

MANGROVE GUIDEBOOK FOR SOUTHEAST ASIA

The designations and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its frontiers or boundaries. The opinions expressed in this publication are those of the authors alone and do not imply any opinion whatsoever on the part of FAO.

Authored by: Wim Giesen, Stephan Wulffraat, Max Zieren and Liesbeth Scholten

ISBN: 974-7946-85-8

© FAO and Wetlands International, 2006

Printed by: Dharmasarn Co., Ltd.

First print: July 2007

For copies write to:

Forest Resources Officer
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
Phra Atit Road, Bangkok 10200
Thailand
E-mail: Masakazu.Kashio@fao.org

FOREWORDS

Large extents of the coastlines of Southeast Asian countries were once covered by thick mangrove forests. In the past few decades, however, these mangrove forests have been largely degraded and destroyed during the process of development. The negative environmental and socio-economic impacts on mangrove ecosystems have led many government and non-government agencies, together with civil societies, to launch mangrove conservation and rehabilitation programmes, especially during the 1990s. In the course of such activities, programme staff have faced continual difficulties in identifying plant species growing in the field. Despite a wide availability of mangrove guidebooks in Southeast Asia, none of these sufficiently cover species that, though often associated with mangroves, are not confined to this habitat. These species include not only grasses, herbs and ferns, but also trees, shrubs and climbers.

Experts working for Wetlands International in Indonesia realized this constraint and commenced preparation of a mangrove guidebook with this extended scope in mind. By 2002, information had been compiled for 204 species. At the beginning of 2003, Wetlands International proposed a partnership with FAO to produce a mangrove guidebook for the whole of Southeast Asia. Thus, a joint effort began. Two and a half years later, a 534 page manuscript with many illustrations had been prepared with the aid of reviews by national mangrove experts. Further editorial work continued by the authors from Wetlands International and FAO forestry officers.

After nearly three years of hard work, this mangrove guidebook has been completed, and it gives me great pleasure to introduce this unique publication to those who study, manage, conserve and utilize mangrove forests. This book will contribute to guiding more people, especially the younger generation, to learn about mangrove forests in Southeast Asia. Thus, it supports further advancement of mangrove conservation and rehabilitation programmes.

We should all acknowledge with thanks the work done by the main authors headed by Mr Wim Giesen, mangrove botanist for Wetlands International, Mr Stephan Wulffraat, forester, now with WWF Indonesia, two FAO foresters, Dr Mette Loyche Wilkie, Senior Forestry Officer, FAO, Rome, Italy, and Mr Masakazu Kashio, Forest Resources Officer, FAO Regional Office for Asia and the Pacific, Bangkok, Thailand, and all of the reviewers in many countries for their valuable contributions. Without their painstaking efforts, this publication would not have seen the light of day.

We would also like to express our appreciation to the “Forestry programme for early rehabilitation of Asian tsunami-affected countries (OSRO/GLO/502/FIN)”, which is funded by the Government of Finland, for providing financial support to print the first 1 000 copies of this guidebook.

This publication is a useful tool for mangrove forest managers, foresters, coastal resource managers, scientists, students and interested lay persons, not only in Southeast Asian countries, but also in many other countries where mangroves grow.



He Changchui
Assistant Director-General and Regional Representative for
Asia and the Pacific
Food and Agriculture Organization of the United Nations


It is with great pleasure that I am writing the foreword for this guide to the mangroves of Southeast Asia. Its development started in 1991 when a young Dutch student, Stephan Wulffraat, entered my office in Bogor (Asian Wetland Bureau – Indonesia), inquiring about possibilities for an internship.

I had worked extensively along the coasts and in the mangrove swamps of West Malaysia and Sumatra and often found it tedious to identify various plant species associated with these magnificent areas; not so much the true mangroves – which comprise relatively few species – but the many species in the backswamps, the slightly elevated areas and the sandy ridges associated with this brackish water habitat. For these, no concise field guide existed. As a Dutch researcher I was used to the fantastic field guides that can be obtained in almost any bookshop in Europe. For students in Southeast Asia it is much more difficult to get acquainted with the tremendous biodiversity around them. There are many more species but hardly any field guides. They have to scramble through many incomplete inventories, herbaria and obscure scientific papers. I believe that this dearth of access to basic knowledge is one of the most significant constraints for both the public and young scientists in Southeast Asia to develop a true appreciation of their biologically rich environment. I believe that this also sustains the limited understanding and awareness of the ecology of mangroves and their incredible productivity and usefulness for people.

I suggested Stephan to start the development of a field guide to the mangroves and associated plants species of Indonesia. I did not foresee that this would become a long process, hampered by lack of funding but carried on through the enthusiasm and interest of its consecutive authors and the drawing talents of Wahyu Gumelar, Triana, Iskak Syamsudin and Tilla Visser. The most significant driving force of it all was Wim Giesen, who was involved from the start and in the end even took the step to expand the focus to Southeast Asia. I would like to thank FAO for their support in the development and publication of this guidebook.

At last, here it is. I am extremely pleased with the end result. I call on students and nature lovers of Southeast Asia to go out there, study and appreciate why and how mangroves should be managed and protected, and to become knowledgeable advocates for their plight. Too many valuable areas have been lost.

It is time to turn the tide.



Marcel Silvius

Senior Programme Manager
Wetlands International
Wageningen, The Netherlands

AUTHORS' PREFACE

The aim of this book is to provide those involved with the management and conservation of mangroves in Southeast Asia with a guidebook for identifying mangrove plants. At the same time, the book aims to provide a brief introduction to mangroves in general and Southeast Asia's mangroves in particular. This would then also be of use to students and interested lay persons. Accordingly, the book has been split into two parts: part one deals with the mangrove habitat in Southeast Asia, while part two focuses on the mangrove plants themselves. The core of the book is formed by the black-and-white drawings of mangrove plants, skilfully drawn by Wahyu Gumelar, Tilla Visser, Iskak Syamsudin and Triana at the Wetlands International – Indonesia Programme office in Bogor, West Java.

Various guidebooks exist for mangroves of Southeast Asia, but all have a limited geographic scope covering only one country: Malaysia (Watson, 1928), Papua New Guinea (Percival & Womersley, 1975), Indonesia (Kitamura *et al.*, 1997; Noor *et al.*, 1999) and the Philippines (Aragones *et al.*, 1998). An even more severe limitation of these guidebooks is that they focus almost exclusively on so-called 'true mangrove species' – i. e. species that occur in the mangrove habitat only and are not found in other habitats. While this is an approach that is common world-wide, the disadvantage is that many plant species found in the mangrove habitat are not dealt with, which can be most frustrating. Another disadvantage of most existing guidebooks is that they tend to ignore species other than trees and shrubs. Epiphytes and lianas, for example, are often ignored entirely even though some may only be found in mangroves.

Up to now, identifying all plants found in Southeast Asian mangroves was a daunting task, as comprehensive taxonomic works (or 'floras') of the region are bulky (Flora of Java, Tree Flora of Malaya), or both bulky and far from complete (Flora Malesiana, Flora of Thailand). The region is endowed with the world's largest expanse of mangrove that at the same time is also the world's most biologically diverse and varied in structure. This unparalleled natural heritage gives the region a particular responsibility, while providing a unique opportunity for all those wanting to study and enjoy this wondrous habitat.

This book represents the first attempt at covering all mangrove plant species in Southeast Asia, and is likely to be incomplete. The authors would therefore warmly welcome additional information, especially regarding geographic coverage and additional species not covered, so that this can be updated in future editions. Please forward your comments and suggestions to the lead author, Wim Giesen, at: wim.giesen@mottmac.nl

ACKNOWLEDGEMENTS

We would like to thank the many external experts who kindly gave their advice and assistance:

Taxonomists & herbaria

The late Dr A.J.G.J. ('Doc') Kostermans (Bogor Herbarium), Dra. J.J. Afriastini (for her kind help identifying specimens in the Bogor Herbarium), Ms Agustina Arobaya checked our orchid list for occurrence in Indonesian Papua, Dr Max van Balgooy (Rijksherbarium Leiden) and Dr E. Hennipman (Institute of Systematic Botany, University of Utrecht, The Netherlands). We thank the library staff of Bogor Herbarium for their kind help in locating (often very obscure) literature. Many thanks to the Royal Botanic Garden, Kew, especially Jim Kay and Trish Long for kindly providing illustrations of some of the most obscure and difficult to locate species, John Dransfield for providing contacts, and Jovita Yesilyurt for the digital image of *Schefflera lanceolata* – the last and most elusive. Lastly, lots of thanks also to Bogor Herbarium and Rijksherbarium Leiden for providing access to the herbarium collections and allowing us to make sketches, which made it possible to complete the illustrations that greatly enhance the usefulness of this book.

Other specialists

Jim Berdach, who provided us with information on protected mangroves and total mangrove area in the Philippines; Sim Cheng Hua, Sundari Ramakrishna and Murugadas Loganathan of Wetlands International Malaysia Programme for information about Malaysian mangroves; Tony Sebastian of Aonyx Environmental (Kuching) for information about mangroves of Brunei; Mam Kosal of Wetlands International Mekong Programme, Melissa Marschke of IDRC and Alvin Lopez of IUCN's Mekong Wetlands Programme for information about mangroves of Cambodia; and last-but-not-least Mette Loyche-Wilkie of FAO for information about the mangroves of Papua New Guinea and Myanmar.

Production team

We would like to especially thank the staff of Wetlands International – Indonesia Programme who assisted with the production of this volume in many ways, but especially with the production of the excellent line drawings. We would like to thank Nyoman Suryadiputra, Yus Rusila Noor, Wahyu Gumelar, Tilla Visser, Triana, Iskak Syamsudin, Rosie Ounsted, Endah Nirarita, Cecilia Luttrell, Penina Mampioper and George Sitania.

Thanks also goes to Taej Mundkur of Wetlands International Asia Programme, Sundari Ramakrishna of Wetlands International Malaysia Programme, and Marcel Silvius of Wetland International's headquarters in the Netherlands, for their enduring support. A lot of thanks also goes to Paul Giesen for the grim task of sorting out the two very long indexes, and for assisting with scanning of the literature. Special thanks go to Masakazu Kashio, FAO, Bangkok, for his final reviews, comments, editing and formatting, and arrangement for printing.

We acknowledge with great thanks the financial support of the FAO "Forestry programme for early rehabilitation of Asian tsunami-affected countries (OSRO/GLO/502/FIN)", which is funded by the Government of Finland, to print this guidebook.

Lastly, we would like to thank UNEP-WCMC for allowing us to reproduce the mangrove map of Southeast Asia, and the International Society for Mangrove Ecosystems (ISME, based in Okinawa, Japan) for their financial contribution towards the production of the Indonesian precursor of this guidebook.

Wim Giesen

Senior consultant with ARCADIS Euroconsult in the Netherlands

wim.giesen@mottmac.nl

&

Stephan Wulffraat

Senior forester/biologist for WWF, Tarakan, East Kalimantan, Indonesia

nebulosa@indo.net.id

Contents

FOREWORDS	iii
-----------	-----

AUTHORS' PREFACE	vi
------------------	----

ACKNOWLEDGEMENTS	vii
------------------	-----

PART ONE: INTRODUCTION TO THE MANGROVES IN SOUTHEAST ASIA

1 INTRODUCTION	1
1.1 What are mangroves ?	1
1.2 Southeast Asia's mangroves: the world's largest and best-developed	2
1.3 Scope of this guidebook	3
2 MANGROVE FLORA	5
2.1 Flora and diversity	5
2.2 Endemic and rare/uncommon plant species	9
3 THE MANGROVE HABITAT IN SOUTHEAST ASIA	11
3.1 Introduction to the mangrove habitat	11
3.2 Physical conditions	12
3.3 Mangrove vegetation types	16
3.4 Mangrove fauna	21
4 BENEFITS DERIVED FROM MANGROVES	29
4.1 Mangrove uses	29
4.2 Mangrove functions	34
4.3 Economic value of mangroves	36
5 THE STATE OF SOUTHEAST ASIAN MANGROVES	39
5.1 Past and present area	39
5.2 Causes of decline	44
5.3 Mangrove conversion for aquaculture	47
5.4 Mangrove restoration	51
5.5 Mangroves and sea level rise	56
6 IMPORTANT AND PROTECTED MANGROVE AREAS IN SOUTHEAST ASIA	57
6.1 Mangroves in the Protected Area System	57
6.2 Important mangrove areas	58
6.2.1 Brunei Darussalam	58
6.2.2 Cambodia	58
6.2.3 Indonesia	59
6.2.4 Malaysia	63
6.2.5 Myanmar	66

6.2.6	Papua New Guinea	67
6.2.7	Philippines	68
6.2.8	Singapore	69
6.2.9	Thailand	69
6.2.10	Timor-Leste	71
6.2.11	Viet Nam	71
7	MANGROVE STUDIES: POINTS FOR BEGINNERS	73
7.1	Important references	73
7.2	Field trip basics	73
7.3	Mangrove plant specimens	74
7.4	Flora studies	76
7.5	Fauna studies	77
	REFERENCES	79
Annex 1	Table of Southeast Asian mangrove species	97
Annex 2	Map of Southeast Asian mangrove areas	104
Annex 3	Index of scientific names	106
Annex 4	Index of local plant names	143

PART TWO: THE MANGROVE PLANT SPECIES

Glossary	187
Keys	197
Descriptions	221
Group A: Ferns	221
Group B: Grasses & grass-like plants	271
Group C: Other ground-dwelling herbs	327
Group D: Epiphytes	375
Group E: Vines & climbers	433
Group F: Palms, cycads & pandans	491
Group G: Trees & shrubs	511

List of Figures:

Figure 1	Mangrove areas in Southeast Asia	2
Figure 2	Species group/lifeform diversity	5
Figure 3	True mangrove species in Southeast Asia	8
Figure 4A	Example of mangrove zonation in Cilacap, south coast of Java, Indonesia	13
Figure 4B	Schematic cross-section of a small mangrove island near Kimbe, West New Britain province, Papua New Guinea	13
Figure 4C	Schematic cross-section of a coastal area on Bintan Island, Riau province, Indonesia	13
Figure 5	Mangrove communities in Viet Nam: relationship with inundation and salinity	18

Figure 6	Food web and use of mangroves in Indonesia	35
Figure 7	Mangrove conversion and fishpond area in the Philippines	48
Figure 8	Area of brackish water fishpond (tambak) in Indonesia, 1990-2001	50

List of Tables:

Table 1	Species group diversity	6
Table 2	True mangrove species in Southeast Asia	7
Table 3	Mangrove (associate) species endemic to Southeast Asia	9
Table 4	Mangrove zones and species in Southeast Asian countries	22
Table 5	Quantitative list of plant products in Southeast Asia	30
Table 6	Mangrove products	33
Table 7	Economic value of various mangrove products	36
Table 8	Changes in mangrove area 1980-2000	43
Table 9	Brackish water fishponds in Southeast Asia	49
Table 10	Mangroves in Protected Areas	57

CHAPTER

1 INTRODUCTION

1.1

WHAT ARE MANGROVES ?

The term 'mangrove' is used to define both the plants that occur in tidal forests, and to describe the community itself (Tomlinson, 1986; Wightman, 1989). In this guidebook, 'mangrove' is generally used to refer to the habitat, and the meaning is usually obvious from the context. Elsewhere, the term 'mangal' is used by some authors (e.g. MacNae, 1968; Chapman, 1976, 1977; Ogino & Chihara, 1988) in reference to mangrove vegetation, but its usage has not met with much support apart from in the Americas, and 'mangal' is therefore not used in this publication.

Mangroves can be broadly defined as woody vegetation types occurring in marine and brackish environments. They are generally restricted to the tidal zone, which is the strip of coast starting from the lowest low water level up to the highest high water level (spring tide). With a few exceptions, they occur only in the tropics and sub-tropics, and their closest equivalent in temperate zones are herbaceous salt marshes. In this publication the term 'mangrove' is used in its broadest sense, i.e. also including the *Nypa* formation and the margins of mangroves. These margins are inundated a few times a year only, mainly during spring tides or due to storm surges, and frequently include species from adjacent vegetation types. The latter may include species from the beach '*Barringtonia* formations', other types of coastal forests, and from the sand dune '*Pes-capre* formation' (van Steenis, 1958; MacNae, 1968; Tomlinson, 1986).

Although mangroves are not as poorly known as many other tropical and subtropical forest habitats, many myths remain. In a tiny 2-page paper on *Mangrove mythology* Jane Snedaker (1997, quoted in Lewis, 2001) proposes a true or false test with five questions:

- a. Mangroves require salt water to develop and grow.
- b. Mangroves extend shorelines.
- c. Mangroves build up land.
- d. The red mangrove (*Rhizophora* species) are the most valuable mangroves.
- e. Some mangrove forest types are more important than others.

In fact, all five are common myths and all are false! Misconceptions are common and need to be addressed in order to fully understand and appreciate these unique ecosystems.

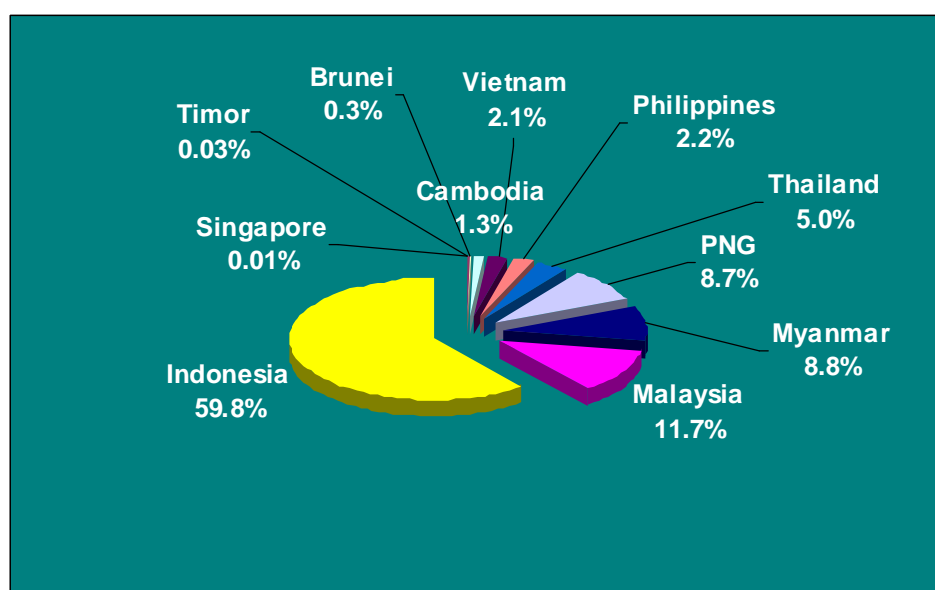
1.2

SOUTHEAST ASIA'S MANGROVES: THE WORLD'S LARGEST AND BEST-DEVELOPED

Estimates of former worldwide extension of mangroves vary from over 15 million hectares (Lanly, in Ogino & Chihara, 1988) to 16.2 (Thurairaja, 1994) and 16.67 (Saenger *et al.*, 1983; Aksornkoae, 1993), and even as much as 19.9 million hectares (based on Groombridge, 1992). From a global perspective, Southeast Asia is well endowed as it supports the world's largest area of mangroves, originally extending over 6.8 million hectares and representing 34-42 percent of the world's total. Mangroves occur throughout Southeast Asia, from the Irrawaddy delta in Myanmar in the northwest, through the more than 17 000 scattered islands of the Indonesian and Philippine archipelagos to Papua New Guinea in the East, spanning a distance of more than 6 000 kilometres from east to west and 3 500 kilometres from north to south.

The largest areas of mangrove in Southeast Asia are found in Indonesia (almost 60 percent of Southeast Asia's total), Malaysia (11.7%), Myanmar (8.8%), Papua New Guinea (8.7%) and Thailand (5.0%; Figure 1). Detailed figures and reports on changes in mangrove area over the past decades are provided in Chapter 5.

FIGURE 1
Mangrove areas in
Southeast Asia



Southeast Asia's mangroves are the best developed and probably the most species-diverse in the world (Giesen & Wulffraat, 1998; chapter 2). Fifty-two Southeast Asian species are found in the mangrove habitat only and nowhere else; this group of so-called 'true mangrove species' includes 42 trees and shrubs (Annex 1). Saenger *et al.* (1983) record a world-wide total of 60 plant species exclusive to the mangrove habitat, and although the lists are not entirely identical, it is apparent that Southeast Asia has a very significant share of 'true' mangrove species.

1.3 SCOPE OF THIS GUIDEBOOK

This manual is intended to be a guide to the mangrove plants of Southeast Asia, i.e. *all* higher plants occurring in mangroves, and not only those species exclusive to this habitat. Southeast Asia was chosen as geographic scope, as this region has proven to be the world's richest in terms of biological diversity (Chapman, 1976a,b; Tomlinson, 1986; Giesen & Wulffraat, 1998). Covered – from west to east – are Myanmar, Thailand, Cambodia, Viet Nam, Malaysia, Singapore, Brunei, the Philippines, Indonesia, Timor-Leste and Papua New Guinea. The criterion for inclusion of a particular plant species in this guidebook has been that it must either be recorded as occurring in the mangrove habitat by the taxonomic reference used, or there must be at least two reliable non-taxonomic records of this species occurring in the mangrove habitat. Hybrid species are mentioned under the description of the parent species and are not treated separately.

In all, 268 species are covered (Annex 1), but more may be recognised in the future as more studies are carried out and as more taxonomic revisions become available. In terms of taxonomy, scientific names as revised by the Flora Malesiana have generally been adhered to, except where they have been superseded by Tomlinson (1986), Flora of Thailand, or revisions by the Missouri Botanical Gardens tropical botany database¹.

It is not surprising to see lists of species that include the same species recorded under various names, or incorrectly spelled names. Partly, this confusion is because of the multitude of synonyms used in taxonomic literature – some species with more than 50 synonyms – especially common but highly variable species are often endowed with many different names. To help sort out this confusion, a separate index of scientific names has been appended to guide the reader to the correct name (Annex 2).

A separate index of local names is also provided (Annex 3), but it may be noted that this is still far from complete as local names are often not recorded in taxonomic (or indeed other) literature. The authors would be grateful if readers could assist with updating this list of local names – preferably by emailing the first author.

Part one of this guidebook provides an introduction to mangroves in general, and to Southeast Asian mangroves in particular. Chapter 1 provides definitions and places Southeast Asia's mangroves in a global context, while Chapter 2 gives an account of the mangrove flora. Chapter 3 describes mangrove habitats in Southeast Asia, including information on soils, vegetation types and fauna.

¹ www.mobot.org

Chapter 4 explains about the benefits derived from mangroves, while Chapter 5 focuses on the current state of mangroves in Southeast Asia. Chapters 6 and 7 are provided for those wanting to engage in field work: six informs us where the most important areas are, while seven explains some of the basic techniques for studying mangroves.

Part two is the heart of the publication, providing the reader with keys for identification of mangrove plants, plus a 1-page data sheet and a line drawing of all mangrove plant species. Where possible, the use of specialist terms has been avoided, and those that have been used are clarified in a glossary of explanatory terms and illustrations. The mangrove plants have been ordered into seven easily recognised groups (mainly lifeforms), namely i) ferns, ii) grasses and grass-like herbs, iii) (other) ground herbs, iv) epiphytes, v) climbers, vi) palms and palm-like plants, and vii) trees and shrubs. Seven identification keys have been developed, one for each of these groups. It must be noted that some variable species can belong to more than one group – for example, *Hypserpa polyandra* (Menispermaceae) can form a shrub, but usually occurs as a large woody climber – in this case the predominant form prevails. Note that lifeforms are also listed in Annex 1.

Appended is a map showing the distribution of mangroves in Southeast Asia, kindly reproduced under licence from UNEP-WCMC (see Annex 2). This map gives an indication of the location of the most important mangrove sites in Southeast Asia. For more detailed maps, please refer to their website².

² http://www.unep-wcmc.org/index.html?http://www.unep-wcmc.org/forest/global_map.htm~main

CHAPTER

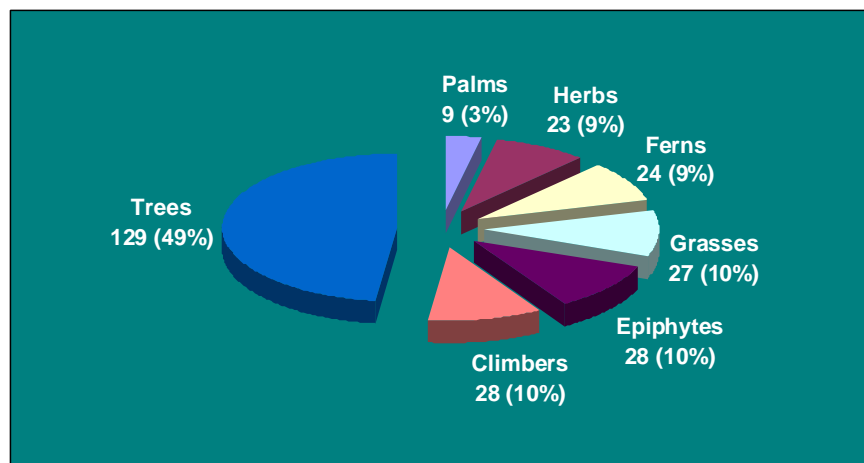
2 MANGROVE FLORA

2.1

FLORA AND DIVERSITY

Southeast Asia's mangroves are the best developed and most species-diverse in the world (Giesen & Wulffraat, 1998). A total of 268 plant species have been recorded in Southeast Asian mangrove vegetation, including 129 trees and shrubs, 50 terrestrial herbs (including 27 grasses and grass-like plants), 28 climbers, 28 epiphytes, 24 ferns, seven palms, one pandan and one cycad (Annex 1; Figure 2). Of these 268 species, 52 are found in the mangrove habitat only, and this group of so-called 'true mangrove species' includes 42 trees and shrubs (Annex 1).

FIGURE 2
Species group/lifeform diversity



Note that 'trees' include shrubs; 'palms' include palm-like pandans and cycads; 'herbs' are non-grass-like terrestrial herbs; 'grasses' include grass-like sedges and bulrushes; and epiphytes do not include epiphytic ferns.

As mentioned in chapter one, Saenger *et al.* (1983) record a world-wide total of 60 plant species exclusive to the mangrove habitat, and although the lists are not entirely identical, it is apparent that Southeast Asia has a very significant share of 'true' mangrove species. The northern Indian Ocean and the north-western Pacific region (stretching from the Red Sea to Japan and Indonesia) harbours the world's most diverse mangroves. Indeed, these two regions respectively harbour 44 and 38 of the 60 'true' mangrove species listed by Saenger *et al.* (1983), while the other four regions harbour only seven (western America/eastern Pacific, eastern America/Caribbean,

western Africa) to nine (eastern Africa) true mangrove species³. In terms of plants, Southeast Asia's biodiversity ranks highest in the northern Indian Ocean/northwestern Pacific region, as is evident in Table 1.

TABLE 1
Species group diversity

	Southeast Asia (this publication)	NE Indian Ocean & West Pacific (Saenger <i>et al.</i> , 1983)	Australia & SW Pacific (Saenger <i>et al.</i> , 1983)
Ferns, cycads, bryophytes	25 *	35	5
Gymnosperms	1	0	0
Monocotyledons	55	73	42
Dicotyledons	187	110	80
totals	268	218	127

* Does not include mosses (Bryophytes)

The largest plant families recorded in Southeast Asian mangroves are the:

- Leguminosae (Fabaceae) or legumes (22 species),
- Cyperaceae or sedges (17 species),
- Rhizophoraceae – usually regarded as *the* family of mangrove trees, many with stilt roots and other adaptations (12 species), although non-mangrove species also exist (e.g. the Southeast Asian *Carallia brachiata*),
- Orchidaceae or orchids (11 species),
- Asclepiadaceae or Milk Weed family – in the mangrove habitat consisting mainly of climbers and epiphytes, all with characteristic white latex (10 species),
- Polypodiaceae or Polypody fern family – one of the main fern families world-wide (10 species),
- Poaceae or true grasses (9 species),
- Arecaceae or palms (7 species),
- Rubiaceae – the coffee family; in the mangrove habitat consisting mainly of trees and shrubs (7 species),
- Combretaceae or Terminalia family (6 species),
- Euphorbiaceae or Spurge family, with many species containing a toxic white latex (6 species),
- Loranthaceae or Mistletoe family, consisting entirely of parasitic epiphytes (6 species),
- Avicenniaceae, another family of true mangrove trees, characterised by pneumatophores, i.e. roots that emerge, peg-like, from the mangrove soil (5 species), and
- Sonneratiaceae, another family consisting predominantly of mangrove tree species (5 species).

Some of these most common families abound in species with a very wide geographic range (e.g. Cyperaceae and Poaceae) and consist largely of ubiquitous weed species.

³ Saenger *et al.* (1983)'s list of 'true mangroves' (60 worldwide) is not the same as our number of 'true mangroves' (52 in Southeast Asia). The reason for this difference is that there are 11 species in Southeast Asia that are exclusive to mangroves (and therefore 'true mangrove' species), but are not recorded in Saenger's list.

Table 2 gives the distribution of all ‘true’ mangrove species (i.e. species found in the mangrove habitat only) in Southeast Asia. At least 48 of the 52 species listed occur in Indonesia, which is the more biodiverse of the Southeast Asian countries, followed in this respect by Malaysia, with 42 species. This supports the claim by Giesen and Wulffraat (1998) that Indonesia’s mangroves are the most biodiverse in the world. Least diverse are Timor-Leste and Brunei Dar es Salaam (Figure 3), which is not surprising given the relatively small size of their territories.

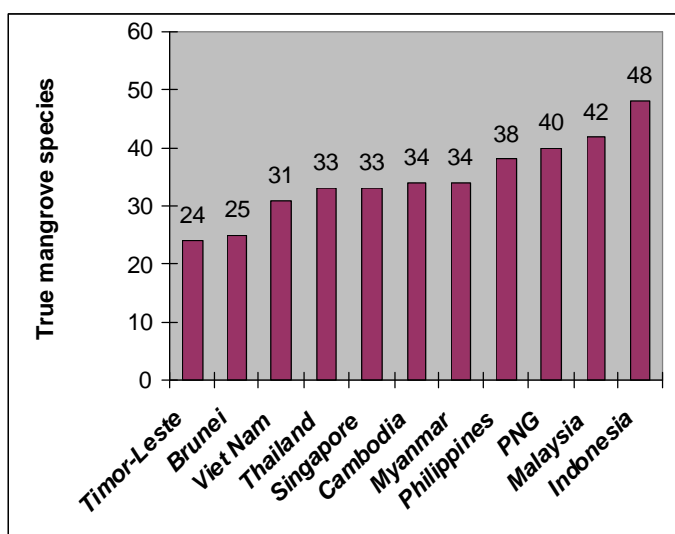
This diversity appears to not only hold for angiosperms, but seems to be true for other (plant) taxons. Tanaka and Chihara (1988), for instance, in their study of macroalgae in eastern Indonesian mangroves, state that “It may be concluded that the Indonesian mangrove area is one of the most important distributional centres of macroalgae associated with mangroves in the world.” Other interesting accounts of mangrove-associated algae and their diversity in the Southeast Asian region are given by Johnson (1979) and Chihara & Tanaka (1988).

TABLE 2
True mangrove species in
Southeast Asia
(These species occur in the
mangrove habitat only)

	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
1 <i>Acanthus ebracteatus</i>	+	+	+	+	+	+	+	+	+		+
2 <i>Acanthus ilicifolius</i>	+	+	+	+	+	+	+	+	+	+	+
3 <i>Acanthus volubilis</i>		+	+	+	+	+		+	+		
4 <i>Acrostichum aureum</i>	+	+	+	+	+	+	+	+	+	+	+
5 <i>Acrostichum speciosum</i>	+	+	+	+	+	+	+	+	+	+	+
6 <i>Aegialitis annulata</i>			+			+				+	
7 <i>Aegialitis rotundifolia</i>		+			+				+		
8 <i>Aegiceras corniculatum</i>	+	+	+	+	+	+	+	+	+	+	+
9 <i>Aegiceras floridum</i>		+	+	+		+	+				+
10 <i>Amyema anisomeres</i>			+								
11 <i>Amyema gravis</i>			+	+							
12 <i>Amyema mackayense</i>			+								
13 <i>Avicennia alba</i>	+	+	+	+	+	+	+	+	+		+
14 <i>Avicennia eucalyptifolia</i>			+			+	+				
15 <i>Avicennia lanata</i>			+	+		+	+	+			+
16 <i>Avicennia marina</i>	+	+	+	+	+	+	+	+	+	+	+
17 <i>Avicennia officinalis</i>		+	+	+	+	+	+	+	+	+	+
18 <i>Brownlowia argentata</i>			+	+	+	+	+	+			
19 <i>Brownlowia tersa</i>	+	+	+	+	+		+	+	+		
20 <i>Bruguiera cylindrica</i>	+	+	+	+	+	+	+	+	+	+	+
21 <i>Bruguiera exaristata</i>			+			+				+	
22 <i>Bruguiera gymnorrhiza</i>	+	+	+	+	+	+	+	+	+	+	+
23 <i>Bruguiera hainesii</i>			+	+	+	+			+		
24 <i>Bruguiera parviflora</i>	+	+	+	+	+	+	+	+	+	+	+
25 <i>Bruguiera sexangula</i>	+	+	+	+	+	+	+	+	+	+	+
26 <i>Camptostemon philippinense</i>			+	?	+		+				

	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
27 <i>Camptostemon schultzei</i>			+			+					
28 <i>Ceriops decandra</i>		+	+	+	+	+	+		+		+
29 <i>Ceriops tagal</i>	+	+	+	+	+	+	+	+	+	+	+
30 <i>Excoecaria agallocha</i>	+	+	+	+	+	+	+	+	+	+	+
31 <i>Heritiera fomes</i>					+						
32 <i>Heritiera globosa</i>	+		+	+							
33 <i>Heritiera littoralis</i>	+	+	+	+	+	+	+	+	+	+	+
34 <i>Kandelia candel</i>	+	+	+	+	+		+	+	+		+
35 <i>Lumnitzera littorea</i>		+	+	+	+	+	+	+			+
36 <i>Lumnitzera racemosa</i>	+	+	+	+	+	+	+	+	+	+	+
37 <i>Nypa fruticans</i>	+	+	+	+	+	+	+	+	+	+	+
38 <i>Osbornia octodonta</i>			+	+		+	+				
39 <i>Oberonia rhizophoreti</i>			+	+							
40 <i>Pemphis acidula</i>			+	+		+	+	+	+		
41 <i>Rhizophora apiculata</i>	+	+	+	+	+	+	+	+	+	+	+
42 <i>Rhizophora mucronata</i>	+	+	+	+	+	+	+	+	+	+	+
43 <i>Rhizophora stylosa</i>			+	+		+	+	+		+	+
44 <i>Scyphiphora hydrophyllacea</i>	+	+	+	+		+	+	+	+		+
45 <i>Sonneratia alba</i>	+	+	+	+	+	+	+	+	+	+	+
46 <i>Sonneratia apetala</i>					+						
47 <i>Sonneratia caseolaris</i>	+	+	+	+	+	+	+	+	+	+	+
48 <i>Sonneratia griffithii</i>		+		+	+				+		
49 <i>Sonneratia ovata</i>		+	+	+		+	+	+	+		+
50 <i>Xylocarpus granatum</i>	+	+	+	+	+	+	+	+	+	+	+
51 <i>Xylocarpus moluccensis</i>		+	+	+	+	+	+	+	+		+
52 <i>Xylocarpus rumphii</i>		+	+	+		+	+			+	
Total number of species	25	34	48	42	34	40	38	33	33	24	31

FIGURE 3
True mangrove
species in Southeast
Asia



2.2

ENDEMIC AND RARE/UNCOMMON PLANT SPECIES

Fifty-one species or 18 percent of the mangrove flora of Southeast Asia are endemic to the region, and includes 22 trees and shrubs, 13 epiphytes, eight ferns, four palms and four climbers (Table 3). These endemics include eight species found in the mangrove habitat only (and are therefore 'true mangroves'), including two mistletoes *Amyema anisomeres* and *A. gravis*, one orchid *Oberonia rhizophoreti*, and five trees *Aegiceras floridum*, *Avicennia eucalyptifolia*, *A. lanata*, *Camptostemon philippinense* and *Heritiera globosa*. Some of the Southeast Asian species are very rare, such as the epiphytic parasite *Amyema anisomeres*.

TABLE 3
Mangrove (associate)
species endemic to
Southeast Asia

Group	Species	Group	Species
Trees & shrubs	<i>Aegiceras floridum</i>	Ferns	<i>Ctenopteris moultoni</i>
" "	<i>Avicennia eucalyptifolia</i>	" "	<i>Davallia parvula</i>
" "	<i>Avicennia lanata</i>	" "	<i>Elaphoglossum amblyphyllum</i>
" "	<i>Azima sarmentosa</i>	" "	<i>Loxogramma involuta</i>
" "	<i>Barringtonia conoidea</i>	" "	<i>Pachypleura angustata</i>
" "	<i>Blumeodendron tokbrae</i>	" "	<i>Photinopteris speciosa</i>
" "	<i>Camptostemon philippinense</i>	" "	<i>Platynerium coronarium</i>
" "	<i>Croton heterocarpus</i>	" "	<i>Selliguea heterocarpa</i>
" "	<i>Fagraea crenulata</i>		
" "	<i>Gluta velutina</i>	Epiphytes	<i>Amyema anisomeres</i>
" "	<i>Heritiera globosa</i>	" "	<i>Amyema gravis</i>
" "	<i>Ilex cymosa</i>	" "	<i>Bulbophyllum xylocarpi</i>
" "	<i>Ilex maingayi</i>	" "	<i>Cymbidium finlaysonianum</i>
" "	<i>Ixora timoriensis</i>	" "	<i>Dendrobium aloefolium</i>
" "	<i>Ochthocharis bornensis</i>	" "	<i>Dendrobium pachyphyllum</i>
" "	<i>Podocarpus polystachyus</i>	" "	<i>Dendrobium subulatum</i>
" "	<i>Quassia harmandiana</i>	" "	<i>Oberonia laeta</i>
" "	<i>Rapanea porteriana</i>	" "	<i>Oberonia rhizophoreti</i>
" "	<i>Scolopia macrophylla</i>	" "	<i>Pachycentria constricta</i>
" "	<i>Serianthes grandiflora</i>	" "	<i>Rhododendron brookeanum</i>
" "	<i>Sindora siamensis</i>	" "	<i>Schefflera lanceolata</i>
" "	<i>Symplocos celastriifolia</i>	" "	<i>Schefflera ridleyi</i>
Palms	<i>Calamus erinaceus</i>	Climbers	<i>Calycopteris floribunda</i>
" "	<i>Corypha saribus</i>	" "	<i>Combretum tetralophum</i>
" "	<i>Licuala spinosa</i>	" "	<i>Combretum trifoliatum</i>
" "	<i>Oncosperma tigillarium</i>	" "	<i>Derris scandens</i>

At least 35 plant species occurring in Southeast Asian mangroves are uncommon or rare:

- Twenty-one of these may be locally relatively common, but rare on the whole: *Acanthus volubilis*, *Aegiceras floridum*, *Blumeodendron tokbrae*,

Calycopteris floribunda, *Cassine viburnifolia*, *Ceriops decandra*, *Croton heterocarpus*, *Dalbergia menoeides*, *Diospyros maritima*, *Ficus curtipes*, *Ilex maingayi*, *Oberonia laeta*, *Olax imbricata*, *Osbornia octodonta*, *Quassia indica*, *Rhizophora exaristata*, *Rhododendron brookeanum*, *Scyphiphora hydrophyllacea*, *Sindora siamensis*, *Smythea lanceata* and *Sonneratia ovata*.

- Eight species are uncommon to rare in Southeast Asia, but common elsewhere (*Cyperus scariosus*, *Eleocharis parvula*, *Eleocharis spiralis*, *Fimbristylis sieberiana*, *Leptochloa neesii*, *Scirpus lacustris*, *S. litoralis*, *S. maritimus*). These are wide ranging, weedy sedge and grass species that do not appear to have gained a firm footing in Southeast Asia.
- The remaining six species, *Amyema anisomeres*, *Kandelia candel*, *Oberonia rhizophoreti*, *Quassia harmandiana*, *Scaevola hainanensis* and *Schefflera lanceolata* are truly rare in Southeast Asia⁴. Apart from the previously mentioned *Amyema anisomeres*, these species are generally known from a few scattered localities only. *Scaevola hainanensis*, for example, is known from only a few scattered localities in Viet Nam and Southern China, while *Quassia harmandiana* has been collected a few times only in Cambodia and Thailand. *Kandelia candel* is rare in Southeast Asia, but has become more common in Viet Nam due to planting programmes. It is also naturally common in Southern China, for example in Guangdong (Zhanjiang Mangrove National Nature Reserve) and Hong Kong (Mai Po Nature Reserve).

⁴ Interestingly, *Kandelia candel* is found as far north as Japan, and is a common species in Hong Kong, being the most common Rhizophoraceae in the Mai Po marshes.

CHAPTER 3 THE MANGROVE HABITAT IN SOUTHEAST ASIA

3.1

INTRODUCTION TO THE MANGROVE HABITAT

A wonderful, unsurpassed general description of Southeast Asian mangroves is given by van Steenis (1958) – one of the fathers of plant taxonomy in Southeast Asia – in his introduction to the taxonomy of the Rhizophoraceae⁵:

“Seen from a distance the mangrove makes the impression of a dark-green more-or-less monotonous type of forest. On entering it on foot with ebb its eerie aspect appears at once from the oppressing heat, the damp atmosphere, the bare, stinking mud, covered with stilt-rooted trees..., and several kinds of other root formations (knee-like roots, knobs, snake-like roots, erect peg- or torpedo-shaped pneumatophores), the mud teeming with crabs, fishes, shells, worms and their holes, mud-heaps and shallow pools, the air with plenty mosquitoes, the silence only interrupted now and then by the sudden rush of monkeys through the gloomy foliage, the thud of a fruit falling in the mud, or the forlorn cry of a passing seabird. For a tourist the place is singularly uninviting, but for the biologist it is a most fascinating biotope, and the secrets of its life and life conditions are certainly far from being exhausted. Entering the mangrove on board a small prahu <local canoe> during high tide..., gliding through the silent waters of the creeks, bordered now and then by the flooded forest which is nearly submerged up to the flattish underside of the tree crowns, the aspect is less fascinating and appears more monotonous, as the foliage of the trees is much alike even of representatives of very different families, all of them having dark-green, elliptic to obovate, medium-sized blades of the laurel type but rather coriaceous <leathery> and slightly fleshy. Flowers are not particularly striking, and those which are, as e.g. of *Sonneratia* and *Dolichandrone*, are nocturnal.”

Van Steenis' view that mangroves are very interesting, but not the place you would go to on a picnic, is pretty much the way these habitats are seen today. Mangroves are not easy environments to work in, but they can be very rewarding. Their structure is generally straightforward and simple,

⁵ Ding Hou (1958) - Rhizophoraceae. Flora Malesiana, Ser.I, 5: 429-493.

and the number of species is limited. However, the species that do occur may be very abundant, and as long-term studies show, they are often highly productive. Fortunately for the average lay person, many protected mangrove areas have now been made at least partially accessible by the construction of walkways, which help overcome at least some of the physical discomfort. For an overview of some of the main protected mangrove areas, see chapter 5.

3.2

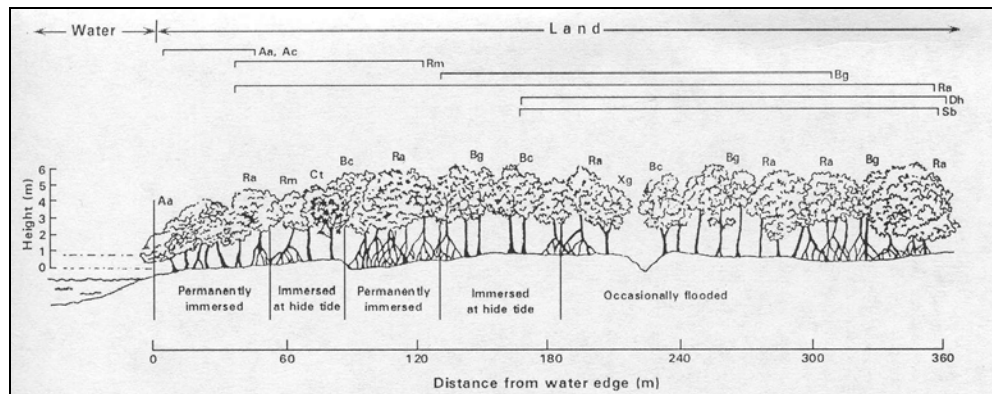
PHYSICAL CONDITIONS

Many mangrove plants have special adaptations to counteract the effects of inundation, high salinity and an unstable soil. A number possess mechanisms to actively remove salt from their tissues (e.g. leaves excreting salt), or have stilt or prop roots for support, and pneumatophores ('air roots') to assist oxygenation of root systems. Many typical mangrove tree genera, such as *Avicennia*, *Bruguiera*, *Ceriops* and *Rhizophora*, are characterized by vivipary. That is, the seeds germinate while still attached to the mother plant, and what is commonly regarded as, for example, a long *Rhizophora* 'fruit', is in fact a hypocotyl (i.e. primary stem) emerging from the fruit.

Zonation

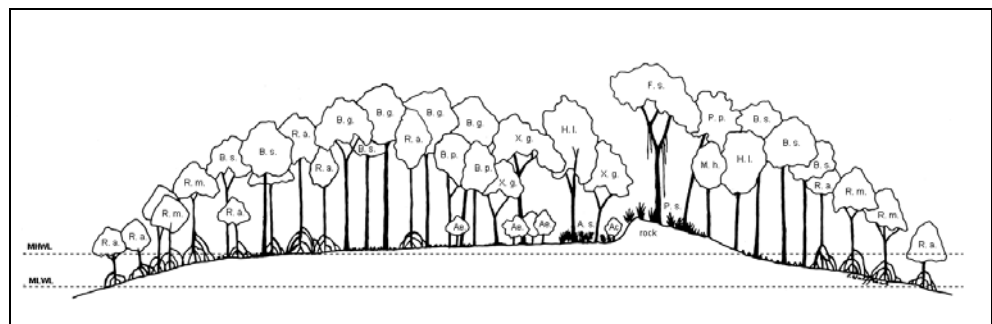
Mangrove vegetation typically displays band-like zonation patterns (e.g. Figures 4, 5), that have alternately been linked by various authors to soil type (mud, sand or peat), exposure to wave action, salinity, freshwater inflow from the hinterland and tidal influence (e.g. Watson, 1928; van Steenis, 1957; Chapman, 1976a, 1976b, 1977; Bunt & Williams, 1981; White *et al.*, 1989; Aragones *et al.*, 1998). The width of a mangrove zone rarely exceeds four kilometres, and usually it is much narrower. On eroding or steep coasts it may be scarcely 50 metres wide, while in some estuaries and sheltered, shallow bays it may be as wide as 18 kilometres (Sungai Sembilang, South Sumatra; Danielsen & Verheugt, 1990) or even 30 kilometres (Bintuni Bay, Papua; Erftemeijer *et al.*, 1989). Along tidal rivers a mangrove fringe may be found occurring upstream for many tens of kilometres, depending on saltwater intrusion. This in turn is determined by tidal amplitudes, river discharges and slopes. The last true mangrove tree species to disappear along tidal rivers is often either *Bruguiera parviflora* (van Steenis, 1957, 1958) or *Sonneratia caseolaris*, while the mangrove palm *Nypa fruticans* may occur even much further inland.

FIGURE 4A
Example of mangrove zonation in Cilacap, south coast of Java, Indonesia



Adapted from (White *et al.*, 1989).

FIGURE 4B
Schematic cross-section of a small mangrove island near Kimbe, West New Britain province, Papua New Guinea



Soil substrates mainly clay, with the exception of a limestone rock in the center of the island.

Ae. - *Aegiceras corniculatum*

Ac. - *Acanthus ilicifolius*

A.s. - *Acrostichum speciosum*

B.g. - *Bruguiera gymnorrhiza*

B.p. - *Bruguiera parviflora*

B.s. - *Bruguiera sexangula*

F.s. - *Ficus* sp. (non-mangrove species)

H.l. - *Heritiera littoralis*

M.h. - *Myristica hollrungii*

P.s. - *Pandanus* cf. *furcatus* (non-mangrove species)

P.p. - *Pongamia pinnata*

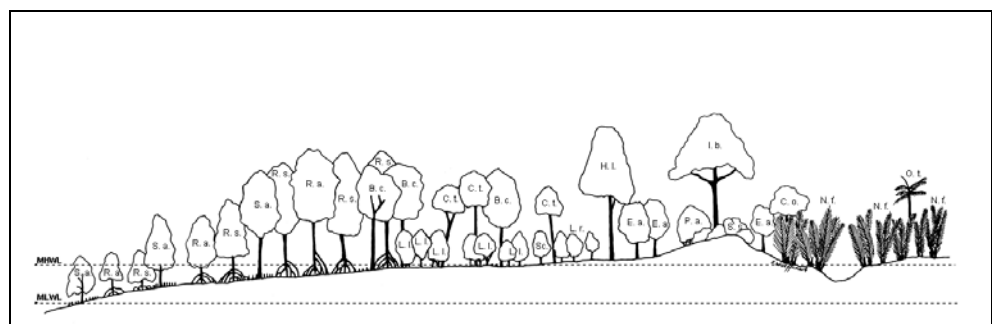
R.a. - *Rhizophora apiculata*

R.m. - *Rhizophora mucronata*

X.g. - *Xylocarpus granatum*

MHWL - Mean High Water level; MLWL - Mean Low Water level

FIGURE 4C
Schematic cross-section of a coastal area on Bintan Island, Riau province, Indonesia



Substrates of frontal area consist of coarse sands, while inland it is mixed with loam & clay.

B.c. - *Bruguiera cylindrica*

C.b. - *Cerbera odollam*

C.t. - *Ceriops tagal*

E.a. - *Excoecaria agallocha*

H.l. - *Heritiera littoralis*

I.b. - *Intsia bijuga*

L.l. - *Lumnitzera littorea*

L.r. - *Lumnitzera racemosa*

N.f. - *Nypa fruticans*

O.t. - *Oncosperma tigillarum*

P.a. - *Pemphis acidula*

R.a. - *Rhizophora apiculata*

R.s. - *Rhizophora stylosa*

Sc. - *Scyphiphora hydrophyllacea*

S.a. - *Sonneratia alba*

Climatic conditions

The impact of climatic conditions and mangrove vegetation is not yet fully understood. Exceptions aside, mangroves are known to occur in areas where the average annual temperature is at or above approximately 18°C (Chapman, 1976a; 1977), or that has absolute temperatures above 15°C (Puff, 2001). Climatic conditions further affect mangroves, especially by influencing the salinity of the landward fringing (back- or hind-) mangroves, and by weather influence upon stream and river discharges, and affecting silt deposition along the coast. Weather conditions also affect coastal accretion or erosion, which is dealt with briefly below.

Salinity

Salinity affects mangrove composition, as various species deal with the 'salinity problem' in different ways. Some simply do not grow in waters that are too saline and are found in brackish zones only. Many species are able to selectively prevent salt absorption at the root, although this requires a good deal of expended energy. Others are able to excrete salt from their (leaf) tissues and may be covered with fine salt crystals. *Aegiceras corniculatum*, for example, has salt-excretion glands located on the leaf surface and stalk, which may be whitish and covered with salt.

Some species have a very wide range of tolerance, such as *Sonneratia caseolaris*, which may be found in pure seawater or along tidal rivers where salinity is almost that of freshwater (i.e. <0.1 % seawater)⁶. The species even thrives in a freshwater pond in the Bogor Botanic Gardens in Java! Species, such as *Bruguiera* species, are generally found only where salinities are low. MacNae (1968), for example, gives 2 percent seawater as the optimum for *Bruguiera parviflora* and 1.0-2.5 percent for *Bruguiera gymnorhiza*. Some mangrove species require high salinities, and *Rhizophora mucronata*, for instance, requires a minimum of 1.2 percent seawater for its growth, while *Aegiceras corniculatum* requires 2.0-4.0 percent seawater for optimal growth (Chapman, 1976a). Seasonality of freshwater reaching the coastal zone also affects the mangrove habitat, as in some areas salinities can fluctuate wildly according to the seasonality of rainfall in the interior.

Some plants are avoided by herbivores because of their ability to accumulate salt. Up to 11 percent dry weight of the grass *Xerochloa imberbis*, for example, may consist of salt, and it is therefore shunned by cattle.

Eroding versus accreting coastlines

Mangrove pioneers are found where sediments accumulate, and usually assist in the stabilisation of coastal sediments, though probably not very actively contributing to the accumulation of sediments (van Steenis, 1957). Mangroves occur on coastlines that are stable, rising or falling. On a rising coastline they form a fringe zone only, while on a stable coast, their extent

⁶ Average seawater salinity is equivalent to about 3.4 % salt content (i.e. 34 grams/litre); 0.1 % seawater is therefore equivalent to 0.0034 % salt content or 0.34 grams/litre.

depends on the slope. On a subsiding coast mangroves tend to be extensive to very extensive (Chapman, 1976b).

Mangroves on an eroding coastline have often developed during an earlier period, when the coastline was still stable. A first pioneer zone is often lacking or degrading, and the seaward fringe often consists of a *Rhizophora*-dominated zone, which is usually the second zone on a stable coastline.

Substrates

Most mangrove species do best on muddy soils, i.e. in areas where silt accumulates (Watson, 1928; van Steenis, 1957; Chapman, 1976a, 1977; Aragones *et al.*, 1998), and typical for muddy substrates in Southeast Asia are the well-developed stands of *Rhizophora mucronata* and *Avicennia marina* (Watson, 1928; Kint, 1934; van Steenis, 1958). Tall stands of *Bruguiera* dominated forests are often found on deep muddy soils.

Certain species such as *Rhizophora stylosa* also do well on sands, and even on coral islands which have a substrate consisting of coral debris, shells and *Halimeda* (calcareous seaweed) fragments (Ding Hou, 1958). Kint (1934) reports that in Indonesia, *Rhizophora stylosa* and *Sonneratia alba* typically occur on sandy, and even rocky shores. Aragones *et al.* (1998) report that in the Philippines *Rhizophora*, *Bruguiera*, *Sonneratia* and *Ceriops* do well on coral beaches and areas along or close to channels, while *Sonneratia* are more common in open bays, and *Xylocarpus*, *Lumnitzera* and *Aegiceras* do well along inner, landward margins. Stands of *Lumnitzera littorea* are common on this kind of sites on islands of the Riau archipelago in Indonesia.

On certain subsiding coasts mangroves may develop on peat soils (e.g. Florida, USA; Chapman, 1976a), and in Indonesia such habitats occur in South Sulawesi, Indonesia (northern Bone Bay and the Lariang-Lumu plains; Giesen *et al.*, 1991). In the Lariang-Lumu area, for example, exceptionally well developed *Rhizophora-Bruguiera* mangroves were found on deep peat (>3 m deep) overlain with a shallow (0.5 m) layer of sand. Mangrove soils with a high content of organic matter (62%) have also been reported from the Thousand Islands group, off Jakarta Bay, Indonesia (Hardjowigeno, 1989).

Another typical feature of soils of mangrove areas is the development of iron pyrites (FeS_2) in the soil. This typically occurs in estuaries because of the presence of iron (scarce in seawater, but abundant in river water), sulphates (in seawater) and organic matter, and a lack of oxygen in the soil. These soils form 'Potential Acid Sulphate' soils, which upon development and exposure to air may turn highly acidic due to the reaction of iron pyrites with oxygen, resulting in the production of sulphuric acid (Dent, 1986; Craswell & Pushparajah, 1989; Hardjowigeno, 1989; Konsten & Klepper, 1992). Mobilisation of toxic aluminium ions due to a lowering of the pH seems to be one of the major problems associated with these soils (Dent, 1986).

Tides

Mangrove vegetation zones are clearly linked with tides, and various authors report of a good correlation with either tidal amplitude or frequency of flooding (Watson, 1928; de Haan, 1931; van Steenis, 1958; Chapman, 1976a). In Southeast Asia, areas that are flooded during all high tides tend to be dominated by *Avicennia alba*, *A. marina* or *Sonneratia alba*, while areas that are flooded by most high tides are dominated by *Rhizophora* species. Mangroves flooded by normal high tides are dominated by *Bruguiera* species, with *Xylocarpus granatum* on the landward fringe. Areas inundated by spring tides only, i.e. for only a few days per month, are dominated by *Bruguiera sexangula*, *Heritiera* species and *Lumnitzera littorea*. Boundaries of vegetation zones therefore often coincide with tidal isohyets (contours). For instance, the seaward facing zone is usually located between the lowest low water level and the mean low water level, above which the second zone often begins (for example, see Figures 4b & 4c).

3.3

MANGROVE VEGETATION TYPES

Structure

Mangroves in Southeast Asia may range from 1-2 metre tall *Avicennia alba* or *Avicennia marina* stands on the seaward side of accreting shores, to 30-40 metre tall stands of mixed *Bruguiera*-*Rhizophora* mangrove forest. On more exposed but not eroding coastlines one may find *Sonneratia alba* and *Avicennia alba*, and along waters of lower salinity (e.g. in estuaries) *Nypa fruticans*, *Cerbera odollam* and *Sonneratia caseolaris* are common. Apart from saplings, undergrowth is often scarce but certainly not absent, and species such as sea holly *Acanthus ilicifolius* and mangrove fern, *Acrostichum aureum* may be common along banks of creeks and in disturbed areas.

In clear tidal creeks of Peninsular Malaysia, Viet Nam, Thailand, western Indonesia and Papua New Guinea one may find the ornamental aroid *Cryptocoryne ciliata*, while *Najas* species and *Ruppia maritima* have been recorded in small mangrove pools. Climbers are relatively common, especially on the landward fringes of mangroves. Epiphytes, such as orchids, ferns and mistletoes are common in older, well-developed mangroves, but may be scarce or absent in younger mangrove stands such as regenerating, logged-over forests.

Mangroves typically display zonation, and when viewed from the air or from an observation tower the bands of different vegetation types can easily be discerned. The cause of this zonation has been attributed to salinity, elevation and exposure to wave action. The general consensus, however, is that these patterns are determined by a combination of these factors, but that tidal inundation is the dominating factor (e.g. Watson, 1928; Kint, 1934; van Steenis, 1958; Chapman, 1976a; Aksornkoae, 1993).

Mangroves are dynamic habitats, with rapid changes (e.g. local die-off) followed by rapid regrowth (Jiménez & Lugo, 1985). Changes may be either

cyclic (Jiménez & Lugo, 1985) or successional (Carter, 1959; Chapman, 1976, 1977), but whatever process may be occurring, the net result is the formation of distinct zones or bands of different vegetation types. Rapid colonisation of newly formed mudflats is a common process along expanding coastlines, such as in the estuaries of large rivers.

Five main mangrove zones

In their simplest form, Southeast Asian mangroves generally occur in five zones:

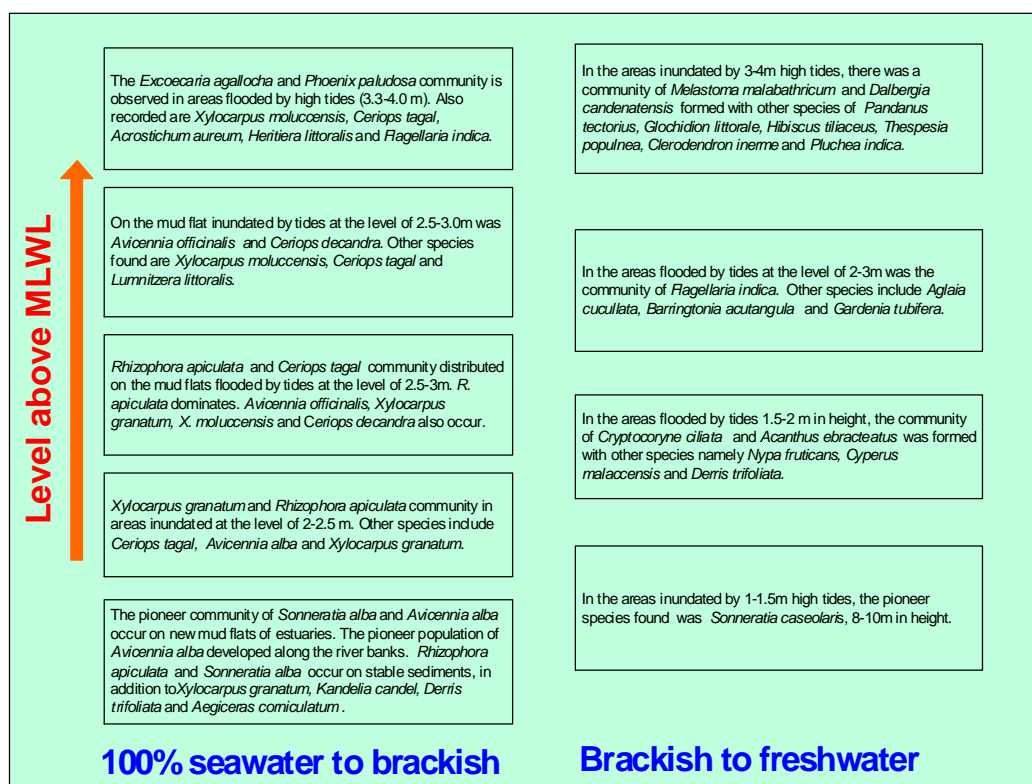
- one on the highly exposed seaward side that is inundated during all high tides;
- one on less dynamic, exposed, seaward sides, inundated by all high tides;
- a central, well-developed mangrove inundated by normal high tides;
- a landward/freshwater-influenced zone (the back-, hind- or rear-mangrove) inundated by spring tides, and
- a zone occurring along brackish to almost fresh streams and/or occasionally inundated by exceptionally high tides.

Hong (2000) recognises a combination of salinity and tidal regime (see Figure 5), which nicely illustrates the interaction between these two factors. However, such combined systems seem to have only a local relevance, as there is much variation throughout the region, and for the sake of simplicity the five zone system recognised by Watson (1928), van Steenis (1958), Chapman (1975) and Aksornkoae (1993) is probably the best point of departure. These zones are described in some detail below, while Table 4 provides a list of species recorded in these zones per country – this is not exhaustive, but based on a number of key references only.

Zone 1) - highly exposed mangrove, occurring on the seaward side of mangrove belts and inundated by all high tides. According to Watson (1928), van Steenis (1958) and Aksornkoae (1993), this type of habitat is devoid of all species except for *Rhizophora mucronata*, and even this species requires that its crown remains above water. This zone is not always present.

Zone 2) - exposed mangrove, occurring on the seaward side of mangrove belts and inundated by medium high tides. According to van Steenis (1958), this is the zone of the *Sonneratias* and *Avicennias*, and most commonly *Sonneratia alba* and *Avicennia alba* co-dominate in this deeply inundated coastal zone. With some minor variation, this observation is supported by most authors reporting on Southeast Asian mangroves, and similar observations have been made by Watson (1928) in Peninsular Malaysia, Percival and Womersley (1975) in Papua New Guinea (where *Avicennia marina* replaces *A. alba* as the most common *Avicennia* in this habitat), Aragones *et al.* (1998) in the Philippines and Hong (2000) in Viet Nam. Often one of the two genera may dominate. Komiyama *et al.* (1988),

FIGURE 5
Mangrove
communities in Viet
Nam: relationship
with inundation and
salinity



Source: adapted from Hong (2000), who developed this system based on Can Gio mangroves in Viet Nam's Mekong Delta. MLWL = Mean Low Water Level.

who found in Halmahera (Moluccas, Indonesia) that this zone was dominated by *Sonneratia alba*, and in Karang Agung (South Sumatra, Indonesia), Samingan (1980) found that this zone was dominated by *Avicennia alba*, which occurred in almost pure stands in a belt along the coast in areas under heavy influence of the sea.

The floristic composition of this more exposed community also depend on substrate, as *Sonneratia alba* tends to dominate on sands, or on corals, as on the islands in the Handeuleum bay of Ujung Kulon (West Java, Indonesia), while according to van Steenis (1958) *Avicennia marina* and *Rhizophora mucronata* tend to dominate on muddier shores. According to Kantor Menteri Negara Lingkungan Hidup (1993), however, *Sonneratia* is associated with the ubiquitous *Avicennia* if the muddy soils are rich in organic matter. On muddy shores on the north coast of West Java, this zone consists mainly of *Avicennia marina* and *A. alba*.

Zone 3) - central mangroves are usually dominated by *Rhizophora* species but in the Karang Agung area (South Sumatra, Indonesia), Samingan (1980) found it to be dominated by *Bruguiera cylindrica* (his *B. caryophylloides*). Other important species he found in this zone in Karang Agung include *Bruguiera sexangula* (his *B. eriopetala*), *B. gymnorrhiza*, *Rhizophora mucronata*, *Xylocarpus granatum* and *X. moluccensis*. In mangroves on the north coast of New Britain (PNG), this zone was found to be dominated by tall *Bruguiera*

gymnorhiza, *B. sexangula* and *Rhizophora apiculata* trees, together with *Bruguiera parviflora* and *Xylocarpus granatum* of somewhat shorter stature. Older *Bruguiera* trees were found to be particularly rich in epiphytes.

Many forms and types have been described in Southeast Asia by various authors (e.g. Watson, 1928; Kartawinata & Walujo, 1977; Kartawinata *et al.*, 1979; Komiyama *et al.* 1988; Mirmanto *et al.*, 1989; Abdulhadi & Suhardjono, 1994, Aragones *et al.*, 1998), and include many combinations of the true mangrove species described in this publication.

This zone can often be sub-divided into a more seaward facing zone dominated by *Rhizophora* species and a more landward facing zone dominated by *Bruguiera* species, frequently with a lower storey of *Ceriops*. The *Rhizophora* zone is then often considered a second pioneer zone, while the *Bruguiera* zone is considered the real climax zone. However, because of the high degree of dynamics of mangroves, some authors tend to regard all mangroves as pioneer vegetation.

Zone 4) - rear mangrove (or hind-mangrove, back mangrove, landward mangrove) occurs in the landward zone behind true mangrove belts, and are inundated by the highest tides only. This does not automatically mean that this zone is less saline than the other mangrove zones, as this depends upon climatic conditions and the shape of the terrain. In a monsoonal climate, this zone can even become hypersaline, as during the dry season, part of the seawater entering the zone during spring tides evaporates, leaving behind salt deposits that are not washed away until the next spring tide several weeks later. In more humid parts of Southeast Asia, however, this zone may be almost freshwater throughout a greater part of the year. Species commonly found in this zone include *Excoecaria agallocha*, *Ficus microcarpa* (often wrongly recorded as *Ficus retusa*), *Intsia bijuga*, *Nypa fruticans*, *Lumnitzera racemosa*, *Pandanus tectorius* and *Xylocarpus moluccensis* (Kantor Menteri Negara Lingkungan Hidup, 1993). On Pulau Rambut, West Java, *Heritiera littoralis* and *Xylocarpus moluccensis* are very common in this zone, but on coral islands in Ujung Kulon, West Java, this zone is dominated by *Lumnitzera littorea*. This is the most species-rich zone, and probably almost three-quarters of all species listed in this field guide are found in this zone at one time or another.

Zone 5) - brackish stream mangroves, found along brackish to almost freshwater streams, are usually dominated by *Nypa* or *Sonneratia* communities. Samangan (1980) found in the Karang Agung area in South Sumatra that the *Nypa fruticans* community occurred in narrow belts along most streams. These belts often consisted of pure stands of *Nypa fruticans*, but was backed by vegetation that included *Cerbera* species, *Gluta velutina*, *Stenochlaena palustris* and *Xylocarpus granatum*. Closer to the coast Samangan found that a mixed *Sonneratia-Nypa* community often occurred. In many areas, however, *Sonneratia caseolaris* may be dominant, especially in almost freshwater parts of the estuaries, for example on Pulau Kaget and Pulau Kembang in the estuary of the Barito river (South Kalimantan, Indonesia),

in the mouth of the Singkil river in Southwest Aceh (Sumatra, Indonesia; Giesen & van Balen, 1991), or on newly formed sedimentation islands in the mouth of the Cisadane River in Banten, West Java.

Sonneratia caseolaris is almost absent along tidal creeks in Way Kambas National Park (Lampung, Indonesia), where the dominant species is in most places *Nypa fruticans*, with many *Cerbera odollam* and *Dolichandrone spathacea* trees. Brackish stream mangroves can also occur in wider areas, such as brackish water marshes, where *Nypa fruticans* is generally (very) dominant, covering up to 90 percent of the area. This is for instance the case in most of the estuaries of the large rivers of eastern Borneo (East Kalimantan and Sabah). In South Sumatra, *Oncosperma tigillarium* is the dominant species of the landward fringe of these brackish water swamps.

Within the exposed and central mangroves one can also recognize zonation of other taxons. Macroalgae associated with Southeast Asian mangroves, for instance, show a clear zonation linked with tidal exposure. *Rhizoclonium* species occur in the upper intertidal zone, *Bostrychia* species in the upper to middle intertidal zones, *Caloglossum* species in the middle intertidal zone and *Catanelia*, *Caldophora* and *Geledium* species in the lower intertidal (Chihara & Tanaka, 1988).

One must be careful not to oversimplify, however, as many forms and overlapping vegetation types/zones occur, and structures/correlations found in one area are often not directly applicable to other areas. As mentioned above, the structure of individual stands may vary from 30+ metre-tall *Rhizophora-Bruguiera* forest to dwarfish stands of 1-2 metre-tall *Avicennia*. Some authors (e.g. Janzen, 1985) have oversimplified the structure concept and concluded that mangroves totally lack an understorey and climbers. Janzen is supported by some, including Corlett (1986), who gives examples of mangrove vines and shrubs, but goes on to conclude that “most mangrove forests do lack an understory and vines”. Southeast Asian mangroves include at least 43 shrub species, 28 climbers and 53 terrestrial herb species, of which many occur exclusively in the ‘true mangrove environment’. In terms of area, vines and shrubs cover very little, but they appear as important elements along streams, on exposed, open patches in mangrove forest, and thinly scattered through the well-developed forest.

Mangrove vegetation is one of the two main types of coastal forest in Southeast Asia. The other type is Beach Forest, which in Southeast Asia is usually identical with the “*Barringtonia* formation” (e.g. van Steenis, 1958) or *Barringtonia asiatica-Terminalia catappa* vegetation. Beach forest generally occurs along exposed, sandy or coral coasts. Unlike mangroves, they are almost never inundated by seawater, but root in freshwater, although evidently influenced by the sea. Many typical beach forest species such as *Barringtonia* species, *Pemphis acidula*, *Terminalia catappa*, *Calophyllum inophyllum* and *Thespesia populnea* can often be found in the landward fringe of mangroves as well.

3.4

MANGROVE FAUNA

Mangroves provide food, shelter and a home for many animal species, which in some ways are not markedly different from terrestrial environments, and in other ways are totally different.

Molluscs

Molluscs are abundant in Southeast Asia's mangroves and Budiman (1985), for instance, has described a total of 91 species from one site in Ceram (in the Moluccas, Indonesia) alone. This included 33 species that normally occur on a reef flat, but also 'visit' adjacent mangroves. Some of these 91 species occur as infauna (in the soil), others are ground dwellers, while the remainder occur on the vegetation. The latter consist of sessile (mainly bivalves) and mobile species, some of which migrate up and down with the tidal movement (Chen, 1982). Other sites may not be quite as rich as the Ceram site: Giesen *et al.* (1991) recorded 74 mollusc species in mangroves of South Sulawesi (Indonesia), while Budiman (1988) found 40 species in Halmahera (Moluccas, Indonesia). A large proportion of the mollusc fauna found in mangroves may be confined to this habitat; 24 out of the 40 species found at Halmahera by Budiman (1988), for instance, are specific mangrove species.

Some of the most common gastropod species include the telescope snail *Telescopium telescopium*, mudcreeper *Terebralia palustris*, zoned horn shell *Batillaria zonalis* and the obtuse horn shell *Cerithidea obtusa*. Common mangrove bivalves include the toothless lucina *Anodontia edentula*, sunset siliqua *Siliqua radiata* and the gaudy asaphis *Asaphis deflorata* (Tucker Abott, 1991).

Crabs

Crabs are particularly abundant in mangroves, and densities of 10-70 individuals per square metres can be found (Macintosh, 1984), especially of burrowing species of the genera *Cleistocoeloma*, *Macrophthalmus*, *Metaplex*, *Ilyoplax*, *Sesarma* and *Uca* (Calling- or Fiddler Crabs) (Tweedie & Harrison, 1954; MacNae, 1968; Macintosh, 1984; Wada & Wowor, 1989; Sasekumar *et al.*, 1989). Special mention should be made of the Mangrove Crab (or Asiatic Edible Crab), *Scylla serrata*, which is an important commercial species and appears confined to this habitat (Delsman, 1927). Many crab fattening industries in Southeast Asia are based on this species. More than 100 brachyuran mangrove crabs are known from Malaysia, and 76 species are known from Singapore; in the latter this represents 22 percent of the total brachyuran fauna for the island state (Tan & Ng, 1994). Indonesia's crab fauna has been studied in less detail, and the records are patchy.

TABLE 4
Mangrove zones and species
in Southeast Asian countries
(note: this is an example only,
and not an exhaustive list)

	Cambodia	Indonesia	Malaysia	PNG	Philippines	Thailand	Timor-Leste	Viet Nam
Zone 1: Highly exposed mangrove								
<i>Rhizophora mucronata</i>		+	+			+		
Zone 2: Exposed mangroves								
<i>Avicennia alba</i>	+	+	+	+	+	+		+
<i>Avicennia marina</i>		+		+	+		+	
<i>Sonneratia alba</i>		+	+	+	+	+	+	+
<i>Rhizophora mucronata</i>		+	+		+	+		
Zone 3: Central mangroves								
<i>Acanthus ilicifolius</i>	+	+	+					
<i>Acrostichum aureum</i>	+							
<i>Aegiceras corniculatum</i>	+	+			+		+	
<i>Avicennia marina</i>		+		+			+	
<i>Avicennia officinalis</i>								+
<i>Bruguiera cylindrica</i>		+	+		+			
<i>Bruguiera gymnorrhiza</i>	+	+	+	+	+			
<i>Bruguiera parviflora</i>		+	+	+	+		+	
<i>Bruguiera sexangula</i>	+	+	+					
<i>Ceriops decandra</i>	+	+		+	+	+		+
<i>Ceriops tagal</i>	+	+	+		+			+
<i>Derris trifoliata</i>								+
<i>Excoecaria agallocha</i>	+	+			+	+		
<i>Kandelia candel</i>								+
<i>Lumnitzera littorea</i>		+	+		+	+		+
<i>Lumnitzera racemosa</i>	+	+			+	+	+	
<i>Rhizophora apiculata</i>		+		+		+	+	+
<i>Rhizophora mucronata</i>	+	+	+	+				
<i>Sonneratia alba</i>	+	+	+	+			+	+
<i>Xylocarpus granatum</i>	+	+	+			+		+
<i>Xylocarpus moluccensis</i>		+	+					+
Zone 4: Rear mangroves								
<i>Acrostichum aureum</i>	+	+					+	+
<i>Aglaia cucullata</i>	+			+		+		+
<i>Barringtonia acutangula</i>		+						+
<i>Bruguiera gymnorrhiza</i>		+		+		+		
<i>Bruguiera sexangula</i>		+	+					
<i>Calophyllum inophyllum</i>	+	+		+				
<i>Camptostemon schultzei</i>				+				
<i>Cycas rumphii</i>							+	
<i>Clerodendrum inerme</i>		+						+
<i>Dalbergia candanensis</i>								+
<i>Dolichandrone spathacea</i>				+			+	
<i>Excoecaria agallocha</i>		+		+	+	+		+
<i>Ficus microcarpa</i>		+						

	Cambodia	Indonesia	Malaysia	PNG	Philippines	Thailand	Timor-Leste	Viet Nam
Zone 4: Rear mangroves (ctd.)								
<i>Flagellaria indica</i>								+
<i>Gardenia tubifera</i>								+
<i>Glochidion littorale</i>	+							+
<i>Heritiera littoralis</i>	+	+		+	+			+
<i>Hibiscus tiliaceus</i>								+
<i>Intsia bijuga</i>		+		+				
<i>Lumnitzera littorea</i>		+		+				+
<i>Lumnitzera racemosa</i>	+	+		+				
<i>Melaleuca cajuputi</i>	+						+	
<i>Melastoma malabathricum</i>								+
<i>Myristica hollrungii</i>				+				
<i>Nypa fruticans</i>		+		+				
<i>Pandanus tectorius</i>		+					+	+
<i>Phoenix paludosa</i>	+							+
<i>Pluchea indica</i>	+	+	+					+
<i>Rhizophora apiculata</i>				+				
<i>Thespesia populnea</i>								+
<i>Xylocarpus granatum</i>		+	+	+	+	+	+	
<i>Xylocarpus moluccensis</i>		+	+	+	+			+
Zone 5: Brackish stream & rarely inundated mangroves								
<i>Acanthus ebracteatus</i>	+							+
<i>Acanthus ilicifolius</i>	+	+						
<i>Barringtonia acutangula</i>	+	+						+
<i>Bruguiera gymnorhiza</i>	+	+	+					
<i>Cerbera manghas</i>		+						
<i>Cerbera odollam</i>		+						
<i>Cryptocoryne ciliolata</i>		+						+
<i>Derris trifoliata</i>		+						+
<i>Dolichandrone spathacea</i>		+						
<i>Gluta velutina</i>		+						
<i>Nypa fruticans</i>	+	+	+	+	+	+	+	+
<i>Oncosperma tigillarium</i>		+	+					
<i>Sonneratia caseolaris</i>	+	+	+					+
<i>Stenochlaena palustris</i>		+						
<i>Xylocarpus granatum</i>		+	+					
<i>Xylocarpus moluccensis</i>		+	+					

Sources: Cambodia (Smith, 2001), Timor-Leste (www.uc.pt/timor/florafauna.html), Indonesia (van Steenis, 1958), Malaysia (Watson, 1928), PNG (Percial & Womersley, 1975), Philippines (Aragones *et al.*, 1998), Thailand (Aksornkoae, 1993), Viet Nam (Hong, 2000).

Giesen, *et al.* (1991) recorded a total of 28 crab species in mangroves of South Sulawesi, and as often is the case, the dominant genera are *Sesarma* and *Uca*. Wada (1988) gives some useful observations on mangrove crab behaviour and the different assemblages associated with various mangrove habitats. The two most common species found by Adiwiryo *et al.* (1984) in South Sumatra were mud lobster *Thalassina anomala* and the fiddler crab *Uca dussumieri*. The numerous mounds seen in mangroves are made by the mud lobster, while the holes themselves are often inhabited by *Sesarma* crabs, which are actually the second 'tenants' (Tweedie & Harrison, 1954).

Other crustaceans

Mangroves are an important habitat for many other crustaceans, and it should be noted that they form a very important breeding and nursery area for commercially important shrimp species. Sasekumar *et al.* (1992) recorded nine species of prawns in the mangrove creeks and inlets of Selangor State, Peninsular Malaysia, the majority of which were present there as juveniles. Giesen *et al.* (1991) record 14 prawn species in mangroves of South Sulawesi, including *Macrobrachium* (8 species), *Metapeneus* (2 species) and *Palaemonetes* (2 species). Toro (1979; quoted by Manuputty, 1984) recorded 28 crustacean species, including eight prawn species, in the mangroves of Pari Island, one of the Thousand Islands, off Jakarta Bay. Adiwiryo *et al.* (1984) found an even higher crustacean diversity - 34 species - in mangroves of Tanjung Bungin (South Sumatra, Indonesia).

Other arthropods

Arboreal mangrove arthropods, including insects, are described for Halmahera (Moluccas, Indonesia) by Abe (1988), and the most common orders were found to be Hymenoptera, Diptera and Psocoptera (all of which are insects). Even to the casual visitor it is obvious that mangroves are great habitats for mosquitoes - although humans may make great meals the most obvious prey of adult mosquitoes in most mangroves are birds and amphibians.

Mosquito attacks are not restricted to any particular group of organisms, and MacNae (1968) reported that he once observed mosquitoes biting the heads of mudskippers. During their aquatic larval life cycle, mosquito larvae may make a significant contribution to the benthic food chain, and various marine organisms (esp. fish) feed on them. Among the most common mosquitoes in Southeast Asia is the *Anopheles (Myzomyia) sundaicus*, which is apparently restricted to the western regions of the Indonesian Archipelago, where it is responsible for most cases of malaria (MacNae, 1968). According to MacNae (1968), *Aedes amesii* is the most common mosquito in mangroves from Malaysia and Sumatra to the Philippines and Thailand. In Sulawesi alone, there are about 125 species of mosquitoes in all (only some of which are mangrove species), but only four genera act as vectors for debilitating diseases such as malaria (*Anopheles* and *Culex*), dengue fever (*Aedes*) and filariasis (*Mansonia* and *Culex*) (Whitten *et al.*, 1988). Species commonly associated with mangroves in Southeast Asia are *Aedes alternans*, *A. amesii*, *A. butleri*, *A. fumidus*, *A.*

littoreus, *A. niveus*, *A. pembaensis*, *A. scutellaris*, *A. vigilax*, *Anopheles amictus*, *A. barbirostris*, *A. farauti*, *A. subpictus*, *A. sundaicus* and *Culex sitiens*. It might be possible to strongly reduce the abundance of mosquitoes in mangroves by ensuring that no stagnant pools remain during low tides. This could be a consideration when aiming to retain mangroves in the vicinity of urban areas.

Fish

Mangroves are highly important breeding and nursery habitats for many fish species, including many commercial fish species. Sasekumar *et al.* (1992) recorded 119 fish species in mangrove creeks and inlets of Selangor State, Peninsular Malaysia, the majority of which were present as juveniles. Conspicuous at low tide are the many species of mudskipper (*Periopthalmus* species, *Scartelaos* species; MacNae, 1968) that occur in pools or perched on the lower stems of mangrove plants, ready to leap if danger should arise. In Indonesia, Burhanuddin (1993) recorded 62 fish species in mangroves of Ujung Kulon-Pulau Penaitan National Park. In both areas, the dominant species is the herbivorous *Mugil cephalus*, while other common species include the carnivorous *Caranx kalla*, *Holocentrum rubrum*, *Lutjanus fulviflamma* and *Plotosus canius*, and the insectivorous *Toxotes jaculator* (the famous 'archer fish').

Amphibians & reptiles

Few amphibians can survive the saline mangrove environment, but two species of frog are nevertheless fairly common, especially in the rear mangrove areas: the mangrove frog *Fejervarya cancrivora* and the grass frog *Fejervarya limnocharis* (formerly known as *Rana cancrivora* and *Rana limnocharis*; MacNae, 1968; Inger & Stuebing, 1997; Iskandar, 1998). *Fejervarya cancrivora* owes its scientific name (and one of its common names) to its habit of devouring small crabs. The common toad *Bufo melanostichus* may also be found upon occasion, especially on landward margins, and in Viet Nam tree frogs *Racophorus lecuomystax* are regularly recorded (Hong, 2004).

Reptiles commonly occurring in Southeast Asian mangroves are the estuarine crocodile *Crocodylus porosus*, water monitor *Varanus salvator*, rainbow water-snake *Enhydria enhydria*, crab-eating water snake *Ferdonia leucobalia*, mangrove snake *Boiga dendrophila*, marine file snake *Acrochordus granulosus*, dog-faced water snake *Cerberus rhynchops*, Wagler's pit viper *Trimeresurus wagleri* and the shore pit viper *Trimeresurus purpureomaculatus* (MacNae, 1968; Keng & Tat-Mong, 1989; Stuebing & Inger, 1999). The dog-faced water snake is a common species of mangrove mudflats, where it feeds mainly on mudskippers (Giesen, 1993). None of these species are exclusive, as most are also found in adjacent freshwater or dryland environments.

Birds

Birds occurring in mangroves may be quite similar to those of adjacent dryland forest. Van Balen (1989) reports that of the 167 bird species

recorded in mangroves of Java, six are confined to mangroves while a further three are characteristic for this habitat. Other groups make use of mangroves, for example as roosts on a daily basis (mainly waterbirds; for example on Pulau Dua and Pulau Rambut, West Java), daily foraging (includes a number of pigeons) and as a seasonal stop-over site on migrations (e.g. a number of waterbirds, and insectivorous birds). The majority of the species, however, are found both in adjacent rain forests, rural and urban areas. The Indonesian Wetland Data Base (operated by Wetlands International-Indonesia Programme) lists a total of more than 200 bird species occurring in mangrove habitats, which is about 13 percent of the (very rich) Indonesian avifauna (1 532 species; Andrew, 1992). Mangroves play an important role for migratory waterbirds, mainly as roosting sites during high tide, but also as places of shelter and foraging.

The total number of bird species found at any one site are of course much lower. In the Sungai Merbok mangroves of Kedah, Malaysia, Noske (1993; cites in Wetlands International-Asia Pacific, 1996) recorded a total of 48 species. On a slightly greater scale (Kedah State mangroves, with 8,000 hectares of mangrove; AWB, 1995), Gregory-Smith (1993) recorded 78 bird species in this habitat, of which 73 fed in the mangrove, 48 were regular or occasional resident species, 15 were mainly mangrove dependent, and 12 roosted in the mangrove. The mainly mangrove dependent species include striated heron *Butorides striatus*, masked finfoot *Heliopais personata*, common kingfisher *Alcedo atthis*, brown-winged kingfisher *Pelargopsis amauropterus*, ruddy kingfisher *Halcyon coromanda*, collared or mangrove kingfisher *Todirhamphus (Halcyon) chloris*, mangrove pitta *Pitta megarhyncha*, ashy drongo *Dicrurus leucophaeus*, golden-bellied gerygone *Gerygone sulphurea*, ashy tailorbird *Orthotomus ruficeps*, mangrove blue-flycatcher *Cyornis ruficastra*, pied fantail *Rhipidura javanica*, mangrove whistler *Pachycephala grisola*, plain-throated sunbird *Anthreptes malacensis* and copper-throated sunbird *Nectarinia calcostetha* (Gregory-Smith, 1993).

Particularly important to migratory waterbirds are the mangroves along the Irrawaddy delta, Myanmar (Scott, 1989; Maung, 2003), the Mekong delta (Scott, 1989; Hong & San, 1993), west coast of Peninsular Malaysia (Scott, 1989), eastern coast of Sumatra (Silvius, 1986; Silvius, Verheugt & Iskandar, 1986; Danielsen & Verheugt, 1989; Giesen, 1991;), the north coast of Java (Erftemeijer & Djuharsa, 1988) and the western coast of South Sulawesi (Baltzer, 1990; Giesen *et al.*, 1991).

East Sumatra's mangrove coasts have been found to seasonally harbour more than 90 percent of the world population of milky stork *Mycteria cinerea* (listed as Vulnerable by IUCN), which does not occur in large numbers elsewhere (<200 in Malaysia). The north coast of Java and the east coast of Sumatra supports about 90 percent of the world population of (IUCN listed) Near-threatened Asian dowitcher *Limnodromus semipalmatus* during migration (Silvius, pers. comm. December 2004).

Mammals

Mammals commonly found in Southeast Asia's mangroves include wild boar *Sus scrofa*, sambar *Cervus unicolor*, hog deer *Cervus porcinus*, mouse deer *Tragulus*

javanicus, barking deer *Muntiacus muntjak*, tapir *Tapirus malayanus*, flying foxes *Pteropus* species (e.g. roosting colony on Pulau Rambut, Jakarta Bay), otters (*Lutra perspicillata* and *Aonyx cinerea*), silvered leaf monkeys *Trachypithecus aurata* (commonly known as *Presbytis cristata*), and proboscis monkey *Nasalis larvatus* (endemic to Borneo; MacNae, 1968; Payne, Francis & Phillipps, 1985; Melisch *et al.*, 1993).

None of these are exclusive to mangroves: although it was formerly thought that proboscis monkey were only found in mangroves (MacNae, 1968), it is now well known that this species also occurs in Kalimantan's (peat-) swamp and riparian forests (e.g. Payne, Francis & Phillipps, 1985). Long-tailed (or crab-eating) macaques *Macaca fascicularis* are common in mangroves throughout their range (Viet Nam and Burma, to Sumatra, Java and Kalimantan)⁷, and are often seen foraging on the mudflats between mangroves and along creeks at low tide (Giesen, 1991a, 1991b). *Macaca ochreata ochreata* (one of the leaf monkeys endemic to Sulawesi) was observed to be common in mangroves near Malili, in Bone Nay, South Sulawesi (Giesen *et al.*, 1991).

More rarely, one may also encounter the rare fish-eating cat *Felis viverrina*, elephant *Elephas maximus*, pather *Panthera pardus* or tiger *Panthera tigris*. Curiously, squirrels are rarely seen in mangroves, although Southeast Asia has an extremely rich squirrel fauna.

Wild elephant are found scattered in small numbers in Southeast Asia, including in Myanmar, Cambodia, Thailand, Viet Nam, Malaysia (Peninsular and Sabah) and Indonesia (Sumatra). Upon occasion they may also be found in mangroves – during dry summer months in Myanmar, for example, elephants come down from the mountains to the mangroves to drink salt water.⁸

Tigers are found in small numbers and widely scattered in Myanmar, Thailand, Cambodia, Malaysia and Indonesia (Sumatra). Because of their affinity for water, they do well in wetland areas including mangroves. The Sumatran tiger *Panthera tigris sumatranus* occurs in the newly established (2003) Sungai Sembilang National Park in South Sumatra (Danielsen & Verheugt, 1989), and in combination with adjacent Berbak National Park in Jambi this area may be the best bet for survival of this sub-species in Southeast Asia (Frazier, 1992). In Myanmar, tigers used to be plentiful throughout the country forty years ago, but now at most 150 remain, and it is unknown how many, if any, use the dwindling mangroves.

⁷ The Long-tailed Macaque has apparently recently been introduced to South Sulawesi (Giesen *et al.*, 1991)

⁸ http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1404_full.html

CHAPTER

4

BENEFITS DERIVED FROM MANGROVES

Mangroves are highly beneficial, as they yield many valuable products, while also performing, free-of-cost, many important functions that support the often dense coastal populations. Economically, they are thus highly important, be it at local, regional or even national level.

4.1

MANGROVE USES

Mangroves are very productive ecosystems, and the list of mangrove products commonly used in Southeast Asia is long and impressive (Table 6). The economies of coastal villages are often very dependent on adjacent mangroves, either directly, because of the products they derive from these habitats and are able to sell, or because of the coastal fisheries that are supported by mangroves, or the coastlines that are sheltered from storms. Many commercially important fish, shellfish and prawn species depend on mangroves at least during part of their life cycle (Foo & Wong, 1980; Adiwiryo *et al.*, 1984; Sasekumar *et al.*, 1992; Burhanuddin, 1993), and it has been demonstrated that the productivity of coastal fisheries is directly correlated with the area of mangrove: the more mangrove, the better the fisheries.

Table 5 presents the main direct uses of mangrove plants in Southeast Asia – apparent is that 77 percent of all mangrove plants have some known use, and that many species have a multiple use. The most common use (41% of all species) is medicinal: mangroves are veritable medicine chests for coastal communities. This is followed by construction material at 25 percent, food (vegetable, spice, fruit) at 22 percent, ornamental use at 17 percent and fuel at (at least) 12 percent. Many minor uses are not tabulated, for example, plants used for making skirts, fruits used in games or as storage vessels, or for making food wrappers.

TABLE 5
Quantitative list of plant
products in Southeast
Asia

Mangrove use	Number of species	Percentage
Medicinal	110	41
Construction material	67	25
Food	58	22
Ornamental	46	17
Fuel*	31	12
Utensils	23	9
Fodder	23	9
Tannin	15	6
Oil & wax	11	4
Rope & binding	11	4
Mats and baskets	10	4
Hedges & fencing	8	3
Dye	8	3
Perfume	8	3
Glue	7	3
Roofing & thatching	5	2
No known use	62	23

* Use as fuel (fuel wood and charcoal) is under reported.

Data is based on the species descriptions provided in Part 2 of this publication

Wood, timber & tannin

For ages, people have exploited mangroves for timber and fuel, and even commercial exploitation has a long history, commencing with the export of timber (esp. durable poles), bark (for tannin) and charcoal from mangrove areas to larger towns. In Indonesia, large amounts of Rhizophoraceae poles are still commonly used for building foundations on soft sediments in coastal areas. Larger scale exploitation of mangroves in Indonesia began early this century, in Java and Sumatra (van Bodegom, 1929; Boon, 1936), but mechanised logging did not really commence until 1972 (Min. of Forestry & FAO, 1990). By 1985, however, 14 companies had been issued licenses for logging concessions covering a total area of 877 200 hectares, or about 35 percent of the mangroves remaining at that time (Min. Forestry & FAO, 1990). Much of the production of these concessions is in the form of wood chips, but also round timber and charcoal are exported. In 1990 these had a total value of about US\$25million, up from US\$2.6million for logs and US\$1.37 million for charcoal in 1978 (Burbridge & Koesoebiono, 1984; chips were not exported). Following a ban on the export of roundwood in the 1990s, the main export was in the form of charcoal and wood chips. In 1998, 330 000 tons of charcoal were produced in Indonesia, both for the local market and for export to Japan, Taiwan and Singapore. At the same time, 250 000 tons of mangrove wood chips were exported to Korea and Japan, at a value of US\$10 million⁹. By 2001, all wood chips exported from Indonesia came from Papua province, indicating that concessions in other provinces are depleted¹⁰.

⁹ www.jica.or.id/p_Bali2_2.html

¹⁰ www.dephut.go.id/informasi/statistik/Stat2002/contents_02.htm

Box 1. Matang forestry, Malaysia

Matang Mangrove Forest Reserve (MMFR), located on the north-west coast of Peninsular Malaysia, has a long and impressive history of sustainable management. MMFR has been managed for the production of fuel wood and poles on a sustainable basis since 1902-04, when almost the entire area was gazetted as a forestry reserve. By 1908, the entire reserve came under intensive management, which has now been carried out for almost a century (Gan, 1993), making the area one of the world's oldest well-managed mangrove area exploited on a sustainable basis. Some small pockets of dryland forest exist, but the majority of the area consists of a large expanse of mangrove forest, of which 34 769 hectares are classified as 'productive forest' and 5 942 hectares 'unproductive forest', managed by the Perak State Forest Department.

Forestry practices at the MMFR are mainly based on the extraction of *Rhizophora apiculata* and *R. mucronata*, for fuel (especially charcoal) and poles. There is a 30-year logging cycle, and about 900 hectare sare harvested annually, of which 800 hectares were for charcoal production, and 100 hectares for poles (MCF, 1987; pers. comm. MMFR 1997). In the past, a rotation cycle of 40 years was tried, but this was found less productive than the current 30 year cycle, which has three thinnings: at 10 years, 15-20 years, and 20-25 years (Ong *et al.*, 1984b). Logging is primarily clear-felling, but at least 5-10 mature trees are left per hectare to ensure an ample supply of seeds and seedlings. Also, a narrow belt of mangrove is left standing along all waterways, to prevent erosion of the river banks. After logging, plots are left for 1-2 years to allow natural regeneration to take hold, following which, enrichment planting - usually with *Rhizophora apiculata*, but also *R. mucronata* - takes place in areas with low stocking rates. About 10 000 seedlings per hectare is deemed optimal. Net productivity of the *Rhizophora apiculata* dominated mangrove forests was found to be in the range of 16-50 tons per hectare, per year (Ong *et al.*, 1984b).

Tannin from mangrove bark has traditionally been an important use of mangroves, and used to be one of the main products. However, in recent years synthetic tannin has to a large extent replaced this use (Hong, 2003).

Mangrove associated fisheries

By far the most important economic gain derived from mangrove products in many areas is that of the coastal fisheries, which depend on particulate organic matter 'exported' from mangroves for food (Boto & Bunt, 1981; Johnstone, 1981; Woodroffe, 1985) and the mangrove environment for shelter (Sasekumar *et al.*, 1992). As stated above, the productivity of these fisheries is directly correlated to the area of mangroves: for every hectare of mangrove cleared, near-coastal fisheries lose approximately 480 kilogramme of fish per year (MacKinnon & MacKinnon, 1986). This compares with an average productivity of 287 kilogrammes per hectare, per year for extensively managed brackish water fishpond or *tambak* in Sumatra (MacKinnon & MacKinnon, 1986).

Certain commercially important species, such as barramundi (ikan kakap) *Lates calcarifer*, mangrove Crab *Scylla serrata* and threadfin salmon *Polynemus sheridani* are directly dependent on mangroves and are caught in this habitat (Griffin, 1985). Indonesia's marine fisheries are largely near-coastal, being carried out by local fishing communities in a little-mechanised fashion, or by commercial fishing fleets operating from larger harbour towns. In 1990, the total production of Indonesia's marine fishery was 2.49 million tons, involving almost 400 000 families, or about 2 million persons (Biro Pusat Statistik, 1993). The total value is not indicated in the national statistics, but is estimated to be in the range of US\$500-1245 million; much of this is for subsistence, local markets and the national market. By 2000,

production had increased to 3.7 million tons, not including the 320 000 tons of crustaceans and molluscs (WRI, 2003)¹¹.

Box 2. Matang fisheries, Malaysia

The Matang Mangrove Forest Reserve is highly important for fisheries, which form the bulk of the income from this area, and targeted species include prawns, shrimps, seabass, mangrove crabs and cockles. While the forests are exploited by the Perak State Forestry Department, fisheries resources are exploited by local fishing communities, and MMFR fisheries are essentially an open-access resource. All fisheries are capture fisheries, although some species, such as sea bass and mangrove crab, may be reared and fattened before being sold. There are no aquaculture ponds.

Fifteen species of penaeid prawn and 5 species of palaemonid prawns are found in the MMFR, with *Parapenaeopsis* species generally preferring the mudflats, and the *Penaeus* and *Metapenaeus* species preferring river mouths and creeks. Mean densities were 7.35 kilogrammes per hectare (4 092 individuals) for rivers and creeks, and 7.19 kilogramme per hectare (2,668 individuals) for mudflats. These areas are important nursery areas for juvenile prawns, which comprise 70-98 percent of the river, and 40-90 percent of the mudflat populations (Chong, 1994). Common prawns in the MMFR are *Penaeus monodon*, *P. merguensis* and *P. indicus* (Khoo, 1991). A total of 117 fish species (of 49 families) have been recorded at MMFR, of which the most abundant are the ambassids (18.0%) and the sciaenids (17.5%). Average biomass in river channels was 40.0 kilogramme per hectare, while that of the adjacent mudflats was 30.5 kilogramme per hectare; fish densities were 8 517 and 6 699 individuals per hectare, respectively, for river channels and mudflats. Juvenile fish comprise 85 percent of all individuals, both in river channels and above mudflats (Sasekumar *et al.*, 1994).

Tourism

Mangrove areas are increasingly becoming important for (eco)tourism, education and study, especially in areas where they are readily accessible. In Malaysia, for example, Kuala Selangor Nature Park on the west coast of Peninsular Malaysia, is a popular destination for nature lovers, birders and students, especially as it only an hour's drive from Kuala Lumpur and has accessible trails and walkways through the mangroves. Chek Jawa on Singapore is similarly popular, especially with schools and students, and has its own home page¹². Indonesian mangroves are generally less accessible, but mangrove islands just off the coast of Java (near Jakarta) such as Pulau Rambut and Pulau Dua, are popular destinations for birders. In Thailand, mangrove sites such as Yaring Mangrove Education Center at Pattani, are popular tourist destinations and much used by local schools.

¹¹ www.earthtrends.wri.org (2003)

¹² <http://habitatnews.nus.edu.sg/news/chekjawa>

TABLE 6
Mangrove products

Category & type of use	Examples of species used
Fuel: <ul style="list-style-type: none"> Firewood Charcoal Alcohol 	Most tree species Many tree species <i>Nypa fruticans</i>
Construction: <ul style="list-style-type: none"> Timber, scaffolds Heavy construction Railroad sleepers Mining pit props Boat building Dock pilings Beams & poles for buildings Flooring, panelling Thatch Matting Fence posts/water pipes Chipboards Glues 	<i>Bruguiera</i> , <i>Rhizophora</i> spp. <i>Bruguiera</i> , <i>Rhizophora</i> spp. <i>Rhizophora</i> , <i>Ceriops</i> spp. <i>Bruguiera</i> , <i>Rhizophora</i> spp. <i>Corypha saribus</i> (masts), <i>Lumnitzera</i> <i>Lumnitzera</i> spp. <i>Rhizophora</i> , <i>Bruguiera</i> spp. <i>Oncosperma tigillarum</i> <i>Nypa fruticans</i> , <i>Acrostichum speciosum</i> <i>Cyperus malaccensis</i> , <i>Eleocharis dulcis</i> <i>Scolopia macrophylla</i> Mainly <i>Rhizophoraceae</i> <i>Cycas rumphii</i>
Fishing: <ul style="list-style-type: none"> Poles for fishing traps Fishing floats Fish poisons Tannings for nets & line Rope Anchors Caulking of boats 	<i>Ceriops</i> spp. <i>Dolichandrone spathacea</i> , <i>Sonneratia alba</i> <i>Derris trifoliata</i> , <i>Cerbera floribunda</i> <i>Rhizophoraceae</i> <i>Stenochlaena palustris</i> , <i>Hibiscus tiliaceus</i> <i>Pemphis acidula</i> , <i>Rhizophora apiculata</i> <i>Atuna racemosa</i> , <i>Osbornia octodonta</i>
Textiles, leather: <ul style="list-style-type: none"> Synthetic fibres (e.g. rayon) Dye for cloth Tannings Clothing (skirts) 	Mainly <i>Rhizophoraceae</i> <i>Excoecaria indica</i> , <i>Peltophorum pterocarpum</i> Mainly <i>Rhizophora</i> , <i>Lumnitzera</i> spp. <i>Eleocharis dulcis</i>
Agriculture: <ul style="list-style-type: none"> Fodder, green manure 	<i>Paspalum vaginatum</i> , <i>Colocasia esculenta</i>
Paper Products: <ul style="list-style-type: none"> Paper of various kinds 	<i>Avicennia marina</i> , <i>Camptostemon schultzei</i>
Household items: <ul style="list-style-type: none"> Furniture Decorations Glue Hair oil Perfume Tool handles Pillow stuffing Baskets Toys Incense Ornamental plant Wax (candles) Medicines Insect repellent Vinegar Buttons Charms, decorations 	Many timber species <i>Xylocarpus granatum</i> , <i>Scaevola taccada</i> <i>Cycas rumphii</i> <i>Xylocarpus mekongensis</i> <i>Phymatodes scolopendria</i> <i>Dolichandrone spathacea</i> , <i>X. granatum</i> <i>Typha angustifolia</i> <i>Cyperus malaccensis</i> , <i>Scirpus grossus</i> <i>Dolichandrone spathacea</i> , <i>Excoecaria indica</i> <i>Cerbera manghas</i> (insecticide) <i>Cryptocoryne ciliata</i> , <i>Crinum asiaticum</i> <i>Horsfieldia irya</i> <i>Drymoglossum piloselloides</i> , <i>Drynaria rigidula</i> <i>Osbornia octodonta</i> , <i>Quassia indica</i> <i>Nypa fruticans</i> <i>Nypa fruticans</i> <i>Nypa fruticans</i>

TABLE 6
Mangrove products (ctd.)

Category & type of use	Examples of species used
Food, drugs & beverages: <ul style="list-style-type: none"> ▪ Sugar ▪ Fruit ▪ Alcohol ▪ Cooking oil ▪ Fermented drinks ▪ Sweetmeats ▪ Vegetables ▪ Cigarette Paper ▪ Substitute for tobacco 	<i>Nypa fruticans</i> <i>Nypa fruticans</i> , <i>Sonneratia</i> spp. <i>Nypa fruticans</i> <i>Terminalia catappa</i> seeds <i>Rhizophora stylosa</i> , <i>Nypa fruticans</i> <i>Bruguiera cylindrica</i> , <i>B. gymnorrhiza</i> <i>Stenochlaena palustris</i> , <i>Avicennia</i> , <i>Inocarpus fagifer</i> <i>Nypa fruticans</i> <i>Loxogramma involuta</i>
Animal products: <ul style="list-style-type: none"> ▪ Fish ▪ Crustaceans ▪ Shellfish ▪ Honey & wax ▪ Birds ▪ Mammals ▪ Reptiles ▪ Others 	<i>Lates calcarifer</i> , <i>Chanos chanos</i> <i>Penaeus</i> spp., <i>Scylla serrata</i> Cockles, mussels, oysters Mainly migratory Asian Bee <i>Apis dorsata</i> Mainly waterbirds Mainly wild boar <i>Sus scrofa</i> <i>Varanus salvator</i> , <i>Crocodylus porosus</i> (leather, food) <i>Fejervarya (Rana) cancrivora</i>

Modified from Saenger *et al.* (1983), including information on individual species from Knox and Miyabara (1984), Fong (1984) and this publication, along with several new categories.

4.2

MANGROVE FUNCTIONS

Shoreline protection

Mangroves play an important role in protecting shorelines from waves, winds and storms. The roots of mangrove plants bind and stabilize the substrate, the plants themselves dissipate wave and current energy, and the vegetation as a whole can trap sediments (Davies & Claridge, 1993; Othman, 1994). They offer the best protection against tropical storms, storm surges and tsunamis, and are being replanted in certain areas where they have been felled in the past (e.g. Bay of Bengal, Mekong Delta of Viet Nam) especially for this purpose. In Bangladesh, a storm surge in 1970 killed 150 000-300 000 persons, and in June 1985, 40 000 people were drowned (Maltby, 1986). A study of the 1970 disaster found that about a third of the survivors saved themselves by clinging to trees. Recognising the role of mangroves, the government of Bangladesh replanted a total of 25 000 hectares of mangrove (Maltby, 1986) and is continuing this process at present. One of the few quantitative studies on wave attenuation reported by Kogo and Kogo (2004), found that a 1.5 kilometre-wide belt of 2 metre tall *Kandelia candel* at Thai Thuy (northern Viet Nam), reduced a 1.0 metre high wave crest to a benign 5 centimetres. Without the young *Kandelia* belt these waves would still have been 75 centimetres tall, and capable of considerable damage.

In October 1999, mangrove forests reduced the impact of a 'super-cyclone' that struck Orissa on India's east coast, killing at least 10 000 people and making 7.5 million homeless. Those human settlements located behind healthy mangrove stands suffered little, if any, losses. According to a report

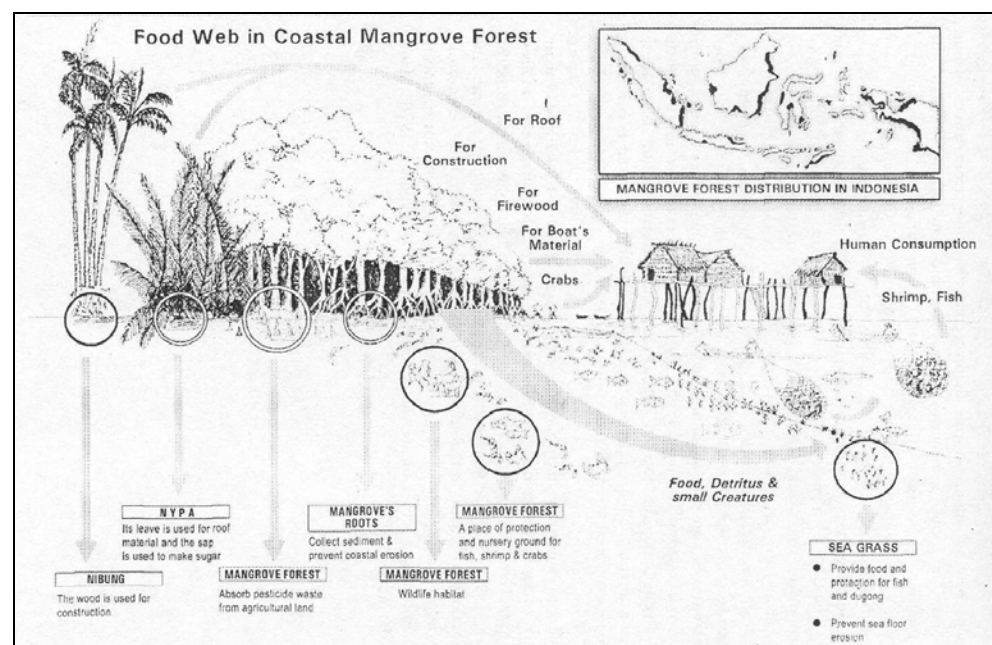
from India, when the tsunami that originated near Aceh, in Sumatra, struck India's southern state of Tamil Nadu on 26 December 2004, areas in Pichavaram and Muthupet with dense mangroves suffered fewer human casualties and less damage to property compared to areas without mangroves (Mangrove Action Project, 4 January 2005¹³). Similar findings are reported for southern Thailand, where evidence suggests that mangroves helped reduce the devastation caused by the tsunami's waves (Harakunarak & Aksornkoae, 2005).

Formerly, sediment binding by mangroves was seen as an active process: "where you have mangroves you would automatically get accretion" (e.g. Steup, 1941), but the consensus now is that mangroves stabilize and bind on already accreting shores (van Steenis, 1958; Chapman, 1976, 1977). Mangrove vegetation can also shield structures, crops and coastlines from damage by strong wind or salt-laden wind.

Support to food web

The role of mangroves in supporting near-shore fisheries is twofold. Firstly, they play an important role in the life cycles of many fish, shrimp and mollusc species (MacNae, 1968; Chapman, 1976; Mann, 1982; Davies & Claridge, 1993; Mastaller, 1997; Figure 6), as these environments provide a combination of shelter and (via the detritus chain) an abundance of organic matter: food. Secondly, mangroves are net exporters of organic matter, thus providing food for organisms that inhabit waters well outside the actual mangrove (Chapman, 1976; Mann, 1982; Sasekumar, 1992; Mastaller, 1997).

FIGURE 6
Food web and use of
mangroves in Indonesia



Adapted from a poster produced by Asian Wetland Bureau - Indonesia Programme (1992)

¹³ <http://www.earthisland.org/map/>

Carbon sequestration

Mangroves are able to sequester some 1.5 metric tons of carbon per hectare per year (Ong, 1993; according to Fujimoto, 2004, this may range from 0.22-1.24 tons per hectares per year), and the upper layers of mangrove sediments have a high carbon content, with conservative estimates indicating levels of 10 percent. Conversion of mangroves to fishponds – which invariably involves excavation of about two metres of sediment – will eventually result in a release of about 1 400 tons of carbon from the sediments alone (Ong, 2002). According to calculations by Ong (2002), the conversion of two percent of mangroves to aquaculture already means that the advantage of mangroves as a sink of atmospheric carbon are lost.

4.3

ECONOMIC VALUE OF MANGROVES

Over the past 10-15 years, numerous economic and valuation studies have been carried out on mangrove ecosystems, both in Southeast Asia and beyond (e.g. Ruitenbeek, 1992; Spaninks & van Beukering, 1997; Gammage, 1997; Satharathai, 1997; Bann, 1998; Khalil, 1999; Pearce *et al.*, 2002; PEMSEA, 2004). These consistently show that these systems are highly valuable assets, and of prime importance to coastal communities and local and regional economies. Fisheries are often the most valuable extracted products, followed by timber products (see Table 7), but mangrove services (e.g. coastal protection or biodiversity value) may be worth many times this. A total economic valuation study in Indonesia (Moosa *et al.*, 1996), for example, shows that the archipelago's mangroves and their biodiversity was worth more than US\$350 billion, or US\$110 000 per hectare if all benefits are included.

TABLE 7
Economic value of various
mangrove products

Product	Country	Kg/ha.year	Value (US\$/ha.yr)	Year	Ref.
Penaeid shrimp	Various	13-756	91-5 292	1999	1
Mud crabs	Various	13-64	39-352	1999	1
Fish	Various	257-900	475-713	1999	1
Molluscs	Various	500-979	140-274	1999	1
Fish & shrimp	Thailand		30-2 000	1978	2
Shrimp & fish	Malaysia		2 772	1979	4
Fishery products	Malaysia		750	1982	5
Forestry products	Malaysia		225	1982	5
Wood products	Malaysia	16 000-50 000		1984	6
Charcoal & wood chips	Indonesia		10-20	1978	2
Charcoal	Thailand		4 000	1991	3

References:

1. Ronnback, 1999 (cited in Primavera, 2004)
2. Hamilton & Snedaker, 1984 (cited in Primavera, 2004)
3. McNeely & Dobias, 1991 (cites in Primavera, 2004)
4. Gedney, Kapetsky & Kuhnhold, 1982 (cited in Primavera, 2004)
5. Ong, 1982 (cited in Primavera, 2004)
6. Ong, 1984b

Indonesia

A landmark economic study carried out in Bintuni Bay, in Indonesia's Papua province by Ruitenbeek (1992) showed that traditional uses of the 300 000 hectare mangrove area by the 3 000 local inhabitants of the bay were valued at US\$10 million per year. At the same time, fisheries were valued at US\$35 million per year, and selective mangrove cutting schemes were calculated to be valued at US\$20 million per year. Selective cutting of 25 percent of the mangrove appeared to be the optimal strategy, under the likely scenario of 5-year delayed linkages between economics and environment. Other scenarios were found to be less optimal, and the economic benefits of limited selective cutting was found to be greater than the clear cutting option, and the option of more extensive cutting (Ruitenbeek, 1992).

Malaysia

The Matang Mangrove Forest Reserve in Malaysia (see 4.1) is of considerable economic importance to Perak State, and the area is a major supplier of seafood to the local and international market. Revenues from forestry were US\$6-9 million annually in the early 1980s (MCF, 1987), and totalled more than US\$ 12 million by the late 1990s. In 1979 the value of the prawn and cockle industries in the area was estimated to be at least US\$30 million (Ong, 1982). By 1994, the prawn industry alone valued at US\$48 million (Sasekumar *et al.*, 1994), and the fishing industry of the area is estimated to be valued at more than US\$60 million annually. The total value of the forestry and fisheries alone means that the Matang mangroves are valued at an impressive US\$1 800 per hectare, per year. Elsewhere, one square kilometre of mangrove forest was calculated to be capable of sustainably producing 38 tonnes of fish per year, and providing nursery grounds for an added 48 tonnes of fish and shrimp that mature elsewhere each year¹⁴.

Thailand

Studies by Sathirathai (1997) and summarised by the Regional Task Force on Economic Valuation¹⁵ indicate that the total economic value (TEV) of Thai mangroves was in the range of US\$520-667 per hectare per year. This calculation included a host of direct uses (timber, fuelwood, wood/animal products), offshore fisheries, coastal protection and carbon sequestration. However, it does not include non use values such as biodiversity, and uniqueness to culture and heritage.

Viet Nam

Studies on mangroves in Qunag Ninh, Nam Dinh, Cuu Long and Ca Mau by Nguyen Ngoc Binh and Huynh Minh Hong (summarised by the Regional Task Force on Economic Valuation¹³) indicate that the total economic value of Vietnamese mangroves was in the range of US\$315-1 085 per hectare per year, averaging at US\$721 per hectare per year. At the lower end of the scale was Qunag Ninh, where environmental services

¹⁴ <http://home.alltel.net/bsundquist1/fi7.html#A>

¹⁵ <http://www.unepscs.org/Documents/RTF-E1/RTF-E.1-6%20Extracts.pdf>

were regarded as zero, as they did not need to mitigate typhoons, and there was no ecotourism. At the upper end of the scale was Nam Dinh in the Red River estuary, where fisheries accounted for two-thirds of mangrove value, but where environmental services and ecotourism were also significant. The valuation study did not include carbon sequestration, nor did it include non use values such as biodiversity, and uniqueness to culture and heritage.

Malacca Straits

A recent valuation study on coastal and marine resources in the Malacca Straits, between Malaysia and Indonesia (PEMSEA, 2004) shows that the TEV of mangrove resources in this area is US\$3.25 billion, with a net market value of US\$582 million. Of this TEV, US\$1.1 billion is attributable to fisheries alone. In Indonesia, Malacca Strait mangroves had a direct use value of US\$734 million, of which 80 percent for fisheries, 12.4 percent for charcoal and poles, 6.1 percent for tourism, 1.2 percent for traditional uses and 0.3 percent for wildlife (PEMSEA, 2004).

CHAPTER 5 THE STATE OF SOUTHEAST ASIAN MANGROVES

5.1 PAST AND PRESENT AREA

All over the world mangrove resources are increasingly being lost due to unsustainable utilization and habitat conversion (Snedaker, 1984; Fiseler *et al.*, 1990; Groombridge, 1992; Aksornkoae, 1993, Thurai Raja, 1994; Mastaller, 1997), and on the whole, Southeast Asia is no exception. Around 1980, the total mangrove area in Southeast Asia totalled 6.8 million hectares (Table 8), which is about 34-42 percent of the world's total (see 1.2). By 1990, however, this had dropped to under 5.7 million hectares, representing a decrease of about 15 percent or more than 110 000 hectares per year. Between 1990-2000 the annual loss had decreased to 79 000 hectares, but as the total area had also decreased there was still a 13.8 percent decline in mangrove area during this decade.

Brunei Darussalam

Brunei's mangrove area has remained relatively constant since about 1980, having declined from about 18 000 to about 16 000 hectares in 2000 (Table 8), although WCMC report a remaining area of only 7 000 hectares in 1990 (see Table 8). Much of this mangrove area is located around Brunei Bay, and significant amounts are included in the country's protected area system (Scott, 1989).

Cambodia

Cambodia's mangroves dropped from 83 000 hectares in 1980, to less than 60 000 hectares by about 1990 (Fisheries Department Cambodia, 2001), having suffered 'tremendous deterioration' over recent decades. Reliable figures later than 1990 are absent, other than a WRM (2000) website report stating that the government admitted that the total area had deteriorated to about 16 000 hectares. Most (75%) of the remaining mangrove area is found in Koh Kong Province, along with 13 500 hectares in Sihanoukville, and 7 900 hectares in Kampot and Kep City (Smith, 2001).

Indonesia

Southeast Asia's largest mangrove area occurs in Indonesia, where just under 60 percent of the region's mangroves are located (Table 8). This extended over 4.25 million hectares in 1980, but had been reduced to under 3 million hectares by 2000, with losses of more than 90 percent in some regions (e.g. Java; see 5.2). Giesen (1993) calculated a total mangrove area of 2.49 million hectares remaining by the late 1980s, based on a combination of RePPProT (1985-1989) mapping data, satellite imagery (Sumatra and South Sulawesi) and data on area converted to brackish water fishponds. The 2.5 million hectares figure is now more generally used in Indonesia (e.g. Soegiarto, 2004), although figures ranging between 3-4.5 million hectares are also in use.

By most calculations, more than half (55%) occurs in Papua province, with a further 19 percent in Sumatra and 16 percent in Indonesian Borneo (Kalimantan). Indonesian data, however, are fraught with inaccuracies, and there are two major sources of error. Firstly, there are very few actual calculations of mangrove area, and more often than not, outdated references are quoted again and again¹⁶ (e.g. Burbridge & Koesoebiono, 1980; Burbridge, 1982). Secondly, estimates for the Papuan region vary widely, from 0.97 to 2.94 million hectares (Min. of Forestry & FAO, 1990), mainly because of a lack of reliable data (little ground truthing, few maps or cloud-free remote sensing imagery).

Malaysia

Malaysia is next in terms of mangrove area, harbouring about 11.7 percent of Southeast Asia's mangroves. This extended over almost 670 000 hectares in 1980, but had been reduced to about 570 000 hectares by 2000. Mangroves primarily occur in Sabah (57%), Sarawak (26%) and the west coast of peninsular Malaysia (17%). Of these, 440 400 hectares are reserve forests. About 20 percent of the total mangrove area has been lost to various development activities in the last two decades. The most significant losses have been in Peninsular Malaysia, where large areas have been converted for agriculture, coastal road development and housing estates.

Myanmar

About 8.8 percent of Southeast Asia's mangroves are located in Myanmar, of which 46 percent is located in Ayeyarwady (Irrawaddy) Division, 37 percent in Tanintahryi Division and 17 percent in Rakhine State. The total area was about 530 000 hectares in 1980, but this had dropped to 425 000 hectares by 2000 (Table 8), or perhaps as low as 382 032ha¹⁷. Prawn and fish ponds are only just being constructed since about 2000 (Maung, 2003). Myanmar's mangroves are reportedly some of the most degraded or destroyed mangrove systems in the Indo-Pacific¹⁸.

¹⁶ www.reefbase.org

¹⁷ <http://www.mangroveweb.net/html/country.htm>

¹⁸ http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1404_full.html

Papua New Guinea

According to most references, Papua New Guinea has about 8.7 percent of Southeast Asia's mangroves, extending just over 500 000 hectares in the 1980s (see Table 8). Areas remain fairly stable, and by 2000 mangrove area amounted to just over 400 000 hectares. WCMC, however, report that only 200 000 hectares existed in the 1970s (Table 8), perhaps because island fringing mangroves were not included in their calculations. The largest areas of mangroves occur in the south, especially along the Gulf of Papua into which several large rivers flow (e.g. the Fly, Kikori and the Purari). On the whole, the north coast is not as rich in mangroves as the south coast, although several species such as *Avicennia alba* and *Sonneratia caseolaris* appear to be confined to the north coast¹⁹.

The Philippines

The Philippines harbours about 2.2 percent of Southeast Asia's remaining mangrove area. Brown and Fisher (1918; cited by Primavera, 2004) calculated that the Philippines had a total mangrove area of 500 000 hectares at the turn of the last century. According to Aragones *et al.* (1998), Janssen and Padilla (1996) and Aypa and Bacongus²⁰, Philippine mangroves declined from 418 990 hectares in 1967 to 288 035 hectares in 1970, 204 253 hectares in 1987 and 123 400 hectares in 1993. By 2000 it was estimated that this had further declined to just over 100 000 hectares (Table 8). According to Davies *et al.* (1990) only 119 000 hectares remained in 1990, of which only 81 400 hectares could be classified as undisturbed (Petocz, 1988). Much of this decline seems linked with the development of brackish water aquaculture (see below; Janssen & Padilla, 1996).

Singapore

Formerly, about 13 percent of Singapore island consisted of mangrove forest, but nowadays less than 0.5 percent (500 ha) remain. Some of this is protected in several small reserves, such as Sungai Buloh²¹.

Thailand

According to Aksornkoae (1993), Thailand had 367 900 hectares of mangrove in 1961, which was reduced to 174 000 hectares by 1990 (Wattayakorn, 1998), and had reportedly further declined to 167 582 hectares by 1996. Most of this dramatic decline appears to have been between 1975-1991²².

Since the mid-1990s, however, two changes have occurred in Thailand that have reversed this trend of decline. Firstly, the method by which the Royal Forest Department (RFD) assessed forest areas changed: formerly they interpreted imagery at a scale of 1:250 000, but in the latest assessments (e.g. 2002), imagery at a scale of 1:50 000 was used. This change in scale

¹⁹ http://earthtrends.wri.org/pdf_library/country_profiles/Coa_cou_598.pdf

²⁰ <http://www.mangroveweb.net/html/country.htm>

²¹ <http://mangrove.nus.edu.sg/guidebooks/text/1016.htm>

²² (www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1402_full.html).

made the assessment of mangrove areas more accurate, and also allowed the inclusion of smaller areas in the overall calculation. Secondly, Thailand has invested in large-scale reforestation programmes in abandoned shrimp pond areas and other degraded sites since the late 1990s. The net effect has been that by 2000, the total mangrove area was determined to be 244 161 hectares (RFD Forestry Statistics 2002). As a result, Thailand is the only Southeast Asian country that has witnessed an increase in mangrove area during the past decade, although total areas are still well below what was present in the 1960s.

Thailand presently has just under five percent of Southeast Asia's mangroves, covering large areas along the western peninsula coast and also along the eastern peninsula coast, in the Chao Phraya delta and along the south-eastern coast. The best developed mangrove forest in Thailand occurs on the west coast of the peninsula in Ranong, Phang Nga, Krabi, Trang and Satun. Mangroves in the inner and western part of the gulf of Thailand are mainly converted into shrimp farms, while the remaining mangroves are largely composed of small sized trees.

Timor-Leste

Timor-Leste's mangroves extend over just 3 000 hectares, and are found mainly on the north coast of the island, where the sea is calmer, especially near Metinaro, Tibar and Maubara. Along the south coast mangroves are not found beyond the mouths of streams and adjacent swampy areas²³.

Viet Nam

Viet Nam has about 2.1 percent of Southeast Asia's mangroves (just over 100,000 hectares in 2000), and the largest area of remaining mangroves is around Ca Mau Point at the southern tip of Viet Nam, with smaller areas in the Mekong delta region (together 66 percent of remaining mangroves), in south central Viet Nam around Cam Ranh Bay, and in northern Viet Nam in the Red River delta area (13%) and in Quang Ninh Province (15%). The central coast of Viet Nam (2%) is largely free of mangroves because of the exposed coastline, absence of major river deltas, and low tidal fluctuations in this area. Far more extensive stands of mangroves once occurred, with 408 500 hectares being recorded in 1945 and 290 000 hectares in 1953 (Hong, 2003). The extensive military use of defoliants and napalm during the Viet Nam War (1962-1972) destroyed a major part of mangrove forests, especially in southern Viet Nam, but these are recovering under active reforestation programmes²⁴.

²³ <http://www.uc.pt/timor/florafauna.html>

²⁴ http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1402_full.html

TABLE 8
Changes in mangrove area
1980-2000

	Most recent reliable mangrove estimate		Mangrove area (ha)	Mangrove area (ha)	Mangrove area (ha)	Percentage of total	Annual change (ha/yr)		WCMC figures		Least optimistic
	ha	year	1980	1990	2000		1980-1990	1990-2000	ha	year	1990s
Brunei Darussalam	17100	1992	18300	17300	16300	0.33	-100	-100	7000	1990	16300
Cambodia	72835	1997	83000	74600	63700	1.30	-840	-1090	60000	1989	16000
Indonesia	3493110	1988	4254000	3530700	2930000	59.79	-72330	-60070	4200000	1987	2496000
Malaysia	587269	1995	669000	620500	572100	11.67	-4850	-4840	630000	1985	572100
Myanmar	452492	1996	531000	480000	432300	8.82	-5100	-4770	517500	1982	382186
Papua New Guinea	464000	1993	525000	492000	425000	8.67	-3300	-6700	200000	1970	425000
Philippines	127610	1990	206500	123400	109700	2.23	-8310	-1370	232100	1987	109700
Singapore	500	1990	2700	500	500	0.01	-220	0			500
Thailand	244161	2000	285500	180559	244161	4.98	-10500	6360	196400	1987	167582
Timor-Leste	3035	2000	4100	3600	3035	0.06	-50	-57			3035
Viet Nam	252500	1983	227000	165000	104000	2.12	-6200	-6100	370000	1987	104000
Total	5714612		6806100	5688159	4900796	100	-111800	-78737	6413000		4292403

Recent reliable figures. Brunei Darussalam: Spalding *et al.* (1997); Cambodia: Department of Forestry and Wildlife (1998); Indonesia, Malaysia and Myanmar: FAO (2003); Papua New Guinea: Saunders (1993); Philippines: Melana (1994); Singapore: Chan & Corlett (1999); Thailand: Thailand RFD Statistics 2002; Timor-Leste: www.ci.uc.pt/Timor/florafauna.html; Viet Nam: Hong & San (1993).

Least optimistic figures. Brunei: Zamorra (1992); Cambodia: WRM (2000), Myanmar, Singapore: Mackinnon (1997); Indonesia: Spalding *et al.* (1997); Malaysia: Chan *et al.* (1993); Philippines: White & de Leon (1996); Viet Nam: ADB (2000).

WCMC figures: http://www.wcmc.org.uk/marine/data/coral_mangrove/marine.maps.main.html

5.2

CAUSES OF DECLINE

Direct causes of mangrove decline

Developments that have contributed to decline of Southeast Asian mangroves are commercial logging, conversion to brackish water fishponds, agriculture (mainly rice paddies and coconut), fuelwood and charcoal production, and conversion for housing. The impact of each of these varies per country. In countries with major fishing industries such as Thailand, Indonesia, the Philippines and Viet Nam, conversion to brackish water aquaculture is a major agent of change. In small, densely inhabited Singapore the need for land for housing and industry has led to infilling and disappearance of mangroves. Myanmar and Papua New Guinea have a less developed fishing industry and no great shortage of land, hence there has been little conversion other than for forestry and fuel production.

Underlying causes of mangrove decline

A complicating factor in mangrove conversion is often land ownership. Legal ownership of mangroves is complicated due to the many different institutions involved, unclear land allocation procedures, and lack of a centralised up-to-date administration of land titles. Mangrove land can be obtained relatively easily and at low investment costs for the development of tambak and housing estates. This low cost does not reflect the true market value of mangroves, a problem that seems to occur throughout Southeast Asia (Othman, 1995; Thurairaja, 1994). Permits may be provided without proper consultation of higher authorities, a problem that is exacerbated by sectoral approaches, with one agency approving what another might find undesirable (e.g. conversion of 2 500 hectares of Karang Gading Langkat Timur Laut in North Sumatra in the 1980s; Giesen & Sukotjo, 1991).

Local people have exploited mangroves for eons, usually without noticable degradation of this environment. This has changed during the past decades, however, with increased internal (e.g. population) and external (e.g. investment, immigration) pressures. To quote Fiselier *et al.* (1990): "Reclamation for aquaculture and agriculture is currently considered the main way to achieve development of mangrove areas. These types of reclamation are costly, often unsustainable, and have adverse environmental effects. They mainly benefit outsiders, and to a lesser extent local communities, to the prejudice of those traditionally engaged in fisheries and the gathering of forest products." This is supported by Ong (1982) in his discussion on mangrove conversion in Malaysia, who concludes that "... both economics and ecology argue against aquaculture."

Cambodia

The main threats to Cambodian mangroves have been from conversion to aquaculture, charcoal production, and salt pan construction. Unregulated exploitation of mangroves for firewood and charcoal took place during the Pol Pot era and further intensified since the 1990s, both for commercial and export purposes. In Peam Krasoap (Koh Kong District) alone, for example,

the number of kilns for producing mangrove charcoal increased to 300 by mid 1996, using 26 760 cubic metres of mangrove wood (Sour, 2003). Although exact figures are lacking, the greatest threat to Cambodian mangroves has been from conversion to shrimp ponds, especially in the area close to the Thai border, where local communities have cleared and converted mangroves following investments by Thai businessmen. Ponds in this area have been heavily impacted by disease, with shrimp production dropping from 731 tons in 1995, to just 52 tons in 2002. As a result, many ponds have been abandoned. Some mangrove areas have also been cleared for construction purposes and for establishing salt pans, especially in Kampot province and Kep Municipality (Sour, 2003).

Indonesia

While conversion for aquaculture contributed about 25 percent of the loss of mangroves (see 5.3), the remaining 75 percent seems to stem from a combination of a) conversion to agriculture, b) growth of secondary (non-forest) vegetation after over-exploitation by coastal communities, c) lack of forest regeneration after commercial logging, and d) coastal erosion (likely to be very minor factor).

Commercial logging of mangroves formerly centered on Riau, South Sumatra, Aceh and Kalimantan provinces, but present activities are mainly in Papua. The area under logging concession has increased from 455 000 hectares in 1978 (Burbridge & Koesoebomo, 1980) to 877 200 hectares in 1985 (Min. of Forestry and FAO, 1990), or about 35 percent of the remaining area of mangroves at the time²⁵. It is difficult to assess the effect logging has had on mangrove loss, however. Nurkin (1979) describes how former mangrove areas in South Sulawesi were invaded by *Acrosticum aureum* ferns following logging operations, a process that often affects mangrove regeneration. However, in other areas mangroves re-establish themselves vigorously, for example in Southeast Riau province, Sumatra (Giesen, 1991b), and in remnant mangroves of Sungei Kecil in West Kalimantan, Indonesia (Abdulhadi & Suhardjono, 1994).

Regeneration does not always imply that the same vegetation returns, however, and quite often less desirable tree species may become dominant, such as *Xylocarpus granatum* (Bakung Island, Riau; Giesen, 1991b), *Excoecaria agallocha* and *Bruguiera parviflora* (both at Karang Gading Langkat Timur Laut, North Sumatra; Giesen & Sukotjo, 1991). Sustainable logging of mangrove forests seems to be a possibility, because of the rapid regeneration, the availability of sufficient nutrients and the relatively simple vegetation structure. However, sustainable forest management generally implies a removal of commercially less-desired species, and thus decrease of biodiversity. Old trees are harvested which causes a significant decrease of epiphytes, parasites and climbers.

²⁵ This did not include the Marubeni concession in Bintuni Bay, Papua, which was more than 250 000 hectares, but has been cancelled since then.

A rather recent development is land-reclamation of former mangrove areas for housing and recreation estates. In Indonesia this started with the successful reclamation of the Ancol marshlands, on the outskirts of Jakarta, in the early 1970s. After that the Pluit marshlands were reclaimed, and reclamation is still continuing in a westward direction. These land reclamation activities are not confined to the urban parts of Java; the city of Ternate (Maluku) is planning to reclaim 30 hectares of former mangrove area (*Kompas*, August 9, 1996).

Malaysia

About 20 percent of Malaysia's total mangrove area has been lost to various development activities in the last two decades. The most significant losses have been in Peninsular Malaysia, where large areas have been converted for agriculture and housing estates, but also to make way for coastal roads. Aquaculture development, however, has been limited. According to the Malaysia Nature Society, Peninsular Malaysia has lost more than one-third of its mangrove forest during the past two decades, a lot of it cleared illegally. Only a relatively small percentage has been lost to aquaculture development (see 5.3), which totalled about 5 100 hectares in 2002.

Myanmar

According to WWF²⁶, Myanmar's mangrove forests are subject to severe degradation because there is no clearly defined land-use system. Mangrove forests have been converted to agriculture and other development activities throughout the country. They have also been felled on a large scale to meet the domestic demand for fuelwood and charcoal production. By 2000, there were about 12 000 hectares of shrimp ponds in former mangrove areas, and there were plans for conversion of another 40 000 hectares for this industry²⁷. The Irrawaddy River is one of the most heavily silted rivers in the world, and with a sedimentation rate of 299 million tons per year, and it ranks fifth behind the Yellow, Ganges, Amazon, and Mississippi rivers in silt deposition. The sedimentation rate is getting worse as deforestation and agricultural erosion continue. If the situation between 1977 and 1986 is maintained, it was estimated that all the mangrove forests will disappear in fifty years.

Philippines

According to Aragones *et al.* (1998) and Aypa and Bacongus²⁸ the main causes of decline of mangroves in the Philippines are charcoal and firewood utilisation, followed by the expansion of agricultural areas, fishponds, urban and industrial development, harbor construction, mining and housing projects. According to Janssen and Padilla (1996), however, shrimp pond construction is the main contributing factor, and this is supported by their data (Figure 7). According to Alvarez (1984), the main cause up to the 1980s was a combination of legal and illegal felling.

²⁶ http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1404_full.html

²⁷ www.mangroveweb.net/html/country.htm

²⁸ <http://www.mangroveweb.net/html/country.htm>

Thailand

Some areas of mangrove forest have been reclaimed for urban development and agriculture, but the main driving force behind the decline of the country's mangroves has been aquaculture (Aksornkoae, 1993). According to Wattayakorn (1998), conversion to aquaculture accounted for 64 percent of mangrove loss between 1960-1990, while coastal development (urbanisation, industrial expansion, infrastructure, ports and harbours) accounted for 24 percent. Thailand's mangroves have been heavily exploited for shrimp farming since 1975 (see 5.3), and especially during 1985-1990 (Aksornkoae, 1993). Most of the remaining mangroves (143 961 ha) are under concessions designated for charcoal production, and at present they are controlled by 40 mangrove management units. Large areas of mangrove have been logged for charcoal production, to supply the domestic market and markets in Malaysia, Singapore, and Hong Kong (Spalding *et al.* 1997²⁹).

Viet Nam

Before 1945, Viet Nam had an estimated 408 500 hectares of mangrove, which subsequently declined to about 290 000 hectares by 1953. The mangrove forests of the Mekong Delta – especially in Can Gio and the Ca Mau peninsula – were extensively damaged by bombs and defoliants, the most notorious of which was 'agent orange'³⁰. The major use of herbicides during the war was from 1966-1970, which resulted in the almost total destruction of the delta's mangroves – a loss of 149 851 hectares of forest – and along with it much of the accompanying biota (Hong, 2003). Even by the early 1990s, satellite images still showed patterns left by the defoliants – broad swathes of vegetation differing in texture and colour. Since the end of the conflicts there have been two major developments: fish and shrimp ponds (see 5.3), and a widespread reforestation drive. By 1999, Viet Nam had an estimated 155 290 hectares of mangrove, of which 96 876 hectares were planted in a number of reforestation programmes (Hong, 2003).

5.3

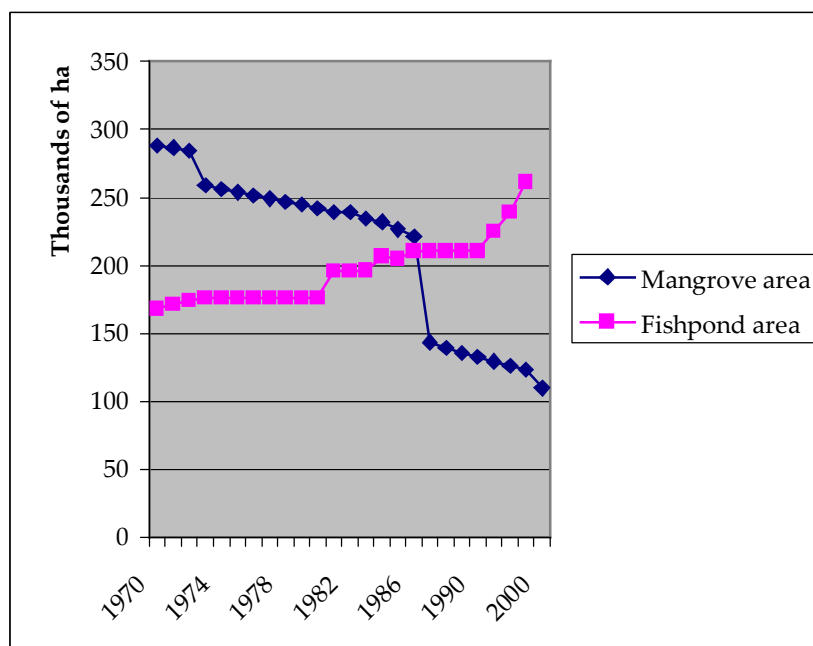
MANGROVE CONVERSION FOR AQUACULTURE

More than 1.2 million hectares of mangrove in Southeast Asia have been converted to brackish water fishponds (see Table 9), and it is regarded as probably the greatest single cause of mangrove decline in the region. Although not all brackish water fishponds have been converted from mangroves, most have been established in (former) mangrove areas, and in most countries in Southeast Asia the link is very evident. In the Philippines, for example, the loss of mangroves from 1970 to 2000 was almost 180 000 hectares, mirroring the 93 000 hectares of brackish water fishponds that were developed during the same period (Figure 7).

²⁹ <http://www.assn.moe.go.th/MANGROVE%20RESOURCE%20MANAGEMENT.htm>.

³⁰ Agent Orange was a 50/50 mix of two herbicides, 2,4,-D (2,4, dichlorophenoxyacetic acid) and 2,4,5-T (2,4,5 trichlorophenoxyacetic acid). Of major health concern is the contamination with dioxin.

FIGURE 7
Mangrove conversion and
fishpond area in the Philippines



Adapted from Janssen & Padilla (1996)

Figures for brackish water fishponds in Southeast Asia have been compiled (Table 8). Four countries (Thailand, Indonesia, Viet Nam and the Philippines) have each developed well over 200 000 hectares of brackish water fishpond, and more than a million hectares of mangrove have been converted to fishponds over the past three decades alone (Table 8). Other countries such as Myanmar have only minor fishpond industries, but have developed plans for similar large-scale development.

Indonesia

In Indonesia, where these ponds are called *tambak*, a total area of almost 269 000 hectares already existed by 1990 (Directorate General of Fisheries, 1991; see chapter 5). There was a surge in *tambak* development in the 1990s, and by 2001 the total area had increased to 438 010 hectares³¹ (see Figure 8). Previously, these fishponds were established within mangrove forest and trees were retained on pond dikes or on islands in the *tambak*. Later, however, clear-felling was carried out prior to the construction of a *tambak*, leaving these more recent fishponds with a tree cover of almost zero. Many of these *tambak* are exploited on an extensive basis, and shrimp fry are usually obtained from adjacent mangrove areas. In many cases, *tambak* development is carried out to obtain land titles to formerly communally-held areas, or areas of government land.

³¹ http://www.perikanan-budidaya.gov.id/statistik/tambak/budidaya_tambak.htm

TABLE 9
Brackish water fishponds
in Southeast Asia

Country	Area of brackish water fishponds (in ha)	Year	Reference
Brunei Darussalam	190	1995	http://www.mangroveweb.net/html/country.htm
Cambodia	>800 850	2000 1994	Smith (2001) http://www.mangroveweb.net/html/country.htm
Indonesia	438 010	2001	www.perikanan-budidaya.gov.id/statistik/tambak/budidaya_tambak.htm
Malaysia	4 700 5 100	1995 2002	http://www.mangroveweb.net/html/country.htm http://www.wrm.org.uy/deforestation/mangroves/book8.html
Myanmar	minor 12 000*	2003 2001	Maung (2003) www.mangroveweb.net/html/country.htm
Papua New Guinea	minor?		
Philippines	261 402	1993	Janssen & Padilla (1996)
Singapore	minor		
Thailand	253 000	1995	http://www.wrm.org.uy/deforestation/mangroves/book8.html
Timor-Leste	minor	?	
Viet Nam	249 394 220 000	1998 2000	Tabuchi (2003) Hong (2003)
TOTAL	1 219 946		

* According to www.mangroveweb.net/html/country.htm, there were plans in 2000 for the conversion of a further 40 000 hectares to shrimp ponds.

In 2001, about 34.0 percent of all *tambak* were located in Java, while a further 28.2 percent were located in Sulawesi, 23.4 percent in Sumatra and 10.8 percent in Kalimantan, which has seen the latest surge in this development. The coastal areas of the northern part of East Kalimantan, around the estuaries of the Kayan, Sesayap and Sebuksu rivers, were until recently covered with broad expanses of mangroves. Most of these have however been converted to prawn ponds in the last decade.

The shrimp industry is a highly valuable one, providing the country with very high revenues. In 1992, for example, exports of shrimp from Indonesia were valued at US\$680 million, of which 65 percent went to Japan, 16 percent to USA and 9 percent to Singapore (Biro Pusat Statistik, 1993). Shrimp exports increased from 97 228 metric tons in 1989, to 117 847 metric tons in 1998³². A second important product from *tambak* are milkfish *Chanos chanos*, which are very popular in Sulawesi and Java. In the 1970s milkfish was the principle crop of all *tambak* (Shang, 1976), but this has been displaced by shrimp since 1979 (Djajadiredja, 1981). Many ponds for prawn production were made by simply deepening former milkfish ponds. Prawn *tambak* are capital intensive enterprises that need a high energy input, and

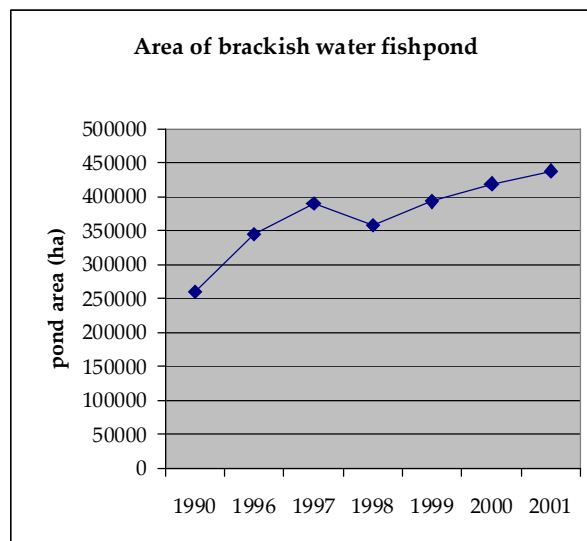
³² <http://www.wrm.org.uy/bulletin/51/Indonesia.html>

their establishment usually requires provision of electricity. In contrast with ordinary *tambak*, which are operated by local farmers, prawn ponds are usually operated by urban entrepreneurs.

The total of 438 010 hectares of *tambak* correspond to more than 10 percent of the former mangrove area, which means that brackish water fish pond development may be responsible for about 25 percent of mangrove loss. In the late 1990s there were plans to expand the total area by a further 320 000 hectares, but this expansion has since been slowed down by the 1997-1998 financial crisis (see Figure 8).

The occurrence of *tambak* does not always mean an absence of mangroves, as is exemplified by the Javan *tambak tumpang sari* fishpond system, whereby a central part of the pond is purposely left shallower and vegetated with mangroves. *Tambak tumpang sari* is a multiple use system involving joint production of mangrove forestry and fishery produce (Sukardjo, 1989); the system is also relatively benign, and can be of importance for maintaining mangrove forest (in some form or other; Sukardjo, 1989) and waterbird populations (Erftemeijer & Djuharsa, 1988). Sometimes vegetation is retained along creeks in fishpond areas, and here the last specimens of mangrove species formerly common in the area can often be found.

FIGURE 8
Area of brackish water fishpond
(*tambak*) in Indonesia, 1990-2001



Note: the area of *tambak* in Indonesia almost doubled in the period 1990-2001, in spite of the financial crisis in Southeast Asia in 1997-98, which led to a temporary decrease in investments, including in the fishpond sector.

Other Southeast Asian countries

Similar developments have occurred in other Southeast Asian countries. Sour (2003) notes that most of the mangroves converted in Cambodia (19 700 hectares in Koh Kong Province alone since the 1990s) have been converted to shrimp ponds. Cambodian mangrove forests near the Thai

border have been cleared by local communities and Thai businessmen, but due to the outbreak of shrimp diseases many of these ponds have now been abandoned.

In Viet Nam's Ca Mau Province, in the Mekong Delta, the area of mangroves declined from over 200 000 hectares in 1962 to 64 572 in 1999, and according to Tan (2001; cited in Hong, 2004) almost all of this destruction has been due to the shrimp culture. There are also plans for further conversion of at least 13 000 hectares in the near future. According to Benthem *et al.* (1999), mangrove forests in Ca Mau had declined from about 200 000 hectares in 1943 to 51,492 hectares in 1995, while shrimp farm acreage increased from 3 000 hectares in 1984 to 76 036 hectares in 1995. According to Tabuchi (2003), the acreage of shrimp ponds in Viet Nam increased from 96 060 hectares in 1990 to 249 394 hectares in 1998.

In Myanmar there has also been extensive conversion (Maung, 2003), but unlike in Cambodia, Thailand, the Philippines and Viet Nam, this has been mainly for agriculture and salt production. The shrimp industry in Malaysia has developed rapidly since the early 1980s, but the country is not one of the major producers of cultured marine prawn in the world, as the area under marine prawn culture is about 5 100 hectares (2 627 hectares in 1995). However, the country's average production (metric tons/ha) is the third highest in the world, after Taiwan and Thailand, and plans for intensification and expansion have been drawn up³³.

5.4

MANGROVE RESTORATION

Introduction to mangrove restoration

Mangrove restoration and rehabilitation is becoming increasingly important in Southeast Asia, especially as the effect of loss of mangroves becomes apparent in the form of loss of coastal fisheries productivity, loss of livelihood of coastal communities, and loss of life and property in the wake of storms and tsunamis. Promotion of regeneration of mangroves has been the goal of mangrove foresters in Southeast Asia, especially in Malaysia and Thailand, leading to establishment of nurseries and enrichment planting since the days of Watson (1928).

Restoration or rehabilitation of mangroves is often recommended when the ecosystem has been altered to such an extent that it cannot regenerate naturally. However, the concept has not been analysed or discussed much in mangrove literature, and as a result, those managing mangrove restoration frequently emphasize planting of mangroves as the primary tool in restoration (Lewis & Streever, 2000). Mangrove habitat can regenerate naturally in 15-30 years if: i) the normal tidal hydrology is not disrupted, and ii) the availability of waterborne seeds or seedlings (propagules) of mangroves from adjacent stands is not disrupted or

³³ <http://www.wrm.org.uy/deforestation/mangroves/book8.html>

blocked. If hydrology is still (near-)normal, but influx of seeds or seedlings is disrupted, then mangroves may be successfully established by planting (Lewis & Streever, 2000).

