk** annular, 10-crenate, hairy in the upper half. **Ovary** superior, ellipsoid-ovoid, ca. 1.5 mm long, glabrous, 2-locular, placentation axile, with many ovules per locule; style filiform, 3-4.5 mm long, glabrous; stigma truncate. **Drupe** ellipsoid, 12-13 by 7.5-8 mm, glabrous, surface wrinkled when dry. **Seed** 1, stony, slightly compressed-ovoid, laterally ridged, ca. 10 by 7 mm, ca. 5 mm thick, surface rough and covered with bristles.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Throughout Peninsular Malaysia, Sumatra, Borneo and Philippines.

**Ecology.**— On the summit ridges and slopes of rocky mountains at 600-900 m alt. Very rare in Thailand. Flowering in May-August, fruiting in July-April. Floral visitors were butterflies.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand. More observations are needed to determine the natural distribution range of this species.

**Specimens examined.**— BETONG: *J. Wai* 642 (BCU, BKF, PSU), 833 (BKF, PSU).



## ERICACEAE

**57. *Rhododendron longiflorum*** Lindl. (non Nutt.), J. Hort. Soc. London 3: 88. 1848; Ridl., Fl. Malay Penins. 2: 219. 1923; M.R. Hend., Malay. Wild Fls., Dicots.: 262. 1959; Sleumer in Fl. Males., Ser. 1, Spermat. 6 (4): 640. 1966; Ng, Tree Fl. Malaya 3: 104. 1978; B.C. Stone, Fed. Mus. J. 26(1): 89. 1981; Soepadmo, Folia Malaysiana 3(1): 11, pl. 8. 2002. **Plate 26A-B.**

Shrub up to 3 m high. **Bark** shallowly fissured, brown or dark brown; branchlets terete, initially green and covered with lepidote scales, becoming brown and glabrous with age; internodes 1.2-10 cm long. **Leaves** simple, pseudowhorled; petiole 1-6 mm long, lepidote, glabrescent; blade coriaceous, elliptic to elliptic-oblong, obovate or sometimes oblanceolate, 2.5-9 by 1-4.5 cm, upper surface shining, green to dark green, lepidote, becoming glabrous when mature, lower surface paler, covered with subpersistent lepidote scales, apex acute, acuminate, obtuse or rounded, base cuneate, margin entire; midrib impressed above, prominent underneath, secondary veins 5-7 pairs, usually inconspicuous. **Inflorescences** terminal, umbellate, 3-7-flowered; outer bud scales broadly ovate, apex acuminate or acute, inner ones obovate or spatulate, hooded, sparsely lepidote outside, apex obtuse or rounded, margin ciliolate, up to 1.5 by 1 cm; bracteoles 2 at the base of each pedicel, filiform to narrowly linear-spatulate, 15-25 by 0.5-3 mm, sparsely lepidote outside. **Flowers** 5-merous (excluding androecium); pedicels 0.7-2.3 cm long, sparsely lepidote. **Calyx** oblique, with very short rim, greenish. **Corolla** salverform-tubular, reddish or yellowish orange, sparsely lepidote outside; tube cylindrical, longitudinally 5-ribbed, 3-4 cm long, pubescent at around the lower part inside; lobes spreading, obovate-oblong, 1.8-2.7 by 1-1.8 cm, apex rounded. **Stamens** 10, inserted at the outer margin of the disk, slightly exserted from the corolla tube; filaments 4-5.2 cm long, sparsely hairy in the lower part, glabrous in the upper half; anthers dorsifixed, opening by 2 terminal pores, oblong, ca. 3 by 1 mm. **Disk** prominent, 10-lobed, densely hairy in the upper half, glabrous below. **Ovary** superior, conical-cylindrical, 5-ribbed, 5-8 by ca. 2 mm, green, densely covered with whitish hairs and with lepidote scales, 5-locular, placentation axile; ovules numerous per locule; style filiform, exserted or included,

1.5-4.2 cm long, persistent, densely hairy and lepidote below, more sparsely so above, glabrous for the last 5-7 mm below the stigma; stigma turbinate-capitate, 1.5-2 mm in diam. **Capsule** septicidally dehiscent from top, 5-valved, cylindrical, conspicuously 5-ribbed, 2.5-5 by 0.4-0.6 cm, hairy and lepidote, beaked by the persistent rest of style. **Seeds** numerous, bearing thread-like tails at both ends, 3.5-4 mm long including the tails.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing on rocks, locally common in open vegetation on quartzitic phyllite ridges, and also found on tree trunks and branches in lowland evergreen and lower montane forests, alt. 600-1,000 m. Very rare in Thailand. Flowering and fruiting all year round, more flowers in September-October. Floral visitors were mainly spiderhunter birds and ants (e.g. *Polyrhachis* sp.).

**Vernacular.**— Kulap Pha (กุหลาบผา), Daeng Pradap Pha (แดงประดับผา) (Narathiwat, Yala).

**Specimens examined.**— BETONG: *J. Wai* 193 (BKF, PSU), 317 (BCU, BKF, PSU), 508 (BCU, BKF, PSU, QBG), 513 (PSU), 616 (PSU), 680 (PSU), 733 (BKF, PSU), 771 (BKF, PSU), 894 (BCU, BK, BKF, KGU, PSU, QBG), 937 (BKF, PSU).

**58. *Vaccinium bancanum*** Miq., Fl. Ned. Ind., Eerste Bijv. 3: 587. 1861; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 3: 454. 1882; Ridl., Fl. Malay Penins. 2: 209. 1923; Sleumer in Fl. Males., Ser. 1, Spermat. 6 (5): 840. 1967; Ng, Tree Fl. Malaya 3: 107. 1978.— *V. bancanum* var. *trinuinervium* J.J. Sm., Bijdr. Boomsoort. Java 13: 157, 159. 1914; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 183. 1965; Sleumer in Fl. Males., Ser. 1, Spermat. 6 (5): 842. 1967; B.C. Stone, Fed. Mus. J. 26(1): 84. 1981.

**Plate 26C-I.**

Shrub or shrubby tree, 2-4(-10) m high. **Bark** smooth, greyish brown or brown, usually with whitish grey blotches; branchlets terete, greyish brown or brown, young part puberulent, soon becoming glabrous. **Leaves** simple, spirally arranged; petiole slightly winged, 1-3 mm long, puberulent and sparsely minutely glandular, soon glabrescent; blade coriaceous, elliptic to elliptic-oblong or sometimes obovate, 2-5.8 by 1-3 cm, upper surface shining, green to dark green, reddish or yellowish in young shoots, glabrous or subglabrous, lower surface paler, laxly minutely glandular, apex acute, acuminate, obtuse or rounded, base cuneate or broadly attenuate, margin entire, usually slightly revolute; midrib flattened or impressed above, prominent underneath, puberulent and sparsely minutely glandular or glabrescent, secondary veins 3-7 pairs, veins and reticulation inconspicuous or slightly raised on both surfaces. **Inflorescences** axillary, racemose, 8-16-flowered, 1.5-7 cm long; bud scales broadly triangular-ovate, 1-1.5 by ca. 1 mm, puberulent and sparsely minutely glandular or glabrescent outside, apex acuminate; peduncle terete, 3-15 mm long, reddish or green, puberulent; rachis slightly angular, reddish or green, puberulent; bracts very early caducous, triangular or oblong-subulate, up to 5 by 2 mm, puberulent or sometimes glabrescent; bracteoles 2 near the base of each pedicel, early caducous, lanceolate-subulate, 1-1.5 by 0.4-0.5 mm, puberulent. **Flowers** fragrant, pendulous, 5-merous (excluding androecium); pedicels 3-8 mm long, reddish or green, puberulent. **Calyx** puberulent; tube cup-shaped, ca. 1.5 mm long, green or greenish cream; lobes broadly triangular, bearing several marginal subsessile glands along the margin, ca. 1 by 1.5-2 mm, greenish cream or creamy white with reddish or pinkish flush, rarely even pink or red. **Corolla** cylindrical-urceolate, creamy white, occasionally tinged with pink; tubes 5-7 mm long, 4-5 mm in diam., glabrous outside, hairy in the lower half inside; lobes recurved or reflexed, triangular, ca. 1 by 1-1.5 cm, inner surface densely glandular-muricate, apex subacute or obtuse. **Stamens** 10, inserted at the outer margin of the disk, included in the corolla tube; filaments subulate-linear, 2-3 mm long, densely hairy; anther lobes broadly oblong, ca. 8 mm long, muricate, with a pair of small dorsal spurs; dorsal spurs muricate, 2-3 mm long; tubules cylindrical, ca. 4 mm long, sparsely covered with glandular hairs. **Disk** annular, hairy in the upper half. **Ovary** inferior, 1.5-2 mm long, 5-locular, placentation axile; ovules numerous per locule; style slender, finally slightly exserted, 4.5-6.5 mm long, hairy in the lower  $\frac{1}{2}$  to  $\frac{2}{3}$ ,

muricate in the upper part; stigma truncate, ca. 0.5 mm in diam. **Berry** with several seeds, crowned by the disk and the persistent calyx, globular, 4-6 mm in diam., dark red to almost black, hairy. **Seeds**  $\pm$  ovoid, irregularly compressed, ca. 1 mm, brown or dark brown; testa cells reticulate.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java and Borneo.

**Ecology.**— On rocky or sandy heath soils or growing in rock crevices, locally common in open vegetation on quartzitic phyllite ridges, alt. 550-700 m. Very rare in Thailand. Flowering in June-February, fruiting in July-May, more flowers in December-February. Floral visitors were mainly hymenopterans, e.g. honey bees (*Apis* sp.), carpenter bees (*Xylocopa* sp.), etc.

**Vernacular.**— Cho Khai Muk Bala (ช่อไข่มุกบาลา) (Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 140 (BCU, PSU), 279 (BCU, BKF, PSU), 323 (BCU, BKF, PSU), 347 (BCU, BKF, PSU), 377 (BCU, PSU), 507 (BCU, BKF, KGU, PSU, QBG), 520 (PSU), 538 (BCU, BKF, PSU, QBG), 683 (BKF, PSU), 802 (PSU), 815 (PSU), 884 (BKF, PSU).

## EUPHORBIACEAE

**59. *Austrobuxus nitidus*** Miq., Fl. Ned. Ind., Eerste Bijv. 3: 444. 1861; Whitmore, Tree Fl. Malaya 2: 63. 1973; Chayam. & Welzen in Fl. Thailand 8(1): 105, fig. 23, pl. 12. 2005.— *Choriophyllum malayanum* Benth., Hooker's Icon. Pl. 13(4): t. 1280. 1879; Hook.f., Fl. Brit. India 5: 344. 1887.— *Longetia malayana* Pax & K. Hoffm., Pflanzenr. (Engler) 81: 291. 1922; Ridl., Fl. Malay Penins. 3: 224. 1924. **Plate 27A-F.**

Shrub or shrubby tree, 3-6 m high, dioecious. **Bark** greyish brown, smooth; branchlets terete, greyish brown, glabrous; terminal buds hairy. **Leaves** simple,

opposite; petiole subterete, adaxially grooved, 3-7 mm long, sparsely hairy, soon becoming glabrous; blade coriaceous, elliptic, oblong or obovate, 5.5-12 by 2.3-6 cm, upper surface shining, green or yellowish green, lower surface paler, old leaves turn bright red or orange in colour before falling, apex acute to rounded or emarginate, base cuneate to obtuse, margin entire or slightly undulate; midrib impressed above, prominent underneath, sparsely hairy, soon becoming glabrous, secondary veins 5-12 pairs, usually inconspicuous. **Male inflorescences** axillary, paniculate cymes, many-flowered, up to 3.2 cm long, axis hairy; bracts thick, triangular-ovate, 1.5-2 by 1-1.2 mm, hairy, apex acute; bracteole minute, hairy. **Staminate flowers** creamy, greenish or yellowish cream; pedicels 2-4 mm long, subglabrous or very sparsely hairy; sepals 4, reflexed, obovate or suborbicular, concave, 1.2-2 by 1-2 mm, inside glabrous, outside sparsely hairy to subglabrous, apex rounded; petals absent. **Stamens** 4, glabrous; filaments 1-1.5 mm long; anthers dehiscing by slits, suborbicular, 0.7-1 mm in diam.; pistillode brown, hairy. **Female inflorescences** axillary, clustered, paniculate cymes, few- to many-flowered, up to 1 cm long, axis densely hairy; bracts thick, broadly triangular, 0.5-1.5 by 1-1.5 mm, hairy, apex acute; bracteole minute, hairy. **Pistillate flowers** greenish or golden brown, sessile or subsessile; pedicels up to 1.5 mm long, densely hairy; sepals 4, persistent, imbricate, broadly triangular-ovate, ca. 1 by 1-2 mm, densely hairy, apex acute or obtuse; petals absent. **Ovary** superior, ovoid, ca. 2 by 1.5-2 mm, surface densely hairy, 2- or 3-locular; ovules 2 per locule, apically attached to the central column; stigmas sessile, 2- or 3-lobed, thick, persistent. **Capsule** dehiscing septicidally and loculicidally into 2-3 bivalved cocci, obovoid, 1.2-1.7 by 1.2-1.5 cm, reddish when ripe, surface glabrescent; columella persistent. **Seeds** 1-3, slightly flattened, ovoid, 7-7.5 by 5-5.5 mm, brown, glossy, each seed partly covered by a yellow fleshy aril.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— On exposed quartzitic phyllite ridges at 650-700 m alt. Rare in Thailand. Flowering in January-August, fruiting in July-January.

**Vernacular.—**

**Specimens examined.**— BETONG: *J. Wai* 195 (BCU, BKF, PSU), 576 (PSU), 778 (BCU, BKF, PSU), 938 (BCU, BKF, PSU), 1111 (BCU, BKF, PSU).

**FABACEAE-MIMOSOIDEAE**

**60. *Archidendron contortum*** (Mart.) I.C. Nielsen, *Adansonia* 19(1): 16. 1979; in *Fl. Thailand* 4(2): 211, fig. 52 (6-7). 1985.— *Pithecellobium contortum* (Graham) Mart., *Flora* 20(2): Beibl. 115. 1837; Baker in *Fl. Brit. India* (J.D. Hooker) 2: 305. 1878; Ridl., *Fl. Malay Penins.* 1: 664. 1922; Corner, *Wayside Trees Mal.* 1: 419. 1940; Whitmore, *Tree Fl. Malaya.* 1: 285. 1972. **Plate 27G-H.**

Shrubby tree up to 5 m high. **Bark** blackish brown or dark grey; branches and branchlets terete, occasionally lenticellate, pubescent, becoming glabrous with age. **Leaves** even-bipinnately compound, alternate; petiole terete, 1.5-7 cm long, pubescent, with a sessile gland at 0.5-1 cm above the base; primary rachis 1.5-6.5 cm long, pubescent, with 2 sessile glands at 1-4 mm below the junctions of the two distal pairs of pinnae; pinnae 3-5 pairs, oblong in outline, 3-15 by 1.5-4 cm; petiolule 3-5 mm long, pubescent; secondary rachis pubescent, with 1-5 small sessile glands at 0.5-1.5 mm below the junctions of the distal pairs of leaflets; leaflets 5-18 pairs, sessile or subsessile, chartaceous to coriaceous, mostly obliquely oblong or occasionally oblanceolate (in a terminal pair), up to 2.5 by 0.8 cm, upper surface sparsely to moderately pubescent, lower surface densely pubescent, apex acute to rounded, base obliquely cuneate; midrib slightly impressed above, raised underneath, secondary veins and reticulation inconspicuous. **Inflorescences** terminal or axillary, paniculate, few- to many-flowered, up to 23 cm long; peduncle 0.5-2.5 cm long, densely hairy; axes densely hairy throughout; bracts and bracteoles oblong to oblong-lanceolate or triangular-lanceolate, 0.8-2 by 0.4-0.6 mm, densely hairy, apex acute. **Flowers** regular, 5-merous (excluding androecium and gynoecium), sessile. **Calyx** campanulate, sparsely covered with minute hairs or subglabrous, 1-2 mm long; lobes triangular 0.3-0.5 by 0.3-0.5 mm, apex acute, margin ciliate. **Corolla** campanulate, 2.5-4 mm long,

glabrous; lobes elliptic-ovate to lanceolate, 1-2 by 0.5-1 mm, apex acute. **Stamens** ca. 20, basally connate; staminal tube 0.8-2 mm long, free filaments 5-9 mm long; anther subglobular, 0.2-0.3 mm in diam. **Pistil** stipitate, glabrous; stalk 1-2 mm long; ovary superior, 0.8-1.2 mm long, 1-locular, placentation marginal, with many ovules; style filiform, 3.5-9 mm long; stigma punctiform, ca. 0.1 mm in diam. **Pod** containing few to many seeds, compressed, spirally twisted in a circle, 5-15 by 1.5-2 cm, outside pubescent, inside reddish orange, finely puberulous. **Seeds** subglobular, 6-8 mm in diam.; testa black, glossy.

**Thailand.**— PENINSULAR: Phuket, Songkhla, Yala.

**Distribution.**— Peninsular Malaysia and Sumatra.

**Ecology.**— On exposed mountain ridges at 650-900 m alt. Uncommon. Flowering and fruiting almost all year round, more flowers in April and September.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 565 (BCU, BKF, PSU), 677 (BKF, PSU), 900 (BKF, PSU); SONGKHLA: *J.F. Maxwell* 84-417 (PSU).

## FABACEAE-PAPILIONOIDEAE

**61. *Callerya atropurpurea*** (Wall.) Schot, *Blumea* 39(1): 15. 1994.— *Pongamia atropurpurea* Wall., *Numer. List n.* 5910. 1831.— *Millettia atropurpurea* (Wall.) Benth., *Pl. Jungh.* 2: 249. 1852; Baker in *Fl. Brit. India* (J.D. Hooker) 2: 108. 1876; Corner, *Wayside Trees Mal.* 1: 372. 1940; Whitmore, *Tree Fl. Malaya.* 1: 296, fig. 17. 1972.— *Phaseolodes atropurpureum* Kuntze, *Revis. Gen. Pl.*: 201. 1891.— *Adinobotrys atropurpureus* (Wall.) Dunn, *Bull. Misc. Inform., Kew* 1911: 197. 1911; Ridl., *Fl. Malay Penins.* 1: 664. 1922.— *Padbruggea atropurpurea* (Wall.) Craib, *Bull. Misc. Inform., Kew* 1927: 61. 1927.— *P. pubescens* Craib, *Bull. Misc. Inform., Kew* 1927: 61. 1927.— *Whitfordiodendron atropurpureum* (Wall.) Merr., *Pap. Michigan*

Acad. Sci. 19: 160. 1934.— *W. pubescens* (Craib) Burkill, Bull. Misc. Inform., Kew 1935: 319. 1935. **Plate 28A-B.**

Tree 10-15 m high. **Bark** dark grey or greyish brown, smooth or shallowly fissured; branches and branchlets greyish brown, young parts covered with appressed pale golden brown hairs, but very soon becoming glabrous. **Leaves** odd-pinnately compound, alternate; petiole terete, 1.5-3.5 cm long, sparsely hairy or glabrescent, pulvinus 4-8 mm long; rachis 2.5-7 cm long, sparsely hairy or glabrescent; leaflets 5, 7 or 9; petiolule 3-6.5 mm long, sparsely hairy or glabrescent; blade coriaceous, elliptic-oblong or ovate to lanceolate, 4-12.5 by 2-4.5 cm, upper surface shining, green to dark green, glabrous, lower surface paler, sparsely hairy when young, very soon glabrous, apex bluntly acuminate or subacute, base cuneate to rounded, margin entire or slightly undulate; midrib flattened or slightly impressed above, prominent underneath, secondary veins 5-9 pairs, reticulation usually inconspicuous. **Inflorescences** terminal, racemose, many-flowered, 7.5-13.5 cm long; peduncle 1.5-3.5 cm long, sparsely hairy or glabrescent; rachis 3.5-9 cm long, sparsely to densely hairy; bracts triangular, 0.5-1 mm long, hairy, caducous; bracteoles 2, opposite, triangular-ovate, minute, densely hairy. **Flowers** irregular, papilionaceous, 5-merous (excluding androecium and gynoecium); pedicels 5-10 mm long, densely golden brown hairy. **Calyx** obliquely campanulate, densely golden brown hairy outside, pinkish and silky hairy inside; tube 5-6 mm long; lobes ovate, recurved, 5-6.5 by 4-6.5 mm, apex acute or obtuse. **Petals** pale pink, narrowly clawed at the base; standard glabrous, concave, with a yellow patch in the middle, obovate or broadly spatulate when flattened, 17-22 by 18-20 mm, claw 5-8 mm long, blade auriculate, apex rounded or emarginate; wings glabrous, slightly concave, obliquely oblanceolate or spatulate, 15-20 by 6-8 mm, claw 3-5 mm long, blade auriculate, apex rounded, upper auricle distinct, lower auricle indistinct; keels slightly concave, obliquely oblanceolate, 15-20 by 6-8 mm, claw 5-7 mm long, blade auriculate, only hairy along the lower margin, apex obtuse, upper auricle distinct, lower auricle usually indistinct, but sometimes very distinct, up to 4 mm long. **Stamens** 10; filaments various in length, 1.2-2.5 cm long, glabrous, upper part curved; anthers oblong, 1.5-2 by 0.8-1 mm. **Pistil** stipitate, linear-cylindrical, 20-25 by 2-2.5 mm; stalks stout, 3-5 mm long,



densely hairy; ovary superior, 7-10 mm long, surface densely hairy, 1-locular, placentation marginal, with 4-5 ovules; style filiform, curved, 1-1.2 cm long, sparsely hairy or subglabrous; stigma punctiform, ca. 0.5 mm in diam. **Fruit** and **seeds** not seen.

**Thailand.**— Throughout the country.

**Distribution.**— Indochina, Myanmar, Peninsular Malaysia and Sumatra.

**Ecology.**— On quartzitic phyllite ridges at 650-700 m alt., and also found in lowland evergreen forest. Common. Flowering in March-May.

**Vernacular.**— Phung Mu (Ubon Ratchathani); Kasae (กาแซะ), Sae (แซะ) (Peninsular); Yi Ni Ke (ยี่นิเกะ) (Malay-Narathiwat).

**Specimen examined.**— BETONG: *J. Wai* 676 (BCU, BKF, KKU, PSU).

## GESNERIACEAE

**62. Aeschynanthus radicans** Jack, Trans. Linn. Soc. London 14(1): 43. 1823; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 4: 343. 1884; Ridl., Fl. Malay Penins. 2: 500. 1923; Barnett, Fl. Siam. 3(3): 202. 1962; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 524. 1965; D.J. Middleton, Edinburgh J. Bot. 64(3): 414, fig. 9. 2007. **Plate 28C-F.**

Subshrubby climber. **Stems** and branches hanging or creeping, slender, terete, with nodal roots, green, hairy; internodes 2-4.5 cm long. **Leaves** simple, opposite; petiole 2-3 mm long, hairy; blade thick, fleshy, ovate or elliptic, 2-4 by 1-2.5 cm, upper surface green, glabrous to sparsely hairy, lower surface paler, sparsely to densely hairy, apex acute or obtuse, base subcordate, rounded or obtuse, margin entire; midrib flattened on both surfaces, usually inconspicuous, secondary veins 5-7 pairs, veins and reticulation obscure. **Inflorescences** axillary, cymose, 1-2-flowered; peduncle 2-3 mm long, hairy; bracts elliptic-oblong or ovate, 4-6 by 1.5-3.5 mm,

hairy. **Flowers** showy, 5-merous (excluding androecium and gynoecium); pedicels 5-9 mm long, hairy. **Calyx** tubular-campanulate, 2-2.5 cm long, hairy, purplish brown, greenish at the base; tube 1.8-2.2 cm long; lobes erect, triangular or ovate, 2.5-3.5 by 2.5-7 mm, apex obtuse or rounded. **Corolla** tubular, slightly curved, bilabiate, 5.5-5.8 cm long, outer surface bright red and hairy, inner surface red with yellow speckles, glandular-muricate; tube 4.5-5 cm long, dilated at the base; upper lip ovate, 2-lobed, sinus 2.5-3 mm deep, lobes rounded, 7-9 by 4-5 mm; lower lip 3-lobed; lateral lobes slightly spreading or not, ovate, 6-9 by 7-9 mm, apex rounded; lower lobes ovate, 6-8.5 by 5-8 mm, apex rounded. **Fertile stamens** 4, didynamous; filaments reddish, very sparsely covered with glandular hairs and sessile glands; anterior filaments inserted at 2.5-3.5 cm from corolla base, 2.5-2.7 cm long; posterior filaments inserted at 2.8-4 cm from corolla base, 1.7-2.2 cm long; anthers connivent in 2 pairs, 2-2.5 by 1-1.5 mm; staminode 1, 1-3 mm long. **Disk** annular, ca. 1 mm high, sparsely hairy to moderately hairy. **Pistil** linear-cylindrical, 1.7-4 cm long, hairy; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma peltate, ca. 0.5 mm in diam. **Capsule** loculicidally dehiscent, bivalved, slender, stipitate, linear-cylindrical, 20-35 cm long, 2-3.5 mm in diam., with numerous seeds, hairy. **Seeds** numerous, with long appendages at both ends; grains 0.75-0.85 by ca. 0.2 mm, papillose; appendages filiform, 6-8 mm long.

**Thailand.**— PENINSULAR: Chumphon, Surat Thani, Nakhon Si Thammarat, Phatthalung, Trang, Satun, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Philippines and Borneo.

**Ecology.**— On moist cliffs in shady areas, often found along the streams in the foothills of mountain ridges, and also growing on tree trunks and branches in lowland evergreen forest, alt. 200-1,000 m. Common. Flowering in June-December, fruiting in October-February.

**Vernacular.**— Thing Thong Hu (หิ้งทองหู) (Nakhon Si Thammarat); Nom Mia (นมเมีย) (Trang).

**Specimens examined.**— BETONG: *J. Wai* 804 (PSU), 834 (PSU), 1097 (PSU).

**63. *Didymocarpus citrinus*** Ridl., J. Linn. Soc., Bot. 32: 508. 1896; Fl. Malay Penins. 2: 509. 1923; A. Weber, B.L. Burtt & Vitek, Ann. Naturhist. Mus. Wien, B 102: 455. 2000. **Plate 29A-D.**

Herb or subshrub, 10-60 cm high. **Stems** bearing few to many branches from base; branches slender, terete, green or sometimes purplish, hairy and covered with small sessile, reddish or brown shining glands; internodes 2-10.5 cm long. **Leaves** simple, opposite decussate, anisophyllous or rarely subisophyllous; petiole 2-5.5 cm long, hairy and covered with small sessile, reddish or brown shining glands; blade herbaceous, ovate to ovate-lanceolate, 3.5-10.5 by 2-4.5 cm, softly hairy, apex gradually acuminate or acute, base usually oblique, cuneate to rounded, margin serrate, upper surface olive green to bright green, usually without pigmented glands, lower surface paler, covered with numerous small sessile, reddish or brown shining glands; midrib and secondary veins grooved above, somewhat flattened when dry, prominent underneath, secondary veins 5-10 pairs. **Inflorescences** axillary or terminal, 2-30-flowered cymes, sometimes flexuous, 5-12 cm long; peduncle 2-4.5 cm long, hairy in the lower part; bracts in pairs, subpersistent, spreading, fleshy, concave, ovate-cordate, 3-4 by 3-4 mm, polish green with reddish edges, 3-veined, glabrous, apex bluntly acute or broadly acuminate. **Flowers** showy, 5-merous (excluding androecium and gynoecium); pedicels 2-9 mm long, glabrous. **Calyx** lobes nearly free to base, spreading, fleshy, ovate to ovate-lanceolate, 2.5-3.5 by 2-2.5 mm, polish green with reddish edges, 3-veined, glabrous, apex bluntly acute. **Corolla** trumpet-shaped, bilabiate, 2-2.7 cm long, yellow, glossy, glabrous; tube 1-1.5 cm long; upper lip 2-lobed, sinus 1.5-2 mm deep, lobes rounded, 3-4 by 5.5-7 mm; lower lib 3-lobed, lobes rounded; middle lobe 4.5-6 by 7-8.5 mm; lateral lobes 4.5-6 by 6-7 mm. **Fertile stamens** 2, included, yellowish; filaments inserted at the middle of corolla tube, 3.5-4 mm long, sparsely covered with sessile or subsessile glands in the upper part; anthers connivent, subtriangular or elliptic in outline, ca. 1.5 by 1 mm, sparsely glandular on dorsal surface; staminodes 3, 0.6-1 mm long. **Disk** cup-shaped, 1.5-2 mm high, ca. 1

mm in diam., rim slightly dentate or subentire. **Pistil** linear-cylindrical, 1-1.2 cm long, hairy and covered with small sessile, reddish or brown shining glands; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma peltate, 1-1.5 mm in diam. **Capsule** loculicidally dehiscent, bivalved, inconspicuous stipitate, linear-cylindrical, subquadrangular in cross section, shallowly 4-grooved, 2.5-3 cm long, 1-1.5 mm in diam., hairy and covered with small sessile, reddish or brown shining glands. **Seeds** numerous, compressed ovoid-ellipsoid, 0.2-0.3 by ca. 0.1 mm, brown or reddish brown, papillose.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On quartzitic-phyllite or granitic cliffs, sometimes growing on rocky or sandy heath soils, locally abundant in shady areas of rocky mountains, alt. 550-1,000 m. Very rare. Flowering in July-December, fruiting in August-February.

**Vernacular.**—

**Remarks.**— *Didymocarpus citrinus* Ridl. was previously known only from one locality on Kedah Peak (Gunung Jerai) in the state of Kedah, Malaysia (Ridley, 1923; Weber *et al.*, 2000). In this study, this species is a new record for Thailand.

**Specimens examined.**— BETONG: *J. Wai* 275 (PSU), 295 (BCU, BK, BKF, KKKU, PSU, QBG), 357 (BCU, BK, BKF, KKKU, PSU, QBG), 380 (PSU), 428 (BCU, BK, BKF, KKKU, PSU, QBG).

**64. *Didymocarpus corchorifolius*** Wall. ex A. DC. in Prodr. (DC.) 9: 265. 1845; Ridl., Fl. Malay Penins. 2: 508. 1923; M.R. Hend., Malay. Wild Fls., Dicots.: 345, fig. 322. 1959; A. Weber, B.L. Burt & Vitek, Ann. Naturhist. Mus. Wien, B 102: 455. 2000. **Plate 29E-F.**

Subshrub, 35-75 cm high. **Stems** bearing few branches from base; braches slender, terete, green, hairy and covered with small dark shining glands; internodes 2-9.5 cm long. **Leaves** simple, opposite decussate, anisophyllous or rarely subisophyllous; petiole 1-3.5 cm long, hairy and covered with small dark shining glands; blade herbaceous, obliquely ovate, sometimes elliptic or obovate, 2.5-12 by 2-6.5 cm, hairy, upper surface green, without pigmented glands, lower surface paler, covered with numerous small dark shining glands, apex acuminate, base usually oblique, cuneate to rounded, margin serrate; midrib and secondary veins grooved above, somewhat flattened when dry, prominent underneath, secondary veins 8-15 pairs. **Inflorescences** axillary or terminal, 2-12-flowered cymes, 3.5-5.5 cm long; peduncle 2-3 cm long, hairy all over or only hairy in the lower half and covered with small dark shining glands; bracts in pairs, subpersistent, spreading, fleshy, concave, ovate, 2.5-3.5 by 2-3.5 mm, glossy, green, greenish white, or sometimes reddish, 5-7-veined, glabrous, apex bluntly acuminate, recurved. **Flowers** 5-merous (excluding androecium and gynoecium); pedicels 5-8 mm long, glabrous. **Calyx** nearly free to base or sometimes connate for about half its length, fleshy, cup-shaped, 3.5-5 mm long; lobes spreading, triangular-ovate or ovate-lanceolate, 2-4 by 1.5-2 mm, glossy, green, greenish white, or sometimes reddish, 3-veined, glabrous, apex bluntly acuminate, recurved. **Corolla** personate, 1.6-2 cm long, glossy, white or greenish white, occasionally tinged with pink or reddish purple, with greenish markings in the mouth, glabrous; tube 1- 1.2 cm long; upper lip 2-lobed, upcurved, 6-6.5 mm long, sinus 1.5-2 mm deep, lobes rounded, 3-4 by 5-7.5 mm; lower lib 3-lobed, much longer than the upper lip, 8-11 mm long; middle lobe 3-6 by 5-7.5 mm, apex rounded, truncate or slightly emarginate; lateral lobes 5-7 by 7-8 mm, apex rounded. **Fertile stamens** 2, included; filaments inserted at 3-4 mm from corolla base, 7-8.5 mm long, sparsely glandular hairy in the upper part; anthers connivent, subtriangular or elliptic in outline, ca. 2 by 1.5 mm, glabrous or sparsely glandular hairy on dorsal surface;

staminodes 3, 1-1.5 mm long. **Disk** cup-shaped, ca. 1.5 mm high, ca. 1 mm in diam., rim shallowly 5-lobed. **Pistil** linear-cylindrical, 1-1.3 cm long, densely glandular hairy and covered with small dark shining glands; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma unequally bifid, lobes ligulate, ca. 1 mm in diam.

**Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On mossy cliffs or growing on rocky or sandy heath soils with the decaying organic matter in shady areas of quartzitic-phyllite ridge, alt. 600-700 m. Very rare. Flowering in April-December, more flowers in July-November.

**Vernacular.**—

**Remarks.**— *Didymocarpus corchorifolius* Wall. ex A. DC. is probably a single species with personate flowers in the genus *Didymocarpus* Wall. (the other being *Didymocarpus antirrhinoides* A. Weber may be a synonym of *D. corchorifolius* Wall. ex A. DC.), it is interesting that this anomalous floral type and other different floral features in this genus may attract different groups of pollinators. The pollination syndrome traditionally used to define the taxonomic groups. Therefore, further field studies are needed.

In the original publication of *D. antirrhinoides* A. Weber, the author mentioned that this species is distinguished from *D. corchorifolius* Wall ex A. DC. by its connate bracts and the cup-shaped calyx (Weber and Burt, 1983). In the present study, it is found that the plant materials having both free and connate cup-shaped calyx in the same plant. It is noticed that *D. antirrhinoides* A. Weber might not be a good species.

**Specimen examined.**— BETONG: *J. Wai* 832 (BCU, BKF, PSU).

**65. *Didymocarpus cordatus*** A. DC. in Prodr. (DC.) 9: 265. 1845; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 4: 350. 1884; A. Weber, B.L. Burtt & Vitek, Ann. Naturhist. Mus. Wien, B 102: 455. 2000.— *Paraboea cordata* (A. DC.) Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 64. 1905; Ridl., Fl. Malay Penins. 2: 528. 1923; M.R. Hend., Malay. Wild Fls., Dicots.: 351. 1959. **Plate 30A-C.**

Herb, 15-60 cm high, with thick and fleshy rhizome. **Stems** usually unbranched, terete, fleshy, green, hairy and sparsely scattered with dark rounded glands; internodes 1-7 cm long. **Leaves** simple, opposite decussate, anisophyllous; petiole 1.5-6.5 cm long, hairy and sparsely scattered with dark rounded glands; blade herbaceous, obliquely ovate, 3-17.5 by 1.7-12 cm, hairy all over and scattered with numerous dark rounded glands, upper surface green, lower surface paler, apex acuminate, base usually oblique, subcordate or rounded, margin serrate; midrib and secondary veins grooved above, somewhat flattened when dry, prominent underneath, secondary veins 4-8 pairs. **Inflorescences** terminal, 8-22-flowered cymes, 15-25 cm long; peduncle 9-16.5 cm long, sparsely to moderately glandular hairy and sparsely scattered with dark rounded glands; bracts in pairs, caducous or subpersistent, spreading, fleshy, boat-shaped, ovate-cordate when flattened, 2.5-3 by 2.5-3 mm, glossy, pale green with conspicuous blackish glands, 5-veined, glabrous, apex bluntly acute or obtuse. **Flowers** 5-merous (excluding androecium and gynoecium); pedicels 1-1.5 mm long, glandular hairy on upper part, sometimes sparsely scattered with dark rounded glands. **Calyx** lobes nearly free to base, spreading, fleshy, ovate to ovate-lanceolate, 2-2.5 by 1-1.5 mm, glossy, green, pale green with conspicuous blackish glands, 3-veined, glabrous, apex bluntly acute or acuminate, recurved. **Corolla** shortly campanulate, bilabiate, 1.2-1.5 cm long, white, greenish white when young, glabrous; tube 6-10 mm long; upper lip 2-lobed, sinus 3-4 mm deep, lobes ovate, 3.5-5 by 3.5-6 mm, apex rounded; lower lip 3-lobed, lobes ovate, apex rounded; middle lobe 4-5.5 by 5-8 mm; lateral lobes 4-5.5 by 4-7.5 mm. **Fertile stamens** 2, included; filaments inserted at 3-3.5 mm from corolla base, 1.5-2 mm long, greenish, glabrous; anthers connivent, suborbicular in outline, 2-2.5 mm in diam., white, partly hairy; staminodes 3, 0.4-0.5 mm long. **Disk** ring-like, inconspicuous. **Pistil** linear-cylindrical, 8-10 mm

long, greenish, glabrous; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma capitate, 0.2-0.25 mm in diam. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia and Sumatra.

**Ecology.**— On moist mossy cliffs or growing in thin layer soils over granitic bedrock, locally abundant in shady areas of lower montane forest, alt. 900-1,050 m. Very rare in Thailand. Flowering in July-December.

**Vernacular.**—

**Remarks.**— *Didymocarpus cordatus* A. DC. is typically distinct from the other species in the genus *Didymocarpus* Wall. in having short campanulate corolla and the larger pair of anthers. In the present study, this species is a new record for Thailand, only a few specimens were collected from the study area. Additional plant collections and field observations in the natural populations along Thai-Malaysian border are needed.

**Specimen examined.**— BETONG: *J. Wai* 789 (BCU, BKF, PSU).

**66. *Henckelia bombycina*** (Ridl.) A. Weber, Beitr. Biol. Pflanzen 70(2-3): 340. 1998; Vitek, A. Weber & B.L. Burt, Ann. Naturhist. Mus. Wien, B 102: 486. 2000.— *Didymocarpus bombycinus* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 48. 1905; Ridl., Fl. Malay Penins. 2: 518. 1923. **Plate 30D-F.**

Subshrub, 30-50 cm high. **Stems** and branches woody, erect or decumbent, terete, brown, glabrescent in old part, leafy part green, hairy. **Leaves** simple, alternate, crowded together or spaced; petiole winged to base; blade herbaceous, narrowly elliptic to lanceolate, 5-17.5 by 1.5-4 cm, upper surface green, lower surface paler, hairy on both surfaces, apex acuminate, base narrow, margin serrate; midrib and



secondary veins grooved above, somewhat flattened when dry, prominent underneath, secondary veins 15-27 pairs. **Inflorescences** axillary, 1-flowered; peduncle 2-4.5 cm long, green or reddish purple, hairy; bracts persistent, linear-lanceolate, 2-3 by 0.5-1 mm, outer surface hairy. **Flowers** showy, 5-merous (excluding androecium and gynoecium); pedicels 0.8-1.8 cm long, green or reddish purple, hairy. **Calyx** lobes free to base or nearly, lanceolate, 2.5-3.5 by ca. 1 mm, 3-veined, outer surface hairy. **Corolla** funnel-shaped, bilabiate, 4-4.8 cm long, white tinged with purple or pale purple, sometimes white, with 2 yellow stripes inside, outer surface pubescent all over, inner surface minutely pubescent at throat only; tube 3-3.5 cm long; upper lip 2-lobed, sinus 3-5 mm deep, lobes rounded, 5-8 by 9-10 mm; lower lip 3-lobed, lobes rounded; middle lobe 8-10 by 10-13 mm; lateral lobes 7-10 by 8-12 mm. **Fertile stamens** 2, included; filaments inserted at 1.8-2.2 cm from corolla base, 10-12 mm long, glabrous; anthers connivent, oblong in outline, 2 by 0.5-1 mm; staminodes 3, 1-5 mm long. **Disk** cup-shaped, ca. 0.8-1 mm high, 1-1.5 mm in diam., rim slightly crenulate. **Pistil** linear-cylindrical, 3-3.5 cm long, hairy; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma capitate, ca. 1 mm in diam., papillate. **Capsule** follicular, opening on the upper side, linear-cylindrical, 6-8 cm long, 1-1.5 mm in diam., hairy. **Seeds** numerous, ellipsoid-ovoid, 0.4-0.5 by 0.15-0.2 mm, brown.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On sandy heath soils with the litter of decaying of leaves over the rocky base, and often found on moist cliffs or on mossy rocks in shady areas of the quartzitic-phyllite ridge, alt. 600-700 m. Very rare. Flowering and fruiting almost all year round, more flowers in April.

**Vernacular.**—

**Remarks.**— *Henckelia bombycina* (Ridl.) A. Weber was previously documented in the state of Perak, Malaysia (Ridley, 1923). The present study demonstrates it as a new record for Thailand.

**Specimens examined.**— BETONG: *J. Wai* 209 (BCU, BK, BKF, PSU), 325 (PSU), 577 (PSU), 678 (BKF, PSU), 730 (BKF, PSU).

**67. *Henckelia inaequalis*** (Ridl.) A. Weber, Beitr. Biol. Pflanzen 70(2–3): 347. 1998; Vitek, A. Weber & B.L. Burt, Ann. Naturhist. Mus. Wien, B 102: 500. 2000; B.L. Burt, Thai Forest Bull., Bot. 29: 96. 2001.— *Didymocarpus inaequalis* Ridl., J. Linn. Soc., Bot. 32: 506. 1896; Ridl., Fl. Malay Penins. 2: 510. 1923. **Plate 31A-C.**

Subshrub, 20-60 cm high. **Stems** and branches woody, erect or decumbent, terete, brown hairy or glabrescent in very old part, leafy part usually purplish brown or reddish purple, sometimes green. **Leaves** simple, alternate, usually distant; petiole 3-15 mm long, hairy; blade herbaceous, narrowly elliptic to lanceolate, usually unequal, sometimes slightly falcate, 2-13 by 0.8-3.5 cm, upper surface green, lower surface paler, hairy on both surfaces, apex acute or acuminate, base cuneate to obliquely cuneate, margin shallowly serrate; midrib and secondary veins grooved above, somewhat flattened when dry, prominent underneath, secondary veins 5-12 pairs. **Inflorescences** axillary, simple dichasium or flowers solitary, 1-3-flowered; peduncle 1.5-5.5 cm long, usually reddish purple or sometimes greenish, hairy; bracts persistent, linear-lanceolate, 1-3 by 0.3-1 mm, 3-veined, outer surface hairy. **Flowers** showy, 5-merous (excluding androecium and gynoecium); pedicels 3-5 mm long, reddish purple or greenish, hairy. **Calyx** lobes nearly free to base, linear-lanceolate, 2.5-4.5 by 0.5-1 mm, 3-veined, outer surface hairy. **Corolla** funnel-shaped, bilabiate, 4-5.5 cm long, white tinged with purple or almost white, central part of mouth yellow, outer surface pubescent all over, inner surface minutely pubescent at throat only; tube 2.5-3.5 cm long; upper lip 2-lobed, sinus 3-5 mm deep, lobes rounded, 5-10 by 6-11 mm; lower lip 3-lobed, lobes rounded; middle lobe 6-10 by 6-11 mm; lateral lobes 6-10 by 5-10 mm. **Fertile stamens** 2, included; filaments inserted at 1.5-2.5 cm from corolla base, 8-12 mm long, upper half white, lower half yellowish, glabrous; anthers connivent,

oblong in outline, 2-3 by ca. 1 mm; staminodes 0-2, 0.5-1 mm long. **Disk** oblique, 1.5-2 mm high. **Pistil** linear-cylindrical, 2.8-3.4 cm long, green, hairy; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma capitate, 0.8-1 mm in diam., papillate. **Capsule** follicular, opening on the upper side, linear-cylindrical, 3.2-5.5 cm long, ca. 1.5 mm in diam., sparsely hairy or glabrescent. **Seeds** numerous, cylindrical-oblong or ellipsoid-ovoid, 0.5-0.6 by 0.2-0.3 mm, brown.

**Thailand.**— PENINSULAR: Songkhla, Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On sandy heath soils with the litter of decaying leaves over the rocky base, and often found on moist cliffs or on mossy rocks in shady areas of the quartzitic-phyllite ridges, alt. 500-650 m. Very rare. Flowering and fruiting almost all year round, more flowers in April-August.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 202 (BKF, PSU), 276 (BKF, PSU), 369 (PSU), 474 (PSU), 665 (PSU), 710 (PSU).

**68. *Paraboea elegans*** (Ridl.) B.L. Burtt, Notes Roy. Bot. Gard. Edinburgh 41(3): 428. 1984.— *Boea elegans* Ridl., J. Linn. Soc., Bot. 32: 522. 1896; Ridl., Fl. Malay Penins. 2: 536. 1923.— *Paraboea obovata* Ridl., J. Straits Branch Roy. Asiat. Soc. 44: 71. 1905; Ridl., Fl. Malay Penins. 2: 533. 1923. **Plate 31D-F.**

Herb, 15-50 cm high. **Stems** bearing few to many branches from base, erect or decumbent, lower part terete, upper part triangular in cross section (especially in leafy part), densely covered with felted woolly hairs, greyish white or pale brown; internodes 0.5-7 cm long. **Leaves** simple, arranged in whorls of 3, sessile; blade herbaceous to subcoriaceous, oblanceolate or spatulate, 2-12 by 0.5-2 cm, upper surface green or greyish white, thinly arachnoid or sometimes glabrescent, lower

surface densely covered with felted woolly hairs, greyish white or pale brown, apex acute, base attenuate, margin entire; midrib and secondary veins white or greyish, arachnoid, slightly grooved above, somewhat flattened when dry, raised on lower surface, secondary veins 5-7 pairs. **Inflorescences** axillary or subterminal, many-flowered cymes, 12-25 cm long; peduncle 7-16 cm long, reddish purple, covered with minute sessile glands; bracts in pairs, persistent, narrowly triangular or lanceolate, 1.5-3 by 0.5-1 mm, reddish purple or green, covered with minute sessile glands, 3-veined, apex bluntly acute or obtuse. **Flowers** 5-merous (excluding androecium and gynoecium); pedicels 0.8-2.5 cm long, reddish purple or green, covered with minute sessile glands. **Calyx** lobes nearly free to base, narrowly triangular or lanceolate, 1.5-2 by 0.6-0.8 mm, reddish purple or green, covered with minute sessile glands, 3-veined, apex bluntly acute. **Corolla** widely open, campanulate, slightly bilabiate, 1.5-2 cm in diam., pink or pinkish white, glabrous; tube 3-5.5 mm long; upper lip 2-lobed, sinus 2-4 mm deep, lobes rounded, ca. 5 by 5-9 mm; lower lip 3-lobed, lobes rounded; middle lobe 5.5-6 by 8-12 mm; lateral lobes 5.5-6 by 6.5-9.5 mm. **Fertile stamens** 2; filaments inserted at 0.5-1 mm from corolla base, 2-2.5 mm long, yellowish white, glabrous; anthers connivent, broadly ovate-cordate in outline, 1.5-2 mm in diam., yellowish, glabrous; staminodes 3, 0.3-0.5 mm long. **Disk** ring-like, inconspicuous. **Pistil** cylindrical, 4.5-6 mm long, greenish or sometimes purplish in the lower part, covered with minute sessile glands; ovary superior, 1-locular, placentation parietal; ovules numerous; stigma capitate, 0.6-0.8 mm in diam., papillate. **Capsule** loculicidally dehiscent, 4-valved, linear-cylindrical, spirally twisted, 1-2.5 cm long, ca. 1 mm in diam. **Seeds** numerous, ellipsoid, 0.25-0.35 by 0.1-0.15 mm, brown.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On moist cliff or growing on rocky or sandy heath soils with the litter of decaying leaves over the rocky base, and often found in mossy banks, locally common in both among open grassland and shady areas of quartzitic-phyllite ridge, alt. 650-700 m. Very rare. Flowering and fruiting almost all year round, more flowers in October-November.

**Vernacular.**—

**Remarks.**— *Paraboea elegans* (Ridl.) B.L. Burt is a new record for Thailand, this species was previously known only from Peninsular Malaysia (Ridley, 1923). It is noticed that the greyish white leaves of this species are replaced by green, less-arachnoid leaves under wet and shady conditions. This finding showed a morphological plasticity under the different environmental conditions.

**Specimens examined.**— BETONG: *J. Wai* 329 (BKF, PSU), 506 (PSU), 519 (PSU), 776 (BKF, PSU), 809 (BKF, PSU), 896 (PSU).

### HAMAMELIDACEAE

**69. *Rhodoleia championii*** Hook.f., Bot. Mag. 76: t. 4509. 1850; Vink in Fl. Males., Ser. 1, Spermat. 5: 372, fig. 6. 1957; Backer & Bakh.f., Fl. Java (Spermatoph.) 1: 646. 1963; Whitmore, Tree Fl. Malaya. 2: 240, fig. 2. 1973; Zhi Y. Zhang, H.T. Zhang & P.K. Endress in Fl. China 9: 25, fig. 12. 2003; Suddee & D.J. Middleton, Thai Forest Bull., Bot. 31: 133. 2003.— *R. teysmanni* Miq., Verslagen Meded. Afd. Natuurk. Kon. Akad. Wetensch. 6: 123. 1857; Ridl., Fl. Malay Penins. 1: 690. 1922.— *R. ovalifolia* Ridl., J. Straits Branch Roy. Asiat. Soc. 75: 33. 1917; Ridl., Fl. Malay Penins. 1: 690. 1922.— *R. latiovatifolia* G.A. Fu. in Guihaia 11(3): 208. 1991. **Plate 32A-C.**

Shrub or tree, up to 20 m high. **Bark** greyish brown, fissured; wood white; branchlets stout, terete, lenticellate, drying dark brown or nearly black, young part densely stellate-lepidote. **Leaves** simple, alternate, densely stellate-lepidote when young, soon becoming glabrous; petiole 1-4 cm long, reddish or yellowish green; blade coriaceous, ovate, elliptic to elliptic-oblong or sometimes obovate, 3-12 by 1.5-6 cm, green to dark green and glossy above, paler and glaucous beneath, apex rounded or obtuse, sometimes slightly emarginate, base cuneate or obtuse, margin entire or undulate, sometimes recurved; midrib flattened or slightly impressed above, prominent underneath, secondary veins 5-10 pairs, inconspicuous to moderately conspicuous, reticulation inconspicuous. **Inflorescences** axillary, recurved or pendulous, capitate, 4-7-flowered, 1.5-3 cm in diam.; peduncle 0.5-2 cm long, stellate-lepidote; outer bracts

broadly ovate, covered with golden brown stellate-lepidote or stellate indument, sometimes glabrescent, apex rounded; inner bracts obovate or spatulate, slightly hooded, up to 1.7 cm long, densely stellate-lepidote and covered with long golden brown basally connate hairs, apex rounded. **Sepals** rudimentary, connate, thin, apically ciliate. **Petals** 0-4, long-clawed, spatulate, 15-24 by 2-7 mm, pink or reddish, glabrous, apex rounded or obtuse. **Stamens** 7-11; filaments 1.4-2 cm long, white or pinkish white, glabrous; anthers basifixed, linear-oblong in outline, 2-3 by ca. 0.5 mm, pinkish. **Ovary** partly inferior, 2-carpellate and 2-locular, ovoid, apically free, 2.5-3 mm long, greenish white, glabrous; ovules many per locule; style 2, filiform, 1.4-2 cm long, white or pinkish, glabrous; stigma bifid. **Fruit heads** subglobular, 1-1.5 by 1.5-2.8 cm, green or pinkish, drying brown. **Capsules** basally connate with the receptacle, 2-celled, loculicidally dehiscent into 4-valves; ovoid, 7-11 mm long, glabrous; pericarp woody. **Seeds** many, flattened, 3-5 by 1.5-3 mm, sterile seeds wingless, fertile seeds laterally narrowly winged.

**Thailand.**— SOUTH-WESTERN: Phetchaburi; PENINSULAR: Narathiwat, Yala.

**Distribution.**— Southern China, Vietnam, Myanmar, Peninsular Malaysia and Sumatra.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or growing in rock crevices, locally abundant in open vegetation on quartzitic phyllite ridges, and also found in montane forest, alt. 550-1,000 m. Rare in Thailand. Flowering and fruiting in October-May, more flowers in November-January. Floral visitors were mainly birds and honey bees.

**Vernacular.**— Nuan Chom Phoo (นวลชมพู) (General).

**Specimens examined.**— BETONG: *J. Wai* 23 (PSU), 198 (BKF, PSU), 372 (BCU, BKF, PSU), 418 (BCU, BKF, PSU), 537 (BCU, BK, BKF, PSU), 548 (PSU), 604 (PSU).

## LOGANIACEAE

**70. *Fagraea acuminatissima*** Merr., J. Straits Branch Roy. Asiat. Soc. 77: 232. 1917; Leenh. in Fl. Males., Ser. 1, Spermat. 6 (2): 319. 1962; Kochummen in Tree Fl. Malaya 2: 271. 1973; Griffin & J. Parn. in Fl. Thailand 6(3): 202, pl. XVIII. 1997.

**Plate 32D-F.**

Lithophytic shrub or scandent epiphyte. **Bark** greyish or reddish brown; branchlets stout, terete, with prominent leaf scars. **Stipules** connate into an ocrea; axillary scale appressed to twig, rounded or obtuse, 1-1.5 mm high in leaf axis. **Leaves** simple, opposite decussate, glabrous; petiole stout, terete, 1-2 cm long, base decurrent, exauriculate; blade rigid, coriaceous, thick and fleshy, elliptic to elliptic-oblong or obovate, 6-12 by 3-6 cm, upper surface shining, yellowish or light green, sometimes dark green, usually dark brown colour when dry, lower surface pale green, reddish brown when dry, apex acuminate or cuspidate, usually reflexed, base cuneate or sometimes rounded, margin entire or slightly undulate; midrib flattened or slightly raised above, prominent underneath, veins invisible. **Inflorescences** terminal, erect, compact cymes, 3-5-flowered, sessile; bracteoles triangular, appressed, keeled, 2.5-3.5 by 2-2.5 mm. **Flowers** fragrant, 5-merous (excluding gynoecium), subsessile; pedicels up to 7 mm long, glabrous. **Calyx** urceolate, rigid, thick and fleshy, yellowish or brownish green, glabrous; tube 4-5 mm long; lobes ovate, 5-6 by 5-6 mm, apex rounded. **Corolla** funnel-shaped, fleshy, inner surface creamy white, often with greenish edges, outer surface greenish, brownish or pale orange; tube 3.5-4 cm long; lobes overlapping to the right in bud, mature lobes oblong or obovate-oblong, 2.4-3 by 1.4-1.7 cm, apex rounded. **Stamens** 5, inserted in corolla throat at 2.5-2.7 cm from base, included or slightly exerted from the corolla tube; filaments 2.5-3 cm long; anthers elliptic-oblong, 4-5 mm long. **Ovary** superior, cylindrical, ca. 1 cm long, glabrous, 1-locular, placentation parietal; ovules many; style filiform, 4-4.5 cm long; stigma obconical, slightly peltate, ca. 1.5 mm in diam. **Infructescences** erect, few-berried. **Berry** ellipsoid, 2-3 by 1.5-2 cm, green, apex beaked. **Seeds** not seen.

**Thailand.**— PENINSULAR: Phangnga, Satun, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing in rock crevice, in open vegetation on quartzitic phyllite ridges, and also found in coastal heath and lowland evergreen forests, from sea level to 700 m alt. Uncommon. Flowering in April-June, fruiting in July-October.

**Vernacular.**— Chaba Pa (ชาปา) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 664 (BKF, PSU), 706 (PSU), 759 (BCU, BKF, PSU), 824 (PSU); SATUN: *P. Pattarakulpisutti et al.* 96 (BKF, PSU).

**71. *Fagraea wallichiana*** Benth., J. Proc. Linn. Soc., Bot. 1: 98. 1856; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 4: 85. 1883; Corner, Wayside Trees Mal. 1: 426. 1940.— *Cyrtophyllum lanceolatum* DC., Prodr. 9: 31. 1845; Ridl., Fl. Malay Penins. 2: 421. 1923. **Plate 33A-D.**

Shrubby tree up to 10 m high. **Bark** greyish brown or dark grey, fissured; wood yellowish or pale orange; branchlets slender, terete, with prominent leaf scars, greyish or brown, sometimes with reddish blotches. **Stipules** connate into an ocrea; axillary scale appressed to twig except for dry specimen, rounded, inconspicuous. **Leaves** simple, opposite decussate, glabrous; petiole slender, terete, slightly winged, 0.7-2 cm long, base decurrent, exauriculate; blade thinly coriaceous, elliptic or obovate to oblanceolate, 5.5-10 by 1.5-5 cm, upper surface dull green, underneath paler, apex acute, acuminate or cuspidate, base cuneate or attenuate, margin usually slightly undulate; midrib flattened or slightly raised above, prominent underneath, secondary veins 5-8 pairs, shallowly grooved and inconspicuous above, slightly raised underneath. **Inflorescences** axillary, erect, corymbose, 1-5-flowered; peduncle 2-4 cm long, glabrous; bracteoles broadly triangular-ovate, appressed, 0.6-0.8 by 0.8-1 mm, apex obtuse or rounded, margin thin, irregular toothed. **Flowers** fragrant, 5-merous (excluding gynoecium); pedicels 5-12 mm long, glabrous. **Calyx** urceolate, rigid, thick and fleshy, yellowish, glabrous; tube very short; lobes ovate to suborbicular, 2.5-3 by 2.5-3 mm, apex rounded. **Corolla** funnel-shaped, fleshy, inner surface creamy white,



often with brownish or pale orange edges, outer surface greenish, yellowish or pale orange; tube 2-2.7 cm long; lobes overlapping to the right in bud, mature lobes oblong or obovate-oblong, 9-10 by 6-8 mm, apex rounded. **Stamens** 5, inserted in corolla throat at 1.2-1.8 cm from base, long exserted from the corolla tube; filaments 3-4 cm long; anthers ovate-oblong, 2.5-3 mm long. **Ovary** superior, ovoid to cylindrical-ovoid, 3-4 mm long, glabrous, 1-locular, placentation parietal; ovules many; style filiform, 3.7-5.5 cm long; stigma obconical, 0.5-0.6 mm in diam. **Infructescences** erect, few-berried. **Berry** narrowly ellipsoid, 12-15 by 7-8 mm, yellowish when young, orange or reddish when ripe, apex shortly beaked. **Seeds** irregularly angled, 1-1.5 mm in diam., dark brown to almost black; testa cells comb-shaped.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On exposed quartzitic phyllite ridges at 650-700 m alt. Very rare in Thailand. Flowering in August-October, fruiting in November-April. Floral visitors were mainly spiderhunter birds and ants (e.g. *Polyrhachis* sp.).

**Vernacular.**—

**Remarks.**— Although *Fagraea wallichiana* Benth. has recently been treated as a synonym of *Fagraea fragrans* Roxb. by several authors, but in the present study has shown morphological and phenological evidence that *F. wallichiana* Benth. is probably a species distinct from *F. fragrans* Roxb. or at least subspecies (ecotype) (Table 7). However, more evidences are strongly needed to determine whether this doubtful species should be regarded as a distinct species or a subspecies of *F. fragrans* Roxb.

**Specimens examined.**— BETONG: *J. Wai* 432 (BCU, BKF, PSU), 481 (BCU, BKF, PSU), 568 (BCU, BKF, PSU), 575 (BCU, BKF, PSU), 607 (BCU, BKF, PSU), 823 (PSU), 862 (PSU), 876 (BCU, BK, BKF, KKU, PSU, QBG), 901 (BCU, BK, BKF, KKU, PSU, QBG).

**Additional specimens examined.**— *Fagraea fragrans* Roxb.; SONGKHLA: *J.F. Maxwell* 86-306 (PSU); *K. Suvatabhandhu* 4 (PSU); *P. Sirirugsa* 1347 (PSU).

**Table 7.** Comparison of some distinguished characters and phenological patterns between *Fagraea wallichiana* Benth. and *Fagraea fragrans* Roxb.

Character	<i>Fagraea wallichiana</i> Benth.	<i>Fagraea fragrans</i> Roxb.
1. Calyx lobe length	2.5-3 by 2.5-3 mm	1-1.5 by 1-1.5 mm
2. Corolla tube length	2-2.7 cm long	0.8-1.2 cm long
3. Corolla lobe length	9-10 by 6-8 mm	6-8 by 4.5-5.5 mm
4. Stamen length	3-4 cm long	1.5-2.2 cm long
5. Ovary and style length	4-6 cm long	1.7-2.5 cm long
6. Infructescence	few-berried, erect	many-berried, pendulous
7. Berry shape and size	ellipsoid, 12-15 by 7-8 mm	globose, 5-8 mm in diam.
<b>Phenology</b>		
1. Flowering period	August-October	March-June
2. Fruiting period	November-March	July-November

LORANTHACEAE

**72. *Dendrophthoe pentandra*** (L.) Miq., Fl. Ned. Ind. 1: 818. 1856; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 72. 1965; B.C. Stone, Fed. Mus. J. 26(1): 113. 1981; Barlow in Fl. Males., Ser. 1, Seed Pl. 13: 318, figs. 2, 21, 22c. 1997; in Fl. Thailand 7(4): 675, fig. 2C. 2002.— *Loranthus pentandrus* L., Mant. Pl.: 63. 1767; Hook.f., Fl. Brit. India 5: 216. 1886; Ridl., Fl. Malay Penins. 3: 155. 1924; M.R. Hend., Malay. Wild Fls., Dicots.: 300. 1959. **Plate 33E-F.**

Parasitic shrub; branches and branchlets terete, grey or greyish brown, glabrous, lenticellate; young parts stellate hairy. **Leaves** simple, alternate or subopposite; petiole 5-10 mm long, yellowish green, stellate hairy when young, becoming glabrous with age; blade coriaceous, elliptic to elliptic-ovate, 3.5-12 by 1.2-7.2 cm, sparsely hairy when young, soon becoming glabrous, upper surface shining, reddish or greenish brown, lower surface dull, paler, apex acute to rounded, base cuneate to attenuate, margin entire or slightly undulate; midrib flattened above, raised

underneath, secondary veins 2-3 pairs, reticulation inconspicuous. **Inflorescences** axillary, racemose, 3-9-flowered, 2.5-3.5 cm long; peduncle very short, up to 5 mm long, stellate hairy; axis 0.5-1.5 cm long, stellate hairy; bract 1 under each flower, broadly ovate to suborbicular, ca. 2 by 2 mm, apex obtuse to rounded. **Flowers** 5-merous (excluding gynoecium), subsessile; pedicels 0.5-1 mm long, stellate hairy. **Calyx** urceolate, densely stellate hairy; limb ca. 1 mm high, apex truncate. **Corolla** in mature bud 15-20 mm long, greenish, yellowish or pale brown, stellate hairy outside, inside glabrous; tube cylindrical or campanulate, 5.5-7.5 mm long; lobes reflexed, linear-triangular, 12.5-13.5 long, broadest at the base, 2-2.5 mm wide, apex acute or subacute, margin thickened. **Stamens** 5, opposite the corolla lobes, epipetalous; filaments basally adnate to the corolla, free part of filaments ca. 5 mm long; anthers basifixed, immobile, opening by longitudinal slits, linear-oblong 2.5-3 by 0.5-0.6 mm. **Ovary** inferior, 1-locular; ovule undifferentiated; style 1.8-1.9 cm long, greenish, glabrous; stigma capitate, 0.7-0.8 mm in diam., greenish. **Fruit** berry-like, crowned by the persistent calyx, ovoid, ca. 7 by 5 mm, stellate hairy. **Seed** 1, albuminous.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Phrae, Tak; NORTH-EASTERN: Loei, Khon Kaen; SOUTH-WESTERN: Kanchanaburi, Ratchaburi, Phetchaburi; CENTRAL: Phra Nakhon Si Ayutthaya, Bangkok; SOUTH-EASTERN: Chon Buri, Rayong, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Yala.

**Distribution.**— India, Southern China, Indochina and throughout the Malesian region.

**Ecology.**— Parasitic on trees or shrubs (e.g. *Melastoma malabathricum* L. subsp. *malabathricum* and *Rhodoleia championii* Hook.f.), usually found in open vegetation, on mountain ridges, and also found in plantations, coastal heath and lowland evergreen forests, from sea level to 1,000 m alt. Common. Flowering in March-June, fruiting in May-July.

**Vernacular.**— Kafak Ma Muang (กาแฟมะม่วง) (Central).

**Specimens examined.**— BETONG: *J. Wai* 199 (BCU, BKF, PSU), 700 (PSU); CHIANG MAI: *B. Nimanong & S. Phusomsaeng* 1718 (PSU); SURAT THANI: *T. Tepnarin* 324 (PSU); KRABI: *P. Wachiraanan* 9 (PSU); SATUN: *P. Pattarakulpisutti et al.* 98 (PSU); SONGKHLA: *P. Wachiraanan* 4 (PSU).

### MELASTOMATACEAE

**73. *Melastoma malabathricum*** L. subsp. *malabathricum*, Sp. Pl. 1: 390. 1753; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 523. 1879; Ridl., Fl. Malay Penins. 1: 764. 1922; Craib, Fl. Siam. 1: 680. 1931; Corner, Wayside Trees Mal. 1-2: 447, pl. 158. 1940; M.R. Hend., Malay. Wild Fls., Dicots.: 141, fig. 137. 1959; B.C. Stone, Fed. Mus. J. 26(1): 116. 1981; Karst. Mey., Blumea 46: 364. 2001; S.S. Renner, Clausen, Cellin. & Karst. Mey. in Fl. Thailand 7(3): 441, pl. XVIB. 2001.— *M. affine* D. Don, Mem. Wern. Nat. Hist. Soc. 4: 288. 1823.— *M. polyanthum* Blume in Flora 14: 480. 1831; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 523. 1879.— *M. malabathricum* var. *polyanthum* (Blume) Benth., Fl. Austral. 3: 292. 1867.— *M. scabrum* Ridl., J. Straits Branch Roy. Asiat. Soc. 79: 66. 1918; Fl. Malay Penins. 1: 766. 1922.— *M. malabathricum* var. *grandiflorum* Craib, Fl. Siam. 1: 681. 1931.— *M. imbricatum* var. *longipes* Craib, Fl. Siam. 1: 679. 1931. **Plate 34A-C.**

Shrub up to 3 m high. **Bark** shallowly fissured, sometimes flaky, more or less smooth on very old parts, brownish; branchlets quadrangular and densely covered with appressed scales; scales various in size and shape, broadly ovate to narrowly lanceolate, apex acuminate. **Leaves** simple, opposite decussate, scaly; petiole 3-10 mm long; blade rigid, coriaceous, lanceolate to elliptic, 1-8 by 0.5-2.5 cm, olive green or green, strigose on both surfaces, apex acute or acuminate, base rounded or cuneate, margin entire and slightly recurved; main veins 3 or 5, channelled above and prominent underneath. **Inflorescences** terminal cymes or sometimes flowers solitary, 1-5-flowered, sessile, scaly; bracts triangular, ovate to lanceolate, 5-10 by 2-5 mm, scaly outside. **Flowers** 5-merous (excluding androecium), sessile to subsessile;

pedicels 0-9 mm long, scaly. *Hypanthium* broadly cylindrical or campanulate, 7-8 by 4-6 mm, scaly; scales appressed, linear, triangular or ovate, 0.5-2.5 mm long; calyx lobes triangular or ovate to lanceolate, 4-9 by 1.5-3 mm, scaly. *Petals* obovate, 1.9-2.7 by 1.4-2 cm, purple, glabrous, apex obtuse or truncate. *Stamens* 10, dimorphic; outer stamens 5, filaments 9-11 mm long, yellow or purple; connective prolongation (pedoconnective) with 2 tubercles in front, 6-10 mm long, anthers 8-9 mm long, purple; inner stamens 5, filaments 8-9 mm long, yellow or purple, anthers 6-8 mm long, yellow. *Ovary* inferior, apical part covered with scales or bristle, 5-locular, placentation axile; ovules numerous per locule; style 1.5-2.2 cm long, purplish; stigma truncate, greenish. *Capsule* fleshy, irregularly transversely dehiscent, broadly campanulate, 7-9 by 6-7 mm, scaly. *Seeds* numerous, cochleate, very small ca. 0.1 mm long, brownish; testa cells papillose.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Nan, Phitsanulok; NORTH-EASTERN: Phetchabun; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Phatthalung, Trang, Satun, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— Widely distributed from Southeast Asia to New Guinea and North Australia.

**Ecology.**— Terrestrial or growing on rocks in open places, on the summit of rocky mountains, and also found in durian and rubber plantations, coastal heath and lowland evergreen forests, from near sea level to 1,000 m alt. Common. Flowering and fruiting all year round, more flowers in March-April.

**Vernacular.**— Ka Du Du (กะดุดู) (Malay-Pattani); Ka Du Do (กาตูโต๊ะ) (Malay-Satun, Pattani); Be (เบ้), Mare (มะเหร), Mang Khre (มังเค้), Mang Re (มังเร้), Sare (สาเร), Samre (สำเร) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 341 (PSU), 375 (PSU), 472 (PSU), 499 (PSU), 518 (BKF, PSU), 661 (PSU), 935 (BKF, PSU); PHANGNGA: *W.*

*Jintapakorn* 9 (PSU); NAKHON SI THAMMARAT: *W. Ramsri* 9 (PSU); PHATTHALUNG: *J. Supapol* 256 (PSU); SATUN: *G. Congdon* 268 (PSU); SONGKHLA: *P. Sirirugsa* 833 (PSU); MALAYSIA (Sabah): *Amin et al.* SAN 96908 (PSU).