In order to achieve successful mangrove restoration, the following five critical steps need to be taken:

- a. Understand the autoecology (i.e. individual species ecology) of the mangrove species at the site, in particular the patterns of reproduction, propagule distribution, and successful seedling establishment.
- b. Understand the normal hydrologic patterns that control distribution and successful establishment and growth of targeted mangrove species.
- c. Assess modifications of the original mangrove environment that currently prevent natural secondary succession.
- d. Design the restoration programme to restore appropriate hydrology and, if possible, utilise natural volunteer mangrove propagule recruitment for plant establishment.
- e. Only utilise actual planting of propagules, collected seedlings, or cultivated seedlings after determining (through steps a-d) that natural recruitment will not provide the quantity of successfully established seedlings, rate of stabilisation, or rate of growth of saplings established as objectives for restoration (Lewis & Streever, 2000).

In a logged mangrove area in Tembilahan, Indonesia, for example, Soemodihardjo *et al.* (1996) found that only 10 percent of the area needed replanting, as the rest of the area had seedling densities of more than 2 500 per hectare, more than enough for natural regeneration.

Practical guidelines for restoration

Mangrove reforestation may be carried out as a phase of a forestry system for sustainable management, as part of a coastal restoration project or simply just to restore a mangrove ecosystem. Exploitation of mangrove forests results in gaps and an open canopy. Generally, if these open patches are not too large and a sufficient number of seed-trees are available, regeneration will occur naturally. In controlled cases, species composition can be manipulated by eliminating undesired seed-trees, but generally the number of species around the gaps will be limited. Productivity of individual trees can be enlarged by carrying out a thinning after 2-5 years, if the young stand is very dense. Control of climbers (especially *Derris* species) and mangrove ferns (*Acrostichum aureum*) is often necessary as they often grow very vigorously in disturbed forests. In some areas *Acanthus ebracteatus* can form a dense cover that prevents regrowth – this was the case in the Tumpat Delta, Kelantan in Peninsular Malaysia, where Sulong *et al.* (2002) found that 25 percent of the mangrove area was covered by this species.

Reforestation of open mudflats is possible with natural regeneration if a sufficient supply of seeds, brought by the currents, is present. The emerging species will be the common pioneer species that naturally occur in that area. If the supply of seeds is insufficient, or if it is desirable that the

species composition shows more variety, sowing of (additional) seeds is an option. Re-greening programs are sometimes applied in fishpond areas, involving the sowing or planting of mangrove trees along fishpond dikes. Planting of young trees in the fishponds themselves is not successful as they cannot tolerate permanent inundation. Unfortunately, very often the exotic species *Acacia auriculiformis*, which can become a harmful pest, is planted in such projects in Southeast Asia. *Acacia auriculiformis* leaves form a litter layer with allelopathic characteristics, i.e. growth of other plant species is inhibited.

Successful reforestation of fishpond areas requires the restoration of original soil conditions and hydrology. Earthworks need to be carried out to remove the fishpond dikes and close the fishponds. Fishpond dikes are usually constructed with soil derived from pond excavation (Wulffraat, 1996b). Therefore, restoration can be carried out by simply reversing this process, and filling the ponds with the material from the surrounding dikes. This should preferably be done by hand, as levelling by bulldozers requires draining until the area is dry enough for entering, and this often has a very negative impact on the soil chemistry.

Planting instead of sowing is a good option if the availability of seeds is limited (difficult to obtain or expensive) and if the success rate of sowing is questionable. The latter can be the case if, for instance, the area is very open, with unfavourable climatic conditions or strong waves, and if seed-(or seedling-)eating crabs are abundant or germination of certain species is difficult. To boost the rate of success, one may opt for establishing a mangrove nursery. The nursery should preferably be established in (former) mangrove areas, where original mangrove soil is available. Young plants can occasionally be flooded by seawater, but this is not necessary. A source of freshwater (not seawater) should be readily available, as young plants need regular watering in the first stage.

Mangrove plants can be grown best in plastic bags (polybags, diameter 20 cm), as this provides the best possibilities for their development, and with the least damage to their (complicated) root system. The bags should be filled with the original mangrove soil. Large seeds or propagules with a high germination success rate could be put directly in the bags, but for all other seeds it is advisable to let them germinate first in special germination trays. These germination trays should be filled with pure sand, with a humus content as low as possible, to avoid development of fungi. Seeds do not need external nutrients for germination. Some seeds need a treatment before being sown. Fruits of *Sonneratia* species, for instance, must be kept in wet sand until they are rotten; then the seeds are removed and let dry for a few hours, before they are sown (Wulffraat, 1996b).

After the seedlings start developing their second pair of leaves, they can be carefully transplanted to polybags. Seedlings of most species prefer some protection from direct sunlight for optimal growth. Seedlings are ready for planting in the field as soon as they have developed a rather strong stem,

usually when they are 30-60 centimetres high. Development of special roots (aerial roots, pneumatophores etc.) starts soon after planting in the field. Planting should preferably take place in a period when low tides occur (partly) during daytime and very high tides occur less often (Wulffraat, 1996b).

As a general rule, mangrove seedlings should be planted with 1 metre spacing, i.e. at a density of 10 000 per hectare. High initial mortality is not unusual, but survival rates of at least 50 percent should be expected. Typical forest density of mature mangroves is about 1 000 trees per hectare, so a 50 percent initial mortality of planted saplings should not lead to an unusually sparse forest (Lewis & Streever, 2000). Indeed, a round of thinning may be required in years 5-10 to prevent the establishment of 'pole forests', i.e. dense stands of thin, tall trees, as these may be particularly susceptible to storm damage.

According to Lewis (2001), the cost of mangrove restoration usually varies from US\$225 per hectare to US\$216 000 per hectare, depending on the location and technique used. Lewis recognises three approaches to restoration: i) planting alone, ii) hydrologic restoration, with or without planting, and iii) excavation or fill, with or without planting. The first type is cheap, costing only US\$100-200 per hectare, but is often unsuccessful as hydrological aspects are not appreciated. The second type, when done with proper planning, can also be inexpensive and have a high rate of success. The third type is usually expensive and viable in developed countries only.

Indonesia

Mangrove restoration in Indonesia has been carried out for more than 10 years, generally carried out by NGOs and/or by donor aided projects, but also by the Forestry Department. Areas replanted have been modest, and during the period 1998-2002, for example, a total area of 7 130 hectares were replanted³⁴, mainly in West and Central Java, North Sulawesi and North Sumatra. Almost 3 000 hectares of damaged mangroves have been rehabilitated in Cilacap on the south coast of Java over the last few years, funded out of a loan of more than US\$45 million for conservation and development of this lagoonal system (ADB, 1996; Soegiarto, 2004). Similarly, more than 10 000 hectares of former mangroves have been replanted and restored on the north coast of West Java (Soegiarto, 2004). The latter were part of an aid scheme aimed at reducing flood damage in Jakarta, while at the same time taking local socio-economic conditions into account. Persons living in the vicinity of the replanted areas are allowed to catch or culture fish in the broad channels surrounding the rehabilitated mangroves for their livelihood. Several mangrove replanting projects have been carried out in Kupang Bay, West Timor, by Japanese organisations and NGOs since the early 1990s. *Rhizophora* and *Avicennia* seedlings were used in the north coast of West Java rehabilitation programme, whereas

³⁴ www.dephut.go.id/informasi/statistik/Stat2002/contents_02.htm

Rhizophora and *Bruguiera* species were used in the Cilacap mangrove area. The survival rate of replanting was reported between 60-75 percent.³⁵

Myanmar

In the Irrawaddy (Ayeyarwady) Delta, mangrove forest plantations were established on a small scale basis from 1980 onwards in the townships of Laputta, Bogalay and Moulmyingyun. Large scale plantations were subsequently started in 1990. Plantations established by the Forestry Department often did not survive, as they were rapidly exploited by local communities. Community forestry mangrove plantations established in former mangrove areas appear to do much better. In Laputta Township, for example, 20 user groups have been formed and by 2003, 3 234 hectares of mangrove plantation had been established. Similarly, in Bogalay some 1 158 hectares, and in Moulmyingyun some 200 hectares of mangrove plantation had been established by 2003, bringing the total in Myanmar to almost 5 000 hectares (Maung, 2003).

Thailand

In Surat Thani, Lewis (2001) describes the restoration of 800 hectares of abandoned shrimp aquaculture ponds back to mangrove forests, being implemented by the Royal Forest Department. Calculation show that these forests can be restored for US\$ 200 per hectare for hydrological restoration only (which according to Lewis may be sufficient), or US\$700 per hectare if these areas are also replanted. Mangrove restoration projects in Thailand have also been carried out by the private sector and by NGOs. For example, a pilot project working with local communities in the Pattani Bay area and carried out by the Prince of Songkla University and Wetlands International, replanted over 100 hectares of mangroves in areas degraded by logging for charcoal or abandoned after being used for intensive shrimp farming. Besides planting of mangroves, the project provided support for alternative income-generating initiatives, and helped increase environmental awareness and community organisation. Bamroongruga (2002) reports that the community forestry programmes in Songkla Lake were not very effective due to the lack of community participation and inadequate knowledge of reforestation techniques. Successful trials were carried out with bagged seedlings and propagules of *Rhizophora mucronata* and wild seedlings of *Sonneratia caseolaris*, which were protected from wave action by bamboo fencing.

Viet Nam

In Viet Nam, the primary goal of mangrove regeneration has been the rehabilitation of land devastated during the war (Tabuchi, 2003), although much of the damage to mangroves was apparently caused in the post-war period, by unbridled conversion of partly affected areas for aquaculture. Over a 20-year period (1977-1997), 20 638 hectares of degraded mangrove were rehabilitated in the Mekong Delta region (Tabuchi, 2003). However, at

³⁵ <http://landbase.hq.unu.edu/Workshops/OkinawaMarch2000/Papers/Sogiertopapermar2000.htm>

the same time much larger areas were converted to brackish water aquaculture, undoing most of the beneficial effects of mangrove restoration (see 5.3). Almost 1 000 hectares were also replanted in the mid-1990s in northern Viet Nam at Tiong Lang, Thai Thuy and Tinh Gio using *Bruguiera gymnorrhiza*, *Kandelia candel*, *Rhizophora stylosa* and *Sonneratia caseolaris* (Kogo & Kogo, 2004).

In the 1990s, about 6 600 hectares of former mangrove areas were restored in the Ca Mau peninsula, in a replanting programme together with five State Forestry/Fisheries Enterprises (Bentham et al., 1999). The main species used in this programme were *Rhizophora apiculata* and *Sonneratia caseolaris*, although other species were also used in trials, mainly in the Can Gio Forestry Enterprise. Hong (2004) found in restored areas in Can Gio (south of Ho Chi Minh City, near the Mekong Delta) that the current mangrove flora is similar to that of the early 1960s before widespread destruction with herbicide occurred. However, the individual numbers and distribution of species has changed significantly.

5.5

MANGROVES AND SEA LEVEL RISE

The Intergovernmental Panel on Climate Change (IPCC) forecasts a global sea level rise of 9-88 centimetres by 2100, and these changes are likely to affect mangrove habitats world-wide (Ellison, 2003). The supply of sediment at a particular locality will determine the ability of mangroves to keep up with sea level rise, and mangroves on low relief islands without rivers are likely to be most affected. Historically, the retreat of mangrove zones has also been demonstrated along the margins of mainland areas, for example, on the extensive coastal swamps of southern Papua (Ellison, 2003).

Mean sea levels in Southeast Asia are rising, and in Indonesia, for example, it is estimated to amount from 4.8 to more than 9 millimetres per year (BAPPENAS, 2004). The predicted sea level rise of 60 centimetres over the coming decades could lead to the destruction or severe degradation of 4.3 million hectares of vital coastal areas in Indonesia (BAPPENAS, 2004), including an estimated one million hectares of mangroves. This sea level rise may also affect most of the remaining mangroves in Indonesia, and likely also in the rest of Southeast Asia. Adaptation of mangrove vegetation to rising sea levels and a retreating coastline would only be possible in area where a flat landscape exists behind the mangroves, and where the back mangroves and the hinterland have not been converted to other land use types.

CHAPTER 6

IMPORTANT AND PROTECTED MANGROVE AREAS IN SOUTHEAST ASIA

6.1 MANGROVES IN THE PROTECTED AREA SYSTEM

Out of the total mangrove area remaining in Southeast Asia, almost 20 percent was incorporated into the region's protected area system by 2003 (Table 10). This is a large percentage, but one needs to be cautious as much of this consists of vast areas that are scarcely protected in the field.

TABLE 10
Mangroves in Protected
Areas

Country	Protected Mangroves (ha)	% remaining mangroves in PA system ##	same, according to WRI *
Brunei Darussalam	7 533	41	4.7
Cambodia	31 100 *	48.8	66
Indonesia	783 400 *	26.7	33
Malaysia	10 900 *	1.9	7
Myanmar	12 500 **	2.9	0
Papua New Guinea	106 300 *	24.6	23
Philippines***	347 ***	unknown	0
Singapore	45	0	9
Thailand	25 600 *	10.5	5
Timor-Leste	0	0	-
Viet Nam	1 600 *	1.5	2
	43 115 #	39	
Total	959 700	19.6	

Sources:

* <http://earthtrends.wri.org/text/forests-grasslands-drylands/variable-317.html>

** http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1404_full.html

*** Figures for the Philippines are generally lacking; earthtrends.wri lists protected mangroves as 'zero', while WCMC (http://www.wcmc.org.uk/marine/data/coral_mangrove/marine.maps.main.html) lists more than 120 marine protected areas – but data regarding mangrove cover is totally lacking. The National Biodiversity Strategy and Action Plan for the Philippines also lists at least 13 Protected Areas with mangroves, but data on mangrove cover is provided for two sites only, Bongsanglay Mangrove Reserve (164 ha) and Pujada Bay Protected Landscape and Seascape (183 ha) (pers. comm. Jim Berdach, 4 September 2004).

Tuan *et al.* (2001)

Spalding *et al.* (1997)

6.2 IMPORTANT MANGROVE AREAS

Southeast Asia's most important mangrove areas are briefly described below for each country, along with protected areas and locations designated as Ramsar sites. Ramsar site descriptions have been adapted from the Ramsar Database, at www.ramsar.org.

6.2.1 BRUNEI DARUSSALAM

Brunei's mangroves are found in the estuaries of its four main river systems: the Temburong, Belait, Tutong and Brunei-Muara. However, the status of these mangroves remains unclear. Forest reserves are under the jurisdiction of the Forestry Department, but mangrove outside these areas are in effect unprotected since the areas are simply classified as "State Land". The Integrated Management Plan for the Coastal Zone of Brunei recommended that 99 percent of the mangroves be protected. The plan proposed conversion of only 200 hectare, while 4 141 hectares were to be protected in national parks and 6 545 hectares were to be maintained for coastal protection. However, this plan was reportedly never implemented (in full) and mangrove clearance continues³⁶.

According to Iremonger *et al.* (1997), 800 hectares of mangrove are protected in Brunei Darussalam. However, according to Anderson & Marsden (1984) 7 533 hectares of mangroves in Brunei are located in the Selirong and Labu Forest Reserve, of which 2 566 hectares is located in the Selirong Recreational Reserve. Charles (2002) states that the status of Selirong was altered from forest reserve to conservation reserve to recreational reserve, and that it is now officially called Pulau Selirong Forest Recreational Park (pers. comm. Anthony Sebastian, 3 September 2004).

6.2.2 CAMBODIA

Mangroves are found scattered along much of Cambodia's coastline, but large and dense forests are found in the main estuarine areas of Peam Krasoap, Andong Tuk, Sre Ambel, Chak Sre Cham and the delta of Prek Kampot. Of the 85 100 hectares area reportedly occurring in 1992-1993, about 63 700 hectares was located in Koh Kong province alone, with 13 500 hectares in Sihanoukville and 7 900 hectares in both Kampot province and Kep Municipality (Sour, 2003).

Mangroves occur in three protected areas in Cambodia (Sour, 2003), namely Ream National Park, Peam Krasoap Wildlife Sanctuary and Batum Sakor National Park. Details on which acreage of mangrove is protected, however, is unavailable. Preah Sihanouk (Ream) National Park (21 000 ha) is covered by secondary, evergreen lowland forest, along with 'some mangrove forest'. Batum Sakor National Park (171 250 ha) has the only

³⁶ http://tracc.org.my/Borneocoast/MANGROVES/MANGROVE_LOSS.html

coastal *Dacrydium-Podocarpus* swamp forest in Cambodia. Peam Krasoap Wildlife Sanctuary (23 750 ha) is reportedly the most important mangrove forest in Cambodia and possibly the most extensive remaining within the Gulf of Thailand. Within the Peam Krasop Wildlife Sanctuary lies the Koh Kapik Ramsar Site, described below.

Koh Kapik and Associated Islets Wildlife Sanctuary. This area was declared a Ramsar Site (No. 998) under the Ramsar Convention³⁷ on 23 June 1999. The total area is 12 000 hectares, and it is located at 11°28'N 103°04'E. It consists of alluvial islands immediately off the mainland of Koh Kong Province. Two major rivers flowing into the area bring a freshwater influence and create sand flats in some places. The site is mainly classified into two wetland types (Estuarine waters, and Intertidal mud, sand, or saltflats). The remaining relatively-intact mangroves are said to have assumed increased importance in providing nursery and feeding grounds for various invertebrate species since the substantial removal of mangrove forests in nearby Thailand. The area of the site is state-owned and lies within the Peam Krasop Wildlife Sanctuary, established in 1993.

6.2.3

INDONESIA

Indonesia reportedly had a total of 30 marine conservation areas in 1995 with a combined area of 2.8 million hectares (Moosa *et al.*, 1996).³⁸ This has grown substantially since then, and statistics of the Forestry Department indicate that this had increased to 4.63 million hectares by 2002³⁹. While some of these protected areas have substantial tracts of mangrove forest, it is unclear which area of mangrove forest this network protects. According to RePPProT (1990; cited by Ministry of Forestry & FAO, 1990) a total of 603,000 hectares of mangroves were gazetted as Conservation Area or Nature Reserve by 1989, and 633 000 hectares as Protection Forest⁴⁰. In 1995 there were 41 officially protected (i.e. gazetted) areas throughout Indonesia that harbour at least some mangrove habitat, and the total area of 'protected' mangrove officially stood at 551 363 hectares.

Since then, the mangroves of Sembilang National Park in South Sumatra have also been gazetted, bringing the total to well over 600 000 hectares. This is equivalent to about one quarter of Indonesia's remaining mangroves and about 15 percent of Indonesia's former mangrove area. The figures are not consistent, however, and according to other sources within the Ministry of Forestry an area of 738 175 hectares of mangrove was protected by law by 1993, which is equivalent to about 17 percent of the original mangrove area in Indonesia (Abdullah *et al.*, 1993; *Kompas*: May 5, 1993).

³⁷ Convention on Wetlands of International Importance, especially for Waterfowl; convened in Ramsar, Iran, in 1971.

³⁸ The Development Plan of Marine Conservation in Indonesia lists 251 marine conservation areas, including 20 marine national parks, with a total area of 6.5 million hectares (Moosa *et al.*, 1996).

³⁹ <http://www.dephut.go.id/INFORMASI/STATISTIK/Stat2002/PHKA/Iii1202.pdf>

⁴⁰ This does not include figures for Java, which were not included in the RePPProT study; however, the total mangrove area in Java is not very significant.

There are two premier mangrove reserves in Indonesia, namely Sembilang National Park in South Sumatra and Bintuni Bay Strict Nature Reserve in Papua. Both of these are described in more detail below. Other sites are briefly described in the island (-group) description.

Sumatra

Apart from large stands of mangrove in Sembilang National Park, reasonable mangrove areas are included in Karang Gading Langkat Timur Laut Wildlife Reserve (North Sumatra) and Hutan Bakau Pantai Timur Laut Wildlife Reserve (Jambi). The former largely consists of secondary forest and abandoned brackish water fishponds, while the second forms a narrow green-belt along much of the coast of Jambi Province. However, both are very important in maintaining large populations of (migratory) waders, storks and ibises (Giesen, 1994). There are a few small islands with protected mangrove (e.g. Pulau Berkeh and Pulau Burung, Riau), but once again these are of importance to water birds, and have not been set aside as representative examples of mangrove habitat. Small remnants of mangrove forest remain in Way Kambas National Park (Lampung Province), where they are mainly located along tidal creeks, with some pioneer mangrove flats near the mouth of the Wako River; however, the mangrove belt lining tidal creeks is often very narrow.

Sembilang National Park. The 200 000 hectares Sembilang National Park (SNP) was gazetted in 2003 and is located in the delta of the Sembilang-Banyumasin-Musi rivers. It includes some of the most extensive mangroves in all of Southeast Asia, along with significant areas of mudflat, freshwater swamp forest and peat swamp forest. In combination with the adjacent Berbak National Park in Jambi Province, the combined wetland ecosystem covers more than 350 000 hectares of peat swamp forest, freshwater swamp forest and mangroves in Jambi and South Sumatra provinces. Along the Sembilang coast, there is an up to 15-18 kilometre wide belt of mangrove forests and mudflats, which forms an important wintering territory for as much as 150 000 migratory birds, and a spawning and nursery site for fish and shrimps. The whole area is considered as one of the most important water bird areas of the whole Indo-Malayan region. About 35 globally endangered species occur inside the Park's borders, including Sumatran tiger *Panthera tigris*, clouded leopard *Neofelis nebulosa*, sun bear *Helarctos malayanus*, milky stork *Mycteria cinerea*, lesser adjutant *Leptoptilos javanicus* and Asian dowitcher *Limnodromus semipalmatus*. The area also includes a large colony of the endangered milky stork *Mycteria cinerea*⁴¹. The SNP mangroves are the second largest contiguous mangrove area in Southeast Asia, after those in Bintuni Bay, Papua.

Kalimantan

In Kalimantan, perhaps more than 15 000 hectares of protected mangroves occurred in Gunung Palung National Park and Muara Kendawangan

⁴¹ Taken from leaflet on the SNP, produced by the Indonesian Forestry Department, Local Government of South Sumatra, and Wetlands International (undated).

Wildlife Reserve (both in West Kalimantan) and Tanjung Puting National Park (Central Kalimantan). There have, however been unconfirmed reports of loss of mangroves in these reserves due to encroachment and illegal logging. Remaining 'protected' mangroves elsewhere in Kalimantan are either small and largely disturbed (Pulau Kaget, Pulau Kembang both South Kalimantan), or are being degazetted because of widespread logging (Kutai National Park in East Kalimantan, Pleihari Tanah Laut, South Kalimantan). All remaining large areas of mangroves in Kalimantan, in the Kapuas delta in West Kalimantan, and in the deltas of the Mahakam in East Kalimantan, either have been logged, or are currently undergoing logging.

Java

Mainland Java has lost more than 90 percent of its mangroves and little of this habitat is included in the current protected area system. The largest gazetted 'mangrove' area in Java (reportedly of 1 700 ha; Forestry Statistics, 2002) is located on Pulau Penaitan, an island off the western coast of West Java. However, this is clearly based on mis-identification of the well-developed *Terminalia catappa-Barringtonia asiatica* beach forests, which are very common on Penaitan. Hoogerwerf's (1951) survey map shows a total area of 250-300 hectares of mangrove, with about two-thirds located around Legon Lentah. During surveys in August 1996, mangroves were found in the vicinity of Legon Sabini only, and this was estimated as being less than 100 hectares. Other important areas are Pulau Dua and Pulau Rambut, two tiny islands off the north coast of West Java. These islands are of primary importance as breeding and roosting sites for many species of water bird (Silvius *et al.*, 1987). About 1 000 hectares of mangrove occur on the northern and northeastern shores of Ujung Kulon National Park (Hommel, 1987).

The Segara Anakan Lagoon, located on the south coast of Central Java near Cilacap, consists of a central lagoon surrounded by mangrove swamps and recently accreted intertidal land that has partially been converted into rice fields. The central lagoon has remaining surface area of about 1 700 hectares, and there are about 12 230 hectares of mangrove forests of which only about 5 600 hectares remains in slightly to moderately disturbed conditions (Abubakar *et al.*, 2001). The lagoon is one of the few remaining wetland areas in the region and offers roosting and nesting places for resident and migratory birds, including the endangered milky stork, *Mycteria cinerea* (pers. comm. R. Dudley, June 2000). Mangroves are dominated by *Avicennia*, *Rhizophora* and *Sonneratia*, and especially *Sonneratia alba*. This area was proposed as a reserve in the early 1980s, but a combination of conservation and sustainable use is now considered the best option because of heavy development pressures (White *et al.*, 1989).

Sulawesi

A total of about 7 000 hectares of mangrove have been officially gazetted in Sulawesi, which is about 8 percent of the mangrove area still occurring in 1990, or about 2.5 percent of the island's former mangrove area. However, little remains of these officially gazetted mangroves. Surveys in South

(Giesen, *et al.*, 1991) and Southeast Sulawesi in 1989-90 revealed that virtually all of the 2 000 hectares of the Lampuko-Mampie reserve (South Sulawesi), and most of the 3 000 hectares of mangroves of Watumohae Hunting Reserve (Southeast Sulawesi), have been felled and converted to brackish water fish ponds. Mangroves of northern Bone Bay (23 000 ha) and the Lariang-Lumu plains (7 800 ha), both in South Sulawesi, were proposed for conservation, for example, in a proposed reserve north of the Lariang River (Giesen *et al.*, 1991) that would include 5 400 hectares of mangrove. However, both areas have since largely been converted for ponds, roads and agriculture.

Lesser Sundas

The mangroves of the Lesser Sunda islands (Nusa Tenggara) are probably well represented by the 3 000 hectares currently included in the Protected Area System, in Komodo National Park and Pulau Menipo Wildlife Reserve. Mangroves have never been that extensive in this part of Indonesia and the current remaining area of about 25 000 hectares represents about two-thirds of the former area. On Sumba Island, Indonesia, mangroves are often the only forest in an otherwise savanna-like landscape (Zieren *et al.*, 1990).

Moluccas

About 14 000 hectares of mangroves have been gazetted in the Moluccas, in Manusela National Park (Ceram, 3 000 ha), Yamdena Nature Reserve (Tanimbar, 10 000 ha) and Pulau Baun Wildlife Reserve (Aru islands, 1 000 ha). This would seem a reasonable representation of this habitat, although for biodiversity conservation, it would be best to gazette further mangrove areas both in the Kei and Aru Islands.

Papua

Large mangrove areas, totalling perhaps as much as 600 000 hectares, have been gazetted in Papua Province, in the Lorentz National Park (total area 300 000 ha), on Pulau Kimaam (about 165 000 ha) in Wasur National Park (6 180 ha) and at Bintuni Bay Nature Reserve (120 000 ha). To date, however, only Wasur and Bintuni are actively managed, and both Kimaam and Lorentz are 'paper reserves', protected by their remoteness alone. Pulau Dolok (Kimaam) lies off the southwestern coast of Papua, and is separated from the mainland by a narrow channel. Pulau Kimaam was gazetted in July 1978 with a total area of 600 000 hectares, of which 165 000 hectares reportedly consists of mangrove forest dominated by *Avicennia*, *Sonneratia* and *Rhizophora* species. The island is an internationally important site for migratory waterfowl, with species such as Mongolian plover *Charadrius mongolus*, large sand plover *Charadrius leschenaultii*, whimbrel *Numenius phaeopus*, red-necked stint *Calidris ruficollis* and eastern curlew *Numenius madagascarensis* all recorded in large numbers.

Teluk Bintuni Nature Reserve: Bintuni Bay or Teluk Bintuni comprises a 450 000 hectares bay located on the western side of the Bird's Head peninsula of Papua. Bintuni Bay consists of a large sheltered bay, bordered by intertidal mudflats, sandbars and extensive mangrove areas. Mangroves

extend over 440 000 hectares, representing perhaps 25 percent of Indonesia's remaining mangrove area, and making this the second largest mangrove area in Asia (after the Sundarbans in Bangladesh-India). The mangrove belt at Bintuni attains a width of more than 30 kilometres at some points and stands of very mature mangrove occur. The mangrove forest is backed at many places by a five kilometre-wide *Nypa* palm zone, which is locally followed by freshwater swamp forests. Tropical lowland rainforest continues inland from the freshwater swamp zone.

Mangroves of the northern part of Bintuni Bay have been designated 'protection forest' (hutan lindung), while a 120 000 hectares Strict Nature Reserve has been established at the far eastern part of the bay and is largely untouched⁴². Most of the southern and southeastern part of the bay is included in a mangrove logging concession held by PT. Bintuni Utama MWI. Erftemeijer *et al.* (1989) identified four main mangrove associations: a) pioneering *Avicennia* forest, b) maturing *Avicennia-Sonneratia* forest, c) *Rhizophora-Bruguiera* forests, and d) *Nypa* forest. The pioneering *Avicennia* forest is dominated by *Avicennia marina*, and locally also by *Avicennia eucalyptifolia*, together with *Sonneratia alba* and *Aegiceras corniculatum*. The maturing *Avicennia-Sonneratia* forest is dominated by *Avicennia marina* and *Sonneratia caseolaris*, together with *Aegiceras corniculatum*, *Avicennia officinalis*, *Nypa fruticans*, *Rhizophora mucronata* and *Xylocarpus granatum*. *Rhizophora-Bruguiera* forests are dominated by *Rhizophora mucronata*, *R. apiculata*, *R. stylosa*, *Bruguiera parvifolia* and *B. gymnorrhiza*, along with *Ceriops tagal*, *Avicennia alba*, *Aegiceras corniculatum* and *Xylocarpus moluccensis*. *Nypa fruticans* forests usually occur as dense stands of this palm, together with an occasional *Xylocarpus granatum* or *Sonneratia caseolaris*.

6.2.4 MALAYSIA

The total area of mangrove forest gazetted in reserves and protected areas in Malaysia is unclear. Information dating from the mid-1990s suggest that not more than about 5-10 percent of the country's mangroves were incorporated in protected areas⁴³. According to statistics of 1993, there were 5 670 hectares of gazetted mangrove conservation areas in Malaysia. Also, the Malaysian Cabinet, in late 1996, directed that all mangrove swamps within 400 metres of the coastline be left intouched to check escalating erosion.⁴⁴

According to other reports (Wetlands International - Asia Pacific, 1996), 446 000 hectares of Malaysian mangrove have been gazetted in forest reserves and protected areas, of which the vast majority is found in forest reserves in Sabah (316 460 hectares or 71 percent of the total). Sarawak has much larger mangrove areas than Peninsular Malaysia, but most of this (131 000 out of 168 000 hectares in 1993) is not protected in forest reserves.

⁴² <http://nature.org/wherewework/asiapacific/indonesia/work/art13456.html>

⁴³ <http://earthtrends.wri.org/text/forests-grasslands-drylands/variable-317.html>

⁴⁴ <http://www.wetlands.org/capacity/WW/past/wwwvol-2/feature/iss10/feature.htm>

Of the 92 000 hectares of mangrove forest reserves in Peninsular Malaysia, almost half (>40 000 hectares or 44%) is located in the Matang Mangrove Forest Reserve in Perak. However, it should be noted that mangroves in forest reserves are not protected, but are as a rule used as production forest and logged on a 20-30 year cycle. Forest reserves have also been converted for other uses (see Sungai Pulai, below).

According to TRACC⁴⁵, it has been suggested that a minimum of 5 percent of mangroves (30 000 ha) in Malaysia should be conserved as National Parks or other forms of protected areas. Progress towards this aim has been made, especially in Sarawak where approximately 2 500 hectares of mangroves are formally protected within various national parks and another 10 000 hectares are in the process of being gazetted.

More than 100 marine protected areas are listed in Malaysia by WCMC⁴⁶, but the extent to which mangroves occur within these reserves is not recorded, either in this list or in the Malaysia Wetland Directory (MCF, 1987), as both record mangrove presence and total reserve area only. According to the World Resources Institute⁴⁷, less than 12 000 hectares are included in the country's Protected Area system. A few of the more well known ones are listed here, including the accessible Kuala Selangor Nature Park in Peninsular Malaysia, and three Malaysian Ramsar Sites. The 40 000 hectares Matang Forest Reserve is primarily a production forest (see 4.3), but is also important from the point of biodiversity.

Kuala Selangor Nature Park: The Park is situated at the mouth of Selangor River, in the state of Selangor, Peninsular Malaysia, some 75 kilometres from Kuala Lumpur. It extends over approximately 240 hectares of mangroves and mudflats and is the home to various wildlife such as smooth otters *Lutra perspicillata* and monkeys (long-tailed macaques *Macaca fascicularis* and silvered leaf monkeys *Trachypithecus aurata*). More than 140 species of birds have been sighted, including Nordman's greenshank *Tringa guttifer* and the mangrove pitta *Pitta megarhyncha*. The park is also involved in a milky stork *Mycteria cinerea* reintroduitory programme. Fireflies inhabit the nearby *Sonneratia* trees lining the Selangor River near Kampong Kuatan, and form a night time attraction for tourists.

Pulau Kukup State Park: This area was declared a Ramsar Site (No. 1287) under the Ramsar Convention on 31 January 2003. The total area is 647 hectares, and it is located in Johore State at 01°19'N 103°25'E.. It consists of an uninhabited mangrove island located 1 kilometre from the southwestern tip of the Malaysian peninsula – one of the few intact sites of this type left in Southeast Asia. Pulau Kukup has been identified by BirdLife International as one of the Important Bird Areas (IBA) for Malaysia. Pulau Kukup is important for flood control, physical protection (e.g. as a wind-

⁴⁵ http://tracc.org.my/Borneocoast/MANGROVES/MANGROVE_LOSS.html

⁴⁶ www.wcmc.org.uk/marine/data/coral_mangrove/marine.maps.main.html

⁴⁷ www.earthtrends.wri.org

breaker), and shoreline stabilization. It also supports an important shellfish and cage culture industry, and has significant potential for ecotourism.

Sungai Pulai Forest Reserve: This area was declared a Ramsar Site (No. 1288) under the Ramsar Convention on 31 January 2003. The total area is 9 126 hectares, and it is located in Johore State at 01°23'N 103°32'E. It is the largest riverine mangrove system in Johore State, located at the estuary of the Pulai River. With its associated seagrass beds, intertidal mudflats and inland freshwater riverine forest the site represents one of the best examples of a lowland tropical river basin, supporting a rich biodiversity dependent on mangrove. It is home for the uncommon mangrove tree *Avicennia lanata*. Although this area has been demarcated as a reserve forest, parts have lately been given way to conversion for land related development programs such as development of new port, aquaculture, charcoal-making industry as well as residential area for supporting the newly developed industries (Hashim & Kadir, 1999).

Tanjung Piai State Park: This area was declared a Ramsar Site (No. 1289) under the Ramsar Convention on 31 January 2003. The total area is 526 hectares, and it is located in Johore State at 01°16'N 103°31'E. The site consists of coastal mangroves and intertidal mudflats located at the southernmost tip of continental Asia, especially important for protection from sea-water intrusion and coastal erosion. Tanjung Piai supports many threatened and vulnerable wetland-dependent species, classified as vulnerable or near threatened listed in the IUCN Red Book 2000. Waters of the four main rivers traversing Tanjung Piai are abundant with commercially valuable species. The site enjoys the status of a State Park for Ecotourism.

Klias Wetland – Sabah. Located about 120 kilometres from Kota Kinabalu on the Klias Peninsula are the Klias Wetlands, extending over an area of about 8 700 hectares (DWNP, 1987). This Mangrove Forest Reserve is reportedly rich with river wildlife and birds, including proboscis monkeys, long-tailed macaques, silver leaf monkeys and a wide variety of birds.

Cowie Bay – Sabah. Extending from the Kalimantan border up to Tawau in the north, with mangroves covering an area of 39 018 hectares and gazetted as Tawau Mangrove Forest Reserve (DWNP, 1987). Sabah's oldest and largest prawn farm is located in this area. The mangrove are also exploited commercially. The forest is composed of *Rhizophora apiculata*, *R. mucronata*, *Bruguiera parviflora* and *Ceriops tagal* with an intermixture of *Excoecaria* and *Avicennia*.

Sepilok, Sandakan Bay, Sabah. The mangrove forest of the Sandakan Bay area covers approximately 45 000 hectares, and is regarded as the largest area of accessible mangrove in Sabah.⁴⁸ Together with the adjacent Tambisan coast

⁴⁸ <http://www.eaga.org.bn/eaga/forestry/MENU/Menu%20Malaysia.htm>

to the southeast, this extends over a total area of about 150 000 hectares (DWNP, 1987), which includes freshwater swamps on the landward side of the mangrove. The area is important for Storm's stork *Ciconia stormi*, lesser adjutant *Leptoptilos javanicus*, proboscis monkey *Nasalis larvatus*, silvered leaf monkey *Trachypithecus aurata* and Bornean gibbon *Hylobates mulleri*.

Pulau Bruit, Sarawak. Extending over an area of 40 000 hectares, this low-lying island has extensive mudflats and mangrove forests on the northern and western shores. The northern area of 1 776 hectares around Tanjong Sirik has been proposed as a national park. A visitor during migration may record 10 000 waders, 14 000 terns, 500 egrets and 20 lesser adjutants, although numbers, especially of waders, have fallen recently⁴⁹.

Rajang delta, Sarawak. An extensive delta system is located at the mouth of the Batang Rajang, the largest river in Malaysia. The central delta area is a complex mangrove and *Nypa* system, with further accreting mangroves and extensive mudflats at the northern end of Pulau Bruit. A substantial part of the Rajang mangroves are clear-felled in rotation for wood-chips. The three most important parts of the delta are the Matu-Daro and Sibu Swamp Forests, Pulau Bruit and the Rajang Mangrove Forest.⁵⁰ The Rajang Delta is particularly important for herons and egrets, migratory shorebirds and terns; over 20 000 shorebirds of at least 25 species and 14 000 terns of seven species utilise the area at certain times. The most abundant shorebirds are common redshank *Tringa totanus*, Terek's sandpiper *Xenus cinereus* and great sand plover *Charadrius leschenaultii*. Several uncommon species such as Swinhoe's egret (or Chinese egret) *Egretta eulophotes*, Asian dowitcher *Limnodromus semipalmatus* and Far-Eastern curlew *Numenius madagascariensis* have been reported at Pulau Bruit. Reptiles include the river monitor *Varanus salvator* and estuarine crocodile *Crocodylus porosus*. The latter breeds in the delta, but despite the abundance of suitable habitat, is now rare, presumably because of the harvesting of live hatchlings. Mammals include proboscis monkey *Nasalis larvatus*, silvered leaf monkey *Trachypithecus aurata* (*Presbytis cristata*), smooth otter *Lutra sumatrana*, leopard cat *Felis bengalensis* and wild boar *Sus barbatus*.

6.2.5

MYANMAR

According to Spalding *et al.* (1997) the largest mangrove areas are in the Irrawaddy (Ayeyarwady) Delta, but these were already heavily degraded in the early 1980s and the best mangroves were thought to occur in the northern state of Rakhine and in Tanintharyi, near the border with Thailand in the south. Maung (2003) reports that the most important mangrove areas in Myanmar still occur in the Irrawaddy Delta, but that other important mangrove areas also occur in coastal areas of Rakhine State and Tanintharyi Division.

⁴⁹ <http://www.arbec.com.my/bos/location.htm>

⁵⁰ http://www.arcbc.org.ph/arcbcweb/wetlands/malaysia/mys_rajangdelta.htm

‘Protected’ mangroves extend over 12 500 hectares and occur in three (proposed) protected areas in Myanmar⁵¹, namely Letkokkon PA (400 ha), Kadonlay Kyun (100 ha) and Meinmahla Kyun (12 000 ha). All three sites occur in the Irrawaddy Delta, and are described in the *Directory of Asian Wetlands* (Scott, 1989), from which the following descriptions have been adapted. Meinmahla Kyun is an estuarine island located in the mouth of the Bogale and Kadonkani rivers, and is almost entirely comprised of sediments from the Bogale River. The island is almost entirely covered with mangrove forest, but has been logged in the past, and much of the forest is degraded. Meinmahla was designated a Reserved Forest since 1895, a status that has been proposed for upgrading to that of Wildlife Reserve.

Kadonlay Kyun is a small, flat, lowlying island of 260 hectares, and like Meinmahla it has been formed out of deposits from the Bogale River. About 100 hectares consists of (degraded) mangrove, while the rest primarily consists of grassland. The island has been proposed as a wildlife sanctuary, as it is an important breeding site for sea turtles, especially olive Ridleys *Lepidochelys olivacea*, loggerhead *Caretta caretta*, green turtle *Chelonia mydas* and leatherback *Dermochelys coriacea*.

Letkokkon consists of a group of small islands and mudflats formed by deposits from the China Bakir River, extending over a total area of about 388 hectares. How much of this consists of mangrove is unclear: while the World Wildlife Fund website reports of 400 hectares of mangrove, Scott (1989) reports that the principal vegetation consists of ‘extensive reedbeds, with low scrub colonising areas above the high tide mark’.

Few recent reports exist on these areas, other than that the mangroves are generally ‘in a sorry state’.

6.2.6

PAPUA NEW GUINEA

Papua New Guinea mangroves are found along extensive lengths of the country’s coastline. There are several disjunct sections along the north coast, including adjacent to the mouths of the Sepik and Ramu rivers, and Dyke Ackland Bay and Ward Hunt Strait. The longest and deepest stretches of mangroves are found on the south side of the island, especially at the mouths of the Purari, Kikori, Fly, Northwest, and Otakwa rivers. On the Pacific (northern) coast of mainland Papua and the smaller islands (New Britain, New Ireland) many smaller mangroves areas occur on less exposed coasts. These mangroves, such as found along the northern coast of West New Britain Province (see Figure 4B), are often rich in plant species, with several mangrove species that are endemic to the eastern part of Southeast Asia, such as *Cerbera floribunda* and *Myristica hollrungii*.

⁵¹ http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im1404_full.html

Although 24 percent of the country's mangroves are listed as 'protected', it is generally acknowledged that PNG lacks a protected area system that is representative of its diverse habitats, and urgently requires specific conservation interventions⁵².

Tonda Wildlife Management Area: Tonda was declared a Ramsar Site (No. 591) under the Ramsar Convention on 16th March 1993. The total area is 590 000 hectares, and it is located in Western Province at 08°45'S 141°23'E. It is also a Shorebird Network Site. It mainly consists of flat, coastal plains subject to seasonal, freshwater flooding. The site, bordering Indonesia, includes tidal river reaches, mangrove areas, grassland, and savannah woodlands. It is an important wetland for over 250 species of resident and migratory waterbirds and as a refuge during drought. Most of the world population of little curlew *Numenius minutus* stage on the plains during migration. Tonda Wildlife Management Area has been declared a Wildlife Management Area under the Fauna Protection and Control Act. The Act allows the local Management Area Committees (consisting of local landowners) to set rules regulating the taking of various species and restricting access to certain areas. In the case of Tonda, rules allow for the issue of licences for the taking of certain species, restrict the use of shotguns, regulate the size and sex of fauna taken, and determine the areas where hunting is allowed.

6.2.7 PHILIPPINES

The *Directory of Asian Wetlands* (Scott, 1989) lists 63 wetland sites, of which 30 had mangrove habitats with an unspecified area. However, most of this information is outdated, and given the rate of mangrove conversion since the 1980s, many of these may no longer exist. According to Spalding *et al.* (1997), the largest remaining areas are located to the south of the archipelago, on Mindanao and Samar, and also on Palawan in the west.

The Philippines has more than 120 marine reserves (see WRI website⁵³), although it is unknown how extensive mangroves are in this system. The National Biodiversity Strategy and Action Plan for the Philippines lists at least 13 Protected Areas that include mangrove habitat, but data on mangrove area is provided for two sites only, Bongsanglay Mangrove Reserve (164 ha) and Pujada Bay Protected Landscape and Seascape (183 ha; Jim Berdach, pers. comm., 4 September 2004). The Philippines has four Ramsar Sites, of which two are freshwater and only one includes protected mangrove habitat, namely Olango Island.

Olango Island Wildlife Sanctuar: The area was declared a Ramsar Site (No. 656) under the Ramsar Convention on 1 July 1994. The total area is 5 800 hectares, and it is located in Cebu at 10°16'N 124°03'E; it is also a Shorebird Network Site. It mainly consists of a low-lying island surrounded by

⁵² http://www.solutions-site.org/artman/publish/article_44.shtml

⁵³ See http://www.wcmc.org.uk/marine/data/coral_mangrove/marine.maps.main.html

extensive intertidal sandflats, mangroves, seagrass beds, coral reefs and islets. It is one of the most important areas in the country for significant numbers of migratory waterbirds, providing habitat for staging, wintering, roosting and feeding birds.

6.2.8 SINGAPORE

Mangrove forest cover has been reduced from an estimated 13 percent of Singapore Island in the 1820s to only 0.5 percent of the total land area at present. Mangrove forest is now found only in small patches with the largest areas in the northern part of the main island and on Pulau Tekong, Pulau Ubin and Pulau Semakau. Singapore has a remaining mangrove area of about 500 hectares, and of this about 9 percent are conserved in two protected areas:

- *Sungai Buloh Nature Park*, which extends over 87 hectares including visitor's area, trails, ponds and about 40 hectares of mangrove; and
- *Pasir Ris Nature Park*, which extends over about 70 hectares and includes about 5 hectares of mangrove⁵⁴

In addition there are interesting remnants of mangrove at Mandai Besar/Kechil, Lim Chu Kang, Kranji, Sungei Pandan, Sungei Punggol, Pulau Tekong and Pulau Ubin.

6.2.9 THAILAND

According to WRI⁵⁵, about 25 000 hectares or 15 percent of the remaining mangroves are protected in Thailand. Both figures have changed considerably over the past years and are not very reliable. According to the 2002 statistics of the Royal Forest Department⁵⁶ (figures are from 2000), the provinces with the largest remaining mangrove areas are Phang Nga (45 500 ha), Satun (35 300 ha), Krabi (35 000 ha), Trang (33 500 ha) and Ranong (25 300 ha). These are all along the west coast of peninsular Thailand, the area affected by the recent (26 December 2004) devastating tsunami. Some of the most important mangrove sites are designated as Ramsar sites and described below.

Gulf of Thailand: This is large area of intertidal mudflats around the shores of a huge, shallow bay forming the estuary of four major rivers, the Mae Klong, Tachin, Chao Phraya and Bang Pakong. The area formerly supported extensive mangroves. While the largest areas have now been cleared for aquaculture and salt pans, much secondary mangrove still remains and is usually found as a narrow (10-100m) fringe along the seaward margins. Extensive areas of low scrub are found in the brackish marshes along the landward edge. In places, the open shrimp ponds and salt pans extend two to three kilometres inland and, together with the offshore mudflats, provide an important feeding and roosting area for

⁵⁴ <http://mangrove.nus.edu.sg/guidebooks/text/1016.htm>

⁵⁵ <http://earthtrends.wri.org/text/forests-grasslands-drylands/variable-317.html>

⁵⁶ www.forest.go.th/stat/stat.htm

many thousands of shorebirds. The human population density is extremely high, and there is an increasing amount of heavy industry, especially extending eastwards from Bangkok along the lower reaches of the Chao Phraya River. Mangroves are usually dominated by *Rhizophora* species, with *Nypa fruticans* along banks and in the understorey. Extensive degraded areas are dominated by the mangrove fern *Acrostichum aureum*. Large areas of “back mangrove” are dominated by scrub formations grading into *Typha* marsh⁵⁷.

Don Hoi Lot: Don Hoi was declared a Ramsar Site (No. 1099) under the Ramsar Convention on 5 July 2001. The total area is 87 500 hectares, and it is located in Samut Songkhram Province at 13°21'N 099°59'E. It forms a rare type of natural wetland for Thailand, comprising sandbars at the mouth of the Mae Klong river with a vast area of intertidal mudflats, and an extremely productive location for the Hoi Lot (*Solen regularis*), an economically important mollusc unique to this region. Mangroves are present along the shoreline on the east side.

Had Chao Mai Marine National Park - Ta Libong Island Non-Hunting Area - Trang River Estuaries: This area was declared a Ramsar Site (No. 1182) under the Ramsar Convention on 14 August 2002. The total area is 66 313 hectares, and it is located in Trang Province at 07°22'N 099°24'E. It consists of three connected wetland ecosystems with riverine, estuarine, and coastal wetlands, including mangroves and *Nypa*, sand beach and rocky marine shores, mud flats, coral reefs and seagrass beds.

Kaper Estuary - Laemson Marine National Park - Kraburi Estuary: This area was declared a Ramsar Site (No. 1183) under the Ramsar Convention on 14 August 2002. The total area is 122 046 hectares, and it is located in Ranong Province at 09°36'N 098°39'E. The area has been declared a UNESCO Biosphere Reserve, and includes the largest concentration of mangrove forest remaining in the country and said to be one of the most extensive in the Indo-Pacific region, the site also includes *Nypa* forests, mud flats, sandy beaches, coral reefs, and seagrass beds.

Krabi Estuary National Reserve Forest: Krabi was declared a Ramsar Site (No. 1100) under the Ramsar Convention on 15 July 2001. The total area is 21 299 hectares, and it is located in Krabi Province at 07°58'N 098°55'E. The reserve consists of an area of sand beach, mangroves, and mudflats, with some steep wooded cliffs and intertidal mudflats extending up to 2 kilometres offshore at low tide. An area of mangroves and mudflats extending from the rocky headland of Khao Laem Nang, east past the complex of rivers which open to the sea at Pak Nam Krabi, to the Khlong Yuan and Khlong Taling Chan, and south to Ban Laem Hin. A complex of rivers open to the sea within the site, and extensive seagrass beds are

⁵⁷ http://www.arcbc.org.ph/arcbcweb/wetlands/thailand/tha_gultha.htm

present at Sriboya Island. Most mangrove areas were forest concession, but were converted to conservation areas in 2001.

Mu Koh Ang Thong Marine National Park: The area was declared a Ramsar Site (No. 1184) under the Ramsar Convention on 14 August 2002. The total area is 10 200 hectares, and it is located in Surathani Province at 9°37'N 99°41'E. The area consists of a complex of 42 small islands in the Gulf of Thailand, including sandy beaches, rocky cliffs, coral reefs, and young mangrove forests.

Pang Nga Bay Marine National Park: Pang Nga was declared a Ramsar Site (No. 1185) under the Ramsar Convention on 14 August 2002. The total area is 40 000 hectares, and it is located in Pang Nga Province at 8°17'N 98°36'E. The area consists of a shallow bay with 42 islands, comprising shallow marine waters and intertidal forested wetlands, with at least 28 species of mangrove; seagrass beds and coral reefs are also present.

6.2.10 TIMOR-LESTE

Mangroves extend over only about 3 000 hectares in Timor-Leste, as natural circumstances are not conducive for the establishment of this habitat. Along most of the southern coastline, the sea is too dynamic, few sediments accumulate, and the coast is too rocky. Mangroves in the south therefore occur only at the mouths of the streams, and in adjacent marshy or swampy terrain. On the north coast, however, the sea is calmer and mangroves are found along wider areas such as in Metinaro, Tibar and Maubara.

6.2.11 VIET NAM

Hong (1993, 2003) recognises four mangrove zones in Viet Nam, each with varying conditions:

- i. *The Northeast Zone* (Quang Ninh Province): 39 400 hectares in 1982; 22 949 hectares in 1999. Low winter temperatures limits the growth of certain species, although 15 true mangrove species have been recorded. Coastal mudflats are shielded by a number of islands, and as a result they are little affected by storms or strong winds. A typical region is Mui Chua cape and Tien Yen estuary, where *Bruguiera gymnorhiza*-*Rhizophora stylosa*-*Avicennia marina*-*Kandelia candel* mangroves can reach a height of about 8 metres.
- ii. *The Northern Delta Zone*: 7 000 hectares in 1982; 20 842 hectares in 1999. This is the area formed by accretion of sediments from the Thai Binh and Hong (Red) rivers. Although the mudflats are large and rich in alluvium and freshwater, this zone is subjected to strong winds, storms and waves. Also, as winter temperatures are low, mangrove stands are not extensive and the trees are relatively small. Mangroves are mainly found in sheltered parts of the estuaries of these two rivers, and are dominated by *Sonneratia caseolaris*, *Kandelia candel* and *Aegiceras corniculatum*.

- iii. *The Central Zone*: 14 300 hectares in 1982; 3 000 hectares in 1999. The coastline along this area is rocky, surrounded by deep sea, and is influenced by strong wave action. As a result there are no mangroves along the seashore, although limited areas occur along river banks and in estuaries of small rivers.
- iv. *The Coast of Southern Viet Nam*: 191 800 hectares in 1982; 102 497 hectares in 1999. Mangroves in this area occur in two main river systems: the Dong Nai River and the Cuu Long (Mekong) River. Conditions here are most favourable for mangrove development, because of higher temperatures, abundant sediments and fresh water, and the proximity of Indonesia and Malaysia, which have the highest level of mangrove species diversity.

According to Spalding *et al.* (1997), the largest areas of mangrove are in the Mekong Delta and further south on the Ca Mau Peninsula. Tuan *et al.* (2001) list 22 existing coastal and marine protected areas in Viet Nam, which altogether protect 43 115 hectares of mangrove habitat, or according to them, 39 percent of the remaining mangroves. Some of the most important sites are described below.

Dat Mui Nature Reserve (also known as Ca Mau cape or Mui Ca Mau) is the southernmost tip of Viet Nam. The area's mangroves suffered badly during the war, but have recovered well since then, due to a combination of rapid accretion of sediments, natural regeneration and rehabilitation. The area is gazetted as a Nature Reserve since 1983 (or 1986, according to Tuan *et al.*, 2001), extending over an area of 4 453 hectares.

Hon Mun Marine Protected Area, established in 2001, includes coral reef, mangroves and seagrass ecosystems. It is located near Nha Trang, Khanh Hoa province, South Viet Nam, and covers about 12 000 hectares, including 8 islands. There is a population of 5 000 people on the islands living in 7 villages.

The *Can Gio* mangrove forest was destroyed thoroughly during the war, but due to rehabilitation efforts it is now one of the country's best mangrove areas. The area was recognised as a Nature Reserve in 1990, and as a UNESCO Biosphere Reserve on 21 January 2000. The Managed Nature Reserve extends over 42 630 hectares and lies in the Mekong Delta, near Ca Mau.

Xuan Thuy Natural Wetland Reserve: Xuan Thuy was declared a Ramsar Site (No. 409) under the Ramsar Convention on 20 September 1988. The total area is 12 000 hectares, and it is located in Nam Ha at 20°10'N 106°20'E. 7 686 has been gazetted as a Strict Nature Reserve since 1995. The area consists of delta and estuary islands supporting the last significant remnants of coastal mangrove and mudflat ecosystems in the Red River Delta; includes land enclosed by sea dikes, with fringing marshes.

CHAPTER 7

MANGROVE STUDIES: POINTS FOR BEGINNERS

7.1

IMPORTANT REFERENCES

Those wanting to study mangroves in greater detail should consult some of the classic references in this field that deal with mangroves in a broad way, such as MacNae (1968), Chapman (1976a), Saenger *et al.* (1983), and Mastaller (1997). Serious students of botany should refer to Tomlinson's (1986) classic tome, augmented by Duke *et al.* (1984) and Duke (1992). Van Steenis (1958) provides a general introduction to mangroves, as a foreword to Ding Hou's (1958) paper on the Rhizophoraceae for Flora Malesiana.

Country-wide publications on mangrove vegetation and flora (limited to 'true mangrove' species) exist for Malaysia (Watson, 1928), Thailand (Aksornkoae, 1993), Viet Nam (Hong & San, 1993), the Philippines (Aragones *et al.*, 1998) and Papua New Guinea (Percival & Womersley, 1975). A general introduction to the mangroves of Indonesia is provided in Part Two of *The Ecology of the Indonesian Seas* (Tomascik *et al.*, 1997), while chapters on mangroves of Sumatra and Sulawesi are provided by Whitten *et al.* (1984, 1987). Part of the present publication has appeared in much condensed form in an Indonesian translation (Noor *et al.*, 1999).

7.2

FIELD TRIP BASICS

Basic mangrove studies require little more than an identification guide, binoculars, pencil-and-paper and a bit of time and endurance. As the mangrove environment is rather hot, wet, muddy and often teeming with mosquitoes, clothing and equipment need to be adapted. Best is cotton clothing, with long sleeves and trousers to avoid scratches and prevent mosquito bites – it is advisable to bring a waterproof repellent. Write in pencil (HB), as notebooks are likely to get damp and ink will run. As many trips to mangroves will involve boat trips, the use of a hat and/or sun block/cream is advisable. A small, collapsible umbrella can be helpful to keep both sun and rain off your back, and is useful for photography in the

rain. Normal cameras will not survive a dip in a saline pool, so waterproof containers are much recommended. Binoculars are of no use if they also have to remain in containers, so these should be waterproof, or cheap enough to run the risk of their being spoiled by moisture and/or fungus.

All gear should preferably fit into a single bag, and a small backpack is usually handy, as this will free both hands when clambering among mangrove roots and simultaneously looking at the canopy for flowering specimens. Remember to bring plenty of drinking water, as mangrove field trips are usually thirsty affairs. Timing a trip is also important, as high water levels make boat travel easier, but impede observations of soil, infauna (animals living in the soil), and root types (important diagnostic characteristics for mangrove tree species).

Very practical advice for beginners is also provided by the *Shorebird Studies Manual* (Howes, 1989), which is still highly useful in spite of its age, and still commercially available.

7.3

MANGROVE PLANT SPECIMENS

Identification

Compared to studying Indonesian lowland forests, the study of mangrove vegetation is relatively easy, as the number of species is limited and flowering is often not very seasonal. This means that there are usually one or two specimens of each species in fruit and flower, making identification a simpler task. In addition, the vegetation is not as tall as lowland forest, and the observer does not need to stare up at a canopy of 40+ metres height. However, mangrove trees appear very similar in many of their vegetative characteristics: having leaves that are dark green, elliptic to obovate, medium-sized, of the laurel type but rather coriaceous and slightly fleshy.

What the observer should therefore focus on are the differences in bark, root types (stilts, pneumatophores, aerial roots), stipules, leaf insertion and flowers/fruit.

People are often inclined to simply browse through the drawings of a guidebook to find a picture that matches the specimen that they want to identify. This might work out well for the smaller plant groups and the moderately large, but highly diverse plant groups (such as the palms and ferns groups in this book), but often not for the larger or more complicated groups. An accurate identification can best be obtained by using the identification keys provided in this book.

These keys were designed in such a way so that the most obvious vegetative characteristics come out first. This will in most cases enable people without training in botany identify the species in question.

The most obvious characteristic of a plant is its general appearance: whether it is a tree or shrub, a herb, a grass (or sedge), a climber or a fern. For herbs and ferns, it is important to look whether the plant is growing on trees or shrubs (i.e. they are epiphytes), or whether it is growing directly on the surface/soil. Several mangrove trees and shrubs have very specific respiration roots, such as aerial roots, knee roots or pencil-shaped roots. These root types are an easy and important characteristic to identify many mangrove taxa, and can readily be observed, even on young trees.

Looking at the leaves is the next step. Compound leaves can usually easily be distinguished from simple leaves, but certain species – such as *Xylocarpus* – may lead to confusion at times. When in doubt, it is usually a good idea to check out a new leaf that is developing from a bud. It is usually obvious whether leaves are opposite or not (to avoid confusion, no distinction is made in this publication between alternate and spirally arranged insertion), but one should not be confused by bunches of leaves apparently randomly grouped at the end of a branch. In that case it is better to observe young, newly developing branches where leaf arrangement may be clearer.

Stipules – small leaflets at the base of a leaf stalk – are also important for identification. These leaflets⁵⁸ are often shed, but if this has happened they will have left a characteristic scar on the twigs. Leaf shapes are often used in the key, in particular the shape of the leaf tip (apex). It is recommended that persons interested in using the guide for identification familiarise themselves with the names of some of the most common leaf shapes.

The calyx (≡outer leaflets of a flower) of several mangrove trees remain more or less persistent on the fruit, and provide a good determination characteristic. Some trees have a white or colored latex or resin in the leaves and/or bark. This can be a handy characteristic for identification. However, one should be careful with this, since most of these resins are poisonous and irritating. Also, we do not want to encourage the slashing of the bark of trees for the sole purpose of identification.

Herbarium

It is always best to try to identify the species in the field, using a guidebook such as this one. If pressed for time, you can take plant specimens with you for later identification in the lab or at home – remember to take notes about site, location, date, trunk type, bark, habit and root type! Plant specimens are best kept folded between newspaper in a plant press (two perforated plywood boards of about 25 by 35 centimetres will do). Without further treatment, pressed specimens will keep for about 2-3 days, after which decay and fungal growth will set in; in many cases, 2-3 days is probably long enough for ‘identification-at-leisure’. If you want to preserve specimens for a longer time, they should be dried in an oven – usually this can be

⁵⁸ Instead of small leaflets, stipules may also consist of small, leafy sheaths that enclose buds of new leaves.

improvised with a box over a low fire, separated by a thin metal sheet. Oven-dried specimens will last one to several months, depending on the ambient humidity.

Herbariums treat their specimens with 'sublimate' (Mercuric oxide), which will allow you to preserve specimens for decades, but this process has its disadvantages as this chemical is highly toxic. If you need to preserve specimens but cannot dry the plants (e.g. on a long boat trip), specimens can be preserved by keeping them in newspaper bound in cardboard, and keeping them in strong, waterproof, well-sealed plastic bags after drenching them with methylated spirits (= Schweinfurth method). Kept wet (in spirits), they will remain in a good condition for many months. The disadvantages are that methylated spirits may be fairly expensive if many specimens are to be collected (requires about 1-1.5 litre for a pile of about 25-35 specimens); in addition, spirits are highly inflammable and they evaporate easily through even the smallest perforation.

7.4

FLORA STUDIES

For studying any kind of vegetation, it is always wise to first obtain good topographic and thematic maps. General, large-scale maps indicating the location of mangroves are available in Spalding *et al.* (1997; now somewhat outdated), and at the UNEP-WCMC website⁵⁹. A smaller and less accurate version of the Southeast Asian part of the latter is appended in Annex 2. Along with maps, remote sensing images are the most useful tool for someone wanting to conduct vegetation studies. Remote sensing images, in their broadest sense, can include photographs taken from the top of a hill or from the window of an aeroplane. More professional imagery is provided by commercial aerial photography (available via national mapping agencies such as BAKOSURTANAL in Indonesia, but this generally requires security clearances), radar imagery, and satellite imagery.

Of the latter, Landsat and SPOT are most commonly available and used. Images are available directly via Landsat or SPOT websites⁶⁰, or via national agencies such as LAPAN in Indonesia (Indonesian Satellite Imagery Receiving Centre, Jakarta), the Bangkok Landsat receiving station, and SPOT headquarters in Toulouse, France. The choice of imagery type depends on the level of details needed for the survey. The present available satellite images can be used for a scale as large as 1:25 000 (for vegetation mapping), but for a larger scale aerial photographs are more suitable. Usually directly discernible on remote sensing imagery are the different vegetation zones within the mangrove belt – this simplifies the making of a draft map of a given site.

⁵⁹ http://www.unep-wcmc.org/index.html?http://www.unep-wcmc.org/forest/global_map.htm-main

⁶⁰ www.Landsat.org or www.SPOT.com

A map produced on the basis of remote sensing imagery alone does not tell us very much, as ground data must be gathered, correlated to the image characteristics and entered into the legend of the map. Data on the vegetation requires identifying which species occur where. This involves elucidating which species occur together (in plant communities), and those which never occur together and may therefore be differentiating species.

The easiest way to do this is to describe vegetation transects in the mangrove vegetation; basically there are two transect types, namely line-intercept transects, and broad swathe transects. Line-intercept transects are the simplest: this involves laying out a line of given length (e.g. 100 m) in a discrete vegetation, and noting which plants (species and number of individuals) the line intercepts. Broad-swathe line (or belt) transects are similar, except that the line has a discrete width, of say 5 or 10 metres: all plants (species and number of individuals) in this broad swathe are then noted. Line transect data can later be compared with each other, either visually, or by means of specific computer programmes.

A remotely sensed image is interpreted and a preliminary map is drawn, based on image characteristics and terrain features, displaying land units with similar characteristics. After that, an adequate number of field samples are taken of each land unit, and the ground data is correlated to the remotely sensed data. Those field samples should not only consist of vegetation records, but soil samples and observations of other physical conditions, such as hydrology, as well. This will result in a land-ecological vegetation map with an integrated legend, clearly displaying the correlation between vegetation (-communities or -types) and physical factors. Mangrove vegetation may also be studied by analyzing quadrats, i.e. estimating the density of certain species in a given (small) area, e.g. a 10 by 10 metre square of vegetation. For obvious reasons, the quadrat method works best in herbaceous vegetation. These methods are described in detail by Mueller-Dombois and Ellenberg (1974), Chapman (1984) and English *et al.* (1994), and in Indonesian language by Kusmana (1997), to name a few examples.

7.5

FAUNA STUDIES

Many qualitative studies have been carried out on mangrove fauna in Southeast Asia, and a good account of the methodology is provided by Sasekumar (1984) and English *et al.* (1994). Studies focus on the zonation of mangrove fauna, faunal density & productivity, vertical distribution patterns (especially in relation to the tide), and soil in fauna. Techniques are generally quite simple, involving no more than sieving, netting, quiet observing and (often more than) a bit of patience. As a scientist involved with education, Lim (1995) regards mangroves as an ideal learning environment for students, both at tertiary and secondary levels, because of the simplicity of structure, and the sheer abundance coupled with a relatively low diversity of animal life. For the study of shorebirds, the volume by Howes (1989) is most

practical and unsurpassed, certainly for beginners. Part Two of *The Ecology of the Indonesian Seas* (Tomascik *et al.*, 1997) provides a good introduction to the fauna of Indonesian mangroves, with extensive species lists of the main faunal groups occurring throughout the archipelago.

REFERENCES

- Abdulahadi, R. & Suhardjono (1994) - The remnant mangroves of Sei Kecil, Simpang Hilir, West Kalimantan, Indonesia. *Hydrobiologia*, 285: 249-255.
- Abe, K. (1988) - Arboreal Arthropod community of mangrove forest in Halmahera, Indonesia. In: K. Ogino & M. Chihara (Ed.s), *Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986*, Ehime University, Japan, p.: 141-151.
- Abubakar, A.Yacub, A.Hasanudin, E. Suhartanto, H. Tabrany, J. Prianggono, J. Christanto, M.Tanari, S.Anwar and S.Marwah (2001) - The environmental management of the Segara Anakan Lagoon and its surroundings, Cilacap, Central Java, Indonesia. Group VI Presentation, Science Philosophy (PPs 702), Graduate Program, Agricultural Institute Bogor. http://rudyc250x.com/sem1_012/ke6_012.htm
- ADB (1996) - ADB Lends US\$45.6 Million to Indonesia to Save Java Ecosystem. Asian Development Bank Press Release, 119/96, 17 October 1996.
- Adema, F., P.W. Leenhouts and P.C. van Welzen (1994) - Sapindaceae. *Flora Malesiana*, Ser.I, Vol. 11:419-768.
- Adiwiryo, S., Sukristiyono & V. Toro, (1984) - The occurrence of crustaceans in the Tanjung Bungin mangrove forest, South Sumatra, Indonesia. *Proc. As. Symp. Mangr. Env. - Res. & Management*, 1984: 241-257.
- Afriastini, J.J. (1988) - Daftar Nama Tanaman. Penebar Swadaya, Jakarta, 176 pp.
- Ahmed, N. (1997) - Wild Flowers of Bangladesh. The University Press Ltd., Dhaka, 142 pp.
- Airy Shaw, H.K. (1975) - The Euphorbiaceae of Borneo. *Kew Bulletin Additional Series IV*, Her Majesty's Stationary Office, London, 245 pp.
- Aksornkoae, S. (1993) - Ecology and management of mangroves. IUCN Wetlands Programme. IUCN, Bangkok, Thailand, 176 pp.
- Alam, M.K. (1986) - Loranaceae. *Flora of Bangladesh No. 33*. Bangladesh National Herbarium and Bangladesh Agricultural Research Council (BRAC), Dhaka, 29 pp.
- Alejandro, G. and S. Liede (2004) - The Philippine Rubiaceae Genera: *Mussaenda*. http://www.uni-bayreuth.de/departments/planta2/wgl/delta_ru/www/mussaend.htm
- Alvarez, J.B. (1984). Our vanishing forests. *Greenfields* 14(2): 6-16.
- Andrew, P. (1992) - The birds of Indonesia. A checklist (Peters' Sequence). Indonesian Ornithological Society, Jakarta, 83 pp.
- Ang, L.H. & W.M. Ho (2002) - Afforestation of Tin tailings in Malaysia. 12th ISCO Conference, Beijing, China, 2002, p.:440-445.
- Anon. (1914) - Een paar kiekjes uit de mangrove. *De Tropische Natuur*, 3: 135-138.
- Anon. (1928) - Mededeelingen van de Vereeniging. Afdeling Batavia. *De Tropische Natuur*, Vol. XVII, p. 16.
- Anon. (2001) - Saptrangi *Salacia chinensis*. *Intellectual Property Rights*, vol. 7 (2):1-3.
- Aragones, E.G., J.P. Rojo & F.C. Pitargue (1998) - Botanical identification handbook on Philippine mangrove trees. Forest Products Research and Development Institute, Department of Science and Technology, Laguna, the Philippines, 127 pp.
- Aronson, J. A. (1989) - Haloph, a data base of salt tolerant plants of the world. Office of Arid Land Studies, Univ. of Arizona, Tucson, 77 pp.
- Ascherson, P. and P. Graebner (1907) - Potamogetonaceae. In: A. Engler (editor), *Das Pflanzenreich - Regni vegetabilis conspectus*, vo. IV.ii, Wilhelm Engelmann Verlag, Leipzig 184 pp.
- Asian Development Bank (2000) - Coastal and Marine Environment Management in the South China Sea (East Sea), Phase 2. Viet Nam Coastal and Marine Protected Areas Plan.
- Ashton, P.S. (1988) - Manual of the non-diptercarp trees of Sarawak. II. Forest Department Sarawak, Kuching, p.:429-468.

- AWB-Indonesia (1994) - Proposed Wetland Conservation Areas: New & Extensions of Existing Reserves. AWB-Indonesia/PHPA, Bogor.
- Backer, C.A. (1918) - Indische duinplanten. (vervolg). *De Tropische Natuur*, 7:5-11 & 55-59.
- Backer, C.A. (1919) - Indische duinplanten. (vervolg). *De Tropische Natuur*, 8:6-10.
- Backer, C.A. (1920) - Indische duinplanten. *De Tropische Natuur*, 9:173-191.
- Backer, C.A. (1934) - Onkruidflora der Javasche Suikerrietgronden.
- Backer, C.A. (1949) - Chenopodiaceae. *Flora Malesiana*, Ser.I, Vol. 4: 99-106.
- Backer, C.A. (1951) - Flagellariaceae. *Flora Malesiana*, Ser.I, Vol. 4:245-250.
- Backer, C.A. (1951) - Aizoaceae. *Flora Malesiana*, Ser.I, Vol. 4:267-275. (=Molluginaceae)
- Backer, C.A. (1951) - Salvadoraceae. In: *Flora Malesiana*, Ser. I, vol. 4: 224-225.
- Backer, C.A. & C.G.G.J. van Steenis (1951) - Sonneratiaceae. *Flora Malesiana*, Ser. I, 4: 286-289.
- Backer, C.A. & R.C. Bakhuizen van den Brink (1963-8) - *Flora of Java*. 3 Volumes, N.V.P. Noordhoff, Leiden, The Netherlands.
- Backer, C.A. & O. Posthumus (1939) - *Varenflora voor Java*. Uitgave van 's Lands Planten tuin, Buitenzorg, Java, 370 pp.
- Baird, D.J. (1994) - Pest control in tropical aquaculture: an ecological hazard assessment of natural and synthetic control agents. *Mitt. Intern. Verein. Limnol.*, 24: 285-292.
- Bailey, C. (1988) - The social consequences of tropical shrimp mariculture development. *Ocean & Shoreline Management*, 11: 31-44.
- Bakhuizen van den Brink, R.C. (1921) *Revisio generis Avicenniae*. In: *Bulletin du Jardin Botanique Buitenzorg*, serie III vol.III.
- Bakhuizen van den Brink, R.C. (1924) - *Revisio Bombacearum*. *Bull. Jardin Bot. Buitenzorg*, Serie III vol. VI:161-240.
- Bakhuizen van den Brink, R.C. (1943-45) - A contribution to the knowledge of the Melastomataceae occurring in the Malay Archipelago especially in the Netherlands East Indies. *Recueil de travaux botaniques néerlandais*, Vol. XL: 1-391.
- Baltzer, M. (1990) - A report on the wetland avifauna of South Sulawesi. *Kukila*, 5: 27-55.
- Bamroongrugs, N. (2002) - A Study on Mangrove Planting Techniques at the Songkla Lake, Southern Thailand. In: A. Ali, C.S.M. Rawd, M. Mansor, R. Nakamura, S. Ramakrishna and T. Mundkur (editors), *The Asian Wetlands: bringing partnerships into good wetland practices*. Proceedings of the Symposium held at Penang, Malaysia, on 27-30 August 2001, p:111-120.
- Bann, C. (1998) - *The Economic Valuation of Mangroves: A Manual for Researchers*. International Development Research Centre (IDRC), Ottawa, Canada. <http://web.idrc.ca/uploads/user-S/10305674900acf30c.html>
- BAPPENAS (2004) *Sumber daya alam dan lingkungan hidup. Antara krisis dan peluang*. Badan Perencanaan Pembangunan Nasional, Jakarta.
- Barlow, B.A. (1997) - Loranthaceae. In: *Flora Malesiana*, Ser. I, vol. 13: 209 - 401.
- Becking J.H., L.G. den Berger & H.W. Meindersma (1922) *Vloed- of mangrovebosschen in Ned.-Indië*. In: *Tectona* XV.
- Benthem, W., L.P. van Lavieren and W.J.M. Verheugt (1999) - Mangrove Rehabilitation in the Coastal Mekong Delta, Vietnam. In: W. Streever (ed.), *An International Perspective on Wetland Rehabilitation*. Kluwer Academic Publishers, the Netherlands, p.:29-36.
- Beverluis, A.J. (1919) *Iets over de samenstelling, verspreiding, gesteldheid en benutting der bosschen in het landschap Boeton c.a.* In: *Tectona* XII, pp. 513-528.
- Biro Pusat Statistik (1993) - *Statistik Indonesia*. Statistical Pocketbook of Indonesia. 1992. Central Bureau of Statistics, Jakarta, 437 pp.
- Blake, S. T. (1968) - A revision of *Melaleuca leucadendron* and its allies (Myrtaceae). Contribution 1, Queensland (Australia) Herbarium, Department of Primary Industries, Brisbane. 114 p.

- Bodegom, A.H. van (1929) De vloedbosschen in het gewest Riouw en onderhorigheden. In: *Tectona* XXII, pp. 1302-1332.
- Boon, D.A. (1936) - De inrichting van de voor exploitatie in aanmerking komende bosschen in de afdeeling Bengkalis, benevens eenige opmerkingen omtrent de samenstelling der terplaatse voorkomende moerasbosschen. *Tectona*, 29: 344-373.
- Boto, K.G. & J.S. Bunt, (1981) - Tidal export of particulate organic matter from a Northern Australian mangrove ecosystem. *Estuarine, Coastal and Shelf Science*, 13: 247-255.
- Budiman, A. (1985) - The molluscan fauna in reef associated mangrove forests in Elpaputih and Wallale, Ceram, Indonesia. *Austr. Nat. Univ., Mangrove Monograph No. 1*, Darwin, p.: 251-258.
- Budiman, A. (1988) - Ecology and behaviour of benthic fauna, crabs and molluscs #2: Ecological distribution of Molluscs. In: K. Ogino & M. Chihara (Ed.s), *Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986*, Ehime University, Japan, p.: 49-57.
- Bunt, J.S. & W.T. Williams, (1981) - Vegetational relationships in the mangroves of tropical Australia. *Marine Ecology - Progress Series*, 4: 349-359.
- Burbridge, P.R. & Koesoebiono (1984) - Management of mangrove exploitation in Indonesia. *Proc. As. Symp. Mangr. Env.-Res. & Manag.*, 740-760.
- Burhanuddin, (1993) - A study on mangrove fish at Handeuleum group and Panaitan Island of Ujung Kulon National Park. In: *Proc. Workshop on mangrove fisheries and connections*, Ipoh, Malaysia, August 26-30, 1991, p.: 173-182.
- Burkill, I.H. (1935) - A dictionary of the economic products of the Malay Peninsula. Crown Agents for the Colonies, London. 2 vols. 2402 pp (2nd ed., 1966, 2 vols. Ministry of Agriculture and Co-operatives, Kuala Lumpur, Malaysia, 2444 pp.).
- Carter, J. (1959) - Mangrove succession and coastal change in south-west Malaya. *Malaysian Forester*.
- Chai, P.P.K. (1982) Mangrove forest in Sarawak. In: *Malaysian Forester* 38-2.
- Chai, P.P.K. (1982) The mangrove trees and shrubs of Sarawak. In: *Malaysian Forester* 38-3.
- Chan, H.T., J.E. Ong, W.K. Gong and A.Sasekumar (1993) - The Socio-Economic, Ecological and Environmental Values of Mangrove Ecosystems in Malaysia and their Present State of Conservation. In: *The Economic and Environmental Values of Mangrove Forests and their Present State of Conservation in the South-East Asia/Pacific Region*. Clough, B. (Ed.). *Mangrove Ecosystems Technical Reports*. International Society for Mangrove Ecosystems, Okinawa, Japan. pp.41-81.
- Chan, L and R. Corlett., eds. (1999) - Biodiversity in the Nature Reserves of Singapore. *The Garden's Bulletin*, Singapore, 49(2): 147-425.
- Chapman, V.J. (1976a) - Mangrove Vegetation. J. Cramer, Valduz, 447 pp.
- Chapman, V.J. (1976b) - Coastal Vegetation. Pergamon Press, 292 pp.
- Chapman, V.J. (ed.) (1977) - Wet coastal ecosystems. *Ecosystems of the World: 1*. Elsevier Scientific Publishing Company, 428 pp.
- Chapman, V.J. (1984) - Botanical surveys in mangrove communities. In: S.C. Snedaker & J.G. Snedaker, *The mangrove ecosystem: research methods*, p.:53-80. UNESCO, *Monograph on oceanological methodology* 8, Paris, 251 pp.
- Chau, L. M. Lau, B. Hau and G. Siu (2000) - The present status and conservation of the biodiversity in Hong Kong. *Chinese Biodiversity* 8(1):25~35, February, 2000.
- Chaudhuri, A.B. & A. Choudhury (1994) - Mangroves of the Sundarbans. Volume One: India. IUCN Wetlands Programme, IUCN, Bangkok, Thailand, 247 pp.
- Chihara, M. & J. Tanaka (1988) - Species composition and ecology of macroalgae in mangrove brackish areas of East Indonesia. In: K. Ogino & M. Chihara (Ed.s), *Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986*, Ehime University, Japan, p.:7-20.
- Chen, G.T.A, (1982) - Some aspects of the cology of the mangrove forest at Sungai Buloh, Selangor. II. Distribution pattern and population dynamics of tree-dwelling fauna. *Malayan Nature Journal*, 36: 267-277.

- Chong, V.C. (1994) - Distribution and abundance of prawns in a Malaysian mangrove system. In: S. Sudara, C.R. Wilkinson and Chou Loke Ming (Editors), Proceedings of the 3rd ASEAN-Australia Symposium on Living Coastal Resources, Bangkok, 16-20 May 1994, p.:437-445.
- Choy, S.C. & W.E. Booth (1994) - Prolongued inundation and ecological changes in an *Avicennia* mangrove: implications for conservation and management. *Hydrobiologia*, 285: 237-247.
- Clayton, W.D., S.M. Phillips and S.A. Renvoize (1974) - Graminae (Parts 1 and 2). Flora of Tropical East Africa, Crown Agents for Oversea Governments and Administrations, 449 pp.
- Cockburn, P.F. (1976) Trees of Sabah volume one. Sabah forest record no. 10, Borneo literature bureau for Forest Department Sabah, Kuching.
- Comber, J.B. (1990) - Orchids of Java. Royal Botanic Gardens, Kew, U.K., 407 pp.
- Cook, C.D.K (1990) - Aquatic Plant Book. SPB Academic Publishers, The Hague, 278 pp..
- Coomans de Ruiter, L. (1935) - Borneo Orchideeën. Joh. Enschede en Zonen, Grafische Inrichting NV. Haarlem, 80 pp.
- Corlett, R.T. (1986) - The mangrove understory: some additional observations. *Journal of Tropical Ecology*, 2: 93-94.
- Corner, E.J.H. (1959) - The Garden's Bulletin, Singapore, 17(3):397.
- Corner, E.J.H. (1988) - Wayside trees of Malaya. Third edition, published by the Malayan Nature Society, Kuala Lumpur, Malaysia. 2 volumes, 861 pp. & 236 plates.
- Craswell, E.T. & E. Pushparajah (1989) - Management of Acid Soils in the Humid Tropics of Asia. Australian Centre for International Agricultural Research (ACIAR) and International Board for Soil Research and Management, Canberra, Australia, 118 pp.
- Danielsen, F. & W. Verheugt (1990) - Integrating conservation with land-use planning in the coastal region of South Sumatra. PHPA, AWB, PPLH-UNSRI and the Danish Ornithological Society, Bogor, Indonesia, 210 pp.
- Danser, B.H. (1927) - Die Polygonaceen Niederländisch-Ostindiens. Bulletin du Jardin Botanique, Jardin Botanique de Buitenzorg. Archipel Drukkerij, Buitenzorg, Serie III, vol. VIII, 117-261.
- Danser, B.H. (1931) - The Loranthaceae of the Netherlands Indies. Bull. Jard. Bot. de Buitenzorg, Ser. III vol. XI: 233-519.
- Darsidi, A. (1984) - Pengelolaan hutan mangrove di Indonesia. In: Soemodihardjo et al. (Eds.). Prosiding Seminar II Ekosistem Mangrove, p.: 19- 28. MAB-LIPI, Jakarta.
- Darsidi, A. (1987) - Perkembangan pemanfaatan hutan mangrove di Indonesia. In: Soerianegara et al. (Eds.). Prosiding Seminar III Ekosistem Mangrove, p.: 27-37. MAB-LIPI, Jakarta.
- Das, S. & N.A. Siddiqi (1985) - The Mangroves and Mangrove Forests of Bangladesh. Bangladesh Forest Research Institute, Mangrove Silvicultural Division Bull. No. 2., 142 pp.
- Davie, J., Merrill, R. and Djameluddin, R. (1996) - The sustainable use and conservation of the mangrove ecosystems of Bunaken National Park. Natural resources management project, Bappenas-Ministry of Forestry & USAID, Jakarta.
- Davies, J., Magsalay, P.M., Rigor, R., Mapalo, A. and Gonzales, H. (1990). A Directory of Philippines wetlands. Two Volumes. Asian Wetland Bureau Philippines Foundation/ Haribon Foundation.
- Davies, J. & G. Claridge, (1993) - Wetland Benefits. The potential for wetlands to support and maintain development. Asian Wetland Bureau, International Waterfowl & Wetlands Research Bureau, Wetlands for the America's, 45 pp.
- de Haan, J. H. (1931) - Het een en ander over de Tjilatjap'sche vloedbosschen. *Tectona* 24: 39-76.
- de Laubenfels, D.J. (1988) - Coniferales. In: Flora Malesiana, Ser. I, vol. 10: 337-453.
- Delsman, H.C., (1927) - Radjoengans. *De Tropische Natuur*, 16: 155-160.
- de Wilde, W.J.J.O. (1962) - Najadaceae. Flora Malesiana, Ser.I, 6: 157-171.
- de Wilde, W.J.J.O. (1972) - Passifloraceae. In: Flora Malesiana, Ser. I, vol. 7:405-434.

- de Wilde, W.J.J.O. (2000) – Myristicaceae. In: Flora Malesiana, Ser. I, vol. 14:1-632.
- Dent, D. (1986) - Acid sulphate soils: a baseline for research and development. International Institute for Land Reclamation and Improvement/ILRI, Wageningen, The Netherlands. ILRI Publication No. 39, 204 pp.
- Department of Forestry and Wildlife, Forest Wildlife Research and Education Institute, Cambodia. (1998) – Forest Cover Statistics.
- Ding Hou (1958) - Rhizophoraceae. Flora Malesiana, Ser.I, 5: 429-493.
- Ding Hou (1962) - Celastraceae I. Flora Malesiana, Ser.I, 6: 227-291.
- Ding Hou (1964) – Celastraceae – II. In: Flora Malesiana, Ser. I, vol. 6: 389-421.
- Ding Hou (1978) - Anacardiaceae. Flora Malesiana, Ser.I, 8: 395-548.
- Ding Hou, K. Larsen and S.S. Larsen (1996) – Caesalpiniaceae. In: Flora Malesiana, Ser. I, vol. 12: 409-730.
- Djajadiredja, R. & T. Daulay (1981) - The status and technology of brackishwater aquaculture in Indonesia. Indonesian Agric. Res. & Dev. J., 3: 65-72.
- Doran, J.C. and B.V. Gunn (1994) – Exploring the genetic resources of tropical *Melaleucas*. Forest Genetic Resources No. 22. FAO, Rome.
http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/V3965E/V3965E07.htm
- Dransfield, J. (1984) - The rattans of Sabah. Sabah Forest Record No. 13, Forest Department, Sabah, 182 pp.
- Dransfield, J. and N. Manokaran (1994) (editors) – Rattans. Plant Resources of South-east Asia (PROSEA) No. 6. Bogor, Indonesia, 137 pp.
- Duke, N.C. (1984) – A mangrove hybrid, *Sonneratia X gulngai* (Sonneratiaceae) from north-eastern Australia. *Austrobaileya* 2:103-105.
- Duke, N.C. (1994) – A mangrove hybrid, *Sonneratia X urama* (Sonneratiaceae) from northern Australia and southern New Guinea. *Austr. Syst. Bot.* 7: 521-1-526, ill. Key to Australasian spp.
- Duke, N.C. (1992) - Mangrove floristics and biogeography. Chapter 4 (p. 63-100) in: Tropical Mangrove Ecosystems (Volume 41), A.I. Robertson & D.M. Alongsi (Eds.), Coastal and Estuarine Studies Series, American Geophysical Union, Washington, D.C., 329pp
- Duke, N.C., J.S. Bunt & W.T. Williams (1984) - Observations on the floral and vegetative phenologies of North-eastern Australian Mangroves. *Aust. J. Bot.*, 32: 87-99.
- Du Puy, D. & P. Cribb (1988) - The genus *Cymbidium*. *Opera Botanica*, 72: 78-.
- Duyfjes, B.E.E. (1996) – Hernandiaceae. In: Flora Malesiana, Ser. I, vol. 12:737-761.
- Ellison, J. (2003) – Assessment of mangroves as a vulnerable coastal system to climate change.
www.cdesign.com.au
- Endert, F.H. (1930) Verslag van een tournee naar de vloedbosschen van Moeara Anke dd. 25 juli 1930. Unpublished.
- English, S., C. Wilkinson & V. Baker (1994) - Survey manual for tropical marine resources. Australian Institute of Marine Science, Townsville, Australia, 368 pp.
- Erfteimeijer, P. & E. Djuharsa (1988) - Survey of coastal wetlands and waterbirds in the Brantas and Solo deltas, East Java (Indonesia). PHPA, AWB/INTERWADER & Catholic University of Nijmegen, Bogor, Indonesia, 92 pp. & XX.
- Erfteimeijer, P., B. van Balen & E. Djuharsa (1988) - The importance of Segara Anakan for Nature Conservation. With special reference to its avifauna. PHPA-AWB/ INTERWADER, Report No. 6, Bogor, Indonesia, 59 pp.
- Erfteimeijer, P., G. Allen & Zuwendra (1989) - Preliminary resource inventory of Bintuni Bay and recommendations for conservation and management. PHPA/ AWB, Bogor, Indonesia, 151 pp.
- Everett, B. & T.C. Whitmore (1972) – Lythraceae. Tree Flora of Malaya, vol. 3, 276-280. Longman, Kuala Lumpur.
- Exell, A.W. (1954) - Combretaceae. Flora Malesiana, Ser.I, 4: 533-589.
- F.A.O. (1982) Management and utilization of mangroves in Asia and the Pacific. FAO environment paper 3, Rome.

- FAO (2003) – Status and trends in mangrove area extent worldwide. By Wilkie, M.L., Fortuna, S. Forest Resources Assessment Working Paper No. 63. Forest Resources Division. FAO, Rome (Unpublished)
- Fernandes, D.A. (1934) Over mangrove culture. In: *Tectona* XXVII, pp. 299-303.
- Fiselier, J.L., W. Altenburg, A. Spaans, F. Baal, G.M. van den Top, W.J.M. Verheugt, A. Purwoko, F. Danielsen, H. Skov & R. Kadarisman (1990) - Living off the Tides. Environmental Database on Wetland Interventions (EDWIN), Centre for Environmental Studies, Leiden, the Netherlands, 119 pp.
- Fisheries Department Cambodia (2001) – Natural Resources Evaluation. Agriculture Productivity Improvement Project (APIP), IIF Credit No. 0110-KH and IFAD Grant No. 423-KH. The Fisheries Component, Technical Paper No. 1, 59 pp. Ministry of Agriculture, Forestry and Fisheries, Phnom Penh.
- Fong, F.W. (1984) - Nipa swamp - a neglected mangrove resource. *Proc. As. Symp. Mangrove Env. - Res. & Management*, 1984: 663-671.
- Foo, H.T. & J.T.S. Wong, (1980) - Mangrove swamp and fisheries in Sabah. In: J.I. Furtado (Ed.), *Tropical Ecology & Development*, Int. Soc. Trop. Ecol., Kuala Lumpur, p.: 1157-1161.
- Forman, L.L. (1986) – Menispermaceae. In: *Flora Malesiana*, Ser. I, vol. 10: 157-253.
- Frazier, S. (1992) – Tiger data in Wetland Data Base and a Recommendation to enhance the chances of Tiger survival. Sumatran Tiger PHVA Workshop, Padang, West Sumatra, Indonesia, 22-26 November 1992.
- Fujimoto, K. (2004) – Below-ground carbon sequestration of mangrove forests in the Asia-Pacific region. In: M. Vannucci (editor), *Mangrove Management and Conservation, Present and Future*. United Nations University Press, Tokyo and New York, p:138-146.
- Gammage, S. (1997) – Estimating the Returns to Mangrove Conversion: Sustainable Management or Short Term Gain? EEP Discussion Papers 97/02, 85 pages, tabs., International Institute for Environment and Development
- Gan, B.K. (1993) - Forest Management in Matang. In: *Proceedings of the Workshop on Mangrove Fisheries and Connections*, Ipoh, Malaysia, 26-30 August 1991. Technical Committee on AAMSP:LCR, Ministry of Science, Technology and the Environment, p.:15-26.
- Geerinck, D.J.L. (1993) – Amaryllidaceae. *Flora Malesiana*, Ser.I, 11: 353-373.
- Giesen, W. (1991a) - Bakung Island, Riau (Pulau Bakung, Pulau Basu). Final Draft Survey Report. PHPA/AWB Sumatra Wetland Project Report No. 11, Bogor, 45pp.
- Giesen, W. (1991b) - Hutan Bakau Pantai Timur Nature Reserve, Jambi, Sumatra. Final Draft Survey Report. PHPA/AWB Sumatra Wetland Project Report No. 17, Bogor, 34 pp.
- Giesen, W. (1993) – Indonesia's mangroves: an update on remaining area and main management issues. Paper presented at the International Seminar on "Coastal Zone Management of Small Island Ecosystems", Ambon, 7-10 April 1993. 10pp.
- Giesen, W. (1993) - Mass feeding of Dog-faced Water Snakes (*Cerberus rhynchops*) on Sumatran mudflats. *Malayan Nature Journal*, 46: 265-266.
- Giesen, W. (1994) - Perubahan habitat lahan basah di kepulauan Sunda Besar dan implikasinya terhadap keragaman hayati [Habitat changes in wetlands of the Greater Sunda's and implications for biodiversity]. In: *Prosiding Simposium Pertama mengenai Berang-berang di Indonesia. Peranan Berang-berang bagi Manusia*. Bogor, 7 April 1994, PHPA/ AWB-Indonesia, Bogor, p.:45-55.
- Giesen, W. (1995) - The Flooded Forests and Blackwater Lakes of Danau Sentarum. UK-ITFMP Project 5: Conservation, report WP B.1.1., 85 pp.
- Giesen, W. (1996) - Selection of Priority Wetland Sites in Kalimantan. Report for the Tropical Forest Management Programme, project 5: Conservation. PHPA/ Wetlands International Indonesia Programme; Bogor.
- Giesen, W., M. Baltzer & R. Baruadi (1991) - Integrating Conservation with Land-use development in Wetlands of South Sulawesi. PHPA/ AWB publication, Bogor, 240pp.
- Giesen, W. & B. van Balen (1991) - Several short surveys of Sumatran Wetlands. Notes and Observations. PHPA/ AWB Sumatra Wetlands Project Report No. 26, 98 pp.

- Giesen, W. & Sukotjo (1991) - Karang Gading-Langkat Timur Laut Wildlife Reserve (North Sumatra). PHPA / AWB Sumatra Wetland Project Report No. 10, 48 pp.
- Giesen, W. & Rudyanto (1994) - Satonda Island, Sumbawa, and its unique stromatolites. Survey report. PHPA / AWB, Bogor, 17 pp.
- Giesen, W. & S. Wulffraat (1998) - Indonesian mangroves part I: Plant diversity and vegetation. *Tropical Biodiversity*, 5(2):11-23.
- Gillett, J.B., R.M. Polhill and B. Verdcourt (1971) - Leguminosae (Part 4), Subfamily Papilionoidae (1 & 2). *Flora of Tropical East Africa*, Crown Agents for Oversea Governments and Administrations, 1108 pp.
- Gilliland, H.B. (1971) *Flora of Malaya* vol. III grasses. Botanic Gardens, Singapore, 319 pp. & 36 plates.
- Gregory-Smith, R. (1993) - Birds and mammals in mangroves of mainland Kedah. *Malayan Nature Journal*, 47:425-430.
- Groombridge, B. (ed.) (1992) - *Global Biodiversity. Status of the Earth's Living Resources*. Chapman & Hall, 585 pp.
- Hance, H. (1878) - *Spicilegia Florae Sinensis*. *Journal of Botany, British and Foreign*. 16(188):229.
- Hannibal, L.S. (undated) - A Systematic Review of the Genus *Crinum* (Amaryllidaceae). Published online at URL: www.crinum.org/review.html (71 pp.)
- Harakunarak, A. & S. Aksornkoae (2005) - Life Saving Belts: Post-tsunami Reassessment of Mangrove Ecosystem Values and Management in Thailand. *Tropical Coasts*, July 2005, p:48-55.
- Hardjowigeno, S. (1989) - Mangrove soils of Indonesia. In: I. Soerianegara et al. (Eds.), *Proc. Symposium on Mangrove Management: its Ecological and Economic Considerations*, Bogor, Indonesia, August 9-11, 1988, p.: 257-265.
- Hardwick, G. (2004) - Economically Useful Plants For Northern Australia MASTER SPECIES LIST. <http://www.brisrain.webcentral.com.au/newsletters/Brain24.pdf>
- Hashim, M. and W. H. W. Kadir (1999) - Comparison of jers-1 and radarsat synthetic aperture Radar data for mapping mangrove and its biomass. GIS Development Net, ACRS: <http://www.gisdevelopment.net/aars/acrs/1999/ps1/ps1017a.shtml>
- Hassan, R.B. & T.L. Ti (1986) - Observations on acid runoff and iron in brackishwater fishponds. Problems and implications. Department of Fisheries, Min. of Agriculture, 14 pp.
- Hay, A. (1980) *Aroids of Papua New Guinea*. Christensen Research Institute, Kristen Press Inc., Madang, Papua New Guinea, 120 pp.
- Henty, E.E. (ed.) (1981) *Handbooks of the flora of Papua New Guinea*, volume II. Government of Papua New Guinea, Lae.
- Heyne, K. (1950) - *De nuttige planten van Indonesië*. Publishers W. van Hoeve, The Hague/Bandung, 2 volumes, 1660 pp. & CCXLI.
- Heywood, V.H. (1993) - *Flowering plants of the world*. B.T. Batsford Ltd., London, 335 pp.
- Hoogerwerf, A. (1951) - *Verslag over de expeditie naar het natuurpark Pulau Panaitan (Prinseneiland) in Straat Sunda van 30 Augustus - 5 October 1951*. Djawatan Penyelidikan Alam (Kebun Raya Indonesia) Bogor, Bagian Perlindungan Alam dan Pemburuan. 31^{ste} Dienstrapport, November-December 1951, 194 pp.
- Hölldobler, B. & E.O. Wilson (1990) - *The Ants*. Springer Verlag, 732 pp.
- Holttum, R.E. (1954) - *Plant Life in Malaya*. Longman, Kuala Lumpur, Malaysia, 254 pp.
- Holttum, R.E. (1966) - *Ferns of Malaya (Revised Flora of Malaya, Vol. II)*, 2nd ed. Govt. Printing Office, Singapore.
- Holttum, R.E. (1978) - *Lomariopsis Group*. *Flora Malesiana*, Ser.II, 1: 255-314.
- Hommel, P.W.F.M. (1987) - *Landscape-ecology of Ujung Kulon (West Java, Indonesia)*. PhD thesis, Agricultural University of Wageningen, the Netherlands, 206 pp.
- Hong, P.N. & H.T. San (1993) - *Mangroves of Vietnam*. The IUCN Wetlands Programme, IUCN, Bangkok, Thailand, 173 pp.

- Hong, P.N. (2000) - Effects of Mangrove Restoration and Conservation on the Biodiversity and Environment in Can Gio District, Ho Chi Minh City Phan Nguyen Hong, International Workshop Asia-Pacific Cooperation on Research for Conservation of Mangroves 26-30 March, 2000 - Okinawa, Japan, 14 pp.
- Hong, P.N. (2003) - Mangrove forests in Vietnam - present status and challenges. Presented at the International Symposium on Conservation and Wise Use of Mangroves in Southeast Asia, 6-8 October 2003, Brunei Darussalam, 17 pp.
- Hong, P.N. (2004) - Effects of mangrove restoration and conservation on the biodiversity and environment in Can Gio District. *In: M. Vannucci (editor), Mangrove Management and Conservation, Present and Future.* United Nations University Press, Tokyo and New York, p:111-137.
- Howes, J. (1987). Rapid assessment of coastal wetlands in the Philippines. IPT-Asian Wetland Bureau, Kuala Lumpur, Malaysia.
- Howes, J. (1989). Shorebird Studies Manual. Illustrations by D. Bakewell. Asian Wetland Bureau Publication No. 55, Kuala Lumpur, Malaysia, 362 pp.
- Howes, J., Y.G. Pei, J. Cai and M. Chen (2004) - Exploring the Mangroves. A Mangrove Education Kit for Middle School Teachers. Integrated Mangrove Management and Coastal Protection project in Leizhou, China. ARCADIS Euroconsult and Wetlands International, for Government of China, State Forestry Administration/Guangdong Forestry Bureau and Ministry of Foreign Affairs of the Netherlands (DGIS). Draft, 28 November 2004, 81 pp.
- Hulster, I.A. de (1939) Definitief bedrijfsplan van het vloedbosch-complex "West Batavia"; het vloedboschcomplex "Tijaseem-Pananoekan"; het vloedboschcomplex "Tjikiong". Three unpublished management plans.
- Hussain, Z. & G. Acharya (1994) - Mangroves of the Sundarbans. Volume two: Bangladesh. IUCN - The World Conservation Union, Gland, Switzerland, 257 pp.
- Hutchings, P. & Saenger, P. (1987) Ecology of mangroves. University of Queensland press, St Lucia, London, New York.
- Inger, R.F. & Stuebing, R.B. (1997) A field guide to the frogs of Borneo. Natural history publications & Science and technology unit, Kota Kinabalu.
- Iremonger, S., C. Ravilious and T. Qinton (1997) - A Statistical Analysis of Global Forest Conservation. *In: S. Iremonger, C. Ravilious and T. Qinton (ed.'s), A Global Overview of Forest Conservation.* CD-ROM. World Conservation Monitoring Centre (WCMC) and the Centre for International Forestry research, Cambridge, U.K.
- Iskandar, D.T. (1998) - The Amphibians of Java and Bali. LIPI - The Field Guide Series. Research and Development Centre for Biology - LIPI, and GEF - Biodiversity Collections Project. Jakarta, 117 pp. & plates.
- Ivens, G.W. (1982) - East African weeds and their control. Oxford University Press, Nairobi & Dar es Salaam, 250 pp.
- Janssen, R. & J.G. Padilla (1996) - Valuation and Evaluation of Management Alternatives for the Pagbilao Mangrove Forest. CREED Working Paper Series No. 9, October 1996. Collaborative Research of the Economics of Environment and Development, London & Amsterdam, 48 pp.
- Janzen, D.H. (1985) - Mangroves: where's the understory? *Journal of Tropical Ecology*, 1: 89-92.
- Jiménez, J.A. & A.E. Lugo (1985) - Tree mortality in mangrove forests. *Biotropica*, 17: 177-185.
- Johnson, A. (1977) - The Ferns of Singapore Island. 2nd ed. Singapore University Press, Singapore.
- Johnson, A. (1979) - The algae of Singapore mangrove. *In: Mangrove & Estuarine Vegetation in Southeast Asia.* BIOTROP Special Publication No. 10, p.: 45-49.
- Johnstone, I.M. (1981) - Consumption of leaves by herbivores in mixed mangrove stands. *Biotropica*, 13: 252-259.
- Jonkers, H.A. (1933) De vloedbosschen van de Riouw-Lingga Archipel. *In: Tectona XXVI*, pp. 717-737. Jacobs, M. (1955) - Malpighiaceae. *Flora Malesiana, Ser.I*, 5: 125-145.
- Kamerling, Z. (1915) - Leerboek der Plantkunde voor Nederlandsch-Indië. H.D. Tjeenk Willink & Zoon, Haarlem, 455 pp.

- Kantor Menteri Negara Lingkungan Hidup (1993) - Pengelolaan Ekosistem Hutan Mangrove. Proc. Workshop on: Pemantapan Strategi Pengelolaan Lingkungan Wilayah Pesisir dan Lautan dalam pembangunan jangka panjang Tahap Kedua. Kapal Kerinci, 11-13 September 1993, 47 pp.
- Kartawinata, K. & E.B. Walujo (1977) - A preliminary study of the mangrove forest on Pulau Rambut, Jakarta Bay. Marine Research in Indonesia, 18: 119-129.
- Kartawinata, K., S. Adisoemarto, S. Soemodihardjo & I.G. Tantra, (1979) - Status pengetahuan hutan bakau di Indonesia. In: S. Soemodihardjo et al. (Eds.), Prosiding Seminar I Ekosistem Mangrove, Panitia Program MAB Indonesia-LIPI, Jakarta, p.: 21-37.
- Keng, H. (1972) - Coniferae. Tree Flora of Malaya, vol. 1, 39-53. Longman, Kuala Lumpur.
- Keng, H., (1987) - Orders and families of Malayan Seed Plants. Singapore University Press, National University of Singapore, 441 pp.
- Keng, F.L.L. & M.L. Tat-Mong, (1989) - Fascinating snakes of Southeast Asia - an introduction. Tropical Press, Kuala Lumpur, 124 pp.
- Kern, J.H.. (1974) - Cyperaceae. In: Flora Malesiana, Ser. I, vol. 7: 435-753.
- Khalil, S. (1999) - Economic valuation of the Mangrove Ecosystems along the Karachi Coastal Areas. In: J.E. Hecht (editor), *The Economic Value of the Environment: Cases from South Asia*. IUCN - the World Conservation Union, 11 pp.
- Khan, I.S.A.N. (1990) - Socio-economic values of aquatic plants (freshwater macrophytes) of Peninsular Malaysia. Asian Wetland Bureau - Institute of Advanced Studies, University of Malaya-WWF-Malaysia, Kuala Lumpur, 124 pp.
- Khan, M.S. (1980) - Sonneratiaceae. Flora of Bangladesh No. 12. Bangladesh National Herbarium and Bangladesh Agricultural Research Council (BRAC), Dhaka, 12 pp.
- Khan, M.S. & A.M. Huq (1972) - Casuarinaceae, Phytolaccaceae, Hydrophyllaceae, Martyniaceae and Caricaceae. Flora of Bangladesh No. 1. Bangladesh Agricultural Research Council (BRAC), Dhaka, 13 pp. + plates.
- Khan, M.S. and B. Khan (1989) - Plumbaginaceae. Flora of Bangladesh No. 22. Bangladesh National Herbarium and Bangladesh Agricultural Research Council (BRAC), Dhaka, 8 pp.
- Khan, M.S. and Hosne-Ara (1989) - Cassythaceae. Flora of Bangladesh No. 43. Bangladesh National Herbarium and Bangladesh Agricultural Research Council (BRAC), Dhaka, 3 pp.
- Khan, M.S. and M.K. Alam (1996) - Homestead flora of Bangladesh. Bangladesh Agricultural Research Council (BRAC) and the International Development research Centre (IDRC), Village and Farm Forestry Project, SDC. Dhaka, 275 pp.
- Khoo, K.H. (1991) - The mangrove fisheries in Matang, Perak and Merbok, Kedah. In: A.C. Alcalá (Ed.) - Proceedings of the Regional Symposium on Living Resources in Coastal Areas, 30 January - 1 February 1989, Manila, p: 521-.
- Kiew, R. (1978) - Aquifoliaceae. Tree Flora of Malaya, Vol. 3, 1-9. Longman, Kuala Lumpur.
- Kiew, R. (1989) - Utilization of palms in Peninsular Malaysia. Malayan Naturalist, vol. 43:43-67.
- Kindt, R & R.W. Burn (2002) - The Biodiversity Analysis Package. Resources and guidelines for the analysis of biodiversity and ecological information. Version 1. World Agroforestry Centre & Faculty of Agricultural and Applied Biological Sciences (Ghent University) and Statistical Services Centre (Reading University).
- Kint, A. (1934) - De luchtfoto en de topografische terreingesteldheid in de mangrove. De Tropische Natuur, 23: 173-189.
- Kitamura, S., C. Anwar, A. Chaniago & S. Baba (1997) - Handbook of Mangroves in Indonesia, Bali and Lombok. JICA and ISME.
- Knox, G.A. & T. Miyabara (1984) - Coastal Zone Resource Development and Conservation in Southeast Asia, with special reference to Indonesia. UNESCO Regional Office for Science & Technology for Southeast Asia, Jakarta, 182 pp.
- Kochummen, K.M. (1972) - Malvaceae. Tree Flora of Malaya, vol. 1, 309-314. Longman, Kuala Lumpur.
- Kochummen, K.M. (1972b) - Sterculiaceae. Tree Flora of Malaya, vol. 2, 353-382. Longman, Kuala Lumpur.

- Kochummen, K.M. (1978a) – Moraceae. Tree Flora of Malaya, vol. 3, 119-168. Longman, Kuala Lumpur.
- Kochummen, K.M. (1978b) – Verbenaceae. Tree Flora of Malaya, vol. 3, 297-313. Longman, Kuala Lumpur.
- Kochummen, K.M. (1978c) – Myrtaceae. Tree Flora of Malaya, vol. 3, 169-254. Longman, Kuala Lumpur.
- Kochummen, K.M. (1978d) – Symplocaceae. Tree Flora of Malaya, vol. 3, 266-274. Longman, Kuala Lumpur.
- Kochummen, K.M. (1978e) – Tiliaceae. Tree Flora of Malaya, vol. 3, 392-412. Longman, Kuala Lumpur.
- Kogo, M. and K. Kogo (2004) – Towards sustainable use and management for mangrove conservation in Vietnam. In: M. Vannucci (editor), *Mangrove Management and Conservation, Present and Future*. United Nations University Press, Tokyo and New York, p:233-248.
- Komiyama, A., H. Moriya, S. Prawiroatmodjo, T. Tomi & K. Ogino (1988) - Forest as an ecosystem, its structure and function; #1: Floristic composition and stand structure. In: K. Ogino & M. Chihara (Ed.s), *Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986*, Ehime University, Japan, p.: 85-96.
- Konsten, C.J.M. & O. Klepper, (1992) - Pyrite in coastal wetlands: a natural chemical time bomb. Paper presented at the European state-of-the-art conference on delayed effects of chemicals in soils and sediments (Chemical Time Bombs), 2-5 September 1992, Veldhoven, The Netherlands, 14 pp.
- Kostermans, A.J.G.J. (1959) - Monograph of the genus *Heritiera* Aitn. (Sterculiaceae). *Reinwardtia*, 4: 256-62.
- Kostermans, A.J.G.J. (1961) - A monograph of the genus *Brownlowia* Roxb. (Tiliaceae). *Comm. For. Res. Inst., Bogor, Indonesia*. 73: 1-33.
- Kostermans, A.J.G.H. (1977) Notes on Asiatic, Pacific and Australian Diospyros. In: *Blumea* vol. 23 no. 2.
- Krajenbrink, J. (1928) – Een Witbloemige *Aerides odoratum*. *De Tropische Natuur*, Vol. XVII: 47-48.
- Kusmana, C. (1997) – *Metoda Survey Vegetasi*. IPB Press, Bogor.
- Lam, H.J. (1919) – The Verbenaceae of the Malayan Archipelago, together with those from the Malayan Peninsula, the Philippines, the Bismarck-Archipelago, and the Palau-, Marianne- and Caroline-Islands. PhD thesis, University of Groningen, 370 pp. + plates.
- Larsen, K. & I. Nielsen (2001) – Melastomataceae. *Flora of Thailand* (in press 2001).
- Leach, G.J. & P.L. Osborne (1985) - Freshwater plants of Papua New Guinea. The University of Papua New Guinea Press, Port Moresby, 254 pp.
- Leenhouts, P.W. (1957) - Goodeniaceae. *Flora Malesiana*, Ser. I, 5: 335-344.
- Leenhouts, P.W. (1962) - Loganiaceae. *Flora Malesiana*, Ser. I, 6: 293-387.
- Lemmens, R.H.M.J. & N. Wulijarni-Soetjipto (ed.s) (1991) - Dye and tannin-producing plants. *Plant Resources of South-East Asia (PROSEA)*, Bogor, 196 pp.
- Lewis, R.R. (2001) – Mangrove Restoration – Costs and Benefits of Successful Ecological Restoration. Proceedings of the Mangrove Valuation Workshop, Universiti Sains, Malaysia, Penang, 4-8 April 2001. Co-hosted by the Beijer International Institute of Ecological Economics, Stockholm, Sweden.
- Lewis, R.R. and B. Streever (2000) – Restoration of mangrove habitat. WRP Technical Notes Collection (EDRCTN-WRP-VN-RS-3.2), US Army Engineer Research and Development Centre, Vicksburg, MS.
www.wes.army.mil/el/wrp
- Lim, L.F. (1995) - Learning about the mangrove forest using concept maps. Presented at the “Wetlands & Development” conference, Kuala Lumpur, 8-13 October 1995.
- Luger, P., M. Weber, N.X. Dung, P.M. Ngoc, D.T. Tuong and D.D. Rang (2000) – The crystal structure of Hop-17(21)-en-3 β -yl acetate of *Pluchea pteropoda* Hemsl. from Viet Nam. *Cryst. Res. Technol.*, 35:355-362.
- Luytjes, A. (1923) De vloedbosschen in Atjeh. In: *Tectona* XVI, pp. 575-601.
- Mabberly, D.J. and C.M. Pannell (1989) – Meliaceae. Tree Flora of Malaya, vol. 4, 199-260. Longman, Kuala Lumpur.
- Mabberly, D.J., C.M. Pannell and A.M. Sing (1995) – Meliaceae. In: *Flora Malesiana*, Ser. I, vol. 12: 1-407.

- MacKinnon, J. (ed.) (1997) – Protected Areas Systems Review of the Indo-Malayan Realm. Asian Bureau for Conservation Ltd., Hong Kong, China and World Conservation Monitoring Center, Canterbury, United Kingdom. 198 pp.
- Macintosh, D.J., (1984) - Ecology and productivity of Malaysian mangrove crab populations (Decapoda: Brachyura). *Proc. As. Symp. Mangr. Env. - Res. & Management*, 1984: 354-377.
- MacNae, W. (1968) - A general account of the fauna and flora of mangrove swamps and forests in the Indo-West-Pacific region. *Adv. mar. Biol.*, 6: 73-270.
- Maltby, E. (1986) – Waterlogged Wealth – Why waste the world's wet places? Earthcan & IIED, London, 200 pp.
- Mann, K.H. (1982) - Ecology of coastal waters. A systems approach. *Studies in Ecology*, Vol. 8, Blackwell Scientific Publications, 322 pp.
- Manuputty, A.E.W. (1984) - Some notes on the crustacean fauna around mangrove area of Pancer Balok, Cimanuk River Estuary, West Java. In: *Proc. As. Symp. Mangr. Env. - Res. & Management*, 1984: 231-240.
- Marschke, M. (2000) (*editor*) – Mangrove meanderings: learning about life in Peam Krasaop Wildlife Sanctuary. Participatory Management of Mangrove Resources (PMMR), Phase 1 Final Report. IDRC, Canada, and the Ministry of Environment, Phnom Penh, Cambodia.
- Mastaller, M. (1997) – Mangroves. The forgotten forest between land and sea. Tropical Press, Kuala Lumpur, 200 pp.
- Maung, W. (2003) – Conservation and Rehabilitation of Mangroves in Ayeyarwady Delta, Myanmar. Paper submitted at the International Symposium on Conservation and Wise Use of Mangroves in South East Asia, 6-8 October 2003, Bandar Seri Begawan, Brunei Darussalam.
- MCF (1987) - Malaysian Wetland Directory. Malaysian Conservation Foundation and Petronas Petroleum National Bhd., Kuala Lumpur, 315 pp.
- Mepharm, R.H. & J.S. Mepharm (1985) – The flora of tidal forests: a rationalization of the use of the term 'mangrove'. *S.Afr.J. Bot.* 1985: 77- 99
- Meindersma, H.W. (1923) - Eenige bijzonderheden over mangrove- bosschen. *De Tropische Natuur*, 12: 25-31, 39-46, 70-77.
- Melana, E.E. (1994) – Mangrove ecosystem: concept and some implications to rehabilitation and management. In proceedings of the Conference: FSP-DENR Component Trainor's Training for CBMFM on Nov. 21 -Dec 2. Held at Owen's Hotel, Lucena City.
- Melisch, R., Y.R. Noor, W. Giesen, E.W. Hanafia & Rudyanto (1993) - An assessment of the importance of Rawa Danau for nature conservation and an evaluation of resource use. PHPA/AWB, Bogor, 97 pp.
- Merrill, E.D. (1946) *Plantlife of the Pacific world*.
- Ministry of Forestry & FAO (1990) - Situation and Outlook of the Forestry Sector in Indonesia. Volume 2: Forest resource base. UTF/INS/065/INS: Forestry Studies, Technical Report No. 1, Jakarta.
- Ministry of Forestry (undated) - Indonesian Mangrove Forests. MoF, Jakarta, 20 pp.
- Mirmanto, E., K. Kartawinata & A. Suriadarma (1989) - Mangrove and associated plant communities in the Barito River estuary and its vicinity, South Kalimantan. *Ekologi Indonesia* 1: 42-55.
- Mogea, J.P., D. Gandawidjaja, H. Wiriadinata, R.E. Nasution & Irawati (2001) – Tumbuhan Langka Indonesia. LIPI – Serie Panduan Lapangan. Pusat Penelitian dan Pengembangan Biologi – LIPI, Balai Penelitian Botani, Herbarium Bogoriense, Bogor, 86 pp.
- Moosa, M.K., R. Dahuri, M. Hutomo, I.S. Suwelo & S. Salim (1996) (editors) – Indonesian Country Study on Integrated Coastal and Marine Biodiversity Management. Ministry of State for Environment, Indonesia, & Directorate for Nature Management, Norway.
- Mueller-Dombois, D. & H. Ellenberg (1974) – Aims and methods of vegetation ecology. Wiley International, 547 pp.
- Ng, F.S.P. (1972) – Sapotaceae. *Tree Flora of Malaya*, vol. 1, 388-439. Longman, Kuala Lumpur.
- Ng, F.S.P. (1972) – Hernandiaceae. *Tree Flora of Malaya*, vol. 2, 244-247. Longman, Kuala Lumpur.
- Ng, F.S.P. (1978) – Casuarinaceae. *Tree Flora of Malaya*, vol. 3, 45-46. Longman, Kuala Lumpur.

- Ng, F.S.P. (1978) – Ebenaceae. Tree Flora of Malaya, vol. 3, 56-94. Longman, Kuala Lumpur.
- Ng, F.S.P. (1989) – Boraginaceae. Tree Flora of Malaya, vol. 4, 58-65. Longman, Kuala Lumpur.
- Ng, P.K.L and Sivasothi, N. eds. (1999) – A guide to the Mangroves of Singapore. Volume 1 The ecosystem & plant diversity. Singapore Science Centre, Singapore, 160 pp.
- Nguyen, H.T., P.N. Hong & T.C. Le (2000) – Can Gio Mangrove Biosphere Reserve, Ho Chi Minh City. Workshop on Can Gio Mangrove Biosphere Reserve, Ho Chi Minh City, 6-11 November 1998. UNESCO-MAB, Hanoi, 48 pp.
- Nielsen, I.C. (1992) – Mimosaceae (Leguminosae-Mimosoidae). In: Flora Malesiana, Ser. I, vol. 11: 1-226.
- Noor, Y.R., M. Khazali & I.N.N. Suryadiputra (1999) – Panduan Pengenalan Mangrove di Indonesia. Wetlands International Indonesia Programme, PKA/WI-IP, Bogor, 220 pp.
- Nooteboom, H.P. (1962) – Simaroubaceae. Flora Malesiana, Ser. I, 6: 193-226.
- Nooteboom, H.P. (1977) – Symplocaceae. Flora Malesiana, Ser. I, 8: 205-274.
- Nurkin, B. (1979) – Beberapa catatan tentang aspek pengusahaan hutan mangrove di Sulawesi Selatan. In: S. Soemidihardjo, A. Nontji & A. Djamali (Eds.), Pros. Seminar Ekosistem Hutan Mangrove, LON, Jakarta, 27 Feb. - 1 March 1978.
- Nurkin, B. (1994) – Degradation of mangrove forests in South Sulawesi, Indonesia. Hydrobiologia, 285: 271-276.
- Ochse, J.J. & R.C. Bakhuizen van den Brink (1977) – Vegetables of the Dutch East Indies. English edition of 'Indische Groenten'. Australian National University Press, Canberra, 1006 pp.
- Ogino, K. & M. Chihara (1988) – Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986. Ehime University, Japan, 181 pp.
- Ong, J.E. (1982) – Mangroves and aquaculture. Ambio, 11: 252- 257.
- Ong, J.E. (1993) – Mangroves – a carbon source and sink. Chemosphere, 27:1097-1107.
- Ong, J.E. (2002) – The Hidden Cost of Mangrove Services: Use of Mangroves for Shrimp Aquaculture. International Science Roundtable for the Media – 4 June 2002, Bali, Indonesia. Joint event of ICSU, IGBP, IHDP, WCRP, DIVERSITAS & START.
- Ong, J.E., Wooi-Khoon Gong, Chee-Hoong Wong and G. Dhanarajan (1984) – Contribution of aquatic productivity in a managed mangrove ecosystem in Malaysia. In: E. Soepadmo, A.N. Rao and D.J. Macintosh (Ed.'s). Proceedings of the Asian Symposium on Mangrove Environment, research and management, Kuala Lumpur, 25-29 August 1980, p.:209-215.
- Othman, M.A., (1994) – Value of mangroves in coastal protection. Hydrobiologia, 285: 277-282.
- Payne, J., C.M. Francis & K. Phillipps, (1985) – A Field Guide to the Mammals of Borneo. The Sabah Society with World Wildlife Fund Malaysia, Kuala Lumpur, 332 pp.
- Pearce, D., C. Pearce and C. Palmer (2002) – Valuing the Environment in Developing Countries. Case Studies, Volume One. Edward Elgar Publ., Cheltenham, UK, 240 pp.
- PEMSEA (2004) – Valuation of Coastal and Marine Resources in the Malacca Straits. APEC Integrated Oceans Management Forum III, Easter Island, Chile, 18-20 October 2004, 24 pp, 2004/IOM FIII/025.
- Peng Ching-I, Chih-Huei Chen, Wen-Pen Leu, and Hsin-Fu Yen (1998) – *Pluchea* Cass. (Asteraceae: Inuleae) in Taiwan. Bot. Bull. Acad. Sin. (1998) 39:287-297.
- Percival, M. & J.S. Womersley (1975) – Floristics and ecology of the mangrove vegetation of Papua New Guinea. Botany Bulletin No. 8, Papua New Guinea National Herbarium, Department of Forests, Lae, 96 pp.
- Petocz, R. (1988). Philippines: strategy for environmental conservation. A draft plan. Unpublished manuscript. 60 pp.
- Philipson, W.R. (1979) – Araliaceae I. Flora Malesiana, Ser.I, 9: 1-105.
- Piggott, A.G. (1988) – Ferns of Malaysia in colour. Tropical Press, Kuala Lumpur, Malaysia, 458 pp.
- Polunin, I. (1988) – Plants and flowers of Malaysia. Times Editions, Singapore, 160 pp.
- Prakash, N. & A.L. Lim (1995) – The systematic position of *Aegialitis*, the enigmatic mangrove. Wallaceana, 74: 11-15.

- Prance, G.T. (1989) - Chrysobalanaceae. *Flora Malesiana*, Ser.I, 10: 635-678.
- Primack, R.B. (1983) - Forester's Guide to the Moraceae of Sarawak. Forest Department of Sarawak, 130 pp. & Figures.
- Primavera, J.H. (1991) - Intensive prawn farming in the Philippines: ecological, social, and economic implications. *Ambio*, 20 (1): 28-33.
- Primavera, J.H. (2004) - Philippine mangroves: Status, threats, and sustainable development. In: M. Vannucci (editor), *Mangrove Management and Conservation, Present and Future*. United Nations University Press, Tokyo and New York, p:192-207.
- Puff, C. (2001) - Flora der Paläotropen: Schwerpunkt SEA. Mangroven. http://homepage.univie.ac.at/Christian.Puff/AS_Mang.htm
- Rahman, M.A. and C.C. Wilcock (1995) - Asclepiadaceae. In: M.S. Khan and M.M. Rahman, *Flora of Bangladesh*, No. 48, Bangladesh National Herbarium, Dhaka, 71 pp.
- Randerson, J. (2004) - Is 'suicide tree' toxin a murder weapon? *New Scientist*, 27 November 2004, p. 15.
- Ridley, H.N. (1924, editor) - The Flora of the Malay Peninsula. Vol. IV Monocotyledones. L. Reeve & Co., Ltd., London, 383 pp.
- Ridley, H.N. (1925, editor) - The Flora of the Malay Peninsula. Vol. V Monocotyledones (concluded), Gymnospermae and General Indices. L. Reeve & Co., Ltd., London, 470 pp.
- Riedl, H.. (1997) - Boraginaceae. In: *Flora Malesiana*, Ser. I, vol. 13: 43-144.
- Rollet, B. (1972) - La Végétation du Cambodge. *Revue Bois et Forêts des Tropiques*, No. 144, Juillet-Aout 1972, p :3-15.
- Saenger, P., E.J. Hegerl & J.D.S. Davie (1983) - Global status of mangrove ecosystems. IUCN Commission on Ecology Papers No. 3, 88 pp.
- Said, I.M. (1990) A list of wetland plant species of Peninsular Malaysia, with particular reference to those having socio-economic value. AWB publication no. 67a.
- Samingan, M.T. (1980) - Notes on the vegetation of the tidal areas of South Sumatra, Indonesia, with special reference to Karang Agung. In: J.I. Furtado (Ed.), *Tropical Ecology & Development*, Int. Soc. Trop. Ecol., Kuala Lumpur, p.: 1107-1112.
- Sasekumar, A., M.U. Leh, V.C. Chong, R. D'Cruz & M.L. Audrey, (1989) - The Sungai Pulai (Johor): A unique mangrove estuary. *Proc. 12th Annual Seminar of the Malaysian Society of Marine Sciences*, p.:191-211.
- Sasekumar, A., V.C. Chong, M.U. Leh & R. D'Cruz (1992) - Mangroves as a habitat for fish and prawns. *Hydrobiologia*, 247: 195-207.
- Sasekumar, A., Chong Ving Chong, K.H. Lim and H.R. Singh (1994) - The fish community of Matang mangrove waters, Malaysia. In: S. Sudara, C.R. Wilkinson and Chou Loke Ming (Editors), *Proceedings of the 3rd ASEAN-Australia Symposium on Living Coastal Resources*, Bangkok, 16-20 May 1994, p.:457-464.
- Sastrapradja, S. et al. (1978) - Palembang Indonesia. Lembaga Biologi Nasional - LIPI, Balai Pustaka, Jakarta.
- Sastrapradja, S., K. Kartawinata, U. Soetisna, Roemantyo, H. Wiriadinata, S. Soekardjo (1979) - Kayu Indonesia. Proyek Sumber Daya Ekonomi, Lembaga Biologi Nasional - LIPI, Bogor, 1977. Balai Pustaka, Jakarta, 116 pp.
- Sastrapradja, S., J.R. Afriastini, D. Darnaedi and E.A. Widjaja (1979b) - Jenis Paku Indonesia. Proyek Sumber Daya Ekonomi, Lembaga Biologi Nasional - LIPI, Bogor. Balai Pustaka, Jakarta, 129 pp.
- Sastrapradja, S. & J.J. Afriastini (1980) - Jenis rumput dataran rendah. Lembaga Biologi Nasional LIPI, LBN 20/SDE 85. Bogor, 120 pp.
- Sastrapradja, S., R.E. Nasoetion, S. Idris, M. Imelda, W. Roedjito, S. Soerohaldoko and L. Soerojo (1980) - Tanaman Hias Indonesia. Proyek Sumber Daya Ekonomi, Lembaga Biologi Nasional - LIPI, Bogor, 1977. Balai Pustaka, Jakarta, 135 pp.
- Sastrapradja, S., R.E. Nasoetion, Irawati, L. Soerojo, M. Imelda, S. Idris, S. Soerohaldoko and W. Roedjito (1980) - Anggrek Indonesia. Proyek Sumber Daya Ekonomi, Lembaga Biologi Nasional - LIPI, Bogor, 1976. Balai Pustaka, Jakarta, 181 pp.

- Sastrapradja, S., N. Wulijarni-Soetjipto, S. Danimihardja & R. Soejono (1981) - Root and tuber crops. IBPGR Secretariat, Rome, 107 pp.
- Sastrapradja, S. & J.J. Afriastini (1984) - Kerabat Beringin. Seri Sumber Daya Alam 115, Lembaga Biologi Nasional LIPI, Bogor, 117 pp.
- Sathirathai, S. (1997) - Economic Valuation of Mangroves and the Roles of Local Communities in the Conservation of Natural Resources: Case Study of Surat Thani, South of Thailand. IDRC, <http://idrinfo.idrc.ca/archive/corpdocs/108378/economic.htm>.
- Saunders, J. (1993) - Agriculture land use of Papua New Guinea: Explanatory Notes to Map. PNGRIS Publication No. 1. AIDAB, Canberra.
- Schnepper, W.C.R. (1933) Vloedbosch culturen. In: Tectona XXVI, pp. 907-919.
- Schreuder, E.J. (1939) Het Niboeng vraagstuk in Bengkalis. In: Tectona XXXII, pp. 165-183.
- Schreuder, H.H.Th. & F.H. van der Maarel (1936) De toepassing en de interpretatie van luchtfoto's bij het in kaart brengen van de vegetatie-typen der mangrove. Geol. rapport no 16488, Pangkalan Brandan.
- Semeniuk, V. et al. (1978) Mangroves of Western Australia. Handbook no. 12, Western Australian naturalists club, Perth.
- Shang, Y.C. (1976) - Indonesian milkfish farming - an economic evaluation. Fish Farming International, 3: 42-44.
- Shuttleworth, F.S., H.S. Zim and G.W. Dillon (1973) - Orchideen. Wildwachsende Arten aus aller Welt. Delphin Verlag, München & Zürich, 160 pp.
- Silvius, M.J. (1986) - Survey of coastal wetlands in Sumatra Selatan and Jambi, Indonesia. March/ April 1986. PHPA - INTERWADER Report No. 1, Bogor, Indonesia, 101 pp.
- Silvius, M.J., W.J.M. Verheugt & J. Iskandar (1986) - Coastal wetlands inventory of South East Sumatra. Report of the Sumatran Waterbird Survey Oct.-Dec. 1984. ICBP Study Report No. 9, Cambridge.
- Silvius, M.J., A.P.J.M. Steeman, E.T. Berczy, E. Djuharsa & A. Taufik, (1987) - The Indonesian Wetland Inventory. A preliminary compilation of existing information on wetlands of Indonesia. PHPA, AWB/INTERWADER, EDWIN, Bogor, Indonesia. 2 vol., 121 & 268 p. & maps.
- Silvius, M.J. & A.W. Taufik, (1989) - Conservation and land-use of Kimaam Island. A survey report and compilation of existing information. PHPA-Asian Wetland Bureau, Bogor.
- Sleumer, H. (1954) - Flacourtiaceae. In: Flora Malesiana, Ser.I, 5: 1-106.
- Sleumer, H. (1966) - Ericaceae. In: Flora Malesiana, Ser.I, 6: 469- 914.
- Sleumer, H. (1971) - Icacinaceae. In: Flora Malesiana, Ser.I, 7: 1- 87.
- Sleumer, H. (1971) - Lophopyxidaceae. In: Flora Malesiana, Ser.I, 7: 89-91.
- Sleumer, H. (1992) - Olacaceae. In: Flora Malesiana, Ser.I, vol. 10: 1-29.
- Smith, J. (2001) - Biodiversity, the life of Cambodia. Cambodia's Biodiversity Status Report - 2001. Ministry of Environment, UNDP, GEF & FAO, Phnom Penh, 244 pp.
- Snedaker, S.C. (1984) - The mangroves of Asia and Oceania: status and research planning. In: Proc. As. Symp. Mangrove Env. - Res. & Management, 1984: 5-15.
- Snedaker, S.C. & J.G. Snedaker (1984) - The Mangrove Ecosystem: research methods. UNESCO, Monographs on oceanographic methodology. UNESCO, Paris, 251 pp.
- Soegiarto, A. (2004) - Research into, and conservation of, mangrove ecosystems in Indonesia. In: M. Vannucci (editor), Mangrove Management and Conservation, Present and Future. United Nations University Press, Tokyo and New York, p:51-58.
- Soemodihardjo & Soerianegara (1989) - Country report: Indonesia. The status of mangrove forests in Indonesia. In: Soerianegara et al. (Eds.) - Symposium on mangrove management: its ecological and economic considerations. Bogor, 9-11 August 1988, p.: 73-113. BIOTROP special publication No. 37.
- Soepadmo, E. (1998) - Plants. The Encyclopedia of Malaysia, vol. 2. Archipelago Press, Editions Didier Millet, Kuala Lumpur, 144 pp.

- Sour, K. (2003) – Country report on the present status of mangroves in Cambodia. Presented at the International Symposium on Conservation and Wise Use of Mangroves in Southeast Asia, 6-8 October 2003, Brunei Darussalam, 9 pp.
- Spalding, M.D., Blasco, F. and Field, C.D. (1997) (editors) – World Mangrove Atlas. The International Society for Mangrove Ecosystems, Okinawa, Japan, World Conservation Monitoring Centre, Cambridge, UK, and the International Tropical Timber Organization. 178 pp.
- Spaninks, F. and P. van Beukering (1997) – Economic Valuation of Mangrove Ecosystems: Potential and Limitations. CREED Working Paper No 14 July 1997, 54 pp. Collaborative Research in the Economics of Environment and Development.
- Steentoft Nielsen, M. (1965) – Introduction to the Flowering Plants of West Africa. University of London Press Ltd, 246 pp.
- Steup, F.K.M. (1941) - Kustaanwas en mangrove. *Natuurwetenschappelijk Tijdschrift voor Ned. Indië*, 12: 353-355.
- Stone, B.C. (1972) – Rutaceae. *Tree Flora of Malaya*, vol. 1, 367-387. Longman, Kuala Lumpur.
- Stone, B.C. (1972) – Araliaceae. *Tree Flora of Malaya*, vol. 3, 10-35. Longman, Kuala Lumpur.
- Stone, B.C. (1989) – Myrsinaceae. *Tree Flora of Malaya*, vol. 4, 264-284. Longman, Kuala Lumpur.
- Stuebing, R.B. & Inger, R.F. (1999) A field guide to the snakes of Borneo. Natural history publications, Kota Kinabalu.
- Struwe, L. & A.A. Victor (2000) – Supermerous corollas, fleshy fruits, and pantropical biogeography in *Anthocleista*, *Fagraea*, and *Potalia* (Gentianaceae).
<http://www.2000.botanyconference.org/section13/abstracts/22.shtml>
- Sukardjo, S. (1989) - Tumpang sari pond as a multiple use concept to save the mangrove forest in Java. In: I. Soerianegara et al. (Eds.), *Proc. Symposium on Mangrove Management: its Ecological and Economic Considerations*, Bogor, Indonesia, August 9-11, 1988, p.: 115-128.
- Sukardjo, S., K. Kartawinata & I. Yamada (1984) - The mangrove forest in Bungin River, Banyuasin, South Sumatra. In: *Proc. As. Symp. Mangrove Env. - Res. & Management*, 1984: 121-141.
- Sulong, I., H.M. Lokman, K.M. Tarmizi and Y. Kamaruzzaman (2002) – Mangroves of Tumpat Delta, Kelantan. In: A. Ali, C.S.M. Rawd, M. Mansor, R. Nakamura, S. Ramakrishna and T. Mundkur (editors), *The Asian Wetlands: bringing partnerships into good wetland practices. Proceedings of the Symposium held at Penang, Malaysia, on 27-30 August 2001*, p:437-443.
- Sunaryo, I. (1982) - A floristic study of mangrove forest in Segara Anakan. Paper presented at the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gajah Mada University, Yogyakarta.
- Suryowinoto, M. (1987) - Mengenal Anggrek Alam Indonesia. P.T. Penebar Swadaya, Anggota IKAPI, Jakarta, 270 pp.
- Svenson, H.K. (1929) - *Rhodora*, 31: 168-189.
- Tabuchi, R. (2003) – The Rehabilitation of Mangroves in Southeast Asia. Ecosystem Technical Report No. 1, International Society for Mangrove Ecosystems, Okinawa, Japan,
<http://www.unu.edu/env/plec/marginal/proceedings/TabuchiCH12.pdf>
- Tan, C.G.S. & P.K.L. Ng (1994) - An annotated checklist of mangrove brachyuran crabs from Malaysia and Singapore. *Hydrobiologia*, 285: 75-84.
- Tanaka, J. & M. Chihara (1988) - Macroalgae in Indonesian Mangrove Forests. *Bull. Natn. Sci. Mus., Tokyo, Ser. B*, 14: 93-106.
- Thurairaja, V. (1994) - Coastal resources development options in the Southeast Asia and Pacific regions: Economic valuation methodologies and applications in mangrove development. *Maritime Studies*, 79: 1-13.
- Tomascik, T., A.J. Mah, A. Nontji and M.K. Moosa (1997) – The Ecology of the Indonesian Seas. Parts One and Two, 1388 pp.. *The Ecology of Indonesia Series*, vol.s VII & VIII. Periplus Editions, Singapore.
- Tomlinson, P.B. & J.S. Womersley (1976) - A species of *Rhizophora* new to New Guinea and Queensland, with notes relevant to the Genus. *Contr. Herb. Austr.*, 19: 1-10.

- Tomlinson, P.B. (1986) - The Botany of Mangroves. Cambridge University Press, Cambridge, U.K., 419 pp.
- Tuan, V.S., R. Petocz and P. McNamee (2001) - Status and perspective of marine protected areas in Vietnam. Proceedings of the International Symposium on Protection and Management of Coastal Marine Ecosystems, Bangkok, 12-13 December 2000, 154-156.
- Tucker Abbott, R. (1991) - Sea Shells of South East Asia. Graham Brash Pte. Ltd, Singapore, 145 pp.
- Tweedie, M.W.F. & J.L. Harrison (1954) - Malayan Animal Life. Longman Malaysia, 237 pp.
- Umali, R.M. et al. (ed.) (1987) Mangroves of Asia and the Pacific: status and management. Technical report of the UNDP/UNESCO Research and Training Pilot Programme on Mangrove ecosystems in Asia and the Pacific, Quezon city, Philippines.
- Appendices of the Integrated Resource Management Plan for the Sunderbans Reserved Forest, Volume 2. Project BGD/84/056.
- van Balen, S. (1989) - The terrestrial mangrove birds of Java. In: I. Soerianegara et al. (ed.s) Proc. Symp. on "Mangrove Management: its ecological and economic considerations", held at Bogor, Indonesia, 9-11 August 1988. BIOTROP Special Publication No. 37, p.:193-205.
- van Bodegom, A.H. (1929) - De vloedbosschen in het gewest Riouw en onderhoorigheden. Tectona, 22: 1302-1332.
- van Borssum Waalkes, J. (1966) - Malesian Malvaceae Revised. J.J. Groen en Zoon, Leiden. PhD thesis, Groningen University, 213 pp.
- van Ooststroom, S.J. (1953) - Convolvulaceae. In: Flora Malesiana, Ser. I, vol. 4: 388-512.
- van Ooststroom, S.J. (1975) - Heukels-van Ooststroom Flora van Nederland. 18th Edition, Wolters-Noordhoff, Groningen, the Netherlands, 913 pp.
- van Royen, P. (1957) - Batidaceae. Flora Malesiana, Ser.I, 5: 414-415.
- van Steenis, C.G.G.J. (1936) - *Osbornia octodonta*, een weinig bekende mangrove-boom. De Tropische Natuur, 26: 194-6.
- van Steenis, C.G.G.J. (1937) De soorten van het geslacht *Acanthus* in Nederlandsch-Indië. In: De Tropische Natuur, jrg. XXVI.
- van Steenis, C.G.G.J. (1954) - Plumbaginaceae. In: Flora Malesiana, Ser. I, vol. 4: 107-112.
- van Steenis, C.G.G.J. (1957) - Outline of vegetation types in Indonesia and some adjacent regions. Proceedings of the 8th Pacific Science Congress, vol. IV: 61-97.
- van Steenis, C.G.G.J. (1958) - Ecology of mangroves. Introduction to account of the Rhizophoraceae by Ding Hou, Flora Malesiana, Ser. I, 5: 431- 441.
- van Steenis, C.G.G.J. (1977) - Bignoniaceae. In: Flora Malesiana, Ser.I, 8: 114-186.
- van Steenis, C.G.G.J., G. den Hoed and P.J. Eyma (1951) - Flora voor de Scholen in Indonesië. Noordhoff-Kolff N.V., Djakarta, 407 pp.
- van Straten, A. (1915) - Excursie naar de mangrove bij Antjol. De Tropische Natuur, 4: 189-191.
- Verheij, E.W.M. and R.E. Coronel (1992) (editors) - Edible fruits and nuts. Plant Resources of South-east Asia (PROSEA) No. 2. Bogor, Indonesia, 446 pp.
- Verheugt, W., A. Purwoko, F. Danielsen, H. Skov & R. Kadarisman, (1991) - Integrating mangrove and swamp forests conservation with coastal lowland development; the Banyuasin Sembilnag swamps case study, South Sumatra Province, Indonesia. Landscape and Urban Planning, 20: 85-94.
- Vermeulen, J.J. (1991) - Orchids of Borneo (Vol 2), Bulbophyllum. 100 sets of figs, 19 col. plates. Bentham-Moxon Trust, Royal Botanic Gardens Kew & Toihaan Publishing, 342 pp.
- Versteegh, F. (1951) Proeve van een bedrijfsregeling voor de vloedbossen van Benkalis. In: Tectona XLI.
- Wada, K. (1988) - Ecology and behaviour of benthic fauna, crabs and molluscs #I: Benthic macrofauna. In: K. Ogino & M. Chihara (Ed.s), Biological system of mangroves. A report of East Indonesian Mangrove Expedition 1986, Ehime University, Japan, p.:45-48.

- Wada, K. & D. Wowor, (1989) - Foraging on mangrove pneumatophores by ocypodid crabs. *J. Exp. Mar. Biol. Ecol.*, 134: 89-100.
- Walker, E.H. (1976) - Flora of Okinawa and the Southern Ryukyu Islands.
- Wardoyo, S.E. & F. Rasyid (1985) - Sumber benih baru di Indonesia Timur untuk menanggulangi masalah perkembangan tambak. *Jawul Penelitian Budidaya Pantai [Coastal Aquaculture Res. J.]*, Maros (S. Sulawesi), 1: 1-8.
- Watson, J.G. (1928) - Mangrove Forests of the Malay Peninsula. *Malayan Forest Records No. 6*, Federated Malay States Government, Singapore, 275 pp.
- Watson, L. and M.J. Dallwitz (2004) - Grass Genera of the World. <http://www.biologie.uni-hamburg.de/b-online/delta/grass/www/xerochlo.htm>
- Wattayakorn, G. (1998) - Economic evaluation and biophysical modelling of the impact of shrimp farming on the mangrove systems of Ban Don Bay. <http://www.wold.nioz.nl/loicz/projects/regional/thailand.htm>
- Westhoff, V. (1976) editor - Wilde Planten. Flora en vegetatie in onze natuurgebieden. Ver. Natuurmonumenten, the Netherlands. 3 volumes.
- Wetlands International-Asia Pacific (1996) - Guidelines for the Sustainable Utilisation and Management of Mangrove Forests in Kedah. Prepared by IPT - WI-AP, Institute of Advanced Studies, University of Malaya, 44 pp.
- White, A.T., P. Martosubroto & M.S.M. Sadorra, (ed.'s) (1989) - The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. *ICLARM Technical Reports 25*, 82 pp.. International Center for Living Aquatic Resources Management, Manila, Philippines.
- White, A.T. and R.O. De Leon (1996) - Mangrove Resource Decline in the Philippines: Government and Community Look for New Solutions. *Tambuli* 1996:6-11.
- Whitmore, T.C. (1972a) - Leguminosae. *Tree Flora of Malaya*, Vol. 1, 237-304. Longman, Kuala Lumpur.
- Whitmore, T.C. (1972b) - Sonneratiaceae. *Tree Flora of Malaya*, Vol. 1, 442-445. Longman, Kuala Lumpur.
- Whitmore, T.C. (1972c) - Lecythidaceae. *Tree Flora of Malaya*, Vol. 2, 257-266. Longman, Kuala Lumpur.
- Whitmore, T.C. (1972d) - Apocynaceae. *Tree Flora of Malaya*, Vol. 1, 3-26. Longman, Kuala Lumpur.
- Whitmore, T.C. (1972e) - Myristicaceae. *Tree Flora of Malaya*, Vol 1:315-345. Longman, Kuala Lumpur, Malaysia.
- Whitmore, T.C. (1972f) - Flacourtiaceae. *Tree Flora of Malaya*, Vol. 2, 137-161. Longman, Kuala Lumpur.
- Whitmore, T.C. (1972g) - Guttiferae. *Tree Flora of Malaya*, Vol. 2:162-236. Longman, Kuala Lumpur, Malaysia.
- Whitmore, T.C. (1972h) - Euphorbiaceae. *Tree Flora of Malaya*, Vol. 1:34-136. Longman, Kuala Lumpur, Malaysia.
- Whitmore, T.C. (1979) - Palms of Malaya. Oxford University Press, Kuala Lumpur, Revised edition, 2nd impression, 132 pp.
- Whitmore, T.C., I.G.M. Tantra & U. Sutisna (1990) - Tree Flora of Indonesia. Check List for Sulawesi. Min. of Forestry, Forest research & Development Centre, Bogor, 204 pp.
- Whitmore, T.C., I.G.M. Tantra & U. Sutisna (1990) - Tree Flora of Indonesia. Check List for Kalimantan. Min. of Forestry, Forest research & Development Centre, Bogor, 620 pp.
- ⁵ Whitten, A.J., S.J. Damanik, J. Anwar & N. Hisyam (1984) - The ecology of Sumatra. Gajah Mada University Press, Yogyakarta, 583 pp.
- Whitten, A.J., M. Mustafa & G.S. Henderson (1988) - The Ecology of Sulawesi. Gajah Mada University Press, Yogyakarta, 777 pp.
- Wickens, G.E. (1973) - Combretaceae. *Flora of Tropical East Africa*. Prepared at the Royal Botanic Gardens, Kew. R.M. Polhill (editor), 1th May 1973, 99 pp.
- Wightman, G.M. (1989) - Mangroves of the Northern Territory. *Northern Territory Botanical Bulletin No. 7*. Conservation Commission of the Northern Territory, Palmerston, N.T., Australia.

- Wilkie, M.L. (1996) – A Mangrove Management and Protection Strategy for Aurora Province. Consultancy Report, Aurora Integrated Area Development Project, EU, Philippines.
- Womersley, J.S. (ed.) (1978) Handbooks of the flora of Papua New Guinea, volume I. Government of Papua New Guinea, Lae.
- Wong, K.M. (1989) – Rubiaceae. Tree Flora of Malaya, vol. 4: 324-425. Longman, Kuala Lumpur.
- Woodroffe, C.D. (1985) - Variability in detrital production and tidal flushing in mangrove swamps. In: K.N. Bardsley, J.D.S. Davie & C.D. Woodroffe (Eds.), Coasts and tidal wetlands of the Australian Monsoon Region. Mangrove Monograph No. 1, Australian Nat. Univ. North Austr. Res. Unit, Darwin, p.: 201-212.
- WRM (2000) – Cambodia: too late and too little to protect mangroves. World Rainforest Movement Bulletin No. 33, April 2000. <http://www.wrm.org.uy/bulletin/33/Cambodia.html>
- Wulffraat, S. (1995) A brief survey of the flora of Indonesian mangroves: BOS Newsletter no. 30 vol. 14 (1).
- Wulffraat, S. (1996a) Survey and inventory of the Cisadane delta. Nedeco/Witteveen + Bos, Jakarta.
- Wulffraat, S. (1996b) Detailed design for the restoration of a mangrove ecosystem in West Java. Nedeco/Witteveen + Bos, Jakarta.
- Yao, C.E. (2000) – Philippine mangroves: Some potential new finds. The Online Magazine for Sustainable Seas. June 2000, Vol 3(6). www.oneocean.org/overseas/200006/philippine_mangroves.html
- Yap, S.K. (1989) – Sapindaceae. Tree Flora of Malaya, Vol. 4, 434-461. Longman, Kuala Lumpur.
- Yoshikawa, M., Y. Pongpiriyadacha, A. Kishi, T. Kageura, T. Wang, T. Morikawa and H. Matsuda (2003) – Biological Activities of *Salacia chinensis* Originating in Thailand: The Quality Evaluation Guided by α -Glucosidase Inhibitory Activity. *Yakugaku Zasshi*, 123 (10):871-880.
- Zamora, P. (1992) – Coastal Resources: Mangroves. In: Chua, T.E., L.M. Chou and M.S.M.Sadorra (Eds), Coastal Environment Profile of Brunei Darussalam: resource assessment and management issues. ICLARM Tech. Rep. 18. 193 pp.
- Zann, L.P. (2002) – Mangrove ecosystems in Australia: structure, function and status. In: State of the Marine Environment Report for Australia: The Marine Environment – Technical Annex:1. ISBN 0.642.17399.0 or www.erin.gov.au/coasts/publications/somer/annex1/mangrove.html
- Zieren, M, Y. Rusila Noor, M. Baltzer and N. Saleh (1990) Wetlands of Sumba, East Nusa Tenggara.
- Zwaan, C.J. van der (1934) Aanteekeningen omtrent de vloed- en moerasbosschen in Indragiri. In: Het Bosch II, pp. 160-178.

ANNEX 1 Table of Southeast Asian mangrove species

NOTE: Numbers correspond with the species number as this is dealt with in part 2 of the mangrove guide.