**74. *Oxyspora umbellulata*** (Hook.f. ex Triana) J.F. Maxwell, Gard. Bull. Singapore 35: 218. 1983; S.S. Renner, Clausen, Cellin. & Karst. Mey. in Fl. Thailand 7(3): 461. 2001.— *Allomorphia umbellulata* Hook. f. ex Triana, Trans. Linn. Soc. London 28: 74, fig. 66a, pl. 6. 1871.— *Anerincleistus collinus* Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 47. 1911.— *Oxyspora collina* (Ridl.) Ridl., Fl. Malay Penins. 1: 768. 1922.— *O. caudata* Geddes, Bull. Misc. Inform., Kew 1930: 313. 1930.— *O. gracilis* Craib, Bull. Misc. Inform., Kew 1930: 314. 1930.— *O. setosa* Craib, Bull. Misc. Inform., Kew 1930: 314. 1930.— *O. collina* var. *subglabra* Craib, Fl. Siam. 1: 684. 1931. **Plate 34D-F.**

Shrub up to 1.5 m high; young branches piloglandulose. **Leaves** simple, opposite decussate; petiole 0.5-6 cm long, piloglandulose; blade thinly chartaceous to subcoriaceous, ovate or elliptic, 4-19 by 2-11.5 cm, olive green or green, glabrous or subglabrous above, piloglandulose or subglabrous underneath, apex apiculate or acuminate, base rounded, cordate or cuneate, margin entire, ciliate; main veins 5 or 7. **Inflorescences** terminal, umbelliform cymes, many-flowered; peduncle 3.5-6.2 cm long, piloglandulose; bracts narrowly triangular lanceolate or oblong, 1-2 mm long. **Flowers** 4-merous (excluding androecium); pedicels 5-10 mm long, piloglandulose. **Hypanthium** campanulate or obconical, 3-5 by 2-4 mm, pinkish, piloglandulose; calyx lobes 4, keeled, triangular, very small, ca. 1 mm long. **Petals** slightly recurved, ovate or lanceolate, 8-9 by 4-6 mm, pinkish, apex acute, margin ciliate. **Stamens** 8; filaments 1-1.5 mm long, whitish, minutely piloglandulose; anthers slightly incurved, 6-8 mm long, connective with a small dorso-basal spur, whitish. **Ovary** inferior, 4-locular, placentation axile; ovules numerous per locule; style 1.2-1.8 cm long, minutely piloglandulose; stigma truncate, creamy. **Capsule** campanulate, pubescent. **Seeds** numerous, ovoid, conical or cylindrical, ca. 0.5 mm long, brownish; testa cells papillose.

**Thailand.**— PENINSULAR: Ranong, Surat Thani, Nakhon Si Thammarat, Phatthalung, Satun, Pattani, Yala.

**Distribution.**— Myanmar and Peninsular Malaysia.

**Ecology.**— Terrestrial or growing on the cliffs in partial shade of rocky ridges, and also found in lowland evergreen forest, alt. 500-1,000 m. Uncommon. Flowering and fruiting in April-January, more flowers in May-July.

**Vernacular.**— Mang Le (มังเล) (Nakhon Si Thammarat); Mang Le Khuan (มังเลควน), Mare Khuan (มะเรควน) (Pattani).

**Specimens examined.**— BETONG: *J. Wai* 46 (PSU), 358 (BKF, PSU), 460 (BKF, PSU), 470 (BKF, PSU), 837 (PSU), 973 (BCU, BKF, PSU); RANONG: *T. Santisuk* 724 (PSU); SATUN: *G. Congdon* 1020 (PSU).

**75. *Pachycentria glauca*** Triana subsp. ***maingayi*** (C.B. Clarke) Clausen, *Blumea* 45(2): 356. 2000.— *Medinilla maingayi* C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 549. 1879; Ridl., Fl. Malay Penins. 1: 803. 1922; M.R. Hend., Malay. Wild Fls., Dicots.: 134, fig. 129. 1959. **Plate 35A-C.**

Small bushy shrub with few to densely branches, up to 30 cm high; branches and branchlets smooth, brownish; young parts scurfy; adventitious roots tuberous, irregularly swollen. **Leaves** simple, opposite decussate; petiole 1-3 mm long, scurfy; blade fleshy and succulent, obovate, 1.2-3 by 0.5-1.7 cm, green, glossy, glabrous, apex rounded or emarginate, base cuneate, margin entire; main veins 3, inconspicuous. **Inflorescences** terminal or axillary, simple dichasium or flowers solitary, 1-3-flowered, sessile, scurfy. **Flowers** 4-merous (excluding androecium); pedicels 1-4 mm long, scurfy. **Hypanthium** campanulate or urceolate, 3-3.5 by 1.5-2 mm, scurfy; calyx tube with 4 thickened lobes, lobes broadly triangular, very small. **Petals** obovate or oblong, 3-4.5 by 1-2 mm, creamy white, with tinted reddish, glabrous, apex acute, margin involute in apical part. **Stamens** 8; filaments ca. 2 mm long, whitish; anthers

cylindrical, straight, erect, ca. 2 mm long, whitish, sometimes with tinged red; connective with a dorsal spur, dorsal spur ca. 0.3 mm long, upcurved. **Ovary** inferior, 4-locular, placentation axile; ovules ca. 22, 4-6 ovules per locule; style 3-4 mm long; stigma truncate, creamy. **Berry** globular or subglobular, 4-5 mm in diam., scurfy, reddish when ripe. **Seeds** 7-10, oblong or cylindrical, 1.5-2 mm long, brownish; testa cells impressed, scrobiculate.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Singapore and Sumatra.

**Ecology.**— On tree trunks and branches or growing on rocks in partial shade of the quartzitic phyllite ridge, and also found in lowland evergreen forest, alt. 500-900 m. Very rare in Thailand. Flowering and fruiting in April-October.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausen differs from other *Pachycentria* species in having more branches and smaller leaves, flowers usually solitary or in few-flowered cymes. Only one plant specimen has been collected, additional specimens and field surveys are still needed.

**Specimen examined.**— BETONG: *J. Wai* 787 (PSU).

**76. *Pachycentria hanseniana* Clausen, Blumea 45(2): 357, fig. 5. 2000. *Plate 35D*.**

Shrub up to 1.5 m high; branches and branchlets smooth, brownish; young parts scurfy. **Leaves** simple, opposite decussate; petiole 0.2-1.4 cm long, scurfy; blade fleshy and coriaceous, sometimes thinly chartaceous when dry, elliptic or ovate, 3-14.5 by 1.5-5.5 cm, green, glossy, glabrous or sparsely covered with small bran-like scales on both surfaces, apex acuminate or acute, base cordate or rounded, margin



entire; main veins 3, midrib subglabrous above, scurfy underneath. **Inflorescences** terminal, many-flowered paniculate cymes, 2.5-3.5 cm long; peduncle 0.5-1.8 cm long, scurfy; bracts and bracteoles minute, triangular or ovate, 0.5-1 mm long. **Flowers** 4-merous (excluding androecium); pedicels 2-3 mm long, scurfy. **Hypanthium** narrowly urceolate or cylindrical, 3-5 by 0.5-2 mm, yellowish green or orange, scurfy; calyx tube with 4 thickened lobes, lobes triangular, ca. 1 mm long. **Petals** oblong-lanceolate, 5-7 by 2-3 mm, white or yellowish green, glabrous or sparsely covered with minute bran-like scales on both surfaces, apex acuminate. **Stamens** 8; filaments ca. 3 mm long, whitish; anthers cylindrical, erect, ca. 3 mm long, whitish, apex curved backwards; connective with a dorsal spur, dorsal spur ca. 1 mm long, straight, sometimes upcurved or rarely twisted, glabrous, sometimes covered with small bran-like scales or frayed margin. **Ovary** inferior, 4-locular, placentation axile; ovules numerous per locule; style 8-10 mm long, whitish; stigma capitate, globular, whitish or greenish. **Berry** narrowly ovoid, 10-12 by 4-5 mm, scurfy, orange or reddish when ripe. **Seeds** numerous, ovoid or oblong, 0.5-1 mm long, brownish; testa cells papillose.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Borneo (Sarawak, Kalimantan).

**Ecology.**— On mossy rocks or growing on rocky or sandy heath soils with the litter of decaying leaves, in semi-exposed areas of granitic ridge, and also found on tree trunks in lower montane forest, alt. 900-1,000 m. Very rare. Flowering in May-July, fruiting in September-December.

**Vernacular.**—

**Remarks.**— *Pachycentria hanseniana* Clausen was previously known only from Borneo (Clausen, 1954). The present study demonstrates it as a new record for Thailand. This species differs from other *Pachycentria* species in having narrowly ovoid berries.

**Specimens examined.**— BETONG: *J. Wai* 244 (BCU, BKF, PSU), 310 (BCU, BKF, PSU), 456 (PSU).

**77. *Pachycentria pulverulenta*** (Jack) Clausing, *Blumea* 45(2): 362, fig. 8. 2000; S.S. Renner, Clausing, Cellin. & Karst. Mey. in *Fl. Thailand* 7(3): 464, fig. 35, pl. XVIIIB. 2001.— *Melastoma pulverulentum* Jack, *Trans. Linn. Soc. London* 14: 19. 1823.— *Pogonanthera pulverulenta* (Jack) Blume, *Flora* 14: 521. 1831; C. B. Clarke in *Fl. Brit. India* (J.D. Hooker) 2: 550. 1879; Ridl., *Fl. Malay Penins.* 1: 805. 1922; M.R. Hend., *Malay. Wild Fls., Dicots.*: 139, fig. 135. 1959.— *P. reflexa* Reinw. ex Blume, *Flora* 14: 521. 1831.— *P. pauciflora* Becc., *Malesia* 2: 241. 1884.— *P. latifolia* O. Schwartz, *Mitt. Inst. Allg. Bot. Hamburg* 7: 252. 1931. **Plate 35E-F.**

Shrub up to 3 m high. **Bark** smooth or warty, brownish; young branchlets and shoots scurfy; adventitious roots sometimes tuberous. **Leaves** simple, opposite decussate; petiole 0.2-1.5 cm long, scurfy; blade fleshy and coriaceous, sometimes thinly chartaceous when dry, elliptic, ovate or obovate, 5.5-17 by 2.5-8 cm, green, glabrous and glossy above, scurfy underneath, apex acuminate, base cuneate or rounded with 2 auricles, margin entire; main veins 3, midrib scurfy on both surfaces. **Inflorescences** terminal, many-flowered paniculate cymes, 5-10 cm long; peduncle 1-4.5 cm long, scurfy; bracts and bracteoles very small, triangular. **Flowers** 4-merous (excluding androecium); pedicels 1-2 mm long, scurfy. **Hypanthium** campanulate or urceolate, 2-2.5 by ca. 1.5 mm, scurfy; calyx tube with 4 thickened lobes, lobes broadly triangular, very small. **Petals** obovate or elliptic, 2-3 by 1-2 mm, orange or reddish, furfuraceous on both surfaces, apex acute. **Stamens** 8; filaments 1-1.5 mm long, whitish; anthers cylindrical, 1-1.5 mm long, whitish, pinkish or reddish; connective with a dorsal tuft of hairs. **Ovary** inferior, 4-locular, placentation axile; ovules numerous per locule; style 3-4 mm long, yellowish orange; stigma truncate, creamy or greenish. **Berry** globular, 6-7 mm in diam., scurfy, reddish when ripe. **Seeds** numerous, ovoid or oblong, ca. 0.5 mm long, brownish; testa cells papillose.

**Thailand.**— PENINSULAR: Phatthalung, Satun, Songkhla, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Borneo and throughout the Malay Archipelago.

**Ecology.**— On moist mossy cliffs or growing on rocky or sandy heath soils over the rocky base in exposed areas of quartzitic phyllite ridges, and also found on tree trunks in lowland evergreen forest and rubber plantation, from near sea level to 700 m alt. Uncommon. Flowering and fruiting all year round, more flowers in July-August.

**Vernacular.**— Khleng Hu (เคลงหู่) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 13 (PSU), 274 (BCU, BKF, PSU), 324 (BCU, BKF, PSU), 346 (BCU, BKF, PSU), 376 (BCU, BKF, PSU), 423 (BCU, BKF, PSU), 545 (BCU, BKF, PSU), 812 (PSU), 932 (PSU); SONGKHLA: *J.F. Maxwell* 84-68 (PSU); MALAYSIA (Sabah): *Fedilis & Sumbing* SAN 95730 (PSU).

**78. *Sonerila griffithii*** C.B. Clarke in Fl. Brit. India (J.D. Hooker) 2: 539. 1879; Ridl., Fl. Malay Penins. 1: 786. 1922; S.S. Renner, Clausen, Cellin. & Karst. Mey. in Fl. Thailand 7(3): 486. 2001.— *S. muscicola* Stapf & King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 69: 31. 1900; Craib, Fl. Siam. 1: 693. 1931; Ridl., Fl. Malay Penins. 1: 785. 1922.— *S. congesta* Stapf & King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 69: 32. 1900; Ridl., Fl. Malay Penins. 1: 785. 1922; Craib, Fl. Siam. 1: 690. 1931.— *S. cyclaminella* Stapf & King, J. Asiat. Soc. Bengal. 69: 33. 1900.— *S. kerrii* Craib & Stapf, Bull. Misc. Inform., Kew 1910: 22. 1910; Craib, Fl. Siam. 1: 692. 1931.— *S. gracilis* Geddes, Bull. Misc. Inform., Kew 1928: 71. 1928; Craib, Fl. Siam. 1: 691. 1931.— *S. parva* Geddes, Bull. Misc. Inform., Kew 1928: 72. 1928; Craib, Fl. Siam. 1: 693. 1931.— *S. deflexa* Craib, Gard. Chron., ser. 3, 83: 140. 1928.— *S. insularis* Craib, Bull. Misc. Inform., Kew 1930: 319. 1930; Fl. Siam. 1: 692. 1931. **Plate 36A-C.**

Small unbranched or rarely branched herb, with succulent tuberous rhizome. **Stems** terete or sometimes quadrangular and winged, usually short or acaulescent, sometimes slender, up to 25 cm high, hairy or glabrous; internodes up to 6 cm long.

**Leaves** simple, opposite decussate, usually in a basal rosette or in a tuft at the top of stem; petiole 0.5-28 mm long, hairy or glabrous; blade membranous when dry, greenish or reddish purple, ovate or elliptic, 0.5-8 by 0.3-4.4 cm, densely setose to subglabrous on both surfaces, apex acute, obtuse or rounded, base rounded, cuneate, cordate or rarely oblique, margin denticulate and finely ciliate. **Inflorescences** terminal, erect, scorpioid cymes or subumbelliform cymes, 1-15-flowered; peduncle 1-9 cm long, glabrous or subglabrous, rarely hairy. **Flowers** 3-merous, subsessile; pedicels 1-4 mm long, glabrous or subglabrous, rarely hairy. **Hypanthium** cylindrical to campanulate or obconical, 2-5 mm long, often glabrous, rarely hairy; calyx lobes 3, triangular ca. 0.5 mm long. **Petals** elliptic or obovate, 4-10 by 2-5 mm, pink or purple, inner surface glabrous, outer surface glabrous or subglabrous, with a row of hairs along the midrib, apex acute or acuminate. **Stamens** 3; filaments 2-5 mm long, pink or purple; anthers slightly incurved, deeply cordate at the base, 2.5-5 mm long, yellow. **Ovary** inferior, 3-locular, placentation axile; ovules numerous per locule; style 5-10 mm long, purplish; stigma globular or conical, purplish, papillate. **Capsule** cylindrical or obpyramidal, 4-9 mm long, glabrous. **Seeds** numerous, very small, oblong, brownish; testa cells papillose.

**Thailand.**— NORTHERN: Chiang Mai; Sukhothai; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Satun, Songkhla, Yala.

**Distribution.**— Myanmar and Peninsular Malaysia.

**Ecology.**— On moist mossy rocks or growing on wet rocky or sandy heath soils with the decaying organic matter, often found in mossy banks, in both among open grassland and shady areas of rocky mountains and also found in coastal heath forest, sometimes growing on tree trunks in montane forest (outside study area), from sea level to 1,200 m alt. Uncommon. Flowering and fruiting in May-January, more flowers in July-August.

**Vernacular.**— Sao Sanom (สาวสนม) (Nakhon Ratchasima).

**Remarks.**— It is very difficult to distinguish *Sonerila griffithii* C.B. Clarke from *Sonerila calophylla* Ridl. In the key and description in Flora of Thailand only stated that this species differs from *S. calophylla* Ridl. in having sparsely minute-setose stem and the shorter internodes (rarely elongated) (Renner *et al.*, 2001). However, it is found that *S. griffithii* C.B. Clarke generally forms acaulescent habit, producing leaves in a basal rosette and densely covered with hairs in exposed and rather dry conditions, whereas the plants that growing in shady and humid conditions often produce elongated stem with long internodes and almost glabrous leaves, it is shown that these distinguish characters reflect the phenotypic plasticity. Furthermore, both species have a similar distribution (occasionally occurring in the same locality). It is convinced that *S. griffithii* C.B. Clarke might be conspecific with *S. calophylla* Ridl.

**Specimens examined.**— BETONG: *J. Wai* 49 (PSU), 273 (PSU), 313 (PSU), 342 (PSU), 379 (PSU), 416 (PSU), 504 (PSU), 764 (BKF, PSU), 808 (BKF, PSU), 813 (BKF, PSU), 877 (PSU), 880 (BKF, PSU); SATUN: *G. Congdon* 79 (PSU).

## MORACEAE

**79. *Ficus deltoidea*** Jack, Malayan Misc. 2(7): 71. 1822; Backer & Bakh.f., Fl. Java (Spermatoph.) 2: 28. 1965; Corner, Philos. Trans., Ser. B: 300. 1969; Kochummen in Tree Fl. Malaya 3: 145. 1978; B.C. Stone, Fed. Mus. J. 26(1): 119. 1981; C.C. Berg, Blumea 48: 533. 2003; C.C. Berg & Corner in Fl. Males., Ser. 1, Seed Pl. 17(2): 90, fig. 24. 2005.— *F. ovoidea* Jack, Malayan Misc. 2(7): 71. 1822.— *F. diversifolia* Blume, Bijdr. Fl. Ned. Ind. 9: 456. 1825; King in Fl. Brit. India (J.D. Hooker) 5: 529. 1888; Ridl., Fl. Malay Penins. 3: 346. 1924.

**Remarks.**— The *Ficus deltoidea* complex (including *Ficus oleifolia* King) was established by Corner (1969). However, until now the taxonomic classification of this complex group is still unclear. Consequently, it is suggested that molecular studies and detailed studies on the fig-pollinator systems should be conducted in order to clarify their taxonomic status and phylogenetic relationships.

**a. var. deltoidea****Plate 36D-F.**

Shrub up to 2 m high, dioecious. **Leafy twigs** 2.5-8 mm thick, dark brown or greyish, minutely hairy when young, very soon becoming glabrous; periderm usually flaking off. **Stipules** caducous, convolute, amplexical and enclosing terminal leaf bud, 6-12 mm long, dark reddish purple, apex acute, margin ciliate. **Leaves** simple, spirally arranged; petiole 0.5-4 cm long, minutely hairy, soon becoming glabrous with age; blade coriaceous, obovate or obdeltoid, 2-11 by 2.5-8 cm, upper surface more or less shining, green to dark green, with scattered rusty-brown hydathodes, lower surface pale-olive green, apex truncate or rounded, base cuneate, margin entire; midrib dichotomous at or above the middle of the blade, flattened above, raised underneath, reticulation faintly to moderately conspicuous; waxy glands dark reddish purple or blackish, 2 or 3(-5), 2 basal, without glands or with 1-3 glands at dichotomies of the midrib; penniveined leaves at the base of lower branches or in young plants elliptic or obovate, apex acute or acuminate, secondary veins 3-4 pairs. **Figs** axillary, solitary or in pairs; peduncle 7-14 mm long, green or yellowish, often tinged with reddish purple, sparsely to moderately minutely hairy; bracts 3, broadly ovate or lunate, 0.8-1 by 2-3 mm, apex obtuse, rounded or truncate, margin ciliate; receptacle ellipsoid or pyriform, 12-17 by 8-10 mm, yellow to dark reddish purple at maturity, glabrous; ostiole ca. 2 mm in diam.; internal hairs present. **Male** and **Gall flowers** not seen. **Female flowers** 20-22 per fig; tepals 4, thick and fleshy, with a few hairs at the tip, ovate or elliptic, 1-1.2 by 0.8-1 mm, glossy, reddish purple, apex obtuse or rounded; ovary sessile, 1-1.5 by 1-1.2 mm; style 1-1.5 mm long; stigma bifid. **Fruit** and **Seed** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— On exposed granitic ridges at 650 m alt. Uncommon. Flowering and fruiting in February-June, September-November.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 371 (BCU, BKF, PSU), 657 (BCU, BKF, PSU).

**b. var. *angustifolia*** (Miq.) Corner, Gard. Bull. Singapore 17: 421. 1960; Philos. Trans., Ser. B: 300, fig. 9. 1969; Kochummen in Tree Fl. Malaya 3: 145. 1978; C.C. Berg & Corner in Fl. Males., Ser. 1, Seed Pl. 17(2): 93. 2005. **Plate 37A-C.**

Shrub up to 2 m high, dioecious. **Leafy twigs** 1-2.5 mm thick, whitish grey, reddish brown, yellowish green or green, minutely hairy when young, very soon becoming glabrous; periderm usually flaking off. **Stipules** caducous, convolute, amplexical and enclosing terminal leaf bud, 2-4 mm long, greenish or purplish brown, apex acute, margin ciliate. **Leaves** simple, spirally arranged; petiole terete or subterete, slightly grooved, adaxially hairy when young, soon becoming glabrous with age, 3-12 mm long, whitish grey; blade coriaceous, oblanceolate to spatulate or obovate, 1.7-6.5 by 0.7-2.5 cm, upper surface more or less shining, olive or yellowish green, with scattered rusty-brown hydathodes, lower surface rusty-coloured, yellowish or pale-olive green, apex rounded, base cuneate, margin entire; midrib dichotomous at or above the middle of the blade, flattened above, raised underneath, reticulation faintly to moderately conspicuous; waxy glands dark reddish purple or blackish, 1-3 at the furcations of the midrib; penniveined leaves in young plants usually larger, petiole up to 14 mm long, blade narrowly elliptic to oblanceolate, up to 10.5 by 2.8 cm, apex acute or acuminate, secondary veins 4-9 pairs. **Figs** axillary, in pairs or solitary; peduncle 8-11 mm long, green or yellowish green, sparsely to moderately minutely hairy; bracts 3, broadly triangular-ovate or semi-orbicular, 0.5-0.7 by 1-1.5 mm, apex obtuse or rounded, margin ciliate; receptacle subglobular, 4-7 by 4-7 mm, yellow to dark reddish purple at maturity, glabrous; ostiole ca. 1.5 mm in diam.; internal hairs present. **Male** and **Gall flowers** not seen. **Female flowers** few; tepals 4, thick and fleshy, with a few hairs at the tip, ovate or ovate-oblong, 1-2 by 0.6-1.2 mm, glossy, reddish purple, apex obtuse or rounded; ovary sessile, ca. 1.5 by 1 mm; style 1-1.2 mm long; stigma bifid. **Fruit** a seed-like achene. **Seed** obliquely ovoid, ca. 4 by 2 mm, 1-5 per fig.

**Thailand.**— PENINSULAR: Trang, Phatthalung, Satun, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Borneo and throughout the Malay Archipelago.

**Ecology.**— On exposed quartzitic phyllite ridges, and also found in coastal heath forest, usually growing on tree trunks or on rocks in lowland evergreen forest, from sea level to 700 m alt. Uncommon. Flowering and fruiting in March-October.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 343 (BKF, PSU), 475 (BCU, BKF, PSU), 828 (BKF, PSU); SATUN: *P. Pattarakulpisutti et al.* 77 (PSU).

**c. var. *kunstleri*** (King) Corner, Gard. Bull. Singapore 17: 423. 1960; Philos. Trans., Ser. B: 300, fig. 13. 1969; Kochummen in Tree Fl. Malaya 3: 145. 1978; C.C. Berg & Corner in Fl. Males., Ser. 1, Seed Pl. 17(2): 93. 2005. **Plate 37D-G.**

Shrub up to 2 m high, dioecious. **Leafy twigs** 2.5-6 mm thick, whitish grey, minutely hairy when young, very soon becoming glabrous; periderm usually flaking off. **Stipules** caducous, convolute, amplexical and enclosing terminal leaf bud, 5-10 mm long, green or pale brown, apex acute, margin ciliate. **Leaves** simple, spirally arranged; petiole terete or subterete, 0.5-3 cm long, minutely hairy, soon becoming glabrous with age; blade obdeltoid or obovate, 2-9 by 1.3-8.5 cm, upper surface more or less shining, olive or yellowish green, with scattered rusty-brown hydathodes, lower surface rusty-coloured, apex slightly emarginate or truncate, base cuneate to attenuate, margin entire; midrib dichotomous in the lower  $\frac{1}{3}$  of the blade, flattened above, raised underneath, reticulation faintly to moderately conspicuous; waxy glands dark brown or blackish, usually 5, 2 basal, 3 further glands at the dichotomies; penniveined leaves in young plants or at the base of lower branches elliptic, apex acute, secondary veins 3-4 pairs. **Figs** axillary, solitary; peduncle 8-18 mm long, green or yellowish green, sparsely to moderately minutely hairy; bracts 3, broadly triangular-



ovate or semi-orbicular, 1-2 by 3-3.5 mm, apex obtuse or rounded, margin ciliate; receptacle ellipsoid or ovoid, 1.5-1.8 by 1.2-1.5 cm, reddish purple at maturity, glabrous; ostiole 2-2.5 mm in diam.; internal hairs present. **Male flowers** in apical part of the fig, sessile to pedicellate; tepals 4, fleshy, concave, triangular-ovate, 0.7-1 by 0.4-0.5 mm, apex acuminate or acute; stamens 2; filaments 0.5-1 mm long, glabrous; anthers oblong, 1-1.2 by 0.7-0.8 mm long. **Gall flowers** sessile to pedicellate; tepals 4, fleshy, with a few hairs at the tip, linear-lanceolate, 1.2-1.7 by 0.2-0.3 mm; gall ovary sessile or stalked, angular-rugose, 1-1.5 by 0.8-1 mm. **Female flowers** 18-25 per fig; tepals 4, thick and fleshy, with a few hairs at the tip, triangular-ovate, 1.2-1.5 by 0.8-1 mm, glossy, reddish purple, apex acute or obtuse; ovary sessile, ca. 1.5 by 1 mm; style 1-1.5 mm long; stigma bifid. **Fruit** a seed-like achene. **Seed** obliquely ovoid, 3-4 by 2 mm, 20-22 per fig.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On exposed granitic ridges, and also found on tree trunks and branches in montane and lowland evergreen forests, alt. 650-1,000 m. Uncommon. Flowering and fruiting almost all year round.

**Vernacular.**— Salika Linthong (สาริกาหลินทอง) (Trade name).

**Specimens examined.**— BETONG: *J. Wai* 640 (PSU); *J. Wai* 1104 (PSU).

**80. *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg, Blumea 48: 541. 2003; C.C. Berg & Corner in Fl. Males., Ser. 1, Seed Pl. 17(2): 100. 2005.— *F. kinabaluensis* Stapf, Trans. Linn. Soc. London, Bot. 4: 226. 1894.— *F. burkillii* Ridl. ex Burkill & Holttum, Gard. Bull. Straits Settlements 3: 73. 1923; Ridl., Fl. Malay Peninsula 3: 330. 1924.— *F. deltoidea* Jack var. *intermedia* Corner, Gard. Bull. Singapore 17: 423. 1960; Philos. Trans., Ser. B: 304, fig. 11. 1969.— *Ficus deltoidea* Jack var. *kinabaluensis* (Stapf) Corner, Philos. Trans., Ser. B: 305, fig. 12. 1969. **Plate 38A-E.****

Shrub up to 2 m high, dioecious. **Leafy twigs** 1.5-5 mm thick, brown, dark brown or greyish, minutely hairy when young, very soon becoming glabrous; periderm persistent. **Stipules** caducous, convolute, amplexical and enclosing terminal leaf bud, 5-12 mm long, green or reddish purple, apex acute, margin ciliate. **Leaves** simple, spirally arranged; petiole 3-12 mm long, minutely hairy, becoming glabrous with age; blade subcoriaceous to coriaceous, penniveined, elliptic to elliptic-oblong, linear-elliptic, obovate to oblanceolate or occasionally spatulate, 1.5-14 by 1.3-4.2 cm, upper surface more or less shining, green to dark green, with or without scattered cream or pale brown hydathodes, lower surface paler, apex acuminate, acute, sometimes rounded, base cuneate, margin entire; midrib flattened above, prominent underneath, secondary veins 3-10 pairs, veins and reticulation conspicuous underneath; waxy glands 2, basal. **Figs** axillary, solitary or in pairs; peduncle 4-12 mm long, green or reddish purple, sparsely to moderately minutely hairy; bracts 3, broadly triangular-ovate or semi-orbicular, 0.7-2 by 2-3 mm, apex obtuse or rounded, margin ciliate; receptacle ellipsoid, pyriform or subglobular, 7-13 by 4-9 mm, red to reddish purple at maturity, glabrous; ostiole 1.5-2.5 mm in diam.; internal hairs present. **Male flowers** in distal half of the fig, sessile to pedicellate; tepals 2 or 4, fleshy, concave, obovate or elliptic, 0.5-0.8 by 0.3-0.5 mm, apex obtuse or rounded; stamens 2; filaments 0.3-1 mm long, glabrous; anthers oblong, 0.8-1 by 0.7-0.8 mm long. **Gall flowers** sessile to pedicellate; tepals 4, fleshy, with a few hairs at the tip, linear-lanceolate, 2-3 by 0.3-0.4 mm; gall ovary sessile or stalked, smooth, 1-1.2 by 0.7-0.9 mm. **Female flowers** 10-13 per fig; tepals 4, sessile or stalked, thick and fleshy, with a few hairs at the tip, elliptic or triangular-ovate, 0.8-1 by 0.4-0.8 mm, glossy, reddish purple, apex subacute or obtuse; ovary sessile, ca. 1.5 by 1 mm; style 1-1.5 mm long; stigma bifid. **Fruit** a seed-like achene. **Seed** obliquely ovoid, 3.5-4.5 by 2-3 mm, ca. 5 per fig.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— Growing on rocks, usually found in rock crevices or on thin layer organic soil over a rocky base, on exposed quartzitic phyllite ridges at 600-700 m alt. Uncommon. Flowering and fruiting almost all year round.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 344 (PSU), 385 (PSU), 419 (PSU), 658 (BKF, PSU), 662 (BKF, PSU), 899 (BCU, BKF, PSU).

**MYRTACEAE**

**81. *Rhodamnia cinerea*** Jack var. ***cinerea***, Malay. Misc. 2(7): 48. 1822; Ridl., Fl. Malay Penins. 1: 716. 1922; Backer & Bakh.f., Fl. Java (Spermatoph.) 1: 334. 1965; Kochummen in Tree Fl. Malaya 3: 250. 1978; J. Parn. & Chantar. in Fl. Thailand 7(4): 806. 2002. **Plate 38F-H.**

Shrubby tree, up to 10 m high. **Bark** dark grey or brownish, narrowly fissured; branchlets terete, young parts densely covered with appressed silver-grey or greyish white hairs. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 5-10 mm long, sericeous or glabrescent; blade triveined, coriaceous, rigid, elliptic, oblong, obovate or sometimes ovate to lanceolate, 4-11 by 1.5-4 cm, upper surface green, glabrescent, lower surface densely covered with appressed silver-grey or greyish white hairs, apex acuminate, base cuneate, margin entire; midrib impressed above, prominent underneath, basal lateral veins conspicuous on lower surface, intramarginal vein near margin, distinct on lower surface. **Inflorescences** axillary, fascicled, 1-10-flowered; peduncle absent or sometimes present but very short; bracts and bracteoles oblong-lanceolate, appressed, ca. 1 mm long, sericeous. **Flowers** 4-merous (excluding androecium and gynoecium); pedicels 2-8 mm long, sericeous. **Hypanthium** greenish, campanulate or urceolate, ca. 2 by 1-1.5 mm, densely sericeous; calyx lobes ovate, 1-1.5 by ca. 1 mm, outer surface sericeous, apex obtuse. **Petals** creamy white, clawed, many gland dotted, obovate, 4-4.5 by 2-2.5 cm, sericeous outside, apex rounded. **Stamens** numerous; filaments 4-5 mm long; anthers elliptic-ovate, 0.5-0.6 mm long. **Ovary** inferior, unilocular, placentation parietal; ovules many; style filiform, 4-5 mm long; stigma punctiform, ca. 0.1 mm in diam. **Berry** globular, with persistent calyx, 6-8 mm in diam., reddish purple to almost black when ripe, sparsely sericeous or glabrescent. **Seeds** 3-5, irregularly shaped, 3-5 mm in diam., brown.

**Thailand.**— NORTH-EASTERN: Sakon Nakhon; PENINSULAR: Surat Thani, Phangnga, Krabi, Satun, Songkhla, Pattani, Yala.

**Distribution.**— Myanmar, Peninsular Malaysia, Sumatra, Java and Borneo.

**Ecology.**— On exposed quartzitic phyllite ridges, and also found on sandstone hills and in coastal heath forest, from near sea level to 700 m alt. Common. Flowering in June-December, fruiting in September-April.

**Vernacular.**— In Khao (อินเขา) (Surat Thani); Phae (แพะ) (Phangnga); Ya Waeng (ยะแวง) (Songkhla); Cha Aeng (ชะแอง) (Songkhla, Pattani); Ya Ai (ยาไอ) (Pattani); Khi Tai (ขี้ไต้) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 348 (BCU, BKF, PSU), 384 (BCU, BKF, PSU), 434 (BCU, KKU, PSU), 551 (PSU), 819 (BCU, BKF, PSU), 933 (BKF, PSU).

**82. *Syzygium gratum*** (Wight) S.N. Mitra var. ***gratum***, Indian Forester 99(2): 100. 1973; Chantar. & J. Parn., Kew Bull. 48(3): 599. 1993; Thai Forest Bull., Bot. 21: 71, pl. IV6. 1994; J. Parn. & Chantar. in Fl. Thailand 7(4): 863. 2002.— *Eugenia grata* Wight, Ill. Ind. Bot. 2: 15. 1841; Duthie in Fl. Brit. India (J.D. Hooker) 2: 486. 1878; Ridl., Fl. Malay Penins. 1: 739. 1922; Corner, Wayside Trees Mal. 1: 498. 1940. **Plate 39A-D.**

Shrubby tree or tree, up to 15 m high. **Bark** reddish or orange brown, thin, papyraceous, flaky; branchlets terete, shallowly fissured, pale brown. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 2-7 mm long; blade coriaceous, rigid, lanceolate to ovate or sometimes elliptic, 2.5-10 by 0.8-2 cm, upper surface usually green and shining, lower surface paler, apex acuminate, sometimes acute or obtuse, base cuneate, obtuse or rounded, margin entire; midrib impressed above, prominent underneath, secondary veins 7-15 pairs, intramarginal veins 2, the inner ones 0.5-2.5 mm from margin, veins and reticulation inconspicuous to moderately

conspicuous. **Inflorescences** axillary and terminal, paniculate, many-flowered, usually erect, 2-6 cm long; peduncle and rachis quadrangular, sometimes slightly winged, peduncle 2-9 mm long; bracts and bracteoles caducous, bracts broadly triangular, 1-1.5 by 2-3 mm, bracteoles oblong, 2-2.5 by 0.8-1.2 mm long. **Flowers** 5-merous (excluding androecium and gynoecium), sessile. **Hypanthium** greenish or cream, funnel-shaped or slightly cylindrical, 4-5 by ca. 2 mm, longitudinally wrinkled and glaucous when dry, sometimes slightly pustulate; pseudostipe 0.5-2 mm long; calyx lobes rounded, 0.5-0.8 by 1.3-1.5 mm. **Petals** creamy white, many gland dotted, suborbicular, 1.5-2 by 1.5-2 mm, apex rounded. **Stamens** numerous; filaments 2-10 mm long; anthers ovate-cordate, 0.25-0.3 by 0.25-0.3 mm. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, 6-9 mm long; stigma truncate, ca. 0.1 mm in diam. **Berry** subglobular, with persistent calyx, 6-8 mm in diam., white when ripe. **Seeds** not seen.

**Thailand.**— NORTHERN: Chiang Mai, Lamphun, Nan, Phitsanulok, Kamphaeng Phet; NORTH-EASTERN: Loei, Udon Thani, Sakon Nakhon, Nakhon Phanom; EASTERN: Chaiyaphum, Surin, Roi Et, Si Sa Ket, Ubon Ratchathani; SOUTH-EASTERN: Prachin Buri, Chon Buri, Rayong, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— India, Myanmar, throughout the Malesian region.

**Ecology.**— On rocky or sandy heath soils, sometimes growing on rock crevices, locally abundant in open vegetation on quartzitic phyllite ridges, and also found on sandstone hills and in coastal heath forest, from sea level to 1,000 m alt. Common. Flowering in January-May, more flowers in April-May, fruiting in April-August. The flowers of this species were visited by numerous groups of insects, such as hymenopterans (honey bees), coleopterans (long-horned beetles), etc.

**Vernacular.**— Krai Met (ไคร้เม็ด) (Chiang Mai); Samet Chun (เสม็ดชุน) (Central); Samet (เสม็ด) (Sakon Nakhon, Satun); Mak (เม็ก) (Prachin Buri); Samet

Daeng (เสม็ดแดง), Samet Khao (เสม็ดเขา) (Trat); Met Chun (เม็ดยุน) (Nakhon Si Thammarat, Peninsular); Yi Mue Lae (ยี่มื่อแล) (Malay-Peninsular).

**Remarks.**— According to Parnell and Chantaranothai (2002), *Syzygium gratum* (Wight) S.N. Mitra is distinguished from *Syzygium zeylanicum* (L.) DC. by its non pustulate wrinkled hypanthial cup, but in the present study found that the plant collected having slightly pustulate hypanthium as well as non pustulate wrinkled hypanthium. Hence, it is noticed that *S. gratum* (Wight) S.N. Mitra might be conspecific with *S. zeylanicum* (L.) DC.

**Specimens examined.**— BETONG: *J. Wai* 544 (BCU, BKF, PSU), 603 (PSU), 679 (BKF, PSU), 707 (BKF, PSU), 726 (BCU, BKF, KKU, PSU); CHIANG MAI: *T. Santisuk* 972 (PSU); SURAT THANI: *Ch. Laongpol* 847 (PSU); SONGKHLA: *Hamilton & Congdon* 445 (PSU), *K. Sridith* 301 (PSU).

**83. *Syzygium helferi*** (Duthie) Chantar. & J. Parn., Kew Bull. 48(3): 599. 1993; Chantar. & J. Parn., Thai Forest Bull., Bot. 21: 73. 1994; J. Parn. & Chantar. in Fl. Thailand 7(4): 863. 2002.— *Eugenia helferi* Duthie in Fl. Brit. India (J.D. Hooker) 2: 480. 1878; Ridl., Fl. Malay Penins. 1: 735. 1922; Kochummen in Tree Fl. Malaya 3: 196. 1978. **Plate 39E.**

Shrubby tree or tree, up to 10 m high. **Bark** greyish brown or brown; branchlets terete, shallowly fissured, brown. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 5-10 mm long; blade coriaceous, elliptic to elliptic-oblong, 3.5-8 by 2-3.5 cm, upper surface green, lower surface paler, apex bluntly acuminate, sometimes acute or obtuse, base cuneate or attenuate, margin entire or slightly undulate; midrib flattened or impressed above, prominent underneath, secondary veins 15-25 pairs, intramarginal vein 1, 1-1.5 mm from margin, veins and reticulation usually inconspicuous. **Inflorescences** usually terminal, paniculate, many-flowered, usually erect, 4-5 cm long; peduncle terete, 5-8 mm long, rachis and branchlets terete, bark rough, flaky, reddish brown. **Flowers** 4-merous (excluding androecium and gynoecium), the central flower sessile, the outer flowers with a pedicel 1.5-2 mm long.

**Hypanthium** greenish white, funnel-shaped, 5.5-6.5 by 4.5-5 mm, rugose when dry; pseudostipe 1-2 mm long; calyx lobes rounded, 1-1.5 by 2-3.5 mm. **Petals** creamy white, numerous gland dotted, suborbicular, 4-4.5 by 4.5-5 mm, apex rounded. **Stamens** numerous; filaments 4-12 mm long; anthers oblong, elliptic or ovate, 0.5-0.6 by 0.3-0.4 mm. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, 10-12 mm long; stigma punctiform, ca. 0.15 mm in diam. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Chiang Mai; EASTERN: Chaiyaphum; SOUTH-EASTERN: Chon Buri, Trat; PENINSULAR: Chumphon, Surat Thani, Phangnga, Trang, Songkhla, Yala.

**Distribution.**— Myanmar and Peninsular Malaysia.

**Ecology.**— On quartzitic phyllite ridges, and also found in secondary and lowland evergreen forests, from sea level to 700 m alt. Uncommon. Flowering in April-June.

**Vernacular.**— Daeng Hin (แดงหิน) (Surat Thani).

**Specimens examined.**— BETONG: *J. Wai* 760 (KKU, PSU); CHIANG MAI: *B. Ninanong & S. Phusomsaeng* 1720 (PSU); SONGKHLA: *Hamilton & Congdon* 379 (PSU), *J.F. Maxwell* 85-438 (PSU), 85-751 (PSU).

**84. *Syzygium samarangense*** (Blume) Merr. & L.M. Perry var. ***parviflorum*** (Craib) Chantar. & J. Parn., Kew Bull. 48(3): 609. 1993; Thai Forest Bull., Bot. 21: 107. 1994; J. Parn. & Chantar. in Fl. Thailand 7(4): 896. 2002.— *Eugenia javanica* Lam. var. *parviflora* Craib, Fl. Siam. 1: 647. 1931. **Plate 39F.**

Shrubby tree or tree, up to 10 m high. **Bark** greyish brown; branchlets terete, smooth or sometimes flaky, greyish brown. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 10-14 mm long; blade chartaceous to subcoriaceous, oblong

or elliptic-oblong, 12.7-19 by 4.3-9 cm, upper surface dark green, lower surface paler, apex caudate or acuminate, base cuneate or obtuse, margin entire or slightly undulate; midrib flattened or impressed above, prominent underneath, secondary veins 10-20 pairs, intramarginal veins 2, the inner ones 2-10 mm from margin, veins and reticulation shallowly grooved and inconspicuous above, prominent underneath. **Inflorescences** axillary and terminal, racemose, 3-flowered, 4-5 cm long; peduncle terete, 6-7 mm long. **Flowers** 4-merous (excluding androecium and gynoecium); pedicels 2.5-6 mm long. **Hypanthium** greenish white or creamy, funnel-shaped, 12-14 by 13-15 mm, rugose when dry; pseudostipe ca. 1 mm long; calyx lobes semi-orbicular, 3.5-6 by 8-11 mm, apex rounded. **Petals** creamy white, numerous gland dotted, suborbicular, broadly clawed, 10-13.5 by 10-13.5 mm, apex rounded or obtuse. **Stamens** numerous; filaments 0.7-2.5 cm long; anthers oblong or elliptic, 6-13 by 4-7 mm. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, 1.5-2.8 cm long; stigma punctiform, ca. 0.2 mm in diam. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala.

**Distribution.**— Peninsular Malaysia (?).

**Ecology.**— Occasional in shady places along the streams in the foothills of the quartzitic phyllite ridges, alt. 550-600 m. Rare. Flowering in January-February.

**Vernacular.**— Kaem Maem Dok Lek (แก้มหม่อมดอกเล็ก) (Peninsular).

**Specimen examined.**— BETONG: *J. Wai* 971 (BKF, KKU, PSU).

**85. *Syzygium syzygioides*** (Miq.) Merr. & L.M. Perry, *J. Arnold Arbor.* 19: 109. 1938; Backer & Bakh.f., *Fl. Java* (Spermatoph.) 1: 341. 1965; Kochummen in *Tree Fl. Malaya* 3: 219. 1978; Chantar. & J. Parn., *Thai Forest Bull., Bot.* 21: 111. 1994; J. Parn. & Chantar. in *Fl. Thailand* 7(4): 901. 2002.— *Jambosa syzygioides* Miq., *Fl. Ned. Ind.* 1: 431. 1855. **Plate 40A-B.**



Shrubby tree or tree, up to 15 m high. **Bark** brown to reddish brown, usually with whitish grey blotches; branchlets terete, reddish brown. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 1-5 mm long; blade thinly coriaceous, elliptic to oblong, 3.5-8 by 1.5-3.5 cm, upper surface usually green and shining, reddish when young, lower surface paler, apex caudate or acuminate, base cuneate, margin entire; midrib impressed above, prominent underneath, secondary veins numerous, intramarginal vein 1, 0.5-1 mm from margin, veins and reticulation usually inconspicuous above, moderately conspicuous underneath. **Inflorescences** both axillary and terminal, paniculate, many-flowered, usually drooping, 1.5-5.5 cm long; peduncle terete, 2-15 mm long; bracts and bracteoles persistent, triangular, minute. **Flowers** 4-merous (excluding androecium and gynoecium), sessile. **Hypanthium** greenish, funnel-shaped, 3-4 by 2-2.5 mm, rugose when dry; pseudostipe 1-2 mm long; calyx lobes triangular, 0.25-0.5 by 1-1.5 mm. **Petals** creamy white, few to many gland dotted, suborbicular, ca. 1.5 by 1.5-2 mm, apex rounded. **Stamens** numerous; filaments 2-5 mm long; anthers ovate-cordate, 0.25-0.3 by 0.25-0.3 mm. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, ca. 5 mm long; stigma punctiform, ca. 0.05 mm in diam. **Berry** subglobular, with persistent calyx, dark red to purplish black when ripe. **Seeds** not seen.

**Thailand.**— NORTH-EASTERN: Nong Khai; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Phetchaburi, Prachuap Khiri Khan; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— India, Myanmar, Indochina and throughout the Malesian region.

**Ecology.**— On rocky or sandy heath soils, sometimes growing on rock crevices, in semi-exposed quartzitic phyllite ridges, and also found in sandstone hills and coastal heath forest, from near sea level to 700 m alt. Common. Flowering in January-February.

**Vernacular.**— Wa San (หัวขี้), Wa Hak Yong (หัวฮากยong) (Nong Khai) ; Wa Som (หัวส้ม) (Chon Buri); Deang Khi Nok (แดงขึ้นก), Deang Dong (แดงดง) (Prachuap Khiri Khan); Deang Khlong (แดงคลอง) (Chumphon); Met Chun (เหม็ดชุน) (Nakhon Si Thammarat).

**Specimens examined.**— BETONG: *J. Wai* 471 (KKU, PSU), 546 (BCU, BKF, KKU, PSU), 566 (BKF, KKU, PSU), 573 (PSU); RANONG: *T. Santisuk* 830 (PSU); SATUN: *G. Congdon* 995 (PSU); SONGKHLA: *J.F. Maxwell* 85-22 (PSU), 85-123 (PSU), 85-234 (PSU), 86-26 (PSU), 86-181 (PSU).

#### 86. *Syzygium* sp. 1

*Plate 40C-E.*

Shrubby tree up to 6 m high. **Bark** purplish or reddish brown, usually with whitish grey blotches; branchlets terete, smooth or shallowly fissured, pale brown, dark purplish or reddish brown, sometimes dark grey. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 3-7 mm long; blade coriaceous, elliptic to elliptic-oblong, 5.5-11.5 by 2-5 cm, upper surface shining, green to dark green, lower surface paler, apex acuminate, caudate or sometimes acute, base cuneate or obtuse, margin entire or slightly undulate; midrib flattened or impressed above, prominent underneath, secondary veins 15-30 pairs, intramarginal veins 1, 0.5-2 mm from margin, veins and reticulation inconspicuous to moderately conspicuous. **Inflorescences** axillary and terminal, simple or compound cymes, 3-11-flowered, 3-4.5 cm long; peduncle terete, 2-10 mm long; bracts and bracteoles subpersistent, triangular, ca. 1 mm long. **Flowers** 4-merous (excluding androecium and gynoecium), sessile or subsessile; pedicels 0-1 mm long. **Hypanthium** greenish, funnel-shaped, 5-7 by 4.5-5 mm, rugose when dry; pseudostipe 0.5-1.5 mm long; calyx lobes semi-orbicular, 2-3 by 4-5 mm, apex rounded. **Petals** creamy white, many gland dotted, suborbicular, 7.5-9 by 6-9 mm, apex rounded. **Stamens** numerous; filaments 0.8-2.2 cm long; anthers subquadrangular or oblong in outline, 0.4-0.9 by 0.4-0.6 mm, pinkish or dull reddish-purple. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, 1.5-2 cm long; stigma punctiform, 0.15-0.2 mm in diam. **Berry** subglobular, with persistent calyx, 10-12 mm in diam. **Seeds** 2, hemispherical, 6-8 mm in diam., 4-5 mm thick.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Known only from this study.

**Ecology.**— On quartzitic phyllite ridge at 600-700 m alt. Uncommon. Flowering in February-March, fruiting in April-June. Floral visitors were mainly carpenter bees (*Xylocopa* sp.).

**Vernacular.**—

**Remarks.**— The plant materials in this study do not fit the descriptions of any *Syzygium* species in Flora of Thailand, this unidentified species might be a new species or a new record for Thailand.

**Specimens examined.**— BETONG: *J. Wai* 572 (BCU, BKF, KKU, PSU), 615 (BKF, KKU, PSU), 675 (BKF, KKU, PSU), 772 (PSU).

## 87. *Syzygium* sp. 2

*Plate 40F.*

Shrubby tree 4-6 m high. **Bark** dark grey or greyish brown, usually with whitish grey blotches; branchlets terete, shallowly fissured, flaky, dark greyish or reddish brown. **Leaves** simple, opposite, glabrous; petiole slightly adaxially winged, 5-12 mm long; blade coriaceous, elliptic to elliptic-oblong, 5.5-13 by 2.5-5 cm, upper surface green, lower surface paler, with scattered small black dots, apex acuminate or caudate, base cuneate, margin entire or slightly undulate; midrib impressed above, prominent underneath, secondary veins 30-45 pairs, intramarginal veins 1, 0.5-1.5 mm from margin, veins and reticulation inconspicuous to moderately conspicuous. **Inflorescences** both axillary and terminal, paniculate, few- to many-flowered, usually erect, 2.5-3.5 cm long; peduncle and rachis quadrangular, peduncle 2-11 mm long, rugose and sometimes epidermis flaking off when dry; bracts and bracteoles caducous, triangular, ca. 0.5 mm long. **Flowers** 4-merous (excluding androecium and gynoecium), sessile or subsessile; pedicels 0-1 mm long. **Hypanthium** greenish tinged

with reddish purple, funnel-shaped, flattened, longitudinally ridged, 7-8 by 4-5 mm; pseudostipe absent or very short; calyx subtriangular, 1-1.5 by 3-4 mm, apex rounded or obtuse. **Petals** pink or reddish purple, many gland dotted, suborbicular, 4-5 by 4-5 mm, apex rounded. **Stamens** numerous; filaments 2-8 mm long; anthers subquadrangular or suborbicular in outline, 0.4-0.6 mm in diam. **Ovary** inferior, 2-locular, placentation axile; ovules many per locule; style filiform, 7-9 mm long; stigma punctiform, ca. 0.1 mm in diam. **Berry** ellipsoid-oblong or subglobular, with persistent calyx, 1.4-1.8 by 1.2-1.5 mm in diam. **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Known only from this study.

**Ecology.**— In open vegetation on granitic ridge, alt. 900-1,000 m. Uncommon. Flowering in March-May, fruiting May-August. Floral visitors were mainly spiny ants (*Polyrhachis armata* Le Guillou, 1842).

**Vernacular.**—

**Remarks.**— This unidentified collections may represent a new species or a new record for Thailand.

**Specimen examined.**— BETONG: *J. Wai* 644 (BKF, KKU, PSU).

## RUBIACEAE

**88. *Argostemma pictum*** Wall. in Fl. Ind. (Carey & Wallich ed.) 2: 327. 1824; Hook.f., Fl. Brit. India 3: 43. 1880; Ridl., Fl. Malay Penins. 2: 24. 1923; M.R. Hend., Malay. Wild Fls., Dicots.: 198, fig. 175. 1959; Sridith, Thai Forest Bull., Bot. 27: 116. 1999. **Plate 41A-C.**

Small unbranched or rarely branched herb, occasionally with succulent tuberous rhizome. **Stems** erect or sometimes prostrate, 1.5-10 cm long, sparsely to moderately minutely hairy. **Stipules** interpetiolar, broadly triangular-ovate, 0.3-0.5 by 0.5-0.8 mm, irregularly toothed, sparsely minutely hairy. **Leaves** simple, opposite decussate, usually only 1 well developed leaf pair per plant, isophyllous or subisophyllous, sessile; blade herbaceous, membranous when dry, broadly ovate or suborbicular, 1.5-5.5 by 1.7-5.2 cm (well developed leaves), upper surface light green to dark green, without white streaks along midrib and veins (in the study area), lower surface paler, sparsely minutely to moderately hairy on both surfaces, apex obtuse or rounded, base subcordate, truncate or rounded; midrib prominent beneath; secondary veins 3-5 pairs. **Inflorescences** terminal, erect, scorpioid cymes or subumbelliform cymes, 5-15-flowered, 3.5-8.5 cm long; peduncle 2.5-7 cm long, glabrous or sparsely hairy; bracts persistent, free or fused, ovate, oblong-lanceolate to lanceolate, linear-oblong to oblong or elliptic, 1.5-4 by 0.5-2 mm, covered with short and thick hairs outside, apex acute. **Flowers** 5-merous (excluding gynoecium), actinomorphic; pedicels 6-9 mm long, glabrous or sparsely hairy. **Calyx** persistent, campanulate, greenish, covered with short and thick hairs outside; lobes ovate or elliptic-ovate, 0.8-1.5 by 0.6-1 mm, apex acute or subacute. **Corolla** star-shaped, white, covered with short and thick hairs outside, papillose inside; tubes 0.5-1 mm long; lobes lanceolate, recurved, 4-5 by 1.2-2 mm, apex acute. **Stamens** 5, inserted at the base of corolla tube, alternate with corolla lobes; filaments 1-1.5 mm long, glabrous; anthers connivent, forming a cone-like structure, basifixed, opening by longitudinal slits, oblong, 2-3 by 0.5-0.7 mm, yellowish green or yellow. **Ovary** inferior, 1.5-2 mm long, covered with short and thick hairs, 2-locular, placentation axile; ovules numerous per locule; style exerted from the anther cone, filiform, 4-5.5 mm long, glabrous; stigma capitate, 0.25-0.3 mm in diam. **Capsule** crowned by the persistent calyx, erect, opening by an apical operculum, campanulate, ca. 3 by 3 mm, covered with short and thick hairs. **Seeds** numerous, flattened, mostly subtriangular, 0.3-0.5 mm in diam.

**Thailand.**— PENINSULAR: Ranong, Phangnga, Phuket, Phatthalung, Trang, Songkhla, Yala.

**Distribution.**— Myanmar and Peninsular Malaysia.

**Ecology.**— On moist cliffs or mossy rocks or growing on wet rocky or heat soils, usually found in shady areas of mountain ridges, and also found on wet sandy soils along the stream banks in lowland evergreen forest and in rubber plantation, alt. 100-1,000 m. Uncommon. Flowering and fruiting in June-December.

**Vernacular.**— Pradap Hin Kap Hoi (ประดับหินกาบหอย) (General).

**Specimens examined.**— BETONG: *J. Wai* 791 (PSU), 803 (PSU), 825 (PSU), 844 (BCU, BKF, PSU); TRANG: *Saithip* 17 (PSU); PHATTHALUNG: *U. Billee* 3 (PSU); SATUN: *Niyom* 11 (PSU), *S. Sonmee* 3 (PSU); SONGKHLA: *J.F. Maxwell* 84-65 (PSU), *Saithip* 4 (PSU).

**89. *Tarenna longifolia*** (G. Don) Ridl., Fl. Malay Penins. 2: 104. 1923; Corner, Wayside Trees Mal. 1: 561. 1940; K.M. Wong in Tree Fl. Malaya. 4: 409. 1989.— *Ixora longifolia* G. Don, Gen. Hist. 3: 573. 1834. — *Webera longifolia* (G. Don) Hook.f., Fl. Brit. India 3: 105. 1880. **Plate 41D.**

Shrub up to 2.5 m high; branches and branchlets terete, greyish, young branchlets hairy. **Stipules** interpetiolar, triangular, 4-10 by 2.5-4 mm, hairy, apex acute. **Leaves** simple, opposite decussate; petiole 0.5-1.5 mm long, hairy; blade chartaceous, elliptic-oblong or oblanceolate, 8.5-26.5 by 2-9 cm, upper surface green to dark green, glabrous, lower surface paler, hairy, apex acuminate to caudate, base cuneate; midrib flattened above, prominent underneath; secondary veins 7-13 pairs, raised underneath. **Inflorescences** terminal, pendulous, corymbose-paniculate cymes, many-flowered, 8-18 cm long; peduncle 2-5.5 cm long, hairy; axis 3-11 cm long, hairy; bract and bracteoles persistent, linear-triangular or linear-lanceolate, hairy outside, apex acute, bracts up to 8 by 1.5 mm, bracteoles on pedicels, 1-3 per flower, 0.5-1.5 by 0.2-0.4 mm. **Flowers** 5-merous (excluding gynoeceium); pedicels 2-6 mm long, hairy. **Calyx** persistent, campanulate or urceolate, greenish, hairy; lobes triangular, ca. 0.5 by 0.25-0.5 mm, apex acute or subacute. **Corolla** salverform, white;

tubes 7-11 mm long, hairy outside, inside glabrous; lobes oblong to oblanceolate, twisted, 7-8 by 2-2.5 mm, sparsely hairy outside, glabrous inside, apex rounded, slightly retuse or obtuse. **Stamens** 5, inserted at corolla throat, alternate with the corolla lobes; filaments 1-2 mm long, glabrous; anthers opening by longitudinal slits, linear, 5-7 by 0.5-1 mm, white. **Disk** annular, ca. 0.3 mm high. **Ovary** inferior, ca. 1.5 mm long, hairy, 2-locular, placentation axile, with a single ovule per locule; style filiform, 1-1.3 cm long, hairy; stylar head exerted from corolla tube, cylindrical, 7-9 mm long, stigmas 2, fused almost of the length. **Fruit** berry-like, crowned by the persistent calyx, globular, 5-8 mm in diam., sparsely to moderately hairy. **Seeds** 1-2, globular or semi-globular, ca. 5 mm in diam., smooth.

**Thailand.**— PENINSULAR: Phangnga, Trang, Songkhla, Yala.

**Distribution.**— India, Myanmar, Peninsular Malaysia, Singapore and Borneo.

**Ecology.**— In shady areas in the foothills or near the summit of mountain ridges at 600-950 m alt. Uncommon. Flowering in March-June, fruiting in May-August.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 241 (BKF, KKU, PSU), 765 (BCU, BKF, PSU).

## SYMPLOCACEAE

**90. *Symplocos adenophylla*** Wall. ex G. Don, Gen. Hist. 4: 3. 1837; C.B. Clarke in Fl. Brit. India (J.D. Hooker) 3: 575. 1882; Ridl., Fl. Malay Penins. 1: 303. 1923; Noot., Fl. Males., Ser. 1, Spermat. 8(2): 239. 1977; in Fl. Thailand 2(4): 452. 1981; Kochummen in Tree Fl. Malaya 3: 268. 1978; R.F. Wu & Noot. in Fl. China 15: 245. 1996. **Plate 41E-F.**

Shrub or shrubby tree, 4-6 m high. **Bark** dark grey, smooth; branchlets terete, blackish or dark grey, glabrescent; young parts hairy. **Leaves** simple, spirally arranged, glabrescent; petiole subterete, slightly adaxially grooved, 5-10 mm long; blade chartaceous to coriaceous, elliptic to oblong or oblanceolate, 5-12.5 by 1.5-4 cm, upper surface yellowish green to dark green above, paler underneath, apex caudate, base cuneate to attenuate, margin toothed, slightly recurved, with many pellucid glands; midrib impressed above, prominent underneath, secondary veins 4-8 pairs, conspicuously raised underneath. **Inflorescences** axillary or subterminal spikes, racemes or panicles, many-flowered, up to 3 cm long, axis hairy; bracts and bracteoles persistent, triangular-ovate, 0.5-1.2 by 0.5-1 mm, hairy, margin with conspicuous glands. **Flowers** fragrant, 5-merous (excluding androecium and gynoecium), 5-7 mm in diam., sessile or subsessile; pedicels up to 1.5 mm long, hairy. **Calyx** greenish brown, with very short tube; lobes imbricate, persistent, triangular-ovate, 0.8-1 by 0.8-1 mm, outer surface hairy, apex obtuse or rounded. **Corolla** white; lobes nearly free to the base, ovate, 2.5-3 by 1.5-2 mm, glabrous, apex rounded. **Stamens** numerous, adnate to the base of corolla tube, glabrous; filaments 1-4 mm long; anthers subglobular, 0.3-0.4 mm in diam. **Disk** annular, fleshy, 0.3-0.4 mm high, yellowish orange, glabrous. **Ovary** inferior, ca. 1 mm long, outer surface hairy, 3-locular, placentation axile; ovules 2-4 per locule; style 3-4 mm long, glabrous; stigma capitate, truncate, 0.6-0.7 mm in diam. **Drupe** crowned by the persistent calyx, ellipsoid to cylindrical-oblong, 6-8 by 3-4 mm, glabrescent; mesocarp thin; stone slightly grooved, reddish or dark brown. **Seed** 1.

**Thailand.**— PENINSULAR: Ranong, Phangnga, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— China, Indochina and throughout the Malesian region.

**Ecology.**— On exposed granitic ridges or found in shady areas in the foothills of quartzitic phyllite ridges and also found in coastal heath, from sea level to 1,000 m alt. Common. Flowering in October-January, fruiting in January-March.



**Vernacular.**— Mueat Bai Tom (เหมือดใบต้อม) (Peninsular); Lot (โลด), Khanom Phru (ขนมพรุ) (Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 433 (BCU, BKF, PSU), 457 (BCU, BKF, PSU), 498 (BCU, BKF, PSU), 550 (BCU, BKF, PSU), 585 (BCU, BKF, PSU); SONGKHLA: *J.F. Maxwell* 85-526 (PSU).

## THEACEAE

**91. *Anneslea fragrans*** Wall., Pl. Asiat. Rar. 1: 5. pl. 5. 1829; Dyer in Fl. Brit. India (J.D. Hooker) 1: 280. 1874; Fl. Brit. India, Fl. Siam. 1: 123. 1925; H. Keng in Fl. Thailand 2(2): 157. 1972; in Tree Fl. Malaya 3: 280, fig. 2. 1978; T.L. Ming & B.M. Barthol. in Fl. China 12: 435. 2007.— *A. crassipes* Hook. ex Choisy in Mém. Soc. Phys. Genève 14: 121. 1855; Dyer in Fl. Brit. India (J.D. Hooker) 1: 280. 1874; Ridl., Fl. Malay Penins. 1: 193. 1922. **Plate 42A-F.**

Shrub or shrubby tree, up to 15 m high. **Bark** reddish or purplish brown, smooth, shallowly fissured or cracked; branchlets terete, reddish or purplish brown, glabrous; terminal buds ovate, glabrous. **Leaves** spirally arranged, often clustered at terminal of branches, coriaceous, glabrous; petiole terete or subterete, 1-2.7 cm long; blade oblong, ovate to lanceolate or elliptic, 5.5-13 by 2-5.5 cm, upper surface yellowish green to dark green, lower surface paler, apex bluntly acute to short acuminate, base cuneate to attenuate, margin cartilaginous and very shallowly toothed; midrib flattened or slightly grooved on upper surface, raised on lower surface, secondary veins 6-10 pairs, usually inconspicuous. **Inflorescences** terminal or subterminal, umbel-like, 2-15-flowered; bracteoles 2, opposite, appressed, broadly ovate, 1.5-4 by 2-4 mm, glabrous, apex obtuse to almost rounded, margin glandular toothed. **Flowers** fragrant, 5-merous (excluding androecium and gynoecium); pedicels 2.5-4 cm long, glabrous. **Sepals** imbricate, basally slightly connate, spreading, creamy white to pinkish or sometimes greenish white; outer sepals 2, ovate to suborbicular, 7-10 by 7-8.5 mm, glabrous, apex obtuse to rounded, margin glandular toothed; inner sepals 3, ovate, 10-13 by 8-10 mm, glabrous, apex acute, margin glabrous to sparsely

glandular toothed. **Petals** basally connate, ovate-lanceolate to oblong-lanceolate, constricted at the middle, 14-20 by 5-7 mm, creamy white, glabrous, apex acute, margin subentire or irregularly and shallowly toothed. **Stamens** numerous, glabrous; filaments basally connate, 3-5.5 mm long; anthers basifixed, linear-lanceolate, 6-8.5 mm long, connective exerted, apex acuminate. **Ovary** almost completely inferior, 4-5 mm long, glabrous, 2-3-locular, placentation axile; ovules 1-4 per locule; style filiform, 1.3-1.7 cm long, apically 2-3-lobed. **Fruit** baccate, campanulate, 1.2-2.1 by 1-1.8 cm, with persistent enlarged sepals, green, lenticellate. **Seeds** 2-3, oblong, slightly flattened, 8-9 by 4-5.5 mm, each seed enclosed in a red fleshy aril.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Phitsanulok; NORTH-EASTERN: Loei, Phetchabun, Sakon Nakhon; EASTERN: Chaiyaphum, Nakhon Ratchasima, Buri Rum, Surin; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Prachin Buri; PENINSULAR: Yala.

**Distribution.**— South China, Indochina, Myanmar and Peninsular Malaysia.

**Ecology.**— On exposed quartzitic phyllite ridges, alt. 600-700 m. Locally common. Flowering in September-January, fruiting in January-May. The flowers of this species were visited by coleopterans (beetles).

**Vernacular.**— Tam Chueng (ตำจัง), Ha Hoi (หาฮอย) (Khmer-Surin); Thue Klo (ทีกลอ), Thue La (ทีลา) (Karen-Mae Hong Son); Pan Ma (ปันม้า), San Daeng (सानแดง), San Daeng Yai (सानแดงใหญ่), Saraphi (สารภี), Saraphi Khwai (สารภีควาย), Saraphi Doi (สารภีดอย), Saraphi Mu (สารภีหมู), Sun (สุน), Huk (ฮัก) (Chiang Mai); Kham So (คำโซ่), Tong Nang (ตองหนัง), Tin Cham (ตินจ๋ำ), Tham Sung (ท่าซุง), Ban Ma (บานมา), Phraram (พระราม), Mong Nang (โมงนัง) (Northeastern); Saraphi Pa (สารภีป่า) (Central); Kaem On (แก้มอัน) (Chumphon).

**Specimens examined.**— BETONG: *J. Wai* 192 (BCU, BK, BKF, KKU, PSU, QBG), 330 (PSU), 522 (PSU), 924 (BCU, BK, BKF, KKU, PSU, QBG); BURI RAM: *C. Phengklai et al.* 3489 (PSU); SURIN: *C. Phengklai et al.* 3625 (PSU).

**92. *Schima wallichii*** (DC.) Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot.: 143. 1842; Dyer in Fl. Brit. India (J.D. Hooker) 1: 289. 1874; Craib, Fl. Siam. 1: 130. 1925; Corner, Wayside Trees Mal. 1-2: 630, figs. 238-239, pl. 187. 1940; Backer & Bakh.f., Fl. Java (Spermatoph.) 1: 321. 1963; H. Keng in Fl. Thailand 2(2): 144. 1972; in Tree Fl. Malaya 3: 291, fig. 7. 1978; B.C. Stone, Fed. Mus. J. 26(1): 148. 1981; T.L. Ming & B.M. Barthol. in Fl. China 12: 422. 2007.— *Gordonia wallichii* DC., Prodr. 1: 528. 1824.— *Schima noronhae* Reinw. ex Blume, Bijdr. Fl. Ned. Ind.: 130. 1825; Ridl., Fl. Malay Penins. 1: 201. 1922; Craib, Fl. Siam. 1: 130. 1925; Corner, Wayside Trees Mal. 1-2: 630, figs. 238-239, pl. 187. 1940.— *S. crenata* Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot.: 143. 1840; Dyer in Fl. Brit. India (J.D. Hooker) 1: 289. 1874; Craib, Fl. Siam. 1: 129. 1925.— *S. brevipes* Craib, Bull. Misc. Inform., Kew 1915: 423. 1915; Fl. Siam. 1: 129. 1925. **Plate 42G.**

Tree up to 20 m high. **Bark** dark grey, cracked; branchlets terete, lenticellate, greyish brown, young part hairy; terminal buds ovate or lanceolate, densely sericeous. **Leaves** spirally arranged, subcoriaceous; petiole slightly winged, 1-2.2 cm long, sparsely hairy or glabrescent; blade elliptic to elliptic-oblong, obovate or sometimes lanceolate, 5-15 by 2-5 cm, upper surface shining, light to dark green, glabrous, lower surface paler, sparsely minutely hairy, apex usually acuminate, sometimes acute or obtuse, base cuneate to attenuate, margin shallowly crenate-serrate to subentire; midrib flattened or slightly grooved above, prominent underneath, secondary veins 8-12 pairs, veins and reticulation visible. **Flowers** solitary, axillary, fragrant, 5-merous (excluding androecium), 3-3.5 cm in diam.; pedicels 1-4.5 cm long, sparsely hairy or glabrescent; bracteoles 2, caducous. **Sepals** persistent, imbricate, basally slightly connate, lunate to semi-orbicular, 1.5-2 by 2.5-3 mm, green, inner surface densely hairy, outer surface usually sparsely hairy or glabrescent, apex broadly rounded, margin ciliate. **Petals** imbricate, basally connate, obovate or suborbicular, 13-19 by 10-17 mm, white, inner surface glabrous, outer surface basally hairy, apex rounded; outermost petal strongly concave, margin ciliate; inner petals slightly to moderately concave, margin glabrous. **Stamens** numerous, glabrous; filaments basally connate with petals, 5-10 mm long; anthers versatile, subquadrangular or suborbicular, 1-1.5 mm in diam. **Ovary** superior, subglobular, 2.5-3 mm long, densely hairy, 5-locular, placentation axile; ovules ca. 3 per locule; style stout, 5-6 mm long, glabrous; stigma

capitate, 5-lobed. **Capsule** septicidally dehiscent, subglobular, 1-1.5 cm in diam.; columella persistent, stout, extending for  $\frac{1}{2}$  to  $\frac{2}{3}$  of locule length; pericarp woody, splitting for  $\frac{2}{3}$  length into 5 valves, outer surface appressed hairy or glabrescent. **Seeds** not seen.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Nan, Phitsanulok; NORTH-EASTERN: Loei, Nakhon Phanom, Nong Khai, Phetchabun; EASTERN: Nakhon Ratchasima, Roi Et, Si Sa Ket, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi, Nakhon Pathom; SOUTH-EASTERN: Trat; PENINSULAR: Ranong, Surat Thani, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— India, Nepal, China, Indochina, Myanmar, Peninsular Malaysia, Sumatra, Java, Borneo, Philippines and Papua New Guinea.

**Ecology.**— On exposed mountain ridges, and also found in secondary vegetation, coastal heath, lowland evergreen and montane forests, from sea level to 1,000 m alt. Locally common. Flowering and fruiting almost all year round, more flowers in March-April and September-October.

**Vernacular.**— Khai (ค้าย), Thalo (ทะโล้), Saraphi Pa (สารภีป่า) (Northern); Khai So (ค้ายโซ่), Champa Dong (จำปาดง), Phra Ram (พระราม) (Loei, Nong Khai); Tue Sue Sa (ตื้อซื่อชะ) (Karen-Chiang Mai); Mu Phi (หมูผี) (Shan-Chiang Mai); Kaso (กาโซ) (Nakhon Phanom); Bunnak (บุนนาค) (Nakhon Ratchasima, Trat); Kanchok (กรรโชก) (Eastern); Phangtan (พังตาน), Phantan (พันตัน), Mangtan (มั่งตาน) (Peninsular); Mue Dae Ka Ta (มือแตกาตะ) (Malay-Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 201 (BCU, BK, BKF, KKU, PSU, QBG), 331 (BCU, BKF, PSU), 611 (PSU); CHIANG MAI: *B. Nimanong & S. Phusomsaeng* 1710 (PSU); RANONG: *T. Santisuk* 1248 (PSU); SATUN: *G. Congdon* 984 (PSU); SONGKHLA: *A. Tongseedum* 6 (PSU), *H. Maseng* 002 (PSU), *K. Larsen et al.* 40942 (PSU), *P. Sirirugsa* 5 (PSU).

## MONOCOTS

### ORCHIDACEAE

**93. *Acriopsis liliifolia*** (J. Koenig) Ormerod in Opera Bot. 124: 58. 1995.—*Epidendrum liliifolium* J. Koenig in Retzia 6: 61. 1971.—*Acriopsis javanica* Reinw. ex Blume, Bijdr.: 377. 1825; Hook.f., Fl. Brit. India 6: 79. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 187. 1907; Fl. Malay Penins. 4: 190. 1924; Holttum, Rev. Fl. Malaya 1: 555, fig. 164. 1953; Seidenf. & Smitinand, Orchids Thailand 3: 514, fig. 379. 1960; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 398. 1968; Seidenf., Opera Bot. 72: 104, fig. 58, pl. VIIIb. 1983; Minderh. & de Vogel, Orchid Monogr. 1: 9, figs. 1, 6, pl. 1c-d. 1986; Seidenf., Opera Bot. 114: 347. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 563, fig. 256e-i, pl. 39c. 1992. **Plate 43A-C.**

Sympodial epiphyte, lithophyte or occasionally terrestrial; rhizome between the pseudobulbs with 3 internodes, 5-7 mm apart, 2-3 mm in diam.; main roots 1-1.5 mm thick; ascending white catch-roots present. **Pseudobulbs** consisting of 3-4 internodes, short and thick, ridged, ovoid, 1.2-4 by 0.6-2 cm, covered by sheath, bearing 2-3 leaves near the top. **Leaves** duplicate, glabrous, sheathing at the base; sheaths clasping the pseudobulbs, 4-6 mm long; blade subcoriaceous, narrowly oblong to linear, 6-15 by 0.5-1 cm, light to dark green, apex acute or obtuse. **Inflorescences** from base of pseudobulb, slender, erect or drooping, racemose or paniculate, many-flowered, up to 50 cm or more long; peduncle 21.5-30 cm long, with 3 internodes, glabrous; peduncular bracts clasping, appressed, 3-5 mm long, glabrous, apex acute; rachis 18.5-20 cm long, glabrous; floral bracts triangular, 0.5-2 by 0.5-1 mm, glabrous. **Flowers** resupinate, 7-10 mm in diam.; pedicels 3-4 mm long, glabrous. **Sepals** concave, boat-shaped, oblong when flattened, creamy or yellowish white, with purple median band, glabrous; dorsal sepal ca. 5.5 by 1.5 mm, 3-veined, apex acute; synsepals ca. 5.5 by 1.5-2 mm, 4-veined, apex obtuse. **Petals** spreading, oblong-obovate, ca. 5 by 2 mm, 3- or 5-veined, white, with purple median band, glabrous, apex rounded. **Lip** 3-lobed; hypochile forming a tube adnate to the column, ca. 2 mm long; blade ca. 5 by 3 mm, with 2 closed parallel halfmoon-shaped keels on the centre,

purple with white edges; side lobes spreading, 2 mm wide, 2.5-3 mm from tip to tip; enlobes small, ovate with a broad base, ca. 0.5 mm long, apex rounded; midlobe oblong, ca. 2 by 1 mm, apex rounded. **Column** nearly straight, 4-5 mm high, reddish or purplish brown, apex hood-shaped; hood creamy or yellowish; stelidia blunt, ca. 1 mm long, purplish brown, yellowish and translucent at the apex; operculum ovate, 0.7-0.8 by 0.4-0.5 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, lanceolate-falcate, ca. 0.6 by 0.2 mm in each pollinium, tips rounded to acute; stipe 0.6-0.7 mm long; viscidium  $\pm$  ovate, 0.15-0.2 by ca. 0.1 mm. **Stigma**  $\pm$  elliptic in outline; rostellum beak-like, ca. 0.5 mm long. **Ovary** inferior, slender, 2-3 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, obovoid or subglobular, 12-13 by 7-9 mm. **Seeds** numerous, elliptic, 0.3-0.5 by 0.1-0.15 mm, creamy, papillose.

**Thailand.**— NORTHERN: Chiang Mai; SOUTH-EASTERN: Chanthaburi; PENINSULAR: Throughout the Peninsula.

**Distribution.**— Widely distributed throughout Southeast Asia and Australia.

**Ecology.**— On tree trunks and branches, often occurring near the ground, growing on rocks or casually terrestrial on the litter of decaying leaves, found in partial shade of the quartzitic phyllite ridges, and also found in lowland evergreen forest, durian and rubber plantations, alt. 200-700 m. Common. Flowering and fruiting almost all year round, more flowers in September-November.

**Vernacular.**— Chuk Rohini (จุกโรหิณี), Ruhini (รุหิณี), Ueang Nom Nu (เอื้องนมหนู) (Nakhon Si Thammarat).

**Specimens examined.**— BETONG: *J. Wai* 387 (PSU); NARATHIWAT: *J.F. Maxwell* 85-1153 (PSU).

**94. *Bromheadia alticola*** Ridl., J. Linn. Soc., Bot. 28: 338, t. 42. 1891; Mat. Fl. Malay. Penins. 1: 144. 1907; Fl. Malay Penins. 4: 151. 1924; Holttum, Rev. Fl. Malaya 1: 543, fig. 160. 1953; Seidenf., Opera Bot. 72: 13, fig. 3. 1983; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 525, fig. 237d-f. 1992. **Plate 43D-F.**

Sympodial epiphyte or lithophyte; rhizome creeping, woody, between shoots (erect stems) 1-2 cm apart, 3-5 mm in diam., with many roots; roots stout, 2.5-3 mm thick. **Stems** tough, flattened, usually erect, with 3-5 leaves, often forming a large clump, up to 50 cm or more long; internodes 1-4 cm long. **Leaves** distichous, dorso-ventrally flattened, duplicate, glabrous, sheathing at the base; sheaths slightly longer than internodes; blade coriaceous, narrowly oblong, 8-14 by 0.8-1.3 cm, yellowish green or light to dark green, apex deeply emarginate or unequally bilobed. **Inflorescences** terminal, racemose, erect or drooping, up to 12 cm or more long, bearing 1 or 2 flowers at a time, sessile; floral bracts laterally compressed, regularly overlapping and clasping the rachis, broad, boat-shaped, 5-10 mm long, glabrous. **Flowers** fragrant, resupinate, ephemeral, 3.5-4 cm in diam., white, creamy white or yellowish; pedicels 2-3 mm long, glabrous. **Sepals** oblong or oblong-ob lanceolate, slightly concave, glabrous, midrib keeled, apex acute; dorsal sepal ca. 2 by 0.6 cm, 8-veined; lateral sepals slightly falcate, ca. 2 by 0.8 cm, 9-veined. **Petals** oblanceolate, ca. 2 by 0.5 cm, glabrous, 8-veined, apex acute. **Lip** 3-lobed, obovate, ca. 1.8 by 1 cm, white or creamy, with yellowish median papillose band extending to the base; side lobes erect, rounded, 2.5-3 mm high, 1.4-1.5 cm long, forward edges papillose; midlobe ovate, 5-6 by 5-6 mm, central callus thick, yellow, papillose, apex acute or obtuse, slightly recurved. **Column** slightly curved, winged, ca. 1.4 cm high, white, creamy or yellowish; operculum  $\pm$  obcordate, ca. 1 by 2-2.5 mm. **Pollinia** 2, equally sized, solid, unequally cleft, ovate or elliptic, ca. 1.5 by 0.7-0.8 mm in each pollinium; stipe and viscidium broad, winged, ca. 1 by 2 mm. **Stigma** semi-orbicular in outline. **Ovary** inferior, 6-10 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, narrowly cylindrical-oblong, ca. 4.3 by 0.9 cm. **Seeds** numerous, oblong, rarely ovate or lanceolate, 0.1-0.2 by ca. 0.05 mm, reddish or rusty coloured (in spirit).

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Trang, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— On tree trunks and branches (e.g. *Syzygium gratum* (Wight) S.N. Mitra and *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh.), often occurring near the ground, sometimes growing on moist rocks and on the litter of decaying leaves, in partial shade of the quartzitic phyllite ridges, and also found in lowland evergreen forest, alt. 300-700 m. Uncommon. Flowering and fruiting all year round, more flowers in rainy season.

**Vernacular.**— Klip Khao (กลีบขาว) (Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 841 (PSU), 893 (PSU).

**95. *Bromheadia finlaysoniana*** (Lindl.) Miq., Fl. Ned. Ind. 3: 709. 1859; Holttum, Rev. Fl. Malaya 1: 541, fig. 159. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 325. 1960; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 324. 1968; Seidenf., Opera Bot. 72: 11, fig. 2. 1983; Opera Bot. 114: 322. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 525, fig. 237a-c. 1992.— *Grammatophyllum finlaysoniana* Lindl., Gen. Sp. Orchid.: 173. 1833.— *Bromheadia palustris* Lindl., Edwards's Bot. Reg. 27: t. 89. 1841; Hook.f., Fl. Brit. India 6: 20. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 143. 1907; Fl. Malay Penins. 4: 150. 1924.— *B. sylvestris* Ridl., J. Linn. Soc., Bot. 28: 337. 1891; Mat. Fl. Malay. Penins. 1: 144. 1907; Fl. Malay Penins. 4: 150. 1924. **Plate 44A-C.**

Sympodial terrestrial plant or occasionally lithophyte; rhizome subterranean, creeping, woody, 5-10 mm in diam., with many roots; roots stout, 2-4 mm thick. **Stems** tough, erect, close or remote, up to 2 m high, upper part flattened, with 4-15 leaves; internodes 1.5-9 cm long. **Leaves** distichous, dorso-ventrally flattened, duplicate, glabrous, sheathing at the base; sheaths usually more or less shorter than internodes or sometimes longer; blade coriaceous, oblong or lanceolate-oblong, 3-17



by 1-4 cm, light to dark green, apex retuse, emarginate or unequally bilobed. **Inflorescences** terminal, racemose, usually erect, often branched, up to 1 m long, bearing 1 or 2 flowers at a time; peduncle 25-50 cm long, glabrous; rachis up to 50 cm long; floral bracts laterally compressed, regularly overlapping and clasping the rachis, boat-shaped, 3-7 mm long, glabrous. **Flowers** fragrant, resupinate, ephemeral, 5-6.5 cm in diam., white or creamy white, tinged with purple; pedicels 2-3 mm long, glabrous. **Sepals** oblong, slightly concave, glabrous, midrib keeled, apex acute-acuminate; dorsal sepal 3.5-4 by 0.9-1 cm, 8-10-veined; lateral sepals slightly falcate, 3.3-3.8 by 0.9-1 cm, 8-10-veined. **Petals** elliptic or ovate, 3-3.5 by 1.2-1.4 cm, glabrous, 10-12-veined, apex acute-acuminate. **Lip** 3-lobed, obovate, 2.5-2.7 by 1.5-1.8 cm, white or creamy, with yellowish median papillose band extending to the base; side lobes erect, rounded, ca. 5 mm high, ca. 2 cm long, with purple veins, forward edges papillose; midlobe ovate or broadly oblong to oblong-obovate, 9-10 by 7-10 mm, white or creamy, with purple veins, central callus warty, yellow, papillose, apex obtuse, truncate with a short tip or acuminate, recurved, margin slightly undulate, minutely toothed. **Column** slightly curved, winged, 1.8-2 cm high, white or creamy; operculum  $\pm$  obcordate, ca. 2 by 2.5-3 mm. **Pollinia** 2, equally sized, solid, unequally cleft, elliptic, 1.5-2 by 0.8-1 mm in each pollinium; stipe and viscidium  $\pm$  triangular, 2-2.5 by 2.5-3 mm. **Stigma** semi-orbicular in outline. **Ovary** inferior, 1.5-1.7 cm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, narrowly cylindrical-oblong, 5-7 by ca. 1 cm. **Seeds** numerous, lanceolate, 0.4-0.5 by 0.1-0.15 mm, brownish.

**Thailand.**— EASTERN: Surin; SOUTH-EASTERN: Trat; PENINSULAR: Chumphon, Surat Thani, Phangnga, Trang, Satun, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— Indochina, Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— On rocky or sandy heath soils with the decaying organic matter, usually found in mossy places or growing on rocks, locally abundant in both exposed

and shady areas of quartzitic phyllite ridges, and also found in rubber plantation, coastal heath and lowland evergreen forests, from sea level to 700 m alt. Common. Flowering and fruiting all year round, more flowers in rainy season.

**Vernacular.**— Kluai Mai Din (กล้วยไม้ดิน) (Chumphon); Tan Khamoi (ตานขโมย) (Surat Thani); Ro Tan Klo (รอตันกลอ) (Malay-Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 37 (PSU), 370 (PSU), 521 (PSU), 807 (PSU), 898 (BCU, PSU); PHANGNGA: *Ch. Laongpol* 759 (PSU); SONGKHLA: *K. Sridith* 325 (PSU); NARATHIWAT: *Ch. Laongpol* 5 (PSU), 103 (PSU).

**96. *Bromheadia truncata*** Seidenf., Opera Bot. 72: 14, fig. 5. 1983; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 529, fig. 238f-g. 1992. **Plate 44D-E.**

Sympodial epiphyte; rhizome short creeping, 1.5-3.5 mm in diam., with many roots; roots stout, 2-2.5 mm thick. **Stems** tufted, with 5-10 leaves, 5-20 cm long; internodes 0.2-1.5 cm long. **Leaves** distichous, laterally compressed, at acute angles to the stem, duplicate, glabrous, sheathing at the base; sheaths slightly longer than internodes; blade rigid and coriaceous, linear, slightly recurved or sometimes strongly curved and twisted, 2.5-11 by 0.3-0.6 cm, light to dark green, apex acute. **Inflorescences** terminal, racemose, very short, occasionally branched, often bearing 1 or 2 flowers at a time, sessile; rachis very short; floral bracts thin, closely overlapping and clasping the rachis, boat-shaped, ovate when flattened, 4-6 mm long, glabrous. **Flowers** resupinate, ephemeral, 2-3 cm in diam., cream to yellowish or greenish yellow; pedicels 2-3 mm long, glabrous. **Sepals** oblong or oblong-ob lanceolate, slightly concave, glabrous, midrib keeled, apex acute-acuminate; dorsal sepal 17-18 by 4-4.5 mm, 7-veined; lateral sepals slightly falcate, 17-18 by 4-4.5 mm, 7-veined. **Petals** oblong or oblong-ob lanceolate, 16-17 by 3-4 mm, glabrous, 7-veined, apex acute-acuminate. **Lip** 3-lobed, ovate, 1.5-1.6 by 1-1.2 cm, pale green or yellowish, with a purple-yellow median papillose band extending to the base; side lobes erect, 2-3 mm high, 8-9 mm long, forward edges truncate, pale green or yellowish; midlobe broadly oblong to orbicular, ca. 6 by 6 mm, purple edged white, central part with a

warty yellow band, papillose, apex truncate with a short tip or emarginate, slightly recurved, margin crenulate-undulate. **Column** slightly curved, winged and broadening upwards, 1-1.2 cm high, pale green or yellowish; operculum  $\pm$  obcordate, ca. 0.8 by 1.3-1.5 mm. **Pollinia** 2, equally sized, solid, provided with a small pore, ovate, 0.6-0.7 by ca. 0.5 mm in each pollinium; stipe and viscidium  $\pm$  broadly ovate, ca. 1.5 by 2 mm. **Stigma** elliptic in outline. **Ovary** inferior, 5-6 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, narrowly cylindrical-oblong, 12-16 by ca. 3 mm. **Seeds** numerous, oblong, lanceolate or ovate, 0.1-0.15 by ca. 0.05 mm, brownish.

**Thailand.**— NORTHERN: Chiang Mai (?); PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia and Sumatra.

**Ecology.**— On tree trunks and branches (e.g. *Syzygium gratum* (Wight) S.N. Mitra), often occurring near the ground in both exposed and shady areas of the quartzitic phyllite ridges, alt. 650-700 m. Uncommon. Flowering and fruiting all year round, more flowers in rainy season.

**Vernacular.**—

**Remarks.**— This species closely resembles *Bromheadia aporoides* Rchb.f. in vegetative characters, but in the original publication of *Bromheadia truncata* Seidenf., Seidenfaden (1983) stated that this species differs from *B. aporoides* Rchb.f. in many floral characters, e.g. the side lobes of lip with truncate front edges and without purple stripes, some different details of midlobe and the viscidium with deeply concave front edge. However, in the present study found that some of those characters may be highly variable. The morphological variations of them are still unclear. Additional collections and filed surveys of their populations are strongly needed.

**Specimens examined.**— BETONG: *J. Wai* 320 (PSU), 495 (PSU), 505 (PSU), 774 (PSU), 781 (PSU), 842 (PSU), 915 (PSU).

**Additional specimen examined.**— *Bromheadia aporoides* Rchb.f.; CULTIVATED: *P. Pholpunthin* 13 (PSU).

**97. *Bulbophyllum corolliferum*** J.J. Sm., Bull. Jard. Bot. Buitenzorg ser. 2, 25: 80. 1917; Holttum, Rev. Fl. Malaya 1: 414. 1953; Seidenf. & Smitinand, Orchids Thailand 3: 369, fig. 278a-d. 1961; Seidenf., Dansk Bot. Ark. 29(1): 92, fig. 44. 1973; Dansk Bot. Ark. 33(3): 161, fig. 109. 1979; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 445, fig. 201h-l, pl. 32a. 1992.— *Cirrhopetalum curtisii* Hook.f., Bot. Mag. 123: t. 7554. 1897; Seidenf., Opera Bot. 124: 34. 1995. **Plate 44F-H.**

Sympodial epiphyte or lithophyte, forming a large clump; rhizome creeping, between the pseudobulbs with 3-5 internodes, 1-3.5 cm apart, ca. 2 mm in diam. **Pseudobulbs** consisting of one internode, strongly angled, conical-ovoid, 1.4-2 by 0.7-1 cm, covered with sheaths when young, bearing one leaf on the top. **Leaf** duplicate, glabrous, not sheathing at the base; petiole-like base 1-2 cm long; blade fleshy, coriaceous, oblong, 7-12.5 by 1.5-3.5 cm, light to dark green, apex minutely retuse, base attenuate. **Inflorescences** subumbelliform racemes, fan-shaped, 8-12-flowered, 9-15 cm long; peduncle 7-13 cm long, with 3-5 internodes, glabrous; peduncular bracts clasping, appressed, 5-7 mm long, glabrous, apex acute-acuminate; rachis 1-2 mm long; floral bracts narrowly triangular-ovate, 3-3.5 by ca. 1 mm, glabrous, apex acute-acuminate. **Flowers** resupinate, reddish purple; pedicels 3-4 mm long, glabrous. **Sepals** 5-veined; dorsal sepal ovate, hooded, 6-7 by ca. 3 mm, apex acuminate, margin fimbriate; lateral sepals oblong-lanceolate, partly connate towards apex, ca. 12 by 3 mm, glabrous. **Petals** obovate, slightly falcate, 4-4.5 by 2-2.5 mm, 3-veined, apex acuminate, margin fimbriate. **Lip** tongue-shaped, 4-4.5 by ca. 1 mm, recurved, glabrous, apex acute. **Column** winged, ca. 2 mm high; stelidia reduced to a mucronate tip; column-foot ca. 2.5 mm long; operculum ovate, ca. 0.9 by 0.5 mm. **Pollinia** 4, unequally sized, arranged in 2 pairs, solid, ca. 0.5 by 0.2 mm in each pair. **Stigma** ± elliptic in outline. **Ovary** inferior, ca. 1.5 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, ellipsoid, 14-20 by 7-8 mm. **Seeds** numerous, linear-elliptic to narrowly elliptic, ca. 0.15 by 0.05 mm, creamy.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Phatthalung, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing on rocks in shady areas of the quartzitic phyllite ridges at 550 m alt., and also found on tree trunks and branches in lowland evergreen forest. Uncommon. Flowering and fruiting all year round, more flowers in rainy season.

**Vernacular.**— Singto Rom Daeng (สิงโตร่มแดง) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 386 (PSU), 435 (PSU), 854 (PSU), 910 (PSU); NARATHIWAT: *J.F. Maxwell* 86-1078 (PSU).

**98. *Bulbophyllum lilacinum*** Ridl., J. Linn. Soc., Bot. 32: 276. 1896; Mat. Fl. Malay. Penins. 1: 71. 1907; Fl. Malay Penins. 4: 68. 1924; Holttum, Rev. Fl. Malaya 1: 460, fig. 132. 1953; Seidenf. & Smitinand, Orchids Thailand 3: 434. 1961; Seidenf., Dansk Bot. Ark. 33(3): 140, fig. 94, pl. 11. 1979; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 491, fig. 223a-e, pl. 35c. 1992. **Plate 45A-C.**

Sympodial epiphyte or lithophyte; rhizome creeping, with 5-6 internodes and 3-7 cm apart between the pseudobulbs, 3-4 mm in diam. **Pseudobulbs** consisting of one internode, strongly angled, conical-ovoid, 3.5-4(-9) by 1.5-2.2(-3) cm, covered with sheaths when young, bearing one leaf on the top. **Leaf** duplicate, glabrous, not sheathing at the base; petiole-like base ca. 0.5(-2.5) cm long; blade fleshy, rigid, coriaceous, oblong, 11.5-18(-30) by 2-3(-5) cm, light to dark green, apex retuse, base attenuate. **Inflorescences** elongated racemes, bearing many overlapping flowers, 12-15(-19.5) cm long; peduncle 5.5-7(-8) cm long, with 2-3(-4) internodes, glabrous; peduncular bracts clasping, appressed, 1.8-2.5(-3) cm long, glabrous, apex acute-acuminate; rachis 6-8(-11.5) cm long; floral bracts narrowly triangular-ovate, 4-7(-9) by 1-2(-2.5) mm, glabrous, apex acute-acuminate. **Flowers** resupinate, creamy, yellowish, pinkish or pale lilac, with deep purple lines and spots, subsessile; pedicels

ca. 1 mm long, glabrous. **Sepals** glabrous; dorsal sepal ovate, hooded, 5-5.5 by 2-2.5 mm, 3-veined, apex acuminate; lateral sepals parallel, connate at the tips and the base of inner edges, obliquely ovate 7-7.5(-9) by 2.5-3 mm, 4-veined, apex acuminate. **Petals** slightly falcate and curved near the base, narrowly triangular-ovate, 3-4 by ca. 1 mm, glabrous, 1-veined, with a long thread at apex. **Lip** tongue-shaped, 2.5-3 by ca. 1 mm, recurved, with 2 small auricles at the base and a longitudinal groove on surface, densely papillose, apex acute. **Column** 2-2.5 mm high, sparsely minutely papillose; stelidia erect, triangular, ca. 0.5 mm long; column-foot 1.5-2 mm long; operculum  $\pm$  obovate, 6-7 by ca. 7 mm. **Pollinia** 4, unequally sized, arranged in 2 pairs, solid, ca. 0.5 by 0.25 mm in each pair. **Stigma** ovate in outline. **Ovary** inferior, 2-2.5 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, oblong, 12-15 by 7-9 mm. **Seeds** numerous, linear-elliptic to narrowly elliptic, ca. 0.2 by 0.1 mm, creamy.

**Thailand.**— PENINSULAR: Satun, Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— Growing on rocks in both exposed and shady areas of the mountain ridges at 550-950 m alt., and also found on tree trunks and branches in lowland evergreen forest. Uncommon. Flowering in December-January, fruiting in February-March.

**Vernacular.**—

**Remarks.**— It is rather difficult to distinguish *Bulbophyllum lilacinum* Ridl. from the several taxa in the section *Careyana* Pfitzer, e.g. *Bulbophyllum peninsularis* Seidenf. In the original publication, Seidenfaden (1979) stated that *B. peninsularis* Seidenf. differs from *B. lilacinum* Ridl. in having different sizes, colours and shape of the flowers. Though one of the studied materials, i.e. *J. Wai* 929 showed many similar characters to *B. peninsularis* Seidenf. in sizes (in parentheses), especially, the length of lateral sepals. It was identified as *B. lilacinum* Ridl., since there are more aspects of

characters that fit to the mentioned species more than those of *B. peninsularis* Seidenf. Moreover, the sizes and colours of a given character are often highly variable. It is also convinced here that *B. peninsularis* Seidenf. might not be a good species. Additional collections, population studies and detailed morphology of the section *Careyana* Pfitzer are, therefore, needed.

**Specimens examined.**— BETONG: *J. Wai* 526 (PSU), 929 (PSU), 1066 (PSU).

**99. *Bulbophyllum medusae*** (Lindl.) Rchb.f., Ann. Bot. Syst. (Walpers) 6: 262. 1861; Hook.f., Fl. Brit. India 5: 757. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 79. 1907; Fl. Malay Penins. 4: 75. 1924; Holttum, Rev. Fl. Malaya 1: 409. 1953; Seidenf. & Smitinand, Orchids Thailand 3: 361, fig. 271, pl. XV. 1961; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 381. 1968; Seidenf., Dansk Bot. Ark. 29(1): 166, fig. 80. 1973; Dansk Bot. Ark. 33(3): 172, fig. 120. 1979; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 468, fig. 212f-j. 1992; Garay, Hamer & Siegerist, Nordic J. Bot. 14: 634. 1994.— *Cirrhopetalum medusae* Lindl., Edwards's Bot. Reg. 28: t. 12. 1842. **Plate 45D-F.**

Sympodial epiphyte or lithophyte; rhizome creeping, between the pseudobulbs with 5-6 internodes, 2.5-4.5 cm apart, 3-4 mm in diam. **Pseudobulbs** consisting of one internode, strongly angled, conical-ovoid, 2-3.2 by 1-1.5 cm, covered with sheaths when young, bearing one leaf on the top. **Leaf** duplicate, glabrous, not sheathing at the base; petiole-like base 1.5-3 cm long; blade fleshy, rigid, coriaceous, oblong, 8.5-16.5 by 2-3.3 cm, light to dark green or yellowish green, apex retuse, base attenuate. **Inflorescences** subumbelliform racemes, head-like, densely many-flowered; peduncle 12.5-15 cm long, with 5-6 internodes, glabrous; peduncular bracts clasping, appressed, boat-shaped, ovate when flattened, 1-3 by 1-1.5 cm, sparsely covered with small scales, apex acute-acuminate; rachis 4-5 mm long; floral bracts narrowly triangular-ovate, 6-18 by 1-4 mm, glabrous or sparsely covered with small scales, apex acuminate. **Flowers** fragrant, resupinate, creamy white; pedicels 1-1.5 mm long, glabrous. **Sepals** with a long tail, ovate-lanceolate, 5-veined, glabrous; dorsal sepal

3.5-4 by 0.3-0.4 cm; lateral sepals 8-16 by 0.2-0.3 cm. **Petals** triangular, ca. 5 by 1 mm, glabrous, 3-veined, with a long thread at apex. **Lip** tongue-shaped, 2-2.5 by ca. 1 mm, with 2 keels, recurved, yellowish or reddish, papillose on the apical part, apex acute. **Column** ca. 2 mm high, winged; stelidia erect, triangular, 1-1.5 mm long; column-foot ca. 1.5 mm long; operculum cordate, 0.7-0.9 by 0.6-0.7 mm. **Pollinia** 4, unequally sized, arranged in 2 pairs, solid, ca. 0.35 by 0.3 mm in each pair. **Stigma** semi-orbicular in outline. **Ovary** inferior, 2-2.5 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** ridged, ellipsoid. **Seeds** not seen.

**Thailand.**— PENINSULAR: Surat Thani, Trang, Krabi, Nakhon Si Thammarat, Phatthalung, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing on the cliffs or on mossy rocks in both exposed and shady areas of quartzitic phyllite ridges, and also found on tree trunks and branches in lowland evergreen forest, alt. 200-700 m. Uncommon. Flowering in August-October, fruiting in October-January.

**Vernacular.**— Singto Khao (สิงโตขาว), Singto Dokmai Fai (สิงโตดอกไม้ไฟ) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 285 (PSU), 875 (PSU), 892 (PSU).

**100. *Bulbophyllum purpurascens*** Teijsm. & Binn., *Natuurk. Tijdschr. Ned.-Indië* 24: 308. 1862; Ridl., *Fl. Malay Penins.* 4: 78. 1924; Holttum, *Rev. Fl. Malaya* 1: 410. 1953; Seidenf. & Smitinand, *Orchids Thailand* 3: 366, fig. 275, pl. XV. 1961; Backer & Bakh.f., *Fl. Java (Spermatoph.)* 3: 380. 1968; Seidenf., *Dansk Bot. Ark.* 29(1): 149, fig. 73. 1973; *Dansk Bot. Ark.* 33(3): 169, fig. 116. 1979; Seidenf. & J.J. Wood, *Orchids Pen. Mal. & Sing.*: 449, fig. 203d-j. 1992.— *Cirrhopetalum citrinum* Ridl., *J. Linn. Soc., Bot.* 32: 279. 1896.— *Bulbophyllum perakense* Ridl., *J. Straits Branch Roy. Asiat. Soc.* 39: 76. 1903; *Fl. Malay Penins.* 4: 77. 1924; Holttum, *Rev. Fl.*



Malaya 1: 411. 1953.— *B. citrinum* Ridl., Mat. Fl. Malay. Penins. 1: 75. 1907.— *B. rhizophoreti* Ridl., Fl. Malay Penins. 4: 77. 1924. **Plate 46A-C.**

Sympodial epiphyte or lithophyte; rhizome creeping, with 3-5 internodes between pseudobulbs, 1-2.5 cm apart, ca. 1.5 mm in diam. **Pseudobulbs** consisting of one internode, ovoid, 6-7.5 by 5-6 mm, covered with sheaths when young, bearing one leaf on the top. **Leaf** duplicate, glabrous, not sheathing at the base, sessile; blade fleshy, thick, rigid, coriaceous, elliptic, ovate or oblong, 1.5-5 by 0.8-1.5 cm, reddish purple or dark olive green, apex minutely retuse, base obtuse to rounded. **Inflorescences** subumbelliform racemes, fan-shaped, 6-10-flowered, 5-8 cm long; peduncle 4-6 cm long, with 2-3 internodes, glabrous; peduncular bracts clasping, appressed, 6-7 mm long, purplish, glabrous, apex acute-acuminate; rachis 2-3 mm long; floral bracts narrowly triangular-ovate, 3-5 by 1-1.5 mm, purplish, glabrous, apex acute-acuminate. **Flowers** resupinate, cream or yellowish; pedicels 1-1.5 mm long, glabrous. **Sepals** 3-veined, glabrous; dorsal sepal ovate, hooded, ca. 5 by 2 mm, apex acuminate; lateral sepals linear-oblong, 16-18 by 2-3 mm, apex hooded, acute. **Petals** ovate, slightly falcate, ca. 4 by 2 mm, 3-veined, apex acuminate, margin serrate at basal part. **Lip** tongue-shaped, 1.5-2 by ca. 1 mm, recurved, glabrous, apex  $\pm$  acute. **Column** ca. 1 mm long, winged; stelidia erect, triangular, 0.3-0.4 mm long; column-foot ca. 1.5 mm long; operculum  $\pm$  cordate, 0.45-0.5 by 0.5-0.55 mm. **Pollinia** 4, unequally sized, arranged in 2 pairs, solid, ca. 0.35 by 0.3 mm in each pair. **Stigma** ovate in outline. **Ovary** inferior, 1-1.5 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Chumphon, Phangnga, Phuket, Phatthalung, Trang, Satun, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java and Borneo.

**Ecology.**— Lithophytic on rocks in exposed areas of the quartzitic phyllite ridges at 650-700 m alt., and also found on tree trunks and branches in lowland evergreen forest. Uncommon. Flowering in January-May.

**Vernacular.**— Singto Thin Tai (สิงโตถิ่นใต้) (Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 210 (PSU), 703 (PSU), 977 (PSU).

**101. *Bulbophyllum stenobulbon*** E.C. Parish & Rchb.f., Trans. Linn. Soc. London 30(1): 153. 1874; Seidenf. & Smitinand, Orchids Thailand 3: 398, fig. 300. 1961; Dansk Bot. Ark. 33(3): 85, fig. 52. 1979; Hook.f., Fl. Brit. India 5: 758. 1890. **Plate 46D-G.**

Sympodial epiphyte, lithophyte, or sometimes terrestrial plant, often forming large clumps; rhizome creeping, with 4-6 internodes between the pseudobulbs, 2.5-5 cm apart, 1-1.5 mm in diam. **Pseudobulbs** consisting of one internode, ridged, cylindrical-oblong, 1.5-3 by 0.3-0.7 cm, bearing one leaf at the top, base covered with sheaths when young. **Leaf** duplicate, glabrous, not sheathing at the base, sessile; blade coriaceous, oblong, 3.3-8 by 1.3-2.5 cm, light to dark green, apex minutely retuse, base attenuate. **Inflorescences** subumbelliform racemes, 3-6-flowered, 1.5-2.5 cm long; peduncle 1-1.5 cm long, with 3 internodes, glabrous; peduncular bracts clasping, appressed, 3-4 mm long, glabrous, apex acute; rachis 1-3 mm long; floral bracts narrowly ovate, 1.5-2.5 by ca. 1 mm, glabrous, apex acute. **Flowers** small, resupinate, creamy white with pale yellow tips; pedicels 1-2 mm long, glabrous. **Sepals** lanceolate, glabrous, 3-veined, apex acute; dorsal sepal ca. 4 by 1 mm; lateral sepals ca. 5 by 1 mm. **Petals** elliptic-oblong, 2-2.5 by ca. 1 mm, glabrous, 3-veined, apex obtuse and slightly hooded. **Lip** tongue-shaped, 1.3-1.4 by 0.6-0.8 mm, with 2 keels, recurved, apex blunt. **Column** ca. 0.7 mm high; stelidia erect and slightly curved at apex, 0.2-0.3 mm long; column-foot ca. 0.5 mm long; operculum  $\pm$  cordate, ca. 0.35 by 0.35 mm. **Pollinia** 4, unequally sized, arranged in 2 pairs, solid, ca. 0.3 by 0.15 mm in each pair. **Stigma** ovate or orbicular in outline. **Ovary** inferior, 0.6-0.8 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Nakhon Si Thammarat, Yala.

**Distribution.**— Vietnam, Laos and Myanmar.

**Ecology.**— Growing on the litter of decaying leaves or on mossy rocks, occurring on rocky or sandy heath soils, often found in mossy places and partially shaded areas on the quartzitic phyllite ridges at 650-700 m alt., and also found on tree trunks and branches in lowland evergreen forest. Uncommon. Flowering in October-February.

**Vernacular.**—

**Remarks.**— There are several taxa in the section *Desmosanthes* (Blume) J.J. Sm. that seem to be very close to *Bulbophyllum stenobulbon* E.C. Parish & Rchb.f., one of them is *Bulbophyllum bakhuizenii* Steenis and it was rather difficult to distinguish those taxa from each other. Unfortunately that it was not mentioned in the previous treatment of the genus *Bulbophyllum* Thouars how *B. bakhuizenii* Steenis was different from *B. stenobulbon* E.C. Parish & Rchb.f. either. The collection in the present study could fit well to the descriptions of both species. It is possible that all of the collections of both described names belong to one widespread species. In the present work, the name *B. stenobulbon* E.C. Parish & Rchb.f. was selected for the specimens collected due to the distribution ranges of both species, i.e. *B. stenobulbon* E.C. Parish & Rchb.f. is distributed in Indochina, Myanmar and Thailand, while *B. bakhuizenii* Steenis is distributed in Peninsular Malaysia, Sumatra, Java and Borneo. However, more collections, field observations and the taxonomic revision of the section *Desmosanthes* (Blume) J.J. Sm. are strongly recommended.

**Specimens examined.**— BETONG: *J. Wai* 976 (PSU), 1077 (PSU).

**102. *Coelogyne cumingii*** Lindl., Edwards's Bot. Reg. 26 (Misc.): 187. 1840; Hook.f., Fl. Brit. India 5: 834. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 131. 1907; Fl. Malay Penins. 4: 134. 1924; Holttum, Rev. Fl. Malaya 1: 249, fig. 50. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 118, fig. 88. 1959; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 284. 1968; Seidenf., Dansk Bot. Ark. 29(4): 58, fig. 22. 1975; Opera Bot. 114: 113. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 209, fig. 89a-c. 1992; D.A. Clayton, Gen. *Coelogyne* (Synopsis): 174, pl. 20E. 2002. **Plate 47A-C.**

Sympodial epiphyte, lithophyte or sometimes terrestrial plant, often forming large masses; rhizome creeping, woody, with 3-4 internodes between the pseudobulbs, 1-6 cm apart, 5-12 mm in diam.; roots hairy when young. **Pseudobulbs** consisting of one internode, shiny, wrinkled when old, ovoid, 3-8 by 1.5-4 cm, greenish or yellowish, bearing 2 leaves at the top, base enclosed with sheathing bracts. **Leaves** convolute, glabrous, not sheathing at the base; petiole grooved, 3-15 cm long; blade thinly coriaceous, rigid, slightly plicate, narrowly elliptic, linear-oblong or oblanceolate, 11-30 by 1.5-5.5 cm, glossy, yellowish to light green or rarely dark green, with 5 or 7 main veins, apex acuminate, base attenuate, margin undulate. **Inflorescences** synanthous, loosely 2-5-flowered, erect, 13-30 cm long; peduncle rigid, enclosed with imbricating bracts and new developing leaves at the base, 10-20 cm long, glabrous; rachis 3-10 cm long, glabrous; floral bracts persistent, boat-shaped, narrowly elliptic when flattened, 2.5-5.5 by 1-2.5 cm, yellowish, glabrous, apex acuminate, margin involute. **Flowers** showy, fragrant, all opening at the same time, resupinate, 6-7 cm in diam.; pedicels 5-15 mm long, glabrous. **Sepals** white, glabrous, 5-11-veined, apex acute-acuminate; dorsal sepal elliptic, 3.5-4.1 by 1.1-1.3 cm; lateral sepals oblong-lanceolate, 3.7-4.2 by 0.8-1 cm. **Petals** linear-oblong, 3.5-4 by 0.4-0.6 cm, white, glabrous, 3- or 5-veined, apex acute. **Lip** 3-lobed, ovate when flattened, 2.9-3.6 by 2-2.3 cm, white with yellowish or orange in the central part; side lobes erect, 7-9 mm high, 1.5-2 cm long, forward edges obtuse or rounded; midlobe elliptic or ovate, 1.4-2 by 1-1.3 cm, apex acuminate, usually recurved, margin crisped, irregularly toothed; keels 5, crenulate-undulate, 3 keels extending from the base of lip to the middle of midlobe, 2 further lateral keels only present on the midlobe. **Column** slender, winged, broadening upwards, curved to the front, 1.8-2.2 cm high, apex hood-

shaped; operculum  $\pm$  obovate in outline, bell-shaped, ca. 4 by 3.5 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, ca. 2 by 1 mm in each pollinium. **Stigma**  $\pm$  elliptic in outline, margin elevated; rostellum semi-orbicular, ca. 3 by 6 mm. **Ovary** inferior, 1-1.3 cm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, distinctly ridged, obovoid or ellipsoid, 4-4.5 by 1.5-2 cm. **Seeds** not seen.

**Thailand.**— NORTHERN: Chiang Mai; EASTERN: Nakhon Ratchasima, Chaiyaphum; SOUTH-EASTERN: Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phatthalung, Songkhla, Narathiwat, Yala.

**Distribution.**— Laos, Peninsular Malaysia, Singapore, Sumatra and Borneo.

**Ecology.**— On moist mossy cliffs or on tree trunks and branches, growing on rocky or sandy heath soils in grassy-mossy places, often locally abundant in exposed areas on the mountain ridges, and also found in lowland evergreen forest, alt. 300-950 m. Common. Flowering in June-August, fruiting in October-May.

**Vernacular.**— Ueang Man (เอื้องมัน) (General).

**Specimens examined.**— BETONG: *J. Wai* 59 (PSU), 321 (PSU), 351 (PSU), 421 (BCU, PSU), 799 (BCU, PSU), 811 (BCU, PSU), 829 (PSU); PHATTHALUNG: *J.F. Maxwell* 86-662 (PSU); SONGKHLA: *K. Sridith* 321 (PSU), *Hamilton & Congdon* 474 (PSU).

**103. *Coelogyne prasina*** Ridl., J. Linn. Soc., Bot. 32: 326. 1896; Mat. Fl. Malay. Penins. 1: 133. 1907; Fl. Malay Penins. 4: 136. 1924; Holttum, Rev. Fl. Malaya 1: 244, fig. 47. 1953; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 201, fig. 85a. 1992; D.A. Clayton, Gen. *Coelogyne* (Synopsis): 112, pl. 10F. 2002.— *C. rhizomatosa* J.J. Sm., Recueil Trav. Bot. Neerl. 1: 146. 1904. **Plate 47D-G.**

Sympodial epiphyte, lithophyte or sometimes terrestrial plant; rhizome creeping, with 4-5 internodes between the pseudobulbs, 7.5-11.5 cm apart, 4-6 mm in diam.; roots long, hairy when young. **Pseudobulbs** consisting of one internode, fusiform or narrowly ovoid-pyriform, 5-8 by 1-1.6 cm, greenish, bearing 2 leaves at the top, base enclosed with sheathing bracts. **Leaves** convolute, glabrous, not sheathing at the base; petiole grooved, 1-1.5 cm long; blade thinly coriaceous, plicate, elliptic or obovate, 8.5-15 by 3-5.5 cm, light to dark green, with 5 or 7 main veins, apex acute-acuminate, base attenuate, margin undulate. **Inflorescences** synanthous, loosely 2-4-flowered, erect, 10-13.5 cm long; peduncle enclosed with imbricating bracts and new developing leaves at the base, 7.5-10 cm long, glabrous; rachis flexuous, 1-3.5 cm long, glabrous; floral bracts caducous, boat-shaped, elliptic-ovate when flattened, 10-20 by 3-7 mm, greenish, glabrous, apex obtuse or acute, margin involute. **Flowers** opening in succession, resupinate, ca. 1.5 cm in diam., pale green; pedicels 7-8 mm long, glabrous. **Sepals** glabrous, apex acute; dorsal sepal ovate, 11-12 by 5-5.5 mm, 5-veined; lateral sepals narrowly ovate, 11-12 by 3.5-4 mm, 3- or 5-veined. **Petals** narrowly triangular, with a narrowly long tip, ca. 10 by 1 mm, glabrous, 3-veined, apex obliquely obtuse. **Lip** 3-lobed,  $\pm$  pandurate when flattened, 10-11 by 7-8 mm; side lobes erect, rounded, ca. 3 mm high, 4-5 mm long; midlobe broadly clawed, orbicular or obovate, 6-7 by ca. 6 mm, apex shortly obtuse or broadly rounded, notched, slightly recurved; keels 2(-3), slightly curved, smooth, 2 prominent keels extending from the base of lip to the middle of midlobe, with a small median keel. **Column** slender, winged, broadening upwards, slightly curved to the front, ca. 5 mm high, apex hood-shaped; operculum broadly obovate to orbicular or cordate, ca. 1 by 1 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate, 0.7-0.8 by 0.5-0.6 mm in each pollinium. **Stigma** semi-orbicular in outline, cup-shaped, margin elevated; rostellum semi-orbicular, ca. 1 by 1 mm. **Ovary** inferior, distinctly ridged, 4-6 mm

long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, distinctly ridged, obovoid or ellipsoid, 2-2.5 by 1-1.2 cm. **Seeds** numerous, elliptic to linear-elliptic, 0.5-0.9 by 0.1-0.15 mm, creamy.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Borneo, Sulawesi and Moluccas.

**Ecology.**— Growing on tree trunks, on rocky or heath soil with the litter of decaying leaves or on moist mossy rocks, usually found on mossy places in partial or deep shade of the quartzitic phyllite ridges at 650-700 m alt., often highly abundant in montane forest (outside Thailand). Very rare in Thailand. Flowering in June-July, fruiting in August-February.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand. A few plant specimens were collected from the study area, more collections are expected from Thai-Malaysian border.

**Specimens examined.**— BETONG: *J. Wai* 580 (PSU), 780 (PSU), 806 (BCU, BKF, PSU), 905 (PSU).

**104. *Coelogyne rochussenii*** de Vriese in Ill. Orch. Pl. (Bauer & Lindley): t. 2. 1854; Ridl., Mat. Fl. Malay. Penins. 1: 128. 1907; Fl. Malay Penins. 4: 131. 1924; Holttum, Rev. Fl. Malaya 1: 257, fig. 54. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 120, figs. 89a-b, 90. 1959; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 282. 1968; Seidenf., Dansk Bot. Ark. 29(4): 63, fig. 25. 1975; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 213, fig. 91a-b, pl. 12c. 1992; de Vogel, Orchid Monogr. 6: 29, fig. 18, pl. 3c. 1992; D.A. Clayton, Gen. *Coelogyne* (Synopsis): 148, pl. 17A. 2002.— *Coelogyne macrobulbon* Hook.f., Fl. Brit. India 5: 836. 1890. **Plate 48A-D.**

Sympodial epiphyte, lithophyte or sometimes terrestrial plant; rhizome creeping, woody, with 5-10 internodes between the pseudobulbs, up to 10 cm apart, 7-12 mm in diam.; roots hairy when young. **Pseudobulbs** consisting of one internode, grooved, narrowly cylindrical, 10-20 by 2-2.8 cm, greenish or yellowish, bearing 2 leaves at the top. **Leaves** convolute, glabrous, not sheathing at the base; petiole grooved, 3-10 cm long; blade thinly coriaceous, rigid, plicate, oblanceolate or narrowly elliptic, 16-45 by 4.5-10.5 cm, glossy, yellowish to dark green, with 5 or 7 main veins, apex shortly acuminate, base attenuate, margin undulate. **Inflorescences** heteranthous, loosely 35-52-flowered, pendulous, up to 100 cm or more long; peduncle enclosed with the scales of young shoot, 5-7 cm long, sparsely minutely hairy; rachis straight or very slightly flexuous, up to 70 cm or more long, sparsely minutely hairy; floral bracts persistent, boat-shaped, elliptic when flattened, 2-2.5 by 1-1.5 cm, pinkish brownish or flesh-coloured, sparsely minutely hairy, apex obtuse, margin involute. **Flowers** fragrant, all opening at the same time, resupinate, 5-6 cm in diam.; pedicels 6-17 mm long, glabrous or subglabrous. **Sepals** greenish or yellowish cream, glabrous, 7- or 9-veined, apex acute; dorsal sepal narrowly elliptic or oblong-lanceolate, 3-3.3 by 0.7-0.8 cm; lateral sepals oblong-lanceolate, slightly falcate, 2.9-3.1 by 0.65-0.7 cm, midrib keeled. **Petals** linear-elliptic to linear-lanceolate, 2.9-3.2 by 0.45-0.5 cm, greenish or yellowish cream, glabrous, 5-veined, apex acute. **Lip** 3-lobed, elliptic to elliptic-ovate when flattened, 2.5-2.9 by 1.7-1.8 cm; side lobes erect, 5.5-7 mm high, 1.5-1.7 cm long, forward edges rounded, erose, slightly recurved, outside whitish, inside white with brown veins; midlobe slightly recurved, ovate, 1.2-1.5 by 1-1.1 cm, white with some brown, apex acute-acuminate, margin erose and usually crisped; keels 7, prominent, 1-2 mm high, margin fimbriate, median keel reaching to



the base of midlobe, 2 prominent keels extending from the base of lip to the middle of midlobe, further 2 inner lateral keels developed from the base of midlobe to the middle of midlobe, 2 outermost keels usually short or not well-developed. **Column** winged, broadening upwards, slightly curved to the front, 1.7-1.9 cm high, apex hooded, emarginate, irregularly toothed; operculum  $\pm$  obovate in outline, bell-shaped, 2.5-3 by 2.5 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, slightly falcate, 1-1.5 by 0.8-1 mm in each pollinium. **Stigma** suborbicular in outline, cup-shaped, margin elevated; rostellum semi-orbicular or ovate, 2-2.5 by ca. 2 mm. **Ovary** inferior, distinctly ridged, 6-8 mm long, minutely hairy, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Borneo and Philippines.

**Ecology.**— On moist mossy cliffs or on tree trunks and branches, occasionally on the rocky or sandy heath soils with the decaying organic matter, locally common in semi-exposed and partially shaded areas of the quartzitic phyllite ridges, and also found in lowland evergreen forest, alt. 100-700 m. Uncommon in Thailand. Flowering in May-July.

**Vernacular.**— Ueang Sai Sert (เอื้องสายเสริต) (Peninsular).

**Specimen examined.**— BETONG: *J. Wai* 1073 (PSU).

**105. *Coelogyne testacea*** Lindl., Edwards's Bot. Reg. 28 (Misc.): 38. 1842; Hook.f., Fl. Brit. India 5: 829. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 127. 1907; Fl. Malay Penins. 4: 128, fig. 169. 1924; Holttum, Rev. Fl. Malaya 1: 259. 1953; de Vogel, Orchid Monogr. 6: 35, fig. 21, pl. 4b. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 215, fig. 91e-g. 1992; D.A. Clayton, Gen. *Coelogyne* (Synopsis): 151, pl. 17E. 2002.— *C. sumatrana* J.J. Sm., Bull. Dept. Agric. Indes Neerl. 15: 5. 1908. **Plate 48E-G.**

Sympodial epiphyte or lithophyte; rhizome creeping, rather short, woody, between the pseudobulbs close together to 2 cm apart, 8-10 mm in diam.; roots hairy when young. **Pseudobulbs** consisting of one internode, grooved, ovoid to narrowly ovoid, 5-13 by 2-4 cm, greenish or yellowish, bearing 2 leaves at the top, base enclosed with sheathing bracts. **Leaves** convolute, glabrous or sparsely minutely hairy, not sheathing at the base; petiole grooved, 4-20 cm long; blade thinly coriaceous, rigid, plicate, oblanceolate or narrowly elliptic, 13-40 by 2.7-8 cm, yellowish green or light to dark green, with 5 main veins, apex acute or short acuminate, base attenuate, margin entire or slightly undulate. **Inflorescences** proteranthous, loosely 5-11-flowered, pendulous, 10-25 cm long; peduncle enclosed with the scales of young shoot, 3-7 cm long, sparsely minutely hairy; rachis straight or slightly flexuous, 7-18 cm long, sparsely minutely hairy; floral bracts persistent, boat-shaped, ovate to orbicular when flattened, 1-1.5 by 0.7-1.3 cm, brownish or greenish, sparsely minutely hairy, apex acute to rounded, margin involute. **Flowers** fragrant, all opening at the same time, resupinate, 4-5 cm in diam.; pedicels 6-12 mm long, glabrous or subglabrous. **Sepals** yellowish cream to flesh-coloured, glabrous, 7- or 9-veined, apex acute; dorsal sepal elliptic-oblong, 2.2-2.9 by 0.7-1 cm; lateral sepals oblong-lanceolate, slightly falcate, 1.9-2.7 by 0.6-0.9 cm, midrib strongly keeled. **Petals** linear-oblong, 2.2-2.6 by 0.3-0.4 cm, yellowish cream to flesh-coloured, glabrous, 3- or 5-veined, apex acute. **Lip** 3-lobed, elliptic when flattened, 1.7-2.5 by 1.4-1.9 cm; side lobes erect, 6-8 mm high, 1-1.8 cm long, forward edges obtuse or rounded, slightly recurved, irregularly toothed or entire, dark brown except the margin; midlobe recurved, broadly spatulate to obovate or broadly elliptic-ovate, 6-7 by 7-9 mm, yellowish cream to flesh-coloured with some brown, apex retuse to truncate with a short tip or acute, margin crisped, irregularly toothed; keels 4(-5) or 6(-7), prominent, up to 1 mm high, with dentate or hair-like processions, with an indistinct median keel, 2 prominent keels extending from the base of lip to near the tip of midlobe, further 2 or 4 lateral keels only present on the midlobe or developed from near the base of hypochile to the top. **Column** slender, winged, broadening upwards, curved to the front, ca. 1.5 cm high, apex hood-shaped; operculum  $\pm$  obovate in outline, bell-shaped, 2.5-3 by ca. 2 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, 1.5-2 by ca. 0.8 mm in each pollinium. **Stigma**  $\pm$  semi-orbicular in outline, cup-

shaped, margin elevated; rostellum semi-orbicular, ca. 1.5 by 2 mm. **Ovary** inferior, distinctly ridged, 5-7 mm long, sparsely minutely hairy, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, distinctly ridged, obovoid, 4.5-5 by 2-2.5 cm. **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Singapore, Sumatra and Borneo.

**Ecology.**— On moist mossy rocks or growing on tree trunks and branches, often locally abundant in both exposed and shady areas of the quartzitic phyllite ridges, and also found in lowland evergreen forest, alt. 300-700 m. Very rare in Thailand. Flowering in February-April, fruiting in May-February.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand. A few plant specimens were collected in the present study. Additional specimens and field surveys along Thai-Malaysian border are still needed.

**Specimens examined.**— BETONG: *J. Wai* 194 (PSU), 686 (BCU, BKF, PSU).

**106. *Coelogyne trinervis*** Lindl., Gen. Sp. Orchid. Pl.: 41. 1830; Hook.f., Fl. Brit. India 5: 832. 1890; Seidenf. & Smitinand, Orchids Thailand 2: 115, fig. 85, pl. IV. 1959; Seidenf., Dansk Bot. Ark. 29(4): 44, fig. 16. 1975; Opera Bot. 114: 112. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 207, fig. 88a-d. 1992; D.A. Clayton, Gen. Coelogyne (Synopsis): 214, pl. 24C. 2002.— *C. cinnamomea* Teijsm. & Binn. (non Lindl.), Natuurk. Tijdschr. Ned.-Indië 24: 306. 1862; Holttum, Rev. Fl. Malaya 1: 253. 1953.— *C. rhodeana* Rchb.f., Gard. Chron.: 901. 1867.— *C. rossiana* Rchb.f., Gard. Chron. 2: 808. 1884.— *C. angustifolia* Ridl., J. Linn. Soc., Bot. 32: 322. 1896; Mat. Fl. Malay. Penins. 1: 130. 1907.— *C. pachybulbon* Ridl., J. Linn. Soc., Bot. 32:

324. 1896.— *C. wettsteiniana* Schltr., Oesterr. Bot. Z. 69: 124. 1920.— *C. stenophylla* Ridl., Fl. Malay Penins. 4: 132. 1924. **Plate 49A-B.**

Sympodial epiphyte or lithophyte; rhizome creeping, woody, with 4-5 internodes between the pseudobulbs, up to 5.5 cm apart, 6-10 mm in diam.; roots hairy when young. **Pseudobulbs** consisting of one internode, ridged, ovoid to cylindrical, 6-10 by 2.5-4 cm, greenish or yellowish, bearing 2 leaves at the top, base enclosed with sheathing bracts. **Leaves** convolute, glabrous, not sheathing at the base; petiole grooved, 4-10 cm long; blade thinly coriaceous, rigid, plicate, narrowly elliptic-oblong to linear-oblong, 18-37 by 2.3-6 cm, yellowish green or light to dark green, with 3 prominent veins, apex acute, base attenuate, margin entire or slightly undulate. **Inflorescences** proteranthous, loosely 3-6-flowered, erect or drooping towards the tip, 10-13 cm long; peduncle enclosed with the scales of young shoot, 5-6.5 cm long, glabrous; rachis rather straight, 5-6.5 cm long, glabrous; floral bracts often caducous, boat-shaped, elliptic when flattened, 2.2-2.5 by 0.8-1.5 cm, creamy or brownish, glabrous, apex acuminate, margin involute. **Flowers** all opening at the same time, resupinate, 3.5-4 cm in diam.; pedicels 4-16 mm long, glabrous. **Sepals** creamy white or yellowish, glabrous, 7- or 9-veined; dorsal sepal elliptic-oblong, 2-2.2 by 0.6-0.8 cm, apex acute or obtuse; lateral sepals oblong-lanceolate, slightly falcate, 1.9-2.1 by 0.5-0.7 cm, apex acute, midrib strongly keeled. **Petals** linear-oblong, 1.9-2 by 0.2-0.3 cm, creamy white or yellowish, glabrous, 3- or 5-veined, apex acuminate. **Lip** 3-lobed, ovate when flattened, 1.8-2 by 1.3-1.5 cm; side lobes erect, 5-6 mm high, 1-1.1 cm long, forward edges obliquely obtuse, reddish brown except the margin; midlobe recurved, broadly clawed, orbicular or broadly elliptic-ovate, 8-9 by 7-8 mm, creamy white, with a brown central patch, apex acute or retuse with a short tip, margin crisped, slightly irregularly toothed; keels 5, creamy white, crenulate-undulate, minutely warty, 3 keels extending from the base of lip to near the tip of midlobe, 2 further lateral keels only present on the midlobe. **Column** slender, winged, broadening upwards, curved to the front, 1.4-1.5 cm high, apex hood-shaped; operculum  $\pm$  obovate in outline, bell-shaped, 2-2.5 by ca. 2 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, ca. 2 by 1 mm in each pollinium. **Stigma** semi-orbicular in outline, cup-shaped, margin elevated; rostellum semi-orbicular, ca. 2 by 3

mm. **Ovary** inferior, ridged, 5-6 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, distinctly ridged, obovoid or ellipsoid, 3.5-4 by 1.3-1.6 cm. **Seeds** numerous, lanceolate or oblong, 0.4-0.6 by 0.1-0.15 mm, creamy.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai; NORTH-EASTERN: Loei, Nong Khai, Phetchabun; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Phangnga, Trang, Yala.

**Distribution.**— Indochina, Myanmar, Peninsular Malaysia, Sumatra, Java and Moluccas.

**Ecology.**— On moist mossy cliffs or growing on tree trunks and branches, often locally abundant in both exposed and shady areas of the mountain ridges at 600-950 m alt., and also found in lowland evergreen forest. Common. Flowering in October-November, fruiting in December-October.

**Vernacular.**— Ueang Mak (เอื้องหมาก) (Northern).

**Specimens examined.**— BETONG: *J. Wai* 287 (PSU), 381 (PSU), 909 (PSU).

**107. *Coelogyne velutina*** de Vogel, Orchid Monogr. 6: 38, fig. 23, pl. 4d. 1992; D.A. Clayton, Gen. Coelogyne (Synopsis): 153, pl. 18B. 2002.— *C. tomentosa* Lindl. var. *penangensis* Hook.f., Fl. Brit. India 5: 830. 1890. **Plate 49C-D.**

Sympodial epiphyte or lithophyte; rhizome creeping, rather short, woody, between the pseudobulbs closed together to 1.5 cm apart, 8-15 mm in diam.; roots hairy when young. **Pseudobulbs** consisting of one internode, grooved, ovoid, 7.5-18 by 4-8 cm, greenish, bearing 2 leaves at the top, base enclosed with sheathing bracts. **Leaves** convolute, minutely hairy, not sheathing at the base; petiole grooved, 4-21 cm long; blade thinly coriaceous, rigid, plicate, oblanceolate, 22-60 by 7-16 cm, usually

dark green, with 5, 7 or 9 main veins, apex acuminate, base attenuate, margin undulate. **Inflorescences** heteranthous, loosely 5-35-flowered, pendulous, 25-90 cm long; peduncle enclosed with the scales of young shoot, 6-11 cm long, densely hairy; rachis slightly flexuous, 19-78 cm long, densely hairy; floral bracts persistent, boat-shaped, broadly elliptic when flattened, 1.3-2.1 by 0.9-1.9 cm, apex obtuse, margin involute, brownish or greenish, densely hairy. **Flowers** all opening at the same time, resupinate, 5-5.5 cm in diam.; pedicels 1.2-2.2 cm long, hairy. **Sepals** pale cream to pinkish cream, sparsely hairy outside, 7- or 9-veined, apex acute; dorsal sepal oblong or oblong-ob lanceolate, 2.5-3 by 0.7-0.9 cm; lateral sepals oblong-lanceolate, slightly falcate, 2.5-2.7 by 0.7-0.8 cm, midrib strongly keeled. **Petals** linear-ob lanceolate, 2.5-2.8 by 0.3-0.4 cm, pale cream to pinkish cream, glabrous, 3- or 5-veined, apex acute. **Lip** 3-lobed, broadly elliptic-ovate when flattened, 2.2-2.4 by 2.1-2.4 cm, outside pale cream to pinkish cream, inside brown with whitish veins, apical part brown on both sides; side lobes erect, 6-9 mm high, 1.7-2.2 cm long, forward edges obtuse or rounded, slightly recurved; midlobe strongly recurved, broadly ovate to orbicular, 7-8 by 9-10 mm, apex emarginate with a short tip, margin irregularly toothed; keels 5, prominent, yellowish (except for the apical part), 1-2 mm high, irregularly toothed, undulate, 3 keels extending from the base of lip to near the tip of midlobe, 2 further lateral keels only present on the midlobe. **Column** slender, winged, broadening upwards, curved to the front, 1.5-1.7 cm high, apex hooded; operculum  $\pm$  obovate in outline, bell-shaped, 3-3.5 by 2.5-3 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, ca. 2 by 1 mm in each pollinium. **Stigma** semi-orbicular in outline, margin elevated; rostellum semi-orbicular, 2.5-3 by 4-5 mm. **Ovary** inferior, ridged, 6-10 mm long, densely hairy, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, distinctly ridged, ellipsoid or obovoid, 4.5-5.5 by 2-2.5 cm. **Seeds** numerous, linear-elliptic, 1-2 by 0.1-0.2 mm, creamy.

**Thailand.**— PENINSULAR: Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On moist mossy cliffs or growing on tree trunks and branches, often locally abundant in both exposed and shady areas of the mountain ridges at 650-1,000 m alt. Rare. Flowering in January-March, fruiting in April-February. Floral visitors were mainly honey bees.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 157 (PSU), 587 (BCU, BKF, PSU).

**108. *Dendrobium acerosum*** Lindl., Edwards's Bot. Reg. 27 (Misc.): 42. 1841; Hook.f., Fl. Brit. India 5: 726. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 43. 1907; Fl. Malay Penins. 4: 38. 1924; Holttum, Rev. Fl. Malaya 1: 338, fig. 93. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 274, fig. 206. 1960; Seidenf., Opera Bot. 83: 239, fig. 162, pl. XXVI. 1985; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 423, fig. 192e-h. 1992. **Plate 49E-F.**

Sympodial epiphyte, without distinct rhizome. **Stems** flexuous, with many leaves, 5-10 cm or more long, 1-2 mm in diam.; internodes 5-10 mm long. **Leaves** distichous, slightly recurved, subterete, forming acute angles to the stem, glabrous, sheathing at the base; sheaths slightly longer than internodes; blade thick and fleshy, rigid, linear, 10-25 by 1-2 mm, light to dark green, apex acute. **Inflorescences** terminal or lateral from the leafless apical part of the stem, 1-flowered; floral bracts appressed, chaffy, elliptic-oblong, ca. 2.5 by 1 mm, glabrous, apex acute. **Flowers** borne in succession from small groups of bracts at nodes, resupinate, ca. 10 by 8 mm, creamy white; pedicels 7-8 mm long, glabrous. **Sepals** with purple veins, glabrous; dorsal sepal triangular-ovate, ca. 4 by 2 mm, 3-veined, apex acute; lateral sepals connate at the base and adnate to the column-foot forming a mentum, triangular-ovate, ca. 9 mm long from tip of mentum, ca. 3 mm wide, 4-veined, apex acute, base oblique. **Petals** oblong, ca. 4 by 1 mm, glabrous, 1-veined, apex obtuse. **Lip** without side lobes, obovate, ca. 9 by 5 mm, with a raised yellow patch in the middle, apex curved forwards, cleft. **Column** ca. 0.5 mm high; column-foot 6-7 mm long, with a small

gland at the base; operculum  $\pm$  orbicular, ca. 1 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, slightly falcate, ca. 0.7 by 0.3 mm in each pollinium. **Stigma**  $\pm$  elliptic in outline. **Ovary** inferior, ca. 2 mm long, greenish, with purple veins, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Phitsanulok; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Narathiwat, Yala.

**Distribution.**— Myanmar, Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing on tree trunks and branches in semi-exposed areas of the quartzitic phyllite ridges, alt. 650 m. Uncommon. Flowering in June.

**Vernacular.**— Kluai Mai Mue Nang (กล้วยไม้มือนาง) (Chumphon); Khao Phae (เขาแพะ) (Chanthaburi).

**Remarks.**— Only one plant was found in this study.

**Specimen examined.**— BETONG: *J. Wai* 784 (PSU).

**109. *Dendrobium bifarium*** Lindl., Gen. Sp. Orchid. Pl.: 81. 1830; Hook.f., Fl. Brit. India 5: 732. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 45. 1907; Fl. Malay Penins. 4: 42. 1924; Holttum, Rev. Fl. Malaya 1: 322. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 247. 1960; Seidenf., Bot. Tidsskr. 67: 103, fig. 24. 1972; Opera Bot. 83: 173, fig. 119, pl. XIXd. 1985; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 399, fig. 180a-c. 1992. **Plate 50A-B.**

Sympodial epiphyte, lithophyte or sometimes terrestrial plant; rhizome very short; roots stout, 1-3 mm in diam. **Stems** close together, erect or pendulous, slender,



fleshy, with many leaves, 15-70 cm long, 2-5 mm in diam.; internodes 5-15 mm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, sheathing at the base; sheaths as long as the internodes; blade thinly coriaceous, oblong to oblong-lanceolate, 1.5-3.6 by 0.4-1 cm, usually light green, apex acute, base twisted. **Inflorescences** lateral from the leafy stem, 1-flowered; floral bracts appressed, triangular-ovate, 1.5-3 by 1-2 mm, glabrous, apex acute to acuminate. **Flowers** borne in succession from small groups of bracts at the nodes, resupinate, ca. 1.5 cm in diam.; pedicels 5-8 mm long, glabrous. **Sepals** creamy white or greenish, glabrous; dorsal sepal ovate, 6-6.5 by 3-3.5 mm, 5-veined, apex acuminate, slightly recurved; lateral sepals connate at the base and adnate to the column-foot forming a mentum, ovate, 10-11 mm long from tip of mentum, 3-4 mm wide, 5-veined, apex acuminate, recurved, base oblique. **Petals** oblong-lanceolate, slightly falcate, 6-6.5 by 1.5-2 mm, creamy white or greenish, glabrous, 3-veined, apex acuminate. **Lip** without distinct side lobes, fleshy, obovate, 12-13 by 7-7.5 mm, with many warty ridges in the central part, creamy white with pale green in the middle, apex rounded or emarginate, base adnate to the edges of column-foot forming a spur. **Column** ca. 2 mm high; column-foot 4-5 mm long; operculum cup-like, subquadrangular, ca. 1 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-oblong, slightly falcate, 0.9-1 by 0.2-0.3 mm in each pollinium. **Stigma** ovate in outline. **Ovary** inferior, 3-4 mm long, creamy white, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Singapore, Sumatra, Borneo and Moluccas.

**Ecology.**— On moist mossy cliffs or on tree trunks and branches, growing on rocky or sandy heath soils with the litter of decaying leaves, often found in both partial shade and semi-exposed areas of the quartzitic phyllite ridges, alt. 600-700 m. Very rare in Thailand. Flowering all year round, more flowers in May-July.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 335 (PSU), 731 (BCU, PSU), 838 (PSU).

**110. *Dendrobium crumenatum*** Sw., J. Bot. (Schrader). 2: 237. 1799; Hook.f., Fl. Brit. India 5: 729. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 48. 1907; Fl. Malay. Penin. 4: 42. 1924; Holttum, Rev. Fl. Malaya 1: 329. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 259, fig. 195, pl. XI. 1960; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 349. 1968; Seidenf., Opera Bot. 83: 200, fig. 138. 1985; Opera Bot. 114: 248. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 409, fig. 185. 1992. **Plate 50C-D.**

Sympodial epiphyte or lithophyte, without distinct rhizome; roots stout, 1-3 mm in diam. **Stems** erect or pendulous, with many leaves, 40-70 cm long, swollen part (pseudobulbs) of 3 internodes near the base, fusiform, 7-10 cm long, 1-2 cm in diam., longitudinal ridged when old; internodes 1.5-4.5 cm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, sheathing at the base; sheaths as long as the internodes; blade fleshy, rigid, coriaceous, elliptic-oblong to oblong-lanceolate, 5-8.5 by 1-2.5 cm, light to dark green or reddish purple, apex retuse. **Inflorescences** lateral from the leafless apical part of the stem, 1-flowered; floral bracts appressed, chaffy, triangular-ovate, 4-8 by 3-5 mm, glabrous, apex acute. **Flowers** fragrant, lasting only one or two days, borne in succession from small groups of bracts at the nodes, resupinate, 3.5-4 cm in diam.; pedicels 1-1.2 cm long, glabrous. **Sepals** white, glabrous; dorsal sepal elliptic-oblong to oblong-lanceolate, 2-2.3 by 0.7-0.8 cm, 7-veined, apex acute, slightly recurved; lateral sepals connate at the base and adnate to the column-foot forming a mentum, triangular-lanceolate, 2.8-3.5 cm long from tip of mentum, 9-10 mm wide, 7-veined, apex acuminate, recurved, base oblique. **Petals** elliptic, ca. 2 by 0.8 cm, white, glabrous, 3- or 5-veined, apex obtuse or acute. **Lip** 3-lobed, elliptic or obovate when flattened, 2.7-3 by 1.5-1.7 cm, white with yellow keels in the middle; side lobes erect, ca. 5 mm high, ca. 2 cm long, forward edges obtuse or rounded, slightly recurved, entire or slightly undulate; midlobe recurved, broadly spatulate, orbicular to obovate or broadly elliptic-ovate, 1-1.1 by 1-1.2 cm, apex rounded to truncate with a short tip or acute, margin crisped, irregularly toothed; keels 5 or 3, extending from the base of lip to the middle of midlobe, crenulate-undulate and

prominent on the midlobe. **Column** 2.5-3 mm high; column-foot 1.5-1.6 cm long, with a small gland at the base; operculum cup-like, subquadrangular, ca. 2-2.5 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, lanceolate-falcate, 2-2.5 by 0.5-1 mm in each pollinium. **Stigma** suborbicular in outline. **Ovary** inferior, 3-5 mm long, greenish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** ellipsoid. **Seeds** not seen.