			Mangrove	Life form	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	FERNS Family	Scientific name													
1	Aspleniaceae	<i>Asplenium macrophyllum</i>		f	+	+	+	+	+	+	+	+	+	+	+
2		<i>Asplenium nidus</i>		f	+	+	+	+	+	+	+	+	+	+	+
3	Blechnaceae	<i>Stenochlaena palustris</i>		f	+	+	+	+	+	+	+	+	+	+	+
4	Davalliaceae	<i>Davallia divaricata</i>		f			+	+	+				+		
5		<i>Davallia parvula</i>		f			+	+							
6		<i>Pachypleuria angustata</i>		f			+	+					+		
7	Grammitidaceae	<i>Ctenopteris moultoni</i>		f			+	+					+		
8	Hymenophyllaceae	<i>Hymenophyllum holochilum</i>		f		+	+	+		+			+	+	+
9	Lomariopsidaceae	<i>Elaphoglossum amblyphyllum</i>		f	+		+	+							
10	Lycopodiaceae	<i>Lycopodium carinatum</i>		f	+	+	+	+	+	+	+		+	+	+
11	Nephrolepidaceae	<i>Nephrolepis acutifolia</i>		f		+	+	+					+		+
12	Polypodiaceae	<i>Drymoglossum piloselloides</i>		f	+	+	+	+	+	+	+	+	+	+	+
13		<i>Drynaria rigidula</i>		f			+	+		+			+		
14		<i>Drynaria sparsisora</i>		f			+	+		+		+	+		
15		<i>Loxogramma involuta</i>		f			+								
16		<i>Myrmecophila sinuosa</i>		f			+	+		+			+		
17		<i>Photinopteris speciosa</i>		f		+	+	+		+	+		+		+
18		<i>Phymatodes scolopendria</i>		f	+	+	+	+	+	+	+	+	+	+	+
19		<i>Platynerium coronarium</i>		f	+		+	+	+			+	+		
20		<i>Pyrrosia longifolia</i>		f			+	+		+					
21		<i>Selliguea heterocarpa</i>		f			+	+					+		
22	Pteridaceae	<i>Acrostichum aureum</i>	M	f	+	+	+	+	+	+	+	+	+	+	+
23		<i>Acrostichum speciosum</i>	M	f	+	+	+	+	+	+	+	+	+	+	+
24	Vittariaceae	<i>Vittaria elongata</i>		f	+	+	+	+	+	+	+	+	+	+	+

	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
52	Acanthaceae	<i>Acanthus ebracteatus</i>	M	h	+	+	+	+	+	+	+	+	+		+
53		<i>Acanthus ilicifolius</i>	M	h	+	+	+	+	+	+	+	+	+	+	+
54		<i>Acanthus volubilis</i>	M	h		+	+	+	+	+		+	+		
55	Aizoaceae	<i>Sesuvium portulacastrum</i>		h		+	+	+	+	+	+	+	+	+	+
56		<i>Trianthema portulacastrum</i>		h			+	+		+	+		+	+	
57	Amaryllidaceae	<i>Crinum asiaticum</i>		h	+	+	+	+	+	+	+	+	+	+	+
140	Anacardiaceae	<i>Gluta velutina</i>		t	+		+	+	+				+		+
141	Apo cynaceae	<i>Cerbera floribunda</i>		t			+			+					
142		<i>Cerbera manghas</i>		t	+	+	+	+	+	+	+	+	+	+	+
143		<i>Cerbera odollam</i>		t		+	+	+	+	+		+	+	+	+
144	Aquifoliaceae	<i>Ilex cymosa</i>		t	+		+	+			+	+	+		+
145		<i>Ilex maingayi</i>		t				+							
58	Araceae	<i>Colocasia esculenta</i>		h	+	+	+	+	+	+	+	+	+	+	+
59		<i>Cryptocoryne ciliata</i>		h	+		+	+		+			+		+
60		<i>Lasia spinosa</i>		h	+		+	+		+					+
146	Araliaceae	<i>Polyscias macgillivrayi</i>		t			+			+					
75		<i>Schefflera elliptica</i>		e			+	+			+	+	+		
76		<i>Schefflera lanceolata</i>		e				+				+			
77		<i>Schefflera ridleii</i>		e				+				+			
131	Arecaceae	<i>Calamus erinaceus</i>		p(c)	+		+	+			+	+	+		
132		<i>Caryota urens</i>		p		+			+				+		
133		<i>Corypha saribus</i>		p		+	+	+			+		+	+	+
134		<i>Licuala spinosa</i>		p	+	+	+	+	+		+	+	+		+
135		<i>Nypa fruticans</i>	M	p	+	+	+	+	+	+	+	+		+	+
136		<i>Oncosperma tigillarum</i>		p	+	+	+	+	+		+	+	+		+
137		<i>Phoenix paludosa</i>		p		+	+	+	+						+
147	Asclepiadaceae	<i>Calotropis gigantea</i>		t(h)			+	+	+				+		
78		<i>Dischidia benghalensis</i>		e		+	+	+	+				+		+
79		<i>Dischidia nummularia</i>		e	+	+	+	+	+	+		+	+	+	+
80		<i>Dischidia rafflesiana</i>		e	+		+	+	+				+		+
103		<i>Finlaysonia obovata</i>		c		+	+	+	+			+	+		+
104		<i>Gymnanthera oblonga</i>		c		+	+	+		+	+		+		+
81		<i>Hoya parasitica</i>		e		+		+	+				+		+
105	Asclepiadaceae	<i>Oxystelma carnosum</i>		c			+	+		+	+				
106		<i>Sarcolobus carinatus</i>		c				+	+				+		
107		<i>Sarcolobus globosus</i>		c			+	+	+				+		+
148	Asteraceae	<i>Pluchea indica</i>		t(h)		+	+	+	+	+	+	+	+	+	+
149		<i>Pluchea pteropoda</i>		t(h)											+
108		<i>Wedelia biflora</i>		c(h)			+	+		+	+	+	+		+
150	Avicenniaceae	<i>Avicennia alba</i>	M	t	+	+	+	+	+	+	+	+	+		+
151		<i>Avicennia eucalyptifolia</i>	M	t			+			+	+				
152		<i>Avicennia lanata</i>	M	t			?	+		+	+	+			+
153		<i>Avicennia marina</i>	M	t	+	+	+	+	+	+	+	+	+	+	+

	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
154		<i>Avicennia officinalis</i>	M	t		+	+	+	+	+	+	+	+	+	+
155	Batidaceae	<i>Batis argillicola</i>		t (h)			+			+					
156	Bigoniaceae	<i>Dolichandrone spathacea</i>		t	+	+	+	+	+	+	+	+	+	+	+
157	Bombaceae	<i>Camptostemon philippinense</i>	M	t			+				+				
158		<i>Camptostemon schultzei</i>	M	t			+			+					
159	Boraginaceae	<i>Cordia cochinchinensis</i>		t		+		+	+				+		+
160		<i>Cordia dichotoma</i>		t		+	+	+	+	+	+	+	+	+	+
161		<i>Cordia subcordata</i>		t		+	+	+		+	+		+	+	+
162	Casuarinaceae	<i>Casuarina equisetifolia</i>		t	+	+	+	+	+	+	+	+	+	+	+
163	Celastraceae	<i>Cassine viburnifolia</i>		t	+		+	+			+	+	+		
109		<i>Loeseneriella macrantha</i>		c	+		+	+		+		+			
164		<i>Maytenus emarginata</i>		t			+	+		+	+				
165		<i>Salacia chinensis</i>		t	+	+	+	+	+	+	+	+	+	+	+
61	Chenopodiaceae	<i>Halocnemum cinereum</i>		h			+			+					
62		<i>Salicornia indica</i>		h			+	+						+	
63		<i>Suaeda maritima</i>		h			+			+			+		+
166	Chrysobalanaceae	<i>Atuna racemosa racemosa</i>		t	+		+	+		+	+	+	+		
110	Combretaceae	<i>Calycoternis floribunda</i>		c(t)		+		+	+				+		
111		<i>Combretum tetralophum</i>		c(t)	+	+	+	+		+		+	+	+	+
112		<i>Combretum trifoliatum</i>		c(t)	?	+	+	+	+	+			+		+
167		<i>Lumnitzera littorea</i>	M	t		+	+	+	+	+	+	+			+
168		<i>Lumnitzera racemosa</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
169		<i>Terminalia catappa</i>		t	+	+	+	+	+	+	+	+	+	+	+
64	Convolvulaceae	<i>Ipomoea gracilis</i>		h		+	+	+			+	+			
65		<i>Ipomoea maxima</i>		h			+	+	+			+	+	+	+
66	Convolvulaceae	<i>Ipomoea pes-caprae</i>		h	+	+	+	+	+	+	+	+	+	+	+
67		<i>Ipomoea tuba</i>		h	+	+	+	+	+	+	+	+	+	+	+
138	Cycadaceae	<i>Cycas rumphii</i>		p	?	?	+	+	+	+	+	?	+	+	+
25	Cyperaceae	<i>Cyperus compactus</i>		g	+	+	+	+	+	+	+	+	+	+	+
26		<i>Cyperus javanicus</i>		g	+	+	+	+	+	+	+	+	+	+	+
27		<i>Cyperus malaccensis</i>		g	+	+	+	+	+	+	+	+	+		+
28		<i>Cyperus scariosus</i>		g			+			+					
29		<i>Cyperus stoloniferous</i>		g	+	+	+	+	+	+	+	+	+	+	+
30		<i>Eleocharis dulcis</i>		g	+	+	+	+	+	+	+	+	+	+	+
31		<i>Eleocharis parvula</i>		g		+	+								
32		<i>Eleocharis spiralis</i>		g			+	+		+	+	+			
33		<i>Fimbristylis cymosa</i>		g	+	+	+	+	+	+	+	+	+	+	+
34		<i>Fimbristylis ferruginea</i>		g	+	+	+	+	+	+	+	+	+		+
35		<i>Fimbristylis polytrichoides</i>		g	+		+	+		+	+				
36		<i>Fimbristylis sericea</i>		g	+	+	+	+	+				+		
37		<i>Fimbristylis sieberiana</i>		g			+				+			+	
38		<i>Scirpus grossus</i>		g	+	+	+	+	+	+	+	+	+		+
39		<i>Scirpus laeustris</i>		g						+	+				+

	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
40		<i>Scirpus litoralis</i>		g			+			+	+				
41		<i>Scirpus maritimus</i>		g						+	+				
170	Ebenaceae	<i>Diospyros ferrea</i>		t		+	+	+	+	+	+		+		+
171		<i>Diospyros malabarica</i>		t		+	+	+	+				+		
172		<i>Diospyros maritima</i>		t			+		+		+				
82	Ericaceae	<i>Rhododendron brookeanum</i>		e	+		+	+							
173	Euphorbiaceae	<i>Blumeodendron tokbrae</i>		t			+	+		+					
174		<i>Croton heterocarpus</i>		t	+			+	+		+	+			
175		<i>Excoecaria agallocha</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
176		<i>Excoecaria indica</i>		t	+	+	+	+	+	+		+	+	+	+
177		<i>Glochidion littorale</i>		t		+	+	+			+	+	+		+
178		<i>Ricinus communis</i>		t	+	+	+	+	+	+	+	+	+	+	+
179	Flacourtiaceae	<i>Scolopia macrophylla</i>		t	+	+	+	+					+		+
113	Flagellariaceae	<i>Flagellaria indica</i>		c	+	+	+	+	+	+	+	+	+	+	+
180	Gentianaceae	<i>Fagraea crenulata</i>		t			+	+				+	+		+
181	Goodeniaceae	<i>Scaevola hainanensis</i>		t											+
182		<i>Scaevola taccada</i>		t	+	+	+	+	+	+	+	+	+	+	+
183	Guttiferae	<i>Calophyllum inophyllum</i>		t	+	+	+	+	+	+	+	+	+	+	+
184	Hernandiaceae	<i>Hernandia ovigera</i>		t	?	+	+	+		+	+		+	+	+
185	Icacinaceae	<i>Merrilliodendron megacarpum</i>		t			+			+	+				
186		<i>Stemonurus ammu</i>		t			+			+					
114	Lauraceae	<i>Cassytha filiformis</i>		c(e)	+	+	+	+	+	+	+	+	+	+	+
187	Lecythidaceae	<i>Barringtonia acutangula</i>		t	+	+	+	+	+	+			+		+
188		<i>Barringtonia asiatica</i>		t	+	+	+	+		+	+	+	+		+
189		<i>Barringtonia conoidea</i>		t	+		+	+	+			?	+		
190		<i>Barringtonia racemosa</i>		t	+	+	+	+	+		+	+	+		+
115	Leguminosae	<i>Abrus precatorius</i>		c	+	+	+	+	+	+	+	+	+	+	+
116		<i>Aganope heptaphylla</i>		c	+		+	+		+	+				
117		<i>Caesalpinia bonduc</i>		c	+	+	+	+	+	+	+	+	+	+	+
118		<i>Caesalpinia crista</i>		c	+	+	+	+	+	+	+	+	+	+	+
68		<i>Canavalia maritima</i>		h	+	+	+	+	+	+	+	+	+	+	+
191		<i>Cathormion umbellatum</i>		t			+						+	+	
192		<i>Cynometra iripa</i>		t			+	+	+		+		+		
193		<i>Cynometra ramiflora</i>		t	+		+	+	+	+	+	+	+	+	
119		<i>Dalbergia candenaensis</i>		c	+		+	+			+	+	+		+
120		<i>Dalbergia menoeides</i>		c			+								
194		<i>Derris pinna ta</i>		t (c)			+	+	+		+				
121		<i>Derris scandens</i>		c					+						
122		<i>Derris trifoliata</i>		c	+	+	+	+	+			+	+		+
123		<i>Entada phaseoloides</i>		c			+			+	+				+
195		<i>Erythrina orientalis</i>		t			+	+	+					+	+
196		<i>Inocarpus fagifer</i>		t			+	+		+					
197		<i>Intsia bijuga</i>		t	+	+	+	+	+	+	+	+	+	+	?

	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
124		<i>Mucuna gigantea</i>		c			+	+	+		+		+		+
198		<i>Peltophorum pterocarpum</i>		t	+		+	+		+	+	+	+	+	+
199		<i>Pongamia pinnata</i>		t	+	+	+	+	+	+	+	+	+	+	+
200		<i>Serianthes grandiflora</i>		t	+	?	+	+		+	+	+			
201		<i>Sindora siamensis var. maritima</i>		t		+							+		+
125	Lophopyxidaceae	<i>Lophopyxis maingayi</i>		c			+	+		+					
83	Loranthaceae	<i>Amyema anisomeres</i>	M	e			+								
84		<i>Amyema gravis</i>	M	e			+	+							
85		<i>Amyema mackayense</i>	M	e			+								
86	Loranthaceae	<i>Dendrophthoe pentandra</i>		e			+	+	+		+	+	+		+
87		<i>Macrosolen cochinchinensis</i>		e	+	+	+	+	?		+	+	+		?
88		<i>Viscum ovalifolium</i>		e	+	+	+	+	+	+	+	+	+	+	+
202	Lythraceae	<i>Pemphis acidula</i>	M	t			+	+			+	+	+		
126	Malpighiaceae	<i>Ryssopterys timoriensis</i>		c			+			+	+			+	
127		<i>Tristellateia australasica</i>		c	+	+	+	+		+	+		+	+	+
203	Malvaceae	<i>Hibiscus tiliaceus</i>		t	+	+	+	+	+	+	+	+	+	+	+
204		<i>Thespesia populnea</i>		t	+	+	+	+	+	+	+	+	+	+	+
205	Melastomataceae	<i>Melastoma malabathricum</i>		t	+	+	+	+	+	+	+	+	+	+	+
206		<i>Melastoma saigonense</i>		t		+			+				+		+
207		<i>Ochthocharis bornensis</i>		t	+	+	+	+				(+)	+		
89		<i>Pachycentria constricta</i>		e	+		+	+	+			+			
208	Meliaceae	<i>Aglaia cucullata</i>		t	+		+	+	+	+	+		+		+
209		<i>Xylocarpus granatum</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
210		<i>Xylocarpus moluccensis</i>	M	t		+	+	+	+	+	+	+	+		+
211		<i>Xylocarpus rumphii</i>	M	t		+	+	+		+	+			+	
128	Menispermaceae	<i>Anamirta cocculus</i>		c		+	+		+	+	+		+		+
129		<i>Hypserpa polyandra</i>		c(t)			+			+				+	
212	Moraceae	<i>Ficus curtipes</i>		t		+	+	+	+				+		+
213		<i>Ficus microcarpa</i>		t			+	+		+	+		+		+
214	Myoporaceae	<i>Myoporum bontiodides</i>		t											+
215	Myristicaceae	<i>Horsfieldia irya</i>		t	+	+	+	+	+	+	+	+	+		
216		<i>Myristica hollrungii</i>		t			+			+					
217	Myrsinaceae	<i>Aegiceras corniculatum</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
218		<i>Aegiceras floridum</i>	M	t		+	+	+		+	+				+
219		<i>Ardisia elliptica</i>		t	+		+	+	+		+	+	+		
220		<i>Rapanea porteri</i>		t	+		+	+					+		
221	Myrtaceae	<i>Melaleuca cajuputi</i>		t		+	+	+	+			+	+	+	+
222		<i>Osbornia octodonta</i>	M	t			+	+		+	+				
69	Najadaceae	<i>Najas browniana</i>		h			+			+					
70		<i>Najas indica</i>		h		+	+	+	+	+	+	+	+	+	+
71		<i>Najas marina</i>		h			+								
223	Olacaceae	<i>Olax imbricata</i>		t(c)	+	?	+	+	+	+	+	+	+	+	?
224		<i>Ximenia americana</i>		t	+	+	+	+	+	+	+	+	+	+	+

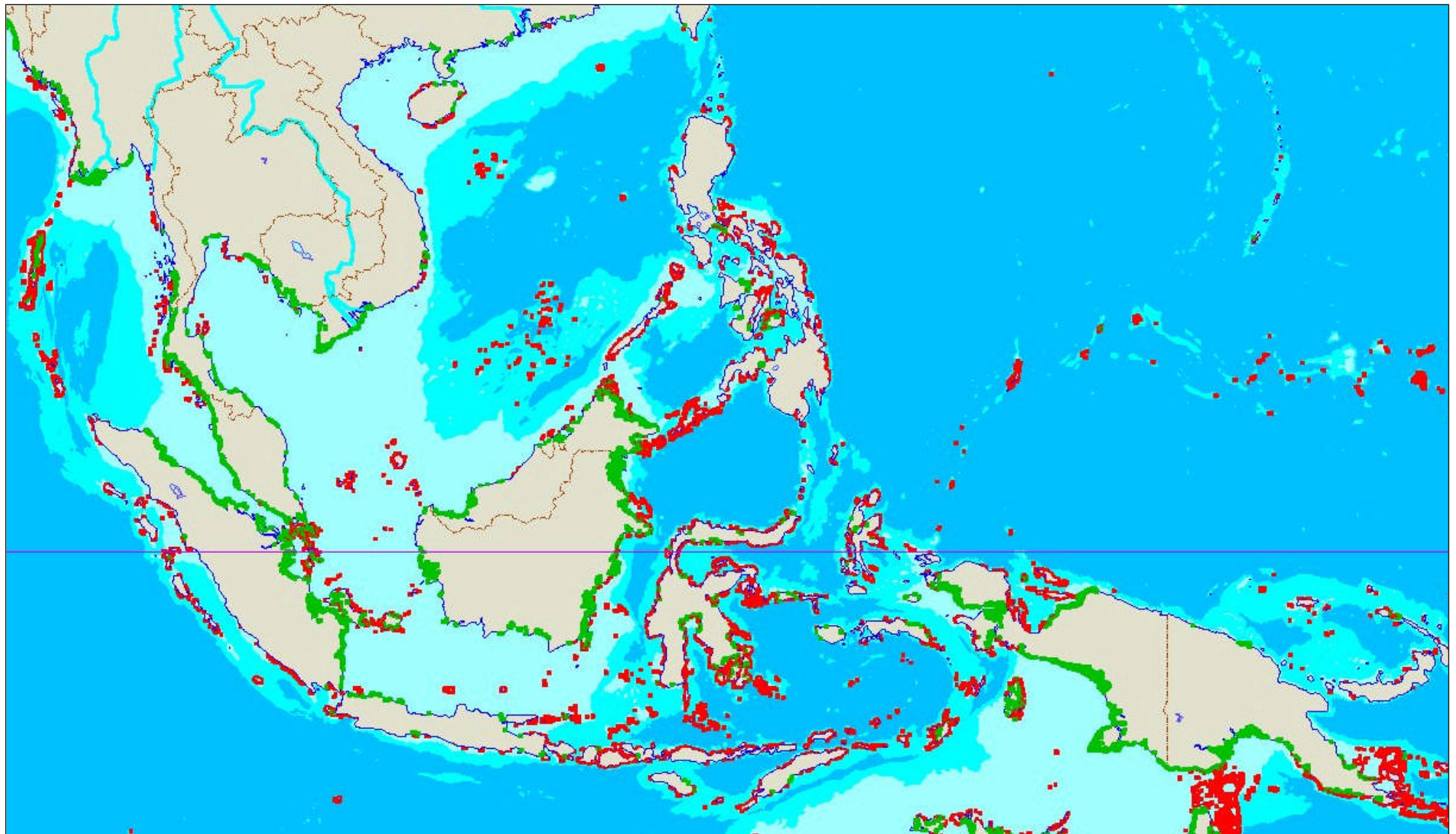
	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
90	Orchidaceae	<i>Aerides odoratum</i>		e			+	+	+		+		+		+
91		<i>Bulbophyllum xylocarpi</i>		e			+	+					+		
92		<i>Cymbidium finlaysonianum</i>		e	+	+	+	+			+	+	+		+
93		<i>Dendrobium aloefolium</i>		e	+		+	+		+				?	
94		<i>Dendrobium moschatum</i>		e					+				+		
95		<i>Dendrobium pachyphyllum</i>		e	+		+	+	+				+		
96		<i>Dendrobium subulatum</i>		e			+	+					+		
97		<i>Dockrillia teretifolium</i>		e			+			+				+	
98		<i>Oberonia iridifolium</i>		e			+	+							
99		<i>Oberonia laeta</i>		e			+	+				+			
100		<i>Oberonia rhizophoreti</i>	M	e			+	+							
139	Pandanaceae	<i>Pandanus tectorius</i>		p	+	+	+	+	+	+	+	+	+	+	+
72	Passifloraceae	<i>Passiflora foetida</i>		h(c)	+	+	+	+	+	+	+	+	+	+	+
225	Plumbaginaceae	<i>Aegialitis annulata</i>	M	t			+			+				+	
226		<i>Aegialitis rotundifolia</i>	M	t		+			+				+		
42	Poaceae	<i>Cynodon dactylon</i>		g	+	+	+	+	+	+	+	+	+	+	+
43		<i>Diplachne fusca</i>		g			+	+	+			+	+		
44		<i>Leptochloa neesii</i>		g	+		+	+	+			+	+		
45		<i>Myriostachya wightiana</i>		g		+	+	+	+				+		+
46		<i>Paspalum vaginatum</i>		g	+	+	+	+	+	+	+	+	+	+	+
47		<i>Phragmites karka</i>		g	+	+	+	+	+	+	+	+	+		+
48		<i>Sporobolus virginicus</i>		g	+	+	+	+	+		+	+	+		+
49		<i>Xerochloa imberbis</i>		g			+						+		
50		<i>Zoysia matrella</i>		g			+	+				+			
227	Poaceae	<i>Podocarpus polystachyus</i>		t	+		+	+			+	+	+		
130	Rhamnaceae	<i>Smythea lanceata</i>		c	+		+	+		+		+			
228	Rhizophoraceae	<i>Bruguiera cylindrica</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
229		<i>Bruguiera exaristata</i>	M	t			+			+				+	
230		<i>Bruguiera gymnorhiza</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
231		<i>Bruguiera hainesii</i>	M	t			+	+	+	+			+		
232		<i>Bruguiera parviflora</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
233		<i>Bruguiera sexangula</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
234		<i>Ceriops decandra</i>	M	t		+	+	+	+	+	+		+		+
235		<i>Ceriops tagal</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
236	Rhizophoraceae	<i>Kandelia candel</i>	M	t	+	+	+	+	+		+	+	+		+
237		<i>Rhizophora apiculata</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
238		<i>Rhizophora mucronata</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
239		<i>Rhizophora stylosa</i>	M	t			+	+		+	+	+		+	+
240	Rubiaceae	<i>Gardenia tubifera</i>		t	+		+	+	+			+	+		+
241		<i>Guetarda speciosa</i>		t		+	+	+	+	+	+	+	+	+	+
101		<i>Hydnophytum formicarum</i>		e	+		+	+							+
242		<i>Ixora timorensis</i>		t			+							+	

	HIGHER PLANTS		Mangrove	Lifeform	Brunei	Cambodia	Indonesia	Malaysia	Myanmar	PNG	Philippines	Singapore	Thailand	Timor-Leste	Viet Nam
No.	Family	Scientific name													
243		<i>Morinda citrifolia</i>		t	+	+	+	+	+	+	+	+	+	+	+
102		<i>Myrmecodia tuberosa</i>		e	+		+	+		+	+				
244		<i>Scyphiphora hydrophyllacea</i>	M	t	+	+	+	+		+	+	+	+		+
73	Ruppiaceae	<i>Ruppia maritima maritima</i>		h			+	+			+		+		+
245	Rutaceae	<i>Acronychia pedunculata</i>		t	+		+	+					+		+
246		<i>Atalantia monophylla</i>		t		+		+	+		+		+		
247		<i>Merope angulata</i>		t			+		+	+		+			
248	Salvadoraceae	<i>Azima sarmentosa</i>		t		+	+	+	+				+		+
249	Sapindaceae	<i>Allophyllus cobbe</i>		t	+	+	+	+		+		+	+	+	
250		<i>Mischocarpus sundaicus</i>		t			+	+			+	+	+		+
251	Sapotaceae	<i>Planchonella obovata</i>		t		+	+	+		+		+	+		+
252	Simaroubaceae	<i>Quassia harmandiana</i>		t		+							+		
253		<i>Quassia indica</i>		t	+	+	+	+	+	+	+		+		+
254	Sonneratiaceae	<i>Sonneratia alba</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
255		<i>Sonneratia apetala</i>	M	t					+						
256		<i>Sonneratia caseolaris</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
257		<i>Sonneratia griffithii</i>	M	t		+		+	+				+		
258		<i>Sonneratia ovata</i>	M	t		+	+	+		+	+	+	+		+
259	Sterculiaceae	<i>Heritiera fomes</i>	M	t					+						
260		<i>Heritiera globosa</i>	M	t	+		+	+							
261		<i>Heritiera littoralis</i>	M	t	+	+	+	+	+	+	+	+	+	+	+
262		<i>Kleinhovia hospita</i>		t		+	+	+	+	+	+		+		+
263	Symplocaceae	<i>Symplocos celastriifolia</i>		t	+		+	+		+	+	+	+		
264	Tiliaceae	<i>Brownlowia argentata</i>	M	t			+	+	+	+	+	+			
265		<i>Brownlowia tersa</i>	M	t	+	+	+	+	+		+	+	+		
51	Typhaceae	<i>Typha angustifolia</i>		g	+	+	+	+	+	+	+	+	+	+	+
266	Verbenaceae	<i>Clerodendrum inerme</i>		t		+	+	+	+		+	+	+		+
267		<i>Premna obtusifolia</i>		t		+	+	+	+	+	+		+	+	
74		<i>Stachytarpheta jamaicensis</i>		h		+	+	+	+	+	+	+	+	+	+
268		<i>Vitex ovata</i>		t(h)		+	+	+	+		+		+		
		TOTALs	52	268	126	141	243	221	148	160	155	138	186	99	152
		Lifeforms (totals):													
		Ferns (f)		24											
		Grasses & grass-like herbs (g)		27											
		Ground herbs (h)		23											
		Epiphytes (e)		28											
		Palms & palm-like species (p)		9											
		Climbers (c)		28											
		Trees & shrubs (t)		129											
				268											

NOTE: M in mangrove column = true mangrove species; i.e. occurring in mangrove habitat only

ANNEX 2 Map of Southeast Asian mangrove areas

The map is provided on the next page, with kind permission from WCMC.
Note that mangroves are indicated in green, coral reefs in red.



ANNEX 3 Index of scientific names

NOTE: Correct scientific names are given in **BOLD**, and the number added denotes the species number as this is dealt with in part 2 of the mangrove guide.

Abildgaardia javanica Steud.; see *Fimbristylis polytrichoides* (Retz.) R. Br.

Abildgaardia javanica Nees.; see *Fimbristylis polytrichoides* (Retz.) R. Br.

Abrus abrus W.Wight; see *Abrus precatorius* L.

Abrus cyaneus R.Vig.; see *Abrus precatorius* L.

Abrus frutex Rumphius; see *Abrus precatorius* L.

Abrus maculatus Noronha; see *Abrus precatorius* L.

Abrus minor Desv.; see *Abrus precatorius* L.

Abrus pauciflorus Desv.; see *Abrus precatorius* L.

***Abrus precatorius* L. – 115**

Abrus precatorius var. *novo-guineensis* Zipp. ex Miq.; see *Abrus precatorius* L.

Abrus squamulosus E. Mey.; see *Abrus precatorius* L.

Abrus tunguensis P. Lima; see *Abrus precatorius* L.

Abrus wittei Baker f. *Glycine a*; see *Abrus precatorius* L.
abus L.

***Acanthus ebracteatus* Vahl – 52**

***Acanthus ilicifolius* L. – 53**

Acanthus neo-guineensis; see *Acanthus ilicifolius* L.

***Acanthus volubilis* Wall. – 54**

Acmella biflora L.; see *Wedelia biflora* (L.) DC.

Acronychia arborea; see *Acronychia pedunculata* (L.) Miq.

Acronychia laurifolia Blume; see *Acronychia pedunculata* (L.) Miq.

***Acronychia pedunculata* (L.) Miq. – 245**

Acrophorus parvula Bedd.; see *Davallia parvula* Wall. ex Hook. & Grev.

***Acrostichum aureum* Linné – 22**

Acrostichum aureum var. *schmidtii* (Christ) C.Chr.; see *Acrostichum speciosum* Willd.

Acrostichum biforme Sw.; see *Platyserium coronarium* (Koenig.) Desv.

Acrostichum decurrens (non Desv.) Bl.; see *Elaphoglossum amblyphyllum* C.R. Bell.

Acrostichum heterophyllum L.; see *Drymoglossum piloselloides* (Linn.) Presl.

Acrostichum inaequale Willd.; see *Acrostichum aureum* Linné

Acrostichum lanceolatum Burm.; see *Pyrrosia longifolia* (Burm.) Morton.

Acrostichum lineare Hassk.; see *Photinopteris speciosa* (Bl.) Persl.

Acrostichum longifolium Burm. f.; see *Pyrrosia longifolia* (Burm.) Morton.

Acrostichum obliquum Blume; see *Acrostichum aureum* Linné

Acrostichum obtusifolium (non Willd.) Bl.; see *Elaphoglossum amblyphyllum* C.R. Bell.

Acrostichum palustre (Burm.f.) C.B. Clarke; see *Stenochlaena palustris* (Burm. f.) Bedd.

Acrostichum rigidum Wall.; see *Photinopteris speciosa* (Bl.) Persl.

Acrostichum scandens (Sw.) Hook.; see *Stenochlaena palustris* (Burm. f.) Bedd.

***Acrostichum speciosum* Willd. – 23**

Acrostichum spectabile Zoll.; see *Acrostichum aureum* Linné

Actegeton sarmentosum Bl.; see *Azima sarmentosa* (Bl.) B. & H.

***Aegialitis annulata* R.Br. – 225**

Aegialites annulata (sic); see *Aegialitis annulata* R.Br.

***Aegialitis rotundifolia* Roxb. – 226**

Aegialites annulata var. *rotundifolia*; see *Aegialitis rotundifolia* Roxb.

Aegianilites Presl.; see *Aegialitis annulata* R.Br.

Aegianilites rotundifolia; see *Aegialitis rotundifolia* Roxb.

***Aegiceras corniculatum* (L.) Blanco – 217**

Aegiceras ferreum Blume; see *Aegiceras floridum* Roemer & Schultes

***Aegiceras floridum* Roemer & Schultes – 218**

Aegiceras fragrans König; see *Aegiceras corniculatum* (L.) Blanco

Aegiceras majus Gaertn.; see *Aegiceras corniculatum* (L.) Blanco

Aegiceras malaspinaea A.DC.; see *Aegiceras corniculatum* (L.) Blanco

Aegiceras nigricans A. Rich.; see *Aegiceras floridum* Roemer & Schultes

Aegiphila viburnifolia Juss.; see *Cassine viburnifolia* (Juss.) Ding Hou

Aerides cornuta Roxb.; see *Aerides odoratum* Reinw. ex Blume

Aerides dayanum hort.; see *Aerides odoratum* Reinw. ex Blume

Aerides nobile Warn.; see *Aerides odoratum* Reinw. ex Blume

Aerides odoratum Lour.; see *Aerides odoratum* Reinw. ex Blume

***Aerides odoratum* Reinw. ex Blume – 90**

Aerides odoratum var. *majus* Ortgies.; see *Aerides odoratum* Reinw. ex Blume

Aerides rohanianum Rchb. f.; see *Aerides odoratum* Reinw. ex Blume

Aerides suavissimum Lindley; see *Aerides odoratum* Reinw. ex Blume

Aerides virens Lindley; see *Aerides odoratum* Reinw. ex Blume

Aerides wilsonianum R.H. Torr.; see *Aerides odoratum* Reinw. ex Blume

Afzelia bijuga A. Gray; see *Intsia bijuga* (Colebr.) Kuntze

Afzelia retusa Kurz.; see *Intsia bijuga* (Colebr.) Kuntze

***Aganope heptaphylla* (L.) Polhill – 116**

Agasta asiatica Miers.; see *Barringtonia asiatica* (L.) Kurz

Aglaia conduplicifolia Elmer; see *Aglaia cucullata* (Roxb.) Pellegrin

***Aglaia cucullata* (Roxb.) Pellegrin – 208**

Aglaia tripetala Merr.; see *Aglaia cucullata* (Roxb.) Pellegrin

Aglaia zollingeri C.DC.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Agrostis matrella L.; see *Zoysia matrella* (L.) Merr.

Agrostis virginica L.; see *Sporobolus virginicus* (L.) Kunth.

Albizia grandiflora (Benth.) F. Muell.; see *Serianthes grandiflora* Benth.

Allophylus amboinensis Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus apiocarpus Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus blancoi Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus cambessedei Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus celebicus Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus chlorocarpus Radlk.; see *Allophylus cobbe* (L.) Raeusch.

***Allophylus cobbe* (L.) Raeusch. – 249**

Allophylus cobbe (L.) Raeuschel.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus dimorphus Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus filiger Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus fulvinervis (Blume) Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus glaber Boerl.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus integrifolius Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus javensis (Blume) Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus leptococcus Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus ligustrina Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus littoralis (Blume) Blume; see *Allophylus cobbe* (L.) Raeusch.

Allophylus macrostachys Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus micrococcus Radlk.; see *Allophylus cobbe* (L.) Raeusch.

Allophylus quinatus Radlk.; see *Allophylus cobbe* (L.) Raeusch.
Allophylus rufescens Blume; see *Allophylus cobbe* (L.) Raeusch.
Allophylus rugosa Blume; see *Allophylus cobbe* (L.) Raeusch.
Allophylus sumatranus Blume; see *Allophylus cobbe* (L.) Raeusch.
Allophylus sundanus Miq.; see *Allophylus cobbe* (L.) Raeusch.
Allophylus ternatus Lour.; see *Allophylus cobbe* (L.) Raeusch.
Allophylus timoriensis (DC.) Blume; see *Allophylus cobbe* (L.) Raeusch.
Allophylus villosus (Roxb.) Blume; see *Allophylus cobbe* (L.) Raeusch.
Allophylus zeylanicus L.; see *Allophylus cobbe* (L.) Raeusch.
Allophylus setulosus Radlk.; see *Allophylus cobbe* (L.) Raeusch.
Allophylus unifoliolatus Radlk.; see *Allophylus cobbe* (L.) Raeusch.
Alocasia dussii Hort.; see *Colocasia esculenta* (L.) Schott
Alocasia illustris W. Br.; see *Colocasia esculenta* (L.) Schott
Ambrosinia ciliata Roxb.; see *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott
Amoora aherniana Merr.; see *Aglaia cucullata* (Roxb.) Pellegrin
Amoora auriculata Miq.; see *Aglaia cucullata* (Roxb.) Pellegrin
Amoora cucullata Roxb.; see *Aglaia cucullata* (Roxb.) Pellegrin
Amoora naumannii sensu C.DC.; see *Xylocarpus rumphii* (Kostel.) Mabb.
Amoora salomonensis C. DC.; see *Xylocarpus granatum* Koen.
Amoora zollingeri (C.DC.) Koord.; see *Xylocarpus rumphii* (Kostel.) Mabb.
Ampactus litorea Rumph.; see *Allophylus cobbe* (L.) Raeusch.

***Amyema anisomeres* Dans. – 83**

Amyema cycnei-sinus; see *Amyema mackayense* (Blakely) Danser

***Amyema gravis* Danser – 84**

***Amyema mackayense* (Blakely) Danser – 85**

Amyema mackayense ssp. *cycnei-sinus*; see *Amyema mackayense* (Blakely) Danser

Amyris arborescens P. Browne; see *Ximenia americana* L.

***Anamirta cocculus* L. Wight & Arn. – 128**

Anamirta jucunda Miers.; see *Anamirta cocculus* L. Wight & Arn.
Andersonia cucullata Roxb.; see *Aglaia cucullata* (Roxb.) Pellegrin
Andropogon dulce Burm.; see *Eleocharis dulcis* (Burm. f.) Henschel
Antrophyum involutum Bl.; see *Loxogramma involuta* Presl.
Aporetica penicellata Blanco; see *Allophylus cobbe* (L.) Raeusch.
Aporetica ternata Forst. & Forst.; see *Allophylus cobbe* (L.) Raeusch.
Aquifolium indicum Rumph.; see *Acanthus ilicifolius* L.
Araistegia davaricata (Blume) M. Kato; see *Davallia divaricata* Blume
Arbor glutinosa Rumphius; see *Cordia dichotoma* G. Forst.
Arbor ovigera Rumph.; see *Hernandia ovigera* L.

***Ardisia elliptica* Thunberg – 219**

Ardisia humilis Vahl.; see *Ardisia elliptica* Thunberg
Ardisia kotoensis Hayata; see *Ardisia elliptica* Thunberg
Ardisia littoralis Andr.; see *Ardisia elliptica* Thunberg
Ardisia squamulosa C. Presl.; see *Ardisia elliptica* Thunberg
Areca tigillaria Jack.; see *Oncosperma tigillarium* (Jack.) Ridl.
Arthrocnenum indicum (Willd.) Moq.; see *Salicornia indica* Willd.
Arum aegyptium Rumph.; see *Colocasia esculenta* (L.) Schott
Arum chinense L.; see *Colocasia esculenta* (L.) Schott
Arum colocasia L.; see *Colocasia esculenta* (L.) Schott
Arum colocasioides Desf.; see *Colocasia esculenta* (L.) Schott
Arum esculentum L.; see *Colocasia esculenta* (L.) Schott

Arum nymphaeifolia (Vent.) Roxb.; see *Colocasia esculenta* (L.) Schott

Arum peltata Lam.; see *Colocasia esculenta* (L.) Schott

Arundo karka Retz.; see *Phragmites karka* (Retz.) Trin. ex Steud.

Asclepias gigantea L.; see *Calotropis gigantea* (L.) R.Br.

Asclepias parasitica Roxb.; see *Hoya parasitica* (Roxb.) Wall. ex Wight

Asplenium adiantoides C.Chr.; see *Asplenium macrophyllum* Sw.

Asplenium antiquum Makino; see *Asplenium nidus* Linn.

Asplenium australasicum (J.Sm.) Hook.; see *Asplenium nidus* Linn.

Asplenium canaliculatum Bl.; see *Asplenium macrophyllum* Sw.

Asplenium falcatum Lamk.; see *Asplenium macrophyllum* Sw.

Asplenium filicifolium Goldm.; see *Asplenium nidus* Linn.

***Asplenium macrophyllum* Sw. – 1**

***Asplenium nidus* Linn. – 2**

Asplenium oxyphyllum Cuming.; see *Asplenium macrophyllum* Sw.

Asplenium pachyphyllum; see *Asplenium nidus* Linn.

Asplenium polyodon Forst.; see *Asplenium macrophyllum* Sw.

Asplenium simile Bl.; see *Asplenium macrophyllum* Sw.

***Atalantia monophylla* DC. – 246**

Atalantia spinosa Tanaka; see *Atalantia monophylla* DC.

Atriplex maritima (L.) Crantz.; see *Suaeda maritima* (L.) Dum.

Atuna alba Rumph.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Atuna elata (King.) Kosterm.; see *Atuna racemosa* ssp. *racemosa* Rafin.

***Atuna racemosa* ssp. *racemosa* Rafin. – 166**

Atuna scabra (Hassk.) Kosterm.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Aubletia caseolaris Gaertn.; see *Sonneratia caseolaris* (L.) Engl.

***Avicennia alba* Blume – 150**

***Avicennia eucalyptifolia* Zipp. ex Moldenke – 151**

Avicennia eucalyptifolia (Zipp. ex Miq) Moldenke; see *Avicennia eucalyptifolia* Zipp. ex Moldenke

Avicennia intermedia Griff.; see *Avicennia marina* (Forssk.) Vierh.

***Avicennia lanata* Ridley – 152**

***Avicennia marina* (Forssk.) Vierh. – 153**

Avicennia marina (Forssk.) Vierh. var. *alba* (Blume) Bakh.; see *Avicennia alba* Blume

Avicennia marina subsp. *eucalyptifolia* (Zipp. ex Moldenke) J. Everett; see *Avicennia eucalyptifolia* Zipp. ex Moldenke

Avicennia marina var. *acutissima* Stapf & Moldenke; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *anomala* Moldenke; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *australasica* (Walp.) J. Everett; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *eucalyptifolia* (Zip. ex Moldenke) N.C. Duke; see *Avicennia eucalyptifolia* Zipp. ex Moldenke

Avicennia marina var. *intermedia* (Griff.) Bakh.; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *marina*; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *resinifera* (Forst.) Bakh.; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *rumphiana* (Hall. f.) Bakh.; see *Avicennia marina* (Forssk.) Vierh.

Avicennia marina var. *typica* Bakhuizen; see *Avicennia marina* (Forssk.) Vierh.

Avicennia mindanaense Elmer; see *Avicennia marina* (Forssk.) Vierh.

***Avicennia officinalis* L. – 154**

Avicennia officinalis L., *Sceura marina* Forssk.; see *Avicennia marina* (Forssk.) Vierh.

Avicennia officinalis var. *eucalyptifolia* Valet.; see *Avicennia eucalyptifolia* Zipp. ex Moldenke

Avicennia officinalis var. *spathulata* Kuntze; see *Avicennia lanata* Ridley

Avicennia rumphiana; see *Avicennia lanata* Ridley

Avicennia tomentosa Willd.; see *Avicennia officinalis* L.

Azalea brookeana Low ex Lindl.; see *Rhododendron brookeanum* Low ex Lindl. var. *brookeanum*

Azima nova Blanco; see *Azima sarmentosa* (Bl.) B. & H.

***Azima sarmentosa* (Bl.) B. & H. – 248**

Baccharis indica L.; see *Pluchea indica* (L.) Less.

Balanopteris minor Gaertn.; see *Heritiera littoralis* Dryand.

Balanopteris tothila Gaertn.; see *Heritiera littoralis* Dryand.

Bancudus latifolia Rumph.; see *Morinda citrifolia* L.

Banisteria dichotoma (non L.) Spanoghe; see *Ryssopteryx timoriensis* (DC.) Jussieu

Banisteria timoriensis A.P. DC.; see *Ryssopteryx timoriensis* (DC.) Jussieu

***Barringtonia acutangula* (L.) Gaertn. – 187**

Barringtonia acutangula subsp. *spicata* (Bl.) Payens; see *Barringtonia acutangula* (L.) Gaertn.

***Barringtonia asiatica* (L.) Kurz – 188**

Barringtonia butonica Forster; see *Barringtonia asiatica* (L.) Kurz

***Barringtonia conoidea* Griff. – 189**

Barringtonia edaphocarpa Gagn.; see *Barringtonia acutangula* (L.) Gaertn.

***Barringtonia racemosa* (L.) Spreng. – 190**

Barringtonia racemosa (L.) Bl. ex DC.; see *Barringtonia racemosa* (L.) Spreng.

Barringtonia rubra Blume; see *Barringtonia racemosa* (L.) Spreng.

Barringtonia speciosa J. R. & G. Forster; see *Barringtonia asiatica* (L.) Kurz

Barringtonia spicata Blume; see *Barringtonia acutangula* (L.) Gaertn.

Barringtonia stravadarium Blanco; see *Barringtonia racemosa* (L.) Spreng.

***Batis argillicola* van Royen – 155b**

Bignonia javanica Thunb.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Bignonia longiflora Willd. ex DC.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Bignonia longissima Lour.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Bignonia spathacea L.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Bintangur maritima Rumph.; see *Calophyllum inophyllum* L.

Bladhia kotoensis (Hayata) Nakai; see *Ardisia elliptica* Thunberg

Blatti acide Lamk.; see *Sonneratia caseolaris* (L.) Engl.

Blatti apetala O.K.; see *Sonneratia apetala* Buch.-Ham.

Blatti caseolaris O.K.; see *Sonneratia caseolaris* (L.) Engl.

Blatti pagatpat Niedenzu; see *Sonneratia caseolaris* (L.) Engl.

Blumeodendron elateriospermum J.J. Smith; see *Blumeodendron tokbrai* (Bl.) Kurz.

Blumeodendron paucinervium (Elm.) Merr.; see *Blumeodendron tokbrai* (Bl.) Kurz.

Blumeodendron tokbrai (Bl.) J.J. Smith; see *Blumeodendron tokbrai* (Bl.) Kurz.

***Blumeodendron tokbrai* (Bl.) Kurz. – 173**

Blumeodendron vernicosum (Hk. f.) Gage; see *Blumeodendron tokbrai* (Bl.) Kurz.

Brachypterum scandens W & A.; see *Derris scandens* (Aubl.) Pittier

Bromus polystachyos Forsk.; see *Diplachne fusca* (L.) Beauv.

***Brownlowia argentata* Kurz. – 264**

Brownlowia beccarii (Mast.) Pierre; see *Brownlowia tersa* (L.) Kosterm.

Brownlowia lanceolata Benth.; see *Brownlowia tersa* (L.) Kosterm.

Brownlowia lepidota; see *Brownlowia argentata* Kurz.

Brownlowia riedelii Hemsl.; see *Brownlowia argentata* Kurz.

***Brownlowia tersa* (L.) Kosterm. – 265**

Bruguiera angulata Griff.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera australis A. Cunn.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera capensis Bl.; see *Bruguiera gymnorrhiza* (L.) Lamk.

Bruguiera caryophylloides Bl.; see *Bruguiera cylindrica* (L.) Bl.

Bruguiera conjugata (non *Rhizophora conjugata* L.) Merr.; see *Bruguiera gymnorrhiza* (L.) Lamk.

***Bruguiera cylindrica* (L.) Bl. – 228**

Bruguiera cylindrica (non Bl.) Hance; see *Bruguiera gymnorrhiza* (L.) Lamk.

Bruguiera cylindrica (non *Rhizophora cylindrica* L.) Bl.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera decandra Griff.; see *Ceriops decandra* (Griff.) Ding Hou

Bruguiera eriopetala W. & A. ex Arn.; see *Bruguiera sexangula* (Lour.) Poir.

***Bruguiera exaristata* Ding Hou – 229**

Bruguiera gymnorrhiza (with one 'r'); see *Bruguiera gymnorrhiza* (L.) Lamk.

***Bruguiera gymnorrhiza* (L.) Lamk. – 230**

***Bruguiera hainessii* C.G.Rogers – 231**

Bruguiera malabarica (non Arn.) F.-Vill.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera malabarica Arn.; see *Bruguiera cylindrica* (L.) Bl.

Bruguiera oxyphylla Miq.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera parietosa Griff.; see *Bruguiera sexangula* (Lour.) Poir.

***Bruguiera parviflora* (Roxb.) W.& A. ex Griff. – 232**

Bruguiera rheedii Bl.; see *Bruguiera gymnorrhiza* (L.) Lamk.

Bruguiera ritchiei Merr.; see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.

Bruguiera rumphii Bl.; see *Bruguiera gymnorrhiza* (L.) Lamk.

***Bruguiera sexangula* (Lour.) Poir. – 233**

Bruguiera sexangularis Spreng.; see *Bruguiera sexangula* (Lour.) Poir.

Bruguiera wightii Bl.; see *Bruguiera gymnorrhiza* (L.) Lamk.

Bruguiera zippelii Bl.; see *Bruguiera gymnorrhiza* (L.) Lamk.

Buglossum litoreum Rumph.; see *Scaevola taccada* (Gaertn.) Roxb.

Bulbophyllum catenarium Ridl.; see *Bulbophyllum xylocarpi* J.J.Smith

Bulbophyllum ovalifolium Lindl. sensu lato; see *Bulbophyllum xylocarpi* J.J.Smith

***Bulbophyllum xylocarpi* J.J.Smith – 91**

Bupariti populnea (L.) Rothmaler; see *Thespesia populnea* (L.) Soland. ex Correa

Butonica rosata Miers.; see *Barringtonia racemosa* (L.) Spreng.

Butonica rumphina Miers; see *Barringtonia asiatica* (L.) Kurz

Butonica terrestris rubra Rumph.; see *Barringtonia racemosa* (L.) Spreng.

Cacara litorea Rumph.; see *Canavalia maritima* Thouars

Cacoucia lucida Hassk.; see *Combretum trifoliatum* Vent.

Cacoucia trifoliata DC.; see *Combretum trifoliatum* Vent.

Caesalpinia arborea Zoll. ex Miq.; see *Peltophorum pterocarpum* (DC.) K. Heyne

***Caesalpinia bonduc* (L.) Roxb. – 117**

Caesalpinia bonducella Flem.; see *Caesalpinia crista* L.

***Caesalpinia crista* L. – 118**

Caesalpinia jayabo Maza.; see *Caesalpinia bonduc* (L.) Roxb.

Caesalpinia laevigata Perr.; see *Caesalpinia crista* L.

Caesalpinia nuga L.; see *Caesalpinia crista* L.

Caesalpinia sogerensis Baker; see *Caesalpinia bonduc* (L.) Roxb.

Caju pinnatum O. Kuntze.; see *Pongamia pinnata* (L.) Pierre

Caladium colocasia W. Wight ex saff.; see *Colocasia esculenta* (L.) Schott

Caladum esculentum (L.) Vent.; see *Colocasia esculenta* (L.) Schott

Caladium nymphaeifolia Vent.; see *Colocasia esculenta* (L.) Schott

Caladium violaceum hort. ex Engl.; see *Colocasia esculenta* (L.) Schott

Calamus aquatilis; see *Calamus erinaceus* (Becc.) Dransfield

***Calamus erinaceus* (Becc.) Dransfield – 131**

Calla gaby Blanco; see *Colocasia esculenta* (L.) Schott

Callista carnosum; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Callista moschata Kuntze.; see *Dendrobium moschatum* (Buch.-Ham.) Sw.
Callista pachyphylla Kuntze.; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.
Callista pumila; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.
Callista teretifolia (Lindl.) Kuntze.; see *Dockrillia teretifolia* (R.Br.) Brieger
Calodium coccinchinensis Lour.; see *Cassytha filiformis* Linn.
Calonyction album House; see *Ipomoea tuba* Schlechtend.
Calonyction grandiflorum Choisy; see *Ipomoea tuba* Schlechtend.
Calonyction muticum Decaisne; see *Ipomoea tuba* Schlechtend.
Calonyction tuba; see *Ipomoea tuba* Schlechtend.

***Calophyllum inophyllum* L. – 183**

***Calotropis gigantea* (L.) R.Br. – 147**

Calotropis gigantea (Willd.) Dryand.; see *Calotropis gigantea* (L.) R.Br.

***Calycopteris floribunda* (Roxb.) Lamk – 110**

Calycopteris nutans Kurz.; see *Calycopteris floribunda* (Roxb.) Lamk

Calystegia affinis (non Endl.) Schum.; see *Ipomoea gracilis* R. Br.

Camptostemon aruense; see *Camptostemon schultzii* Masters

***Camptostemon philippinense* (Vidal) Becc. – 157**

***Camptostemon schultzii* Masters – 158**

Canavalia apiculata Piper; see *Canavalia maritima* Thouars

Canavalia arenicola Piper; see *Canavalia maritima* Thouars

Canavalia baueriana Endl.; see *Canavalia maritima* Thouars

Canavalia emarginata (Jacq.) G.Don.; see *Canavalia maritima* Thouars

Canavalia lineata Prain non DC.; see *Canavalia maritima* Thouars

Canavalia lineata (Thunb.) DC.; see *Canavalia maritima* Thouars

Canavalia maritima (Aubl.) Urb.; see *Canavalia maritima* Thouars

***Canavalia maritima* Thouars – 68**

Canavalia miniata (Kunth.) DC.; see *Canavalia maritima* Thouars

Canavalia moneta Welw.; see *Canavalia maritima* Thouars

Canavalia obcordata (Roxb.) Voigt.; see *Canavalia maritima* Thouars

Canavalia obtusifolia DC.; see *Canavalia maritima* Thouars

Canavalia podocarpa Dunn.; see *Canavalia maritima* Thouars

Canavalia rosea (Sw.) DC.; see *Canavalia maritima* Thouars

Canavali maritima; see *Canavalia maritima* Thouars

Capriola dactylon (L.) O.K.; see *Cynodon dactylon* (L.) Pers.

Carapa borneensis Becc.; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Carapa granatum (Koen.) Alston; see *Xylocarpus granatum* Koen.

Carapa indica A. Juss.; see *Xylocarpus granatum* Koen.

Carapa mekongensis (Pierre) Pellegr.; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Carapa moluccensis auct. non Lam.; see *Xylocarpus granatum* Koen.

Carapa moluccensis auct. non. Lam.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Carapa moluccensis Lam.; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Carapa obovata auct. non Blume; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Carapa obovata Blume; see *Xylocarpus granatum* Koen.

Carapa rumphii Kostel.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Carex tuberosa (non Degl.) Blanco; see *Eleocharis dulcis* (Burm. f.) Henschel

***Caryota urens* L. – 132**

Cassia candenatensis Dennst.; see *Dalbergia candenatensis* (Dennst.) Prain

***Cassine viburnifolia* (Juss.) Ding Hou – 163**

Cassytha americana Nees.; see *Cassytha filiformis* Linn.

Cassytha aphylla (Forssk.) Raenschel.; see *Cassytha filiformis* Linn.

Cassytha archboldiana C.K. Allen; see *Cassytha filiformis* Linn.

Cassytha brasiliensis Mart. ex Nees.; see *Cassytha filiformis* Linn.

Cassytha dissitiflora Meisn.; see *Cassytha filiformis* Linn.

***Cassytha filiformis* Linn. – 114**

Cassytha filiformis L. var. *pseudopubescens* Domin.; see *Cassytha filiformis* Linn.

Cassytha filiformis L. var. *subpubescens* Meisn.; see *Cassytha filiformis* Linn.

Cassytha guineensis Schumach. & Thonn.; see *Cassytha filiformis* Linn.

Cassytha novoguineensis Kaeh. & Harusima; see *Cassytha filiformis* Linn.

Cassytha timorensis Gand.; see *Cassytha filiformis* Linn.

Cassytha zeylanica Gaertn.; see *Cassytha filiformis* Linn.

***Casuarina equisetifolia* L. – 162**

Casuarina equisetifolia J.R. & G. Forst.; see *Casuarina equisetifolia* L.

Casuarina equisetifolia subsp. *equisetifolia*; see *Casuarina equisetifolia* L.

Casuarina equisetifolia subsp. *incana* (Benth.) L.A.S. Johnson; see *Casuarina equisetifolia* L.

Casuarina equisetifolia var. *equisetifolia*; see *Casuarina equisetifolia* L.

Casuarina equisetifolia var. *incana* Benth.; see *Casuarina equisetifolia* L.

Casuarina equisetifolia var. *microcarpa* F. Muell.; see *Casuarina equisetifolia* L.

Casuarina litorea L. ex Fosberg & Sachet; see *Casuarina equisetifolia* L.

Casuarina muricata Roxb.; see *Casuarina equisetifolia* L.

Catha montana G.Don.; see *Maytenus emarginata* (Willd.) Ding Hou

***Cathormion umbellatum* (M.Vahl.) Kosterm. – 191**

Cattimarus Rumph.; see *Kleinhovia hospita* L.

Caulinia indica Willd.; see *Najas indica* (Willd.) Cham.

Celastrus emarginatus Willd.; see *Maytenus emarginata* (Willd.) Ding Hou

Celastrus montanus Roth.; see *Maytenus emarginata* (Willd.) Ding Hou

Celastrus semiarillata Turcz.; see *Maytenus emarginata* (Willd.) Ding Hou

***Cerbera floribunda* K. Schumann – 141**

Cerbera forsteri Seem.; see *Cerbera manghas* L.

Cerbera lactaria Hamilton; see *Cerbera manghas* L.

Cerbera linneai Montr.; see *Cerbera manghas* L.

***Cerbera manghas* L. – 142**

Cerbera micrantha Kanehira; see *Cerbera floribunda* K. Schumann

Cerbera odallam Bl.; see *Cerbera manghas* L.

***Cerbera odollam* Gaertn. – 143**

Cerbera tanghina Hook.; see *Cerbera manghas* L.

Cerbera venenifera (Poir.) Steud.; see *Cerbera manghas* L.

Cerbera venenifera A.J.M.; see *Cerbera manghas* L.

Ceriops australis White; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops boiviniana Tul.; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops candolleana Arn.; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops candolleana var. *sasakii* Hayata; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops candolleana var. *spathulata* Blume; see *Ceriops tagal* (Perr.) C.B.Rob.

***Ceriops decandra* (Griff.) Ding Hou – 234**

Ceriops forsteniana; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops lucida Miq.; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops pauciflora Benth.; see *Ceriops tagal* (Perr.) C.B.Rob.

Ceriops roxburghiana Arn.; see *Ceriops decandra* (Griff.) Ding Hou

Ceriops somalensis Chiovenda; see *Ceriops tagal* (Perr.) C.B.Rob.

***Ceriops tagal* (Perr.) C.B.Rob. – 235**

Ceriops tagal var. *australis* White; see *Ceriops tagal* (Perr.) C.B.Rob.

- Ceriops timoriensis* Domin; see *Ceriops tagal* (Perr.) C.B.Rob.
Ceriops zippeliana Bl.; see *Ceriops decandra* (Griff.) Ding Hou
Chenopodina australis (R.Br.) Moq.; see *Suaeda maritima* (L.) Dum.
Chenopodina maritima (L.) Moq.; see *Suaeda maritima* (L.) Dum.
Chenopodina maritima var. *vulgaris*; see *Suaeda maritima* (L.) Dum.
Chenopodium australe R.Br.; see *Suaeda maritima* (L.) Dum.
Chenopodium maritimum L.; see *Suaeda maritima* (L.) Dum.
Chiratia leucantha Montr.; see *Sonneratia alba* J.E. Smith
Chlorocyperus malaccensis Palla; see *Cyperus malaccensis* Lamk.
Chrysodium aureum Mett.; see *Acrostichum aureum* Linné
Chrysodium aureum var. *schmidtii* Christ; see *Acrostichum speciosum* Willd.
Chrysodium inaequale Fée.; see *Acrostichum aureum* Linné
Chrysodium speciosum Fée.; see *Acrostichum speciosum* Willd.
Chrysodium vulgare Fée.; see *Acrostichum aureum* Linné
Clerodendrum buxifolium (Willd.) Spreng.; see *Clerodendrum inerme* (L.) Gaertn.
Clerodendrum capsulare Blanco; see *Clerodendrum inerme* (L.) Gaertn.
Clerodendrum commersonii Spr. ; see *Clerodendrum inerme* (L.) Gaertn.
***Clerodendrum inerme* (L.) Gaertn. – 266**
Clerodendrum nereifolium (Roxb.) Schauerr.; see *Clerodendrum inerme* (L.) Gaertn.
Climacandra obovata Miq.; see *Ardisia elliptica* Thunberg
Climacandra salicifolia Miq.; see *Ardisia elliptica* Thunberg
Clitoria rotundifolia (Vahl.) Sessé & Moc.; see *Canavalia maritima* Thouars
Cocculus populifolius Dc.; see *Anamirta cocculus* L. Wight & Arn.
Cocos nypa Lour.; see *Nypa fruticans* Wurmbr.
Collyris minor Vahl.; see *Dischidia nummularia* R.Br.
Colocasia acris (R.Br.) Schott.; see *Colocasia esculenta* (L.) Schott
Colocasia antiquorum Schott. & Endl.; see *Colocasia esculenta* (L.) Schott
***Colocasia esculenta* (L.) Schott – 58**
Colocasia euchlora K. Koch & Linden; see *Colocasia esculenta* (L.) Schott
Colocasia fontanesii Schott.; see *Colocasia esculenta* (L.) Schott
Colocasia himalensis Royle; see *Colocasia esculenta* (L.) Schott
Colocasia nymphaeifolia (Vent.) Kunth; see *Colocasia esculenta* (L.) Schott
Colocasia peregrina Raf.; see *Colocasia esculenta* (L.) Schott
Colocasia vulgaris Raf.; see *Colocasia esculenta* (L.) Schott
Combretopsis pentaptera K. Sch.; see *Lophopyxis maingayi* Hook.f.
Combretum acuminatum (non Roxb.) K. Schum. & Holrr.; see *Combretum tetralophum* Clarke
Combretum neurophyllum (non Miq.) Backer; see *Combretum tetralophum* Clarke
Combretum lucidum Blume; see *Combretum trifoliatum* Vent.
Combretum tetragonocarpum (non Kurz.) Koord.; see *Combretum tetralophum* Clarke
***Combretum tetralophum* Clarke – 111**
***Combretum trifoliatum* Vent. – 112**
Commia cochinchinensis Lour.; see *Excoecaria agallocha* L.
Comocladia serrata Blanco; see *Salacia chinensis* L.
Convolvulus bilobatus Roxb.; see *Ipomoea pes-capre* (L.) Sweet.
Convolvulus brasiliensis Linné; see *Ipomoea pes-capre* (L.) Sweet.
Convolvulus catharticus Blanco; see *Ipomoea tuba* Schlechtend.
Convolvulus denticulatus Desr.; see *Ipomoea gracilis* R. Br.
Convolvulus grandiflorus Jacq.; see *Ipomoea tuba* Schlechtend.
Convolvulus marinus Rumph.; see *Ipomoea pes-capre* (L.) Sweet.
Convolvulus maritima; see *Ipomoea pes-capre* (L.) Sweet.

Convolvulus maritimus Desr.; see *Ipomoea pes-capre* (L.) Sweet.

Convolvulus maximus L.; see *Ipomoea maxima* (L.f.) Don ex Sweet

Convolvulus pes-caprae Linné; see *Ipomoea pes-capre* (L.) Sweet.

Convolvulus tuba L.; see *Ipomoea tuba* Schlechtend.

Cordia banalo Blanco; see *Cordia subcordata* Lam.

Cordia blancoi Vid.; see *Cordia dichotoma* G. Forst.

***Cordia cochinchinensis* Gagnep. – 159**

***Cordia dichotoma* G. Forst. – 160**

Cordia griffithii C.B. Clarke ; see *Cordia dichotoma* G. Forst.

Cordia moluccana Roxb.; see *Cordia subcordata* Lam.

Cordia myxa auct. non. L. ; see *Cordia dichotoma* G. Forst.

Cordia obliqua auct. non. Willd. ; see *Cordia dichotoma* G. Forst.

Cordia premnifolia Ridl.; see *Cordia cochinchinensis* Gagnep.

Cordia rumphii Blume; see *Cordia subcordata* Lam.

Cordia suaveolens Bl. ; see *Cordia dichotoma* G. Forst.

Cordia suaveolens Vidal ; see *Cordia dichotoma* G. Forst.

***Cordia subcordata* Lam. – 161**

Cordia subdentata Miq. ; see *Cordia dichotoma* G. Forst.

***Corypha saribus* Lour. – 133**

Crinum amabile Donn.; see *Crinum asiaticum* L.

***Crinum asiaticum* L. – 57**

Crinum cortifolium Hallier; see *Crinum asiaticum* L.

Crinum defixum auct. non. Ker-Gawl.; see *Crinum asiaticum* L.

Crinum firmifolium var. *hygrophilum*; see *Crinum asiaticum* L.

Crinum giganteum auct. non. Andr. Blanco; see *Crinum asiaticum* L.

Crinum macrantherum Engler; see *Crinum asiaticum* L.

Crinum macrophyllum Hallier; see *Crinum asiaticum* L.

Crinum northianum Baker; see *Crinum asiaticum* L.

Crinum pedunculatum R.Br.; see *Crinum asiaticum* L.

Crinum rumphii Merr.; see *Crinum asiaticum* L.

Crinum sumatranum Roxb.; see *Crinum asiaticum* L.

Crinum toxicarium; see *Crinum asiaticum* L.

Crithmus indicus Rumph.; see *Sesuvium portulacastrum* (L.) L.

Croton ardisioides Hook. f. ; see *Croton heterocarpus* Müll. Arg.

***Croton heterocarpus* Müll. Arg. – 174**

Croton heteropetalum (Sphalm.) Ridl.; see *Croton heterocarpus* Müll. Arg.

***Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott – 59**

Cryptocoryne ciliata var. *latifolia* (Roxb.) Rataj; see *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott

***Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu – 7**

Ctenopteris moultoni (Copel.) Holtt.; see *Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu

Cumingia philippinensis Vidal; see *Camptostemon philippinense* (Vidal) Becc.

Cupania erythrorhachis Miq.; see *Mischocarpus sundaicus* Blume

Cupania lessertiana Cambess.; see *Mischocarpus sundaicus* Blume

Cupania mischocarpus Steud.; see *Mischocarpus sundaicus* Blume

Cupania revoluta Turcz. ; see *Mischocarpus sundaicus* Blume

Cupania spinosa Blanco.; see *Maytenus emarginata* (Willd.) Ding Hou

Cycas celebica Miq.; see *Cycas rumphii* Miq.

Cycas circinalis L.; see *Cycas rumphii* Miq.

Cycas corsoniana D. Don.; see *Cycas rumphii* Miq.

Cycas recurvata Blume ex J. Schuster; see *Cycas rumphii* Miq.

***Cycas rumphii* Miq. – 138**

Cycas sundaica Miq. ex J. Schuster; see *Cycas rumphii* Miq.

Cyclandrophora elata (King.) Kosterm.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Cyclandrophora glaberrimima Hassk.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Cyclandrophora scabra (Hassk.) Kosterm.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Cyclophorus acrostichoides (G. Forst.) Presl.; see *Pyrrosia longifolia* (Burm.) Morton.

Cyclophorus cinnamomeus; see *Pyrrosia longifolia* (Burm.) Morton.

Cyclophorus longifolius Desv.; see *Pyrrosia longifolia* (Burm.) Morton.

Cymbidium aloifolium (L.) Sw.; see *Cymbidium finlaysonianum* Wall ex Lindl.

***Cymbidium finlaysonianum* Wall ex Lindl. – 92**

Cymbidium iridifolium Roxb.; see *Oberonia iridifolia* Lindl.

Cymbidium iridifolium Sw. ex Steud.; see *Oberonia iridifolia* Lindl.

Cymbidium moschatum Willd.; see *Dendrobium moschatum* (Buch.-Ham.) Sw.

Cymbidium pendulum (Roxb.) Sw. sensu latu; see *Cymbidium finlaysonianum* Wall ex Lindl.

Cymbidium pendulum var. *brevilabre* Lindl.; see *Cymbidium finlaysonianum* Wall ex Lindl.

Cymbidium tricolor Miq.; see *Cymbidium finlaysonianum* Wall ex Lindl.

Cyminosma pedunculata DC.; see *Acronychia pedunculata* (L.) Miq.

Cynanchum carnosum Domin.; see *Oxystelma carnosum* R. Br.

Cynanchum carnosum Merr. & Rolfe; see *Oxystelma carnosum* R. Br.

Cynanchum carnosum (R.Br.) Schltr.; see *Oxystelma carnosum* R. Br.

Cynodon arcuatus J.S. Presl. ex C.B. Presl.; see *Cynodon dactylon* (L.) Pers.

***Cynodon dactylon* (L.) Pers. – 42**

Cynodon dactylon var. *glabratus* (Steud.) Chiov.; see *Cynodon dactylon* (L.) Pers.

Cynodon glabratus Steud.; see *Cynodon dactylon* (L.) Pers.

Cynodon parviglumus Ohwi; see *Cynodon dactylon* (L.) Pers.

Cynodon polevansii Stent.; see *Cynodon dactylon* (L.) Pers.

Cynometra bijuga Span. ex Miq.; see *Cynometra ramiflora* L.

Cynometra bijuga var. *mimosoides* Merr.; see *Cynometra iripa* Kostel.

***Cynometra iripa* Kostel. – 192**

Cynometra polyandra auct. non Roxb.; see *Cynometra ramiflora* L.

***Cynometra ramiflora* L. – 193**

Cynometra ramiflora var. *Wight & Arn.*; see *Cynometra iripa* Kostel.

Cynometra ramiflora var. *mimosoides* Baker; see *Cynometra iripa* Kostel.

Cynometra schumanniana Harms.; see *Cynometra ramiflora* L.

Cynometra whitfordii Elmer; see *Cynometra ramiflora* L.

Cynomorium silvestre; see *Cynometra ramiflora* L.

Cyperus anomalus Steud.; see *Cyperus javanicus* Houtt.

Cyperus bulboso-stoloniferus Steud.; see *Cyperus stoloniferus* Retz.

Cyperus bulbosus (non Vahl.) Camus.; see *Cyperus stoloniferus* Retz.

Cyperus canescens Vahl.; see *Cyperus javanicus* Houtt.

***Cyperus compactus* Retz. – 25**

Cyperus corymbosus Rottb. var. *scariosus* Kük.; see *Cyperus scariosus* R.Br.

Cyperus difformis (non L.) Blanco; see *Scirpus grossus* Linné

Cyperus dilutus Vahl.; see *Cyperus compactus* Retz.

Cyperus diphyllus (Retz) Valck.; see *Cyperus scariosus* R.Br.

Cyperus dulcis Rumph.; see *Eleocharis dulcis* (Burm. f.) Henschel

Cyperus firmus Presl.; see *Cyperus javanicus* Houtt.

Cyperus grabowskianus Bolck.; see *Cyperus compactus* Retz.

Cyperus holciflorus Presl.; see *Cyperus javanicus* Houtt.

***Cyperus javanicus* Houtt. – 26**

Cyperus lamprocarpus Nees; see *Cyperus stoloniferus* Retz.

Cyperus litoralis R.Br.; see *Cyperus stoloniferus* Retz.

Cyperus luzonensis Llanos; see *Cyperus compactus* Retz.

***Cyperus malaccensis* Lamk. – 27**

Cyperus mayeri Kük.; see *Cyperus stoloniferus* Retz.

Cyperus parviflorus Vahl.; see *Cyperus javanicus* Hoult.

Cyperus pennatus Lamk.; see *Cyperus javanicus* Hoult.

Cyperus rotundus (non L.) Benth.; see *Cyperus stoloniferus* Retz.

Cyperus rotundus L. var. *pallidus* Benth.; see *Cyperus scariosus* R.Br.

***Cyperus scariosus* R.Br. – 28**

Cyperus septatus Steud.; see *Cyperus compactus* Retz.

Cyperus spaniophyllus Steud.; see *Cyperus malaccensis* Lamk.

Cyperus stigmatus Steud.; see *Cyperus javanicus* Hoult.

***Cyperus stoloniferus* Retz. – 29**

Cyperus stuppeus Forst.; see *Cyperus javanicus* Hoult.

Cyperus tegetiformis (non Roxb.) Benth.; see *Cyperus malaccensis* Lamk.

Cyperus tegetum (non Roxb.) Ridl.; see *Cyperus malaccensis* Lamk.

Cyperus tuberosus (non Rottb.) Kunth.; see *Cyperus stoloniferus* Retz.

Cytisus pinnatus Linn.; see *Pongamia pinnata* (L.) Pierre

Daemonorops erinaceus; see *Calamus erinaceus* (Becc.) Dransfield

Daemonorops leptopus; see *Calamus erinaceus* (Becc.) Dransfield

Dalbergia arborea Willd.; see *Pongamia pinnata* (L.) Pierre

***Dalbergia candenatensis* (Dennst.) Prain – 119**

Dalbergia heterophylla, *Robinia uliginosa* Willd.; see *Derris trifoliata* Lour.

***Dalbergia menoeides* Prain. – 120**

Dalbergia monosperma Dalzell; see *Dalbergia candenatensis* (Dennst.) Prain

Dalbergia pinnata (Lour.) Prain.; see *Derris pinnata* (Lour.) Prain

Dalbergia tamarindifolia Roxb.; see *Derris pinnata* (Lour.) Prain

Dalbergia torta Graham; see *Dalbergia candenatensis* (Dennst.) Prain

Davallia angustata Wall.; see *Pachypleuria angustata* (Wall. ex Hook. & Grev.) J. Sm.

Davallia divaricata Blume

Davalia mucronata Bl.; see *Davallia divaricata* Blume

Davallia parvula Wall.; see *Davallia parvula* Wall. ex Hook. & Grev.

***Davallia parvula* Wall. ex Hook. & Grev. – 4**

Davalia polyantha Hook; see *Davallia divaricata* Blume

Deguelia negrensis (Benth.) Taub.; see *Derris scandens* (Aubl.) Pittier

Deguelia scandens Aubl.; see *Derris scandens* (Aubl.) Pittier

Deguelia uliginosa (Willd.) Baill.; see *Derris trifoliata* Lour.

***Dendrobium aloefolium* (Bl.) Rchb.f. – 93**

Dendrobium aloifolium; see *Dendrobium aloefolium* (Bl.) Rchb.f.

Dendrobium baseyanum St. Cloud; see *Dockrillia teretifolia* (R.Br.) Brieger

Dendrobium borneense Finet.; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Dendrobium calamiforme Lodd. ex Lindley; see *Dockrillia teretifolia* (R.Br.) Brieger

Dendrobium carnosum Teijsm. et Binn.; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

***Dendrobium moschatum* (Buch.-Ham.) Sw. – 94**

***Dendrobium pachyphyllum* (O.K.) Bakh. f. – 95**

Dendrobium perpusillum Balakaristan; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Dendrobium pisibulbum Guillaumin; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Dendrobium pumila Roxb.; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Dendrobium pusillum (Bl.) Lindl.; see *Dendrobium pachyphyllum* (O.K.) Bakh. f.

Dendrobium serra; see *Dendrobium aloefolium* (Bl.) Rchb.f.

Dendrobium subulatum* (Bl.) Lindl. – 96Dendrobium teretifolium* R. Br.; see *Dockrillia teretifolia* (R.Br.) Brieger*Dendrobium teretifolium forma aureum* (F.M. Bailey) Clemesha; see *Dockrillia teretifolia* (R.Br.) Brieger*Dendrobium teretifolium var. aureum* F.M. Bailey; see *Dockrillia teretifolia* (R.Br.) Brieger*Dendrobium teretifolium var. fasciculata* Rupp.; see *Dockrillia teretifolia* (R.Br.) Brieger*Dendrophthoe farinosus* Mart.; see *Dendrophthoe pentandra* (L.) Miq.*Dendrophthoe leucobotrya* Miq.; see *Dendrophthoe pentandra* (L.) Miq.***Dendrophthoe pentandra* (L.) Miq. – 86***Dendrophthoe venosus* Mart.; see *Dendrophthoe pentandra* (L.) Miq.*Derris guianensis* Benth.; see *Derris scandens* (Aubl.) Pittier*Derris heptaphylla* (L.) Merr.; see *Aganope heptaphylla* (L.) Polhill*Derris heterophylla* (Willd.) Backer; see *Derris trifoliata* Lour.*Derris indica* (Lam.) Bennet.; see *Pongamia pinnata* (L.) Pierre*Derris macroloba*; see *Aganope heptaphylla* (L.) Polhill*Derris negrensis* Benth.; see *Derris scandens* (Aubl.) Pittier***Derris pinnata* (Lour.) Prain – 194***Derris pinnata* Lour.; see *Derris pinnata* (Lour.) Prain*Derris pterocarpus* (DC.) Killip.; see *Derris scandens* (Aubl.) Pittier***Derris scandens* (Aubl.) Pittier – 121***Derris scandens* Benth. J. Linn.; see *Derris scandens* (Aubl.) Pittier*Derris scandens* (Roxb.) Benth.; see *Derris scandens* (Aubl.) Pittier*Derris sinuata* Thwaites; see *Aganope heptaphylla* (L.) Polhill***Derris trifoliata* Lour. – 122***Deguelia trifoliata* (Lour.) Taub.; see *Derris trifoliata* Lour.*Derris uliginosa* Willd. Benth.; see *Derris trifoliata* Lour.*Dialycarpa beccarii* Mast.; see *Brownlowia tersa* (L.) Kosterm.*Dicerolepis paludosa* Blume; see *Gymnanthera oblonga* (Burm. f) P.S. Green*Didymoglossum affine* v.d.B.; see *Hymenophyllum holochilum* (Bosch) C. Chr.*Didymoglossum holochilum* Bosch; see *Hymenophyllum holochilum* (Bosch) C. Chr.*Dinebra verticillata* Wight ex Steud.; see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.*Diospyros abyssinica* (Hiern.) F.White; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros embryopteris* Pers.; see *Diospyros malabarica* (Descr.) Kostel.*Diospyros embryopteris var. siamensis* (Hochr.) Phengklai; see *Diospyros malabarica* (Descr.) Kostel.***Diospyros ferrea* (Willd.) Bakh. – 170***Diospyros ferrea var. buxifolia* (Rottb.) Bakh.; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros ferrea var. guineensis* (Schumach. & Tonn.) Bakh.; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros ferrea var. littorea*; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros ferrea var. madagascarensis* (A.DC.) Bakh.; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros ferrea var. reticulata*; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros glutinosa* Koenig. & Roxb.; see *Diospyros malabarica* (Descr.) Kostel.*Diospyros kusanoi* Hayata; see *Diospyros maritima* Blume*Diospyros littorea* (R.Br.) Kostermans; see *Diospyros ferrea* (Willd.) Bakh.*Diospyros liukuensis* Makino; see *Diospyros maritima* Blume***Diospyros malabarica* (Descr.) Kostel. – 171***Diospyros malabarica var. malabarica*; see *Diospyros malabarica* (Descr.) Kostel.***Diospyros maritima* Blume – 172***Diospyros maritima var. transita* (Bakh.) Kosterm.; see *Diospyros maritima* Blume*Diospyros melanoxylon* Hassk.; see *Diospyros malabarica* (Descr.) Kostel.*Diospyros peregrina f. javanica* (Gaert.) Guerke.; see *Diospyros malabarica* (Descr.) Kostel.*Diospyros peregrina* Guerke.; see *Diospyros malabarica* (Descr.) Kostel.

Diospyros siamensis Hochr.; see *Diospyros malabarica* (Descr.) Kostel.

Diospyros siamensis Ridl.; see *Diospyros malabarica* (Descr.) Kostel.

Diphyes ovalifolia Blume; see *Bulbophyllum xylocarpi* J.J.Smith

***Diplachne fusca* (L.) Beauv. – 43**

Diplachne polystachya; see *Diplachne fusca* (L.) Beauv.

***Dischidia benghalensis* Colebr. – 78**

Dischidia benghalensis var. *cuneifolia* (Wall.) Kuntze; see *Dischidia benghalensis* Colebr.

Dischidia benghalensis var. *spathulata* (Blume) Kuntze; see *Dischidia benghalensis* Colebr.

Dischidia cuneifolia Wall.; see *Dischidia benghalensis* Colebr.

Dischidia gaudichaudii Decne.; see *Dischidia nummularia* R.Br.

Dischidia minor (Vahl.) Merr.; see *Dischidia nummularia* R.Br.

***Dischidia nummularia* R.Br. – 79**

Dischidia orbicularis Decne.; see *Dischidia nummularia* R.Br.

***Dischidia rafflesiana* Wall. – 80**

Dischidia spathulata (Bl.); see *Dischidia benghalensis* Colebr.

Dockrillia calamiforme (Lodd. ex Lindl.) M.A. Clem. & D.L. Jones; see *Dockrillia teretifolia* (R.Br.)

Brieger

***Dockrillia teretifolia* (R.Br.) Brieger – 97**

Dolichandrone longissima K. Sch.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Dolichandrone rheedii Seem; see *Dolichandrone spathacea* (l.f.) K.Schum.

***Dolichandrone spathacea* (l.f.) K.Schum. – 156**

Dolichos emarginata Jacq.; see *Canavalia maritima* Thouars

Dolichos gigantea Willd.; see *Mucuna gigantea* (Willd.) DC.

Dolichos giganteus Willd.; see *Mucuna gigantea* (Willd.) DC.

Dolichos littoralis Vahl.; see *Canavalia maritima* Thouars

Dolichos maritimus Aubl.; see *Canavalia maritima* Thouars

Dolichos miniatus Kunth.; see *Canavalia maritima* Thouars

Dolichos obcordatus Roxb.; see *Canavalia maritima* Thouars

Dolichos obovatus Schumach. & Thonn.; see *Canavalia maritima* Thouars

Dolichis obtusifolius Lam.; see *Canavalia maritima* Thouars

Dolichos rosea Sw.; see *Canavalia maritima* Thouars

Dolichos rotundifolia Vahl.; see *Canavalia maritima* Thouars

Dondia maritima (L.) Druce; see *Suaeda maritima* (L.) Dum.

Dracontium spinosum L.; see *Lasia spinosa* (L.) Thwaites.

Drymoglossum heterophyllum C. Chr.; see *Drymoglossum piloselloides* (Linn.) Presl.

***Drymoglossum piloselloides* (Linn.) Presl. – 12**

Drynaria linnaei Bory.; see *Drynaria sparsisora* (Desv.) Moore

***Drynaria rigidula* (Sw.) Bedd. – 13**

***Drynaria sparsisora* (Desv.) Moore – 14**

Dryostachyum speciosum Kuhn; see *Photinopteris speciosa* (Bl.) Persl.

Duraljouvea diluta Palla; see *Cyperus compactus* Retz.

Duvaljouvea pennata Palla.; see *Cyperus javanicus* Houtt.

Dysosmia foetida (L.) M. Roem; see *Passiflora foetida* L.

Ebenus buxifolius (Rottb.) Kuntze; see *Diospyros ferrea* (Willd.) Bakh.

Ebenus parvifolius Rumphius; see *Diospyros ferrea* (Willd.) Bakh.

Ehretia ferrea Willd.; see *Diospyros ferrea* (Willd.) Bakh.

Elaeodendron horizontale Turcz.; see *Maytenus emarginata* (Willd.) Ding Hou

Elaeodendron subrotundum King.; see *Cassine viburnifolia* (Juss.) Ding Hou

Elaeodendron viburnifolium Merr.; see *Cassine viburnifolia* (Juss.) Ding Hou

***Elaphoglossum amblyphyllum* C.R. Bell. – 9**

Elaphoglossum decurrens Moore; see *Elaphoglossum amblyphyllum* C.R. Bell.

Elaphoglossum obtusifolium Bell.; see *Elaphoglossum amblyphyllum* C.R. Bell.

Elateriospermum paucinervia; see *Blumeodendron tokbrai* (Bl.) Kurz.

Elateriospermum tokbrai Bl.; see *Blumeodendron tokbrai* (Bl.) Kurz.

Elcana seminuda Blanco; see *Cerbera manghas* L.

***Eleocharis dulcis* (Burm. f.) Henschel – 30**

Eleocharis dulcis Trin.; see *Eleocharis dulcis* (Burm. f.) Henschel

Eleocharis equisetina Presl.; see *Eleocharis dulcis* (Burm. f.) Henschel

Eleocharis indica Druce; see *Eleocharis dulcis* (Burm. f.) Henschel

***Eleocharis parvula* (R. & S.) Link ex Bluff – 31**

Eleocharis plantaginea; see *Eleocharis dulcis* (Burm. f.) Henschel

Eleocharis plantaginoides Domin.; see *Eleocharis dulcis* (Burm. f.) Henschel

***Eleocharis spiralis* (Rottb.) R. & S. – 32**

Eleocharis tuberosa R & S Mant.; see *Eleocharis dulcis* (Burm. f.) Henschel

Eleocharis variegata (non Presl., nec Kunth.) Merr.; see *Eleocharis spiralis* (Rottb.) R. & S.

Elytranthe ampullacea G. Don.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Elytranthe cochinchinensis G. Don.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Elytranthe elmeri Merr.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Elytranthe farinosa & *rigida* G. Don.; see *Dendrophthoe pentandra* (L.) Miq.

Embryogonia lucida Blume; see *Combretum trifoliatum* Vent.

Entada monostachya DC.; see *Entada phaseoloides* (L.) Merr.

***Entada phaseoloides* (L.) Merr. – 123**

Entada pursaetha DC.; see *Entada phaseoloides* (L.) Merr.

Entada rumphii Scheff.; see *Entada phaseoloides* (L.) Merr.

Entada scandens (L.) Benth.; see *Entada phaseoloides* (L.) Merr.

Eperua decandra Blanco; see *Intsia bijuga* (Colebr.) Kuntze

Epidendrum moschatum Buch.-Ham.; see *Dendrobium moschatum* (Buch.-Ham.) Sw.

Epidendrum odoratum Poir.; see *Aerides odoratum* Reinw. ex Blume

Eragrostis wightiana Benth.; see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.

Erigeron denticulatum Burm. f.; see *Pluchea indica* (L.) Less.

Erythrina corallodendrum L. var. *orientalis*; see *Erythrina orientalis* (L.) Murr.

Erythrina indica Lamk.; see *Erythrina orientalis* (L.) Murr.

Erythrina indica var. *alba* W.S. Millard & E. Blatter; see *Erythrina orientalis* (L.) Murr.

Erythrina indica var. *fastigiata* Guillaumin; see *Erythrina orientalis* (L.) Murr.

Erythrina indica var. *marmorata* (Planchon) B. & M.; see *Erythrina orientalis* (L.) Murr.

Erythrina indica var. *picta* (L.) B. & M.; see *Erythrina orientalis* (L.) Murr.

Erythrina indica Zoll.; see *Erythrina orientalis* (L.) Murr.

***Erythrina orientalis* (L.) Murr. – 195**

Erythrina variegata L.; see *Erythrina orientalis* (L.) Murr.

Erythrina variegata var. *orientalis* (L.) Merr.; see *Erythrina orientalis* (L.) Murr.

Eugenia racemosa L.; see *Barringtonia racemosa* (L.) Spreng.

Eugeniodes celastriifolius O.K.; see *Symplocos celastriifolia* Griff. ex Clarke

Euonymus cochinchinensis Merr.; see *Cassine viburnifolia* (Juss.) Ding Hou

Euonymus viburnifolius Merr.; see *Cassine viburnifolia* (Juss.) Ding Hou

Eurycoma harmandiana Pierre; see *Quassia harmandiana* (Pierre) Nootboom

***Excoecaria agallocha* L. – 175**

***Excoecaria indica* (Willd.) Muell. Arg. – 176**

Faba marina major Rumph.; see *Entada phaseoloides* (L.) Merr.

***Fagraea crenulata* Maingay ex C.B. Clarke – 180**

Fagraea fastigiata (non Bl.) Ridl.; see *Fagraea crenulata* Maingay ex C.B. Clarke

Ferolia glaberrima (Hassk.) O. Ktze.; see *Atuna racemosa* ssp. *racemosa* Rafin.
Ferolia scabra (Hassk.) O. Ktze.; see *Atuna racemosa* ssp. *racemosa* Rafin.
Ferreola guineensis Schumach. & Tonn.; see *Diospyros ferrea* (Willd.) Bakh.
Festuca fusca L.; see *Diplachne fusca* (L.) Beauv.
Feuilleea serianthes Kuntze; see *Serianthes grandiflora* Benth.
Feuilleea umbellata (Vahl.) Kuntze; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

***Ficus curtipes* Corner – 212**

***Ficus microcarpa* L.f. – 213**

Ficus obtusifolia Roxb.; see *Ficus curtipes* Corner
Ficus retusifolia H. Lév.; see *Ficus microcarpa* L.f.
Fimbristylus laevis Steud.; see *Fimbristylis cymosa* R. Br.
Fimbristylis albescens Steud.; see *Fimbristylis polytrichoides* (Retz.) R. Br.
Fimbristylis arvensis Vahl.; see *Fimbristylis sieberiana* R. Br.
Fimbristylis atollensis St. John; see *Fimbristylis cymosa* R. Br.
Fimbristylis ciliolata Steud.; see *Fimbristylis cymosa* R. Br.

***Fimbristylis cymosa* R. Br. – 33**

Fimbristylis cyrtophylla Miq.; see *Fimbristylis ferruginea* (L.) Vahl
Fimbristylis dasyphylla Miq.; see *Fimbristylis sericea* R. Br.
Fimbristylis decora Nees & Mey. ex Nees; see *Fimbristylis sericea* R. Br.

***Fimbristylis ferruginea* (L.) Vahl – 34**

Fimbristylis ferruginea (non Vahl.) Decne; see *Fimbristylis sieberiana* R. Br.
Fimbristylis ferruginea var. *foliata* Benth.; see *Fimbristylis sieberiana* R. Br.
Fimbristylis ferruginea var. *sieberiana* Boeck.; see *Fimbristylis sieberiana* R. Br.
Fimbristylis glomerata Nees ex Kunth.; see *Fimbristylis cymosa* R. Br.
Fimbristylis juncea (non R. & S.) Boeck.; see *Fimbristylis polytrichoides* (Retz.) R. Br.
Fimbristylis junciformis var. *latifolia* (non Clarke) Camus; see *Fimbristylis sericea* R. Br.
Fimbristylis longispicata (non Steud.) Camus; see *Fimbristylis ferruginea* (L.) Vahl
Fimbristylis marginata Labill.; see *Fimbristylis ferruginea* (L.) Vahl
Fimbristylis paucispicata F.v.M.; see *Fimbristylis sieberiana* R. Br.
Fimbristylis polytrichoides (non R.Br.) Ridl.; see *Fimbristylis ferruginea* (L.) Vahl

***Fimbristylis polytrichoides* (Retz.) R. Br. – 35**

Fimbristylis pycnocephala Hillebr.; see *Fimbristylis cymosa* R. Br.
Fimbristylis rigida Kunth.; see *Fimbristylis cymosa* R. Br.

***Fimbristylis sericea* R. Br. – 36**

***Fimbristylis sieberiana* R. Br. – 37**

Fimbristylis spathacea Roth.; see *Fimbristylis cymosa* R. Br.
Fimbristylis subbulbosa Boeck.; see *Fimbristylis polytrichoides* (Retz.) R. Br.
Fimbristylis trispicata Steud.; see *Fimbristylis ferruginea* (L.) Vahl
Fimbristylis tristachya R.Br.; see *Fimbristylis sieberiana* R. Br.
Fimbristylis warburgii K. Sch.; see *Fimbristylis cymosa* R. Br.
Finlaysonia maritima Backer; see *Finlaysonia obovata* Wall.

***Finlaysonia obovata* Wall. – 103**

***Flagellaria indica* L. – 113**

Flagellaria indica var. *gracilis* Backer; see *Flagellaria indica* L.
Flagellaria indica var. *minor* (Bl.) Koord.; see *Flagellaria indica* L.
Palmijuncus laevis Rumph.; see *Flagellaria indica* L.
Flagellaria minor Bl.; see *Flagellaria indica* L.
Flagellaria philippinensis Elmer; see *Flagellaria indica* L.
Fragarius niger Rumph.; see *Melastoma malabathricum* var. *malabathricum* L.
Funis convolutus Rumph.; see *Aganope heptaphylla* (L.) Polhill

Galedupa indica Lam.; see *Pongamia pinnata* (L.) Pierre
Galedupa maculata Blanco; see *Pongamia pinnata* (L.) Pierre
Galedupa pinnata Taub.; see *Pongamia pinnata* (L.) Pierre
Garcinia malabarica Desr.; see *Diospyros malabarica* (Descr.) Kostel.
Gardenia elata Ridl.; see *Gardenia tubifera* Wall.
Gardenia gummifera; see *Gardenia tubifera* Wall.
Gardenia lucida Roxb.; see *Gardenia tubifera* Wall.
Gardenia resinifera Korth.; see *Gardenia tubifera* Wall.
Gardenia speciosa (Hk.) Hk. f.; see *Gardenia tubifera* Wall.

***Gardenia tubifera* Wall. – 240**

Gela lanceolata Lour.; see *Acronychia pedunculata* (L.) Miq.
Gelala litorea Rumphius (=type)
Getonia floribunda Roxb.; see *Calycopteris floribunda* (Roxb.) Lamk
Glabraria tersa Linné; see *Brownlowia tersa* (L.) Kosterm.

***Glochidion littorale* Bl. – 177**

Glochidion littoralis; see *Glochidion littorale* Bl.
Gluta coarctata Hook.; see *Gluta velutina* Bl.

***Gluta velutina* Bl. – 140**

Gmella trifolia Lour.; see *Allophylus cobbe* (L.) Raeusch.
Goniophlebium rigidulum Moore; see *Drynaria rigidula* (Sw.) Bedd.
Grammitis heterocarpa Bl.; see *Selliguea heterocarpa* Blume
Grammitis involuta Don.; see *Loxogramma involuta* Presl.
Granadilla foetida (L.) Gaertn.; see *Passiflora foetida* L.
Granatum litoreum parvifolium Rumph.; see *Xylocarpus moluccensis* (Lamk) M. Roem.
Granatum littoreum parvifolium Rumph.; see *Xylocarpus granatum* Koen.
Granatum moluccensis (Lam.) Kuntze; see *Xylocarpus moluccensis* (Lamk) M. Roem.
Granatum obovatum (Blume) Kunz; see *Xylocarpus granatum* Koen.
Grewia meyeniana Walp.; see *Kleinhovia hospita* L..
Guarea oblongifolia Griff.; see *Xylocarpus granatum* Koen.

***Guettarda speciosa* Linn. – 241**

Guettarda vermicularis Blanco; see *Guettarda speciosa* Linn.
Guilandina bonduc L.; see *Caesalpinia bonduc* (L.) Roxb.
Guilandina bonducella L.; see *Caesalpinia crista* L.
Guilandina nuga L.; see *Caesalpinia crista* L.
Gymnanthera nitida R. Br.; see *Gymnanthera oblonga* (Burm. f) P.S. Green

***Gymnanthera oblonga* (Burm. f) P.S. Green – 104**

Gymnanthera paludosa (Bl.) K.Schum.; see *Gymnanthera oblonga* (Burm. f) P.S. Green
Gymnogramma heterocarpa Bl.; see *Selliguea heterocarpa* Blume
Gymnogramma involuta Hook.; see *Loxogramma involuta* Presl.
Gymnosporia ambigua Vidal.; see *Maytenus emarginata* (Willd.) Ding Hou
Gymnosporia emarginata Thw.; see *Maytenus emarginata* (Willd.) Ding Hou
Gymnosporia inermis Merr. & Perry.; see *Maytenus emarginata* (Willd.) Ding Hou
Gymnosporia montana Benth.; see *Maytenus emarginata* (Willd.) Ding Hou
Gymnosporia spinosa (Blanco) Merr. & Rolfe.; see *Maytenus emarginata* (Willd.) Ding Hou
Gyrosorium cinnamomeus; see *Pyrrosia longifolia* (Burm.) Morton.
Gyrosorium fissum Bak.; see *Pyrrosia longifolia* (Burm.) Morton.

Haemanthus pubescens auct. non. L. f : Blanco; see *Crinum asiaticum* L.

***Halocnemum cinereum* F.v.Muell. – 61**

Halosarcia indica (Willd.) Moq.; see *Salicornia indica* Willd.
Helicteres apetala Blanco; *Heritiera littoralis* Dryand.

Heptapleurum avene sensu King; see *Schefflera lanceolata* Ridl.

Heritiera attenuata; see *Brownlowia tersa* (L.) Kosterm.

***Heritiera fomes* Buch. Ham. – 259**

***Heritiera globosa* Kostermans – 260**

Heritiera lanceolata; see *Brownlowia tersa* (L.) Kosterm.

***Heritiera littoralis* Dryand. – 261**

Heritiera littoralis Dryand. ex W.Ait.; see *Heritiera littoralis* Dryand.

Heritiera minor Lam.; see *Heritiera littoralis* Dryand.

Hernandezia sonora (L.) Hoffman; see *Hernandia ovigera* L.

Hernandia guianensis Aubl.; see *Hernandia ovigera* L.

Hernandia javanica Tuyama; see *Hernandia ovigera* L.

Hernandia nymphaeifolia (Presl.); see *Hernandia ovigera* L.

***Hernandia ovigera* L. – 184**

Hernandia papuana C.T. White; see *Hernandia ovigera* L.

Hernandia peltata Meisn.; see *Hernandia ovigera* L.

Hernandia peltata Sessé/ & Moc.; see *Hernandia ovigera* L.

Hernandia sonora L.; see *Hernandia ovigera* L.

Heymassoli inermis Aubl. ; see *Ximenia americana* L.

Heymassoli spinosa Aubl. ; see *Ximenia americana* L.

Hibiscus abutiloides Willd.; see *Hibiscus tiliaceus* L.

Hibiscus bacciferus Forster; see *Thespesia populnea* (L.) Soland. ex Correa

Hibiscus celebicus Koord.; see *Hibiscus tiliaceus* L.

Hibiscus cuspidatus Sol. ex Park.; see *Hibiscus tiliaceus* L.

Hibiscus elatus (non Sw.) Miq.; see *Hibiscus tiliaceus* L.

Hibiscus hastatus L.; see *Hibiscus tiliaceus* L.

Hibiscus macrophyllus (Bl.) Oken; see *Thespesia populnea* (L.) Soland. ex Correa

Hibiscus populneus L.; see *Thespesia populnea* (L.) Soland. ex Correa

Hibiscus similis Blume; see *Hibiscus tiliaceus* L.

***Hibiscus tiliaceus* L. – 203**

Hibiscus tricuspidatus Sol. ex Park.; see *Hibiscus tiliaceus* L.

Hieraea reclinata Blanco; see *Tristellateia australasiae* A. Rich.

Hillia longiflora Blanco; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Hippocratea hasseltiana Miq.; see *Loeseneriella macrantha* (Korth.) A.C. Smith

Hippocratea macrantha Korth.; see *Loeseneriella macrantha* (Korth.) A.C. Smith

Hippocratea trilobulata Ridl.; see *Loeseneriella macrantha* (Korth.) A.C. Smith

Hippuris indica Lour.; see *Eleocharis dulcis* (Burm. f.) Henschel

Hiraea obscura Blume; see *Ryssopterys timoriensis* (DC.) Jussieu

Hiraea ovata Blume; see *Ryssopterys timoriensis* (DC.) Jussieu

Homalium gilgianum Laut.; see *Lophopyxis maingayi* Hook.f.

Horsfieldia acuminata Merr.; see *Horsfieldia irya* (Gaertn.) Warb.

Horsfieldia amklaal Kaneh.; see *Horsfieldia irya* (Gaertn.) Warb.

Horsfieldia congestiflora A.C. Sm.; see *Horsfieldia irya* (Gaertn.) Warb.

***Horsfieldia irya* (Gaertn.) Warb. – 215**

Horsfieldia labillardieri Warb.; see *Horsfieldia irya* (Gaertn.) Warb.

Horsfieldia lemanniana (A.DC.) Warb.; see *Horsfieldia irya* (Gaertn.) Warb.

Horsfieldia nunu Kaneh.; see *Horsfieldia irya* (Gaertn.) Warb.

Horsfieldia subglobosa (Miq.) Warb.; see *Horsfieldia irya* (Gaertn.) Warb.

Hoya hookeriana Wight; see *Hoya parasitica* (Roxb.) Wall. ex Wight

***Hoya parasitica* (Roxb.) Wall. ex Wight – 81**

Humata angustata (Wall.) J.Sm.; see *Pachypleuria angustata* (Wall. ex Hook. & Grev.) J. Sm.

Humata angustata (Wall. ex Hook. & Grev.) J.Sm.; see *Pachypleuria angustata* (Wall. ex Hook. & Grev.) J. Sm.

Humata parvula (Wall.) Mett.; see *Davallia parvula* Wall. ex Hook. & Grev.

Huperzia carinata (Desv. ex Poir.) Trevis.; see *Lycopodium carinatum* Desv.

Hydnophytum amboinense Becc.; see *Hydnophytum formicarum* Jack

***Hydnophytum formicarum* Jack – 101**

Hymenochaeta lacustris (L.) Nakai; see *Scirpus lacustris* L.

***Hymenophyllum holochilum* (Bosch) C. Chr. – 8**

Hymenophyllum smithii Hook; see *Hymenophyllum holochilum* (Bosch) C. Chr.

Hypserpa latifolia; see *Hypserpa polyandra* Becc.

Hypserpa monilifera; see *Hypserpa polyandra* Becc.

***Hypserpa polyandra* Becc. – 129**

Hypserpa raapii; see *Hypserpa polyandra* Becc.

Hypserpa selebica; see *Hypserpa polyandra* Becc.

Ichthyoctonos litorea Rumph.; see *Excoecaria indica* (Willd.) Muell. Arg.

***Ilex cymosa* Blume – 144**

***Ilex maingayi* Hook f. – 145**

Ilex singaporeana Wall.; see *Ilex cymosa* Blume

Inga corcondiana DC.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Inga pterocarpa DC.; see *Peltophorum pterocarpum* (DC.) K. Heyne

Inga umbellata (Vahl.) Willd.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Inocarpus edulis J.R. & G. Forst.; see *Inocarpus fagifer* (Parkinson) Fosb.

***Inocarpus fagifer* (Parkinson) Fosb. – 196**

Inocarpus fagiferus; see *Inocarpus fagifer* (Parkinson) Fosb.

Inodaphnis lanceolata Miq.; see *Inocarpus fagifer* (Parkinson) Fosb.

Intsia amboinensis Thouars.; see *Intsia bijuga* (Colebr.) Kuntze

***Intsia bijuga* (Colebr.) Kuntze – 197**

Intsia madagascariensis Thouars ex DC; see *Intsia bijuga* (Colebr.) Kuntze

Intsia retusa Colebr.; see *Intsia bijuga* (Colebr.) Kuntze

Ipomoea alba L.; see *Ipomoea tuba* Schlechtend.

Ipomoea biloba Forsk.; see *Ipomoea pes-capre* (L.) Sweet.

Ipomoea denticulata Choisy; see *Ipomoea gracilis* R. Br.

***Ipomoea gracilis* R. Br. – 64**

Ipomoea grandiflora Hallier f.; see *Ipomoea tuba* Schlechtend.

Ipomoea macrantha Roem. & Schult.; see *Ipomoea tuba* Schlechtend.

Ipomoea maritima R.Br.; see *Ipomoea pes-capre* (L.) Sweet.

***Ipomoea maxima* (L.f.) Don ex Sweet – 65**

Ipomoea littoralis Bl.; see *Ipomoea gracilis* R. Br.

Ipomoea pes-caprae Roth.; see *Ipomoea pes-capre* (L.) Sweet.

***Ipomoea pes-capre* (L.) Sweet. – 66**

Ipomoea sepiaria Koen. ex Roxb.; see *Ipomoea maxima* (L.f.) Don ex Sweet

Ipomoea subtrilobans Miq.; see *Ipomoea maxima* (L.f.) Don ex Sweet

***Ipomoea tuba* Schlechtend. – 67**

Ipomoea verrucosa Bl.; see *Ipomoea maxima* (L.f.) Don ex Sweet

Ipomoea violacea L.; see *Ipomoea tuba* Schlechtend.

Iridorchis iridifolia (Lindl.) Kuntze; see *Oberonia iridifolia* Lindl.

Iriha cymosa O.K.; see *Fimbristylis cymosa* R. Br.

Iriha ferruginea O.K.; see *Fimbristylis ferruginea* (L.) Vahl

Iriha glomerata Nees; see *Fimbristylis cymosa* R. Br.

Iriha polytrichoides O.K.; see *Fimbristylis polytrichoides* (Retz.) R. Br.

Iriha sericea O.K.; see *Fimbristylis sericea* R. Br.

Ichnostemma carnosum (Schltr.) Merr. & Rolfe; see *Oxystelma carnosum* R. Br.

Isolepis haenkei Presl.; see *Fimbristylis cymosa* R. Br.

Isoloma lanuginosa Sm.; see *Nephrolepis acutifolia* (Desv.) H. Christ.

Ixora manila Blanco; see *Scyphiphora hydrophyllacea* Gaertn. f.

***Ixora timorensis* Decne - 242**

Jambolifera pedunculata L.; see *Acronychia pedunculata* (L.) Miq.

Jasminum litoreaum Rumph.; see *Clerodendrum inerme* (L.) Gaertn.

Jasminum oblongum Burm.; see *Gymnanthera oblonga* (Burm. f) P.S. Green

Kambala apetala Rafin.; see *Sonneratia apetala* Buch.-Ham.

***Kandelia candel* (L.) Druce - 236**

Kandelia rheedei W. & A.; see *Kandelia candel* (L.) Druce

Kanilia caryophylloides Bl.; see *Bruguiera cylindrica* (L.) Bl.

Kanilia parviflora Bl.; see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.

Kerinozoma cheribon Steud.; see *Xerochloa imberbis* R. Br.

Kerinozoma collina Zoll.; see *Xerochloa imberbis* R. Br.

Kerinozoma littoralis Zoll.; see *Xerochloa imberbis* R. Br.

Kerinozoma suraboja Steud.; see *Xerochloa imberbis* R. Br.

***Kleinhovia hospita* L. - 262**

Kleinhovia serrata Blanco; see *Kleinhovia hospita* L.

Lagondium vulgare Rumph.; see *Vitex ovata* Thunb.

Laguncularia purpurea Gaud.; see *Lumnitzera littorea* (Jack) Voigt.

Languncularia rosea Gaud.; see *Lumnitzera racemosa* Willd.

Lasia aculeata Lour.; see *Lasia spinosa* (L.) Thwaites.

Lasia crassifolia Engl.; see *Lasia spinosa* (L.) Thwaites.

Lasia descisens Schott.; see *Lasia spinosa* (L.) Thwaites.

Lasia heterophylla Schott.; see *Lasia spinosa* (L.) Thwaites.

Lasia roxburgii Griff.; see *Lasia spinosa* (L.) Thwaites.

***Lasia spinosa* (L.) Thwaites. - 60**

Lasia zollingeri Schott.; see *Lasia spinosa* (L.) Thwaites.

Lasiosstoma auct. non Schreber *Myrmecodia echinata*; see *Myrmecodia tuberosa* DC.

Lecanopteris sinuosa Copel.; see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito

Lens phaseoloides L.; see *Entada phaseoloides* (L.) Merr.

***Leptochloa neesii* (Thw.) Bth. - 44**

Leptochloa panicea (Retz.) Ohwi; see *Leptochloa neesii* (Thw.) Bth.

Leptochloa polystachya Retz.; see *Leptochloa neesii* (Thw.) Bth.

Leptochloa wightiana Nees ex Steud.; see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.

Leptocionium affine v.d. B.; see *Hymenophyllum holochilum* (Bosch) C. Chr.

Leptocionium holochilum (Bosch) Bosch; see *Hymenophyllum holochilum* (Bosch) C. Chr.

Lerchena maritima (L.) Kuntze.; see *Suaeda maritima* (L.) Dum.

Leucostegia parvula J. Sm.; see *Davallia parvula* Wall. ex Hook. & Grev.

Licuala horrida; see *Licuala spinosa* Wurmmb.

Licuala spinosa Poir.; see *Licuala spinosa* Wurmmb.

Licuala spinosa Thunb.; see *Licuala spinosa* Wurmmb.

Licuala spinosa var. *cochinchinensis* Becc.; see *Licuala spinosa* Wurmmb.

***Licuala spinosa* Wurmmb. - 134**

Lignum equinum Rumph.; see *Dolichandrone spathacea* (L.f.) K.Schum.

Limacia monilifera; see *Hypserpa polyandra* Becc.

Lindsaya acutifolia Desv.; see *Nephrolepis acutifolia* (Desv.) H. Christ.

Lindsaya lanuginosa Wall. ex Hook.; see *Nephrolepis acutifolia* (Desv.) H. Christ.

Litsea tersa; see *Brownlowia tersa* (L.) Kosterm.

Livistona cochinchinensis; see *Corypha saribus* Lour.

Livistona saribus (Lour.) Merr. ex Chev.; see *Corypha saribus* Lour.

Lobelia frutescens Mill.; see *Scaevola taccada* (Gaertn.) Roxb.

Lobelia plumieri (non L.) Burm.; see *Scaevola taccada* (Gaertn.) Roxb.

Lobelia taccada Gaertn.; see *Scaevola taccada* (Gaertn.) Roxb.

Locandia glandulifera Pierre; see *Quassia indica* (Gaertn.) Nootboom

Locandia harmandii Pierre; see *Quassia harmandiana* (Pierre) Nootboom

Locandia indica O.K.; see *Quassia indica* (Gaertn.) Nootboom

Locandia madagascariensis O.K.; see *Quassia indica* (Gaertn.) Nootboom

Locandia mekongensis Pierre; see *Quassia indica* (Gaertn.) Nootboom

Locandia merguensis Pierre; see *Quassia indica* (Gaertn.) Nootboom

Locandia pendula Pierre; see *Quassia indica* (Gaertn.) Nootboom

***Loeseneriella macrantha* (Korth.) A.C. Smith - 109**

Lomaria mollis Zoll; see *Photinopteris speciosa* (Bl.) Persl.

Lomaria scandens (Sw.) Willd.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Lomaria speciosa Bl.; see *Photinopteris speciosa* (Bl.) Persl.

Lomariopsis palustris (Burm.f.) Kuhn.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Lomariopsis scandens (Sw.) Mett.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Lonchitis volubilis Rumph.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Lonchocarpa pterocarpus DC.; see *Derris scandens* (Aubl.) Pittier

Lonchocarpa scandens (Aubl.) Ducke.; see *Derris scandens* (Aubl.) Pittier

Lophopyxis combretocarpa (Boerl.) Engl.; see *Lophopyxis maingayi* Hook.f.

***Lophopyxis maingayi* Hook.f. - 125**

Lophopyxis pentaptera (K. Sch.) Engl.; see *Lophopyxis maingayi* Hook.f.

Lophopyxis schumannii Boerl.; see *Lophopyxis maingayi* Hook.f.

Loranthus ampullaceus Roxb.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus carinatus D.C.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus cochinchinensis Lour.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus crassus Hook. f.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus cycnei-sinus; see *Amyema mackayense* (Blakely) Danser

Loranthus farinaceous Griff.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus flavus Bl.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus globosus Roxb.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus mackayensis Blakely; see *Amyema mackayense* (Blakely) Danser

Loranthus obovatus Schröt. & Back.; see *Amyema gravis* Danser

Loranthus oleoides D.C.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus pallens D.C.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus patulus Jack.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus pentandrus L.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus shawianus Elm.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus sphaeocarpus Bl.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus sphaerocephalus Wurtth.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus subglobosus D.C.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus subumbellatus Bl.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus tribracteatus Ridl.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus venosus Bl.; see *Dendrophthoe pentandra* (L.) Miq.

Loranthus viridiflorus Wall.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Loranthus zimmermanni Warb.; see *Dendrophthoe pentandra* (L.) Miq.

***Loxogramma involuta* Presl. - 15**

Lumnitzera coccinea W. & A.; see *Lumnitzera littorea* (Jack) Voigt.

***Lumnitzera littorea* (Jack) Voigt. – 167**

Lumnitzera purpurea Presl.; see *Lumnitzera littorea* (Jack) Voigt.

Lumnitzera racemosa var. *lutea* Gaud.; see *Lumnitzera racemosa* Willd.

Lumnitzera racemosa var. *pubescens* Koord. & Vahl.; see *Lumnitzera racemosa* Willd.

Lumnitzera racemosa var. *racemosa* Willd.; see *Lumnitzera racemosa* Willd.

***Lumnitzera racemosa* Willd. – 168**

Lumnitzera rosea Presl.; see *Lumnitzera racemosa* Willd.

***Lycopodium carinatum* Desv. – 10**

Lycopodium laxum Spring.; see *Lycopodium carinatum* Desv.

Lythrum pemphis L.; see *Pemphis acidula* J.R. & G. Forst.

Maba buxifolia (Rottb.) Juss.; see *Diospyros ferrea* (Willd.) Bakh.

Maba buxifolia Pers.; see *Diospyros ferrea* (Willd.) Bakh.

Maba cumingiana A.DC.; see *Diospyros maritima* Blume

Maba ebenus Spreng.; see *Diospyros ferrea* (Willd.) Bakh.

Maba ferrea (Willd.) Aubév.; see *Diospyros ferrea* (Willd.) Bakh.

Maba guineensis (Schumach. & Thonn.) A.DC.; see *Diospyros ferrea* (Willd.) Bakh.

Maba papuana (R.Br.) Kosterm.; see *Diospyros maritima* Blume

Maba madagascarensis A.DC.; see *Diospyros ferrea* (Willd.) Bakh.

Maba smeathmannii A.DC.; see *Diospyros ferrea* (Willd.) Bakh.

Macrolobium amboinensis Teijsm. ex Hassk.; see *Intsia bijuga* (Colebr.) Kuntze

Macrolobium bijugum Colebr.; see *Intsia bijuga* (Colebr.) Kuntze

***Macrosolen cochinchinensis* (Lour.) Tiegh. – 87**

Macrosolen tribracteatus Dans.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Macrostomium aloefolium; see *Dendrobium aloefolium* (Bl.) Rchb.f.

Malapoenna tersa; see *Brownlowia tersa* (L.) Kosterm.

Malaspinia lamifolia Presl.; see *Aegiceras corniculatum* (L.) Blanco

Malaxis iridifolia (Lindl.) Rchb. f.; see *Oberonia iridifolia* Lindl.

Mallotus tokbrai (Bl.) Muell.; see *Blumeodendron tokbrai* (Bl.) Kurz.

Mallotus vernicosus (Hook. f.) Gage; see *Blumeodendron tokbrai* (Bl.) Kurz.

Malvaviscus populneus (L.) Gaertn.; see *Thespesia populnea* (L.) Soland. ex Correa

Mammea asiatica Linne; see *Barringtonia asiatica* (L.) Kurz

Mangifera xylocarpa Laut.; see *Merrilliodendron megacarpum* (Hemsl.) Sleum.

Mangium candelarium Rumph.; see *Rhizophora apiculata* Bl. and *Rhizophora mucronata* Lam.

Mangium caryophylloides Rumph.; see *Bruguiera cylindrica* (L.) Bl. and *Ceriops tagal* (Perr.) C.B.Rob.

Mangium caseolare album Rumph.; see *Sonneratia alba* J.E. Smith

Mangium caseolare rubrum Rumph.; see *Sonneratia caseolaris* (L.) Engl.

Mangium celsum Rumph.; see *Bruguiera gymnorhiza* (L.) Lamk.

Mangium digitatum Rumph.; see *Bruguiera sexangula* (Lour.) Poir.

Mangium ferreum Rumph.; see *Pemphis acidula* J.R. & G. Forst.

Mangium minus Rumph.; see *Bruguiera cylindrica* (L.) Bl. and *Bruguiera gymnorhiza* (L.) Lamk.

Mangium procellanicum Rumph.; see *Pemphis acidula* J.R. & G. Forst.

Manungala pendula Blanco; see *Quassia indica* (Gaertn.) Nooteboom

Mariscus compactus Boldingh; see *Cyperus compactus* Retz.

Mariscus dilutus Nees; see *Cyperus compactus* Retz.

Mariscus javanicus Merr. & Metc; see *Cyperus javanicus* Houtt.

Mariscus microcephalus Presl.; see *Cyperus compactus* Retz.

Mariscus pennatus Domin.; see *Cyperus javanicus* Houtt.

Mariscus stuppeus Merr.; see *Cyperus javanicus* Houtt.

Marquartia leucacantha; see *Pandanus tectorius* Sol

Mauduita penduliflora Comm.; see *Quassia indica* (Gaertn.) Nooteboom

***Maytenus emarginata* (Willd.) Ding Hou – 164**

Meiena axillaris Rafin.; see *Dendrophthoe pentandra* (L.) Miq.

***Melaleuca cajuputi* Roxb. – 221**

Melaleuca cajuputi subsp. *cajuputi* Roxb.; see *Melaleuca cajuputi* Roxb.

Melaleuca cajuputi subsp. *cumingiana* (Turcz.) Barlow; see *Melaleuca cajuputi* Roxb

Melaleuca leucadendra L.; see *Melaleuca cajuputi* Roxb

Melaleuca leucadendron (sensu lato); see *Melaleuca cajuputi* Roxb

Melanium fruticosum Spreng.; see *Pemphis acidula* J.R. & G. Forst.

Melastoma adpressum Wall., ex Triana; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma affine D.Don.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma asperum Bl.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma baumianum Naud.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma candidum D.Don.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma constrictum Blume; see *Pachycentria constricta* (Bl.) Blume

Melastoma imbricatum var. *longipes* Craib.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma malabathricum var. *grandiflorum* Craib.; see *Melastoma malabathricum* var. *malabathricum* L.

***Melastoma malabathricum* var. *malabathricum* L. – 205**

Melastoma malabathricum var. *polyanthum* (Bl.) Benth.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma oliganthum Naud.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma polyanthemum (Bl.) G.Don.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma polyanthum Blume; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma polyanthum Burm.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma pusillum Bl.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma royeri Bl.; see *Melastoma malabathricum* var. *malabathricum* L.

***Melastoma saigonense* (Kuntze) Merr. – 206**

Melastoma scabrum Ridl.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma setigerum Bl.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma tondanense Bl.; see *Melastoma malabathricum* var. *malabathricum* L.

Melastoma villosum Sims [non Aublet]; see *Melastoma saigonense* (Kuntze) Merr.

Menispermum cocculus L.; see *Anamirta cocculus* L. Wight & Arn.

Menispermum lacunosum Lamk.; see *Anamirta cocculus* L. Wight & Arn.

Meringium holochilum (Bosch) Copel.; see *Hymenophyllum holochilum* (Bosch) C. Chr.

***Merope angulata* (Willd.) Swingle – 247**

Merope spinosa; see *Merope angulata* (Willd.) Swingle

***Merrilliodendron megacarpum* (Hemsl.) Sleum. – 185**

Merrilliodendron rotense Kanehe; see *Merrilliodendron megacarpum* (Hemsl.) Sleum.

Millania rupestre Zipp.; see *Pemphis acidula* J.R. & G. Forst.

Millettia pinnata; see *Pongamia pinnata* (L.) Pierre

Mimosa corcondiana Roxb.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Mimosa scandens L.; see *Entada phaseoloides* (L.) Merr.

Mimosa umbellata Vahl.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Mischocarpus lessertianus Ridley; see *Mischocarpus sundaicus* Blume

Mischocarpus oppositifolius auct. non (Lour.) Merr. ; see *Mischocarpus sundaicus* Blume

Mischocarpus pyriformis auct. non Radlk. ; see *Mischocarpus sundaicus* Blume

***Mischocarpus sundaicus* Blume – 250**

Mischocarpus vulcanicus Elmer ex Merrill; see *Mischocarpus sundaicus* Blume

Monetia barlerioides (non L'Hér) Miq.; see *Azima sarmentosa* (Bl.) B. & H.

Monetia sarmentosa Baill.; see *Azima sarmentosa* (Bl.) B. & H.

Monosoma littorata Griff.; see *Xylocarpus granatum* Koen.

Morinda citrifolia Hunter; see *Morinda citrifolia* L.

***Morinda citrifolia* L. – 243b**

***Mucuna gigantea* (Willd.) DC. – 124**

***Myoporum bontiodides* (Siebold & Zucc.) A. Gray – 214**

***Myriostachya wightiana* (Nees ex Steud.) Hook.f. – 45**

Myriostachya wightiana var. *longispiculata* Hook.f.; see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.

Myriostachya wightiana var. *wightiana*; see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.

Myristica albertisii Warb.; see *Myristica hollrungii* Warb.

Myristica euryocarpa Warb.; see *Myristica hollrungii* Warb.

Myristica globularia Blume; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica heterophylla K. Schum; see *Myristica hollrungii* Warb.

***Myristica hollrungii* Warb. – 216**

Myristica irya Gaertn.; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica javanica Blume; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica lemanniana A. DC.; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica micrantha Wall.; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica sphaerocarpa Wall.; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica subglobosa Miq.; see *Horsfieldia irya* (Gaertn.) Warb.

Myristica vriesseana Miq.; see *Horsfieldia irya* (Gaertn.) Warb.

Myrmecodia armata; see *Myrmecodia tuberosa* DC.

Myrmecodia rumphii Becc.; see *Myrmecodia tuberosa* DC.

***Myrmecodia tuberosa* DC. – 102**

***Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito – 16**

Myrobalanus catappa Kuntze; see *Terminalia catappa* L.

Myrsine avensis (Blume) Mez.; see *Rapanea porteriana* Wall. ex A. DC.

Myrsine porteriana Wall. ex A. DC.; see *Rapanea porteriana* Wall. ex A. DC.

Myrsine umbellulata A. DC.; see *Rapanea porteriana* Wall. ex A. DC.

Nageia polystachyus (R.Br. ex Endl.); see *Podocarpus polystachyus* R.Br. ex Endl.

Nageia thevetiaefolia (Blume) F.v.M.; see *Podocarpus polystachyus* R.Br. ex Endl.

***Najas browniana* Rendle – 69**

Najas falciculata A. Braun.; see *Najas indica* (Willd.) Cham

Najas foveolata A.Br.; see *Najas indica* (Willd.) Cham

***Najas indica* (Willd.) Cham. – 70**

Najas intermedia Gorski; see *Najas marina* L. var. *marina*

Najas kingii Kingi; see *Najas indica* (Willd.) Cham

Najas lacerata Rendle; see *Najas indica* (Willd.) Cham

Najas lobata Blanco; see *Najas indica* (Willd.) Cham

Najas major All.; see *Najas marina* L. var. *marina*

Najas marina var. *angustifolia et intermedia* Rendle; see *Najas marina* L. var. *marina*

***Najas marina* L. var. *marina* – 71**

Najas minor var. *indica* A. Br.; see *Najas indica* (Willd.) Cham

Najas palustris Blanco; see *Najas indica* (Willd.) Cham

Najas tenuifolia (non R.Br.) Miq.; see *Najas indica* (Willd.) Cham

Neesia altissima (non Bl.) F.Vill.; see *Camptostemon philippinense* (Vidal) Becc.

Neottopteris maritania Fée; see *Asplenium nidus* Linn.

Neottopteris musaeifolia J.Sm.; see *Asplenium nidus* Linn.

Neottopteris nidus (L.) J.Sm.; see *Asplenium nidus* Linn.

Neottopteris rigida Fée; see *Asplenium nidus* Linn.

***Nephrolepis acutifolia* (Desv.) H. Christ. – 11**

- Neuroplatyceros biformis* Fée.; see *Platycerium coronarium* (Koenig.) Desv.
Nidus formicarum niger Rumph.; see *Hydnophytum formicarum* Jack
Nidus formicarum ruber Rumph.; see *Myrmecodia tuberosa* DC.
Niota commersonii Pers.; see *Quassia indica* (Gaertn.) Nootboom
Niota lamarckiana Bl.; see *Quassia indica* (Gaertn.) Nootboom
Niota lucida Wall.; see *Quassia indica* (Gaertn.) Nootboom
Niota pentapetala Poir.; see *Quassia indica* (Gaertn.) Nootboom
Niota polyandra; see *Brownlowia tersa* (L.) Kosterm.
Niota tetrapetala Poir.; see *Quassia indica* (Gaertn.) Nootboom
Niphobolus acrostichoides (G. Forst.) A.Richt.; see *Pyrrosia longifolia* (Burm.) Morton.
Niphobolus cinnamomeus; see *Pyrrosia longifolia* (Burm.) Morton.
Niphobolus fissus Bl.; see *Pyrrosia longifolia* (Burm.) Morton.
Niphobolus longifolium Spr.; see *Pyrrosia longifolia* (Burm.) Morton.
Niphobolus puberulus Bl.; see *Pyrrosia longifolia* (Burm.) Morton.
Nothopanax macgillivrayi Seem.; see *Polyscias macgillivrayi* (Seem.) Harms.
Notochlaena piloselloides Kaulf.; see *Drymoglossum piloselloides* (Linn.) Presl.
Novella litorea Rumph.; see *Thespesia populnea* (L.) Soland. ex Correa
Novella nigra Rumph.; see *Cordia subcordata* Lam.
Novella repens; see *Hibiscus tiliaceus* L.
Novella rubra; see *Hibiscus tiliaceus* L.
Nugae silvarum Rumph.; see *Caesalpinia crista* L.
Nummularia lactea minor Rumph.; see *Dischidia nummularia* R.Br.
Nyctanthes hirsuta Linn.; see *Guettarda speciosa* Linn.
Nypa fruticans Thunb.; see *Nypa fruticans* Wurmbr.
***Nypa fruticans* Wurmbr. – 135**
Oberonia bertoldii; see *Oberonia laeta* J.J.S.
Oberonia gracillima; see *Oberonia laeta* J.J.S.
***Oberonia iridifolia* Lindl. – 98**
***Oberonia laeta* J.J.S. – 99**
***Oberonia rhizophoreti* Schltr. – 100**
Oberonia rhizophoreti J.J. Sm.; see *Oberonia rhizophoreti* Schltr
Ochthocharis attenuata Backh. f.; see *Ochthocharis bornensis* Bl.
Ochthocharis borneensis (sic); see *Ochthocharis bornensis* Bl.
***Ochthocharis bornensis* Bl. – 207**
Ochthocharis buruensis T. & B.; see *Ochthocharis bornensis* Bl.
Ochthocharis javanica (haud Bl.); see *Ochthocharis bornensis* Bl.
Oetosis piloselloides O.K.; see *Drymoglossum piloselloides* (Linn.) Presl.
***Olax imbricata* Roxb. – 223**
Olax laxiflora Ridl.; see *Olax imbricata* Roxb.
Olax multiflora A. Rich.; see *Olax imbricata* Roxb.
Olax multiflora Ridl.; see *Olax imbricata* Roxb.
Olax rosea Ridl.; see *Olax imbricata* Roxb.
Olax semiinfera Valet.; see *Olax imbricata* Roxb.
Olax wightiana Wall. ex Wight & Arn.; see *Olax imbricata* Roxb.
Olfersia blumeana Presl.; see *Elaphoglossum amblyphyllum* C.R. Bell.
Olfersia decurrens Presl.; see *Elaphoglossum amblyphyllum* C.R. Bell.
Olfersia scandens (Willd.) C. Presl.; see *Stenochlaena palustris* (Burm. f.) Bedd.
Olus calappoides Rumph.; see *Cycas rumphii* Miq.
Olus crepitans Rumph.; see *Finlaysonia obovata* Wall.
Oncosperma filamentosa Blume; see *Oncosperma tigillarium* (Jack.) Ridl.

Oncosperma filamentosum Blume; see *Oncosperma tigillarium* (Jack.) Ridl.

***Oncosperma tigillarium* (Jack.) Ridl. – 136**

Oncospermum tigillaria (Jack.) Ridl.; see *Oncosperma tigillarium* (Jack.) Ridl.

Onoclea scandens Sw.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Onychium subulatum Bl.; see *Dendrobium subulatum* (Bl.) Lindl.

Oporum serra; see *Dendrobium aloefolium* (Bl.) Rchb.f.

Ornitrophe integrifolia Willd.; see *Allophylus cobbe* (L.) Raeusch.

Ornitrophe glabra Roxb.; see *Allophylus cobbe* (L.) Raeusch.

Ornitrophe repanda Roxb.; see *Allophylus cobbe* (L.) Raeusch.

Ornitrophe villosa Roxb.; see *Allophylus cobbe* (L.) Raeusch.

Orxera cornuta Raf.; see *Aerides odoratum* Reinw. ex Blume

Osbeckia royeri (Bl.) Miq.; see *Melastoma malabathricum* var. *malabathricum* L.

Osbeckia saigonense Kuntze; see *Melastoma saigonense* (Kuntze) Merr.

***Osbornia octodonta* F.v.Muell. – 222**

Osmunda coronaria J. König; see *Platynerium coronarium* (Koenig.) Desv.

Outea bijuga DC.; see *Intsia bijuga* (Colebr.) Kuntze

***Oxystelma carnosum* R. Br. – 105**

***Pachycentria constricta* (Bl.) Blume – 89**

Pachycentria cordata Blume; see *Pachycentria constricta* (Bl.) Blume

Pachycentria elliptica Blume; see *Pachycentria constricta* (Bl.) Blume

Pachycentria formicaria Merr.; see *Pachycentria constricta* (Bl.) Blume

Pachycentria javanensis Hochr.; see *Pachycentria constricta* (Bl.) Blume

Pachycentria junghuhniana Miq.; see *Pachycentria constricta* (Bl.) Blume

Pachycentria lanceolata O.Schwartz; see *Pachycentria constricta* (Bl.) Blume

Pachycentria laxiflora Blume; see *Pachycentria constricta* (Bl.) Blume

Pachycentria macrorrhiza Becc.; see *Pachycentria constricta* (Bl.) Blume

Pachycentria oligosperma O.Schwartz; see *Pachycentria constricta* (Bl.) Blume

Pachycentria rigida Blume; see *Pachycentria constricta* (Bl.) Blume

Pachycentria tuberculata Korth.; see *Pachycentria constricta* (Bl.) Blume

Pachycentria varingiaefolia; see *Pachycentria constricta* (Bl.) Blume

Pachycentria zollingeriana Naudin; see *Pachycentria constricta* (Bl.) Blume

***Pachypleuria angustata* (Wall. ex Hook. & Grev.) J. Sm. – 6**

Panax grandifolia Volken; see *Polyscias macgillivrayi* (Seem.) Harms.

Panax macgillivrayi (Seem.) Benth.; see *Polyscias macgillivrayi* (Seem.) Harms.

Pandanus fascicularis; see *Pandanus tectorius* Sol

Pandanus foetidus; see *Pandanus tectorius* Sol

Pandanus inermis Reinw.; see *Pandanus tectorius* Sol

Pandanus laevis Kunth.; see *Pandanus tectorius* Sol

Pandanus littoralis Jungh.; see *Pandanus tectorius* Sol

Pandanus moschatus Miq.; see *Pandanus tectorius* Sol

Pandanus odoratissimus Park.; see *Pandanus tectorius* Sol

Pandanus odoratus Salisb.; see *Pandanus tectorius* Sol

Pandanus odorifer (Forssk.) Kuntze; see *Pandanus tectorius* Sol

***Pandanus tectorius* Sol – 139**

Pandanus versus; see *Pandanus tectorius* Sol

Panicum dactylon L.; see *Cynodon dactylon* (L.) Pers.

Paramignya angulata (Willd.) Burkill; see *Merope angulata* (Willd.) Swingle

Paramignya longispina Hk.; see *Merope angulata* (Willd.) Swingle

Paratropia micrantha Miq.; see *Schefflera elliptica* (Blume) Harms.

Parechites bowringii Hance.; see *Gymnanthera oblonga* (Burm. f.) P.S. Green

Parinarium amboinense Teijsm. & Binn.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium curranii; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium elatum King.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium glaberimum Hassk.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium hahlii Warb.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium lanceolatum Teijsm.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium laurinum A. Gray.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium macrophyllum T. & B.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium margarata A. Gray; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium mindanaense Perk.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium scabrum Hassk.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Parinarium warburgii Perk. ex Merr.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Paritium tiliaceum (L.) St. Hil.; see *Hibiscus tiliaceus* L.

***Paspalum vaginatum* Sw. - 46**

Paspalum distichum sensu Ridley; see *Paspalum vaginatum* Sw.

Paspalum littorale; see *Paspalum vaginatum* Sw.

***Passiflora foetida* L. - 72**

Paulinia seriana auct. non L.: Burm F., *Rhus cobbe* L.; see *Allophylus cobbe* (L.) Raeusch.

Pedicellia sundaica Pierre; see *Mischocarpus sundaicus* Blume

Peckeliodendron missionariorum Sleum.; see *Merrilliodendron megacarpum* (Hemsl.) Sleum.

Peltophorum ferruginea Decne.; see *Peltophorum pterocarpum* (DC.) K. Heyne

Peltophorum ferrugineum (Decne.) Benth.; see *Peltophorum pterocarpum* (DC.) K. Heyne

Peltophorum inerme Nav.; see *Peltophorum pterocarpum* (DC.) K. Heyne

Peltophorum inermis Roxb.; see *Peltophorum pterocarpum* (DC.) K. Heyne

***Peltophorum pterocarpum* (DC.) K. Heyne - 198**

Peltophorum pterocarpum (DC.) Backer ex Heyne; see *Peltophorum pterocarpum* (DC.) K. Heyne

***Pemphis acidula* J.R. & G. Forst. - 202**

Pemphis angustifolia Roxb.; see *Pemphis acidula* J.R. & G. Forst.

Pemphis setosa Blanco; see *Pemphis acidula* J.R. & G. Forst.

Pentacoeium bontioides Sieb. et Zucc.; see *Myoporum bontioides* (Siebold & Zucc.) A. Gray

Petaloma alba Blanco; see *Lumnitzera racemosa* Willd.

Petaloma coccinea Blanco; see *Lumnitzera littorea* (Jack) Voigt.

Petrocarya glaberrima (Hassk.) Miers.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Petrocarya scabra (Hassk.) Miers.; see *Atuna racemosa* ssp. *racemosa* Rafin.

Phaseolus maritimus purgans Aubl.; see *Canavalia maritima* Thouars

Phlegmariurus carinatus (Desv.) Ching.; see *Lycopodium carinatum* Desv.

Phoberos macrophylla W. & A.; see *Scolopia macrophylla* (W. & A.) Clos

Phoberos maritima Miq.; see *Scolopia macrophylla* (W. & A.) Clos

Phoberos rhinantha Benn. & Br.; see *Scolopia macrophylla* (W. & A.) Clos

***Phoenix paludosa* Roxb. - 137**

Photinopteris acuminata (Willd.) C.V. Morton; see *Photinopteris speciosa* (Bl.) Persl.

Photinopteris horsfieldii J. Sm.; see *Photinopteris speciosa* (Bl.) Persl.

Photinopteris rigida Bedd.; see *Photinopteris speciosa* (Bl.) Persl.

***Photinopteris speciosa* (Bl.) Persl. - 17**

Phragmites communis sensu Ridley; see *Phragmites karka* (Retz.) Trin. ex Steud.

Phragmites filiformis; see *Phragmites karka* (Retz.) Trin. ex Steud.

***Phragmites karka* (Retz.) Trin. ex Steud. - 47**

Phragmites roxburghii; see *Phragmites karka* (Retz.) Trin. ex Steud.

Phyllanthus litoralis [sic] (Bl.) Muell.; see *Glochidion littorale* Bl.

Phyllitis arborea Rumph.; see *Asplenium nidus* Linn.

***Phymatodes scolopendria* (Burm.) Ching. – 18**

Phymatodes sinuosa (Wall.) J. Sm.; see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito

Phymatodes sinuosa Wall. ex Hook.; see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito

Phymatodes vulgare Presl.; see *Phymatodes scolopendria* (Burm.) Ching.

Phymatosorus scolopendria (Burm.) Pichi Serm.; see *Phymatodes scolopendria* (Burm.) Ching.

Pimecaria odorata Raf.; see *Ximenia americana* L.

Pisonia buxifolia Rottb.; see *Diospyros ferrea* (Willd.) Bakh.

Pithecellobium malayanum Pierre; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Pithecellobium moniliferum Miq.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

Pithecellobium umbellatum (Vahl) Bth.; see *Cathormion umbellatum* (M.Vahl.) Kosterm.

***Planchonella obovata* (R.Br.) Pierre. – 251**

Platycterium biforme (Sw.) Blume; see *Platycterium coronarium* (Koenig.) Desv.

***Platycterium coronarium* (Koenig.) Desv. – 19**

Pleopeltis heterocarpa v.A.bv. R.; see *Selliguea heterocarpa* Blume

Pleopeltis phymatodes Moore; see *Phymatodes scolopendria* (Burm.) Ching.

Pleopeltis schoutenii v.A.v.R.; see *Selliguea heterocarpa* Blume

Pleopeltis sinuosa (Wall. ex Hook.) Bedd.; see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito

Pluchea leptophylla Hong & Chen; see *Pluchea pteropoda* Hemsl.

Pluchea indica* (L.) Less. – 148**Pluchea pteropoda* Hemsl. – 149**

Poa panicea Retz.; see *Leptochloa neesii* (Thw.) Bth.

Podocarpus neriifolius D.Don.; see *Podocarpus polystachyus* R.Br. ex Endl.

***Podocarpus polystachyus* R.Br. ex Endl. – 227**

Podocarpus thevetiifolia Blume; see *Podocarpus polystachyus* R.Br. ex Endl.

Podocarpus thevetiifolius D.Don.; see *Podocarpus polystachyus* R.Br. ex Endl.

Pogonanthra pulverulenta; see *Pachycentria constricta* (Bl.) Blume

Polypodium acrostichoides G. Forst.; see *Pyrrosia longifolia* (Burm.) Morton.

Polypodium cinnamomeus; see *Pyrrosia longifolia* (Burm.) Morton.

Polypodium decorum; see *Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu

Polypodium diversifolium R. Br.; see *Drynaria rigidula* (Sw.) Bedd.

Polypodium forbesii v.A.a.R.; see *Phymatodes scolopendria* (Burm.) Ching.

Polypodium gaudichaudi Bory.; see *Drynaria rigidula* (Sw.) Bedd.

Polypodium heterocarpum Mett.; see *Selliguea heterocarpa* Blume

Polypodium linnaei Bory.; see *Drynaria sparsisora* (Desv.) Moore

Polypodium mettenianum Cesati; see *Selliguea heterocarpa* Blume

Polypodium moultoni Copel.; see *Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu

Polypodium palustre Burm.f.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Polypodium phymatodes L.; see *Phymatodes scolopendria* (Burm.) Ching.

Polypodium rigidulum Sw.; see *Drynaria rigidula* (Sw.) Bedd.

Polypodium rigidum; see *Drynaria rigidula* (Sw.) Bedd.

Polypodium schoutenii v.A.v.R.; see *Selliguea heterocarpa* Blume

Polypodium scolopendria Burm.; see *Phymatodes scolopendria* (Burm.) Ching.

Polypodium scolopendrinum C. Chr.; see *Loxogramma involuta* Presl.

Polypodium sinuosum Wall. ex Hook.; see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito

Polypodium sparsisorum Desv.; see *Drynaria sparsisora* (Desv.) Moore

Polypodium speciosum Bl.; see *Drynaria rigidula* (Sw.) Bedd.

***Polyscias macgillivrayi* (Seem.) Harms. – 146**

Pongamia glabra Vent.; see *Pongamia pinnata* (L.) Pierre

Pongamia mitis Merr.; see *Pongamia pinnata* (L.) Pierre

***Pongamia pinnata* (L.) Pierre – 199**

- Pongelia longiflora* Rafin.; see *Dolichandrone spathacea* (L.f.) K.Schum.
Portulaca axilliflora (non Pers.) Blanco; see *Trianthema portulacastrum* L.
Portulaca monogynum (L.) Medik.; see *Trianthema portulacastrum* L.
Portulaca portulacastrum L.; see *Sesuvium portulacastrum* (L.) L.
Portulaca toston Blanco; see *Trianthema portulacastrum* L.
Potamogeton filiformis Phil.; see *Ruppia maritima* L. var. *maritima*
Pothos heterophyllus Roxb.; see *Lasia spinosa* (L.) Thwaites.
Pouteria obovata (R. Br.) Baehni.; see *Planchonella obovata* (R.Br.) Pierre.
Problastes cuneifolia; see *Lumnitzera littorea* (Jack) Voigt.
Pseudaleia imbricata (Roxb.) Hassk.; see *Olox imbricata* Roxb.
Pseudaleia longistylis Hassk.; see *Olox imbricata* Roxb.
Premna abbreviata Miq.; see *Premna obtusifolia* R. Br.
Premna corymbosa (Burm. f.) Rottl. & Willd.; see *Premna obtusifolia* R. Br.
Premna cyclophylla Miq.; see *Premna obtusifolia* R. Br.
Premna foetida Reinw. ex Blume; see *Premna obtusifolia* R. Br.
Premna gaudichaudii Schau. ; see *Premna obtusifolia* R. Br.
Premna integrifolia L.; see *Premna obtusifolia* R. Br.
Premna laevigata Miq.; see *Premna obtusifolia* R. Br.
Premna littoralis K. & G.; see *Premna obtusifolia* R. Br.
Premna nitida K. Schum.; see *Premna obtusifolia* R. Br.
***Premna obtusifolia* R. Br. – 267**
Premna opulifolia Miq.; see *Premna obtusifolia* R. Br.
Premna ovalifolia Wall.; see *Premna obtusifolia* R. Br.
Premna ovata R.Br.; see *Premna obtusifolia* R. Br.
Premna sambucina Wall.; see *Premna obtusifolia* R. Br.
Premna scandens Boj.; see *Premna obtusifolia* R. Br.
Premna serratifolia Blanco; see *Premna obtusifolia* R. Br.
Premna serratifolia L.; see *Premna obtusifolia* R. Br.
Premna subcordata Turcz. ; see *Premna obtusifolia* R. Br.
Pteris piloselloides O.K.; see *Drymoglossum piloselloides* (Linn.) Presl.
Pteris scandens (Willd.) Roxb.; see *Stenochlaena palustris* (Burm. f.) Bedd.
Pterocarpus flavus Lour.; see *Pongamia pinnata* (L.) Pierre
Pterocarpus guianensis (Benth.) Kuntze.; see *Derris scandens* (Aubl.) Pittier
Pterocarpus negrensis (Benth.) Kuntze.; see *Derris scandens* (Aubl.) Pittier
Pyranthus littoreus Jack.; see *Lumnitzera littorea* (Jack) Voigt.
Pyrrosia acrostichoides G. Forst.; see *Pyrrosia longifolia* (Burm.) Morton.
***Pyrrosia longifolia* (Burm.) Morton. – 20**
Pyxipoma polyandrum Fenzl.; see *Sesuvium portulacastrum* (L.) L.
***Quassia harmandiana* (Pierre) Nooteboom – 252**
***Quassia indica* (Gaertn.) Nooteboom – 253**
Radix toxicaria; see *Crinum asiaticum* L.
***Rapanea porteriana* Wall. ex A. DC. – 220**
Rhamnicastrum rhinanthera O. Ktze; see *Scolopia macrophylla* (W. & A.) Clos
Rhinanthra blumei Steud.; see *Scolopia macrophylla* (W. & A.) Clos
Rhizophora angula Lour.; see *Bruguiera sexangula* (Lour.) Poir.
***Rhizophora apiculata* Bl. – 237**
Rhizophora australis Steud.; see *Bruguiera sexangula* (Lour.) Poir.
Rhizophora candel (non L.) Blanco; see *Ceriops tagal* (Perr.) C.B.Rob.
Rhizophora candel Linné; see *Kandelia candel* (L.) Druce
Rhizophora candelaria DC.; see *Rhizophora apiculata* Bl.

- Rhizophora candelaria* Wight & Arn.; see *Rhizophora mucronata* Lam.
Rhizophora caryophylloides (non Burm. f) Griff.; see *Bruguiera hainessii* C.G.Rogers
Rhizophora caryophylloides Burm.; see *Bruguiera cylindrica* (L.) Bl.
Rhizophora caseolaris Linné; see *Sonneratia alba* J.E. Smith and *Sonneratia caseolaris* (L.) Engl.
Rhizophora ceratophylloides Gmel.; see *Bruguiera cylindrica* (L.) Bl.
Rhizophora conjugata (non Linné) Arn.; see *Rhizophora apiculata* Bl.
Rhizophora corniculata L.; see *Aegiceras corniculatum* (L.) Blanco
Rhizophora cylindrica (non L.) Roxb.; see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
Rhizophora cylindrica Linné; see *Bruguiera cylindrica* (L.) Bl.
Rhizophora decandra Roxb.; see *Ceriops decandra* (Griff.) Ding Hou
Rhizophora eriopetala Steud.; see *Bruguiera sexangula* (Lour.) Poir.
Rhizophora glomerulata Zipp. ex Bl.; see *Ceriops decandra* (Griff.) Ding Hou
Rhizophora gymnorhiza L.; see *Bruguiera gymnorhiza* (L.) Lamk.
Rhizophora lamarckii; see *Rhizophora apiculata* Bl.
Rhizophora latifolia Miq.; see *Rhizophora mucronata* Lamk.
Rhizophora longissima Blanco; see *Rhizophora mucronata* Lamk.
Rhizophora macrorrhiza Griff.; see *Rhizophora mucronata* Lamk.
Rhizophora mangle (non Linné); see *Rhizophora apiculata* Bl.
Rhizophora mangle (non Linné) Roxb.; see *Rhizophora mucronata* Lamk.
***Rhizophora mucronata* Lamk. – 238**
Rhizophora mucronata var. *stylosa* Schimp.; see *Rhizophora stylosa* Griff.
Rhizophora mucronata var. *typica* Schimp.; see *Rhizophora mucronata* Lamk.
Rhizophora palun; see *Bruguiera gymnorhiza* (L.) Lamk.
Rhizophora parviflora Roxb.; see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
Rhizophora plicata Blanco; see *Bruguiera sexangula* (Lour.) Poir.
Rhizophora polyandra Blanco; see *Bruguiera sexangula* (Lour.) Poir.
Rhizophora rheedii Steud.; see *Bruguiera gymnorhiza* (L.) Lamk.
Rhizophora sexangula; see *Bruguiera sexangula* (Lour.) Poir.
***Rhizophora stylosa* Griff. – 239**
Rhizophora tagal Perr.; see *Ceriops tagal* (Perr.) C.B.Rob.
Rhizophora timoriensis DC.; see *Ceriops tagal* (Perr.) C.B.Rob.
Rhizophora tinctoria Blanco; see *Bruguiera gymnorhiza* (L.) Lamk.
Rhizophora lamarckii; see *Rhizophora stylosa* Griff.
***Rhododendron brookeanum* Low ex Lindl. var. *brookeanum* – 82**
***Ricinus communis* L. – 178**
Ricinus inermis Mill.; see *Ricinus communis* L.
Ricinus spectabilis Bl.; see *Ricinus communis* L.
Robinia mitis Linn.; see *Pongamia pinnata* (L.) Pierre
Rottlera tokbrai (Bl.) Scheff.; see *Blumeodendron tokbrai* (Bl.) Kurz.
Rumputris fasciculata Raf.; see *Cassytha filiformis* Linn.
Ruppia didyma Swartz ex Wickstr.; see *Ruppia maritima* L. var. *maritima*
Ruppia filifolia (Phil.) Skottstr.; see *Ruppia maritima* L. var. *maritima*
Ruppia marina Fries; see *Ruppia maritima* L. var. *maritima*
***Ruppia maritima* L. var. *maritima* – 73**
Ruppia pectinata Rydberg; see *Ruppia maritima* L. var. *maritima*
Ruppia rostellata W.D.J. Koch ex Rchb.; see *Ruppia maritima* L. var. *maritima*
Ryssopterys abutilifolia Jussieu; see *Ryssopterys timoriensis* (DC.) Jussieu
Ryssopterys albida *Ryssopterys chrysantha* (non Hassk.) Hochr.; see *Ryssopterys timoriensis* (DC.) Jussieu
Ryssopterys cumingana Jussieu; see *Ryssopterys timoriensis* (DC.) Jussieu

Ryssospterys dealbata Jussieu; see *Ryssospterys timoriensis* (DC.) Jussieu

Ryssospterys intermedia Hochr.; see *Ryssospterys timoriensis* (DC.) Jussieu

Ryssospterys microstema Jussieu; see *Ryssospterys timoriensis* (DC.) Jussieu

***Ryssospterys timoriensis* (DC.) Jussieu – 126**

Ryssospterys timorensis var. *tiliifolia* (non Vent.) K. Sch. & Laut.; see *Ryssospterys timoriensis* (DC.) Jussieu

***Salacia chinensis* L. – 165**

Salacia latifolia Wall.; see *Salacia chinensis* L.

Salacia naumannii Engl.; see *Salacia chinensis* L.

Salacia littoralis Back.; see *Salacia chinensis* L.

Salacia kraemeri (non Loes.) Kanehira; see *Salacia chinensis* L.

Salacia patens Decne.; see *Salacia chinensis* L.

Salacia prinoides D.C.; see *Salacia chinensis* L.

Salacia socia Craib.; see *Salacia chinensis* L.

Salicornia australasica; see *Salicornia indica* Willd.

Salicornia brachiata; see *Salicornia indica* Willd.

Salicornia fruticosa; see *Salicornia indica* Willd.

Salicornia cinerea F.v.Muell.; see *Halocnemum cinereum* F.v.Muell.