**Thailand.**— EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Krabi, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Satun, Songkhla, Pattani, Narathiwat, Yala.

**Distribution.**— India, China, Myanmar, Peninsular Malaysia and Philippines.

**Ecology.**— Growing on rocks, on the litter of decaying leaves or on tree trunks and branches, found in both exposed and shady areas of the quartzitic phyllite ridges, and also found in coastal heath forest, lowland evergreen forest, durian and rubber plantations, from sea level to 700 m alt. Very common. Flowering all year round, more flowers in rainy season.

**Vernacular.**— Nok Kayang (นกกระยาง) (Chon Buri); Buap Klang Hao (บัวบกกลางหา) (Chiang Mai); Sae Phra In (เส้าพระอินทร์) (Chanthaburi, Trat); Wai Tamoi (ห้วยตะมอย), Ueang Mali (เอื้องมะลิ) (Central, Peninsular).

**Specimens examined.**— BETONG: *J. Wai* 427 (PSU), 766 (PSU); PHANGNGA: *Ch. Laongpol* 805 (PSU); TRANG: *J.F. Maxwell* 85-280 (PSU); SONGKHLA: *J.F. Maxwell* 85-1153 (PSU); NARATHIWAT: *J.F. Maxwell* 87-496 (PSU).

**111. *Dendrobium farmeri*** Paxton, Mag. Bot. 15: 241. 1849; Hook.f., Fl. Brit. India 5: 750. 1890; Holttum, Rev. Fl. Malaya 1: 282, fig. 65. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 195. 1960; Seidenf., Opera Bot. 83: 26, fig. 10, pl. IId. 1985; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 365, fig. 161f-k, pl. 24c. 1992. **Plate 50E-G.**

Sympodial epiphyte or lithophyte, without distinct rhizome; roots stout, 2-3 mm in diam. **Pseudobulbs** of 6-9 internodes, more or less erect, with 3-4 leaves, fusiform, strongly 4-angled, thickened upwards from a slender base, up to 40 cm or more long, 1.5-3 cm in diam.; internodes 0.5-6 cm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, without distinct sheaths at the base; blade coriaceous, rigid, elliptic-oblong, 14-18.5 by 2.5-5 cm, green, apex acute to acuminate. **Inflorescences** lateral from near the apical part of stem, racemose, loosely many-flowered, pendulous, up to 30 cm or more long; peduncle 4-5.5 cm long, glabrous; peduncular bracts appressed, 4-6 mm long, glabrous, apex obtuse; rachis 13.5-22 cm long, glabrous; floral bracts appressed, oblong-lanceolate, 5-8 by 2.5-4 mm, glabrous, apex acute. **Flowers** showy, fragrant, long lasting, resupinate, 4-5 cm in diam.; pedicels 2-2.5 cm long, glabrous. **Sepals** white tinged purple, glabrous; dorsal sepal oblong-lanceolate or elliptic-oblong, 2.3-2.6 by 0.9-1.1 cm, 5- or 7-veined, apex obtuse, curved forwards; lateral sepals connate at the base and adnate to the column-foot forming a mentum, slightly concave, ovate-lanceolate or elliptic, 2.7-2.9 cm long from tip of mentum, 1-1.2 cm wide, 7-veined, apex acute, base oblique. **Petals** clawed, broadly ovate, 2.2-2.7 by 1.4-1.8 cm, white tinged purple, 5- or 7-veined, apex obtuse, margin finely fringed. **Lip** without distinct side lobes, clawed, with a fleshy thickening near the base, concave, ovate to suborbicular when flattened, 2-2.5 by 1.5-1.7 cm, apex obtuse, margin finely fringed, white tinged purple, with yellow in the middle, densely hairy. **Column** 3-4 mm high; column-foot 4-5 mm long, with a distinct hollow nectary; operculum cup-like, obovate or suborbicular, ca. 2-2.5 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, linear-oblong, slightly falcate, 1.5-2 by 0.2-0.3 mm in each pollinium. **Stigma** ovate or elliptic in outline. **Ovary** inferior, 8-10 mm long, creamy, yellowish or greenish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Chiang Mai; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Narathiwat, Yala.

**Distribution.**— Nepal, Sikkim, Bhutan, India, Vietnam, Myanmar and Peninsular Malaysia.

**Ecology.**— Growing on rocks or on tree trunks and branches, found in partial shade of the quartzitic phyllite ridges, alt. 600-700 m. Uncommon. Flowering in February-April.

**Vernacular.**— Ueang Mat Chanu (เอื้องมัจฉาณู) (General).

**Specimens examined.**— BETONG: *J. Wai* 609 (PSU), 621 (PSU).

**112. *Dendrobium leonis*** (Lindl.) Rchb.f., Ann. Bot. Syst. (Walpers) 6: 280. 1861; Hook.f., Fl. Brit. India 5: 723. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 41. 1907; Fl. Malay Penins. 4: 37. 1924; Holttum, Rev. Fl. Malaya 1: 334, fig. 90. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 272, fig. 204, pl. XII. 1960; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 355. 1968; Seidenf., Opera Bot. 83: 225, fig. 153, pl. XXVb. 1985; Opera Bot. 114: 252. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 417, fig. 189g-k, pl. 30b. 1992.— *Aporum leonis* Lindl., Edwards's Bot. Reg. 26 (Misc.): 59. 1840.— *Callista leonis* Kuntze, Revis. Gen. Pl. 2: 655. 1891. **Plate 51A-B.**

Sympodial epiphyte or lithophyte, without distinct rhizome. **Stems** flexuous, often pendulous, with many leaves, leafy to the apex, flattened, up to 15 cm long, 1-2.5 mm in diam.; internodes 2-10 mm long. **Leaves** distichous, laterally compressed, overlapping at the base, glabrous, sheathing at the base; sheaths as long as the internodes; blade thick and fleshy, rigid, asymmetrically triangular-ovate, 8-15 by 7-11 mm, olive to dark green or purplish, apex acute. **Inflorescences** terminal, 1-flowered; floral bracts appressed, chaffy, elliptic-ovate, 2-3 by 1.5-2 mm, glabrous, apex acute or obtuse. **Flowers** fragrant, borne in succession from small groups of

bracts, resupinate, ca. 1.5-2 cm in diam., yellowish or pale green, outside reddish purple or reddish brown; pedicels 2-3 mm long, glabrous. **Sepals** glabrous; dorsal sepal triangular-ovate, ca. 7 by 6 mm, 7-veined, apex obtuse; lateral sepals connate at the base and adnate to the column-foot forming a mentum, triangular-ovate, 1.3-1.4 cm long from tip of mentum, 9-10 mm wide, 3-veined, apex obtuse, base oblique. **Petals** elliptic, ca. 6 by 4 mm, glabrous, 3-veined, apex obtuse to rounded. **Lip** without side lobes, curved forwards, fleshy, oblong-obovate, 12-13 by 7-8 mm, with a papillose patch at the tip, apex emarginate with a short tip, margin of apical part irregularly toothed, yellowish, with scattered reddish purple or reddish brown spots. **Column** very short; column-foot curved, ca. 1 cm high; operculum cup-like, ovate or suborbicular, ca. 2 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, elliptic, slightly falcate, 0.8-1.3 by 0.5-0.7 mm in each pollinium. **Stigma** suborbicular in outline. **Ovary** inferior, 3-5 mm long, greenish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Lampang; NORTH-EASTERN: Loei, Sakon Nakhon, Nakhon Phanom; EATERN: Ubon Ratchathani; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Indochina, Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Growing on rocks or on tree trunks and branches in partial shade of the quartzitic phyllite ridges, and also found in lowland evergreen forest, alt. 300-700 m. Uncommon. Flowering all year round, more flowers in rainy season.

**Vernacular.**— Ueang Ta Khap Yai (เอื้องตะขาบใหญ่) (General).

**Specimens examined.**— BETONG: *J. Wai* 286 (PSU), 360 (PSU), 583 (PSU); SONGKHLA: *J.F. Maxwell* 85-760 (PSU).

**113. *Dendrobium metrium*** Kraenzl. in Pflanzenr. (Engler) 45: 221. 1910; Ridl., Fl. Malay Penins. 4: 45. 1924; Holttum, Rev. Fl. Malaya 1: 314, fig. 79. 1953; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 368, fig. 162a-b. 1992.— *D. modestum* Ridl. (non Rchb.f.), J. Bot. 36: 211. 1898, nom. illeg.; Mat. Fl. Malay. Penins. 1: 50. 1907.

**Plate 51C-D.**

Sympodial lithophyte or sometimes terrestrial plant, without distinct rhizome; roots slender, 0.5-1 mm in diam. **Stems** erect or creeping, slender, fleshy, with many leaves, up to 40 cm long; internodes 1-3.5 cm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, sheathing at the base; sheaths as long as the internodes or slightly longer or shorter than the internodes; blade thin, linear-lanceolate, 3.5-7 by 0.4-0.9 cm, green, apex obliquely acute. **Inflorescences** lateral, near the apical part of stem, 1-2-flowered; peduncle 3-5 mm long, glabrous; peduncular bracts appressed, triangular-ovate, ca. 3 by 2.5 mm, glabrous, apex obtuse or acute; floral bracts appressed, ovate, ca. 3 by 2 mm, apex acuminate, glabrous. **Flowers** fragrant, resupinate, 1.5-2 cm in diam.; pedicels 6-7 mm long, glabrous. **Sepals** white, often tinged with purple outside and with greenish tips, glabrous; dorsal sepal narrowly triangular-ovate or oblong, 10-11 by ca. 4 mm, 5-veined, apex acute or obtuse; lateral sepals connate at the base and adnate to the column-foot forming a mentum, narrowly triangular-ovate, 1.6-1.8 cm long from tip of mentum, 4-5 mm wide, 5-veined, apex acute, base oblique. **Petals** narrowly elliptic-oblong, 9-10 by 2.5-3 mm, white, glabrous, 3- or 5-veined, apex acute. **Lip** without distinct side lobes, clawed, concave, rhombic-elliptic when flattened, 1.5-1.8 by 0.8-1 cm, white, with purple stripes and a fleshy yellow band in the middle, hairy, apex acute, slightly recurved, margin slightly undulate, irregularly toothed except the basal part. **Column** 2.5-3 mm high, white; column-foot 8-8.5 mm long; operculum cup-like, suborbicular, ca. 1 mm in diam., minutely papillose. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, oblong-lanceolate, slightly falcate, 0.8-1 by ca. 0.3 mm in each pollinium. **Stigma** ovate in outline, margin purple. **Ovary** inferior, 3-5 mm long, greenish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, obovoid, 2.2-2.4 by 0.7-0.8 cm. **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia.

**Ecology.**— On moist mossy rocks or growing on the litter of decaying leaves, found in partial shade of the quartzitic phyllite ridges, alt. 650-700 m. Very rare. Flowering in April-May, fruiting in June-August.

**Vernacular.**—

**Remarks.**— *Dendrobium metrium* Kraenzl., a new record of Thailand, was formerly endemic to Peninsular Malaysia. This species was recorded in Malaysian states of Penang and Pahang (Seidenfaden and Wood, 1992).

**Specimens examined.**— BETONG: *J. Wai* 685 (PSU), 734 (BCU, BKF, PSU), 805 (PSU).

**114. *Dendrobium pachyglossum*** E.C. Parish & Rchb.f., Trans. Linn. Soc. London 30(1): 149. 1874; Hook.f., Fl. Brit. India 5: 727. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 44. 1907; Fl. Malay Penins. 4: 40. 1924; Holttum, Rev. Fl. Malaya 1: 342. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 281. 1960; Seidenf., Opera Bot. 83: 251, fig. 169, pl. XXVIIId. 1985; Opera Bot. 114: 254. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 429, fig. 195d-h. 1992.— *Callista pachyglossa* (E.C. Parish & Rchb.f.) Kuntze, Revis. Gen. Pl. 2: 655 (1891).— *Conostalix pachyglossa* (E.C. Parish & Rchb.f.) Rauschert, Feddes Repert. 94(7-8): 444. 1983. **Plate 51E-F.**

Sympodial epiphyte or lithophyte, without distinct rhizome. **Stems** slightly flexuous, erect or pendulous, with many leaves, up to 40 cm or more long, 1-4 mm in diam.; internodes 4-20 mm long. **Leaves** distichous, spreading at acute angles to the stem, dorso-ventrally flattened, sheathing at the base; sheaths brown, slightly longer than the internodes, covered with blackish hairs; blade fleshy, linear, adaxially sulcate to concave, 4-7 by 0.1-0.2 cm, olive green to dark green, apex acute. **Inflorescences**



lateral from the nodes of leafy stem, 1-3-flowered; peduncle 1-2 mm long, glabrous; peduncular bracts appressed, narrowly triangular-ovate, 3-3.5 by 1-1.5 mm, covered with blackish hairs, apex acute; floral bracts appressed, narrowly triangular-ovate, 1.5-2 by 0.5-1 mm, covered with blackish hairs, apex acute. **Flowers** long lasting, resupinate, 8-9 mm in diam.; pedicels 1-1.5 mm long, glabrous. **Sepals** yellowish or flesh-coloured, with brownish veins, glabrous; dorsal sepal slightly concave, elliptic-oblong, 4-4.5 by ca. 2 mm, 3- or 5-veined, apex acute to short acuminate; lateral sepals connate at the base and adnate to the column-foot forming a mentum, oblong, 8-8.5 mm long from tip of mentum, ca. 2.5 mm wide, 5-veined, apex acute to short acuminate, base oblique. **Petals** yellowish or flesh-coloured, with a brownish vein, linear-oblong, 3.5-4.5 by ca. 0.5 mm, glabrous, 1-veined, apex acute. **Lip** 3-lobed, clawed, obovate when flattened, 8-8.5 by 4.5-5 mm, base adnate to the edges of column-foot forming a spur; side lobes erect, 1-1.5 mm high, 7-7.5 mm long, forward edges rounded; midlobe  $\pm$  semi-orbicular, ca. 1 by 2 mm, slightly warty, apex emarginate; keels 2, extending from the base of lip to the base of midlobe. **Column** 2.5-3 mm high, creamy white; column-foot 4-4.5 mm long; operculum cup-like, subquadrangular, ca. 1 mm in diam., minutely papillose. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, narrowly oblong to oblong-lanceolate, 0.8-0.9 by 0.2-0.25 mm in each pollinium. **Stigma** ovate to suborbicular in outline. **Ovary** inferior, 3-3.5 mm long, brownish or flesh-coloured, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Phitsanulok; EASTERN: Si Sa Ket; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Ranong, Yala.

**Distribution.**— Laos, Vietnam, Myanmar, Peninsular Malaysia and Borneo.

**Ecology.**— On mossy rocks, found in semi-exposed areas of the granitic ridges at 900-1,000 m alt., and also found on tree trunks and branches in lower montane forest. Uncommon. Flowering in September-November.

**Vernacular.**— Ueang Khon Mu (เอื้องชนหมู) (General).

**Specimen examined.**— BETONG: *J. Wai* 307 (PSU).

**115. *Dendrobium sanguinolentum*** Lindl., Edwards's Bot. Reg. 28 (Misc.): 62. 1842; Hook.f., Fl. Brit. India 5: 731. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 55. 1907; Fl. Malay Penins. 4: 50. 1924; Holttum, Rev. Fl. Malaya 1: 314, fig. 79. 1953; Seidenf., Opera Bot. 83: 163, fig. 111. 1985; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 371, fig. 163a-b. 1992. **Plate 52A-B.**

Sympodial epiphyte or lithophyte, without distinct rhizome. **Stems** erect or horizontal to pendulous, fairly stout, fleshy, with many leaves, up to 100 cm or more long; internodes 1.5-4.5 cm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, sheathing at the base; sheaths as long as the internodes or slightly longer than the internodes, purplish; blade coriaceous, oblong-lanceolate or elliptic to elliptic-oblong, 4.5-12 by 1.3-3.5 cm, green, purplish when young, apex acute. **Inflorescences** lateral from the apical part of the leafless stem, 2-3-flowered; peduncle 4-7 mm long, glabrous; peduncular bracts appressed, triangular-ovate, 5-6 by 3-4 mm, glabrous, apex acute or acuminate; floral bracts appressed, triangular or ovate, 3-5 by 1.5-3 mm, glabrous, apex acute or acuminate. **Flowers** showy, yellowish cream, with or without purple tips of sepals, petals and lip, fragrant, long lasting, resupinate, 3-3.8 cm in diam.; pedicels 1-1.5 cm long, creamy white, glabrous. **Sepals** glabrous; dorsal sepal oblong-ovate, 17-18 by 8.5-9 mm, 5-, 7- or 9-veined, apex obtuse; lateral sepals connate at the base and adnate to the column-foot forming a mentum, oblong-ovate, 2.6-2.9 cm long from tip of mentum, 9-10 mm wide, 7- or 9-veined, apex obtuse, base oblique. **Petals** obovate, 1.5-1.8 by 1-1.2 cm, glabrous, 5-veined, apex slightly emarginate. **Lip** 3-lobed, with a orange patch in the middle, clawed,  $\pm$  flabellate when flattened, 2.9-3.2 by 2.1-2.6 cm, with a spine-like appendage near the base, the appendage bent downward, 4-5 mm long; side lobes erect, rounded, 7-8 mm high, 15-17 mm long; midlobe broad,  $\pm$  semi-orbicular, 6-7 by 12-13 mm, apex retuse or emarginate. **Column** short; column-foot 1.1-1.2 cm long; operculum cup-like, subquadrangular, 2-3 mm in diam., minutely papillose. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, flattened, ovate, 1.5-1.8 by 0.8-1 mm in each pollinium. **Stigma** ovate or elliptic in outline, margin purplish, ciliate. **Ovary** inferior, 8-10 mm

long, creamy white or purplish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Pattani, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java and Borneo.

**Ecology.**— Growing on rocks or on the litter of decaying leaves, found in semi-exposed areas of the granitic ridges at 900-1,000 m alt., and also found on tree trunks in evergreen lowland forest and rubber plantation. Uncommon. Flowering almost all year round, more flowers in rainy season.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 58 (PSU), 510 (PSU), 542 (PSU).

**116. *Dendrobium tortile*** Lindl., Gard. Chron.: 797. 1847; Hook.f., Fl. Brit. India 5: 744. 1890; Ridl., Fl. Malay Penins. 4: 52. 1924; Holttum, Rev. Fl. Malaya 1: 294, fig. 71. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 215, fig. 165. 1960; Seidenf., Opera Bot. 83: 77, fig. 43, pl. Xa. 1985; Opera Bot. 114: 234. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 383, fig. 172a-f, pl. 26b. 1992.— *D. haniffii* Ridl. ex Burkill, Gard. Bull. Straits Settlem. 3: 295. 1924; Ridl., Fl. Malay Penins. 4: 51. 1924. **Plate 52C-D.**

Sympodial epiphyte or lithophyte; rhizome short creeping, between shoots (erect stems) up to 1.5 cm apart, ca. 5 mm in diam.; roots slender, 1-2 mm in diam. **Stems** with 6-13 internodes, erect or horizontal to pendulous, with many leaves, slightly flattened, thickened at the middle, up to 60 cm or more long, 1-1.5 cm in diam., yellowish or greenish; internodes 1-5.5 cm long. **Leaves** distichous, dorso-ventrally flattened, glabrous, sheathing at the base; sheaths as long as the internodes or slightly longer or shorter than the internodes; blade coriaceous, elliptic-oblong, 7-14 by 1-2.5 cm, usually light or yellowish green, apex unequally bilobed. **Inflorescences**

lateral near the apical part of stem, 1-2-flowered; peduncle 1.5-2 cm long, glabrous; peduncular bracts appressed, triangular, 4-5 by 6-10 mm, glabrous, apex obtuse; floral bracts appressed, triangular, 4.5-5 by 4-5 mm, glabrous, apex acuminate. **Flowers** showy, fragrant, long lasting, resupinate, 7-8 cm in diam., pale lilac; pedicels 3.5-4.5 cm long, glabrous. **Sepals** twisted, glabrous; dorsal sepal linear-oblong or linear-lanceolate, ca. 4 by 0.8 cm, 5- or 7-veined, apex obtuse; lateral sepals connate at the base and adnate to the column-foot forming a mentum, linear-lanceolate, 4.2-4.5 cm long from tip of mentum, 8-9 mm wide, 7-veined, apex acute or obtuse, base oblique. **Petals** twisted, oblong to oblong-lanceolate, 4-1.2 by 1.2-1.3 cm, glabrous, 5- or 7-veined, apex acute. **Lip** without distinct side lobes, clawed, with a fleshy thickening at the base, broadly elliptic to orbicular when flattened, concave, 3.9-4 by 3.2-3.4 cm, white tinged purple, with purple veins at the base, densely hairy, apex acute or obtuse, recurved, margin undulate, minutely toothed. **Column** ca. 5 mm high; column-foot 6-7 mm long; operculum cup-like, obovate, ca. 2.5 by 2 mm, minutely papillose. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, lanceolate, slightly falcate, 1.5-2 by ca. 0.3 mm in each pollinium. **Stigma** ovate or elliptic in outline. **Ovary** inferior, 8-10 mm long, purplish, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Yala.

**Distribution.**— Indochina, Myanmar and Peninsular Malaysia.

**Ecology.**— Growing on mossy rocks, on the litter of decaying leaves or on tree trunks, found in exposed areas of mountain ridges, alt. 600-900 m. Uncommon. Flowering in January-April.

**Vernacular.**— Tin Nok (ตีนนก) (Chiang Mai); Ueng Mai Tueng (เอื้องไม้ตึง) (Mae Hong Son); Ueng Kao Kio (เอื้องเต่ากิว), Ueng Kao Kio Mae Sarieng (เอื้องเต่ากิวแม่สะเรียง) (Northern).

**Specimens examined.**— BETONG: *J. Wai* 543 (PSU), 667 (PSU), 974 (PSU).

**117. *Dendrobium* sp.**

***Plate 52E-F.***

Sympodial epiphyte, lithophyte or sometimes terrestrial plant, without distinct rhizome. **Stems** slightly flexuous, horizontal to pendulous, usually erect when young, with many leaves, up to 55 cm or more long, 5-7 mm in diam.; internodes 1-2.5 mm long. **Leaves** distichous, spreading at  $\pm$  right angle to the stem, dorso-ventrally flattened, sheathing at the base; sheaths brown, slightly longer than the internodes, covered with blackish hairs; blade rigid, coriaceous, narrowly lanceolate to oblong-lanceolate, 2.5-5.5 by 1-1.5 cm, olive green to dark green, covered with blackish hairs, apex reflexed, unequally bilobed. **Inflorescences** lateral from the nodes of leafy stem or rarely on a leafless stem, 2-3-flowered; peduncle 1.5-2 mm long, glabrous; peduncular bracts appressed, triangular, 1.5-2 by 1-1.5 mm, covered with blackish hairs, apex acute; floral bracts appressed, triangular, ca. 1.5 by 1 mm, subglabrous, apex acute. **Flowers** long lasting, resupinate, 1.2-1.3 cm in diam., yellowish or flesh-coloured, with brownish veins; pedicels ca. 3 mm long, glabrous. **Sepals** glabrous; dorsal sepal slightly concave, elliptic-oblong, ca. 5 by 3 mm, 3- or 5-veined, apex acute to short acuminate; lateral sepals connate at the base and adnate to the column-foot forming a mentum, oblong, 11-12 mm long from tip of mentum, ca. 3 mm wide, 5-veined, apex acute to short acuminate, base oblique. **Petals** linear-oblong or linear-oblong-lanceolate, 5-5.5 by ca. 1 mm, glabrous, 1-veined, apex acute. **Lip** 3-lobed, clawed, obovate when flattened, 11-12 by 5-5.5 mm, base adnate to the edges of column-foot forming a spur; side lobes erect, 1.5-2 mm high, 10-11 mm long, forward edges acute or obtuse, slightly recurved; midlobe  $\pm$  semi-orbicular, 1.5-2 by 3-3.5 mm, apex truncate or emarginate, margin irregularly crenate-undulate; keels 3, yellowish, 2 lateral keels extending from the base of lip to the base of midlobe, median keel short, not reaching to the base. **Column** 3-3.5 mm high; column-foot 5-6 mm long; operculum cup-like, subquadrangular, 1-1.5 mm in diam., minutely papillose. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, narrowly oblong-lanceolate, 0.8-1 by 0.2-0.25 mm in each pollinium. **Stigma** ovate or elliptic in outline. **Ovary** inferior, 4-5 mm long, flesh-coloured, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Known only from this study.

**Ecology.**— On tree trunks or on rocks, growing on the litter of decaying leaves, found in partial shade of the quartzitic phyllite ridges, alt. 650-700 m. Very rare. Flowering in August-February.

**Vernacular.**—

**Remarks.**— This unidentified species belonging to the section *Conostalix* Kraenzl. due to the slender wiry stem and blackish hairy leaf-sheaths, it shares some vegetative characters to *Dendrobium villosulum* Lindl., however, the former is differed from the latter in floral characters. In fact, the flower characters of this species resemble *Dendrobium pachyglossum* E.C. Parish & Rchb.f. in some aspects, i.e. the prominent keels in the middle of lip. In any case, this species differs from the other species in the section *Conostalix* Kraenzl. in having different details of the floral parts, especially, the lip. It is probably to be a new species. More collections, field observations and population studies of this unidentified species in Thai-Malay Peninsula are strongly needed.

**Specimens examined.**— BETONG: *J. Wai* 288 (PSU), 865 (PSU).

**118. *Dienia ophrydis*** (J. Koenig) Ormerod & Seidenf., Contrib. Orchid Fl. Thailand 13: 18. 1997; Marg. & Kowalk., Ann. Bot. Fenn. 45: 99. 2008.— *Epidendrum ophrydis* J. Koenig in Observ. Bot. (Retzius) 6: 46. 1791.— *Malaxis latifolia* Sm. in Rees. Cyclo. 22: 3. 1812; Seidenf. & Smitinand, Orchids Thailand 2: 146, fig. 112. 1959; Seidenf., Dansk Bot. Ark. 33(1): 45, fig. 35. 1978; Opera Bot. 114: 146. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 219, fig. 93a-c, pl. 13b. 1992.— *Microstylis congesta* Rchb.f., Ann. Bot. Syst. (Walpers) 6: 206. 1861; Ridl., Mat. Fl. Malay. Penins. 1: 14. 1907; Fl. Malay Penins. 4: 12. 1924.— *Malaxis ophrydis* (J. Koenig) Ormerod in Descr. Epidendrorum J. Koenig: 18. 1995.— *Crepidium ophrydis*

(J. Koenig) M.A. Clem. & D.L. Jones, *Lasianthera* 1: 38. 1996.— *Dienia latifolia* (Sm.) M.A. Clem. & D.L. Jones, *Lasianthera* 1(1): 41. 1996.— *D. montana* (Blume) M.A. Clem. & D.L. Jones, *Lasianthera* 1(1): 41. 1996. **Plate 53A-D.**

Sympodial terrestrial plant, without distinct rhizome. **Stems** elongated, erect, fleshy, 3-6-leaved, 7-15 cm long, ca. 1 cm in diam. **Leaves** persistent, duplicate, glabrous, sheathing at the base; sheaths covering the stem, 3-12 cm long; blade thin, plicate, elliptic, 5.5-15 by 2-5.5 cm, usually light green, apex acuminate, margin undulate, base attenuate. **Inflorescences** terminal, erect, many-flowered, 15-35 cm long; peduncle ribbed, 10-26 cm long, glabrous; rachis ridged, 5-9 cm long, glabrous; peduncular bracts and floral bracts usually reflexed, linear-triangular, 4-5 by 0.5-1 mm, glabrous, apex acute. **Flowers** non-resupinate, ca. 5 mm in diam., reddish purple; pedicels 1-1.5 mm long, ribbed, glabrous. **Sepals** glabrous; dorsal sepal oblong, ca. 3.5 by 1 mm, 1-veined, apex obtuse, margin recurved; lateral sepals reflexed or curved forwards, elliptic, slightly falcate, ca. 3.5 by 1.5 mm, 2-veined, apex obtuse. **Petals** linear-oblong, ca. 3.5 by ca. 0.5 mm, glabrous, 1-veined, apex obtuse. **Lip** with a hollow near the base, 3-lobed, ovate when flattened, 2.5-3 by ca. 2 mm; side lobes erect, ca. 1 mm high, ca. 1.5 mm long, forward edges obtuse, base clasping the column; midlobe ovate, 1 by 0.5 mm, apex obtuse. **Column** 1.5-2 mm high; operculum on the back of the column, broad,  $\pm$  suborbicular, 0.45-0.55 by ca. 0.3 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, ovate-lanceolate, 0.25-0.3 by ca. 0.1 mm in each pollinium. **Stigma** semi-elliptic in outline. **Ovary** inferior, 2-2.5 mm long, green, with reddish purple ribs, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, ellipsoid, 6-7 by 3-4 mm. **Seeds** numerous, narrowly lanceolate to linear-oblong, ca. 0.5 by 0.1 mm, creamy.

**Thailand.**— NORTHERN: Chiang Mai, Nakhon Sawan; EASTERN: Nakhon Ratchasima; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Chumphon, Surat Thani, Phangnga, Nakhon Si Thammarat, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Sri Lanka, China, Malaysia, Philippines, through Indonesia and new Guinea to Australia.

**Ecology.**— Growing on rocky or sandy heath soils with the decaying organic matter in partial or deep shade of the quartzitic phyllite ridges, and also found in lowland evergreen forest and rubber plantation, from near sea level to 650 m alt. Common. Flowering in May-July, fruiting in July-December.

**Vernacular.**— Pro Nok Khum (เปราะนกกุ่ม), Si Khun Khon (สีขุนคณ) (General); Hu Tan (หุตัน) (Malay-Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 356 (PSU), 762 (BCU, PSU); NARATHIWAT: *K. Larsen et al.* 42999 (PSU).

**119. *Dipodium pictum*** (Lindl.) Rchb.f., *Xenia Orchid.* 2: 15. 1865; Hook.f., *Fl. Brit. India* 6: 19. 1890; Ridl., *Mat. Fl. Malay. Penins.* 1: 141. 1907; *Fl. Malay Penins.* 4: 147. 1924; Holttum, *Rev. Fl. Malaya* 1: 513, fig. 148. 1953; Seidenf. & J.J. Wood, *Orchids Pen. Mal. & Sing.*: 553. 1992; Seidenf., *Opera Bot.* 124: 58, pl. 11d. 1995.— *Waillesia picta* Lindl., *J. Hort. Soc. London* 4: 261. 1849. **Plate 53E-G.**

Monopodial epiphyte, lithophyte or sometimes terrestrial plant. **Stem** elongated, scandent, up to 10 m or more long, terete, ca. 1.5 cm in diam., internodes 0.5-1.5 cm long. **Leaves** distichous, duplicate, glabrous, sheathing at the base; sheaths overlapping and covering the stem, 10-15 cm long; blade thinly coriaceous, rigid, linear-oblong, 30-35 by 2-3 cm, yellowish to light green or rarely dark green, apex obliquely acute. **Inflorescences** lateral near the apical part of stem, erect or suberect, many-flowered, up to 30 cm or more long; peduncle stout, fleshy, 10-15 cm long, glabrous, 5 mm in diam.; rachis fleshy, 15-20 cm long, glabrous; floral bracts fleshy, appressed, triangular, 4-8 by 3-8 mm, glabrous, apex acute. **Flowers** resupinate, 4-4.5 cm in diam., creamy white or pale yellowish, with brownish or reddish spots, the spots of the sepals and petals more deeply coloured on the outside than on the inside; pedicels 1-1.7 cm long, glabrous. **Sepals** oblanceolate, 2.2-2.3 by 0.5-0.6 cm, glabrous, 5- or 7-veined, apex obtuse. **Petals** oblanceolate, 2.1-2.2 by ca. 0.5 cm, glabrous, 5-veined, apex obtuse. **Lip** 3-lobed, ca. 1.8 cm long, hairy, base adnate to the column forming a small sac-like; side lobes erect, ligulate, ca. 5 by 1.5 mm, forward



edges obtuse or rounded, subglabrous; midlobe folded, sides deflexed, elliptic when flattened, ca. 13 by 5 mm, apex acute, upcurved; median keel hairy, divided into 2 branches at the base of midlobe, apical half densely covered with villous hairs, basal part papillose. **Column** thick, slightly winged, ca. 7 mm high, hollow at the base and hairy in the front; operculum on the back of the column, cap-like, elliptic-ovate, ca. 2.5 by 2 mm. **Pollinia** 2, equally sized, solid, cleft, depressed-globular, 0.8-1 mm in diam. in each pollinium; stipe present, V-shaped, ca. 2 mm long; viscidium broad. **Stigma** suborbicular or elliptic in outline. **Ovary** inferior, 1.3-1.8 cm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, cylindrical, oblong-obovoid, 7.5 by 1.5 cm, glabrous. **Seeds** not seen.

**Thailand.**— PENINSULAR: Chumphon (cultivated?), Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia, Sumatra, Java, Borneo and Philippines.

**Ecology.**— Climbing on tree trunks and rocks or growing on the litter of decaying leaves, usually found in mossy places and in partial or deep shade of the mountain ridges, alt. 600-1,000 m. Very rare in Thailand. Flowering in March-April, fruiting in May-June.

**Vernacular.**— Ueang Kra (เอื้องกระ) (Narathiwat).

**Remarks.**— In the keys and descriptions of the previous treatments, the shape of the side lobes of lip is described as triangular and acute at apex, but the specimens collected in the present study have ligulate and obtuse side lobes of lip.

**Specimen examined.**— BETONG: *J. Wai* 692 (PSU).

**120. *Epigeneium geminatum*** (Blume) Summerh., Kew Bull. 12(2): 262. 1957; Seidenf., Dansk Bot. Ark. 34(1): 78, fig. 37. 1980; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 351, fig. 155a-c, pl. 22d. 1992.— *Desmotrichum geminatum* Blume, Bijdr. Fl. Ned. Ind. 7: 332. 1825.— *Dendrobium geminatum* (Blume) Lindl., Gen. Sp. Orchid. Pl.: 77. 1830; Hook.f., Fl. Brit. India 5: 713. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 35. 1907; Holttum, Rev. Fl. Malaya 1: 273, fig. 60. 1953; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 355. 1968.— *Sarcopodium geminatum* (Blume) Rolfe, Orchid Rev. 18: 238. 1910; Ridl., Fl. Malay Penins. 4: 28. 1924. **Plate 54A-B.**

Sympodial epiphyte, lithophyte or sometimes terrestrial plant; rhizome creeping, woody, with 5-6 internodes between the pseudobulbs, up to 5.5 cm apart, 3-4 mm in diam. **Pseudobulbs** consisting of one internode, shiny, narrowly ovoid, 2-3 by 0.6-1 cm, green or brownish, bearing 2 leaves at the top, base covered with brown sheaths when young. **Leaves** duplicate, glabrous, not sheathing at the base, sessile; blade coriaceous, rigid, oblong, 7.5-11 by 1.4-2 cm, green, apex minutely unequally bilobed, base cuneate. **Inflorescences** terminal, usually 2 together on one pseudobulb, loosely 3-5-flowered, slightly to moderately drooping, 7.5-8.5 cm long; peduncle 2.5-2.6 cm long, glabrous; peduncular bracts appressed, triangular-oblong, 6-8 by 2-4 mm, glabrous, apex acuminate; rachis 2.9-3.5 cm long, glabrous; floral bracts persistent, appressed, triangular-ovate, 4-5 by ca. 1.5 mm, glabrous, apex acuminate. **Flowers** all opening at the same time, long lasting, resupinate, ca. 3 cm in diam.; pedicels 6-8 mm long, glabrous. **Sepals** white, glabrous; dorsal narrowly oblong-lanceolate, 16-18 by ca. 4 mm, 5-veined, apex acute; lateral sepals lanceolate, slightly falcate, 15.5-17.5 by 4-5 mm, 5-veined, apex acute, base to the column-foot. **Petals** linear-oblong, slightly falcate, 15-17 by 2-2.5 mm, white, glabrous, 3- or 5-veined, apex acute. **Lip** 3-lobed, pandurate-elliptic when flattened, 10.5-11.5 by 6-6.5 mm, with 3 thickened ridges near the base and 2 lobulate calli at the base; side lobes purplish or reddish brown, erect, ca. 2.5 mm high, 6-6.5 mm long, forward edges rounded; midlobe with warty-papillose band in the middle, white, the basal part yellowish with some reddish marks, elliptic, 6-6.5 by ca. 3 mm, apex acute, slightly recurved. **Column** winged, slightly curved to the front, 5-5.5 mm high; column-foot 3-4 mm long; operculum rectangular-oblong in outline, 1.5-1.8 by ca. 1 mm. **Pollinia** 4, equally sized, arranged in 2 pairs, solid,

oblong-lanceolate, slightly falcate, 0.75-0.9 by 0.25-0.35 mm in each pollinium. *Stigma*  $\pm$  suborbicular in outline. *Ovary* inferior, 1-1.1 cm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. *Fruit* and *Seeds* not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia, Java and Borneo.

**Ecology.**— Growing on tree trunks, on moist mossy rocks or on the litter of decaying leaves, usually found in shady areas of the quartzitic phyllite ridges at 650-700 m alt. Very rare in Thailand. Flowering in October-November.

**Vernacular.**—

**Remarks.**— This species is a new record for Thailand.

**Specimen examined.**— BETONG: *J. Wai* 1079 (PSU).

**121. *Eria pulchella*** Lindl., Edwards's Bot. Reg. 27 (Misc.): 52. 1841; Hook.f., Fl. Brit. India 5: 801. 1890; Holttum, Rev. Fl. Malaya 1: 372. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 293, fig. 221. 1960; Backer & Bakh.f., Fl. Java (Spermatoph.) 3: 336. 1968; Seidenf. Opera Bot. 62: 51, fig. 24, pl. IIIc. 1982; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 275, fig. 118, pl. 17c. 1992. **Plate 54C-D.**

Sympodial epiphyte or lithophyte; rhizome creeping, between the pseudobulbs with 5-7 internodes, 2-15 cm apart, 2.5-5 mm in diam.; roots slender, hairy when young. *Pseudobulbs* consisting of (1-)2-3 internodes, rather laterally flattened, ridged, ovate or oblong, 3-12 by 1-2.5 cm, bearing (1-)2-3 leaves near the top, base covered with sheaths. *Leaves* distichous, dorso-ventrally flattened, duplicate, glabrous, not sheathing at the base; blade coriaceous, elliptic to elliptic-lanceolate or oblong, 8-15.5 by 2-4 cm, yellowish or light to dark green, apex minutely retuse, slightly oblique,

base attenuate. **Inflorescences** terminal or lateral, erect, bearing a succession of many flowers, 1-2 flowers at a time, 3.5-7 cm long, densely covered with white wooly hairs; peduncle 2-3.5 cm long, hairy; sterile bract 1, clasping, ca. 2 mm long, hairy, apex obtuse; rachis 1-2.5 cm long, hairy; floral bracts recurved, broadly elliptic-ovate, ca. 4 by 3.5 mm, hairy, apex obtuse. **Flowers** resupinate, 2-2.3 cm in diam., yellowish or orange; pedicels 5-9 mm long, hairy. **Sepals** 7-veined, hairy; dorsal sepal elliptic-oblong, 12-14 by ca. 5 mm, apex acute to obtuse or minutely retuse; lateral sepals elliptic-ovate, slightly falcate, 10-12 by 5-5.5 mm, apex acute, base adnate to the column-foot. **Petals** elliptic-oblong, slightly falcate, 10-11 by 3.5-4.5 mm, hairy, 5-veined, apex obtuse. **Lip** hinged with the column-foot, highly mobile, cordate or suborbicular, ca. 5 by 6.5 mm, hairy, pale brown or orange, with a raised dark brown or deeply reddish brown patch in the middle, divided into 3 ridges at the base, apex obtuse or rounded, margin recurved. **Column** slender, strongly curved to the front, 6-6.5 mm long; column-foot with a dark brown callus, 3-3.5 mm high; operculum suborbicular, ca. 1.5 mm in diam. **Pollinia** 8, arranged in 2 groups of 4, solid, subquadrangular or suborbicular, 0.6-0.7 mm in diam. in each pollinium. **Stigma** cordate or suborbicular in outline. **Ovary** inferior, 6-9 mm long, densely covered with white wooly hairs, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Laos, Myanmar, Peninsular Malaysia, Sumatra, Java, Borneo and Sulawesi.

**Ecology.**— Growing on the cliffs in both exposed and shady areas of quartzitic phyllite ridges, and also found on tree trunks in coastal heath and lowland evergreen forests, from sea level to 700 m alt. Uncommon. Flowering almost all year round, more flowers in rainy season.

**Vernacular.**— Nuan Phong (นวลฟ่อง) (Peninsular).

**Remarks.**— This species is closely related to *Eria discolor* Lindl., but the latter is distinguished from the former by some vegetative and floral characters, i.e. *E. discolor* Lindl. is a stout plant with many leaves on the pseudobulb, while *Eria pulchella* Lindl. is a smaller plant with few-leaved pseudobulbs and having rather larger flowers. Moreover, the details on the lip and the pattern of callus are different.

**Specimens examined.**— BETONG: *J. Wai* 73 (PSU), 500 (PSU); PHANGNGA: *Ch. Laongpol* 744 (PSU); SONGKHLA: *J.F. Maxwell* 85-608 (PSU).

**Additional specimen examined.**— *Eria discolor* Lindl.; BETONG: *J. Wai* 1064 (PSU).

**122. *Pholidota articulata*** Lindl., Gen. Sp. Orchid. Pl.: 38. 1830; Hook.f., Fl. Brit. India 5: 844. 1890; Ridl., Mat. Fl. Malay. Penins. 1: 136. 1907; Holttum, Rev. Fl. Malaya 1: 236. 1953; Seidenf. & Smitinand, Orchids Thailand 2: 139, fig. 108. 1959; Seidenf., Opera Bot. 86: 96, fig. 54, pl. VIIc. 1986; de Vogel, Orchid Monogr. 3: 21, fig. 8, pl. 2a-b. 1988; Seidenf., Opera Bot. 114: 122. 1992; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 192, fig. 81a-d, pl. 11c. 1992.— *P. decurva* Ridl., J. Linn. Soc., Bot. 32: 328. 1896; Fl. Malay Penins. 4: 139. 1924. **Plate 54E-F.**

Sympodial epiphyte or lithophyte, up to 60 cm or more long, often pendulous, each new shoot develops near the top of the last developed pseudobulb; rhizome very short; roots long, slender. **Pseudobulbs** in long series, each consisting of one internode, cylindrical, 4-16.5 by 0.7-1.2 cm, greenish, 2-leaved, base covered with sheaths, each new pseudobulb rising from the apex of the last. **Leaves** convolute, glabrous, not sheathing at the base; petiole grooved, 0.5-1.5 cm long; blade thinly coriaceous, slightly plicate, elliptic to elliptic-oblongate, 9.5-19.5 by 3-5.2 cm, glossy, light to dark green, with 5 or 7 main veins, apex acute to acuminate, base attenuate, margin slightly undulate. **Inflorescences** initially synanthous or becoming hysteranthous, usually drooping, racemose, bearing a succession of many distichous flowers, 7.5-8 cm long; peduncle 3-4 cm long, glabrous; peduncular bract 1, clasping, boat-shaped, elliptic-ovate when flattened, ca. 15 by 8 mm, apex acute; rachis

flexuous, 3-4 cm long, curved, glabrous; floral bracts usually falling at the flowering, boat-shaped, broadly ovate when flattened, 9-13 by 7-10 mm, greenish or yellowish, often with scattered hairs inside, apex acute, margin involute. **Flowers** resupinate, 7-10 mm in diam., greenish or yellowish cream to flesh-coloured; pedicels 2-4 mm long, glabrous. **Sepals** 3- or 5-veined, glabrous; dorsal sepal elliptic-ovate to elliptic-oblong, 7-7.5 by 4-4.5 mm, apex obtuse; lateral sepals ovate, slightly falcate, concave, 8-8.5 by 3.5-4.5 mm, apex acute or obtuse. **Petals** oblong, 6-6.5 by 2-2.5 mm, glabrous, 3-veined, apex acute-acuminate. **Lip** without side lobes, constricted at the junction of hypochile and epichile; hypochile boat-shaped, elliptic-ovate, 5-5.5 by 2.5-3 mm, ca. 2 mm high, with 5 prominent keels in basal half; epichile recurved, broad, suborbicular in outline, ca. 3 by 4-5 mm, apex emarginate with a short tip. **Column** stout, winged, erect, 2-3 mm high, apex hood-shaped; operculum obcordate, ca. 1 mm in diam. **Pollinia** 4, equally sized, arranged in 2 pairs, solid, with a deep hole, ovoid, ca. 0.7 by 0.5 mm in each pollinium. **Stigma** orbicular to elliptic in outline; rostellum triangular, ca. 1 by 1 mm, apex acuminate. **Ovary** inferior, 3-4 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, ellipsoid, 14-15 by 6-7 mm. **Seeds** numerous, lanceolate or oblong, 0.2-0.4 by ca. 0.1 mm, creamy.

**Thailand.**— Throughout the country.

**Distribution.**— Himalaya, Assam, China, Indochina, Myanmar, Peninsular Malaysia, Sumatra, Java, Borneo and Sulawesi.

**Ecology.**— Growing on mossy cliffs in exposed areas of the quartzitic phyllite ridges at 550-600 m alt., and also found on tree trunks in lowland evergreen forest. Common. Flowering in September-October, fruiting in November-February.

**Vernacular.**— Ueang Lam To (เอื้องลำต้อ) (General).

**Specimens examined.**— BETONG: *J. Wai* 907 (PSU), 908 (PSU).

**123. *Tainia penangiana*** Hook.f., Fl. Brit. India 5: 820. 1890; Holttum, Rev. Fl. Malaya 1: 182. 1953; Seidenf., Nordic J. Bot. 5: 157. 1985; Opera Bot. 89: 33, figs. 9d, 14, pl. IId. 1986; Seidenf. & J.J. Wood, Orchids Pen. Mal. & Sing.: 156, fig. 67a-c. 1992.— *T. hookeriana* King & Pantl., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 64(2): 336. 1895; Seidenf., Opera Bot. 89: 32, figs. 9c, 13, pl. IIc. 1986; Opera Bot. 114: 80, pl. Vb. 1992.— *Ania penangiana* (Hook.f.) Summerh., Bot. Mag. 161: t. 9663. 1939; H. Turner, Orchid Monogr. 6: 55, fig. 29, pl. 5c. 1992. **Plate 55A-C.**

Sympodial terrestrial plant or casual lithophyte; rhizome creeping, ca. 5 mm in diam.; roots slender, densely hairy. **Pseudobulbs** consisting of one internode, covered with sheaths when young, ridged, wrinkled when old, conical-ovoid, 3.5-4.5 by 1.5-3.5 cm, brown, reddish brown or brownish purple, bearing only one leaf at the top. **Leaf** convolute, glabrous, not sheathing at the base; petiole 10.5-20 cm long; blade thinly herbaceous to subcoriaceous, plicate, narrowly elliptic, 20-35 by 3-5.5 cm, light to dark green, with 5 prominent veins beneath, apex acuminate, base attenuate. **Inflorescences** lateral, arising from the base of the pseudobulbs, erect, loosely many-flowered, 30-80 cm long; peduncle 20-45 cm long, glabrous; peduncular bracts clasping, appressed, 1.5-4.2 cm long, glabrous, apex acute to acuminate; rachis 10-35 cm long, glabrous; floral bracts narrowly triangular, 5-20 by 1.5-3 mm, brownish purple, glabrous, apex acuminate. **Flowers** opening in succession, resupinate, 3-4.5 cm in diam.; pedicels 3-4 mm long, glabrous. **Sepals** greenish or yellowish, with 7 purple veins, glabrous, apex acuminate; dorsal sepal narrowly elliptic, 2.1-2.7 by 0.4-0.5 cm; lateral sepals narrowly elliptic, falcate, 1.9-2.6 by 0.4-0.55 cm. **Petals** narrowly elliptic, falcate, 1.9-2.3 by 0.4-0.45 cm, greenish or yellowish, with 7 purple veins, glabrous, apex acuminate. **Lip** with a distinct spur of 2-4 mm long, blade of lip 3-lobed, elliptic-obovate when flattened, 1.4-1.5 by 0.8-1.1 cm, white or creamy white, often with purple spots; side lobes erect, 3-4 mm high, 1.1-1.2 cm long, forward edges obtuse or rounded; midlobe recurved, orbicular to broadly elliptic, 5-8 by 6-8 mm, apex acuminate or rounded with a short tip, margin slightly undulate, slightly toothed; keels 3 (without 2 outer lateral keels) or 5, usually abruptly increasing in height and undulating on the midlobe, 3 keels extending from near the base of lip to the middle of midlobe, 2 further lateral keels only present on the midlobe. **Column** winged, curved

to the front, 1-1.2 cm high; column-foot 1-2 mm long; operculum with 2 small horns, cup-like, subquadrangular, 1-1.5 mm in diam., the 2 thecae 4-celled. **Pollinia** 8, solid, arranged in 4 pairs, subequal, a smaller pair proximally and a larger pair distally in each thecae, obliquely ovate, 0.9-1 by 0.5-0.7 mm in each pollinium. **Stigma** semi-orbicular in outline; rostellum semi-orbicular, ca. 1 by 1.5 mm. **Ovary** inferior, 7-9 mm long, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, cylindrical-oblong, 2.5 by 0.6 cm. **Seeds** numerous, linear-elliptic, ca. 1 by 0.1 mm, creamy.

**Thailand.**— NORTHERN: Chiang Mai, Phitsanulok; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima, Surin; SOUTH-EASTERN: Trat; PENINSULAR: Ranong, Satun, Songkhla, Yala.

**Distribution.**— Northeastern India, Sikkim, China, Vietnam and Peninsular Malaysia.

**Ecology.**— On rocky or sandy heath soils with the litter of decaying leaves or sometimes growing on rocks, often locally abundant in partial shade of the mountain ridges, and also found in lowland evergreen forest and rubber plantation, alt. 100-1,050 m. Uncommon. Flowering in November-February, fruiting in January-March.

**Vernacular.**— Ueang Sila Pak Lai (เอื้องสีลาปากลาย), Ueang Sila Lueang (เอื้องสีลาเหลื่อง) (General).

**Specimens examined.**— BETONG: *J. Wai* 85 (PSU), 414 (PSU), 464 (PSU), 524 (PSU), 525 (PSU), 920 (PSU), 975 (PSU); SONGKHLA: *Hamilton & Congdon* 107 (PSU), *J.F. Maxwell* 85-92 (PSU), 85-1154 (PSU).



**124. *Thrixspermum calceolus*** (Lindl.) Rehb.f., *Xenia Orchid.* 2: 122. 1867; Ridl., *Mat. Fl. Malay. Penins.* 1: 181. 1907; *Fl. Malay Penins.* 4: 184. 1924; Holttum, *Rev. Fl. Malaya* 1: 604, fig. 176. 1953; Seidenf. & Smitinand, *Orchids Thailand* 4: 523. 1963; Backer & Bakh.f., *Fl. Java (Spermatoph.)* 3: 404. 1968; Seidenf., *Opera Bot.* 95: 158, fig. 94, pl. XVIa. 1992; *Opera Bot.* 114: 403, pl. XXIXa. 1992; Seidenf. & J.J. Wood, *Orchids Pen. Mal. & Sing.*: 645, fig. 292a-d. 1992.— *Sarcochilus calceolus* Lindl., *Edwards's Bot. Reg.* 32: t. 19. 1846.— *S. brachystachys* Hook.f., *Fl. Brit. India* 6: 41. 1890. **Plate 55D-E.**

Monopodial epiphyte, lithophyte or sometimes terrestrial plant; roots stout, 2-3 mm in diam. **Stem** long, creeping, elongated, with many leaves, slightly flattened, 3-5 mm thick; internodes 1.5-2.5 cm long. **Leaves** distichous, spreading at  $\pm$  right angles to the stem, duplicate, glabrous, sheathing at the base; sheaths as long as the internodes; blade fleshy, rigid, coriaceous, oblong, 4-8 by 1.5-2 cm, yellowish green or light to dark green, apex unequally bilobed, base twisted. **Inflorescences** lateral from the nodes of stem, 2-3-flowered at a time, 3-5 cm long; peduncle and rachis 1.5-2.5 cm long; bracts distichous, laterally compressed, overlapping, clasping, boat-shaped, 5-8 mm long, glabrous. **Flowers** fragrant, resupinate, ephemeral, 3.5-4.5 cm in diam., white. **Sepals** fleshy, glabrous, 7-veined, midrib keeled, apex acute; dorsal sepal oblong, 2-2.1 by 0.7-0.8 cm; lateral sepals oblong to oblong-lanceolate, 1.9-2.3 by 0.8-1 cm. **Petals** fleshy, oblanceolate, 1.7-2 by 0.6-0.7 cm, glabrous, 5-veined, apex acute and slightly hooded. **Lip** fleshy, 3-lobed, 1.3-1.4 cm long, base adnate to the column-foot and forming a small sac-like, with a callus in front of sac; side lobes erect, 7-8 mm high, 7-8 mm long, forward edges narrowly acute, curved to the front; midlobe thick, with a yellow patch around the base, conical, triangular in outline, 6-7 by 4-5 mm, apex bluntly acute. **Column** stout, erect, winged, 3-3.5 mm high; column-foot 3-3.5 mm long; operculum cup-like, subquadrangular, ca. 1.5 mm in diam. **Pollinia** 4, unequally sized, arranged in 2 pairs oblong-ovate, 1-1.5 by 0.4-0.6 mm in each pollinium; stipe and viscidium broad, ca. 0.7 by 0.7 mm. **Stigma** semi-elliptic in outline. **Ovary** and pedicel 1-1.2 cm long, ovary inferior, glabrous, 3-carpellate, 1-locular, placentation parietal; ovules numerous, minute. **Capsule** with persistent column and perianth parts, ridged, cylindrical, linear-oblong, ca. 9 by 0.5-0.6 cm. **Seeds** numerous, linear to linear-elliptic, 0.5-0.7 by ca. 0.05 mm, creamy.

**Thailand.**— PENINSULAR: Chumphon; Surat Thani, Phangnga, Songkhla, Yala.

**Distribution.**— Peninsular Malaysia, Singapore, Sumatra and Borneo.

**Ecology.**— On mossy rocks or on tree trunks, often occurring near the ground or sometimes growing on rocky or sandy heath soils with the litter of decaying leaves, found in both exposed and shady areas of the quartzitic phyllite ridges, and also found in coastal heath and lowland evergreen forests, from sea level to 700 m alt. Uncommon. Flowering in June-July, fruiting in October-January.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 322 (PSU), 801 (PSU); PHANGNGA: *Ch. Laongpol* 742 (PSU).

## POACEAE

**125. *Eulalia speciosa*** Kuntze, Revis. Gen. Pl.: 775. 1891; S.L. Chen & S.M. Phillips in Fl. China 22: 586. 2006.— *Erianthus speciosus* Debeaux, Actes Soc. Linn. Bordeaux 32: 53. 1878.— *Eulalia lanipes* Ridl., J. Fed. Malay States Mus. 7: 56. 1916; Fl. Malay Penin. 5: 196. 1925; Holttum, Rev. Fl. Malaya 3: 243. 1971.— *Pseudopogonatherum lanipes* (Ridl.) Ohwi, Bull. Tokyo Sci. Mus. 18: 3. 1947. **Plate 56A-B.**

Perennial herb, up to 1.3 m high. **Culms** densely tufted, the basal portion covered by overlapping basal sheaths and imbricate cataphylls; cataphylls chaffy, castaneous, densely woolly in the basal part; nodes hairy or glabrescent; internodes up to 30 cm long. **Leaves:** sheath densely overlapping below, looser above, the base of lower sheaths densely woolly, the upper sheaths hairy in the basal part just above the hairy nodes and also hairy in upper parts just below the mouth, up to 25 cm long; ligule thin, 1-2 mm long, inner surface glabrous, outer surface hairy, margin minutely

fimbriate, bordered by a dense tuft of whitish hairs; blade linear, 30-50 by 0.3-0.8 cm, olive green or yellowish green, gradually narrowed to a long-acuminate apex, base narrowed to the sheath, surfaces mealy in texture, but seemingly glabrous, the basal part hairy on both surfaces, margin very finely toothed, but seemingly entire; main veins slightly grooved, flattened or slightly raised above, prominent underneath; longitudinal veins slightly raised on both surfaces. **Inflorescences** composed of 4-8 subdigitate racemes; peduncle hairy in the upper part; racemes simple, 5-18.5 cm long, with many spikelets pairs, alternately arranged on rachis, one sessile, one pedicelled, both fertile, the sessile spikelets slightly larger than pedicelled spikelets; rachis slender and wiry, angular in cross section, densely covered with whitish hairs; rachis-internodes 3-6 mm long; pedicels of pedicelled spikelet rather flattened, 2-4 mm long densely covered with long whitish or creamy hairs. **Spikelets** dorsally compressed, elliptic-lanceolate, 4.5-6 mm long, with a hairy callus; callus 0.3-0.4 mm long; lower glume boat-shaped, oblong-lanceolate, 5-6 by 1-1.5 mm, 2-4-veined, outer surface long hairy, inner surface glabrous; upper glume boat-shaped, oblong-lanceolate, 4.5-5.5 by 1-1.5 mm, 3-veined, outer surface long hairy, inner surface glabrous; lower floret membranous, boat-shaped, oblong-lanceolate, 3.5-4 by ca. 1 mm, outer surface sparsely hairy below, scaberulose in the upper half, inner surface glabrous, 3-veined; upper lemma membranous, hyaline, 1.5-2 mm long, outer surface scaberulose, inner surface glabrous, 3-veined in the lower part, the main vein excurrent in a long awn, apex bifid; awn twisted when dry, 1.5-2 cm long, scaberulose on the back; palea membranous, hyaline, triangular-ovate, 10-12 by 5-7 mm, apex  $\pm$  acute, margin finely toothed; lodicules 2, fleshy, obdeltoid, 0.4-0.45 by 0.4-0.45 mm. **Stamens** 3; filaments up to 6 mm long; anthers oblong, ca. 2 mm long, yellow. **Ovary** ovoid, ca. 5 by 2 mm, glabrous, 1-locular, with a single ovule; styles 2, 1.5-2 mm long, glabrous; stigmas 2, plumose, 2-2.5 mm long. **Grain** narrowly ellipsoid or oblong, beaked.

**Thailand.**— NORTHERN: Chiang Mai; PENINSULAR: Yala (Betong).

**Distribution.**— China, Japan, Korea, India, Indochina, Myammar and Malesia.

**Ecology.**— On the summits and slopes of the exposed quartzitic-phyllite ridges at 550-700 m alt. Locally common. Flowering in July-February, grain maturity in January-April.

**Vernacular.**—

**Specimens examined.**— BETONG: *J. Wai* 326 (PSU), 339 (PSU), 373 (PSU), 422 (BKF, PSU), 882 (BCU, BKF, PSU).

## ZINGIBERACEAE

**126. *Etlingera subterranea*** (Holtum) R.M. Sm., Notes Roy. Bot. Gard. Edinburgh 43: 250. 1986; Gard. Bull. Singapore 53: 225. 2001.— *Achasma subterraneum* Holtum, Gard. Bull. Singapore 13: 187. 1950. **Plate 56C-D.**

Herb. **Rhizome** subterranean, long creeping, 5-12 mm in diam.; scales overlapping, triangular-ovate, 2-2.5 by 1.5-2 cm, pale brown, glabrous, apex acute. **Leafy shoots** 1.5-2 m high, with 15-20 leaves; base ca. 2 cm in diam., green or reddish brown. **Leaves** petiolate; sheath green or yellowish brown, longitudinally ribbed when dry, basal part densely covered with golden brown hairs; ligule 4-7 mm long, outer surface puberulent to glabrous, inner surface glabrous, apex obtuse or rounded, margin ciliate; petiole 5-8 mm long, puberulent to glabrous; blade firmly chartaceous, oblong to linear-oblong, 21.5-60 by 1.5-11.5 cm, green to dark green, with dark purple stripes (especially in young leaves), upper surface glabrous, lower surface pubescent, apex acuminate, base obtuse or cuneate, margin undulate; midrib grooved above, prominent and pubescent underneath. **Inflorescences** arising from the rhizome, usually near the base of leafy shoot, 10-18 cm long, 7-9-flowered, 1-3 flowers open at a time; peduncle subterranean, erect, 2.5-8 cm long, 4-6 mm in diam., sparsely to moderately covered with appressed woolly hairs; peduncular bracts clasping, appressed, imbricate, triangular-ovate to triangular-oblong, 1.5-3 by 1-1.5 cm, cream to pale brown, sparsely hairy or subglabrous outside, glabrous inside, apex acute or short acuminate, margin usually ciliate, veins rather prominent. **Spike** ovoid to cylindrical, 7-9 by 2-3 cm;

sterile bracts 6-7, imbricate, concave, triangular-oblong or oblong, 4-4.2 by 1.2-1.5, pale reddish brown or cream with reddish apex, sparsely hairy outside, glabrous inside, longitudinally ribbed when dry, apex acute or short acuminate, margin ciliate; floral bracts membranous, slightly fleshy in the central part, concave, narrowly oblong or spatulate, 3.4-4.2 by 0.7-1.2 cm, cream with reddish apex, sparsely to moderately hairy outside, glabrous inside, longitudinally ribbed when dry, apex acute or short acuminate, margin ciliate; bracteoles membranous, tubular, usually unequally bilobed, 3-3.5 cm long, hairy outside, glabrous inside; lobes triangular-ovate, 6-10 mm wide, sinus 9-16 mm deep. **Flowers** 3-merous (excluding androecium). **Calyx** membranous, tubular, 2- or 3-lobed, 5.4-6 cm long, deeply split down on one side, 1-2.2 cm deep, hairy outside, glabrous inside. **Corolla** reddish; tube 3-4 cm long, glabrous; lobes 3, very thin, membranous, oblong, apex obtuse to rounded, ciliate apically but otherwise glabrous; dorsal lobe 20-22 by 5.5-6 mm, 5-7-veined; lateral lobes 16-18 by 4-4.5 mm, 3-veined. **Labellum** 3-lobed, glabrous; lateral lobes erect, rounded, 8-10 mm high, 1.5-2 cm long, forward edges reflexed, deep red with white edges; central lobe elongate, spatulate or obovate when flattened, 3-3.5 by 1.8-2 cm, red, apex emarginate, base clawed, margin slightly crisped. **Fertile stamen** 1; staminal tube 1.2-1.5 cm long above the base of the corolla lobes; filament thick, 5-6 mm long, seemingly glabrous but sparsely covered with minute hairs; anther oblong, 10-11 by 4-5 mm, reddish, partly hairy on pollen sacs. **Epigynous glands** massive, fleshy, split down to the base on one side, 3-4 mm high, inside warty, apex irregular lobed. **Ovary** inferior, 3-4 mm long, outer surface hairy, 3-locular, placentation axile; ovules numerous; style filiform, 6.5-7 cm long, very sparsely hairy; stigma triangular to pentangular, dark red to almost black, ca. 3 by 2 mm; ostiole transverse, elliptic-oblong in outline, with ciliate margin. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— Occasional in shady places along the streams in the foothills of the quartzitic phyllite ridges at 550-600 m alt. Uncommon. Flowering in December-March.

**Vernacular.**— Put Bai Lai (ปุดใบลาย) (Narathiwat).

**Specimens examined.**— BETONG: *J. Wai* 539 (BKF, PSU); NARATHIWAT: *C. Maknoi* T 76 (PSU).

**127. *Geostachys holttumii*** K. Larsen, Bot. Tidsskr. 58: 47. 1962; Thai Forest Bull., Bot. 24: 42. 1996. *Plate 56E-G*.

Herb. **Rhizome** short, stout, woody, 5-7 mm in diam., slightly above or at ground level, supported by stilt roots. **Leafy shoots** 35-70 cm high, with 5-9 leaves; base 1-1.3 cm in diam. **Leaves** petiolate; sheath green, longitudinally ribbed when dry, glabrous; ligule 7-15 mm long, apex acute or obtuse, margin glabrous to ciliate; petiole up to 3 cm long, glabrous; blade firmly chartaceous, slightly to moderately plicate, linear-elliptic to elliptic, 7.5-30.5 by 1-8 cm, yellowish green to dark green, glabrous, apex acuminate, base cuneate, margin entire or slightly undulate; midrib grooved above, prominent underneath. **Inflorescences** arising from the rhizome at the base of leafy shoot, 11-15.5 cm long, 1-2 flowers open at a time; peduncle erect, slightly curved, 4.5-8.5 cm long, sparsely puberulent to subglabrous; peduncular bracts clasping, appressed, imbricate, concave, triangular-ovate to oblong, brown, glabrous, apex rounded to acute, margin ciliate or glabrous (especially in uppermost bract), the uppermost bract up to ca. 7 by 1.5 cm; rachis decurved, with 10-13 cincinnae, 4-6 cm long, green, reddish or pinkish cream, sparsely puberulent; primary bracts clasping, appressed, membranous, 1-3(-10) mm long, yellowish brown, outer surface sparsely puberulent to subglabrous, apex rounded or obtuse, rarely acute or acuminate, margin ciliate. **Cincinnae** all secund, erect; stalks 5-15 mm long, green or pinkish cream, sparsely puberulent; floral bracts inflated-tubular, split  $\frac{1}{3}$  to  $\frac{1}{2}$  down, chartaceous, yellowish brown, glabrous, outer ones 2-3.8 cm long, apex acuminate. **Flowers** 1-3 per cincinnus, 3-merous (excluding androecium); pedicels 2-5 mm long. **Calyx** membranous, yellowish, tubular, hooded, split half-way down, 1.8-2 cm long, glabrous, 7-9-veined, apex acuminate. **Corolla** cream or yellowish, glabrous; tube 1.7-1.9 cm long; lobes 3, membranous, oblong; dorsal lobe 13-17 by 6-8 mm, 5- or 7-veined, apex hooded, obtuse or rounded; lateral lobes 12-15 by 4-6 mm, 3- or 5-

veined, apex slightly hooded, obtuse or rounded. **Labellum** 3-lobed, yellowish cream with red spots; lateral lobes spreading or slightly erect, ligulate to subtriangular or nearly semi-orbicular, 7-8 mm long, inner surface puberulent in basal part, the upper part glabrous, outer surface glabrous, apex rounded to subacute or sometimes emarginate, margin often slightly recurved; central lobe obovate, 2-2.1 by 1.3-1.6 cm, apex bifid and curved downward, margin slightly crumpled and recurved, inner surface puberulent, outer surface glabrous. **Fertile stamen** 1; filament flattened, 4-7 mm long, puberulent; anther oblong, 7-8 by 2-2.5 mm, yellowish cream, puberulent on pollen sacs; anther crest with reddish blotch, ca. 1 mm long, apex rounded, margin sparsely ciliate to glabrous. **Epigynous glands** usually comprising 2 fleshy masses, sometimes connate into a single mass (only split down to the base on one side), 2-3 mm high, glabrous, apex rounded to subacute, subentire to slightly irregularly lobed. **Ovary** inferior, ca. 3 mm long, outer surface glabrous, 3-locular, placentation axile; ovules many per locule; style filiform, 2.7-3.2 cm long, glabrous; stigma cup-shaped, obconical, yellowish cream, ca. 1 mm in diam.; ostiole transverse,  $\pm$  elliptic in outline, with ciliate margin. **Capsule** ellipsoid, red, glabrous, crowned by the persistent calyx. **Seeds** not seen.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Endemic (?).

**Ecology.**— Growing on the litter of decaying leaves or on thin layer rocky or sandy heath soils over the rocky base in shady or partially shaded areas of quartzitic-phyllite ridges at 650-700 m alt., and also found in lower montane forest. Very rare. Flowering in May-August, fruiting in July-October.

**Vernacular.**—

**Remarks.**— In the original publication, Larsen (1962) gave the type locality of *Geostachys holttumii* K. Larsen as “Gunong Ina prope urbem Betong provinciae thailandicae Pattani”. There has been much confusion about the exact position of this

locality, since the name “Gunong Ina” does not appear on the map of Thailand. However, it is most likely that the name of type locality of this species may be spelled as “Gunung Inas”, this name appears on the map of Perak region, Malaysia. Consequently, it is convinced that the type specimen of this species (*Kerr* 7358) was not collected from (Betong) Thailand. The generally misunderstanding of this type locality leads to the erroneous determination of biogeographical range in this species.

*Geostachys holttumii* K. Larsen is probably a synonym of *Geostachys rupestris* Ridl., but no evidence is provided in this study. Hence, a comprehensive taxonomic revision of the genus *Geostachys* Ridl. in Thailand and Peninsular Malaysia is necessary in order to clarify their variation and taxonomic status.

**Specimens examined.**— BETONG: *J. Wai* 773 (BKF, PSU), 800 (PSU).

**128. *Geostachys penangensis*** Ridl., J. Straits Branch Roy. Asiat. Soc. 32: 159. 1899; Ridl., Mat. Fl. Malay. Penins. 2: 45. 1907; Fl. Malay Penins. 4: 276. 1924; R.M. Sm., Notes Roy. Bot. Gard. Edinburgh 43(3): 463. 1986. **Plate 57A-C.**

Herb. **Rhizome** short, stout, woody, 6-12 mm in diam., slightly above or at ground level, supported by stilt roots. **Leafy shoots** 45-100 cm high, with 5-8 leaves; base 1-1.8 cm in diam. **Leaves** petiolate; sheath green or brownish green, longitudinally ribbed when dry, glabrous; ligule 7-14 mm long, glabrous, apex obtuse, margin apically ciliate and sometimes slightly erose, soon becoming glabrous; petiole up to 3 cm long, glabrous; blade firmly chartaceous, not plicate to occasionally slightly plicate, usually linear-oblong, sometimes narrowly elliptic (especially in lowest leaves), 23.5-48.5 by 1-5.5 cm, usually green on both surfaces, occasionally tinged maroon or purplish on lower surface, glabrous, apex acuminate, base cuneate, margin entire or slightly undulate; midrib grooved above, prominent underneath. **Inflorescences** arising from the rhizome at the base of leafy shoot, only one flower opens at a time, 12-19.5 cm long; peduncle erect, slightly curved, 5.5-10 cm long, very sparsely and minutely puberulent to glabrous; peduncular bracts clasping, appressed, imbricate, concave, triangular-ovate to oblong, pinkish cream, glabrous to subglabrous, apex rounded to acute or sometimes slightly lobed, margin sparsely



ciliate to glabrous, the uppermost bract up to ca. 8 by 2.2 cm; rachis decurved, with 10-15 cincinnae, 3.8-6 cm long, reddish or green, very sparsely and minutely puberulent to glabrous; primary bracts clasping, appressed, membranous, 0.5-3.5 mm long, outer surface sparsely puberulent to glabrous, reddish, apex rounded. **Cincinnae** all secund, erect; stalks 7-15 mm long, reddish or green, sparsely puberulent to subglabrous; floral bracts inflated-tubular, split half-way down, chartaceous, reddish or pinkish cream, very sparsely and minutely puberulent to glabrous, outer ones 2.8-3.2 cm long, apex acuminate. **Flowers** 3-5 per cincinnus, 3-merous (excluding androecium); pedicels 2.5-5 mm long. **Calyx** membranous, pinkish cream, tubular, hooded, split half-way down, 2.2-2.3 cm long, 10-veined, apex acuminate, apically ciliate but otherwise glabrous. **Corolla** pinkish cream, glabrous; tube 1.6-1.8 cm long; lobes 3, membranous, oblong; dorsal lobe 15-17 by 6-8 mm, 7- or 9-veined, apex hooded, obtuse or rounded; lateral lobes 14-16 by 4.5-5 mm, 3- or 5-veined, apex slightly hooded, obtuse or rounded. **Labellum** 3-lobed, yellow; lateral lobes spreading or suberect, subtriangular, ca. 6 mm long, inner surface sparsely puberulent in basal part, the upper part glabrous, outer surface glabrous, apex rounded to subacute; central lobe obovate, 2.2-2.3 by 1.6-1.7 cm, inner surface puberulent, outer surface glabrous, apex retuse or slightly emarginate, margin slightly undulate. **Fertile stamen** 1; filament flattened, 5.5-6 mm long, sparsely to moderately puberulent; anther oblong, 6.5-7 by ca. 2 mm, yellowish cream, puberulent on pollen sacs; anther crest hooded, ca. 1 mm long, glabrous, apex rounded. **Epigynous glands** comprising 2 fleshy masses, 2.5-3 mm high, glabrous, apex truncate, rounded, entire or sometimes slightly lobed. **Ovary** inferior, 3-3.5 mm long, outer surface glabrous, 3-locular, placentation axile; ovules many per locule; style filiform, 3-3.1 cm long, sparsely hairy in the apical part; stigma cup-shaped, obconical, yellowish cream, ca. 1 mm in diam.; ostiole transverse,  $\pm$  narrowly oblong in outline, with ciliate margin. **Capsule** ellipsoid or subglobular, 12-18 by 10-12 mm, dark reddish brown, glabrous, crowned by the persistent calyx. **Seeds** 8-11, angular, irregularly shaped, covered with a thin fleshy aril, 3-5 mm in diam., black.

**Thailand.**— PENINSULAR: Yala (Betong).

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— Growing on the litter of decaying leaves or on thin layer rocky or sandy heath soils over the rocky base, locally common in shady or partially shaded areas of granitic ridges at 900-1,050 m alt., and also found in the deep shade of lower montane forest. Very rare in Thailand. Flowering in May-August, fruiting in July-October.

**Vernacular.**—

**Remarks.**— *Geostachys penangensis* Ridl. is a new record for Thailand.

**Specimens examined.**— BETONG: *J. Wai* 218 (PSU), 240 (BKF, PSU), 309 (PSU).

**129. *Globba pendula*** Roxb., *Asiat. Res.* 11: 359. 1810; Baker in *Fl. Brit. India* (J.D. Hooker) 6: 205. 1890; Ridl., *Mat. Fl. Malay. Penins.* 2: 4. 1907; *Fl. Malay Penins.* 4: 236. 1924; M.R. Hend., *Malay. Wild Fls., Monocots.*: 137, fig. 80. 1954; K. Larsen, *Thai Forest Bull., Bot.* 24: 44. 1996.— *Ceratanthera pendula* (Roxb.) T. Lestib., *Ann. Sci. Nat., Bot., ser 2*, 15: 335. 1841.— *Globba montana* Ridl., *J. Straits Branch Roy. Asiat. Soc.* 32: 92. 1899.— *G. fasciata* Ridl., *J. Straits Branch Roy. Asiat. Soc.* 57: 101. 1911.— *G. kingii* Baker in *Fl. Brit. India* (J.D. Hooker) 6: 204. 1890.— *G. stenothyrsa* Baker in *Fl. Brit. India* (J.D. Hooker) 6: 204. 1890.— *G. wallichii* Baker in *Fl. Brit. India* (J.D. Hooker) 6: 202. 1890. **Plate 57D-G.**

Herb. **Rhizome** short, slender, fleshy, 3-7 mm in diam., with fleshy roots. **Leafy shoots** slender, 25-70 cm high, with 3-13 leaves; basal sheaths glabrous to sparsely hairy, margin ciliate. **Leaves** sessile or subsessile; sheath green or purplish, longitudinally ribbed when dry, sparsely to densely hairy; ligule 0.5-1(-2) mm long, outer surface sparsely to densely hairy, apex rounded; blade chartaceous, slightly plicate, elliptic-oblong to oblong or sometimes lanceolate (especially in lowest leaves), (1.5-)7-28.5 by (0.7-)1.4-6.5 cm, pale to dark green above, paler underneath, upper

surface nearly glabrous, with scattered hairs only on the main veins, lower surface appressed hairy, apex long acuminate to caudate, base cuneate to almost rounded, margin entire or slightly undulate; midrib hairy, slightly grooved above, prominent underneath. **Inflorescences** terminal, usually erect, sometimes slightly drooping, with 6-45 cincinnae, 6.5-30 cm long above highest leaf-sheath, usually minutely glandular throughout; peduncle and rachis green or purplish, sparsely to densely hairy, rachis 4-22 cm long; primary bracts often early caducous, green, usually, concave, elliptic when flattened, oblong or spatulate, 3-9 by 1.5-3 mm, outer surface sparsely to densely hairy, 3-veined, apex subacute to rounded; branches of inflorescence with 1-3 flowers arranged in a cincinnus; stalks up to 1.2 cm long, green or purplish, glabrous to hairy; bulbils present on some inflorescences; floral bracts green or yellowish, usually with many gland dots, concave, elliptic-ovate when flattened, 2-3.5 by 1-2 mm, outer surface glabrous to sparsely hairy, 3-veined, apex subacute to almost rounded. **Flowers** 3-merous (excluding androecium and gynoecium); pedicels 0-2 mm long, glabrous. **Calyx** tubular, 3-lobed, 4-5 mm long, yellowish orange, glabrous; upper lobes triangular-ovate, 1.5-2 by 1.5-2 mm apex hooded, acute to short acuminate; lower lobe slightly concave, broadly ovate, 0.5-1 by 1.5-2 mm, apex obtuse to rounded, margin glabrous to sparsely ciliate. **Corolla** yellowish orange; tube 8-12 mm long, hairy in the upper part, glabrous in the lower half; lobes 3, elliptic or elliptic-ovate when flattened, glabrous; dorsal lobe strongly concave, 4.5-5 by 3-4 mm, 5-veined, apex hooded, acute; lateral lobes concave, 4-4.5 by 2-3 mm, 3-4-veined, apex obtuse to rounded, sometimes slightly hooded. **Labellum** adnate to filament to form a slender tube, bilobed, 8-10 mm long, yellowish orange, upper half papillose, lower part glabrous. **Staminodes** 2, yellowish orange, glabrous, oblong to oblong-spatulate, 8-10.5 by 2-3 mm, 5-6-veined, apex rounded or obtuse. **Fertile stamen** 1; filament extending 1-1.5 cm beyond junction with labellum, glabrous; anther ca. 2 mm long, partly papillose on the dorsal surface; basal appendages 2, slightly curved, ca. 3 mm long. **Epigynous glands** comprising 2 fleshy masses, slender, 2.5-3 mm high, glabrous. **Ovary** inferior, 1-2 mm long, green or purplish, glabrous, unilocular, placentation parietal; ovules many; style filiform, 3-4 cm long, glabrous; stigma clavate, 0.2-0.25 mm in diam.; ostiole transverse,  $\pm$  elliptic in outline, with ciliate margin. **Capsule** globular, slightly ridged, ca. 5 mm in diam., green,

glabrous, crowned by the persistent calyx. **Seeds** many,  $\pm$  ellipsoid-ovoid, with a lacerate basal aril, 2-3 by 1-1.5 mm, brown, puberulent.

**Thailand.**— PENINSULAR: Ranong, Surat Thani, Phangnga, Krabi, Trang, Satun, Songkhla, Narathiwat, Yala.

**Distribution.**— Peninsular Malaysia and Borneo.

**Ecology.**— On the litter of decaying leaves or on thin layer rocky or sandy heath soils over the rocky base or growing on moist cliffs or mossy rocks, often found in shady places along the streams in the foothills of mountain ridges, and also found in lowland evergreen forest, alt. 100-1,000 m. Locally common. Flowering in May-December, fruiting in July-February.

**Vernacular.**— Put Nok Yung (ปุดนกกุง) (Yala).

**Specimens examined.**— BETONG: *J. Wai* 278 (BCU, BKF, PSU), 293 (BKF, PSU), 794 (PSU), 814 (BCU, BKF, KKU, PSU, QBG), 846 (BCU, BK, BKF, PSU), 885 (BCU, BK, BKF, PSU), *C. Maknoi* T20 (PSU), T63 (PSU); RANONG: *K. Larsen et al.* 43108 (PSU), 43242 (PSU); SURAT THANI: *K. Larsen et al.* 40838 (PSU); PHANGNGA: *W. Nongmanee* 1 (PSU); KRABI: *K. Larsen et al.* 43252 (PSU), 43288 (PSU), 43290 (PSU); TRANG: *J.F. Maxwell* 85-954 (PSU); SATUN: *K. Larsen et al.* 42710 (PSU); SONGKHLA: *C. Maknoi* T4 (PSU), T34 (PSU), T34 (PSU).

**Altitudinal distribution**

There were 53 species (41 %) found over a wide range of altitudes, occurring in both lowlands and montane rain forests, 44 species (34 %) were restricted to moderate and high altitudes and 32 species (25%) were only found below 700 m in lowland forests (Table 8).

**Table 8.** Altitudinal ranges of vascular plant species found in the study sites.

Lowlands 0-500(-700) m	Lower montane (400-) 500-1000(-1500) m	Lowlands to lower montane 0-1000(-1500) m
32 species	44 species	53 species
Total number of species investigated		129 species

**Geographical distribution**

The 129 species recorded in the present study could be divided into 11 types (Table 9). From the table it could be seen that the most common type is Malesian (53 species, 41%). When considering the major taxonomic groups, it is found that 11 species of non-flowering plants are widely distributed in Paleotropics, while 47 species of flowering plants are confined to Malesia. There are two species recorded as endemic to Thailand, i.e. *Hoya rigida* Kerr and *Geostachys holttumii* K. Larsen. In addition, five species are known only from the present study (*Hoya* sp., *Begonia* sp., *Syzygium* sp. 1, *S.* sp. 2. and *Dendrobium* sp.). Seven species of Indo-Chinese/Asiatic elements invade to their southern limitation in Peninsular Malaysia (*Oleandra undulata* (Willd.) Ching, *Begonia sinuata* Wall. ex Meisn. var. *sinuata*, *Sonerila griffithii* C.B. Clarke, *Syzygium helferi* (Duthie) Chantar. & J. Parn., *Anneslea fragrans* Wall., *Dendrobium tortile* Lindl. and *Tainia penangiana* Hook.f.) and two species of Indo-Chinese elements are also expected to be found in Peninsular Malaysia as well (*Selaginella siamensis* Hieron. and *Bulbophyllum stenobulbon* E.C. Parish & Rchb.f.).

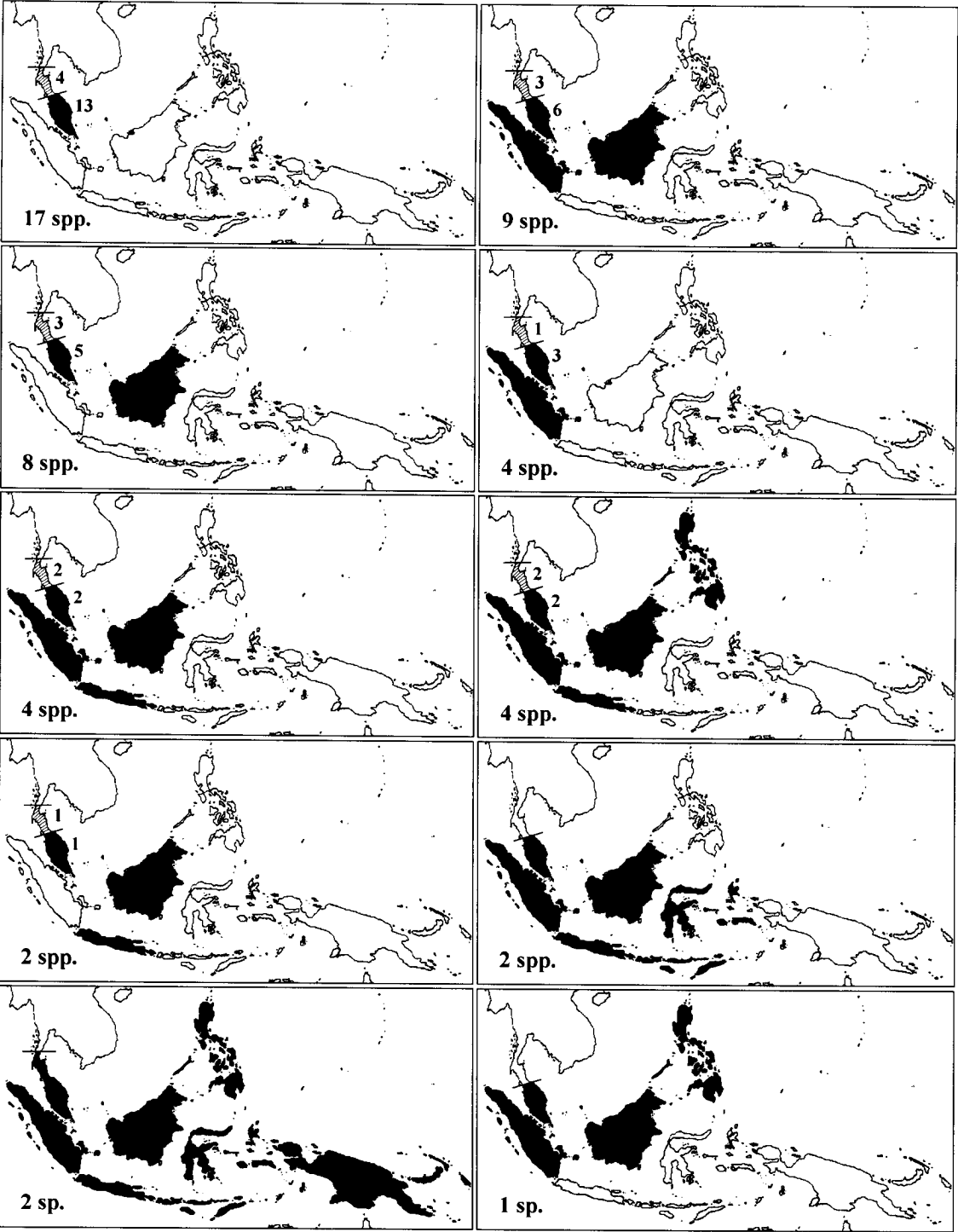
With regard to the phytogeographical subareas of Malesian region, 10 distribution patterns of 53 Malesian plant species are shown in Figure 8. Of these, the three most common patterns are as follows: (1) Thai-Malay Peninsula (17 species), i.e. *Selaginella strigosa* Bedd., *Syngramma minima* Holttum, *Dischidia fruticulosa* Ridl., *Hoya plicata* King & Gamble, *Didymocarpus citrinus* Ridl., *D. corchorifolius* Wall. ex A. DC., *Henckelia bombycina* (Ridl.) A. Weber, *H. inaequalis* (Ridl.) A. Weber,

*Paraboea elegans* (Ridl.) B.L. Burtt, *Fagraea wallichiana* Benth., *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, *Syzygium samarangense* (Blume) Merr. & L.M. Perry var. *parviflorum* (Craib) Chantar. & J. Parn., *Argostemma pictum* Wall., *Bulbophyllum lilacinum* Ridl., *Coelogyne velutina* de Vogel, *Dendrobium metrium* Kraenzl. and *Etlingera subterranea* (Holtum) R.M. Sm. Among them, three species are restricted to Perak sub-province and adjacent areas (*Didymocarpus citrinus* Ridl., *Henckelia bombycina* (Ridl.) A. Weber and *Fagraea wallichiana* Benth.); (2) Thai-Malay Peninsula, Sumatra and Borneo (9 species), i.e. *Pyramidanthe prismatica* (Hook.f. & Thomson) J. Sinclair, *Rhododendron longiflorum* Lindl., *Austrobuxus nitidus* Miq., *Fagraea acuminatissima* Merr., *Ficus deltoidea* Jack var. *deltoidea*, *Bulbophyllum corolliferum* J.J. Sm., *B. medusae* (Lindl.) Rchb.f., *Coelogyne testacea* Lindl. and *Thrixspermum calceolus* (Lindl.) Rchb.f.; (3) Thai-Malay Peninsula and Borneo (8 species), i.e. *Gnetum gnemon* L. var. *tenerum* Markgr., *Schefflera cephalotes* (C.B. Clarke) Harms, *Hoya imperialis* Lindl., *Pachycentria hanseniana* Clausen, *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg, *Bromheadia alticola* Ridl., *Geostachys penangensis* Ridl. and *Globba pendula* Roxb.

Moreover, it is apparent that there are 35 Malesian species extending their northern range limits at Kangar-Pattani line, while 18 Malesian species reach their northern limits of distribution at near Ismuth of Kra.

**Table 9.** Distribution types of 129 vascular plant species found in the study sites.

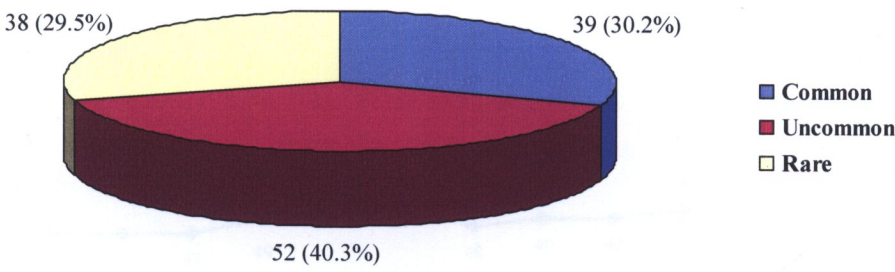
Distribution types	Number of species		
	Non-flowering plants	Flowering plants	Total
1. Cosmopolitan	1	-	1
2. Pantropics and subtropics	1	-	1
3. Paleotropics	11	-	11
4. India, Himalayas, Indochina, Malesia and Australia	1	3	4
5. India, Himalayas, Indochina and Malesia	5	11	16
6. Indochina, Malesia, Oceania and Australia	3	-	3
7. Indochina and Malesia	10	21	31
Indochina and Peninsular Malaysia	-	7	7
8. Indochina and Thailand	1	1	2
9. Malesia	6	47	53
10. Endemic (known only from Thailand)	-	2	2
11. Unknown (known only from Betong)	-	5	5



**Figure 8.** Ten distribution patterns of 53 Malaysian plant species found in the study sites.

**Rarity status**

The status of 129 vascular plant species could be classified into three categories, i.e. rare, uncommon and common. There were 38 rare species (29.5%), 52 uncommon species (40.3%) and 39 common species (30.2%) (Fig. 9). When defining rarity, geographical distribution, habitat specificity and local population size were considered. List of rare plants is shown in Appendix 3.



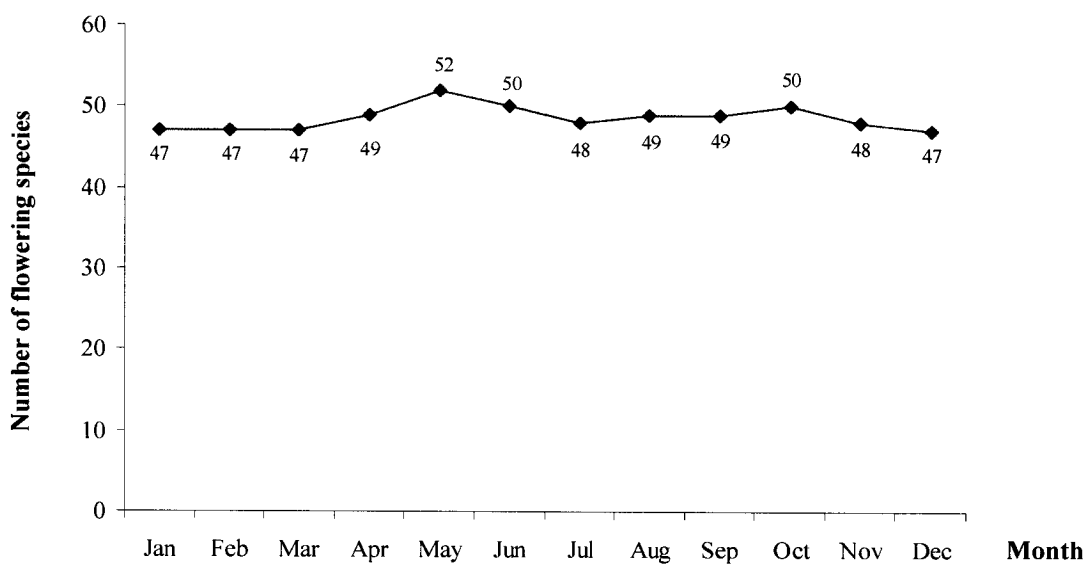
**Figure 9.** Pie chart showing the distribution of rarity status.



Reproductive phenology of flowering plants

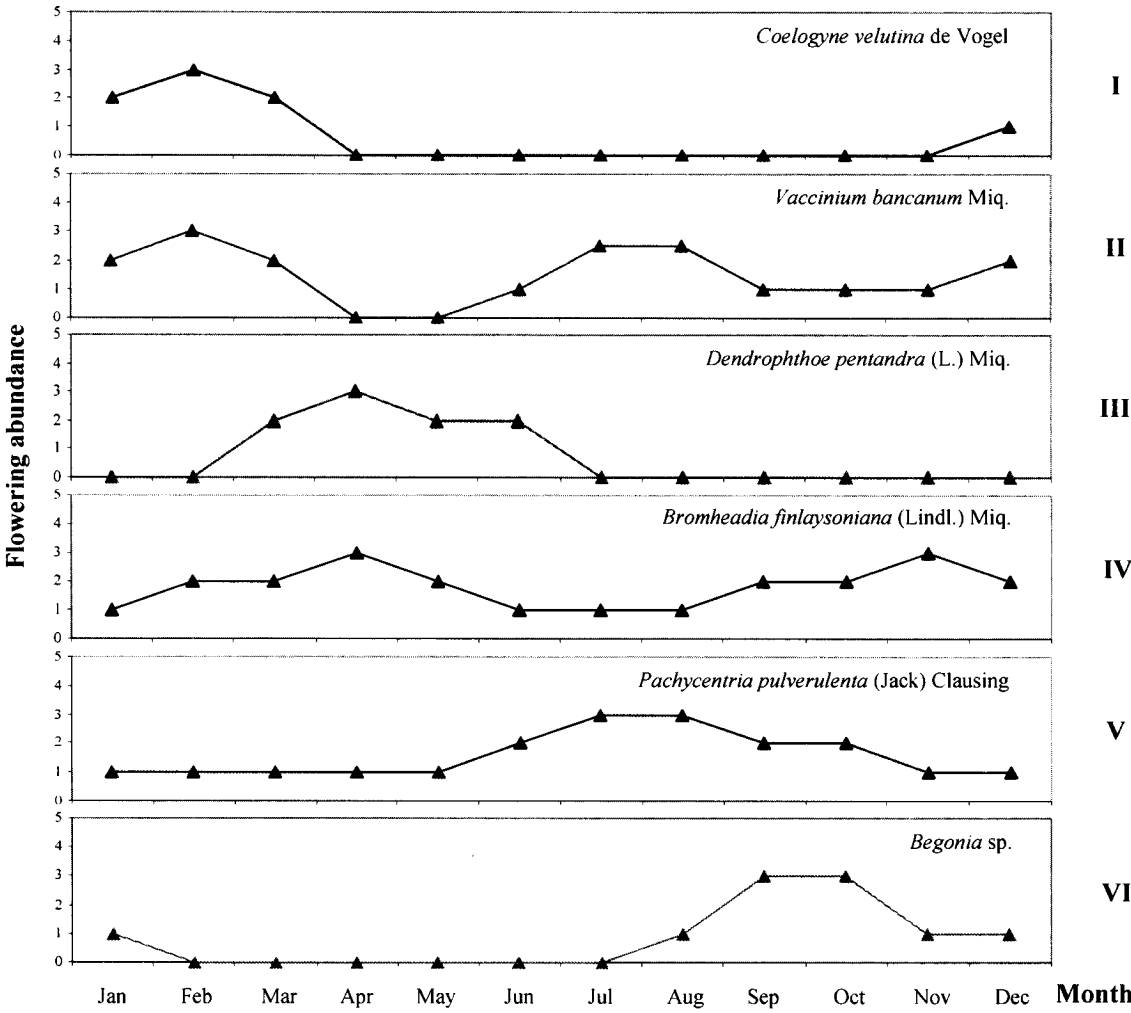
1. Flowering

Flowering phenology of 90 species were observed (Appendix 4). There were 24 species flowered all through the year, most of these were perennial herbs. The number of flowering species varied little from month to month (Fig. 10) and rose to the highest peak in May (52 species, 58%), followed by October and June (50 species, 56%) and drawn to the lowest points in December, January, February and March (47 species, 52%).



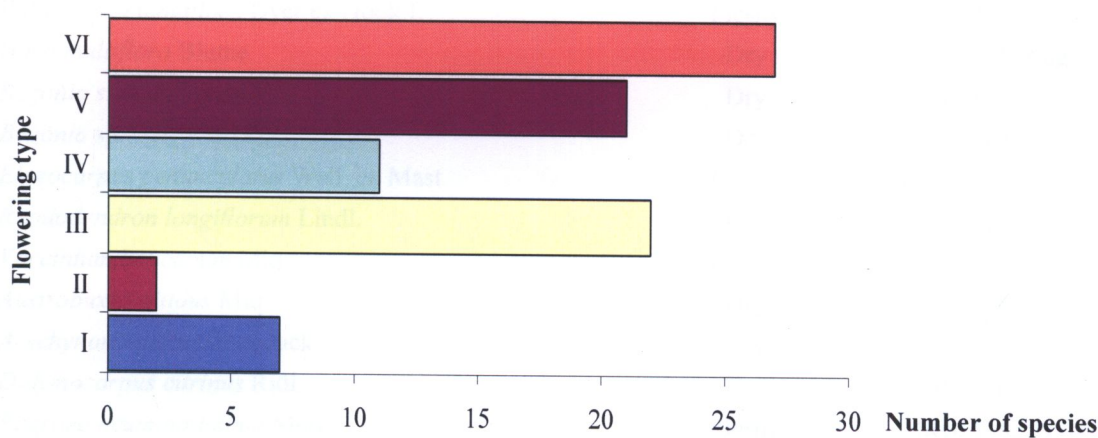
**Figure 10.** Number of flowering species during each month of the year, the month of flowering was pooled over 2 years (2006-2007).

The patterns of peak flowering time of 90 flowering plant species were observed and classified into six types (Fig. 11): *Type I*: Single peak of flowering time in the first dry season from January-March; *Type II*: Two peaks of flowering time, the first peak in the first dry season from December-February and the second peak in the second (short) dry season from June-August; *Type III*: Single peak of flowering time in the first (short) rainy season from March-May; *Type IV*: Two peaks of flowering time, the first peak in the first (short) rainy season from March-May and the second peak in the main rainy season from September-November; *Type V*: Single peak of flowering time in the second (short) dry season from June-August; *Type VI*: Single peak of flowering time in the main rainy season from September-November.



**Figure 11.** Patterns of peak flowering (type I-VI) and examples of plant species.

The most abundant type was type VI (27 species, 30%), followed by type III (22 species, 24%), type V (21 species, 23%), type IV (11 species, 12%), type I (7 species, 8%) and type II (2 species, 2%) (Fig. 12).



**Figure 12.** Frequency distribution of six patterns of peak flowering (type I-VI).

**2. Fruiting**

The fruit types and fruit/seed maturity periods of 38 observed species are shown in Table 10. Most dry fruits (capsules and follicles) ripened in dry months (January-February, June-August), while mature fleshy fruits (berries and drupes) were abundant in wet months (March-May, September-December).

**Table 10.** Fruit types and fruit/seed maturity periods of 38 flowering plant species.

Taxa	Fruit type	Fruit/seed maturity period
<i>Alstonia rostrata</i> C.E.C. Fisch.	Dry	Aug.
<i>Willughbeia coriacea</i> Wall.	Fleshy	Sep.-Oct.
<i>Willughbeia tenuiflora</i> Dyer ex Hook.f.	Fleshy	Nov.-Dec.
<i>Hoya multiflora</i> Blume	Dry	Jan.-Feb., Jul.-Aug.
<i>Begonia sinuata</i> Meisn.	Dry	Jan.-Feb.
<i>Begonia</i> sp.	Dry	Jan.-Feb.
<i>Elaeocarpus pedunculatus</i> Wall. ex Mast.	Fleshy	Oct.-Nov., Apr.
<i>Rhododendron longiflorum</i> Lindl.	Dry	Feb.-Mar.
<i>Vaccinium bancanum</i> Miq.	Fleshy	Apr.-May
<i>Austrobuxus nitidus</i> Miq.	Dry	Jan.-Feb.
<i>Aeschynanthus radicans</i> Jack	Dry	Dec.-Feb
<i>Didymocarpus citrinus</i> Ridl.	Dry	Jan.-Feb.
<i>Fagraea acuminatissima</i> Merr.	Fleshy	Sep.-Oct.
<i>Fagraea wallichiana</i> Benth.	Fleshy	Mar.-Apr.
<i>Oxyspora umbellulata</i> (Hook.f. ex Triana) J.F. Maxwell	Dry	Dec.-Jan.
<i>Pachycentria glauca</i> Triana subsp. <i>maingayi</i> (C.B. Clarke) Clausen	Fleshy	Sep.-Oct.
<i>Pachycentria hanseniana</i> Clausen	Fleshy	Sep.-Dec.
<i>Pachycentria pulverulenta</i> (Jack) Clausen	Fleshy	Oct.-Dec.
<i>Sonerila griffithii</i> C. B. Clarke	Dry	Jan.-Feb.
<i>Rhodamnia cinerea</i> Jack var. <i>cinerea</i>	Fleshy	Mar.-Apr.
<i>Syzygium gratum</i> (Wight) S.N. Mitra var. <i>gratum</i>	Fleshy	Jul.-Aug.
<i>Syzygium</i> sp. 1	Fleshy	May.-Jun.
<i>Syzygium</i> sp. 2	Fleshy	May-Aug.
<i>Argostemma pictum</i> Wall.	Dry	Nov.-Dec.
<i>Tarenna longifolia</i> Ridl.	Fleshy	May-Aug.
<i>Bulbophyllum lilacinum</i> Ridl.	Dry	Feb.-Mar.
<i>Bulbophyllum medusae</i> (Lindl.) Rchb.f.	Dry	Dec.-Jan.
<i>Coelogyne prasina</i> Ridl.	Dry	Feb.
<i>Coelogyne testacea</i> Lindl.	Dry	Feb.
<i>Coelogyne trinervis</i> Lindl.	Dry	Feb.-Mar.
<i>Coelogyne velutina</i> de Vogel	Dry	Feb.-Mar.
<i>Dendrobium metrium</i> Kraenzl.	Dry	Jun.-Aug.
<i>Dienia ophrydis</i> (J. Koenig) Ormerod & Seidenf.	Dry	Nov.-Dec.
<i>Dipodium pictum</i> (Lindl.) Rchb.f.	Dry	Jun.
<i>Pholidota articulata</i> Lindl.	Dry	Jan.-Feb.
<i>Tainia penangiana</i> Hook.f.	Dry	Jan.-Mar.
<i>Thixspermum calceolus</i> (Lindl.) Rchb.f.	Dry	Dec.-Jan.
<i>Eulalia lanipes</i> Ridl.	Dry	Jan.-Apr.

## PART II: VEGETATION STUDY

### VEGETATION DESCRIPTIONS

#### 1. Vegetation on quartzitic phyllite ridges (Plates 1-3)

The vegetation on quartzitic phyllite ridges were classified into two sub-vegetation types based on microhabitats and habits/life forms of plants. The species composition of this vegetation type varies locally and the details of common and characteristic taxa in each study site are as follows:

##### 1.1 Grassland and scrub vegetation

This vegetation found on the cliffs or near vertical slopes, exposed ridges and the rocky summits with no or little soil cover, it is characterised by the presence of *Eulalia speciosa* Kuntze as a dominant species and with scattered small shrubs and shrubby trees, many species of lithophytes and facultative epiphytes (orchids and ferns). Some climbers are also found. Although, this vegetation is sparse and open, but shrubby trees rooted in rock crevice are present, these shrubby trees are only 3-4 m high.

##### A. Gunung Silipid (Fig. 13A, Plate 1B-E)

**Shrubs/Shrubby trees:** *Rhodoleia championii* Hook.f., *Vaccinium bancanum* Miq., *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Alstonia rostrata* C.E.C. Fisch., *Melastoma malabathricum* L. subsp. *malabathricum*, *Pachycentria pulverulenta* (Jack) Clausing, *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg.

**Climber:** *Epipremnum giganteum* Schott.

**Herbs:** *Eulalia speciosa* Kuntze, *Coelogyne cumingii* Lindl., *Eriachne pallescens* R. Br., *Sonerila griffithii* C.B. Clarke, *Bromheadia finlaysonian* (Lindl.) Miq., *Coelogyne trinervis* Lindl., *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda.

**Ferns:** *Pteridium aquilinum* (L.) Kuhn, *Dicranopteris linearis* (Burm.f.) Underw., *Davallia solida* (G. Forst.) Sw., *Oleandra pistillaris* (Sw.) C. Chr.,

*Oleandra undulata* (Willd.) Ching, *Nephrolepis* sp., *Cibotium barometz* J. Sm., *Drynaria sparsisora* (Desv.) T. Moore.

### **B. Khao Hin Ban Chantharat** (Fig. 14A, Plate 2B-D)

**Shrubs/Shrubby trees:** *Vaccinium bancanum* Miq., *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Melastoma malabathricum* L. subsp. *malabathricum*, *Rhododendron longiflorum* Lindl., *Anneslea fragrans* Wall., *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh., *Syzygium* sp. 1, *Pachycentria pulverulenta* (Jack) Clausen, *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg, *Ficus deltoidea* Jack var. *angustifolia* (Miq.) Corner.

**Climber:** *Epipremnum giganteum* Schott.

**Herbs:** *Eulalia speciosa* Kuntze, *Coelogyne cumingii* Lindl., *Coelogyne testacea* Lindl., *Paraboea elegans* (Ridl.) B.L. Burtt, *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda.

**Ferns:** *Dicranopteris linearis* (Burm.f.) Underw., *Pteridium aquilinum* (L.) Kuhn, *Oleandra pistillaris* (Sw.) C. Chr., *Dipteris conjugata* Reinw., *Davallia solida* (G. Forst.) Sw., *Nephrolepis* sp., *Cibotium barometz* J. Sm., *Drynaria sparsisora* (Desv.) T. Moore.

### **C. Khao Hin Ban Bo Num Ron** (Fig. 15A, Plate 3B-D)

**Shrubs/Shrubby trees:** *Vaccinium bancanum* Miq., *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Pachycentria pulverulenta* (Jack) Clausen, *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg., *Ficus deltoidea* Jack var. *angustifolia* (Miq.) Corner.

**Climber:** *Epipremnum giganteum* Schott.

**Herbs:** *Eulalia speciosa* Kuntze, *Coelogyne cumingii* Lindl., *Sonerila griffithii* C.B. Clarke, *Coelogyne trinervis* Lindl., *Bulbophyllum medusae* (Lindl.) Rchb.f., *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda.

**Ferns:** *Dicranopteris linearis* (Burm.f.) Underw., *Pteridium aquilinum* (L.) Kuhn, *Davallia solida* (G. Forst.) Sw., *Davallia heterophylla* Sm., *Oleandra pistillaris* (Sw.) C. Chr., *Oleandra undulata* (Willd.) Ching, *Nephrolepis* sp., *Cibotium barometz* J. Sm., *Drynaria sparsisora* (Desv.) T. Moore.

## 1.2 Woodland vegetation

This vegetation usually occurred on the hill slopes and could be found on the summits with a decaying litter/organic matter and considerable soils cover. The soils over the rocky base may be thin or with a depth of 1 m or more. The vegetation is moderately spaced to fairly dense, usually with a continuous canopy, commonly 5-15 m high, occasionally with emergent trees which could reach to 20-30 m high. The canopy is characterised by a low uniform layer, with single or only few dominant tree species. The most common dominant tree species in this vegetation is *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, which found in every localities of quartzitic phyllite ridges. In the understory, most plants are the saplings and seedlings of tree species, with few shrubby plant species, climbers and shaded palms. The ground vegetation is fairly rich in bryophytes and ferns. Ground orchids are quite common in partially shaded areas (including facultative epiphytes and true terrestrials). The Zingiberaceae, Gesneriaceae and Begoniaceae are the most common families in more sheltered niches.

### A. Gunung Silipid (Fig. 13B, Plate 1F-G)

**Trees/Shrubby trees:** *Rhodoleia championii* Hook.f., *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Syzygium syzygioides* (Miq.) Merr & L.M. Perry, *Schima wallichii* (DC.) Korth., *Rhodamnia cinerea* Jack var. *cinerea*, *Lithocarpus elegans* (Blume) Hatus. ex Soepadmo, *Cratoxylum maingayi* Dyer, *Fagraea wallichiana* Benth.

**Palms:** *Pinanga disticha* Blume.

**Shrubs:** *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, *Oxyspora exigua* (Jack) J.F. Maxwell, *Tarenna longifolia* (G. Don) Ridl., *Eurycoma longifolia* Jack, *Ardisia crenata* Sims.

**Climbers:** *Gnetum macrostachyum* Hook.f., *Willughbeia tenuiflora* Dyer ex Hook.f., *Aeschynanthus radicans* Jack.

**Herbs/Subshrubs:** *Globba pendula* Roxb., *Sonerila griffithii* C.B. Clarke, *Begonia sinuata* Wall. ex Meisn. var. *sinuata*, *Argostemma pictum* Wall., *Henckelia inaequalis* (Ridl.) A. Weber, *Didymocarpus citrinus* Ridl., *Tainia penangiana* Hook.f., *Dienia ophrydis* (J. Koenig) Ormerod & Seidenf.,

*Dipodium pictum* (Lindl.) Rchb.f., *Acrotrema costatum* Jack.

**Ferns:** *Oleandra pistillaris* (Sw.) C. Chr., *Oleandra undulata* (Willd.) Ching, *Cibotium barometz* J. Sm., *Vittaria ensiformis* Sw., *Schizaea dichotoma* (L.) J. Sm., *Schizaea digitata* (L.) Sw.

### **B. Khao Hin Ban Chantharat** (Fig. 14B, Plate 2E-F)

**Trees/Shrubby trees:** *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Tristaniaopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh., *Anneslea fragrans* Wall., *Syzygium syzygioides* (Miq.) Merr & L.M. Perry, *Rhodamnia cinerea* Jack var. *cinerea*, *Lithocarpus* sp., *Cratoxylum maingayi* Dyer, *Schima wallichii* (DC.) Korth., *Elaeocarpus pedunculatus* Wall. ex Mast., *Cratoxylum maingayi* Dyer, *Fagraea wallichiana* Benth., *Ficus xylophylla* (Miq.) Wall. ex Miq., *Schefflera cephalotes* (C.B. Clarke) Harms.

**Palms:** *Eugeissona triste* Griff., *Plectocomia macrostachya* Kurz, *Pinanga scortechini* Becc.

**Shrubs:** *Pandanus monothea* Martelli, *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, *Ixora lobbii* King & Gamble, *Ardisia crenata* Sims.

**Climbers:** *Artabotrys suaveolens* Blume, *Pyramidanthe prismatica* (Hook.f. & Thomson) J. Sinclair, *Willughbeia coriacea* Wall., *Willughbeia tenuiflora* Dyer ex Hook.f., *Aeschynanthus radicans* Jack, *Dischidia bengalensis* Colebr., *Psychotria sarmentosa* Blume.

**Herbs:** *Begonia* sp., *Sonerila griffithii* C.B. Clarke, *Argostemma pictum* Wall., *Bromheadia finlaysoniana* (Lindl.) Miq., *Henckelia bombycina* (Ridl.) A. Weber, *Didymocarpus corchorifolius* Wall. ex A. DC., *Coelogyne prasina* Ridl., *Dienia ophrydis* (J. Koenig) Ormerod & Seidenf., *Dipodium pictum* (Lindl.) Rchb.f., *Tainia penangiana* Hook.f., *Geostachys holttumii* K. Larsen, *Globba* sp.

**Ferns:** *Oleandra pistillaris* (Sw.) C. Chr., *Oleandra undulata* (Willd.) Ching, *Vittaria scolopendrina* (Bory) Schkuhr ex Thwaites, *Dipteris conjugata* Reinw., *Selliguea heterocarpa* (Blume) Blume, *Davallia repens* (L.f.) Kuhn, *Davallia heterophylla* Sm., *Hymenophyllum serrulatum* (C. Presl) C. Chr., *Asplenium affine* Sw., *Crepidomanes minutum* (Blume) K. Iwats., *Hymenophyllum blandum* Racib.,



*Cibotium barometz* J. Sm., *Nephrolepis* sp., *Taenitis blechnoides* (Willd.) Sw., *Vittaria ensiformis* Sw., *Schizaea dichotoma* (L.) J. Sm., *Schizaea digitata* (L.) Sw.

**C. Khao Hin Ban Bo Num Ron** (Fig. 15B, Plate 3E-F)

**Trees/Shrubby trees:** *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, *Syzygium syzygioides* (Miq.) Merr & L.M. Perry, *Alstonia rostrata* C.E.C. Fisch., *Schima wallichii* (DC.) Korth., *Rhodamnia cinerea* Jack var. *cinerea*, *Fagraea wallichiana* Benth., *Elaeocarpus pedunculatus* Wall. ex Mast.

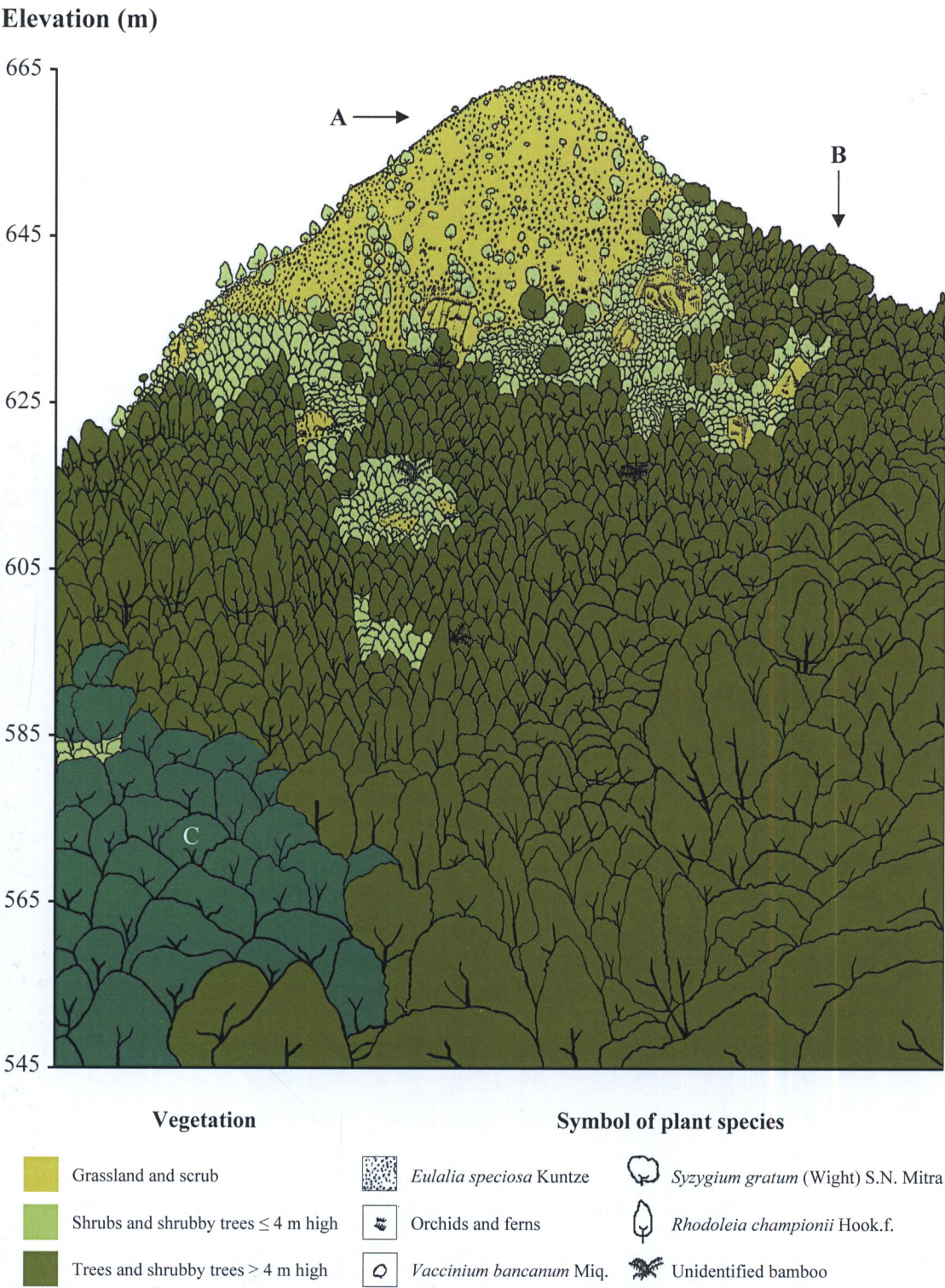
**Palm:** *Livistona speciosa* Kurz.

**Shrubs:** *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, *Eurycoma longifolia* Jack, *Ardisia crenata* Sims.

**Climbers:** *Ficus punctata* Thunb., *Anodendron axillare* Merr., *Dischidia bengalensis* Colebr.

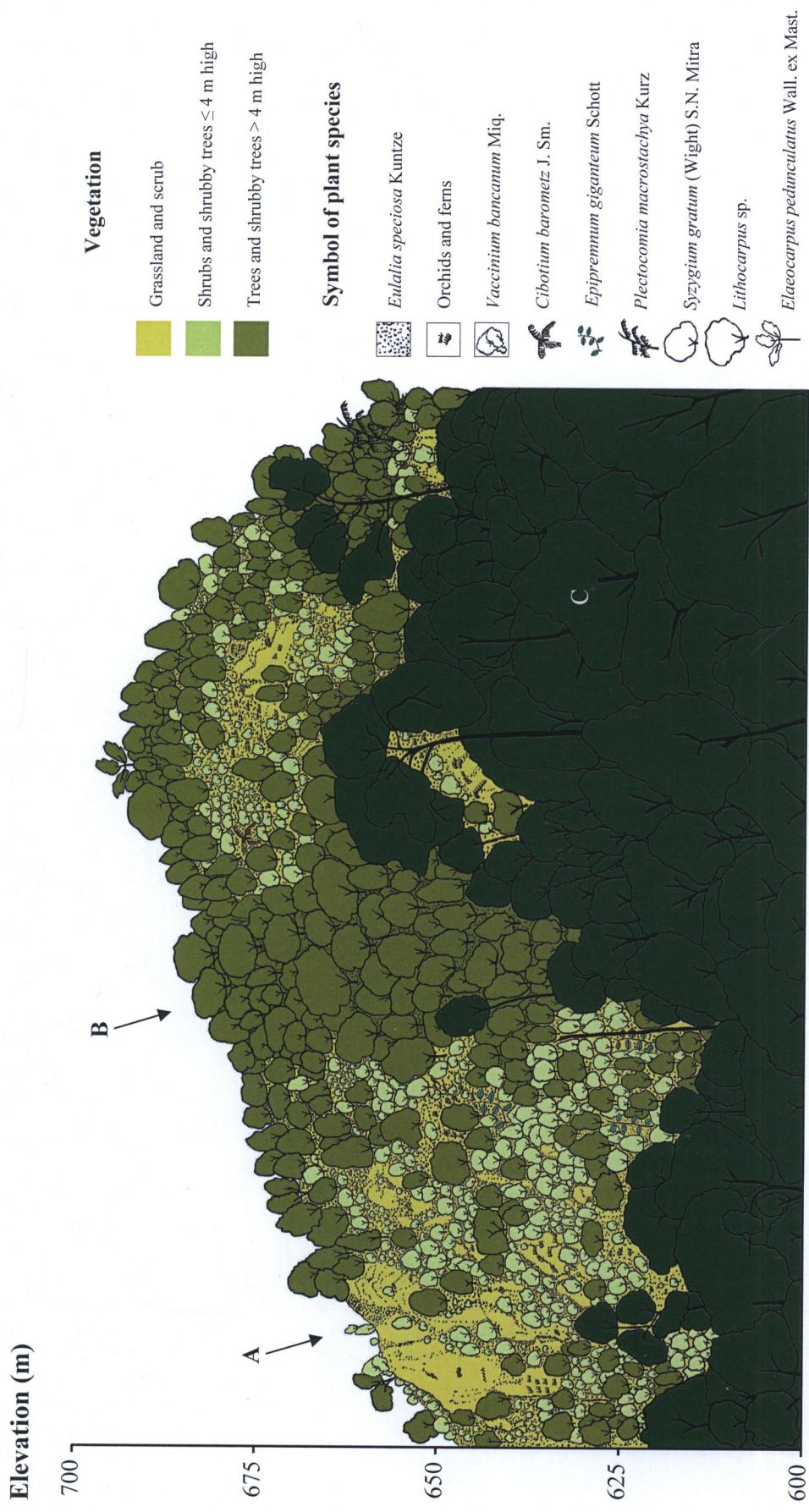
**Herbs/Subshrubs:** *Henckelia inaequalis* (Ridl.) A. Weber, *Didymocarpus citrinus* Ridl., *Tainia penangiana* Hook.f., *Dienia ophrydis* (J. Koenig) Ormerod & Seidenf., *Dipodium pictum* (Lindl.) Rchb.f.

**Ferns:** *Oleandra pistillaris* (Sw.) C. Chr., *Oleandra undulata* (Willd.) Ching, *Dipteris conjugata* Reinw., *Cibotium barometz* J. Sm., *Vittaria ensiformis* Sw.



**Figure 13.** Vegetation on Gunung Silipid: A. Grassland and scrub vegetation on the cliffs and summit ridge; B. Woodland vegetation; C. Para-rubber plantation.





**Figure 14.** Vegetation on Khao Hin Ban Chantharat: A. Grassland and scrub vegetation on the cliffs and rocky ridge; B. Woodland vegetation; C. Hill dipterocarp and secondary forests.



Elevation (m)



**Figure 15.** Vegetation on Khao Hin Ban Bo Num Ron: A. Grassland and scrub vegetation on the cliffs and summit ridge; B. Woodland vegetation; C. Hill dipterocarp and secondary forests.

## 2. Vegetation on granitic ridges

There are a few isolated narrow ridges at the moderate and high altitudes. They are very close to Thai-Malaysian border. The species composition of this vegetation type closely resembles the vegetation on quartzitic phyllite ridges. The vegetation occurring on these narrow ridges is rather sparse and open, it is composed of many ferns and orchids, with few scattered trees and shrubs. In addition, climbers and scandent shrubs are commonly found. Surrounding area of the exposed ridges are covered with soil, therefore, it supports a dense, close vegetation with 10-20 m canopy high. Ground vegetation in the sheltered area is rich in bryophytes and ferns. The most common families of ground herbs occurring on the cliffs are Gesneriaceae, Orchidaceae, Zingiberaceae and Begoniaceae.

### D. Khao Hin Ban Piyamit 2 (Plate 4A-C)

**Trees/Shrubby trees:** *Dacrydium elatum* (Roxb.) Wall. ex Hook., *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh., *Schima wallichii* (DC.) Korth., *Elaeocarpus pedunculatus* Wall. ex Mast., *Syzygium* sp. 2, *Vaccinium* sp.

**Palms:** *Livistona speciosa* Kurz., *Licuala scortechini* Becc., *Pinanga scortechini* Becc., *Plectocomia macrostachya* Kurz.

**Shrubs:** *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, *Ficus deltoidea* Jack var. *kunstleri* (King) Corner, *Ardisia crenata* Sims.

**Scandent shrubs/Climbers:** *Ancistrocladus tectorius* (Lour.) Merr., *Ficus heteropleura* Blume, *Ficus sagittata* J. Koenig ex Vahl, *Ficus villosa* Blume, *Gnetum macrostachyum* Hook.f., *Willughbeia coriacea* Wall., *Passiflora perakensis* Hallier f., *Uncaria cordata* (Lour.) Merr., *Epipremnum giganteum* Schott., *Psychotria sarmentosa* Blume, *Aeschynanthus radicans* Jack, *Dischidia bengalensis* Colebr., *Hoya rigida* Kerr, *Hoya plicata* King & Gamble.

**Herbs/Subshrubs:** *Didymocarpus citrinus* Ridl., *Didymocarpus cordatus* A. DC, *Begonia sinuata* Wall. ex Meisn. var. *sinuata*, *Sonerila griffithii* C.B. Clarke, *Argostemma pictum* Wall., *Globba pendula* Roxb., *Coelogyne cumingii* Lindl., *Coelogyne trinervis* Lindl., *Coelogyne velutina* de Vogel, *Dipodium pictum* (Lindl.) Rehb.f., *Geostachys penangensis* Ridl.

**Ferns:** *Dicranopteris linearis* (Burm.f.) Underw., *Pteridium aquilinum* (L.) Kuhn, *Oleandra pistillaris* (Sw.) C. Chr., *Oleandra undulata* (Willd.) Ching, *Cibotium barometz* J. Sm., *Asplenium affine* Sw., *Asplenium normale* D. Don, *Asplenium pellucidum* Lam., *Davallia repens* (L.f.) Kuhn, *Davallia solida* (G. Forst.) Sw., *Davallia trichomanoides* Blume var. *lorrainii* (Hance) Holttum, *Drynaria rigidula* (Sw.) Bedd., *Drynaria sparsisora* (Desv.) T. Moore, *Pyrrosia adnascens* (Sw.) Ching, *Vittaria scolopendrina* (Bory) Schkuhr ex Thwaites.

### 3. Vegetation on limestone hills

The limestone vegetation could be found near the town of Betong at Ban Ko Mo 4. Typically the limestone hills are tower-like, abruptly rising from surrounding area. Due to the erosion of calcareous rock, this landscape is characterised by the present of the caves. The species composition of this vegetation differs distinctly from the others in non-limestone study sites. There are some few vascular plant species overlapping between limestone and non-limestone habitats. The vegetation on the exposed cliffs and summit ridges is sparse and open. However, the medium-sized trees could be found in rock crevices, e.g. *Ficus* spp., *Cycas clivicola* K.D. Hill, *Senna timorensis* (DC.) H.S. Irwin & Barneby, etc. In the sheltered areas, the ground vegetation is rich in bryophytes and ferns, and the most common families of flowering plants are Gesneriaceae and Orchidaceae.

#### E. Khao Hin Ban Ko Mo 4 (Plate 4D-F)

**Trees/Shrubby trees:** *Cycas clivicola* K.D. Hill, *Senna timorensis* (DC.) H.S. Irwin & Barneby, *Morinda elliptica* Ridl., *Pterospermum diversifolium* Blume, *Alphonsea* sp., *Oreorhamnus serrulatus* Ridl., *Aglaia* sp., *Ficus* sp., *Aidia* sp.

**Shrubs:** *Croton cascarilloides* Raeusch., *Tarenna stellulata* (Hook.f.) Ridl.

**Climbers:** *Parameria laevigata* (Juss.) Moldenke, *Epipremnum giganteum* Schott.

**Herbs/Subshrubs:** *Paraboea lancifolia* (Ridl.) B.L. Burt., *Chirita involucrata* Craib, *Chirita* sp., *Epithema* sp. 1, *Epithema* sp. 2, *Peperomia kotana* C. DC., *Geophila repens* (L.) I.M. Johnst., *Arisaema fimbriatum* Mast., *Eria javanica*

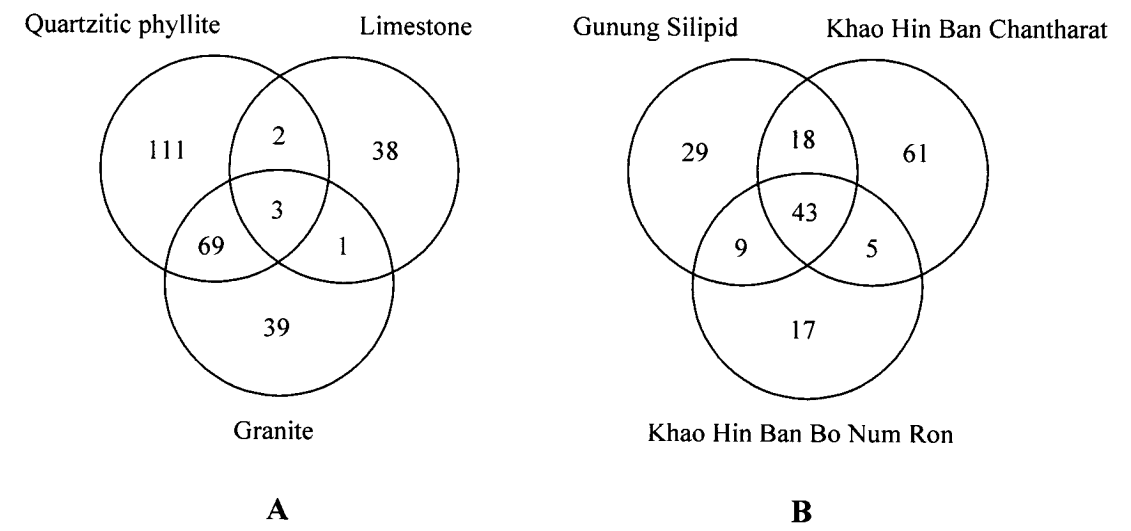
(Sw.) Blume, *Flickingeria xantholeuca* (Rchb.f.) A.D. Hawkes, *Habenaria reflexa* Blume, *Pomatocalpa maculosum* (Lindl.) J.J. Sm. subsp. *maculosum*.

**Ferns:** *Pyrrosia stigmosa* (Sw.) Ching, *Pyrrosia penangiana* (Hook.) Holttum, *Drynaria quercifolia* (L.) J. Sm., *Davallia denticulata* (Burm.f.) Mett. ex Kuhn, *Loxogramme scolopendrina* (Bory) C. Presl, *Anthrophyllum parvulum* Blume, *Adiantum caudatum* L., *Asplenium adiantoides* (L.) C. Chr., *Asplenium salignum* Blume.

**Note:** List of plant species commonly found on limestone pavements is shown in Appendix 2.

**Plant species composition and floristic similarity**

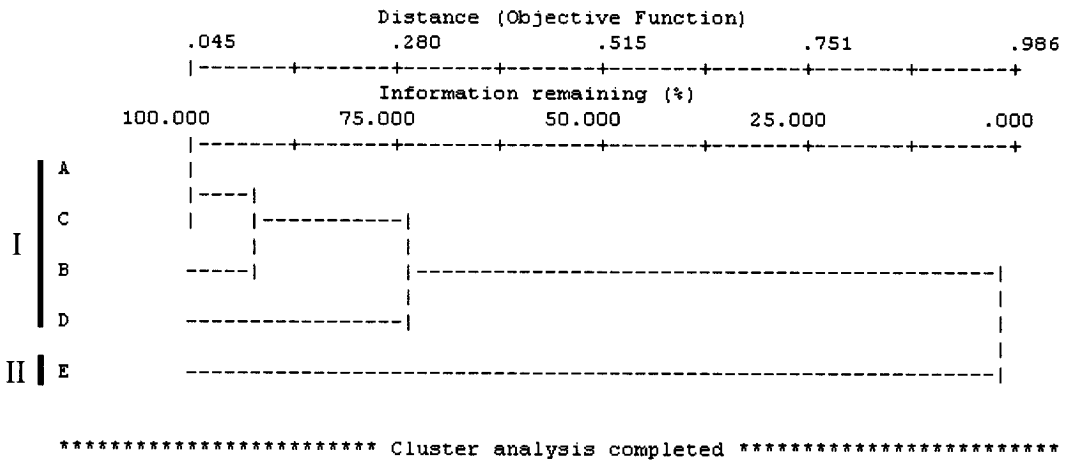
Venn-Euler diagrams of the numbers of plant species found in three different substrates and among three study sites of quartzitic phyllite ridges, the numbers of plant species found in each substrate and each site of three quartzitic phyllite ridges are indicated (Fig. 16A-B). The result showed that only three species overlapped between three different substrates and there were very few taxa shared between limestone and non-limestone habitats (6 species), while 72 species were found in both quartzitic phyllite and granitic ridges. One hundred and eleven species were restricted to quartzitic phyllite and 39 species were restricted to granite and 38 species were only recorded from limestone. When considering the shared taxa among quartzitic phyllite ridges, a high number of shared taxa were recorded in three study sites (43 species). However, there were 61 species restricted to Khao Hin Ban Chantharat, while the number of restricted taxa recorded in other two study sites were lower, 29 species in Gunung Silipid and 17 species in Khao Hin Ban Chantharat, respectively.



**Figure 16.** Venn-Euler diagrams of the numbers of species found in the three different substrates (A) and among three quartzitic phyllite ridges (B).



From the hierarchical cluster analysis (Fig. 17), two groups can be recognised, study site A-D (group I: non-limestone) were closely associated, the result showed a high value ( $> 70\%$ ) of floristic similarity within non-limestone study sites. Study site E (group II: limestone) was very dissimilar from the group I.



**Figure 17.** Cluster analysis dendrogram based on similarity of plant species composition and their abundance among study sites.

## CHAPTER 4

### DISCUSSION AND CONCLUSION

#### **Floristic richness and taxonomic diversity**

In the present study, 70 families, 141 genera and 223 species were recorded from the mountain ridges. The observed number of species might be underestimated, due to the undersampling of locally rare species. According to the extrapolation of species accumulation or species area curves, it was estimated that there were at least 250 species of vascular plants in these mountain ridges. The number of species recorded in the present study is higher than the number of species reported by several studies in the similar habitat type (rocky mountains) [Sridith, 1989 (88 species of flowering plants); Boonjaras, 2002 (107 species of flowering plants)]. It shows that the mountain ridges in Betong district are rather rich in vascular plant diversity, compared with other regions of similar habitat type in Thailand, e.g. Phu Hin Rong Kla National Park (Sridith, 1989) and Pha Taem National Park (Boonjaras, 2002), in spite of their smaller size (only 5-10 hectares/study site). Nevertheless, the species richness of plants in these mountain ridges are relatively low, compared with other forest types in surrounding areas, particularly tree species are less diverse in comparison to lowland forests (pers. obs.). However, it is to be concerned that the variations in species richness are strongly affected by the sampling efforts (both in space and time) and by the different criteria in the analyses of each study.

Considering comparisons of species richness between grassland sites and woodland sites, the higher of plant species richness observed in woodland sites might be the result of the mixing of two different plant assemblages along common ecotone (between rocky outcrops and lowland evergreen forest) and they might be correlated with their particular fine niche partitioning (habitat heterogeneity), whereas fewer plant species richness were observed in the grassland sites. It might be due to the extreme environment conditions. In general, species richness of ecotones is often higher than that of either surrounding habitats (Krohne, 2001). Moreover, several publications have confirmed the observations of greater species richness in an ecotone (Li *et al.*, 2007; Hou *et al.*, 2008). Lloyd *et al.* (2000), however, suggested that high

species richness in an ecotone is not a general phenomenon. Furthermore, the exact position of the ecotones and their widths were identified subjectively. As a consequence, it should be considered seriously in the further research.

With regard to the altitudinal distribution of the plant species, several authors have suggested that a mid-altitudinal peak in species richness is the most common pattern of plant species richness along altitudinal gradients (Wolf and Alejandro, 2003; Bhattarai *et al.*, 2004; Watkins *et al.*, 2006). The mid-altitude vegetation types (500-1,000 m) in the present study shared species with lowland and highland vegetation types as well, this may lead to the increase of plant species richness. However, this study did not focus on the pattern of species richness along the altitudinal gradients. Further studies addressing this issue are needed.

The predominant families in each major group were Selaginellaceae and Lycopodiaceae (lycophytes); Polypodiaceae, Davalliaceae and Aspleniaceae (pterophytes); Asclepiadaceae, Rubiaceae, Melastomataceae, Myrtaceae, Gesneriaceae and Moraceae (dicots); Orchidaceae, Arecaceae and Zingiberaceae (monocots). It is not surprising that these families are species-rich as most of them are the largest families in the Thai flora (see Larsen and Nielsen, 1994). The most speciose family of vascular plants in this study was Orchidaceae. This family is one of the largest families of flowering plants with the estimation of 17,000-35,000 species (Dressler, 1993) and there are about 170 genera and 1,230 species in Thailand (Nanakorn and Indharamusika, 1999). The members of family Myrtaceae are prominent in heath forest (including rocky outcrops), especially *Tristaniopsis* and *Syzygium* (Whitmore, 1975; Davies and Kamariah, 1999), while several species of the Rubiaceae and Melastomataceae are also the commonest ones in the heath forest and on the exposed ridges (MacKinnon *et al.*, 1996). In addition, according to their habits/life forms, herbaceous flowering plants were the commonest plants in these mountain ridges and indeed, most of the common species are lithophytes and/or facultative epiphytes. The majority of them belong to few families, e.g. Orchidaceae, Asclepiadaceae and Gesneriaceae. These agree well with previous reports from the similar habitats, e.g. mountain summits (Stone, 1981), rocky outcrops (Sridith, 1989; Suddee, 1995; Boonjaras, 2002) and coastal heath forest (Laongpol, 2003). However, it is interesting to note here that there were only four species of Fabaceae found in the present study,

this pattern is in contrast with the data from other rocky outcrops, since Fabaceae is one of the most species-rich families in several rocky outcrops in the northern and northeastern parts of Thailand (Sridith, 1989; Suddee, 1995; Boonjaras, 2002). The possible explanation is due to a different phytogeographical affinity. According to Takhtajan's (1986) classification system of floristic regions, most of the legume species found in the northern and northeastern parts of Thailand are Indo-Chinese elements and they are seasonal plant species (mostly annual herbs) such as *Lespedeza sulcata* Craib, *Desmodium* spp., etc. (Sridith, 1982), which require an intensive dry season. The large areas of ever-wet rain forest might be barriers for distribution of these monsoon climate species. Another explanation is that legume species might be abruptly reduced in richness and abundance in the moderate and high altitudes, as the family Fabaceae (Leguminosae) is one of the species-rich families in the tropical rain forest (Whitmore, 1990), which is often abundant in lowlands, e.g. Tarutao National Park (Congdon, 1982) and Pha Taem National Park (Boonjaras, 2002).

### **New records**

It is interesting to note here that a high number of new records (16 species) were recognised in this study. All of them are indigenous species of Malesian region. This could be expected, since the study area is very close to Malaysia. Furthermore, due to the fact that these mountain ridges are isolated and inaccessible, therefore, there is a high probability to find many Malesian elements and rare plant species. Nowadays, many areas of Betong region are still unexplored, more new records or little known plant species as well as new species of plants could be expected.

### **Unidentified species**

Twenty five species could not be identified to the specific level, due to the lack of reproductive structures and no available related taxonomic literatures. Among the totally unidentified species, several species of which are probably new to science (as mentioned in Chapter 3).

### **Disturbance and alien species**

Although the mountain ridges in Betong district are relatively inaccessible, but some areas have been partly disturbed by human activities, such as agriculture, construction of the road, etc. The consequences are the invasion of alien species. This study reveals that four species of alien plants, i.e. *Ageratum* sp., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clidemia hirta* D. Don and *Lantana camara* L. are native to tropical America. They are often found in disturbed areas and forest edges. The spatial distribution of these alien plants reflects the impact of human activities on the invasion of alien species. The occurrence of these plants can be used to indicate the level of anthropogenic disturbance and habitat quality of the natural forest. These plants should be added to the list of invasive alien plants of Thailand. The prevention of introduction, control and eradication of these invasive alien species are urgently required.

### **Taxonomic problems and species delimitation**

In the present study, even though most of the species found in the non-limestone mountain ridges are clearly distinct species, but some species exist more or less taxonomic problems (as mentioned in Chapter 3). The variation in most morphological characters studied in several plants appeared to be more or less continuous. One possible explanation for the overlap in morphological characters in several plants might be the effect of microclimate and edaphic factors on the variation in shape and size of vegetative and floral characters. It could be noticed, for example, that the cultivated plants have a wide variation in both vegetative and floral characters. The extreme forms (variants) of a single species have erroneously been described by taxonomists as separate species, especially when so few specimens were available. On the other hand, several cryptic species may be erroneously considered as a single widely distributed species. In any case, it could be interpreted that the diversification of morphological forms may be a sign of recent (undergoing) speciation.