***Salicornia indica* Willd. – 62**

Salsola indica Willd.; see *Suaeda maritima* (L.) Dum.

Salsola maritima (L.) Poir.; see *Suaeda maritima* (L.) Dum.

Samadera brevipedata Scheff.; see *Quassia indica* (Gaertn.) Nootteboom

Samadera glandulifera; see *Quassia indica* (Gaertn.) Nootteboom

Samadera harmandiana Pierre; see *Quassia harmandiana* (Pierre) Nootteboom

Samadera harmandiana (Pierre) Greshoff; see *Quassia harmandiana* (Pierre) Nootteboom

Samadera harmandii Engl.; see *Quassia harmandiana* (Pierre) Nootteboom

Samadera indica Gaertn.; see *Quassia indica* (Gaertn.) Nootteboom

Samadera madagascariensis A. Juss.; see *Quassia indica* (Gaertn.) Nootteboom

Samadera madagascariensis Gaertn.; see *Quassia indica* (Gaertn.) Nootteboom

Samadera mekongensis Pierre; see *Quassia indica* (Gaertn.) Nootteboom

Samadera pentapetala G.Don.; see *Quassia indica* (Gaertn.) Nootteboom

Samadera tetrapetala (Poir.) G. Don.; see *Quassia indica* (Gaertn.) Nootteboom

Samandura harmandiana Pierre; see *Quassia harmandiana* (Pierre) Nootteboom

Samandura harmandii Pierre; see *Quassia harmandiana* (Pierre) Nootteboom

Samandura indica Baill.; see *Quassia indica* (Gaertn.) Nootteboom

Sapium indicum Willd.; see *Excoecaria indica* (Willd.) Muell. Arg.

Sarcolobus banksii; see *Sarcolobus globosus* Wall.

Sarcolobus banksii Roem. & Schult.; see *Sarcolobus carinatus* Wall.

***Sarcolobus carinatus* Wall. – 106**

Sarcolobus globosa R. & S.; see *Sarcolobus globosus* Wall.

***Sarcolobus globosus* Wall. – 107**

Sarcolobus globosus subsp. *globosus*; see *Sarcolobus globosus* Wall.

Sarcolobus globosus subsp. *peregrinus* (Blanco) R.E. Rintz.; see *Sarcolobus globosus* Wall.

Scaevola frutescens; see *Scaevola taccada* (Gaertn.) Roxb.

***Scaevola hainanensis* – 181**

Scaevola koenigii Vahl.; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola leschenaultii DC.; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola lobelia Murr.; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola macrocalyx de Vriese; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola piliplena Miq.; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola plumieri (non Vahl.) Bl.; see *Scaevola taccada* (Gaertn.) Roxb.

Scaevola sericea Vahl.; see *Scaevola taccada* (Gaertn.) Roxb.

***Scaevola taccada* (Gaertn.) Roxb. – 182**

Scaevola velutina Presl.; see *Scaevola taccada* (Gaertn.) Roxb.

***Schefflera elliptica* (Blume) Harms. – 75**

Schefflera elliptica var. *microphylla* Harms. ; see *Schefflera elliptica* (Blume) Harms.

***Schefflera lanceolata* Ridl. – 76**

Schefflera micrantha (Miq.) Ridley ; see *Schefflera elliptica* (Blume) Harms.

Schefflera minimiflora Ridley ; see *Schefflera elliptica* (Blume) Harms.

Schefflera musangensis Hend.; see *Schefflera ridleyi* (King) Viguier

Schefflera nitida Merr. ; see *Schefflera elliptica* (Blume) Harms.

***Schefflera ridleyi* (King) Viguier – 77**

Schefflera venulosa sensu Ridley ; see *Schefflera elliptica* (Blume) Harms.

Schefflera venulosa var. *curtisii* Ridley ; see *Schefflera elliptica* (Blume) Harms.

Scheffleropsis polyandra (Ridley) Ridley ; see *Schefflera ridleyi* (King) Viguier

Schmidelia bantamensis Blume; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia cobbe (L.) DC.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia fulvinervis Blume; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia glabra (Roxb.) Steud.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia grossedentata Turcz.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia javensis Blume; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia leptostachya Blume; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia ligustrina Blume ex Teijsm.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia littoralis Blume; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia macrophylla Zipp. ex Span.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia mutabilis Bl.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia obovata A. Gray; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia parviflora Zipp. ex Span.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia racemosa L.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia ternata (Forst. & Forst.) Cambess.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia timoriensis DC.; see *Allophylus cobbe* (L.) Raeusch.

Schmidelia tormentosa Hook.f. *Usubis triphylla* Burm. f.; see *Allophylus cobbe* (L.) Raeusch.

Schoberia linifolia Nutt. ex Moq.; see *Suaeda maritima* (L.) Dum.

Schoenoplectus grossus Pallas; see *Scirpus grossus* Linné

Schoenoplectus lacustris (L.) Pallas.; see *Scirpus lacustris* L.

Sciandophyllum elliptica Blume; see *Schefflera elliptica* (Blume) Harms.

Scirpus aemulans Steud.; see *Scirpus grossus* Linné

Scirpus arvensis Retz.; see *Fimbristylis ferruginea* (L.) Vahl

Scirpus ferrugineus L.; see *Fimbristylis ferruginea* (L.) Vahl

***Scirpus grossus* Linné – 38**

Scirpus grossus var. *kysoor* (non Clarke); see *Scirpus grossus* Linné

Scirpus kysoor (non Roxb.) Llanos.; see *Scirpus grossus* Linné

***Scirpus lacustris* L. – 39**

Scirpus lacustris (non L.) Merr.; see *Scirpus litoralis* Schrad.

Scirpus lacustris subsp. *validus* (Vahl.) T. Koyama; see *Scirpus lacustris* L.

***Scirpus litoralis* Schrad. – 40**

Scirpus littoralis (sic); see *Scirpus litoralis* Schrad.

***Scirpus maritimus* L – 41**

Scirpus maritimus var. *aemulans* Miq.; see *Scirpus grossus* Linné

Scirpus nanus (non Poir.) Spreng.; see *Eleocharis parvula* (R. & S.) Link ex Bluff

Scirpus parvulus R. & S.; see *Eleocharis parvula* (R. & S.) Link ex Bluff

- Scirpus polytrichoides* Retz.; see *Fimbristylis polytrichoides* (Retz.) R. Br.
Scirpus plantagineus Retz.; see *Eleocharis dulcis* (Burm. f.) Henschel
Scirpus pterolepis (Nees) Kunsch.; see *Scirpus lacustris* L.
Scirpus pusillus Vahl.; see *Eleocharis parvula* (R. & S.) Link ex Bluff
Scirpus spiralis Rottb.; see *Eleocharis spiralis* (Rottb.) R. & S.
Scirpus subulatus Vahl.; see *Scirpus litoralis* Schrad.
Scirpus thermalis Trab.; see *Scirpus litoralis* Schrad.
Scirpus triqueter var. *segregatus* Clarke; see *Scirpus lacustris* L.
Scirpus tuberosus Roxb.; see *Eleocharis dulcis* (Burm. f.) Henschel
Scirpus tumidus Roxb.; see *Eleocharis dulcis* (Burm. f.) Henschel
Scirpus validus Vahl.; see *Scirpus lacustris* L.
Scirpus validus (non Vahl.) Beetle.; see *Scirpus litoralis* Schrad.
Sclerostylis spinosa see *Merope angulata* (Willd.) Swingle
Scolopia crenata [non (Wall.) Clos.] King; see *Scolopia macrophylla* (W. & A.) Clos
***Scolopia macrophylla* (W. & A.) Clos - 179**
Scolopia maritima Warb.; see *Scolopia macrophylla* (W. & A.) Clos
Scolopia rhinanthra Clos; see *Scolopia macrophylla* (W. & A.) Clos
Scurrula pentandra & *venosa* G. Don.; see *Dendrophthoe pentandra* (L.) Miq.
Scyphiphora hydrophyllacea; see *Scyphiphora hydrophyllacea* Gaertn. f.
***Scyphiphora hydrophyllacea* Gaertn. f. - 244**
Secamone maritima Bl.; see *Finlaysonia obovata* Wall.
Selliguea feei Bory; see *Selliguea heterocarpa* Blume
***Selliguea heterocarpa* Blume - 21**
Selliguea metteniana var. *lateritium* (Baker) Tardieu & C. Chr.; see *Selliguea heterocarpa* Blume
Serianthes dilmyi Fosberg; see *Serianthes grandiflora* Benth.
***Serianthes grandiflora* Benth. - 200**
Sersalisia obovata R. Br.; see *Planchonella obovata* (R.Br.) Pierre.
***Sesuvium portulacastrum* (L.) L. - 55**
Sesuvium polyandrum Fenzl. ex Britt.; see *Sesuvium portulacastrum* (L.) L.
Sesuvium repens Willd.; see *Sesuvium portulacastrum* (L.) L.
Sideroxylon argentatum; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon bancanum; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon chrysophyllum; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon ferrugineum Hook. & Arn.; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon indicum; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon microcarpum Burck.; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon nodosum; see *Planchonella obovata* (R.Br.) Pierre.
Sideroxylon obovatum; see *Planchonella obovata* (R.Br.) Pierre.
Sinapistrum Rumph.; see *Lophopyxis maingayi* Hook.f.
Sindora conchinchinensis Baillon; see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
Sindora maritima Pierre; see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
Sindora siamensis Teijsm. ex Miq.; see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
Sindora siamensis Teysm. ex Miq.; see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
***Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen - 201**
Sindora wallichii var. *siamensis* (Teijsm.) Bak.; see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
***Smythea lanceata* (Tul.) Summerh. - 130**
Smythea pacifica Seem; see *Smythea lanceata* (Tul.) Summerh.
Soldanella marina indica Rumph.; see *Ipomoea pes-capre* (L.) Sweet.
Sonneratia acida Benth.; see *Sonneratia alba* J.E. Smith

Sonneratia acida Linné; see *Sonneratia caseolaris* (L.) Engl.

Sonneratia acida var. *griffithii* King.; see *Sonneratia griffithii* Kurz.

Sonneratia alba F.Vill.; see *Sonneratia alba* J.E. Smith

***Sonneratia alba* J.E. Smith – 254**

Sonneratia alba auct. plur. Watson; see *Sonneratia ovata* Back.

Sonneratia alba (non SM) Griff.; see *Sonneratia griffithii* Kurz.

***Sonneratia apetala* Buch.-Ham. – 255**

***Sonneratia caseolaris* (L.) Engl. – 256**

Sonneratia caseolaris Engl.; see *Sonneratia alba* J.E. Smith

Sonneratia evenia Bl.; see *Sonneratia caseolaris* (L.) Engl.

***Sonneratia griffithii* Kurz. – 257**

Sonneratia griffithii (non Kurz) Watson; see *Sonneratia alba* J.E. Smith

Sonneratia X *gulngai*; = hybrid of *Sonneratia caseolaris* (L.) Engl. and *Sonneratia alba* J.E. Smith

Sonneratia iriomotensis Masamune; see *Sonneratia alba* J.E. Smith

Sonneratia lanceolata Bl.; see *Sonneratia caseolaris* (L.) Engl.

Sonneratia mossambicensis Klotzsch ex Peters; see *Sonneratia alba* J.E. Smith

Sonneratia neglecta Bl.; see *Sonneratia caseolaris* (L.) Engl.

Sonneratia obovata Bl.; see *Sonneratia caseolaris* (L.) Engl.

Sonneratia ovalis Korth.; see *Sonneratia caseolaris* (L.) Engl.

***Sonneratia ovata* Back. – 258**

Sonneratia pagatpat Blanco; see *Sonneratia caseolaris* (L.) Engl.

Sonneratia rubra; see *Sonneratia caseolaris* (L.) Engl.

Sophora heptaphylla L.; see *Aganope heptaphylla* (L.) Polhill

Spathodea diepenhorstii Miq.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Spathodea longiflora Vent. Choix.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Spathodea loureiriana DC.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Spathodea luzonica Blanco; see *Dolichandrone spathacea* (l.f.) K.Schum.

Spathodea rheedii Spreng.; see *Dolichandrone spathacea* (l.f.) K.Schum.

Sphaeromariscus microcephalus Camus.; see *Cyperus compactus* Retz.

Spilanthus acmella Blanco; see *Wedelia biflora* (L.) DC.

Spilanthus peregrina Blanco; see *Wedelia biflora* (L.) DC.

Spironema aphyllum (Forssk.) Raf.; see *Cassytha filiformis* Linn.

***Sporobolus virginicus* (L.) Kunth. – 48**

Stachytarpheta friedrichsthalii Hayek; see *Stachytarpheta jamaicensis* (L.) Vahl

***Stachytarpheta jamaicensis* (L.) Vahl – 74**

Stemmodontia biflora W.F. Wight; see *Wedelia biflora* (L.) DC.

***Stemonurus ammu* (Kaneh.) Sleum. – 186**

Stemonurus ellipticus (Schellenb.) Sleum.; see *Stemonurus ammu* (Kaneh.) Sleum.

***Stenochlaena palustris* (Burm. f.) Bedd. – 3**

Stenochlaena scandens (Sw.) J.Sm.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Sterculia cymbiformes Blanco; *Heritiera littoralis* Dryand.

Stillingia agallocha (L.) Baill.; see *Excoecaria agallocha* L.

Stillingia diversifolia; see *Excoecaria indica* (Willd.) Muell. Arg.

Stillingia indica (Willd.) Baill.; see *Excoecaria indica* (Willd.) Muell. Arg.

Stizolobium giganteum (Willd.) Sprengel; see *Mucuna gigantea* (Willd.) DC.

Suaeda indica Moq.; see *Suaeda maritima* (L.) Dum.

***Suaeda maritima* (L.) Dum. – 63**

Suaeda australis (R.Br.) Moq.; see *Suaeda maritima* (L.) Dum.

Suaeda nudiflora Moq.; see *Suaeda maritima* (L.) Dum.

Symplocos candicans Brand.; see *Symplocos celastriifolia* Griff. ex Clarke

***Symplocos celastrifolia* Griff. ex Clarke – 263**

Symplocos hutchinsonii Brand.; see *Symplocos celastrifolia* Griff. ex Clarke

Symplocos nigricans Brand.; see *Symplocos celastrifolia* Griff. ex Clarke

Symplocos peninsularis Brand.; see *Symplocos celastrifolia* Griff. ex Clarke

Syndesmis coarctata Griff.; see *Gluta velutina* Bl.

Tabernaemontana obtusifolia Poir.; see *Cerbera manghas* L.

Taenites piloselloides R. Br.; see *Drymoglossum piloselloides* (Linn.) Presl.

Tanghinia manghas (L.) G. Don.; see *Cerbera manghas* L.

Tarachia. canaliculata Presl.; see *Asplenium macrophyllum* Sw.

Tarachia falcata; see *Asplenium macrophyllum* Sw.

Tarachia oxyphylla Presl.; see *Asplenium macrophyllum* Sw.

Tecticornia australasica (Moq.) P.G. Wilson; see *Halocnemum cinereum* F.v.Muell.

Tecticornia cinerea F.v.Muell.; see *Halocnemum cinereum* F.v.Muell.

***Terminalia catappa* L. – 169**

Terminalia catappa var. *chlorocarpa* Hassk.; see *Terminalia catappa* L.

Terminalia catappa var. *macrocarpa* Kassk.; see *Terminalia catappa* L.

Terminalia catappa var. *rhodocarpa* Hassk.; see *Terminalia catappa* L.

Terminalia latifolia Blanco; see *Terminalia catappa* L.

Terminalia mauritiana (non Lamk.) Blanco; see *Terminalia catappa* L.

Terminalia moluccana Lamk.; see *Terminalia catappa* L.

Tetranthera tersa; see *Brownlowia tersa* (L.) Kosterm.

Thamnopteris nidus Presl.; see *Asplenium nidus* Linn.

Thamnopteris pachyphylla; see *Asplenium nidus* Linn.

Thelypteris palustris (A.Gray) Schott.; see *Stenochlaena palustris* (Burm. f.) Bedd.

Thespesia banalo Blanco; see *Thespesia populnea* (L.) Soland. ex Correa

Thespesia howii Hu; see *Thespesia populnea* (L.) Soland. ex Correa

Thespesia macrophylla Blume; see *Thespesia populnea* (L.) Soland. ex Correa

***Thespesia populnea* (L.) Soland. ex Correa – 204**

Thespesia populneoides Roxb.; see *Thespesia populnea* (L.) Soland. ex Correa

Thicuania moschata (Sw.) Raf.; see *Dendrobium moschatum* (Buch.-Ham.) Sw.

Tieghemopanax macgillivrayi Viguiet; see *Polyscias macgillivrayi* (Seem.) Harms.

Tinus squamulosa (C.Presl.) Kuntze; see *Ardisia elliptica* Thunberg

Tittius litorea; see *Guettarda speciosa* Linn.

Tonsella prinoidea Willd.; see *Salacia chinensis* L.

Tonsella chinensis (L.) Spreng.; see *Salacia chinensis* L.

Trachelospermum bowringii (Hance) Hemsl.; see *Gymnanthera oblonga* (Burm. f.) P.S. Green

Treubia combretocarpa Pierre ex Boerl.; see *Lophopyxis maingayi* Hook.f.

Trianthema flexuosum Schumach. & Thon.; see *Trianthema portulacastrum* L.

Trianthema littoralis Cordem.; see *Trianthema portulacastrum* L.

Trianthema monanthogyna L.; see *Trianthema portulacastrum* L.

Trianthema monogyna L.; see *Trianthema portulacastrum* L.

Trianthema obcordata Roxb.; see *Trianthema portulacastrum* L.

Trianthema polyandrum Bl.; see *Sesuvium portulacastrum* (L.) L.

***Trianthema portulacastrum* L. – 56**

Trianthema procumbens Mill.; see *Trianthema portulacastrum* L.

Tripsilina foetida (L.) Raf.; see *Passiflora foetida* L.

***Tristellateia australasiae* A. Rich. – 127**

Tristellateia australasica Miq.; see *Tristellateia australasiae* A. Rich.

Tristellateia australis Jussieu; see *Tristellateia australasiae* A. Rich.

Tristellateia malintana Blanco; see *Tristellateia australasiae* A. Rich.

Tristerix viridiflorus Mart.; see *Macrosolen cochinchinensis* (Lour.) Tiegh.

Tuba baccifera Rumph.; see *Anamirta cocculus* L. Wight & Arn.

Typha angustata; see *Typha angustifolia* Linné

***Typha angustifolia* Linné – 51**

Typha angustifolia ssp. *javanica*; see *Typha angustifolia* Linné

Typha capensis (non Rohrb.) Hall.; see *Typha angustifolia* Linné

Typha domingensis Pers.; see *Typha angustifolia* Linné

Typha domingensis var. *javanica* Geze; see *Typha angustifolia* Linné

Typha javanica Schnizl.; see *Typha angustifolia* Linné

Typha orientalis Briggs & Johnson; see *Typha angustifolia* Linné

Umbraculum corniculatum (L.) Kuntze.; see *Aegiceras corniculatum* (L.) Blanco

Urandra ammui Kaneh.; see *Stemonurus ammui* (Kaneh.) Sleum.

Urandra elliptica Schellenb.; see *Stemonurus ammui* (Kaneh.) Sleum.

Urostachys carinatus (Desv.) Herter ex Nesse.; see *Lycopodium carinatum* Desv.

Urostigma microcarpum (L.f.) Miq.; see *Ficus microcarpa* L.f.

Urostigma obtusifolia (Roxb.) Miq.; see *Ficus curtipes* Corner

Varronia sinensis Loureiro; see *Cordia dichotoma* G. Forst.

Verbena jamaicensis L.; see *Stachytarpheta jamaicensis* (L.) Vahl

Verbesina biflora Linné; see *Wedelia biflora* (L.) DC.

Vidara littorea Rump.; see *Ximenia americana* L.

Vincetoxium carnosum (R. Br.) Benth.; see *Oxystelma carnosum* R. Br.

Viscum heyneanum DC.; see *Viscum ovalifolium* DC.

Viscum monoicum Presl.; see *Viscum ovalifolium* DC.

Viscum navicellatum Kirth.; see *Viscum ovalifolium* DC.

Viscum obtusum DC.; see *Viscum ovalifolium* DC.

Viscum orientale auct. non Willd.; see *Viscum ovalifolium* DC.

***Viscum ovalifolium* DC. – 88**

Viscum pamattonis Korth.; see *Viscum ovalifolium* DC.

Viscum pedunculatum Barlow; see *Viscum ovalifolium* DC.

Viscum roxburghianum Korth.; see *Viscum ovalifolium* DC.

***Vitex ovata* Thunb. – 268**

Vitex rotundifolia L. f.; see *Vitex ovata* Thunb.

Vitex trifoliata var. *ovata* (Thunb.) Makino; see *Vitex ovata* Thunb.

Vitex trifolia var. *simplicifolia* Chamisso; see *Vitex ovata* Thunb.

Vitex trifolia var. *unifoliolata* Schauert.; see *Vitex ovata* Thunb.

Viscum verticillatum Roxb.; see *Viscum ovalifolium* DC.

Vitmannia elliptica Vahl.; see *Quassia indica* (Gaertn.) Nootboom

***Vittaria elongata* Sw. – 24**

Vittaria loricea Fée; see *Vittaria elongata* Sw.

Vittaria planipes Kunze; see *Vittaria elongata* Sw.

Vittmannia polyandra; see *Brownlowia tersa* (L.) Kosterm.

Volkameria buxifolia Willd.; see *Clerodendrum inerme* (L.) Gaertn.

Volkameria inermis L.; see *Clerodendrum inerme* (L.) Gaertn.

Volkameria neriifolia Roxb.; see *Clerodendrum inerme* (L.) Gaertn.

Volutella aphylla Forssk.; see *Cassytha filiformis* Linn.

***Wedelia biflora* (L.) DC. – 108**

Wedelia glabrata; see *Wedelia biflora* (L.) DC.

Wollastonia biflora DC.; see *Wedelia biflora* (L.) DC.

***Xerochloa imberbis* R. Br. – 49**

Xerochloa littoralis Baill.; see *Xerochloa imberbis* R. Br.

Ximenia aculeata Crantz ; see *Ximenia americana* L.

***Ximenia americana* L. – 224**

Ximenia americana fo. *inermis* (Aubl.) Engl.; see *Ximenia americana* L.

Ximenia americana var. *ovata* DC.; see *Ximenia americana* L.

Ximenia arborescens Tussac ex Walp.; see *Ximenia americana* L.

Ximenia fluminensis M.Roem.; see *Ximenia americana* L.

Ximenia inermis L.; see *Ximenia americana* L.

Ximenia loranthifolia Span.; see *Ximenia americana* L.

Ximenia montana Macfad. ; see *Ximenia americana* L.

Ximenia multiflora Jacq. ; see *Ximenia americana* L.

Ximenia oblonga Lam. ex Hemsl. ; see *Ximenia americana* L.

Ximenia olacoides Wight & Arn.; see *Olex imbricata* Roxb.

Ximenia spinosa Salisb. ; see *Ximenia americana* L.

Ximenia verrucosa M. Roem. ; see *Ximenia americana* L.

Xylocarpus australiasicus Ridley; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Xylocarpus bednadirensis Mattei; see *Xylocarpus granatum* Koen.

Xylocarpus carnulosus Zoll. & Mor.; see *Xylocarpus granatum* Koen.

Xylocarpus forstenii Miq.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Xylocarpus gangeticus (Prain.) C.E. Parkinson; see *Xylocarpus moluccensis* (Lamk) M. Roem.

***Xylocarpus granatum* Koen. – 209**

Xylocarpus granatum auct. non Koen.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Xylocarpus mekongensis Pierre; see *Xylocarpus moluccensis* (Lamk) M. Roem.

Xylocarpus minor Ridley; see *Xylocarpus granatum* Koen.

***Xylocarpus moluccensis* (Lamk) M. Roem. – 210**

Xylocarpus moluccensis auct. non M. Roem.; see *Xylocarpus granatum* Koen.

Xylocarpus moluccensis auct. non M. Roem.; see *Xylocarpus rumphii* (Kostel.) Mabb.

Xylocarpus obovatus (Blume) A. Juss.; see *Xylocarpus granatum* Koen.

Xylocarpus parvifolius Ridley; see *Xylocarpus moluccensis* (Lamk) M. Roem.

***Xylocarpus rumphii* (Kostel.) Mabb. – 211**

Zamia corsoniana G. Don.; see *Cycas rumphii* Miq.

Zizyphus littorea Teysm.; see *Ximenia americana* L.

Zoysia malaccensis Gandoger; see *Zoysia matrella* (L.) Merr.

***Zoysia matrella* (L.) Merr. – 50**

Zoysia pungens Willd.; see *Zoysia matrella* (L.) Merr.

ANNEX 4 Index of local plant names

Bruneian:

Apung, see *Nypa fruticans* Wurm.
 Bagu, see *Tristellateia australasiae* A. Rich.
 Bejau, see *Tristellateia australasiae* A. Rich.
 Patakoana, see *Croton heterocarpus* Müll. Arg.
 Pulut-pulut, see *Kandelia candel* (L.) Druce
 Pungsu, see *Cassine viburnifolia* (Juss.) Ding Hou
 Rambai, see *Derris scandens* (Aubl.) Pittier
 Sugang, see *Gardenia tubifera* Wall
 Sulang-sulang, see *Gardenia tubifera* Wall
 Wariemerie, see *Croton heterocarpus* Müll. Arg.

Cambodian:

Ampea, see *Sonneratia griffithii* Kurz.
 Ampea, see *Sonneratia ovata* Back.
 Ampou-krohom, see *Sonneratia caseolaris* (L.) Engl.
 Ampouthmar, see *Sonneratia alba* J.E. Smith
 Basac kroahom, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Basac, see *Bruguiera cylindrica* (L.) Bl.
 Basacsor, see *Bruguiera sexangula* (Lour.) Poir.
 Brong, *Acrostichum aureum* Linné
 Brong, see *Acrostichum speciosum* Willd.
 Chark, see *Nypa fruticans* Wurm.
 Chheu chhor, see *Excoecaria agallocha* L.
 Chompouprey, see *Cerbera odollam* Gaertn.
 Dawm cheungtia, see *Cerbera odollam* Gaertn.
 Dawm trojiekbrs, see *Barringtonia racemosa* (L.) Spreng.
 Dawm-beus, see *Hibiscus tiliaceus* L.
 Dawm-klai, see *Heritiera littoralis* Dryand.
 Dyerehatt, see *Cordia cochinchinensis* Gagnep.
 Kab-baspreyteukbray, see *Hibiscus tiliaceus* L.
 Kann-kai, see *Heritiera littoralis* Dryand.
 Kbagn, see *Avicennia marina* (Forssk.) Vierh.
 Kbagnkmao, see *Avicennia officinalis* L.
 Kbagsor, see *Avicennia alba* Blume
 Khnag n, see *Acrostichum speciosum* Willd.
 Kongkang-slektoch, see *Rhizophora apiculata* Bl.
 Krognungteukbray, see *Intsia bijuga* (Colebr.) Kuntze
 Krognyp krohom, see *Lumnitzera littorea* (Jack) Voigt.
 Krognyp sor, see *Lumnitzera racemosa* Willd.
 Krognyp-pka-krohom, see *Lumnitzera littorea* (Jack) Voigt.
 Krognyp-pkasor, see *Lumnitzera racemosa* Willd.
 Krokos-teukpray, see *Intsia bijuga* (Colebr.) Kuntze
 Mouroujsrotorb, see *Avicennia alba* Blume
 Mouroujsrotorb, see *Avicennia marina* (Forssk.) Vierh.
 Omlann, see *Bruguiera cylindrica* (L.) Bl.
 Pchek tekbray, see *Barringtonia racemosa* (L.) Spreng.
 Pdao ondawk, see *Flagellaria indica* L.
 Peng, see *Phoenix paludosa* Roxb.
 Pilpicht, see *Cerbera odollam* Gaertn.

Porhteukprey, see *Thespesia populnea* (L.) Soland. ex Correa
 Rhumjeik-samot, see *Pandanus tectorius* Sol
 Rompea-chheu, see *Sonneratia alba* J.E. Smith
 Semornsakmot, see *Heritiera littoralis* Dryand.
 Smairsor, see *Ceriops decandra* (Griff.) Ding Hou
 Sman, see *Avicennia alba* Blume
 Smerkrohorm, see *Ceriops tagal* (Perr.) C.B. Rob.
 Spong, see *Avicennia officinalis* L.
 Spornng, see *Avicennia marina* (Forssk.) Vierh.
 Tabann, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Tabonkmao, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Tabonsor, see *Xylocarpus granatum* Koen.
 Tatom, see *Excoecaria agallocha* L.
 Trohjekcragh pkapor sar, see *Acanthus ebracteatus* Vahl.
 Trohjekcragh pkaporsvay, see *Acanthus ilicifolius* L.
 Trohjekcragh slekbanla, see *Acanthus ilicifolius* L.
 Trohjekcragh slekweng, see *Acanthus ebracteatus* Vahl.
 Vorre, see *Flagellaria indica* L.

East-Timorese:

Bakulu, see *Morinda citrifolia* L.
 Kayu gelang, see *Melaleuca cajuputi* Roxb.
 Olas Mea, see *Ryssopterys timoriensis* (DC.) Jussieu
 Sosa, see *Cyperus javanicus* Houtt.
 Taktenas, see *Typha angustifolia* Linné

Indonesian:

Abat, see *Rhizophora apiculata* Bl.
 Adad, see *Symplocos celastriifolia* Griff. ex Clarke
 Adu-adu, see *Lumnitzera racemosa* Willd.
 Ahaha, see *Suaeda maritima* (L.) Dum.
 Ai Bon, see *Bruguiera sexangula* (Lour.) Poir.
 Ai elane, see *Melaleuca cajuputi* Roxb.
 Ai kelane, see *Melaleuca cajuputi* Roxb.
 Ai Pue, see *Excoecaria indica* (Willd.) Muell. Arg.
 Ai Tohi, see *Excoecaria indica* (Willd.) Muell. Arg.
 Ai Tui, see *Excoecaria indica* (Willd.) Muell. Arg.
 Ai, see *Brownlowia argentata* Kurz.
 Ain Hual, see *Inocarpus fagifer* (Parkinson) Fosb.
 Akan pelanduk, see *Salacia chinensis* L.
 Akang kangkong bulu, see *Ipomoea maxima* (L.f.) Don ex Sweet
 Akar Aru, see *Combretum tetralophum* Clarke
 Akar Bani, see *Dischidia rafflesiana* Wall.
 Akar Banok, see *Dischidia rafflesiana* Wall.
 Akar beluru, see *Entada phaseoloides* (L.) Merr.
 Akar beting, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Akar Hitang, see *Ipomoea gracilis* R. Br.
 Akar Kelinci, see *Caesalpinia crista* L.
 Akar Kul, see *Dischidia rafflesiana* Wall.

Akar Kusu, see *Drynaria sparsisora* (Desv.) Moore
 Akar nangkei, see *Combretum trifoliatum* Vent.
 Akar Pakis, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Akar song song harus, see *Combretum trifoliatum* Vent.
 Al tuban, see *Vitex ovata* Thunb.
 Alakang, see *Barringtonia acutangula* (L.) Gaertn.
 Alakang, see *Barringtonia racemosa* (L.) Spreng.
 Alakang, see *Barringtonia racemosa* (L.) Spreng.
 Alere, see *Ipomoea pes-capre* (L.) Sweet.
 Alur, see *Suaeda maritima* (L.) Dum.
 Ama, see *Cordia subcordata* Lam.
 Ambung-ambung, see *Scaevola taccada* (Gaertn.) Roxb.
 Anas, see *Scaevola taccada* (Gaertn.) Roxb.
 Anggrek, see *Dendrobium subulatum* (Bl.) Lindl.
 Anggrek, see *Dendrobium pachyphyllum* (O.K.) Bakh. f.
 Angkaeng, see *Inocarpus fagifer* (Parkinson) Fosb.
 Angkrek lilin, see *Aerides odoratum* Reinw. ex Blume
 Anuanga, see *Cordia dichotoma* G. Forst.
 Api, see *Scolopia macrophylla* (W. & A.) Clos
 Api-api Abang, see *Avicennia marina* (Forssk.) Vierh.
 Api-api Balah, see *Lumnitzera racemosa* Willd.
 Api-api Daun Lebar, see *Avicennia officinalis* L.
 Api-api Jambu, see *Lumnitzera racemosa* Willd.
 Api-api Ludat, see *Avicennia officinalis* L.
 Api-api Putih, see *Avicennia marina* (Forssk.) Vierh.
 Api-api Uding, see *Lumnitzera littorea* (Jack) Voigt.
 Api-api, see *Avicennia alba* Blume
 Api-api, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Api-api, see *Avicennia lanata* Ridley
 Aram Aron, see *Cathormion umbellatum* (M.Vahl.) Kosterm.
 Areuj, see *Caesalpinia bonduc* (L.) Roxb.
 Areuj, see *Caesalpinia crista* L.
 Areuy ki loma, see *Derris pinnata* (Lour.) Prain
 Areuy ki menter, see *Derris pinnata* (Lour.) Prain
 Areuy Ki Tonggeret, see *Derris trifoliata* Lour
 Areuy munding serakit, see *Derris pinnata* (Lour.) Prain
 Arnana, see *Planchonella obovata* (R.Br.) Pierre.
 Aru, see *Casuarina equisetifolia* L.
 Aruk, see *Caesalpinia bonduc* (L.) Roxb.
 Aruk, see *Caesalpinia crista* L.
 Asa-Asa, see *Allophylus cobbe* (L.) Raeusch.
 Asawali, see *Pongamia pinnata* (L.) Pierre
 Asinan, see *Paspalum vaginatum* Sw.
 Asiwung raja matri, see *Typha angustifolia* Linné
 Atung Laut, see *Heritiera littoralis* Dryand.
 Awakal, see *Pongamia pinnata* (L.) Pierre
 Baba koan Lelaki, see *Scaevola taccada* (Gaertn.) Roxb.
 Babakoan, see *Scaevola taccada* (Gaertn.) Roxb.
 Babawangan, see *Eleocharis dulcis* (Burm. f.) Henschel

Badak, see *Cerbera odollam* Gaertn.
 Bagoré, see *Caesalpinia bonduc* (L.) Roxb.
 Bagoré, see *Caesalpinia crista* L.
 Bahu, see *Hibiscus tiliaceus* L.
 Baibui, see *Intsia bijuga* (Colebr.) Kuntze
 Ba'ileu, see *Fimbristylis ferruginea* (L.) Vahl
 Bajang, see *Intsia bijuga* (Colebr.) Kuntze
 Bajongbong, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Bakau Hitam, see *Rhizophora mucronata* Lamk.
 Bakau Hitam, see *Rhizophora stylosa* Griff.
 Bakau Korap, see *Rhizophora mucronata* Lamk.
 Bakau Korap, see *Rhizophora stylosa* Griff.
 Bakau Merah, see *Rhizophora mucronata* Lamk.
 Bakau Merah, see *Rhizophora stylosa* Griff.
 Bakau Tampusing, see *Bruguiera sexangula* (Lour.) Poir.
 Bakau, see *Bruguiera exaristata* Ding Hou
 Bakong, see *Crinum asiaticum* L.
 Bakung, see *Crinum asiaticum* L.
 Balam Timah, see *Planchonella obovata* (R.Br.) Pierre.
 Balang, see *Heritiera littoralis* Dryand.
 Balim-balim, see *Ipomoea pes-capre* (L.) Sweet.
 Bampesu, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Bangka Itam, see *Rhizophora mucronata* Lamk.
 Bangka Itam, see *Rhizophora stylosa* Griff.
 Bangka Minyak, see *Rhizophora apiculata* Bl.
 Bangkita, see *Rhizophora apiculata* Bl.
 Bangkong, see *Pongamia pinnata* (L.) Pierre
 Bara laut, see *Cordia subcordata* Lam.
 Barak Laut, see *Cassine viburnifolia* (Juss.) Ding Hou
 Barang-barang, see *Drynaria sparsisora* (Desv.) Moore
 Barat Barat, see *Cassine viburnifolia* (Juss.) Ding Hou
 Baru galang, see *Melaleuca cajuputi* Roxb.
 Baru laut, see *Thespesia populnea* (L.) Soland. ex Correa
 Baru, see *Hibiscus tiliaceus* L.
 Batai Laut, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Batai, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Batang Lampung, see *Scaevola taccada* (Gaertn.) Roxb.
 Batin-batin, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Bawang Hutan, see *Crinum asiaticum* L.
 Bawuntulon, see *Scaevola taccada* (Gaertn.) Roxb.
 Bebawangan, see *Scirpus grossus* Linné
 Bebira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Bekil, see *Lasia spinosa* (L.) Thwaites
 Belangan, see *Scolopia macrophylla* (W. & A.) Clos
 Belibu, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Belohila, see *Heritiera littoralis* Dryand.
 Belukap, see *Rhizophora mucronata* Lamk.
 Belukap, see *Rhizophora stylosa* Griff.
 Beluntas, see *Pluchea indica* (L.) Less

Bendan, see *Derris scandens* (Aubl.) Pittier
 Bendoh, see *Entada phaseoloides* (L.) Merr.
 Bengkak, see *Hernandia ovigera* L.
 Bengkudu, see *Morinda citrifolia* L.
 Beowa, see *Terminalia catappa* L.
 Beruwas Laut, see *Scaevola taccada* (Gaertn.) Roxb.
 Beureum, see *Eleocharis dulcis* (Burm. f.) Henschel
 Beus, see *Kandelia candel* (L.) Druce
 Bhalang tambal, see *Entada phaseoloides* (L.) Merr.
 Bhalang, see *Entada phaseoloides* (L.) Merr.
 Bhunjok, see *Nypa fruticans* Wurmb.
 Bidada, see *Sonneratia alba* J.E. Smith
 Bidada, see *Sonneratia caseolaris* (L.) Engl.
 Bidara laut, see *Ximenia americana* L.
 Bidara, see *Ximenia americana* L.
 Bidaro, see *Ximenia americana* L.
 Bido-bido, see *Ceriops decandra* (Griff.) Ding Hou
 Bido-bido, see *Ceriops tagal* (Perr.) C.B. Rob.
 Biet, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Bilu Tasi, see *Cerbera manghas* L.
 Bilu Tasi, see *Cerbera odollam* Gaertn.
 Binasi, see *Planchonella obovata* (R.Br.) Pierre.
 Bingalo, see *Viscum ovalifolium* DC.
 Binong laut, see *Hernandia ovigera* L.
 Bintan, see *Cerbera manghas* L.
 Bintan, see *Cerbera odollam* Gaertn.
 Bintana, see *Kleinhovia hospita* L..
 Bintangur, see *Kleinhovia hospita* L..
 Bintangur Pantai, see *Symplocos celastriifolia* Griff. ex Clarke
 Bintaro, see *Cerbera manghas* L.
 Bintaro, see *Cerbera odollam* Gaertn.
 Bintit, see *Mischocarpus sundaicus* Blume
 Bira bira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Biring jene, see *Clerodendrum inerme* (L.) Gaertn.
 Biron, see *Stachytarpheta jamaicensis* (L.) Vahl
 Bitung, see *Barringtonia asiatica* (L.) Kurz
 Blakangabu, see *Heritiera littoralis* Dryand.
 Boak, see *Avicennia alba* Blume
 Bogem, see *Sonneratia alba* J.E. Smith
 Bogem, see *Sonneratia caseolaris* (L.) Engl.
 Bogem, see *Sonneratia ovata* Back.
 Bojo, see *Scaevola taccada* (Gaertn.) Roxb.
 Bojolo, see *Scaevola taccada* (Gaertn.) Roxb.
 Bolowereke, see *Entada phaseoloides* (L.) Merr.
 Bonduc, see *Caesalpinia crista* L.
 Boppa Ceda, see *Scaevola taccada* (Gaertn.) Roxb.
 Boroslanang, see *Eleocharis spiralis* (Rottb.) R. & S.
 Buah letus, see *Ardisia elliptica* Thunberg
 Buah Pitri, see *Passiflora foetida* L.

Buah tikus, see *Passiflora foetida* L.
 Bubira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Bukolako, see *Scaevola taccada* (Gaertn.) Roxb.
 Bulangan, see *Azima sarmentosa* (Bl.) B. & H.
 Bundung, see *Scirpus grossus* Linné
 Bunga Batang, see *Wedelia biflora* (L.) DC.
 Bungan pulir, see *Passiflora foetida* L.
 Bungkangan, see *Mischocarpus sundaicus* Blume
 Burus, see *Bruguiera cylindrica* (L.) Bl.
 Bus, see *Melaleuca cajuputi* Roxb.
 Busing, see *Bruguiera sexangula* (Lour.) Poir.
 Busung, see *Bruguiera sexangula* (Lour.) Poir.
 Buta badak, see *Cerbera manghas* L.
 Buta-buta Madang, see *Cerbera manghas* L.
 Buta-buta Madang, see *Cerbera odollam* Gaertn.
 Buta-buta, see *Excoecaria agallocha* L.
 Butun Darat, see *Barringtonia racemosa* (L.) Spreng.
 Butun, see *Barringtonia asiatica* (L.) Kurz
 Buwa Goro, see *Caesalpinia bonduc* (L.) Roxb.
 Buwa Goro, see *Caesalpinia crista* L.
 Buyuk, see *Nypa fruticans* Wurmb.
 Calpong, see *Calophyllum inophyllum* L.
 Cangkudu, see *Morinda citrifolia* L.
 Cantigi, see *Pemphis acidula* J.R. & G. Forst.
 Cantinggi, see *Pemphis acidula* J.R. & G. Forst.
 Cariju, see *Entada phaseoloides* (L.) Merr.
 Cemara laut, see *Casuarina equisetifolia* L.
 Cempaga, see *Tristellateia australasiae* A. Rich.
 Cempaka hutan, see *Gardenia tubifera* Wall
 Cena, see *Cordia dichotoma* G. Forst.
 Cerlang Laut, see *Heritiera littoralis* Dryand.
 Cikai, see *Eleocharis dulcis* (Burm. f.) Henschel
 Cilekle, see *Scaevola taccada* (Gaertn.) Roxb.
 Cingam, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Cukilan, see *Allophylus cobbe* (L.) Raeusch.
 Culiket, see *Diospyros malabarica* (Descr.) Kostel.
 Dadap, see *Erythrina orientalis* (L.) Murr.
 Dalere, see *Ipomoea pes-capre* (L.) Sweet.
 Dandulit, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Dangsa, see *Phoenix paludosa* Roxb.
 Darendeng, see *Cyperus malaccensis* Lamk.
 Daruyu, see *Acanthus ilicifolius* L.
 Dau, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Daun kambing, see *Premna obtusifolia* R. Br.
 Daun korpa, see *Dischidia benghalensis* Colebr.
 Daun pitis kecil, see *Dischidia benghalensis* Colebr.
 Daun Pitis Kecil, see *Dischidia nummularia* R.Br.
 Daun puyu, see *Salacia chinensis* L.
 Daun saga, see *Abrus precatorius* L.

Da-usa, see *Crinum asiaticum* L.
 Dekeng, see *Eleocharis dulcis* (Burm. f.) Henschel
 Dekeng, see *Cyperus javanicus* Houtt.
 Delima hutan, see *Gardenia tubifera* Wall
 Dempul Lelet Gajah, see *Glochidion littorale* Bl.
 Dempul, see *Glochidion littorale* Bl.
 Dingkaran, see *Calophyllum inophyllum* L.
 Donggo Akit, see *Rhizophora apiculata* Bl.
 Dongoh Korap, see *Rhizophora mucronata* Lamk.
 Dongoh Korap, see *Rhizophora stylosa* Griff.
 Duduk Agung, see *Aegiceras corniculatum* (L.) Blanco
 Duduk Agung, see *Lumnitzera littorea* (Jack) Voigt.
 Duduk Gedeh, see *Lumnitzera littorea* (Jack) Voigt.
 Duduk Laki-laki, see *Lumnitzera racemosa* Willd.
 Duduk Perempuan, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Duduk, see *Lumnitzera racemosa* Willd.
 Dudul Rayap, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Dudulan, see *Scaevola taccada* (Gaertn.) Roxb.
 Dulang jai, see *Ricinus communis* L.
 Dulok-dulok, see *Osbornia octodonta* F.v.Muell.
 Dumpajang, see *Terminalia catappa* L.
 Dungu, see *Heritiera littoralis* Dryand.
 Dungun air, see *Brownlowia tersa* (L.) Kosterm.
 Dungun laut, see *Heritiera littoralis* Dryand.
 Dungun, see *Heritiera littoralis* Dryand.
 Dunuko, see *Vitex ovata* Thunb.
 Embet, see *Typha angustifolia* Linné
 Endong, see *Eleocharis spiralis* (Rottb.) R. & S.
 Endong, see *Scirpus litoralis* Schrad.
 Fala, see *Cordia subcordata* Lam.
 Fana, see *Cordia subcordata* Lam.
 Fanasa, see *Ardisia elliptica* Thunberg
 Fau, see *Hibiscus tiliaceus* L.
 Fete-fete, see *Crinum asiaticum* L.
 Fikus, see *Ficus microcarpa* L.f.
 Fojet, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Gabus Cina, see *Scaevola taccada* (Gaertn.) Roxb.
 Gabus, see *Scaevola taccada* (Gaertn.) Roxb.
 Gabusan, see *Scaevola taccada* (Gaertn.) Roxb.
 Gadel, see *Derris trifoliata* Lour
 Gagabusan, see *Scaevola taccada* (Gaertn.) Roxb.
 Gajam, see *Inocarpus fagifer* (Parkinson) Fosb.
 Gajang, see *Inocarpus fagifer* (Parkinson) Fosb.
 Gajonggong, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Galala, see *Erythrina orientalis* (L.) Murr.
 Gali-gali, see *Lasia spinosa* (L.) Thwaites.
 Galumi, see *Vitex ovata* Thunb.
 Gambir ayer, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Gambir laut, see *Clerodendrum inerme* (L.) Gaertn.

Gandu, see *Entada phaseoloides* (L.) Merr.
 Ganggeng, see *Najas indica* (Willd.) Cham.
 Gasep, see *Inocarpus fagifer* (Parkinson) Fosb.
 Gatep Pahit, see *Quassia indica* (Gaertn.) Nooteboom
 Gayamu, see *Inocarpus fagifer* (Parkinson) Fosb.
 Gegambo, see *Passiflora foetida* L.
 Geida, see *Cyperus malaccensis* Lamk.
 Gelala, see *Erythrina orientalis* (L.) Murr.
 Gelam, see *Melaleuca cajuputi* Roxb.
 Geriting, see *Lumnitzera littorea* (Jack) Voigt.
 Gigi Gajah, see *Aegiceras corniculatum* (L.) Blanco
 Gikirintangan, see *Cynodon dactylon* (L.) Pers.
 Gilitopa, see *Scaevola taccada* (Gaertn.) Roxb.
 Glagah Asu, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Gli-gli, see *Lasia spinosa* (L.) Thwaites
 Gloah, see *Ricinus communis* L.
 Goboel, see *Derris scandens* (Aubl.) Pittier
 Gogopoa, see *Cycas rumphii* Miq.
 Goleng, see *Mischocarpus sundaicus* Blume
 Goro-goro Raci, see *Excoecaria agallocha* L.
 Goro-goro, see *Cerbera manghas* L.
 Goro-goro, see *Cerbera odollam* Gaertn.
 Grintangan, see *Cynodon dactylon* (L.) Pers.
 Gumi Guraci, see *Cassytha filiformis* Linn.
 Gumulong, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Haha, see *Batis argillicola* van Royen
 Hapo-hapo, see *Hernandia ovigera* L.
 Harendong, see *Melastoma malabathricum* var. *malabathricum* L.
 Haruna, see *Guettarda speciosa* Linn.
 Hata Diuk, see *Acrostichum aureum* Linné
 Hau Kolo, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Heikre, see *Typha angustifolia* Linné
 Hirang Krama, see *Cathormion umbellatum* (M.Vahl.) Kosterm.
 Hokal, see *Scaevola taccada* (Gaertn.) Roxb.
 Hutu, see *Barringtonia asiatica* (L.) Kurz
 Inggolom, see *Melaleuca cajuputi* Roxb.
 Ipi, see *Intsia bijuga* (Colebr.) Kuntze
 Ipil, see *Intsia bijuga* (Colebr.) Kuntze
 Ipilo, see *Intsia bijuga* (Colebr.) Kuntze
 Ipus in cawok, see *Entada phaseoloides* (L.) Merr.
 Irono Ngelak, see *Melaleuca cajuputi* Roxb.
 Iwal, see *Hibiscus tiliaceus* L.
 Jabai, see *Ficus microcarpa* L.f.
 Jabal, see *Cerbera manghas* L.
 Jabal, see *Cerbera odollam* Gaertn.
 Jaga, see *Barringtonia asiatica* (L.) Kurz
 Jampak luyak, see *Derris pinnata* (Lour.) Prain
 Jankar, see *Rhizophora apiculata* Bl.
 Jankar, see *Rhizophora mucronata* Lamk.

Jankar, see *Rhizophora stylosa* Griff.
 Jarak kosta, see *Ricinus communis* L.
 Jarak, see *Ricinus communis* L.
 Jaran Pelok, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Jaranan, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Jarang, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Jarang, see *Ricinus communis* L.
 Jarong, see *Stachytarpheta jamaicensis* (L.) Vahl
 Jarongan lalaki, see *Stachytarpheta jamaicensis* (L.) Vahl
 Jarongan, see *Stachytarpheta jamaicensis* (L.) Vahl
 Jati Pasir, see *Guettarda speciosa* Linn.
 Jejawi, see *Ficus microcarpa* L.f.
 Jekeng, see *Cyperus compactus* Retz.
 Jekeng, see *Cyperus javanicus* Houtt.
 Jengkok, see *Planchonella obovata* (R.Br.) Pierre.
 Jeraman, see *Glochidion littorale* Bl.
 Jeruju, see *Acanthus ebracteatus* Vahl.
 Jeruju, see *Acanthus ilicifolius* L.
 Jerukan, see *Acronychia pedunculata* (L.) Miq.
 Jingalo, see *Viscum ovalifolium* DC.
 Joa-joa dowongi, see *Canavalia maritima* Thouars
 Jomba, see *Xylocarpus granatum* Koen.
 Kaap, see *Passiflora foetida* L.
 Kabai-kabai, see *Ipomoea pes-capre* (L.)
 Kabar, see *Hibiscus tiliaceus* L.
 Kacang kayu laut, see *Pongamia pinnata* (L.) Pierre
 Kacang Laut, see *Canavalia maritima* Thouars
 Kaceprok, see *Passiflora foetida* L.
 Kadong, see *Cerbera manghas* L.
 Kadong, see *Cerbera odollam* Gaertn.
 Kailau, see *Rhizophora apiculata* Bl.
 Kajang-kajang, see *Crinum asiaticum* L.
 Kajeng Kapal, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kaju Ambong, see *Scaevola taccada* (Gaertn.) Roxb.
 Kaju Pelok, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kaju Pelumping, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kala Keok, see *Acrostichum aureum* Linné
 Kalak Kambing, see *Finlaysonia obovata* Wall.
 Kalapa tiyung, see *Horsfieldia irya* (Gaertn.) Warb.
 Kalapinrang, see *Excoecaria agallocha* L.
 Kalembeba, see *Entada phaseoloides* (L.) Merr.
 Kalikih alang, see *Ricinus communis* L.
 Kalumagus, see *Rhizophora apiculata* Bl.
 Kambing-kambing, see *Sarcolobus globosus* Wall.
 Kampis, see *Hernandia ovigera* L.
 Kamulut, see *Derris trifoliata* Lour
 Kandeka, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Kangkong Laut, see *Ipomoea gracilis* R. Br.
 Kaniker, see *Caesalpinia bonduc* (L.) Roxb.

Kaniker, see *Caesalpinia crista* L.
 Kanonang, see *Cordia dichotoma* G. Forst.
 Kapal, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kapo-kapo, see *Glochidion littorale* Bl.
 Karamunting, see *Ochthocharis bornensis* Bl.
 Kasjanaf, see *Hibiscus tiliaceus* L.
 Kasongket, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Katang-katang, see *Ipomoea pes-capre* (L.) Sweet.
 Katé-katé, see *Caesalpinia bonduc* (L.) Roxb.
 Katé-katé, see *Caesalpinia crista* L.
 Kateng, see *Cynometra iripa* Kostel.
 Kateng, see *Cynometra ramiflora* L.
 Kati-kati, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Katimaga, see *Kleinhovia hospita* L..
 Katimaha, see *Kleinhovia hospita* L..
 Katimahar, see *Kleinhovia hospita* L..
 Kaya Kil, see *Olax imbricata* Roxb.
 Kayu Besi Ambon, see *Intsia bijuga* (Colebr.) Kuntze
 Kayu Bulan, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Kayu buta, see *Excoecaria agallocha* L.
 Kayu buta, see *Excoecaria agallocha* L.
 Kayu Jaran Binek, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kayu Jaran, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kayu Jiharan, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kayu Juwok, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Kayu keramat, see *Podocarpus polystachyus* R.Br. ex Endl.
 Kayu Kuda, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kayu Kurita, see *Cerbera manghas* L.
 Kayu Kurita, see *Cerbera odollam* Gaertn.
 Kayu lampiko, see *Ardisia elliptica* Thunberg
 Kayu Pahit, see *Quassia indica* (Gaertn.) Nooteboom
 Kayu pel, see *Cynometra iripa* Kostel
 Kayu Pel, see *Cynometra ramiflora* L.
 Kayu puti, see *Melaleuca cajuputi* Roxb.
 Kayu Semidra, see *Acronychia pedunculata* (L.) Miq.
 Kayu Semilit, see *Pachycentria constricta* (Bl.) Blume
 Kayu sentigi, see *Pemphis acidula* J.R. & G. Forst.
 Kayu Sila, see *Aegiceras corniculatum* (L.) Blanco
 Kayu Susu, see *Cerbera manghas* L.
 Kayu Susu, see *Cerbera odollam* Gaertn.
 Kayu Tahun, see *Kleinhovia hospita* L..
 Kayu Tanyong, see *Symplocos celastriifolia* Griff. ex Clarke
 Kayu tulak, see *Gardenia tubifera* Wall
 Kayu urum, see *Mischocarpus sundaicus* Blume
 Kayu Wuta, see *Excoecaria agallocha* L.
 Keben-keben, see *Barringtonia asiatica* (L.) Kurz
 Kecipir, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Kedabu, see *Sonneratia ovata* Back.
 Kedot, see *Cyperus malaccensis* Lamk.

Kekara Laut, see *Canavalia maritima* Thouars
 Kekara pedang, see *Canavalia maritima* Thouars
 Keladi Payau, see *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott
 Keladi, see *Colocasia esculenta* (L.) Schott
 Kelaju, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kelepis, see *Quassia indica* (Gaertn.) Nooteboom
 Kemadean, see *Dendrophthoe pentandra* (L.) Miq.
 Kemaduhan, see *Macrosolen cochinchinensis* (Lour.) Tiegh.
 Kemalahala, see *Salicornia indica* Willd.
 Kemanden, see *Melastoma malabathricum* var. *malabathricum* L.
 Kembang bugang, see *Clerodendrum inerme* (L.) Gaertn.
 Kemlandean, see *Dendrophthoe pentandra* (L.) Miq.
 Kemrournggi, see *Caesalpinia bonduc* (L.) Roxb.
 Kemrournggi, see *Caesalpinia crista* L.
 Kena, see *Cordia subcordata* Lam.
 Kendal, see *Cordia dichotoma* G. Forst.
 Kendung, see *Symplocos celastriifolia* Griff. ex Clarke
 Keneas, see *Pemphis acidula* J.R. & G. Forst.
 Keneras, see *Allophylus cobbe* (L.) Raeusch.
 Kenyang-kenyang, see *Guettarda speciosa* Linn.
 Kenyen Putih, see *Cerbera odollam* Gaertn.
 Kenyeri Putih, see *Cerbera odollam* Gaertn.
 Kepala Berok, see *Hydnophytum formicarum* Jack
 Kepel, see *Cynometra iripa* Kostel.
 Kepel, see *Cynometra ramiflora* L.
 Keptun, see *Barringtonia asiatica* (L.) Kurz
 Ketapang, see *Terminalia catappa* L.
 Ketapas, see *Terminalia catappa* L.
 Keterung, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Ketowang, see *Ricinus communis* L.
 Ketumbang, see *Glochidion littorale* Bl.
 Ketuwer, see *Clerodendrum inerme* (L.) Gaertn.
 Ki Arak, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Ki howe, see *Mischocarpus sundaicus* Blume
 Ki Jaran, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Ki Pahang Laut, see *Pongamia pinnata* (L.) Pierre
 Ki putri, see *Podocarpus polystachyus* R.Br. ex Endl.
 Ki salira, see *Acronychia pedunculata* (L.) Miq.
 Kiei, see *Brownlowia argentata* Kurz.
 Kikisa, see *Cyperus javanicus* Houtt.
 Kilaula, see *Terminalia catappa* L.
 Kisokka, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Kiu Tasi, see *Cathormion umbellatum* (M.Vahl.) Kosterm.
 Kleca, see *Diospyros malabarica* (Descr.) Kostel.
 Klega, see *Diospyros malabarica* (Descr.) Kostel.
 Klengkeng, see *Caesalpinia bonduc* (L.) Roxb.
 Klengkeng, see *Caesalpinia crista* L.
 Klihi, see *Terminalia catappa* L.
 Klimasada, see *Cordia subcordata* Lam.

Klindo, see *Scaevola taccada* (Gaertn.) Roxb.
 Klis, see *Terminalia catappa* L.
 Kluruk, see *Melastoma malabathricum* var. *malabathricum* L.
 Knadate, see *Cordia dichotoma* G. Forst.
 Knias, see *Lumnitzera racemosa* Willd.
 Koak, see *Avicennia alba* Blume
 Kodokan, see *Fimbristylis cymosa* R. Br.
 Kodokan, see *Fimbristylis ferruginea* (L.) Vahl
 Koi a koi, see *Clerodendrum inerme* (L.) Gaertn.
 Kokole, see *Scaevola taccada* (Gaertn.) Roxb.
 Kokrok, see *Flagellaria indica* L.
 Korma Rawa, see *Phoenix paludosa* Roxb.
 Koyandan, see *Cerbera odollam* Gaertn.
 Krajep, see *Trianthema portulacastrum* L.
 Krakas, see *Acrostichum aureum* Linné
 Kranji, see *Pongamia pinnata* (L.) Pierre
 Krokot, see *Sesuvium portulacastrum* (L.) L.
 Krokot, see *Trianthema portulacastrum* L.
 Krunjing, see *Symplocos celastriifolia* Griff. ex Clarke
 Kruppe, see *Anamirta cocculus* L. Wight & Arn.
 Kubaing, see *Combretum trifoliatum* Vent.
 Kuda-kuda, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kudo-kudo Uwi, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kulimbabok, see *Symplocos celastriifolia* Griff. ex Clarke
 Kumbu, see *Cyperus malaccensis* Lamk.
 Kumpai Lubang, see *Lycopodium carinatum* Desv.
 Kungkungan, see *Barringtonia racemosa* (L.) Spreng.
 Kutuk, see *Caesalpinia bonduc* (L.) Roxb.
 Kutuk, see *Caesalpinia crista* L.
 Kwakatehi, see *Rysopterys timoriensis* (DC.) Jussieu
 Lagundi, see *Vitex ovata* Thunb.
 Lalang-kapan, see *Wedelia biflora* (L.) DC.
 Lambaran, see *Cathormion umbellatum* (M.Vahl.) Kosterm.
 Lambideing, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Lampeni, see *Ardisia elliptica* Thunberg
 Lamutasi, see *Pluchea indica* (L.) Less
 Lana-lana, see *Ricinus communis* L.
 Landing-landing, see *Cassine viburnifolia* (Juss.) Ding Hou
 Langgade, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Lantolo, see *Cordia dichotoma* G. Forst.
 Lau bintang, see *Aerides odoratum* Reinw. ex Blume
 Lau pandan, see *Cymbidium finlaysonianum* Wall ex Lindl.
 Lawanan Kete, see *Heritiera littoralis* Dryand.
 Lawang, see *Heritiera littoralis* Dryand.
 Lawarani, see *Vitex ovata* Thunb.
 Lemanas, see *Passiflora foetida* L.
 Lemiding, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Lempeni, see *Ardisia elliptica* Thunberg
 Lempoyan Paya, see *Horsfieldia irya* (Gaertn.) Warb.

Lenabou, see *Pluchea indica* (L.) Less
 Lenggadai, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Lenggayong, see *Rhizophora mucronata* Lamk.
 Lenggayong, see *Rhizophora stylosa* Griff.
 Lenteng, see *Olex imbricata* Roxb.
 Libung, see *Oncosperma tigillarium* (Jack.) Ridl.
 Lilanga, see *Drynaria sparsisora* (Desv.) Moore
 Lilegundi, see *Vitex ovata* Thunb.
 Lindur, see *Bruguiera cylindrica* (L.) Bl.
 Lindur, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Lindur, see *Bruguiera sexangula* (Lour.) Poir.
 Lingi, see *Scirpus grossus* Linné
 Lingkaren, see *Calophyllum inophyllum* L.
 Lipa, see *Nypa fruticans* Wurmmb.
 Lisa, see *Terminalia catappa* L.
 Lolaro, see *Rhizophora mucronata* Lamk.
 Lolaro, see *Rhizophora stylosa* Griff.
 Loleso, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Loloro, see *Ipomoea pes-capre* (L.) Sweet.
 Lom, see *Cathormion umbellatum* (M.Vahl.) Kosterm.
 Lomo, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Lulang, see *Ricinus communis* L.
 Luluk, see *Ricinus communis* L.
 Lulun, see *Heritiera littoralis* Dryand.
 Lumpui, see *Flagellaria indica* L.
 Lumut Siarang, see *Najas indica* (Willd.) Cham.
 Lutur bal, see *Ricinus communis* L.
 Luumpoyang, see *Terminalia catappa* L.
 Ma Gorago, see *Lumnitzera littorea* (Jack) Voigt.
 Machlana, see *Hernandia ovigera* L.
 Mahandap, see *Hernandia ovigera* L.
 Mahar, see *Kleinhovia hospita* L..
 Makasuta, see *Excoecaria agallocha* L.
 Makente, see *Entada phaseoloides* (L.) Merr.
 Makusi, see *Diospyros malabarica* (Descr.) Kostel.
 Malabira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Malegai, see *Barringtonia racemosa* (L.) Spreng.
 Malur, see *Suaeda maritima* (L.) Dum.
 Mampapu, see *Cordia dichotoma* G. Forst.
 Mangandeauh, see *Macrosolen cochinchinensis* (Lour.) Tiegh.
 Mangandeuh, see *Dendrophthoe pentandra* (L.) Miq.
 Mangar, see *Kleinhovia hospita* L..
 Mangga Brabu, see *Cerbera manghas* L.
 Mangga Brabu, see *Cerbera odollam* Gaertn.
 Mangi-mangi Putih, see *Avicennia alba* Blume
 Mangkinang Tikus, see *Symplocos celastriifolia* Griff. ex Clarke
 Manonang, see *Cordia dichotoma* G. Forst.
 Manor utan, see *Clerodendrum inerme* (L.) Gaertn.
 Manuru dowongi, see *Clerodendrum inerme* (L.) Gaertn.

Mapopo, see *Hernandia ovigera* L.
 Marauwen, see *Pongamia pinnata* (L.) Pierre
 Marong, see *Scolopia macrophylla* (W. & A.) Clos
 Mas Semasan, see *Cassytha filiformis* Linn.
 Mata Buaya, see *Bruguiera sexangula* (Lour.) Poir.
 Mata Huli, see *Excoecaria agallocha* L.
 Mata ikan, see *Hernandia ovigera* L.
 Mata Kijang, see *Caesalpinia bonduc* (L.) Roxb.
 Mata Kijang, see *Caesalpinia crista* L.
 Matonda, see *Asplenium nidus* Linné
 Mawiao, see *Hernandia ovigera* L.
 Mayu serai, see *Podocarpus polystachyus* R.Br. ex Endl.
 Medang geliser, see *Gardenia tubifera* Wall
 Mekudu, see *Morinda citrifolia* L.
 Melabira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Melat, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Mempenai, see *Cassine viburnifolia* (Juss.) Ding Hou
 Menengan, see *Excoecaria agallocha* L.
 Mengelangan, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Mengkuang, see *Pandanus tectorius* Sol
 Mengkudu, see *Morinda citrifolia* L.
 Mentigi, see *Pemphis acidula* J.R. & G. Forst.
 Merbau cangkat, see *Intsia bijuga* (Colebr.) Kuntze
 Merbau, see *Intsia bijuga* (Colebr.) Kuntze
 Meta Pelandok, see *Cassine viburnifolia* (Juss.) Ding Hou
 Miding, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Migin, see *Brownlowia argentata* Kurz.
 Miju, see *Barringtonia asiatica* (L.) Kurz
 Mojong Tihulu, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Moju, see *Barringtonia asiatica* (L.) Kurz
 Mokal, see *Scaevola taccada* (Gaertn.) Roxb.
 Molowahu, see *Hibiscus tiliaceus* L.
 Monot-bonot, see *Osbornia octodonta* F.v.Muell.
 Moteti, see *Passiflora foetida* L.
 Murmasada, see *Cordia subcordata* Lam.
 Namu-namu utan, see *Cynometra iripa* Kostel.
 Namu-namu Utan, see *Cynometra ramiflora* L.
 Nawoko ma lako, see *Hernandia ovigera* L.
 Ngadi renga, see *Stachytarpheta jamaicensis* (L.) Vahl
 Ngoa, see *Erythrina orientalis* (L.) Murr.
 Niangka, see *Scaevola taccada* (Gaertn.) Roxb.
 Nibong, see *Oncosperma tigillarium* (Jack.) Ridl
 Nibung, see *Oncosperma tigillarium* (Jack.) Ridl.
 Nipah, see *Nypa fruticans* Wurmb.
 Niri Batu, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Niri, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Nonang, see *Cordia dichotoma* G. Forst.
 Nonwai tasi, see *Cordia subcordata* Lam.
 Nopu, see *Crinum asiaticum* L.

Nunang, see *Cordia dichotoma* G. Forst.
 Nyalako, see *Hernandia ovigera* L.
 Nyalu, see *Hernandia ovigera* L.
 Nyambing, see *Lasia spinosa* (L.) Thwaites
 Nyamplung, see *Calophyllum inophyllum* L.
 Nyatoh labar, see *Planchonella obovata* (R.Br.) Pierre.
 Nyatoh lamber, see *Planchonella obovata* (R.Br.) Pierre.
 Nyireh, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Nyiri Gundik, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Nyiri Hutan, see *Xylocarpus granatum* Koen.
 Nyiri Udang, see *Xylocarpus granatum* Koen.
 Nyuru, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Olas Mea, see *Ryssopterys timoriensis* (DC.) Jussieu
 Onne, see *Quassia indica* (Gaertn.) Nooteboom
 Onunang, see *Cordia dichotoma* G. Forst.
 Owar, see *Flagellaria indica* L.
 Oyod Kambing, see *Finlaysonia obovata* Wall.
 Oyod peron, see *Anamirta cocculus* L. Wight & Arn.
 Oyod sambaing, see *Derris pinnata* (Lour.) Prain
 Pacean, see *Passiflora foetida* L.
 Paceda, see *Scaevola taccada* (Gaertn.) Roxb.
 Padang Kawat, see *Cynodon dactylon* (L.) Pers.
 Padang Lepas, see *Cynodon dactylon* (L.) Pers.
 Pagoro, see *Eleocharis dulcis* (Burm. f.) Henschel
 Pake Saukatibu, see *Merrilliodendron megacarpum* (Hemsl.) Sleum.
 Pakis Bang, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Pakis Dongol, see *Cycas rumphii* Miq.
 Pakis Duitan, see *Drymoglossum piloselloides* (Linn.) Presl.
 Pakis Gajah, see *Cycas rumphii* Miq.
 Pakis Haji, see *Cycas rumphii* Miq.
 Pakis Laut, see *Cycas rumphii* Miq.
 Pakis Menjangan, see *Platynerium coronarium* (Koenig.) Desv.
 Pakis Raja, see *Cycas rumphii* Miq.
 Pakis sarang semut, see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito
 Pakis Tanduk Rusah, see *Platynerium coronarium* (Koenig.) Desv.
 Paku Cacing, see *Phymatodes scolopendria* (Burm.) Ching.
 Paku haji, see *Cycas rumphii* Miq.
 Paku hata, see *Acrostichum aureum* Linné
 Paku Hurang, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku kawat, see *Lycopodium carinatum* Desv.
 Paku Kayakas, see *Drynaria rigidula* (Sw.) Bedd.
 Paku Latig Layangan, see *Drynaria sparsisora* (Desv.) Moore
 Paku Laut, see *Acrostichum aureum* Linné
 Paku layang layang, see *Drynaria sparsisora* (Desv.) Moore
 Paku Lumut Batu, see *Davallia parvula* Wall. ex Hook. & Grev.
 Paku Ramiding, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku sarang burung, see *Asplenium nidus* Linné
 Paku Tjaj, see *Acrostichum aureum* Linné
 Paku ton, see *Ricinus communis* L.

Paku Ular, see *Phymatodes scolopendria* (Burm.) Ching.
 Palas duri, see *Licuala spinosa* Wurmmb.
 Palas, see *Licuala spinosa* Wurmmb.
 Palawan, see *Combretum trifoliatum* Vent.
 Palun, see *Ceriops decandra* (Griff.) Ding Hou
 Palun, see *Ceriops tagal* (Perr.) C.B. Rob.
 Palungpung, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Pamuli, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Pancal, see *Planchonella obovata* (R.Br.) Pierre.
 Pandan nipah, see *Pandanus tectorius* Sol
 Pandan pudak, see *Pandanus tectorius* Sol
 Pandaram Boheng, see *Inocarpus fagifer* (Parkinson) Fosb.
 Pangoke, see *Eleocharis dulcis* (Burm. f.) Henschel
 Panimburana, see *Scaevola taccada* (Gaertn.) Roxb.
 Panimburang, see *Scaevola taccada* (Gaertn.) Roxb.
 Papa Blung, see *Cycas rumphii* Miq.
 Papaceda, see *Scaevola taccada* (Gaertn.) Roxb.
 Papajaran, see *Azima sarmentosa* (Bl.) B. & H.
 Parai, see *Rhizophora apiculata* Bl.
 Parongpong, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Parun, see *Ceriops decandra* (Griff.) Ding Hou
 Parun, see *Ceriops tagal* (Perr.) C.B. Rob.
 Pasilan kelapa, see *Drynaria rigidula* (Sw.) Bedd.
 Pasilan, see *Dendrophthoe pentandra* (L.) Miq.
 Pasilan, see *Macrosolen cochinchinensis* (Lour.) Tiegh.
 Pasisir, see *Heritiera littoralis* Dryand.
 Patuku, see *Cycas rumphii* Miq.
 Pea-pea, see *Cyperus malaccensis* Lamk.
 Pedada, see *Sonneratia alba* J.E. Smith
 Pedada, see *Sonneratia caseolaris* (L.) Engl.
 Pelenda Laut, see *Scaevola taccada* (Gaertn.) Roxb.
 Peler kambing sejuk, see *Sarcolobus globosus* Wall.
 Peler kambing, see *Sarcolobus globosus* Wall.
 Pemandum, see *Brownlowia argentata* Kurz.
 Penarahan, see *Horsfieldia irya* (Gaertn.) Warb.
 Penggung, see *Barringtonia racemosa* (L.) Spreng.
 Penjalinan, see *Mischocarpus sundaicus* Blume
 Penjalinan, see *Scirpus litoralis* Schrad
 Peperetan, see *Eleocharis dulcis* (Burm. f.) Henschel
 Percut kuda, see *Stachytarpheta jamaicensis* (L.) Vahl
 Peredah Burung, see *Horsfieldia irya* (Gaertn.) Warb.
 Perepat Lanang, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Perepat Tudung, see *Aegiceras corniculatum* (L.) Blanco
 Perepat, see *Sonneratia alba* J.E. Smith
 Perepat, see *Sonneratia caseolaris* (L.) Engl.
 Permot, see *Passiflora foetida* L.
 Perpat Kecil, see *Aegiceras corniculatum* (L.) Blanco
 Pertut, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Perumpung, see *Phragmites karka* (Retz.) Trin. ex Steud.

Peru-peru, see *Eleocharis dulcis* (Burm. f.) Henschel
 Piai Lasa, see *Acrostichum speciosum* Willd.
 Pidada, see *Sonneratia alba* J.E. Smith
 Pidada, see *Sonneratia caseolaris* (L.) Engl.
 Pijisan, see *Drymoglossum piloselloides* (Linn.) Presl.
 Pikal, see *Abrus precatorius* L.
 Pikat, see *Entada phaseoloides* (L.) Merr.
 Piling-piling, see *Abrus precatorius* L.
 Pisang-pisang laut, see *Kandelia candel* (L.) Druce
 Piuweh, see *Gardenia tubifera* Wall
 Pohodo'elang, see *Scaevola taccada* (Gaertn.) Roxb.
 Pohon Kira-kira, see *Xylocarpus granatum* Koen.
 Pohon Soga, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Pokok Serunai, see *Wedelia biflora* (L.) DC.
 Pong-pong, see *Gluta velutina* Bl.
 Porang, see *Scaevola taccada* (Gaertn.) Roxb.
 Posi-posi Merah, see *Sonneratia caseolaris* (L.) Engl.
 Posi-posi, see *Lumnitzera littorea* (Jack) Voigt.
 Posi-posi, see *Sonneratia alba* J.E. Smith
 Pribo, see *Brownlowia argentata* Kurz.
 Prumpung, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Prumpungan, see *Cyperus compactus* Retz.
 Puang Tawang, see *Tristellateia australasiae* A. Rich.
 Pulas laut, see *Mischocarpus sundaicus* Blume
 Pulut-pulut, see *Kandelia candel* (L.) Druce
 Punaga, see *Calophyllum inophyllum* L.
 Punaga, see *Calophyllum inophyllum* L.
 Purnamasada, see *Cordia subcordata* Lam.
 Purun, see *Fimbristylis ferruginea* (L.) Vahl
 Putat Sungai, see *Barringtonia racemosa* (L.) Spreng.
 Putat, see *Barringtonia acutangula* (L.) Gaertn.
 Putat, see *Barringtonia racemosa* (L.) Spreng.
 Putut, see *Bruguiera gymnorhiza* (L.) Lamk.
 Rabut loteng, see *Derris scandens* (Aubl.) Pittier
 Rala, see *Vitex ovata* Thunb.
 Rambai Laut, see *Cassine viburnifolia* (Juss.) Ding Hou
 Rambai, see *Sonneratia caseolaris* (L.) Engl.
 Rambut Putri, see *Cassytha filiformis* Linn.
 Rampansi, see *Ardisia elliptica* Thunberg
 Randai, see *Lumnitzera littorea* (Jack) Voigt.
 Raoaimarinu, see *Ryssopterys timoriensis* (DC.) Jussieu
 Rappae-rappae, see *Clerodendrum inerme* (L.) Gaertn.
 Rapus, see *Quassia indica* (Gaertn.) Nooteboom
 Raru, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Rebha Core Koko, see *Cynodon dactylon* (L.) Pers.
 Rebha Kaproleam, see *Fimbristylis polytrichoides* (Retz.) R. Br.
 Rebha sekem-sekeman, see *Zoysia matrella* (L.) Merr.
 Reduk, see *Scirpus grossus* Linné
 Regil, see *Mischocarpus sundaicus* Blume

Remek getih, see *Stachytarpheta jamaicensis* (L.) Vahl
 Remugak, see *Passiflora foetida* L.
 Rengas Ayer, see *Gluta velutina* Bl.
 Rengas Pantai, see *Gluta velutina* Bl.
 Rengas Pendek, see *Gluta velutina* Bl.
 Rengas, see *Gluta velutina* Bl.
 Resak, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Riang Laut, see *Lumnitzera littorea* (Jack) Voigt.
 Rotan Bakau, see *Calamus erinaceus* (Becc.) Dransfield
 Rotan Dapit, see *Flagellaria indica* L.
 Rotan Dini, see *Flagellaria indica* L.
 Rotan Kroh, see *Flagellaria indica* L.
 Rotan Laki, see *Flagellaria indica* L.
 Rotan Macik, see *Flagellaria indica* L.
 Ru, see *Casuarina equisetifolia* L.
 Rukam Iaka, see *Scolopia macrophylla* (W. & A.) Clos
 Rukem Betina, see *Scolopia macrophylla* (W. & A.) Clos
 Rumah Semut Hitam, see *Hydnophytum formicarum* Jack
 Rumput asinan, see *Paspalum vaginatum* Sw.
 Rumput bilulang, see *Xerochloa imberbis* R. Br.
 Rumput Kuluwing, see *Cyperus malaccensis* Lamk.
 Rumput peking, see *Zoysia matrella* (L.) Merr.
 Rumung, see *Heritiera littoralis* Dryand.
 Rurun, see *Heritiera littoralis* Dryand.
 Sabrise, see *Terminalia catappa* L.
 Sadina, see *Terminalia catappa* L.
 Saga buncik, see *Abrus precatorius* L.
 Saga, see *Abrus precatorius* L.
 Saghakan, see *Abrus precatorius* L.
 Sakat Ribu-ribu, see *Drymoglossum piloselloides* (Linn.) Presl.
 Sakelan, see *Melaleuca cajuputi* Roxb.
 Sakot Kelembai, see *Dendrobium pachyphyllum* (O.K.) Bakh. f.
 Sala-sala, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Salimolé, see *Cordia subcordata* Lam.
 Salimuli, see *Thespesia populnea* (L.) Soland. ex Correa
 Salinsa, see *Barringtonia acutangula* (L.) Gaertn.
 Salira, see *Acronychia pedunculata* (L.) Miq.
 Sambang, see *Lasia spinosa* (L.) Thwaites
 Sambiring, see *Planchonella obovata* (R.Br.) Pierre.
 Sambuta, see *Excoecaria agallocha* L.
 Sampi, see *Lasia spinosa* (L.) Thwaites
 Sana keeling, see *Derris pinnata* (Lour.) Prain
 Sana sungu, see *Derris pinnata* (Lour.) Prain
 Sangari, see *Vitex ovata* Thunb.
 Sangga Langit, see *Cassytha filiformis* Linn.
 Sangi, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Sangir Langit, see *Cassytha filiformis* Linn.
 Sariboe, see *Corypha saribus* Lour.
 Sarirah, see *Acronychia pedunculata* (L.) Miq.

Sarisa, see *Terminalia catappa* L.
 Sarisei, see *Terminalia catappa* L.
 Saruni, see *Wedelia biflora* (L.) DC.
 Sayur kambing, see *Premna obtusifolia* R. Br.
 Sayur Kelapa, see *Cycas rumphii* Miq.
 Sekar laru, see *Stachytarpheta jamaicensis* (L.) Vahl
 Semur, see *Crinum asiaticum* L.
 Sendudok Air, see *Ochthocharis bornensis* Bl.
 Senduduk, see *Melastoma malabathricum* var. *malabathricum* L.
 Senggani, see *Melastoma malabathricum* var. *malabathricum* L.
 Sentigi, see *Pemphis acidula* J.R. & G. Forst.
 Senumpol, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Sepang, see *Combretum trifoliatum* Vent.
 Serdang, see *Corypha saribus* Lour.
 Seremai, see *Wedelia biflora* (L.) DC.
 Serilang, see *Acronychia pedunculata* (L.) Miq.
 Sernai, see *Wedelia biflora* (L.) DC.
 Serunai Laut, see *Wedelia biflora* (L.) DC.
 Seruni, see *Wedelia biflora* (L.) DC.
 Sesak, see *Lumnitzera littorea* (Jack) Voigt.
 Sesiil, see *Barringtonia racemosa* (L.) Spreng.
 Sesira, see *Acronychia pedunculata* (L.) Miq.
 Sesop, see *Lumnitzera littorea* (Jack) Voigt.
 Seyawu saloyon, see *Ipomoea gracilis* R. Br.
 Siba-siba, see *Cycas rumphii* Miq.
 Sicancang, see *Allophylus cobbe* (L.) Raeusch.
 Sijangè, see *Allophylus cobbe* (L.) Raeusch.
 Silu Tasi, see *Pemphis acidula* J.R. & G. Forst.
 Simaralah, see *Horsfieldia irya* (Gaertn.) Warb.
 Simbar Layangan, see *Drynaria rigidula* (Sw.) Bedd.
 Simbar Layangan, see *Drynaria sparsisora* (Desv.) Moore
 Simbar menjangan, see *Platyserium coronarium* (Koenig.) Desv.
 Simbar, see *Drynaria sparsisora* (Desv.) Moore
 Simbole, see *Entada phaseoloides* (L.) Merr.
 Simpuru, see *Lophopyxis maingayi* Hook.f.
 Sira, see *Intsia bijuga* (Colebr.) Kuntze
 Sirisal, see *Terminalia catappa* L.
 Siron, see *Hibiscus tiliaceus* L.
 Sisik Naga, see *Drymoglossum piloselloides* (Linn.) Presl.
 Siureuh, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Sobi, see *Derris scandens* (Aubl.) Pittier
 Soga, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Sompini, see *Caesalpinia bonduc* (L.) Roxb.
 Sompini, see *Caesalpinia crista* L.
 Songsong Harus, see *Combretum tetralophum* Clarke
 Sono keling, see *Derris pinnata* (Lour.) Prain
 Sosa, see *Cyperus javanicus* Hoult.
 Subang-subang, see *Scaevola taccada* (Gaertn.) Roxb.
 Subeng-subeng, see *Scaevola taccada* (Gaertn.) Roxb.

Suket Dem, see *Cyperus malaccensis* Lamk.
 Suket Dot, see *Fimbristylis ferruginea* (L.) Vahl
 Suket Godokan, see *Fimbristylis ferruginea* (L.) Vahl
 Suket Grinting, see *Cynodon dactylon* (L.) Pers.
 Suket, see *Cyperus compactus* Retz.
 Sulang Watu, see *Fimbristylis cymosa* R. Br.
 Sungsung Arus, see *Combretum tetralophum* Clarke
 Susong Harus, see *Combretum tetralophum* Clarke
 Susung Arus, see *Combretum tetralophum* Clarke
 Taburuh, see *Lophopyxis maingayi* Hook.f.
 Taheup, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Talas, see *Colocasia esculenta* (L.) Schott
 Tales, see *Colocasia esculenta* (L.) Schott
 Tali Putri, see *Cassytha filiformis* Linn.
 Tali Sasawi, see *Lophopyxis maingayi* Hook.f.
 Talise, see *Barringtonia asiatica* (L.) Kurz
 Talisei, see *Terminalia catappa* L.
 Tangar, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tangkal Daon, see *Nypa fruticans* Wurmb.
 Tangkele, see *Kleinhovia hospita* L..
 Taning bajang, see *Abrus precatorius* L.
 Tanjang, see *Bruguiera cylindrica* (L.) Bl.
 Tanjang, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Tanjang, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Tanjang, see *Bruguiera sexangula* (Lour.) Poir.
 Tanjang Sukim, see *Bruguiera cylindrica* (L.) Bl.
 Tanjong Jawa, see *Symplocos celastriifolia* Griff. ex Clarke
 Tanjong-tanjong, see *Symplocos celastriifolia* Griff. ex Clarke
 Taruntung, see *Lumnitzera littorea* (Jack) Voigt.
 Tasi, see *Guettarda speciosa* Linn.
 Tasi, see *Terminalia catappa* L.
 Tatampayan besar, see *Ipomoea tuba* Schlechtend.
 Tatepal, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Tatupele, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Tualis, see *Osbornia octodonta* F.v.Muell.
 Tawi, see *Symplocos celastriifolia* Griff. ex Clarke
 Tekere, see *Eleocharis dulcis* (Burm. f.) Henschel
 Teki Parang, see *Fimbristylis cymosa* R. Br.
 Teki Tike, see *Eleocharis dulcis* (Burm. f.) Henschel
 Teki, see *Eleocharis dulcis* (Burm. f.) Henschel
 Tekurung, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Telekan, see *Trianthema portulacastrum* L.
 Temahau, see *Kleinhovia hospita* L..
 Temampapu, see *Cordia dichotoma* G. Forst.
 Tembaga Suasa, see *Crinum asiaticum* L.
 Tenggel, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Teo-teo, see *Cordia dichotoma* G. Forst.
 Teruntum, see *Lumnitzera racemosa* Willd.
 Teruntun, see *Aegiceras corniculatum* (L.) Blanco

Teruntun, see *Aegiceras floridum* Roemer & Schultes
 Teruntung, see *Aegiceras corniculatum* (L.) Blanco
 Tike, see *Eleocharis dulcis* (Burm. f.) Henschel
 Tiliho, see *Terminalia catappa* L.
 Ting, see *Bruguiera sexangula* (Lour.) Poir.
 Tingi, see *Ceriops decandra* (Griff.) Ding Hou
 Tingih, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tingting, see *Combretum tetralophum* Clarke
 Titi Laut, see *Guettarda speciosa* Linn.
 Tokbrai, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Tolok, see *Inocarpus fagifer* (Parkinson) Fosb.
 Tomana, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tomatangtang, see *Cordia dichotoma* G. Forst.
 Tomo, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Tongke Perampuan, see *Bruguiera sexangula* (Lour.) Poir.
 Tongke, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Toteo, see *Cordia dichotoma* G. Forst.
 Toweran, see *Derris trifoliata* Lour
 Toyokuku, see *Diospyros malabarica* (Descr.) Kostel.
 Tuba Abal, see *Derris trifoliata* Lour
 Tuba biji, see *Anamirta cocculus* L. Wight & Arn.
 Tuba Laut, see *Derris trifoliata* Lour
 Tudung Laut, see *Aegiceras corniculatum* (L.) Blanco
 Tumu, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Tumu, see *Bruguiera sexangula* (Lour.) Poir.
 Turak, see *Dischidia nummularia* R.Br.
 Tutu pupu, see *Asplenium nidus* Linné
 Tuw, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tuwa Areuy, see *Derris trifoliata* Lour
 Tuwe-ej, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tuwung, see *Caesalpinia bonduc* (L.) Roxb.
 Tuwung, see *Caesalpinia crista* L.
 Ukayu Datu, see *Cycas rumphii* Miq.
 Urek-urek Polo, see *Hydnophytum formicarum* Jack
 Urek-urek Polo, see *Myrmecodia tuberosa* DC.
 Waba, see *Cerbera manghas* L.
 Waba, see *Cerbera odollam* Gaertn.
 Wahat Merah, see *Sonneratia caseolaris* (L.) Engl.
 Wahat Putih, see *Sonneratia alba* J.E. Smith
 Wakat Besi, see *Pemphis acidula* J.R. & G. Forst.
 Wakati, see *Hibiscus tiliaceus* L.
 Wali Ahuhun, see *Aganope heptaphylla* (L.) Polhill
 Walik elar, see *Mischocarpus sundaicus* Blume
 Walingi, see *Scirpus grossus* Linné
 Walini, see *Typha angustifolia* Linné
 Wama-wama, see *Ximenia americana* L.
 Waran pisang, see *Anamirta cocculus* L. Wight & Arn.
 Waru galang Iren, see *Melaleuca cajuputi* Roxb.
 Waru Laut, see *Hibiscus tiliaceus* L.

Waru Laut, see *Thespesia populnea* (L.) Soland. ex Correa
 Waru Lenga, see *Hibiscus tiliaceus* L.
 Waru Lengis, see *Hibiscus tiliaceus* L.
 Waru Lot, see *Hibiscus tiliaceus* L.
 Waru Lot, see *Thespesia populnea* (L.) Soland. ex Correa
 Waru Pantai, see *Thespesia populnea* (L.) Soland. ex Correa
 Waru, see *Casuarina equisetifolia* L.
 Waru, see *Hibiscus tiliaceus* L.
 Watata Ruruan, see *Ipomoea pes-capre* (L.) Sweet.
 Wawalingian, see *Typha angustifolia* Linné
 Weda, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Wegil, see *Mischocarpus sundaicus* Blume
 Welompelong, see *Lumnitzera littorea* (Jack) Voigt.
 Wesele, see *Intsia bijuga* (Colebr.) Kuntze
 Wewa, see *Terminalia catappa* L.
 Widuri, see *Calotropis gigantea* (L.) R.Br.
 Wikakas, see *Acrostichum aureum* Linné
 Wintangar, see *Kleinhovia hospita* L..
 Wintungtasi, see *Scaevola taccada* (Gaertn.) Roxb.
 Wiri salo, see *Clerodendrum inerme* (L.) Gaertn.
 Wlingen, see *Scirpus grossus* Linné
 Wlingian, see *Scirpus grossus* Linné
 Wowo, see *Flagellaria indica* L.
 Wrekas, see *Acrostichum aureum* Linné
 Wunut, see *Cynometra iripa* Kostel.
 Wunut, see *Cynometra ramiflora* L.
 Wutunu, see *Barringtonia asiatica* (L.) Kurz

Malaysian:

Akar bintong, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Akar China, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Akar Kelinci, see *Caesalpinia bonduc* (L.) Roxb.
 Akar mata pelanduk, see *Loeseneriella macrantha* (Korth.) A.C. Smith
 Akar Pengalasan, see *Cassytha filiformis* Linn.
 Akik, see *Rhizophora apiculata* Bl.
 Ambong-ambong, see *Scaevola taccada* (Gaertn.) Roxb.
 Anggrek hutan, see *Dendrobium moschatum* (Buch.-Ham.) Sw.
 Anggrek, see *Dendrobium subulatum* (Bl.) Lindl.
 Api-api berbulu, see *Avicennia lanata* Ridley
 Api-api bulu, see *Avicennia lanata* Ridley
 Api-api puteh, see *Avicennia marina* (Forssk.) Vierh.
 Api-api, see *Avicennia alba* Blume
 Api-api, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Api-api, see *Avicennia officinalis* L.
 Aru, see *Casuarina equisetifolia* L.
 Asinan, see *Paspalum vaginatum* Sw.
 Bakau akik, see *Rhizophora apiculata* Bl.
 Bakau belukap, see *Bruguiera cylindrica* (L.) Bl.
 Bakau belukap, see *Rhizophora mucronata* Lamk.

Bakau belukap, see *Rhizophora stylosa* Griff.
 Bakau berus, see *Bruguiera cylindrica* (L.) Bl.
 Bakau besar, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Bakau gelukap, see *Rhizophora mucronata* Lamk.
 Bakau gelukap, see *Rhizophora stylosa* Griff.
 Bakau hitam, see *Rhizophora mucronata* Lamk.
 Bakau hitam, see *Rhizophora stylosa* Griff.
 Bakau jankar, see *Rhizophora mucronata* Lamk.
 Bakau jankar, see *Rhizophora stylosa* Griff.
 Bakau kecil, see *Bruguiera cylindrica* (L.) Bl.
 Bakau kurap, see *Rhizophora mucronata* Lamk.
 Bakau kurap, see *Rhizophora stylosa* Griff.
 Bakau minyak, see *Rhizophora apiculata* Bl.
 Bakau puteh, see *Bruguiera cylindrica* (L.) Bl.
 Bakau puteh, see *Rhizophora apiculata* Bl.
 Bakau tandok, see *Rhizophora apiculata* Bl.
 Bakau, see *Bruguiera exaristata* Ding Hou
 Baru, see *Hibiscus tiliaceus* L.
 Baru-baru, see *Hibiscus tiliaceus* L.
 Batata Pantai, see *Ipomoea pes-capre* (L.) Sweet.
 Bebaru bulu, see *Hibiscus tiliaceus* L.
 Bebaru, see *Hibiscus tiliaceus* L.
 Bebaru, see *Thespesia populnea* (L.) Soland. ex Correa
 Bedara laut, see *Ximenia americana* L.
 Begau, see *Eleocharis dulcis* (Burm. f.) Henschel
 Beluntas, see *Pluchea indica* (L.) Less.
 Benaga, see *Calophyllum inophyllum* L.
 Benjek, see *Inocarpus fagifer* (Parkinson) Fosb.
 Beras-beras, see *Kandelia candel* (L.) Druce
 Berembang, see *Sonneratia caseolaris* (L.) Engl.
 Berus Mata Buaya, see *Bruguiera hainessii* C.G.Rogers
 Berus-berus, see *Kandelia candel* (L.) Druce
 Betut, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Bidari, see *Ximenia americana* L.
 Biga, see *Eleocharis dulcis* (Burm. f.) Henschel
 Bintangur Laut, see *Calophyllum inophyllum* L.
 Bonduc, see *Caesalpinia bonduc* (L.) Roxb.
 Bosang, see *Bruguiera cylindrica* (L.) Bl.
 Bosua, see *Inocarpus fagifer* (Parkinson) Fosb.
 Buah keras laut, see *Hernandia ovigera* L.
 Bubpuk, see *Ilex cymosa* Blume
 Bundung, see *Cyperus malaccensis* Lamk.
 Bungor, see *Pemphis acidula* J.R. & G. Forst.
 Bunyung, see *Cyperus malaccensis* Lamk.
 Busing, see *Bruguiera sexangula* (Lour.) Poir.
 Buta buta, see *Cerbera manghas* L.
 Buta buta, see *Cerbera odollam* Gaertn.
 Buta-Buta, see *Excoecaria agallocha* L.
 Butong, see *Barringtonia asiatica* (L.) Kurz

Butun, see *Barringtonia asiatica* (L.) Kurz
 Cemar, see *Cassytha filiformis* Linn.
 Chempaka utan, see *Gardenia tubifera* Wall
 Dadap, see *Erythrina orientalis* (L.) Murr.
 Damak-damak, see *Scolopia macrophylla* (W. & A.) Clos
 Dangsa, see *Phoenix paludosa* Roxb.
 Daun kambing, see *Premna obtusifolia* R. Br.
 Daun Katang, see *Ipomoea pes-capre* (L.) Sweet.
 Daun korpa, see *Dischidia benghalensis* Colebr.
 Daun Korpo, see *Finlaysonia obovata* Wall.
 Daun pitis kecil, see *Dischidia benghalensis* Colebr.
 Daun seberneh panjang, see *Drymoglossum piloselloides* (Linn.) Presl.
 Daun Songa, see *Wedelia biflora* (L.) DC.
 Dedahruang, see *Rapanea porteri* Wall. ex A. DC.
 Dedap, see *Erythrina orientalis* (L.) Murr.
 Demundi, see *Vitex ovata* Thunb.
 Derdap, see *Erythrina orientalis* (L.) Murr.
 Dungun besar, see *Heritiera globosa* Kostermans
 Dungun laut, see *Heritiera littoralis* Dryand.
 Dungun, see *Brownlowia argentata* Kurz.
 Dungun, see *Brownlowia tersa* (L.) Kosterm.
 Dungun, see *Heritiera littoralis* Dryand.
 Durian laut, see *Brownlowia argentata* Kurz.
 Gambir laut, see *Clerodendrum inerme* (L.) Gaertn.
 Gedabu, see *Sonneratia ovata* Back.
 Gelam, see *Melaleuca cajuputi* Roxb.
 Gelang, see *Sesuvium portulacastrum* (L.) L.
 Gurah, see *Excoecaria indica* (Willd.) Muell. Arg.
 Hitam, see *Acanthus ebracteatus* Vahl.
 Jambu kera, see *Glochidion littorale* Bl.
 Jambulan pantai, see *Ardisia elliptica* Thunberg
 Jangon, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Jarak, see *Ricinus communis* L.
 Jati bukit, see *Podocarpus polystachyus* R.Br. ex Endl.
 Jawi jawi, see *Ficus microcarpa* L.f.
 Jejawi, see *Ficus microcarpa* L.f.
 Jemerlang Laut, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Jempalang, see *Barringtonia acutangula* (L.) Gaertn.
 Jeruju puteh, see *Acanthus ilicifolius* L.
 Jeruju, see *Acanthus ebracteatus* Vahl.
 Jeruju, see *Acanthus volubilis* Wall.
 Jukut Kakawatan, see *Cynodon dactylon* (L.) Pers.
 Jukut Raket, see *Cynodon dactylon* (L.) Pers.
 Kacang Kayu Laut, see *Pongamia pinnata* (L.) Pierre
 Kacang Laut, see *Canavalia maritima* Thouars
 Kachang kachang, see *Aegiceras corniculatum* (L.) Blanco
 Kambing-kambing, see *Sarcolobus globosus* Wall.
 Kankong, see *Ipomoea gracilis* R. Br.
 Kapit, see *Inocarpus fagifer* (Parkinson) Fosb.

Karamunting, see *Ochthocharis bornensis* Bl.
 Kateng, see *Cynometra iripa* Kostel.
 Kateng, see *Cynometra ramiflora* L.
 Katong laut, see *Cynometra iripa* Kostel.
 Katong laut, see *Cynometra ramiflora* L.
 Kayu buta-buta, see *Excoecaria agallocha* L.
 Kayu Puteh, see *Melaleuca cajuputi* Roxb.
 Kekara Laut, see *Canavalia maritima* Thouars
 Kekara pedang, see *Canavalia maritima* Thouars
 Keladi Payau, see *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott
 Keladi, see *Colocasia esculenta* (L.) Schott
 Kemedu, see *Morinda citrifolia* L.
 Kerepit, see *Inocarpus fagifer* (Parkinson) Fosb.
 Keretung, see *Blumeodendron tokbrai* (Bl.) Kurz.
 Ketapang, see *Terminalia catappa* L.
 Kodak acing, see *Oxal imbricata* Roxb.
 Komoi, see *Diospyros malabarica* (Descr.) Kostel.
 Korma Paya, see *Phoenix paludosa* Roxb.
 Kumun, see *Diospyros malabarica* (Descr.) Kostel.
 Lagarteiro (Sabah), see *Croton heterocarpus* Müll. Arg.
 Lagundi, see *Vitex ovata* Thunb.
 Laki-laki, see *Finlaysonia obovata* Wall.
 Landing-landing, see *Ceriops decandra* (Griff.) Ding Hou
 Langkong, see *Barringtonia acutangula* (L.) Gaertn.
 Lemau lilang, see *Merope angulata* (Willd.) Swingle
 Lembang, see *Typha angustifolia* Linné
 Lemuning, see *Vitex ovata* Thunb.
 Lenggadai, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Lenggadis, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Lenggundi, see *Vitex ovata* Thunb.
 Limau Hantu, see *Atalantia monophylla* DC.
 Limau Lelang, see *Merope angulata* (Willd.) Swingle
 Lunok, see *Ficus microcarpa* L.f.
 Malabera, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Margimaly (Sarawak), see *Croton heterocarpus* Müll. Arg.
 Masiang, see *Scirpus grossus* Linné
 Mata ayam, see *Ardisia elliptica* Thunberg
 Mata itek, see *Ardisia elliptica* Thunberg
 Mata pelanduk, see *Ardisia elliptica* Thunberg
 Melokan, see *Croton heterocarpus* Müll. Arg.
 Membatu, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Mempisang, see *Kandelia candel* (L.) Druce
 Menaga, see *Calophyllum inophyllum* L.
 Menasi, see *Planchonella obovata* (R.Br.) Pierre.
 Mendarong, see *Scirpus grossus* Linné
 Mengkadai, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Mengkudu besar, see *Morinda citrifolia* L.
 Mengkudu daun besar, see *Morinda citrifolia* L.
 Mensiang, see *Scirpus grossus* Linné

Mensirah, see *Ilex cymosa* Blume
 Mentiong, see *Gardenia tubifera* Wall
 Menurong, see *Scirpus grossus* Linné
 Merambong, see *Scaevola taccada* (Gaertn.) Roxb.
 Merbau ipil, see *Intsia bijuga* (Colebr.) Kuntze
 Meribut, see *Olax imbricata* Roxb.
 Merlimau, see *Atalantia monophylla* DC.
 Misi, see *Planchonella obovata* (R.Br.) Pierre.
 Muning, see *Vitex ovata* Thunb.
 Murong, see *Scirpus grossus* Linné
 Naga, see *Calophyllum inophyllum* L.
 Nibung, see *Oncosperma tigillarium* (Jack.) Ridl.
 Nikong, see *Oncosperma tigillarium* (Jack.) Ridl.
 Niri, see *Xylocarpus granatum* Koen.
 Niri, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Nona burung, see *Cordia dichotoma* G. Forst.
 Nyan, see *Cerbera manghas* L.
 Nyan, see *Cerbera odollam* Gaertn.
 Nyireh batu, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Nyireh Bunga, see *Xylocarpus granatum* Koen.
 Nyireh hudang, see *Xylocarpus granatum* Koen.
 Nyireh, see *Xylocarpus granatum* Koen.
 Nyireh, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Nyiri, see *Xylocarpus granatum* Koen.
 Pakis sarang semut, see *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito
 Paku achu, see *Calophyllum inophyllum* L.
 Paku akar, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku gajah, see *Cycas rumphii* Miq.
 Paku haji, see *Cycas rumphii* Miq.
 Paku laut, see *Cycas rumphii* Miq.
 Paku midung, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku naga, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku Pandan, see *Asplenium nidus* Linné
 Paku ramu, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Paku Wanggi, see *Phymatodes scolopendria* (Burm.) Ching.
 Palas duri, see *Licuala spinosa* Wurmmb.
 Palas, see *Licuala spinosa* Wurmmb.
 Pandan laut, see *Pandanus tectorius* Sol
 Pedada, see *Sonneratia alba* J.E. Smith
 Pedada, see *Sonneratia griffithii* Kurz.
 Pekan heran, see *Gardenia tubifera* Wall
 Pelampong, see *Scaevola taccada* (Gaertn.) Roxb.
 Pelawas, see *Calycopteris floribunda* (Roxb.) Lamk
 Peler kambing, see *Sarcolobus globosus* Wall.
 Penaga laut, see *Calophyllum inophyllum* L.
 Penah, see *Ardisia elliptica* Thunberg
 Penggu, see *Horsfieldia irya* (Gaertn.) Warb.
 Perepat, see *Sonneratia alba* J.E. Smith
 Periah, see *Ardisia elliptica* Thunberg

Pertun, see *Barringtonia asiatica* (L.) Kurz
 Petekat, see *Cordia dichotoma* G. Forst.
 Piai laut, see *Acrostichum speciosum* Willd.
 Piai Raya, see *Acrostichum aureum* Linné
 Pianggu, see *Horsfieldia irya* (Gaertn.) Warb.
 Pidada, see *Sonneratia alba* J.E. Smith
 Pidaroh, see *Ximania americana* L.
 Pisang-pisang laut, see *Kandelia candel* (L.) Druce
 Podo laut, see *Podocarpus polystachyus* R.Br. ex Endl.
 Poko kulo, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Pokok rukam gajah, see *Scolopia macrophylla* (W. & A.) Clos
 Pong pong, see *Cerbera manghas* L.
 Pong pong, see *Cerbera odollam* Gaertn.
 Pong-pong, see *Gluta velutina* Bl.
 Pulas laut, see *Mischocarpus sundaicus* Blume
 Pulut-pulut, see *Kandelia candel* (L.) Druce
 Putat ayam, see *Barringtonia racemosa* (L.) Spreng.
 Putat Ayer, see *Barringtonia conoidea* Griff.
 Putat Laut, see *Barringtonia asiatica* (L.) Kurz
 Putat, see *Barringtonia acutangula* (L.) Gaertn.
 Rengas Ayer, see *Gluta velutina* Bl.
 Rengas Pantai, see *Gluta velutina* Bl.
 Rengas, see *Gluta velutina* Bl.
 Rotan Bakau, see *Calamus erinaceus* (Becc.) Dransfield
 Rotan Tikus, see *Flagellaria indica* L.
 Ru, see *Casuarina equisetifolia* L.
 Rukem Laut, see *Scolopia macrophylla* (W. & A.) Clos
 Rumah Semut Merah, see *Myrmecodia tuberosa* DC.
 Rumput laut, see *Myriostachya wightiana* (Nees ex Steud.) Hook.f.
 Rumput Lingsing, see *Cyperus javanicus* Houtt.
 Rumput Ruchut, see *Fimbristylis ferruginea* (L.) Vahl
 Saga, see *Abrus precatorius* L.
 Sakat Hitam, see *Phymatodes scolopendria* (Burm.) Ching.
 Sakat ribu-ribu, see *Drymoglossum piloselloides* (Linn.) Presl.
 Sapokei (Sabah), see *Croton heterocarpus* Müll. Arg.
 Sarai, see *Cyperus javanicus* Houtt.
 Sari pelanduk, see *Croton heterocarpus* Müll. Arg.
 Saruni Air, see *Sesuvium portulacastrum* (L.) L.
 Sayur kambing, see *Premna obtusifolia* R. Br.
 Sechirik laut, see *Diospyros ferrea* (Willd.) Bakh.
 Sekendai, see *Cordia dichotoma* G. Forst.
 Sekendal, see *Cordia dichotoma* G. Forst.
 Selar Makan, see *Guettarda speciosa* Linn.
 Selensur, see *Glochidion littorale* Bl.
 Semun bidadari, see *Platynerium coronarium* (Koenig.) Desv.
 Sendudok Air, see *Ochthocharis bornensis* Bl.
 Senduduk, see *Melastoma malabathricum* var. *malabathricum* L.
 Sepetir mempelas, see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
 Serdang, see *Corypha saribus* Lour.

Sisek naga, see *Drymoglossum piloselloides* (Linn.) Presl.
 Sugi, see *Mischocarpus sundaicus* Blume
 Sulengseng, see *Cyperus javanicus* Houtt.
 Tali Berkumpul, see *Aganope heptaphylla* (L.) Polhill
 Tamu (Sabah), see *Croton heterocarpus* Müll. Arg.
 Tapak Kuda Kecil, see *Ipomoea gracilis* R. Br.
 Tapak Kuda, see *Ipomoea pes-capre* (L.) Sweet.
 Tatampayan besar, see *Ipomoea tuba* Schlechtend.
 Tebu Salah, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Temahau, see *Kleinhovia hospita* L..
 Tengah, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tengal, see *Ceriops decandra* (Griff.) Ding Hou
 Tengar, see *Ceriops decandra* (Griff.) Ding Hou
 Tengar, see *Ceriops tagal* (Perr.) C.B. Rob.
 Teruntum Merah, see *Lumnitzera littorea* (Jack) Voigt.
 Teruntum, see *Lumnitzera littorea* (Jack) Voigt.
 Timah-timah, see *Ilex cymosa* Blume
 Timun dendang, see *Passiflora foetida* L.
 Timun hutan, see *Passiflora foetida* L.
 Timun padang, see *Passiflora foetida* L.
 Tuj, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Tumbus, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Tumu berau, see *Bruguiera sexangula* (Lour.) Poir.
 Tumu mata buaya, see *Bruguiera sexangula* (Lour.) Poir.
 Tumu, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Tumus, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Waru, see *Casuarina equisetifolia* L.
 Wlingi Laut, see *Cyperus malaccensis* Lamk.

Myanmar:

Kanazo, see *Heritiera fomes* Buch. Ham.
 Kaya, see *Aegiceras corniculatum* (L.) Blanco
 Kyana, see *Xylocarpus granatum* Koen.
 Madame, see *Ceriops decandra* (Griff.) Ding Hou
 Madame, see *Ceriops tagal* (Perr.) C.B. Rob.
 Mong-tain, see *Cycas rumphii* Miq.
 Myinga, see *Cynometra ramiflora* L.
 Pin-lay-see, see *Ximenia americana* L.
 Pinle-kanazo, see *Heritiera littoralis* Dryand.
 Thame, see *Avicennia officinalis* L.
 Thayaw, see *Excoecaria agallocha* L.

Papua New Guinean:

Ahake, see *Batis argillicola* van Royen
 Aikanu, see *Stemonurus ammui* (Kaneh.) Sleum.
 Aikove, see *Polyscias macgillivrayi* (Seem.) Harms.
 Ailalo see *Stemonurus ammui* (Kaneh.) Sleum.
 Aimarako see *Stemonurus ammui* (Kaneh.) Sleum.
 Ainunura see *Stemonurus ammui* (Kaneh.) Sleum.

Ammui see *Stemonurus ammui* (Kaneh.) Sleum.
 Arara, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Asikua, see *Atuna racemosa* ssp. racemosa Rafin.
 Asista, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Awol, see *Xylocarpus granatum* Koen.
 Bata-bata, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Biagi, see *Eleocharis dulcis* (Burm. f.) Henschel
 Dodogo kubar, see *Scaevola taccada* (Gaertn.) Roxb.
 Ecahi, see *Xylocarpus granatum* Koen.
 Gambou, see *Polyscias macgillivrayi* (Seem.) Harms.
 Geida, see *Cyperus malaccensis* Lamk.
 Kaav, see *Xylocarpus granatum* Koen.
 Kabahai, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Kaikikira, see *Scaevola taccada* (Gaertn.) Roxb.
 Kalis, see *Terminalia catappa* L.
 Koriki, see *Rhizophora mucronata* Lamk.
 Koriki, see *Rhizophora stylosa* Griff.
 Kris, see *Terminalia catappa* L.
 Latita, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Latiu, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Mala Sata see *Stemonurus ammui* (Kaneh.) Sleum.
 Manggaresi, see *Merrilliodendron megacarpum* (Hemsl.) Sleum.
 Mapeke, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Mokkemoffe, see *Xylocarpus granatum* Koen.
 Naikaigwoo, see *Polyscias macgillivrayi* (Seem.) Harms.
 Pabo, see *Rhizophora mucronata* Lamk.
 Pabo, see *Rhizophora stylosa* Griff.
 Paimeh, see *Scaevola taccada* (Gaertn.) Roxb.
 Raumonas, see *Polyscias macgillivrayi* (Seem.) Harms.
 Runge, see *Terminalia catappa* L.
 Saki, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Tawihi, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Tew, see *Combretum trifoliatum* Vent.
 Togo, see *Rhizophora mucronata* Lamk.
 Togo, see *Rhizophora stylosa* Griff.
 Tortor, see *Rhizophora mucronata* Lamk.
 Tortor, see *Rhizophora stylosa* Griff.
 Totoa, see *Rhizophora mucronata* Lamk.
 Totoa, see *Rhizophora stylosa* Griff.
 Vabilisi, see *Merrilliodendron megacarpum* (Hemsl.) Sleum.
 Wadawada, see *Xylocarpus rumphii* (Kostel.) Mabb.
 Wampi lang, see *Cyperus compactus* Retz.
 Wapi lang, see *Cyperus javanicus* Houtt.

Philippine:

Agás, see *Scirpus grossus* Linné
 Agnaa, see *Lumnitzera littorea* (Jack) Voigt.
 Agnaya, see *Lumnitzera racemosa* Willd.
 Agnaya, see *Scyphiphora hydrophyllacea* Gaertn. f.

Agoho, see *Casuarina equisetifolia* L.
 Agonoi, see *Wedelia biflora* (L.) DC.
 Agua Anilai, see *Lumnitzera littorea* (Jack) Voigt.
 Agunoi, see *Wedelia biflora* (L.) DC.
 Alagot-ot, see *Cordia subcordata* Lam.
 Alai, see *Bruguiera sexangula* (Lour.) Poir.
 Alipata, see *Excoecaria agallocha* L.
 Almendras, see *Terminalia catappa* L.
 Almendro, see *Terminalia catappa* L.
 Aluma, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Amarok-barok, see *Pongamia pinnata* (L.) Pierre
 Angasin, see *Tristellateia australasiae* A. Rich.
 Anoioi, see *Wedelia biflora* (L.) DC.
 Anudd, see *Flagellaria indica* L.v
 Api-api, see *Avicennia alba* Blume
 Api-api, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Api-api, see *Avicennia marina* (Forssk.) Vierh.
 Apung-apung, see *Kleinhovia hospita* L..
 Aragan, see *Najas indica* (Willd.) Cham.
 Aranaya, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Arbon, see *Cerbera manghas* L.
 Arinaya, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Arodaidai, see *Ipomoea pes-capre* (L.) Sweet.
 Array, see *Anamirta cocculus* L. Wight & Arn.
 Audi, see *Flagellaria indica* L.
 Audi-si-gayang, see *Flagellaria indica* L.
 Ayam, see *Trianthema portulacastrum* L.
 Baga-as, see *Cyperus malaccensis* Lamk.
 Bagaolan, see *Guettarda speciosa* Linn.
 Bagit, see *Tristellateia australasiae* A. Rich.
 Bagnang-lalake, see *Glochidion littorale* Bl.
 Bagnei, see *Pongamia pinnata* (L.) Pierre
 Bagnit, see *Tristellateia australasiae* A. Rich.
 Bago, see *Hibiscus tiliaceus* L.
 Bahau, see *Tristellateia australasiae* A. Rich.
 Bait, see *Cycas rumphii* Miq.
 Bakau, see *Bruguiera gymnorhiza* (L.) Lamk.
 Bakau, see *Rhizophora apiculata* Bl.
 Bakau, see *Rhizophora mucronata* Lamk.
 Bakau, see *Rhizophora stylosa* Griff.
 Bakauan baler, see *Kandelia candel* (L.) Druce
 Bakauan bato, see *Rhizophora stylosa* Griff.
 Bakauan lalaki, see *Bruguiera sexangula* (Lour.) Poir.
 Bakauan lalaki, see *Rhizophora apiculata* Bl.
 Bakauan, see *Bruguiera cylindrica* (L.) Bl.
 Bakauan, see *Bruguiera gymnorhiza* (L.) Lamk.
 Bakauan, see *Bruguiera sexangula* (Lour.) Poir.
 Bakauan, see *Ceriops decandra* (Griff.) Ding Hou
 Bakauan, see *Rhizophora apiculata* Bl.

Bakauan-babae, see *Rhizophora mucronata* Lamk.
 Bakauan-babae, see *Rhizophora stylosa* Griff.
 Bakauan-lalake, see *Rhizophora apiculata* Bl.
 Bakauan-lalaki, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Bakhau, see *Rhizophora apiculata* Bl.
 Bakhau, see *Rhizophora mucronata* Lamk.
 Bakhau, see *Rhizophora stylosa* Griff.
 Bakhaw, see *Rhizophora apiculata* Bl.
 Bakhaw, see *Rhizophora mucronata* Lamk.
 Bakhaw, see *Rhizophora stylosa* Griff.
 Baki-baking-pula, see *Cyperus compactus* Retz.
 Bakting, see *Lumnitzera littorea* (Jack) Voigt.
 Balabago, see *Hibiscus tiliaceus* L.
 Balagon, see *Olax imbricata* Roxb.
 Balak-balak, see *Scaevola taccada* (Gaertn.) Roxb.
 Balangigan, see *Guettarda speciosa* Linn.
 Balangot, see *Typha angustifolia* Linné
 Balansi, see *Kleinhovia hospita* L..
 Balasiai, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Balibagan, see *Guettarda speciosa* Linn.
 Balibago, see *Hibiscus tiliaceus* L.
 Balikbalik, see *Pongamia pinnata* (L.) Pierre
 Balinsarayan, see *Bruguiera sexangula* (Lour.) Poir.
 Balitbitan, see *Cynometra ramiflora* L.
 Balok, see *Pongamia pinnata* (L.) Pierre
 Balok-balok, see *Pongamia pinnata* (L.) Pierre
 Balok-Balok, see *Scaevola taccada* (Gaertn.) Roxb.
 Balotbalot, see *Pongamia pinnata* (L.) Pierre
 Balu, see *Cordia subcordata* Lam.
 Balu, see *Thespesia populnea* (L.) Soland. ex Correa
 Balu-balu, see *Pongamia pinnata* (L.) Pierre
 Balu-balu, see *Pongamia pinnata* (L.) Pierre
 Baluk-baluk, see *Pongamia pinnata* (L.) Pierre
 Baluno, see *Camptostemon philippinense* (Vidal) Becc.
 Balut-balut, see *Pongamia pinnata* (L.) Pierre
 Banag, see *Thespesia populnea* (L.) Soland. ex Correa
 Banago, see *Thespesia populnea* (L.) Soland. ex Correa
 Banalo, see *Thespesia populnea* (L.) Soland. ex Correa
 Banaro, see *Guettarda speciosa* Linn.
 Banaro, see *Thespesia populnea* (L.) Soland. ex Correa
 Bangbangi, see *Najas indica* (Willd.) Cham.
 Bangkau, see *Rhizophora mucronata* Lamk.
 Bangkau, see *Rhizophora stylosa* Griff.
 Bango-pula, see *Thespesia populnea* (L.) Soland. ex Correa
 Bani, see *Pongamia pinnata* (L.) Pierre
 Banit, see *Pongamia pinnata* (L.) Pierre
 Bantana, see *Kleinhovia hospita* L..
 Bantigi, see *Pemphis acidula* J.R. & G. Forst.
 Banting, see *Lumnitzera littorea* (Jack) Voigt.

Banung-kalauai, see *Hernandia ovigera* L.
 Baobao, see *Pongamia pinnata* (L.) Pierre
 Ba-ot, see *Thespesia populnea* (L.) Soland. ex Correa
 Barabai, see *Cerbera manghas* L.
 Baraibai, see *Cerbera manghas* L.
 Basit, see *Heritiera littoralis* Dryand.
 Batag-batag, see *Aegiceras corniculatum* (L.) Blanco
 Batag-batag, see *Aegiceras floridum* Roemer & Schultes
 Batano, see *Cerbera manghas* L.
 Batano, see *Excoecaria agallocha* L.
 Bating, see *Lumnitzera littorea* (Jack) Voigt.
 Batulinao, see *Diospyros ferrea* (Willd.) Bakh.
 Bauan, see *Hibiscus tiliaceus* L.
 Baut, see *Heritiera littoralis* Dryand.
 Bayag-kabayo, see *Heritiera littoralis* Dryand.
 Bayok-bayok, see *Pongamia pinnata* (L.) Pierre
 Bigi, see *Xylocarpus granatum* Koen.
 Bignon, see *Kleinhovia hospita* L..
 Biknong, see *Kleinhovia hospita* L..
 Bilang-bilang, see *Sesuvium portulacastrum* (L.) L.
 Biluan, see *Kleinhovia hospita* L..
 Bingkit, see *Ryssospterys timoriensis* (DC.) Jussieu
 Binoil-ure, see *Xylocarpus granatum* Koen.
 Binong, see *Kleinhovia hospita* L..
 Binusisi, see *Tristellateia australasiae* A. Rich.
 Biosan, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Biris, see *Bruguiera cylindrica* (L.) Bl.
 Bitanag, see *Kleinhovia hospita* L..
 Bitnong, see *Kleinhovia hospita* L..
 Biton, see *Olex imbricata* Roxb.
 Bitoon, see *Barringtonia asiatica* (L.) Kurz
 Biuis, see *Bruguiera cylindrica* (L.) Bl.
 Bius, see *Bruguiera cylindrica* (L.) Bl.
 Bokabok, see *Scaevola taccada* (Gaertn.) Roxb.
 Bo-o, see *Ximenia americana* L.
 Bosboron, see *Scaevola taccada* (Gaertn.) Roxb.
 Botabon, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Bota-bota, see *Excoecaria agallocha* L.
 Botga, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Boto, see *Scaevola taccada* (Gaertn.) Roxb.
 Bual, see *Ximenia americana* L.
 Bubutigan, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Bugtung-aha, see *Ryssospterys timoriensis* (DC.) Jussieu
 Bulakan, see *Ipomoea gracilis* R. Br.
 Bulali, see *Aegiceras corniculatum* (L.) Blanco
 Bulali, see *Aegiceras floridum* Roemer & Schultes
 Bulokbulok, see *Lumnitzera littorea* (Jack) Voigt.
 Bulubadiang, see *Ceriops decandra* (Griff.) Ding Hou
 Bunayon, see *Sonneratia alba* J.E. Smith

Buñgalon, see *Avicennia marina* (Forssk.) Vierh.
 Buñgalon, see *Camptostemon philippinense* (Vidal) Becc.
 Buñgalon, see *Sonneratia alba* J.E. Smith
 Bungalon-puti, see *Avicennia alba* Blume
 Bungalon-sahing, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Buñgalu, see *Avicennia marina* (Forssk.) Vierh.
 Bungkuang, see *Scirpus grossus* Linné
 Busain, see *Bruguiera cylindrica* (L.) Bl.
 Busain, see *Bruguiera sexangula* (Lour.) Poir.
 Busaing, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Busaing, see *Bruguiera sexangula* (Lour.) Poir.
 Busiin, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Buta, see *Excoecaria agallocha* L.
 Butabul, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Buta-buta, see *Excoecaria agallocha* L.
 Buta-buti, see *Cerbera manghas* L.
 Buto-buto, see *Cerbera manghas* L.
 Butong, see *Pongamia pinnata* (L.) Pierre
 Cabezas de negrito, see *Eleocharis dulcis* (Burm. f.) Henschel
 Dalunu-babae, see *Lumnitzera littorea* (Jack) Voigt.
 Dampalit, see *Sesuvium portulacastrum* (L.) L.
 Dandulit, see *Camptostemon philippinense* (Vidal) Becc.
 Dangliu, see *Hibiscus tiliaceus* L.
 Danglog, see *Hibiscus tiliaceus* L.
 Darah-darah, see *Croton heterocarpus* Müll. Arg.
 Daraput, see *Quassia indica* (Gaertn.) Nooteboom
 Dik-duk, see *Osbornia octodonta* F.v.Muell.
 Dipodata, see *Excoecaria agallocha* L.
 Dita, see *Cerbera manghas* L.
 Ditadit, see *Ipomoea gracilis* R. Br.
 Dulok-dulok, see *Lumnitzera littorea* (Jack) Voigt.
 Dulok-dulok, see *Osbornia octodonta* F.v.Muell.
 Dumanai, see *Aegiceras corniculatum* (L.) Blanco
 Dumanai, see *Aegiceras floridum* Roemer & Schultes
 Duñgas, see *Cerbera manghas* L.
 Dungon, see *Heritiera littoralis* Dryand.
 Dungon-late, see *Heritiera littoralis* Dryand.
 Durugi, see *Cyperus compactus* Retz.
 Gabi, see *Colocasia esculenta* (L.) Schott
 Gapas-gapas, see *Camptostemon philippinense* (Vidal) Becc.
 Getabon, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Giron, see *Cyperus compactus* Retz.
 Gullum, see *Osbornia octodonta* F.v.Muell.
 Gumaingat, see *Excoecaria agallocha* L.
 Gumilum, see *Osbornia octodonta* F.v.Muell.
 Habag, see *Hernandia ovigera* L.
 Hagonoi, see *Wedelia biflora* (L.) DC.
 Hamitanago, see *Kleinhovia hospita* L..
 Hanbulali, see *Scyphiphora hydrophyllacea* Gaertn. f.

Hangalia, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Hangarai, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Hanot, see *Hibiscus tiliaceus* L.
 Hikau-hikauan, see *Sonneratia alba* J.E. Smith
 Hikau-hikauan, see *Sonneratia caseolaris* (L.) Engl.
 Himbabau, see *Excoecaria agallocha* L.
 Iden, see *Thespesia populnea* (L.) Soland. ex Correa
 Iiñgi, see *Excoecaria agallocha* L.
 Ilukabban, see *Sonneratia alba* J.E. Smith
 Ilukabban, see *Sonneratia caseolaris* (L.) Engl.
 Ingual, see *Flagellaria indica* L.
 Ipil, see *Intsia bijuga* (Colebr.) Kuntze
 Ipil-lalao, see *Intsia bijuga* (Colebr.) Kuntze
 Itil, see *Intsia bijuga* (Colebr.) Kuntze
 Jojo saffranhout, see *Cassine viburnifolia* (Juss.) Ding Hou
 Kabantigi, see *Pemphis acidula* J.R. & G. Forst.
 Kachuchis, see *Avicennia alba* Blume
 Kachuchis, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Kadel, see *Pongamia pinnata* (L.) Pierre
 Kai-kai, see *Cyperus javanicus* Houtt.
 Kalabayuan, see *Bruguiera sexangula* (Lour.) Poir.
 Kalapinai, see *Bruguiera cylindrica* (L.) Bl.
 Kalapini, see *Avicennia marina* (Forssk.) Vierh.
 Kalapini, see *Lumnitzera littorea* (Jack) Voigt.
 Kalapini-mañgitit, see *Avicennia marina* (Forssk.) Vierh.
 Kalapini-maputi, see *Avicennia marina* (Forssk.) Vierh.
 Kalimbabau, see *Xylocarpus granatum* Koen.
 Kalkiptan, see *Cerbera manghas* L.
 Kalumpangin, see *Guettarda speciosa* Linn.
 Kamigang, see *Ipomoea pes-capre* (L.) Sweet.
 Kapagan, see *Guettarda speciosa* Linn.
 Karifurong, see *Lumnitzera littorea* (Jack) Voigt.
 Kasouai, see *Barringtonia racemosa* (L.) Spreng.
 Katang-katang, see *Ipomoea pes-capre* (L.) Sweet.
 Kayong, see *Glochidion littorale* Bl.
 Kayongkong, see *Glochidion littorale* Bl.
 Kindug-kindug, see *Aegiceras corniculatum* (L.) Blanco
 Kindug-kindug, see *Aegiceras floridum* Roemer & Schultes
 Kolimbauing, see *Xylocarpus granatum* Koen.
 Kolinkogun, see *Hernandia ovigera* L.
 Kolon-kogon, see *Hernandia ovigera* L.
 Kolung-kolung, see *Hernandia ovigera* L.
 Komon, see *Cynometra ramiflora* L.
 Koron-koron, see *Hernandia ovigera* L.
 Kulasi, see *Lumnitzera littorea* (Jack) Voigt.
 Kulasi, see *Lumnitzera racemosa* Willd.
 Kulasi, see *Osbornia octodonta* F.v.Muell.
 Kulasi, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Kung-kung, see *Hernandia ovigera* L.

Kurunggut, see *Passiflora foetida* L.
 Kutkut-timbalon, see *Barringtonia racemosa* (L.) Spreng.
 Kuyapi, see *Avicennia marina* (Forssk.) Vierh.
 Labnig, see *Intsia bijuga* (Colebr.) Kuntze
 Labnot, see *Olex imbricata* Roxb.
 Labui, see *Najas indica* (Willd.) Cham.
 Lagairai, see *Ipomoea pes-capre* (L.) Sweet.
 Lagasak, see *Bruguiera sexangula* (Lour.) Poir.
 Lagbangan, see *Guettarda speciosa* Linn.
 Lagoron, see *Wedelia biflora* (L.) DC.
 Lagtang, see *Anamirta cocculus* L. Wight & Arn.
 Lagun, see *Ryssopterys timoriensis* (DC.) Jussieu
 Lagut-ut, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Lahunai, see *Wedelia biflora* (L.) DC.
 Lambagu, see *Hibiscus tiliaceus* L.
 Lambon, see *Guettarda speciosa* Linn.
 Landing, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Langarai, see *Bruguiera cylindrica* (L.) Bl.
 Langarai, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Langari, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Langari, see *Bruguiera sexangula* (Lour.) Poir.
 Laogo, see *Hibiscus tiliaceus* L.
 Lapa-lapa, see *Camptostemon philippinense* (Vidal) Becc.
 Lapuis, see *Kleinhovia hospita* L..
 Laumus, see *Ryssopterys timoriensis* (DC.) Jussieu
 Libato, see *Lumnitzera littorea* (Jack) Voigt.
 Libatong-puti, see *Camptostemon philippinense* (Vidal) Becc.
 Libatu-pula, see *Lumnitzera littorea* (Jack) Voigt.
 Ligad, see *Pemphis acidula* J.R. & G. Forst.
 Ligat, see *Pemphis acidula* J.R. & G. Forst.
 Ligtang, see *Anamirta cocculus* L. Wight & Arn.
 Linas, see *Lumnitzera littorea* (Jack) Voigt.
 Linatog-anat, see *Quassia indica* (Gaertn.) Nooteboom
 Liñgog, see *Avicennia marina* (Forssk.) Vierh.
 Linton-gamai, see *Quassia indica* (Gaertn.) Nooteboom
 Linu, see *Scaevola taccada* (Gaertn.) Roxb.
 Lipata, see *Cerbera manghas* L.
 Lipata, see *Excoecaria agallocha* L.
 Lipatang-buhai, see *Excoecaria agallocha* L.
 Lubanayong, see *Xylocarpus granatum* Koen.
 Lukabban, see *Sonneratia alba* J.E. Smith
 Lulasi, see *Avicennia marina* (Forssk.) Vierh.
 Lupa pula, see *Rhizophora apiculata* Bl.
 Mabaran, see *Avicennia marina* (Forssk.) Vierh.
 Mabungdato, see *Quassia indica* (Gaertn.) Nooteboom
 Magalai, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Magalolo, see *Lumnitzera littorea* (Jack) Voigt.
 Magayao, see *Heritiera littoralis* Dryand.
 Magit, see *Pongamia pinnata* (L.) Pierre

Magkanai, see *Cerbera manghas* L.
 Magtangud, see *Bruguiera cylindrica* (L.) Bl.
 Magtongod, see *Ceriops tagal* (Perr.) C.B. Rob.
 Magtongog, see *Bruguiera cylindrica* (L.) Bl.
 Malabagio, see *Olax imbricata* Roxb.
 Malabutong, see *Olax imbricata* Roxb.
 Malarayap, see *Atalantia monophylla* DC.
 Malarungon, see *Heritiera littoralis* Dryand.
 Malasaga, see *Derris scandens* (Aubl.) Pittier
 Malasurut, see *Guettarda speciosa* Linn.
 Malatanggal, see *Ceriops decandra* (Griff.) Ding Hou
 Malat-antañgan, see *Hernandia ovigera* L.
 Malibago, see *Hibiscus tiliaceus* L.
 Maligang, see *Osbornia octodonta* F.v.Muell.
 Malubago, see *Hibiscus tiliaceus* L.
 Manlok-balok, see *Pongamia pinnata* (L.) Pierre
 Manotbonot, see *Osbornia octodonta* F.v.Muell.
 Maoro, see *Lumnitzera littorea* (Jack) Voigt.
 Maragomon, see *Brownlowia tersa* (L.) Kosterm.
 Maraibai, see *Cerbera manghas* L.
 Marakapas, see *Hibiscus tiliaceus* L.
 Marakapas, see *Kleinhovia hospita* L..
 Marobahai, see *Pongamia pinnata* (L.) Pierre
 Maruk-baruk, see *Pongamia pinnata* (L.) Pierre
 Matangal, see *Ceriops decandra* (Griff.) Ding Hou
 Mayambago, see *Hibiscus tiliaceus* L.
 Miapi, see *Avicennia marina* (Forssk.) Vierh.
 Mosboron, see *Scaevola taccada* (Gaertn.) Roxb.
 Mulato, see *Intsia bijuga* (Colebr.) Kuntze
 Nala, see *Intsia bijuga* (Colebr.) Kuntze
 Nigad, see *Glochidion littorale* Bl.
 Nigi, see *Xylocarpus granatum* Koen.
 Nigi-puti, see *Camptostemon philippinense* (Vidal) Becc.
 Nilad, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Nilar, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Nipa, see *Nypa fruticans* Wurm.
 Nuling, see *Barringtonia racemosa* (L.) Spreng.
 Odling, see *Cynometra ramiflora* L.
 Padi-padi, see *Glochidion littorale* Bl.
 Pagatpat baye, see *Sonneratia ovata* Back.
 Pagatpat, see *Sonneratia alba* J.E. Smith
 Pagatpat, see *Sonneratia caseolaris* (L.) Engl.
 Pagatpat, see *Sonneratia ovata* Back.
 Pagatpat-babae, see *Xylocarpus granatum* Koen.
 Pagatput, see *Aegiceras corniculatum* (L.) Blanco
 Pagatput, see *Aegiceras floridum* Roemer & Schultes
 Pakat, see *Ceriops tagal* (Perr.) C.B. Rob.
 Palagarium, see *Quassia indica* (Gaertn.) Nooteboom
 Palagium, see *Quassia indica* (Gaertn.) Nooteboom

Palalan, see *Sonneratia alba* J.E. Smith
 Palapat, see *Sonneratia caseolaris* (L.) Engl.
 Palata, see *Sonneratia caseolaris* (L.) Engl.
 Palatpat, see *Sonneratia alba* J.E. Smith
 Paling, see *Barringtonia racemosa* (L.) Spreng.
 Palingapoi, see *Heritiera littoralis* Dryand.
 Palugapig, see *Heritiera littoralis* Dryand.
 Palunag, see *Wedelia biflora* (L.) DC.
 Palunai, see *Wedelia biflora* (L.) DC.
 Palupa, see *Pemphis acidula* J.R. & G. Forst.
 Pampas, see *Kleinhovia hospita* L..
 Panabulon, see *Cerbera manghas* L.
 Panampat, see *Kleinhovia hospita* L..
 Pantigi, see *Pemphis acidula* J.R. & G. Forst.
 Panting-panting, see *Lumnitzera littorea* (Jack) Voigt.
 Pantog-lubo, see *Hernandia ovigera* L.
 Papasil, see *Lumnitzera littorea* (Jack) Voigt.
 Paronapin, see *Heritiera littoralis* Dryand.
 Pata, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Patotan, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Patpat, see *Sonneratia alba* J.E. Smith
 Paunapin, see *Heritiera littoralis* Dryand.
 Payan, see *Sonneratia alba* J.E. Smith
 Payar, see *Sonneratia caseolaris* (L.) Engl.
 Pedada, see *Sonneratia caseolaris* (L.) Engl.
 Petutan, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Piagao, see *Xylocarpus granatum* Koen.
 Piagau, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Piapi, see *Avicennia alba* Blume
 Piapi, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Piapi, see *Avicennia marina* (Forssk.) Vierh.
 Piksik, see *Avicennia marina* (Forssk.) Vierh.
 Pilapil, see *Aegiceras corniculatum* (L.) Blanco
 Pilapil, see *Aegiceras floridum* Roemer & Schultes
 Pilit, see *Pemphis acidula* J.R. & G. Forst.
 Pindak, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Pipisig, see *Avicennia marina* (Forssk.) Vierh.
 Pipisik, see *Aegiceras corniculatum* (L.) Blanco
 Pipisik, see *Aegiceras floridum* Roemer & Schultes
 Pipisik, see *Avicennia marina* (Forssk.) Vierh.
 Pitogo, see *Cycas rumphii* Miq.
 Ponoan, see *Quassia indica* (Gaertn.) Nooteboom
 Potat, see *Barringtonia racemosa* (L.) Spreng.
 Pototan lalaki, see *Bruguiera cylindrica* (L.) Bl.
 Pototan, see *Bruguiera cylindrica* (L.) Bl.
 Pototan, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Pototan, see *Bruguiera parviflora* (Roxb.) W.& A. ex Griff.
 Pototan, see *Bruguiera sexangula* (Lour.) Poir.
 Pulit, see *Xylocarpus granatum* Koen.

Pundung, see *Avicennia alba* Blume
 Pundung, see *Avicennia eucalyptifolia* Zipp. ex Moldenke
 Putad, see *Barringtonia racemosa* (L.) Spreng.
 Putat, see *Barringtonia racemosa* (L.) Spreng.
 Pututan, see *Bruguiera cylindrica* (L.) Bl.
 Pututan, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Pututan, see *Bruguiera sexangula* (Lour.) Poir.
 Puyugan, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Ragindi, see *Hibiscus tiliaceus* L.
 Ragiudiu, see *Scirpus grossus* Linné
 Rungon, see *Ceriops tagal* (Perr.) C.B. Rob.
 Sabasa, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Sagarai, see *Avicennia marina* (Forssk.) Vierh.
 Sagasa, see *Bruguiera sexangula* (Lour.) Poir.
 Sagasa, see *Glochidion littorale* Bl.
 Sagasa, see *Lumnitzera littorea* (Jack) Voigt.
 Sagasa, see *Osbornia octodonta* F.v.Muell.
 Sagasa, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Sagasak, see *Bruguiera sexangula* (Lour.) Poir.
 Saging-saging, see *Aegiceras corniculatum* (L.) Blanco
 Saging-saging, see *Aegiceras floridum* Roemer & Schultes
 Salasa, see *Lumnitzera littorea* (Jack) Voigt.
 Salonai, see *Wedelia biflora* (L.) DC.
 Sangkuyong, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Santing, see *Lumnitzera littorea* (Jack) Voigt.
 Sapsap, see *Nypa fruticans* Wurmb.
 Sasa, see *Nypa fruticans* Wurmb.
 Sauang, see *Cycas rumphii* Miq.
 Siak, see *Excoecaria agallocha* L.
 Solasi, see *Lumnitzera racemosa* Willd.
 Stanghas, see *Dolichandrone spathacea* (L.f.) K.Schum.
 Sulasig, see *Aegiceras corniculatum* (L.) Blanco
 Sulasig, see *Aegiceras floridum* Roemer & Schultes
 Supsupun, see *Lumnitzera littorea* (Jack) Voigt.
 Taag, see *Kleinhovia hospita* L..
 Taal, see *Intsia bijuga* (Colebr.) Kuntze
 Tabaño, see *Glochidion littorale* Bl.
 Tabao, see *Lumnitzera racemosa* Willd.
 Tabataba, see *Hernandia ovigera* L.
 Tabau, see *Lumnitzera littorea* (Jack) Voigt.
 Tabau, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Tabau-tabau, see *Cerbera manghas* L.
 Tabigi, see *Xylocarpus granatum* Koen.
 Tabigi, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Tabon-tabon, see *Atuna racemosa* ssp. *racemosa* Rafin.
 Tabon-tabon, see *Guettarda speciosa* Linn.
 Tabug, see *Guettarda speciosa* Linn.
 Tagasa, see *Bruguiera sexangula* (Lour.) Poir.
 Tagasa, see *Ceriops tagal* (Perr.) C.B. Rob.

Tagnag, see *Kleinhovia hospita* L..
 Tagsiak, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Talau, see *Lumnitzera littorea* (Jack) Voigt.
 Talisai, see *Terminalia catappa* L..
 Tamanag, see *Kleinhovia hospita* L..
 Tambon, see *Guettarda speciosa* Linn.
 Tambo-tambo, see *Xylocarpus granatum* Koen.
 Tambubunot, see *Xylocarpus granatum* Koen.
 Tan-ag, see *Kleinhovia hospita* L..
 Tanak, see *Kleinhovia hospita* L..
 Tangag, see *Kleinhovia hospita* L..
 Tangal lalaki, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tangal, see *Ceriops decandra* (Griff.) Ding Hou
 Tangal, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tangalan, see *Bruguiera cylindrica* (L.) Bl.
 Tangal-babae, see *Bruguiera cylindrica* (L.) Bl.
 Tañgas, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tanggal, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tangi, see *Xylocarpus granatum* Koen.
 Tangile, see *Xylocarpus granatum* Koen.
 Tangkuyon, see *Xylocarpus granatum* Koen.
 Tanhas, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tarumpalit, see *Sesuvium portulacastrum* (L.) L.
 Tualis, see *Osbornia octodonta* F.v.Muell.
 Tayokon, see *Aegiceras corniculatum* (L.) Blanco
 Tayokon, see *Aegiceras floridum* Roemer & Schultes
 Tibigi, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Tigal, see *Intsia bijuga* (Colebr.) Kuntze
 Tiganan, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tiker, see *Scirpus lacustris* L..
 Timbabukis, see *Aegiceras corniculatum* (L.) Blanco
 Timbabukis, see *Aegiceras floridum* Roemer & Schultes
 Tindok-tindok, see *Aegiceras corniculatum* (L.) Blanco
 Tindok-tindok, see *Aegiceras floridum* Roemer & Schultes
 Tinduk-tindukan, see *Aegiceras corniculatum* (L.) Blanco
 Tinduk-tindukan, see *Aegiceras floridum* Roemer & Schultes
 Tiuayos, see *Osbornia octodonta* F.v.Muell.
 Tiwi, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Toauis, see *Osbornia octodonta* F.v.Muell.
 Toktok-kalau, see *Cerbera manghas* L..
 Toloktok, see *Kleinhovia hospita* L..
 Toston, see *Trianthema portulacastrum* L..
 Tua, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tuauis, see *Osbornia octodonta* F.v.Muell.
 Tuba-tuba, see *Barringtonia racemosa* (L.) Spreng.
 Tuba-tuba, see *Thespesia populnea* (L.) Soland. ex Correa
 Tugsiak, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Tui, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Tulatalisai, see *Guettarda speciosa* Linn.

Tungod, see *Ceriops tagal* (Perr.) C.B. Rob.
 Tungug, see *Ceriops decandra* (Griff.) Ding Hou
 Tungung, see *Ceriops decandra* (Griff.) Ding Hou
 Twei, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Uaduat, see *Pemphis acidula* J.R. & G. Forst.
 Uakatan Bakad, see *Rhizophora apiculata* Bl.
 Uakatan, see *Rhizophora apiculata* Bl.
 Ubet-ubet, see *Olex imbricata* Roxb.
 Ula, see *Cynometra ramiflora* L.
 Ulisuman, see *Trianthema portulacastrum* L.
 Ulud, see *Cynometra ramiflora* L.
 Unapong, see *Kleinhovia hospita* L..
 Unas, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Valo, see *Thespesia populnea* (L.) Soland. ex Correa
 Venagalang, see *Flagellaria indica* L.

Thai:

Chaa luead, see *Premna obtusifolia* R. Br.
 Chaak, see *Nypa fruticans* Wurmb.
 Chak, see *Nypa fruticans* Wurmb.
 Cha khraam, see *Suaeda maritima* (L.) Dum.
 Chik an, see *Barringtonia asiatica* (L.) Kurz
 Chik le, see *Barringtonia asiatica* (L.) Kurz
 Chik nam, see *Barringtonia asiatica* (L.) Kurz
 Chik suan, see *Barringtonia racemosa* (L.) Spreng.
 Chuk rohini, see *Dischidia rafflesiana* Wall.
 Daeng nam, see *Aglaia cucullata* (Roxb.) Pellegrin
 Eng-air, see *Melastoma saigonense* (Kuntze) Merr.
 Faad daeng, see *Lumnitzera littorea* (Jack) Voigt.
 Faad khao, see *Lumnitzera racemosa* Willd.
 Fat, see *Lumnitzera littorea* (Jack) Voigt.
 Fat, see *Lumnitzera racemosa* Willd.
 Gluey mu lang, see *Dischidia rafflesiana* Wall.
 Hu kwang, see *Terminalia catappa* L.
 Ka fak ma muang, see *Dendrophthoe pentandra* (L.) Miq.
 Ka fak mai ta tum, see *Viscum ovalifolium* D.C.
 Ka thok rok, see *Passiflora foetida* L.
 Khale thale, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Kha pho, see *Licuala spinosa* Wurmb.
 Khlongkleng khon, see *Melastoma saigonense* (Kuntze) Merr.
 Khluu, see *Pluchea indica* (L.) Less.
 Klong-kleng, see *Melastoma saigonense* (Kuntze) Merr.
 Kongkaang bai leu, see *Rhizophora apiculata* Bl.
 Kongkaang bai yai, see *Rhizophora mucronata* Lamk.
 Kongkang, see *Rhizophora apiculata* Bl.
 Kongkang, see *Rhizophora mucronata* Lamk.
 Kongkang, see *Rhizophora stylosa* Griff.
 Krathing, see *Calophyllum inophyllum* L.
 Kruai, see *Horsfieldia irya* (Gaertn.) Warb.

Laao cha own, see *Oncosperma tigillarium* (Jack.) Ridl.
 Lambit thale, see *Diospyros ferrea* (Willd.) Bakh.
 Lampaen, see *Sonneratia ovata* Back.
 Lampaen thale, see *Sonneratia griffithii* Kurz.
 Lam phaen, see *Sonneratia griffithii* Kurz.
 Lam phu, see *Sonneratia caseolaris* (L.) Engl.
 Lampoo, see *Sonneratia caseolaris* (L.) Engl.
 Lampoo thale, see *Sonneratia alba* J.E. Smith
 Lao cha on, see *Oncosperma tigillarium* (Jack.) Ridl.
 Lumnok, see *Olox imbricata* Roxb.
 Lumpho thale, see *Intsia bijuga* (Colebr.) Kuntze
 Ma-kba-ling, see *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen
 Maphrao-sida, see *Cycas rumphii* Miq.
 Melabira, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Nam nong, see *Brownlowia tersa* (L.) Kosterm.
 Ngaa sai, see *Planchonella obovata* (R.Br.) Pierre.
 Ngon gai, see *Intsia bijuga* (Colebr.) Kuntze
 Ngon kai, see *Heritiera littoralis* Dryand.
 Ngonkai thale, see *Heritiera littoralis* Dryand.
 Ngueak plaamo dok khao, see *Acanthus ilicifolius* L.
 Ngueak plaamo dok muang, see *Acanthus ebracteatus* Vahl.
 Nom pi kad, see *Hoya parasitica* (Roxb.) Wall. ex Wight
 Nom tam lia, see *Hoya parasitica* (Roxb.) Wall. ex Wight
 Non see, see *Peltophorum pterocarpum* (DC.) K. Heyne
 Pangka hua sum dok khao, see *Bruguiera gymnorrhiza* (L.) Lamk
 Pangka hua sum dok khao, see *Bruguiera sexangula* (Lour.) Poir.
 Peng, see *Phoenix paludosa* Roxb.
 Peng tha le, see *Phoenix paludosa* Roxb.
 Pho thale, see *Hibiscus tiliaceus* L.
 Pho thale, see *Thespesia populnea* (L.) Soland. ex Correa
 Phueak, see *Colocasia esculenta* (L.) Schott
 Phutsa-tha-le, see *Ximenia americana* L.
 Po thale, see *Hibiscus tiliaceus* L.
 Prasak, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Prasak nu, see *Bruguiera sexangula* (Lour.) Poir.
 Prong, see *Ceriops decandra* (Griff.) Ding Hou
 Prong, see *Ceriops tagal* (Perr.) C.B. Rob.
 Prong, see *Cycas rumphii* Miq.
 Prong daeng, see *Ceriops tagal* (Perr.) C.B. Rob.
 Prong khao, see *Ceriops decandra* (Griff.) Ding Hou
 Prong nuu, see *Acrostichum speciosum* Willd.
 Prong thale, see *Acrostichum aureum* L.
 Prong-tha-le, see *Cycas rumphii* Miq.
 Raamyai, see *Ardisia elliptica* Thunberg
 Rang ka thae, see *Kandelia candel* (L.) Druce
 Rock, see *Corypha saribus* Lour.
 Rok thale, see *Scaevola taccada* (Gaertn.) Roxb.
 Sai yoi bai thuu, see *Ficus microcarpa* L.f.
 Samae, see *Aegialitis rotundifolia* Roxb.

Samae, see *Avicennia marina* (Forssk.) Vierh.
 Samae, see *Avicennia officinalis* L.
 Samae dam, see *Avicennia officinalis* L.
 Samae khao, see *Avicennia alba* Blume
 Samae thale, see *Avicennia marina* (Forssk.) Vierh.
 Samed, see *Melaleuca cajuputi* Roxb.
 Sam ma ngaa, see *Clerodendrum inerme* (L.) Gaertn.
 Samo thale, see *Excoecaria indica* (Willd.) Muell. Arg.
 See ngam, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Son thale, see *Casuarina equisetifolia* L.
 Taatum thale, see *Excoecaria agallocha* L.
 Ta bun dam, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Ta bun khao, see *Xylocarpus granatum* Koen.
 Tako suan, see *Diospyros malabarica* (Descr.) Kostel.
 Tao rang, see *Caryota urens* L.
 Tatum, see *Excoecaria agallocha* L.
 Teenped saai, see *Cerbera manghas* L.
 Teenped thale, see *Cerbera odollam* Gaertn.
 Thian le, see *Pemphis acidula* J.R. & G. Forst.
 Thua dam, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Thua khao, see *Bruguiera cylindrica* (L.) Bl.
 Ti tang, see *Melastoma saigonense* (Kuntze) Merr.
 Tin pet, see *Cerbera manghas* L.
 Toei thale, see *Pandanus tectorius* Sol.
 To sai, see *Allophylus cobbe* (L.) Raeusch.
 Yee thale, see *Pongamia pinnata* (L.) Pierre
 Yi thale, see *Pongamia pinnata* (L.) Pierre

Vietnamese:

Bả'n dâng, see *Sonneratia alba* J.E. Smith
 Bả'n ố'i, see *Sonneratia ovata* Back.
 Bả'n sé, see *Sonneratia caseolaris* (L.) Engl.
 Bàng nú'ố'c, see *Fagraea crenulata* Maingay ex C.B. Clarke
 Bó'm Bà, see *Scolopia macrophylla* (W. & A.) Clos
 Bó'n bớ'n, see *Typha angustifolia* Linné
 Bông nem, see *Erythrina orientalis* (L.) Murr.
 Caay cui, see *Heritiera littoralis* Dryand.
 Cây Lú'c, see *Pluchea pteropoda* Hemsl.
 Chà là, see *Phoenix paludosa* Roxb.
 Chiế'c vàng, see *Barringtonia asiatica* (L.) Kurz
 Chiế'c, see *Barringtonia acutangula* (L.) Gaertn.
 Choai, see *Stenochlaena palustris* (Burm. f.) Bedd.
 Chóc gai ho'cói, see *Lasia spinosa* (L.) Thwaites
 Chùm lé, see *Azima sarmentosa* (Bl.) B. & H.
 Cồ' cáy, see *Fimbristylis ferruginea* (L.) Vahl
 Cồ' cáy, see *Sporobolus virginicus* (L.) Kunth.
 Cồ' gà, see *Cynodon dactylon* (L.) Pers.
 Có gầ'u bién, see *Cyperus stoloniferus* Retz.
 Có sài hó', see *Pluchea pteropoda* Hemsl.