Concerning the species definition, there are three important aspects of species delimitation, i.e. morphological distinctness, interbreeding isolation and their historical relevance (Kornet, 1989). It is therefore suggested that more investigation of specimens as well as evidences from molecular data, deep morphology, population studies, chromosomal studies and detailed studies on the ecology (e.g. pollination ecology) in the further studies are strongly needed in order to resolve the taxonomic problems and these evidences might be able to determine whether such phenomena are in fact only a single polymorphic species or consist of several closely related species.

### Phytogeographical affinities

Based on geographical distribution of species, the flora in the study area could be categorised into 11 phytogeographical elements (Table 9). It is noticed here that the widely distributed paleotropic elements are in a small group. All of these paleotropical species are non-flowering plants (lycophytes and ferns) and they are commonly known throughout Thailand and have no special phytogeographical importance.

The phytogeographical affinities of the flora in the study area are predominantly Malesian (41%). This high percentage is confirmed that the flora in the study area is part of the Malayan flora and belongs to the Malesian floristic region as suggested by Takhtajan (1986). In addition, *Eugeissona triste* Griff. and *Pinanga* spp., used by Whitmore (1975) to characterise the Malayan forests, are also found in the study area. Considering the phytogeographical subareas, there are high numbers of plants species restricted to Thai-Malay Peninsula. This confirms the phytogeographical status of Thai-Malay Peninsula. In the present study, there are three species of plants restricted to Perak sub-province and the adjacent areas. This result weakly supports that the flora in the area is part of the Perak sub-province as proposed by Aston (1992). It is also noticed here that though Borneo is farther than the Sumatra to the study area, but it has more common plant species with the flora of the study area than that of Sumatra. This result is far less expected in term of its geographical proximity. It might be due to the collecting bias and the local edaphic differences. Many other areas remain poorly collected and the distribution of each plant species is not known. It is suggested that much more information on distribution patterns of plants is needed in order to clarify the phytogeographical affinities of the floras in the areas.

In the present study, there are seven species of Indo-Chinese elements, this may be a coincidence with a core area of seasonal Asiatic intrusion in the Thai-Malay Peninsula (Wong, 1998). Two species are recorded as endemic to Thailand, i.e. *Hoya rigida* Kerr and *Geostachys holttumii* K. Larsen. However, since the study area is very close to Thai-Malaysian border, these species are also expected to be found in Peninsular Malaysia as well. Furthermore, because of the problem in species delimitation and the poorly known overall distribution ranges of many plants species, these may lead to the erroneous determination of geographical range in several species.

From the results, it is suggested that there are apparently two phytogeographical transitions on the Thai-Malay Peninsula as many Malesian elements reach their northern limits at these two transitions, i.e. Kangar-Pattani line (35 species) and near Isthmus of Kra (18 species). The results of this study are in agreement with the previous report of Woodruff (2003).

### **Rarity and endemism**

With regard to the rarity concept, the classification of rarity status of plants is based on three important parameters, i.e. geographical range, habitat specificity and local population size (Pullin, 2002; Magurran, 2004). Many plant species found in this study are considered as rare plants. Several species of these rare plants are listed in the Thailand Red Data: Plants (Santisuk *et al.*, 2006); A Preliminary Check-list of Threatened Plants in Thailand (Pooma *et al.*, 2005) and the 2007 IUCN Red List of Threatened Species ([www.iucnredlist.org](http://www.iucnredlist.org), accessed on 04 October 2008) (Appendix 3). Fourteen species are endemic to Thai-Malay Peninsula, and most of them are restricted to the non-limestone mountain ridges. This study reveals that the high degrees of endemisms occur among the herbaceous species, such as the members of Gesneriaceae (71% of 7 species), and most of *Geostachys* (Zingiberaceae) (50% of 2 species). As many authors have pointed out that the degree of endemism is high in herbaceous dicots, especially in the family Gesneriaceae (Bidin, 1989; Kiew, 1989; Wong, 1998). Most *Geostachys* species are hyper-endemic and many of them are known only from one or a few localities (Larsen, 1962; Lau *et al.*, 2007). It is confirmed that the mountain ridges and rocky outcrops are among the special areas of high rarity and endemism of plants. This study is in accordance with the findings of Wong (1998) and Jacobi *et al.* (2007).

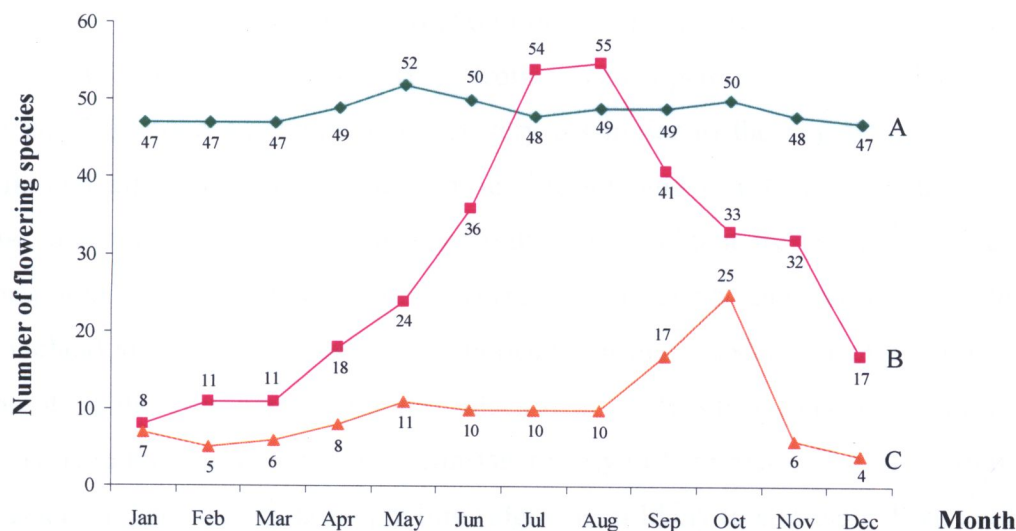


### Reproductive phenology

There are many species of flowering plants that flower and fruit all year round. However, many plant species have a wide range in the flowering and fruiting time of individuals and populations. For example, flowering of *Paraboea elegans* (Ridl.) B.L. Burt has irregular annual or sub-annual flowering patterns at the individual level, but continuous flowering at the population level. Moreover, the various flowering patterns are found among plants in this vegetation type. It is confirmed that there is great variation and high diversity in phenological patterns in tropical rain forest.

It could be seen in the Figure 18 that there is not clearly seasonal in flowering patterns of plants in the study area, while the flowering patterns of plants in Phu Hin Rong Kla National Park and Pha Taem National Park are clearly seasonal. Most of the plant species flower only in rainy season (annual plant species) according to Sridith (1989) and Boonjaras (2002). However, most plants (67%) found in this study showed flowering peaks in the rainy seasons, while relative few species (33%) showed flowering peaks in the dry seasons. It is convinced here according to the fact that the rainfall pattern is the predominant factor even in the tropical rain forest, where the climate is almost non-seasonal.

Considering the relation of fruit types (dry or fleshy) and fruit maturity periods of plants, the results showed that a larger proportion of dry fruited species have their fruits ripening in dry seasons rather than in rainy seasons, while fleshy fruited species have their fruits ripening in the rainy seasons more than in dry seasons. The results from this study indicate that fruit maturity phenology of any fruit types might be adaptations to their dispersal mechanisms. Most of the dry fruited species are wind-dispersed, which mature their seeds during the dry season when the probability of long-distance seed dispersal is highest, whereas most of the fleshy fruited species are animal-dispersed, therefore, fruit maturity periods may coincide with the abundance of dispersers (e.g. birds or mammals).



**Figure 18.** Periodicity of flowering of plants recorded from three different areas.  
◆ Present study (A); ■ Pha Taem National Park (B), (source: Boonjaras, 2002);  
▲ Phu Hin Rong Kla National Park (C), (source: Sridith, 1989).

### **Vegetation on non-limestone mountain ridges**

This vegetation forms on infertile, highly acidic (pH often less than 5), rocky and sandy heath soils (derived from siliceous parent materials). The vegetation on non-limestone mountain ridges is very dissimilar to the vegetation on limestone hills and differs distinctly from surrounding lowland forest, it is characterised by a low, uniform canopy, with single or only few dominant tree species and generally composed of two sub-vegetation types, i.e. grassland and scrub vegetation and woodland vegetation. However, it is noticed that the grassland plant communities are absent on the very narrow granitic ridges (e.g. study site D) and these are probably also due to the lack of soil cover (consists mostly of bare rock). The two different sub-vegetation types on quartzitic phyllite ridges seem likely to correspond with soil depth and organic matter. The grassland vegetation dominated by *Eulalia speciosa* Kuntze occurred on a thin layer of soil over the rocky base, while the woodland vegetation dominated by *Syzygium gratum* (Wight) S.N. Mitra var. *gratum* and/or *Rhodoleia championii* Hook.f. appeared on a greater depth of soil and better organic matter.

Plant species of these isolated mountain ridges, like those of other rocky outcrops, are subjected to extreme environmental conditions. Most plants found in this study were facultative epiphytes and had typical xeromorphic features. These plants are notably herbaceous, succulent in habit, etc. Many herbaceous plants with underground parts (such as tubers or rhizomes) are able to survive the dry period by shedding their leaves and undergoing a dormant period, e.g. *Begonia sinuata* Wall. ex Meisn. var. *sinuata* and *Sonerila griffithii* C.B. Clarke. The tree species are generally smaller than those surrounding lowland forests, leaves in this vegetation type are typically small, coriaceous (sclerophyllous), thickly cutinised, pale colored, pubescence, characteristics which can be considered adaptations to hot (including solar radiation) and dry conditions, but also may be adaptations to nutrient deficiency on very acidic soils (Whitmore, 1975; Richards, 1996; Davies and Kamariah, 1999). Such characteristics are in coincidence with those of the heath forests and montane forests (Whitmore, 1975; 1990; Stone, 1981; Davies and Kamariah, 1999; Sridith, 2002; Sridith and Laongpol, 2003; Laongpol *et al.*, 2005). As a matter of fact, however, the xeromorphism is not restricted to xerophytes and not all xerophytic species display xeromorphic characteristics (Batanouny, 2001). The causes of these

xeromorphic characteristics of many plants have long been of interest to botanists (Bruckley *et al.*, 1980; Proctor *et al.*, 1983; Read *et al.*, 2006). However, until now this phenomenon is still enigmatic. Some of these xeromorphic characteristics, for instance sclerophylly, this xeromorphic feature is most likely occurred under the extreme environmental conditions where multiple stresses are operating and it is thought to be a complex phenomenon (Read *et al.*, 2006). However, more details of the morphology, anatomy and ecophysiology of the plants are necessary in order to better understand the adaptations of plants to these multiple stressful environments.

### **Plant species composition and floristic similarity**

The similarity analysis showed a high degree of dissimilarity ( $\beta$ -diversity) between non-limestone study sites and a limestone study site and indeed there were very few plant species widely occurring in all three substrates (limestone, granite, quartzitic phyllite). It could be interpreted by the fact that the substrates (geology) or edaphic factors (e.g. soil pH, soil depth, water and nutrient availability) might be the limiting factor determining the species composition of these plant communities. Several studies have confirmed that the edaphic factors are among the most important factors that influence the distribution of plants (Newbery and Proctor, 1984; Masunaga *et al.*, 1998; Clark *et al.*, 1999) and the variation of plant species composition in the plant communities (floristic patterns) (Sollins, 1998; Parmetier, 2003; Ruokolainen *et al.*, 2007). However, there is not enough evidence available in this study. It is therefore suggested that further studies should be carried out on the relationship between plants and edaphic factors in the areas.

### Floristic variation within quartzitic phyllite ridges

Within the Sankalakhiri range, there are three quartzitic phyllite ridges under the similar climatic and edaphic conditions (the same habitat niche), this has supported a high degree of similarity in floristic composition in the plant communities. Many species were found in all three quartzitic phyllite ridges. However, in more detail, there are quantitative differences. It is important to note that some dominant tree species, such as *Rhodoleia championii* Hook.f., *Anneslea fragrans* Wall. and *Tristaniopsis merguensis* (Griff.) Peter G. Wilson & J.T. Waterh. are highly abundant and restricted to only one or two study sites. It seems likely that the variation in floristic composition among the study sites and the abundance patterns of these dominant tree species cannot easily be explained by traditional niche theory. Two possible explanations for variation in the floristic composition and abundance patterns of plants are proposed here: (1) dispersal limitation between study sites; (2) Other factors, related to germination and establishment of plants (e.g. specificity of the plant-mycorrhizal association, competition, etc.).

The first possible explanation is the dispersal limitation due to isolation by distance (insular property) of these isolated mountain ridges. Concerning the influence of chance or neutral processes on the floristic composition in Hubbell's (2001) dispersal-limited neutral theory, this theory states that the differences in floristic composition between sites are related to isolation by distance, while the habitat preferences of plant species play no important role in their distribution and abundance patterns. Several studies have suggested that the dispersal limitation plays an important role in the composition of plant communities (Ehrlén and Eriksson, 2000; Cascante-Marín *et al.*, 2009).

The second alternative explanation is the specificity of the plant-mycorrhizal association, which influences the germination and establishment of plants. Mycorrhiza fungi are important for the seed germination and seedling establishment (Richards, 1996; Kitajima and Fenner, 2000; Batty *et al.*, 2002; Larpkern *et al.*, 2003; Porras-Alfaro and Bayman, 2007). The specificity of the plant-mycorrhizal association has long been recognised (Warcup, 1971; Molina *et al.*, 1992; Brundrett and Cairney, 2002; Porras-Alfaro and Bayman, 2007). Many plant species are reported as forming ectomycorrhizal associations, such as the members of the Dipterocarpaceae, Ericaceae,

Fabaceae (Leguminosae), Fagaceae, Myrtaceae and Orchidaceae (Cranbrook and Edwards, 1994; Richards, 1996; Kitajima and Fenner, 2000; Batty *et al.*, 2002). Moreover, several authors have suggested that mycorrhizal symbiosis could influence plant community structure and diversity (Hartnett and Wilson, 1999; Smith *et al.*, 1999; Brundrett and Cairney, 2002; Karanika *et al.*, 2008).

In conclusion, both niche and neutral processes may be important and could be incorporated into new comprehensive models (e.g. Tilman, 2004; Gravel *et al.*, 2006; Jabot *et al.*, 2008). This study indicate that dispersal limitation play an important role at very small scales (within the habitat), whereas niche differentiation can occur at small scales (microhabitat differentiation) or at large scales (edaphic and geographic differentiation). With regard to the allopatric speciation model, there is no evidence to suggest that the isolation of these mountain ridges can cause speciation. This is probably due to the fact that the mode of speciation may occur at larger geographic scales. In any case, there is not enough empirical evidence, supporting these assumptions. Consequently, it is suggested that further experiments are strongly needed in order to understand the factors and the important processes shaping plant communities and biodiversity patterns at the spatio-temporal scales.

### Remarks:

Niyomdham *et al.* (2000) stated that the limestone vegetation in Hala-Bala forest is mainly composed of ericaceous plants and *Dacrydium elatum* (Roxb.) Wall. ex Hook. This, however, seems to be a misleading conclusion because according to the geological map of Hala-Bala forest, there is no evidence showing the occurrence of limestone habitat in this area. Based on the results of the present study, the plant composition on limestone hills is very different to that on non-limestone ridges. Consequently, it is possible that this confusion is due to misidentification of the habitat type. As a matter of fact, the problem of possible wrongly categorised habitat types in some herbarium labels might have occurred and these may have lead to the erroneous determination of habitat preference of many plant species. It is therefore suggested that during future plant collecting, the label information should be carefully and critically noted including the habitat and geology of the locality.

### **Suggestions for further studies on vegetation**

It is strongly recommended that further studies on the numerical syntaxonomy, nomenclature of plant communities on the mountain ridges and rocky outcrops and long-term studies on vegetation dynamics should be undertaken, not only in the Sankalakhiri range, but also other parts of Thailand and the Thai-Malay Peninsula in order to provide a broad overview of the region and to gain more comprehensive knowledge of vegetation in this interesting part of the world.

### **Conservation perspectives**

In Thailand, conservation management often focus on areas of high biodiversity, but since there are many regions with locally differences in the species composition, even the lower biodiversity habitats (low  $\alpha$ -diversity), such as rocky outcrops, the priority of habitat conservation should be given. From a conservation perspective, it is interesting to note that beta diversity may be more important than alpha diversity, because species turnover between habitats influences diversity at large scales. The mountain ridges and rocky outcrops generally have a low potential for commercial land use, since they are inaccessible habitat. However, some areas of mountain ridges and rocky outcrops have been destroyed by human activities (as already mentioned), these anthropogenic disturbances may lead to the local extinction of native plant species.

Based on the results from the present study, the vegetation on the cliffs and rocky ridges is considered rare and unique compared with the other vegetation types (high  $\beta$ -diversity). There are many unique/rare species (including narrow endemics) in these mountain ridges that need protection. Among these, several plants are beautiful and showing great horticultural potential, such as orchids, ferns, lycopods, gesneriads and ericaceous plants. They are threatened with extinction in the wilds because of commercial collecting in a massive scale. Furthermore, due to the fact that none of all study sites in this study belong to any types of protected areas. Consequently, it is suggested that the existing natural vegetation on rocky outcrops should be protected by the establishment of regional habitat conservation plans. New protected areas must be created and the existing forest reserves should be upgraded to National Parks or Wildlife Sanctuaries.

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## **APPENDICES**

**APPENDIX 1.** List of vascular plant species found in non-limestone study sites.

Scientific name	Habit	Non-limestone			
		A	B	C	D
<b>LYCOPHYTES</b>					
<b>Lycopodiaceae</b>					
1. <i>Huperzia phlegmaria</i> (L.) Rothm.	EF/LF	1	1	0	0
2. <i>Huperzia squarrosa</i> (G. Forst.) Trevis.	EF/LF	0	0	0	1
3. <i>Lycopodiella cernua</i> (L.) Pic. Serm.	TerF/LF	3	0	0	0
<b>Selaginellaceae</b>					
4. <i>Selaginella intermedia</i> (Blume) Spring	TerF	2	0	0	0
5. <i>Selaginella siamensis</i> Hieron.	LF/TerF	2	0	0	0
6. <i>Selaginella strigosa</i> Bedd.	LF	2	0	0	0
7. <i>Selaginella wallichii</i> (Hook. & Grev.) Spring	TerF	0	0	1	2
<b>PTERIDOPHYTES</b>					
<b>Adiantaceae</b>					
8. <i>Syngamma minima</i> Holttum <sup>NR</sup>	LF	0	1	0	0
9. <i>Taenitis blechnoides</i> (Willd.) Sw.	TerF/LF	0	2	0	0
<b>Aspleniaceae</b>					
10. <i>Asplenium affine</i> Sw.	EF/LF	0	3	0	3
11. <i>Asplenium nidus</i> L. var. <i>nidus</i>	EF/LF	0	1	0	0
12. <i>Asplenium normale</i> D. Don	LF/TerF	0	0	0	3
13. <i>Asplenium pellucidum</i> Lam.	EF/LF	2	2	2	3
<b>Blechnaceae</b>					
14. <i>Stenochlaena palustris</i> (Burm.f.) Bedd.	LF/TerF	2	2	0	0
<b>Davalliaceae</b>					
15. <i>Davallia angustata</i> Wall. ex Hook. & Grev.	EF/LF	0	0	0	2
16. <i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn *	EF/LF	2	2	2	2
17. <i>Davallia heterophylla</i> Sm.	EF/LF	0	3	3	0
18. <i>Davallia pectinata</i> Sm.	EF/LF	1	0	0	0
19. <i>Davallia repens</i> (L.f.) Kuhn	EF/LF	0	4	0	2
20. <i>Davallia solida</i> (G. Forst.) Sw.	EF/LF	4	3	3	3
21. <i>Davallia trichomanoides</i> Blume var. <i>lorrainii</i> (Hance) Holttum	EF/LF	2	0	0	3
<b>Dennstaedtiaceae</b>					
22. <i>Lindsaea bouillodii</i> Christ	LF	0	1	0	1
23. <i>Pteridium aquilinum</i> (L.) Kuhn	TerF	5	3	5	4
<b>Dicksoniaceae</b>					
24. <i>Cibotium barometz</i> J. Sm.	LF/TerF	4	3	4	3
<b>Dipteridaceae</b>					
25. <i>Dipteris conjugata</i> Reinw.	LF/TerF	0	4	2	1
<b>Gleicheniaceae</b>					
26. <i>Dicranopteris linearis</i> (Burm.f.) Underw.	LF/TerF	5	4	5	4
<b>Hymenophyllaceae</b>					
27. <i>Crepidomanes minutum</i> (Blume) K. Iwats.	EF/LF	0	3	0	0
28. <i>Hymenophyllum blandum</i> Racib.	EF/LF	0	3	0	0
29. <i>Hymenophyllum serrulatum</i> (C. Presl) C. Chr.	EF/LF	0	4	0	2
<b>Nephrolepidaceae</b>					
30. <i>Nephrolepis</i> sp.	LF/TerF	3	3	3	0
<b>Oleandraceae</b>					
31. <i>Oleandra pistillaris</i> (Sw.) C. Chr.	TeF/LF	3	5	4	3

## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
Oleandraceae					
32. <i>Oleandra undulata</i> (Willd.) Ching	TerF/LF	5	4	4	3
Polypodiaceae					
33. <i>Aglaomorpha heraclea</i> (Kunze) Copel.	EF/LF	0	0	0	2
34. <i>Drynaria quercifolia</i> (L.) J. Sm. *	EF/LF	3	3	3	0
35. <i>Drynaria rigidula</i> (Sw.) Bedd.	EF/LF	3	0	0	3
36. <i>Drynaria sparsisora</i> (Desv.) T. Moore	EF/LF	3	3	3	3
37. <i>Loxogramme avenia</i> (Blume) C. Presl	LF	0	0	0	2
38. <i>Microsorium nigrescens</i> (Blume) Copel. *	EF/LF	2	0	0	0
39. <i>Microsorium punctatum</i> (L.) Copel.	EF/LF	0	0	3	1
40. <i>Pyrrosia adnascens</i> (Sw.) Ching	EF/LF	3	2	3	3
41. <i>Pyrrosia penangiana</i> (Hook.) Holttum *	EF/LF	0	0	0	1
42. <i>Selliguea heterocarpa</i> (Blume) Blume	EF/LF	0	4	0	0
43. <i>Selliguea stenophylla</i> (Blume) Parris	EF/LF	0	2	0	1
Pteridaceae					
44. <i>Pteris dalhousiaw</i> Hook.	TerF/LF	0	0	1	1
Schizaeaceae					
45. <i>Schizaea dichotoma</i> (L.) J. Sm.	TerF	2	2	0	2
46. <i>Schizaea digitata</i> (L.) Sw.	TerF	2	2	0	1
Vittariaceae					
47. <i>Vittaria ensiformis</i> Sw.	EF/LF	3	3	3	1
48. <i>Vittaria scolopendrina</i> (Bory) Schkuhr ex Thwaites	EF/LF	0	4	0	3
GYMNOSPERMS					
Gnetaceae					
49. <i>Gnetum gnemon</i> L. var. <i>tenerum</i> Markgr.	S	0	2	0	2
50. <i>Gnetum macrostachyum</i> Hook.f.	C	2	0	0	2
Podocarpaceae					
51. <i>Dacrydium elatum</i> (Roxb.) Wall. ex Hook.	T	0	0	0	2
ANGIOSPERMS					
Dicots					
Anacardiaceae					
52. <i>Mangifera</i> sp.	ST	0	0	1	0
Ancistrocladaceae					
53. <i>Ancistrocladus tectorius</i> (Lour.) Merr.	C	0	0	0	2
Annonaceae					
54. <i>Artabotrys suaveolens</i> Blume	C	0	2	0	0
55. <i>Desmos cochinchinensis</i> Lour.	S	0	0	1	0
56. <i>Goniothalamus</i> sp.	S	0	0	0	1
57. <i>Pyramidanthe prismatica</i> (Hook.f. & Thomson) J. Sinclair	C	0	1	0	0
58. <i>Xylopia stenopetala</i> Oliv.	T	0	1	0	0
Apocynaceae					
59. <i>Alstonia rostrata</i> C.E.C. Fisch.	T	2	2	2	0
60. <i>Alyxia reinwardtii</i> Blume	C	2	2	2	2
61. <i>Anodendron axillare</i> Merr. <sup>NR</sup>	C	0	0	2	1
62. <i>Willughbeia coriacea</i> Wall.	C	0	2	0	2
63. <i>Willughbeia tenuiflora</i> Dyer ex Hook.f. <sup>NR</sup>	C	2	2	0	0
Araliaceae					
64. <i>Schefflera cephalotes</i> (C.B. Clarke) Harms	ST/T	0	2	0	0

## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
Asclepiadaceae					
65. <i>Cynanchum ovalifolium</i> Wight	C	0	0	0	1
66. <i>Dischidia bengalensis</i> Colebr.	C	0	3	3	2
67. <i>Dischidia fruticulosa</i> Ridl.	C	0	2	0	0
68. <i>Hoya imperialis</i> Lindl. <sup>NR</sup>	C	1	0	0	0
69. <i>Hoya lacunosa</i> Blume	C	0	2	0	0
70. <i>Hoya multiflora</i> Blume	SubS	0	0	2	1
71. <i>Hoya obtusifolia</i> Wight	C	2	0	0	0
72. <i>Hoya plicata</i> King & Gamble	C	0	0	0	2
73. <i>Hoya rigida</i> Kerr	C	0	0	0	2
74. <i>Hoya</i> sp. <sup>NS</sup>	C	0	2	0	0
Asteraceae					
75. <i>Ageratum</i> sp.	ExH	2	0	0	0
76. <i>Chromolaena odorata</i> (L.) R.M. King & H. Rob. *	ExH	0	0	1	3
Begoniaceae					
77. <i>Begonia sinuata</i> Wall. ex Meisn. var. <i>sinuata</i>	H	3	0	2	3
78. <i>Begonia</i> sp.	H	0	4	0	0
Bombacaceae					
79. <i>Durio griffithii</i> Bakh.	ST/T	1	0	0	0
Celastraceae					
80. <i>Salacia</i> sp.	ScanS	0	0	0	1
Clusiaceae					
81. <i>Cratoxylum maingayi</i> Dyer	ST	2	2	0	1
82. <i>Garcinia</i> sp.	S/ST	0	0	0	1
Crypteroniaceae					
83. <i>Crypteronia paniculata</i> Blume	ST	0	1	0	0
Dilleniaceae					
84. <i>Acrotrema costatum</i> Jack	H	2	0	0	0
Elaeocarpaceae					
85. <i>Elaeocarpus pedunculatus</i> Wall. ex Mast. <sup>NR</sup>	T	1	2	2	2
Ericaceae					
86. <i>Rhododendron longiflorum</i> Lindl.	ES/LS	1	3	0	0
87. <i>Vaccinium bancanum</i> Miq.	LS/ST	4	4	3	0
88. <i>Vaccinium</i> sp.	S/ST	0	0	0	2
Erythroxylaceae					
89. <i>Erythroxylum cuneatum</i> Kurz	S	0	0	1	0
Euphorbiaceae					
90. <i>Austrobuxus nitidus</i> Miq.	S/ST	0	2	0	0
Fabaceae					
91. <i>Archidendron contortum</i> (Mart.) I.C. Nielsen	ST	0	2	2	1
92. <i>Callerya atropurpurea</i> (Wall.) A. Schott	T	0	1	0	0
93. <i>Dalbergia phyllanthoides</i> Blume ex Miq.	ScanS	0	0	0	1
94. <i>Entada spiralis</i> Ridl.	C	0	0	1	0
Fagaceae					
95. <i>Lithocarpus cyclophorus</i> (Endl.) A. Camus	T	0	2	0	0
96. <i>Lithocarpus elegans</i> (Blume) Hatus. ex Soepadmo	T	2	0	2	0
97. <i>Lithocarpus</i> sp.	T	0	2	0	0
98. <i>Quercus lineata</i> Blume	ST	0	0	0	1

## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
<b>Fagaceae</b>					
99. <i>Quercus</i> sp.	T	0	1	0	0
<b>Gesneriaceae</b>					
100. <i>Aeschynanthus radicans</i> Jack	SubSC	3	3	0	3
101. <i>Didymocarpus citrinus</i> Ridl. <sup>NR</sup>	H/SubS	3	0	3	4
102. <i>Didymocarpus corchorifolius</i> Wall. ex A. DC.	SubS	0	2	0	0
103. <i>Didymocarpus cordatus</i> A. DC. <sup>NR</sup>	H	0	0	0	4
104. <i>Henckelia bombycina</i> (Ridl.) A. Weber <sup>NR</sup>	SubS	0	4	0	0
105. <i>Henckelia inaequalis</i> (Ridl.) A. Weber	SubS	4	0	3	0
106. <i>Paraboea elegans</i> (Ridl.) B.L. Burtt <sup>NR</sup>	H	0	4	0	0
<b>Hamamelidaceae</b>					
107. <i>Rhodoleia championii</i> Hook.f.	S/T	5	0	0	0
<b>Juglandaceae</b>					
108. <i>Engelhardia roxburghiana</i> Lindl. ex Wall.	T	0	0	0	1
<b>Lamiaceae</b>					
109. <i>Vitex longisepala</i> King & Gamble	S	2	0	0	0
<b>Loganiaceae</b>					
110. <i>Fagraea acuminatissima</i> Merr.	LS/ES	2	1	0	0
111. <i>Fagraea wallichiana</i> Benth.	ST	2	2	2	0
<b>Loranthaceae</b>					
112. <i>Dendrophthoe pentandra</i> (L.) Miq.	PaS	1	2	0	1
113. <i>Taxillus chinensis</i> (DC.) Danser	PaS	0	0	0	1
<b>Melastomataceae</b>					
114. <i>Clidemia hirta</i> D. Don	ExS	2	0	2	2
115. <i>Melastoma malabathricum</i> L. subsp. <i>malabathricum</i>	LS/S	2	4	2	1
116. <i>Oxyspora exigua</i> (Jack) J.F. Maxwell	S	2	0	0	0
117. <i>Oxyspora umbellulata</i> (Hook.f. ex Triana) J.F. Maxwell	LS/S	2	2	2	4
118. <i>Pachycentria glauca</i> Triana					
subsp. <i>maingayi</i> (C.B. Clarke) Clausing <sup>NR</sup>	ES/LS	0	2	0	1
119. <i>Pachycentria hanseniana</i> Clausing <sup>NR</sup>	ES/LS	0	0	0	1
120. <i>Pachycentria pulverulenta</i> (Jack) Clausing	ES/LS	3	3	3	0
121. <i>Sonerila griffithii</i> C.B. Clarke	H	4	3	2	2
<b>Moraceae</b>					
122. <i>Ficus deltoidea</i> Jack					
a. var. <i>deltoidea</i>	ES/LS	1	0	1	0
b. var. <i>angustifolia</i> (Miq.) Corner	ES/LS	0	2	2	0
c. var. <i>kunstleri</i> (King) Corner	ES/LS	0	0	0	3
123. <i>Ficus heteropleura</i> Blume	S	0	0	0	2
124. <i>Ficus oleifolia</i> King subsp. <i>intermedia</i> (Corner)					
C.C. Berg	LS	3	2	3	0
125. <i>Ficus punctata</i> Thunb.	C	0	0	2	0
126. <i>Ficus sagittata</i> J. Koenig ex Vahl	ScanS	0	0	0	2
127. <i>Ficus villosa</i> Blume	C	0	0	0	2
128. <i>Ficus xylophylla</i> (Miq.) Wall. ex Miq.	ST	0	3	0	0
<b>Myristicaceae</b>					
129. <i>Myristica cinnamomea</i> King	T	0	1	0	0
<b>Myrsinaceae</b>					
130. <i>Ardisia colorata</i> Roxb.	ST	2	2	0	0



## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
<b>Myrsinaceae</b>					
131. <i>Ardisia crenata</i> Sims	S	2	2	2	2
132. <i>Maesa ramentacea</i> (Roxb.) A. DC.	ST	2	2	0	0
133. <i>Myrsine seguinii</i> H. Lév.	S	0	1	0	0
<b>Myrtaceae</b>					
134. <i>Rhodamnia cinerea</i> Jack var. <i>cinerea</i>	ST	3	3	3	0
135. <i>Syzygium gratum</i> (Wight) S.N. Mitra var. <i>gratum</i>	ST/T	5	5	5	0
136. <i>Syzygium helferi</i> (Duthie) Chantar. & J. Parn.	ST/T	2	0	0	0
137. <i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry var. <i>parviflorum</i> (Craib) Chantar. & J. Parn.	ST/T	1	0	0	0
138. <i>Syzygium syzygioides</i> (Miq.) Merr & L.M. Perry	ST/T	3	3	3	0
139. <i>Syzygium</i> sp. 1	ST	0	3	0	0
140. <i>Syzygium</i> sp. 2	ST	0	0	0	2
141. <i>Tristaniopsis merguensis</i> (Griff.) Peter G. Wilson & J.T. Waterh.	ST	0	4	0	2
<b>Ochnaceae</b>					
142. <i>Campylospermum serratum</i> (Gaertn.) Bittrich & M.C.E. Amaral	S	0	0	0	1
<b>Passifloraceae</b>					
143. <i>Passiflora perakensis</i> Hallier f.	C	0	0	0	2
<b>Piperaceae</b>					
144. <i>Piper</i> sp.	C	0	0	0	2
<b>Rubiaceae</b>					
145. <i>Argostemma pictum</i> Wall.	H	3	3	0	3
146. <i>Gaertnera</i> sp.	S	0	0	0	2
147. <i>Greenea</i> sp.	S	2	2	2	2
148. <i>Hedyotis</i> sp.	H	2	2	2	0
149. <i>Ixora lobbii</i> King & Gamble	S	0	2	0	0
150. <i>Ixora</i> sp.	S	0	0	0	2
151. <i>Psychotria sarmentosa</i> Blume	C	0	2	0	2
152. <i>Tarenna longifolia</i> (G. Don) Ridl.	S	2	0	0	2
153. <i>Uncaria cordata</i> (Lour.) Merr.	C	0	0	0	2
<b>Rutaceae</b>					
154. <i>Evodia</i> sp.	T	0	1	0	0
155. <i>Tetractomia</i> sp.	ST	0	1	0	0
<b>Santalaceae</b>					
156. <i>Dendrotrophe varians</i> (Blume) Miq.	PaS	0	0	2	2
<b>Simaroubaceae</b>					
157. <i>Eurycoma longifolia</i> Jack	S/ST	2	2	2	0
<b>Sterculiaceae</b>					
158. <i>Sterculia lanceolata</i> Cav. var. <i>coccinea</i> (Jack) Phengklai	S	0	0	0	1
<b>Symplocaceae</b>					
159. <i>Symplocos adenophylla</i> Wall. ex G. Don	S/ST	2	2	0	2
<b>Theaceae</b>					
160. <i>Anneslea fragrans</i> Wall.	S/ST	0	4	0	0
161. <i>Schima wallichii</i> (DC.) Korth.	T	2	2	2	2
<b>Tiliaceae</b>					
162. <i>Schoutenia</i> sp.	ST	0	0	0	2

## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
<b>Ulmaceae</b>					
163. <i>Trema tomentosa</i> (Roxb.) H. Hara	S	0	0	1	2
<b>Verbenaceae</b>					
164. <i>Lantana camara</i> L.	ExC	0	0	0	2
<b>Monocots</b>					
<b>Araceae</b>					
165. <i>Epipremnum giganteum</i> Schott *	C	2	2	2	2
<b>Arecaceae</b>					
166. <i>Eugeissona triste</i> Griff.	P	0	3	0	0
167. <i>Licuala scortechini</i> Becc.	P	0	0	0	2
168. <i>Livistona speciosa</i> Kurz	P	0	0	3	1
169. <i>Pinanga disticha</i> Blume	P	2	0	0	0
170. <i>Pinanga scortechini</i> Becc.	P	0	2	0	2
171. <i>Plectocomia macrostachya</i> Kurz	CP	0	2	0	2
<b>Dioscoreaceae</b>					
172. <i>Dioscorea orbiculata</i> Hook.f.	HC	0	0	0	2
<b>Dracaenaceae</b>					
173. <i>Dracaena</i> sp. 1	ST	0	0	2	0
174. <i>Dracaena</i> sp. 2	S	2	0	2	2
<b>Orchidaceae</b>					
175. <i>Acriopsis liliifolia</i> (J. Koenig) Ormerod	EO/LO	2	2	2	0
176. <i>Aerides odorata</i> Lour.	EO	0	0	0	2
177. <i>Bromheadia alticola</i> Ridl.	EO/LO	0	2	0	0
178. <i>Bromheadia finlaysoniana</i> (Lindl.) Miq.	TerO/LO	4	4	0	0
179. <i>Bromheadia truncata</i> Seidenf.	EO	0	2	0	0
180. <i>Bulbophyllum corolliferum</i> J.J. Sm.	EO/LO	2	0	0	0
181. <i>Bulbophyllum lilacinum</i> Ridl.	EO/LO	2	0	3	1
182. <i>Bulbophyllum medusae</i> (Lindl.) Rchb.f.	EO/LO	3	0	3	0
183. <i>Bulbophyllum purpurascens</i> Teijsm. & Binn.	EO/LO	0	1	0	0
184. <i>Bulbophyllum stenobulbon</i> E.C. Parish & Rchb.f.	EO/LO	0	3	0	0
185. <i>Cleisostoma</i> sp.	EO	0	0	0	1
186. <i>Coelogyne cumingii</i> Lindl.	EO/LO	5	5	4	3
187. <i>Coelogyne prasina</i> Ridl. <sup>NR</sup>	EO/LO	0	2	0	0
188. <i>Coelogyne rochussenii</i> de Vriese	EO/LO	2	2	0	0
189. <i>Coelogyne testacea</i> Lindl. <sup>NR</sup>	EO/LO	0	4	0	0
190. <i>Coelogyne trinervis</i> Lindl.	EO/LO	3	0	3	3
191. <i>Coelogyne velutina</i> de Vogel	EO/LO	0	0	1	3
192. <i>Cymbidium bicolor</i> Lindl.	EO/LO	2	2	2	2
193. <i>Cymbidium dayanum</i> Rchb.f.	EO/LO	0	0	2	0
194. <i>Cymbidium finlaysonianum</i> Lindl.	EO/LO	0	2	0	0
195. <i>Dendrobium acerosum</i> Lindl.	EO	1	0	0	0
196. <i>Dendrobium bifarium</i> Lindl.	EO/LO	0	3	0	0
197. <i>Dendrobium crumenatum</i> Sw.	EO/LO	2	2	2	0
198. <i>Dendrobium farmeri</i> Paxton	EO/LO	2	2	0	0
199. <i>Dendrobium leonis</i> (Lindl.) Rchb.f.	EO/LO	0	2	2	0
200. <i>Dendrobium metrium</i> Kraenzl.	LO	0	2	0	0
201. <i>Dendrobium pachyglossum</i> E.C. Parish & Rchb.f.	EO/LO	0	0	0	2
202. <i>Dendrobium sanguinolentum</i> Lindl.	EO/LO	0	0	0	2

## APPENDIX 1. (Continued).

Scientific name	Habit	Non-limestone			
		A	B	C	D
Orchidaceae					
203. <i>Dendrobium tortile</i> Lindl.	EO/LO	2	0	0	1
204. <i>Dendrobium</i> sp. <sup>NS</sup>	EO/LO	0	1	0	0
205. <i>Dienia ophrydis</i> (J. Koenig) Ormerod & Seidenf.	TerO	3	3	2	0
206. <i>Dipodium pictum</i> (Lindl.) Rchb.f.	EO/LO	2	3	2	3
207. <i>Epigeneium geminatum</i> (Blume) Summerh. <sup>NR</sup>	EO/LO	0	2	0	0
208. <i>Eria puchella</i> Lindl.	EO/LO	0	3	0	0
209. <i>Eria xanthocheila</i> Ridl.	EO/LO	0	2	0	2
210. <i>Grammatophyllum speciosum</i> Blume	EO/LO	1	2	1	0
211. <i>Spathoglottis plicata</i> Blume	TerO	1	0	0	1
212. <i>Pholidota articulata</i> Lindl.	EO/LO	1	0	0	0
213. <i>Tainia penangiana</i> Hook.f.	TerO/LO	3	3	3	1
214. <i>Thixspermum calceolus</i> (Lindl.) Rchb.f.	EO/LO	2	2	0	0
Pandanaaceae					
215. <i>Pandanus monotheca</i> Martelli	S	0	3	0	0
Poaceae					
216. <i>Eriachne pallescens</i> R. Br.	G	3	0	0	0
217. <i>Eulalia speciosa</i> Kuntze	G	5	4	5	0
218. <i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda	G	3	3	3	3
Zingiberaceae					
219. <i>Etlingera subterranea</i> (Holttum) R.M. Sm.	H	2	0	0	0
220. <i>Geostachys holttumii</i> K. Larsen	H	0	2	0	0
221. <i>Geostachys penangensis</i> Ridl. <sup>NR</sup>	H	0	0	0	2
222. <i>Globba pendula</i> Roxb.	H	4	0	0	4
223. <i>Globba</i> sp.	H	0	2	0	0

**NOTE:** <sup>NR</sup> new record; <sup>NS</sup> expected new species; \* also found in limestone study site

**Habit:** C = Climber; CP = Climbing palm; EF = Epiphytic fern (including lycophytes); EO = Epiphytic orchid; ES = Epiphytic shrub; ExC = Exotic climber; ExH = Exotic herb; ExS = Exotic shrub; G = Grass; H = Herb; HC = Herbaceous climber; L = Lithophyte; LF = Lithophytic fern; LO = Lithophytic orchid; LS = Lithophytic shrub; P = Palm; PaS = Parasitic shrub; S = Shrub; ScanS = Scandent shrub; ST = Shrubby tree; SubS = Subshrub; SubSC = Subshrubby climber; T = Tree; TerF = Terrestrial fern; TerO = Terrestrial orchid

**Study site:** A = Gunung Silipid; B = Khao Hin Ban Chantharat; C = Khao Hin Ban Bo Num Ron; D = Khao Hin Ban Piyamit 2

**Abundance:** 0 = absent; 1 = scarce; 2 = few; 3 = common; 4 = abundant; 5 = highly abundant

**APPENDIX 2.** List of vascular plant species found in limestone study site.

Scientific name	Habit	Limestone E
<b>PTEROPHYTES</b>		
<b>Adiantaceae</b>		
1. <i>Adiantum caudatum</i> L.	LF	3
<b>Aspleniaceae</b>		
2. <i>Asplenium adiantoides</i> (L.) C. Chr.	LF	3
3. <i>Asplenium salignum</i> Blume	LF	3
<b>Davalliaceae</b>		
4. <i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn *	EF/LF	2
<b>Polypodiaceae</b>		
5. <i>Drynaria quercifolia</i> (L.) J. Sm. *	EF/LF	3
6. <i>Loxogramme scolopendrina</i> (Bory) C. Presl	LF	3
7. <i>Microsorium nigrescens</i> (Blume) Copel. *	LF	2
8. <i>Pyrrosia nummularifolia</i> (Sw.) Ching	EF/LF	3
9. <i>Pyrrosia penangiana</i> (Hook.) Holttum *	EF/LF	4
10. <i>Pyrrosia stigmosa</i> (Sw.) Ching	LF	5
<b>Vittariaceae</b>		
11. <i>Anthrophyllum parvulum</i> Blume	LF	3
<b>GYMNOSPERMS</b>		
<b>Cycadaceae</b>		
12. <i>Cycas clivicola</i> K.D. Hill	ST	4
<b>ANGIOSPERMS</b>		
<b>Dicots</b>		
<b>Acanthaceae</b>		
13. <i>Ruellia</i> sp.	H	3
<b>Annonaceae</b>		
14. <i>Alphonsea</i> sp.	ST	2
<b>Apocynaceae</b>		
15. <i>Parameria laevigata</i> (Juss.) Moldenke	C	2
<b>Asteraceae</b>		
16. <i>Chromolaena odorata</i> (L.) R.M. King & H. Rob. *	ExH	3
<b>Balsaminaceae</b>		
17. <i>Impatiens</i> sp.	H	2
<b>Euphorbiaceae</b>		
18. <i>Croton cascarilloides</i> Raeusch.	S	3
<b>Fabaceae</b>		
19. <i>Senna timorensis</i> (DC.) H.S. Irwin & Barneby	ST	4
<b>Gesneriaceae</b>		
20. <i>Chirita involucrata</i> Craib	H	3
21. <i>Chirita</i> sp.	H	3
22. <i>Epithema</i> sp. 1	H	4
23. <i>Epithema</i> sp. 2	H	3
24. <i>Paraboea lancifolia</i> (Ridl.) B.L. Burt	H	5
<b>Meliaceae</b>		
25. <i>Aglaiia</i> sp.	T	2
<b>Moraceae</b>		
26. <i>Ficus</i> sp.	T	2
<b>Piperaceae</b>		
27. <i>Peperomia kotana</i> C. DC.	H	3

## APPENDIX 2. (Continued).

Scientific name	Habit	Limestone E
<b>Rhamnaceae</b>		
28. <i>Oreorhamnus serrulatus</i> Ridl.	ST	3
<b>Rubiaceae</b>		
29. <i>Aidia</i> sp.	ST	3
30. <i>Geophila repens</i> (L.) I.M. Johnst.	H	3
31. <i>Morinda elliptica</i> Ridl.	T	3
32. <i>Tarenna stellulata</i> (Hook.f.) Ridl.	S	2
<b>Sterculiaceae</b>		
33. <i>Pterospermum diversifolium</i> Blume	T	3
<b>Monocots</b>		
<b>Araceae</b>		
34. <i>Arisaema fimbriatum</i> Mast.	H	3
35. <i>Epipremnum giganteum</i> Schott *	C	2
<b>Orchidaceae</b>		
36. <i>Adenoncos vesiculosa</i> Carr	EO	2
37. <i>Cleisostoma complicatum</i> (Seidenf.) Garay	EO/LO	1
38. <i>Eria javanica</i> (Sw.) Blume	EO/LO	2
39. <i>Eria mucronata</i> Lindl.	EO/LO	2
40. <i>Flickingeria xantholeuca</i> (Rchb.f.) A.D. Hawkes	EO/LO	3
41. <i>Habenaria reflexa</i> Blume	TerO	2
42. <i>Liparis condylobulbon</i> Rchb.f.	EO/LO	3
43. <i>Oxystophyllum carnosum</i> Blume	EO	2
44. <i>Pomatocalpa maculosum</i> (Lindl.) J.J. Sm. subsp. <i>maculosum</i>	LO	3

**NOTE:** \* also found in non-limestone study sites

**Habit:** C = Climber; EF = Epiphytic fern; EO = Epiphytic orchid; ExH = Exotic herb; H = Herb; LF = Lithophytic fern; LO = Lithophytic orchid; S = Shrub; ST = Shrubby tree; T = Tree; TerO = Terrestrial orchid

**Study site:** E = Khao Hin Ban Ko Mo 4

**Abundance:** 0= absent; 1 = scarce; 2 = few; 3 = common; 4 = abundant; 5 = highly abundant

APPENDIX 3. List of rare plants.

Taxa	Distribution range	Habitat specificity	Local population size	Conservation status
1. <i>Selaginella strigosa</i> Bedd.	Narrow <sup>+</sup>	Restricted	Small	-
2. <i>Syngamma minima</i> Holtum	Narrow <sup>+</sup>	Restricted	Small	-
3. <i>Dipteris conjugata</i> Reinw.	Wide	Restricted	Large	Rare (Thailand) <sup>3</sup>
4. <i>Hymenophyllum serrulatum</i> (C. Presl) C. Chr.	Wide	Restricted	Large	-
5. <i>Selliguea stenophylla</i> (Blume) Parris	Wide	Restricted	Small	-
6. <i>Pyramidanthe prismatica</i> (Hook.f. & Thomson) J. Sinclair	Wide	Restricted	Small	-
7. <i>Anodendron axillare</i> Merr.	Wide	Broad	Small	-
8. <i>Willughbeia tenuiflora</i> Dyer ex Hook.f.	Wide	Broad	Small	-
9. <i>Schefflera cephalotes</i> (C.B. Clarke) Harms	Wide	Restricted	Small	Endangered <sup>1</sup>
10. <i>Dischidia fruticulosa</i> Ridl.	Narrow <sup>+</sup>	Restricted	Small	-
11. <i>Hoya imperialis</i> Lindl.	Wide	Broad	Small	-
12. <i>Hoya plicata</i> King & Gamble	Narrow <sup>+</sup>	Restricted	Small	-
13. <i>Hoya</i> sp.	Unknown	Broad	Small	-
14. <i>Elaeocarpus pedunculatus</i> Wall. ex Mast.	Wide	Restricted	Small	-
15. <i>Rhododendron longiflorum</i> Lindl.	Wide	Restricted	Large	Threatened <sup>2</sup> , Rare <sup>3</sup>
16. <i>Vaccinium bancanum</i> Miq.	Wide	Restricted	Large	-
17. <i>Austroboxus nitidus</i> Miq.	Wide	Restricted	Small	Rare <sup>3</sup>
18. <i>Didymocarpus citrinus</i> Ridl.	Narrow <sup>+</sup>	Restricted	Large	-
19. <i>Didymocarpus corchorifolius</i> Wall. ex A. DC.	Narrow <sup>+</sup>	Restricted	Small	-
20. <i>Didymocarpus cordatus</i> A. DC.	Wide	Restricted	Large	-
21. <i>Henckelia bombycina</i> (Ridl.) A. Weber	Narrow <sup>+</sup>	Restricted	Large	-
22. <i>Henckelia inaequalis</i> (Ridl.) A. Weber	Narrow <sup>+</sup>	Restricted	Large	-

# APPENDIX 3. (Continued).

Taxa	Distribution range	Habitat specificity	Local population size	Conservation status
23. <i>Paraboea elegans</i> (Ridl.) B.L. Burt	Narrow <sup>+</sup>	Restricted	Large	-
24. <i>Rhodoleia championii</i> Hook.f.	Wide	Restricted	Large	Threatened <sup>2</sup> , Rare <sup>3</sup>
25. <i>Fagraea wallichiana</i> Benth.	Narrow <sup>+</sup>	Restricted	Small	-
26. <i>Pachycentria glauca</i> Triana subsp. <i>maingayi</i> (C.B. Clarke) Clausen	Wide	Broad	Small	-
27. <i>Pachycentria hanseniana</i> Clausen	Wide	Broad	Small	-
28. <i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry var. <i>parviflorum</i> (Craib) Chantar. & J. Parn.	Narrow <sup>+</sup>	Restricted	Small	Rare <sup>3</sup>
29. <i>Coelogyne prasina</i> Ridl.	Wide	Restricted	Small	-
30. <i>Coelogyne testacea</i> Lindl.	Wide	Restricted	Large	-
31. <i>Coelogyne velutina</i> de Vogel	Narrow <sup>+</sup>	Restricted	Large	-
32. <i>Dendrobium bifarium</i> Lindl.	Wide	Restricted	Small	-
33. <i>Dendrobium metrium</i> Kraenzl.	Narrow <sup>+</sup>	Restricted	Small	-
34. <i>Dendrobium</i> sp.	Unknown	Restricted	Small	-
35. <i>Dipodium pictum</i> (Lindl.) Rehb.f.	Wide	Restricted	Large	-
36. <i>Epigeneium geminatum</i> (Blume) Summerh.	Wide	Restricted	Small	-
37. <i>Geostachys holtumii</i> K. Larsen	Narrow <sup>+</sup>	Restricted	Small	Endemic* and Vulnerable <sup>3</sup>
38. <i>Geostachys penangensis</i> Ridl.	Wide	Restricted	Small	-

**Note:** <sup>+</sup> restricted to Thai-Malay Peninsula; \* probably erroneous

**Source:** <sup>1</sup> Frodin, 1998; <sup>2</sup> Pooma *et al.*, 2005; <sup>3</sup> Santisuk *et al.*, 2006

**Appendix 4.** Flowering period and flowering abundance of 90 flowering plant species (classified into six patterns of peak flowering).

Taxa	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<b>Type I (7 spp.)</b>												
<i>Anodendron axillare</i> Merr.	**	***	**									*
<i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry												
var. <i>parviflorum</i> (Craib) Chantar. & J. Parn.	**	***										
<i>Syzygium syzygioides</i> (Miq.) Merr & L.M. Perry	**	***										
<i>Syzygium</i> sp. 1	*	***	**									
<i>Coelogyne velutina</i> de Vogel	**	***	**									
<i>Dendrobium farmeri</i> Paxton		***	**	*								
<i>Etilingera subterranea</i> (Holtum) R.M. Sm.	**	***	*									*
<b>Type II (2 spp.)</b>												
<i>Vaccinium bancanum</i> Miq.	***	***				*	**	***	*	*	*	**
<i>Austrobuxus nitidus</i> Miq.	*	***	**	*	**	***	**	*				
<b>Type III (22 spp.)</b>												
<i>Alstonia rostrata</i> C.E.C. Fisch.				**	***	*						
<i>Willughbeia tenuiflora</i> Dyer ex Hook.f.	**	**	**	***	**					*	*	**
<i>Schefflera cephalotes</i> (C.B. Clarke) Harms			*	**	***							
<i>Dischidia bengalensis</i> Colebr.			**	***	**							
<i>Hoya plicata</i> King & Gamble	*	*	**	***	*	*	*	*	*	*	*	*
<i>Hoya rigida</i> Kerr			***	***								
<i>Cratogeomys maingayi</i> Dyer		**	***	**								
<i>Henckelia bombycina</i> (Ridl.) A. Weber	*	*	**	***	**	**	**	**	**	**	**	*
<i>Henckelia inaequalis</i> (Ridl.) A. Weber	*	*	*	***	***	**	**	**	*	*	*	*
<i>Callerya atropurpurea</i> (Wall.) A. Schott			**	***	**							
<i>Fagraea acuminatissima</i> Merr.				**	***	**						



## Appendix 4. (Continued).

Taxa	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<b>Type III (continued)</b>												
<i>Dendrophthoe pentandra</i> (L.) Miq.			**	***	**	**						
<i>Melastoma malabathricum</i> L. subsp. <i>malabathricum</i>	*	**	***	***	**	*	*	*	*	*	*	*
<i>Syzygium gratum</i> (Wight) S.N. Mitra var. <i>gratum</i>	*	*	*	***	***							
<i>Syzygium helferi</i> (Duthie) Chantar. & J. Parn.				**	***	**						
<i>Syzygium</i> sp. 2			**	***	**							
<i>Tarenna longifolia</i> Ridl.			*	**	***	***						
<i>Bulbophyllum purpurascens</i> Teijsm. & Binn.	*	*	**	***	*							
<i>Coelogyne testacea</i> Lindl.		**	***	***								
<i>Dendrobium metrium</i> Kraenzl.				**	***							
<i>Dendrobium tortile</i> Lindl.	*	**	**	***	*							
<i>Dipodium pictum</i> (Lindl.) Rchb.f.			**	***								
<b>Type IV (11 spp.)</b>												
<i>Hoya</i> sp.	*	*	*	**	***	*	*	*	**	***	**	*
<i>Archidendron contortum</i> (Mart.) I.C. Nielsen	*	*	**	***	**	*	*	*	**	***	**	*
<i>Didymocarpus corchorifolius</i> Wall. ex A. DC.				**	**	*	*	**	**	***	**	*
<i>Ficus deltoidea</i> Jack	*	*	**	***	**	*	*	*	**	***	**	*
<i>Ficus oleifolia</i> King subsp. <i>intermedia</i> (Corner) C.C. Berg	**	**	***	***	**	**	*	*	***	***	**	**
<i>Schima wallichii</i> (DC.) Korth.	*	*	**	***	*	*	*	*	**	***	*	*
<i>Bromheadia finlaysoniana</i> (Lindl.) Miq.	*	**	**	***	**	*	*	*	**	***	**	**
<i>Bromheadia truncata</i> Seidenf.	**	*	***	***	***	**	*	*	***	***	**	*
<i>Dendrobium crumenatum</i> Sw.	*	**	**	***	**	*	*	*	**	***	**	*
<i>Dendrobium leonis</i> (Lindl.) Rchb.f.	*	*	**	***	***	*	*	*	**	***	**	**
<i>Eria pulchella</i> Lindl.	*	*	**	***	**	*	*	*	**	***	**	**

# Appendix 4. (Continued).

Taxa	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<b>Type V (21 spp.)</b>												
<i>Pyramidanthe prismatica</i> (Hook.f. & Thomson) J. Sinclair	*	*	*	*	*	**	***	***	**	**	*	*
<i>Willughbeia corticea</i> Wall.					*	**	***	***	**			
<i>Dischidia fruticulosa</i> Ridl.		*	*	*	*	**	**	*				
<i>Elaeocarpus pedunculatus</i> Wall. ex Mast.					*	**	***	**				
<i>Oxyspora umbellulata</i> (Hook.f. ex Triana) J.F. Maxwell	*				**	**	**	*	*	*	*	*
<i>Pachycentria glauca</i> Triana												
subsp. <i>maingayi</i> (C.B. Clarke) Clausen			*		*	**	**	**	*	*		
<i>Pachycentria hanseniana</i> Clausen					*	**	**					
<i>Pachycentria pulverulenta</i> (Jack) Clausen	*	*	*	*	*	**	***	***	**	**	*	*
<i>Sonerila griffithii</i> C. B. Clarke	*				*	**	***	***	**	*	*	*
<i>Rhodamnia cinerea</i> Jack var. <i>cinerea</i>						**	***	*	*	*	*	*
<i>Argostemma pictum</i> Wall.						*	**	***	**	*	*	*
<i>Coelogyne cumingii</i> Lindl.						**	***	**				
<i>Coelogyne prasina</i> Ridl.						**	***					
<i>Coelogyne rochussenii</i> de Vriese					**	***	**					
<i>Dendrobium acerosum</i> Lindl.						***						
<i>Dendrobium bifarium</i> Lindl.						**	***	*	*	*	*	*
<i>Denia ophrydis</i> (J. Koenig) Ormerod & Seidenf.	*	*	*	*	**	**	***	*	*	*	*	*
<i>Thixspermum calceolus</i> (Lindl.) Rchb.f.						**	***					
<i>Geostachys holtumii</i> K. Larsen					*	***	**	*				
<i>Geostachys penangensis</i> Ridl.					*	***	**	*				
<i>Globba pendula</i> Roxb.					*	**	***	***	**	**	*	*

## Appendix 4. (Continued).

Taxa	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Type VI (27 spp.)												
<i>Hoya multiflora</i> Blume	**	*	*	**	*	*	*	*	*	**	***	**
<i>Hoya imperialis</i> Lindl.	**	*	*	*						*	***	***
<i>Begonia sinuata</i> Meisn.							*	**	***	**	*	
<i>Begonia</i> sp.	*							*	***	***	*	*
<i>Rhododendron longiflorum</i> Lindl.	*	*	*	**	*	*	*	*	***	***	**	**
<i>Aeschynanthus radicans</i> Jack						*	**	**	**	***	**	*
<i>Didymocarpus citrinus</i> Ridl.							*	*	**	***	***	**
<i>Didymocarpus cordatus</i> A. DC.							*	**	***	**	**	**
<i>Paraboea elegans</i> (Ridl.) B.L. Burtt	**	*	*	*	*	*	*	**	**	***	***	**
<i>Rhodoleia championii</i> Hook.f.	**	*	*	*				**	*	**	***	***
<i>Fagraea wallichiana</i> Benth.								*	***	**		
<i>Symplocos adenophylla</i> Wall. ex G. Don	*								**	***	***	**
<i>Anneslea fragrans</i> Wall.	*							*	**	**	***	***
<i>Acriopsis liliifolia</i> (J. Koenig) Ormerod	*	*	*	*	*	*	*	*	**	***	**	*
<i>Bromheadia alticola</i> Ridl.	*	*	*	*	*	*	*	**	***	***	**	*
<i>Bulbophyllum corolliferum</i> J.J. Sm.	*	*	*	*	*	*	*	**	**	***	**	*
<i>Bulbophyllum lilacinum</i> Ridl.	**	*										***
<i>Bulbophyllum medusae</i> (Lindl.) Rehb.f.								**	***	***		
<i>Bulbophyllum stenobulbon</i> E.C. Parish & Rehb.f.	**	*						**	**	**	***	***
<i>Coelogyne trinervis</i> Lindl.										***	***	
<i>Dendrobium pachyglossum</i> E.C. Parish & Rehb.f.									**	***	**	
<i>Dendrobium sanguinolentum</i> Lindl.	**	*	*	**	*	*	**	**	**	***	**	***
<i>Dendrobium</i> sp.	*	*						*	***	***	*	*

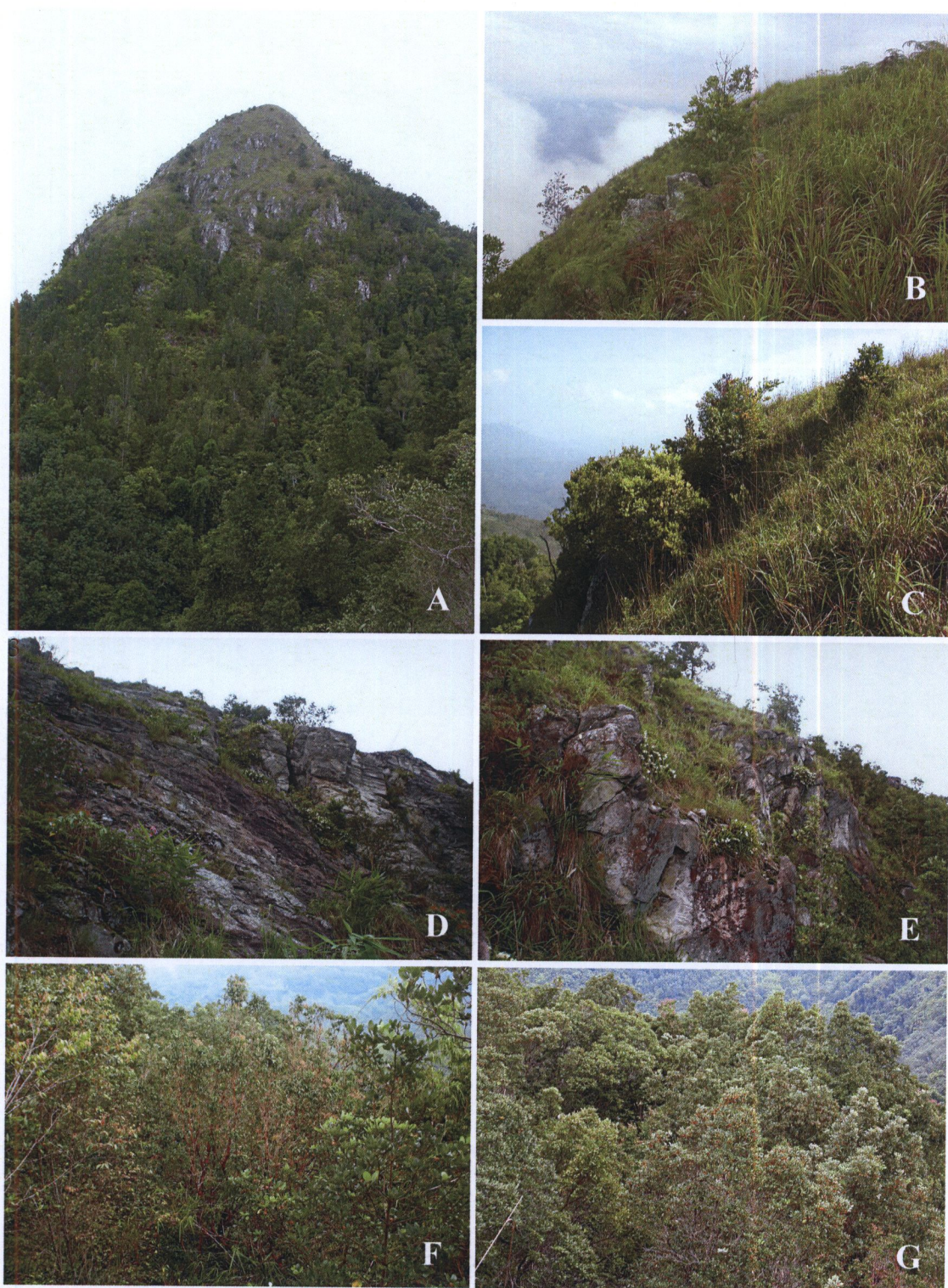
Appendix 4. (Continued).

Taxa	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Type VI (continued)												
<i>Epigeneium geminatum</i> (Blume) Summerh.										***	***	
<i>Pholidota articulata</i> Lindl.									**	***		
<i>Tainia penangiana</i> Hook.f.	**	*									***	***
<i>Eulalia speciosa</i> Kuntze	**	*					*	**	**	***	***	***
Total	47	47	47	49	52	50	48	49	47	50	48	47

**Flowering abundance:** \* = few flowering (flowering individuals 1-25%); \*\* = moderate flowering (flowering individuals 25-50%); \*\*\* = abundant flowering (flowering individuals > 50%)

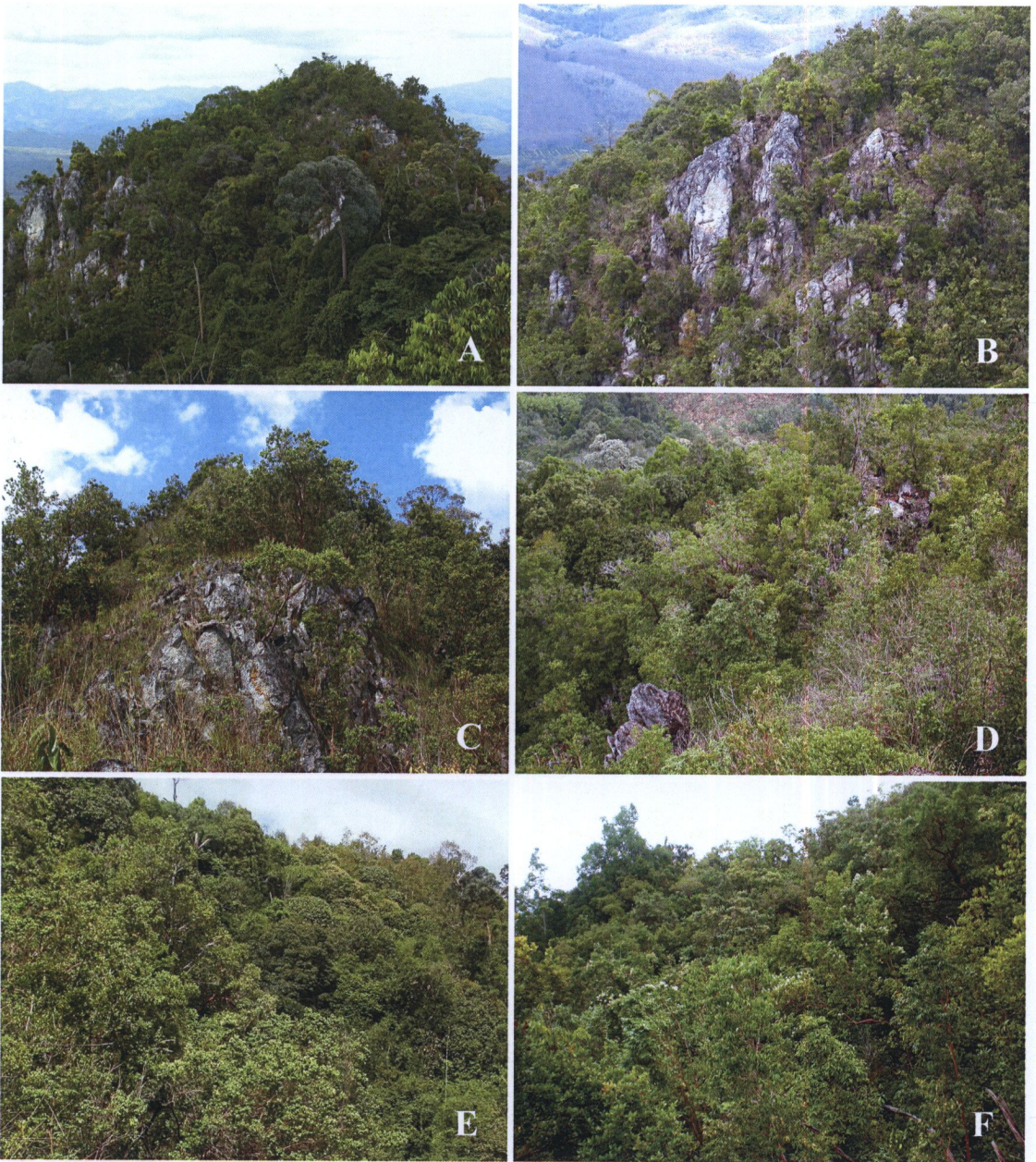
## **COLOUR PLATES**





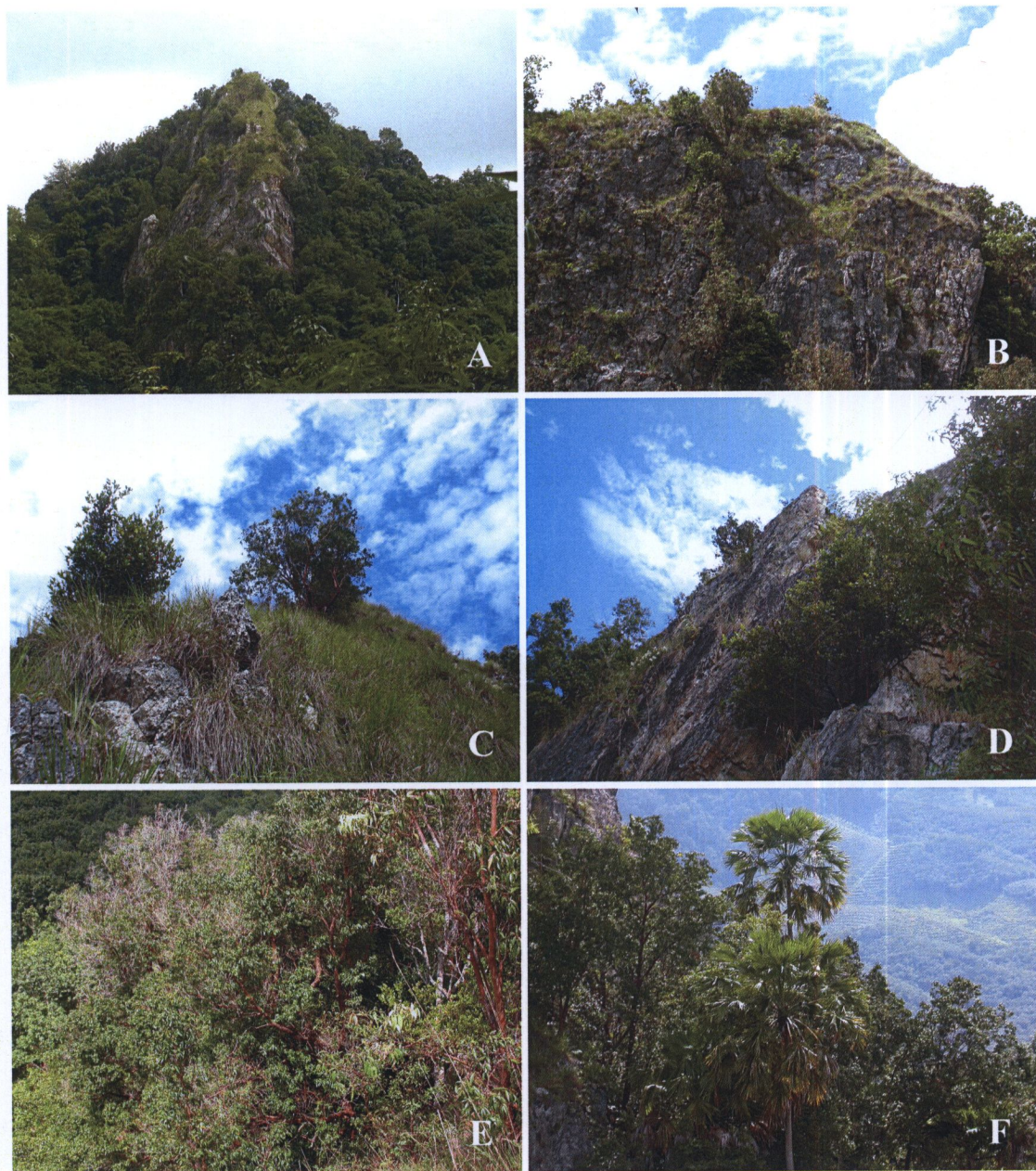
**Plate 1.** A-G. Gunung Silipid and its vegetation, A. Overview, B-E. Grassland and scrub vegetation, F-G. Woodland vegetation.





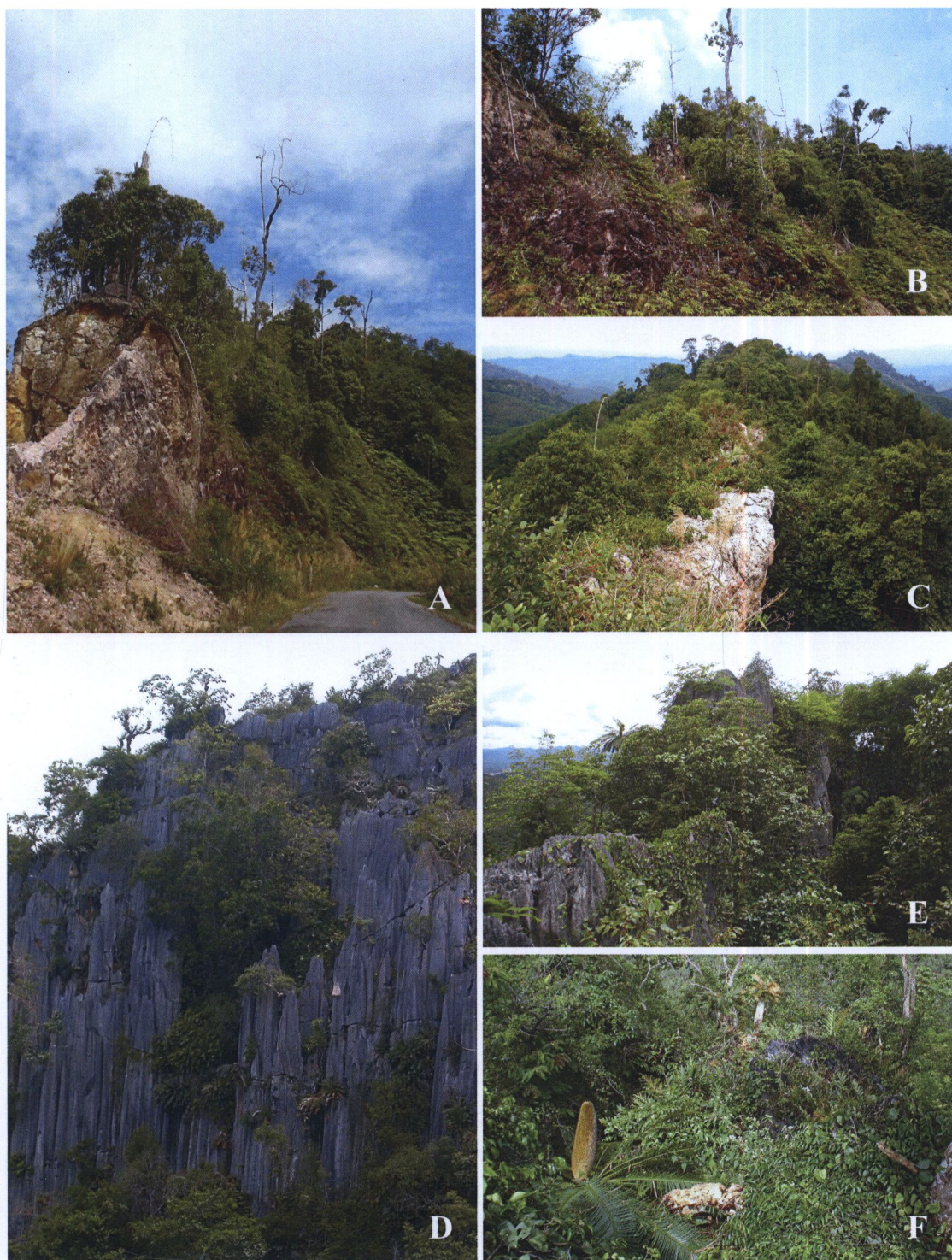
**Plate 2.** A-F. Khao Hin Ban Chantharat and its vegetation, A. Overview, B-D. Grassland and scrub vegetation, E-F. Woodland vegetation.





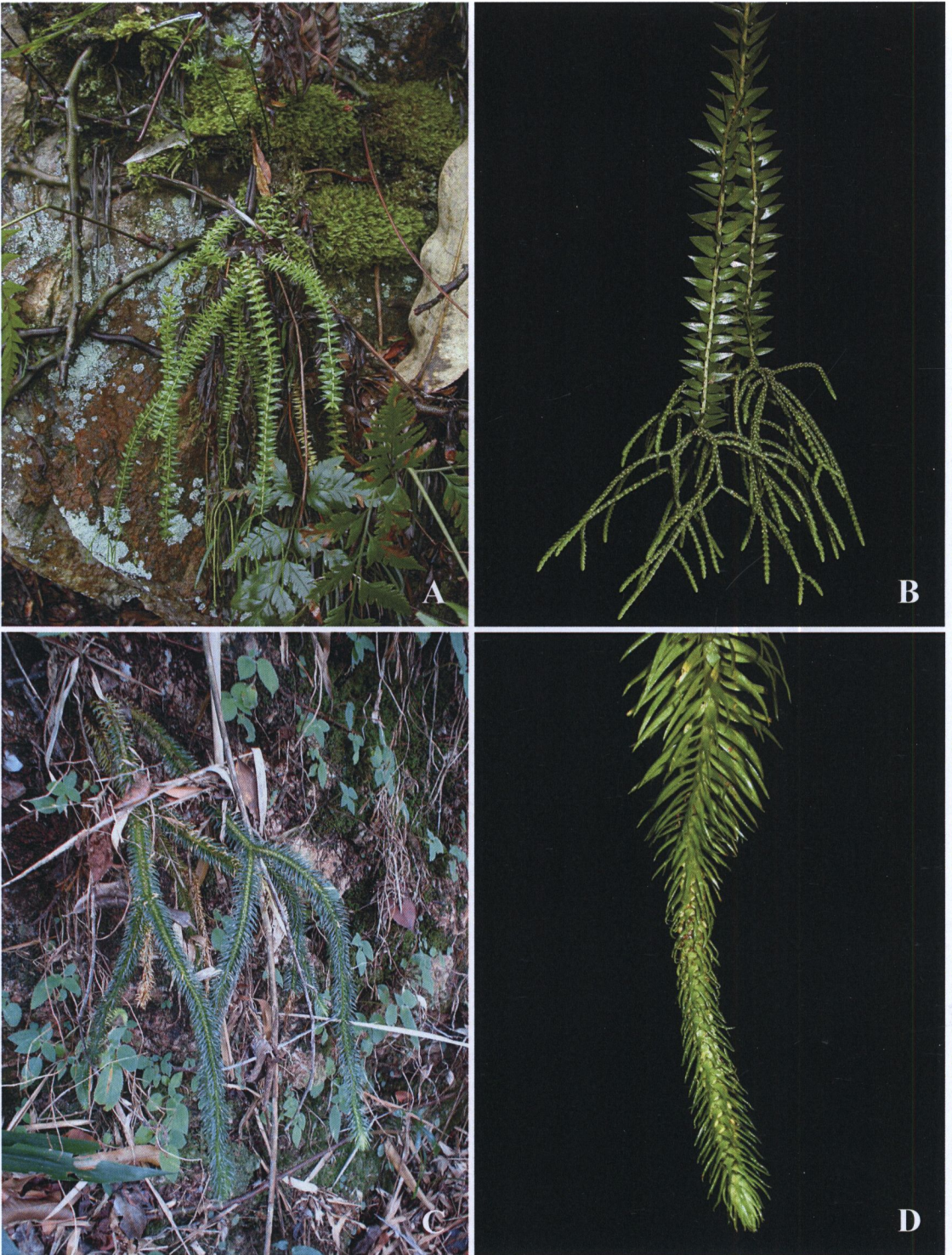
**Plate 3.** A-F. Khao Hin Ban Bo Num Ron and its vegetation, A. Overview, B-D. Grassland and scrub vegetation, E-F. Woodland vegetation.





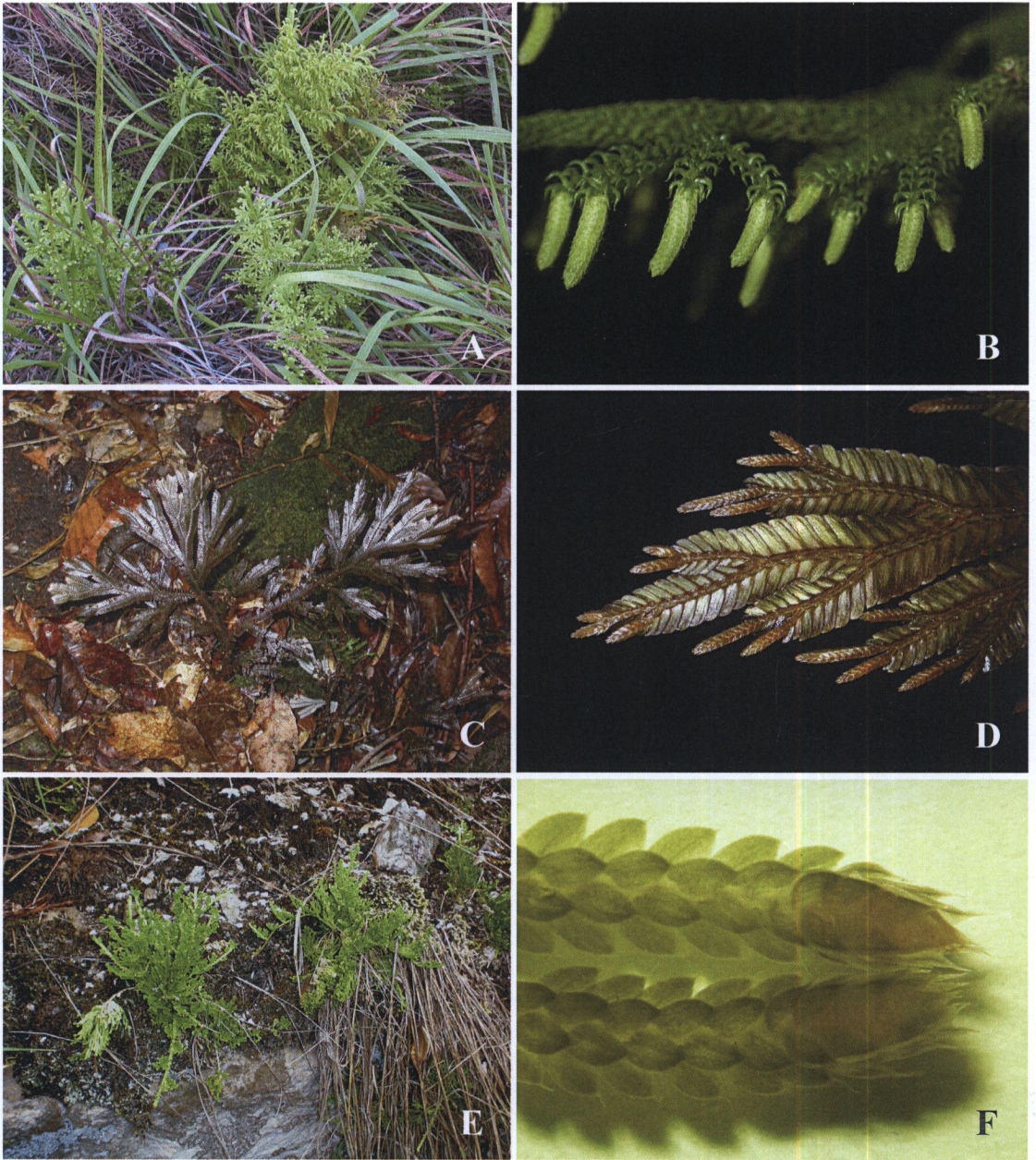
**Plate 4.** A-C. Khao Hin Ban Piyamit 2 and its vegetation; D-F. Khao Hin Ban Ko Mo 4 and its vegetation.





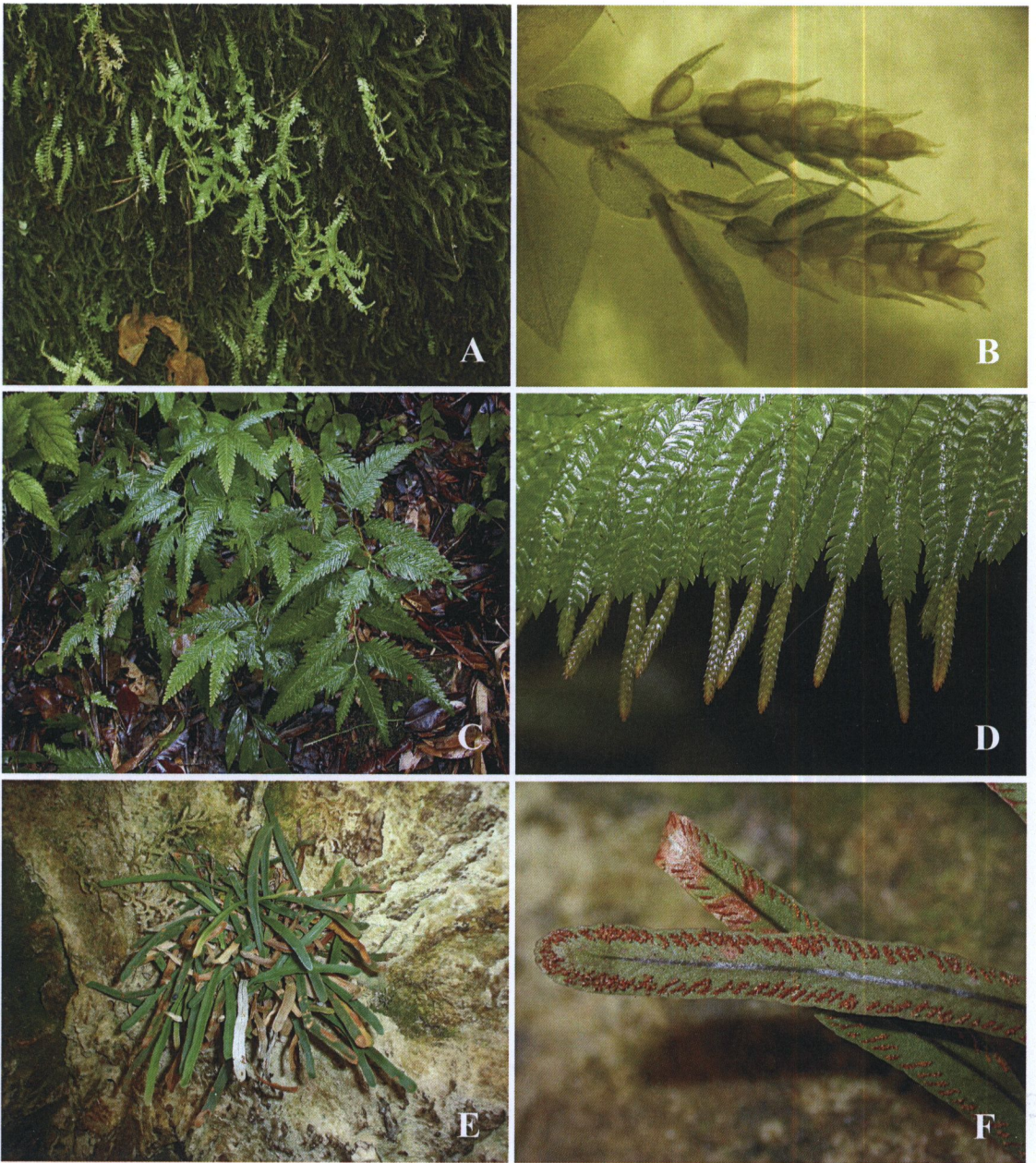
**Plate 5.** A-B. *Huperzia phlegmaria* (L.) Rothm., A. Habit and habitat, B. Strobili and vegetative branches; C-D. *Huperzia squarrosa* (G. Forst.) Trevis., C. Habit and habitat, D. Strobilus and vegetative branch bearing it.





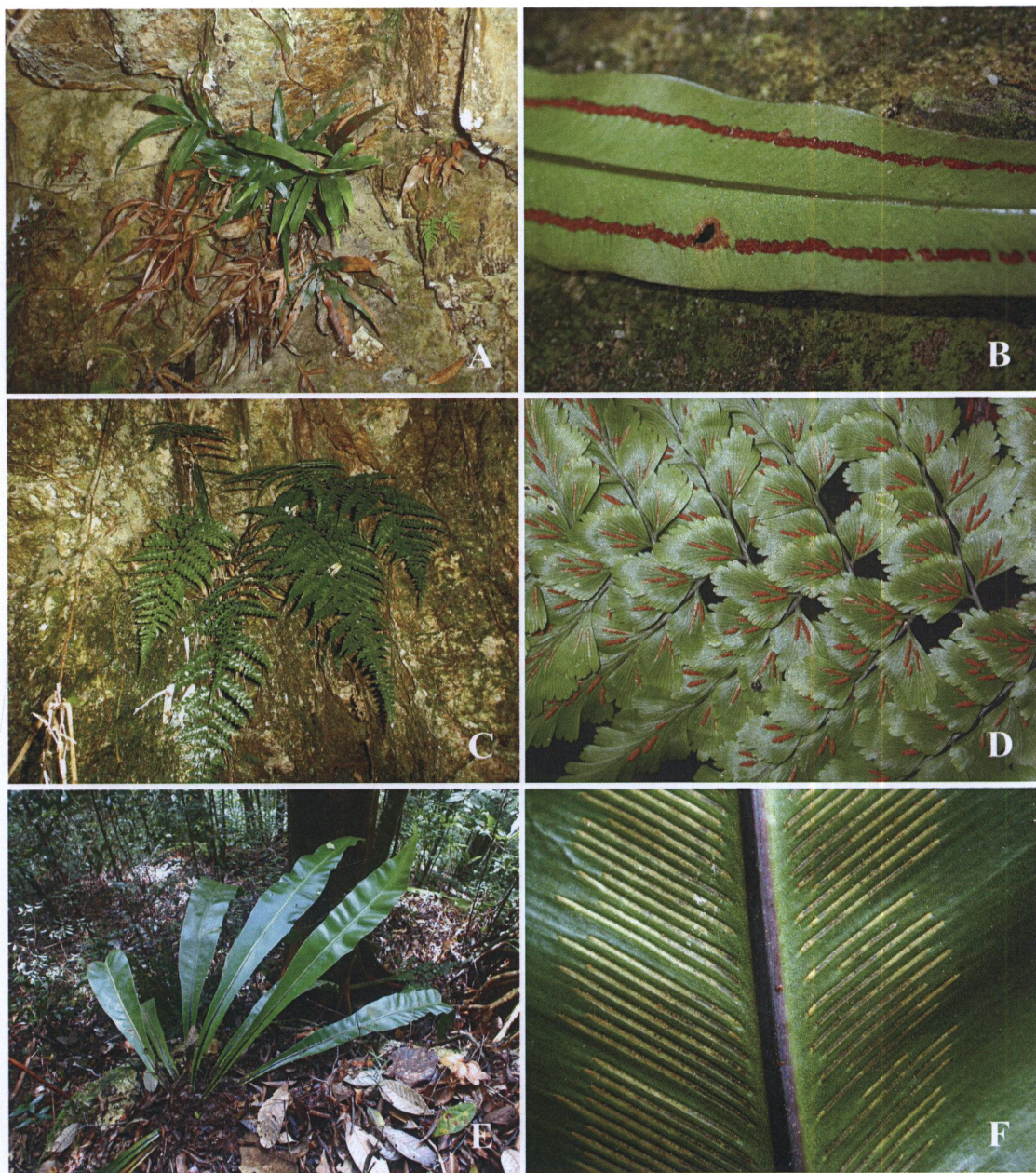
**Plate 6.** A-B. *Lycopodiella cernua* (L.) Pic. Serm., A. Habit and habitat, B. Strobili and vegetative branches; C-D. *Selaginella intermedia* (Blume) Spring, C. Habit and habitat, D. Strobili and vegetative branches; E-F. *Selaginella siamensis* Hieron., E. Habit and habitat, F. Strobili and vegetative branches.





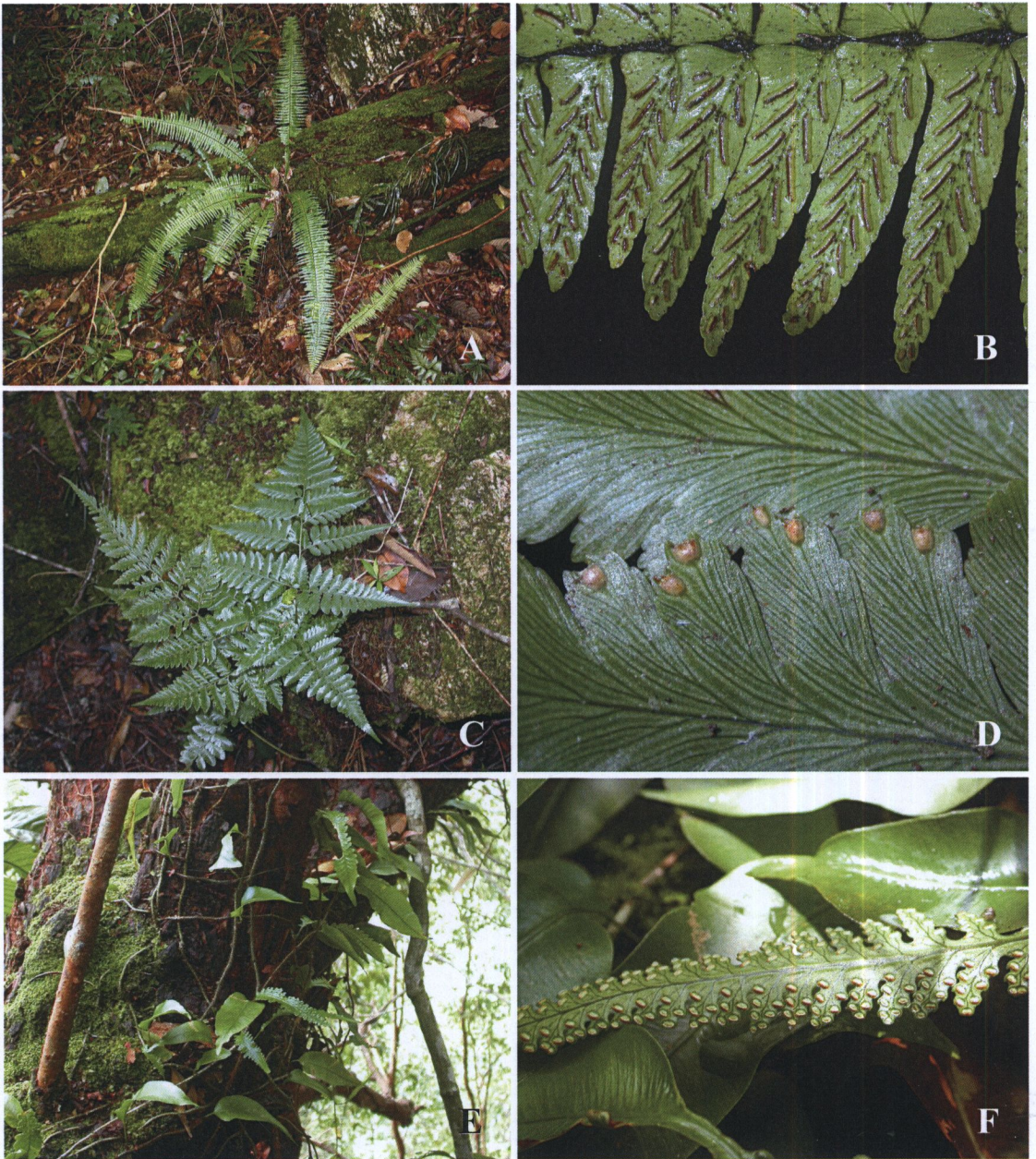
**Plate 7.** A-B. *Selaginella strigosa* Bedd., A. Habit and habitat, B. Strobili; C-D. *Selaginella wallichii* (Hook. & Grev.) Spring, C. Habit and habitat, D. Strobili and vegetative branches; E-F. *Syngramma minima* Holttum, E. Habit and habitat, F. Fertile laminae with sori.





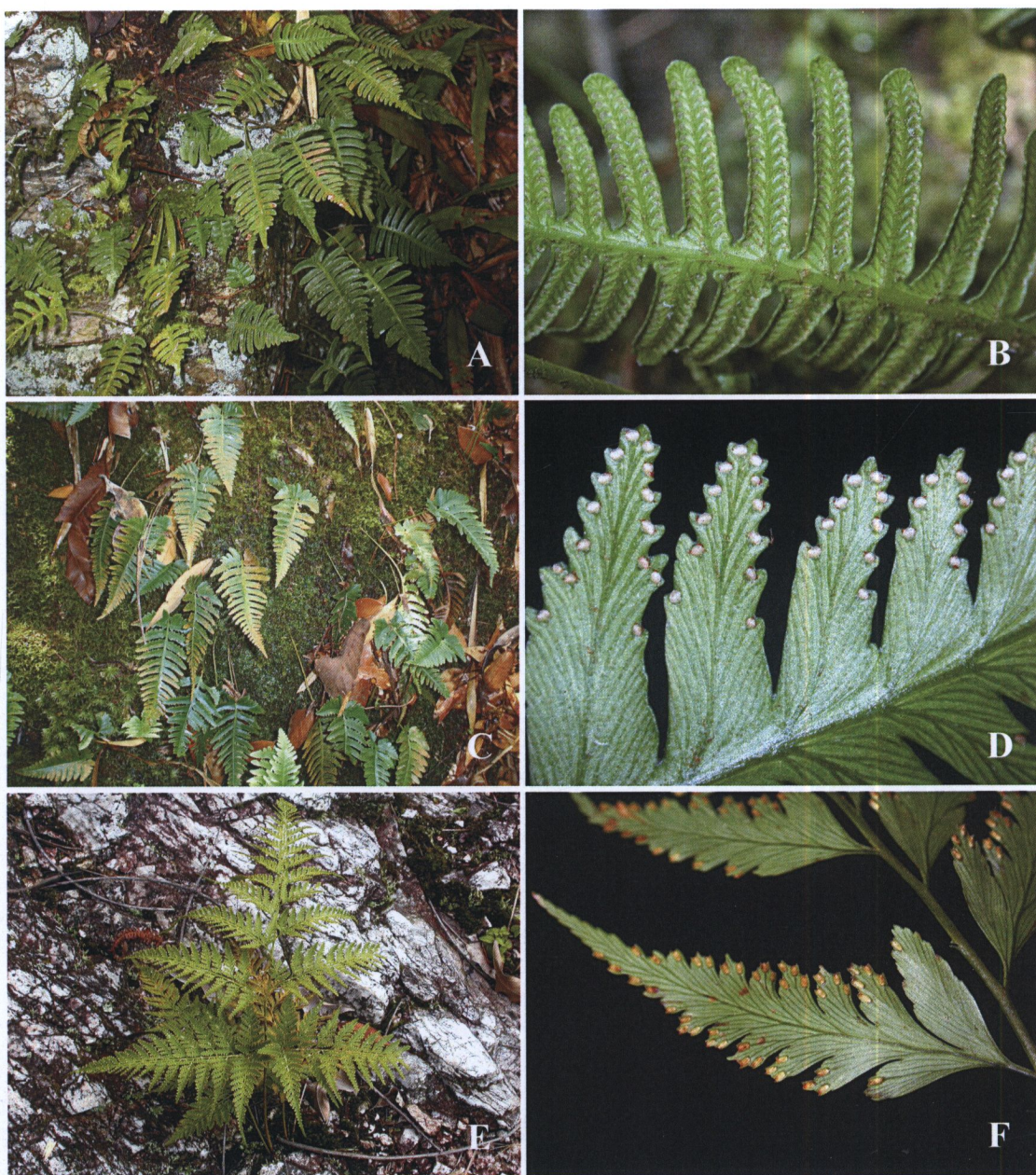
**Plate 8.** A-B. *Taenitis blechnoides* (Willd.) Sw., A. Habit and habitat, B. Sori on underside of fertile lamina; C-D. *Asplenium affine* Sw., C. Habit and habitat, D. Sori on underside of fertile pinnules; E-F. *Asplenium nidus* L. var. *nidus*, E. Habit and habitat, F. Underside of frond with sori.





**Plate 9.** A-B. *Asplenium pellucidum* Lam., A. Habit and habitat, B. Underside of fertile pinnae with sori; C-D. *Davallia denticulata* (Burm.f.) Mett. ex Kuhn, C. Habit and habitat, D. Sori on underside of fertile pinnules; E-F. *Davallia heterophylla* Sm., E. Habit and habitat, F. Sori on underside of fertile lamina.





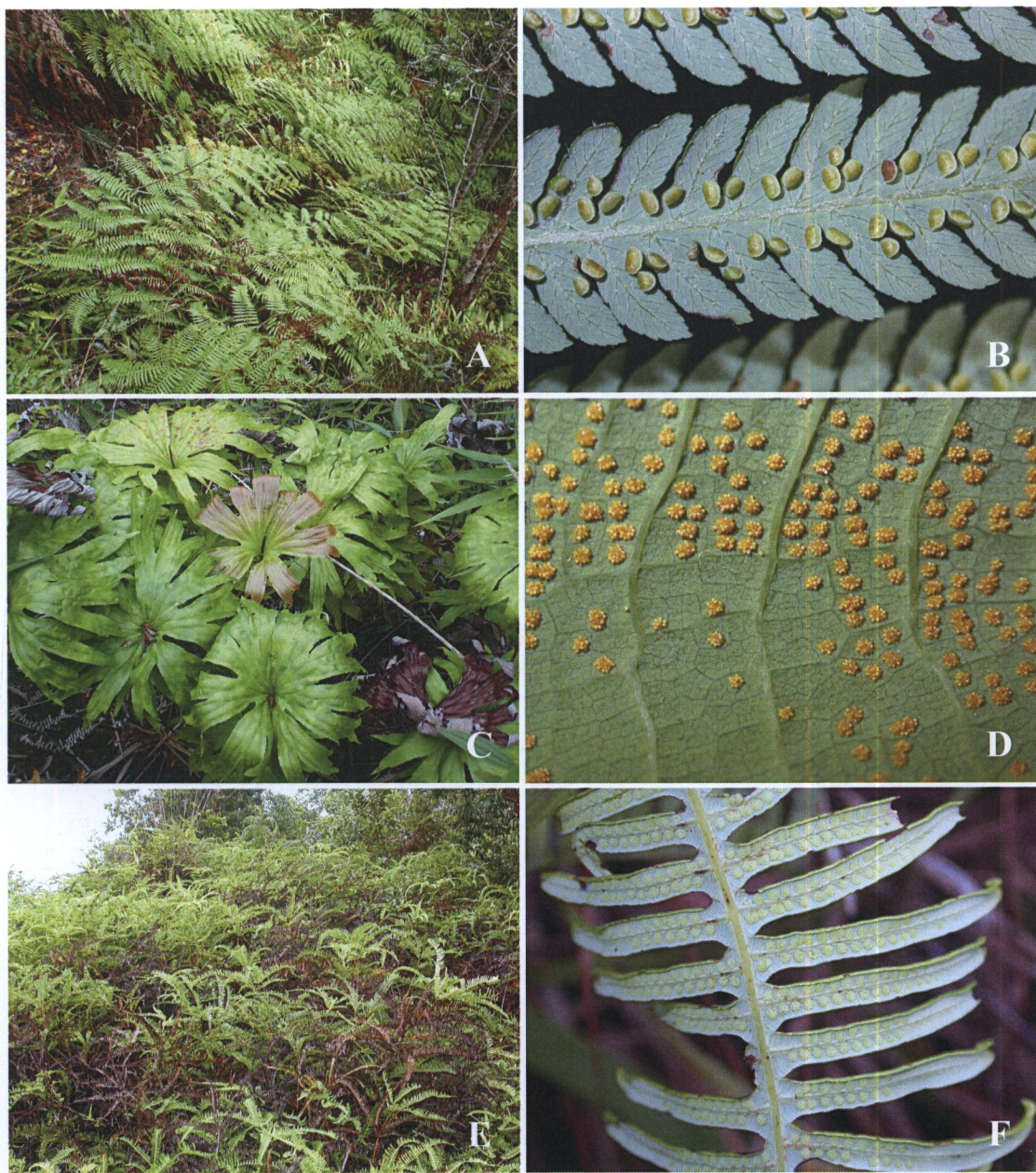
**Plate 10.** A-B. *Davallia pectinata* Sm., A. Habit and habitat, B. Sori on underside of fertile lamina; C-D. *Davallia repens* (L.f.) Kuhn, C. Habit and habitat, D. Sori on underside of fertile lamina; E-F. *Davallia solida* (G. Forst.) Sw., E. Habit and habitat, F. Underside of fertile pinnules with sori.





**Plate 11.** A-B. *Davallia trichomanoides* Blume var. *lorrainii* (Hance) Holttum, A. Habit and habitat, B. Sori on underside of fertile pinnules; C-D. *Lindsaea bouillodii* Christ, C. Habit and habitat, D. Sori on underside of fertile pinnules; E-F. *Pteridium aquilinum* (L.) Kuhn, E. Habit and habitat, F. Underside of fertile pinnae with sori.





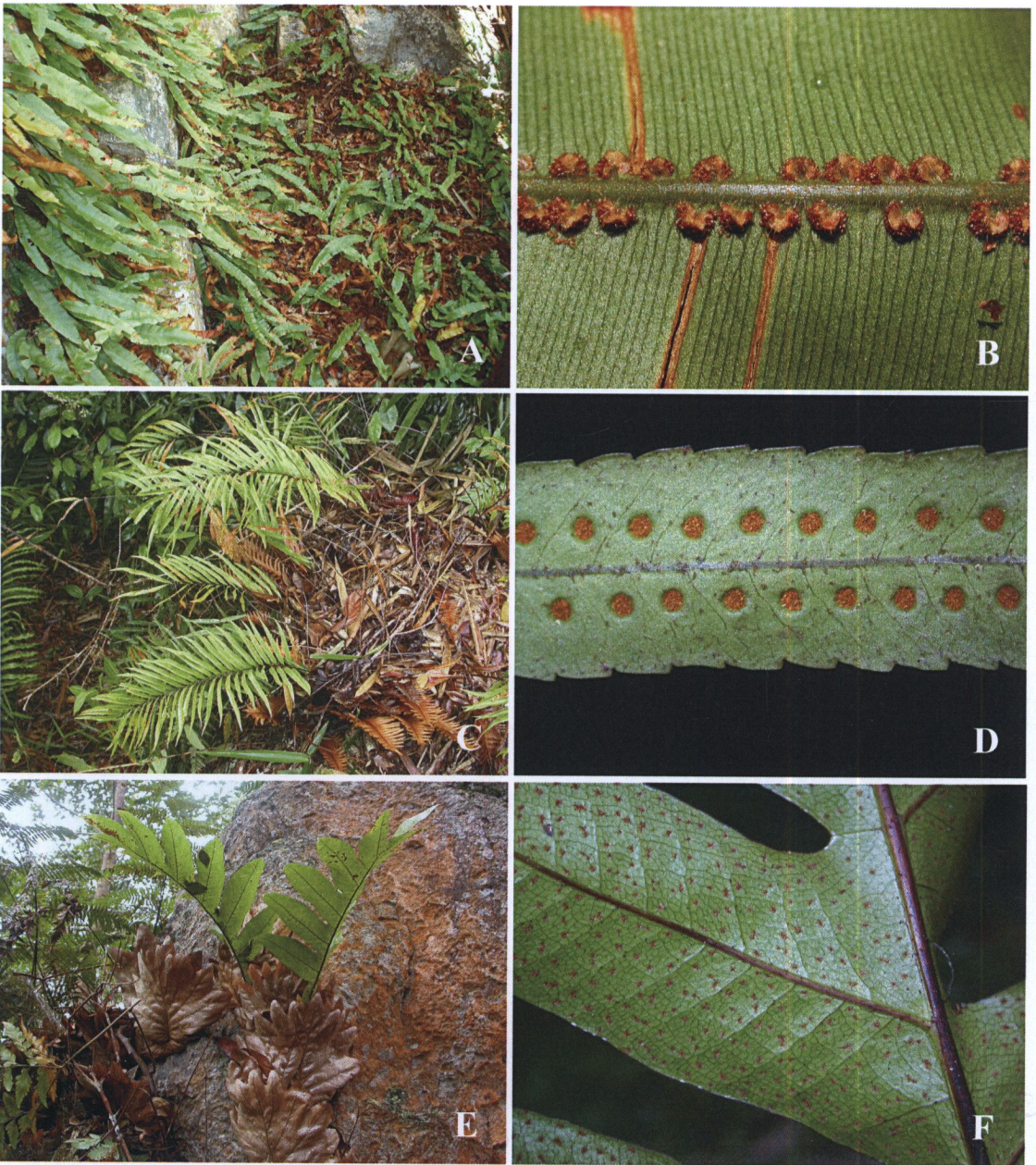
**Plate 12.** A-B. *Cibotium barometz* J. Sm., A. Habit and habitat, B. Sori on underside of fertile pinnules; C-D. *Dipteris conjugata* Reinw., C. Habit and habitat, D. Sori on underside of frond; E-F. *Dicranopteris linearis* (Burm.f.) Underw., E. Habit and habitat, F. Underside of fertile lamina with sori.





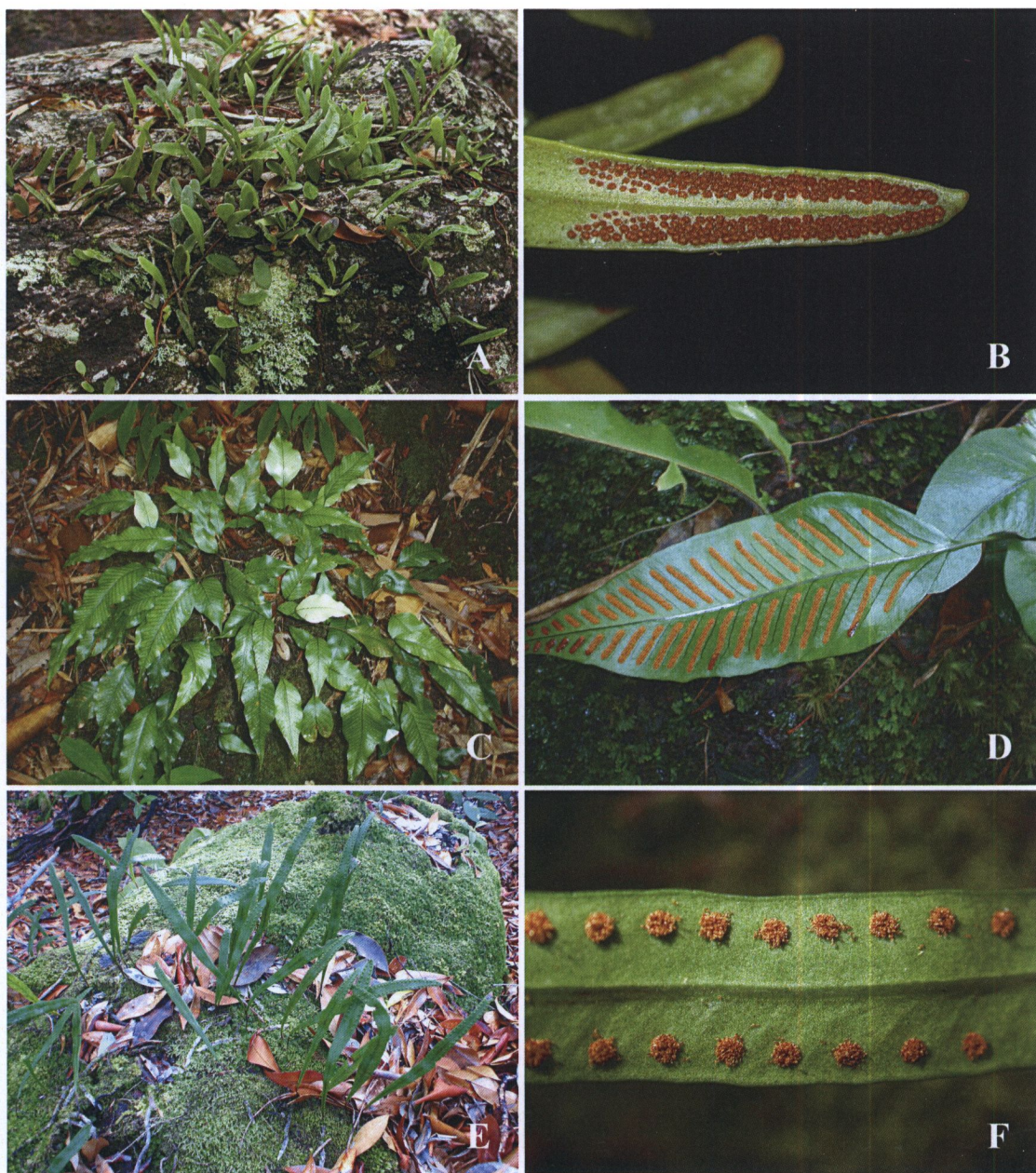
**Plate 13.** A-B. *Crepidomanes minutum* (Blume) K. Iwats., A. Habit and habitat, B. Fertile fronds with sori; C-D. *Hymenophyllum serrulatum* (C. Presl) C. Chr., C. Habit and habitat, D. Fertile frond with sori; E-F. *Oleandra pistillaris* (Sw.) C. Chr., E. Habit and habitat, F. Sori on underside of fertile lamina.





**Plate 14.** A-B. *Oleandra undulata* (Willd.) Ching, A. Habit and habitat, B. Sori on underside of fertile lamina; C-D. *Drynaria rigidula* (Sw.) Bedd., C. Habit and habitat, D. Sori on underside of fertile pinna; E-F. *Drynaria sparsisora* (Desv.) T. Moore, E. Habit and habitat, F. Part of fertile lamina with venation and sori.





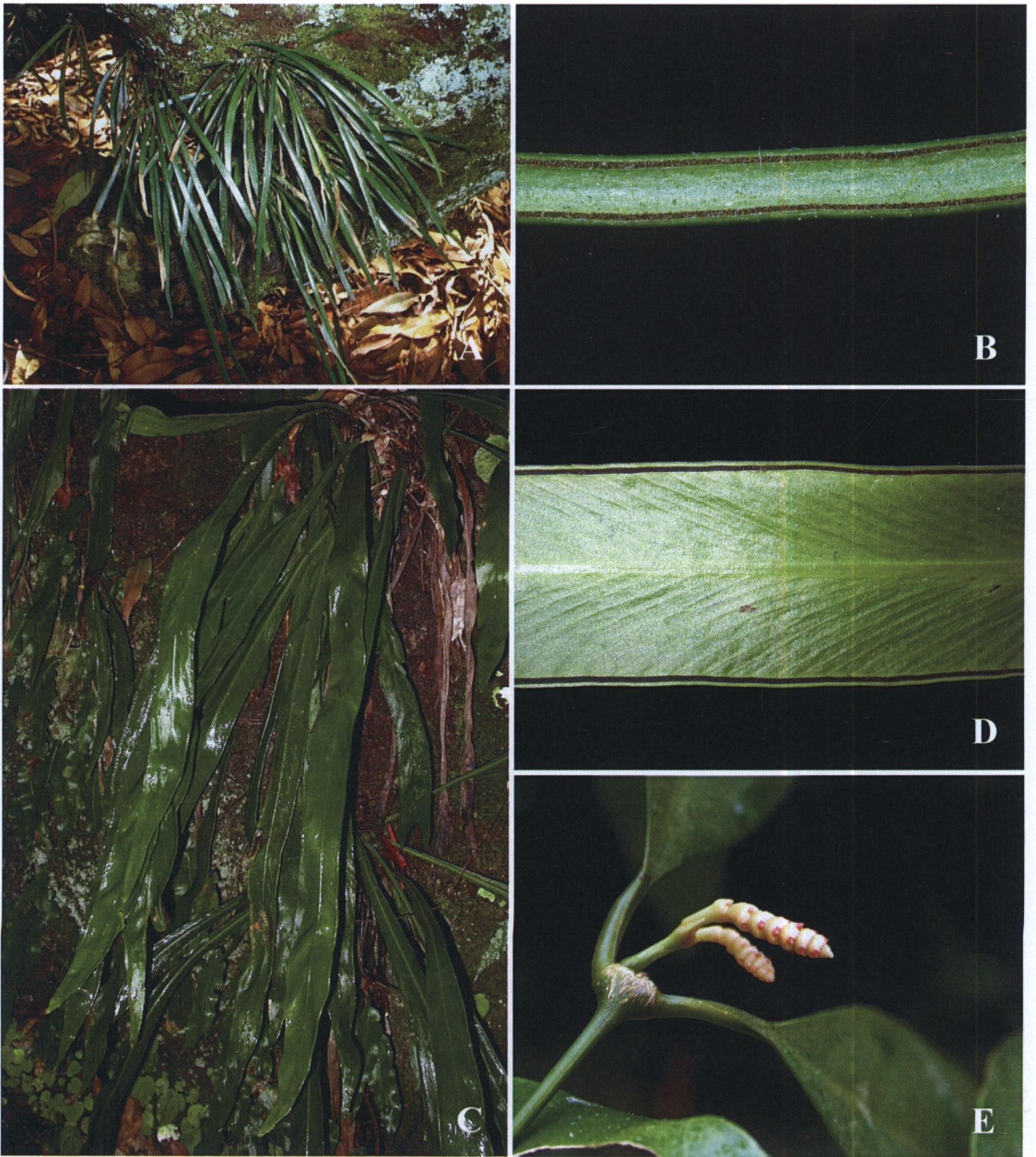
**Plate 15.** A-B. *Pyrrosia adnascens* (Sw.) Ching, A. Habit and habitat, B. Sori on underside of fertile lamina; C-D. *Selliguea heterocarpa* (Blume) Blume, C. Habit and habitat, D. Sori on underside of fertile lamina; E-F. *Selliguea stenophylla* (Blume) Parris, E. Habit and habitat, F. Sori on underside of fertile lamina.





**Plate 16.** A-B. *Pteris dalhousiae* Hook., A. Habit and habitat, B. Sori on underside of fertile pinnules; C-D. *Schizaea dichotoma* (L.) Sm., C. Habit and habitat, D. Fertile lamina with terminal sorophores; E-F. *Schizaea digitata* (L.) Sw., E. Habit and habitat, F. Sorophores in pseudodigitate group at the apex of fertile lamina.





**Plate 17.** A-B. *Vittaria ensiformis* Sw., A. Habit and habitat, B. Sori on underside of fertile frond; C-D. *Vittaria scolopendrina* (Bory) Schkuhr ex Thwaites, C. Habit and habitat, D. Sori on underside of fertile frond; E. *Gnetum gnemon* L. var. *tenerum* Markgr., female strobili.





**Plate 18.** A-C. *Dacrydium elatum* (Roxb.) Wall. ex Hook., A. Seedling, B. Upper crown of a mature tree, C. Seed-bearing branch (left), sterile branch (right); D-F. *Pyramidanthe prismatica* (Hook.f. & Thomson) J. Sinclair, D. Habit and habitat, E. Flower, F. Fruit.





**Plate 19.** A-B. *Alstonia rostrata* C.E.C. Fisch., A. Habit, B. Inflorescence and flowers; C-D. *Anodendron axillare* Merr., C. Habit, D. Inflorescence and flowers; E-F. *Willughbeia coriacea* Wall., E. Inflorescences and flowers, F. Fruits.





**Plate 20.** A-C. *Willughbeia tenuiflora* Dyer ex Hook.f., A. Habit, B. Inflorescence and flowers, C. Fruit; D-F. *Schefflera cephalotes* (C.B. Clarke) Harms, D. Upper crown, E. Branch with inflorescences, F. Flowering head.





**Plate 21.** A-B. *Dischidia bengalensis* Colebr., A. Epiphytic habit, B. Lithophytic habit; C-E. *Dischidia fruticulosa* Ridl., C. Habit of mature plant and its seedlings, D. Flowering branch, E. Inflorescence and flowers.





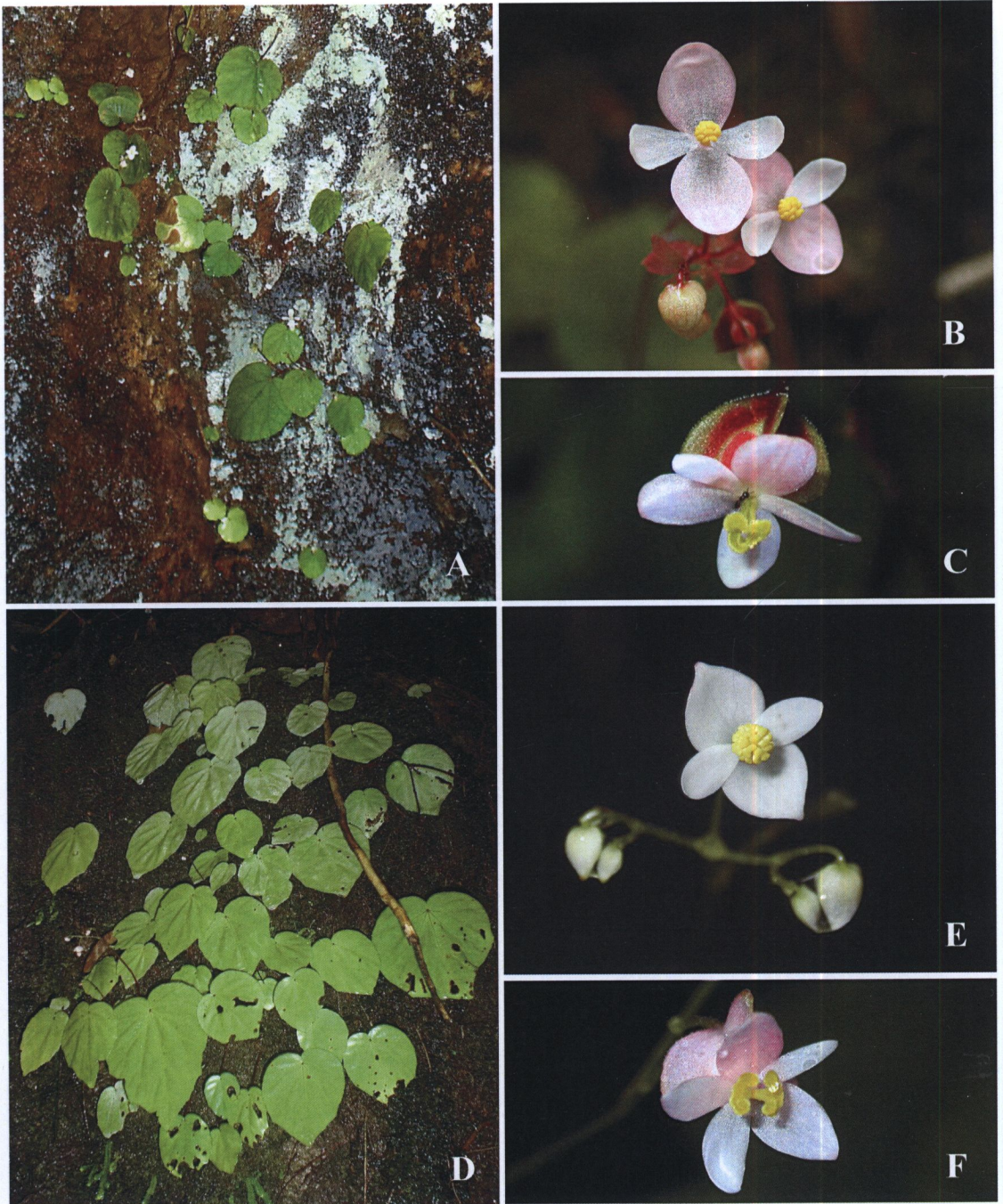
**Plate 22.** A-D. *Hoya imperialis* Lindl., A. Habit and habitat, B. Flowering branch, C. Inflorescence, D. Flowers with a visitor (honey bee); E-F. *Hoya multiflora* Blume, E. Habit and habitat, F. Inflorescence and flowers.





**Plate 23.** A. *Hoya plicata* King & Gamble, inflorescence and flowers; B. *Hoya rigida* Kerr, B. Habit and habitat, C. Inflorescence and flowers; D-F. *Hoya* sp., D. Habit and habitat, E-F. Flower, side view (E), front view (F).





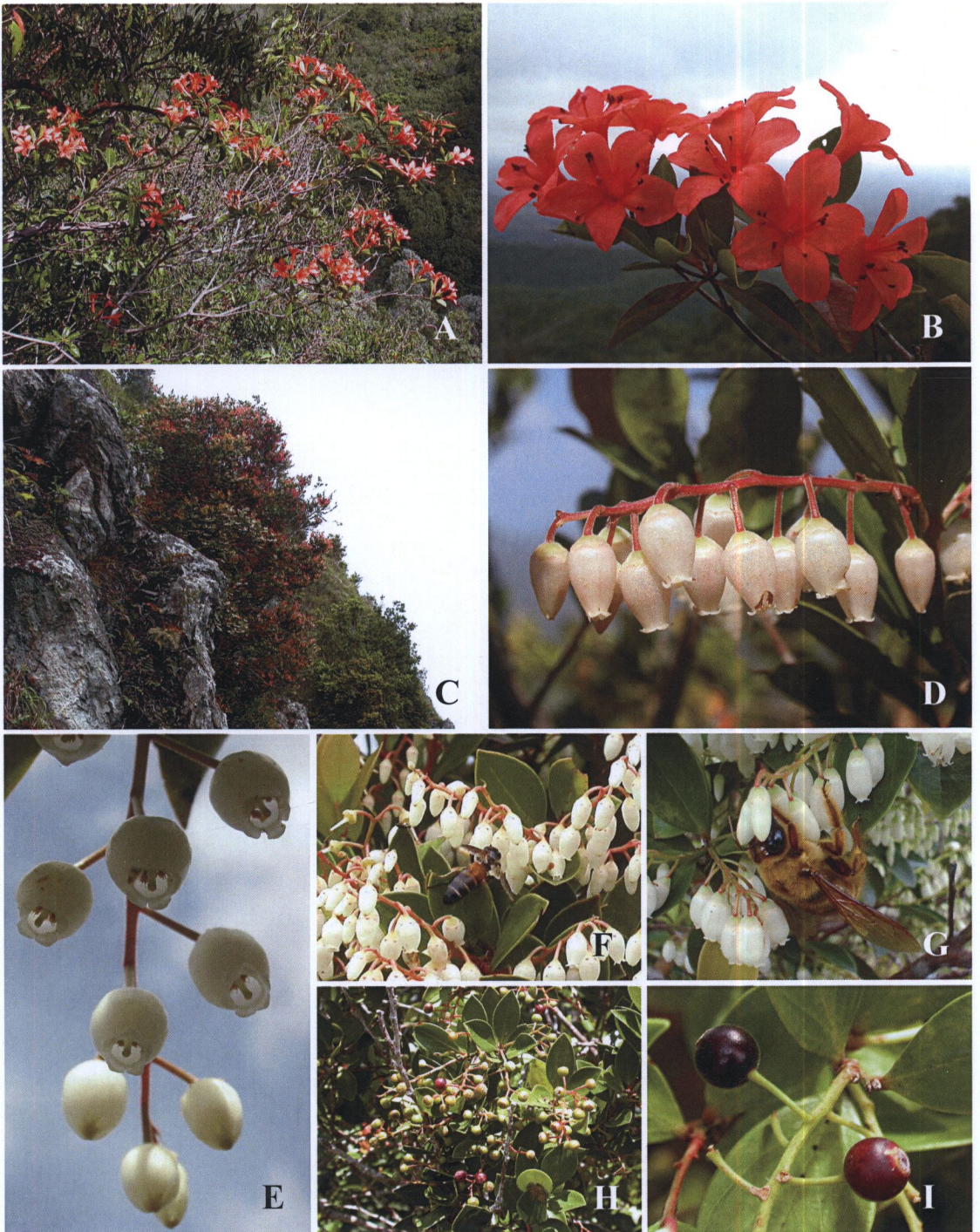
**Plate 24.** A-C. *Begonia sinuata* Wall. ex Meisn. var. *sinuata*, A. Habit and habitat, B. Male flowers and buds, C. Female flower; D-F. *Begonia* sp., D. Habit and habitat, E. Male flower and buds, F. Female flower.





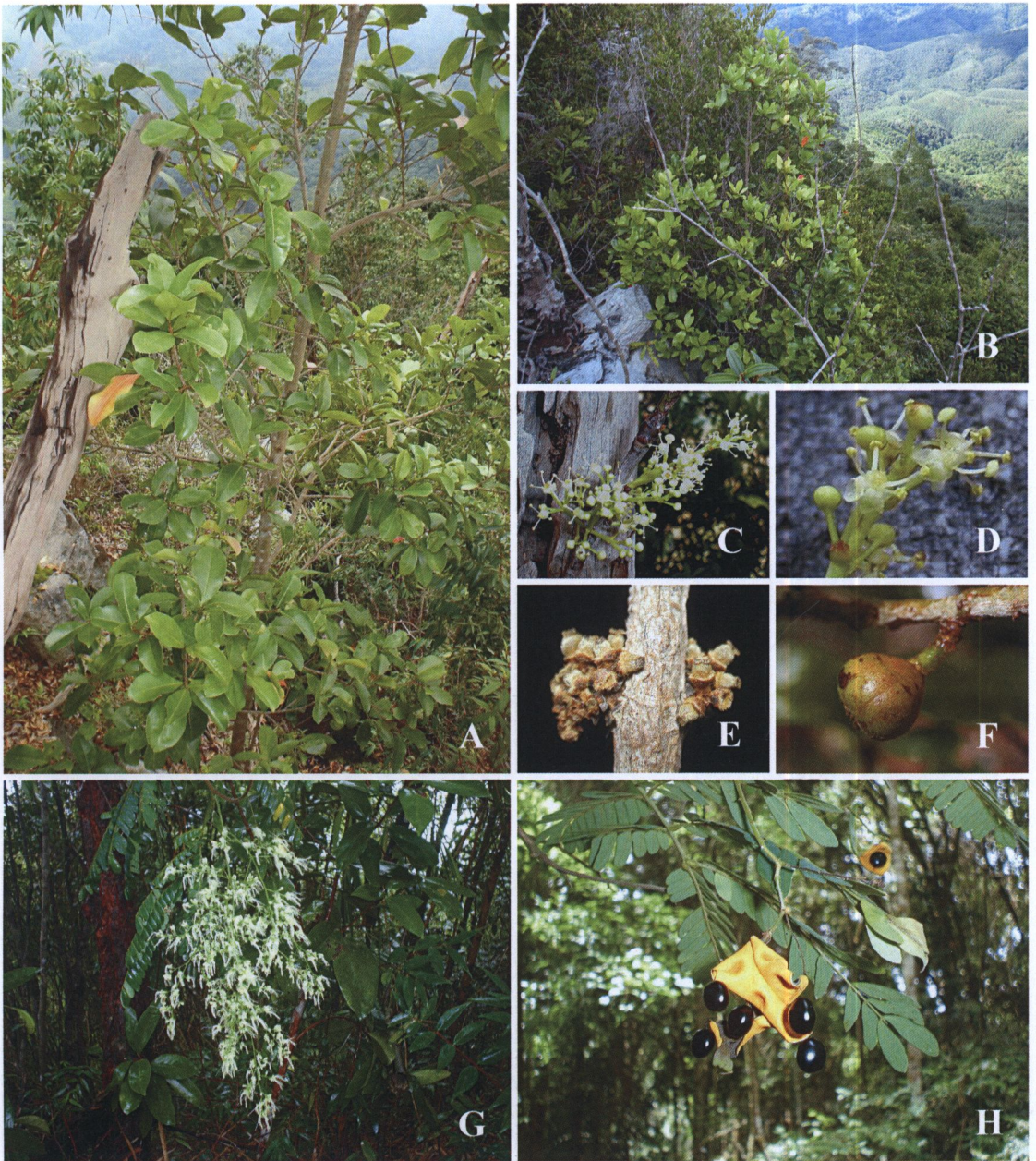
**Plate 25.** A-B. *Cratoxylum maingayi* Dyer, A. Habit, B. Flowers; C-E. *Elaeocarpus pedunculatus* Wall. ex Mast., C. Habit, D. Flowering branch, E. Flowers.





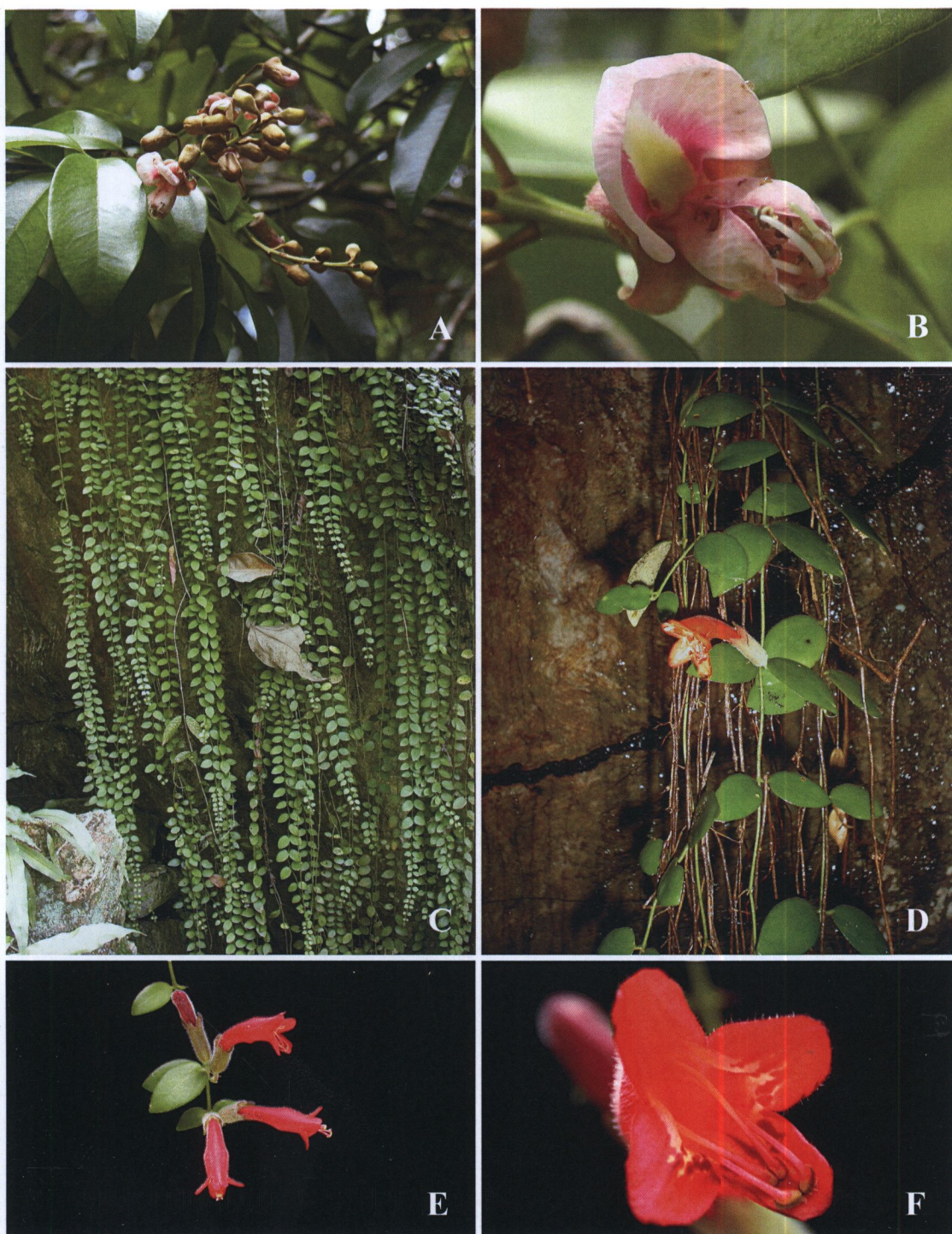
**Plate 26.** A-B. *Rhododendron longiflorum* Lindl., A. Habit, B. Flowers; C-I. *Vaccinium bancanum* Miq., C. Habit and habitat, D-E. Inflorescence and flowers, F-G. Flowers with a visitor, honey bee (F), carpenter bee (G), H. Infructescences, I. Fruits.





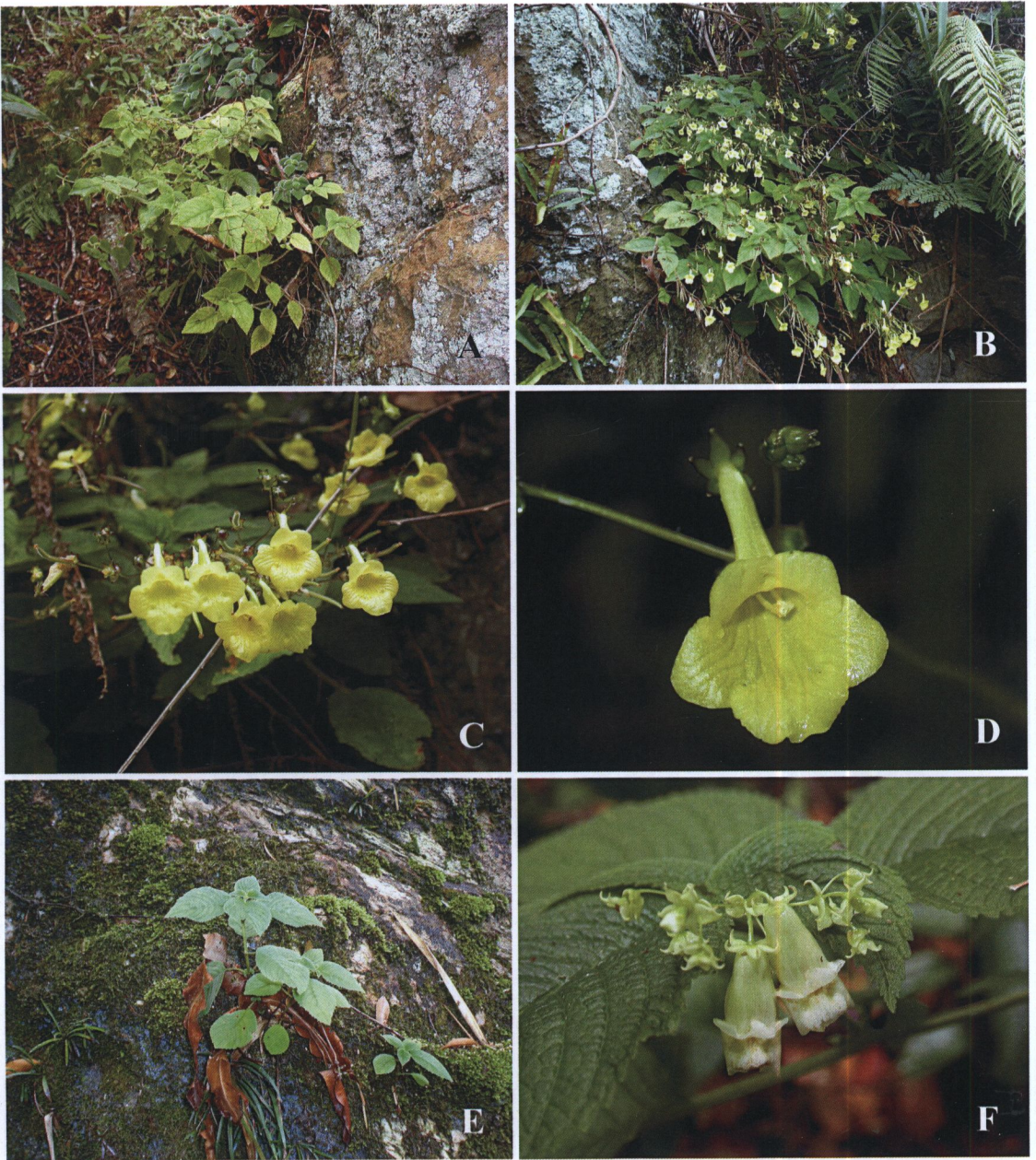
**Plate 27.** A-F. *Austrobuxus nitidus* Miq., A-B. Habit and habitat, female plant (A), male plant (B), C. Male inflorescences, D. Staminate flowers, E. Female inflorescences and pistillate flowers, F. Fruit; G-H. *Archidendron contortum* (Mart.) I.C. Nielsen, G. Inflorescence, H. Fruits and seeds.