Cóc dỏ, see *Lumnitzera littorea* (Jack) Voigt.
 Cóc kèn, see *Derris trifoliata* Lour.
 Cóc trắ'ng, see *Lumnitzera racemosa* Willd.
 Cói, see *Cyperus malaccensis* Lamk.
 Côi, see *Scyphiphora hydrophyllacea* Gaertn. f.
 Co'm nguôi, see *Ardisia elliptica* Thunberg
 Cui bien, see *Heritiera littoralis* Dryand.
 Cui, see *Heritiera littoralis* Dryand.
 Đà quắnh, see *Ceriops decandra* (Griff.) Ding Hou
 Đà vôi, see *Ceriops tagal* (Perr.) C.B. Rob.
 Da-ba, see *Ficus curtipes* Corner
 Dái ngu'a nư'ớ'c, see *Aglaia cucullata* (Roxb.) Pellegrin
 Dây cá'm, see *Sarcolobus globosus* Wall.
 Dây chùm gớ'i, see *Dendrophthoe pentandra* (L.) Miq.
 Dây chùm gong, see *Clerodendrum inerme* (L.) Gaertn.
 Dây ghi, see *Viscum ovalifolium* DC.
 Dây Mồ qua, see *Dischidia rafflesiana* Wall.
 Dây môt tiể'n, see *Dischidia nummularia* R.Br.
 Dây Mu, see *Finlaysonia obovata* Wall.
 Dây mu, see *Gymnanthera oblonga* (Burm. f) P.S. Green
 Du'ong dầu kêt ho'p, see *Olax imbricata* Roxb.
 Dú'a nư'ớ'c, see *Nypa fruticans* Wurm. b.
 Dư'ng, see *Rhizophora mucronata* Lamk.
 Dư'ng, see *Rhizophora stylosa* Griff.
 Dư'ớ'c, see *Rhizophora apiculata* Bl.
 Giá, see *Excoecaria agallocha* L.
 Gồ nư'ớ'c, see *Intsia bijuga* (Colebr.) Kuntze
 Gú'a, see *Ficus microcarpa* L.f.
 Ho dầu, see *Casuarina equisetifolia* L.
 Kề, see *Corypha saribus* Lour.
 Ký nam, see *Hydnophytum formicarum* Jack
 Lá lua, see *Cynometra ramiflora* L.
 Lac tiên, see *Passiflora foetida* L.
 Lác, see *Cyperus malaccensis* Lamk.
 Lú'c cây, see *Pluchea indica* (L.) Less
 Má' dắ'm, see *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott
 Má'm den, see *Avicennia officinalis* L.
 Má'm lu'ớ'i dớ'ng, see *Avicennia alba* Blume
 Má'm ớ'i, see *Avicennia marina* (Forssk.) Vierh.
 Má'm quắn, see *Avicennia lanata* Ridley
 Mắy nư'ớ'c, see *Flagellaria indica* L.
 Môn nư'ớ'c, see *Colocasia esculenta* (L.) Schott
 Mù u, see *Calophyllum inophyllum* L.
 Mua, see *Melastoma malabathricum* var. *malabathricum* L.
 Múi, see *Glochidion littorale* Bl.
 Muoi bien, see *Suaeda maritima* (L.) Dum.
 Muóp xác vàng, see *Cerbera odollam* Gaertn.
 Nắgg ho' ráy, see *Crinum asiaticum* L.
 Nắng bốp, see *Eleocharis dulcis* (Burm. f.) Henschel

Nhan lố'ng, see *Passiflora foetida* L.
 Nhum, see *Oncosperma tigillarium* (Jack.) Ridl.
 Ô rô gai, see *Acanthus ilicifolius* L.
 Ô rô, see *Acanthus ebracteatus* Vahl.
 Phi lao, see *Casuarina equisetifolia* L.
 Quao nư'ố'c, see *Dolichandrone spathacea* (l.f.) K.Schum.
 Ráng, see *Acrostichum aureum* Linné
 Rau heo, see *Sesuvium portulacastrum* (L.) L.
 Rau mui, see *Wedelia biflora* (L.) DC.
 Rau muố'ng biề' n, see *Ipomoea pes-capre* (L.) Sweet.
 Sây, see *Phragmites karka* (Retz.) Trin. ex Steud.
 Su ó'i, see *Xylocarpus granatum* Koen.
 Su sú'ng, see *Xylocarpus moluccensis* (Lamk) M. Roem.
 Sú, see *Aegiceras corniculatum* (L.) Blencor
 Tân môt lang see *Cordia cochinchinensis* Gagnep.
 Thien tue, see *Cycas rumphii* Miq.
 Tim lang, see *Barringtonia racemosa* (L.) Spreng.
 Tra bô' dề', see *Thespesia populnea* (L.) Soland. ex Correa
 Tra nhố't, see *Hibiscus tiliaceus* L.
 Tràm, see *Melaleuca cajuputi* Roxb.
 Trang, see *Kandelia candel* (L.) Druce
 Vet dù bông dó, see *Bruguiera gymnorrhiza* (L.) Lamk.
 Vet dù, see *Bruguiera sexangula* (Lour.) Poir.
 Vet tách, see *Bruguiera parviflora* (Roxb.) W. & A. ex Griff.
 Vet thâng, see *Bruguiera cylindrica* (L.) Bl.

GLOSSARY

GEOGRAPHICAL

cosmopolitan	found all over the globe
New World	the America's
Old World	Eurasia and Africa
pantropical	occurring in all of the tropical regions of the world

HABITAT

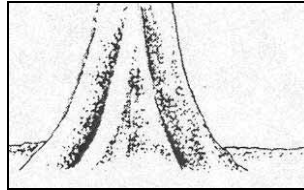
brackish	slightly to very saline/salty, but not having the salinity of seawater
lagoon	(often shallow) body of seawater that is (almost) disconnected from the sea
littoral	the intertidal zone
riparian	along a river or stream
terrestrial	occurring on land
vine forest	certain type of evergreen, tropical forest that is particularly abundant in climbers (e.g. in parts of Queensland, Australia)
wetland	an area that is either permanently, periodically or occasionally covered with fresh, brackish- or saline water, including coastal waters up to a depth of up to 6 metres below MLWL; includes natural and man-made habitats (Ramsar definition)

HABIT

annual	plant that completes its life cycle from seed to seed in a single year (or season)
aroid	member of the <i>Araceae</i> family
bryophyte	mosses
clump-forming	growing closely together in a compact cluster or group
dicotyledons	with two cotyledons, i.e. primary leaves of the embryo; includes most seed plants
ephemeral	temporary, soon disappearing
epiphyte	growing on another plant (usually a herb growing on a tree), without being rooted in soil
gregarious	large numbers of the same species occurring together at a single site (not necessarily compact)
halophyte	plant that only occurs in salty, saline areas
hemi-parasite	a plant that partially parasites on a host, but supplements this with its own (often feeble) photosynthesis; can exist without a host
liana	a woody climbing plant, usually of (semi-)tropics
monocotyledons	with one cotyledon, i.e. primary leaf of the embryo; includes groups such as grasses, sedges, orchids and lilies (see dicotyledons)
perennial	plant which lives for more than one year
pitcher plant	a member of the <i>Nepenthaceae</i> family, characteristically with leaf-ends that are modified into vessels, that contain rain water and enzymes, and serve to trap insects
rattan	a climbing palm (or in trade: the stem of the climbing palm), of which most species occur in Southeast Asia; the largest genus is <i>Calamus</i> , of which there are at least several hundred species
scandent	climbing, without use of tendrils, hooks, etc.
sedge	grass-like herb of the <i>Cyperaceae</i> family
succulent	plant with juicy, thick leaves and (often) thickened stems; often occurs in plants adapted to dry and desert conditions, or physiologically dry conditions such as with high salinity
thicket	a thick clump of shrubs, often impenetrable
tussock	grasses or sedges growing closely together in a compact cushion
viviparous	see under FRUIT

BARK/TRUNK/STEM

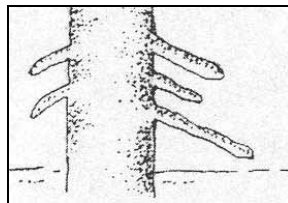
columnar trees	trunk of tree is tall and straight
fissured	deeply grooved
flanged	with projecting rim or edge
fluted trunk	spreading outward towards the bottom:



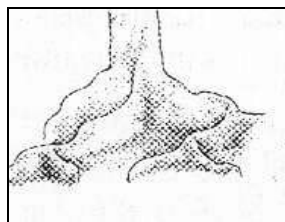
hypocotyl	that portion of the embryonic stem below the cotyledons (i.e. the primary leaves of the embryo)
latex	thick, milky juice
lenticel	a special pore in the bark of trees and shrubs, to allow air to pass to inner tissues; often with characteristic shape, colour and size
scales	flat, plate-like external structure, formed from the epidermis; often visible only if viewed under magnification

ROOTS

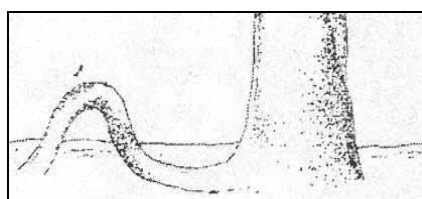
aerial root	root-like structure that emerges from lower trunk or branches; some may eventually develop into stilt-roots (e.g. in some <i>Rhizophoraceae</i>):
--------------------	--



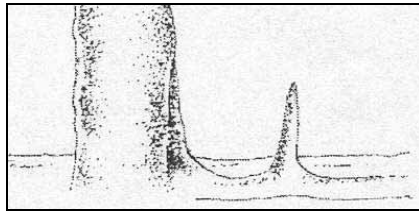
buttress	roots that branch off above the ground, arching away from the stem before entering the ground; they are not separated from the stem before entering the soil as are stilt-roots:
-----------------	--



cable roots	strong, fairly thin (<1-2 cm ϕ), horizontally-running roots, often just below soil surface
knee root	a loop of a root that emerges above the ground:



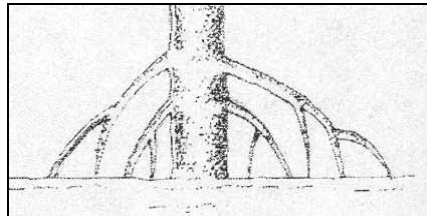
pneumatophore a root rising above the (waterlogged) soil, that acts as a respiratory organ:



pseudo-bulb (orchid) thickened internode of orchids and some other plants, for storage of water and reserves

rhizome thick, horizontal stem, usually underground, sending out shoots above and roots below

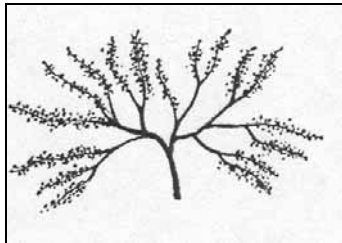
stilt-roots growing from the stem above ground and entering the soil, usually for mechanical support:



tuber thickened, fleshy, food-storing underground root

BRANCHES

dichotomous branching that results from division of a growing point into two equal parts, giving repeated forking:



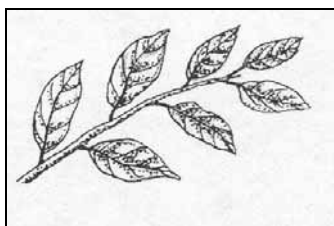
internodes the part between two nodes or joints

nodes knob or joint of a stem at which leaves arise

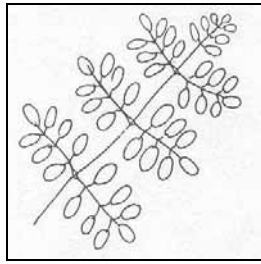
stolon creeping plant stem or runner, capable of developing rootlets and stem, and ultimately developing new individuals

LEAVES

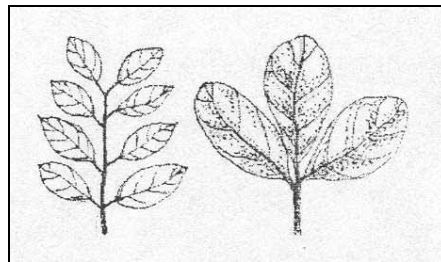
alternate leaves occurring at different levels successively along a stem:



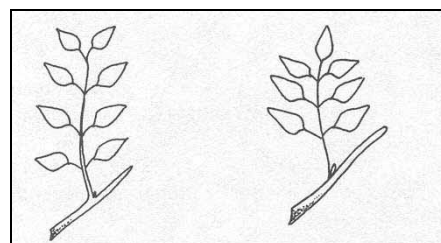
axil the point of the upper angle formed between the axis of a stem and a leaf(-stalk)
bipinnate twice divided compound leaf, with leaflets on opposite sides (see pinnate):



compound leaf see leaflet
deciduous shedding its leaves periodically (e.g. during dry season)
domatium crevice or hollow in some plants, serving as a lodging for insects (esp. ants) or mites
evergreen not shedding its leaves
frond a leaf, esp. of ferns or palms
gall abnormal outgrowth from plant leaf (or stem) caused by the presence of young insects (e.g. gall wasps)
gland an appendage, or other structure on a plant which secretes sticky or oily substances
leaflet a division of a compound (i.e. subdivided) leaf:



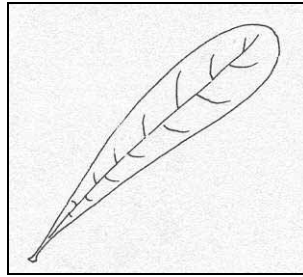
ligule a tongue-shaped or strap-shaped organ
margin the edge of a leaf
midrib the central rib or vein of a leaf
nerve a prominent, simple vein or rib of a leaf
pinnate a compound leaf with leaves arranged on opposite sides of an elongated axis; left is even pinnate, right is odd pinnate or imparipinnate:



secondary leaflets a (further) division of a leaflet (see above)
sheath organ that (partially) surrounds another organ (e.g. a leaf base)

spat(h)ulate

leaf shaped like a spatula:

**tendrils**

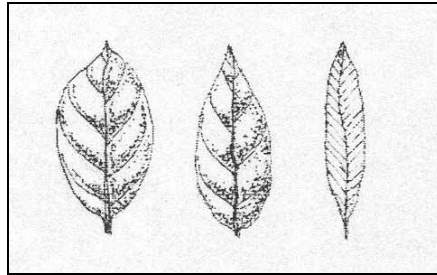
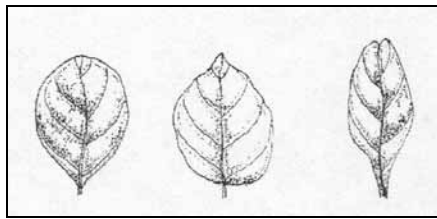
a slender, twining organ used to grasp support for climbing

vein

a vascular bundle, usually visible externally, e.g. on the leaf surface

whorls (leaves)

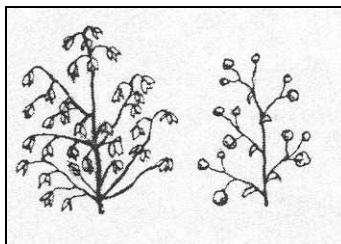
a ring-like arrangement of leaves from a common point or node

LEAF SHAPE**elliptic/lanceolate/linear-lanceolate:****obovate/ovate:****FLOWER CLUSTER****axillary**

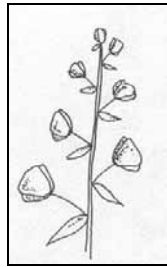
positioned in or arising from an axil, which is the point of the upper angle formed between the axis of a stem and any part (usually a leaf(-stalk))

catkinsa cluster of flowers consisting of a dense spike of petal-less, unisexual flowers (e.g. in *Salix*)**panicle**

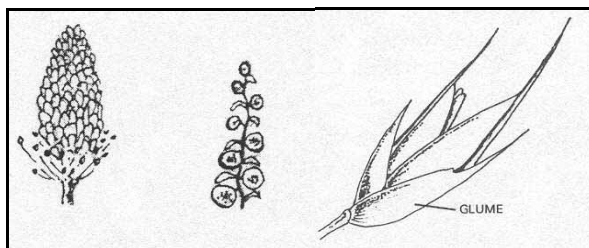
a branched flower cluster, with flowers maturing from the bottom upwards:



raceme an unbranched, elongated flower cluster with flowers maturing from the bottom upwards:



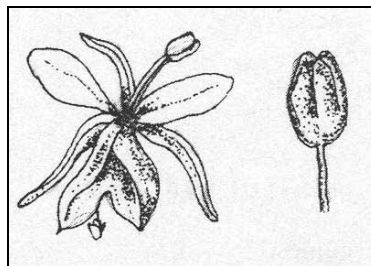
spike an unbranched, elongated flower cluster with (sub-)sessile flowers, maturing from the bottom upwards:



spikelet a secondary spike
terminal located at the end, e.g. of a branch or twig
whorls (flowers) a ring-like arrangement of flowers from a common point or node

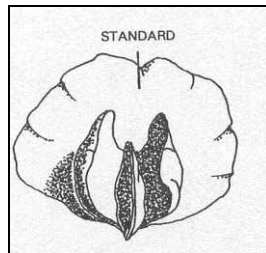
FLOWER

anther the pollen-bearing portion of the stamen; usually expanded and located at the tip/end of this organ:



calyx collective term for all the sepals of a flower
corolla collective term for all the petals of a flower
disk an enlargement or outgrowth of the receptacle around the base of the ovary; in the *Asteraceae*, it is the central portion of the flower-head, on which all the individual flowers are implanted
epicalyx a whorl of leaflets at the base of a flowers, outside the calyx (DRAW)
filament the stalk of the stamen, which supports the anther (of the anthers)
nectar a sugary, sticky fluid secreted by many plants
petals (very) modified leaflets that envelope the sexual organs of a flower; often white or coloured
pollen male gametophytes of a seed plant
sepals modified leaflets that form a second envelope around the sexual organs of a flower, outside the envelope provided by the petals; often green or greenish-

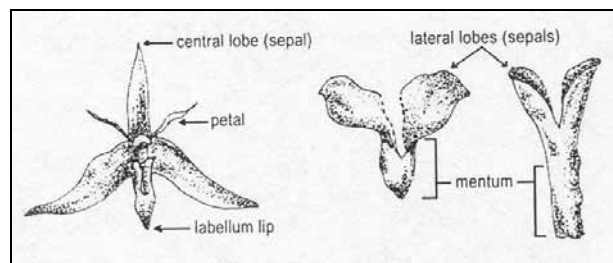
spur yellow
standard small, hook-like appendage
 the upper and usually largest petal of a Papilionaceae flower:



stigma portion of the female organs of the flower which is receptive to pollen
style (usually) narrow, stalk-like part of the female organ which connects the stigma to the ovary
theca a pollen sac or cell of the anther (plural = thecae)
tube a hollow, cylindrical structure

ORCHID FLOWER

column the united filaments and style (see below)
column-foot base of the column
lip exceptional base petal of an orchid (see below)
mentum lateral sepals, united into one appendage, that can have very different forms: sac-like, feather-like, globular, etc. (see below)
midlobe the central lobe

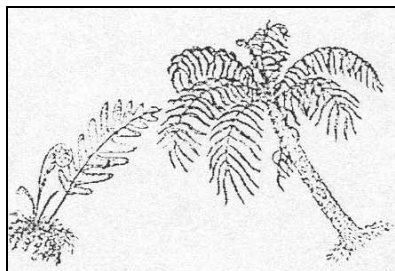


FRUIT

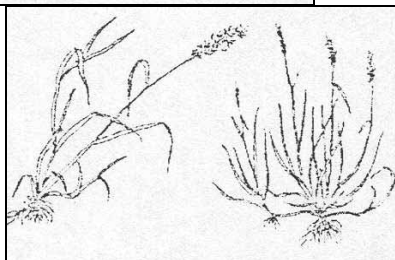
aril an appendage growing at or near the hilum of a seed; fleshy thickening of the seed coat (e.g. in *Myristicaceae*)
beaked a narrowed or prolonged tip
berry a fleshy fruit developing from a single female reproductive organ; may be applied to any fruit which is fleshy or pulpy throughout, i.e. without a stony pit or core
hilum scar left at former point of attachment
keeled with a prominent, longitudinal ridge
pod a dry fruit that opens at maturity, e.g. of legumes (*Leguminosae*)
propagule a structure, such as a seed or spore, which gives rise to a new plant
sorus cluster of sporangia on the surface of a fern leaf (plural = sori)
sporangium spore-bearing case or sac (of fern) (plural = sporangia)
spore reproductive cell of a fern
spurred small, hook-like appendage
viviparous sprouting on the parent plant (e.g. many *Rhizophoraceae*)
wing thin, flat margin bordering the fruit

THE MAIN PLANT GROUPS:**GROUP A. Ferns (including epiphytic ferns)**
(*paku, pakis*)

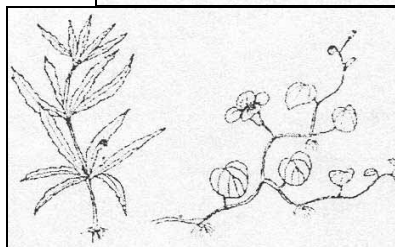
Plants without flowers or stem. Typically, ferns have a woody, root-like rhizome upon which stiff leaf-stalks are directly implanted.

**GROUP B. Grass-like plants**

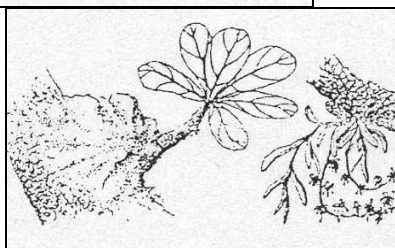
Ground-dwelling herbs, typically with long, linear leaves and inconspicuous flowers.

**GROUP C. Other ground-dwelling herbs.**

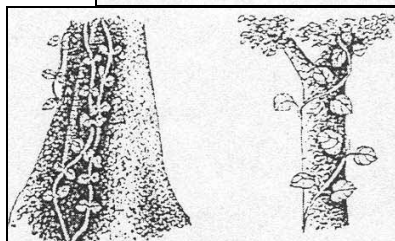
Ground-dwelling herbs, which are not grass-like: i.e., their leaves are not long and linear, and usually have conspicuous flowers. These have soft stems, that are only occasionally woody. Generally they are not taller than two metres.

**GROUP D. Epiphytes (other than ferns)**

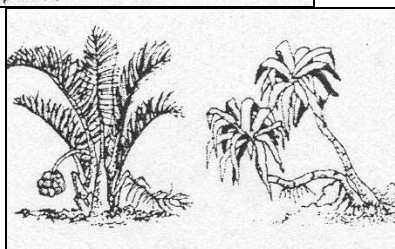
Plants which live on the surface of other plants (usually trees or palms). Epiphytes may be (semi-) parasitic, such as the mistletoes (*bingalo*).

**GROUP E. Vines and climbers.**

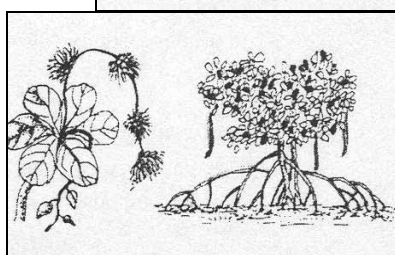
Woody or herbaceous plants that are not self-supporting, but climbing or trailing on some support, such as on trees and shrubs. Note that rattans (*rotan*) are included in the palm section (see Group F.).

**GROUP F. Palms, pandans and cycads**

Stems are woody, straight, and usually tall; unbranched up to the first leaves. Leaves are longer than 1m, and usually divided into many leaflets. This group includes rattans.

**GROUP G. Trees and shrubs**

Large woody plants, either a) tall, with a single main stem or trunk (=tree); or b) smaller, with stems that divide (from the base) into many (sub-) stems (=shrub).



KEYS

GROUP A: FERNS

Note: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

- 1 a Ground ferns (growing on the soil): **2**
 b Epiphytic (growing on other plants): **4**

- 2 a Large (> 1 m), woody fern, with a stout main stem, that is erect, covered with large scales, and has thick, fleshy roots; leaves do not have a serrated or toothed edge: **3**
 b Creeping or climbing fern with a green and scaleless root; edges of leaves are sharply toothed: *Stenochlaena palustris* – 3 (Blechnaceae)

- 3 a Tip of sterile leaflets (i.e., the larger, normal leaflets) rounded or blunt, with a short tip: *Acrostichum aureum* – 22 (Pteridaceae)
 b Tip of sterile leaflets long and pointed: *Acrostichum speciosum* – 23 (Pteridaceae)

- 4 a Leaves inserted in a dense spiral, forming a nest-like clump: **5**
 b Other types of ferns: **9**

- 5 a The fern has two, very different types of leaves: **6**
 b Has only one type of leaf: **8**

- 6 a Fertile leaves (with spores on underside) are dichotomously divided into branchlets with a diameter less than 4 cm, pendulous, up to 2 m long: *Platyserium coronarium* – 19 (Polypodiaceae)
 b Fertile leaves are not pendulous: **7**

- 7 a Fertile leaves with distinct leaflets (compound), up to 2 m long: *Drynaria rigidula* – 13 (Polypodiaceae)
 b Fertile leaves lobed, up to 70 cm long: *Drynaria sparsisora* – 14 (Polypodiaceae)

- 8 a Nest-like clump formed by simple, undivided leaves, up to 1.5 m long and with an edge that is not toothed or serrated: *Asplenium nidus* – 2 (Aspleniaceae)
 b The nest-like clump if formed by compound leaves, that are subdivided into leaflets and have a toothed edge: *Asplenium macrophyllum* – 1 (Aspleniaceae)

- 9 a Leaves compound (i.e. subdivided into leaflets): **10**
 b Leaves simple (i.e. not divided)(! note: deeply lobed, but simple leaves sometimes resemble compound leaves): **14**

- 10 a Leaves are pinnate (leaflets not sub-divided again): **11**
 b Leaves are bi-pinnate (leaflets once more sub-divided): **13**

- 11 a Hairs, if present, only on rhizome: *Photinopteris speciosa* – 17 (Polypodiaceae)
 b Hairs on leaf stalk and leaflets: **12**

- 12 a Leaflets are densely covered with hairs on both sides: *Nephrolepis acutifolia* - 11 (Nephrolepidaceae)
 b Leaflets are hairy on one sides: *Ctenopteris moultoni* – 7 (Grammitidaceae)

- 13 a Hairs, if present, only on rhizome: *Davallia divarcata* – 4 (Davalliaceae)
 b Leaf stalk and lower surface of leaf axis covered with (scattered) hairs: *Hymenophyllum holochilum* – 8 (Hymenophyllaceae)

- 14 a Leaves very small and numerous, spirally arranged in pairs of three and covering the entire branch like scales. Sporangia occur at the end of the leafy spikes: *Lycopodium carinatum* – 10 (Lycopodiaceae)

- b Leaves larger, bearing sporangia in clusters (sori) on their lower surface: **15**
- 15 a Leaves lobed or dissected: **16**
- b Leaves entire (not lobed), lanceolate, elliptic or round: **17**
- 16 a Rhizome very slender, about 1 mm diameter. Scales brown with pale edge, about 3 mm long. Leaf stalk very slender, 1-3 cm long: *Davallia parvula* – 5 (Davalliaceae)
- b Rhizome 7 mm diameter, scales, 3-4 mm, edge finely toothed in the narrow part. Leaf stalk up to about 30 cm long: *Phymatodes scolopendria* – 18 (Polypodiaceae)
- 17 a Sterile leaves with a toothed edge: *Pachypleuria angustata* – 6 (Davalliaceae)
- b Sterile leaves with a smooth or wavy edge (*Myrmecophila sinuosa*): **18**
- 18 a Sori growing in elongated clusters or grooves along the edge of the leaves: **19**
- b Sori not arranged in elongated clusters along margin of leaves: **20**
- 19 a Fertile and sterile leaves very different in size and shape. Sterile leaves nearly round, 1cm: *Drymoglossum piloselloides* – 12 (Polypodiaceae)
- b Rhizome with scales nearly black, about 1 cm long with a hair-like tip. Leaves 30-60 by 0.7-2 cm with sori (spore clusters) in marginal groove: *Vittaria elongata* – 24 (Vittariaceae)
- 20 a Fertile leaves long, lanceolate, with a distinct sterile section and a fertile end section with the sori located on the lower surface. Scales of rhizome round, 1 mm: *Pyrrosia longifolia* – 20 (Polypodiaceae)
- b Sori spread evenly on the blade of fertile leaves, with no clear distinction between sterile and fertile sections: **21**
- 21 a Sori evenly spread over the fertile leaves, not arranged in rows. Fertile leaves shorter than sterile leaves but with a longer stalk: *Elaphoglossum amblyphyllum* – 9 (Lomariopsidaceae)
- b Sori arranged in rows along veins or midrib: **22**
- 22 a Sori arranged in one or more rows along the midrib: *Myrmecophila sinuosa* – 16 (Polypodiaceae)
- b Sori arranged in rows along or in between the parallel main veins: **23**
- 23 a Sori linear, in single lines between adjacent main veins, at maturity about 2 mm wide, the lines sometimes interrupted, not reaching midrib or margin of leaf. Rhizome about 2 mm diameter, bearing leaves about 5-10 mm apart, the younger parts densely scaly; scales about 6 mm long, stiff and almost bristle-like: *Selliguea heterocarpa* – 21 (Polypodiaceae)
- b Lines of sori project from the midrib, sloping and running up to the edge of the leaf. Rhizome covered with large, lanceolate scales: *Loxogramma involuta* – 15 (Polypodiaceae)

GROUP B: GRASSES & GRASS-LIKE PLANTS

Note: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

- 1 a Leaf blades absent (at most a sheath around stem): **2**
- b Leaf blades present: **6**
- 2 a Flower clusters branched (compound): **3**
- b Flower cluster a single, terminal spike: **4**
- 3 a Stem 50-200 cm tall, 5-20 mm wide at base, flower cluster 5-10(-15) cm long, dense and much branched: *Scirpus lacustris* – 39 (Cyperaceae)
- b Stem 60-150 cm tall, 3-10 mm wide at base, flower cluster 2-8 cm long, loose and less compound: *Scirpus litoralis* – 40 (Cyperaceae)

- 4
 - a Stem hollow, divided by partitions, 0.8-2m tall: *Eleocharis dulcis* – 30 (Cyperaceae)
 - b Stem not divided by partitions, usually filled with pith: 5
- 5
 - a Dwarf sedge, 1-7 cm tall, stem round: *Eleocharis parvula* – 31 (Cyperaceae)
 - b Small sedge, 25-60 cm tall, stem round at base, bluntly triangular just below the flower cluster: *Eleocharis spiralis* – 32 (Cyperaceae)
- 6
 - a Stem bluntly to very sharply triangular (occasionally only just below the flower cluster: 7
 - b Stem round, occasionally flattened or grooved: 18
- 7
 - a Spikelet ovoid (or oblong-ovoid), 1½-3 times as long as wide: 8
 - b Spikelet linear, or compressed oblong, 3-15 times as long as wide: 14
- 8
 - a Usually large (80-180(-200) cm) sedge, with long (30-80 cm) leaves, also just below or enveloping the compound flower cluster: 9
 - b Small to medium-sized (5-80 cm) sedges, simple to compound flower cluster: 10
- 9
 - a Always large sedge (80-200 cm), with large, loose terminal flower clusters: *Scirpus grossus* – 38 (Cyperaceae)
 - b Small to large sedge (15-)30-180 cm tall, with dense terminal flower clusters: *Scirpus maritimus* – 41 (Cyperaceae)
- 10
 - a Ligule (tongue-like appendage at base of leaf blade) present: 11
 - b Ligule absent: 13
- 11
 - a Leaves much shorter than stem: *Fimbristylis ferruginea* – 34 (Cyperaceae)
 - b Leaves 0.5-1 times length of stem: 12
- 12
 - a Small sedge (5-30 cm), glabrous, creeping rhizome, simple flower cluster: *Fimbristylis polytrichoides* – 35 (Cyperaceae)
 - b Medium-sized sedge (20-80 cm), leaf sheath hairy, flower cluster simple to sub-compound, creeping rhizome: *Fimbristylis sieberiana* – 37 (Cyperaceae)
- 13
 - a Small to medium-sized sedge (10-50 cm), glabrous, with short rhizome and compound flower cluster: *Fimbristylis cymosa* – 33 (Cyperaceae)
 - b Small to medium-sized sedge (10-30 (-60) cm), pubescent to glabrous, flower cluster simple to sub-compound: *Fimbristylis sericea* – 36 (Cyperaceae)
- 14
 - a Slender stemmed sedges (diameter 1-2mm), with a simple or sub-compound flower cluster: 15
 - b Stout stemmed sedges (diameter 3-10 mm), with compound flower cluster: 16
- 15
 - a Spikelet linear-lanceolate, round, 5-15 mm by 2-2½ mm, leaves less than half of stem length, bracts 1-6 cm long, stolons creeping, long: *Cyperus stoloniferus* – 29 (Cyperaceae)
 - b Spikelet linear, strongly compressed, 10-20 by 2-2½ mm, bracts up to 30 cm long, creeping rhizome: *Cyperus scariosus* – 28 (Cyperaceae)
- 16
 - a Leaves few, short (up to 30 cm), large sedge (0.6-1.75 m), spikelets linear, compressed, 10-30 by 1.3-1.8 mm, stem diameter up to 10 mm, flower cluster compound, creeping rhizome, bracts up to 75 cm: *Cyperus malaccensis* – 27 (Cyperaceae)
 - b Leaves many, length varying from just shorter to longer than the stem, stem diameter 3-6 mm, no or very short rhizome: 17
- 17
 - a Bracts very long, up to 100 cm, stem up to 6 mm diameter, spikelet oblong, compressed, 5-9(-13) by 2-2½ mm: *Cyperus javanicus* – 26 (Cyperaceae)
 - b Bracts shorter, 10-30 cm long, stem 3-4 mm diameter, spikelets linear, round, 5-15 by 1-1½ mm: *Cyperus compactus* – 25 (Cyperaceae)

- 18 a Very large, robust plants, 1.5-4 m tall: **19**
b Small to medium-large grasses, 0.1-1.5 m: **21**
- 19 a Leaves as long as stem, 1.5-3 m, erect, flower cluster a single terminal cigar-shaped spike 15-30 cm long: *Typha angustifolia* – 51 (Typhaceae)
b Leaves alternate, 20-80 cm long, stem 1.5-3(-4) m, flower cluster a large 20-60-(75) cm terminal panicle, not cigar-like but looser: **20**
- 20 a Leaves 20-60 cm long, stem up to 4 m, flower clusters a large, loose silvery plume, 10-30 cm wide and 20-75 cm long: *Phragmites karka* – 47 (Poaceae)
b. Leaves up to 80 cm long, stem up to 3 m, flower clusters a long narrow panicle, 25-60 cm long by 4-10 cm wide: *Myriostachya wightiana* – 45 (Poaceae)
- 21 a Ligule long (0.75-4 mm), grasses 0.15-1.5 m tall: **22**
b Ligule very short (0.2 mm), grasses, 0.5 m tall: **24**
- 22 a Flower cluster consists of 2 terminal spikes, stem is 0.12-0.5 m, creeping rhizome: *Paspalum vaginatum* – 46 (Poaceae)
b Flower cluster is a terminal panicle: **23**
- 23 a Ligule 2-3 mm, irregularly toothed, annual without creeping rhizome, 0.5-1.5 m tall: *Leptochloa neesii* – 44 (Poaceae)
b Ligule 3-4 mm, membranous, perennial with or without stolon, 0.5-1.0 m tall: *Diplachne fusca* – 43 (Poaceae)
- 24 a Flower cluster a single 1½-4 cm by 1½ mm spike, 0.1-0.25 (-0.4) m tall, stem filled with pith, creeping rhizome: *Zoysia matrella* – 50 (Poaceae)
b Otherwise: **25**
- 25 a Flower cluster 3-9 terminal spikes, each 1½-11 cm long, stems 0.1-0.4 m tall, creeping rhizome: *Cynodon dactylon* – 42 (Poaceae)
b Otherwise: **26**
- 26 a Flower cluster a terminal panicle, 4½-12 cm long, with spikelets 2.25-3 cm long, stems 0.25-0.5 m long, hollow: *Sporobolus virginicus* – 48 (Poaceae)
b Flower cluster 2-5(-6) alternate spikelets, each 8-18 mm long, stems 0.1-0.45 m tall, solid: *Xerochloa imberbis* – 49 (Poaceae)

GROUP C: OTHER GROUND-DWELLING HERBS

Note 1: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

Note 2: Excluding grass-like herbs and ground-dwelling herbs.

- 1 a Aquatic plants, usually submerged in the water, rooting or free-floating : **2**
b Not so: **6**
- 2 a Aquatic or marsh herb with latex in the long, broad pointed leaves; leaves are alternate and have a smooth edge: *Cryptocoryne ciliata* – 59 (Araceae)
b Strict aquatic herbs, without latex. Leaves in clusters or opposite: **3**
- 3 a Opposite, 3-7.5 cm long, thread-like leaves, with a smooth edge: *Ruppia maritima* – 73 (Ruppiaceae)
b Leaves in clusters, and with toothed edges: **4**

- 4 a Spines absent on lower side of leaf; leaf blade has 12-21 spiny teeth along each side: *Najas browniana* – 69 (Najadaceae)
- b Lower side of leaf has 1-30 spines: **5**

- 5 a Edge of leaf has 1-40 conspicuous, dark brown teeth, each up to half as long as the width of the leaf blade: *Najas indica* 70 (Najadaceae)
- b Edge of leaf with 2-7 coarse, brown, spiny teeth, each up to as long as the width of the leaf blade: *Najas marina* – 71 (Najadaceae)

- 6 a Plants with copious, thick latex in leaves and stem: **7**
- b No latex: **10**

- 7 a Long, pointed leaves: **8**
- b Leaves triangular: **9**

- 8 a Marsh or aquatic herb, 35-50 cm tall, with 15-41 cm long, pointed leaves, and a smooth edge. Flowers are purplish and not scented: *Cryptocoryne ciliata* – 59 (Araceae)
- b Plant of sandy soils, beaches, swamps, edges of mangroves, 40-60 cm tall. Flowers large (7-12 cm), white, sweet-scented and showy: *Crinum asiaticum* – 57 (Amaryllidaceae)

- 9 a Large plant, 75-140 cm tall, with spiny stem: *Lasia spinosa* – 60 (Araceae)
- b Large plant, up to 2m tall, with large, ovate to triangular leaves with lobes at the base. The leaf stalk is 30-150 cm long, and not spiny: *Colocasia esculenta* – 58 (Araceae)

- 10 a Plants apparently without leaves: **11**
- b With leaves: **12**

- 11 a Succulent herb with erect branches, 15-30 cm tall: *Halocnemum cinereum* – 61 (Chenopodiaceae)
- b Robust herb, 30-60 cm tall, lower part woody, widely forked from base. Leaf sheaths are typically bluish-green: *Salicornia indica* – 62 (Chenopodiaceae)

- 12 a Leaves sub-divided into leaflets. Creeping or scrambling plant, 2-6 m long, with pink flowers and pods: *Canavalia maritima* – 68 (Leguminosae)
- b Leaves not subdivided into leaflets: **13**
- 13 a Leaves opposite (but sometimes very unequal in size): **14**
- b Leaves alternate: **20**

- 14 a Prostrate to straggling, succulent herb, with smooth-edged leaves and pink flowers: **15**
- b Erect or climbing, non succulent herb, leaf edges spiny, toothed or norched, flowers white to pale mauve, violet or yellow: **16**

- 15 a Flowers solitary in leaf axils, with distinct stalk and narrow leaves: *Sesuvium portulacastrum* – 55 (Aizoaceae)
- b Flowers singularly or in groups in leaf axils, without a distinct stalk, leaves oval to obovate: *Trianthema portulacastrum* – 56 (Aizoaceae)

- 16 a Often climbing herb with a slender stem, thin toothed leaves and yellow flowers. *Wedelia biflora* – 108 (Asteraceae) Note: included among the climbers, as this is its usual habit.
- b Robust – occasionally straggling – herb or shrublet, with violet, white or mauve flowers: **17**

- 17 a Flowers in a 20-40 cm terminal raceme with many small, deep violet flowers (<10 mm long): *Stachytarpheta jamaicensis* – 74 (Verbenaceae)
- b Flowers in 5-20 cm long terminal spikes, with white to pale mauve flowers, >2 cm long: **18**

- 18 a Flowers white and small (19-25mm), spines (on leaves) absent, usually straggling to climbing slender stems: *Acanthus volubis* – 54 (Acanthaceae)

- b Flowers white to pale mauve, leaves spiny, plant usually robust, not climbing: **19**
- 19 a Flowers 3.5-4 cm, pale bluish violet to pale violet (seldom white), with one leaflet and two supporting leaflets. Leaves spiny. Fruit 2.5-3 cm long, seeds 10 mm long: *Acanthus ilicifolius* – 53 (Acanthaceae)
- b Flowers 2-2.5(-3) cm, white, with only one leaflet. Leaves spiny. Fruit less than 2 cm long, seeds 5-7 mm: *Acanthus ebracteatus* – 52 (Acanthaceae)
- 20 a Erect succulent plant, up to 45 cm tall, leaves narrow, rounded in cross-section, juicy fleshy tissue, salty to taste: *Suaeda maritima* – 63 (Chenopodiaceae)
- b Straggling ground vines: **21**
- 21 a Leaves 3-lobed, foetid smelling when crushed, flowers with 5 sepals and 5 petals, surrounded by a whorl of fine, threadlike green filaments: *Passiflora foetida* – 72 (Passifloraceae)
- b Leaves not 3-lobed, flower fused to large white, pink or purplish, trumpet-like flowers: **22**
- 22 a Flowers 9-12 cm long, usually white (sometimes purple/violet), fruit 2-2.5 cm long: *Ipomoea tuba* – 67 (Convolvulaceae)
- b Flowers no longer than 5 cm, usually pink, purple or violet, fruit <2 cm long: **23**
- 23 a Fruit 12-17 mm diameter, seeds 6-10 mm long; leaves deeply notched at the top, shaped like a goat's hoof (hence the name): *Ipomoea pes-capre* – 66 (Convolvulaceae)
- b Fruit 6-9 mm, leaves with pointed tip, usually deeply heart-shaped or kidney-shaped: **24**
- 24 a Flowers 3-4.5 cm long, fruit usually 9 mm, leaves 1-7.5 by 1-10 cm, green: *Ipomoea gracilis* – 64 (Convolvulaceae)
- b Flowers 2-3 cm long, fruit 6-7 mm, leaves 2.5-6 by 2-5 cm, usually with purplish edge and spots: *Ipomoea maxima* – 65 (Convolvulaceae)

GROUP D: EPIPHYTES

Note 1: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

Note 2: Epiphytic ferns are discussed in Group A

- 1 a Orchids, usually with pseudo-bulbs or tuberous roots, leaves alternate, lanceolate or elliptic, and often with leaf-sheaths extending around the stem: **2**
- b Other types of plants, without the typical orchid flowers, thick roots, leaf-sheaths or pseudo-bulbs: **12**
- 2 a Orchids with small leaves, maximum 1.5 cm long by 0.4 cm broad; only one distant leaf between nodes or per pseudobulb: **3**
- b Orchids with leaves longer than 1.5 cm; often more than one leaf between nodes, not distant but covering stem or bulb, or one leaf per node, but drooping: **4**
- 3 a Plant with pseudo-bulbs, and stiff, elliptic leaves, one per pseudobulb. Flower clusters borne on rhizome, with orange coloured flowers (about 6 mm broad), often with dark red veins: *Bulbophyllum xylocarpi* – 91 (Orchidaceae)
- b Plant without pseudo-bulbs, but with thin, erect stems, measuring about 0.5 cm between nodes, with one leaf each. Flowers occur singularly, pale yellowish (violet-veined): *Dendrobium subulatum* – 96 (Orchidaceae)
- 4 a Plants with clearly distinguishable stems. Plants at least 25 cm large when fully grown: **5**
- b Plants with (very) short, not clearly distinguishable stems, much smaller than 25 cm when fully grown: **8**

- 5
 - a Leaves small, the largest about 2.5 by 0.7 cm, covering the stem like scales. End part of the plant has club-shaped, sheathing leaves only. Many, single, white flowers (4 x 4 mm), with reflexed sepals and petals: *Dendrobium aloifolium* – 93 (Orchidaceae)
 - b Leaves at least 7.5 cm long, not covering the stem like scales; with a multi-flowered flower cluster. Plants measure up to 75 cm: 6
- 6
 - a Flowers large, 8-10 cm across, branches with leaves usually 1-2 m tall, semi-erect: *Dendrobium moschatum* – 94 (Orchidaceae)
 - b Flowers smaller, 2-3.5 cm across, branches usually spreading or drooping, 30-75 cm tall: 7
- 7
 - a Widely branched plant, measuring 5-6 cm between nodes. Leaves only one between nodes, 7.5-30 by 0.5 cm. Flower cluster 7 cm long, with yellow-white flowers: *Dendrobium teretifolium* – 97 (Orchidaceae)
 - b Drooping, long stem, branched, with thick roots. Leaves with overlapping leaf-sheaths, 10-25 by 2-3 cm. Flower clusters 20-30 cm long, white flowers (often violet-red blotches). Petals are curved back. Strong aromatic smell: *Aerides odoratum* – 90 (Orchidaceae)
- 8
 - a Plants with pseudobulbs, often hidden by leaves: 9
 - b Plants without pseudobulbs: 10
- 9
 - a Clearly distinguishable pseudo-bulbs, each with two leaves. Flowers occur singularly; pale yellow, sweet smelling: *Dendrobium pachyphyllum* – 95 (Orchidaceae)
 - b Large plant, up to 80 cm. Pseudo-bulbs hidden by the 45-80 cm by 5 cm leaves. Flowers in clusters, at least 75 cm long: *Cymbidium finlaysonianum* – 92 (Orchidaceae)
- 10
 - a Plant up to 20 cm long, with a very short, erect stem, bearing 4-6 leaves, the largest about 18 by 2 cm. Flower clusters up to 23 cm long, with flowers greenish or brownish in dense whorls. Petals and sepals are curved back: *Oberonia iridifolia* – 98 (Orchidaceae)
 - b Plants significantly smaller in size, and with leaves about 3 by 0.5 cm. Flower cluster is 7-15 cm long: 11
- 11
 - a Flower cluster 7-15 cm long, with very small, tomato-red flowers, the lower ones crowded, the upper whorled; all sepals are curved back. Leaves measure 3.5 by 0.7 cm: *Oberonia laeta* – 99 (Orchidaceae)
 - b Flower cluster up to 7 cm long, flowers in regular whorls of about 8; flowers yellow to orange, lip red-brown, 1-1.5 mm across. Only the lateral sepals are curved back. Leaves measure 3 by 0.4 cm: *Oberonia rhizophoreti* – 100 (Orchidaceae)
- 12
 - a Plants with a much swollen, usually ant-inhabited base of the stem: 13
 - b Plants without a much swollen base of the stem: 14
- 13
 - a Swollen base of plant is spineless. Leaves measure 5-15 by 2-7 cm. Flowers occur in groups of 3-5 in cavities in the strongly thickened nodes of the stem: *Hydnophytum formicarium* – 101 (Rubiaceae)
 - b The swollen base of the plant is armed with hard spines. Leaves measure 12-16 by 4-8 cm. Flowers occur in pairs in cavities on the stem: *Myrmecodia tuberosa* – 102 (Rubiaceae)
- 14
 - a Small herbaceous plants with latex, leaves opposite: 15
 - b Larger shrub-like plants without latex: 18
- 15
 - a Large epiphyte, branches 0.8-1.5 m long, leaves 10-15 cm long, pointed, flowers in drooping, terminal, 15-30-flowered clusters: *Hoya parasitica* – 81 (Asclepiadaceae)
 - b Smaller epiphytes, 30-100 cm long, usually creeping or climbing, flowers in leaf axils in clusters of up to 10 flowers: 16
- 16
 - a Plant with flat, broadly-oval leaves, covered with a fine 'powder'; leaves are all more-or-less of the same type: *Dischidia nummularia* – 79 (Asclepiadaceae)

- b Climbing or winding plant, with two types of leaves: **17**
- 17 a The two types of leaves are: i) bag-like, 5-12 cm long, and ii) oval-elliptic leaves, 1-2 cm long: *Dischidia rafflesiana* – 80 (Asclepiadaceae)
- b The two types of leaves are: i) round, thick and fleshy, spoon-like, 1.5-4 cm long, and ii) flat and oblong, 1.5-2.5 cm long: *Dischidia benghalensis* – 78 (Asclepiadaceae)
- 18 a Leaves fleshy, with three parallel main veins. Some roots developed into thick, sausage-like tubers; tops of stems are compressed. Flowers and fruit occur on bright, orange-red stalks: *Pachycentria constricta* – 89 (Melastomataceae)
- b Leaves not with three main parallel veins; no roots developed into tubers, roots often not clearly visible: **19**
- 19 a No clear roots, but a slightly swollen base of the stem, where the plant is attached to its host plant - parasitic (Loranthaceae/mistletoes): **20**
- b Roots normal and clearly visible; plants may also occur as terrestrial plants on occasion: **25**
- 20 a Leaves without stalks or with very short stalks (<2 mm), flowers very small, greenish-yellow: *Viscum ovalifolium* – 88 (Loranthaceae)
- b Leaves with distinct stalks, flower tubes at least 10 mm long when mature: **21**
- 21 a Leaves variable, but large, usually 4-20 cm long, flowers not in groups of 3, but often >10: **22**
- b Leaves less than 8.5 cm long, flowers in groups of 3: **23**
- 22 a Flower tubes 13-26 mm long, often in dense clusters of up to 20 flowers; flowers 5-merous: *Dendrophthoe pentandra* – 86 (Loranthaceae)
- b Flower tubes 5-10(-14) mm long, often in clusters of 4-14 flowers; flowers 6-merous: *Macrosolen cochinchinensis* – 87 (Loranthaceae)
- 23 a Leaves fleshy, up to 5 cm long; flowers up to 30 mm long, red, with greenish-yellow base: *Amyema gravis* – 84 (Loranthaceae)
- b Leaves not fleshy, 2.5-8.5 cm long, flowers not more than 20 mm long: **24**
- 24 a Flowers orange, 19-20 mm long; leaf stalk 8-10 mm: *Amyema anisomeres* – 83 (Loranthaceae)
- b Flowers 10-16 mm long; leaf stalk 3-6 mm: *Amyema mackayense* – 85 (Loranthaceae)
- 25 a All leaves simple, occurring in whorls of 3-5 at the upper two nodes of the stem. Flowers large, showy, orange-red and trumpet-shaped: *Rhododendron brookeanum* – 82 (Ericaceae)
- b Leaves compound, usually hand-shaped with 3-7 leaflets; some plants may have simple leaves in the upper part, and compound leaves in the lower parts: **26**
- 26 a Leaves simple in the upper parts, trifoliolate in the lower parts; leaves thinly leathery, leaf edges flat, venation evident to merely obscure; flower clusters larger than the leaf, drooping: *Schefflera lanceolata* – 76 (Araliaceae)
- b Leaves compound, with 3-7 leaflets: **27**
- 27 a Leaves compound, hand-shaped, leaflets 4-6, smooth, ovate-elliptic to obovate-elliptic, not more than 1.5 times as long as broad; flower clusters with some branches as long as or shorter than the elongated main axis; flowers very small; fruits usually splitting into 5-6 parts, yellow or orange, later black: *Schefflera elliptica* – 75 (Araliaceae)
- b Compound leaves, hand-shaped, with 3-7 leaflets; leaflets thin, with narrowed base, pointed tip, and leaf edges coarsely and obscurely toothed; flower clusters in panicles that are large and open; flowers small, ovary 6-8 locular; stamens 6-16: *Schefflera ridleyi* – 77 (Araliaceae)

GROUP E: VINES & CLIMBERS

Note: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

- 1 a Leaves apparently absent; thin, thread-like twining climber: *Cassytha filiformis* – 114 (Lauraceae)
 b Leaves present: **2**
- 2 a Leaves simple: **3**
 b Leaves compound: **22**
- 3 a Leaves opposite: **4**
 b Leaves alternate/spirally arranged: **17**
- 4 a Stem with lenticels/warts/dots on older stems: **5**
 b Not as above: **10**
- 5 a Hairs or scales on (young) stems: **6**
 b No such hairs/scales on stems: **8**
- 6 a With leaflets (stipules) at base of the leaf stalk: *Ryssopterys timoriensis* – 126 (Malpighiaceae)
 b No stipules present: **7**
- 7 a Finely grooved, soft hairy (young stems) branchelets with lenticels; fruit globular and covered by orange remains of flower (calyx), 1.5 -2.5 cm: *Olex imbricata* – 223 (Olacaceae) (Note: normally a tree or shrub, and included in group G trees/shrubs)
 b Stem full of warts and short, smoothly hairy; thin fruits, 10-12 cm, with a hooked point: *Gymnanthera paludosa* – 104 (Asclepiadaceae)
- 8 a With leaflets at base of leaf stalk (= stipules); no latex (check bark!): *Tristellateia australasiae* – 127 (Malpighiaceae)
 b No stipules; with latex: **9**
- 9 a Leaf stalk thin; leaf surface and leaf stalk sparsely covered with hairs; stem pale-dotted: *Oxystelma carnosum* – 105 (Asclepiadaceae)
 b Leaf stalk thick; leaves , not hairy; stem with warts: *Finlaysonia obovata* – 103 (Asclepiadaceae)
- 10 a With leaflets at base of leaf stalk (=stipules): *Loeseneriella macrantha* – 109 (Celastraceae)
 b No stipules: **11**
- 11 a Leaf margin notched or toothed: **12**
 b Leaf margin smooth: **13**
- 12 a Hairy on leaves and stem: *Wedelia biflora* – 108 (Asteraceae)
 b Both leaves and stem smooth: *Smythea lanceata* – 130 (Rhamnaceae)
- 13 a Flowers large (4cm long), white with purple-reddish stamens protruding 2 cm beyond the rest of the flower, fruit egg-shaped to round, 1.5 cm diameter: *Clerodendron inerme* – 266 (Verbenaceae)
 Note: the species is more commonly a shrub or small tree, and is described in group G trees/shrubs.
 b Flowers smaller, usually yellow, yellowish-green, or whitish: **14**
- 14 a Flowers in many-flowered clusters (>15-20), small and yellowish green or white: **15**
 b Flowers in smaller clusters of 3-10, yellow: **16**
- 15 a Flowers yellowish-green, fruit ellipsoid,, 2-3 by 7-8 mm, hairy: *Calycopteris floribunda* – 110

- (Combretaceae)
- b Flowers yellowish-green, whitish, or greenish-white, fruit ellipsoid 2.5-4 cm long, scaly, with four wings: *Combretum tetralophum* – 111 (Combretaceae)
- 16 a Leaves small, 10-18 mm by 30-60(-80)mm, flowers in clusters of 3-4, fruit 2 by 3.5-4 cm: *Sarcolobus carinatus* – 106 (Asclepiadaceae)
 - b Leaves larger, 30-55 by 40-90 mm, flowers in clusters of 5-10, fruit large, 7 by 8 cm: *Sarcolobus globosus* – 107 (Asclepiadaceae)
- 17 a Tendrils present, for climbing: **18**
 - b Tendrils absent: **20**
- 18 a Tendrils at the ends of long, lanceolate leaves; fruits small orange berries in large clusters: *Flagellaria indica* – 113 (Flagellariaceae)
 - b Tendrils located in leaf axils: **19**
- 19 a Robust woody vine, with ovate to oblong leaves, small flowers (<6mm) and elongated 3.5 cm long fruits with 5 papery wings: *Lophopyxis maingayi* – 125 (Lophopyxidaceae)
 - b Herbaceous small vine, with 3-lobed (simple) leaves, large flowers (3-5 cm), and a round, succulent orange berry, 20 mm diameter: *Passiflora foetida* – 72 (Passifloraceae) Note: included among the ground herbs, as this is its more common habit.
- 20 a Leaves in whorls, elliptic to lanceolate, flowers 5-merous, white or yellowish-white, sweet-scented, in whorls of 3; fruit 10-12 by 30-35 cm, usually with 5 wings: *Combretum trifoliatum* – 112 (Combretaceae)
 - b Leaves alternate: **21**
- 21 a Leaves broadly heart-shaped, 16-28 by 10-24 cm, flowers greenish-white to yellowish, on a cluster 16-40 cm long; fruit a white berry, 9-10 mm long: *Anamirta cocculus* – 128 (Menispermaceae)
 - b Leaves ovate to ovate-elliptic, 6-17 by 4-11 cm, flowers yellowish-green, on a cluster up to 11 cm long; fruit a white or red berry, 4-6 by 7-8 mm: *Hypserpa polyandra* – 129 (Menispermaceae)
- 22 a Leaves conspicuously twice divided into leaflets: **23**
 - b Leaves only once divided into leaflets: **24**
- 23 a Leaves pale bluish-green, up to 30 cm long; 2-6 pairs of primary leaflets; minute, undivided leaflets (stipules) located at base of leaf stalk: *Caesalpinia crista* – 118 (Leguminosae)
 - b Leaves up to 1 m long, 6-10 pairs of primary leaflets; conspicuous (once or twice divided) leaflets at the base of the leaf stalk: *Caesalpinia bonduc* – 117 (Leguminosae)
- 24 a Leaflets many, 8-17 pairs (i.e. 16-34 leaflets), flower clusters 2-7 cm long, flowers 9-15 mm long, variable in colour, pods oblong, swollen, 2-4(5) cm long, 1-1.5 cm wide: *Abrus precatorius* – 115 (Leguminosae)
 - b Leaflets few, numbering 3-14 (<7 pairs): **25**
- 25 a Leaflets always 3, large, woody liana, 8-15 m, flowers in long, pendulous clusters from leaf axils; flowers greenish-white; pods 10-15(-30) cm long, flat and have two wings along suture; densely covered with orange-brown irritant bristles: *Mucuna gigantea* – 124 (Leguminosae)
 - b Leaflets 3-14, variable on same plant: **26**
- 26 a With leaflets (stipules) at the base of the leaf stalk: **27**
 - b Without stipules: **28**
- 27 a Old stems dark brown or black with many lenticels; 3-7 leaflets: *Dalbergia candenatensis* – 119 (Leguminosae)
 - b Old stems light to darkbrown, few or no lenticels; 3-5 leaflets: *Dalbergia menoeides* – 120 (Leguminosae)

- 28 a Leaflets 7-11 (3-5 pairs, plus one terminal leaflet); sepals 5, deep purple; petals 5, white to pink; pod, hairy, flat, oblong, pointed, 2 by 5-10 cm: *Derris scandens* – 121 (Leguminosae)
- b Leaflets usually less than 7: **29**
- 29 a Huge woody climber, flowers greenish, petals tinged reddish at base; pods huge, straight to slightly curved, up to 100-135 cm by 7-15 cm; seeds 4-6 cm in diameter: *Entada phaseoloides* – 123 (Leguminosae)
- b Pods less than 30 cm long: **30**
- 30 a Leaflets 5-7; flowers green; pod 6-27 cm long, constricted between seeds: *Aganope heptaphylla* – 116 (Leguminosae)
- b Leaflets 3-7, but most leaves trifoliate; flowers white or pinkish; pod 2-4.5 cm long, not constricted: *Derris trifoliata* – 122 (Leguminosae)

GROUP F: PALMS, CYCADS & PANDANS

Note: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

- 1 a Climbing, very spiny rattan: *Calamus erinaceus* – 131 (Arecaceae)
- b Not climbing: **2**
- 2 a Stemless, with 2-9 m long leaves deriving from near the ground: *Nypa fruticans* – 135 (Arecaceae)
- b With distinct stems: **3**
- 3 a With distinct, tall stilt-roots; leaves 70-250 cm long: *Pandanus tectorius* – 139 (Pandanaceae)
- b Without stilt-roots: **4**
- 4 a Leaves not sub-divided into leaflets, but large and round: *Corypha saribus* – 133 (Arecaceae)
- b Leaves elongated, and sub-divided into many leaflets: **5**
- 5 a Leaflets drooping, with a blade 1.8-3.6 m long; stem with many 2.5-6.5 cm long black spines: *Oncosperma tigillarium* – 136 (Arecaceae)
- b Leaflets not drooping, leaf blades less than 1.6 m long; stem not spiny: **6**
- 6 a Thorns on the leaf stalk: **7**
- b No thorns on leaf stalk: **8**
- 7 a Leaf elongated, with many leaflets spread along a central stem, pointed upwards sometimes yellowish: *Phoenix paludosa* – 137 (Arecaceae)
- b Leaf fan-shaped, with leaflets radiating from one central point: *Licuala spinosa* – 134 (Arecaceae)
- 8 a Leathery leaflets are linear-shaped, plant usually 2-5 m tall: *Cycas rumphii* – 138 (Cycadaceae)
- b Leaves fish-tail (rhomboid) shaped, tall (10-20m) palm: *Caryota urens* – 132 (Arecaceae)

GROUP G: TREES & SHRUBS

Note: Bold numbers denote number in key, while normal numbers following a species name correspond with the species number as this is dealt with in this second part of the mangrove guidebook.

- 1
 - a Trees and shrubs with very small leaves (not to be confused with leaflets of compound leaves), less than 1.5 cm long or apparently absent altogether: **2**
 - b Trees and shrubs with leaves > 1.5 cm long: **4**
- 2
 - a Leaves reduced to tiny, pointed scales arranged in whorls of 6-10 (mostly 7-8) at the joints of the twigs; greenish, needle-like young twigs give the tree the appearance of a conifer; fruit a small cylindrical, woody cone, 1.8 by 1.5 cm: *Casuarina equisetifolia* – 162 (Casuarinaceae)
 - b Leaves conspicuous, but small, 4-15 mm long: **3**
- 3
 - a Small, succulent shrublet, < 1m tall, with linear to rounded or egg-shaped leaves, 4-15 mm long; white flowers, fruit a 9-11 by 4-5 mm berry: *Batis argillicola* – 155 (Batidaceae)
 - b Shrub or small tree, 1-20 (very occasionally 40) m tall, commonly about 6m; mature leaves linear to oval, 3-10 by 6-13 mm, pointed; fruit are cones, 2-4 cm long: *Podocarpus polystachyus* – 227 (Podocarpaceae)
- 4
 - a Leaves simple: **5**
 - b Leaves sub-divided into leaflets (= compound): **113**
- 5
 - a Leaves opposite: **6**
 - b Leaves alternate or spirally arranged: **44**
- 6 Leaves simple and opposite.
 - a Trees with extensively developed, tall stilt-roots (0.5-6m tall): **7** (*Rhizophora* spp.)
 - b Trees or shrubs without stilt-roots or occasionally with small stilt roots (<1m): **9**
- 7
 - a Leaf stalk 1.5-3 cm, reddish, midrib on underside of leaf reddish; flower stalk short, 0.5-1 cm, always with flowers (or fruit) occurring in pairs; calyx lobes yellowish brown to reddish: *Rhizophora apiculata* – 237 (Rhizophoraceae)
 - b Leaf stalk 2-5.5 cm, green, with a green midrib on underside of leaf; flower stalk 1.5-5.5cm, usually three times forked; calyx lobes pale yellow: **8**
- 8
 - a Leaves up to 10 by 25 cm; hypocotyl (the elongate, pendulous 'fruit') 40-60 cm: *Rhizophora mucronata* – 238 (Rhizophoraceae)
 - b Leaves up to 7 by 12 cm; hypocotyl 25-45 cm: *Rhizophora stylosa* – 239 (Rhizophoraceae)
- 9
 - a Stipules, leaflets at the base of the leaf stalk occur just above where the leaf stalk is attached; these stipules are often shed, leaving a ring-shaped scar: **10**
 - b Stipules) absent: **24**
- 10
 - a Stipules usually shed, leaving a ring-shaped scar just above the leaf stalk; fruit expanding while still on the tree to an elongate 'fruit' (= the hypocotyl), >10 cm; usually trees >5m: **11**
 - b Stipules often persistent, connecting both leaf stalks and leaving a scar in between, or two persistent leaflets at base of each leaf stalk; fruit round, or if elongate, < 1cm long; shrubs or small trees <5m: **19**
- 11
 - a Tip of leaf is pointed; flowers and fruit with 8-16 calyx lobes; larger trees, usually with many knee-shaped roots: **12** (*Bruguiera* spp.)
 - b Leaf tip is rounded; flowers and fruit with 5 or 6 calyx lobes; smaller trees up to 15 m tall: **17** (*Kandelia* & *Ceriops* spp.)
- 12
 - a Flowers occur solitary, with one (occasionally two) on each stalk: **13**
 - b With 2-6 flowers on each stalk: **15**

- 13 a Leaves obovate, 3-7 by 5-9 cm; flowers 2-2.5 cm long, yellowish green: *Bruguiera exaristata* – 229 (Rhizophoraceae)
- b Leaves elliptic-oblong, 3-7 by 8-22 cm; flowers 3-4 cm long, reddish: **14**

- 14 a Leaves up to 7 by 22 cm, leaf stalk often reddish and covered with white, powdery puff. Mature hypocotyl (the 'fruit') 15-25 cm long: *Bruguiera gymnorhiza* – 230 (Rhizophoraceae)
- b Leaves up to 6 by 15 cm, with a green leaf stalk, not covered with white 'powder'; mature hypocotyl (the 'fruit') 6-8 cm long: *Bruguiera sexangula* – 233 (Rhizophoraceae)

- 15 a Calyx is 10-lobed, often recurved back ; mature flowers 18-23 mm long; bark brown to grey, with many large, corky, yellow-brown lenticels: *Bruguiera hainesii* – 231 (Rhizophoraceae)
- b Calyx is 8-lobed; mature flowers up to 12 mm long; bark grey, with only a few small lenticels: **16**

- 16 a Calyx lobes <3 mm, not recurved; hypocotyl (the 'fruit') is smooth; has many small flowers: *Bruguiera parviflora* – 232 (Rhizophoraceae)
- b Calyx lobes 4-6 mm, often recurved ; hypocotyl rough, and often curved: *Bruguiera cylindrica* – 228 (Rhizophoraceae)

- 17 a Leaves oblong-elliptic to narrow elliptic-lanceolate, up to 13 cm long; leaf stalk 1-1.5 cm; calyx lobes long and slender; hypocotyl (the 'fruit') 15-40 cm long, smooth; no knee-shaped roots: *Kandelia candel* – 236 (Rhizophoraceae)
- b Leaves ovate to slightly obovate, usually shorter than 10 cm; leaf stalk 1-3.5 cm; calyx lobes short and blunt; hypocotyl usually <25 cm long; with small ridges; often with knee-shaped roots: **18**

- 18 a Calyx lobed curled back in fruit; hypocotyl (the 'fruit') 15-25 (rarely 35) cm long;; petals are each tipped with three small lobes; flowers stalk 1-2 cm long, slender; occasionally with small stilt roots: *Ceriops tagal* – 235 (Rhizophoraceae)
- b Calyx lobes not curled back on fruit; hypocotyl 9-15 cm long; petals with more than three small lobes on the tip; flower stalk shorter than 1 cm; thick; stilt roots absent: *Ceriops decandra* – 234 (Rhizophoraceae)

- 19 a Sharp, 2-16 mm long spines in leaf axils; flowers small (4mm) and green; shrub with lax branches, fruit a round white berry, 6 mm diameter: *Azima sarmentosa* – 248 (Salvadoraceae)
- b Shrubs or small trees not armed with spines, flowers white or white slightly tinged with red: **20** (Rubiaceae)

- 20 a Young shoots often reddish and resinous; fruit a small cylinder, 8 mm long and ribbed; flowers white, sometimes tinged with red; calyx tube 5 mm long, with 2-4 mm long corolla protruding; leaves 2-5 by 4-9 cm: *Scyphiphora hydrophyllacea* – 244 (Rubiaceae)
- b Young shoots otherwise; fruit otherwise: **21**

- 21 a Fruit a round to irregular head with many seeds, 1.5-10 cm long; flowers white, later turning yellowish; corolla tube 10-12 mm long; leaves 3-10 by 5-26 cm: *Morinda citrifolia* – 243 (Rubiaceae)
- b Fruit not a head with many seeds, smaller than 3.5 cm across: **22**

- 22 a Fruit a hard, almost dry berry, greyish green but later red, 6-7 mm across; corolla is tube shaped, 1-1.5 cm long; leaves 3.5-7.5 by 10-17 cm, often with pointed tip: *Ixora timorensis* – 242 (Rubiaceae)
- b Fruit larger than 10 mm across: **23**

- 23 a Fruit round but slightly flattened, 15-30 mm across, without a persistent calyx present, but a small rim only: *Guettarda speciosa* – 241 (Rubiaceae)
- b Fruit round, 2.5-5 across or more, with a persistent, conspicuous calyx present on the top, fruit splitting open to reveal the orange-red pulp: *Gardenia tubifera* – 240 (Rubiaceae)

- 24 a Trees with pencil-shaped or conical respiration roots (emerging from the soil): **25**
 b Trees or shrubs without such roots: **35**

- 25 a Leaves usually white, yellowish, or grey beneath; leaf tip is pointed or rounded; flowers small (3-10(-15) mm), with an orange or yellow corolla; stamens few, yellow; fruit with very short calyx lobes attached; bark not furrowed: **26** (*Avicennia* spp.)
 b Leaves green beneath, leaf tip rounded; flowers are large (several cm across the stamens), but with the corolla either very small or absent; stamens are numerous, white or reddish; fruit with large calyx lobes attached; bark furrowed: **30** (*Sonneratia* spp.)

- 26 a Leaves usually with rounded tip: **25**
 b Leaves usually with a pointed tip: **29**

- 27 a Flowers 6-10(-15)mm across when fully expanded; leaves usually with a rounded tip; leaves never whitish below; fruit 2-2.5 cm long, abruptly narrowed to a sharp beak, rust-brown: *Avicennia officinalis* – 154 (Avicenniaceae)
 b Flowers 3-4 mm across when expanded; leaves sometimes whitish beneath; fruit sometimes beaked, but never rusty-brown: **28**

- 28 a Young twigs, leaf stalks, midrib and lower and upper surfaces of leaves conspicuously covered with fine, yellowish-white, woolly hairs; fruit with a rounded tip or with a short beak, covered with dense, woolly hairs: *Avicennia lanata* – 152 (Avicenniaceae)
 b Young twigs, leaf stalks, and leaves covered with short (not woolly) yellowish hairs; fruit rounded or at most shortly beaked, greyish-green, never yellowish: *Avicennia marina* – 153 (Avicenniaceae).

- 29 a Leaves silvery grey or white beneath; fruit up to 4 cm long, greyish-green, gradually narrowed to an extended beak; bark greyish, with lenticels: *Avicennia alba* – 150 (Avicenniaceae)
 b Leaves greenish-yellow beneath; fruit shorter than 3 cm, greenish yellow, without conspicuous beak; bark flaky, peeling in patches, mottled brown or green: *Avicennia eucalyptifolia* – 151 (Avicenniaceae)

- 30 a Calyx 4(-6) lobed; fruit 1.5-2.2 cm diameter; leaves narrow, less than 5 cm wide, gradually tapering towards the tip: *Sonneratia apetala* – 255 (Sonneratiaceae)
 b Calyx usually 6-8 lobed; fruit 3-7 cm diameter; leaves usually 5 cm wide or wider: **31**

- 31 a Calyx flat, extended horizontally, not enclosing the ripe fruit, which is at most obscurely ribbed: **32**
 b Calyx cup-shaped, enclosing the base of the fruit, prominently ribbed: **33**

- 32 a Twigs not pendulous; leaves obovate to almost round, very short leaf stalk; midrib green throughout; veins conspicuous, prominent on the upper blade; petals absent: *Sonneratia griffithii* – 257 (Sonneratiaceae)
 b Twigs slender and pendulous; leaves elliptic-oblong, oval-obovate to narrowly elliptic; leaf stalk short; midrib often red at base; petals usually present: *Sonneratia caseolaris* – 256 (Sonneratiaceae)

- 33 a Tip of fruit not depressed at the base of the style; tube of the fruiting calyx smooth, lobes curved back, petals present; leaves ovate to oblong-ovate, with a short, thick petiole: *Sonneratia alba* – 254 (Sonneratiaceae)
 b Tip of fruit depressed at the base of the style; tube of the fruiting calyx finely warted; petals absent; leaves broadly ovate, with a distinct narrow leaf stalk: *Sonneratia ovata* – 258 (Sonneratiaceae)

- 34 a Leaves shorter than 5 cm, usually 1-4 cm long: **35**
 b Leaves longer than 5 cm: **36**

- 35 a Leaves 3-13 by 10-32 mm, elliptic-oblong, covered with fine, flattened hairs; not aromatic when crushed: flowers occur along, rarely in pairs; corolla lobes are white: *Pemphis acidula* – 202 (Lythraceae)
- b Leaves 1-3 by 2.5-5 cm, obovate hairless, aromatic when crushed; flowers occur in groups of 1-3; corolla absent: *Osbornia octodonta* – 222 (Myrtaceae)
- 36 a Leaves with a large number of uniformly parallel veins, perpendicular to the leaf axis; leaves measure 10-21.5 by 6-11 cm; white, 4-merous flowers, 2-3 cm across: *Calophyllum inophyllum* – 183 (Guttiferae)
- b Leaves not with such veins: **37**
- 37 a Leaves with 5 conspicuous principal veins (3 central, 2 along leaf margin), flowers 5-merous: **38** (Melastomataceae)
- b Leaves without 5 conspicuous principal veins: **40**
- 38 a Flowers small, 3 mm across; leaves ovate to narrowly-ovate or lanceolate, 5-10(-14) by 2-4(-6) cm, leaf stalk 1-5(-6.5) cm; flowers on stalkless clusters: *Ochthocharis bornensis* – 207 (Melastomataceae)
- b Flowers > 2 cm across, leaf stalks <3.5 cm long; flowers on distinctly stalked clusters: **39**
- 39 a Leaf 2-19 cm long, leaf stalk 7-35 mm long; fruit dark reddish purple to almost black, 8-9 mm long; flowers purple, whitish or pink, in groups of about 10, with 2-3 cm long cluster stalk: *Melastoma malabathricum* – 205 (Melastomataceae)
- b Leaf 3-9 cm long, leaf stalk 6-20 mm long; fruit reddish purple, 12-14 mm long; flowers purple: *Melastoma saigonense* – 206 (Melastomataceae)
- 40 a Flowers smaller than 1 cm: **41**
- b Flowers usually larger than 1 cm across or long: **43**
- 41 a Fruit round, reddish-orange, 1.5-2 cm diameter, flowers with 4 mm long petals; leaves 1.75-5 by 4-17 cm: *Salacia chinensis* – 165 (Celastraceae)
- b Fruit ≤1 cm long or across at maximum: **42**
- 42 a Fruit a reddish to almost black, round berry, 5-6 mm diameter; leaves 8-25 by 4-10 cm; flowers 4-5 lobed, ≤5 mm across, greenish-yellow to yellow: *Premna obtusifolia* – 267 (Verbenaceae)
- b Fruit a corky yellow berry, narrowed at the base, up to 1 cm long; leaves 4-10 by 2-6 cm; flowers 4-merous, 2-3 mm across: *Cassine viburnifolia* – 163 (Celastraceae)
- 43 a Shrub, with copious amounts of white latex exuding if damaged; fruit an inflated capsule, 3-5 by 6.5-8 cm; flowers white, lilac or purple, 2-3 cm across: *Calotropis gigantea* – 147 (Asclepiadaceae)
- b Shrubs or trees without white latex: **44**
- 44 a Tree, often with short, blunt spines on trunk and main branches; leaves large, 14-25 by 18-45 cm, broadly obovate, without stalks; flowers large >2 cm long, white and trumpet-shaped; fruits oblong, 2.5 cm long: *Fagraea crenulata* – 180 (Gentianaceae)
- b Tree unarmed; flowers not trumpet-shaped; fruit round, green or cream-coloured, less than 1 cm diameter; flowers 8-20 mm; leaves 3-6 by 5-15 cm; small to large tree: *Acronychia pedunculata* – 245 (Rutaceae)
- 45 Leaves simple, and either alternate or spirally arranged.
 - a Most leaf blades are longer than 15 cm, broader than 6 cm: **46**
 - b Most leaf blades are shorter than 15 cm, less than 6 cm broad: **71**

- 46 a Without coloured sap or latex: **47**
b With white, yellowish, or clear sap or latex, the clear sap turning reddish or black after exposure to the air: **64**
- 47 a Leaves heart-shaped: **48**
b Leaves not heart-shaped: **49**
- 48 a Leaves heart-shaped, occasionally with a pointed tip, 7-24 cm by 5-16 cm; leaf stalks 6-16 cm; flowers with a 2.5-10 cm long stalk; corolla is 6-7 cm, bell-shaped, light yellow with a purple centre: *Thespesia populnea* – 204 (Malvaceae)
b Leaves 5-15 by 8-20 cm, sometimes with a few small teeth along the edges, corolla is large and trumpet-shaped, 3.5-5 cm long, clear orange or pinkish orange: *Cordia subcordata* – 161 (Boraginaceae)
- 49 a Underside of leaf is white, silvery, brown or coppery: **50** (*Heritiera* spp.)
b Underside of leaf is green or pale green: **52**
- 50 a Leaf stalk 2-4 cm; lower side of leaf coppery- brown; fruit round, with a folded wing and a beak at the far end of the fruit: *Heritiera globosa* – 260 (Sterculiaceae)
b Leaf stalk < 2cm long, lower side of leaf silvery-white to white, fruit egg-shaped, flattened, without a beak at the far end: **51**
- 51 a Fruit knobby with a ridge on the lower side, together with a transverse circular ridge; sometimes with pneumatophores: *Heritiera fomes* – 259 (Sterculiaceae)
b Fruit smooth with a rudder-like crest, but without a transverse circular ridge; never with pneumatophores: *Heritiera littoralis* – 261 (Sterculiaceae)
- 52 a Leaf stalks usually very short, <1 cm; trees usually crooked; Flowers with clusters of more than 20 conspicuous, large, white, pink or reddish stamens, at least 4-5 cm across, fruits are woody and angled: **53**
b Leaf stalks longer, Flowers unlike this: **56**
- 53 a Flowers occur in short (<20 cm), erect or slightly drooping clusters; flowers 7-15 cm across the stamens: **54**
b Flowers occur in pendulous racemes, 20-65(-80) cm long, flowers 4-10 cm across the stamens: **55**
- 54 a Leaves 8-28 cm long, flowers up to 5 cm across the stamens, petals < 1cm long, fruit bluntly 4-angled, 2 by 7 cm: *Barringtonia acutangula* – 187 (Lecythidaceae)
b Leaves 17.5-43 cm long, flowers 7-10 cm across the stamens, petals up to 3 cm long, fruit 4- to 6-angled, usually 5-7(-9) by 3-4(-5) cm: *Barringtonia racemosa* – 190 (Lecythidaceae)
- 55 a Leaves 15-45 cm long, flowers 10-15 cm across the stamens, petals up to 7.5 cm long, fruit cube-shaped, 10-15 cm diameter: *Barringtonia asiatica* – 188 (Lecythidaceae)
b Leaves 20-35 cm long, flowers 7.5-8 cm across the stamens, fruit conical shaped, 5-7.5 cm long, 3.7-5.0 cm wide: *Barringtonia conoidea* – 189 (Lecythidaceae)
- 56 a Leaf tips rounded (though often with small point): **57**
b Leaf tips pointed: **58**
- 57 a Leaves measure 15-25 by 6-12 cm, conspicuous white or pale yellow flowers 2-2.5 cm long, occur on 4 cm long clusters in the axils; fruit 1 cm long, white: *Scaevola taccada* – 182 (Goodeniaceae)
b Leaves 8-25 by 5-14 cm, older leaves turning red; flowers small, white or pale green, stemless, occurring in 8-16 cm-long clusters in axils; fruit 5-7cm long: *Terminalia catappa* – 169 (Combretaceae)

- 58 a Stipules present: **59**
 b Stipules absent: **61**

- 59 a Leaves hand-shaped, with 5-9 lobes, with pointed tips and serrated edges, 15-30(-40) cm in diameter; flower spikes are borne in the axils of the upper leaves and are 15-30 cm long; fruits spherical capsules covered with soft spines, 12-18 mm across: *Ricinus communis* – 178 (Euphorbiaceae)
 b Leaves not hand-shaped : **60**

- 60 a Stipules large, to 20 mm, and persistent, young leaves not purplish: *Atuna racemosa* – 166 (Chrysobalanaceae)
 b Stipules smaller, not persistent, young leaves purplish: *Blumeodendron tokbrae* – 173 (Euphorbiaceae)

- 61 a Leaves with (two) conspicuous glands at the base; all parts of plant are very bitter: *Quassia indica* – 253 (Simaroubaceae)
 b Leaves without conspicuous glands at the base: **62**

- 62 a Bark very dark, to almost black; young leaves reddish: *Diospyros malabarica* – 171 (Ebenaceae)
 b Bark not very dark; young leaves not reddish: **63**

- 63 a Numerous minute transparent points visible in the leaf blade when held to the light; fruits 4-10 cm long: *Merrilliodendron megacarpum* – 185 (Icacinaceae)
 b No transparent points in leaves visible when held to light; fruits 2-2.5 by 1.7-2.2 cm: *Hernandia ovigera* – 184 (Hernandiaceae)

- 64 a Latex or sap is white or pale yellow: **65**
 b Latex or sap clear but soon turning reddish or black: **68**

- 65 a Leaf tips rounded, fruit less than 2 cm across or long, flowers greenish-yellow, 4-12 mm across: *Planchonella obovata* – 251 (Sapotaceae)
 b Leaf tips pointed, fruit usually much larger than 2 cm; flowers white, often with coloured centre: **66** (*Cerbera* spp.)

- 66 a More than 40 flowers per cluster, corolla tube shorter than 1 cm, fruit egg-shaped: *Cerbera floribunda* – 141 (Apocynaceae)
 b Less than 30 flowers per cluster, corolla tube 1.5-4 cm long, fruit ovoid to globose: **67**

- 67 a Flower with a yellow centre, not densely hairy inside; flower tube 1.5-2 cm: *Cerbera odollam* – 143 (Apocynaceae)
 b Flower with a reddish centre, many hairs inside tube; tube 2.5-4 cm long: *Cerbera manghas* – 142 (Apocynaceae)

- 68 a Latex or sap is clear, but soon turns black after exposure; very irritant and painful on skin (careful!); older leaves are black-spotted: *Gluta velutina* – 140 (Anacardiaceae)
 b Sap is reddish or clear and soon turning red; leaves not black-spotted: **69**

- 69 a Mature leaves up to 52 cm long; flowers occur in spikes; fruits are pods, 5-7 by 5.5-10 cm and yellow when mature, that contain one seed; sap red. *Inocarpus fagifer* – 196 (Leguminosae)
 b Mature leaves up to 21-35 cm long; flowers and fruit occur on short stalks in the leaf axis; often with (short) stilt-roots: **70**

- 70 a Bark flaky, finely fissured; fruit oblong-ovoid, 3-5 cm, sometimes hairy, yellow-orange when mature. *Myristica hollrungii* – 216 (Myristicaceae)
 b Bark smooth to slightly fissured; fruit round, up to 2.5 cm across, smooth, ochre-yellow to bright pinkish-orange, with a 2 cm-long stalk; often has knee roots: *Horsfieldia irya* – 215 (Myristicaceae)

- 71 Leaves simple, alternate or spiraled, usually smaller than 15 by 6 cm.
 - a Leaf stalk is expanded into a sheath that encircles the twig: **72** (*Aegialitis* spp.)
 - b Leaf stalk unlike this: **73**
- 72 a Calyx 7-8 mm, corolla is 9-10 lobed; fruits oblong, 3-5 mm by 4-5 cm; leaf 6-9 by 2-5; shrub, 1.5-3m: *Aegialitis annulata* – 225 (Plumbaginaceae)
- b Calyx 13 mm, corolla is 12 lobed; fruits 8-10 by 0.5 cm, 5-angular; leaf 4-8 by 4-8.5 cm shrub, 1-3m: *Aegialitis rotundifolia* – 226 (Plumbaginaceae)
- 73 a Branches and twigs armed with thorns/spines: **74**
- b Branches and twigs unarmed: **78**
- 74 a Leaves with two orange glands where the leaf stalk is attached to the branch; small tree, up to 10 m tall; spiny trunk and branches, spines may be up to 3 cm; fruit an orange, round berry 6-7 mm: *Scolopia macrophylla* – 179 (Flacourtiaceae)
- b Leaves without orange coloured glands at the base of the leaf stalk: **75**
- 75 a Leaves smelling of oranges or lemons when crushed, with indented/notched leaf edges: **76** (Rutaceae)
- b Leaves not smelling of oranges when crushed, leaf edges entire or wavy: **77**
- 76 a Shrubby tree, with thick leathery, aromatic leaves have transparent dots and measure 4.5-16 by 2-7 cm; flowers white, 5-merous, about 2 cm long, fragrant, stamens 10; strongly smelling berry-like fruits are yellow, oblong or ovoid triangular, lemon-like, 2-5 cm long, with 3 flattened sides: *Merope angulata* – 247 (Rutaceae)
- b Shrub or small tree; leaf blade elliptic, 3.5-6.5(-11) cm by 3-4(-6.5) cm, rather leathery; flowers 12 mm wide and 10-13 mm long, white or tinged with pink; 5 petals; Fruit rounded oblong, green, 12-19 mm wide: *Atalantia monophylla* – 246 (Rutaceae)
- 77 a Shrub, leaves variable: spoon-like or elliptic to elliptic-oblong, rarely round, 2.5-14.5 by 1-9 cm; flowers pale green and whitish along the margins, or entirely white; calyx lobes, 0.5 mm long; petals 2-3.5 by 1-1.5 mm; fruits 2.5-3.5 by 2-3 mm: *Maytenus emarginata* – 164 (Celastraceae)
- b Shrub, leaves 2.5-5(-10) cm by 1.2-2.5(-6) cm, usually elliptic but variable in shape; flowers small, greenish-white; calyx is cup-like with 4-5 teeth, 0.5-1.5 mm; petals 4(-5), curved back, (5-)8-10(-12) mm by 1.5-2 mm; fruit rounded, pulpy and with a hard stone, yellow to orange (occasionally bright red or scarlet), with green flesh, 15-25(-35) mm by 12-20(-30) mm: *Ximenia americana* – 224 (Olacaceae)
- 78 a Leaves generally heart-shaped or rounded heart-shaped: **79**
- b Leaves otherwise: **82**
- 79 a Leaves usually light green; flowers in terminal spikes that protrude from the canopy, flowers pink: *Kleinhovia hospita* – 262 (Sterculiaceae)
- b Leaves usually darker green; flowers not in terminal spikes, not pink: **80**
- 80 a Leaf stalks less than 6 cm long; flowers about 5 mm long, corolla orange; fruits a bi-lobed small nut: *Brownlowia argentata* – 264 (Tiliaceae)
- b Leaf stalks usually longer than 6 cm, and even up to 20 cm; flowers large, 5-7.5 cm, light yellow with a dark purple centre; fruit not bi-lobed: **81**
- 81 a Leaves usually with 9-11 main veins, blade more rounded, beneath usually densely covered with short hairs; young leaves not scaly; calyx 5-lobed: *Hibiscus tiliaceus* – 203 (Malvaceae)
- b Leaves usually with 7 main veins, blade more pointed, not covered with hairs beneath; young leaves with brown scales; calyx not lobed: *Thespesia populnea* – 204 (Malvaceae)

- 82 a Trees or shrubs with white latex/sap in leaves and bark: **83**
 b Without white latex/sap: **87**

- 83 a Older trees many-stemmed, with hanging aerial roots. Leaves small, dark green, with stalks less than 1 cm long. Mature fruit globose, 7-10 mm diameter. *Ficus microcarpa* – 213 (Moraceae)
 b Older trees or shrubs without hanging aerial roots; leaf stalks 1-2.5 cm long: **84**

- 84 a Leaf edges toothed, leaves generally not longer than 11 cm; two small glands at the base of the leaf blade: **85** (*Excoecaria* spp.)
 b Leaf edges entire, most leaves rather large, from 10 to 17.5 (-25) cm long;; glands absent: **86**

- 85 a Leaves oval to ovate-oval, withering reddish orange; fruit 3-lobed, less than 1 cm diameter; no thorns on the trunk: *Excoecaria agallocha* – 175 (Euphorbiaceae)
 b Leaves lanceolate, fruit globose and hard, 3 cm diameter; trunk thorny: *Excoecaria indica* – 176 (Euphorbiaceae)

- 86 a Leaves thick and leathery, (narrowly-)elliptic-oblong to obovate, 5.5-7 by 10-17.5 cm, tip squared, base wedge-shaped; secondary nerves 8-12; figs in pairs in axils, without stalk, round, yellow or yellow-tinged pink, dark red to purplish-red when mature, (7-) 10-15 mm, 3 persistent leaflets at the base, 3-4 mm: *Ficus curtipes* – 212 (Moraceae)
 b Leaves obovate to elliptic, 2-10 by 3.5-25 cm, with rounded tip and tapered base; leaves velvety beneath; flowers (4- or)5(or 6)-merous, with 10 stamens, 4-12 mm across; corolla 2.5 mm long; berry, sometimes woody, 7.5 by 12 mm, 5 persistent sepals: *Planchonella obovata* – 251 (Sapotaceae)

- 87 a Leaves spatulate (spatula-shaped, see glossary) and thick-fleshy, with a broadly rounded tip: **88** (*Lumnitzera* spp.)
 b Leaves otherwise: **91**

- 88 a Flowers red or purple, and flower clusters located at the end of branches; fruit 15-20 mm long; often with knee- shaped roots: *Lumnitzera littorea* – 167 (Combretaceae)
 b Flowers white or yellow; fruit not longer than 15 mm; no knee-shaped roots: **89**

- 89 a Flowers yellow; fruit ellipsoidal, fibrous and woody fruit is distinctly compressed, measuring 10-12 by 3-4 mm: *Lumnitzera racemosa* var. *lutea* – 168 (Combretaceae)
 b Flowers white: **90**

- 90 a Fruit ellipsoidal, fibrous and woody fruit is distinctly compressed, measuring 10-12 by 3-4 mm: *Lumnitzera racemosa* var. *racemosa* – 168 (Combretaceae)
 b Five petals are united and like an outstretched hand, densely hairy on the inside, smooth on the outside, 4-5 cm long; white, with purplish marking inside; fruit a white fleshy berry, 5-8 mm diameter: *Scaevola hainanensis* – 181 (Goodeniaceae)

- 91 a Small shrub (< 2 m) with (slightly) pubescent branches, toothed leaf edges, small purple, violet or reddish brown composite flowers: **92**
 b Shrubs or trees without pubescent branches, no composite flowers: **93**

- 92 a (Pale) purplish or violet flowers, leaves obovate with tapering base, 2.5-9 by 1-5.5 cm; few small, inconspicuous glands, very aromatic, with a sharp, fine-toothed edge: *Pluchea indica* – 148 (Asteraceae)
 b Reddish brown flowers, obovate to oblong-lanceolate, 3-5 cm by 0.7-1.7 cm, blunt to rounded leaf tip; without a stalk, leaf edges irregularly and sparsely toothed: *Pluchea pteropoda* – 149 (Asteraceae)

- 93 a Leaves obovate and leaf tip (usually) rounded: **94**
 b Leaves not obovate, but usually elliptic to lanceolate, leaf tip usually pointed: **98**

- 94 a Fruits globose to ovoid, 8-22mm diameter, up to 30 mm long: **95**
 b Fruits elongated, about 5 cm long, usually curved or bent: **97** (*Aegiceras* spp.)
- 95 a Fruits splitting in with 12-15 segments; fruit is red and smooth or partly covered with fine hairs; flowers small, green or yellowish-green, corolla absent: *Glochidion littorale* – 177 (Euphorbiaceae)
 b Fruits round to oblong, not splitting into segments, surrounded by persistent calyx: **96**
- 96 a Calyx 3 mm long and wide, immediately after flowering; 8-10 mm long and 10-15 mm wide in fruit; 4-5 lobes; corolla 15 mm long, tube 8 mm, straight, 4 lobes, fruit ovoid berry, up to 30 mm long and 22 mm diameter (more usually 8-10 mm diameter): *Cordia cochinchinensis* – 159 (Boraginaceae)
 b Calyx 3-5 mm long; 3-4 mm wide in flower, 6-10 mm wide in fruit; with short, dense hairs in flower, later smooth; corolla 5-6(-8) mm long, tube 3 mm, fruit an egg-shaped drupe, slimy pulp, 10(-15) mm by 8(-10)mm: *Cordia dichotoma* – 160 (Boraginaceae)
- 97 a Leaves up to 6 by 11 cm; flowers sweet-scented, white, persistent calyx is white to green; white corolla tube is covered with short, soft hairs, 5-6 mm long; fruit is green to red, strongly curved and pointed, 5-7.5 cm long: *Aegiceras corniculatum* – 217 (Myrsinaceae)
 b Leaves up to 3 by 6 cm; flowers have sour odour, white; persistent calyx is white to green; corolla tubes are about 4 mm long; fruit green to red, only slightly curved, 3 cm long: *Aegiceras floridum* – 218 (Myrsinaceae)
- 98 a Leaves with scales on lower and/or upper surface: **99**
 b Leaves without scales: **102**
- 99 a Underside of leaf rather shiny and coppery (coloured like red copper); fruit globose, with a folded wing: *Heritiera globosa* – 260 (Sterculiaceae)
 b Leaf underside not shiny, coppery; fruit not globose: **100**
- 100 a Leaves narrowly elliptic-lanceolate; flowers in clusters on an axis; fruits bilobed and asymmetrical: *Brownlowia tersa* – 265 (Tiliaceae)
 b Leaves oblong-ovate to broadly elliptic-lanceolate; flowers 3-6 on a spike; fruit an oblong, symmetrical capsule, 8 by 15 mm: **101** (*Camptostemon* spp.)
- 101 a Scales only on lower leaf surface; flowers with more than 5 stamens; fruit is a round capsule, 1 cm long, scaly, with a persistent, scaly calyx and outer calyx: *Camptostemon schultzei* – 158 (Bombacaceae)
 b Scales on upper and lower surface; flowers with only 5 stamens; fruit a small, pear-shaped capsule, 1-1.5 cm long, scaly, with persistent calyx and epicalyx: *Camptostemon philippinense* – 157 (Bombacaceae)
- 102 a Twigs are swollen at the base, and easily detach; elliptic to obovate, somewhat fleshy leaves are 2.5-5 cm by 8-12; calyx with overlapping lobes, petals are white or pink; 5 stamens; fruit a berry, 5-12 mm across, first reddish-purple, turning black: *Ardisia elliptica* – 219 (Myrsinaceae)
 b Twigs not swollen at the base: **103**
- 103 a Young leaves white or purplish: **104**
 b Young leaves not white or purplish: **105**
- 104 a Margins of adult leaves often whitish when leaf is fresh and dry; flowers occur on 5-7 cm-long clusters, sepals 3-5, not overlapping; petals absent; stamens 14-35; fruits round, slightly flattened, about 3.2 cm across, orange when ripe: *Blumeodendron tokbrae* – 173 (Euphorbiaceae)
 b Leaves 2.5-6.3 by 5-10(-14) cm, elliptic with a blunt tip, dark green and glossy above, pale beneath, 6-8 pairs of veins; flowers 2-3 mm across, greenish-white; fruit an egg-shaped berry, 4(-5) mm long and 3-4 mm wide, pinkish-purple, then black: *Ilex cymosa* – 144 (Aquifoliaceae)

- 105 a Fruits larger than 1.5 cm: **106**
 b Fruits smaller than 1.5 cm across or long: **108**
- 106 a Flowers yellowish-white, lemon-scented, fruit an elongated berry, 1.5-1.7 by 4-5 cm; leaves oblong or obovate-elliptic; calyx not covering the berry: *Stemonurus ammui* – 186 (Icacinaeae)
 b Fruit round, flowers white to pinkish: **107**
- 107 a Leaves ovate or elliptic-oblong; many-flowered clusters measure 0.5-3.5 cm, calyx very small; petals are white or pinkish, 10-12 mm long; fruit a round berry 1.7-2.5 cm in diameter, orange calyx almost completely covering the berry: *Olex imbricata* – 223 (Olacaceae)
 b Leaves elliptic to widely elliptic, calyx bell-shaped, silky white, 3 mm long, deeply 4-lobed; corolla salver-shaped, white, with tube 10 mm by 4 mm, densely white silky outside, smooth inside, 4-lobed; fruit a berry, round, 2.5-3 cm in diameter, silky when young: *Diospyros maritima* – 172 (Ebenaceae)
- 108 a Flowers unisexual, i.e. either male or female: **109**
 b Flowers bisexual, i.e. with stamens and style: **110**
- 109 a Bark charcoal grey to black, flowers white or pale yellow; male flowers usually in groups of (1-3); calyx 3-lobed, 4 mm long and loosely attached to the 6 mm long, also 3-lobed corolla that is covered with dense hairs; fruits yellow or orange: *Diospyros ferrea* – 170 (Ebenaceae)
 b Bark grey or brown, male flower cluster a panicle bearing minute, crowded flowers; female flower clusters on a stout stalk, 2.5-3 cm; flowers 4-6 merous, female flowers 5 mm across; fruit round, 6-7 mm diameter, greenish-yellow, ripening deep red: *Ilex maingayi* – 145 (Aquifoliaceae)
- 110 a Leaves scented of ethereal oils (like *Eucalyptus*) when crushed, flowers white, fluffy because of the numerous projecting white stamens, fruit a small, 3mm wide woody capsule: *Melaleuca cajuputi* – 221 (Myrtaceae)
 b Leaves not scented of ethereal oils, flowers mainly white or whitish, but without numerous projecting stamens: **111**
- 111 a Flowers white with purple spots, leaf blade oblong to elliptic, 2-4 by 5-12 cm; corolla bell-shaped 2-2.5 cm long, more or less fleshy; tube stout, 10-15 mm long, 5-lobed; lobes about 10 mm long; shrublet 1 m tall: *Myoporum bontioides* – 214 (Myoporaceae)
 b Flowers white or creamy coloured, not spotted; small tree, 7-10(-12)m: **112**
- 112 a Leaves leathery, narrowly elliptic to ovate-elliptic, 12-25(-30) by 36-80 mm; flowers tiny, 3(-5) mm wide, hairy at the mouth, 5-merous, sepals free or shortly fused; petals white; fruit a 1-seeded berry, 5-6 mm wide, pale green, turning pinkish purple: *Rapanea portieriana* – 220 (Myrsinaceae)
 b Leaves elliptic, 5.5-15 by 2-6 cm, flowers scented, creamy-coloured to whitish; flower cluster 3-12 cm long; calyx smooth, 1.5-2.5 mm; corolla 4-6 mm long, stamens numerous stamens; fruit is round and pink, green, yellow or dark blue, 4-10 by 3-8 mm: *Symplocos celastriifolia* – 263 (Symplocaceae)
- 113 Leaves compound.
 a Leaves (often) trifoliate: **114**
 b Leaves once sub-divided into leaflets (pinnate): **116**
 c Leaves twice divided into leaflets (bipinnate): **129**
- 114 a Leaflets not longer than about 5 cm, 1-3 leaflets; calyx cup-shaped, 4-5 mm, corolla purplish mauve to lilac blue, stamens and style protruding; shrublet; fruit round 6 mm: *Vitex ovata* - 268 (Verbenaceae)

- b Leaflets always 3, 10-26 cm long, larger shrubs – medium sized trees: **115**
- 115 a Shrub, 2-4 m; leaflets up to 13 by 26 cm; flowers 2 mm, white; fruit globose, 7.5 by 12.5 cm, orange when ripe: *Allophylus cobbe* – 249 (Sapindaceae)
- b Medium sized tree, 12-15 m, spines on thicker branches; leaflets 10-15 cm long, flowers bright scarlet, in clusters 25-40 cm, flowers 6-8 cm long; fruit a pod, 15-30(-40) cm: *Erythrina orientalis* – 195 (Leguminosae)
- 116 a Leaflets odd in number, with an end, unpaired leaflet (inparipinnate): **117**
- b All leaflets paired (paripinnate): **122**
- 117 a Fruit elongated pod or pod-like, 5-70 cm long; flower trumpet shaped or legume flower: **118**
- b Fruit round or rounded: **120**
- 118 a Flower is large, trumpet-shaped, white or greenish-white 12-18 cm long, 7-12 cm diameter; fruit is horn-like 25-70 by 2-3 cm; tree, 5-20 m: *Dolichandrone spathacea* – 156 (Bignoniaceae)
- b Flowers at most 2 cm long, pods 6-7 cm long: **119**
- 119 a White to pale violet, legume (bean-like) flower, 11-18 mm long; fruit a 2-3 by 5-7 cm pod containing one seed; leaves with 3-7 leaflets: *Pongamia pinnata* – 199 (Leguminosae)
- b White legume (bean-like) flowers, 6 mm long; fruit a 1-1.4 by 2.5-6 cm long pod; leaves 12-15 cm long, with 21-42 leaflets: *Derris pinnata* – 194 (Leguminosae)
- 120 a Leaves 8-18 cm, leaflets linear, up to 0.5 by 7 cm, hard and leathery; flowers small, 5-merous; all parts very bitter to taste; dwarf tree, usually <2m: *Quassia harmanidana* – 252 (Simaroubaceae)
- b Leaves 45-100 cm long: **121**
- 121 a Flowers tiny, <2 mm across, 3 petals; leaves 45 cm long, 5-9 leaflets; fruit about 6-7 mm diameter and round; small to medium-sized tree, up to 15m: *Aglaia cucullata* – 208 (Meliaceae)
- b Flowers <6 mm across, 5 petals; leaves up to 100 cm long, with (7-)11 leaflets; fruit round, 6 mm diameter; small to medium-sized tree, to 15 m tall: *Polyscias macgillivrayi* – 146 (Araliaceae)
- 122 Leaflets paired (paripinnate)
 - a Fruit in flattened pods: **123** (Leguminosae)
 - b Fruit round or irregular in shape: **124**
- 123 a Leaflets usually in 3(-5) pairs; petals light yellow to red; pods flat, irregularly round or ovate, rather diffusely spiny (spines up to 4 mm), 5-7 by 6-10 cm; tree, 10-15 m: *Sindora siamensis* – 201 (Leguminosae)
- b Leaflets usually in 2(-3) pairs; flowers white, later turning orange/reddish; pod, oblong, measuring 4-5(-7.2) by 8.5-15(-28) cm, with a white, fleshy stalk; tree, up to 40m: *Intsia bijuga* – 197 (Leguminosae)
- 124 a Leaves slightly leathery; fruits round, with a smooth exterior, 6-25 cm diameter: **125** (*Xylocarpus* spp.)
- b Leaves not leathery; fruit round, either with a highly wrinkled exterior and 5-6 cm, or smooth and <2.5 cm: **127**
- 125 a Leaflets in 2-4(-5) pairs, ovate to heart-shaped, flower stalks not conspicuously swollen, fruit 6-8 cm diameter, no buttresses or pneumatophores: *Xylocarpus rumphii* – 211 (Meliaceae)
- b Leaflets in 1-3(-4) pairs, obovate to elliptic, flower stalks swollen, fruit 6-25 cm diameter, trees often with buttresses or pneumatophores: **126**

- 126 a Leaflets somewhat elliptic-ovate, not rounded at tip, fruit 6-11 cm diameter, buttresses not ribbon-like; pneumatophores erect: *Xylocarpus moluccensis* – 210 (Meliaceae)
 b Leaflets usually rounded at the tip, fruit 12-25 cm diameter; buttresses flattened, ribbon-like; pneumatophore absent: *Xylocarpus granatum* – 209 (Meliaceae)
- 127 a Fruit 7-9(-20) mm long, smooth or very sparsely covered with hairs; at first sharply 3-angled, ripening red; contains red seed pulp; stalk 2-2.5 mm; shrub or tree, 3-10(-30) m tall; flowers are small, 1.5 mm diameter, and yellowish-green to greenish: *Mischocarpus sundaicus* – 250 (Sapindaceae)
 b Fruit an irregular, deeply wrinkled, rounded woody pod, 2-4(-4) cm: **128**
- 128 a Stalk of leaf about 3 mm long; leaflets in 2 pairs, fruit stalk on one side of the pod, 2 by 3 cm, with a distinct beak; shrub or tree, 6 m tall: *Cynometra iripa* – 192 (Leguminosae)
 b Stalk of leaf 3-15 mm long; fruit stalk in the centre of the pod; pod 3-4 by 2-3 cm, not beaked; tree, up to 25 m: *Cynometra ramiflora* – 193 (Leguminosae)
- 129 Bipinnate leaves.
 a 1-2 pairs of leaflets, the upper pair being the largest; 6-16 pairs of secondary leaflets per leaflet; pods 2-3 by 10-20 cm, 5-13 seeded; flowers white: *Cathormion umbellatum* – 191 (Leguminosae)
 b 3-11 pairs of leaflets, flowers yellow: **130**
- 130 a 3-9 pairs of leaflets, all of approximately equal size; 12-36 secondary leaflets per leaflet; pods are 5-6 by 10-15 cm, 4-8 seeded; yellowish-white flowers: *Serianthes grandiflora* – 200 (Leguminosae)
 b 5-11 pairs of leaflets, with 9-20 pairs of secondary leaflets; flowers bright yellow; fruit is a purplish-brown pod, 2.5 by 6-14 cm, with 1-5 seeds: *Peltophorum pterocarpum* – 198 (Leguminosae)

GROUP A: FERNS

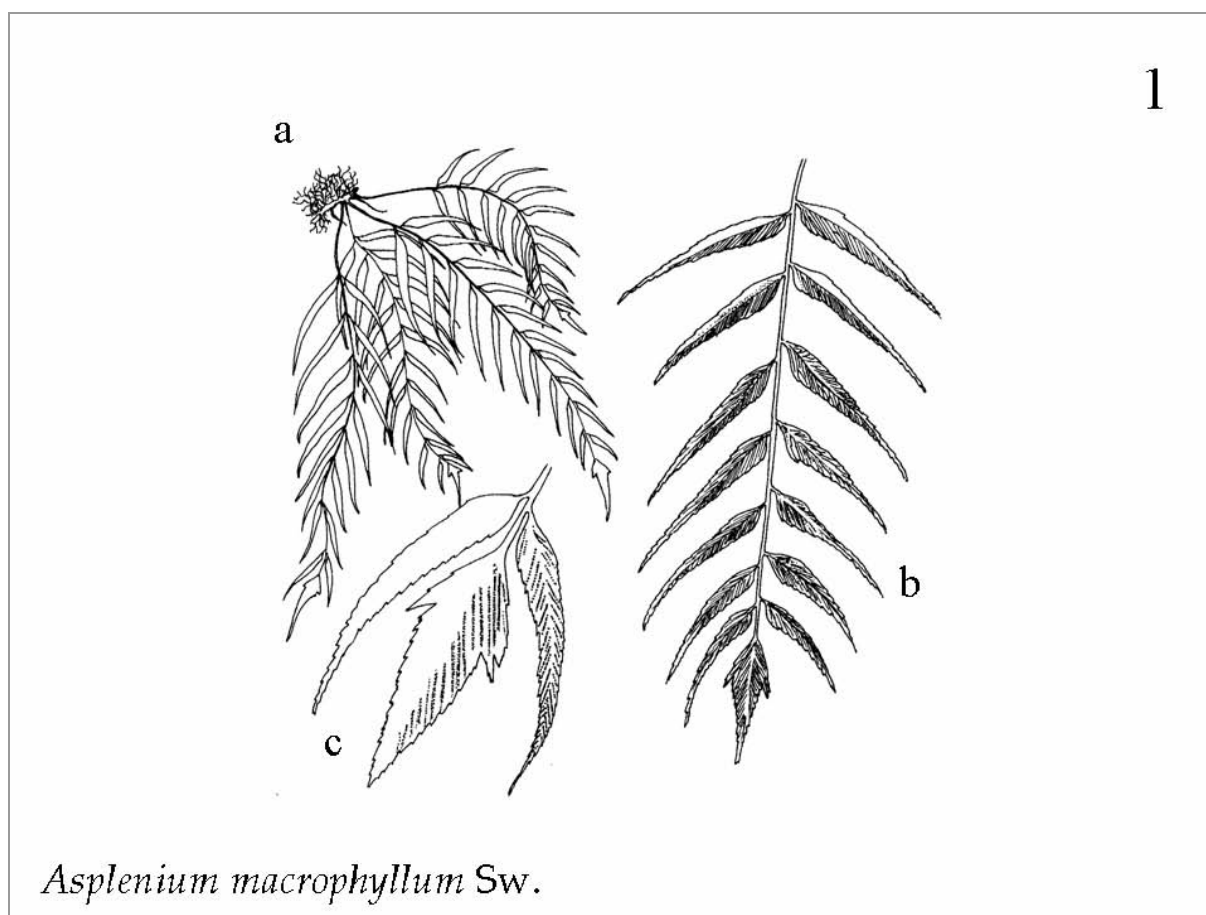


Fig. 1. *Asplenium macrophyllum* Sw. (a) Habit, (b) fertile frond, (c) detail of fertile frond showing the sporangia.

ASPLENIACEAE**1*****Asplenium macrophyllum* Sw.**

Synonyms : *Asplenium adiantoides* C.Ch., *Asplenium canaliculatum* Bl., *Asplenium falcatum* Lamk., *Asplenium oxyphyllum* Cuming, *Asplenium polyodon* Forst., *Asplenium simile* Bl., *Tarachia canaliculata* Presl., *Tarachia falcata*, *Tarachia oxyphylla* Presl.

Vernacular name(s) : Unknown.

Description : Epiphytic fern, 15-80 cm tall, with a short, creeping rhizome, bearing a tuft of fronds. The leaf stalks are rather slender and almost black when dry, up to about 20 cm long. Leaves are 20-50 cm long, 10-20 cm wide, and have one set of leaflets at the base. Veins are very obliquely slanted, once or twice-forked, and hardly visible on the upper surface. The sori (containing the spores) are long, often stretching almost from the base to the end of the veins. The spores themselves are dark. A highly variable species.

Ecology : Usually occurs on rocks, especially on limestone, from sea level up to an altitude of 1,700 m, on moderately to very shaded sites. Spores are borne all year round. Mangrove associate species.

Distribution : Occurs from Madagascar throughout Southeast Asia to Australia and Polynesia. In a northerly direction, its range stretches to Assam, India.

Abundance : Relatively common.

Use(s) : Unknown.

Source of illustration : Piggott (1988).

Reference(s) : Backer & Posthumus (1939), Holttum (1966), Piggott & Piggott (1988).

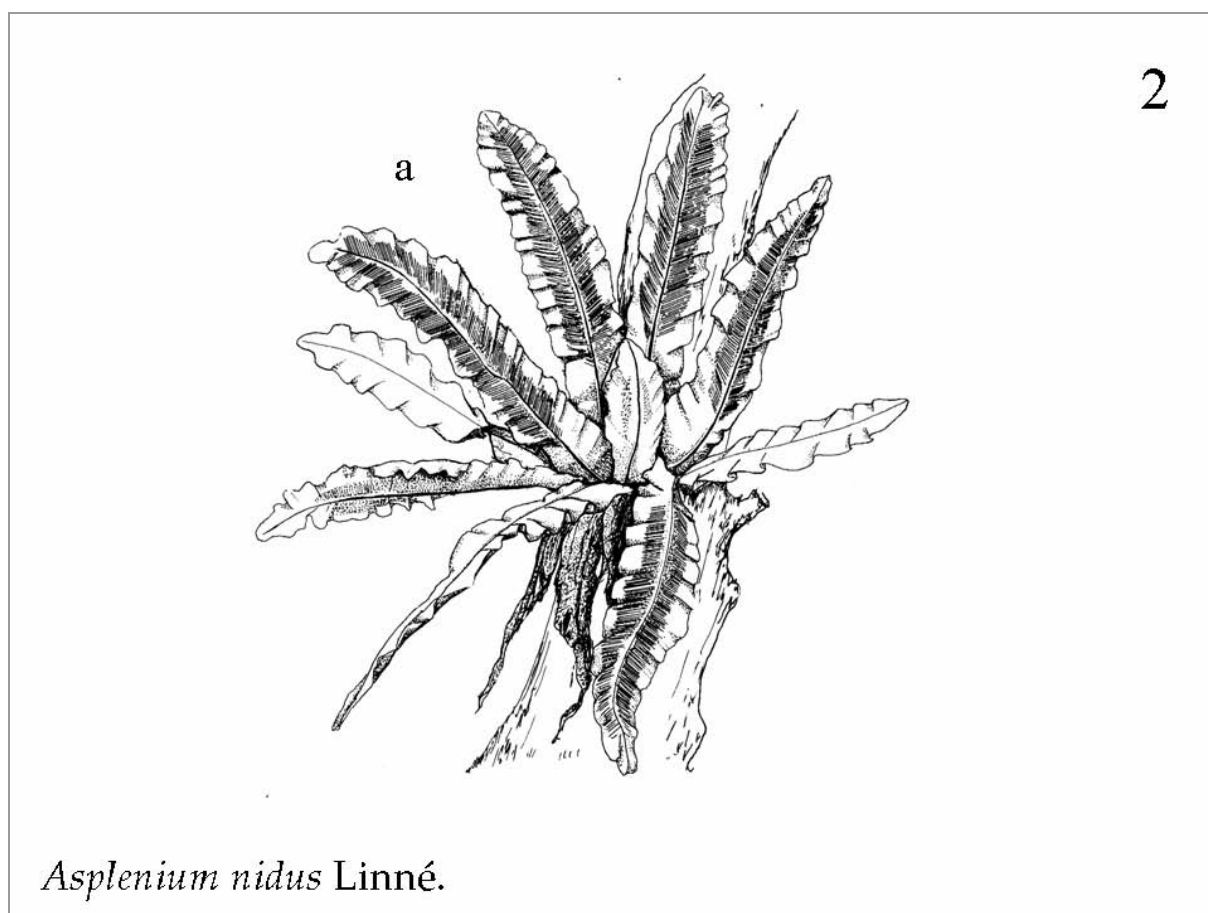


Fig. 2. *Asplenium nidus* Linné. Entire plant, with some leaves upturned showing the sporangia underneath.

ASPLENIACEAE

2

***Asplenium nidus* Linné**

Synonyms : *Asplenium antiquum* Makino, *Asplenium australasicum* (J.Sm.) Hook., *Asplenium filicifolium* Goldm., *Asplenium pachyphyllum*, *Neottopteris maritania* Fée, *Neottopteris musaefolia* J.Sm., *Neottopteris nidus* (L.) J.Sm., *Neottopteris rigida* Fée, *Phyllitis arborea* Rumph., *Thamnopteris nidus* Presl., *Thamnopteris pachyphylla*

Vernacular name(s) : Bird's-nest Fern (E), Paku Pandan (Mal.), Matonda, Tutu pupu - *Paku sarang burung* (Ind.)

Description : Epiphytic fern with a stout, erect rhizome, bearing a rosette of leaves at the top. The plant has a large mass of roots, with many persistent, brown root hairs. The leaf stalks are stout and almost black, up to 5 cm long. The leaf is simple, up to 150 cm or more long and up to 20 cm wide. It narrows gradually, tapering both towards the pointed tip and towards the base. The veins are usually once-forked, sometimes twice-forked; the first forking is often near the midrib. Veins are straight, slightly at an angle to the midrib, and unite to form a continuous vein about 0.5 mm from the margin. The sori (containing the spores) are narrow, and occur on every vein of the top half of the frond. Spores are light brown, transparent when fresh and opaque when old.

Ecology : The nest-shaped rosette of fronds traps dead leaves that are held firmly between the bases of successive new leaves. This forms a spongy humus, which is effective in holding a lot of water after rains. Other epiphytes share this water, growing on *Asplenium. Nidus'* roots or on the tree beneath them. Occurs from sea level up to an altitude of about 1,700 m. It is particularly common above 250m altitude. Occurs in shaded and not too dry localities. Mangrove associate species.

Distribution : Tropics of the Old World. Found throughout Southeast Asia.

Abundance : Abundant.

Use(s) : Common pot plant (Europe) and garden ornamental (tropics). It's leaves – in combination with rasped coconut – are used a shampoo.

Source of illustration : Live specimen & Sastrapradja *et al.* (1979).

Reference(s) : Backer & Posthumus (1939), Heyne (1950), Holttum (1966), Piggott & Piggott (1988).

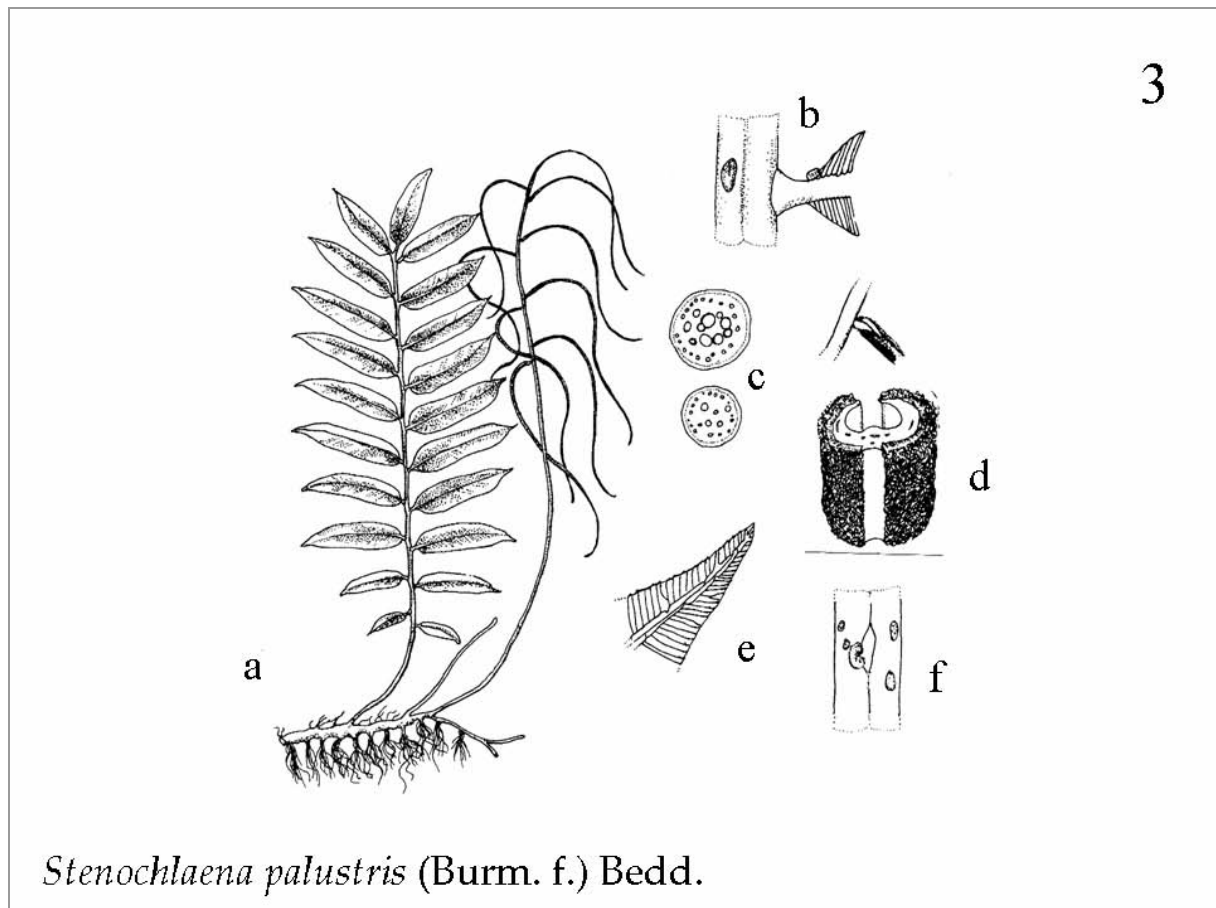


Fig. 3. *Stenochlaena palustris* (Burm. f.) Bedd. (a) Sterile (left) and fertile leaf frond (right), (b) detail of gland at the base of each leaflet, (c) cross-sections of stem, (d) cross section of fertile leaflet covered with sporangia, (e) detail of tip of sterile leaflet, and (f) detail of grooved leaf axis.

BLECHNACEAE

3

***Stenochlaena palustris* (Burm. f.) Bedd.**

Synonyms : *Acrostichum palustre* (Burm.f.) C.B. Clarke, *Acrostichum scandens* (Sw.) Hook., *Lomaria scandens* (Sw.) Willd., *Lomariopsis palustris* (Burm.f.) Kuhn, *Lomariopsis scandens* (Sw.) Mett., *Lonchitis volubilis* Rumph., *Olfersia scandens* (Willd.) C. Presl., *Onoclea scandens* Sw., *Polypodium palustre* Burm.f., *Pteris scandens* (Willd.) Roxb., *Stenochlaena scandens* (Sw.) J.Sm., *Thelypteris palustris* (A.Gray) Schott.

Vernacular names : Paku midung, Paku akar, Paku naga, Paku ramu (Mal.), Akar Pakis, Lemiding, Melat, Miding, Paku Ramiding, Paku Hurang, Pakis Bang, Bampesu, Lambideing – *Paku hurang* (Ind.), Choại (Viet.)

Description : Ground fern with a creeping or climbing, up to 10 m-long, green rhizome that is scale-less when mature. Only the growing end is covered with overlapping, round to shield-shaped, brown scales. The 15-20 cm-long leaf stalks are well-spaced on the rhizome and are smooth and hairless except when they are very young. The leaf axis is slightly grooved on the upper surface. Mature leaves are particularly stiff, leathery and dark green, while young leaves are pale reddish-green. There are two types of leaf frond: sterile and fertile. Both types are 40-80 cm long, and have 8-15 pairs of leaflets and one terminal leaflet. The upper leaflets are somewhat reduced in size. The lateral leaflets usually have ear-like lobes, but this is absent in the terminal leaflet. The sterile fronds are smooth and glossy, and paler underneath; they have narrowly elliptical and short-stalked leaflets. Although varying much in size and shape, they are commonly about 15 by 3 cm. Their edges are colourless and sharply toothed. There is a gland present on the edge of each leaflet, close to the base. The fertile fronds have narrowly linear leaflets, measuring about 20 cm by 3 mm, and their lower surface is covered with sporangia except for narrow marginal bands. The spores have a 2-sided symmetry, are colourless and transparent.

Ecology : Occurs everywhere in the lowlands, in open places and secondary forests where there is enough moisture, in both brackish- and freshwater. Most common in (peat-)swamp forests. As a climber, it can densely festoon a tree, for example in areas where the forest canopy has been disturbed. Mangrove associate species.

Distribution : Occurs from India through Southeast Asia (where it is found throughout) to Polynesia and Australia.

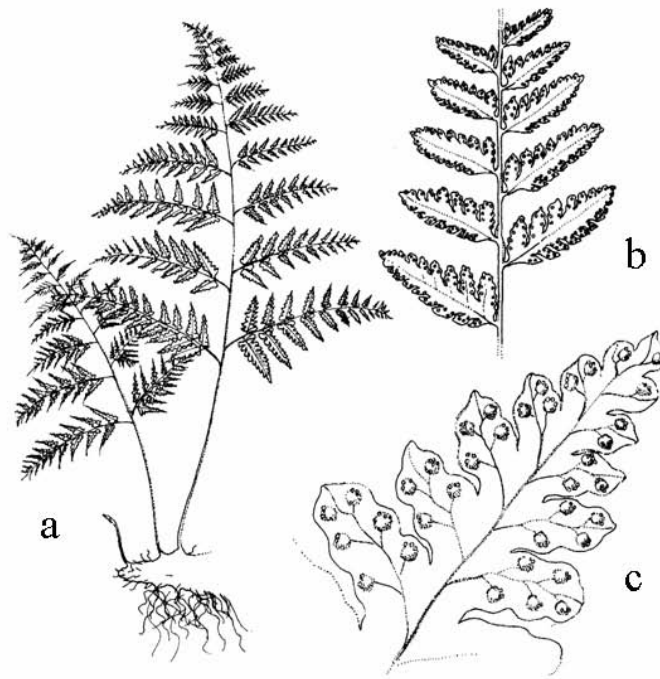
Abundance : Common and abundant.

Use(s) : A very durable rope can be made from the stems, that reportedly is more durable in seawater than rattan. The young 'reddish' leaves are eaten as a vegetable and sold on local markets in Indonesia.

Source of illustration : Backer & Posthumus (1939), Sastrapradja *et al.* (1979), Piggott (1988).

Reference(s) : Heyne (1950), Holttum (1966), Piggott (1988), Said (1990)

4



Davallia divaricata Blume.

Fig. 4. *Davallia divaricata* Blume. (a) Habit, (b) detail of fertile frond, (c) detail of a single fertile leaflet depicting round sporangia at the end of each vein.

DAVALLIACEAE

4

***Davallia divaricata* Blume**

Synonyms : *Araiostegia davaricata* (Blume) M. Kato, *Davalia mucronata* Bl., *Davalia polyantha* Hook.

Vernacular name(s) : Hare's Foot Fern (E)

Description : Epiphytic fern with compound leaves. Rhizome stout, densely covered with thin, brown scales that are about 1-2 cm long and up to 2 mm or more wide. Leaf stalks are stout, 15-60 cm long and smooth. The large, up to 60 cm-long leaves are broadly triangular, bifurcating four times, each time into smaller leaflets. Leaves are dark crimson when young. Sterile and fertile leaves are different. Lobes of sterile leaflets are elliptic, entire to shallowly toothed; when dry, they discolour to a dark reddish-brown. Lobes of fertile leaflets are elliptic-oblong, and deeply lobed with an undulating margin. The sori (clusters of spores) are located on the tip of each vein.

Ecology : Grows both in shaded forests as well in agricultural areas. In Peninsular Malaysia this species has been collected at several localities in mountainous areas at 700-1,300 m elevation. In Java it is reported to occur from lowland to 1,300 m. Usually collected on rocky substrates, but it is probably equally abundant as an epiphyte on trees. Mangroves associate species.

Distribution : Southeast Asian species, recorded from Southern China, Myanmar, Thailand, Peninsular Malaysia and Indonesia (Java).

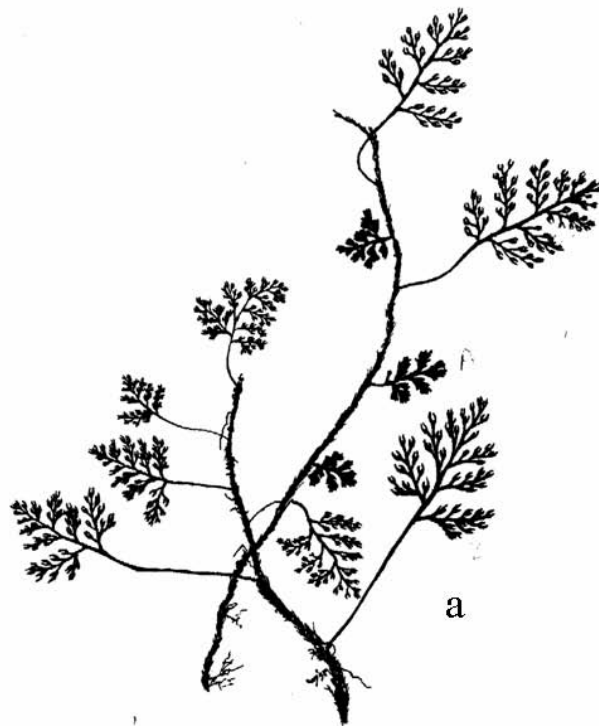
Abundance : Common.

Use(s) : Unknown.

Source of illustration : Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966), Piggott (1988).

5



Davallia parvula Wall. ex Hook. & Grev.

Fig. 5. *Davallia parvula* Wall. ex Hook. & Grev. (a) Habit.

DAVALLIAVEAE

5

***Davallia parvula* Wall. ex Hook. & Grev.**

Synonyms : *Acrophorus parvula* Bedd., *Davallia parvula* Wall., *Humata parvula* (Wall.) Mett., *Leucostegia parvula* J. Sm.

Vernacular name(s) : Paku Lumut Batu (Mal.)

Description : Epiphytic fern with simple, but deeply-lobed leaves. Rhizomes are very slender, only a little over 1 mm in diameter. Leaves are about 0.5-1.0 cm apart. Scales on the rhizome are chestnut-brown with a slightly paler, entire edge, about 3 mm long, and are narrowed evenly from the heart-shaped base to the pointed tip. Leaf stalks are very slender, 1-3 cm long. Leaves are up to 2.5 cm long and 2.5 cm wide. They are narrowly triangular in shape, with the blade so deeply dissected as to leave only a very narrow wing along each vein. Sori (containing the spores) are borne at the base of the terminal fork in the leaf blade, with the (usually unequal) arms of the fork extending beyond the sorus by 1-1.5 mm.

Ecology : Occurs on old, mossy mangrove trees. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Peninsular Malaysia and Indonesia (Bogor Herbarium has specimens from Borneo, Sumatra, Sulawesi, Papua and the Moluccas). Not (yet) confirmed from Java.

Abundance : Relatively common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

References : Holttum (1966), <http://www.sdfern.com/ferncat.htm>

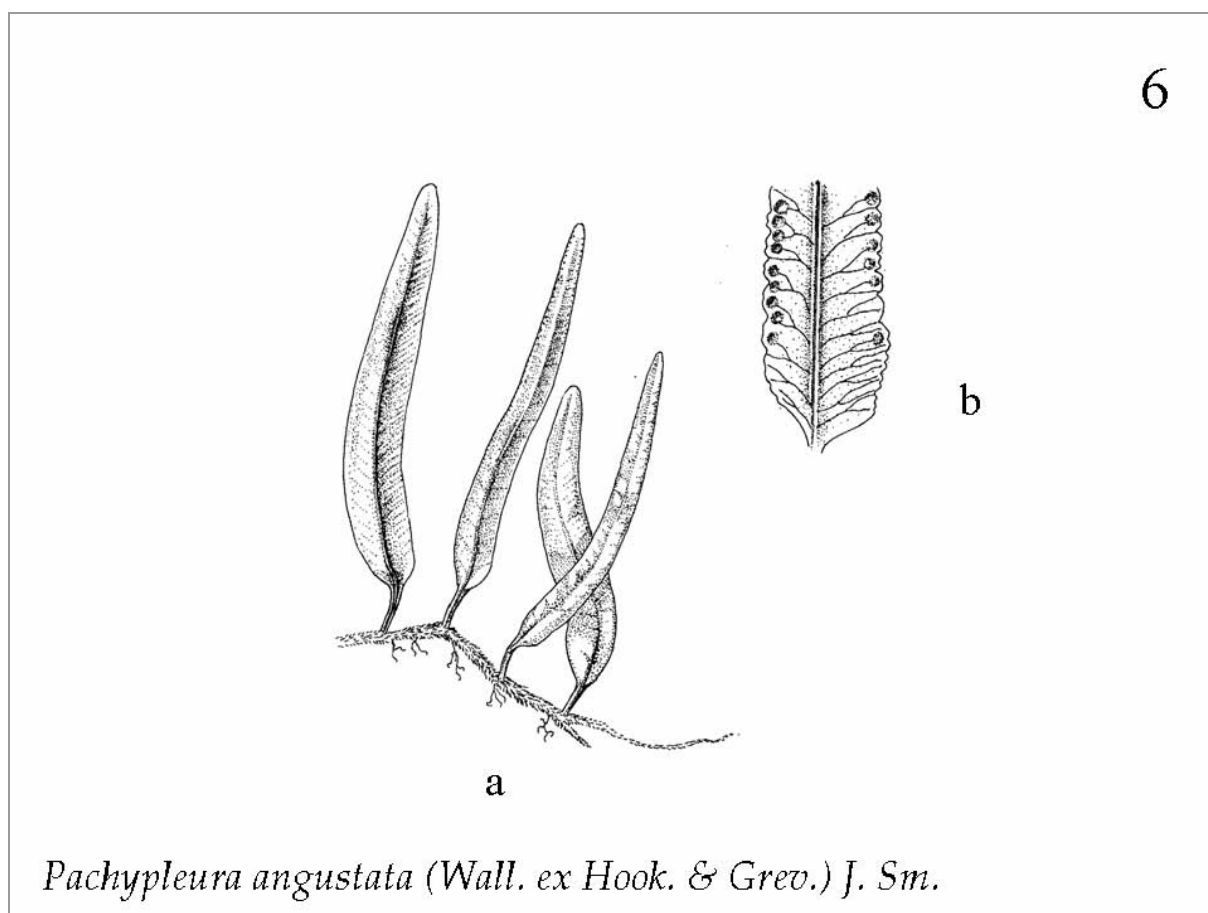


Fig. 6. *Pachypleura angustata* (Wall. ex Hook. & Grev.) J. Sm. (a) Habit: end of creeping frond, (b) detail of fertile leaflet depicting sporangia at the end of each vein.

DAVALLIACEAE

6

***Pachypleuria angustata* (Wall. ex Hook. & Grev.) J. Sm.**

Synonym(s) : *Davallia angustata* Wall., *Humata angustata* (Wall.) J.Sm., *Humata angustata* (Wall. ex Hook. & Grev.) J.Sm.

Vernacular name(s) : Unknown.

Description : Epiphytic fern. The rhizome is slender, long and creeping, covered with chestnut-brown scales. The scales are about 5 mm long, and are evenly-narrowed from base (about 1 mm wide) to tip, with entire edges. Leaves occur about 1-2 cm apart. There are two types of leaf: sterile and fertile, and both have an undivided, simple structure. Leaf stalks are 0.5-6 cm long and deeply grooved. Leaf blades are leathery, about 10-20 cm long; sterile leaves are 2 cm wide, while fertile leaves are wider. The leaf-base is unequal, always slightly extending down the stalk. Leaves are gradually narrowed up to the blunt tip. Edges of sterile leaves are rather irregularly toothed, with one tooth located opposite the end of each vein. Leaf-edges are sometimes slightly and irregularly lobed. Veins are not prominent but visible on both leaf surfaces, emerging nearly at a right angle to the midrib, and are usually once-forked in sterile leaf fronds. Veins are somewhat more widely spaced in fertile than in sterile leaves. Sori (containing the spores) occur at the end of each vein, while teeth along the edge of the leaf are notched opposite each sorus. This sometimes gives the appearance that the teeth (or small lobes) occur between the sori.

Ecology : Common epiphyte in mangroves. Occurs in lowlands along forest streams, and on mossy rocks and fallen trees in the hills. Unlike *Humata heterophylla*, this species does not occur in exposed places. Mangrove associate species.

Distributions : Southeast Asian species, recorded from Peninsular Malaysia, Thailand and Indonesia (Sumatra).

Abundance : Unknown.

Use(s) : Unknown.

Source of illustration : Holttum (1966)

References : Holttum (1966), Piggott (1988),
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

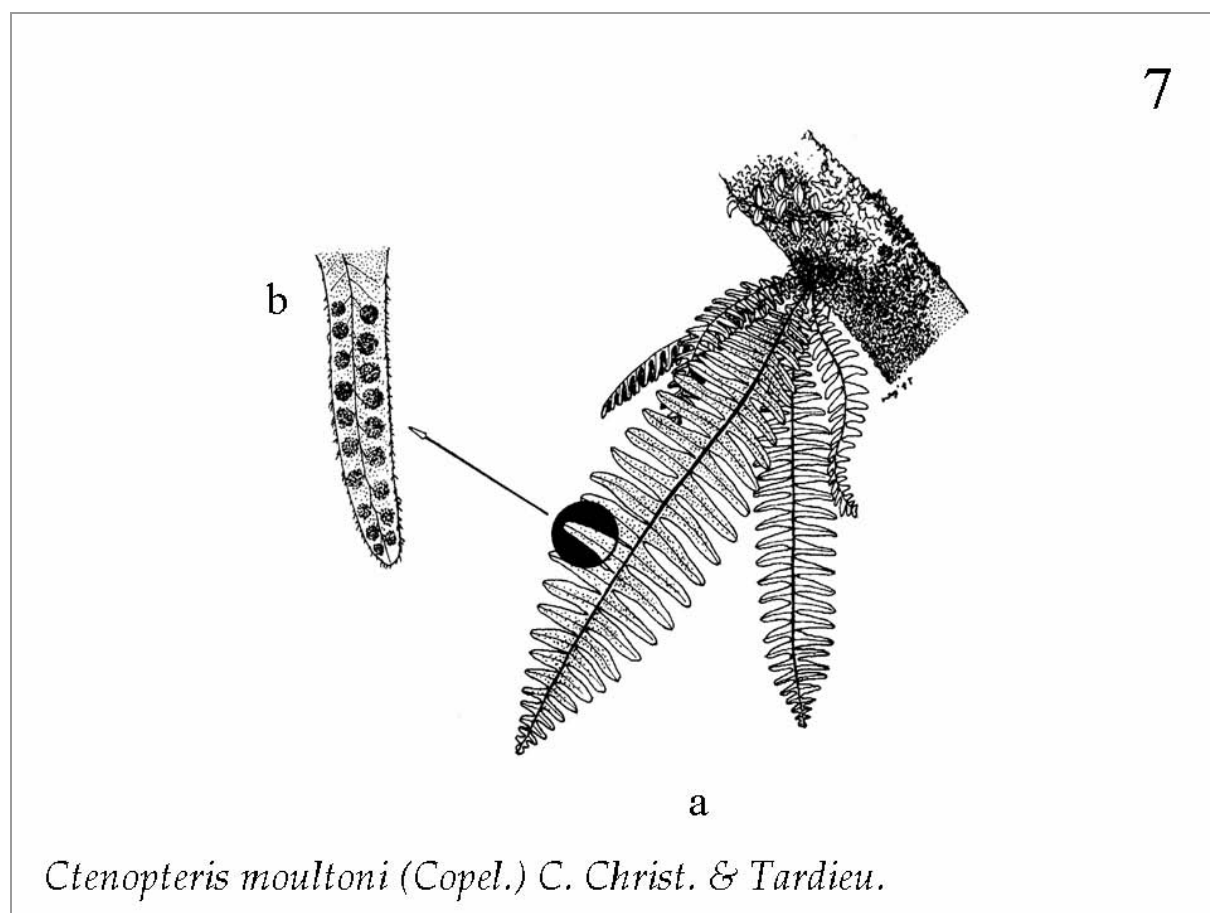


Fig. 7. *Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu. (a) Habit, (b) detail of fertile leaflet depicting the sporangia.

GRAMMITIDACEAE

7

***Ctenopteris moultoni* (Copel.) C. Christ. & Tardieu**

Synonyms : *Ctenopteris moultoni* (Copel.) Holtt., *Polypodium decorum*, *Polypodium moultoni* Copel.

Vernacular name(s) : Unknown.

Description : Epiphytic fern with a short rhizome, creeping or nearly erect, with a densely scaly tip. Scales are light brown, 3 mm long, narrowed evenly to a blunt tip. The leaf stalk is about 5 mm long, almost black, and bears hairs. Leaves are about 10-20 cm long, 1-2.5 cm wide, with a dark midrib and a blade that is narrowed gradually to both base and tip. Leaflets bear scattered, stiff, star-shaped hairs on the lower surface, and have entire leaf edges that extend almost at right angles to the midrib. Leaflets are attached to the midrib by the whole of their (broad) bases, that virtually touch each other and are 3-4 mm wide. Sori (containing the spores) are located in shallow depressions, with about eight occurring on each side of the midrib of a leaflet. The sori are (almost) round and each individual sorus extends nearly from midrib to the edge of the leaflet.

Ecology : Occurs in lowlands, on trees in old mangroves and along rivers in primary forest. It is also found on trees and rocks on various isolated mountains. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Thailand, Peninsular Malaysia and Western Indonesia (Borneo, Sumatra).

Abundance : Common.

Use(s) : Unknown.

Source of illustration : Holttum (1966).

Reference : Holttum (1966),
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

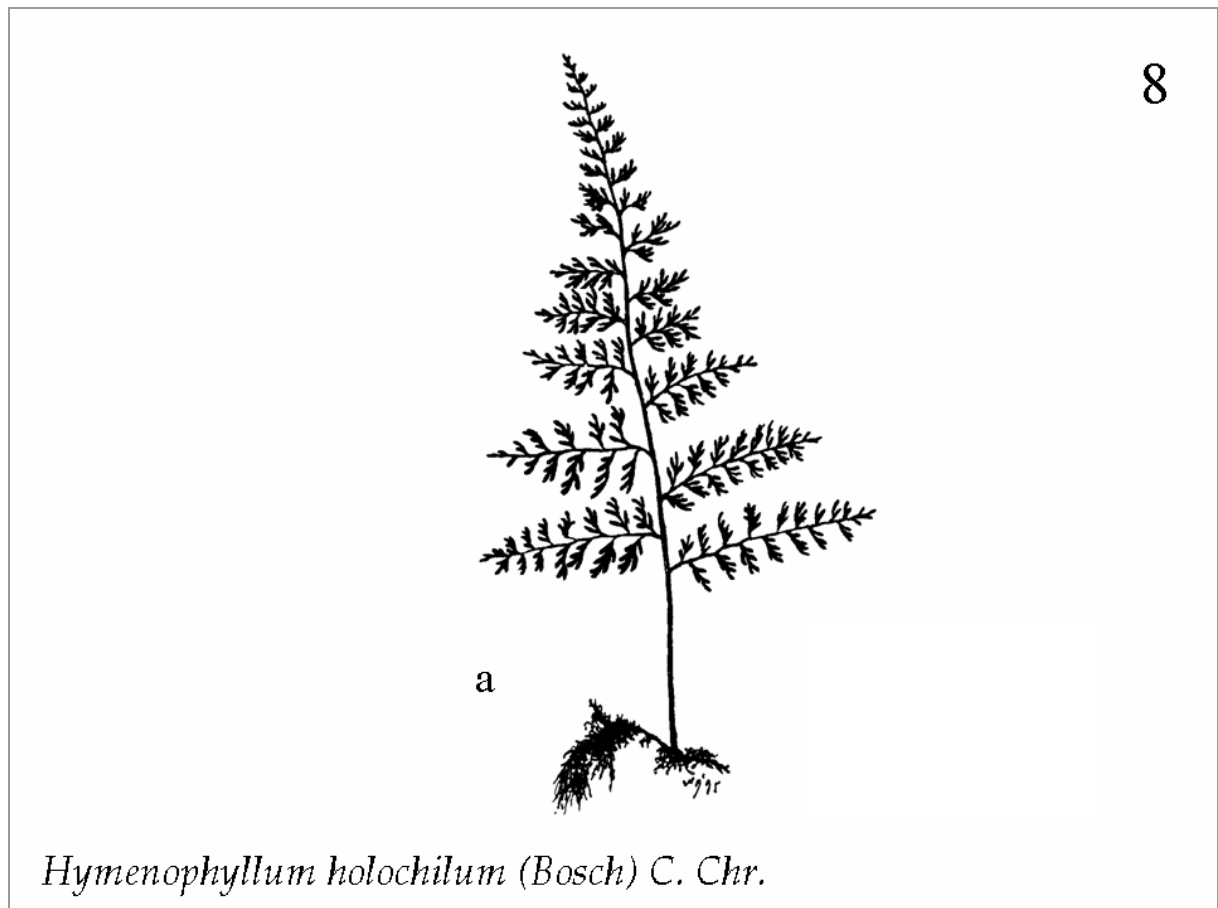


Fig. 8. *Hymenophyllum holochilum* (Bosch) C. Chr. (a) Habit.

HYMENOPHYLLACEAE

8

***Hymenophyllum holochilum* (Bosch) C. Chr.**

Synonyms : *Didymoglossum affine* v.d.B., *Didymoglossum holochilum* Bosch, *Hymenophyllum smithii* Hook, *Leptocionium affine* v.d. B., *Leptocionium holochilum* (Bosch) Bosch, *Meringium holochilum* (Bosch) Copel.

Vernacular name(s) : Unknown.

Description : An epiphyte or rock-plant, with long, creeping, hairy rhizomes. Leaf stalks 1-4 cm long, bearing scattered hairs, and usually narrowly winged in the upper part. Leaves are divided into leaflets, 4-10 cm long and 2.5-4 cm wide. The leaf axis is hairy on the lower surface and usually winged. Leaflets lie close to the leaf axis, and the largest leaflets have 4-6 lobes on each side. These lobes are forked or sometimes divided into three parts, the outer segments of which are about 1 mm wide with sharply toothed edges. Sori (containing spores) occur towards the tips of the leaflet lobes. The base of the sori are hollow, inversely conical, more or less winged, with 1-3 low, longitudinal ridges (sometimes ending in hairs) at the base on the lower surface.

Ecology : Widely distributed in lowlands, especially along rivers, in well-developed mangroves and on trees in freshwater swamp forest. Occurs from sea level up to an altitude of 2,100 m, in shaded, moist forests. Mangrove associate species.

Distribution : Found from Southeast to Southern China, Taiwan and Southeast Asia. It is widely distributed in Thailand, Malaysia and Indonesia (Sumatra, Java, Kalimantan, Sulawesi, the Moluccas, the Lesser Sundas and Papua). Highly likely to occur in Cambodia, Vietnam and Papua New Guinea.

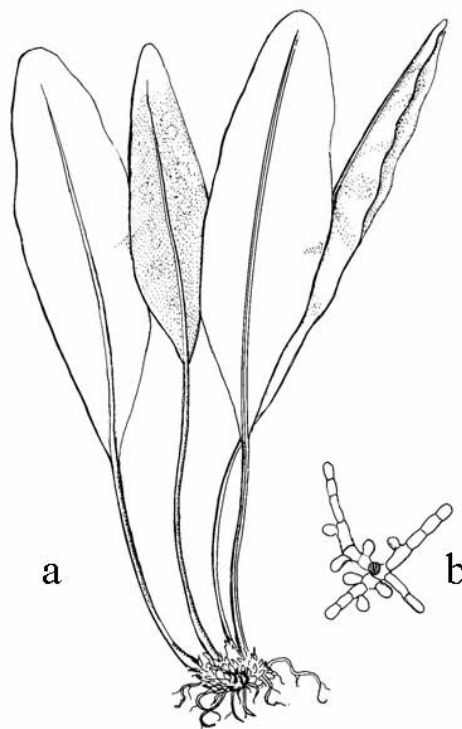
Abundance : Common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

References : Backer & Posthumus (1939), Holttum (1966), Johnson (1977), <http://mobot.mobot.org/W3T/Search/index/focaH.html> (Flora of China), <http://www.geocities.com/fernparadise/Hymenophyllaceae/Hymeno.html>

9



Elaphoglossum amblyphyllum C.R. Bell.

Fig. 9. *Elaphoglossum amblyphyllum* C.R. Bell. (a) Habit, and (b) detail of germinating spore.

LOMARIOPSIDACEAE

9

***Elaphoglossum amblyphyllum* C.R. Bell.**

Synonyms : *Acrostichum decurrens* (non Desv.) Bl., *Acrostichum obtusifolium* (non Willd.) Bl., *Elaphoglossum decurrens* Moore, *Elaphoglossum obtusifolium* Bell., *Olfersia blumeana* Presl., *Olfersia decurrens* Presl.

Vernacular name(s) : Unknown.

Description : Epiphytic, or more rarely a ground-dwelling fern. Creeping rhizome with pale brown scales that are 10-12 mm long and 2 mm wide at base, with edges that are more or less hairy. Leaves are simple and have an entire leaf edge. Sterile leaves have a 7-15 cm-long stalk and a leathery blade, measuring up to 29 by 8.5 cm. Leaves have broadly rounded tips, and a distinctly pale edge. Fertile fronds have leaf stalks that measure 20 cm, and a leaf blade that measures up to 20 by 4 cm. Rhizomes are short.

Ecology : Epiphyte or ground-dwelling fern, occurring in shaded, moist sites, on old (mangrove) trees and steep, moist riverbanks, at altitudes of 0-800 m. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Brunei, Malaysia (Peninsular and Sarawak) and Indonesia (Sumatra, Java, Borneo, the Moluccas).

Abundance : Relatively common.

Use(s) : Unknown.

Source of illustration : Holttum (1978).

References : Backer & Posthumus (1939), Holttum (1978).

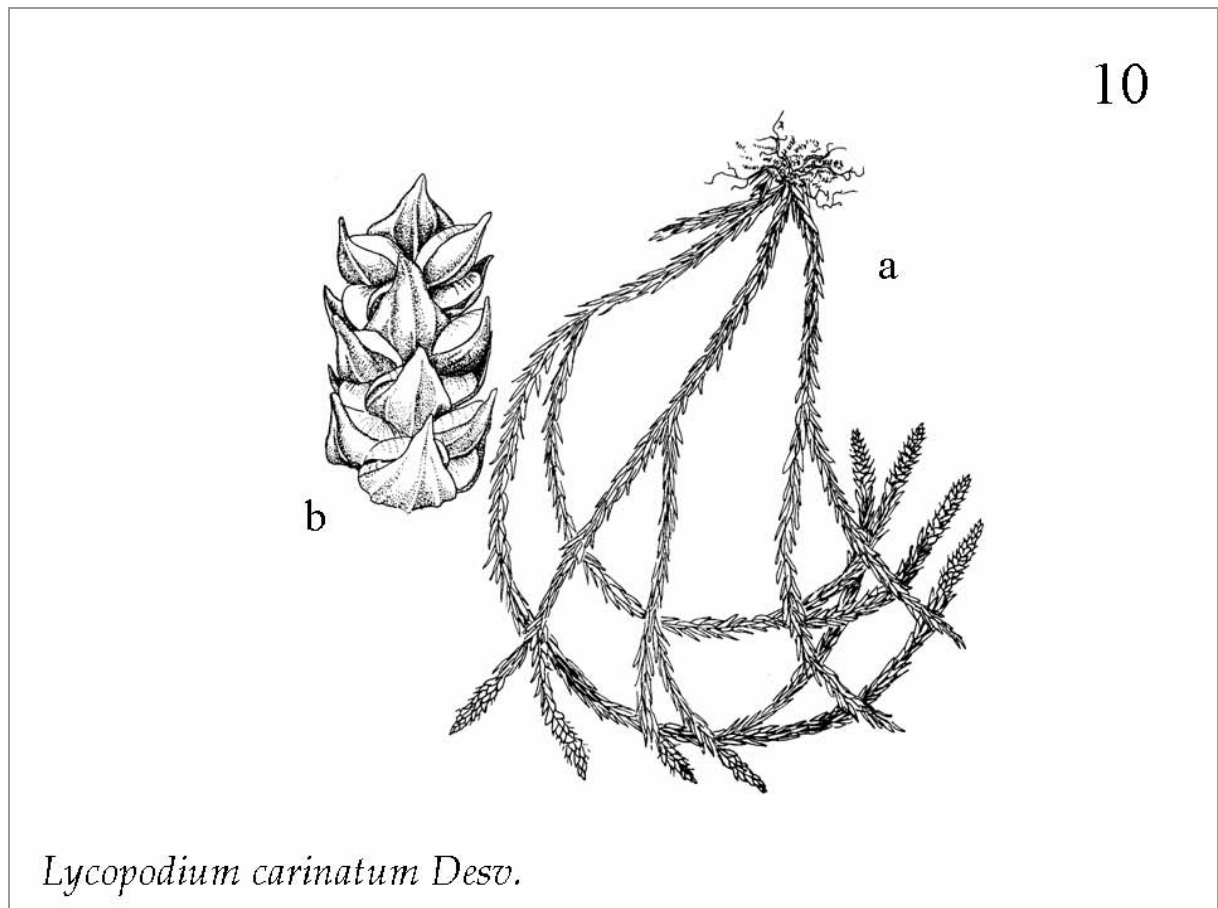


Fig. 10. *Lycopodium carinatum* Desv. (a) Habit, and (b) detail of spore-bearing end of leaflet.

LYCOPODIACEAE

10

***Lycopodium carinatum* Desv.**

Synonyms: *Huperzia carinata* (Desv. ex Poir.) Trevis., *Lycopodium laxum* Spring., *Phlegmariurus carinatus* (Desv.) Ching., *Urostachys carinatus* (Desv.) Herter ex Nesse.

Vernacular name(s): Wolfsklauw (NL), Kumpai Lubang – *Paku kawat* (Ind.)

Description: Epiphytic fern, with hanging, 0.1-1 m-long, dichotomously branching stems. Leaves are closely, spirally arranged in groups of three, more or less concave, or flat with a slight keel on the lower side, 6-19 mm long. Sori (bearing the spores) occur in terminal spikes that may be up to 25 cm long.

Ecology: Epiphyte, growing from sea level up to an altitude of 1,000 m, on trunks of trees, both in natural forests such as mangroves, and in cultivated areas. Mangrove associate species.

Distribution: Pan-tropical species, found throughout Southeast Asia.

Abundance: Common.

Use(s): Planted as an ornamental. People in Java have been reported to use an extract of the plant to stimulate hair growth. Reportedly difficult to propagate artificially.

Source of illustration : Sastrapradja *et al.* (1979)

Reference(s): Backer & Posthumus (1939), Heyne (1950), Sastrapradja *et al.* (1979)

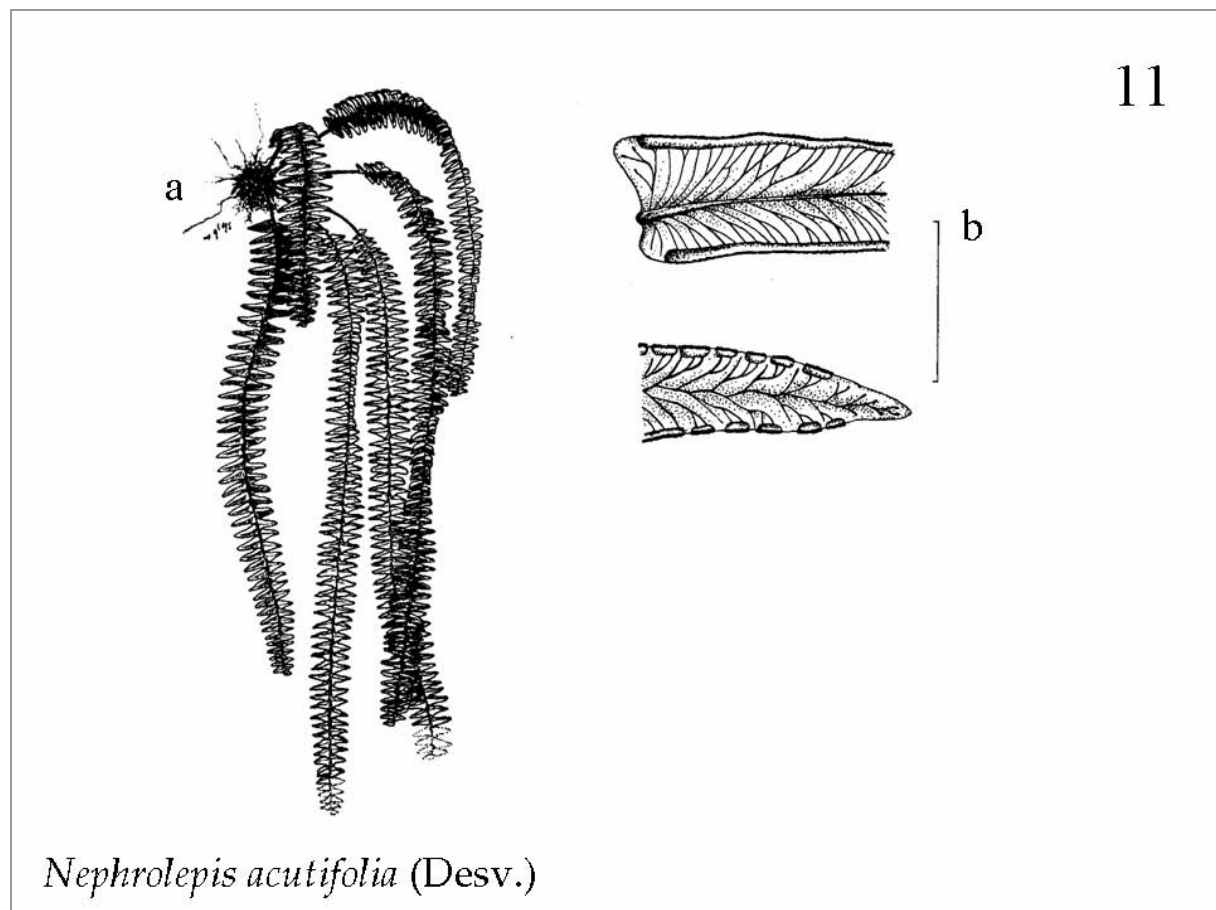


Fig. 11. *Nephrolepis acutifolia* (Desv.) H. Christ. (a) Habit and (b) detail of fertile leaflet.

NEPHROLEPIDACEAE

11

***Nephrolepis acutifolia* (Desv.) H. Christ.**

Synonyms : *Isoloma lanuginosa* Sm., *Lindsaya acutifolia* Desv., *Lindsaya lanuginosa* Wall. ex Hook.

Vernacular name(s) : Unknown.

Descriptions : Epiphytic fern. The rhizome is long, and creeps along on tree trunks. It has a dense tuft of leaves and a compact, scaly tip. It is covered with dark brown scales and has short hairs along the edges, especially at the base. Leaf stalks are up to 30 cm long and are densely scaly when young. Leaves bear leaflets at the base, and have a densely scaly midrib with very narrow, hair-like scales. The leaf blade is up to 100 cm or more long and 12 cm wide. Leaflets are very numerous and inserted at right angles to the midrib. Fertile leaves are much narrower than the sterile ones, and are densely covered with brown hairs on both surfaces when young. Later they are more or less smooth on the upper surface. Fertile leaflets measure up to about 7 by 1 cm, and are relatively more widened and equal at the base than sterile leaflets. Sterile leaflets measure up to about 6 by 1.5 cm, and have a slightly leathery texture. Leaf veins are usually once-forked. The sori (containing the spores) are located in the continuous groove along the underside of the margins of the leaflets. Towards the end of the leaf, the sori may end abruptly.

Ecology : An epiphyte on old trees, especially on mangroves, but it may also occasionally be found on oil palm. In Indonesia it is rarely recorded outside coastal areas, although it has once been recorded at 200 m above sea level. Spores are formed all year round. Mangrove associate species.

Distribution : Found from Tropical Africa through Southeast Asia to northern Australia (Northern Territory, Queensland) and Polynesia. In Southeast Asia recorded in Thailand, Cambodia, Vietnam, Malaysia, Indonesia (Java, Borneo).

Abundance : Locally common, but reportedly rare in Indonesia (once found in West Java in the early 1800s; further collected in Central Java [Nusa Kambangan] and Kutai, East Borneo).

Use(s) : Unknown.

Source of illustration : Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966), Piggott (1988), Missouri Botanical garden TROPICOS database (<http://mobot.mobot.org/>, <http://www.mekonginfo.org/>, <http://www23.brinkster.com/fernsiam/Nephrolepidaceae/Neph.html>, <http://www.anbg.gov.au/apni/apniN.html>;

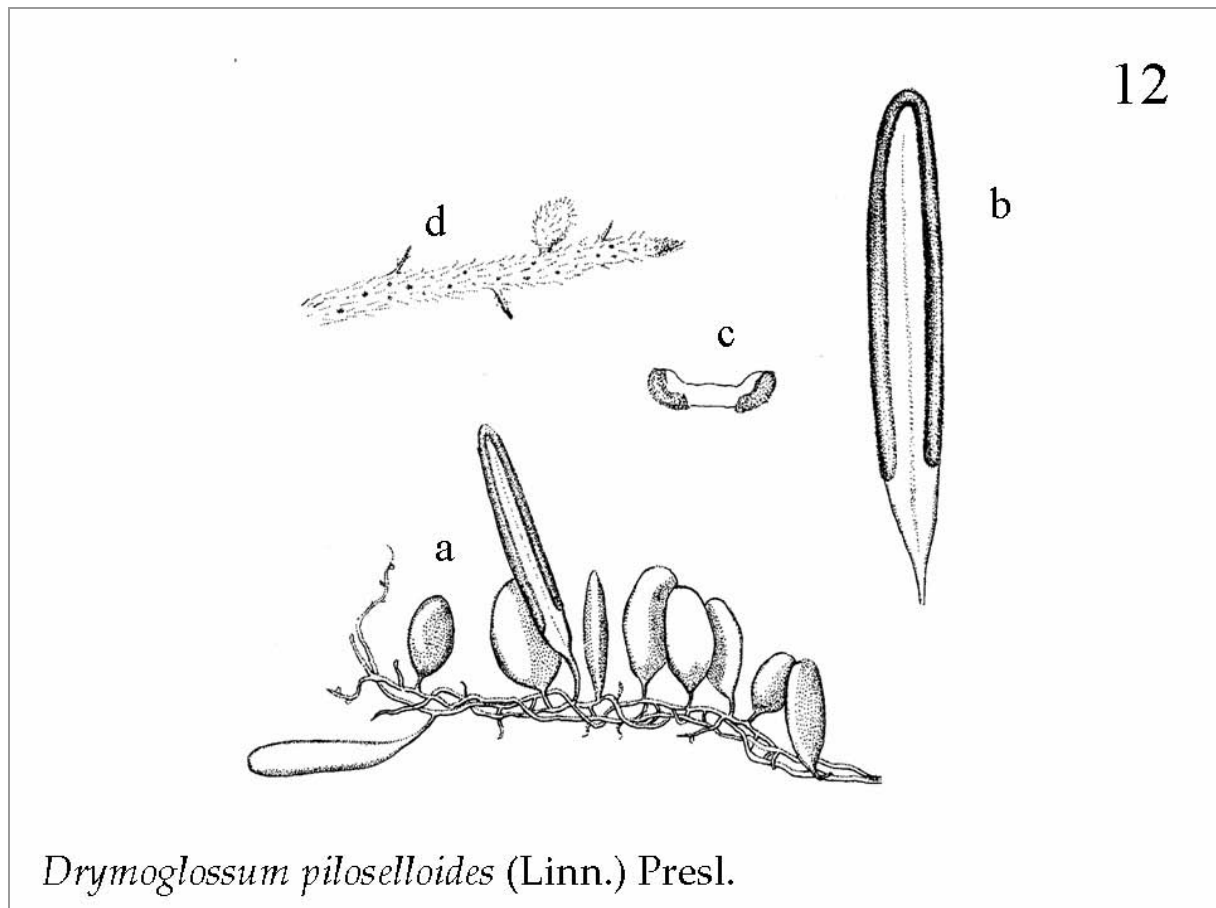


Fig. 12. *Drymoglossum piloselloides* (Linn.) Presl. (a) Habit, with sterile and fertile leaves, (b) fertile leaf, with sporangia along the leaf margins, (c) cross-section of leaf showing the position of the sporangia, and (d) detail of tip of rhizome.

POLYPODIACEAE

12

***Drymoglossum piloselloides* (Linn.) Presl.**

Synonyms : *Acrostichum heterophyllum* L., *Drymoglossum heterophyllum* C. Chr., *Notochlaena piloselloides* Kaulf., *Oetosis piloselloides* O.K., *Pteris piloselloides* O.K., *Taenites piloselloides* R. Br.

Vernacular name(s) : Duitvaren, Duiteblad (NL), Sakat ribu-ribu, Daun seberneh panjang, Sisek naga (Mal.), Pakis Duitan, Pijisan, Sakat Ribu-ribu – *Sisik Naga* (Ind.)

Description : Small epiphyte. Rhizome is long and creeping, with a diameter of barely 1 mm and is covered with small, almost round or heart-shaped scales. Scales have a dark centre and paler edges, with relatively long hairs that are white when very young, but soon turn brown. Leaves are simple and entire. Sterile leaves are without stalks, nearly circular, and about 1 cm across. Occasionally they are broadly elliptic. Sterile leaves are very fleshy and have a smooth surface. Fertile leaves are very different from the sterile ones. They have a stalk of about 1 cm length and are elongated, measuring 3-12 cm by 5-8 mm. Sometimes the ends of the fertile leaves are branching. The sori (containing the spores) are arranged in a broad band along the edge of the leaf that may be about 2.5 mm wide when mature.

Ecology : One of the commonest epiphytic ferns in the lowlands of Southeast Asia. It occurs everywhere on old trees including those in the mangroves. Found in fairly exposed places, including gardens, from sea level up to an altitude of about 1,000 m. Mangrove associate species.

Distribution : From Northeastern India, throughout Southeast Asia to Papua New Guinea and northern Australia.

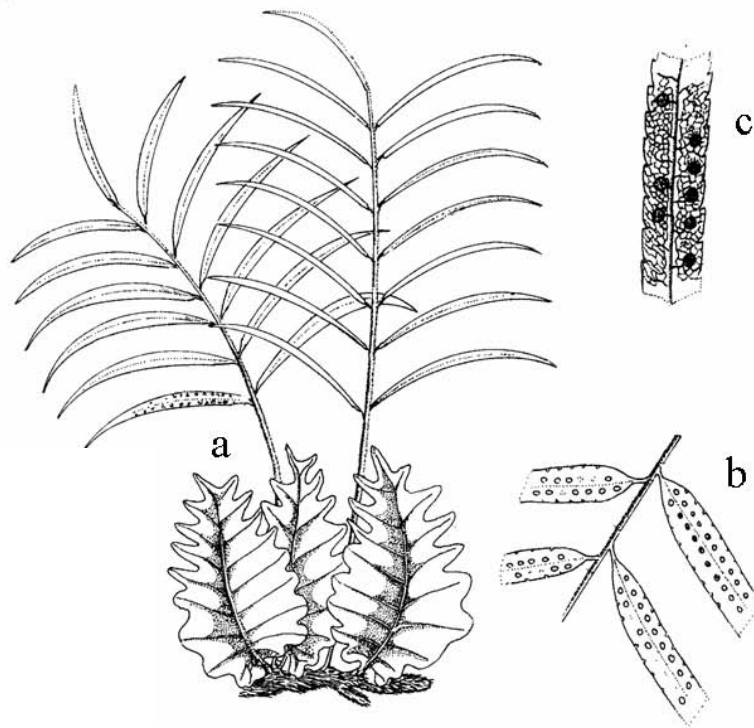
Abundance : Very common.

Use(s) : Leaves pounded with gypsum may be applied to irritating rashes, whilst a decoction is used in a lotion for smallpox. This species is also used as a poultice for headaches.

Source of illustration : Drawn from live specimen.

References : Backer & Posthumus (1939), Heyne (1950), Holttum (1966), Piggott (1988)

13



Drynaria rigidula (Sw.) Bedd.

Fig. 13. *Drynaria rigidula* (Sw.) Bedd. (a) Habit, depicting sterile leaves at the base, and fertile leaves emerging, (b) detail of fertile leaf showing (part of) four fertile leaflets, and (c) detail of a single fertile leaflet showing the sporangia.

POLYPODIACEAE

13

***Drynaria rigidula* (Sw.) Bedd.**

Synonyms : *Goniophlebium rigidulum* Moore, *Polypodium diversifolium* R. Br., *Polypodium gaudichaudi* Bory., *Polypodium rigidulum* Sw, *Polypodium rigidum*, *Polypodium speciosum* Bl.

Vernacular name(s) : Bird's nest fern, Oak-leaf fern (E), Eikebladvaren (NL), Paku Kayakas, Simbar Layangan – *Pasilan kelapa* (Ind.)

Description : Epiphytic bird's-nest fern, with two distinct types of leaf: short-stemmed oak leaf-like 'nest' leaves and long-stemmed fertile leaves that bear leaflets. The rhizome creeps and is about 1 cm in diameter. It is densely covered with 7 mm-long scales that are reddish-brown, rather thin, and narrowed gradually from the dark, heart-shaped base. Nest-leaves measure 15-30 by 7-10 cm, tapering to the top, and lobed about half-way to the midrib. Lobes are usually about 1 cm wide, are tapering and sometimes pointed. The whole nest-leaf is covered with star-shaped hairs when young. Fertile leaves may be up to 200 cm or more long, and bear leaflets throughout their entire length. The leaf stalk is about 30 cm long. Leaflets are usually about 15 cm by 8-12 mm. However, they may be up to 25 cm long, and if the leaflet is sterile (occasionally the case on a fertile leaf) it may be more than 2 cm wide. Sori (containing the spores) are solitary, and located between adjacent main veins, usually nearer the midrib than the edge, at a junction of veins. The sorus is located in a small depression, and appears as a small, round lump on the upper surface.

Ecology : Common epiphyte on old trees, occurring from lowland hills to lower mountains, from sea level up to about 800 m. Also occurs in mangroves. The rhizome creeps more or less horizontally, and often completely surrounds the trunk of the tree, forming a cup-shaped depression. Prefers sunny to moderately shaded sites. Rarely occurs on the ground. Mangrove associate species.

Distribution : Occurs from Southeast Asia to Polynesia (Fiji) and Australia. In Southeast Asia it has been recorded from Malaysia, Thailand, Indonesia (throughout) and Papua New Guinea.

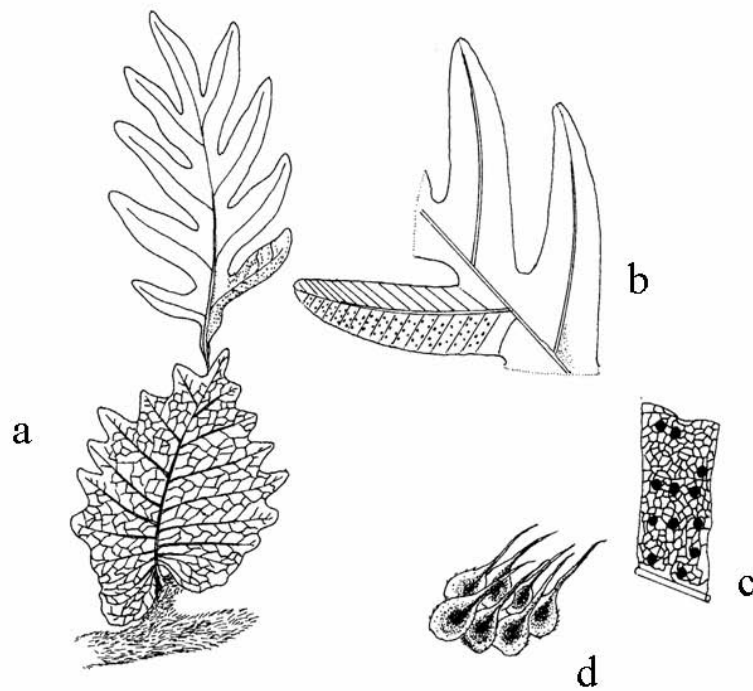
Abundance : Locally common.

Use(s) : In Java the rhizome of this plant is known as 'pasilan kelapa', a traditional medicine.

Source of illustration : Sastrapradja *et al.* (1979), Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966),
<http://www.fernfactory.com/shop/mixed/drynaria.asp>
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

14



Drynaria sparsisora (Desv.) Moore.

Fig. 14. *Drynaria sparsisora* (Desv.) Moore. (a) Habit, depicting sterile leaf at the base, and fertile leaf emerging, (b) detail of fertile leaf, (c) detail of fertile leaflet, depicting sporangia, and (d) detail of scales on rhizome.

POLYPODIACEAE

14

***Drynaria sparsisora* (Desv.) Moore**

Synonyms : *Drynaria linnaei* Bory., *Polypodium linnaei* Bory, *Polypodium sparsisorum* Desv.

Vernacular name(s) : Basket fern, Oak leaf fern (E), Eikebladvaren (NL), Akar Kusu, Paku Latig Layangan, Simbar Layangan, Simbar, Barang-barang, Lilanga – *Paku layang layang* (Ind.)

Description : Epiphytic bird's-nest fern, with two distinct types of leaf: erect nest leaves and fertile foliage leaves. The rhizome is fleshy, creeping and scaly. Scales have a broad base and a stiff, narrow point that soon breaks off from the base so that old rhizomes appear to have almost round scales. Nest leaves are up to about 20 cm long, with many, sometimes rather pointed lobes. Foliage leaves are stiff and leathery, up to about 70 cm long including the stalk, and deeply lobed up to 1 cm from the central vein. Sori (containing the spores) are small and numerous, occurring in irregular rows at the junction of veins, often with some sori irregularly placed between the rows. Closely resembles *Drynaria quercifolia*, but the whole plant is usually smaller.

Ecology : Occurs in old trees in the lowlands, and can probably tolerate exposed places. Also common in mangroves. Mangrove associate species.

Distribution : From Sri Lanka, through Southeast Asia to Malaysia to Polynesia and tropical Australia. In Southeast Asia it is recorded from Malaysia, Thailand, Singapore, Indonesia and Papua New Guinea.

Abundance : Common.

Use(s) : An extract of the rhizome is used to treat eye infections. Mixed with other plants it is used to cure many diseases, including gonorrhoea.

Source of illustration : Sastrapradja *et al.* (1979), Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966), Johnson (1977)
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

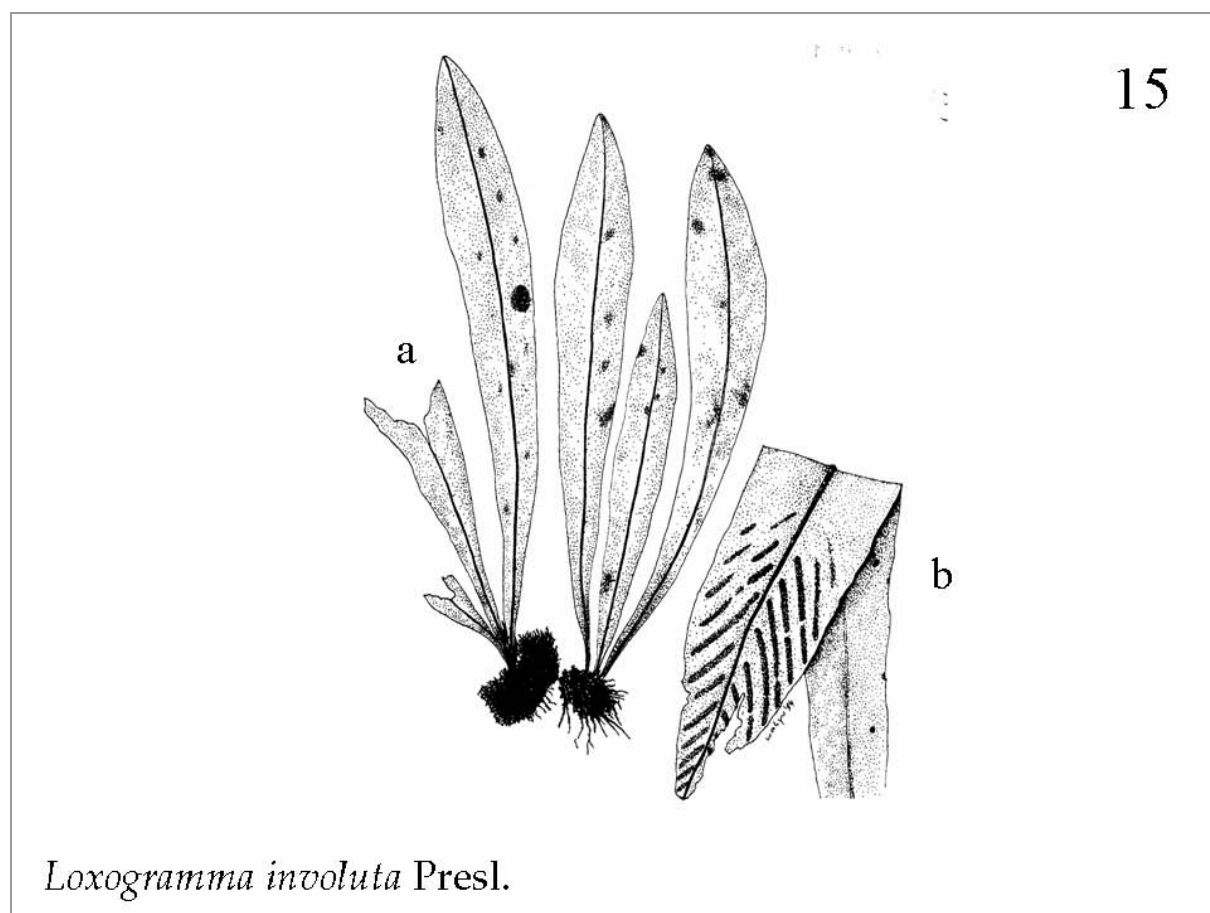


Fig. 15. *Loxogramma involuta* Presl. (a) Habit, and (b) detail of fertile leaf, showing sporangia.

POLYPODIACEAE

15

***Loxogramma involuta* Presl.**

Synonyms : *Antrophyum involutum* Bl., *Grammitis involuta* Don., *Gymnogramma involuta* Hook., *Polypodium scolopendrinum* C. Chr.

Vernacular name(s) : Unknown.

Description : Epiphytic fern, 15-50 cm, with a creeping rhizome that is covered with large, brown, lanceolate scales. Leaf stalks are short and thick. Leaves are entire, lanceolate, with a pointed tip and a wedge-shaped base, 15-75 by 2-10 cm. They are thick, leathery, and have a smooth surface. The midrib is broad and flat on the upper leaf surface, while it is prominent and has a keel on the lower surface. Sori (containing the spores) occur in lines that extend, at an angle, from the midrib to the edge of the leaf.

Ecology : Occurs in mangroves and inland forests, including low hills, and prefers places with sufficient shade. Leaf margins roll up during dry spells. Mangrove associate species.

Distribution: Limited to Indonesia, where it is reported to occur in Sumatra and Java. Bogor Herbarium has specimens from Java, the Lesser Sundas, Sumatra and the Moluccas.

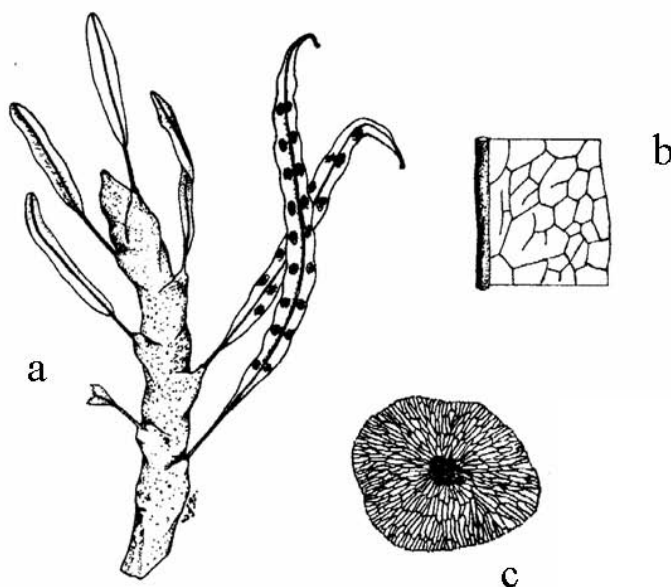
Abundance : Unknown.

Use(s): Leaves are smoked with tobacco (reported for Sumatra in 1927).

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s): Burkill (1935), Backer & Posthumus (1939)

16



Myrmecophila sinuosa (Wall. ex Hook.) Nakai ex Hito.

Fig. 16. *Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito. (a) Habit, with fertile and sterile leaves, (b) detail of leaf venation, and (c) detail of rhizome scale.

POLYPODIACEAE

16

***Myrmecophila sinuosa* (Wall. ex Hook.) Nakai ex Hito**

Synonyms : *Lecanopteris sinuosa* Copel., *Phymatodes sinuosa* (Wall.) J. Sm., *Phymatodes sinuosa* Wall. ex Hook., *Pleopeltis sinuosa* (Wall. ex Hook.) Bedd., *Polypodium sinuosum* Wall. ex Hook.

Vernacular name(s) : Pakis sarang semut (Mal., Ind.)

Description : Epiphytic fern, with simple leaves. The rhizome is usually 1-1.5 cm in diameter, fleshy, hollow and ant-inhabited. It bears two rows of leaves, attached to swollen conical bases that are about 1 cm high and 1-2 cm apart. The whole rhizome and stalk-bases are covered with scales that are almost circular, 1-3 mm in diameter, pale with a dark centre. Leaf stalks are about 2-7 cm long. Leaves are simple, about 15-30 cm by 1.5-2.5 cm, with a very narrow base and a rounded tip. Leaf edges are thickened, smooth, and wavy-indentated. Each indentation is located next to a sorus (containing the spores). Sterile leaves are often shorter than the fertile ones. Sori are large and occur in a single row on each side of the midrib. This is usually about half-way or slightly closer to the leaf edge, sunken in sharply defined but shallow, elliptic depressions that are up to 3-5 mm wide. These are most conspicuous on the upper surface.

Ecology : One of Southeast Asia's most unusual ferns, and intriguing because of its close association with ants that dwell in the hollow rhizome. The species found are most commonly *Crematogaster deformis*, *Crematogaster yappii*, *Iridomyrmex cordatus* (= *Iridomyrmex myrmecodiae*) or *Technomyrmex albigaster* (Hölldobler & Wilson, 1990). It is often accompanied by other ant-plants. A typical lowland plant (though occasionally reported up to 1000 m asl), occurring on trees in moderately exposed places and usually not in densely shaded spots. Mangrove associate species.

Distribution : Found from Thailand and Malaysia through Indonesia – where it is found throughout – to Papua New Guinea, the New Hebrides and the Solomon Islands.

Abundance : Common.

Use(s) : Unknown.

Source of illustration : Backer & Posthumus (1939).

References : Backer & Posthumus (1939), Holttum (1966),
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

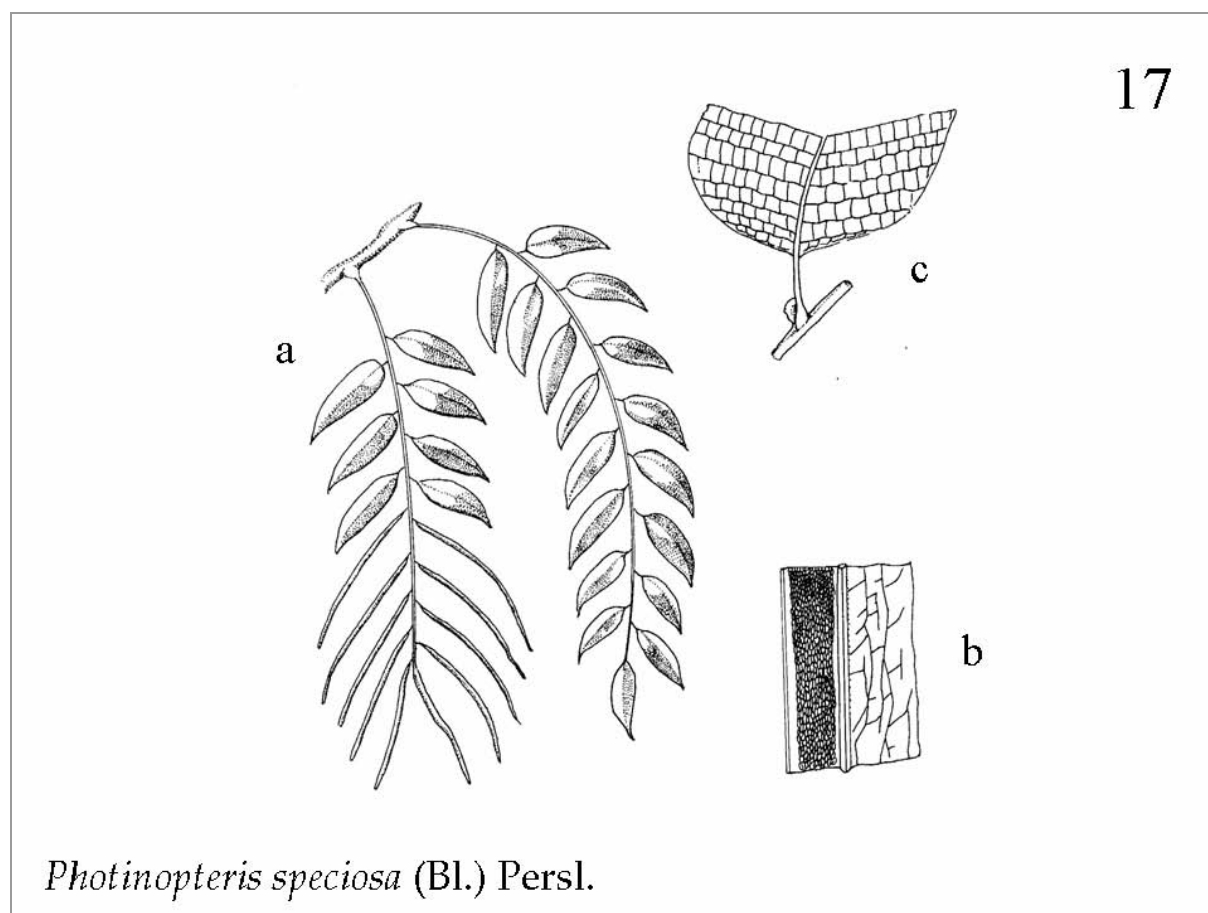


Fig. 17. *Photinopteris speciosa* (Bl.) Persl. (a) Habit, with fertile (terminal) and sterile leaves, (b) detail of fertile leaf, showing sporangia, and (c) detail of leaf venation.

POLYPODIACEAE

17

***Photinopteris speciosa* (Bl.) Persl.**

Synonyms : *Acrostichum lineare* Hassk., *Acrostichum rigidum* Wall., *Dryostachyum speciosum* Kuhn, *Lomaria mollis* Zoll, *Lomaria speciosa* Bl., *Photinopteris acuminata* (Willd.) C.V. Morton, *Photinopteris horsfieldii* J. Sm., *Photinopteris rigida* Bedd.

Vernacular name(s) : Unknown.

Description : Epiphytic fern. The rhizome is thick, long and creeping, 1 cm or more in diameter. When the plant is young the rhizome is green, but later it is bluish-green or white, and scaly. Scales are narrow, about 8 mm long, thin, transparent when young, dull brown when old, and with many short hairs along the edges. Leaves are large, up to about 70 cm long, with many leaflets. Leaf stalks are 12-30 cm or more long, bearing small, flattened appendages similarly spaced as the leaflets. The sterile leaf has up to about 10 pairs of leaflets, 10-4.5 cm by 25-10 cm, more or less ovate and with a similar terminal leaflet. In exposed places, leaflets have white spots on the upper surface. In fertile leaves, the top part bears more closely-spaced and more numerous fertile leaflets. Fertile leaflets are 10-25 cm long and are up to about 6 mm wide. The lower surface is covered with sori (bearing the spores), except for the midrib and a narrow band near the edge.

Ecology : Occurs in mature mangroves and along rivers, from sea level up to an altitude of about 1,500 m. Usually occurs in partially shaded or in open situations, including exposed places on rocks. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Cambodia, Vietnam, Thailand, Malaysia, and the Philippines, throughout Indonesia, and in Papua New Guinea.

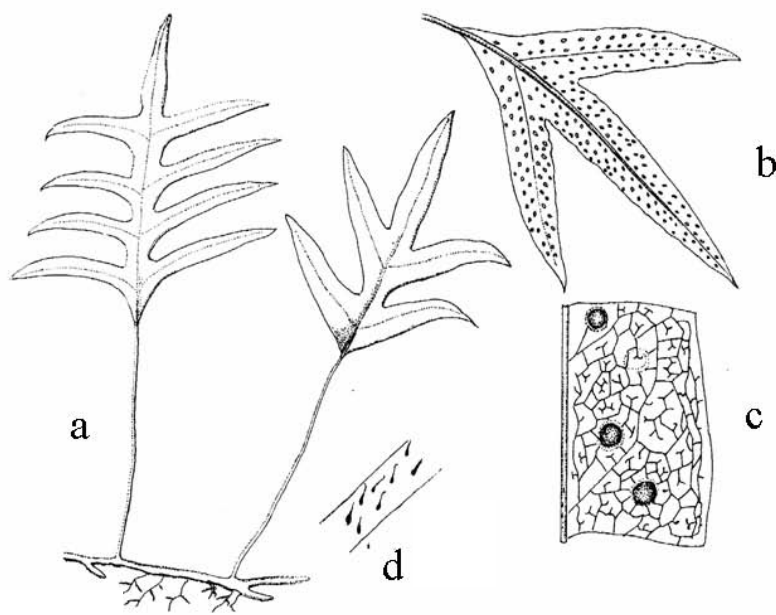
Abundance : Probably common.

Use(s) : Unknown.

Source of illustration : Piggott (1988).

References : Holttum (1966), Piggott (1988),
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

18



Phymatodes scolopendria (Burm.) Ching.

Fig. 18. *Phymatodes scolopendria* (Burm.) Ching. (a) Habit, (b) detail of fertile leaf, showing sporangia underneath, (c) detail of leaf section and sporangia, and (d) detail of hairs on rhizome.

POLYPODIACEAE**18*****Phymatodes scolopendria* (Burm.) Ching.**

Synonyms : *Phymatodes vulgare* Presl., *Phymatosorus scolopendria* (Burm.) Pichi Serm., *Pleopeltis phymatodes* Moore, *Polypodium forbesii* v.A.a.R., *Polypodium phymatodes* L., *Polypodium scolopendria* Burm.

Vernacular name(s) : Paku Wanggi, Sakat Hitam (Mal.), Paku Ular, Paku Cacing (Ind.)

Descriptions : Epiphytic fern. It has a long, creeping rhizome that measures up to about 7 mm diameter, is fleshy green and bears scattered, very dark brown scales. The latter have a length of 3-4 mm, and edges that are finely toothed in the narrow part. Simple, lobed leaves occur up to about 5 cm apart on leaf stalks that are smooth and up to about 30 cm long. Leaves are light green and thinly leathery, up to about 40 cm long and deeply lobed (to 1-2 cm from midrib), with 1-4 (rarely more) pairs of lobes. Leaf edges are smooth, and veins are not raised but are visible when the frond is held up to the light. Sori (containing the spores) usually occur in two (1-3) irregular rows on either side of midrib of each lobe. They sometimes also occur on the wing on either side of midrib of the leaf. Sori are round or somewhat elliptic, 3-4 mm across, and a ripe sorus is orange-yellow.

Ecology : Occurs on old trees, including mangroves, clumps of bamboo, and on palms in plantations. Sometimes it may also occur on rocks and on the ground in open places, withstanding exposure to full sunlight. Mangrove associate species.

Distribution : From tropical Africa through Sri Lanka, Southeast Asia, southern China to Polynesia and Australia. Occurs throughout Southeast Asia.

Abundance : Very common.

Use(s) : The leaves contain 'coumarin', a fragrance that has been used to perfume clothes and to scent coconut oil. Planted as an ornamental fern. The rhizome can be used to treat gecko bites and to accelerate childbirth.

Source of illustration : Based on Holttum (1966) and Piggott (1988).

References : Backer & Posthumus (1939), Heyne (1950), Holttum (1966), Piggott (1988).

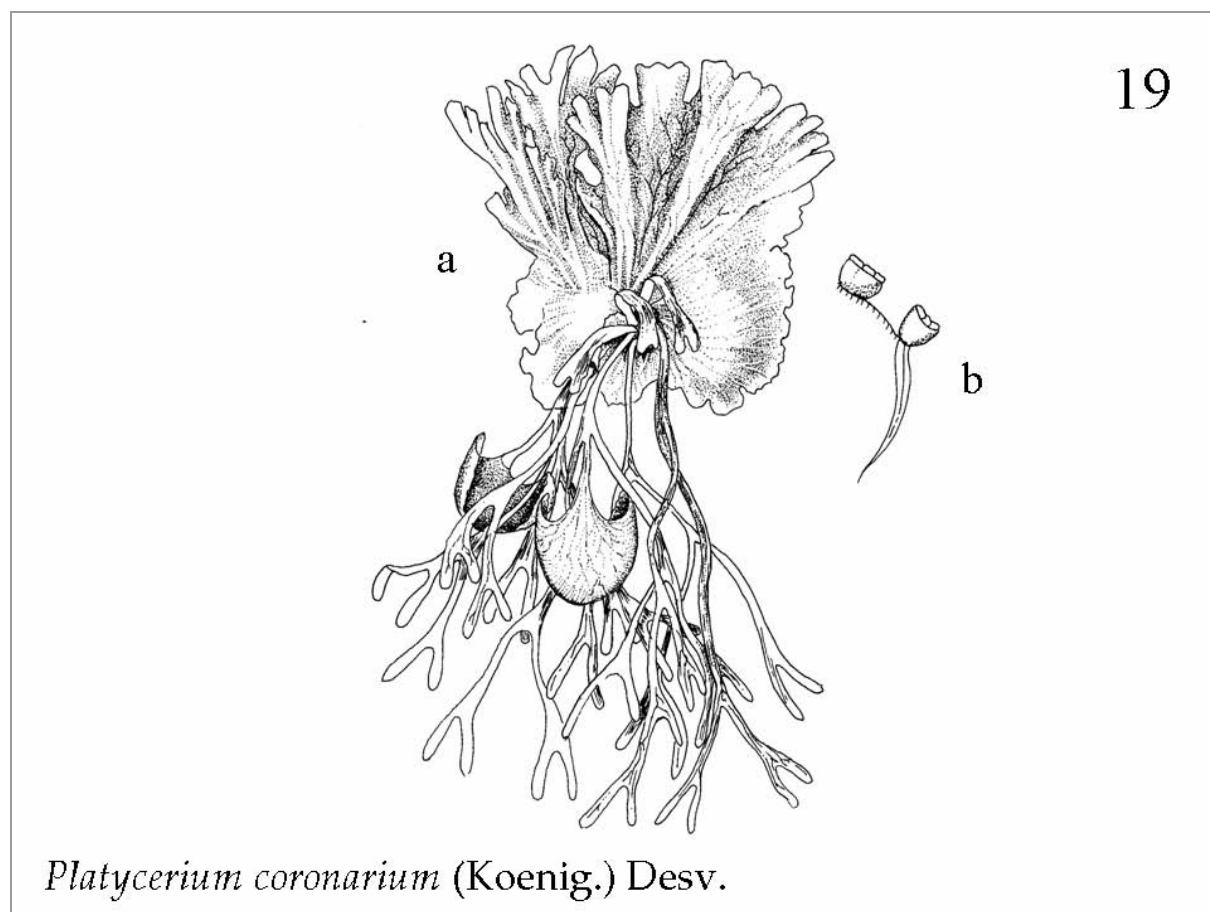


Fig. 19. *Platycerium coronarium* (Koenig.) Desv. (a) Habit, and (b) detail of two sporangia, viewed from one side.

POLYPODIACEAE

19

***Platycerium coronarium* (Koenig.) Desv.**

Synonyms : *Acrostichum biforme* Sw., *Neuroplatyceros biformis* Fée., *Osmunda coronaria* J. König, *Platycerium biforme* (Sw.) Blume

Vernacular name(s) : Stag's Horn Fern (E), Semun bidadari (Mal.), Pakis Menjangan, Pakis Tanduk Rusa – *Simbar menjangan* (Ind.)

Description : Epiphyte with a short, fleshy-branched rhizome that, together with the roots, is covered by 'nest-leaves'. Young parts of the rhizome are covered with broad scales. There are two kinds of leaves: sterile nest-leaves and fertile leaves. The nest-leaves are erect when living, with free upper edges, measuring up to 60 cm or more, and are dichotomously lobed. The deepest lobes are about 25 cm deep, while the end lobes are rounded and about as wide as long. The main veins are prominent and dichotomous, and the base of the leaf is very thick and fleshy. Fertile leaves measure up to 200 cm or more, are limp and pendulous, and repeatedly dichotomous. All branches of the fertile leaves are narrow, the widest being about 4 cm across, and end lobes about 2-3 cm wide. The first three forkings are very unequal, producing a short, sterile branch on each side and a single, heart-shaped, fertile lobe in the centre. This is paired with a very long branch, which is undivided for 60 cm or more, then repeatedly dichotomous. Fertile lobes are shortly stalked, semi-circular to deeply heart-shaped, up to about 25 cm wide. All parts of young leaves are densely covered with (branched) hairs.

Ecology : Occurs on old trees in the lowlands, both on wayside and village trees. Also found on the upper branches of the tallest trees in primary forest, and in many types of lowland forest, including mangroves. Old nest-leaves are an almost-perfect litter trap, providing nutrients and storing water for this epiphytic plant. Mangrove associate species.

Distribution : Southeast Asian species, found throughout western Indonesia (Sumatra, Java, Borneo), Brunei, Singapore, Peninsular Malaysia and northwards to Thailand and Tenasserim (Myanmar).

Abundance : Locally abundant.

Use(s) : Used as ornamental plant in tropical gardens and indoors (in temperate regions), and as medicine.

Source of illustration : Sastrapradja *et al.* (1979), Piggott (1988)

References : Backer & Posthumus (1939), Holttum (1966), Said (1990), <http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

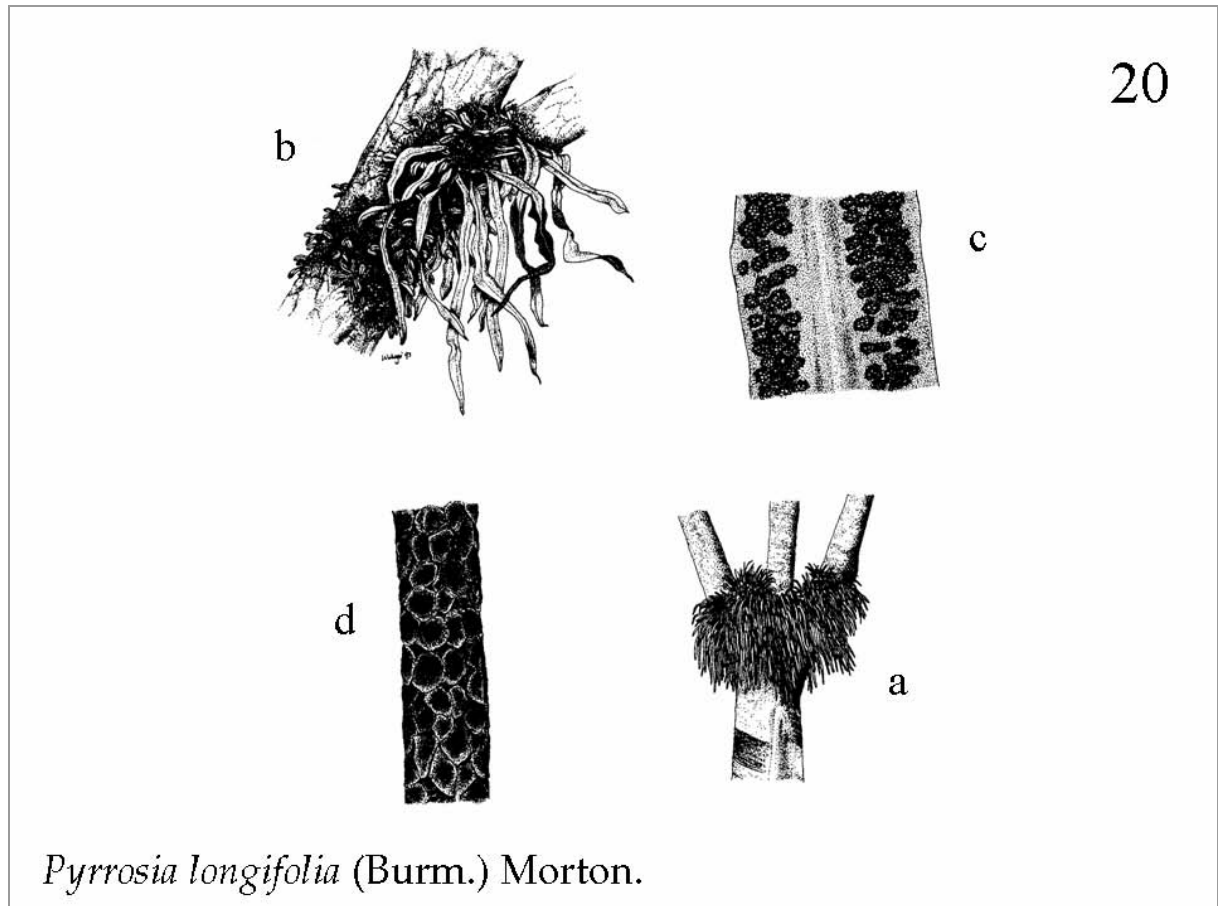


Fig. 20. *Pyrrosia longifolia* (Burm.) Morton. (a) Habit, showing dense cluster in tree, (b) habit, somewhat closer, (c) detail of underside of fertile leaf, showing sporangia, and (d) detail of rhizome showing the scales.

POLYPODIACEAE

20

***Pyrrhosia longifolia* (Burm.) Morton.**

Synonyms : *Acrostichum lanceolatum* Burm., *Acrostichum longifolium* Burm. f., *Cyclophorus acrostichoides* (G. Forst.) Presl., *Cyclophorus cinnamomeus*, *Cyclophorus longifolius* Desv., *Gyrosorium cinnamomeus*, *Gyrosorus fissum* Bak., *Niphobolus acrostichoides* (G. Forst.) A.Richt., *Niphobolus cinnamomeus*, *Niphobolus fissus* Bl., *Niphobolus longifolium* Spr., *Niphobolus puberulus* Bl., *Polypodium acrostichoides* G. Forst., *Polypodium cinnamomeus*, *Pyrrhosia acrostichoides* G. Forst.

Vernacular name(s) : Unknown.

Description : Epiphytic fern with simple, entire leaves. The rhizome is long and creeping, 2-3 mm thick and scaly throughout. Scales are usually almost round, about 1 mm diameter, almost black, and with pale, entire edges. Occasionally they may be twice as long as broad. Leaf stalks are up to about 10 cm long, gradually broadening into the narrow base of the leaf blade. Leaves are usually 20-60 cm long, sometimes up to 120 cm, 1-2(-2.5) cm wide in the sterile basal part. The fertile part towards the end of the leaf is usually narrower, and rarely more than 1 cm wide. Leaves are very fleshy, about 1 mm thick, with an upper surface that is smooth and hairless. The lower surface is covered with a thin layer of grey, star-shaped hairs. The midrib is grooved above and strongly raised below. Sori (containing the spores) are very compact, less than 1 mm in diameter, and covering the whole lower surface in the upper part of the leaves. They occur in about 4-8 irregular rows between midrib and leaf edge.

Ecology : Growing on old trees in open places, or in the crowns of forest trees, including mangroves. Never occurs in very shaded sites. Also found in rubber plantations. Occurs up to an altitude of 600 m. In Java it is found growing on *Heritiera littoralis*. Small plants in very exposed places may have stiff leaves, but are recognizable at once by the round rhizome-scales. Mangrove associate species.

Distribution : From Thailand and Peninsular Malaysia to northern Australia (Queensland), Papua New Guinea and Polynesia. Occurs throughout Indonesia.

Abundance : Very common.

Use(s) : Concoctions from plants pounded in cold water are administered to ease labour pains in childbirth.

Source of illustration : Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966), Piggott (1988), Hennipman (pers. comm. 1994), <http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

21



Selliginea heterocarpa Blume.

Fig. 21. *Selliginea heterocarpa* Blume. (a) Habit, showing fertile (left) and sterile (right) leaves, and (b) detail of two rhizome scales.

POLYPODIACEAE**21*****Selliguea heterocarpa* Blume**

Synonyms : *Grammitis heterocarpa* Bl., *Gymnogramma heterocarpa* Bl., *Pleopeltis heterocarpa* v.A.bv. R., *Pleopeltis schoutenii* v.A.v.R., *Polypodium heterocarpum* Mett., *Polypodium mettenianum* Cesati, *Polypodium schoutenii* v.A.v.R., *Selliguea feei* Bory, *Selliguea metteniana* var. *lateritium* (Baker) Tardieu & C.Chr.

Vernacular name(s) : Unknown.

Description : Epiphytic, creeping fern, measuring 20-50 cm. Rhizomes are about 2 mm in diameter, bearing fronds about 5-10 mm apart. The younger parts are often densely covered with scales that are reddish-brown, stiff and almost bristle-like. They are about 6 mm long and are abruptly narrowed above the base, where the scale is less than 1 mm wide. Leaf stalks are slender, 5-25 cm long, being longest in sterile leaves. Leaves are simple, with an entire edge, and very variable in shape and size. Sterile leaves are usually shorter and proportionally broader than the fertile ones. Sterile leaves measure about 6 by 2-5 cm to 14 by 8-5 cm, are ovate to elliptic, shortly pointed or rounded at the tip. They are thinly leathery, have thickened edges and a glossy surface, with main lateral veins raised on both surfaces. The fertile leaves are about 7 by 1 cm to 15 by 5 cm, evenly elliptic or widest near the base, usually with a pointed tip. Leaf texture and venation is as with the sterile fronds. The sori (containing the spores) are linear and occur in single lines between adjacent main veins. These lines are sometimes interrupted, and do not reach the midrib or edge. When mature, the sori are about 2 mm wide, occurring in a rather shallow groove that appears as a low ridge on the upper surface.

Ecology : Common in lowlands to about 1,700 m. Especially occurring on old mangrove trees or on trees along rivers. Plants sometimes grow on rocks or on the ground. In Java most commonly recorded from 800-1,700 m. Mangrove associate species.

Distribution : Southeast Asian species, found in Thailand, Peninsular Malaysia and Indonesia (Sumatra, Java).

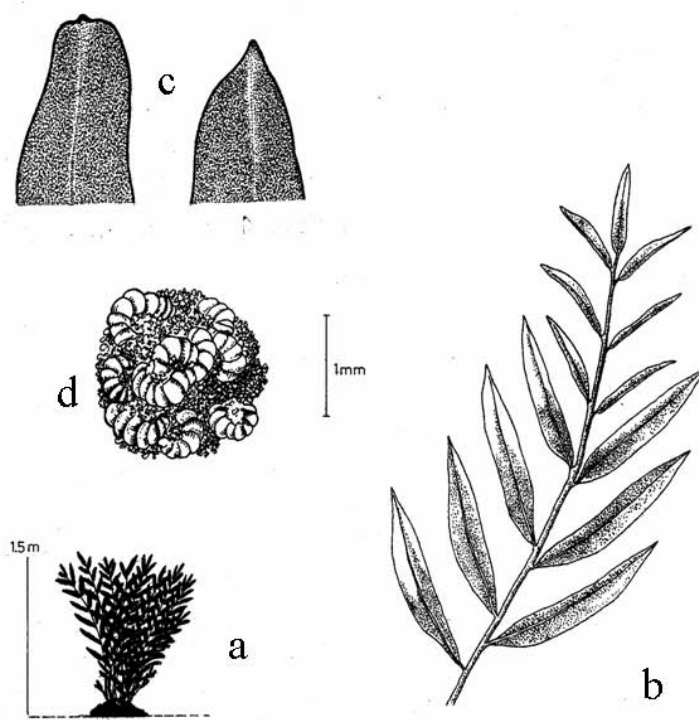
Abundance : Common.

Use(s) : Unknown.

Source of illustration : Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966),
<http://www.forest.go.th/Botany/Flora/Pteridophytes.htm>

22



Acrostichum aureum Linné.

Fig. 22. *Acrostichum aureum* Linné. (a) Habit, (b) detail of leaf frond, (c) detail of leaf tip, with left *A. aureum* and right *A. speciosum*, and (d) detail of sporangia.

PTERIDACEAE

22

***Acrostichum aureum* Linné**

Synonym : *Acrostichum inaequale* Willd., *Acrostichum obliquum* Blume, *Acrostichum spectabile* Zoll., *Chrysodium aureum* Mett., *Chrysodium inaequale* Fée., *Chrysodium vulgare* Fée.

Vernacular name (s) : Mangrove fern (E), Mangrove Varen (NL), Piai Raya (Mal.), Hata Diuk, Paku Tjaj, Kala Keok, Wikakas, Krakas, Wrekas, Paku Laut – *Paku hata* (Ind.), Ráng (Viet.), Brong (Camb.), Prong thale (Thai)

Description : Large, clump-forming terrestrial fern, up to 4 m tall. Stems are stout and erect, covered with large scales. They are thickened towards the base, dark brown with a broad, pale, thin margin, mixed with narrow, thin scales. The very distinctive, tall leaves are 1-3 m long, but do not have more than 30 leaflets. The latter may be spaced far apart and are often irregularly distributed. The lowest leaflets are always widely spaced, with long stalks that measure up to 3 cm. The tops of fertile leaves are rusty-brown coloured, later turning dark brown. The undersides of these 10-20 topmost leaflets are uniformly covered with large sporangia. Tips of the longer, sterile leaflets are abruptly rounded or blunt, with a short tip. Spines (= midrib of shed leaflet) are frequent and black. Leaf venation is net-like. The broad scales, up to 1 cm long, are restricted to the base of the fronds; they have a thickened middle, an entire edge and leave no prominent scar. Spores are large and have a tetrahedral shape. The species is often confused with the closely related *Acrostichum speciosum*. In general, *Acrostichum aureum* is taller than *Acrostichum speciosum*, and the young plants are more reddish than the brownish *Acrostichum speciosum*. The easiest diagnostic feature are the leaf tips, which are generally blunt, but with a small point in *Acrostichum aureum*, and elongate-pointed in *Acrostichum speciosum* (see figure).

Ecology : Perennial and most common ground dwelling fern in mangroves, on bunds in brackish-water fish ponds (*tambak*), long brackish creeks and rivers, and drainage canals. It does not tolerate as much inundation by sea-water as *Acrostichum speciosum*, and is found on the inland side of mangroves. It often occurs in places that have been seriously disturbed, and can often be a nuisance in logged-over mangroves, as it forms dense stands that prevent forest regeneration. Unlike *Acrostichum speciosum*, it prefers bright, sunny areas. Mangrove species.

Distribution : Pan-tropical. Occurs throughout Southeast Asia.

Abundance : Locally very abundant.

Use(s) : Rhizome and old leaves are used for medicinal purposes. Leaves used for thatching and as litter for cattle. Young leaves are reportedly eaten in East Timor and Indonesia (North Sulawesi).

Source of illustration : Piggott (1988), Holttum (1954), and live material.

References : Watson (1928), Heyne (1950), Holttum (1966), Tomlinson (1986), Piggott (1988), Aksornkoae (1993), Marschke (2000)

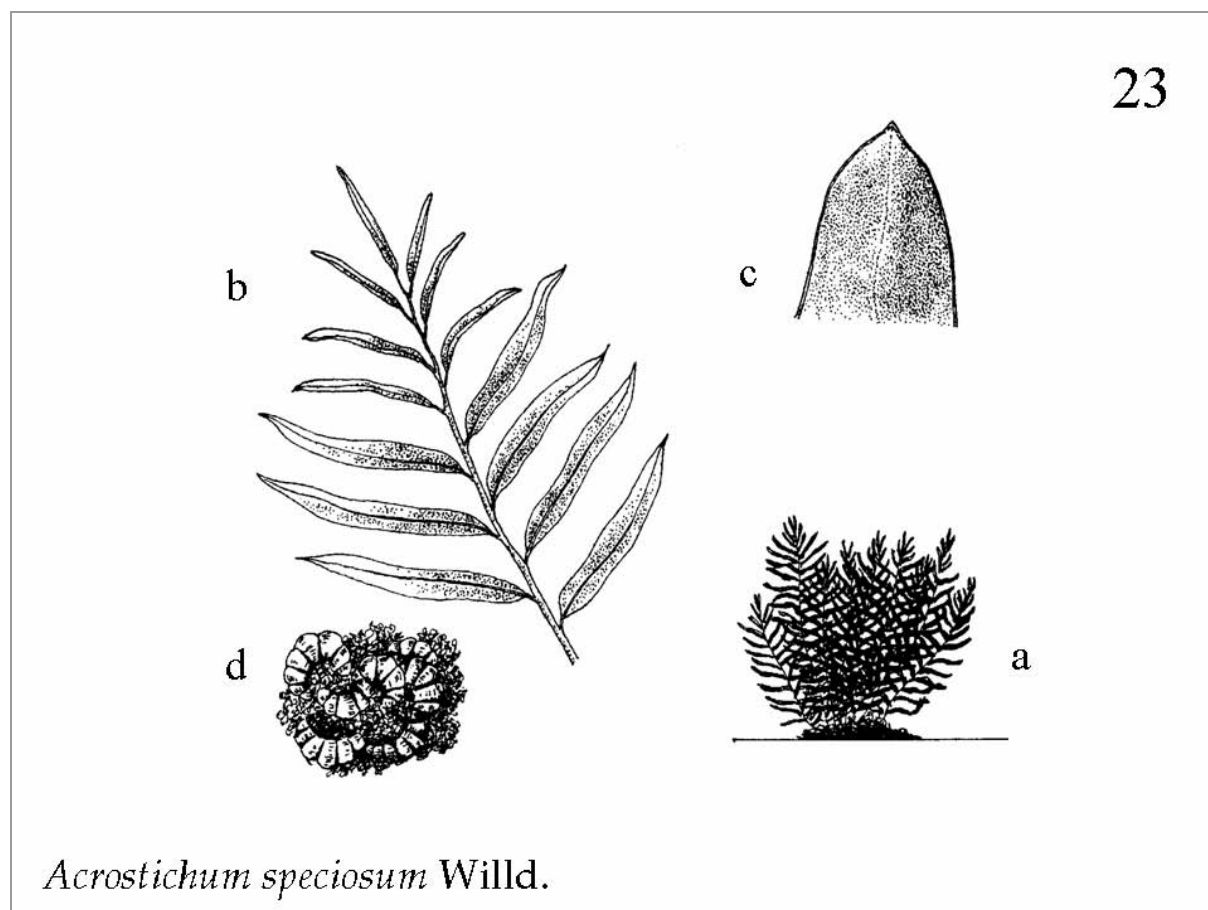


Fig. 23. *Acrostichum speciosum* Willd. (a) Habit, (b) detail of leaf frond, (c) detail of leaf tip, and (d) detail of sporangia.

PTERIDACEAE

23

***Acrostichum speciosum* Willd.**

Synonyms : *Acrostichum aureum* var. *schmidtii* (Christ) C.Chr., *Chrysodium aureum* var. *schmidtii* Christ, *Chrysodium speciosum* Fée

Vernacular name(s) : Mangrove fern (E), Piai laut (Mal.), Piai Lasa (Ind.), Brong, Khnag n (Camb.), Prong nuu (Thai)

Description : Terrestrial fern, forming coarse clumps to 1.5 m tall. Scales on the rhizome are up to about 8 mm long. The very distinctive leaves are commonly less than 1 m long and have rusty, fertile leaflets at the top. These are uniformly covered with large sporangia. Leaflets measure about 28 by 10 cm, and the tips of the smaller, sterile leaflets are narrowly pointed. The species differs from *Acrostichum aureum* by its smaller total size, smaller leaflets, brownish-green young leaves, pointed leaflets, and the dark brown lower surface of fertile leaflets covered with sporangia. Leaf venation is net-like. The broad scales, up to 1 cm long, are restricted to the base of the leaves. Scales have a thickened middle and an entire margin. Spores are large and tetrahedral in shape.

Ecology : Perennial fern. Occurs in parts of mangroves that are more frequently inundated by tides. It especially occurs on heaps of mud raised by lobsters and crabs above the general level of the ground. Usually prefers shaded areas. Like the mangrove trees themselves, the fern is often supported by prop roots. Fertile fronds are produced from August to April. ‘Seedlings’ (actually, ‘sporelings’) are abundant from January to April (in Java). Mangrove species.

Distribution : Tropical Asia and Australia. Throughout Southeast Asia.

Abundance : Locally abundant.

Use(s) : A high-quality thatch.

Source of illustration : Wightman (1989).

References : Watson (1928), Holttum (1966), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Marschke (2000)

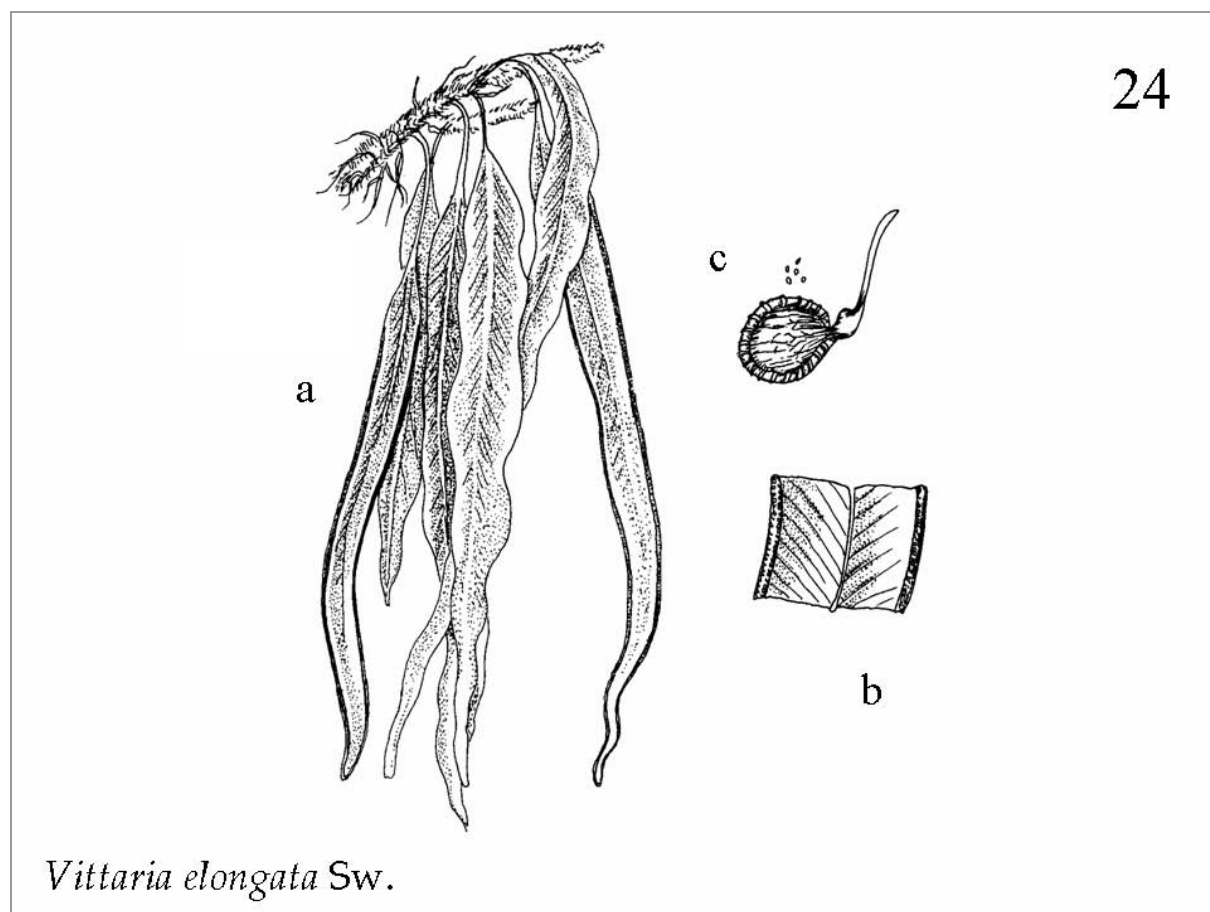


Fig. 24. *Vittaria elongata* Sw. (a) Habit, (b) detail of leaf, showing sporangia in the marginal groove, and (c) detail of sporangium.

VITTARIACEAE**24*****Vittaria elongata* Sw.****Synonyms :** *Vittaria loricea* Fée, *Vittaria planipes* Kunze**Vernacular name(s) :** Ribbon Fern (E)

Descriptions : Epiphyte or growing on rocky substrates. The rhizome is rather long, creeping and scaly, with a nearly black, about 1 cm long, hair-like tip. It bears leaves at intervals of about 1 cm. Leaves are distinctly stalked and measure (20-)30-60(-180) cm by 0.7-2 cm. They are gradually tapered towards both base and tip, and have a single midrib that is distinct on the upper surface, but usually less distinct on the lower surface. Veins are often distinct in the broader specimens, very slanted, with up to about six veins occurring between midrib and margin. Sori (containing the spores) occur in a deep, almost marginal groove that is more or less curled back towards the lower surface at maturity.

Ecology : A common epiphytic fern in the lowlands, including mangroves. It may also grow on rocks, particularly in moderately shaded places, and occurs up to an altitude of 2,200 m in primary forest. Spores are found all year round. Abundant on older palms in oil palm plantations. Mangrove associate species.

Distributions : Occurs from East and Southern Africa, through India and Southeast Asia to Southern China, Taiwan, Japan, Australia and Polynesia. Found throughout Southeast Asia.

Abundance : Locally common.

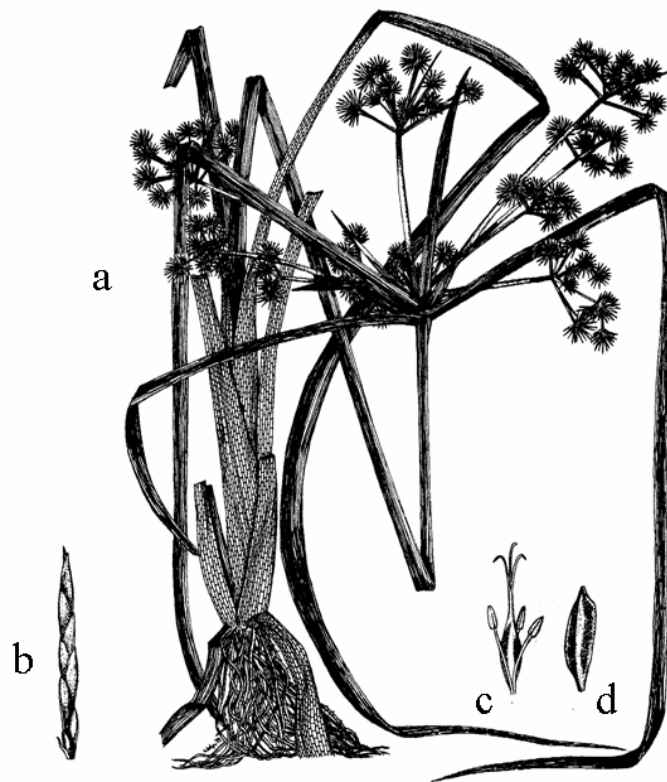
Use(s) : Ornamental.

Source of illustration : Holttum (1966) and Piggott (1988).

References : Backer & Posthumus (1939), Holttum (1966), Johnson (1977), Piggott (1988).

GROUP B: GRASSES & GRASS-LIKE PLANTS

25



Cyperus compactus Retz.

Fig. 25. *Cyperus compactus* Retz. (a) Habit, (b) spikelet, (c) flower and (d) nut.

CYPERACEAE

25

***Cyperus compactus* Retz.**

Synonyms : *Cyperus dilutus* Vahl., *Cyperus grabowskianus* Bolck., *Cyperus luzonensis* Llanos, *Cyperus septatus* Steud., *Duraljouvea diluta* Palla, *Mariscus compactus* Boldingh, *Mariscus dilutus* Nees, *Mariscus microcephalus* Presl., *Sphaeromariscus microcephalus* Camus

Vernacular name(s) : Prumpungan, Jekeng, Suket (Ind.), Wampi lang (PNG), Baki-baking-pula, Durugi, Giron (Phil.).

Description : A robust, perennial herb, 15-120 cm tall. Does not have stolons, and the rhizome is either very short or absent altogether. Stems are bluntly 3-angular, sometimes almost round, smooth, and with a diameter of up to 6 mm. The stem, leaves and sheath have numerous air-chambers. Leaves are 5-12 mm wide, stiff, deeply channelled, and as long as or shorter than the stem. Leaf edges and midrib are coarse towards the end of the leaf. Lower leaves are spongy and reddish-brown. Flowers are terminal and grouped in a large, up to 30 cm diameter umbrella-shaped cluster that has a reddish-brown colour. Large leaflets at the base of the flower cluster are up to 100 cm long. Spikelets (see illustration) are stemless and measure 5-15 by 1-1.5 mm.

Ecology : Occurs in a variety of wetlands, including swamps, wet grasslands, coastal marshes, ditches, riverbanks, and occasionally in the landward margin of mangroves. Occurs up to altitudes of 500 (rarely 1,000) m. Also a common weed of ricefields. Mangrove associate species.

Distribution : From India to southern China and Taiwan; occurs throughout Southeast Asia, from Myanmar to Papua New Guinea.

Abundance : Common.

Use(s) : Unknown

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974), Soerjani *et al.* (1987).

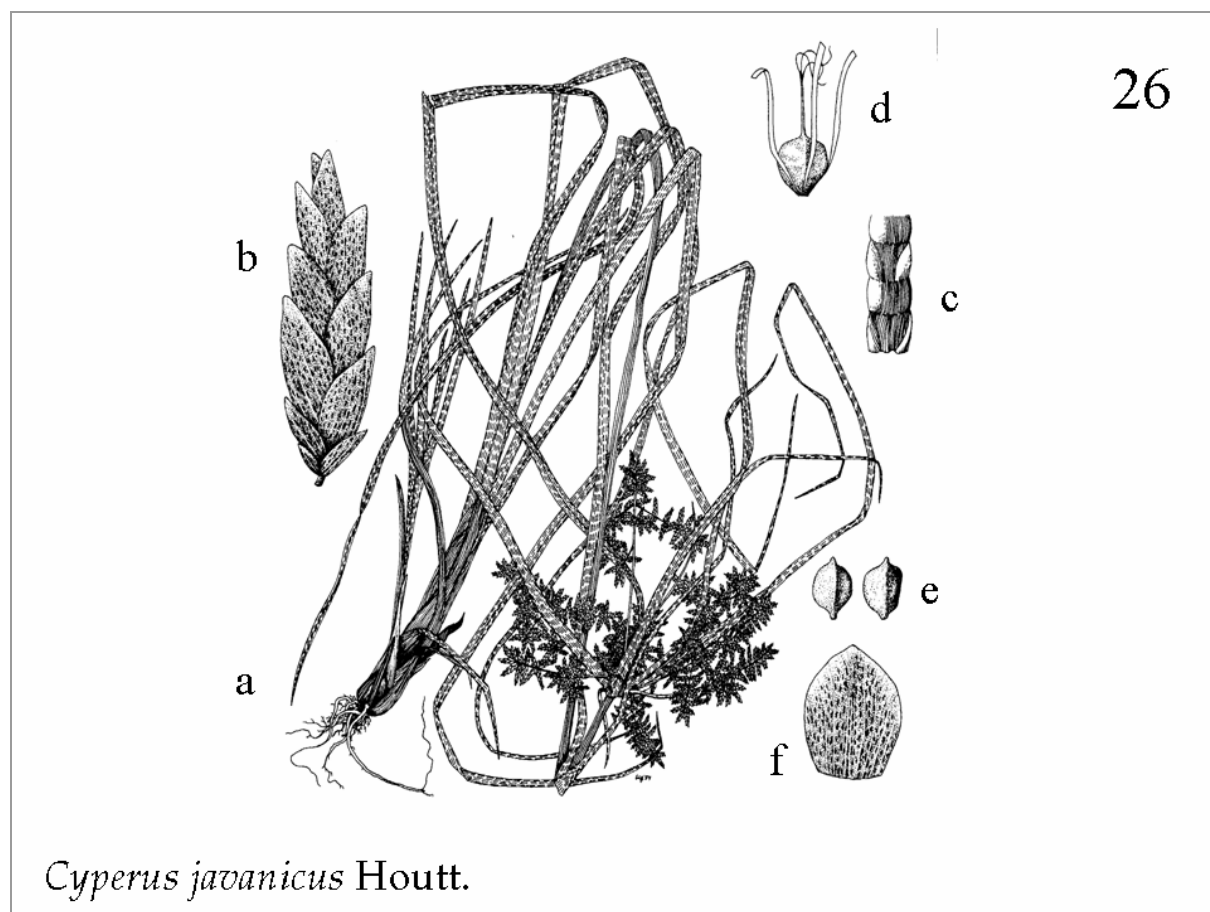


Fig. 26. *Cyperus javanicus* Houtt. (a) Habit, (b) spikelet, (c) detail of spikelet, (d) flower, (e) nut, and (f) leaflet sheathing the nut.

CYPERACEAE

26

***Cyperus javanicus* Houtt.**

Synonyms : *Cyperus anomalus* Steud., *Cyperus canescens* Vahl., *Cyperus firmus* Presl., *Cyperus holciflorus* Presl., *Cyperus parviflorus* Vahl., *Cyperus pennatus* Lamk., *Cyperus stigmatosus* Steud., *Cyperus stuppeus* Forst., *Duvaljouvea pennata* Palla., *Mariscus javanicus* Merr. & Metc., *Mariscus pennatus* Domin., *Mariscus stuppeus* Merr..

Vernacular name(s) : Rumput Lingsing, Sarai, Sulengseng (Mal.), Jekeng, Dekeng, Sosa, Kikisa (Ind.), Wapi lang (PNG), Kai-kai (Phil.), Sosa (ET)

Description : Perennial herb with a very short rhizome and no stolons, 30-70 (rarely 110) cm tall. Stems are stout, bluntly 3-angular or nearly round, up to 4 mm wide. Leaves are 5-10 mm wide, rigid, channelled, coarse and with a drooping, pointed top. Lower leaves are reddish-brown at the base. Flowers are terminal and grouped in a large, up to 15 cm diameter umbrella-shaped cluster. Spikelets (see illustration) are 5-9 (rarely 13) by 2-2.5 mm, brownish to slightly purple. Very similar to *Cyperus ligularis* L. of West Africa and South America, and possibly the same species.

Ecology : Occurs in exposed, sunny wetlands, usually under brackish or saline conditions such as sandy foreshores, along dikes of brackish water fishponds, muddy banks of creeks and landward margins of mangroves. Coastal, rarely occurring inland, up to altitudes of 250 m. Mangrove associate species.

Distribution : Tropical Africa (very rare), Madagascar, South Asia, southern China, Taiwan, Ryukus, throughout Southeast Asia, Taiwan, to tropical Australia and the Pacific islands.

Abundance : Common.

Use(s) : Unknown.

Source of illustration : Bogor Herbarium specimen.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

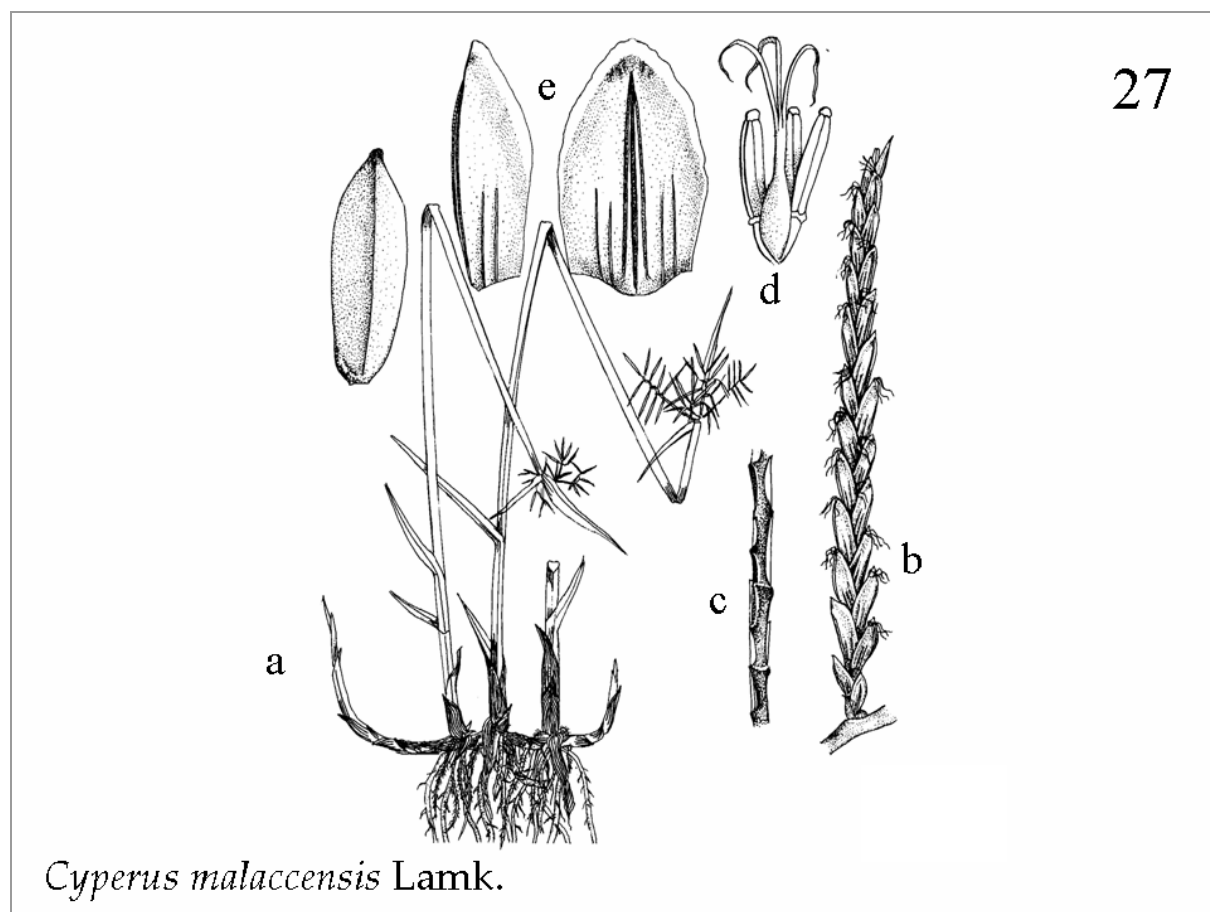


Fig. 27. *Cyperus malaccensis* Lamk. (a) Habit, (b) spikelet, (c) stalk of spikelet, (d) flower, and (e) leaflets sheathing the nut.

CYPERACEAE

27

***Cyperus malaccensis* Lamk.**

Synonyms : *Chlorocyperus malaccensis* Palla, *Cyperus spaniophyllus* Steud., *Cyperus tegetiformis* (non Roxb.) Benth., *Cyperus tegetum* (non Roxb.) Ridl.

Vernacular name(s) : Bundung, Bunyung, Wlingi Laut (Mal.), Darendeng, Kedot, Suket Dem, Kumbu, Pea-pea, Rumput Kuluwing, Geida (Ind.), Geida (PNG), Baga-as (Phil.), Lác, Cói (Viet.)

Description : Large, perennial species, up to 175 cm tall. Stems are robust, spongy, sharply 3-angled, towards the top almost 3-winged, 12-15 mm diameter. Stolons are well-developed, pale, covered with large, membranous, dark brown scales. As they age the stolons harden into a dark brown, woody rhizome. There are only a few, short leaves. The lower ones are reduced to spongy, bladeless, purplish sheaths, while the upper ones may have a 20 cm-long sheath. Leaves may reach up to about halfway up the stem. Flower clusters are terminal and (very) dense, up to 10 by 15 cm. The leaflets at the base of the flower cluster measure 8-15 mm by 10-30 cm. Spikelets (see illustration) measure 1-3 cm by 1.3-1.8 mm and are pale green, later turning brown.

Ecology : Coastal wetland species, occurring in muddy estuaries, sandy fore-shores, mudflats, often forming a dense, fringe vegetation. Also found in tidal rice fields. The plant prefers light (sandy) and medium (loamy) soils and can grow well in saline soil. It does not tolerate shady conditions and requires moist or wet soil, often colonising new terrain, especially in brackish waters. Mangrove associate species.

Distribution : From the Middle East though South Asia to southern China, throughout Southeast Asia (except for parts of Indonesia [Lesser Sunda Islands, Moluccas] and East Timor) to northern Australia and Polynesia. In Vietnam it is usually recorded as *Cyperus tegetiformis*.

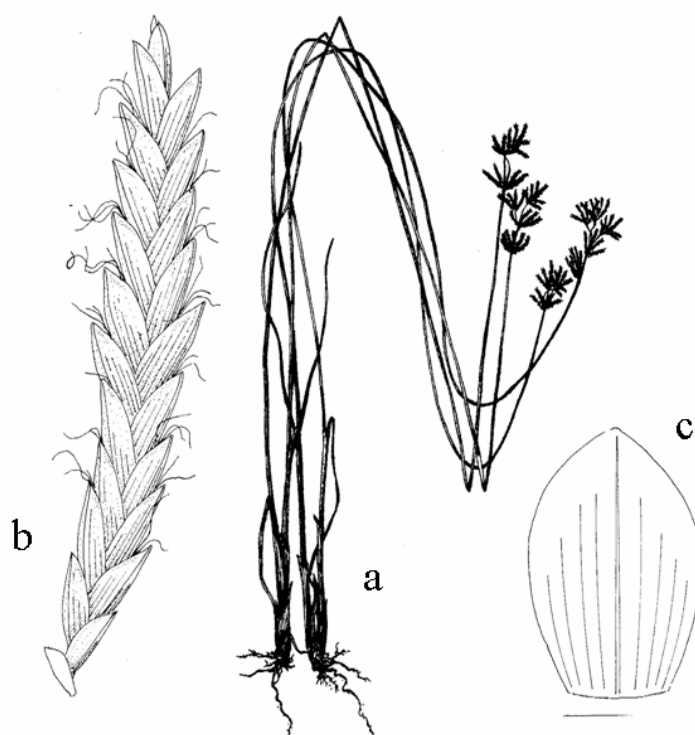
Abundance : Common.

Use(s) : Stems are used for making mats and baskets. Also used as binding material. In Central Java, stems are plaited into ropes that are strung in the sea to attract fish fry. A fibre is obtained from the stalks or the leaves, and this is used for weaving mats. The whole leaves can also be used for weaving mats and other items. It is cultivated for its fibre, especially in China.

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Kern (1974), Soerjani *et al.* (1987), <http://plants.usda.gov/>, www.comp.leeds.ac.uk

28



Cyperus scariosus R.Br.

Fig. 28. *Cyperus scariosus* R.Br. (a) Habit, (b) spikelet, and (c) leaflet sheathing the nut.

CYPERACEAE

28

***Cyperus scariosus* R.Br.**

Synonyms : *Cyperus corymbosus* Rottb. var. *scariosus* Kük., *Cyperus diphyllus* (Retz) Valck., *Cyperus rotundus* L. var. *pallidus* Benth.

Vernacular name(s) : Unknown.

Description : Perennial herb, 50-80 cm tall, with a creeping rhizome and slender, short stolons that may be up to 5 cm long. Stems are slender, 1.5-2 mm wide, almost round in the lower parts, and rounded 3-angular in the upper part. There are usually at most only three, short leaves, that are barely half as long as the stem, measuring 0.5-12 cm by about 2 mm. Flower clusters are usually small and simple, usually thrust to one side by the lowermost leaflet at the base of the cluster. Flower cluster leaflets are variable in size, and are 0.5-6 cm long. Spikelets are strongly compressed, 1-2 (rarely 2.5) cm by 2-2.5 mm.

Ecology : Coastal species, virtually restricted to swampy, brackish localities. Mangrove associate species.

Distribution : From eastern India to tropical Australia. In Southeast Asia it is known only from the island of New Guinea (Indonesian Papua and Papua New Guinea).

Abundance : Uncommon.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Kern (1974).

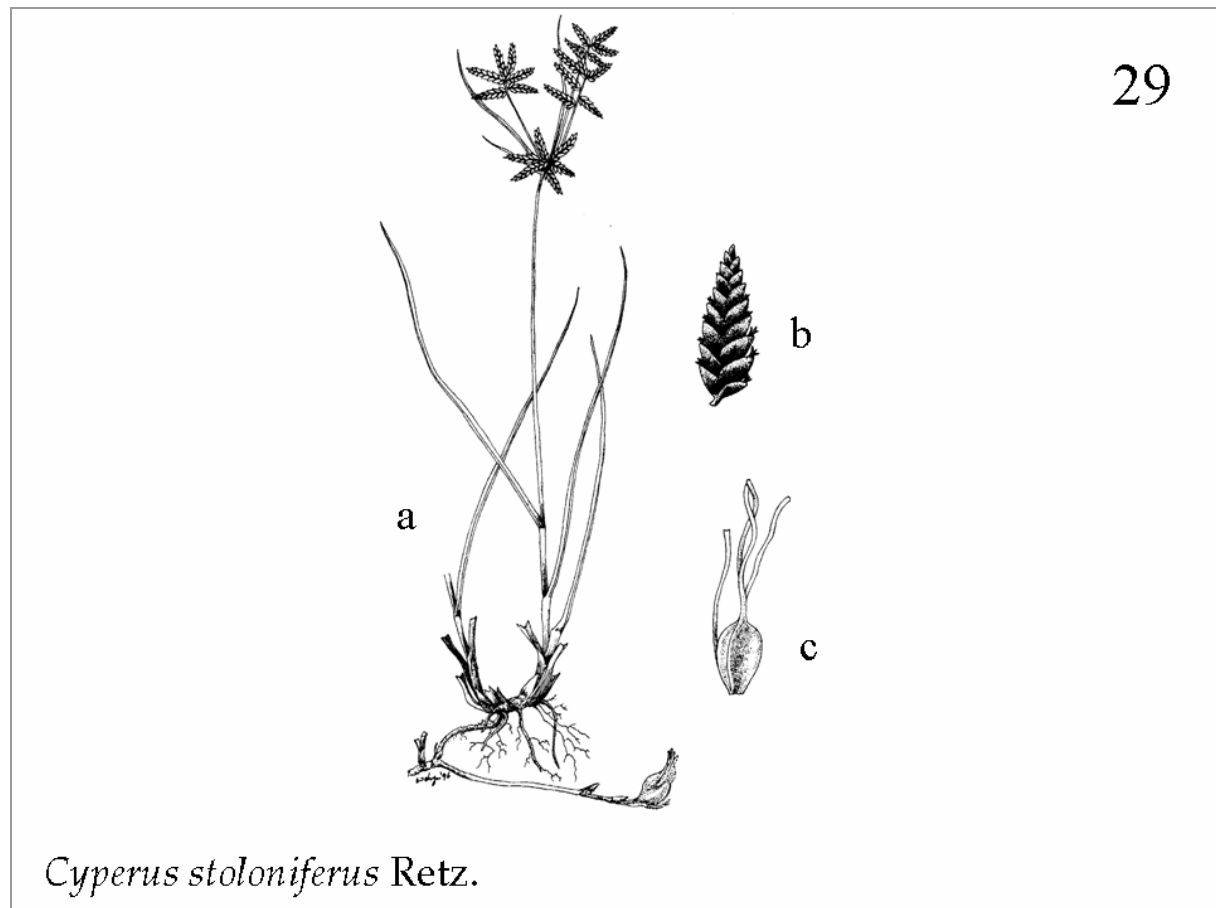


Fig. 29. *Cyperus stoloniferus* Retz. (a) Habit, (b) spikelet, and (c) nut.

CYPERACEAE

29

***Cyperus stoloniferus* Retz.**

Synonyms : *Cyperus bulbosus* (non Vahl.) Camus., *Cyperus bulboso-stoloniferus* Steud., *Cyperus lamprocarpus* Nees, *Cyperus litoralis* R.Br., *Cyperus mayeri* Kük, *Cyperus rotundus* (non L.) Benth., *Cyperus tuberosus* (non Rottb.) Kunth.

Vernacular name(s) : Có gâ'u bién (Viet.)

Description : A perennial species, with long, creeping stolons, which harden into a woody rhizome that forms stout tubers. Stems are slender, 15-50 cm tall and 1-2 (occasionally 3) mm wide. Leaves are pointed and coarse in the upper part. In dry localities, leaves are rigid and narrow (1-1.5 mm), in wetter areas they are limper and may be up to 4 mm wide. Flower clusters are variable, and may be either dense or loose, often small, and rarely up to 5-6 cm across. Spikelets measure 5-15 by 2-2.5 mm and are round in cross-section. The 2-3 leaflets at the base of the cluster may be up to 30 cm long.

Ecology : On coastal sands, often acting as a sand binder on dunes and beaches. Occasionally it also occurs in saline, muddy places, such as landward margins of mangroves. Mangrove associate species.

Distribution : Mauritius, Madagascar, to Melanesia and northern Australia. Occurs throughout Southeast Asia.

Abundance : Relatively common.

Use(s) : Unknown, but because of the sand binding characteristics it may be useful in stabilizing coastal sands.

Source of illustration : Backer (1918).

Reference(s) : Backer (1918), Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

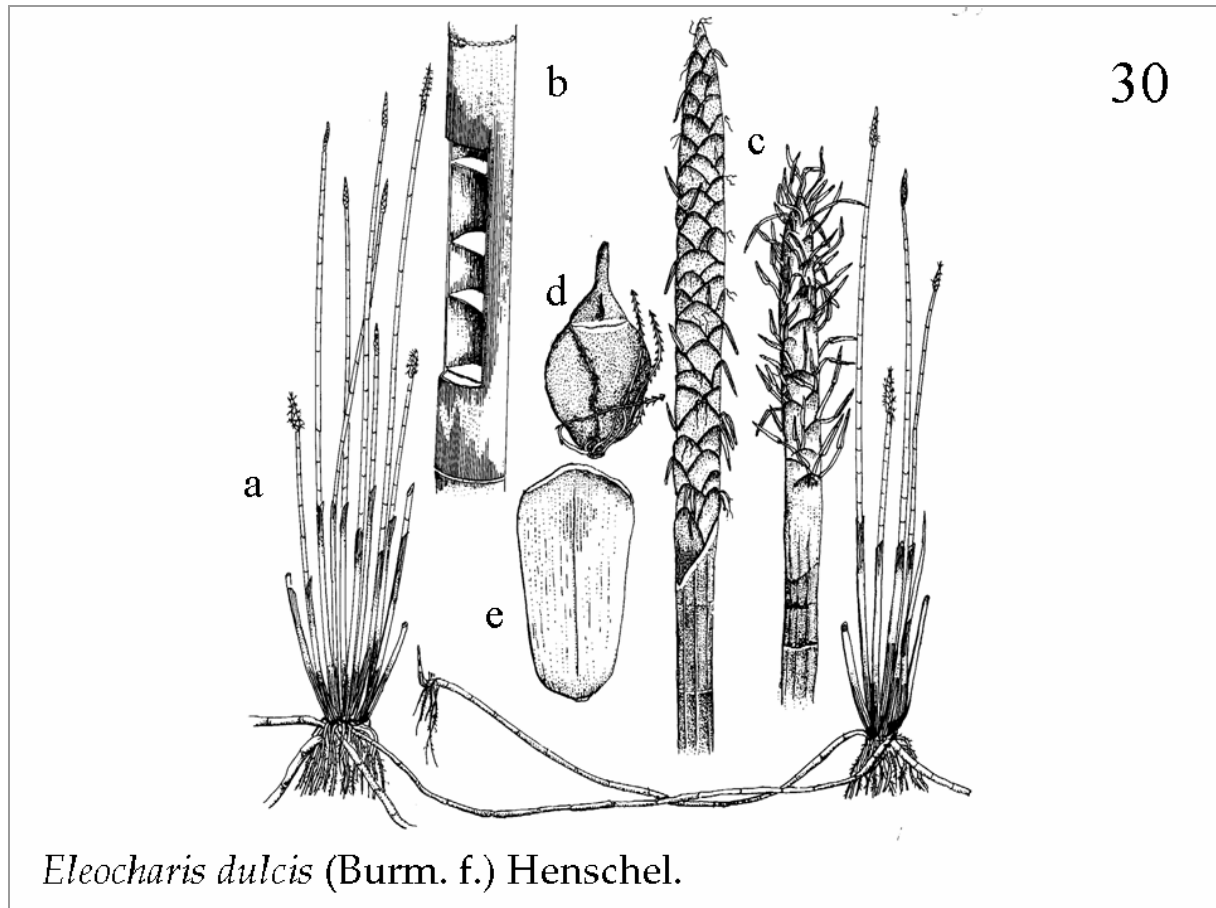


Fig. 30. *Eleocharis dulcis* (Burm. f.) Henschel. (a) Habit, showing mature plants linked by stolon, (b) detail of stem, showing partitions, (c) flowering spikelets, (d) nut, and (e) leaflet sheathing the nut.

CYPERACEAE

30

***Eleocharis dulcis* (Burm. f.) Henschel**

Synonyms : *Andropogon dulce* Burm., *Carex tuberosa* (non Degl.) Blanco, *Cyperus dulcis* Rumph., *Eleocharis dulcis* Trin., *Eleocharis equisetina* Presl., *Eleocharis indica* Druce, *Eleocharis plantaginea*, *Eleocharis plantaginoidea* Domin., *Eleocharis tuberosa* R & S Mant., *Hippuris indica* Lour., *Scirpus plantagineus* Retz., *Scirpus tuberosus* Roxb., *Scirpus tumidus* Roxb.

Vernacular name(s) : Chinese Water Chestnut (E), Begau, Biga (Mal.) Peperetan, Teki, Tike, Babawangan, Beureum, Dekeng, Teki Tike, Cikai, Pangoke, Tekere, Pagoro, Peru-peru (Ind.), Biagi (PNG), Cabezas de negrito (Phil.), Nang bôp (Viet.)

Description : A very variable, erect perennial sedge, 40-200 cm tall. The rhizome is short, with long stolons and sometimes with a 1-4 cm-long (to rounded) tuber. Stems are usually round, smooth, grey to glossy-green, 1.5-10 mm wide. They are hollow and have characteristic partitions. Leaves are virtually absent, being reduced to a bladeless, purplish sheath along the base of the stem. Flower clusters consist of a single, terminal spike (see illustration), 15-60 by 3-6 mm, brownish.

Ecology : Occurs in open wetlands, both in freshwater and saline environments, in freshwater swamps, rice fields, ponds, pools and landward margins of mangroves. Often forming dense, pure stands. Occurs up to 1,350 m, occasionally up to 2,000 m (Dieng Plateau, Java; not flowering at this altitude). Mangrove associate species.

Distribution : Tropical West Africa, throughout Asia to Melanesia and northern Australia. Found throughout Southeast Asia, but not (yet) reported from Borneo.

Abundance : Common, but local.

Use(s) : Tubers are eaten throughout Southeast and East Asia. In West Java, boiled tubers are made into chips (*kripik, emping teki*). In Sumatra, sleeping mats are woven out of this sedge. In Indonesian Papua and Papua New Guinea the stems are used for making grass skirts. A cultivated variety with much larger tubers that taste vaguely like apples has been introduced into Indonesia from China. At Chinese New Year these are imported from China, and sold on the Jakarta market as *Ma ti*.

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Kern (1974), Soerjani *et al.* (1987).

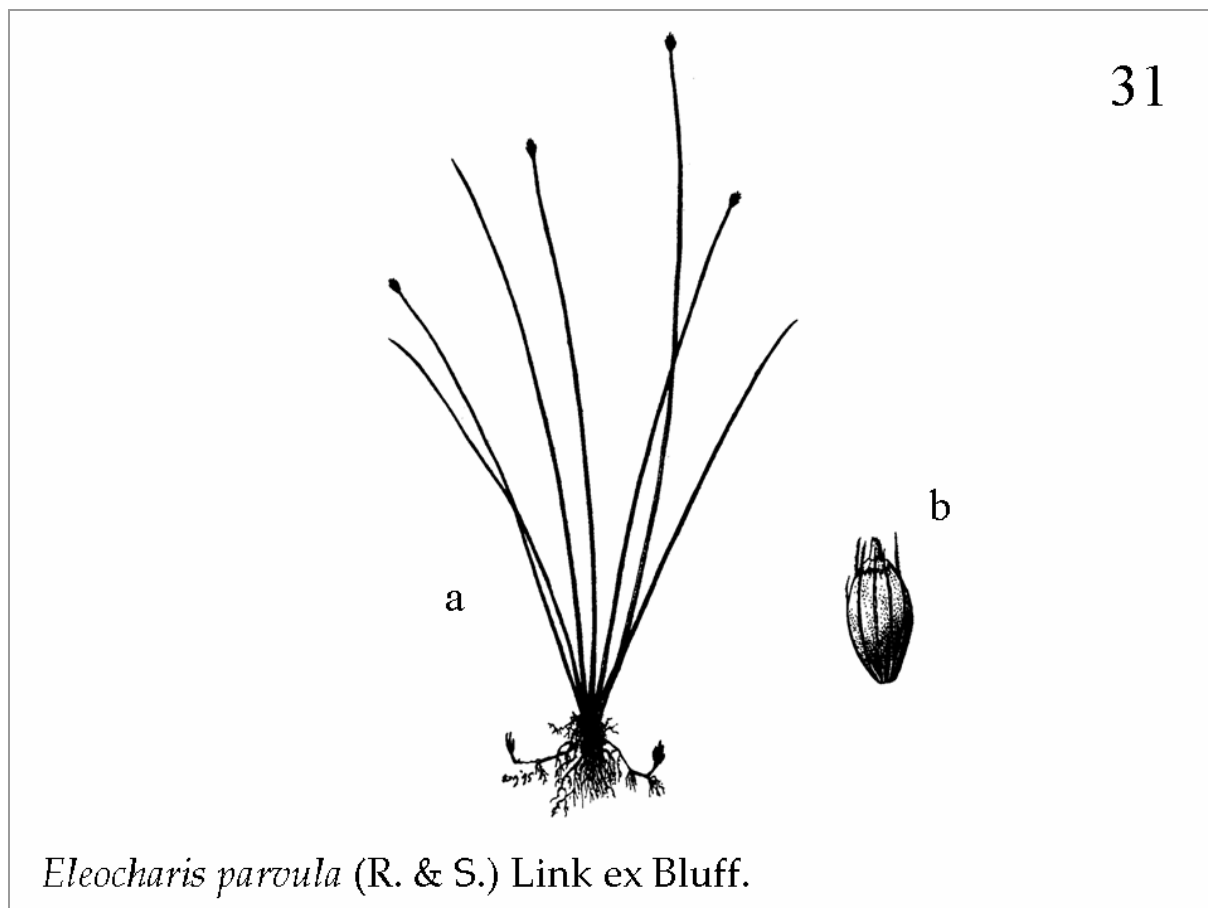


Fig. 31. *Eleocharis parvula* (R. & S.) Link ex Bluff. (a) Habit, and (b) nut.

CYPERACEAE

31

***Eleocharis parvula* (R. & S.) Link ex Bluff**

Synonyms : *Scirpus nanus* (non Poir.) Spreng., *Scirpus parvulus* R. & S., *Scirpus pusillus* Vahl..

Vernacular name(s) : Unknown.

Description : Dwarf sedge, with stems measuring only 1-7 cm by 0.25-0.35 mm. Has small, 3-6 mm long, brown or purplish tubers at the end of thread-like stolons. Leaves are reduced to membranous sheaths. The spikelets (see illustration) are egg-shaped, compressed, few-flowered (2-9), and measure 2-4 by 1.5-2 mm, brownish. The nut is triangular, with prominent angles, obovate, smooth and shiny. Often treated as a species of *Scirpus*, but according to Kern (1974), it is more closely related to *Eleocharis* and is perhaps the most primitive member of *section Pauciflorae*.

Ecology : Found in salt marshes and brackish mud along the coast, both in temperate and tropical climates. In the tropics it is decidedly rare. In Indonesia known only from iodine salt wells near Bangil, south of Surabaya. It forms mats, propagating by small, fused tubers located at the end of thread-like stolons. Mangrove associate species.

Distribution : Found both in temperate and tropical regions, in the Americas, Europe, northern Africa and scattered in Asia. From Southeast Asia known only from Cambodia (once collected) and Indonesia, where it is known only from the Bangil salt wells, south of Surabaya in East Java.

Abundance : In the tropics it is rare, and in Southeast Asia it is very rare.

Use(s) : Unknown.

Source of illustration : Svenson (1929).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

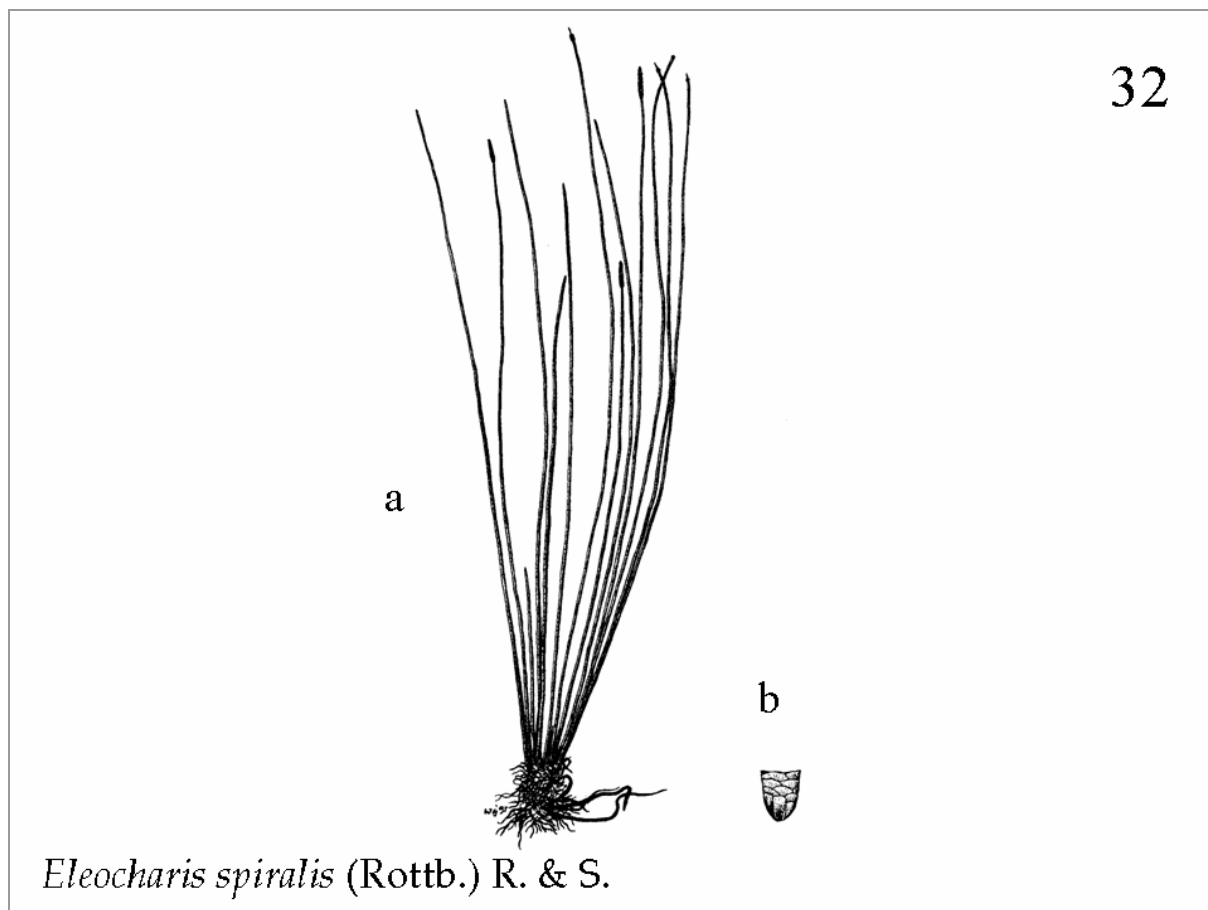


Fig. 32. *Eleocharis spiralis* (Rottb.) R. & S. (a) Habit and (b) detail of spikelet tip.

CYPERACEAE

32

***Eleocharis spiralis* (Rottb.) R. & S.**

Synonyms : *Eleocharis variegata* (*non* Presl., *nec* Kunth.) Merr., *Scirpus spiralis* Rottb.

Vernacular name(s) : Boroslanang, Endong (Ind.)

Description : Perennial, with a short rhizome and creeping stolons. Stems erect, rather robust, 3-angular in the upper part, smooth, without partitions, and measuring 25-60 cm by 2-4 mm. Leaf reduced to a thin sheath that may be loose at the end, green to brownish. Spikelets (see illustration) are round in cross-section, yellowish-green, with many flowers, 1.5-3.5 cm by 3-5 mm. Nut is swollen biconvex, obovate, shiny, deep brown when ripe, 1.5-1.75 by 1.25 mm. This species is closely related to *Eleocharis mutata* of America and tropical Africa, and may eventually be recognised as a sub-species of this pan-tropical species.

Ecology : In open, exposed wetlands at low altitudes (below 100 m), preferring clayey soils. Virtually restricted to coastal brackish and saline habitats, where it sometimes forms extensive pure stands. In Indonesia it is known inland only from a saline mud well near Kesongo (Java). Mangrove associate species.

Distribution : From tropical Africa, Madagascar, Mauritius and South Asia to northern Australia and New Caledonia. Found in a few scattered localities in Southeast Asia: Malay Peninsula, Singapore, Indonesia (Madura, Java, Papua), the Philippines (Luzon, Rizal) and Papua New Guinea.

Abundance : Uncommon to rare.

Use(s) : Used for making mats in Indramayu (Java).

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

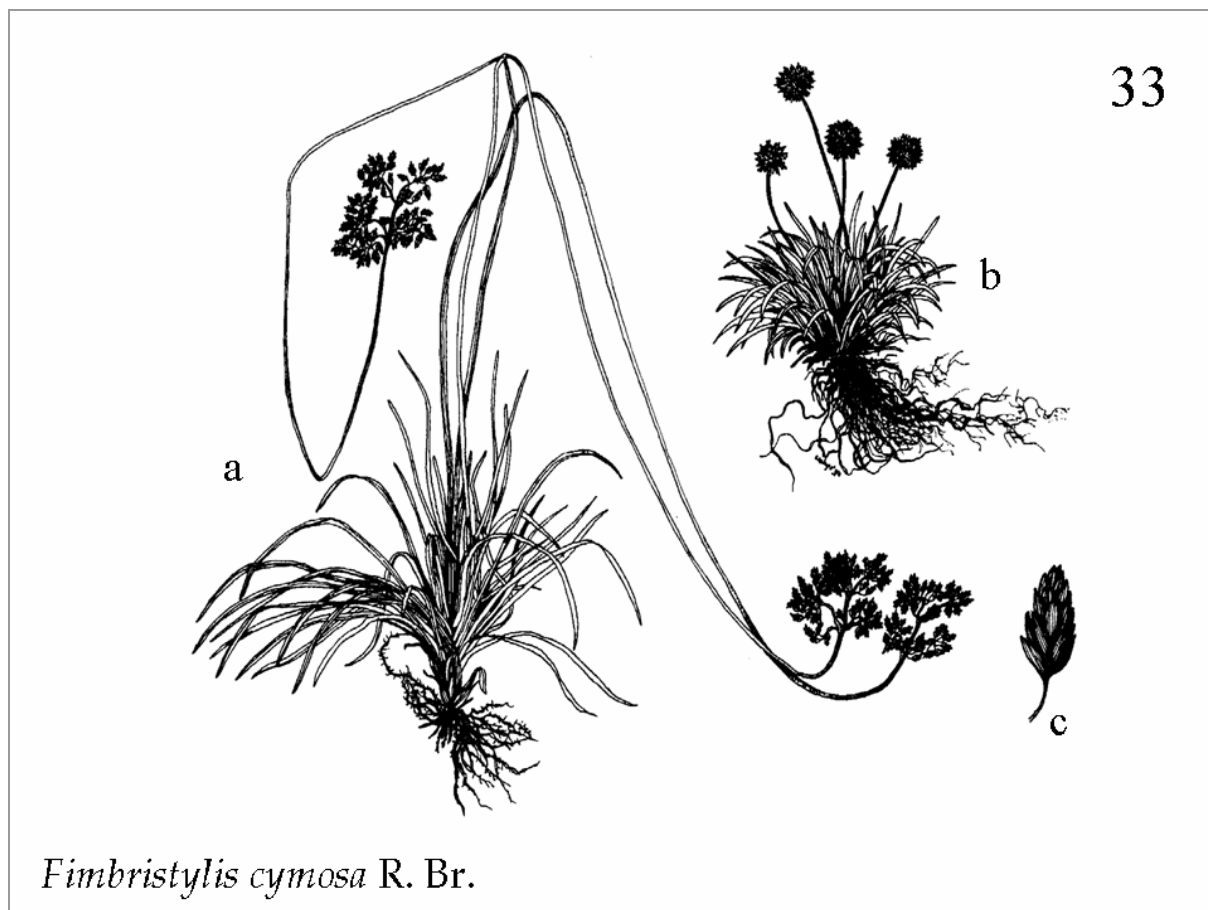


Fig. 33. *Fimbristylis cymosa* R. Br. (a) Habit of large specimen, (b) habit of diminutive specimen, and (c) spikelet.

CYPERACEAE

33

***Fimbristylis cymosa* R. Br.**

Synonyms : *Fimbristylis atollensis* St. John, *Fimbristylis ciliolata* Steud., *Fimbristylis glomerata* Nees ex Kunth., *Fimbriatylus laevisissima* Steud., *Fimbristylis pycnocephala* Hillebr., *Fimbristylis rigida* Kunth., *Fimbristylis spathacea* Roth., *Fimbristylis warburgii* K. Sch., *Iriha cymosa* O.K., *Iriha glomerata* Nees, *Isolepis haenkei* Presl.

Vernacular name(s) : Kodokan, Sulang Watu, Teki Parang (Ind.)

Description : Perennial species with a short rhizome. Stems are smooth, rigid, flattened 3-angular to almost round, 10-50 cm by 1-2 mm. There are many leaves at the base, which are all much shorter than the stems. Leaves are 1-2 (rarely 3) mm wide, and do not have a tongue. Spikelets (see illustration) are either solitary or occur in clusters, and measure 3-6 by 2 mm. Nut is biconvex or rounded-triangular, smooth or slightly rough, chestnut to black when ripe, 0.8 by 0.7 mm maximum size. A very variable species, as flower clusters may consist of well-developed rays, or contracted into a single head. Flower and fruit parts are also very variable in size.

Ecology : In open, sandy, clayey or rocky places by the sea, on beaches, wet dune hollows and mangroves. Sometimes inland near hot springs. Mangrove associate species.

Distribution : Pan-tropical, occurring throughout Southeast Asia.

Abundance : Relatively common, and locally abundant.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

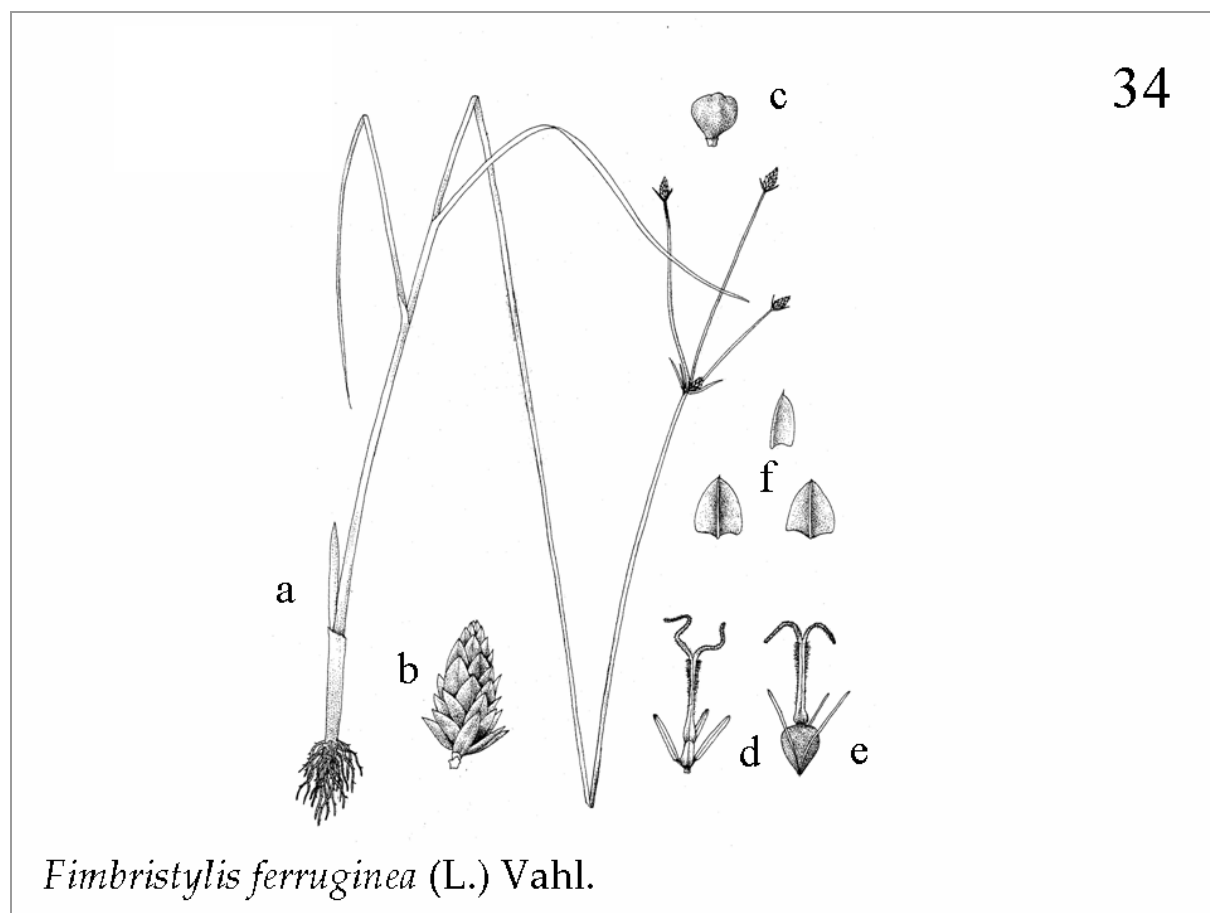


Fig. 34. *Fimbristylis ferruginea* (L.) Vahl. (a) Habit, (b) spikelet, (c) nut, (d) style and stamens, (e) young nut, with stigma still attached, (f) leaflets covering the nut.

CYPERACEAE

34

***Fimbristylis ferruginea* (L.) Vahl**

Synonyms : *Fimbristylis cyrtophylla* Miq., *Fimbristylis longispicata* (non Steud.) Camus, *Fimbristylis marginata* Labill., *Fimbristylis polytrichoides* (non R.Br.) Ridl., *Fimbristylis trispicata* Steud., *Iriha ferruginea* O.K., *Scirpus arvensis* Retz., *Scirpus ferrugineus* L.

Vernacular name(s) : Rumput Ruchut (Mal.), Purun, Suket Dot, Suket Godokan, Kodokan, Ba'ileu (Ind.), Cồ' cây (Viet.)

Description : Perennial species, with a short, woody, creeping rhizome. Stems are rigid, compressed, smooth, greyish-green, measuring 20-80 cm by 1.5-3 mm. Leaves are much shorter than the stems, measuring 2-10 cm by 0.5-1.5 mm. They have a tongue, consisting of a dense fringe of short hairs. Flower clusters are simple and usually contracted into a dense head, 3-5 cm long. There are 2-3 leaflets at the base of the flower cluster. Spikelets (see illustration) are solitary, dull brown and measure 5-20 by 3-4 mm. Nut biconvex, strongly compressed, obovate to oblong-obovate, straw like to dark, greyish-brown, 1-1.25 by 0.75-1 mm.

Ecology : Found in sunny, wet localities with clayey soils, especially in areas subjected to regular inundation by brackish water. More rarely it occurs inland near saline pools and mud-wells. From sea level to about 100 m above sea level. Mangrove associate species.

Distribution : Pan-tropical, and occurs throughout Southeast Asia. As yet not recorded in the Lesser Sunda Islands of Indonesia or in East Timor.

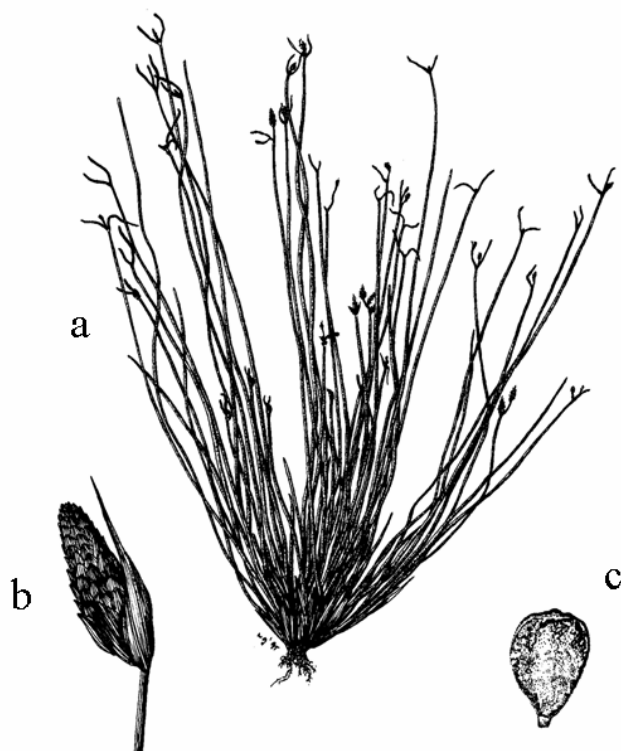
Abundance : Locally abundant.

Use(s) : Unknown.

Source of illustration : Backer (1934).

Reference(s) : Backer (1934), Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

35



Fimbristylis polytrichoides (Retz.) R. Br.

Fig. 35. *Fimbristylis polytrichoides* (Retz.) R. Br. (a) Habit, (b) spikelet, and (c) nut.

CYPERACEAE

35

***Fimbristylis polytrichoides* (Retz.) R. Br.**

Synonyms : *Abildgaardia javanica* Nees., *Abildgaardia javanica* Steud., *Fimbristylis albescens* Steud., *Fimbristylis juncea* (non R. & S.) Boeck, *Fimbristylis subbulbosa* Boeck., *Iriha polytrichoides* O.K., *Scirpus polytrichoides* Retz.

Vernacular name(s) : Rebha Kaproleam (Ind.)

Description : Perennial herb, forming dense tufts, with erect, smooth stems that are 5-30 cm tall and 1 mm in diameter. Leaves are up to half as long as the stem, wiry, 0.5-1 mm wide, and with a tongue consisting of a row of short hairs. Flower clusters consist of a single, terminal spikelet (see illustration), that is pale brown and measures 5-15 by 2-3 mm. Nut biconvex, with sharp angles, wedge-shaped/obovate or oblong-obovate, rounded at the tip, smooth or warted, delicately covered with net-like pattern, greyish or blackish-brown, 0.8-1.1 by 0.5-0.75 mm.

Ecology : In open, wet places, especially on sandy or muddy sea-shores and in rock crevices near the sea, including landward margins of mangroves. Sometimes it occurs further inland on saline soil. Mangrove associate species.

Distribution : Tropical Africa, Asia and Australia. In Southeast Asia recorded in Malaysia (Peninsular), the Philippines (Luzon, Panay), Indonesia (Sumatra, Java, Madura and Papua) and Papua New Guinea (Port Morseby).

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Backer (1934).

Reference(s) : Backer (1934), Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

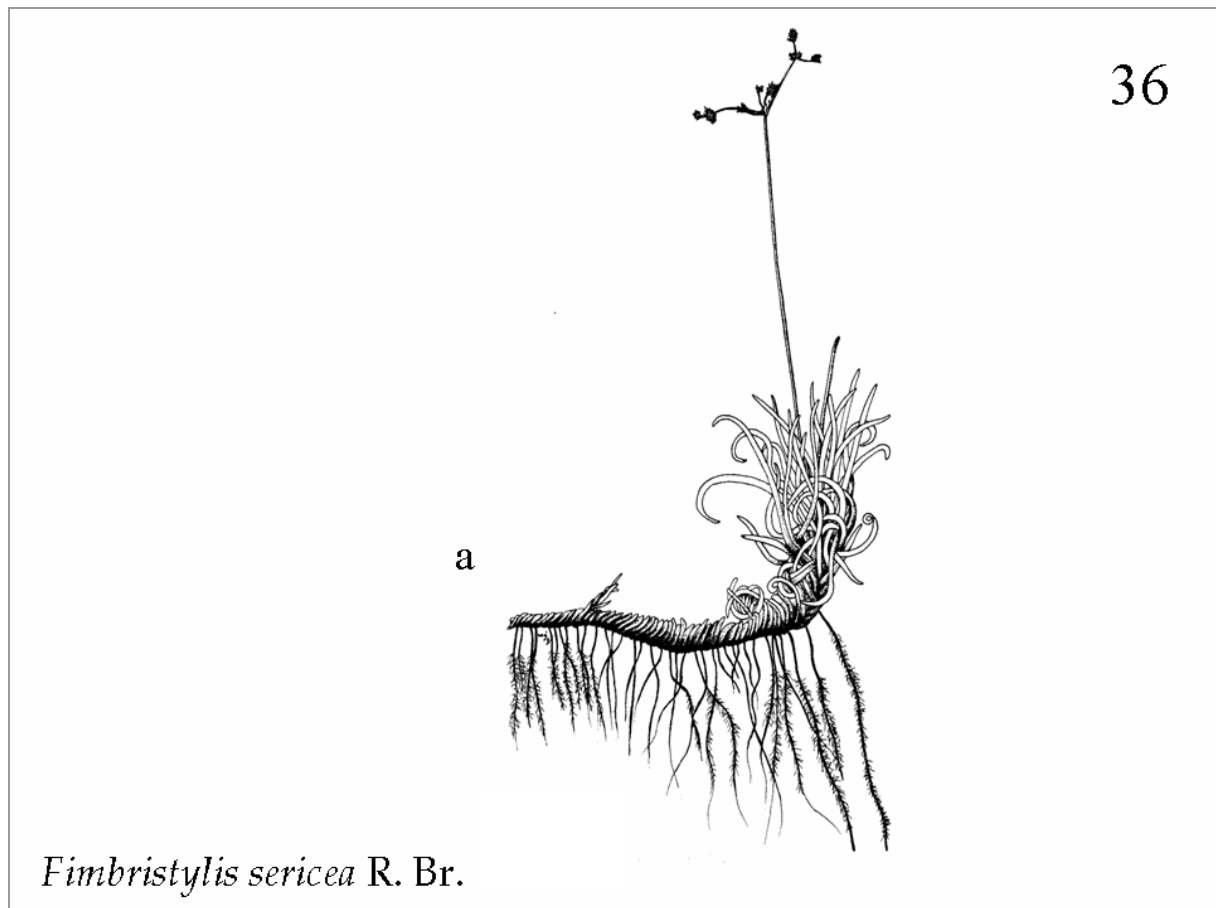


Fig. 36. *Fimbristylis sericea* R. Br. (a) Habit.

CYPERACEAE

36

***Fimbristylis sericea* R. Br.**

Synonyms : *Fimbristylis dasyphylla* Miq., *Fimbristylis decora* Nees & Mey. ex Nees, *Fimbristylis junciformis* var. *latifolia* (non Clarke) Camus, *Iriha sericea* O.K..

Vernacular name(s) : Unknown.

Description : Perennial herb, with a thick, woody, creeping or ascending often-branched rhizome. This is often densely clad with the remains of old leaf sheaths. The rhizome smells of varnish when bruised. Stems are solitary, erect, bluntly 3-angular or almost round, occasionally (partially) covered with short hairs, and 10-30 (rarely 60) cm long and 1-2.5 mm wide. The lower 5-15 cm of the stem is surrounded by 2-3 tubular leaf sheaths. Leaves are much shorter than the stem, rigid, covered with short silky hairs. They have incurved edges, are pointed and 2-4 mm wide. Flower clusters are loose, 5-10 cm long, with 2-3 hairy leaflets at their base. Spikelets (see illustration) are silvery-grey to brownish, 6-10 by 2.5-3 mm. Nut is biconvex, more-or-less stalkless, smooth, dark greyish-brown, 1-1.3 by 0.8-1 mm.

Ecology : Occurs on sandy sea-shores, coastal dunes, (sandy) landward margins of mangroves and dikes in brackish-water fishponds. Acts as a sand-binder. Mangrove associate species.

Distribution : From India, through Southeast Asia to southern China, Taiwan, Japan and northern Australia. In Southeast Asia it has been recorded in Thailand, Malaysia (Peninsular, Sarawak) and Indonesia (Bangka, Java, Madura and Kalimantan).

Abundance : Locally common.

Use(s) : Sand-binding characteristic may be an important potential use for stabilizing dunes.

Source of illustration : Backer (1919).

Reference(s) : Backer (1919), Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

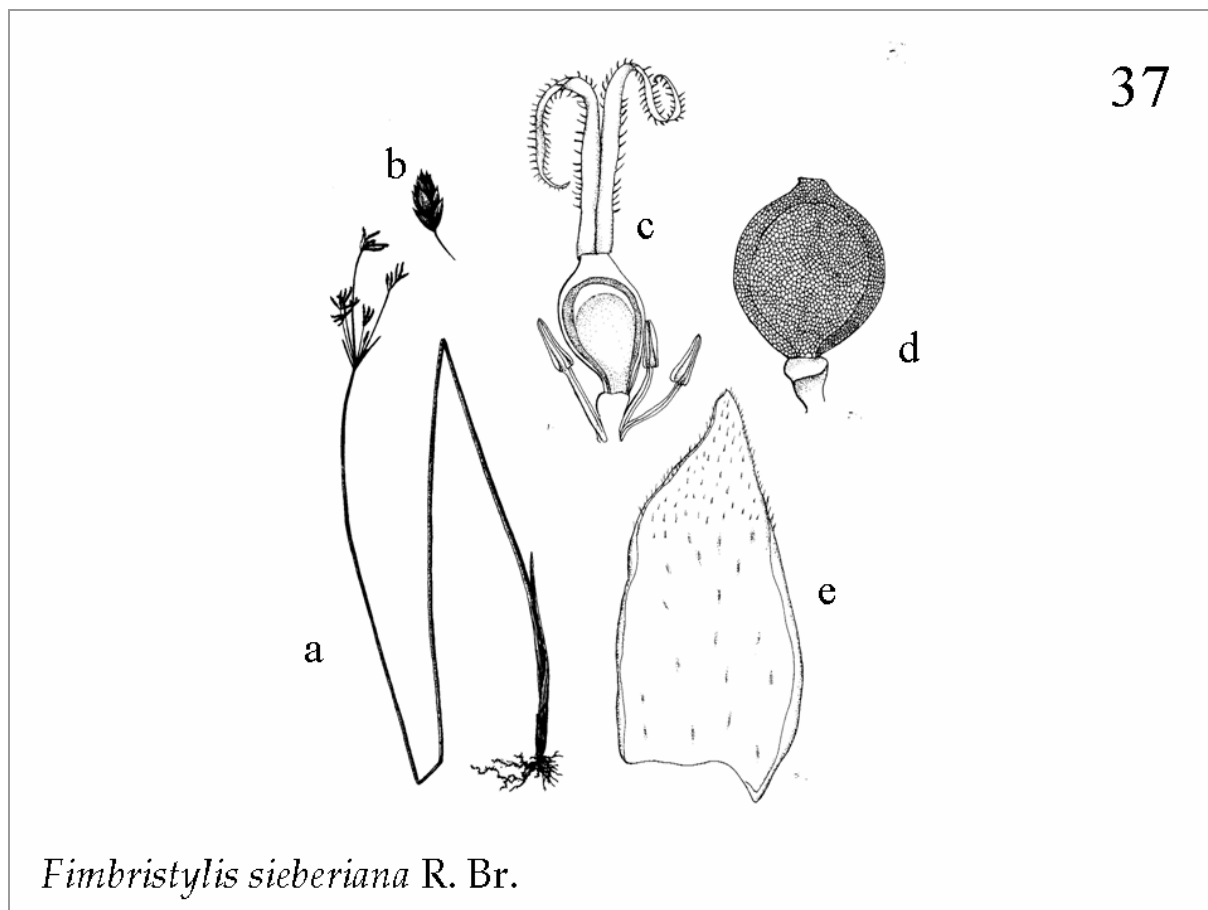


Fig. 37. *Fimbristylis sieberiana* R. Br. (a) Habit, (b) spikelet, (c) flower, (d) nut, and (e) leaflet sheathing the nut.

CYPERACEAE

37

***Fimbristylis sieberiana* R. Br.**

Synonyms : *Fimbristylis arvensis* Vahl., *Fimbristylis ferruginea* (*non* Vahl.) Decne, *Fimbristylis ferruginea* var. *foliata* Benth., *Fimbristylis ferruginea* var. *sieberiana* Boeck., *Fimbristylis paucispicata* F.v.M., *Fimbristylis tristachya* R.Br.

Vernacular name(s) : Unknown.

Description : Perennial herb, with erect stems 20-80 cm, and a woody, creeping rhizome. Leaves are stiff, flat, up to 35 cm long and 1.5-2 mm wide. Lowest of the 2-3 leaflets at the base of the flower cluster is as long as, or overtops the cluster. Spikelets are blunt, solitary, dull brown, measuring 5-20 by 3-4 mm. Nut broadly obovate or orbicular, distinctly borne on a stalk, 1.25-1.5 by 1.1-1.25 mm. It is often confused with *Fimbristylis ferruginea*, from which, however, it is clearly distinguished by its larger leaves (2-10 cm by 1-1.5 mm *versus* up to 35 cm by 1.5-2 mm).

Ecology : Occurs in brackish marshes at low altitudes. Mangrove associate species.

Distribution : From Africa, Madagascar, Middle East and South Asia, through Southeast Asia to northern Australia. In Southeast Asia it has been recorded in the Philippines, Indonesia (Lesser Sunda Islands) and East Timor.

Abundance : Uncommon; very rare in Southeast Asia.

Use(s) : Unknown.

Source of illustration : Icones Rijksherbarium Leiden, and herbarium specimens, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

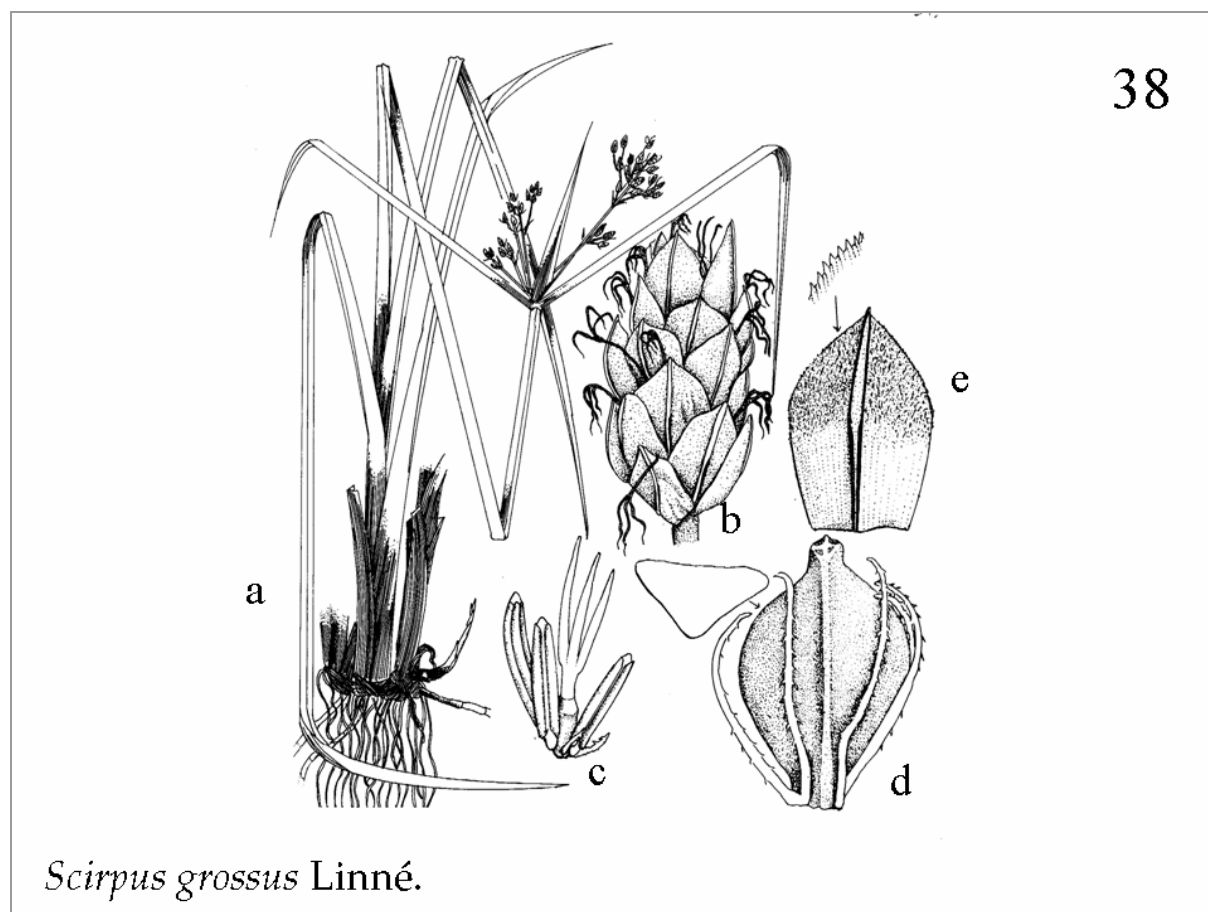


Fig. 38. *Scirpus grossus* Linné. (a) Habit, (b) spikelet, (c) flower, (d) nut, and (e) leaflet sheathing the nut.

CYPERACEAE

38

***Scirpus grossus* Linné**

Synonyms : *Cyperus difformis* (non L.) Blanco, *Schoenoplectus grossus* Palla, *Scirpus aemulans* Steud., *Scirpus grossus* var. *kysoor* (non Clarke), *Scirpus kysoor* (non Roxb.) Llanos., *Scirpus maritimus* var. *aemulans* Miq.

Vernacular name(s) : Mendarong, Mensiang, Masiang, Murong, Menurong (Mal.), Bebawangan, Walingi, Lingi, Wlingen, Wlingian, Bundung, Reduk (Ind.), Agás, Bungkuang, Ragiudiu (Phil.)

Description : Erect and stout perennial herb, up to 2 m tall, with an erect, sharply 3-angular stem, up to 2.5 cm (at top 0.5-1 cm) thick. Leaves emerge from the base, and are 50-180 cm long and up to 3 cm wide. Flower clusters are terminal, loose and large, with leaflets that are up to 70 cm long. Spikelets (see illustration) are solitary, stemless, and measure 4-10 by 3.5-4 mm. Nut rounded-triangular, obovate, ending abruptly in a small point, smooth, brown, 1.25-1.75 by 1 mm. Specimens of *Scirpus kysoor* and *Scirpus grossus* var. *kysoor* are from India, and vary in finer characteristics of the fruiting head.

Ecology : In swampy or inundated localities, pools, ditches, rice fields and landward margins of mangroves. Often coastal, but may occur well inland up to altitudes of 850 m. Mangrove associate species.

Distribution : From India, through Southeast Asia and southern China to northern Australia. Found throughout Southeast Asia except East Timor and parts of Indonesia (Lesser Sunda Islands and the Moluccas).

Abundance : Locally common.

Use(s) : Often used for making sleeping mats, bags and baskets. Stems are dried, flattened and bleached in the sun.

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Kern (1974) Soerjani *et al.* (1987).

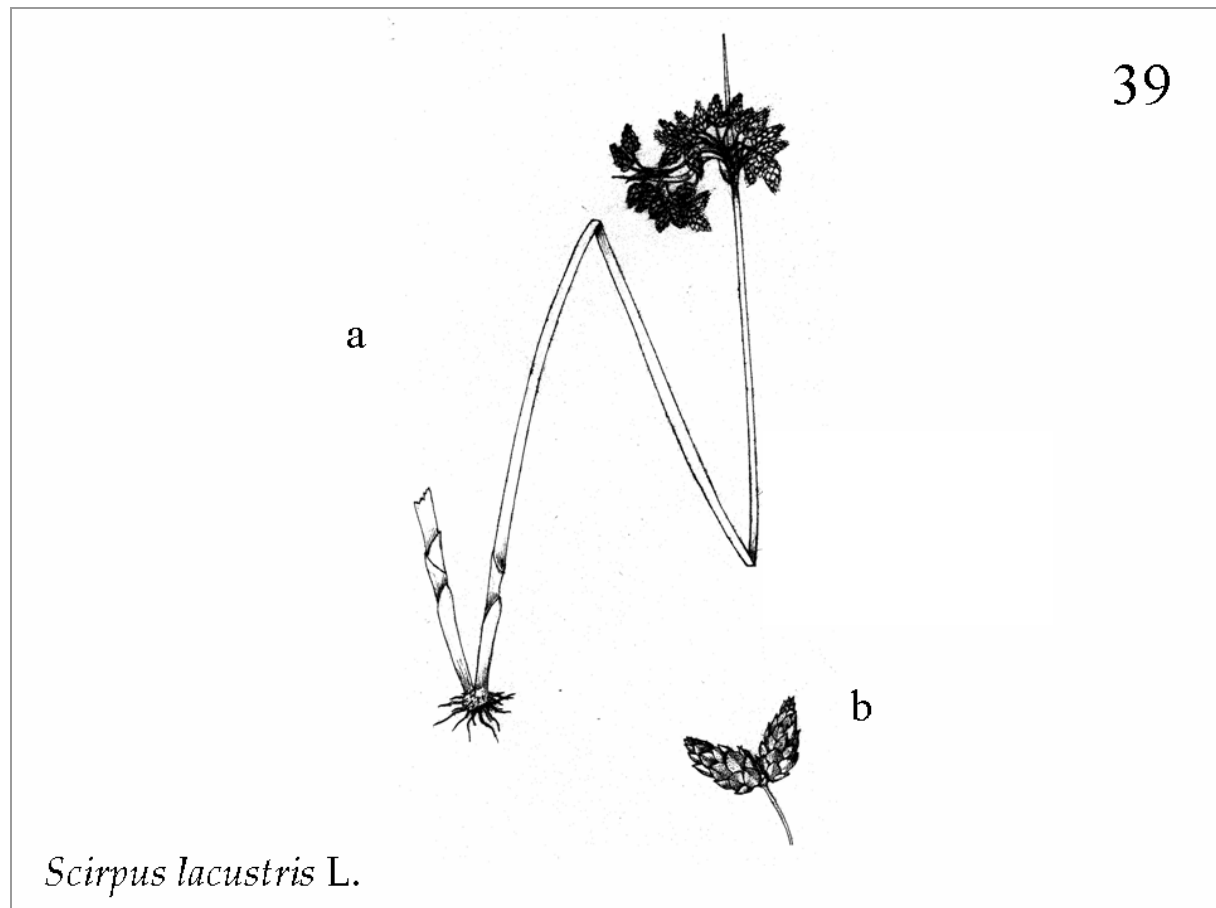


Fig. 39. *Scirpus lacustris* L. (a) Habit, and (b) inflorescence.

CYPERACEAE

39

***Scirpus lacustris* L.**

Synonyms : *Hymenochaeta lacustris* (L.) Nakai, *Schoenoplectus lacustris* (L.) Palla., *Scirpus lacustris* subsp. *validus* (Vahl.) T. Koyama, *Scirpus pterolepis* (Nees) Kunsch., *Scirpus triqueter* var. *segregatus* Clarke, *Scirpus validus* Vahl.

Vernacular name(s) : Tiker (Phil.)

Description : Perennial herb with a stout, scaly rhizome, creeping horizontally. Stems borne rather closely together, erect, (nearly) round, soft and easily compressed, smooth, 5-20 mm at base, 50-200 cm tall. Leaves reduced to sheathing bases, rarely the uppermost with an up to 10 cm long blade. Flower clusters (well) below the top of the stem, 5-10(-15) cm long, consisting of many spikelets. Leaflets at the base of the flower cluster is shorter than the cluster, 2-5 cm. Spikelets solitary or partly in clusters of 2-3, ovoid to oblong-ovoid, rather pointed, densely many flowered, deep brown, 4-5 by 5-10 mm. Nuts with low rounded back, obovate, ending abruptly in a short point, smooth, greyish black, 1.25-1.5 by 2 mm.

Ecology : In open marshes, landward margins of mangroves, open sandy foreshores and freshwater swamps. From 0-1900 m asl. Highly variable cosmopolitan species, found from temperate to tropical areas. Mangrove associate species.

Distribution : Cosmopolitan, from temperate to tropical regions. In Southeast Asia recorded in Vietnam, the Philippines (Luzon) and Papua New Guinea.

Abundance : Very locally distributed in Southeast Asia. Common in temperate regions.

Use(s) : Used for weaving mats in northern Luzon.

Source of illustration : Linnean Herbarium.

Reference(s) : Kern (1974).