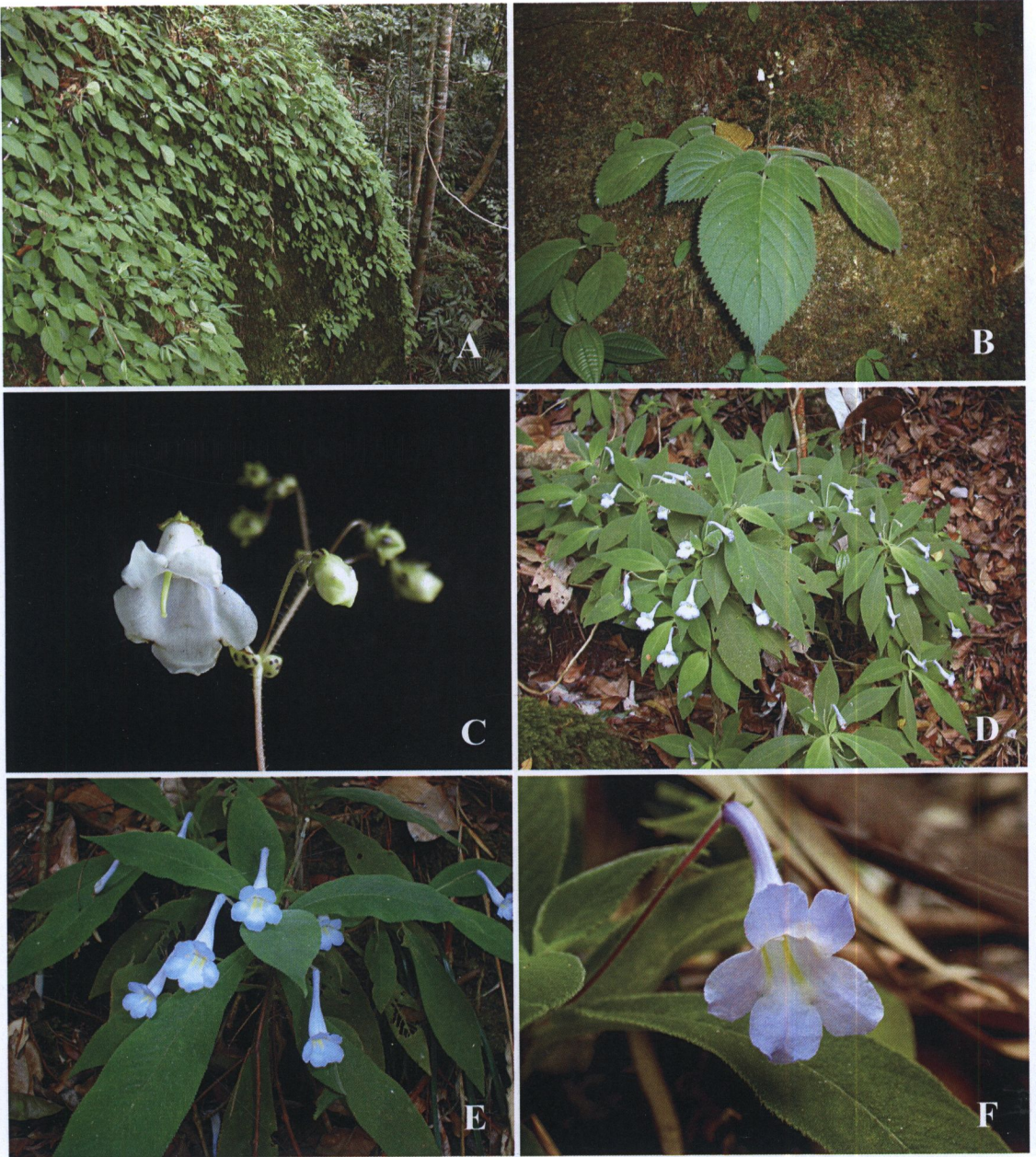
**Plate 28.** A-B. *Callerya atropurpurea* (Wall.) Schot, A. Inflorescences, B. Flower; C-F. *Aeschynanthus radicans* Jack, C-D. Habit and habitat, E. Inflorescences and flowers, F. Flower.





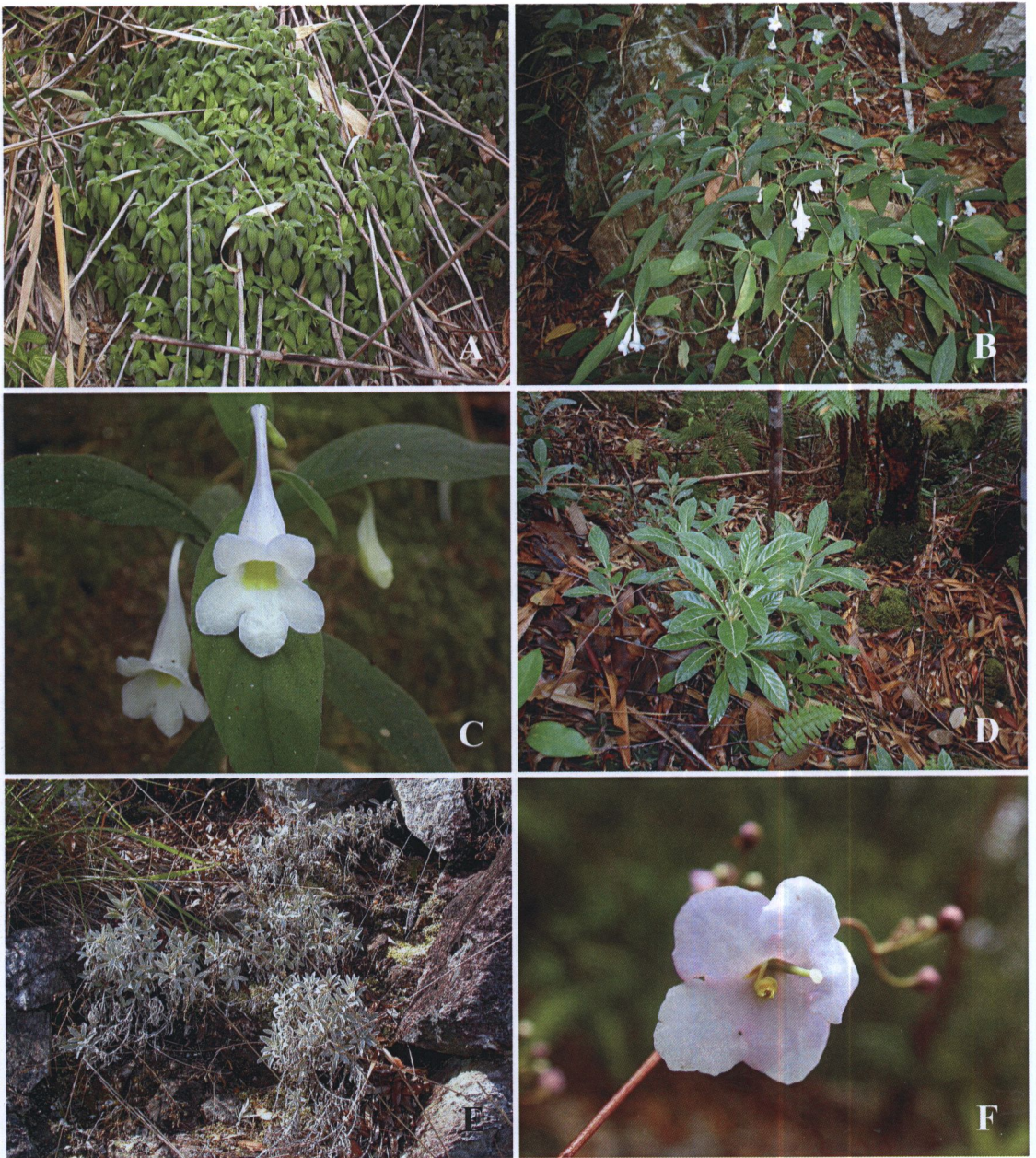
**Plate 29.** A-D. *Didymocarpus citrinus* Ridl., A-B. Habit and habitat, C. Inflorescences and flowers, D. Flower; E-F. *Didymocarpus corchorifolius* Wall ex A. DC., E. Habit and habitat, F. Inflorescences and flowers.





**Plate 30.** A-C. *Didymocarpus cordatus* A. DC., A-B. Habit and habitat, C. Inflorescence and flowers; D-F. *Henckelia bombycina* (Ridl.) A. Weber, D-E. Habit and habitat, F. Flower.





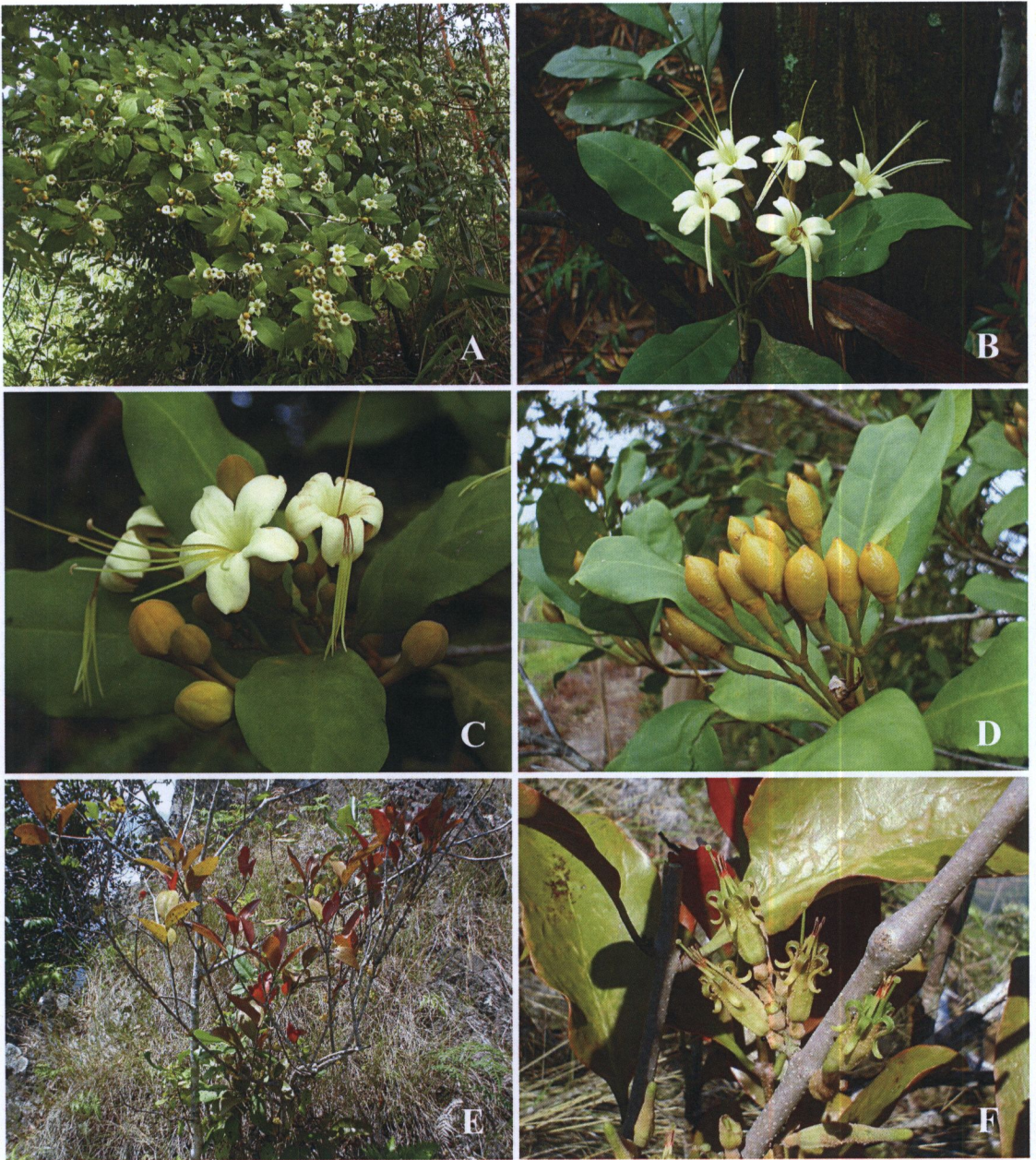
**Plate 31.** A-C. *Henckelia inaequalis* (Ridl.) A. Weber, A-B. Habit and habitat, C. Flowers; D-F. *Paraboea elegans* (Ridl.) B.L. Burtt, D-E. Habit and habitat, shady area (D), exposed area (E), F. Flower.





**Plate 32.** A-C. *Rhodoleia championii* Hook.f., A. Habit and habitat, B. Inflorescence, C. Fruits; D-F. *Fagraea acuminatissima* Merr., D. Habit and habitat, E. Inflorescence, F. Flowers.





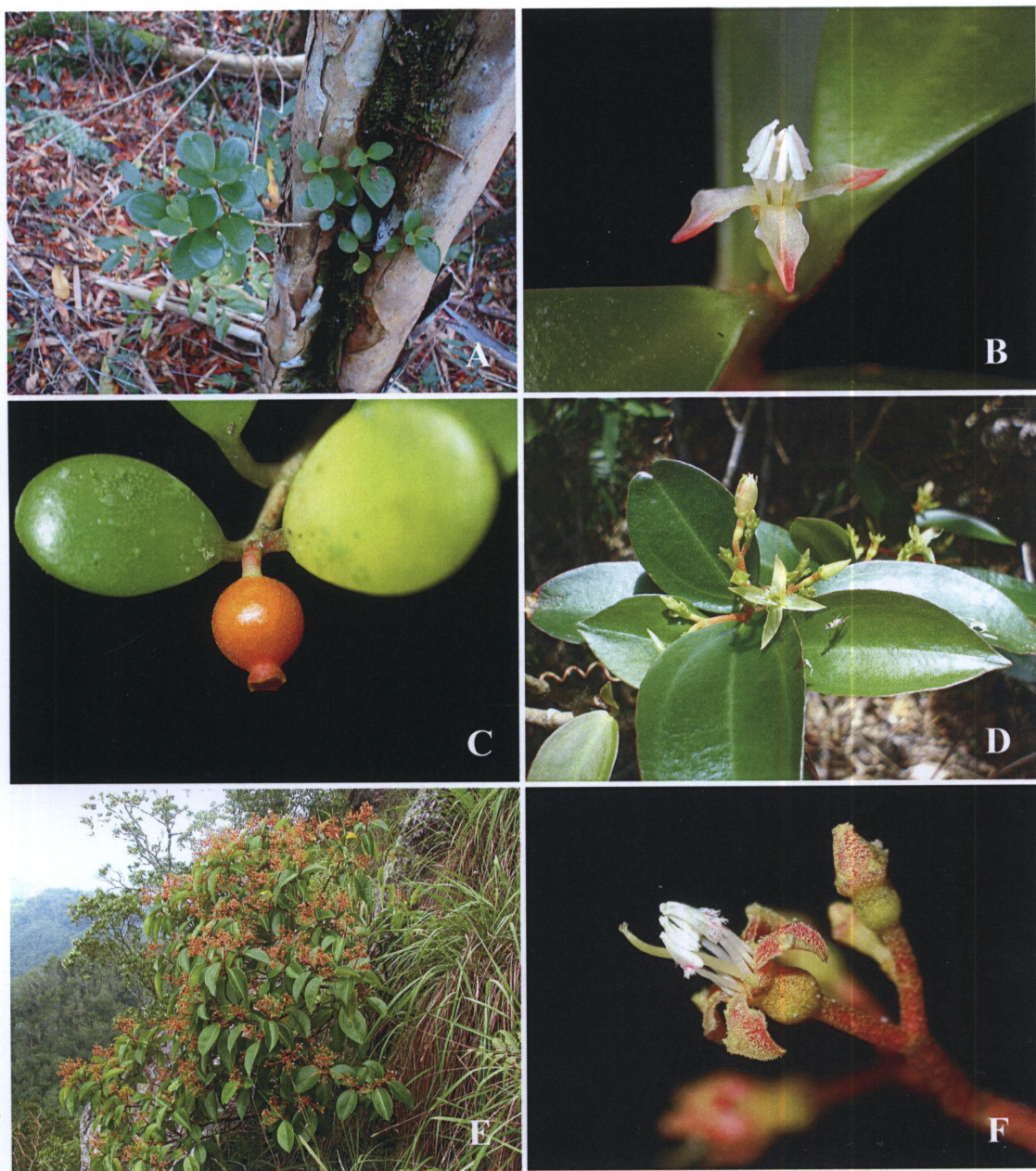
**Plate 33.** A-D. *Fagraea wallichiana* Benth., A. Habit, B-C. Inflorescences and flowers, D. Infructescences and fruits; E-F. *Dendrophthoe pentandra* (L.) Miq., E. Habit and habitat, F. Inflorescences and flowers.





**Plate 34.** A-C. *Melastoma malabathricum* L. subsp. *malabathricum*, A. Habit and habitat, B. Flowering branch, C. Flower; D-F. *Oxyspora umbellulata* (Hook.f. ex Triana) J.F. Maxwell, D. Habit and habitat, E. Flowers, F. Infructescences and fruits.





**Plate 35.** A-C. *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausing, A. Habit and habitat, B. Flower, C. Fruit; D. *Pachycentria hanseniana* Clausing, flowers; E-F. *Pachycentria pulverulenta* (Jack) Clausing, E. Habit and habitat, F. Flowers.





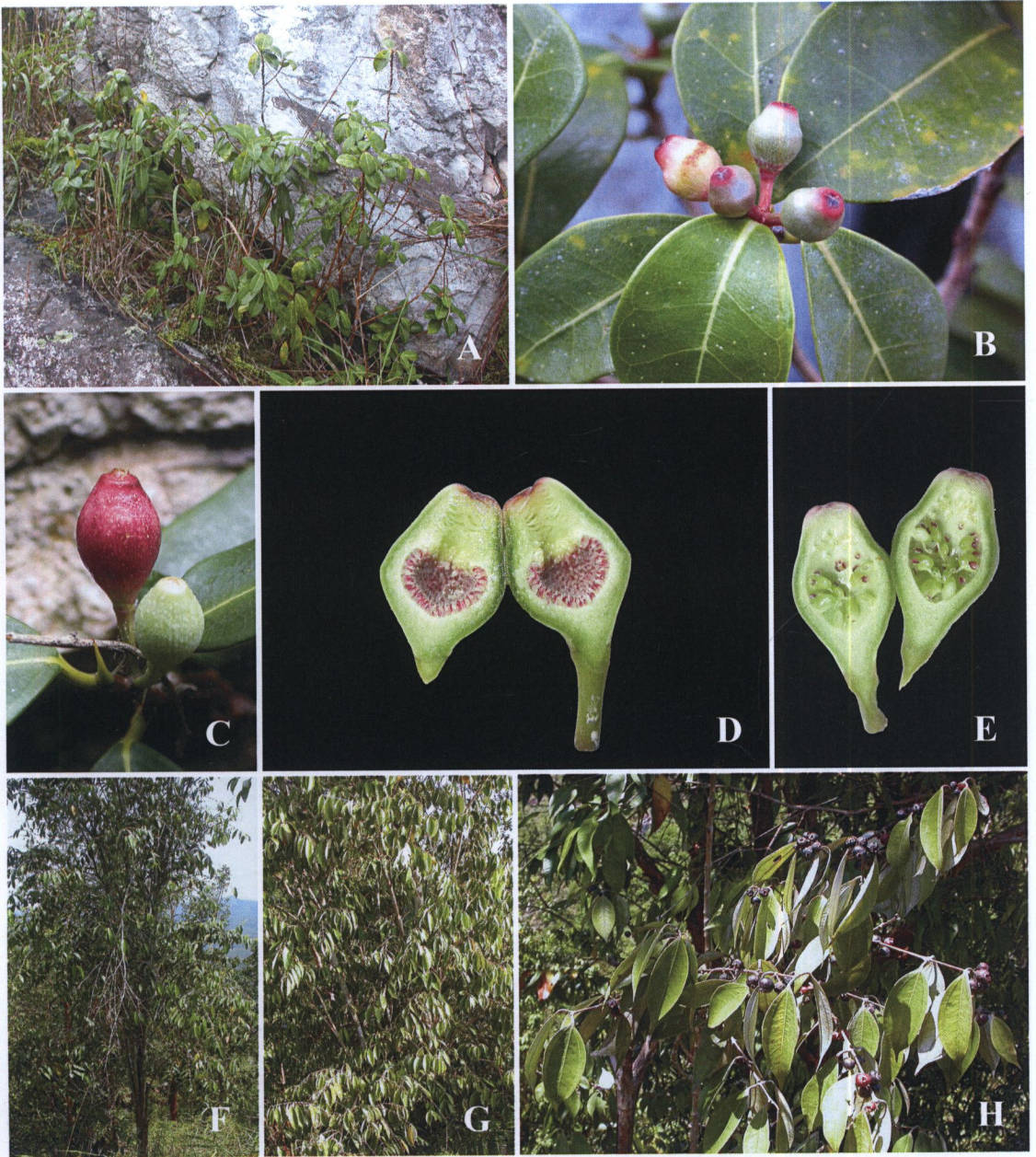
**Plate 36.** A-C. *Sonerila griffithii* C.B. Clarke, A-B. Habit and habitat, C. Flower; D-F. *Ficus deltoidea* Jack var. *deltoidea*; D. Habit and habitat, E. Figs, F. Longitudinal section of fig, showing female flowers.





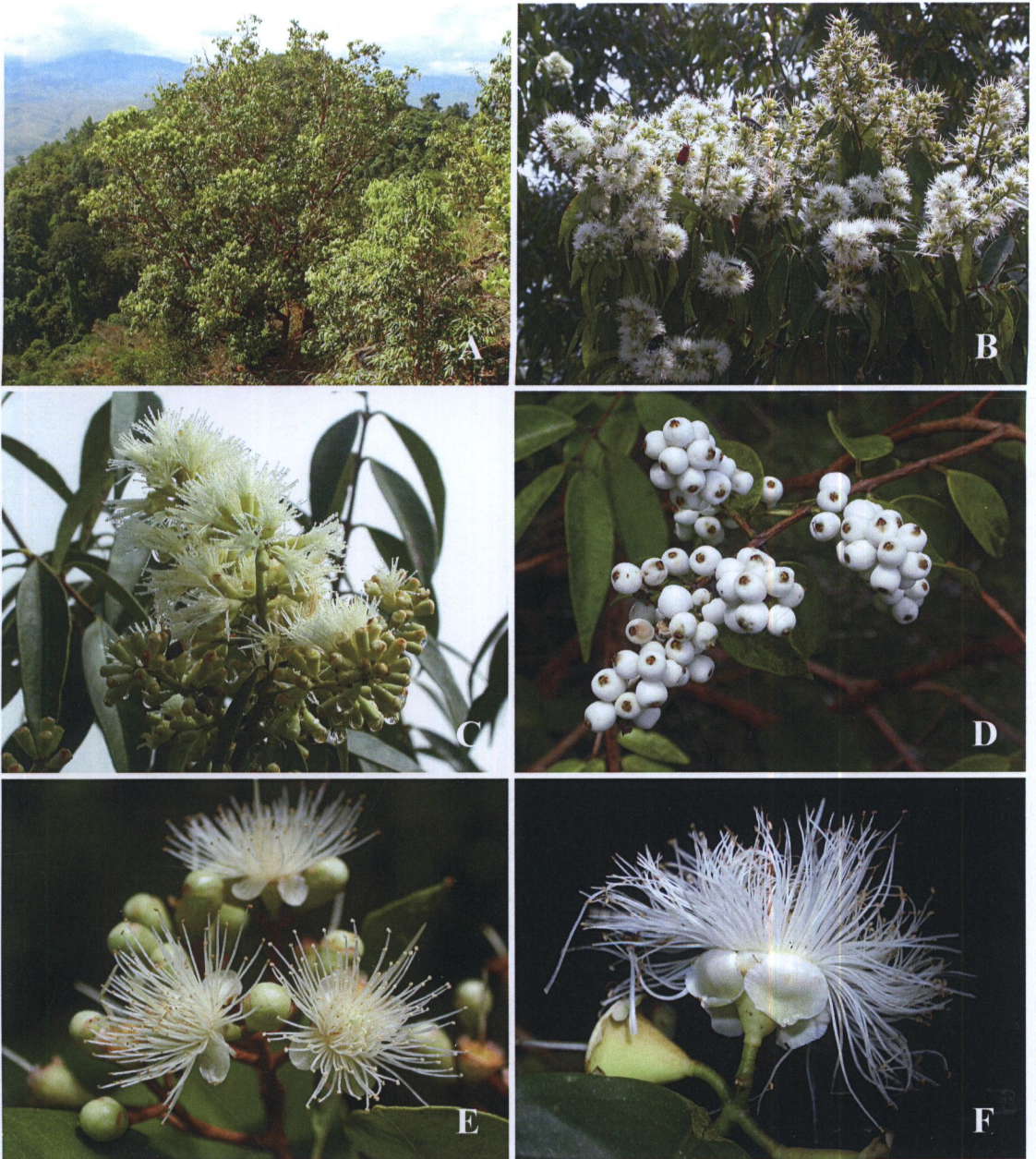
**Plate 37.** A-C. *Ficus deltoidea* Jack var. *angustifolia* (Miq.) Corner, A-B. Habit, C. Figs; D-G. *Ficus deltoidea* Jack var. *kunstleri* (King) Corner, D-E. Habit, F. Fig, G. Longitudinal section of fig, showing male and gall flowers.





**Plate 38.** A-E. *Ficus oleifolia* King subsp. *intermedia* (Corner) C.C. Berg, A. Habit and habitat, B-C. Figs, D. Longitudinal section of fig, showing male and gall flowers, E. Longitudinal section of fig, showing female flowers; F-H. *Rhodamnia cinerea* Jack var. *cinerea*, F-G. Habit, H. Fruiting branches.





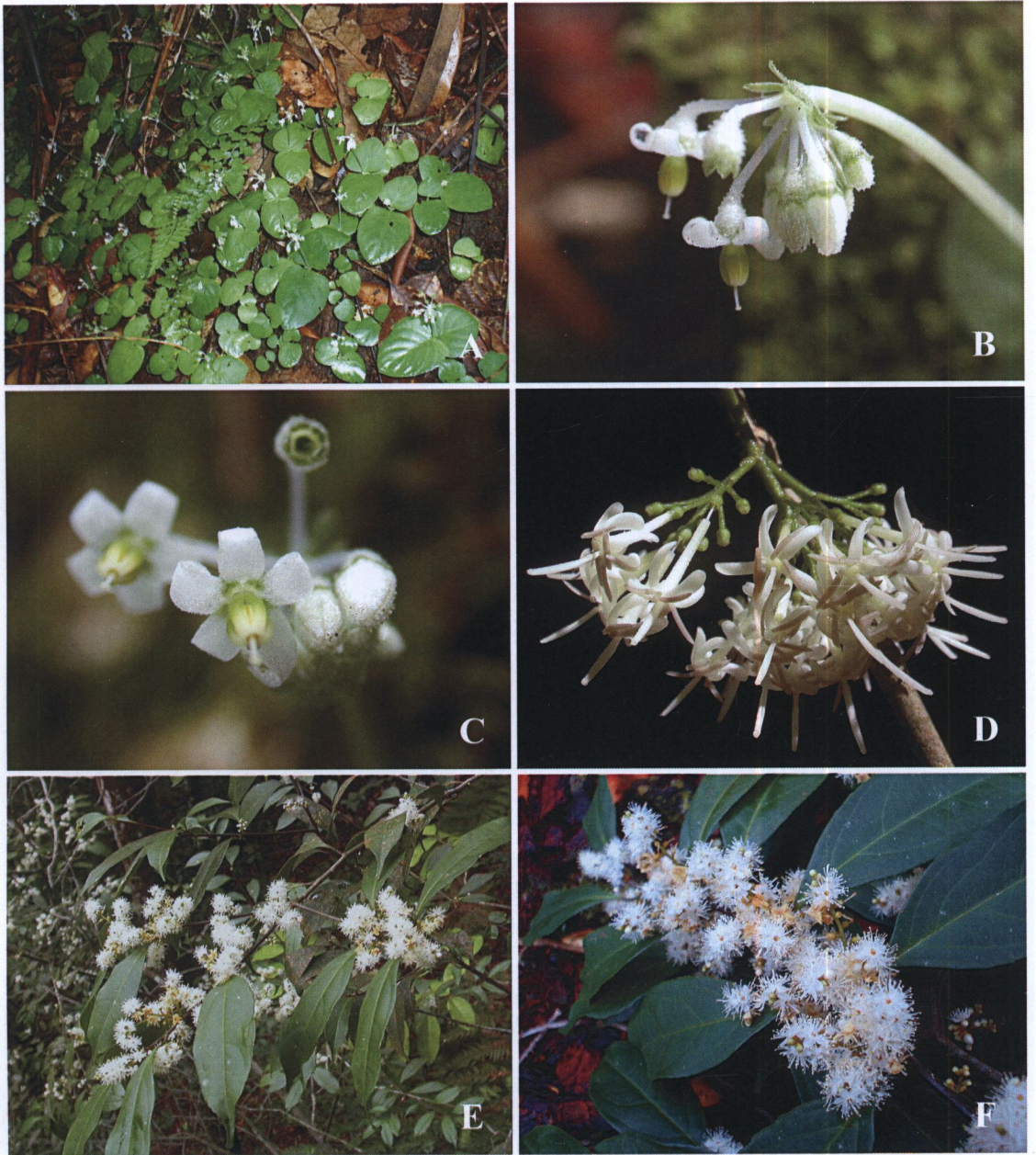
**Plate 39.** A-D. *Syzygium gratum* (Wight) S.N. Mitra var. *gratum*, A. Habit and habitat, B. Flowering branches, C. Inflorescences and flowers, D. Infructescences and fruits; E. *Syzygium helferi* (Duthie) Chantar. & J. Parn., flowers; F. *Syzygium samarangense* (Blume) Merr. & L.M. Perry var. *parviflorum* (Craib) Chantar. & J. Parn., flower.





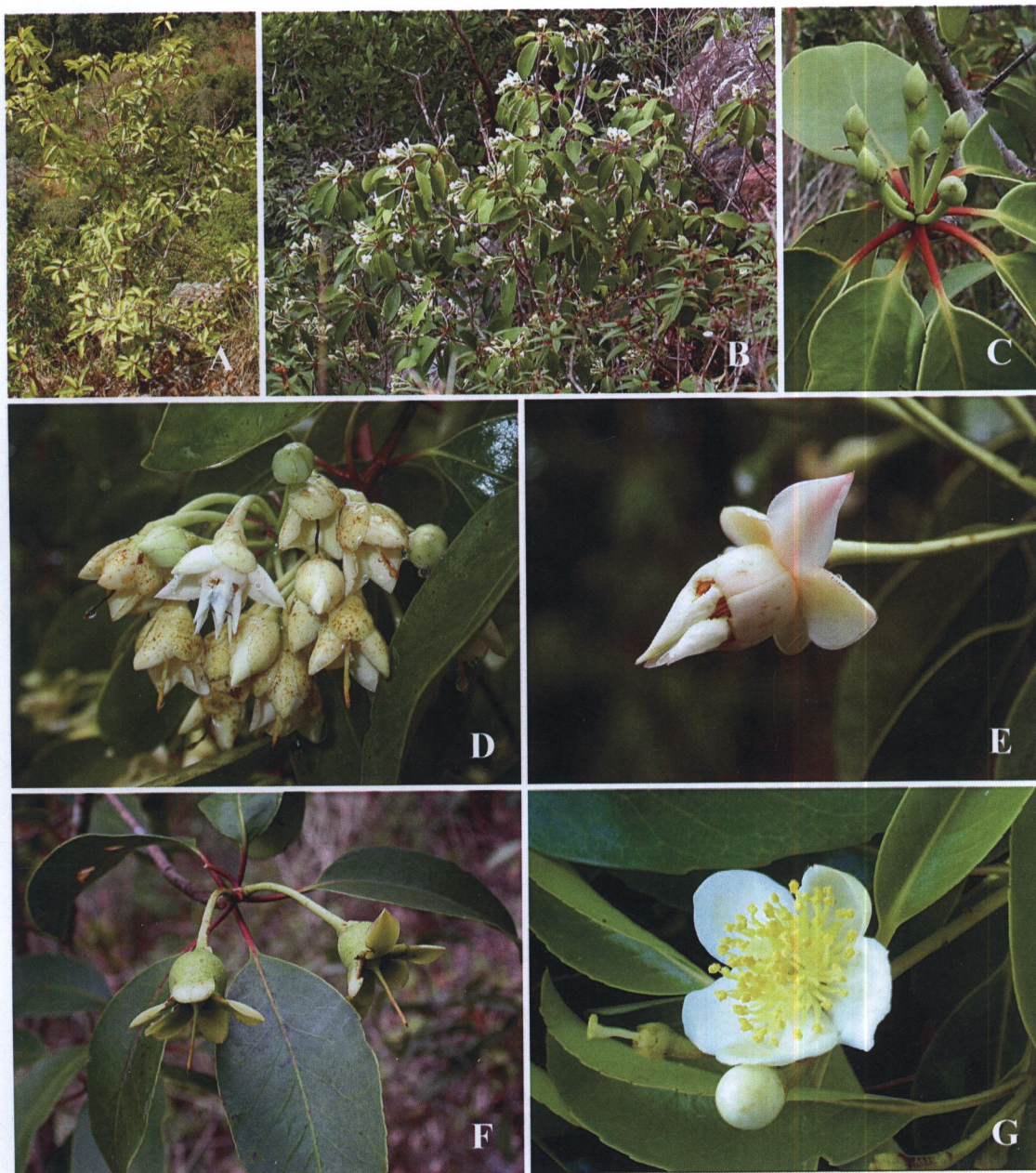
**Plate 40.** A-B. *Syzygium syzygioides* (Miq.) Merr. & L.M. Perry, A. Habit, B. Inflorescences and flowers; C-E. *Syzygium* sp. 1, C. Habit with flowers, D. Inflorescences and flowers, E. Fruits; F. *Syzygium* sp. 2, inflorescences and flowers.





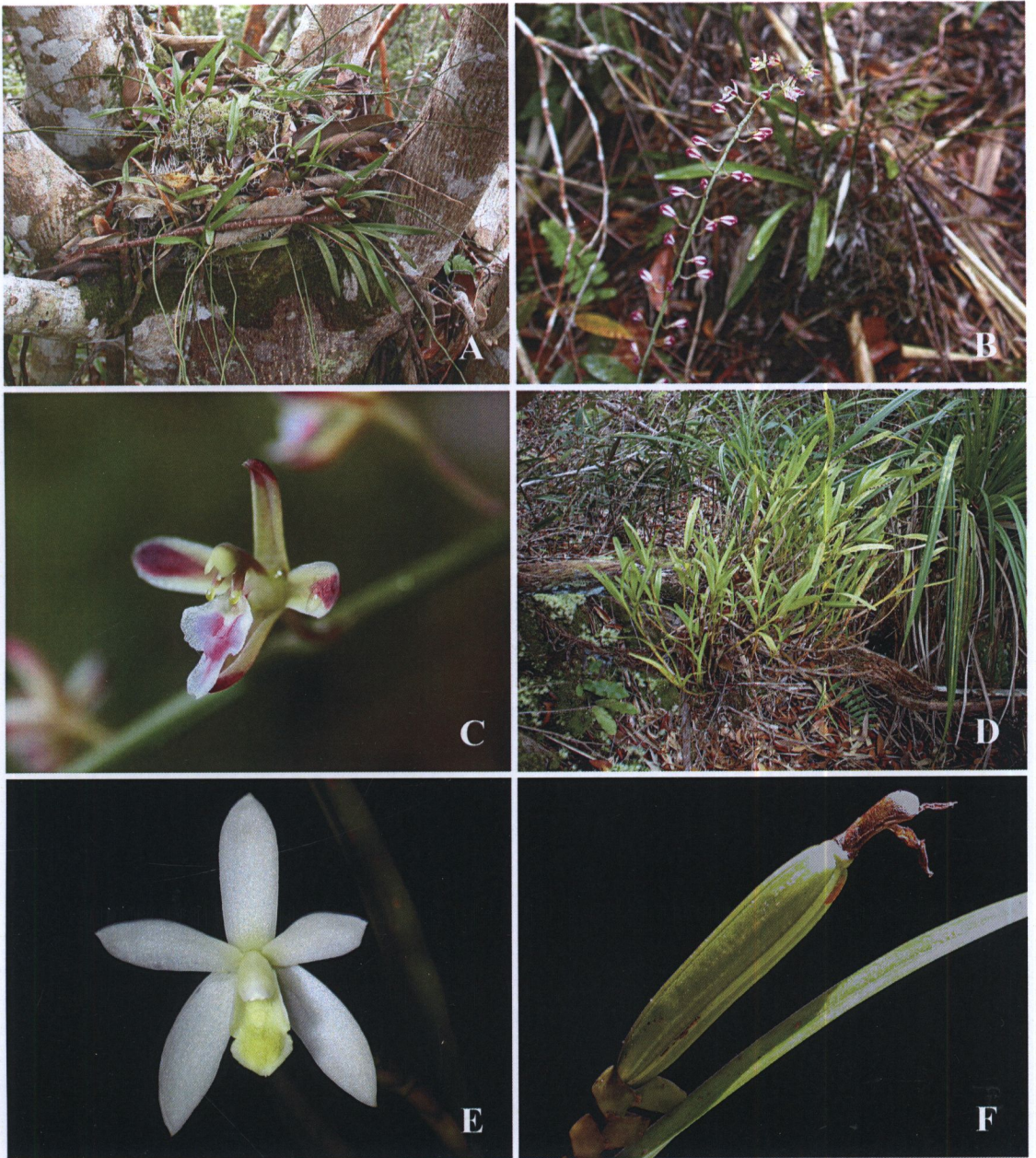
**Plate 41.** A-C. *Argostemma pictum* Wall., A. Habit and habitat, B. Inflorescences and flowers, side view, C. Flowers, front view; D. *Tarenna longifolia* (G. Don) Ridl., inflorescence and flowers; E-F. *Symplocos adenophylla* Wall. ex G. Don, E. Flowering branches, F. Inflorescences and flowers.





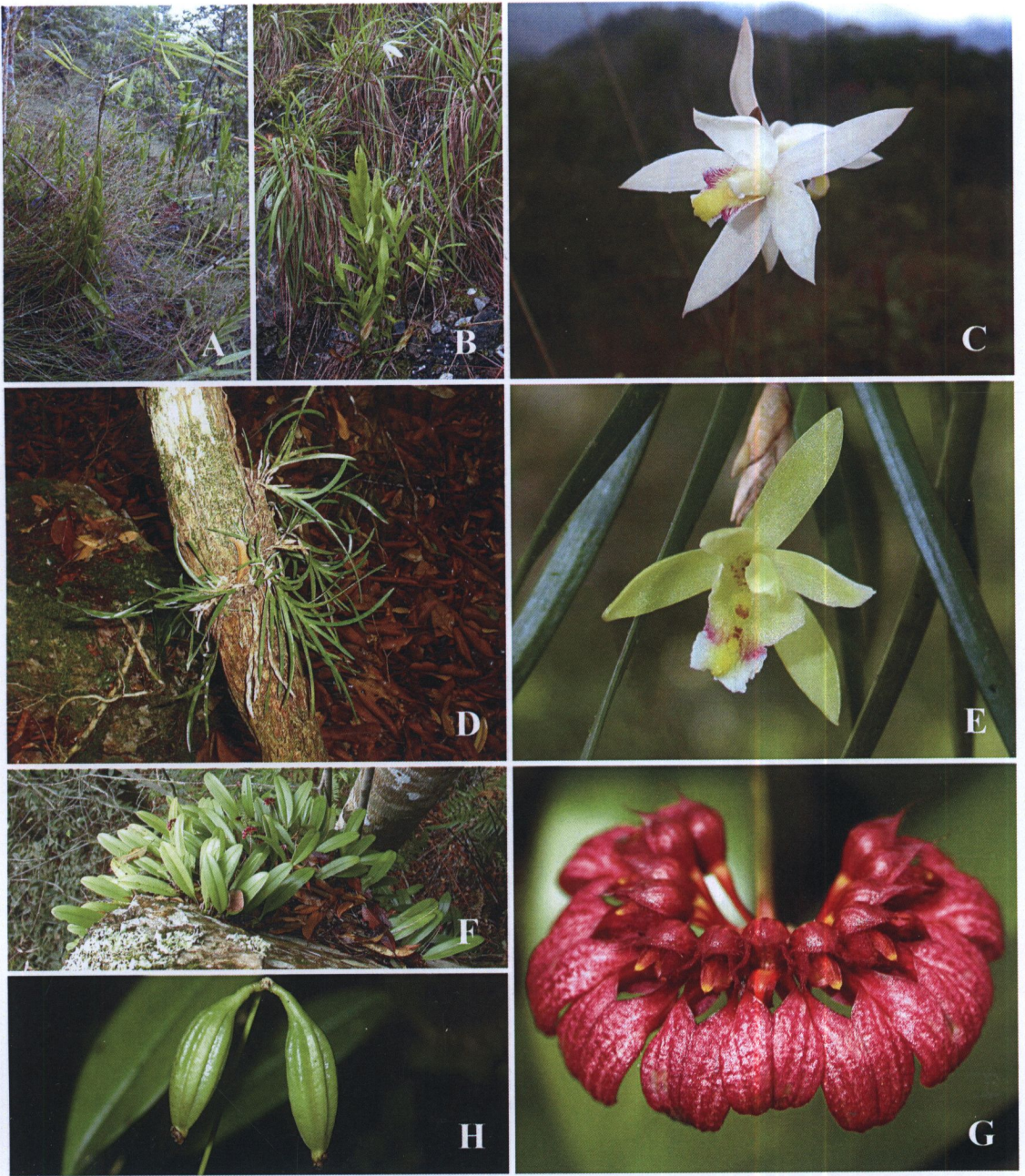
**Plate 42.** A-F. *Anneslea fragrans* Wall., A-B. Habit and habitat, C. Flower buds, D. Inflorescences and flowers, E. Flower, F. Fruits; G. *Schima wallichii* (DC.) Korth., flower and bud.





**Plate 43.** A-C. *Acriopsis liliifolia* (J. Koenig) Ormerod, A-B. Habit and habitat, C. Flower; D-F. *Bromheadia alticola* Ridl., D. Habit and habitat, E. Flower, F. Fruit.





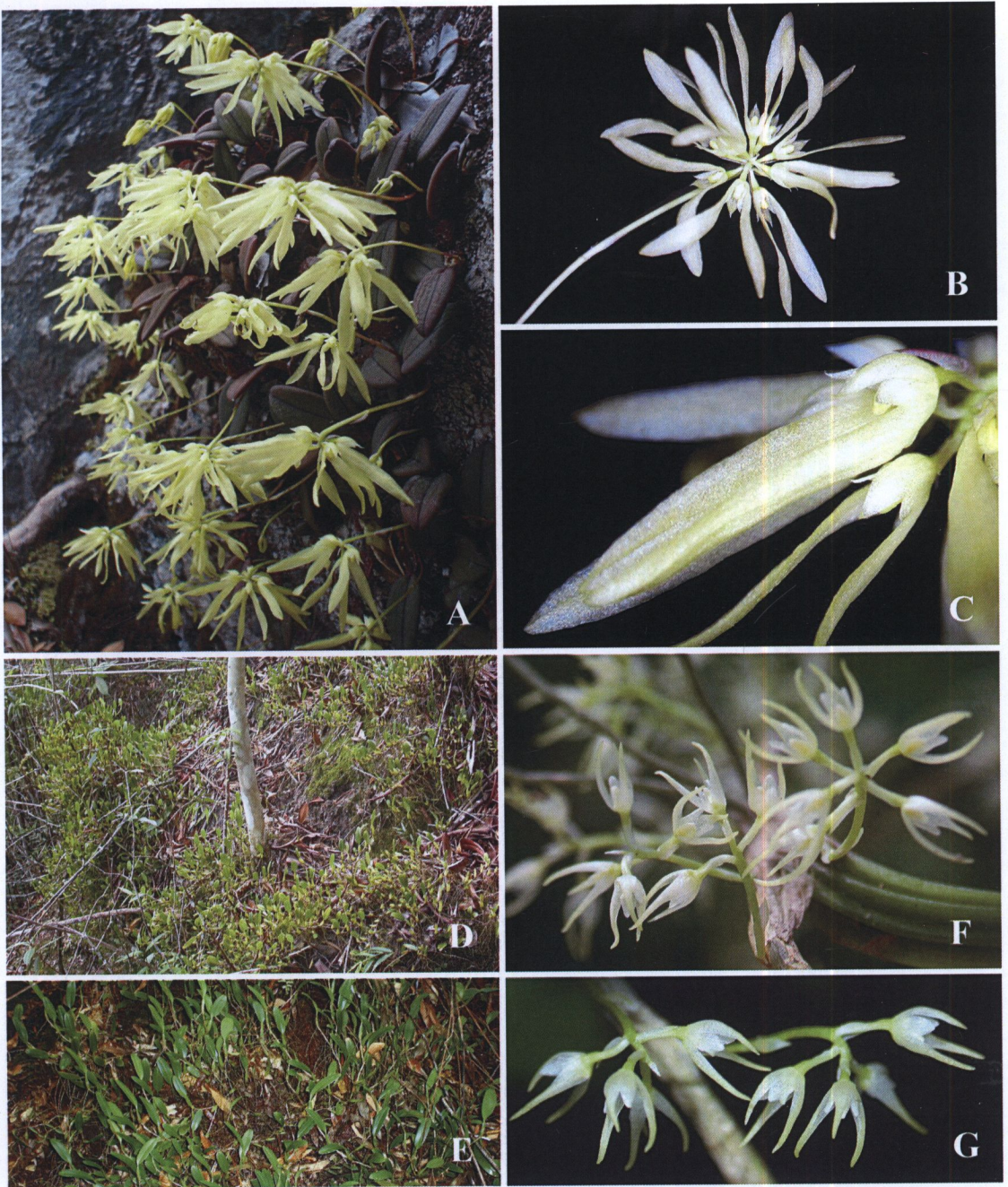
**Plate 44.** A-C. *Bromheadia finlaysoniana* (Lindl.) Miq., A-B. Habit and habitat, C. Flower; D-E. *Bromheadia truncata* Seidenf., D. Habit and habitat, E. Flower; F-H. *Bulbophyllum corolliferum* J.J. Sm., F. Habit and habitat, G. Inflorescence and flowers, H. Fruits.





**Plate 45.** A-C. *Bulbophyllum lilacinum* Ridl., A. Habit and habitat, B. Flowers, C. Fruits; D-F. *Bulbophyllum medusae* (Lindl.) Rchb.f., D. Habit and habitat, E. Inflorescences, F. Flowers.





**Plate 46.** A-C. *Bulbophyllum purpurascens* Teijsm. & Binn., A. Habit and habitat, with flowers, B. Inflorescence, C. Flowers; D-G. *Bulbophyllum stenobulbon* E.C. Parish & Rchb.f., D-E. Habit and habitat, F-G. Inflorescences and flowers.





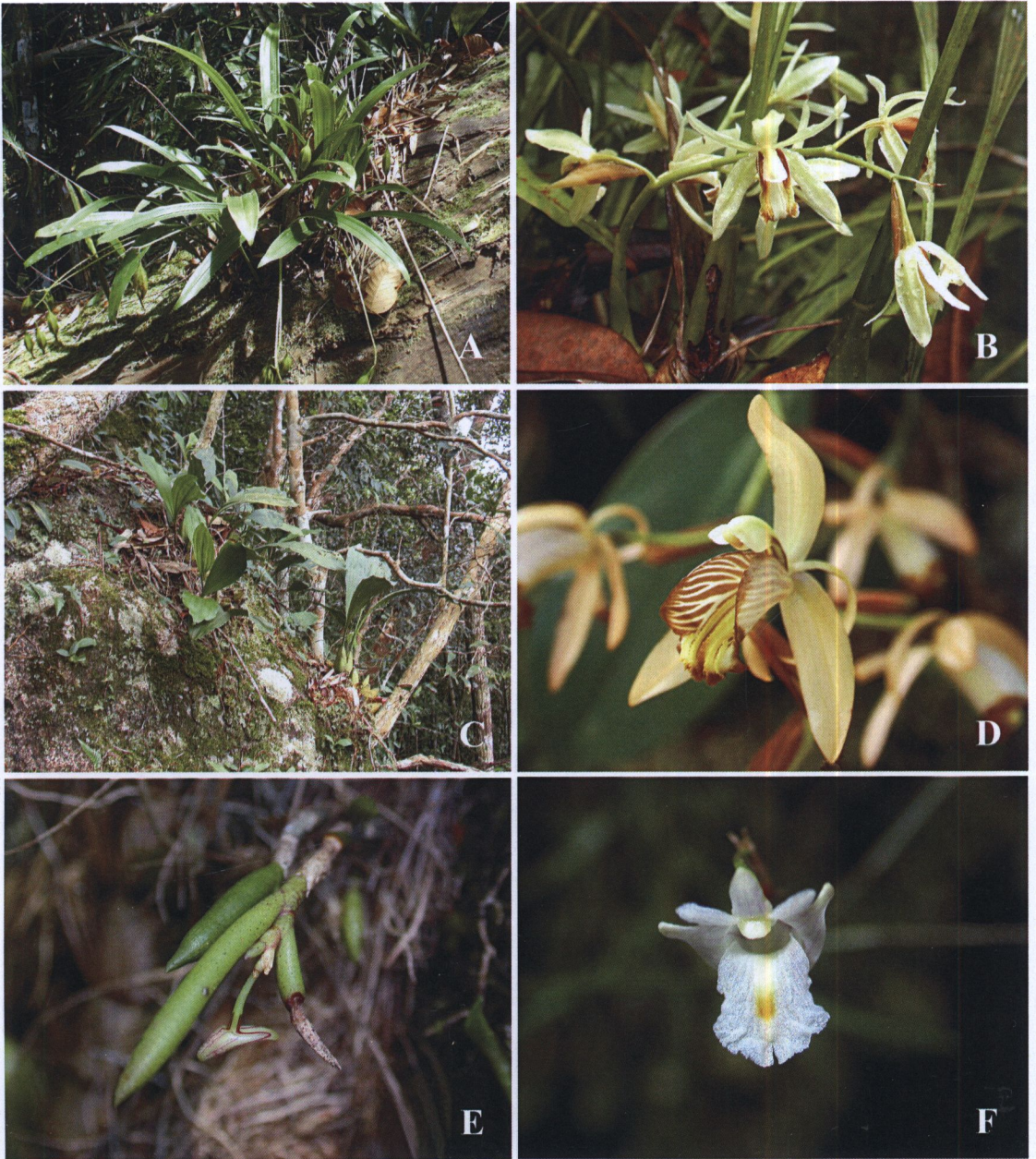
**Plate 47.** A-C. *Coelogyne cumingii* Lindl., A-B. Habit and habitat, with flowers (A), with fruits (B), C. Flower; D-G. *Coelogyne prasina* Ridl., D. Habit and habitat, E. Habit with fruit, F. Inflorescence and flowers, G. Flower.





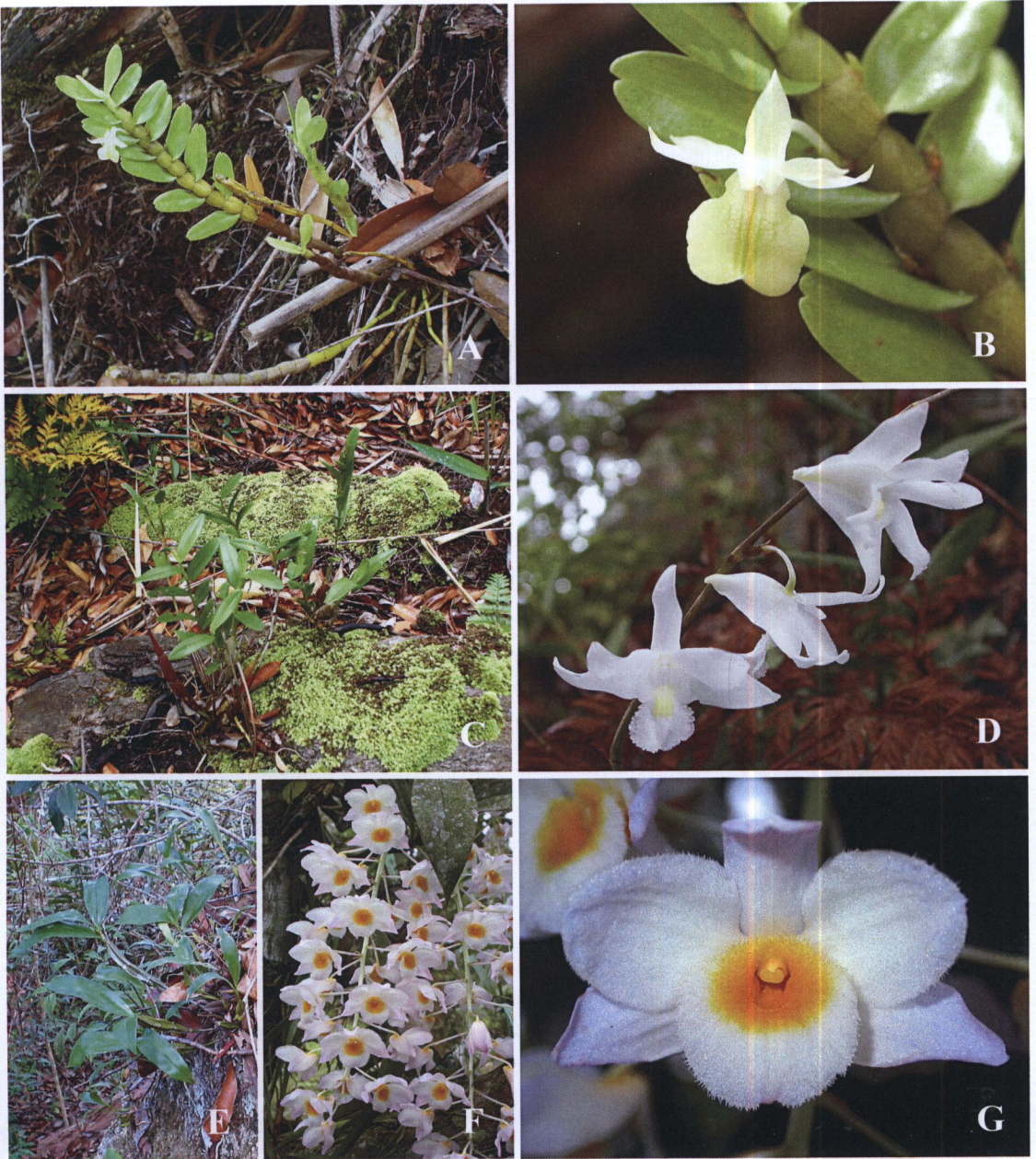
**Plate 48.** A-D. *Coelogyne rochussenii* de Vriese, A-B. Habit and habitat, C. Inflorescence, D. Flower; E-G. *Coelogyne testacea* Lindl., E-F. Habit and habitat, with flowers (E), with fruits (F), G. Flower.





**Plate 49.** A-B. *Coelogyne trinervis* Lindl., A. Habit and habitat, with fruits, B. Inflorescence and flowers; C-D. *Coelogyne velutina* de Vogel, C. Habit and habitat, D. Flower; E-F. *Dendrobium acerosum* Lindl., E. Habit, with flower bud, F. Flower.





**Plate 50.** A-B. *Dendrobium bifarium* Lindl., A. Habit and habitat, B. Flower; C-D. *Dendrobium crumenatum* Sw., C. Habit and habitat, D. Flowers; E-G. *Dendrobium farmeri* Paxton, E. Habit and habitat, F. Inflorescence, G. Flower.





**Plate 51.** A-B. *Dendrobium leonis* (Lindl.) Rchb.f., A. Habit and habitat, B. Flower; C-D. *Dendrobium metrium* Kraenzl., C. Habit and habitat, D. Flower; E-F. *Dendrobium pachyglossum* E.C. Parish & Rchb.f., E. Habit and habitat, F. Flower.





**Plate 52.** A-B. *Dendrobium sanguinolentum* Lindl., flower; C-D. *Dendrobium tortile* Lindl., C. Habit and habitat, D. Flower; E-F. *Dendrobium* sp., E. Habit and habitat, F. Flower.





**Plate 53.** A-C. *Dienia ophrydis* (J. Koenig) Ormerod & Seidenf., A-B. Habit and habitat, with flowers (A), with fruits (B), C. Flowers; D-G. *Dipodium pictum* (Lindl.) Rchb.f., D. Habit and habitat, E. Inflorescence, F. Flower, G. Fruit.





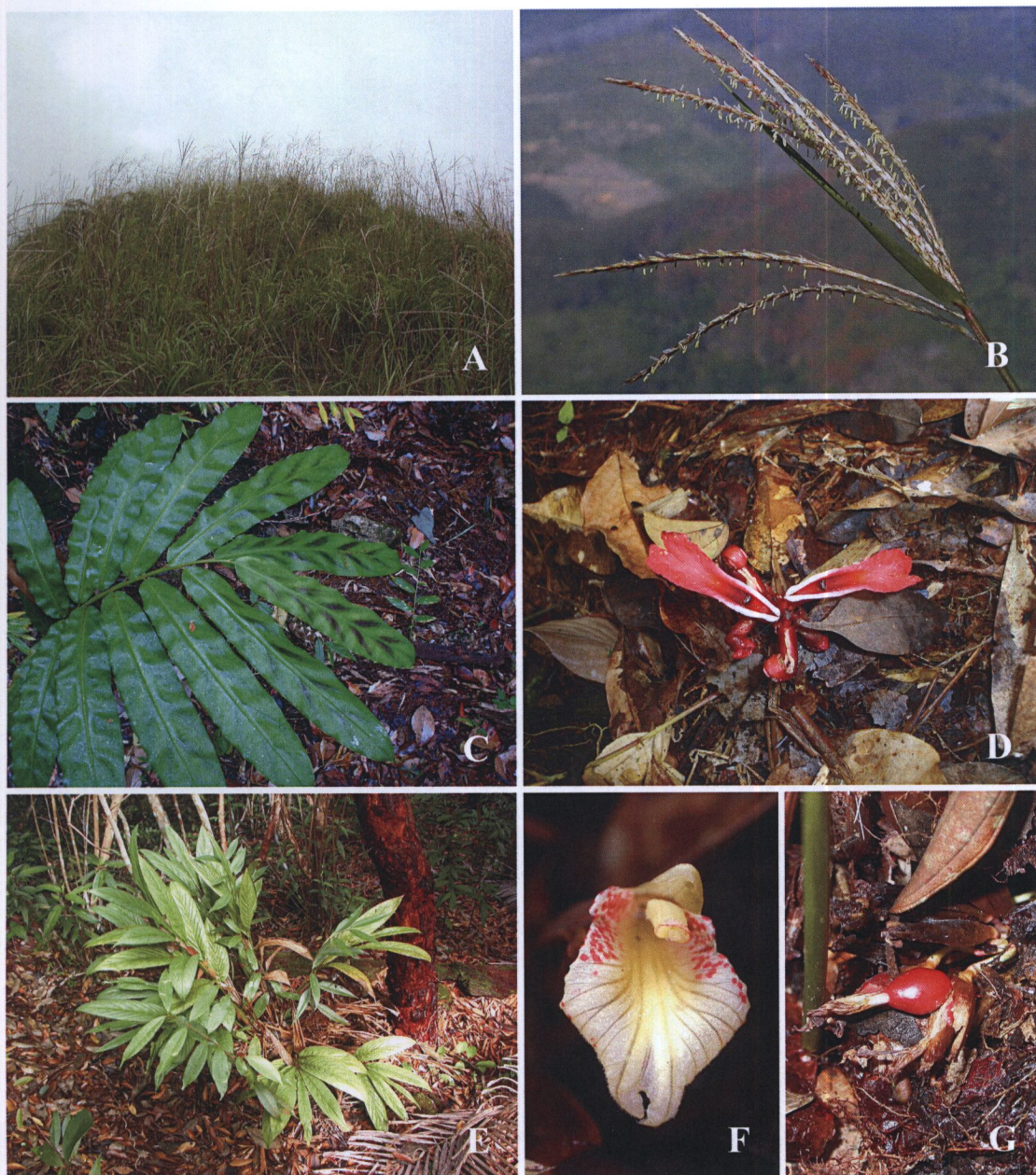
**Plate 54.** A-B. *Epigeneium geminatum* (Blume) Summerh., A. Habit and habitat, B. Flower; C-D. *Eria pulchella* Lindl., C. Habit and habitat, D. Inflorescences and flowers; E-F. *Pholidota articulata* Lindl., E. Habit and habitat, F. Flowers.





**Plate 55.** A-C. *Tainia penangiana* Hook.f., A. Habit and habitat, B. Inflorescences, C. Flower; D-E. *Thrixspermum calceolus* (Lindl.) Rchb.f., D. Habit and habitat, with flower buds, E. Inflorescence and flowers.





**Plate 56.** A-B. *Eulalia speciosa* Kuntze, A. Habit and habitat, B. Inflorescence; C-D. *Etlingera subterranea* (Holtum) R.M. Sm., C. Leafy shoot, D. Flowers; E-G. *Geostachys holttumii* K. Larsen, E. Habit and habitat, F. Flower, G. Fruits.





**Plate 57.** A-C. *Geostachys penangensis* Ridl., A. Habit and habitat, B. Flower, C. Fruits; D-G. *Globba pendula* Roxb., D. Habit and habitat, E. Inflorescence, F. Flower, G. Bulbils and fruits.

## **SCIENTIFIC NAME INDEX**



Scientific name	Page
<i>Acriopsis liliifolia</i> (J. Koenig) Ormerod	163
<i>Aeschynanthus radicans</i> Jack	111
<i>Alstonia rostrata</i> C.E.C. Fisch.	77
<i>Anneslea fragrans</i> Wall.	159
<i>Anodendron axillare</i> Merr.	78
<i>Archidendron contortum</i> (Mart.) I.C. Nielsen	108
<i>Argostemma pictum</i> Wall.	154
<i>Asplenium affine</i> Sw.	35
<i>Asplenium nidus</i> L. var. <i>nidus</i>	36
<i>Asplenium pellucidum</i> Lam.	37
<i>Austrobuxus nitidus</i> Miq.	106
<i>Begonia sinuata</i> Wall. ex Meisn. var. <i>sinuata</i>	96
<i>Begonia</i> sp.	98
<i>Bromheadia alticola</i> Ridl.	165
<i>Bromheadia finlaysoniana</i> (Lindl.) Miq.	166
<i>Bromheadia truncata</i> Seidenf.	168
<i>Bulbophyllum corolliferum</i> J.J. Sm.	170
<i>Bulbophyllum lilacinum</i> Ridl.	171
<i>Bulbophyllum medusae</i> (Lindl.) Rchb.f.	173
<i>Bulbophyllum purpurascens</i> Teijsm. & Binn.	174
<i>Bulbophyllum stenobulbon</i> E.C. Parish & Rchb.f.	176
<i>Callerya atropurpurea</i> (Wall.) Schot	109
<i>Cibotium barometz</i> J. Sm.	50
<i>Coelogyne cumingii</i> Lindl.	178
<i>Coelogyne prasina</i> Ridl.	180
<i>Coelogyne rochussenii</i> de Vriese	182
<i>Coelogyne testacea</i> Lindl.	183
<i>Coelogyne trinervis</i> Lindl.	185
<i>Coelogyne velutina</i> de Vogel	187
<i>Cratoxylum maingayi</i> Dyer	99
<i>Crepidomanes minutum</i> (Blume) K. Iwats.	55
<i>Dacrydium elatum</i> (Roxb.) Wall. ex Hook.	74
<i>Davallia denticulata</i> (Burm.f.) Mett. ex Kuhn	38
<i>Davallia heterophylla</i> Sm.	40

Scientific name	Page
<i>Davallia pectinata</i> Sm.	41
<i>Davallia repens</i> (L.f.) Kuhn	42
<i>Davallia solida</i> (G. Forst.) Sw.	44
<i>Davallia trichomanoides</i> Blume var. <i>lorrainii</i> (Hance) Holttum	46
<i>Dendrobium acerosum</i> Lindl.	189
<i>Dendrobium bifarium</i> Lindl.	190
<i>Dendrobium crumenatum</i> Sw.	192
<i>Dendrobium farmeri</i> Paxton	194
<i>Dendrobium leonis</i> (Lindl.) Rchb.f.	195
<i>Dendrobium metrium</i> Kraenzl.	197
<i>Dendrobium pachyglossum</i> E.C. Parish & Rchb.f.	198
<i>Dendrobium sanguinolentum</i> Lindl.	200
<i>Dendrobium tortile</i> Lindl.	201
<i>Dendrobium</i> sp.	203
<i>Dendrophthoe pentandra</i> (L.) Miq.	128
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	53
<i>Didymocarpus citrinus</i> Ridl.	113
<i>Didymocarpus corchorifolius</i> Wall ex A. DC.	115
<i>Didymocarpus cordatus</i> A. DC.	117
<i>Dienia ophrydis</i> (J. Koenig) Ormerod & Seidenf.	204
<i>Dipodium pictum</i> (Lindl.) Rchb.f.	206
<i>Dipteris conjugata</i> Reinw.	52
<i>Dischidia bengalensis</i> Colebr.	83
<i>Dischidia fruticulosa</i> Ridl.	85
<i>Drynaria rigidula</i> (Sw.) Bedd.	60
<i>Drynaria sparsisora</i> (Desv.) T. Moore	62
<i>Elaeocarpus pedunculatus</i> Wall. ex Mast.	101
<i>Epigeneium geminatum</i> (Blume) Summerh.	208
<i>Eria pulchella</i> Lindl.	209
<i>Etlingera subterranea</i> (Holttum) R.M. Sm.	218
<i>Eulalia speciosa</i> Kuntze	216
<i>Fagraea acuminatissima</i> Merr.	125
<i>Fagraea wallichiana</i> Benth.	126
<i>Ficus deltoidea</i> Jack var. <i>angustifolia</i> (Miq.) Corner	141

Scientific name	Page
<i>Ficus deltoidea</i> Jack var. <i>deltoidea</i>	140
<i>Ficus deltoidea</i> Jack var. <i>kunstleri</i> (King) Corner	142
<i>Ficus oleifolia</i> King subsp. <i>intermedia</i> (Corner) C.C. Berg	143
<i>Geostachys holttumii</i> K. Larsen	220
<i>Geostachys penangensis</i> Ridl.	222
<i>Globba pendula</i> Roxb.	224
<i>Gnetum gnemon</i> L. var. <i>tenerum</i> Markgr.	73
<i>Henckelia bombycina</i> (Ridl.) A. Weber	118
<i>Henckelia inaequalis</i> (Ridl.) A. Weber	120
<i>Hoya imperialis</i> Lindl.	86
<i>Hoya multiflora</i> Blume	88
<i>Hoya plicata</i> King & Gamble	90
<i>Hoya rigida</i> Kerr	92
<i>Hoya</i> sp.	94
<i>Huperzia phlegmaria</i> (L.) Rothm.	24
<i>Huperzia squarrosa</i> (G. Forst.) Trevis.	25
<i>Hymenophyllum serrulatum</i> (C. Presl) C. Chr.	56
<i>Lindsaea bouillodii</i> Christ	47
<i>Lycopodiella cernua</i> (L.) Pic. Serm.	26
<i>Melastoma malabathricum</i> L. subsp. <i>malabathricum</i>	130
<i>Oleandra pistillaris</i> (Sw.) C. Chr.	58
<i>Oleandra undulata</i> (Willd.) Ching	59
<i>Oxyspora umbellulata</i> (Hook.f. ex Triana) J.F. Maxwell	132
<i>Pachycentria glauca</i> Triana subsp. <i>maingayi</i> (C.B. Clarke) Clausing	133
<i>Pachycentria hanseniana</i> Clausing	134
<i>Pachycentria pulverulenta</i> (Jack) Clausing	136
<i>Paraboea elegans</i> (Ridl.) B.L. Burt	121
<i>Pholidota articulata</i> Lindl.	211
<i>Pteridium aquilinum</i> (L.) Kuhn	48
<i>Pteris dalhousiae</i> Hook.	67
<i>Pyramidanthe prismatica</i> (Hook.f. & Thomson) J. Sinclair	75
<i>Pyrrosia adnascens</i> (Sw.) Ching	63
<i>Rhodamnia cinerea</i> Jack var. <i>cinerea</i>	145
<i>Rhododendron longiflorum</i> Lindl.	103

Scientific name	Page
<i>Rhodoleia championii</i> Hook.f.	123
<i>Schefflera cephalotes</i> (C.B. Clarke) Harms	82
<i>Schima wallichii</i> (DC.) Korth.	161
<i>Schizaea dichotoma</i> (L.) Sm.	69
<i>Schizaea digitata</i> (L.) Sw.	70
<i>Selaginella intermedia</i> (Blume) Spring	27
<i>Selaginella siamensis</i> Hieron.	28
<i>Selaginella strigosa</i> Bedd.	30
<i>Selaginella wallichii</i> (Hook. & Grev.) Spring	31
<i>Selliguea heterocarpa</i> (Blume) Blume	65
<i>Selliguea stenophylla</i> (Blume) Parris	66
<i>Sonerila griffithii</i> C.B. Clarke	137
<i>Symplocos adenophylla</i> Wall. ex G. Don	157
<i>Syngramma minima</i> Holttum	32
<i>Syzygium gratum</i> (Wight) S.N. Mitra var. <i>gratum</i>	146
<i>Syzygium helferi</i> (Duthie) Chantar. & J. Parn.	148
<i>Syzygium samarangense</i> (Blume) Merr. & L.M. Perry var. <i>parviflorum</i> (Craib) Chantar. & J. Parn.	149
<i>Syzygium syzygioides</i> (Miq.) Merr. & L.M. Perry	150
<i>Syzygium</i> sp. 1	152
<i>Syzygium</i> sp. 2	153
<i>Taenitis blechnoides</i> (Willd.) Sw.	33
<i>Tainia penangiana</i> Hook.f.	213
<i>Tarenna longifolia</i> (G. Don) Ridl.	156
<i>Thrixspermum calceolus</i> (Lindl.) Rchb.f.	215
<i>Vaccinium bancanum</i> Miq.	104
<i>Vittaria ensiformis</i> Sw.	71
<i>Vittaria scolopendrina</i> (Bory) Schkuhr ex Thwaites	72
<i>Willughbeia coriacea</i> Wall.	79
<i>Willughbeia tenuiflora</i> Dyer ex Hook.f.	81

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