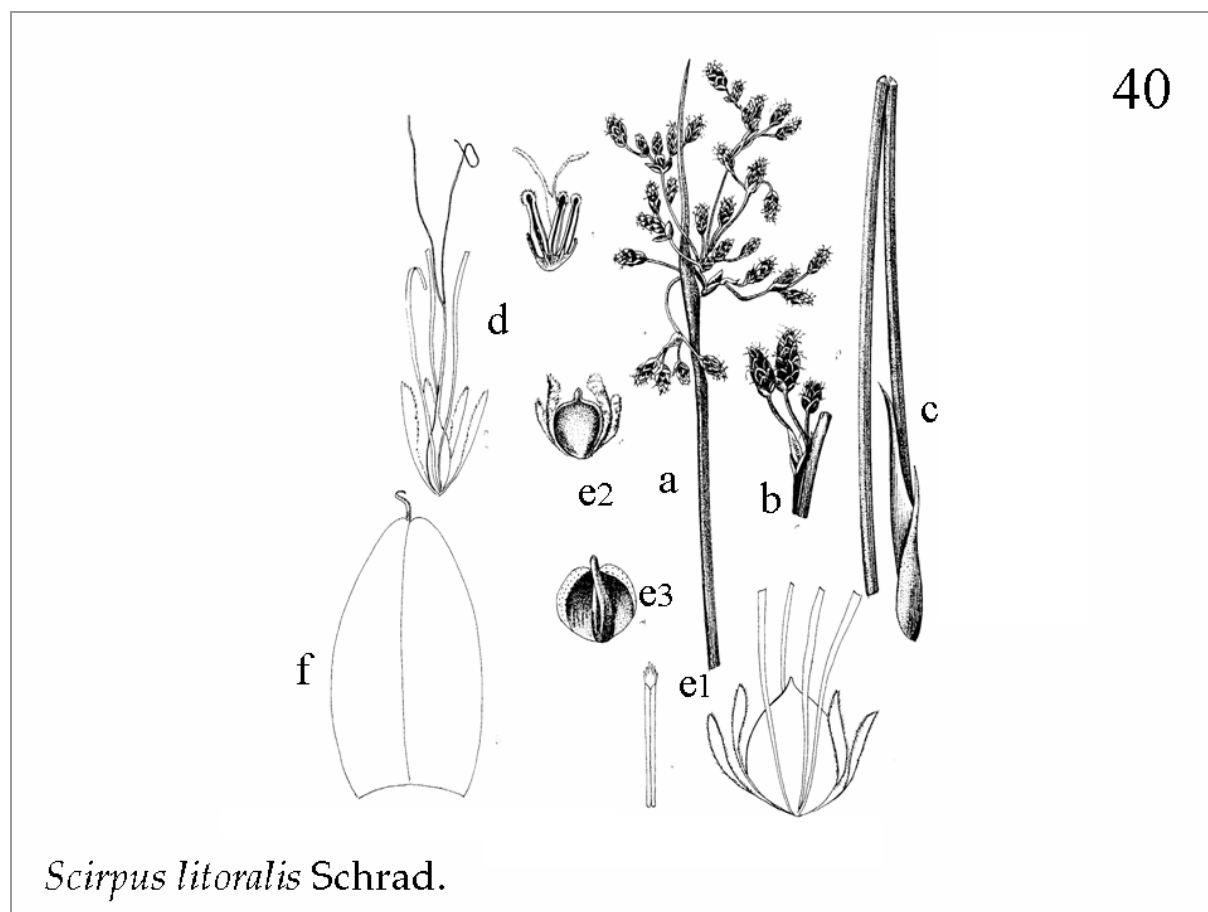


Fig. 40. *Scirpus litoralis* Schrad. (a) Inflorescence, (b) cluster of spikelets, (c) base of stem showing sheathing leaves, (d) flowers, (e) nuts, and (f) leaflet sheathing the nut.

CYPERACEAE

40

***Scirpus littoralis* Schrad.**

Synonyms : *Scirpus lacustris* (non L.) Merr., *Scirpus littoralis* (sic), *Scirpus subulatus* Vahl., *Scirpus thermalis* Trab., *Scirpus validus* (non Vahl.) Beetle.

Vernacular name(s) : Endong, Penjalinan (Ind.)

Description : Large, perennial herb with a short rhizome. Stems are erect, stout, 60-150 cm tall and 3-10 mm wide, round, to bluntly 3-angular near the top. Leaves are reduced to short leaf sheaths, without blades. Flower clusters are 2-8 cm long, and spikelets (see illustration) are solitary, measuring 8-15 by 3-4 mm. It appears very similar to *Scirpus lacustris*, but has looser, less compound flower clusters.

Ecology : Occurs in brackish swamps and saline pools near the sea; habitat includes landward margins of mangroves and brackish water fish ponds. Up to 800 m near Mt. Guntur hot springs (W. Java), and up to 1,000 m along Lake Batur (Bali). Mangrove associate species.

Distribution : From the Mediterranean through South Asia to Australia and Africa. Found in only a few localities in Southeast Asia, in the Philippines (Luzon), Indonesia (a few localities in Java, Bali, Madura, Kangean and the Lesser Sunda Islands, possibly Papua) and Papua New Guinea (Northeast).

Abundance : Rare in Southeast Asia, but locally common.

Use(s) : In Java (Indramayu) it is used for making mats.

Source of illustration : Icones Rijksherbarium Leiden.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Kern (1974).

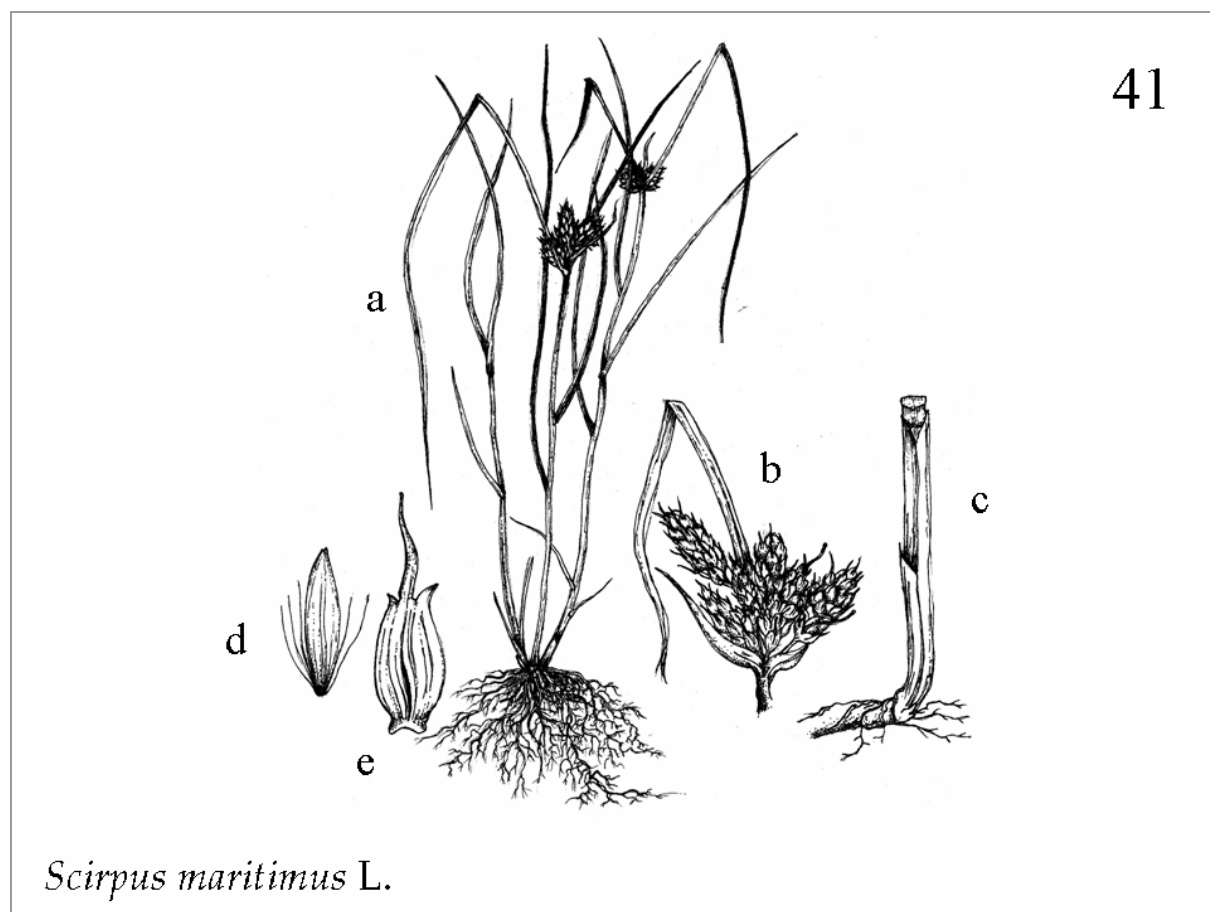


Fig. 41. *Scirpus maritimus* L. (a) Habit, (b) inflorescence, (c) base of stem, (d) nut, and (e) leaflet covering the nut.

CYPERACEAE**41*****Scirpus maritimus* L.****Synonyms :** Unknown.**Vernacular name(s) :** Zeebies (NL)

Description : Extremely variable perennial sedge, 15-180 cm tall, erect. Stem sharply triangular, usually smooth, 1-15 mm thick towards the base, with horizontally creeping rhizome forming hard, round tubers at the nodes. Leaves stiff, flat, long and (1-)2-12 mm wide, the uppermost overtopping the flower clusters. Flowers grouped in terminal clusters or umbels, 1-4(10) cm long, rust-coloured to brownish; spikelets solitary or in groups of 3-10; ovoid to oblong-ovoid, round 1-2(-4) cm long. Fruit a nut, two-sided or bluntly triangular, 2.5-4 mm long, shiny, brown to blackish. Leaflets enveloping the nut are incised, and are armed with one long spike.

Ecology : Generally occurs in brackish habitats. In Southeast Asia it is known from lowland ricefields, tall reed swamps, loose sands on foreshores, and in moist localities. Occurs from sea level to 2500 m asl. Lower Fly River specimens in Papua New Guinea are all very slender. Mangrove associate species.

Distribution : Cosmopolitan, found in temperate, subtropical and tropical regions world-wide. In Southeast Asia it is known from only a few coastal localities namely Laguna de Bay (Philippines) and the Lower Fly River (Papua New Guinea).

Abundance : Common to very common world-wide, but uncommon in Southeast Asia where it is known from four localities only, including the aforementioned two coastal sites. The other two sites are not coastal.

Use(s) : Unknown.

Source of illustration : van Ooststroom (1975), Linnean Herbarium
www.linnaeus.nrm.se/botany/fbo

Reference(s) : Kern (1974), van Ooststroom (1975).

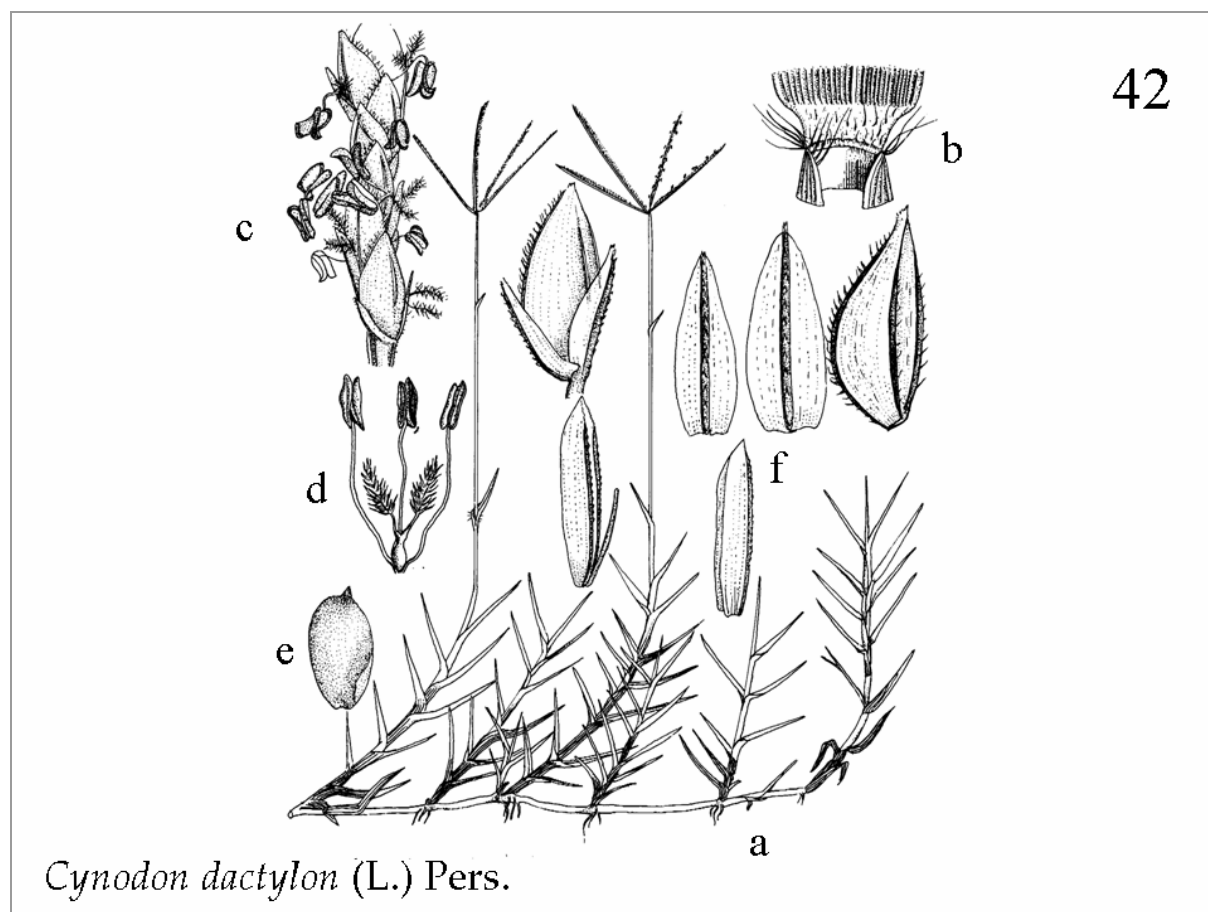


Fig. 42. *Cynodon dactylon* (L.) Pers. (a) Habit, showing creeping stolon, (b) detail of leaf base showing the ligula, (c) detail of spikelet, (d) flower, (e) nut, and (f) various leaflets sheathing the nut.

POACEAE

42

***Cynodon dactylon* (L.) Pers.**

Synonyms : *Capriola dactylon* (L.) O.K., *Cynodon arcuatus* J.S. Presl. ex C.B. Presl., *Cynodon dactylon* var. *glabratus* (Steud.) Chiov., *Cynodon glabratus* Steud., *Cynodon parviglumus* Ohwi, *Cynodon polevansii* Stent., *Panicum dactylon* L.

Vernacular name(s) : Bermuda grass, Carpet grass, Couch grass (E), Jukut Kakawatan, Jukut Raket (Mal.), Gikirintangan, Suket Grinting, Padang Lepas, Padang Kawat, Rebha Core Koko – *Grintangan* (Ind.), Cô'gà (Viet.)

Description : Perennial herb, with wiry, creeping stems that root from the internodes. Flowering stems are erect or ascending, 10-40 cm tall. These flowering stems are slender, compressed, smooth and hollow (in older stems). Leaves occur in two rows, often paired, are pointed, bluish-green, and measure 25-150 by 2-7 mm. Leaves are sparsely covered with long hairs, and have a very short tongue at their base. The flower cluster consists of 3-9 spikelets all located at the end of the flower stalk. Individual spikelets measure 1.5-11 cm, and are sometimes purplish-green. Parts of the plant may produce hydrogen cyanide in their tissues when allowed to wilt under certain conditions, and under such circumstances it may be toxic to cattle.

Ecology : Occurs in sunny to lightly shaded, dry or moist (not marshy) sites, also on hardened soils. Occurs on fallow lands, roadsides and grasslands, sometimes in drier, landward parts of mangroves. Up to an altitude of 2,100 m. Prefers medium to heavy soils, grows on both alkaline and acid soils, and survives both floods and droughts. Mangrove associate species.

Distribution : Pan-tropical, sub-tropical and warm temperate. Found throughout Southeast Asia, but in Indonesia it has not yet recorded in Sulawesi.

Abundance : Common.

Use(s) : Reported by Soerjani *et al.* (1987) as perhaps the most serious weed of the grass family. However, it is a very suitable species for lawns, sports fields and as cattle fodder. It is also a good soil binder.

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Heyne, (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Clayton *et al.* (1974), Soerjani *et al.* (1987).

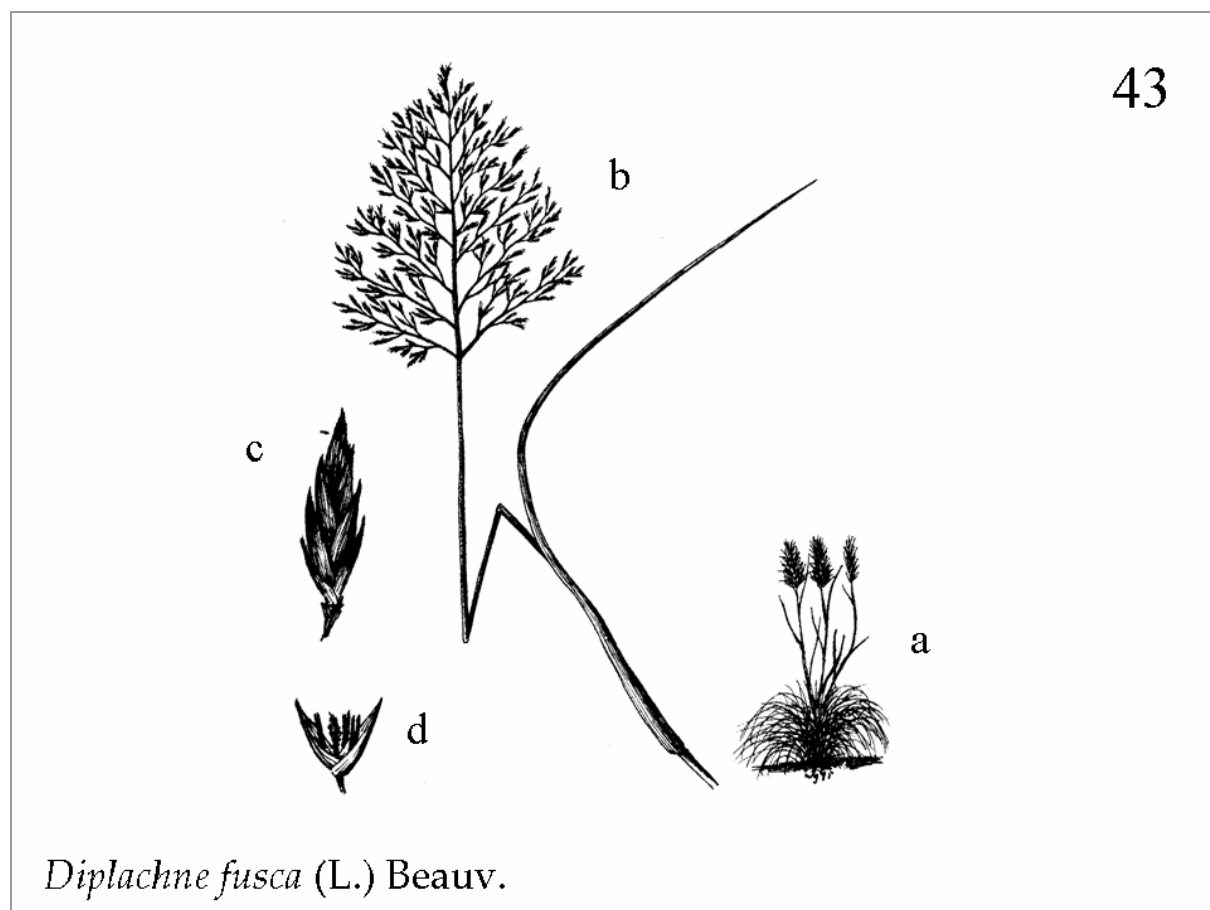


Fig. 43. *Diplachne fusca* (L.) Beauv. (a) Habit, (b) inflorescence, (c) spikelet, and (d) detail of base of spikelet.

POACEAE

43

***Diplachne fusca* (L.) Beauv.**

Synonyms : *Bromus polystachyos* Forsk., *Diplachne polystachya*, *Festuca fusca* L..

Vernacular name(s) : Unknown.

Description : Ascending to erect grass, 30-100 cm tall, that often forms large tussocks. Stems are smooth and without hairs. Leaf blades are 10-25 cm by 6 mm, and are inrolled along the edges and wiry. Leaf sheaths are 10-25 cm long. The tongue at the base of the leaf consists of a 2-5 mm long, finely hairy membrane. The flower cluster is terminal, and about 20 cm long. There are usually 6-10 spikelets (see glossary), 5-10 mm long.

Ecology : Salt-loving grass, occurring in sunny, saline, moist or marshy sites, especially in littoral areas, but also further inland along saline pools and lakes. According to Heyne (1950) it occurs at sea level only, but Sastrapradja & Afriastini (1980) report that it occurs up to 750 m altitude. May form very large, spreading tussocks. Flowering occurs all year round in Indonesia. Mangrove associate species.

Distribution : Tropical and subtropical old world species. Occurs from Africa, Sri Lanka and India, to Southeast Asia and Australia. In Southeast Asia it has been recorded in Myanmar, Thailand, Malaysia (Peninsular), Singapore and Indonesia (known only from Java and Madura).

Abundance : Locally it may be common, but on the whole it is rather uncommon.

Use(s) : Fodder, but perhaps of inferior quality.

Source of illustration : Sastrapradja & Afriastini (1980).

Reference(s) : Heyne, (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Clayton *et al.* (1974), Sastrapradja & Afriastini (1980).

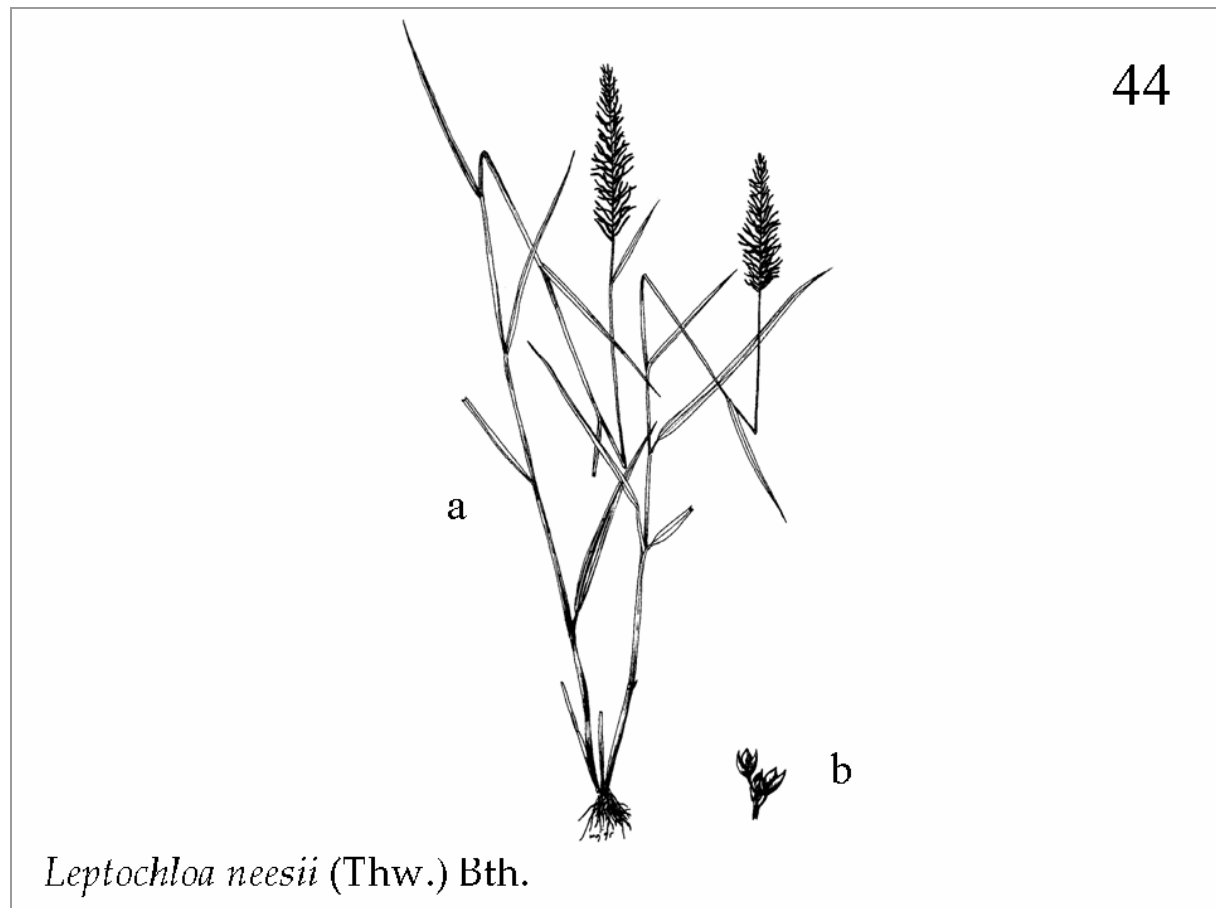


Fig. 44. *Leptochloa neesii* (Thw.) Bth. (a) Habit, and (b) detail of spikelet.

POACEAE

44

***Leptochloa neesii* (Thw.) Bth.**

Synonyms : *Leptochloa panicea* (Retz.) Ohwi, *Leptochloa polystachya* Retz., *Poa panicea* Retz.

Vernacular name(s) : Unknown.

Description : Annual herb, with round, smooth stems, 50-150 cm tall. Leaf sheaths are keeled, smooth, with some long hairs on the nodes. Leaf blades are narrowly linear, pointed, flat, smooth and measure 10-45 cm by 3-6 mm. The irregularly-toothed tongue at the base of the leaf is 2-3 mm long. Flower clusters measure 15-25 cm across.

Ecology : Occurs on heavy, wet clayey soils in coastal areas, preferring saline soils, but also found on inundated rice fields. Flowering recorded in Indonesia (Java) from March-April. Mangrove associate species.

Distribution : Found from Africa to South and Southeast Asia. In Southeast Asia is has been recorded in Myanmar, Thailand, Brunei, Singapore, Malaysia (Peninsular) and Indonesia (Java, but likely to also occur in Sumatra).

Abundance : Uncommon.

Use(s) : Unknown.

Source of illustration : Backer (1934).

Reference(s) : Backer (1934), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971).

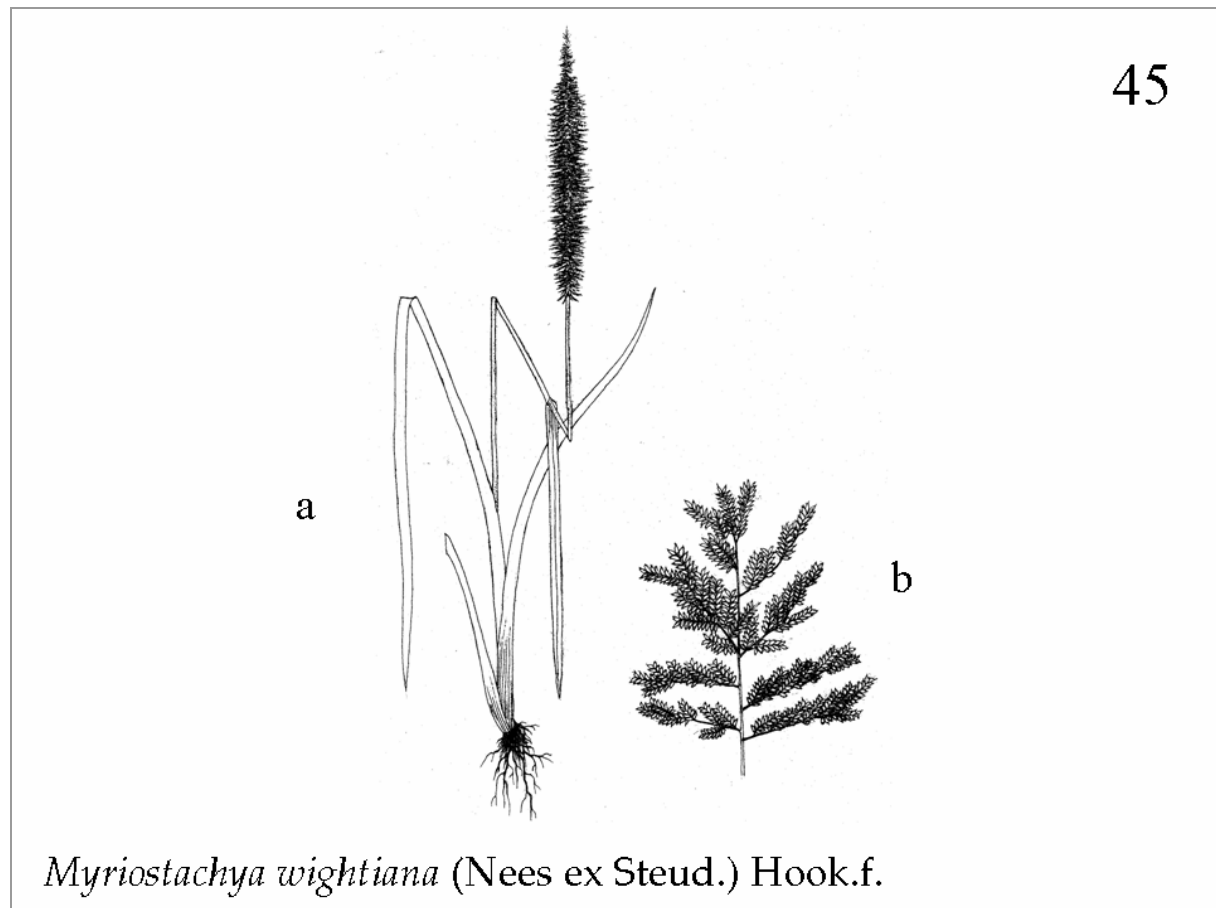


Fig. 45. *Myriostachya wightiana* (Nees ex Steud.) Hook.f. (a) Habit, and (b) inflorescence.

POACEAE

45

***Myriostachya wightiana* (Nees ex Steud.) Hook.f.**

Synonyms : *Dinebra verticillata* Wight ex Steud., *Eragrostis wightiana* Benth., *Leptochloa wightiana* Nees ex Steud., *Myriostachya wightiana* var. *longispiculata* Hook.f., *Myriostachya wightiana* var. *wightiana*

Vernacular name(s) : Rumput laut (Mal.)

Description : Large, densely tufted grass up to 3m tall, stem round, but compressed at the base. Leaf sheaths quite smooth, keeled. Leaf blades usually flat, smooth, long, linear-pointed, up to 80 cm long by 2.6 cm wide; upper leaves narrower; leaf tongue (ligule) is reduced to a very narrow rim. Inflorescence a long narrow panicle, 25-60 cm long by 4-10 cm wide; common stalk of inflorescence is angular and covered with short hairs; primary branches are short and hairy; secondary branches arranged in a numerous spiral. Spikelets are 7-15 mm long by 2.5-3 mm wide, 3-11(-13) flowered. Glumes 1 & 2 unequal, 1-nerved, keeled with a long awn ; stamens 3. Grain obliquely ovoid with a large scutellum. Malayan plants were formerly called var. *longispiculata* by Hooker, their only distinction being that the spikelets are up to (more than) 12 mm long, while the type is 6-8 mm.

Ecology : Estuarine grass in mud or soil influenced by the tides. Often occurring together with *Nypa fruticans*. Mangrove associate species.

Distribution : From South Asia (India, Bangladesh, Sri Lanka) to Southeast Asia, where it has been recorded in Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia and Indonesia (Sumatra).

Abundance : Locally common to very common.

Use(s) : Fodder grass.

Source of illustration : Kindt & Burn (2002)

Reference(s) : Gilliland *et al.* (1971), Kindt & Burn (2002), Missouri Botanical Garden TROPICOS database (www.mobot.org).

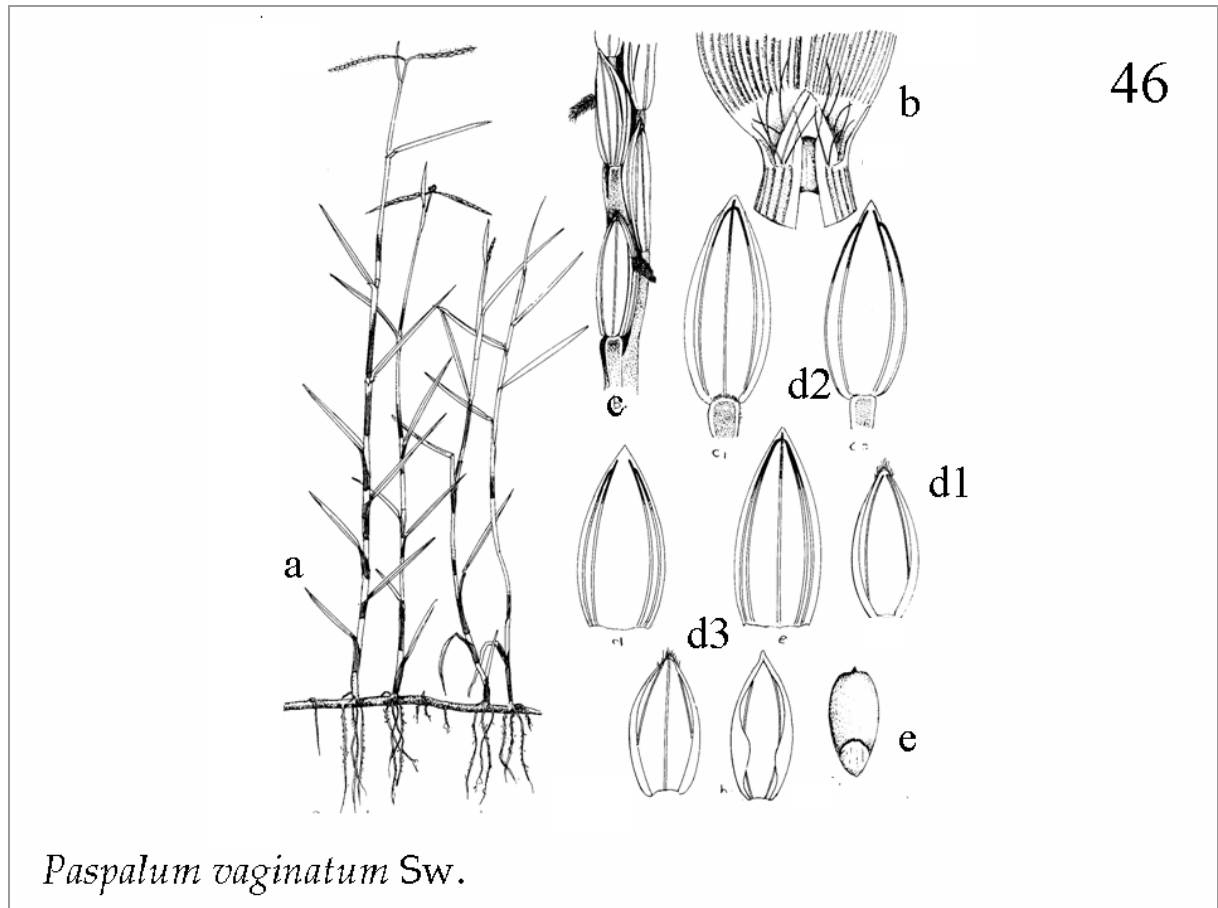


Fig. 46. *Paspalum vaginatum* Sw. (a) Habit, (b) detail of leaf base showing the ligula, (c) detail of spikelet, (d) various leaflets sheathing the nut, and (e) nut.

POACEAE

46

***Paspalum vaginatum* Sw.**

Synonyms : *Paspalum distichum sensu* Ridley, *Paspalum littorale*

Vernacular name(s) : Water Couch Grass, Saltwater Couch, Seaside Millet, Silt Grass (E), Asinan (Mal.), Asinan – *Rumput asinan* (Ind.)

Description : Perennial herb, with creeping, often reddish stolons and erect flowering stems, 12-50 cm tall. Leaves are hairless, bluish-green, 5-17 cm long and 1.5-3.5 (-6) mm wide. Leaf sheaths are smooth, 2.5 cm long. Tongues at the base of the leaves are 0.75-1.25 mm long and membranous, flanked by a few long hairs. The flower clusters are terminal, and usually consist of two spikelets (see glossary), each 15-65 mm long. Occasionally there may be a third, located somewhat lower on the stem.

Ecology : Found on saline mud flats in coastal areas, or inland along saline pools and on wet, waterlogged, or inundated clayey soils. Often in and around mangroves, around brackish-water fish ponds and lagoons. Rarely found on sandy beaches and in tidal rice fields. Rarely occurs in non-saline environments. May form dense stands. Flowering occurs all year round. Mangrove associate species.

Distribution : Pan-tropical and sub-tropical. Recorded throughout Southeast Asia.

Abundance : Relatively common.

Use(s) : Fodder grass, though not of great quality. Used for stabilizing frequently flooded, saline soils. In Taiwan it is reported to be a good salt-binder.

Source of illustration : Soerjani *et al.* (1987).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Soerjani *et al.* (1987).

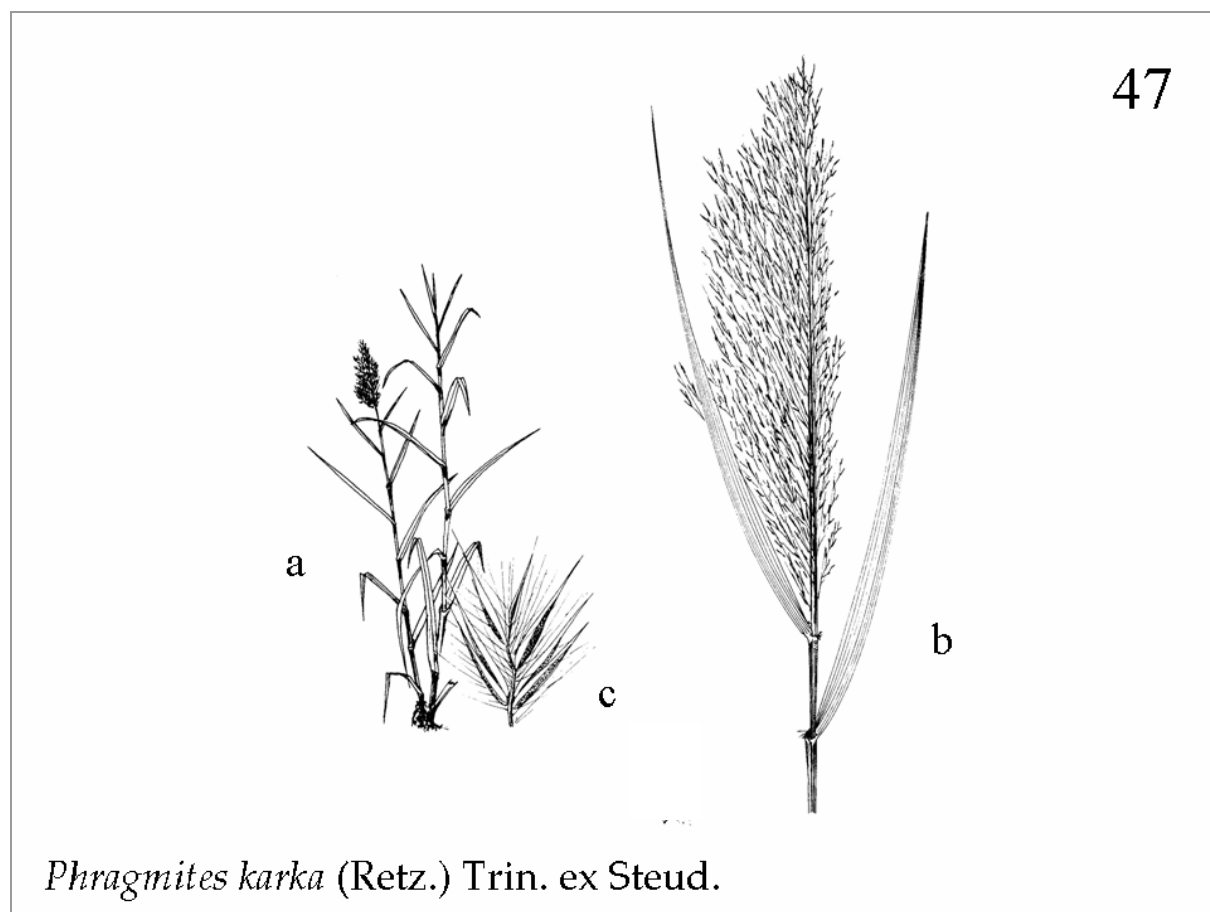


Fig. 47. *Phragmites karka* (Retz.) Trin. ex Steud. (a) Habit, (b) inflorescence, and (c) spikelet.

POACEAE

47

***Phragmites karka* (Retz.) Trin. ex Steud.**

Synonyms : *Arundo karka* Retz., *Phragmites communis sensu* Ridley, *Phragmites filiformis*, *Phragmites roxburghii*

Vernacular name(s) : Reed (E), Riet (NL), Tebu Salah (Mal.), Perumpung, Bajongbong, Gajonggong, Kasongket, Palungpung, Glagah Asu, Prumpung, Parongpong, Gumulong, Tatepal, Tatupele, Biet, Weda – *Palungpung* (Ind.), Sây (Viet.)

Description : Very tall, robust, erect, perennial herb 2-4 m tall with creeping stolons that may be up to 20 m long. Stems are hollow and up to 1.5 cm diameter. Leaves do not have rough edges, and blades measure 20-60 cm by 8-35 mm. Leaf sheaths are smooth, and 15-25 cm long. The leaf tongue or ligule consists of a minute rim, at least on older and larger leaves. Leaves usually have 2-3 shallow depressions, caused by the pressure of mouths of older sheaths. The flower cluster is a 20-75 cm-long, silvery plume, with very many hairy spikelets. *Phragmites karka* is very similar to the temperate *Phragmites communis*, but differs in the presence of hairs on the stems.

Ecology : Occurs from sea level to 1,700 (rarely 2,200) m, in moist and water-logged areas, both freshwater and brackish, along lake shores, streams and walls of moist ravines, and on landward margins of mangroves. Often gregarious. Flowering occurs all year round. Favoured site for nesting or roosting birds, and a number of important bird colonies are located in reed beds (e.g. Javan Pond-herons, Great Egrets and Black-capped Night-herons along the Tulang Bawang River in Lampung, Sumatra; Javan Pond-herons in lakes near Negara, along the Negara River in South Borneo). Mangrove associate species.

Distribution : From India and Sri Lanka, through Southeast Asia to northern Australia. In Southeast Asia it has been recorded in Myanmar, Thailand, Cambodia, Brunei, Malaysia, Vietnam, the Philippines, East Timor, Indonesia (Sumatra, Java, Kalimantan, the Lesser Sundas, the Moluccas and Papua) and Papua New Guinea.

Abundance : Common, locally very common.

Use(s) : Used as thatch, but not very durable. Sometimes flattened with a mallet and used for coarse weaving.

Source of illustration : Adapted from Gilliland *et al.* (1971) and Melisch *et al.* (1993).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Sastrapradja & Afriastini (1980), Melisch *et al.* (1993).

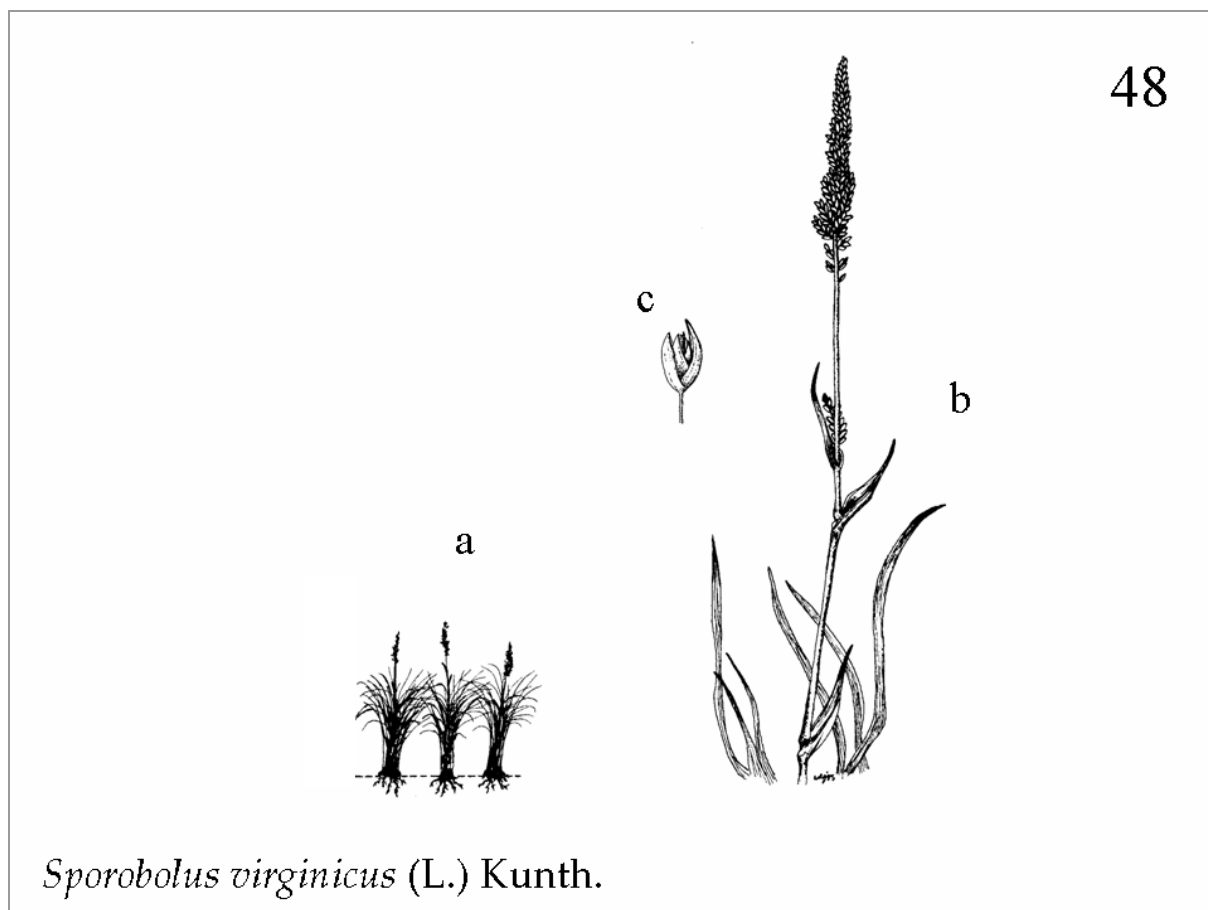


Fig. 48. *Sporobolus virginicus* (L.) Kunth. (a) Habit of several specimens connected by stolons, (b) inflorescence, and (c) spikelet.

POACEAE

48

Sporobolus virginicus* (L.) Kunth.*Synonyms :** *Agrostis virginica* L.**Vernacular name(s) :** Cỏ cây (Viet.)

Description : Perennial herb, with a creeping stolon (Gilliland *et al.*, 1971) or horizontally creeping, deep-lying rhizome (Backer & Bakhuizen van den Brink, 1968) which roots at the nodes. Flowering stems are erect, round, hollow, hard and smooth, 25-50 cm tall. Alternately there are one long and two short internodes. Leaf sheaths are hairy near the blade, and sometimes also along the edge. The leaf tongue (or ligule) consists of a very short rim and is hair-like. Leaf blades are linear, pointed, hairless, fairly rigid, and measure 4-16 cm by 1.5-4 mm. The flower cluster is 10 cm long. The light green leaves are conspicuous.

Ecology : Sand-binding, salt-loving species, occurring on beaches just above high tide levels. Also known from open, sunny, clayey sites that are irregularly inundated with brackish water. Usually occurs gregariously. Flowering probably occurs all year round, but is scarce. Mangrove associate species.

Distribution : From Africa, via Sri Lanka, India, through Southeast Asia to Australia. In Southeast Asia it has been recorded in the Philippines, Myanmar, Cambodia, Peninsular Malaysia, Singapore, Vietnam and Indonesia (Java). According to Heyne (1950) it also occurs in Jamaica. In Indonesia it is rare, and known only from Java and several adjacent small islands.

Abundance : Locally abundant, but rather rare in Indonesia.

Use(s) : Good fodder grass, though rather coarse. Provides a good soil cover on saline soils.

Source of illustration : Wightman (1989).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Wightman (1989), Nguyen *et al.* (2000).

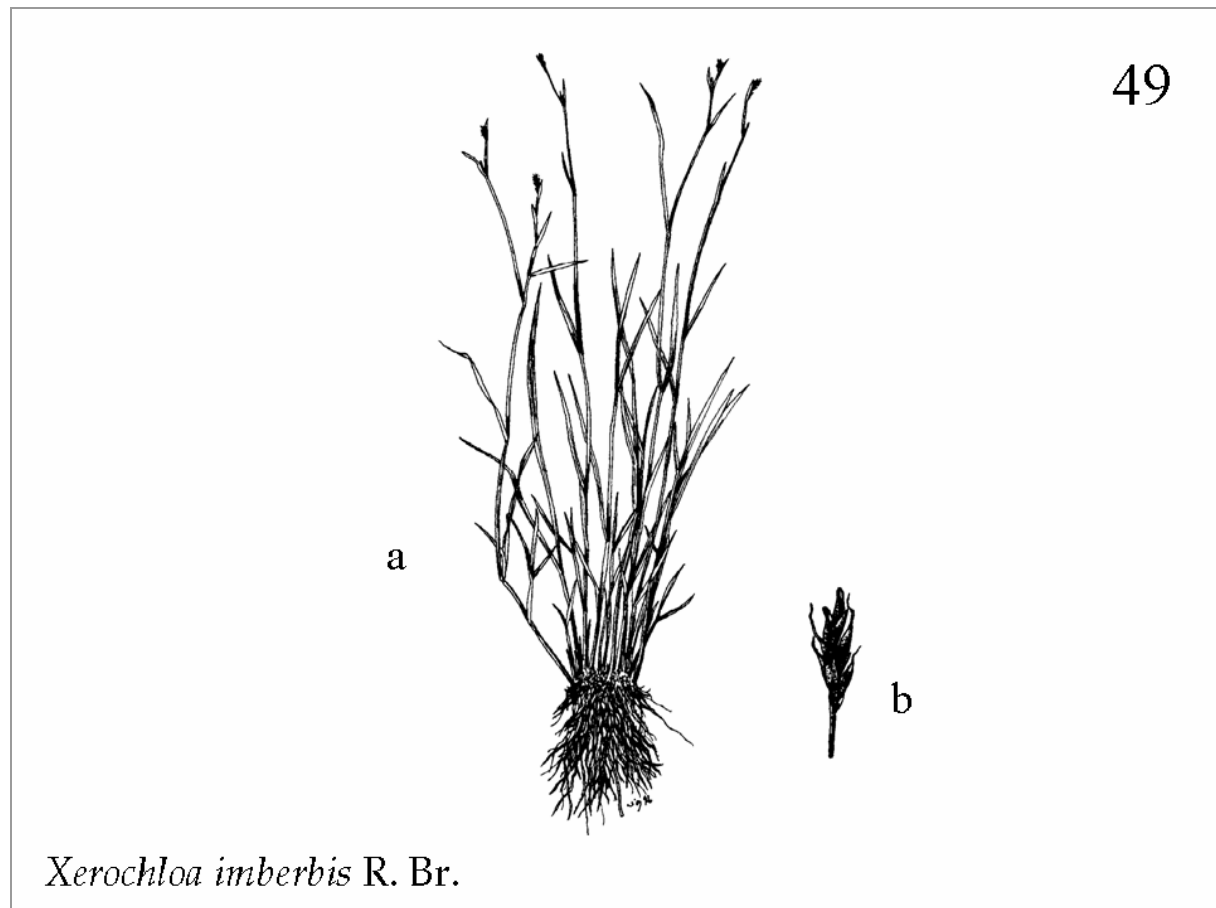


Fig. 49. *Xerochloa imberbis* R. Br. (a) Habit, and (b) spikelet.

POACEAE

49

***Xerochloa imberbis* R. Br.**

Synonyms : *Kerinozoma cheribon* Steud., *Kerinozoma collina* Zoll., *Kerinozoma littoralis* Zoll., *Kerinozoma suraboja* Steud., *Xerochloa littoralis* Baill.

Vernacular name(s) : Rumput bilulang (Ind.)

Description : Perennial herb with creeping stolons and erect flowering stems that are 10-45 cm tall. Stems are slender, round, smooth, solid and hard. Leaf sheaths are short and smooth. Leaf blades are dark green, pointed, narrow, channelled, and measure 1.5-12 cm by 1.5-3 mm. The leaf tongue (or ligule) is very short and hair-like.

Ecology : Salt loving species. Found around salt-wells and on heavy, moist, saline clays that desiccate in the dry season. Especially common around brackish-water fish ponds, along shallow, saline pools and edges of mangroves. In the latter it may form a typical vegetation, characterized by the pale colour of the desiccated leaves. Flowering occurs all year round. Avoided by cattle, as up to 11% of the dry weight may consist of salt. Mangrove associate species.

Distribution : From Southeast Asia to northern Australia, in dry tropical regions. In Southeast Asia it has been recorded from Thailand and Indonesia (dry parts of Java and Madura).

Abundance : Locally not uncommon, but on the whole relatively rare in Indonesia.

Use(s) : May be used to bind soil, and to remove salt from the soil.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Watson and Dallwitz (2004).

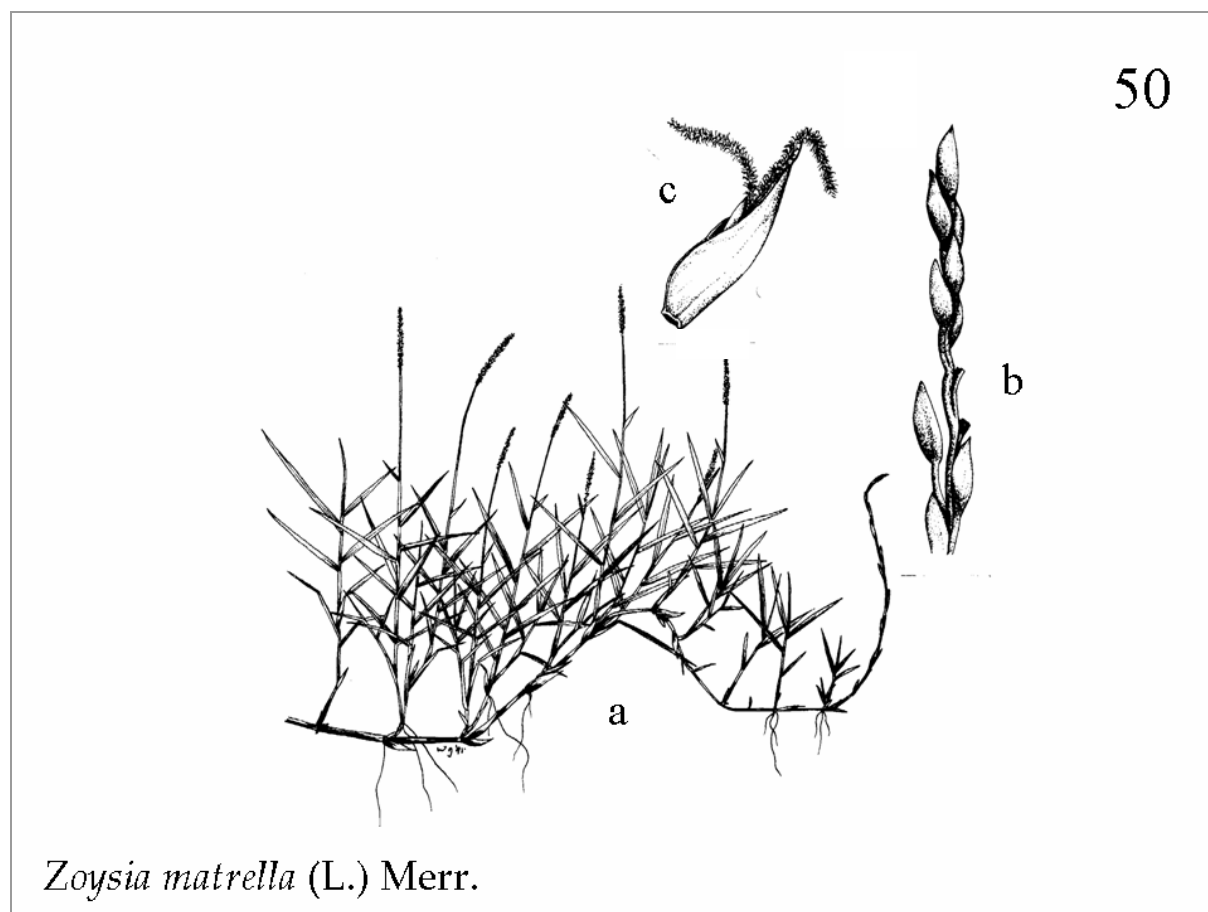


Fig. 50. *Zoysia matrella* (L.) Merr. (a) Habit, showing creeping stolon, (b) spikelet, and (c) detail of flowering.

POACEAE

50

***Zoysia matrella* (L.) Merr.**

Synonyms : *Agrostis matrella* L., *Zoysia malaccensis* Gandoger, *Zoysia pungens* Willd.

Vernacular name(s) : Rebha sekem-sekeman – *Rumput peking* (Ind.)

Description : Small, perennial grass with a creeping rhizome of variable length, or partly with stolons. From the latter arise a large number of erect, flowering stems that are 10-40 cm tall. Rhizomes are 2-3 mm thick, with 2-5 cm-long internodes. Stems are smooth, and partially filled with foamy pith. Leaf sheaths are 1-2.5 cm long, at first tight, later loosening. Leaf blades are linear, pointed, usually inrolled along the edges, smooth, hairless, and measure 3-10.5 cm by 1.5-3 mm. The leaf tongue (or ligule) is very short, about 0.1 mm, and membranous. Spikelets (see glossary) are 2.5-3.5 mm long. May be confused with *Cynodon dactylon* or *Digitaria timorensis*.

Ecology : Occurs in sunny to slightly shaded localities, in moist to dry places, along the coast. From sea level to 300 m altitude, on both saline and non-saline soils, especially on loam, sandy loam or soils with abundant calcium carbonate. Occasionally found near salt-wells. May form dense, extensive stands, but usually with a low biomass. Occasionally it occurs in the landward parts of mangroves. Flowering occurs all year round. Mangrove associate species.

Distribution : Tropical and subtropical Asia and Australia, introduced elsewhere (e.g. Kenya). Recorded in Southeast Asia in Peninsular Malaysia, Singapore and Indonesia (Sumatra, Bangka, Kalimantan, Java and the Moluccas).

Abundance : Common.

Use(s) : In coastal areas it is useful as a lawn grass. Low biomass and nutritive value make it a poor fodder grass.

Source of illustration : Gilliland *et al.* (1971).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Gilliland *et al.* (1971), Clayton *et al.* (1974), Sastrapradja & Afriastini (1980).

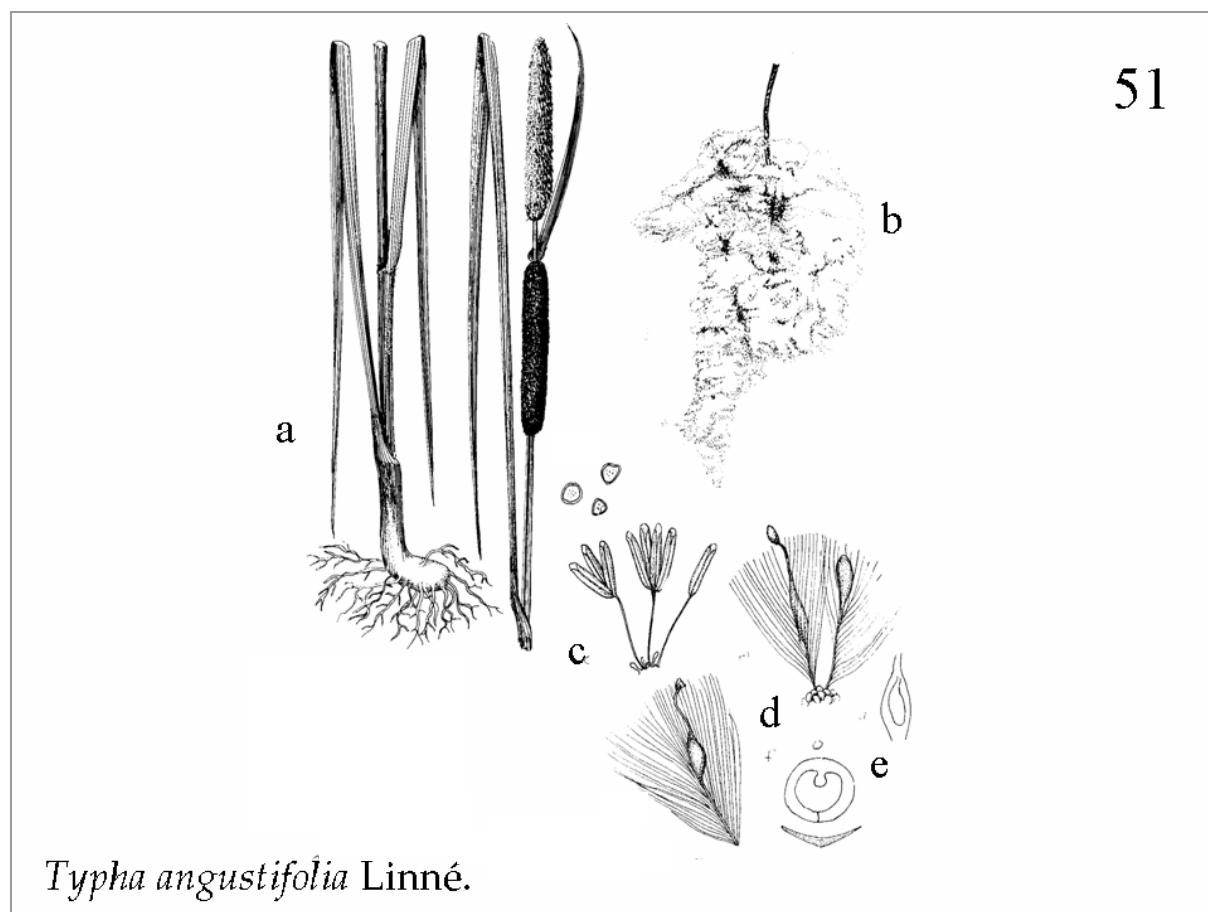


Fig. 51. *Typha angustifolia* Linné. (a) Habit, (b) ripe inflorescence, (c) stamens, (d) flowers interspersed with long, woolly hairs, and (e) cross sections of embryo (nut).

TYPHACEAE

51

Typha angustifolia Linné

Synonyms : *Typha angustata*, *Typha angustifolia* ssp. *javanica*, *Typha capensis* (non Rohrb.) Hall., *Typha domingensis* Pers., *Typha domingensis* var. *javanica* Geze, *Typha javanica* Schnizl., *Typha orientalis* Briggs & Johnson.

Vernacular name(s) : Cattail, Bulrush (E), Lisdodde (NL), Lembang (Mal.), Embet, Walini, Asiwung raja matri, Wawalingian, Heikre (Ind.), Balangot (Phil.), Taktenas (ET)., Bô'n bô'n (Viet.)

Description : Robust, erect, perennial herb, 1.5-3 m tall, with a round stem. Leaves are linear, rather pointed, 8-22 cm by 6-16 mm, very convex beneath, and divided by partitions into a great number of compartments. Flowers are arranged on a brown, cigar-like spike, the males on the top 15-30 cm, and the females on a slightly shorter section below this. They are separated by 0.5-12 cm without flowers. Flowers are interspersed with long, fluffy, woolly hairs. Briggs & Johnson (in van Steenis, 1972) are of the opinion that Malesian *Typha angustifolia* differs from northern hemispheric material. On the basis of material from Australia and the Philippines they established that the former is *Typha domingensis* (2n = 30), different from the Southeast Asian material (2n = 60), which they term *Typha orientalis*.

Ecology : Occurs at low altitudes, often growing gregariously, and in brackish waters. Also in mountainous areas up to an altitude of 1,725 m. Found along brackish-water fish ponds, and on landward margins of mangroves. Mangrove associate species.

Distribution : The genus occurs between the arctic circle and 35°S, and *Typha angustifolia* reportedly occurs throughout this range. In Southeast Asia it has been recorded from the Philippines, Myanmar, Brunei, Thailand, Malaysia, Vietnam, Cambodia, Singapore, Indonesia (Sumatra, Java, Karimunjawa, Bawean, Madura, Kangean and Papua), East Timor and Papua New Guinea.

Abundance : Common, but with a very local distribution.

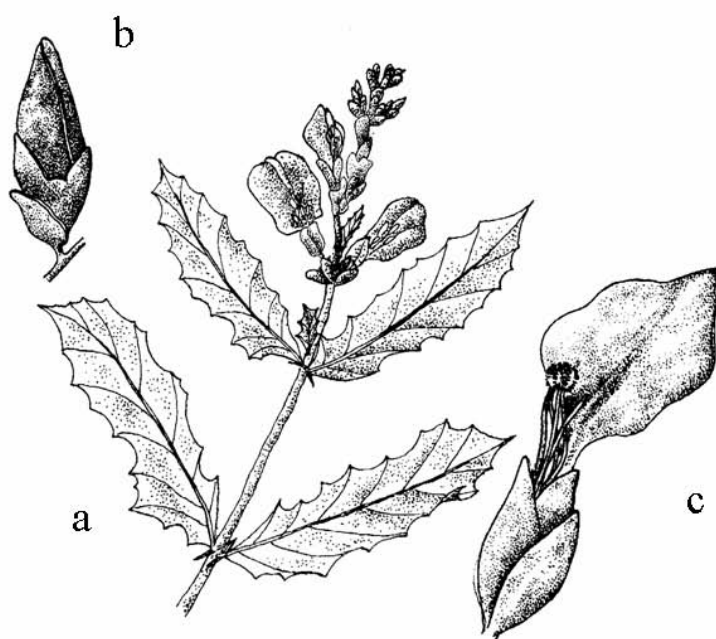
Use(s) : Rhizomes are rich in starch, and are eaten in many regions when food is scarce. Leaves are used for thatching, matting and coarse basket work. The spikes (flower/fruit clusters) are often used for decoration. Plush of the ripe spike was formerly used for stuffing pillows. Unripe plush is used for making fuses.

Source of illustration : van Steenis (1972), and Icones Rijksherbarium Leiden.

Reference(s) : Heyne (1950), Backer (1951), van Steenis (1972).

**GROUP C: OTHER GROUND-DWELLING
HERBS
(not grasses or ferns)**

52

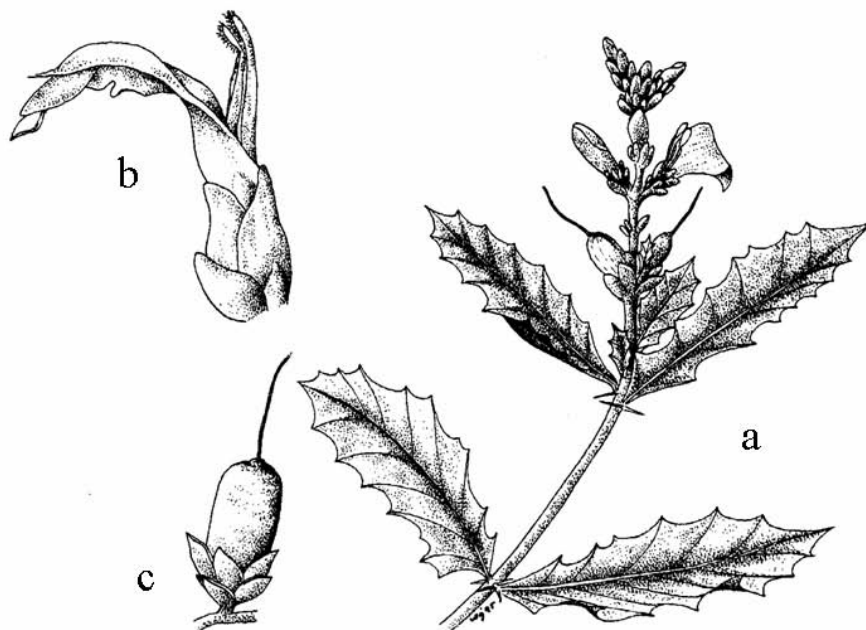


Acanthus ebracteatus Vahl.

Fig. 52. *Acanthus ebracteatus* Vahl. (a) Habit, (b) bud, and (c) flower.

ACANTHACEAE**52*****Acanthus ebracteatus* Vahl.****Synonyms :** Unknown.**Vernacular name(s) :** Sea Holly (E), Jeruju (hitam) (Mal.), Jeruju (Ind.), Ô rô (Viet.), Trohjekcragh pkapor sar, Trohjekcragh slekweng (Camb.), Ngueak plaamo dok muang (Thai)**Description :** *Acanthus ebracteatus* resembles *Acanthus ilicifolius* (see next page), but all parts are smaller. Flowers measure 2-3 cm and are (usually) white; the fruit is shorter than 2.0 cm; seeds measure 5-7 mm. Flowers have only one main enveloping leaflet, as the secondary ones are usually rapidly shed. The species described by Rumphius as the male specimen of *Acanthus ilicifolius* was later identified by Merrill as *Acanthus ebracteatus* Vahl. Some authors regard *Acanthus ebracteatus*, *Acanthus ilicifolius* and *Acanthus volubilis* as one highly variable species (e.g. Heyne, 1950). Note that in *Acanthus* young leaves or leaves on the ends of branches may be unarmed (i.e. without spines), while older specimens may be armed.**Ecology :** Where this species occurs together with *Acanthus ilicifolius* the two seem distinct in the characters used in the descriptions, but they are often confused. Flowering usually occurs in June (in Indonesia). True mangrove species.**Distribution :** From India to tropical Australia, Southeast Asia and the west Pacific islands (e.g. Solomon Islands). In Southeast Asia it has been recorded in Cambodia, Myanmar, the Philippines, Vietnam, Malaysia, Singapore, Indonesia and Papua New Guinea. Perhaps overlooked elsewhere (East Timor, Brunei).**Abundance :** Common.**Use(s) :** Fruit is pounded and used as a blood purifier and dressing for burns. Leaves relieve rheumatism. A compress of the fruit or roots is sometimes applied in cases of snakebite and arrow poisoning. Seeds are said to be used to treat internal worms.**Source of illustration :** Tomlinson (1986) and Wightman (1989).**Reference(s) :** Watson (1928), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Ng & Sivasothi (1999), Marschke (2000), <http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>

53



Acanthus ilicifolius L.

Fig. 53. *Acanthus ilicifolius* L. (a) Habit, (b) flower, and (c) fruit.

ACANTHACEAE

53

***Acanthus ilicifolius* L.**

Synonyms : *Acanthus neo-guineensis*, *Aquifolium indicum* Rumph.

Vernacular name(s) : Sea Holly (E), Jeruju puteh (Mal), Jeruju, Daruyu – *Jeruju* (Ind.), Ô rô gai (Viet.), Trohjekcragh pkaporsvay, Trohjekcragh slekbanla (Camb.), Ngueak plaamo dok khao (Thai)

Description : A low, sprawling or somewhat straggling, robust herb, slightly woody, up to 2 m tall. Shoots are initially erect but tend to lean or sprawl with age. Branching is infrequent and commonly occurs from older shoots. Aerial roots emerge from the lower surface of horizontal stems. Two spines flank the leaf stalk on the stem. The leaves are smooth, 9-30 x 4-12 cm, and gradually taper towards the base; broadly lanceolate, either with or without an entire leaf edge. The rounded leaf tip usually has a spiny edge and always has a spine on the very end. Flowers occur in terminal spikes, 10-20 cm long. Individual flowers measure 3.5-4 cm long, and are usually pale mauve or violet; rarely they are white, and this may lead to confusion with *Acanthus ebracteatus*. Flowers have one main enveloping leaflet subtended by two secondary ones. Unlike *Acanthus ebracteatus*, these leaflets remain attached throughout the life of the plant. Fruits are 2.5-3 cm long, nut-like, with seeds that measure 10 mm. The flower cluster is usually longer than 10 cm. Some authors regard *Acanthus ebracteatus*, *Acanthus ilicifolius* and *Acanthus volubilis* as one highly variable species (e.g. Heyne, 1950). Note that in *Acanthus* young leaves or leaves on the ends of branches may be unarmed (i.e. without spines), while older specimens may be armed.

Ecology : The species nearly always occurs in and near mangroves, and only very rarely is it found further inland. Typically a low, robust herb that owes its ability to spread vegetatively to its rooting of horizontal stems so that it forms large, thorny (and hence impenetrable) patches. Flowers are probably pollinated both by birds and insects. Seeds are propelled away, up to about 2 m. True mangrove species.

Distribution : Found from India to southern China, tropical Australia and the western Pacific islands, including New Caledonia and the Solomon Islands. Occurs throughout Southeast Asia.

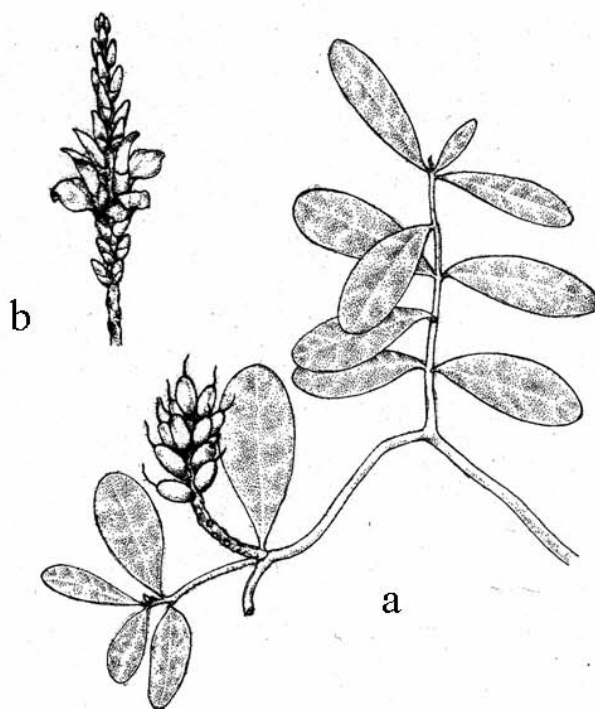
Abundance : Common.

Use(s) : Fruit is pounded and used as a blood purifier and dressing for burns. Leaves relieve rheumatism. A compress of the fruit or roots is sometimes applied in cases of snakebite and arrow poisoning. Seeds are said to be used to treat internal worms. The plant is also used for fodder.

Source of illustration : Tomlinson (1986) and Wightman (1989).

Reference(s) : Watson (1928), Burkill (1935), Heyne (1950), Backer & Bakhuizen van de Brink (1963), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Ng & Sivasothi (1999), Marschke (2000).

54



Acanthus volubilis Wall.

Fig. 54. *Acanthus volubilis* Wall. (a) Stem with fruit, and (b) inflorescence.

ACANTHACEAE

54

Acanthus volubilis* Wall.*Synonyms :** Unknown.**Vernacular name(s) :** Jeruju (Mal.)

Description : Semi-erect to climbing herb with thin, wiry, (usually) spineless, dark-green, smooth stems. The plant is a twining herb/shrub, attaining height up to 4(-8) m, with many branches. Often a tap root system develops, and occasionally the base of the stem is supported by slender stilt-roots arising from basal nodes. Leaf blades have smooth, entire (i.e. not toothed) edges or may be slightly lobed. They are usually without spines, succulent to leathery, oblong-lanceolate, measuring 2.5-5 by 7-9 cm and have a blunt tip. Leaves simple, opposite, with a leaf stalk about 1.0 cm long, slightly flattened and green. Flowers occur in neatly organised 10-12 cm long spikes located at the ends of the branches. Like *Acanthus ebractatus* the petals are white, turning brown when older. Flowers measure 1.9-2.5 cm length. There are 4 sepals of mixed sized, green, smooth, leathery, curved and pointed; petals number 5, fused to form single plate, and the base is fused, forming a hollow, short tube, while the point flattened to form 5 short 2-lipped lobes. Fruits are very rarely formed, consisting of a capsule about 2.5 cm long, ellipsoid and flattened. Differs from *Acanthus ilicifolius* by its smaller flowers, and from both *Acanthus ilicifolius* and *Acanthus ebractatus* by the absence of spines, and its slender, sprawling to twining stems. Note that in *Acanthus* young leaves or leaves on the ends of branches may be unarmed (i.e. without spines), while older specimens may be armed.

Ecology : Found in tidal mud among grasses and other herbs. Similar mangrove habitat as other *Acanthus* species. True mangrove species.

Distribution : Found from South to Southeast Asia. Recorded in eastern India (Orissa), Sri Lanka and the Andaman Islands, to Myanmar, Indonesia, Cambodia, Malaysia, Singapore, Thailand and Papua New Guinea.

Abundance : Uncommon. Only known from a few localities in small numbers. Listed as vulnerable in Singapore.

Use(s) : From Malay folklore, powdered seeds are taken with water as a blood cleansing medicine and against ulcers.

Source of illustration : <http://www.indian-ocean.org/bioinformatics/mangrove/MANGCD/Acanth4.htm>

Reference(s) : Tomlinson (1986), Ng & Sivasothi (1999)
<http://mangrove.nus.edu.sg/guidebooks/text/1047.htm>
<http://www.indian-ocean.org/bioinformatics/mangrove/MANGCD/Acanth4.htm>

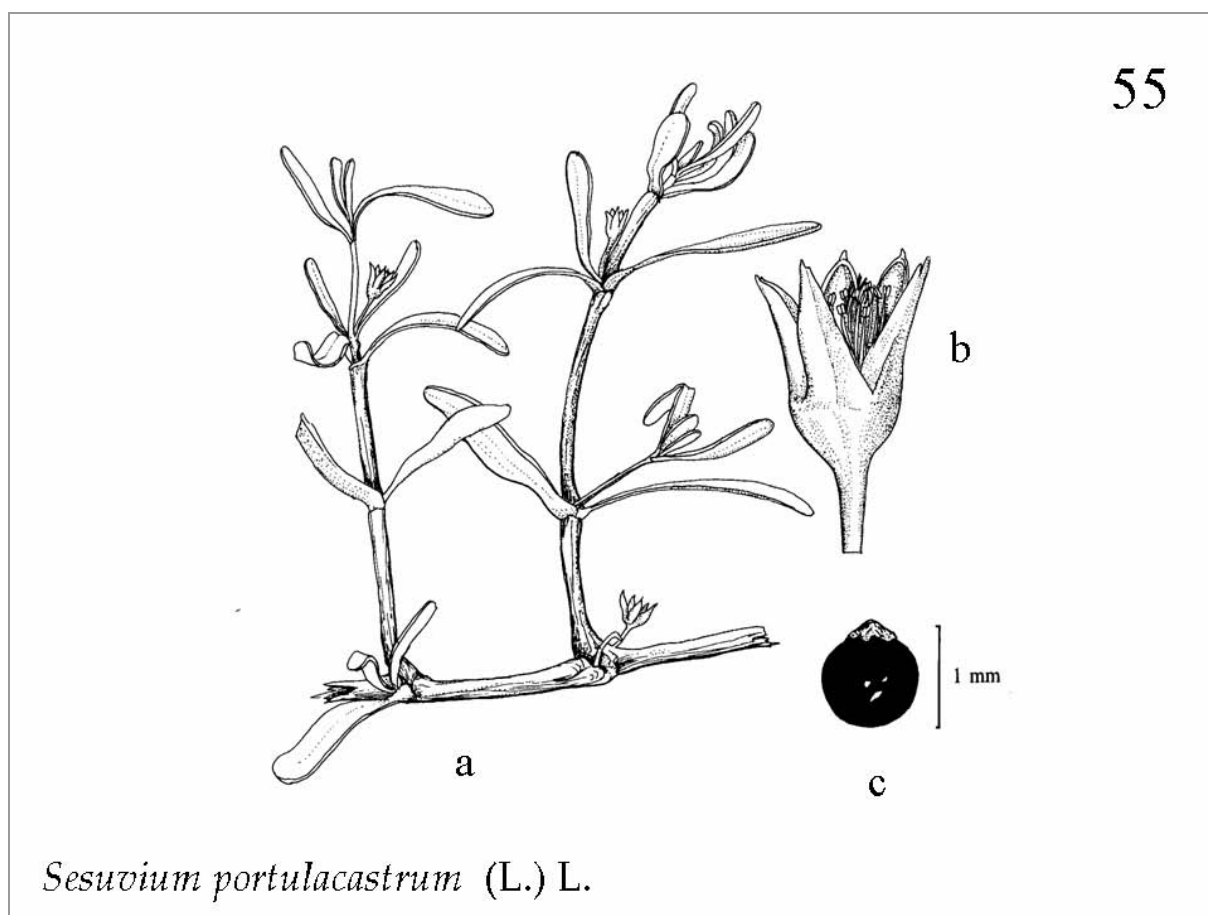


Fig. 55. *Sesuvium portulacastrum* (L.) L. (a) Detail of flowering stem, (b) flower, and (c) fruit.

AIZOACEAE

55

***Sesuvium portulacastrum* (L.) L.**

Synonyms : *Crithmus indicus* Rumph., *Portulaca portulacastrum* L., *Pyxipoma polyandrum* Fenzl., *Sesuvium polyandrum* Fenzl. ex Britt., *Sesuvium repens* Willd., *Trianthema polyandrum* Bl.

Vernacular names : Gelang (-laut), Saruni Air (Mal.), Krokot (Ind.), Bilang-bilang, Dampalit, Tarumpalit (Phil.), Rau heo (Viet.)

Description : Usually a many branched, spreading, creeping and succulent perennial herb. It is up to 1 m long, with smooth, frequently conspicuous, bright red stems that root at the nodes. The fleshy leaves are linear, lanceolate or oblong-lanceolate, 2.5-7 by 0.5-1.5 cm. Flowers occur in the leaf axils. The pink flowers have a 3-15 mm-long stalk and a 3 mm-long flower tube with five 6-9 mm-long lobes that have membranous edges. Flowers have numerous pink or pinkish-violet stamens and 3-4 styles. The capsule-like fruit is round and smooth, and is about 8 mm across. There are several pea-shaped, smooth, black seeds, 1.5 mm across. In older literature, it is often recorded as a member of the closely related Molluginaceae family, or as a member of the Ficoidaceae (a synonym of the Aizoaceae).

Ecology : Commonly found in dense patches, along landward margins of mangroves, and on mudflats and sand dunes in areas that are irregularly inundated by tides. Substrates of sands, muds and clayey soils are colonised. It is also found on rocky beaches, between coastal fish ponds and along tidal creeks. The flowers close at night and when the sky is overcast. Flowering occurs throughout the year. Small, pollen-collecting bees and day-flying moths pollinate the flowers. The seeds are not buoyant. Mangrove associate species.

Distribution : Pan-tropical species; found throughout Southeast Asia, but not (yet) recorded in Borneo.

Abundance : Locally common.

Use(s) : Leaves are edible after repeated washing and cooking. In Thailand, this plant is also used widely as forage and feed for sheep, cattle and pigs and even as a vegetable for human consumption.

Source of illustration : Wightman (1989).

Reference(s) : Heyne (1950), Backer (1951), Backer & Bakhuizen van den Brink (1963-8), Wightman (1989), <http://ratree.psu.ac.th/~bnoparat/MANGROVE.html>

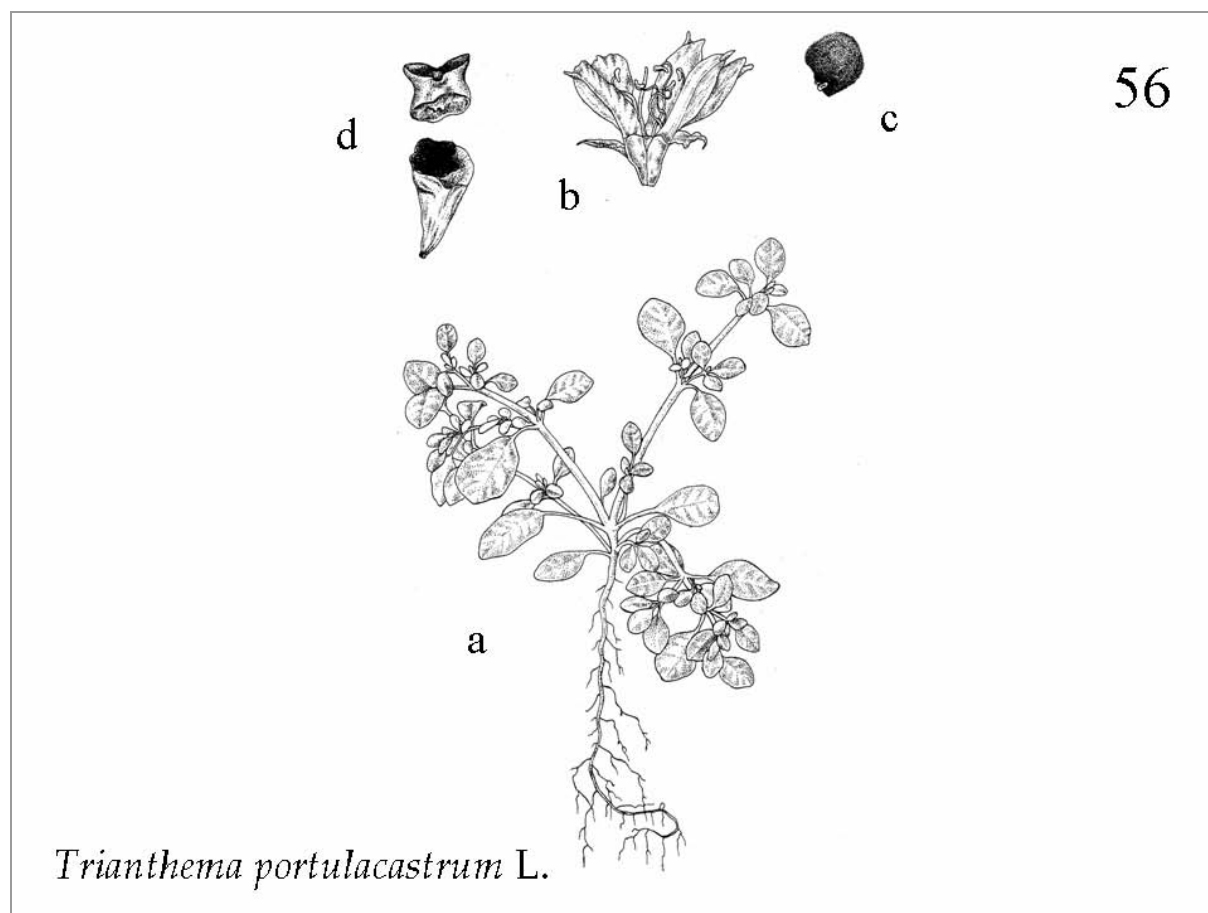


Fig. 56. *Trianthema portulacastrum* L. (a) Habit of flowering plant, (b) flower, (c) seed, (d) fruit two crested (opened), with seeds exposed.

AIZOACEAE**56*****Trianthema portulacastrum* L.**

Synonyms : *Portulaca axilliflora* (non Pers.) Blanco, *Portulaca monogynum* (L.) Medik., *Portulaca toston* Blanco, *Trianthema flexuosum* Schumach. & Thon., *Trianthema littoralis* Cordem., *Trianthema monanthogyna* L., *Trianthema monogyna* L., *Trianthema obcordata* Roxb., *Trianthema procumbens* Mill.

Vernacular name(s) : Horse purslane (E), Krokot, Telekan, Krajep (Ind.), Ayam, Ulisuman, Toston (Phil.)

Description : Prostrate or ascending, often much branched annual succulent herb, that usually forms a robust taproot. The stems are almost round or slightly angular, thickened and flattened at the nodes, smooth or finely hairy, and 15-50 cm long. Branches in the axils of the smaller leaves of the pairs, in an alternating pattern. Leaves are bright green, (thinly-)fleshy, and are opposite, entire, with a purple edge, smooth (except for the stalk). Leaves of each pair are very unequal in size: the larger leaves are oval-obovate with a wedge shaped base, 1-4.5 by 1.5-5 cm; smaller leaves are 4-25 by 8-30 mm. Leaf stalks 4-30 mm long, slightly hairy; sheathing, and membranous bases link pair wise into a funnel-shaped pouch, bearing a small leaflet. Flowers have no visible stalks, and their lower parts hidden by the leaf stalk pouch. Flowers occur singly or in small groups together in the leaf and branch axils, and are open only in the mornings. The calyx/corolla measures 4-5 mm across, is 5-merous, usually pale pink, rarely white and rose-purple within. The tube of the flower is fused throughout its length to the base of 1-2 leaflets; each flower bears a thickened hornlike tip on the back. Stamens number 6-10(-25), with smooth, white filaments, 2-3 mm, and pale pink anthers. Fruit is a top-shaped capsule/small seedpod, with the upper part thickened and 2-crested, falling away as a lid when the 1-2(-5) seeds are mature. The thick, blackish seeds are square-shaped, somewhat heart-shaped, or kidney-shaped, about 1.75-2.5 mm broad, and covered by whitish, wavy ridges. In older literature, it is often recorded as a member of the Ficoidaceae, which is a synonym of the Aizoaceae.

Ecology : Found in dry areas, especially along the coast, up to an altitude of 200 m asl (Java); in sunny, periodically dry areas on saline soils. Also common along roadsides and in cultivated areas. Its preferred habitat appears to be clayey soils near the sea. Mangrove associate species.

Distribution : Pantropical. In Southeast Asia recorded in the Philippines, Thailand, Malaysia, Indonesia (Java, Lesser Sundas, Moluccas, Papua), East Timor and Papua New Guinea.

Abundance : Locally common.

Use(s) : Young leaves are sometimes eaten as a vegetable.

Source of illustration : <http://www.doa.go.th/botany/trianthema%20portulacastrum.html>
<http://www.uapress.arizona.edu/online.bks/weeds/graphics/fig61.gif>

Reference(s) : Backer (1951).

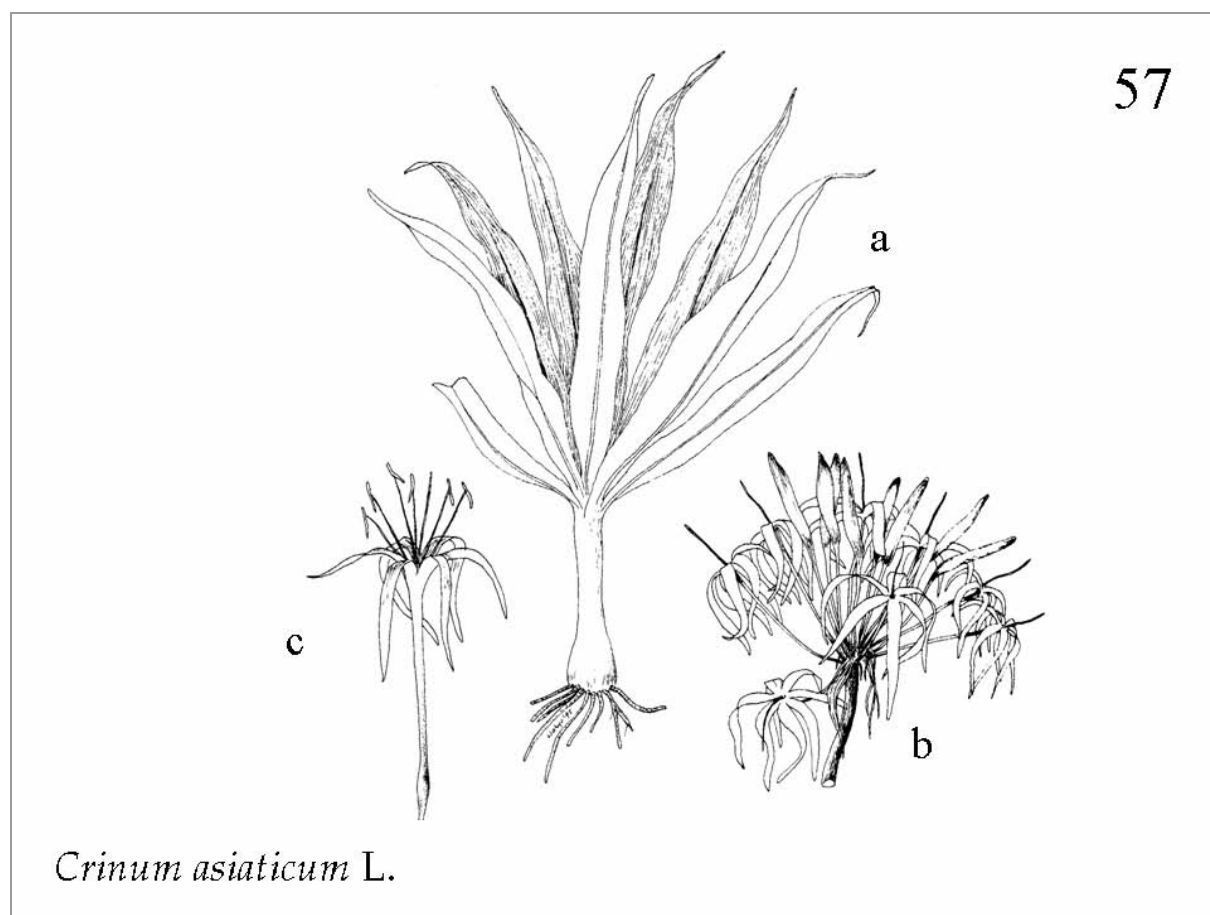


Fig. 57. *Crinum asiaticum* L. (a) Habit, (b) flower cluster, and (c) single flower.

AMARYLLIDACEAE

57

***Crinum asiaticum* L.**

Synonym(s) : *Crinum amabile* Donn., *Crinum cortifolium* Hallier, *Crinum defixum* auct. non. Ker-Gawl., *Crinum firmifolium* var. *hygrophilum* H.Perrier, *Crinum giganteum* auct. non. Andr. Blanco, *Crinum macrantherum* Engler, *Crinum macrophyllum* Hallier, *Crinum northianum* Baker, *Crinum pedunculatum* R.Br., *Crinum rumphii* Merr., *Crinum sumatranum* Roxb., *Crinum toxicarium*, *Haemanthus pubescens* auct. non. L. f : Blanco, *Radix toxicaria*

Vernacular name(s) : Poison Lily (E), Tembaga Suasa, Bakong, Bakung, Bawang Hutan, Kajang-kajang, Semur, Fete-fete, Nopu, Da-usa – *Bakung* (Ind.), Nàgg ho' ráy (Viet.)

Description : The base of the stem (actually the lower part of the leaves) is rounded and fleshy, large, and has a stout, 60 cm long neck. It has an underground, fleshy bulb. Leaves are lanceolate, with a pointed tip and measure 50 cm to 1.25 m long, and 12-15 cm wide. Flowers are usually quite numerous and conspicuous. The flower tube is green, 7-15 cm, while the flower lobes are white, sweet scented and measure up to 8-9 cm long. Stamens are crimson with a white base, and the style is dark red. Fruit is irregularly rounded and white, about 5 cm in diameter. Seeds are green and irregular in shape. This species may be confused with *Hanguana malayana* (*Flagellariaceae*), which is known throughout Malesia as *bakung* and is superficially the same, especially when both are not flowering. In Australia and PNG the species is often recorded as *Crinum pedunculatum*, which was recognised by Hooker (1894) as a subspecies of *Crinum asiaticum*.

Ecology : Usually found in shaded areas, from sea level to 700 m altitude, but may also occur fully exposed to the sun. Occurs on sandy beaches, beach swales, freshwater swamps and occasionally in (sandy) mangroves. Large specimens occur in freshwater and brackish swamps, while those occurring on dry, sandy seashores are usually smaller. Mangrove associate species.

Distribution : Occurs from continental Asia (India to Southeast Asia) to Australia and the Pacific. In Southeast Asia it has been recorded from Myanmar, Cambodia, Thailand, Vietnam, the Philippines, Indonesia (Sumatra, Java, Kalimantan, north Sulawesi, Papua and the Moluccas), Brunei, Singapore, East Timor and Papua New Guinea.

Abundance : Common.

Use(s) : Planted as an ornamental. Poisonous, and used in traditional medicine as a purgative and for treating foot sores (Heyne, 1950; Polunin, 1988).

Source of illustration : Keng (1987) and Polunin (1988).

Reference(s) : Ridley (1924), Heyne (1950), Backer & Bakhuizen van de Brink (1963-68), Polunin (1988), Geerinck (1993), Nguyen *et al.* (2000), Hannibal (undated).

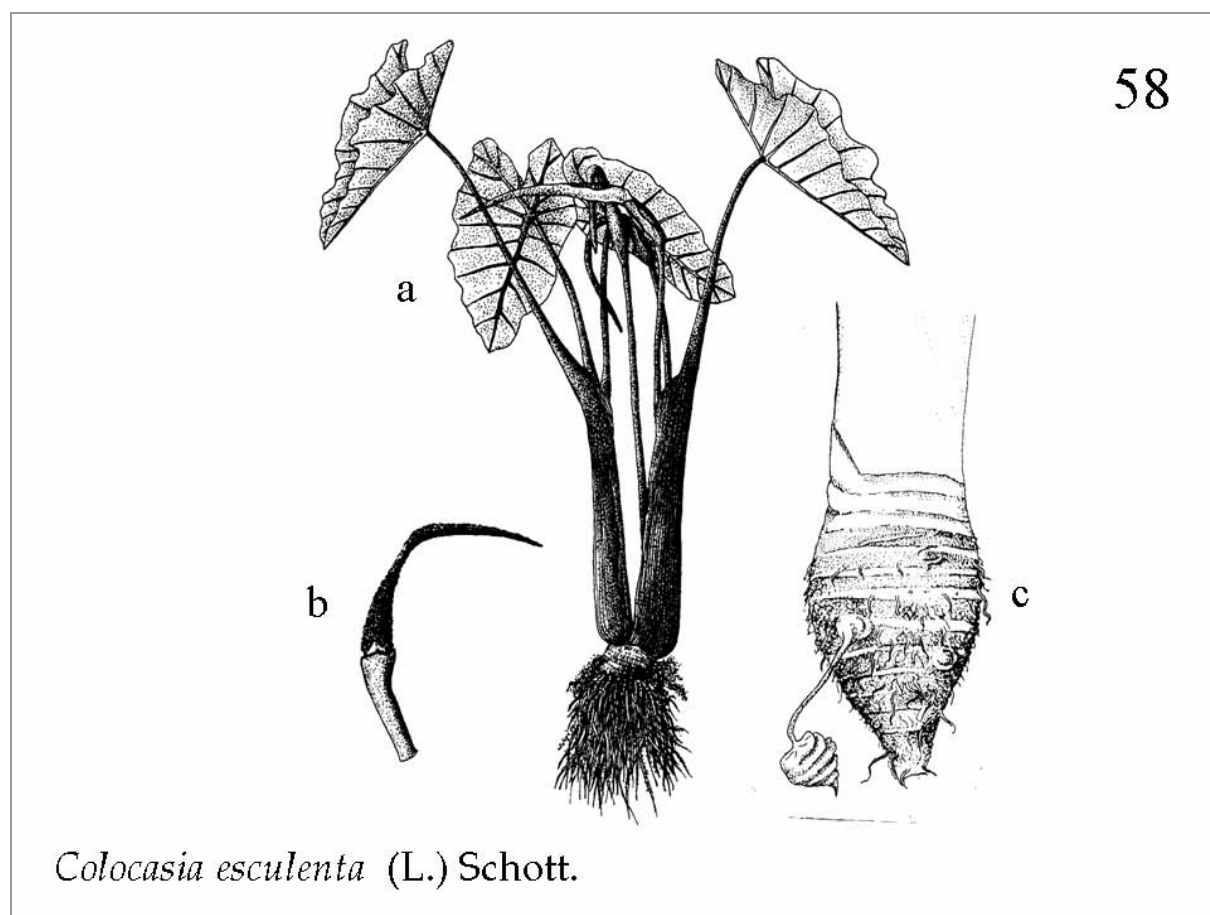


Fig. 58. *Colocasia esculenta* (L.) Schott. (a) Habit of flowering plant, (b) flower, and (c) tuberous root.

ARACEAE

58

***Colocasia esculenta* (L.) Schott**

Synonyms : *Alocasia dussii* Hort., *Alocasia illustris* W. Br., *Arum aegyptium* Rumph., *Arum chinense* L., *Arum colocasia* L., *Arum colocasioides* Desf., *Arum esculentum* L., *Arum nymphaeifolia* (Vent.) Roxb., *Arum peltata* Lam., *Caladium colocasia* W. Wight ex Saff., *Caladum esculentum* (L.) Vent., *Caladium nymphaeifolia* Vent., *Caladium violaceum* hort. ex Engl., *Calla gaby* Blanco, *Colocasia acris* (R.Br.) Schott., *Colocasia antiquorum* Schott. & Endl., *Colocasia euchlora* K. Koch & Linden, *Colocasia fontanesii* Schott., *Colocasia himalensis* Royle, *Colocasia nymphaeifolia* (Vent.) Kunth, *Colocasia peregrina* Raf., *Colocasia vulgaris* Raf.

Vernacular name(s) : Taro (E), Keladi (Mal.), Keladi, Talas, Tales – *Talas* (Ind.), Phueak (Thai.), Gabi (Phil.), Mòn nu'óc (Viet.)

Description : Erect, fleshy herb with an underground rhizome, often with stolons, and may be up to 2 m tall. The large, pointed leaves, 20-55 by 11-36 cm, are thin, ovate-triangular, slightly undulating along the leaf edge, green above and green or purplish-green beneath. They have basal lobes that are fused along more than half of their length, and are directed downward. The leaf stalk is green, purple, reddish- or yellowish-green, and 30-150 cm long. Several flowers occur together at or near the top of the plant. The 4-5 cm, tubular part of the fleshy flower spike is surrounded by a lanceolate leaflet that is 3-5 times its length, greenish-yellow to orange and encloses the naked, unisexual flowers. The berry is green, 4 mm across, and contains a few seeds.

Ecology : Found along the margins of ponds, streams and pools, in floating masses of reeds, swamps and waste places, from sea level up to 2,000 m. Common in coastal *Barringtonia asiatica* vegetation. Flowering occurs all year round. Mangrove associate species.

Distribution : Its place of origin is probably Southeast Asia – where it is found throughout, and from where it has been spread by human activity to (sub-)tropical regions in Africa, the Caribbean, Asia and the Pacific Islands.

Abundance : Very common.

Use(s) : Important food plant in much of its (expanded) range. The tuberous roots are rich in starch, and leaves are eaten as a vegetable. All parts contain oxalic acid, and must be boiled for a long time before consumption is possible. Also used as green fodder for fish and pigs. Many different cultivated forms occur as a result of efforts by subsistence farmers.

Source of illustration : Sastrapradja *et al.* (1981).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Sastrapradja *et al.* (1981), Hay (1990).

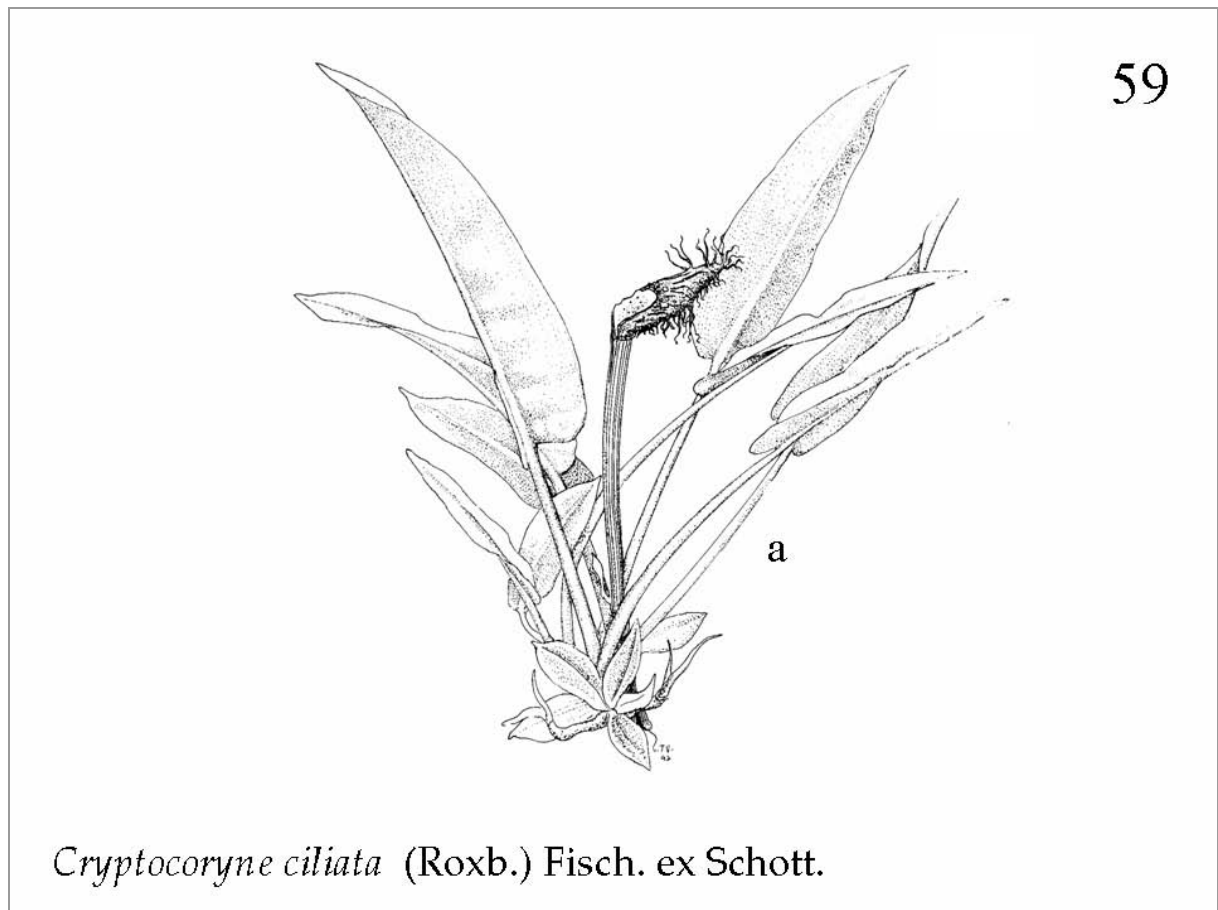


Fig. 59. *Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott. (a) Flowering plant with single flower.

ARACEAE

59

Cryptocoryne ciliata* (Roxb.) Fisch. ex Schott*Synonyms :** *Ambrosinia ciliata* Roxb., *Cryptocoryne ciliata* var. *latifolia* (Roxb.) Rataj**Vernacular name(s) :** Keladi Payau (Mal., Ind.), Mái dâ'm (Viet.)

Description : Erect, 35-50 cm tall, swamp- or aquatic herb with short underground stolons. Leaves occur in two forms. Most leaves are lanceolate with a stout, strongly prominent midrib, are thin-fleshy, and measure 15-41 by 5-11 cm. The leaf immediately below the flower, however, is bladeless, 12-16 cm long, and has a single longitudinal groove. Flowers are solitary and have a short stalk. The lower part of the leaflet surrounding the flower spike is curled up and tubular; the upper part is spread out and has a frilled margin. The tubular part is pale green, with purple veins and lines; the inside of the tube is densely, minutely warty, and the tube wall has numerous tiny air ducts. The spread out part of the flower is purple, and greenish-yellow at the base. The leaflet envelops the flower spike entirely. The base of the flower spike bears a whorl of a few female flowers, above which numerous male flowers are arranged. Between the male and female flowers a small, bare section occurs. Above the male flowers is a naked, short appendage that is firmly attached to the tongue of the enveloping leaflet. Flowers are naked. The fleshy fruit is round, black, 2.5-3 cm long and breaks open into 6-8 parts. Seedlings are remarkably like small 'octopuses', having 10-20 green 'tentacles', which are of course the roots.

Ecology : Occurs in coastal vegetation with brackish water (often in the *Nypa* formation), sometimes also in freshwater swamps. Common in tidal streams, and is then exposed at low tide. Flowering occurs all year round. Mangrove associate species.

Distribution : Occurs from eastern India through Southeast Asia to Papua New Guinea (mainly south coast). In Southeast Asia it has been recorded in Thailand, Malaysia, Vietnam, Indonesia (Sumatra, Java, Borneo, Papua) and Papua New Guinea. Probably also occurs in Brunei. In Papua it is possibly represented by an endemic sub-species, with a spathe that differs in form, and with a warty limb.

Abundance : Locally common.

Use(s) : Rather large aquarium plant – collected and exported. It is also planted in villages as an ornamental.

Source of illustration : Adapted from photograph by Polunin (1988).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Leach & Osborne (1985), Westphal & Jansen (1986), Polunin (1988), Hay (1990).

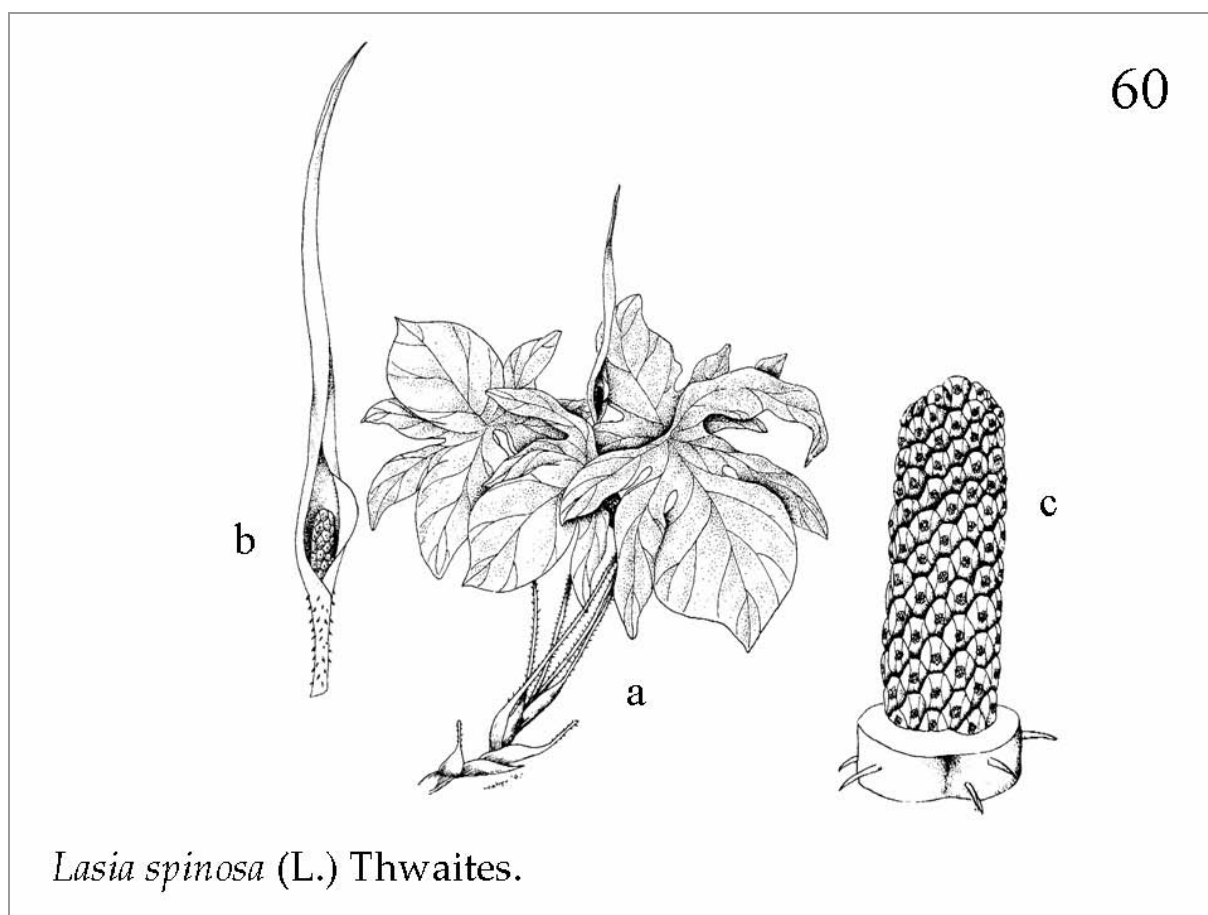


Fig. 60. *Lasia spinosa* (L.) Thwaites. (a) Habit, (b) flower, and (c) detail of flower with enveloping leaflet cut away, exposing the spadix.

ARACEAE

60

***Lasia spinosa* (L.) Thwaites.**

Synonym(s) : *Dracontium spinosum* L., *Lasia aculeata* Lour., *Lasia crassifolia* Engl., *Lasia descisens* Schott., *Lasia heterophylla* Schott., *Lasia roxburgii* Griff., *Lasia zollingeri* Schott., *Pothos heterophyllus* Roxb.

Vernacular name(s) : Gali-gali, Nyambing, Sampi, Gli-gli, Bekil – *Sambang* (Ind.), Chóc gai ho' cói (Viet.)

Description : Rhizome creeping or ascending, up to 75 cm long, plant up to 0.80-1.40 m. Leaves have spiny stems and are variable in shape: early leaves are shaped like an arrow-head, while later ones are more deeply, pinnately lobed. Leaves usually measuring 35-65 cm long and 5-30 cm wide, with short spines on the main nerves underneath and on the stalk. Flowers occur near the end of the plant, solitary in the axis of a leaf. The spadix (a stem-like part of aroid flowers) is cylindrical, yellow to pale orange-yellow, and 3-5 cm long. The flower is 4-partite and pale green, as are the stamens. Fruit is green, fleshy and spiny, measuring 1.5 cm.

Ecology : Occurs from sea level to 500 m altitude, in open, wet places, on muddy soils, along streams, rivers, in marshes, (peat-) swamps and ditches, including tidal areas and brackish swamps. Mangrove associate species.

Distribution : Widespread in Asia, from China, India and Sri Lanka through Southeast Asia, where it has been recorded in Vietnam, Malaysia (Peninsular, Sarawak), Brunei, Indonesia (Sumatra, Java, Borneo, Papua) to Papua New Guinea.

Abundance : Common.

Use(s) : Used to treat stomach ailments and sore joints. In Sri Lanka it is eaten as a vegetable (Heyne, 1950).

Source of illustration : Leach & Osborne (1985).

Reference(s) : Ridley (1925), Heyne (1950), Leach & Osborne (1985), Hay (1990), Hong & San (1993).

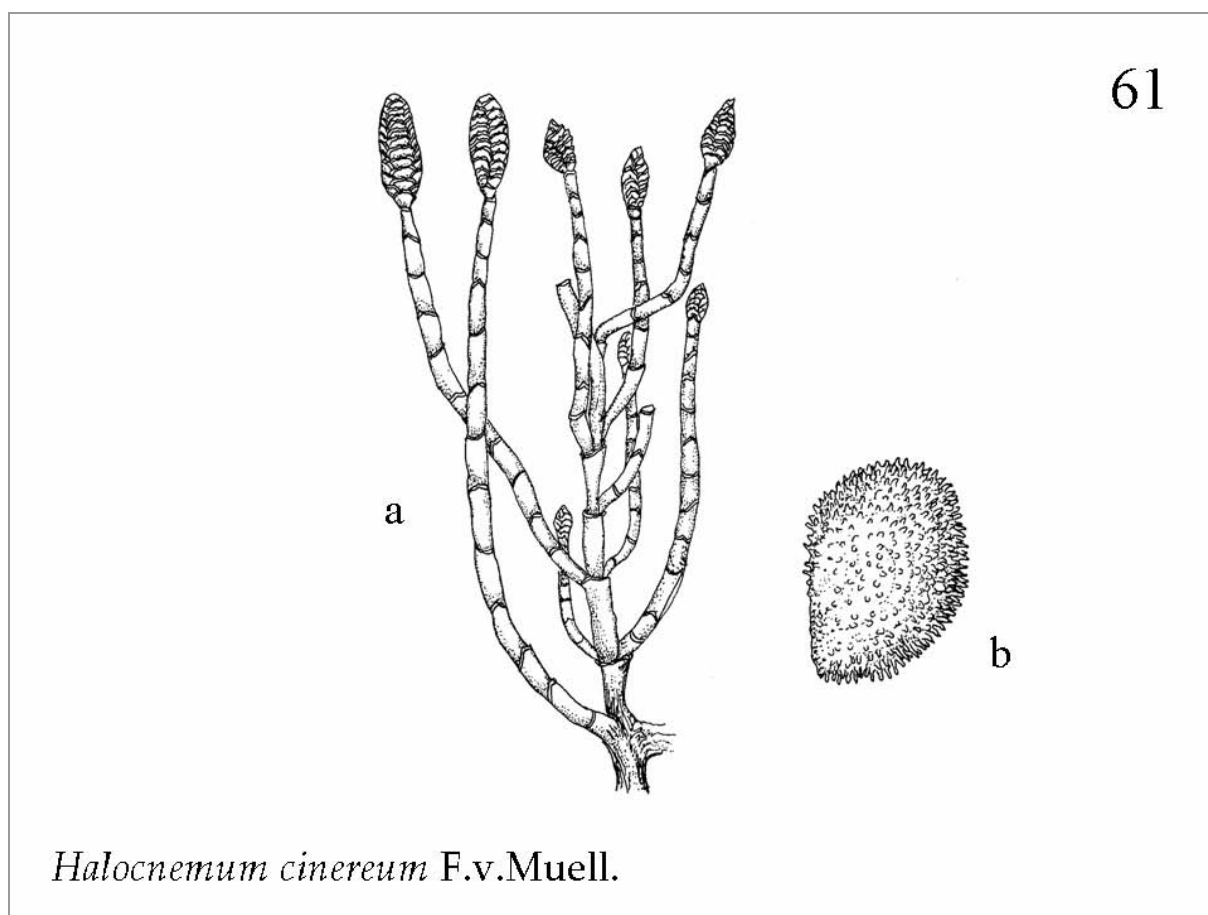


Fig. 61. *Halocnemum cinereum* F.v.Muell. (a) Terminal branchlet of fruiting plant, and (b) seed.

CHENOPODIACEAE**61*****Halocnemum cinereum* F.v.Muell.**

Synonyms : *Salicornia cinerea* F.v.Muell., *Tecticornia australasica* (Moq.) P.G. Wilson
Tecticornia cinerea F.v.Muell.

Vernacular name(s) : Unknown.

Description : Succulent herb, seemingly leafless, with erect branches, 15-30 cm tall. After removal of leaf-sheaths, the young stems are thin and stiff as a wire. Old stems are rather robust, cylindrical and woody. The internodes of the mature plant are spaced 1-2 cm apart. When dry, the whole plant appears greyish in colour. Flower spikes usually consist of one terminal spike, along with 2-6 spikes located in the higher axils. The latter spikes are opposite, and 0.5-2.25 cm long. Fruits are brown, 1-2 mm long, with yellowish-brown seeds.

Ecology : Perennial, salt-tolerant plant, growing on mudflats and low lying soils. It is especially common in areas that are seasonally swampy, but that dry out completely in the dry season. Mangrove associate species.

Distribution : Recorded from Northern Australia and Southeast Asia: Indonesia (Papua, near Merauke, and the east coast of Java) and possibly Papua New Guinea.

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Backer (1949).

References : Backer (1949), Van Steenis (1954), Backer & Bakhuizen van den Brink (1963-8).

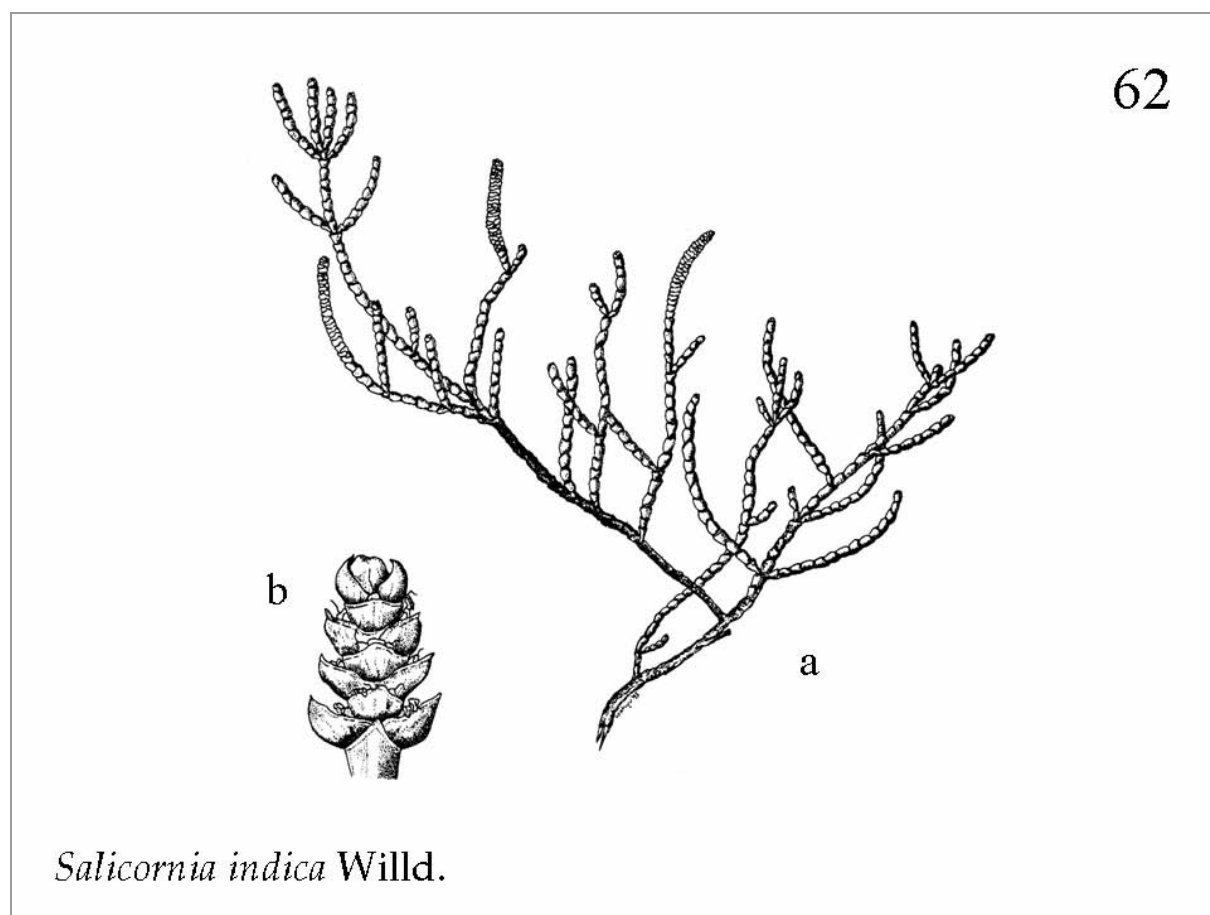


Fig. 62. *Salicornia indica* Willd. (a) Terminal branchlet of fruiting plant, and (b) flower head.

CHENOPODIACEAE**62*****Salicornia indica* Willd.**

Synonym(s) : *Arthrocnenum indicum* (Willd.) Moq., *Halosarcia indica* (Willd.) Moq., *Salicornia australasica*, *Salicornia brachiata*, *Salicornia fruticosa*

Vernacular name(s) : Kemalahala (Ind.)

Description : Rather robust, perennial herb, 30-60 cm long, lower parts woody, widely forked from the base. Young shoots are very thin and wire-like after removal of the leaf sheaths. When mature they are thick and woody, and do not break up in segments like the young parts of the plant. Leaf sheaths, typically bluish-green, are 7-10 mm long on young branches, and have a tip that has a thin, very minutely-toothed margin. Flower heads are a cylindrical spike with a rounded tip, 1.5-4.5 cm long, thicker than the ordinary branches. Spikes are unisexual, but both sexes are present on one single plant. Flowers number 12-30. Individual flowers are not attached to each other, and may be either thin or fleshy. Male flowers are rounded-triangular and tiny, with one stamen extending beyond the petals. Female flowers are flask-shaped, split at the tip, and 1.5-2 mm long. Fruits are flattened, while seeds are round or shield-shaped, and pale brown. This species is very variable and four sub-species are known from its area of distribution.

Ecology : Occurs in coastal areas on marine clays, or on marine clays covered with a thin layer of sand. In mangrove environments it is found on the drier and saltier inland margins. Flowers all year round (in Australia May to November). Mangrove associate species.

Distribution : Found in tropical coastal areas around the Indian Ocean, including East Africa, South Asia, Southeast Asia and northern Australia. In Southeast Asia recorded in Malaysia, Indonesia (Java, Madura, Kangean Archipelago, Sumbawa, Sumba) and East Timor.

Abundance : Locally abundant.

Use(s) : The succulent, salty stems are grazed by cattle, and are said to be fit for human consumption.

Source of illustration : Wightman (1989).

References : van Steenis (1954), Wightman (1989).

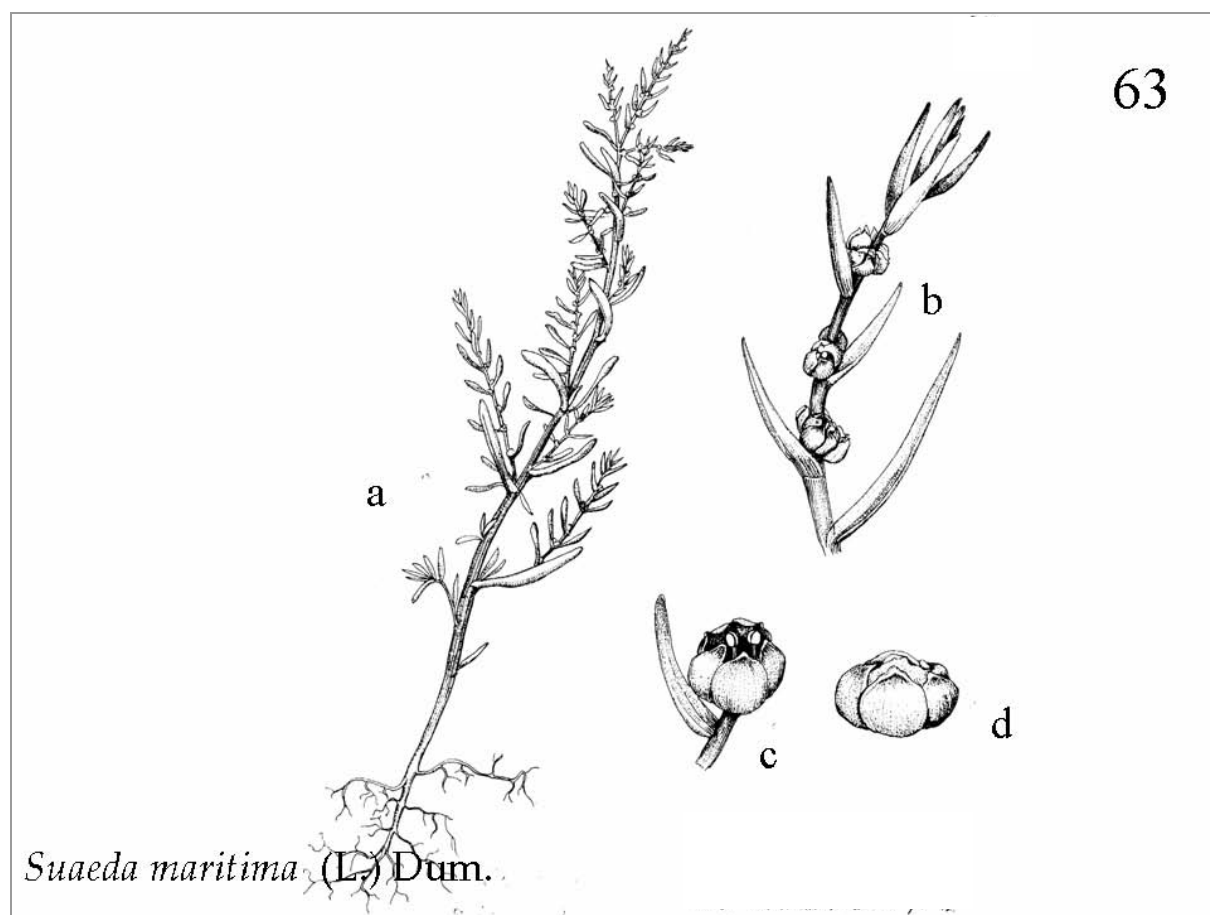


Fig. 63. *Suaeda maritima* (L.) Dum. (a) Terminal branchlet of fruiting plant, (b) detail of flowering branchlet, (c) flower, and (d) fruit.

CHENOPODIACEAE

63

***Suaeda maritima* (L.) Dum.**

Synonyms : *Atriplex maritima* (L.) Crantz., *Chenopodium australe* R.Br., *Chenopodium maritimum* L., *Chenopodina australis* (R.Br.) Moq., *Chenopodina maritima* (L.) Moq., *Chenopodina maritima* var. *vulgaris*, *Dondia maritima* (L.) Druce, *Lerchena maritima* (L.) Kuntze., *Salsola indica* Willd., *Salsola maritima* (L.) Poir., *Schoberia linifolia* Nutt. ex Moq., *Schoberia maritima* (L.) C.A. Mey., *Sueda australis* (R.Br.) Moq., *Suaeda indica* Moq., *Suaeda maritima* (L.) Dum., *Suaeda nudiflora* Moq.

Vernacular names : Alur, Ahaha – *Malur* (Ind.), Muoi bien (Viet.), Cha khraam (Thai)

Description : Perennial, smooth herb, up to 45 cm tall. When mature it is often woody at the base, and usually dividing from the base into erect or ascending branches that may root from the lower joints. Old stems are warty because of scars of fallen leaves. The many linear, semi-cylindrical leaves have a juicy, fleshy tissue. These are pale bluish-green or are tinged with purple or are entirely purple, 1-4.5 cm long, and have a salty taste. The flower spike usually consists of a panicle, one to many flowered, and is 2.5-15 cm long. The lower leaflets located at the base of the flower stalks are rather large and appear similar to normal leaves. Towards the top of the plant the leaflets are generally smaller. 2-3 transparent, small leaflets, about 1 mm long, are located at the base of the flower; these are retained after flowering and spread horizontally after the fruit has been shed. Flowers are bisexual. Individual flowers have transparent margins and tips, and are green or slightly purple. In the female stage the flower is about 1.25 mm in diameter, in the male stage about 2.5 mm. The fruiting flower is flattened, succulent, 2-2.5 mm across and contains one shiny brown seed with an embryo coiled into a flat spiral. The plant is highly variable in appearance.

Ecology : Moist or swampy, clayey, brackish to marine coastal soils. Often occurring gregariously, frequently very conspicuous because of its purple colour. Red and green specimens often grow intermixed. Flowering occurs throughout the year. Found in temperate, Mediterranean, subtropical and tropical climates. Mangrove associate species.

Distribution : Wide ranging cosmopolitan species, found in Europe, North Africa, Asia, Australia, North America. In Southeast Asia it has been recorded from Thailand, Vietnam, Indonesia (West and East Java, Madura, Sumatra and probably Papua) and Papua New Guinea.

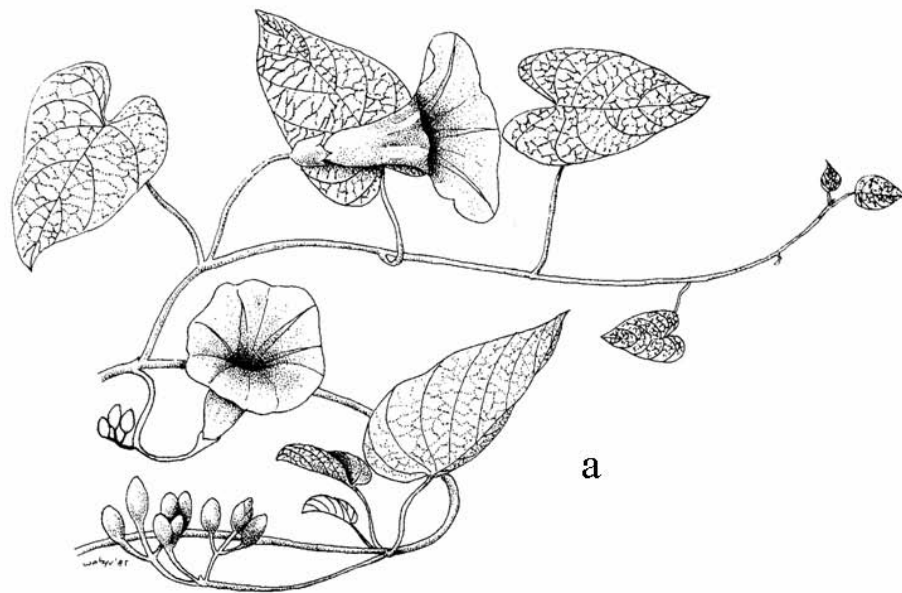
Abundance : Locally common.

Use(s) : Leaves sometimes eaten as a vegetable.

Source of illustration : Icones Rijksherbarium Leiden.

Reference(s) : Backer (1949), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Giesen & van Balen (1991), Aksornkoae (1993), Nguyen *et al.* (2000).

64



Ipomoea gracilis R. Br.

Fig. 64. *Ipomoea gracilis* R. Br. (a) Detail of flowering, creeping stem.

CONVOLVULACEAE

64

***Ipomoea gracilis* R. Br.**

Synonym(s) : *Calystegia affinis* (non Endl.) Schum., *Convolvulus denticulatus* Desr., *Ipomoea denticulata* Choisy, *Ipomoea littoralis* Bl.

Vernacular name(s) : Kankong, Tapak Kuda Kecil (Mal.), Kangkong Laut, Akar Hitang, Seyawu saloyon, (Ind.), Bulakan, Ditadit (Phil.).

Description : Smooth or sparsely hairy prostrate, creeping plant with a thin, herbaceous twining stem that may become somewhat woody as the plant matures. Leaves are membrane-like or thicker, broadly ovate to oblong, occasionally kidney-shaped or round; variable in size, from 1-10 by 1-7.5 cm. The leaf margin may be slightly wavy, but otherwise does not have a serrated edge or lobes. Flowers occur in the axis of the leaves, and one to several may occur in one leaf axis. The flower stalks are 1-3 (occasionally 9) cm long. The corolla is funnel-shaped, 3-4.5 cm long, pink or purple, but often darker near the base. The fruit is a flattened capsule, about 9 mm in diameter, with two cells and four smooth, black seeds that are 3.5-4 mm long.

Ecology : Occurs from sea level to about 15 m altitude, on sandy beaches, thickets near the sea, edges of (sandy) mangroves. Rarely occurring inland. May run over sandy dunes or climb into trees. Mangrove associate species.

Distribution : Found throughout the Indian and Pacific Ocean coasts. In Southeast Asia it has been reported from Cambodia, the Philippines, Malaysia, Singapore and Indonesia (Moluccas, Sulawesi, Sumatra and Papua), but probably occurs throughout the region.

Abundance : Common.

Use(s) : Sand binding. Used as shampoo (Sulawesi) and for treating Chickenpox. Young leaves may be eaten (Heyne, 1950).

Source of illustration : van Ooststroom (1953).

Reference(s) : Heyne (1950), van Ooststroom (1953).

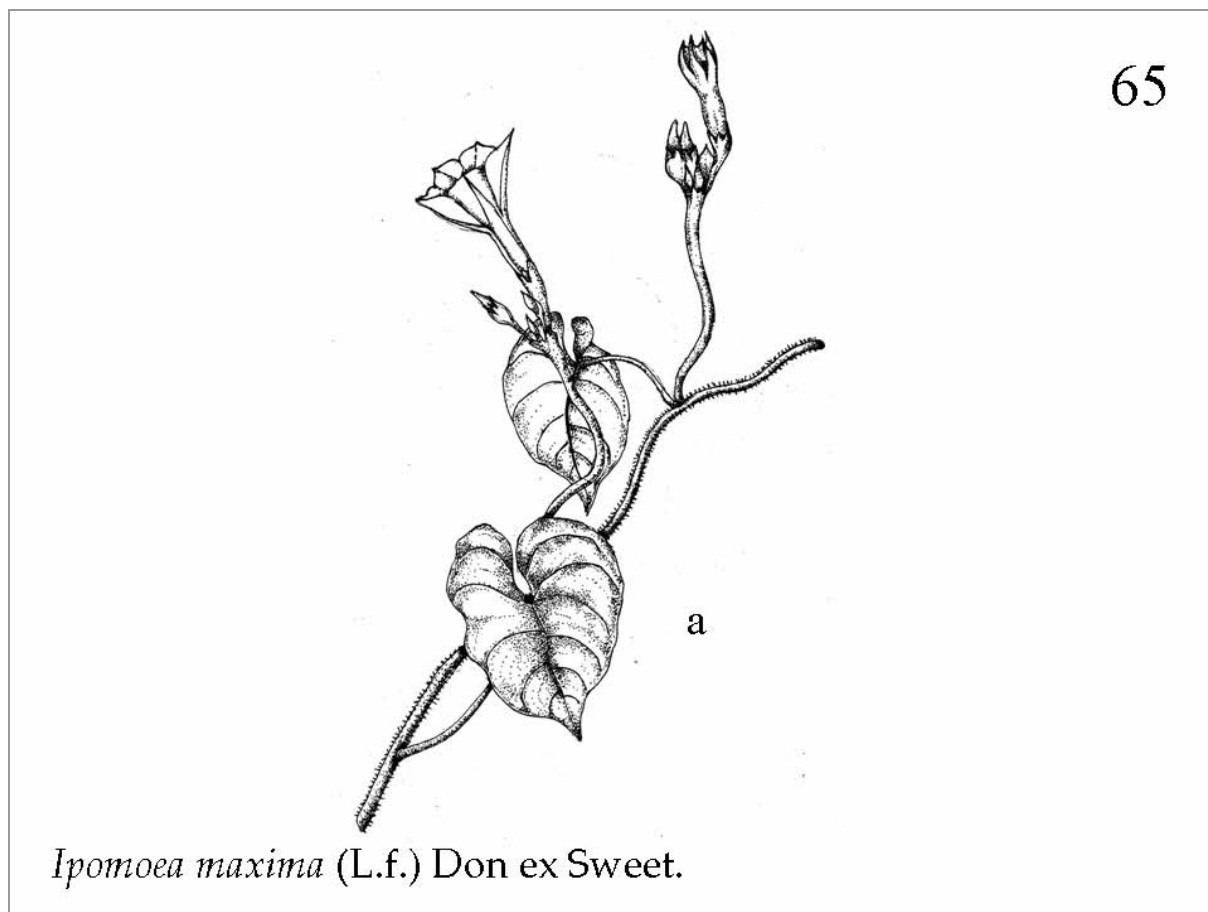


Fig. 65. *Ipomoea maxima* (L.f.) Don ex Sweet. (a) Detail of flowering, creeping stem.

CONVOLVULACEAE

65

***Ipomoea maxima* (L.f.) Don ex Sweet**

Synonyms : *Convolvulus maximus* L., *Ipomoea sepiaria* Koen. ex Roxb., *Ipomoea subtrilobans* Miq., *Ipomoea verrucosa* Bl.

Vernacular name(s) : Akang kangkong bulu (Ind.)

Description : A herbaceous perennial, with a few (to several) twining to prostrate stems that may be 1-2.5 m long, and be either sparsely covered with hairs or quite smooth. Forms a stout perpendicular root. Leaves are alternate, broadly ovate, rounded or kidney-shaped, (1-)2.5-6 by (1-)2-5 cm, usually deeply heart-shaped at the base, sometimes slightly heart-shaped. Leaves are generally smooth, but with fine hairs along the edges; they often have a purple edge and are covered with purplish spots. The leaf stalk is usually shorter than the leaf blade, measuring 1-3 cm. Flowers are located in the leaf axils and have a thick stalk, 1.5-12 cm long. Sepals equal in length or the inside ones slightly longer, 4-6 mm long and smooth. The corolla is trumpet-shaped, pale lilac, pink or nearly white, with a purple centre, 2-3 cm long, and the stem of the trumpet 1.25-2.5 cm diameter. Fruit is a dry capsule, round but somewhat flattened, 6-7 mm high, smooth, with 4 partitions that each contain 1 seed. Seeds are covered with a dense, very short, pale greyish or white felt-like hair.

Ecology : In moist, usually saline habitats including beaches, moist grasslands, fields, thickets, hedges, waste grounds and along waysides. In Malaysia it reportedly occurs mainly on clayey soils. Occasionally found on landward edges of mangroves. Mangrove associate species.

Distribution : From India and Sri Lanka, to northeastern Australia and southern China. In Southeast Asia it is found in Myanmar, Thailand, Vietnam, Peninsular Malaysia, East Timor and Indonesia (Sumatra, Java, Lesser Sundas, Moluccas, Papua).

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : van Ooststroom (1953)

Reference(s) : van Ooststroom (1953).

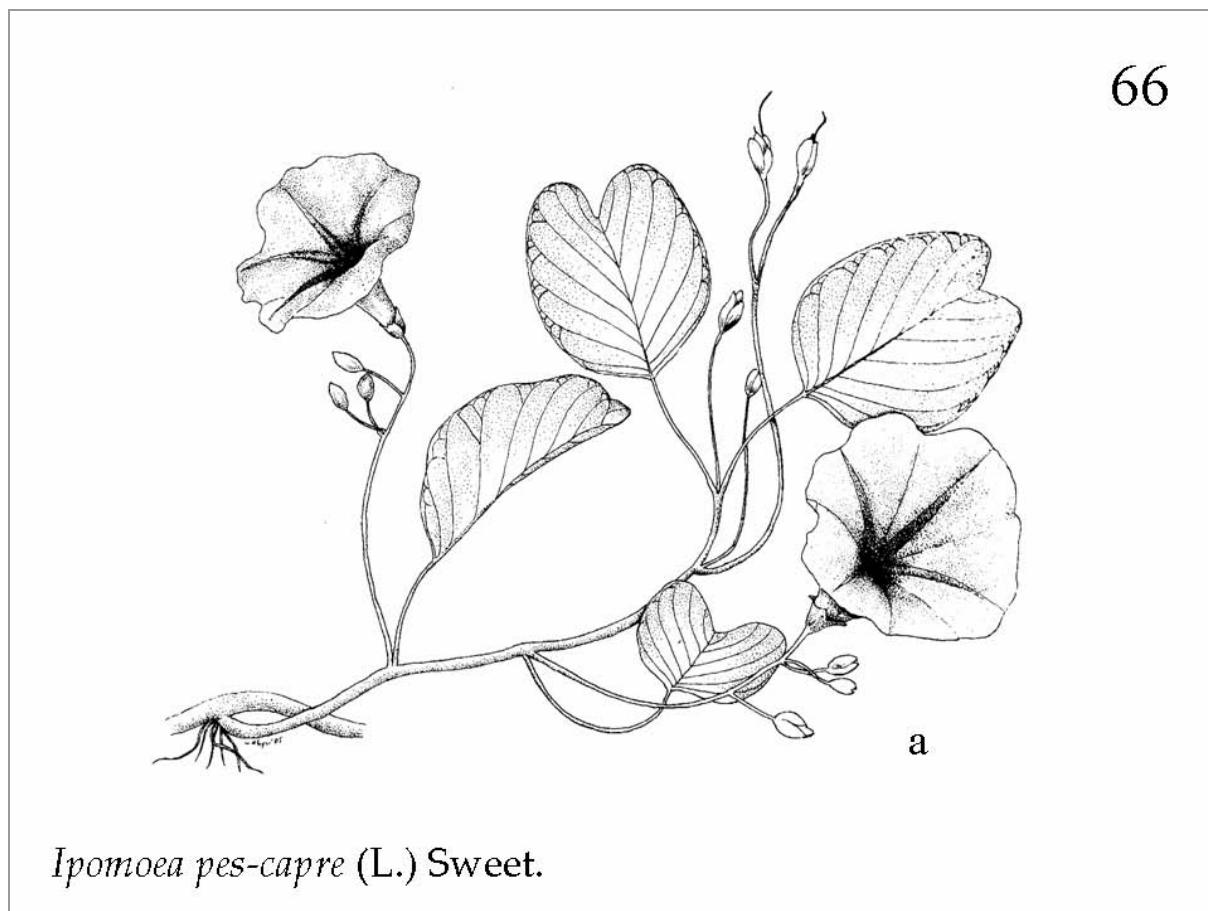


Fig. 66. *Ipomoea pes-capre* (L.) Sweet. (a) Detail of flowering, creeping stem.

CONVOLVULACEAE

66

***Ipomoea pes-caprae* (L.) Sweet.**

Synonym(s) : *Convolvulus bilobatus* Roxb., *Convolvulus brasiliensis* Linné, *Convolvulus marinus* Rumph., *Convolvulus maritima*, *Convolvulus maritimus* Desr., *Convolvulus pes-caprae* Linné, *Ipomoea biloba* Forsk., *Ipomoea maritima* R.Br., *Ipomoea pes-caprae* Roth., *Soldanella marina indica* Rumph.

Vernacular name(s) : Batata Pantai, Daun Katang, Tapak Kuda (Mal.), Katang-katang, Dalere, Watata Ruruan, Alere, Loloro, Balim-balim, Kabai-kabai (Ind.), Arodaidai, Katang-katang, Lagairai, Kamigang (Phil.), Rau mu'ng biê'n (Viet.)

Description : Perennial herb, with a thick taproot. Stems are 5-30 m long and creeping, taking root at the nodes; they contain a milky juice. Leaves alternate, and may be deeply lobed or only notched at the end, 3-10 by 3-10.5 cm. Flowers occur in the axils of leaves, and have 3-16 cm long stalks. The corolla is funnel-shaped, 3-5 cm long, smooth, pink, reddish purple or violet, and usually darker at the base. Fruit is a round to slightly flattened dry capsule, 12-17 mm, 2-celled, with four black, densely hairy seeds, 6-10 mm long. Two sub-species are recognized by some authors: *Ipomoea pes-caprae* ssp. *pes-caprae* with deeply lobed leaves, and *Ipomoea pes-caprae* ssp. *brasiliensis* with notched leaf ends. Both occur in Southeast Asia, although the latter is known only from Indonesia (West Sumatra and Krakatau Island).

Ecology : Occurs from sea level up to 600 m, usually on sandy beaches, but also immediately behind sea shores, and occasionally along waysides, ditches and canals. Flowers open early in the morning and shrivel by the afternoon. Mangrove associate species.

Distribution : Pan-tropical. Found throughout Southeast Asia.

Abundance : Very common.

Use(s) : The seeds are reportedly a good remedy for stomach ache and cramp. Leaves are made into a poultice and applied to swellings, boils and ulcers. Juice of stems is used to treat bites and stings.

Source of illustration : Backer (1918), van Ooststroom (1953).

Reference(s) : Backer (1918), Heyne (1950), van Ooststroom (1953).

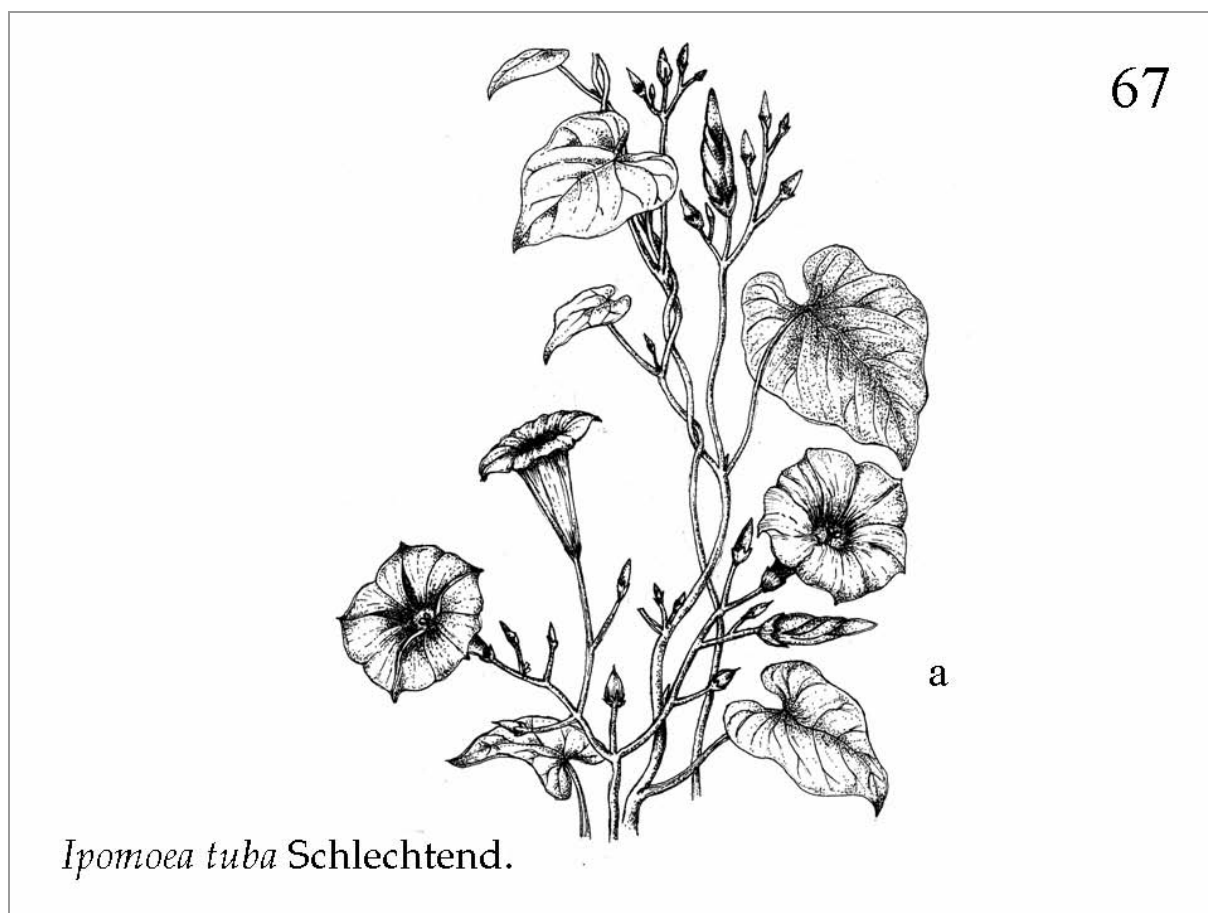


Fig. 67. *Ipomoea tuba* Schlechtend. (a) Detail of flowering, creeping stem.

CONVOLVULACEAE

67

***Ipomoea tuba* Schlechtend.**

Synonyms : *Calonyction album* House, *Calonyction grandiflorum* Choisy, *Calonyction muticum* Decaisne, *Calonyction tuba*, *Convolvulus catharticus* Blanco, *Convolvulus grandiflorus* Jacq., *Convolvulus tuba* L., *Ipomoea alba* L., *Ipomoea grandiflora* Hallier f., *Ipomoea macrantha* Roem. & Schult., *Ipomoea violacea* L.

Vernacular name(s) : Moon flower, Hawaii moon flower (E), Tatampayan besar (Mal./Ind.)

Description : A perennial twining species, with a round to angular, herbaceous smooth stem that may be 5m or more in length and has a woody base. In dried specimens the stem is straw coloured. Leaves are alternate, round or ovate to kidney-shaped, thick and sometimes fleshy, (5-)8-16 by 5-14 cm, with 7-8 lateral veins, deeply heart-shaped at the base with rounded or (rarely) angular lobes, and with a pointed tip; leaf stalk 3.5-16 cm. Flowers occur in leaf axils, usually 1 but occasionally 2-3(-4) flowered, flower stalk 0.75-7(-12) cm. Sepals are rounded, inner ones slightly longer than outer ones, 15-20(-25) mm, thick. Sepals are enlarged when the plant bears fruit, at first enclosing the dry capsule as a cup, afterwards curling backwards. The trumpet-shaped corolla is usually white with greenish bands, but may occasionally be purple or violet, opening at night, 9-12 cm long; the corolla tube is cylindrical and 7-8 cm long. Fruit a dry capsule, rounded, 2-2.5 cm long, smooth, pale brown, with 4 partitions and (1-)4 seeds. Seeds are dark brown to black, rounded, 1 cm long, with dense short hairs, and longer hairs (up to 3 mm) along edges.

Ecology : Occurs on beaches and in thickets near the sea. Occasionally on landward margins of mangroves. Occasionally regarded as a noxious weed species, as it can be invasive (e.g. Caroline Atoll in French Polynesia). Mangrove associate species.

Distribution : Widely distributed in the tropics world-wide, and found in America, East Africa, continental Asia and Polynesia. It has been recorded throughout Southeast Asia.

Abundance : Common.

Use(s) : Prized for its beauty, and planted as an ornamental. Its seeds contain alkaloids such as lysergic acid amide. This chemical is an alkaloid derivative of LSD with about one tenth of its potency, and is used in traditional medicine and shamanism.

Source of illustration : http://www.hear.org/pier/species/ipomoea_violacea.htm
<http://www.siena.edu/boswell/Drug%20Projects/Erik/Morningglory2.htm>
<http://www.gnosticgarden.com/seeds3.htm>

Reference(s) : Ooststroom (1953),
www.unep-wcmc.org/info/wetlands/caroline.htm
http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=IPVI;
<http://www.fau.edu/divdept/biology/synonyms.htm>.

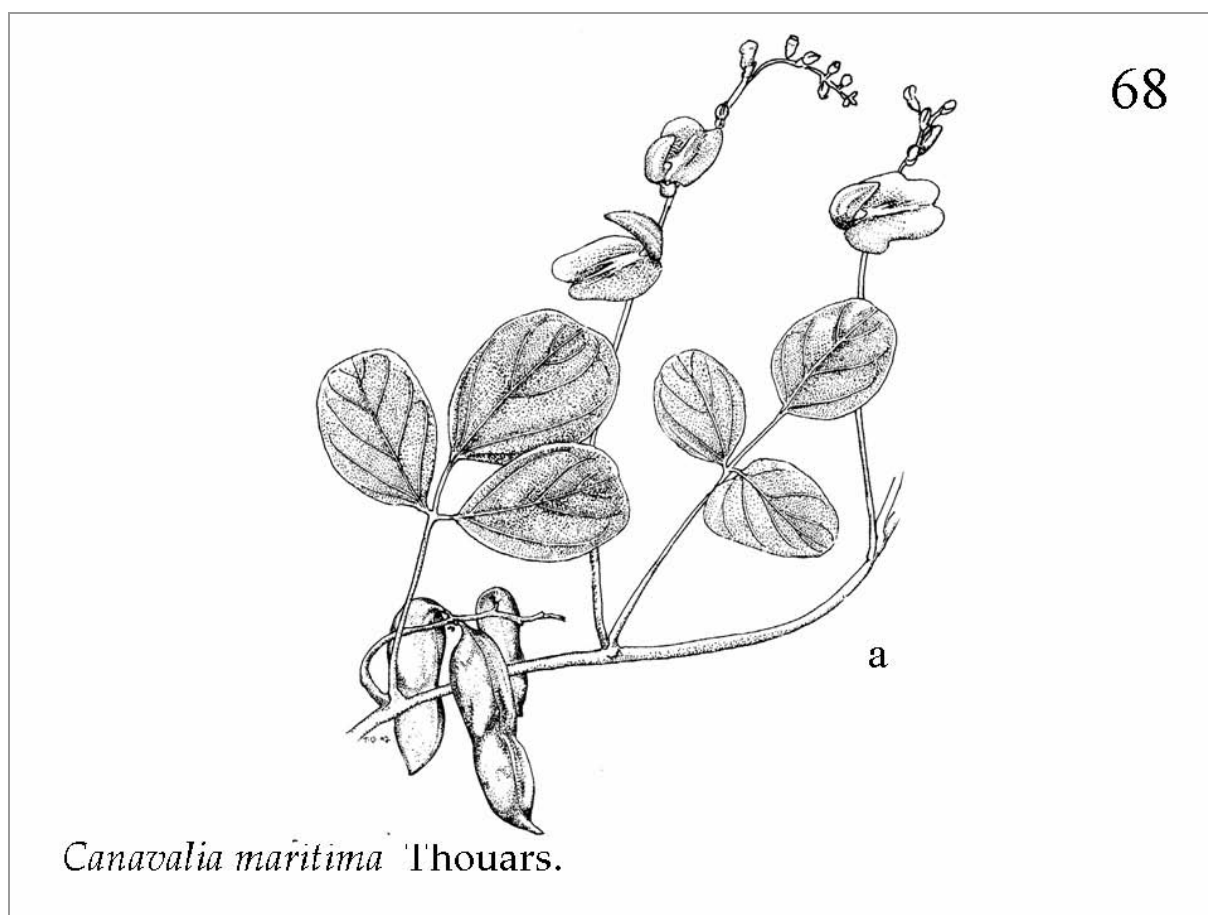


Fig. 68. *Canavalia maritima* Thouars. (a) Detail of flowering and fruiting, creeping stem.

LEGUMINOSAE

68

***Canavalia maritima* Thouars**

Synonyms : *Canavalia apiculata* Piper, *Canavalia arenicola* Piper, *Canavalia baueriana* Endl., *Canavalia emarginata* (Jacq.) G.Don., *Canavalia lineata* Prain *non* DC., *Canavalia lineata* (Thunb.) DC., *Canavalia maritima* (Aubl.) Urb., *Canavalia miniata* (Kunth.) DC., *Canavalia moneta* Welw., *Canavalia obcordata* (Roxb.) Voigt., *Canavalia obtusifolia* DC., *Canavalia podocarpa* Dunn., *Canavalia rosea* (Sw.) DC., *Canavali maritima*, *Cacara litorea* Rumph., *Clitoria rotundifolia* (Vahl.) Sessé & Moc., *Dolichos emarginata* Jacq., *Dolichos littoralis* Vahl., *Dolichos maritimus* Aubl., *Dolichos miniatus* Kunth., *Dolichos obcordatus* Roxb., *Dolichos obovatus* Schumach. & Thonn., *Dolichis obtusifolius* Lam., *Dolichos rosea* Sw., *Dolichos rotundifolia* Vahl., *Phaseolus maritimus purgans* Aubl.

Vernacular name(s) : Kacang Laut, Kekara Laut – *Kekara pedang* (Mal., Ind.) Joa-joa dowongi (Ind.)

Description : Scandent or creeping herb, 2-6(-10) m long. The end of the plant sometimes twines and often it roots from the nodes. Leaves have three fleshy leaflets, each measuring 3-15 by 2-2.5 cm. These leaflets are obovate or broadly oval, and their top is rounded, with a distinct notch or ending abruptly, and often with a triangular tip. The flower clusters occur in the leaf axils and have long stalks. Flowers are reddish-violet with a white streak down the middle, and are upside down when fully opened. Fruits are bean-like pods, which are either straight or faintly curved, 6-15 cm long, with 2-10 seeds. Hybridises with *Canavalia cathartica*, from which it can easily be distinguished by the longer pods (max. 11.5-15 cm for *Canavalia maritima* versus 8-12 cm for *Canavalia cathartica*).

Ecology : Occurs on sandy beaches, dunes and adjacent localities, seldom occurring inland to more than an altitude of 30 m, although rarely it has been recorded up to an altitude of 500 m asl. Occasionally it may be found on landward margins of mangroves. Flowering occurs all year round. Mangrove associate species.

Distribution : Pantropical, and one of the most common strand plants. Throughout Southeast Asia.

Abundance : One of the most common (sub-)tropical beach plants worldwide.

Use(s) : Young pods and seeds are edible after (prolonged) boiling. Flower used as spice. Plant suitable as ground cover crop against soil erosion on eroding coastal lands.

Source of illustration : Adapted from photograph by Polunin (1988).

Reference(s) : Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Gillett *et al.* (1971), Polunin (1988).

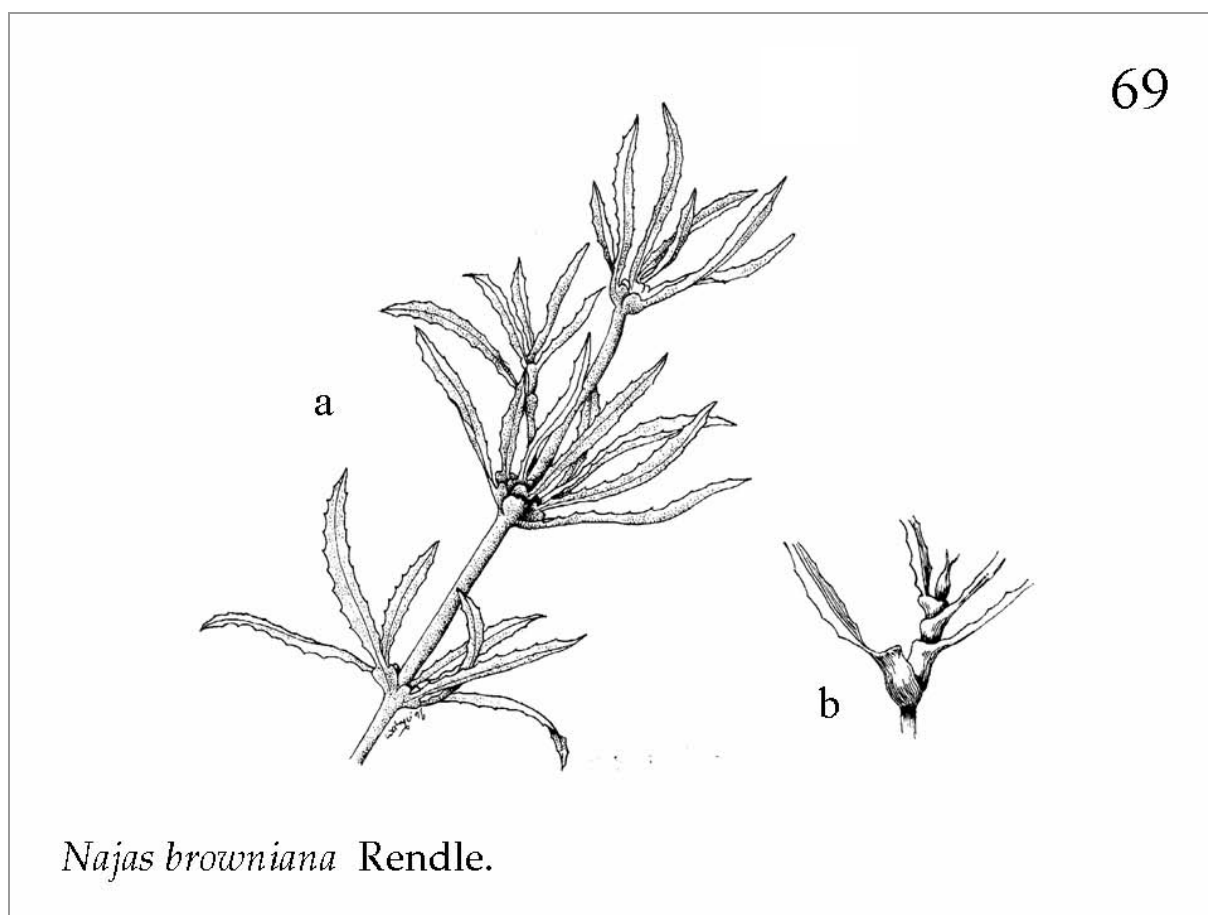


Fig. 69. *Najas browniana* Rendle. (a) Stem section of plant, and (b) detail of leaf insertion.

NAJADACEAE**69*****Najas browniana* Rendle****Synonyms :** Unknown.**Vernacular name(s) :** Unknown.

Description : Small aquatic plant, up to 15 cm long, with the lower internodes measuring 1-6 by 0.5-0.9 mm. The flat, sometimes slightly fleshy leaves are 1.5-2.25 cm by 0.4-0.8 mm. Near the leaf tip the leaves narrow to a width of 0.23-0.6 mm. Each leaf edge is armed with 12-21, dark brown, spiny teeth, which are mainly located in the upper part of the blade. There are no spines on the lower surface. The teeth can be up to as long as 0.2 times the width of the blade. Using a magnifying glass, one can see that cavities occupy about one quarter of the width of the blade, and there are no distinct partitions. The sheath has 1-10 spines on either side, and measures about 2 by 1.5-3 mm. Spines are absent on the inner edge of the broad, ear-like appendage at the base of the leaf. Flowers usually occur in groups of three, often in different stages. Male flowers may occur alone. The leaflet enveloping the male flower is 1.3-2 mm long and is constricted into a long, cylindrical neck. It is absent in the female flower. The mature anther is 1-celled and 0.6-0.9 by 0.2-0.3 mm. The female flower is 1.5-2 mm long. Seeds measure 1.5-2 by 0.5-0.75 mm. The vegetative characters in this genus are very uniform, but show a rather large variability within each species. Sometimes more than one species is represented at a single locality.

Ecology : Occurs in saline localities at (or near) sea level, such as mud wells, brackish water fish ponds, pools near the sea (e.g. in mangroves) and in lagoons. Mangrove associate species.

Distribution : Very scattered distribution, known from India (rare), Indonesia (Java, Madura), Papua New Guinea (between the Oromo and Fly rivers), and the Northern Territory of Australia.

Abundance : Locally common.

Use(s) : A source of food for fish, also utilised as pig food.

Source of illustration : de Wilde (1962).

Reference(s) : de Wilde (1962), Backer & Bakhuizen van den Brink (1963-8).

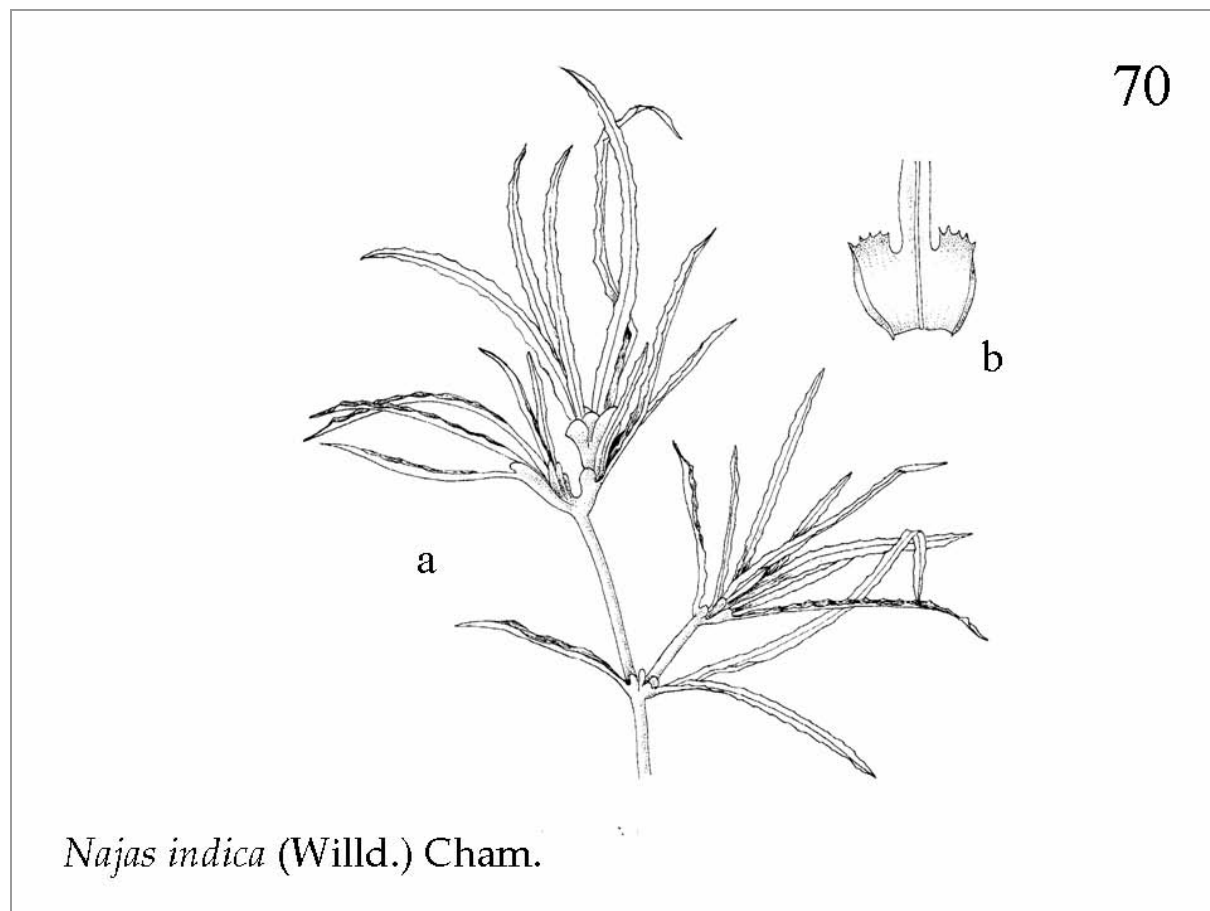


Fig. 70. *Najas indica* (Willd.) Cham. (a) Stem section of plant, and (b) detail of base of leaf.

NAJADACEAE

70

***Najas indica* (Willd.) Cham.**

Synonyms : *Caulinia indica* Willd., *Najas falciculata* A. Braun., *Najas foveolata* A.Br., *Najas kingii* Kingi, *Najas lacerata* Rendle, *Najas lobata* Blanco, *Najas minor* var. *indica* A. Br., *Najas palustris* Blanco, *Najas tenuifolia* (non R.Br.) Miq.

Vernacular name(s) : Lumut Siarang, Ganggeng (Ind.), Aragan, Bangbangi, Labui (Phil.)

Description : Aquatic plant, up to 1-2 m long, with lower internodes measuring 2-10 cm by 0.6-1.7 mm. Leaves are flat to nearly cylindrical or triangular in cross-section, 1.25-6 cm by 0.3-1.6 mm; 0.2-0.5 mm wide 3 mm below the tip. The leaf edge has 1-40 conspicuous, spiny, dark brown teeth along both sides. Sometimes, however, the lower 15 mm of the blade has no teeth. The lower surface of the leaf sometimes has 1-30 spines. The length of the teeth may equal the width of the leaf, especially in the upper half of the leaf. Using a magnifying glass, one can see that cavities occupy about half or almost the entire width of the blade, and often have distinct partitions. The leaf sheath, 2-5 by 1.5-6 mm, has 2-20 spines on either side. However, the sheath has no teeth on the inner edge of the big, ear-like appendages at its base. These appendages may be absent. Flowers are usually solitary. The male flowers have an enveloping leaflet, 2.2-3.6 mm, with a usually cylindrical neck, and nearly stemless, 4-celled anthers. The female flowers are 1.7-3.4 mm long, and seeds are 1.5-2.3 by 0.75-0.9 mm. The vegetative characters in this genus are very uniform, but show a rather large variability within each species. Sometimes more than one species is represented at a single locality. Female flowers in Indonesia probably never have a sheath.

Ecology : Found in a great variety of habitats, from various freshwater to marine biotopes; usually occurs in shallow waters but may be found down to depths of 5 m. It occurs from sea level up to an altitude of 1,000 m; found in brackish water fish ponds near Jakarta, and in pools in mangroves and lagoons; both in very wet regions and in those subject to a distinct dry season. Mangrove associate species.

Distribution : Tropical, continental Asia (from Kashmir to Tonkin), Japan and throughout Southeast Asia, where it has been recorded in all areas except Borneo and the Moluccas. Perhaps also found in Africa.

Abundance : One of the commonest *Najas* species, locally often very abundant.

Use(s) : A source of food for fish, also utilised as pig fodder.

Source of illustration : de Wilde (1962) and Icones Rijksherbarium Leiden.

Reference(s) : de Wilde (1962), Backer & Bakhuizen van den Brink (1963-8).

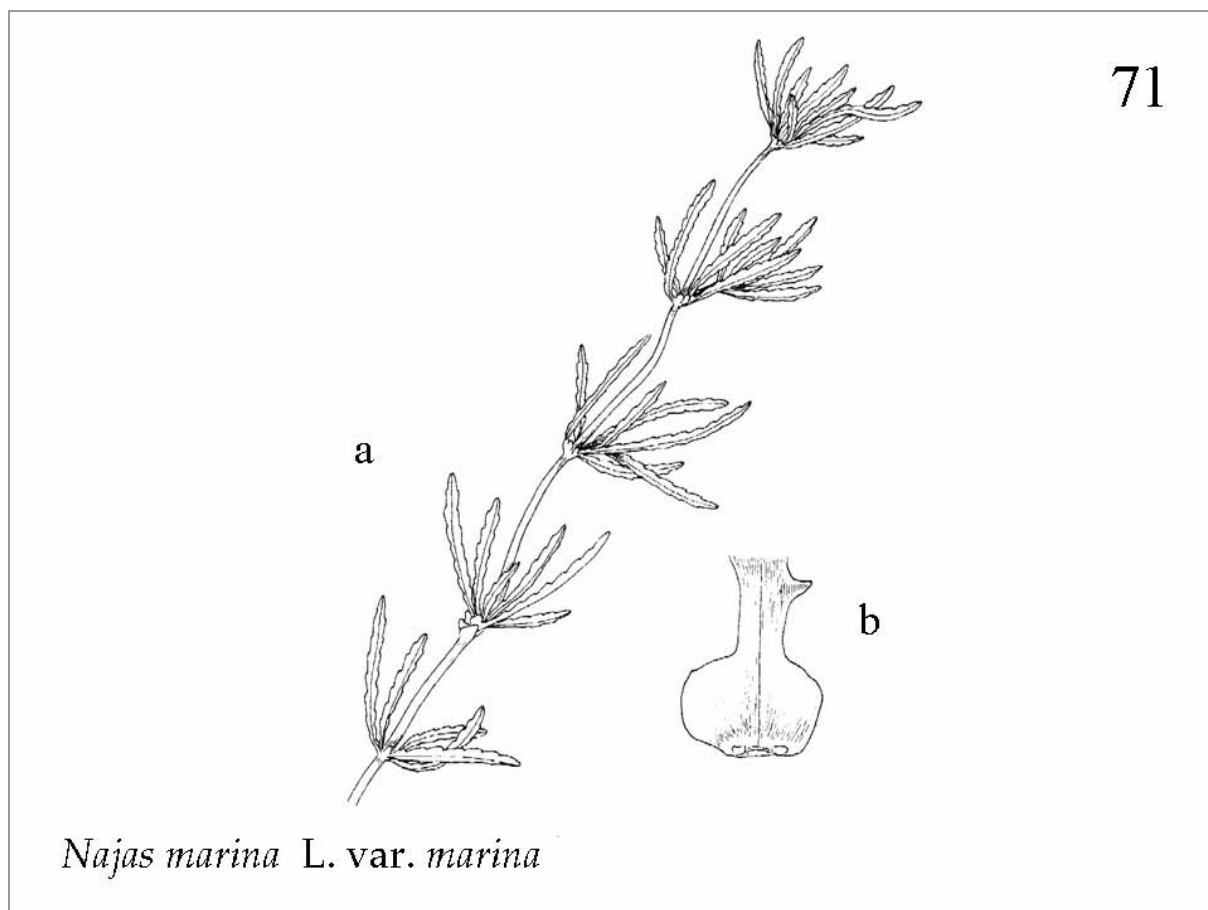


Fig. 71. *Najas marina* L. var. *marina*. (a) Stem section of plant, and (b) detail of base of leaf.

NAJADACEAE

71

Najas marina* L. var. *marina

Synonyms : *Najas intermedia* Gorski, *Najas major* All., *Najas marina* var. *angustifolia* et *intermedia* Rendle

Vernacular name(s) : Unknown.

Description : Aquatic plant, up to 30 cm long, with lower internodes measuring up to 6 cm. The linear or slightly spoon-shaped, somewhat fleshy leaves are flat to triangular in cross-section and measure 0.5-3 cm by 1.5-3 mm; they are about 2-3 mm wide about 3 mm below the tip. The leaf edge has 2-7 coarse, spiny teeth along each side. The upper surface usually has 1-6 spiny teeth. Rarely, however, it is unarmed. The long teeth are brown, triangular to conical, and almost as long as the width of the leaf blade. Using a magnifying glass, one can see that cavities in the leaf are often indistinct and occupy half the leaf width. The sheath, which measures 2-4 by 3-6 mm, bears 1-2 inconspicuous spines on either side. Ear-like appendages at the base of the leaf are either absent or very small. The leaflet enveloping the solitary male flower is 1.8 mm long and tipped with three small, transparent spines of 0.1 mm. The solitary female flower has no enveloping leaflet and is 2-3 mm long. Seeds have not been recorded in Southeast Asia.

Ecology : In brackish waters, including lagoons, fish ponds, and pools in mangroves. Mangrove associate species.

Distribution : Very widely distributed, from northwestern Europe to western Australia, Japan and the Sandwich Islands. In Southeast Asia it has been recorded only in Indonesia, where it is found in the southern part of the Moluccas.

Abundance : Locally common.

Use(s) : Most important as a source of food for fish. It is cultivated for this purpose in brackish water fish ponds.

Source of illustration : de Wilde (1962) and Icones Rijksherbarium Leiden.

Reference(s) : de Wilde (1962).

72



Passiflora foetida L.

Fig. 72. *Passiflora foetida* L. (a) Creeping stem with fruit.

PASSIFLORACEAE**72*****Passiflora foetida* L.**

Synonyms : *Dysosmia foetida* (L.) M. Roem, *Granadilla foetida* (L.) Gaertn., *Tripsilina foetida* (L.) Raf.

Vernacular name(s) : Stinking passion fruit, Wild water lemon, Love in a mist (E), Timun dendang, Timun padang, Timun hutan (Mal.), Buah tikus, Kaceprok, Pacean, Gegambo, Lemanas, Remugak, Kaap, Bungan pulir, Moteti, Buah Pitri – *Permot* (Ind.), Kurunggut (Phil.), Ka thok rok (Thai), Nhân lô'ng, Lac tiên (Viet).

Description : Variable, lax ground herb, occasionally a vine, stems 1.5-5m long. Stems are cylindrical, and rather densely covered with long hairs. Spiralling tendrils occur next to the leaves on the shaded sides, and are yellowish green and sparsely hairy. Leaves are spirally arranged, ovate, simple but 3-lobed, 5.5-12 by 3.75 by 12 cm, both sides covered with hairs and with long stalked glands on both sides and along the leaf edges. Leaves are foul smelling when crushed. The leaf stalk is 2-10 cm long. Flowers are bisexual, and are either solitary or occur in pairs in the leaf axils; flower stalk 1-7 cm long, sparsely covered with hairs. A whorl of leaflets occurs at the base of the flower consisting of three overlapping leaflets, 3-30 mm long, and are finely and deeply divided. A second row of leaflets are threadlike, crossed, pale green or purple, with glandularly swollen yellow tips. The calyx tube is widely bell-shaped, 2.5-5 cm long, with 5 lobes, inside white, outside pale, greenish. There are 5 petals that are oblong, thin and white, and have a prominent midrib, 14-25 by 6-10 mm. Corona filaments are purplish. Fruit is a round berry, 15-20 by 12-17 mm, glossy yellow to orange when ripe, and enclosed by leaflets. Seeds are numerous and compressed, 4-5 by 1.75 mm, black or dark brown, shallowly pitted and ridged.

Ecology : Occurs both in wet areas and in areas with a pronounced dry season; in hedges, scrub, wasteland, roadsides, plantation margins. Also on landward margins of mangroves, above high tide mark. In Java, found from 0-1000(-1500) m asl. Flowering occurs all year round. Fruit is readily taken and spread by birds and small mammals. Flowers open in the morning and close before noon, after which they begin to wilt. Mangrove associate species.

Distribution : Originally from tropical South America, but now widespread throughout the tropics world-wide. Found throughout Southeast Asia.

Abundance : Common.

Use(s) : Sometimes planted as a soil cover (the Philippines) to control *Imperata* grass and erosion. Young leaves are a good vegetable, marketed in West Java. Seed aril tasty and edible, and tastes like cultivated passion fruit, but is slightly bitter. Young fruit cyanogenic and poisonous; suspected of poisoning livestock. In Papua New Guinea it is intercropped with sweet potato to suppress *Imperata*. Parts of the entire plant are used to treat coughs and a sore throat.

Source of illustration : Drawn from live specimen.

Reference(s) : Heyne (1950), de Wilde (1972), Soerjani *et al.* (1987), Verheij & Coronel (1992).

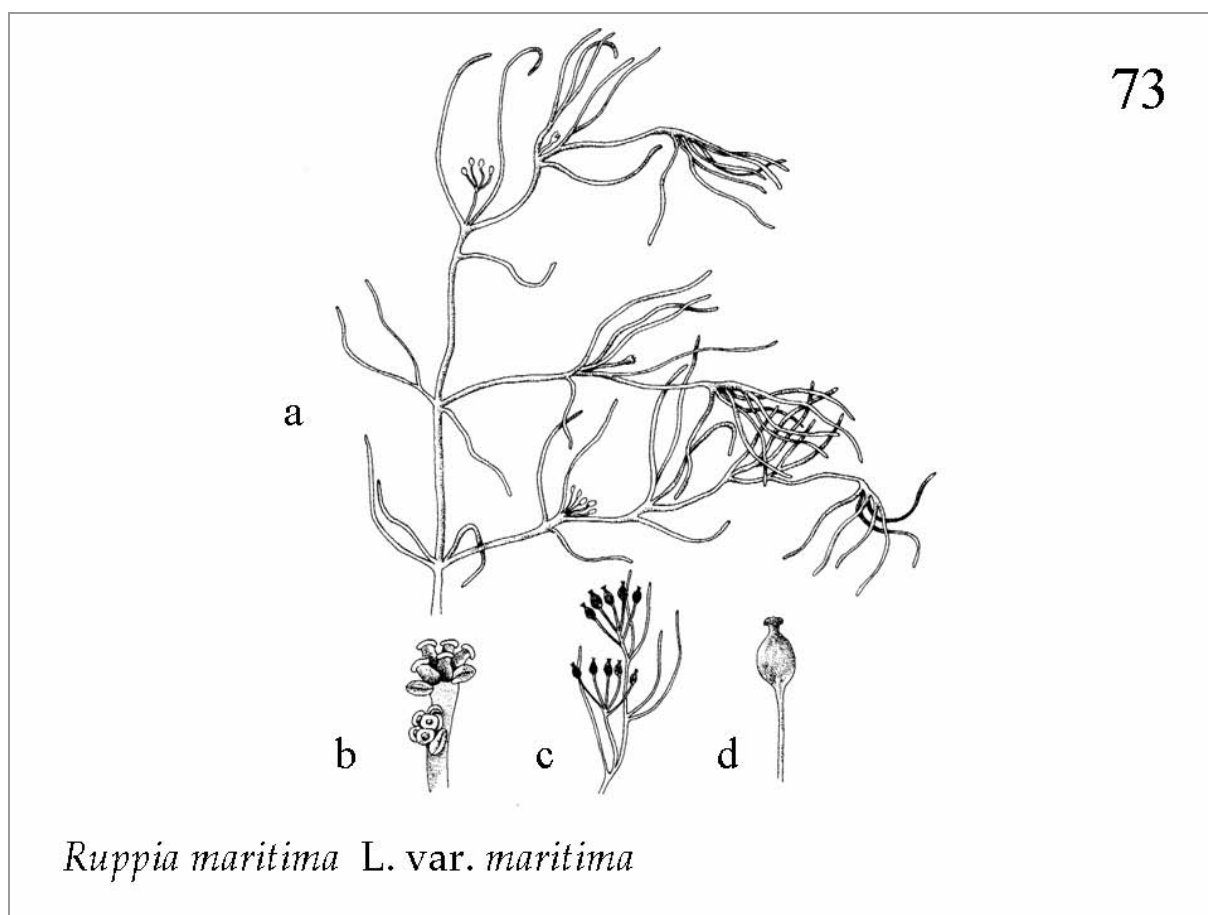


Fig. 73. *Ruppia maritima* L. var. *maritima*. (a) Detail of fruiting stem, (b) detail of group of flowers, (c) cluster of fruits, and (d) single fruit.

RUPPIACEAE**73*****Ruppia maritima* L. var. *maritima***

Synonyms : *Potamogeton filiformis* Phil., *Ruppia didyma* Swartz ex Wickstr., *Ruppia filifolia* (Phil.) Skottstr., *Ruppia marina* Fries, *Ruppia pectinata* Rydberg, *Ruppia rostellata* W.D.J. Koch ex Rchb.

Vernacular name(s) : Widgeon grass (E).

Description : Aquatic plant, with floating leaves located just below the water's surface; it's stems may be up to 1 m-long, and it has opposite leaves. Leaves have no stalk and are 3-7.5 cm long. They are narrow and thread-like with a sheathing base and a tongue-like appendage. The naked, bisexual flowers are only just exposed above the water. The 2-flowered spikes occur at an unequal level on opposite sides of the main flower stem. There are two opposite stamens located on very short, broad stalks. The stigma has no stalk. Each spike has at most four ripe fruits, each borne on a 8-14 mm-long stalk. They are distinctly beaked, hard, about 2.5 mm long and do not open when ripe. *Ruppia marina* is a highly variable species, with many subspecies and varieties; Ascherson and Graebner, for example, recognise the following: *brevirostris*, *curvicarpa*, *drepanensis*, *intermedia*, *obliqua*, *occidentalis*, *rostellata* and *spiralis*.

Ecology : Entirely submerged aquatic plant, occurring both in freshwater (e.g. ricefields in northern Peninsular Malaysia), brackish or marine water (coastal fish ponds, pools or lagoons, also in mangrove areas), or even hyper saline conditions (e.g. salt pans in South Sulawesi). Mangrove associate species.

Distribution : Cosmopolitan species. In Southeast Asia recorded from the Philippines, Vietnam, Malaysia (northern Peninsular Malaysia) and Indonesia (Java, Madura and Sulawesi).

Abundance : Very local, but locally abundant.

Use(s) : Unknown.

Source of illustration : Westhoff (1976), Cook (1990).

Reference(s) : Ascherson & Graebner (1907), Backer & Bakhuizen van den Brink (1963-8), Keng (1987), Giesen, Baltzer & Baruadi (1991), Missouri Botanical Garden TROPICOS database (www.mobot.mobot.org). <http://www.worldseagrass.org/species.pdf>

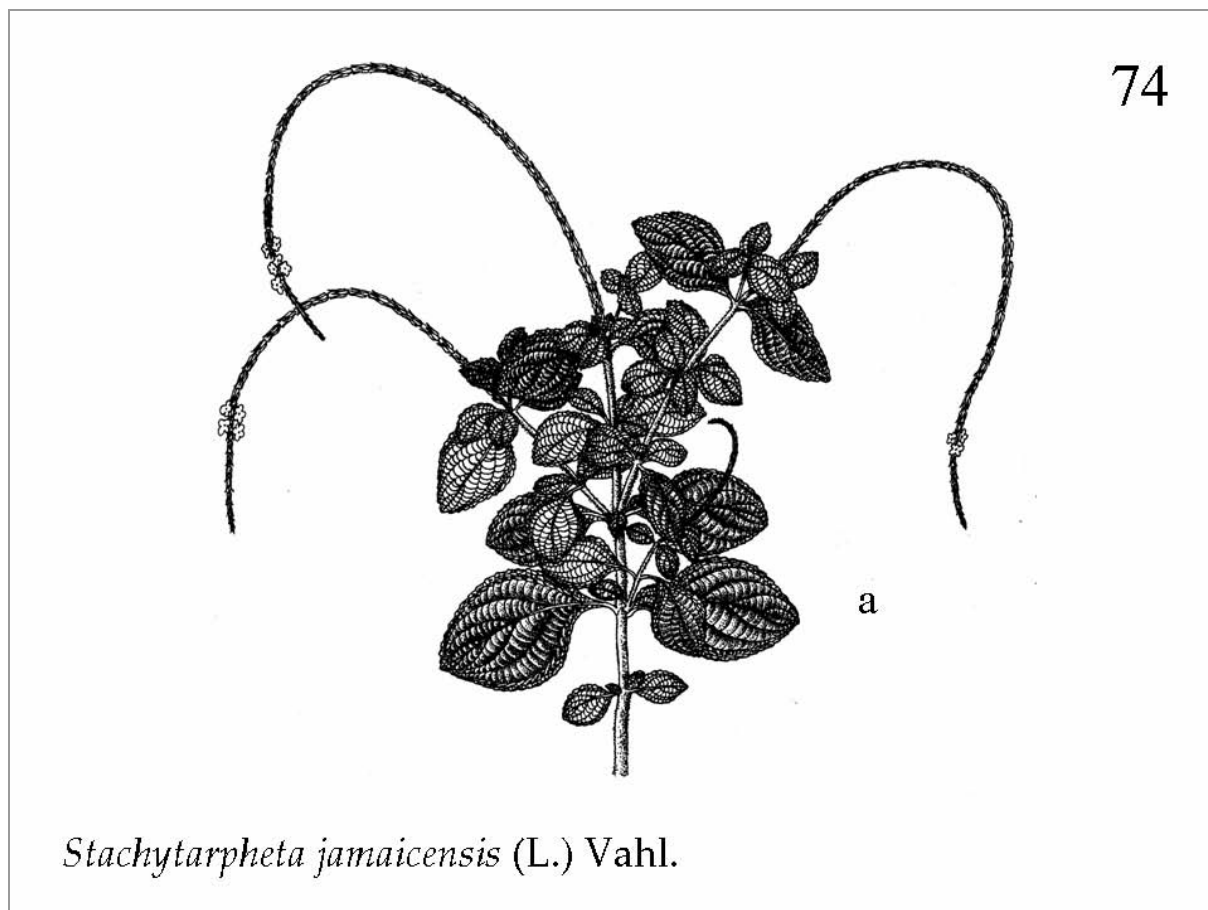


Fig. 74. *Stachytarpheta jamaicensis* (L.) Vahl. (a) Flowering terminal branchlet.

VERBENACEAE

74

***Stachytarpheta jamaicensis* (L.) Vahl**

Synonyms : *Stachytarpheta friedrichsthali* Hayek, *Verbena jamaicensis* L.

Vernacular name(s) : Blue Porterweed, Light-blue snakeweed (E), Pecut kuda, jarongan, jarongan lalaki, ngadi renga, remek getih, jarong, biron, sekar laru – *Percut kuda* (Ind.)

Description : Erect, large woody herb or shrublet with erect or curved branches, up to 1-2 m tall but usually < 1m. Young stems are bluntly quadrangular, compressed at the top of the internodes, either smooth or with scattered flat-lying curved hairs; older stems are smooth, often marked with white blotches. Leaves are opposite, with a fairly long stalk, ovate to ovate-elliptic, 4-9 by 3-6 cm, dark green, and with a wrinkled appearance between the lateral nerves; leaf edges are serrated. Flowers are arranged in terminal racemes, 20-40 cm long, and are either erect or curved upwards. The calyx is compressed, 5-6 mm long, smooth, with 4 short, sharp teeth. The corolla tube is 10-12 mm long, bent from the axis, thin, widening at the top, dark violet, with a paler to almost white base; smooth outside, but with long hairs on the inside. When in fruit, the calyx is elongate; fruits measure 5-6 by 2-2.5 mm.

Ecology : Occurs in sunny or slightly shaded areas, moist areas, waysides, secondary forest, ricefields, along streams, landward edges of mangroves, and on dikes in brackish water fishponds (tambak) in former mangrove areas. Often gregarious. Mangrove associate species.

Distribution : Exotic, originating from Tropical America from where it has been spread world-wide; pantropical. It now occurs throughout Southeast Asia.

Abundance : Locally very common.

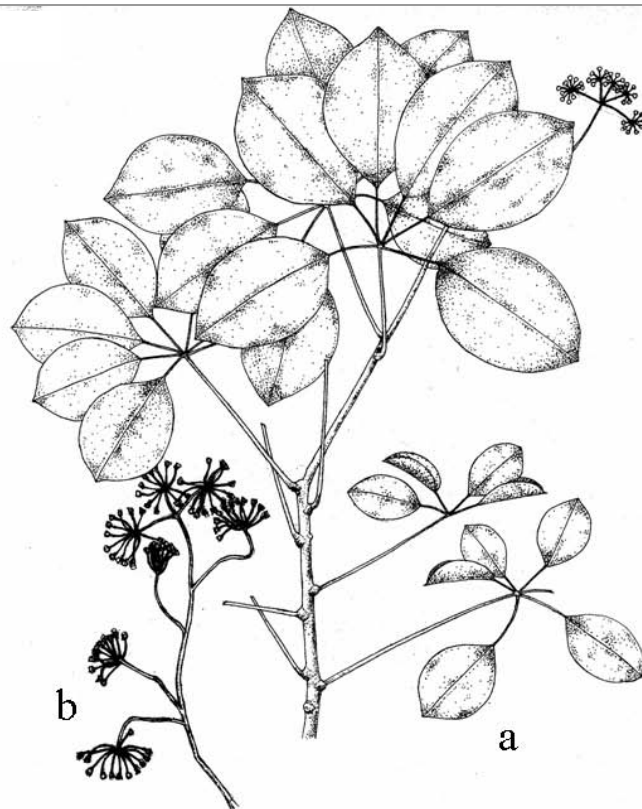
Use(s) : Planted as hedge for fencing of fields. Used as medicine to treat rheumatism, throat infections, as an anti-diuretic, and for purifying the blood.

Source of illustration : Soerjany *et al.* (1987)

Reference(s) : Soerjany *et al.* (1987), Noor *et al.* (1999), Maung (2003)

GROUP D: EPIPHYTES (other than ferns)

75



Schefflera elliptica (Blume) Harms.

Fig. 75. *Schefflera elliptica* (Blume) Harms. (a) Fruiting branches, and (b) fruit cluster.

ARALIACEAE

75

***Schefflera elliptica* (Blume) Harms.**

Synonyms : *Paratropia micrantha* Miq., *Schefflera elliptica* var. *microphylla* Harms., *Schefflera micrantha* (Miq.) Ridley, *Schefflera minimiflora* Ridley, *Schefflera nitida* Merr., *Schefflera venulosa* sensu Ridley, *Schefflera venulosa* var. *curtisii* Ridley, *Sciandophyllum elliptica* Blume

Vernacular name(s) : Unknown.

Description : (Often) epiphytic woody climber to straggling shrub, with broadly spreading and sometimes drooping branches; unarmed. Leaves compound, hand-shaped, leaflets 4-6, smooth, ovate-elliptic to obovate-elliptic, not more than 1.5 times as long as broad. Flower clusters with some branches as long as or shorter than the elongated main axis. Flowers very small; calyx inconspicuous. Fruits usually splitting into 5-6 parts, yellow or orange, later black.

Ecology : Lowland hill forest and scrub, sometimes along rivers and also frequent along coasts and in mangrove formations. In mangroves it usually occurs as an epiphyte. Mangrove associate species.

Distribution : East and Southeast Asian species, recorded from Thailand, Southern China, Malaysia, Singapore, Indonesia (Java, Sumatra, Sulawesi) and the Philippines.

Abundance : Widespread and common.

Use(s) : Unknown.

Source of illustration : Online collection Leiden Herbarium, the Netherlands.

Reference(s) : Stone (1978).

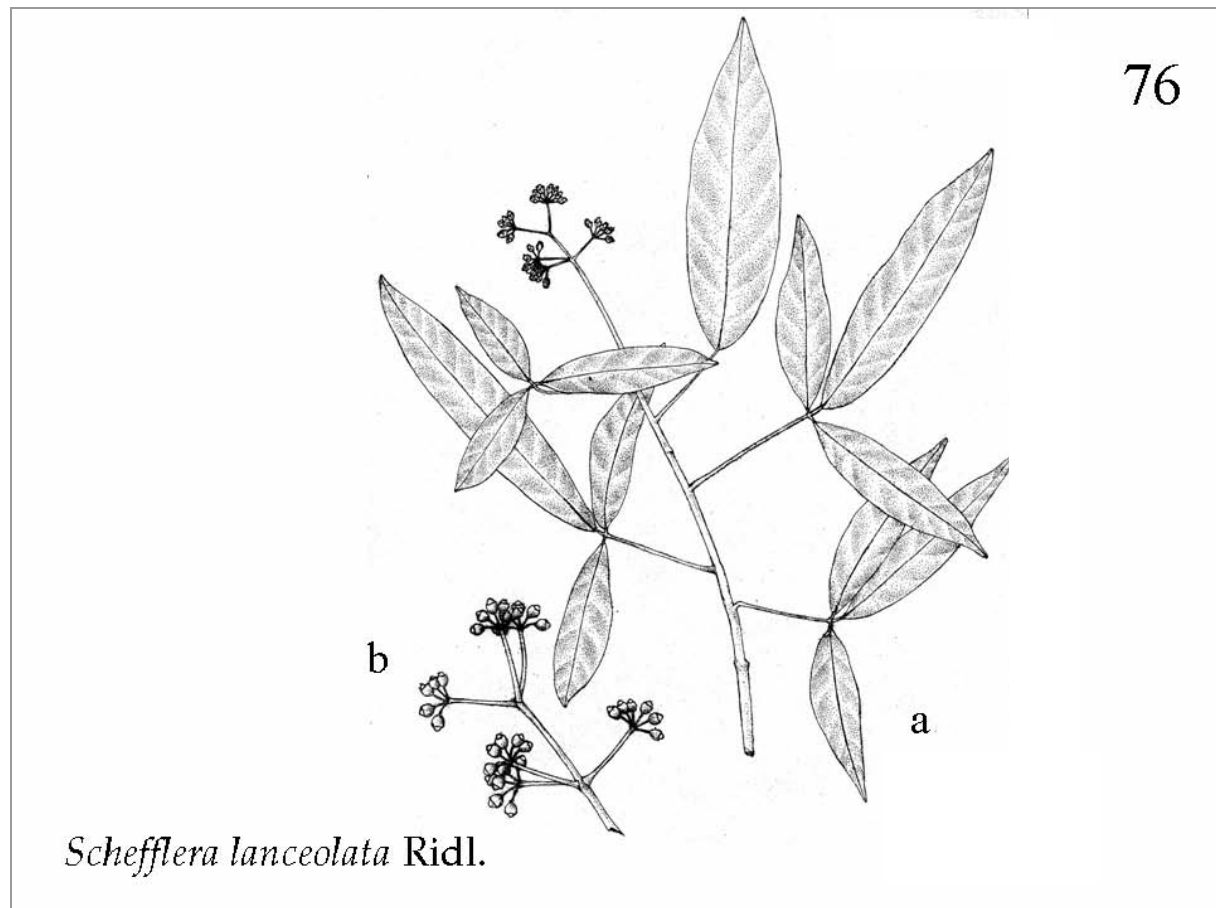


Fig. 76. *Schefflera lanceolata* Ridl. (a) Fruiting branches, and (b) fruit cluster.

ARALIACEAE

76

***Schefflera lanceolata* Ridl.**

Synonyms : *Heptapleurum avene* sensu King non Seemann

Vernacular name(s) : Unknown.

Description : A slender, epiphytic, unarmed climber. Leaves simple or trifoliate: simple on the upper parts of the plant, and trifoliate on the lower parts; on the whole, simple leaves predominate; these are spirally or alternately arranged. Leaves thinly leathery, leaf edges flat, venation evident to merely obscure; stipules fused and strap-shaped, like a ligula in grasses. Flower clusters larger than the leaf, drooping. Calyx inconspicuous. In appearance similar to *Schefflera simplicifolia* Merr..

Ecology : Coastal lowlands, occurring on river banks, rocky coasts (where it may occur growing on rocks rather than as an epiphyte) and in mangroves. Mangrove associate species.

Distribution : Southeast Asian species, known from Peninsular Malaysia (Telok Sisik in Pahang; Trengganu) and Singapore (type locality Sungei Murei, where it may have disappeared). Sungei Murei lies in the western part of Singapore and is part of the Western Catchment; nowadays it consists of a series of small, coastal freshwater lagoons, created by damming up river mouths (pers. comm. Dr. Darren Yeo, University of Singapore, November 2004).

Abundance : Uncommon to rare, with a very restricted range. Possibly no longer found in Singapore.

Use(s) : Unknown.

Source of illustration : Based on digital images provided by Royal Botanic Gardens, Kew (RBG Kew) of specimen K000250955, and the type specimen K000250956. With the permission of the Board of Trustees of The Royal Botanic Gardens, Kew.

Reference(s) : Stone (1978);
Journal of the Federated Malay States Museums 10: 137. 1920.

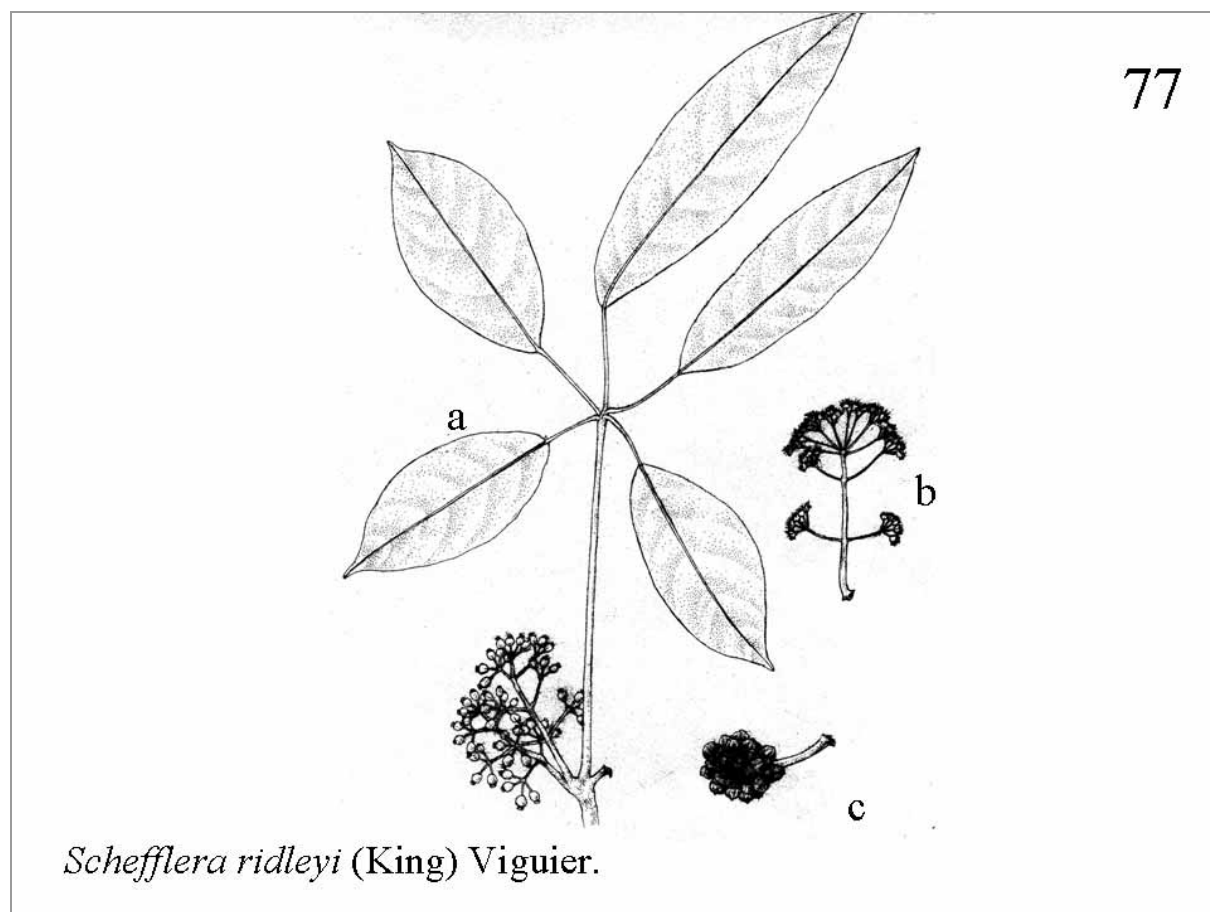


Fig. 77. *Schefflera ridleii* (King) Viguier. (a) 5-lobed leaf with cluster of fruit, (b) flower cluster, and (c) fruit cluster.

ARALIACEAE

77

***Schefflera ridleii* (King) Viguier**

Synonyms : *Schefflera musangensis* Hend., *Scheffleropsis polyandra* (Ridley) Ridley

Vernacular name(s) : Unknown.

Description : Epiphytic, sometimes straggling shrub, occasionally terrestrial on rocks near sea coasts; unarmed. Compound leaves, hand-shaped, with 3-7 leaflets; leaflets thin, with narrowed base, pointed tip, and leaf edges coarsely and obscurely toothed; dark green above, lighter below. Flower clusters in panicles that are large and open. Flowers small, cream-coloured and fragrant, ovary 6-8 locular; stamens 6-16. Calyx inconspicuous.

Ecology : Epiphyte, that may occasionally be terrestrial on rocks near sea coasts. Occurs in lowland and hill forest up to an altitude of 900 m asl. sometimes extending into the montane zone up to 1150m asl. Often as epiphyte along rivers. Recorded in mangroves in southern Peninsular Malaysia and Singapore. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Peninsular Malaysia (Malacca, Johore, Pahang, Trengganu, Kelantan) and Singapore.

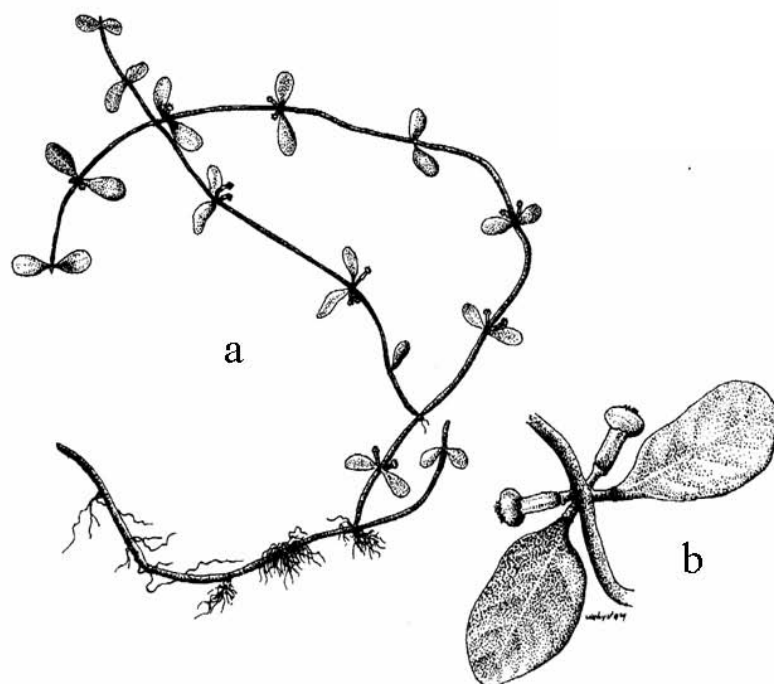
Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Photo of herbarium specimens kept at FRIM herbarium (composite of several specimens).

Reference(s) : Stone (1978), FRIM herbarium (Mohd. Shah & Mohd. Noor No. M8. 1805, collected in Ulu Sungai Sat, Pahang on 11 July 1970).

78



Dischidia benghalensis Colebr.

Fig. 78. *Dischidia benghalensis* Colebr. (a) Habit of flowering stem, and (b) detail of two fruits.

ASCLEPIADACEAE

78

***Dischidia benghalensis* Colebr.**

Synonyms : *Dischidia benghalensis* var. *cuneifolia* (Wall.) Kuntze, *Dischidia benghalensis* var. *spathulata* (Blume) Kuntze, *Dischidia cuneifolia* Wall., *Dischidia spathulata* (Bl.)

Vernacular name(s) : Daun pitis kecil, Daun korpa (Mal., Ind.)

Description : Climbing, fleshy epiphytic herb, 30-100 cm long, with a smooth stem and pendulous roots emerging from nodes. Leaves have very short stalks, are smooth and occur in widely spaced pairs. They are light green or yellowish-green and may occur in various shapes on the same plant. Some are smooth and round, thickly fleshy, linear or linear-spoon-shaped, 1.5-4 cm long. Other leaves are flat, oblong-lanceolate or oblong-obovate, 1.5-2.5 cm long. Flowers occur between the stalks of a leaf pair or terminally in dense, often umbrella-shaped clusters. The stalk of a flower cluster is at most 5 mm long and bears at most 10 flowers. The corolla is yellowish-white and 4 mm long. Calyx and tube of the corolla are virtually smooth and free of hairs. The circle of scale-like appendages between corolla and stamens is divided into two narrow segments that are recurved. Fruits are 4-6 cm long.

Ecology : Occurs in open forest, on village and roadside trees and in mangroves, up to an altitude of 600 m. Flowering occurs all year round. Mangrove associate species.

Distribution : From India and Bhutan, eastwards to Southeast Asia, where it has been recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia (Peninsular) and Indonesia (Sumatra, Java).

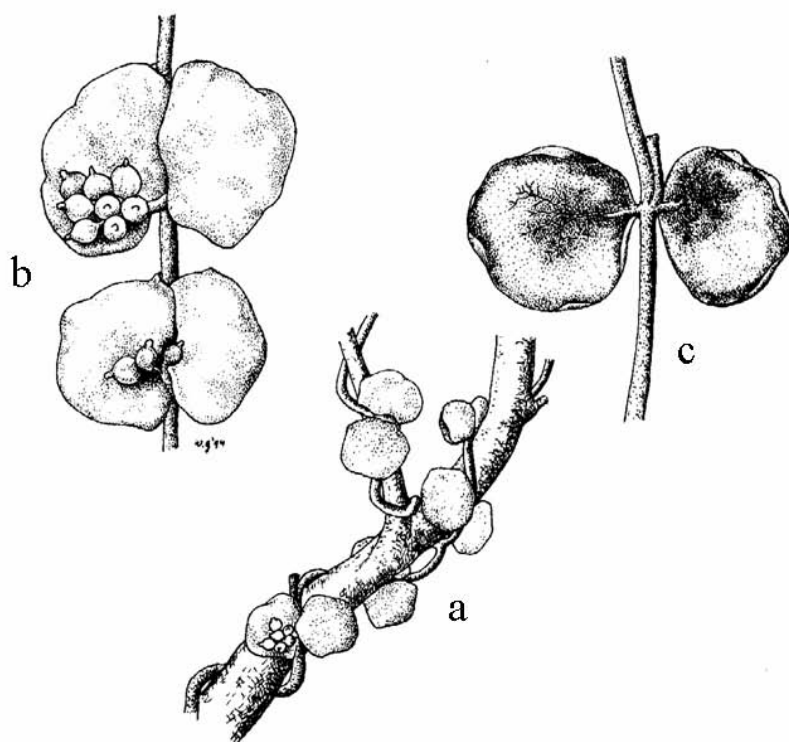
Abundance : Relatively common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Rahman & Wilcock (1995), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

79



Dischidia nummularia R.Br.

Fig. 79. *Dischidia nummularia* R.Br. (a) Flowering stem, (b) detail of flowering stem showing flower cluster and two leaves, and (c) two leaves.

ASCLEPIADACEAE

79

***Dischidia nummularia* R.Br.**

Synonyms : *Collyris minor* Vahl., *Dischidia gaudichaudii* Decne., *Dischidia minor* (Vahl.) Merr., *Dischidia orbicularis* Decne., *Nummularia lactea minor* Rumph.

Vernacular name(s) : Daun Pitis Kecil, Turak (Ind.), Dây môt tiê'n (Viet.)

Description : Epiphytic herb, 10-50 cm long, with a much divided, smooth stem. The flat and smooth leaves are all similarly shaped, broadly oval-orbicular and with a very short point. The top of the leaf appears to be covered with 'powder' and may be dotted, while underneath the leaves are not dotted, but are obscurely veined. Leaves are 1-1.5 times as long as wide, measuring 4-11 by 4-8 mm. Flowers are located between the stalks of a leaf pair or occur at the end of branchlets in dense, often umbrella-shaped groups on stalks. The calyx is smooth, but inside the red, 3 mm-long corolla there is a tuft of hairs at the base of each segment. The circle of scale-like appendages between corolla and stamens is divided into two segments. Fruits are 2.5-4 cm long, and the seeds contain fat particles that attract ants.

Ecology : On wayside trees, in mangroves, and in mixed- and teak forests, up to an altitude of 550 m. Flowering occurs from May to November. The seeds are often dragged away by ants which feed upon the fat particles. Mangrove associate species.

Distribution : From Sri Lanka, India and Bangladesh through Southeast Asia and Australia. In Southeast Asia it has been recorded in Myanmar, Cambodia, Vietnam, Thailand, Malaysia, Singapore, Brunei, Indonesia (throughout) and Papua New Guinea.

Abundance : Very common.

Use(s) : The abundant latex has been used to ease the pain of stings from *Ikan Sembilang* (a spiny catfish) and *Ikan Swanggi*. Leaves are used to treat gonorrhea and *aphthae tropicae* (tropical sores).

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium, and based on Holttum (1954).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Rahman & Wilcock (1995), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

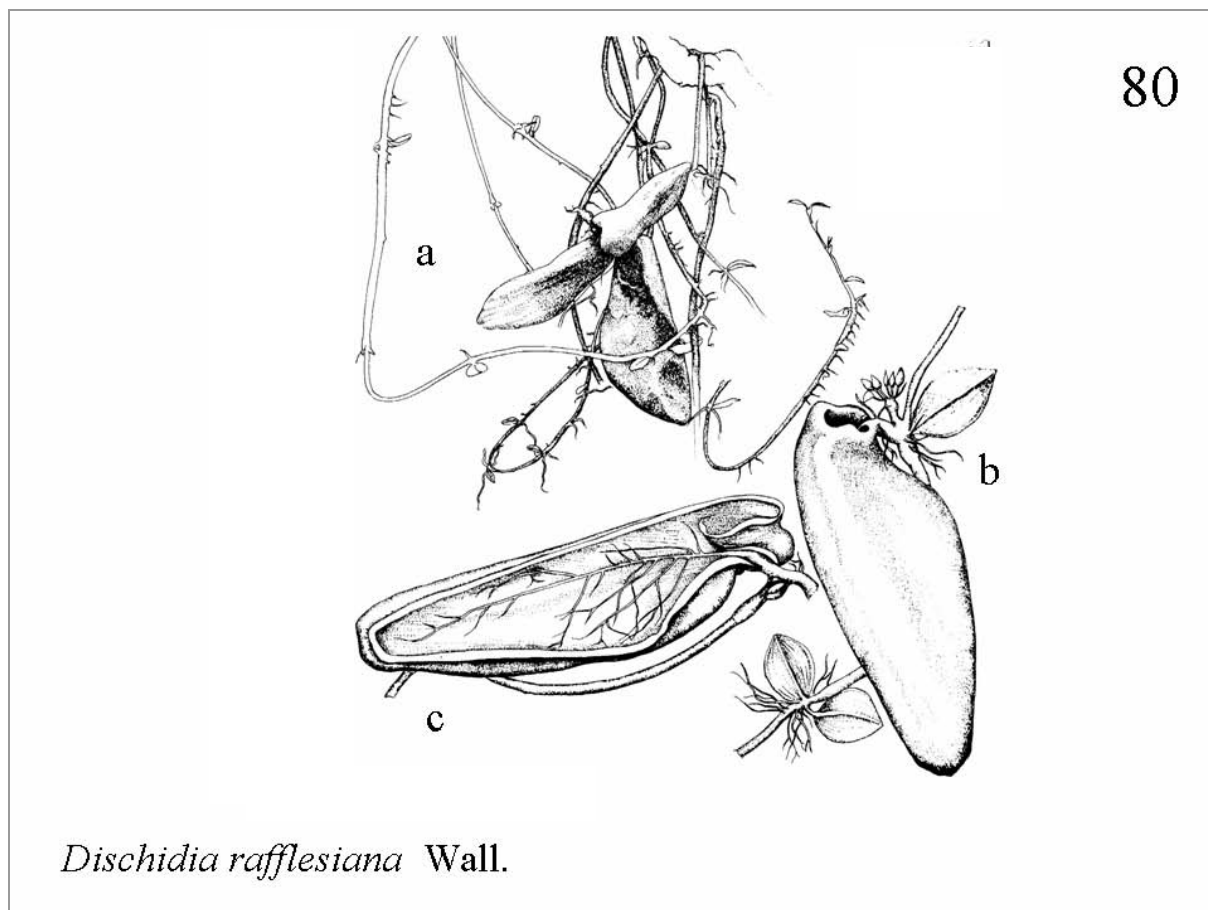


Fig. 80. *Dischidia rafflesiana* Wall. (a) Flowering stem, (b) detail of flowering stem showing large and small leaves, and flower cluster, and (c) detail of underside of large leaf.

ASCLEPIADACEAE

80

Dischidia rafflesiana* Wall.*Synonyms :** Unknown.**Vernacular name(s) :** Flower pot plant, Malayan urn vine (E), Akar Kul, Akar Banok, Akar Bani (Ind.), Dây Mõ qua (Viet.), Chuk rohini, Gluey mu lang (Thai)**Description :** A climbing and winding epiphytic herb with a smooth stem. Its leaves are partly, and often group-wise, transformed into minutely stalked, bag-shaped, narrow-mouthed ‘vessels’ or ‘pitchers’ (similar to those of the pitcher plant, *Nepenthes*) that are green or yellow on the outside and purple inside, and 5-12.5 cm long. The normal, smooth, ovate-elliptic-orbicular leaves are thick fleshy, have short stalks, occur in widely-spaced pairs and measure 1-2 cm. The calyx is 1 mm long, and, together with the outside of the corolla tube, is sparsely covered with short hairs. The 5 mm-long corolla is pale yellow, and the mouth of the tube is tinged with purple. The circle of scale-like appendages between corolla and stamens are two-lobed. The lobes are recurved, and have a small, bent tip. The fruits are orange-yellow, 5-7.5 cm long with hairs that are 2.5 mm or longer, and contain fat particles that attract ants.**Ecology :** Occurs in sunny or slightly shaded localities, up to an altitude of 600 m, in teak- and secondary mixed forests, on roadside trees and in mangroves. The climbing, winding stems frequently coat the branches and the higher parts of a not-too-shaded tree trunk, often hanging down in long garlands. Flowering occurs all year round. Very frequently the ‘pitchers’ contain rain water and detritus. Near the mouth of the pitcher the stem emits a much-branched root which descends deeply into the pitcher. Pitchers are often inhabited by ants. The seeds are often dragged away by ants, which feed on fat particles produced by the plant. In Thailand recorded on *Sonneratia ovata* and *Excoecaria agallocha*. Mangrove associate species.**Distribution :** From India through Southeast Asia to Australia. In Southeast Asia recorded from Myanmar, Thailand, Vietnam, Malaysia, Brunei and Indonesia.**Abundance :** Common.**Use(s) :** Root may be folded in the betel-nut quid and chewed to cure coughs.**Source of illustration :** Holttum (1954).**Reference(s) :** Burkill (1935), Backer & Bakhuizen van den Brink (1963-8), Aksornkoae (1993), http://florawww.eeb.uconn.edu/acc_num/200300316.html, Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

81



Hoya parasitica (Roxb.) Wall. ex Wight.

Fig. 81. *Hoya parasitica* (Roxb.) Wall. ex Wight. (a) Flowering plant, and (b) detail of flower cluster.

ASCLEPIADACEAE

81

Hoya parasitica* (Roxb.) Wall. ex Wight*Synonyms :** *Asclepias parasitica* Roxb., *Hoya hookeriana* Wight**Vernacular name(s) :** Wax plant (E), Nom pi kad, Nom tam lia (Thai)

Description : Epiphytic, creeping shrub, with stout, smooth branches, 0.8-1.5 m long, somewhat pendulous. Leaves are variable, ovate-elliptic, oblong-elliptic or lanceolate, fleshy and smooth, 10-15.5 cm by 2.5-3.5(-5) cm, with a pointed tip. Copious amounts of white latex are present in all parts of the plant. Flowers are present in umbrella-shaped, pendulous, many flowered clusters; flower cluster stems are stout, about 3-5.5 cm long. Calyx lobes are oblong, with blunt tips, 1.2-1.8 cm long, and whitish. The corolla is smooth on the outside, with a 3-4 mm long tube; corolla lobes are broadly ovate, with sharp tips, 4-5 mm long, pale pink to purplish, with short hairs on the inside. Fruits (called 'follicles') are either solitary or occur in pairs, 10-15 cm long, pointed, smooth, and brown spotted. Seeds are 4-5 mm long, oblong-elliptic, with hairs 3.5-4 cm long.

Ecology : In spite of the scientific name, the plant is a non-parasitic epiphyte. It is found in a wide variety of habitats including mangroves. In Thailand it has been recorded on *Excoecaria agallocha* (Aksornkoae, 1993). Mangrove associate species.

Distribution : Found from India to Thailand and Cambodia, including Myanmar and Peninsular Malaysia.

Abundance : Locally common.

Use(s) : Not described, but possibly has potential as an ornamental.

Source of illustration : Ahmed (1997), www.TeessideCacti.org

Reference(s) : Aksornkoae (1993), Rahman & Wilcock (1995).

82



Rhododendron brookeanum Low ex Lindl. var. *brookeanum*.

Fig. 82. *Rhododendron brookeanum* Low ex Lindl. var. *brookeanum*. (a) Detail of branchlet with flowers and fruits.

ERICACEAE

82

Rhododendron brookeanum* Low ex Lindl. var. *brookeanum**Synonym(s) :** *Azalea brookeana* Low ex Lindl.**Vernacular name(s) :** Unknown.

Description : Epiphytic or terrestrial shrub, up to 2 m, occasionally 4 m tall, with large, fleshy roots. The upper internodes, which measure 2-15 cm by 3-6 mm, are bluntly-angular or almost cylindrical, and set with scales. The lower internodes are cylindrical and smooth. The more or less leathery and smooth leaves, 12-28 by 3-9 cm, occur in 3-4(-5)-merous pseudo whorls on the upper 1-2 nodes. Leaves are oblong or lanceolate-oblong, often almost without a stalk. After falling off, the scales leave dense, minute, dark depressions on the leaves. The flower heads have 5-14 flowers. Flower stalks are 2-5 cm long and often scaly. The calyx is 4-5 mm long. The funnel-shaped, more or less fleshy, often lemon-scented corolla, 5-9 cm long, is a beautiful orange-pink colour, with a white or cream centre. The corolla may occasionally be pale golden-yellow, or more rarely, a brick-red colour with a yellowish throat. When aging, the corolla turns red or rosy-orange on the outside. The nearly cylindrical fruit measures 4-5 by almost 1 cm. It is scaly and covered with short, soft hairs. The fruit stalk is 3-6 cm, and the seeds measure 7-9 mm, including the 'tails'. Four varieties are recognized: *Rhododendron brookeanum* var. *brookeanum* (endemic to Borneo), var. *cladotrichum* (rare, once found in East Kalimantan), var. *gracile* (endemic to Borneo), and var. *extraneum* (found in West Sumatra). The description above is for var. *brookeanum*, which is the only variety found in mangroves.

Ecology : Epiphytic on mangrove trees or rocks, occurring from sea level up to an altitude of 1,525 m in moss forest. It has a preference for trees along rivers. Flowering occurs throughout the year. Mangrove associate species.

Distribution : Endemic to Borneo (Indonesian Kalimantan, Brunei, Sarawak).

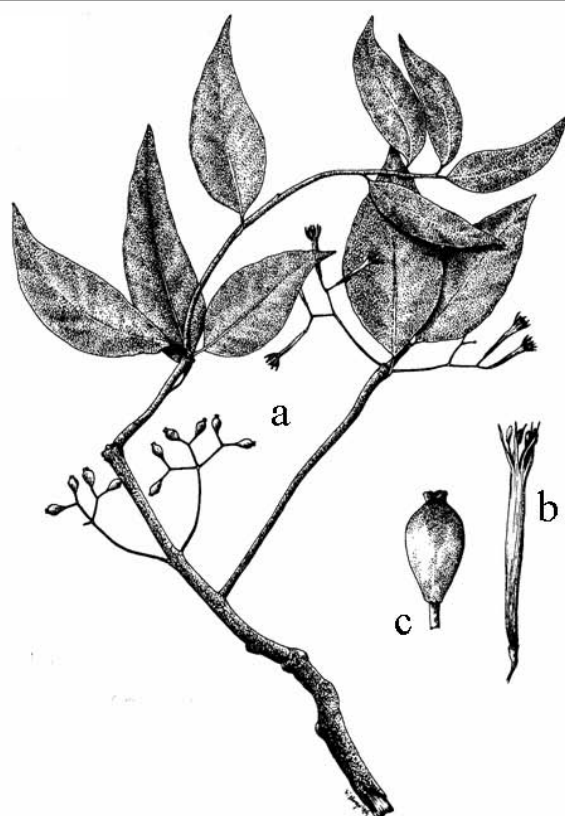
Abundance : Unknown. Probably uncommon, but possibly quite rare.

Use(s) : Formerly used for cross-pollination of cultivated *Rhododendrons*; now practically out of cultivation.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Sleumer (1966).

83



Amyema anisomeres Dans.

Fig. 83. *Amyema anisomeres* Dans. (a) Flowering and fruiting branchlet, (b) flower, and (c) fruit.

LORANTHACEAE

83

Amyema anisomeres* Dans.*Synonyms :** Unknown.**Vernacular name(s) :** Unknown.

Description : Smooth parasitic epiphyte, with round branchlets. Leaves are sparse and opposite, oblong to lanceolate, measuring 5.5-8.5 by 1.25-3 cm. The base of the leaf tapers narrowly to the 8-10 mm-long leaf stalk. Flower clusters occur singularly or paired in leaf axils, with drooping, umbrella-like groups of three flowers. The flower stalk is round and 4-7 mm long. The calyx tube is funnel-shaped and 2.5 mm long. The corolla is orange coloured, almost cylindrical, 19-20 mm long, with 4 or 5 blunt petals that measure 3.5 mm. The loose part of the filaments (of the anthers) is 1.5 mm long, and the anthers themselves are oblong and measure 1 mm. Fruit is unknown. One of the few species that is possibly endemic to Southeast Asian mangroves.

Ecology : Collected only once in *Rhizophora* mangroves. True mangrove epiphyte species, as it is known only from this habitat.

Distribution : Probably very localised, as it has only been collected once, at Kampong Lato-u near Malili in South Sulawesi, Indonesia. Endemic to Sulawesi.

Abundance : Very rare. As the mangroves in the Malili area are under threat due to conversion, this species may be considered endangered.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Danser (1931).

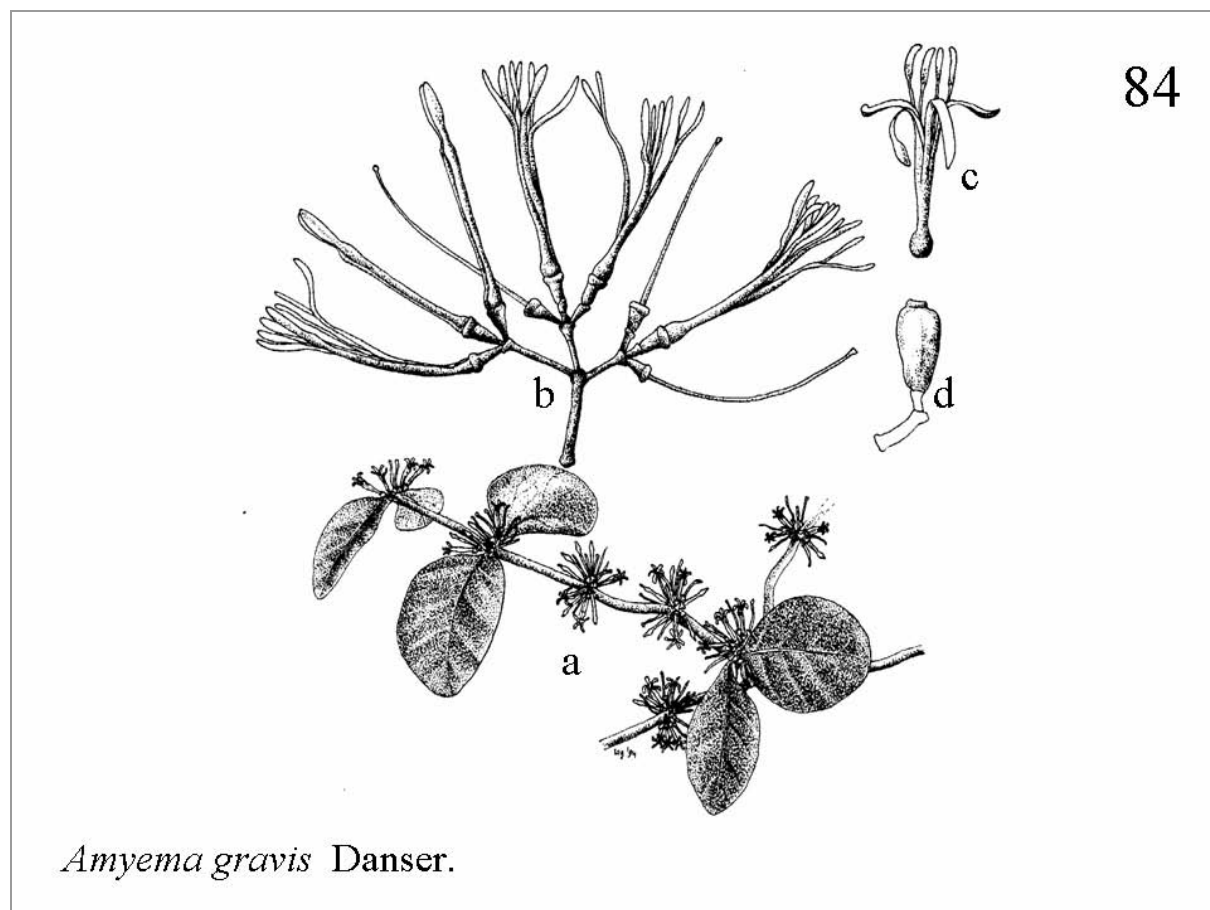


Fig. 84. *Amyema gravis* Danser. (a) Flowering branchlet, (b) cluster of flowers, (c) flower, and (d) fruit.

LORANTHACEAE

84

Amyema gravis* Danser*Synonyms :** *Loranthus obovatus* Schröt. & Back.**Vernacular name(s) :** Unknown.

Description : Hemi-parasite that usually hangs upside down and measures 0.5-1 m. It has very thick, fleshy opposite leaves 1.5-3 by 2.5-5 cm, with a leaf stalk of 3-5 mm. The flower clusters occur solitarily in the leaf axils. The clusters consist of 2-3 stalked groups of three, and therefore number 6-9 flowers. Flower stalks of lateral flowers are 1-2 mm long. The 28-30 mm-long corolla is red and has a greenish-yellow, inflated base. Anthers are about 4 mm long. Fruit is not described, but for the genus these are all ellipsoid to egg-shaped

Ecology : Hemi-parasite on *Avicennia*, *Rhizophora* and *Sonneratia*. Flowering occurs all year round. True mangrove epiphyte species, as it is known only from this habitat.

Distribution : Southeast Asian species, found in Malaysia (Sabah) and Indonesia (Borneo, Java, Kangean Archipelago).

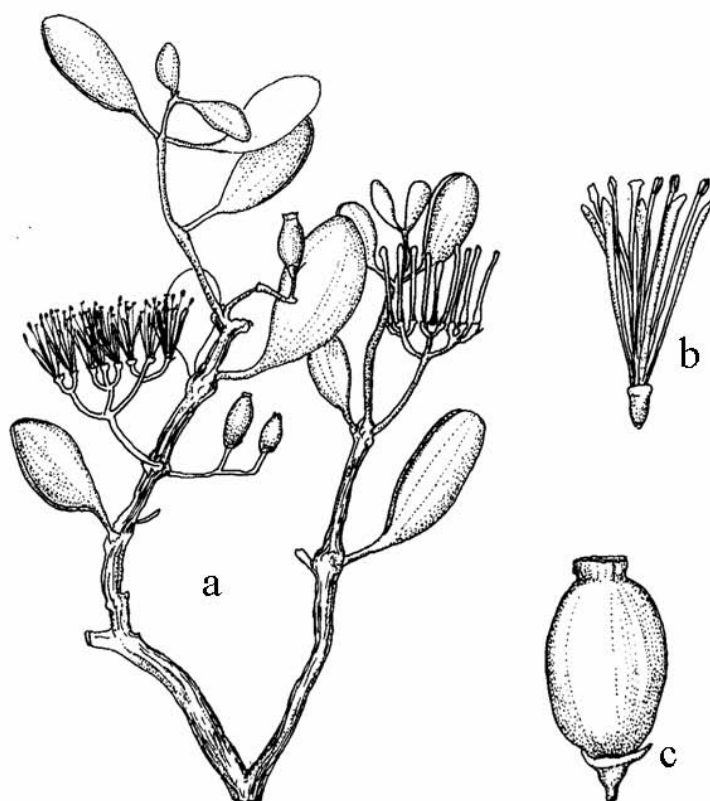
Abundance : Locally abundant.

Use(s) : Unknown.

Source of illustration : Danser (1931), Barlow (1997).

Reference(s) : Danser (1931), Backer & Bakhuizen van den Brink (1963-8), Barlow (1997).

85



Amyema mackayense (Blakely) Danser.

Fig. 85. *Amyema mackayense* (Blakely) Danser. (a) Flowering and fruiting branchlet, (b) flower, and (c) fruit.

LORANTHACEAE

85

***Amyema mackayense* (Blakely) Danser**

Synonyms : *Amyema cycnei-sinus*, *Amyema mackayense* ssp. *cycnei-sinus*, *Loranthus cycnei-sinus*, *Loranthus mackayensis* Blakely

Vernacular name(s) : Unknown.

Description : Epiphytic parasite, with smooth stems that are enlarged at the nodes and are much branched. Leaves are opposite, broadly spoon-shaped to ovate, measuring 2.5-4 by 1.5-4 cm, with a distinct leaf stalk measuring 3-6 mm. Flower clusters are solitary or paired in the leaf axils. Flower stalks are usually recurved and 6-15 mm long. The calyx is funnel-shaped. The corolla in the mature bud is slender, 5-merous, trumpet-shaped and 10-28 mm long, red, yellow or green. Anthers are 1.5 mm long, and free parts of the filaments supporting the anthers measure 3-5 mm. Fruit is ellipsoid, crowned by the persistent calyx.

Ecology : Exclusively parasitic on mangroves, recorded on *Avicennia*, *Camptostemon*, *Ceriops*, *Excoecaria*, *Lumnitzera*, *Rhizophora* and *Sonneratia*. True mangrove epiphyte species, as it is known only from this habitat.

Distribution : Northern Australia, Papua New Guinea and Indonesia (Papua, near Merauke).

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Barlow, in Henty (1981).

Reference(s) : Barlow, in Henty (1981), Barlow (1997).

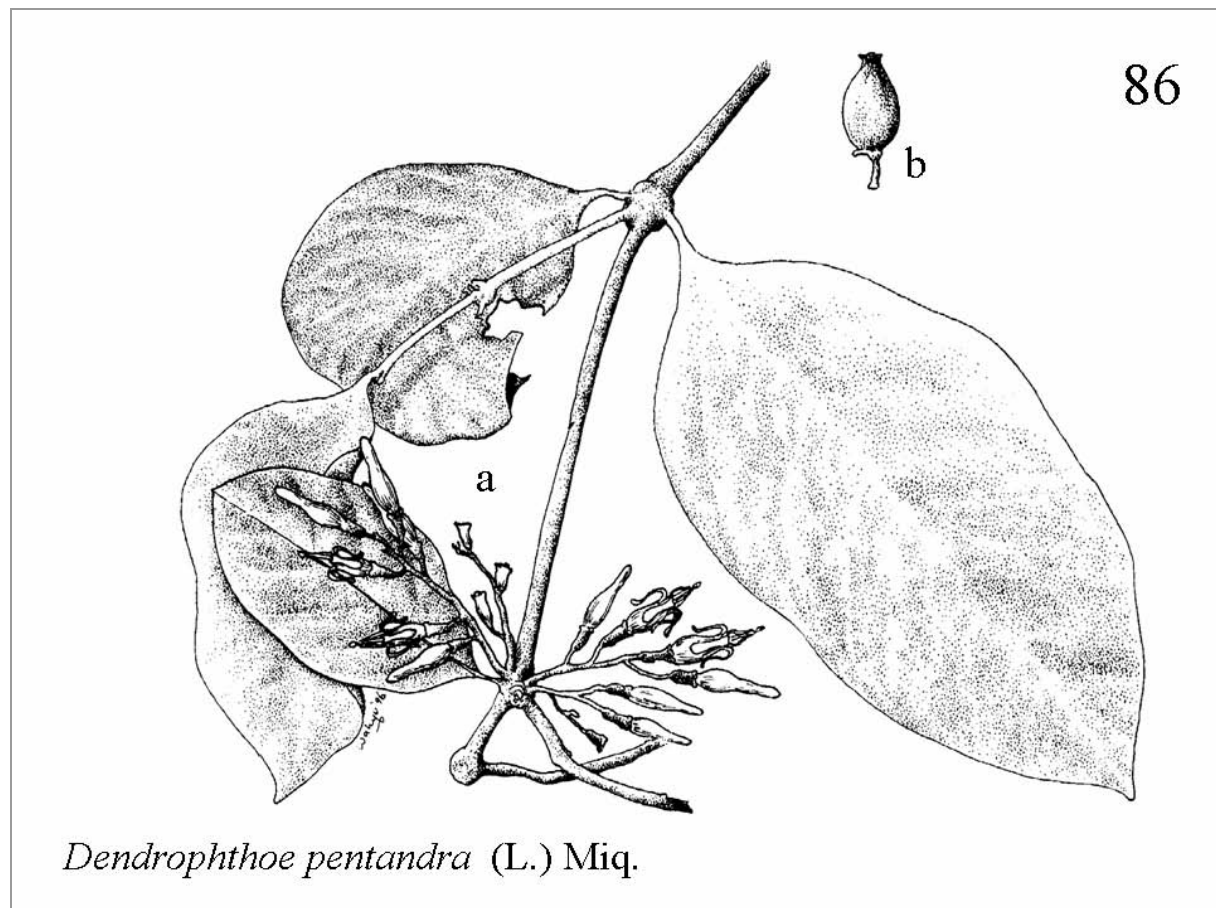


Fig. 86. *Dendrophthoe pentandra* (L.) Miq. (a) Flowering branchlet, and (b) fruit.

LORANTHACEAE

86

Dendrophthoe pentandra (L.) Miq.

Synonym(s) : *Dendrophthoe farinosus* Mart., *Dendrophthoe leucobotrya* Miq., *Dendrophthoe venosus* Mart., *Elytranthe farinosa & rigida* G. Don., *Loranthus crassus* Hook. f., *Loranthus farinaceous* Griff., *Loranthus flavus* Bl., *Loranthus pentandrus* L., *Loranthus shawianus* Elm., *Loranthus venosus* Bl., *Loranthus zimmermanni* Warb., *Meiema axillaris* Rafin., *Scurrula pentandra & venosa* G. Don.

Vernacular name(s) : Mistletoe (E) Kemadean, Kemlandean, Mangandeuh, Pasilan (Ind.), Dây chùm gối (Viet.), Ka fak ma muang (Thai.)

Description : Rather stout, strongly branched parasitic epiphyte with smooth, almost hairless stems and leaves, but with densely hairy flowers and flower stalks. The overall stem of the plant may measure over 1 m, and occasionally even up to 3 m. Leaves are highly variable, from lanceolate to round, but are usually elliptical or oblong, 5-20 cm by 2.5-12 cm, with a pointed or rounded tip. Leaf stalks are flattened on top, rounded below, and 5-20 mm long. Flower clusters may have a few to 20 flowers, each on 1-4 mm long stalks. The calyx tube is usually small, 1.5-2 mm long and 1.5 mm wide near the base. The corolla is 13-26 mm long, up to 5 mm wide, with five longitudinal folds, later splitting into five lobes down to 2/3's of the length. Colour of corolla is variable, most common being yellow to orange-reddish with greenish lobes, but variations include 'salmon-coloured with green lobes' and 'dirty red with green buds'. Fruit is ovoid, up to 10 mm long and 6 mm diameter, crowned by the remains of the calyx.

Ecology : Common parasite, from sea level to 300 m (occasionally up to 1,500 m), reported on *Dacrydium* and *Araucaria* (Danser, 1931); on *Avicennia* and *Excoecaria agallocha* in Vietnam (Hong & San, 1993); and on *Lumnitzera*, *Bruguiera* and *Hibiscus tiliaceus* in Thailand (Aksornkoae, 1993). Mangrove associate species.

Distribution : Found from eastern India and Bangladesh eastwards throughout Southeast Asia where it has been recorded from Myanmar (Tenasserim), Thailand, the Philippines (rare, on Luzon and Palawan), Singapore, Vietnam, Malaysia (Peninsular) and Indonesia (Sumatra, Borneo, Java).

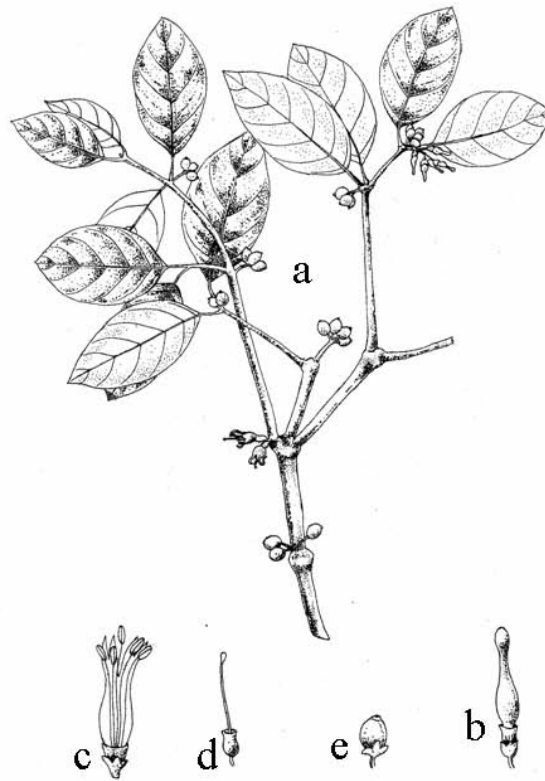
Abundance : Common to locally very common.

Use(s) : Used to treat cancer (in Java).

Source of illustration : Adapted from Danser (1931) and Holttum (1954).

Reference(s) : Danser (1931), van Steenis *et al.* (1951), Backer & Bakhuizen van den Brink (1963-8), Alam (1986), Hong and San (1993), Aksornkoae (1993), Barlow (1997).

87



Macrosolen cochinchinensis (Lour.) Tiegh.

Fig. 87. *Macrosolen cochinchinensis* (Lour.) Tiegh. (a) Flowering and fruiting branch, (b) flower bud, (c) longitudinal section of flower showing the stamens, (d) flower with corolla and stamens removed, showing the stigma and calyx, and (e) fruit.

LORANTHACEAE

87

***Macrosolen cochinchinensis* (Lour.) Tiegh.**

Synonyms : *Elytranthe ampullacea* G. Don., *Elytranthe cochinchinensis* G. Don., *Elytranthe elmeri* Merr., *Hillia longiflora* Blanco, *Loranthus ampullaceus* Roxb., *Loranthus carinatus* D.C., *Loranthus cochinchinensis* Lour., *Loranthus globosus* Roxb., *Loranthus oleoides* D.C., *Loranthus pallens* D.C., *Loranthus patulus* Jack., *Loranthus sphaeocarpus* Bl., *Loranthus sphaerocephalus* Wurm., *Loranthus subglobosus* D.C., *Loranthus subumbellatus* Bl., *Loranthus tribracteatus* Ridl., *Loranthus viridiflorus* Wall., *Macrosolen tribracteatus* Dans., *Tristerix viridiflorus* Mart.

Vernacular name(s) : Mistletoe (E), Kemaduhan, Pasilan, Mangandeah (Ind.)

Description : Epiphytic parasite, many branched, nodes swollen, base of plant swollen at the attachment to the host plant, the adventitious roots running along the host. Smooth or rarely with some short hairs on the flowers. Leaves opposite or scattered, the normally developed ones sometimes alternating with vestigial scale-like leaves; leaf blade narrowly to broadly elliptic or ovate, 2-7 by 4-16 cm, wedge-shaped or squared at the base, with a leaf stalk of (1-)3-10 mm; leaf shiny on top, dull below, with a conspicuous mid-rib, flat above, prominent below. Flowers clustered at the nodes in (2-)3-6(-7) opposite pairs of flowers, on stalk of 5-20(-40) mm that has 1-2 pairs of small leaflets at its' base; stalks of individual flowers are 0-6 mm long. Corolla is 6-merous in mature bud, 8-18(-23) mm long, gradually widened or slightly inflated upwards, weakly winged near the middle, angular, club-shaped (or rarely pointed) towards the tip; mostly yellow or green, or rarely pink or red below, dark coloured at the neck and yellow or red above. Tube in open flower 5-10(-14) mm long with the lobes recurved; tips of lobes often purplish. Anthers 0.5-2 mm long, pointed, about one half to one third as long as the free part of the filament. Fruit rounded, 6-8 mm long, successively green, yellow and dark purple, supported by leaflets at the base and tipped with the remains of the style; seeds ellipsoidal.

Ecology : Humid and open forests and disturbed sites; very common in the lowlands but occasionally reaching as high as 2270m altitude; many hosts recorded. Also recorded in mangroves. Mangrove associate species.

Distribution : Southern Asia from the Himalayas (Sikkim) eastwards to southern China and Southeast Asia. In Southeast Asia recorded from Thailand, Cambodia, the Philippines, Singapore, Malaysia (Peninsular, Sabah), Brunei and Indonesia (Sumatra, Borneo, Java, Papua). Possibly also occurs in Myanmar and Vietnam. It's easternmost extension appears to be the Bird's Head Peninsula of Indonesian Papua.

Abundance : Common.

Use(s) : Glue extracted from the fruit pulp is used for trapping birds.

Source of illustration : Alam (1986)

Reference(s) : Danser (1931), van Steenis *et al.* (1951), Alam (1986), Barlow (1997).

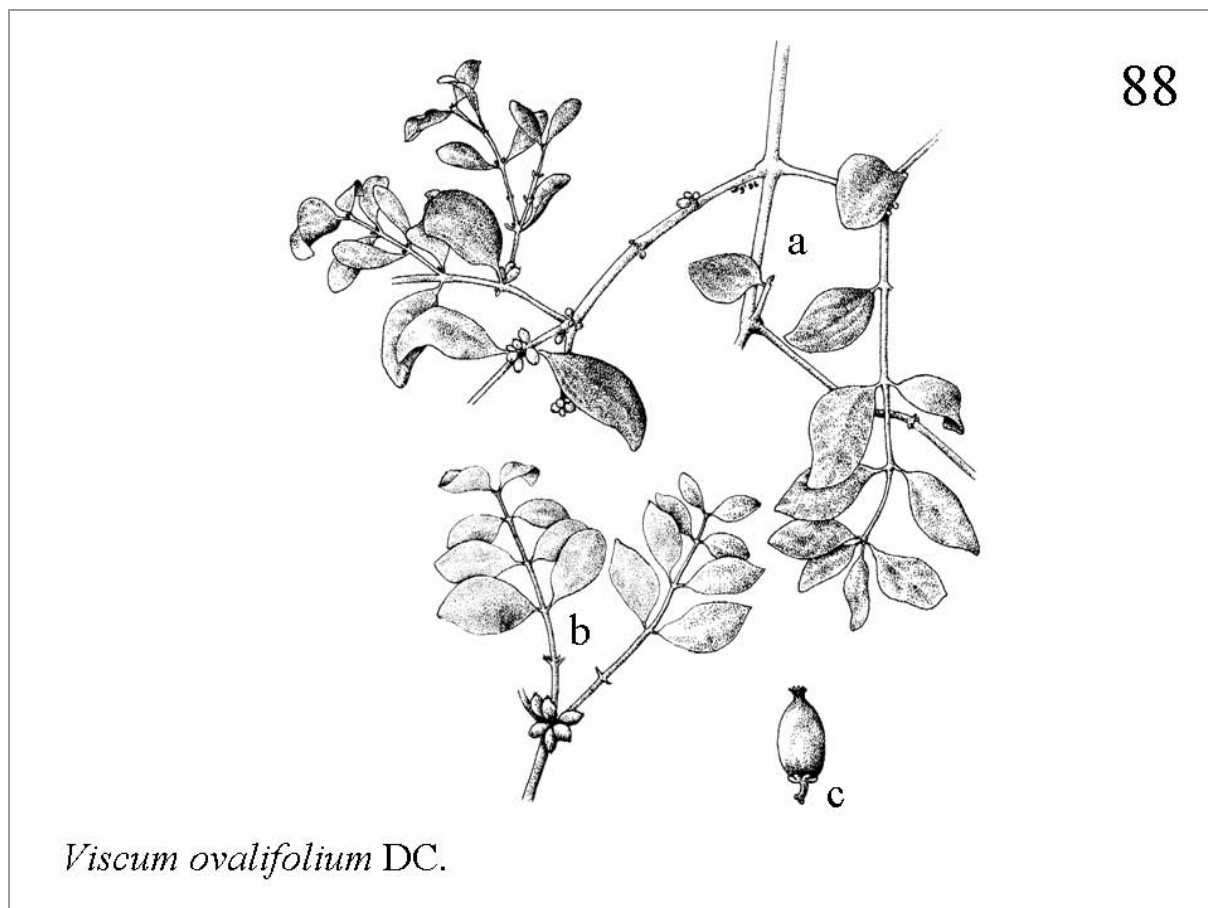


Fig. 88. *Viscum ovalifolium* DC. (a) Flowering and fruiting branchlet, (b) detailing of fruiting branchlet, and (c) fruit.

LORANTHACEAE

88

***Viscum ovalifolium* DC.**

Synonym(s) : *Viscum heyneanum* DC., *Viscum monoicum* Presl., *Viscum navicellatum* Kirth., *Viscum obtusum* DC., *Viscum orientale* auct. non Willd., *Viscum pamattonis* Korth., *Viscum pedunculatum* Barlow, *Viscum roxburghianum* Korth., *Viscum verticillatum* Roxb.

Vernacular name(s) : Mistletoe (E) Bingalo, Jingalo (Ind.), Dây ghi (Viet.), Ka fak mai ta tum (Thai)

Description : Small, much branched, entirely smooth parasitic shrub, erect to 1.5 m high; stem internodes round, sometimes flattened. Leaves measure 3.5-8.5 cm by 2-3.5 cm and are lanceolate-obovate. They are stemless or have a very short stalk, with a blunt or rounded tip and a gradually-narrowed base. Leaves are opposite, leathery, with 3-5 main veins arranged in a fan-shaped pattern. Between these they have a fine, net-like venation. Flowers are arranged in groups of three, the central one female and the lateral ones male. The lobes of the female flowers measure 0.75-1 mm, and those of the male flowers 1.5-2 mm; these segments are shorter than the flower tube. Fruit is almost round, and warty until shortly before maturity. Fully ripe fruit is smooth, yellowish-green, brownish-green or orange-red, measuring 5 by 4 mm, and is tipped by the conical style. Often recorded as *Viscum orientale* in Southeast Asian literature.

Ecology : Parasite growing on various woody plants, generally in lowlands up to an altitude of 500 m asl (occasionally up to 1400 m), often in swamp forests. In mangroves it is often recorded on *Excoecaria agallocha*, e.g. in Indonesia (Danser, 1931) and Thailand (Aksornkoae, 1993). Most commonly recorded on wild fig (*Ficus*) species. Mangrove associate species.

Distribution : From Bangladesh and Myanmar eastward to Hong Kong and southeast towards northern Australia (Queensland). Recorded throughout Southeast Asia.

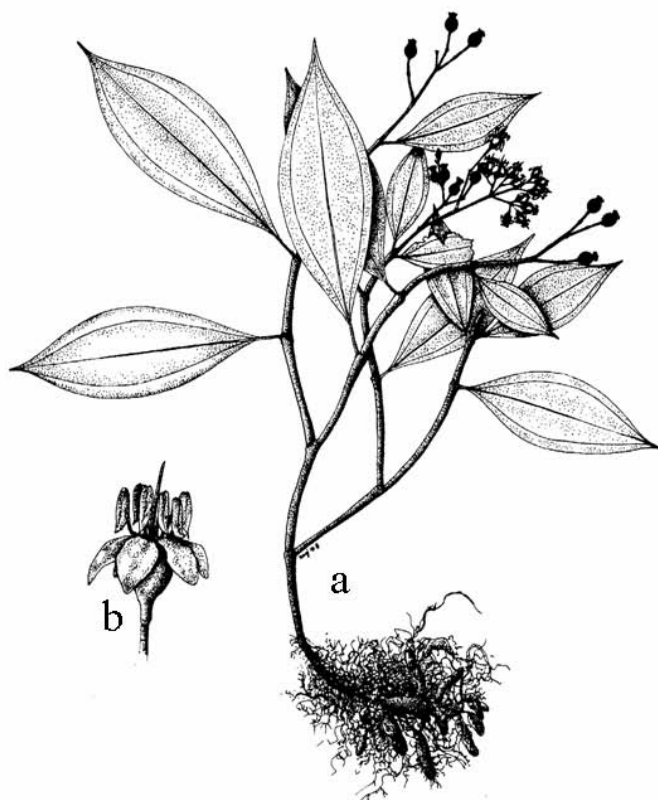
Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen Bogor Herbarium.

Reference(s) : Danser (1931), Backer & Bakhuizen van den Brink (1963-8), Alam (1986), Aksornkoae (1993), Barlow (1997).

89



Pachycentria constricta (Bl.) Blume.

Fig. 89. *Pachycentria constricta* (Bl.) Blume. (a) Habit of flowering and fruiting specimen, and (b) flower.

MELASTOMATACEAE

89

***Pachycentria constricta* (Bl.) Blume**

Synonyms : *Melastoma constrictum* Blume, *Pachycentria cordata* Blume, *Pachycentria elliptica* Blume, *Pachycentria formicaria* Merr., *Pachycentria javanensis* Hochr., *Pachycentria junghuhniana* Miq., *Pachycentria lanceolata* O.Schwartz, *Pachycentria laxiflora* Blume, *Pachycentria macrorhiza* Becc., *Pachycentria oligosperma* O.Schwartz, *Pachycentria rigida* Blume, *Pachycentria tuberculata* Korth., *Pachycentria varingiaefolia*, *Pachycentria zollingeriana* Naudin, *Pogonanthera pulverulenta*

Vernacular name(s) : Kayu Semilit (Ind.)

Description : Erect to drooping, epiphytic shrub with tuberous roots. The tops of the stems are compressed and fleshy, while leaves are opposite, variable (oval-oblong-lanceolate-obovate), and measure 5.5-24 by 2-8.5 cm. Flower clusters occurring at the ends of branches or in the axils, 2-12 cm across, have 1-3 bisexual flowers grouped together. These have a bright red stalk and a quadrangular 0.5-5 cm-long individual flower stalk. The constricted petals/sepals, 3-4 mm long, are located above the ovary. The upper margin of the flower is shortly toothed, persistent, and its base is pale yellow with a fine, scaly pattern. Petals are red and pale at both ends, 6-7 mm long. Anthers are beaked and white. The fruiting stalk is equally thick over the entire length, 1-3 mm long. The round berry is 5-7 mm in diameter. An extremely variable species.

Ecology : Occurs in open forest and on wayside trees, up to an altitude of 1,000 m. Flowering occurs throughout the year. The system of holes inside the tubers is usually inhabited by numerous ants. Mangrove associate species.

Distribution : Occurs from Myanmar, through Peninsular Malaysia, Singapore, Brunei and Indonesia (Sumatra, Java, Borneo and Sulawesi).

Abundance : Common.

Use(s) : Tubers are boiled and eaten to treat haemorrhoids.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Bakhuizen van den Brink (1943-1945), Backer & Bakhuizen van den Brink (1963-1968), Taylor & Wong (1987), www.rbgkew.org/herbarium/brunei/fams/68.htm.

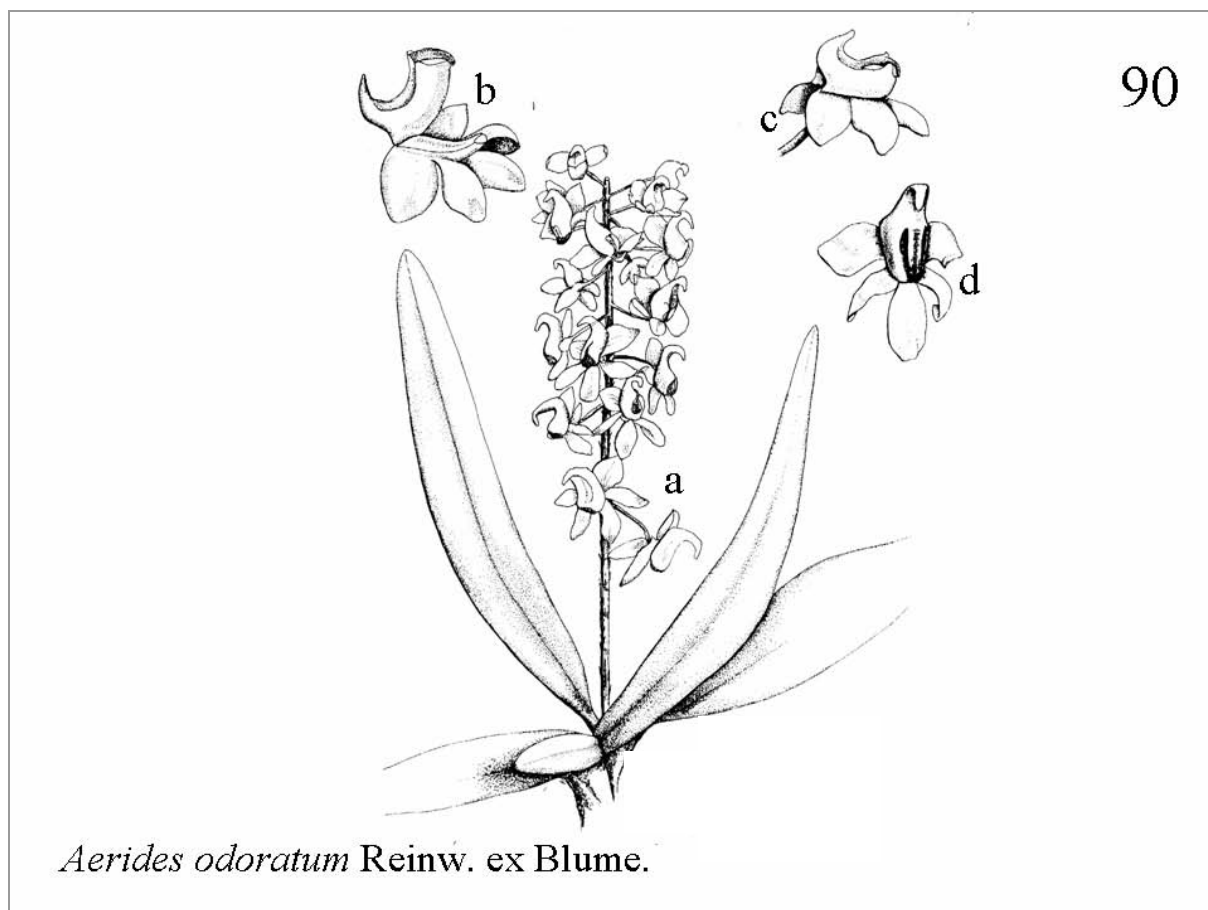


Fig. 90. *Aerides odoratum* Reinw. ex Blume. (a) Habit, and (b,c,d) flowers, viewed from different angles.

ORCHIDACEAE

90

***Aerides odoratum* Reinw. ex Blume**

Synonyms : *Aerides cornuta* Roxb., *Aerides dayanum* hort., *Aerides nobile* Warn., *Aerides odoratum* Lour., *Aerides odoratum* var. *majus* Ortgies., *Aerides rohanianum* Rchb. f., *Aerides suavissimum* Lindley, *Aerides virens* Lindley, *Aerides wilsonianum* R.H. Torr., *Epidendrum odoratum* Poir., *Orxera cornuta* Raf.

Vernacular name(s) : Fragrant Aerides, Cat's tail orchid, Fox's tail orchid (E), Angkrek lilin, Lau bintang (Ind.)

Description : Rather robust, epiphytic orchid, measuring 30-75 cm. The stem is usually long, often branched, and it has thick roots. Leaves are 2.5-3.25 by 10-25 cm, strap-shaped, with a 2-lobed, pointed tip. They are stiffly leathery, shiny, often violet-blotched and have overlapping leaf-sheaths. Buds are very sticky. Flower clusters are located on the nodes and perforate the leaf-sheaths. As the name indicates, the flowers are waxy and very sweet scented, reminiscent of Lilies of the Valley (*Convallaria*). Flower clusters are 20-40 cm long, which includes the up to 10-20 cm long, rather lax stalk. Flowers number 20-30, each measuring 2-3 cm across. The 11-12 mm long sepals and petals are white, usually with violet-red blotches. Sepals are ovate-obovate and blunt; the unpaired sepal is 6-7 mm broad, while the lateral ones are 8-9 mm long. Petals are recurved, oblong-obovate and measure about 5 mm across. The lip of the flower is white and the median segment with an incurved top measures 9-10 mm by 3-5 mm. The lateral segment of the lip is more than half the length of the median segment, often being almost the same length. The column-foot (see glossary) of the flower is 1-1.25 cm long. The fruit is about 2 cm long. A completely white-flowering variety occurs on Java.

Ecology : Occurs in open forest, on wayside trees and on (older) mangrove trees. It is found in moderately exposed positions. Flowering has been recorded in Java from October to December. From sea level up to 500 m asl (occasionally up to 2000 m asl.). Mangrove associate species.

Distribution : From Myanmar and southern China through Vietnam, Thailand, Malaysia and Indonesia (Java, Sumatra, Borneo, Sulawesi) to the Philippines.

Abundance : Locally common.

Use(s) : Has potential as an ornamental plant because of its beautiful, scented flowers. In Java the scented flowers are plaited into the hair during special occasions.

Source of illustration : Icones Rijksherbarium Leiden.

References : Anon. (1928), Krajenbrink (1928), Coomans de Ruiter (1935), Backer & Bakhuizen van den Brink (1963-8), Shuttleworth *et al.*, (1973), Sastrapradja *et al.* (1980), <http://orchidweb.org/orchids/az/aerides.html>, Missouri Botanical Garden TROPICOS database, <http://www.orchidspecies.com/indexa.htm>.

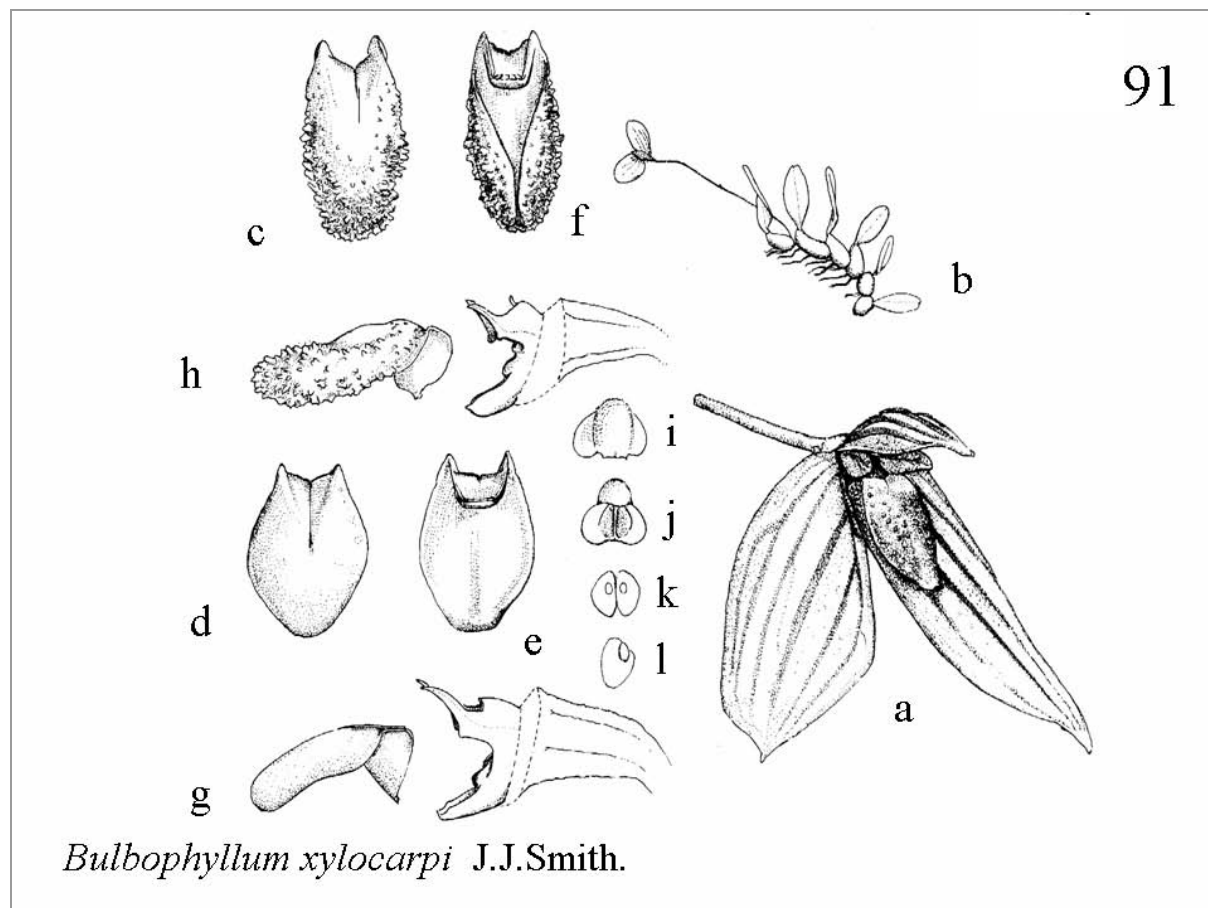


Fig. 91. *Bulbophyllum xylocarpi* J.J.Smith. (a) Flower, (b) habit, and (c-l) flower segments.

ORCHIDACEAE

91

***Bulbophyllum xylocarpi* J.J.Smith**

Synonyms : *Bulbophyllum ovalifolium* Lindl. *sensu lato*, *Bulbophyllum catenarium* Ridl., *Diphyes ovalifolia* Blume

Vernacular name(s) : Unknown.

Description : Very small epiphyte with stiff, elliptic leaves that measure 6-7 by 3-4 mm. The pseudo-bulbs are oval-oblong, 5-7 by 2-4 mm. The solitary flower cluster is borne on the rhizome and is located on a 20-24 cm-long flower stalk. Flowers are orange, often with deep-red veins, and measure 6 mm across. The column (see glossary) of the flower has rectangular broadened margins and an almost straight foot. The lateral sepals are broadly oval-obovate, pointed, and about 4 mm long. The odd, unpaired sepal is almost 3 mm long, ovate-oval, blunt or with a small point, and has three dorsally prominent veins. The deep red lip is very much recurved, above the erect base, which has two thickened parts. It is apparently a highly variable species.

Ecology : Occurs in mangroves in constantly humid regions, epiphytic on *Xylocarpus* and *Heritiera*. In Malaysia, it has also been recorded on trees in mountainous areas at 1,500 m. Flowering in Java recorded in May. On Borneo apparently found only at 1,700-2,000 m. Mangrove associate species.

Distribution : The species is reportedly common and widespread in Thailand, peninsular Malaysia, Java, Flores and Sulawesi; in Borneo it is relatively uncommon. Found on the south coast of Central Java in the mangroves of Segara Anakan.

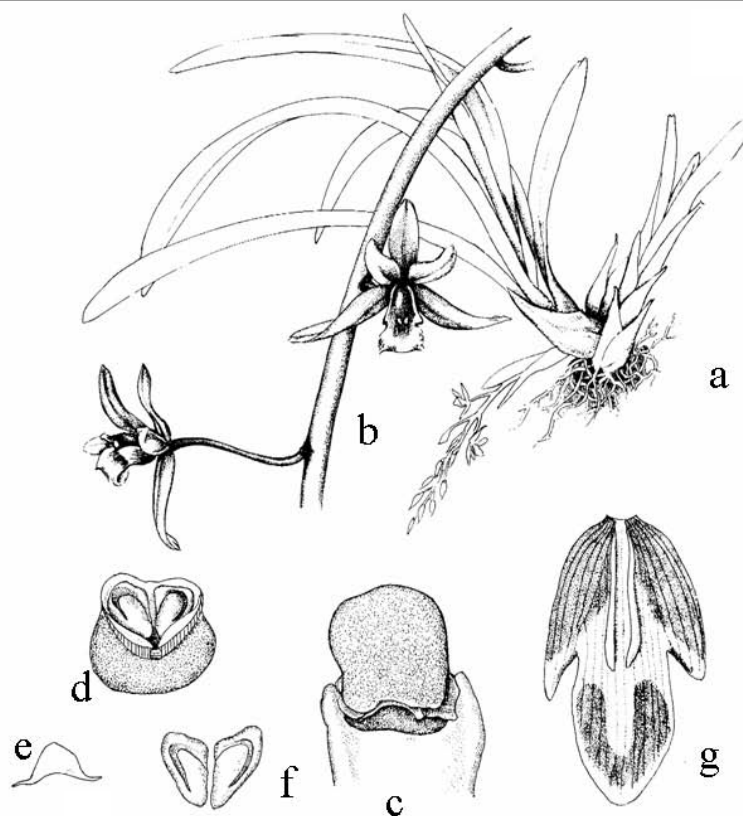
Abundance : Locally abundant.

Use(s) : Unknown. Potential ornamental species.

Source of illustration : Comber (1990), Vermeulen (1991).

Reference(s) : Ridley (1924), Backer & Bakhuizen van den Brink (1963-8), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org>).

92



Cymbidium finlaysonianum Wall ex Lindl.

Fig. 92. *Cymbidium finlaysonianum* Wall ex Lindl. (a) Habit of flowering specimen, (b) detail of flower cluster with two flowers, and (c-f) flower segments.

ORCHIDACEAE

92

***Cymbidium finlaysonianum* Wall ex Lindl.**

Synonyms : *Cymbidium aloifolium* (L.) Sw., *Cymbidium pendulum* (Roxb.) Sw. *sensu lato*, *Cymbidium pendulum* var. *brevilabre* Lindl., *Cymbidium tricolor* Miq.

Vernacular name(s) : Lau pandan (Ind.)

Description : Epiphytic orchid with about five 2-lobed, thick, stiff leaves that are unequal at the base and measure 45-80 cm by 4.5-5 cm. They are individually attached to a pseudo-bulb that is hidden by leaf sheaths measuring about 11 cm in length. The many-flowered (up to 25), drooping flower spikes have very short individual flower stalks, and measure 75-100 cm (to well over 1 m). Individual flowers are 5.5-6.5 cm across. The sepals and petals are dull greenish-yellow, flushed with dull purple down the centre. The side lobes are dull purplish outside, paler within, and have deep purple veins. The midlobe is white with a yellow patch at the base and a broadly sickle-shaped, purple patch on the inside of the tip. The middle of the lip has two continuous, straight, deep red keels that are yellow towards the front and are located between the side lobes. The column (see glossary) of the flower is curved, yellowish-green, and flushed with purple at its base. The colour of the flowers may occasionally be somewhat brownish, and the lip may have extra purple spots on the midlobe.

Ecology : Found in teak plantations and open mixed forest up to an altitude of 300m (occasionally up to 1,350m), and in mangroves in constantly humid regions. Flowering occurs all year round. In addition to the normal, dangling rootlets, special vertically raised rootlets apparently serve to trap detritus (esp. falling leaves and twigs) and nourish the plant. Flowering has been recorded in March-June, and September-November on Borneo. Recorded in South Sulawesi mangroves, and South Borneo freshwater swamps. Mangrove associate species.

Distribution : Southeast Asian species, found from Cambodia, South Vietnam, Thailand and the Philippines, to Malaysia (Peninsular, Sabah), Singapore, Brunei and Indonesia (Sumatra, Java, Borneo, Sulawesi). In Java it is commoner on the western half of the island. It has been recorded in East Java only once, but this may have been a cultivated specimen. In Peninsular Malaysia it is most abundant in the north.

Abundance : Relatively common.

Use(s) : Frequently cultivated as an ornamental.

Source of illustration : Du Puy & Cribb (1988).

Reference(s) : Ridley (1924), Coomans de Ruiter (1935), van Steenis *et al.* (1951), Backer & Bakhuizen van den Brink (1963-8), Giesen, Baltzer & Baruadi (1991), <http://www.geocities.com/RainForest/Jungle/5532/finlayso.html>.

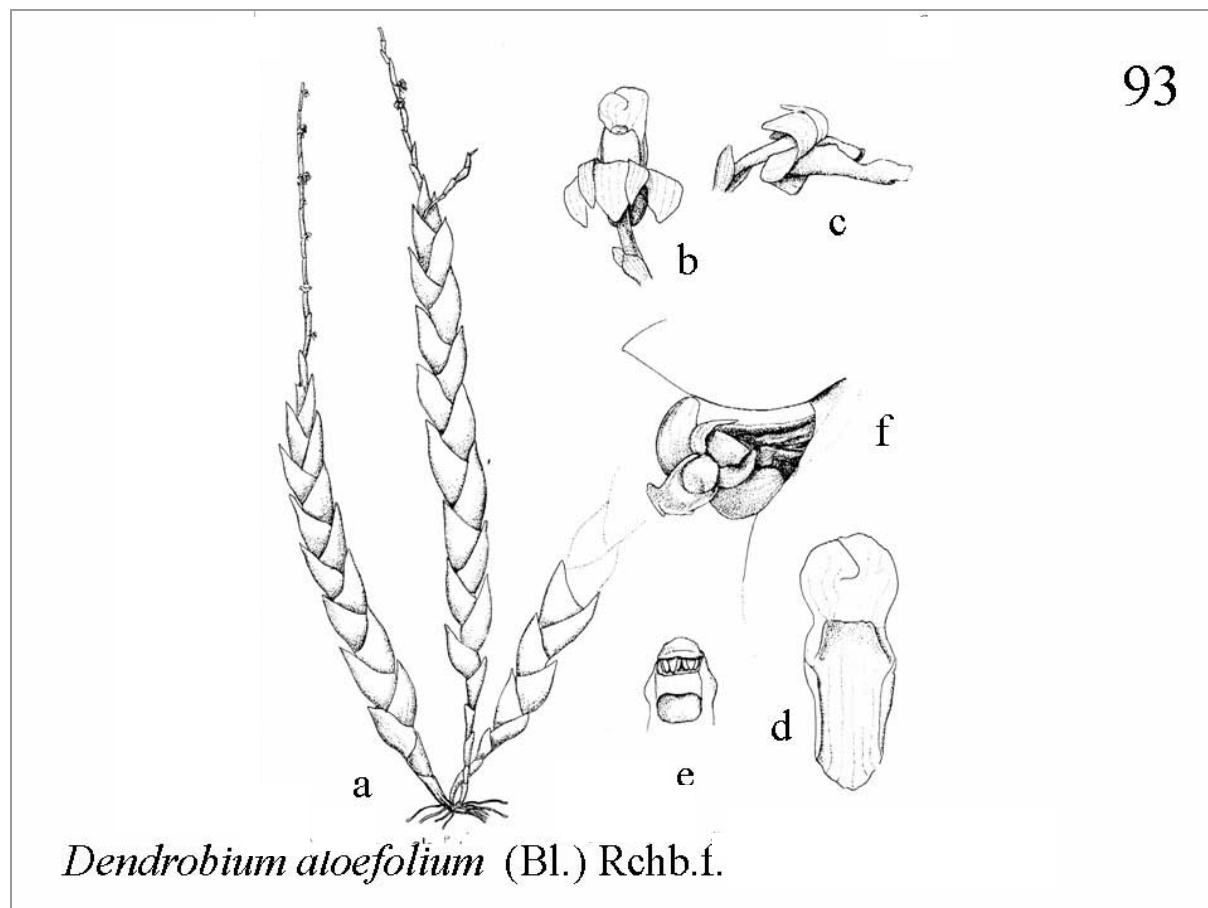


Fig. 93. *Dendrobium aloefolium* (Bl.) Rchb.f. (a) Habit, (b) flower, viewed from above, (c) flower, viewed from side, and (d-f) flower segments.

ORCHIDACEAE

93

***Dendrobium aloefolium* (Bl.) Rchb.f.**

Synonyms : *Dendrobium aloifolium*, *Dendrobium serra*, *Macrostomium aloefolium*, *Oporum serra*.

Vernacular name(s) : Unknown.

Description : Epiphytic orchid, with stems hanging down, about 45 cm long. Only the last 15 cm or so bear sheathing leaves. Leaves are dull green, often much interspersed with violet, and measure about 2.5 cm along the lower margin, to about 9 mm wide. Flowers are white or yellowish-white, and measure about 4 mm across. The odd, unpaired sepal is ovate in shape and is about 2 mm long. Both sepals and petals are bent backwards. The lip of the flower is 3.5 mm long, straight, the sides distinctly curved upwards, with ends that appear to be cut off abruptly. The middle lobe is not widened, but deeply bilobed, about 1 mm wide; anthers are green. Flower stalk and ovary are just over 4 mm long.

Ecology : Occurs in various types of forests. In humid regions it is also found on mangrove trees and on wayside trees. Flowering occurs all year round. Mangrove associate species.

Distribution : Southeast Asian species, found in Malaysia (Peninsular and Sarawak), Brunei, Indonesia (Borneo, Sumatra, Java, Papua) and probably in Papua New Guinea.

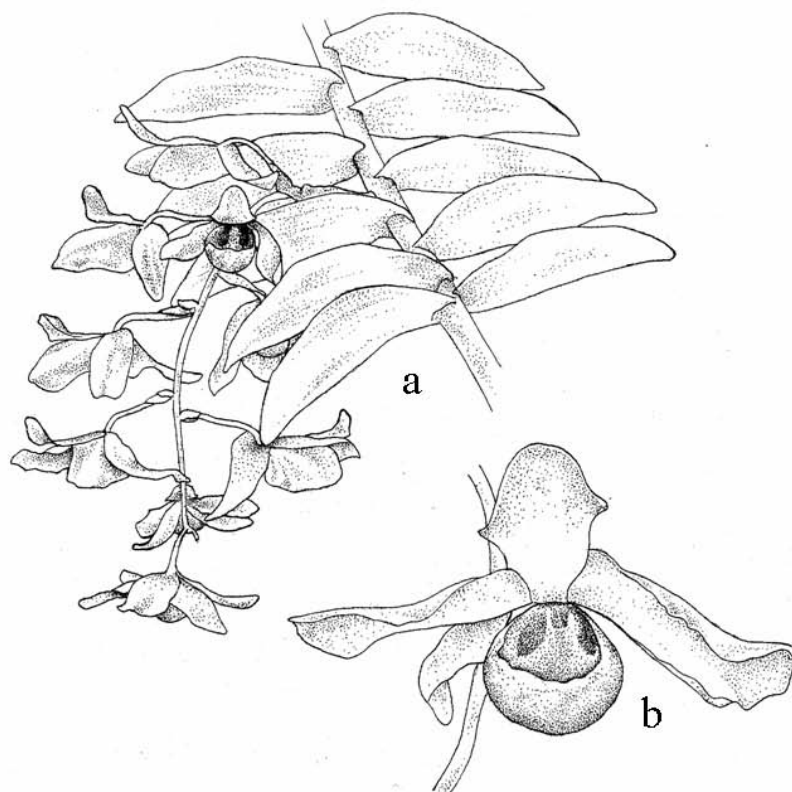
Abundance : Locally common.

Use(s) : Pounded leaves are used as a medicine to treat headache. The species has potential as an ornamental plant because of its beautiful flowers.

Source of illustration : Opera Botanica (1985), Comber (1988).

Reference(s) : Ridley (1924), Burkill (1935), Backer & Bakhuizen van den Brink (1963-8), <http://www.angelfire.com/or3/orchidsnz/denframes/den-a.htm>, http://www.rbgekew.org.uk/data/monocots/orchid_synonyms.pdf.

94



Dendrobium moschatum (Buch.-Ham.) Sw.

Fig. 94. *Dendrobium moschatum* (Buch.-Ham.) Sw. (a) Flowering stem, and (b) flower.

ORCHIDACEAE

94

***Dendrobium moschatum* (Buch.-Ham.) Sw.**

Synonyms : *Callista moschata* Kuntze., *Cymbidium moschatum* Willd., *Epidendrum moschatum* Buch.-Ham., *Thicuania moschata* (Sw.) Raf.

Vernacular name(s) : Musky smelling Dendrobium (E), Anggrek hutan (Mal.)

Description : Large epiphytic orchid, with fleshy stems and alternate leaves up to 1-2 m tall; leaves may be tinged with purple. Sprays of flowers emerging from the base, also 1-2 m long, with pendulous clusters of 7-12(-15) flowers. Individual flowers are 8-10 cm across, with a cup-shaped lower lip. Bracts of each individual flower are often tinged with purple. Flowers are creamy coloured to light yellow, with purple-tinged tips of petals; the lower cup-shaped lip is tinged purple on the outside, with a deep purple coloured interior.

Ecology : Epiphyte, occurring in a variety of lowland habitats, including mangroves. Mangrove associate species.

Distribution : Occurs from Northwest India and the Himalayas to Southeast Asia, where it is found in Myanmar, Laos and Thailand. Cultivated elsewhere as an ornamental.

Abundance : Locally common.

Use(s) : Ornamental species, widely cultivated.

Source of illustration : Shuttleworth *et al.* (1973)

Reference(s) : Shuttleworth *et al.* (1973),
<http://www.orchidspecies.com/indexde.htm>.

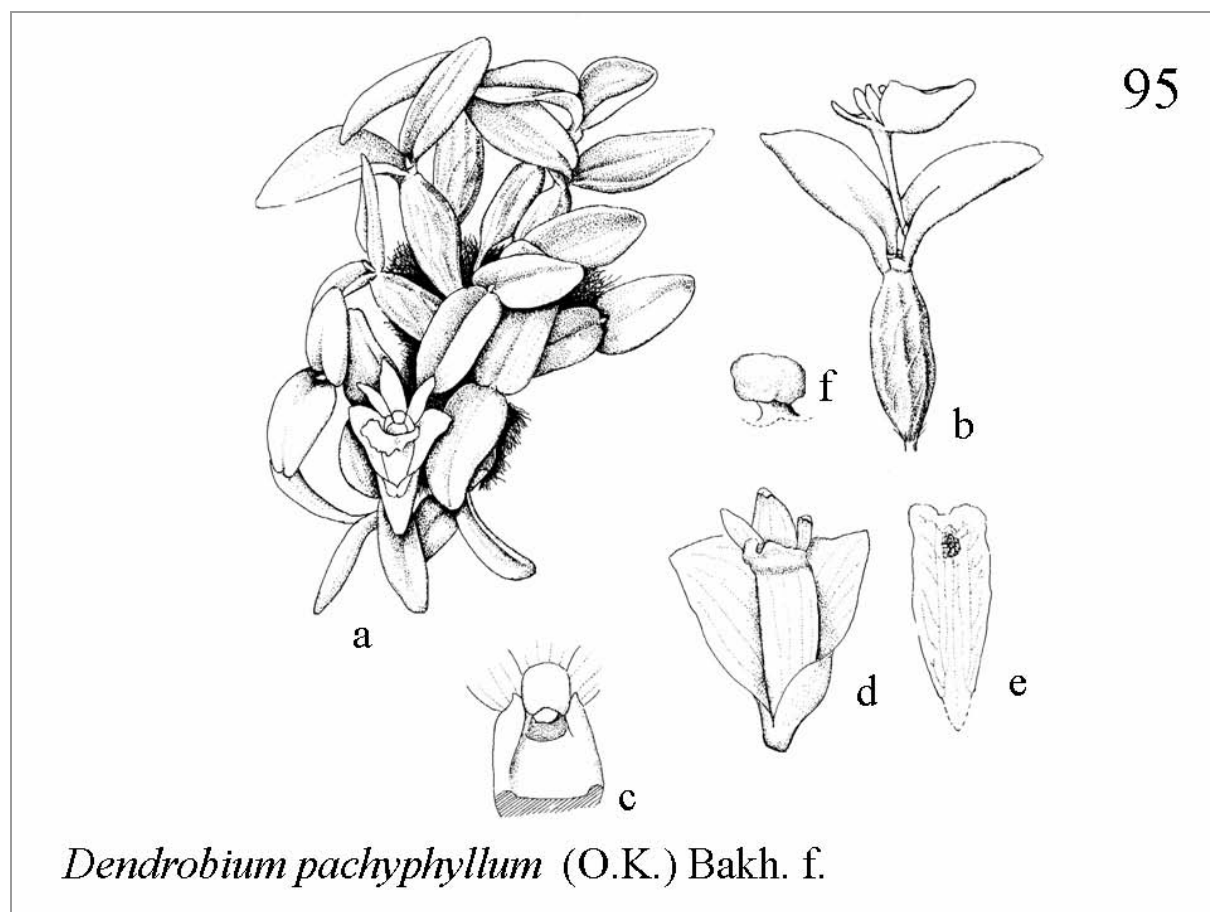


Fig. 95. *Dendrobium pachyphyllum* (O.K.) Bakh. f. (a) Habit of flowering specimen, (b) part of plant with two leaves and one flower, and (c-g) segments of flower.

ORCHIDACEAE

95

***Dendrobium pachyphyllum* (O.K.) Bakh. f.**

Synonyms : *Callista carnosum*, *Callista pachyphylla* Kuntze., *Callista pumila*, *Dendrobium borneense* Finet., *Dendrobium carnosum* Teijsm. et Binn., *Dendrobium perpusillum* Balakaristan, *Dendrobium pisibulbum* Guillaumin, *Dendrobium pumila* Roxb., *Dendrobium pussillum* (Bl.) Lindl.

Vernacular name(s) : Broad-stemmed Dendrobium (E), Anggrek, Sakot Kelembai (Ind.)

Description : Small epiphytic orchid, with trumpet-shaped stems, 3-6 cm long. The two oblong-lanceolate, fleshy leaves have a notch at the end and measure 1.25-2.25 by 0.75 cm. The flower cluster produces several flowers intermittently and has small basal leaflets. Individual flower stalks are very short. The scented flowers bloom for only a short time; they are delicate, pale yellow, often red-veined, and measure 1 cm across. The mentum (see glossary) is large and conical. The lip is immobile, with rounded end lobes and a triangular, yellow thickening beneath the end incision. Ovary plus flower stalk is about 8.5 mm long.

Ecology : Occurs in forests and mangroves, in humid regions and in teak forest, up to 1,000 m. Flowering occurs from April to December (in Java). Mangrove associate species.

Distribution : Occurs in Southeast Asia from Myanmar to the Greater Sundas; recorded from Myanmar, Malaysia (Peninsular, Sarawak), Thailand, Brunei and Indonesia (Borneo, Sumatra, Java).

Abundance : Relatively common.

Use(s) : Ornamental species, cultivated.

Source of illustration : Opera Botanica (1985).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8),
<http://www.orchidspecies.com/indexde.htm>.

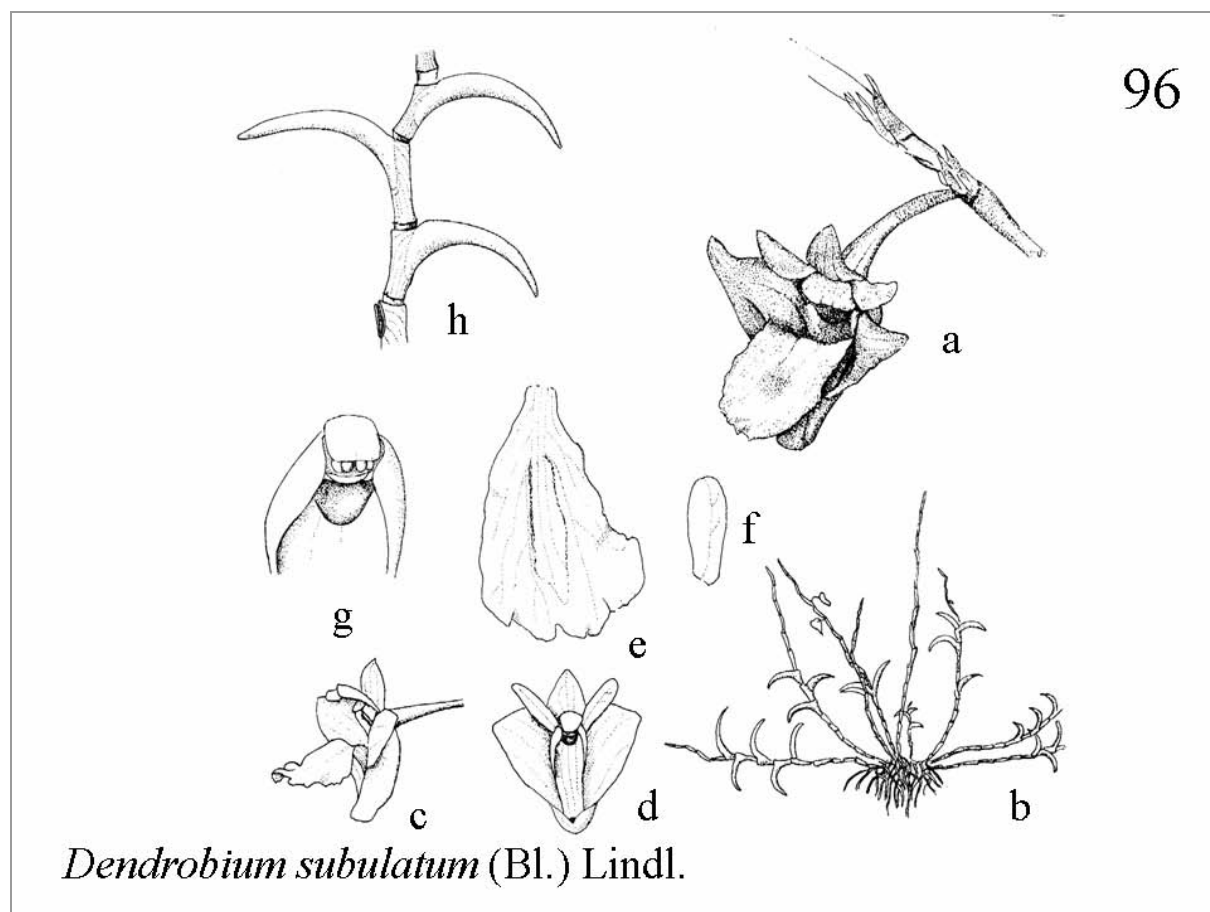


Fig. 96. *Dendrobium subulatum* (Bl.) Lindl. (a) Flower, viewed from angle above, (b) habit, (c-g) segments of flower, and (h) detail of stem with leaves.

ORCHIDACEAE

96

Dendrobium subulatum* (Bl.) Lindl.*Synonyms :** *Onychium subulatum* Bl.**Vernacular name(s) :** Anggrek (Mal., Ind.)

Description : Small epiphytic orchid, measuring up to 10 cm. Stems are erect, simple and thin, with 5 mm-long internodes. The leafless top of the stem is comparatively long and slender. Leaves are much longer than the internodes, partly recurved, fleshy, often reddish brown, round in cross-section, measuring about 11 mm by 2-3.5 mm. The upper leaves are rudimentary. There is no pseudo-bulb. Flowers are about 2.5 mm long and about 6 mm broad, pale yellow, often finely violet-veined. The odd, unpaired sepal is convex and about 2 mm long. The lateral sepals are broader and triangular. The mentum (see glossary) is rather large, slightly curved upwards and blunt. The lip is obovate with a broader base, while on the inner side it has a thickened, (towards the top) 3-ribbed band in the middle. Lateral segments are recurved and rounded. The central segment is erect, short and curved, while the column foot (see glossary) of the flower occurs at right angles to the ovary, curved upwards, with a short, yellow rib at the top. Flower stalk and ovary measure about 6.5 mm in length.

Ecology : Occurs in various types of forest, including mangroves, in humid regions. In Thailand recorded as epiphyte on *Sonneratia ovata*. Often found on older trees on sheltered places in villages. Flowering occurs all year round. Mangrove associate species.

Distribution : Recorded from Malaysia (Peninsular), Thailand and Indonesia (Borneo, Sumatra, Java).

Abundance : Locally often abundant.

Use(s) : Unknown.

Source of illustration : Opera Botanica (1985), Comber (1988)

References : Ridley (1924), Backer & Bakhuizen van den Brink (1963-8), Aksornkoae (1993).

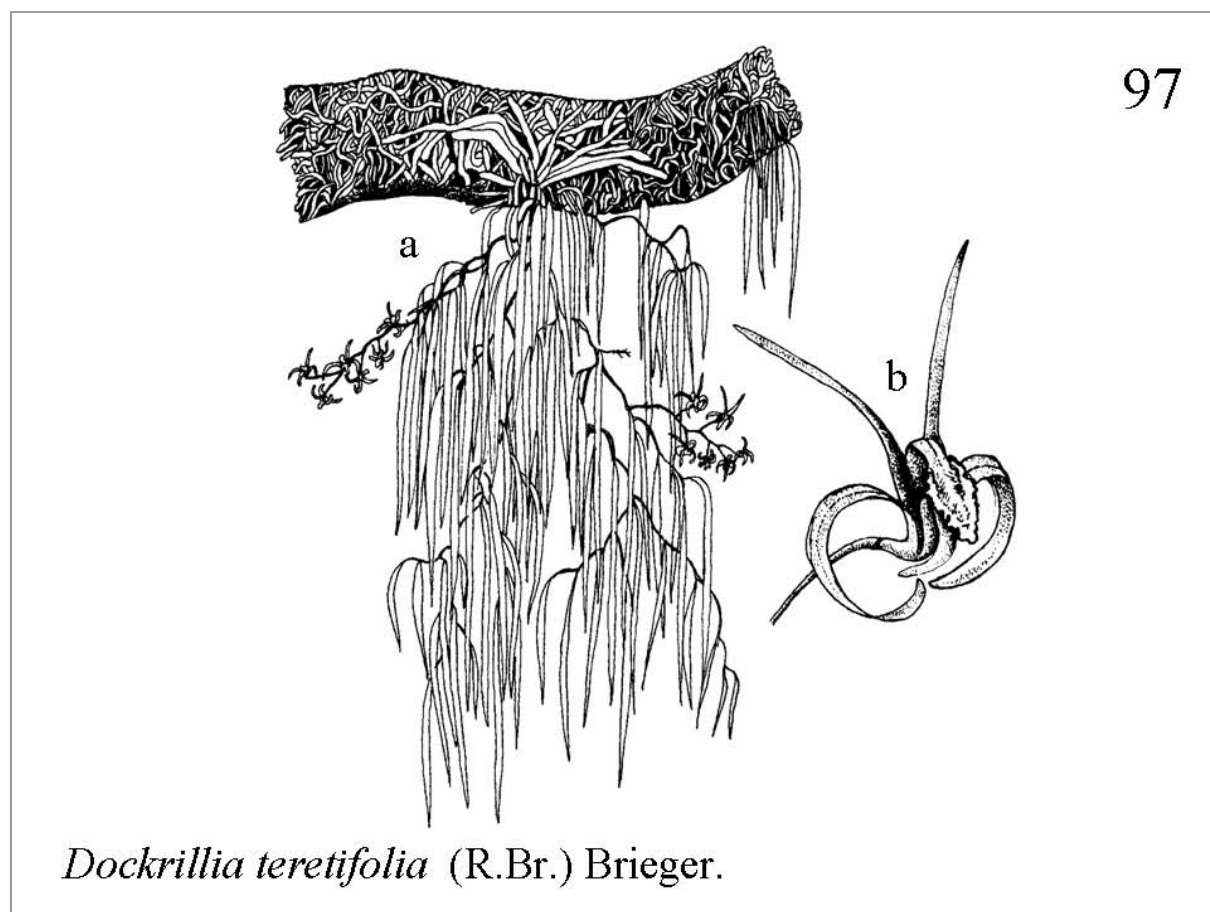


Fig. 97. *Dockrillia teretifolia* (R.Br.) Brieger. (a) Habit of flowering plant, and (b) flower.

ORCHIDACEAE

97

***Dockrillia teretifolia* (R.Br.) Brieger**

Synonyms : *Callista teretifolia* (Lindl.) Kuntze., *Dendrobium baseyanum* St. Cloud, *Dendrobium calamiforme* Lodd. ex Lindley, *Dendrobium teretifolium* R. Br., *Dendrobium teretifolium forma aureum* (F.M. Bailey) Clemesha, *Dendrobium teretifolium* var. *aureum* F.M. Bailey, *Dendrobium teretifolium* var. *fasciculata* Rupp., *Dockrillia calamiforme* (Lodd. ex Lindl.) M.A. Clem. & D.L. Jones

Vernacular name(s) : Bridal Veil Orchid, Pencil Orchid, Ratstail Orchid, Clematis Orchid, Terete-Leafed Dockrillia

Description : Epiphyte, measuring 50-75 cm, with a widely-branched stem, consisting of numerous, curved, 5-6 cm-long internodes each bearing one leaf. Leaves are cylindrical with a narrowed top, and measure 7.5-30 by 0.5 cm. The flower spikes are lateral and drooping, up to 7(-30) cm long, often branching, and have up to 12 fragrant flowers that arise from near the leaf bases or from the rhizome. Sepals and petals are narrowly linear-subulate with a pointed, often recurved tip. They are 2-3.5 cm long and yellowish-white with small, brownish-red basal streaks. The mentum (see glossary) is about 5 mm long. The lip is recurved. Its median segment is dotted with brownish-red spots, and has three prominent ridges. The column (see glossary) of the flower is speckled with brownish-red spots. Commonly termed *Dendrobium teretifolium* in Southeast Asian literature.

Ecology : In Australia, it is found in rainforests along stream banks, rivers, lakes or swamps and are pendant, cool to hot growing epiphytes. They are also occasionally found growing on rocks. Flowering occurs from winter through the end of spring, with the end of spring as the most prolific time. Also occurs in mangroves. Mangrove associate species.

Distribution : Found in northern Australia, Papua New Guinea, East Timor and Indonesia (Papua).

Abundance : Locally common.

Use(s) : Cultivated as an ornamental.

Source of illustration : Saenger, Hegerl & Davie (1983) and Suryowinoto (1987).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Saenger, Hegerl & Davie (1983), Suryowinoto (1987),
<http://www.orchidspecies.com/indexdendroc.htm>.

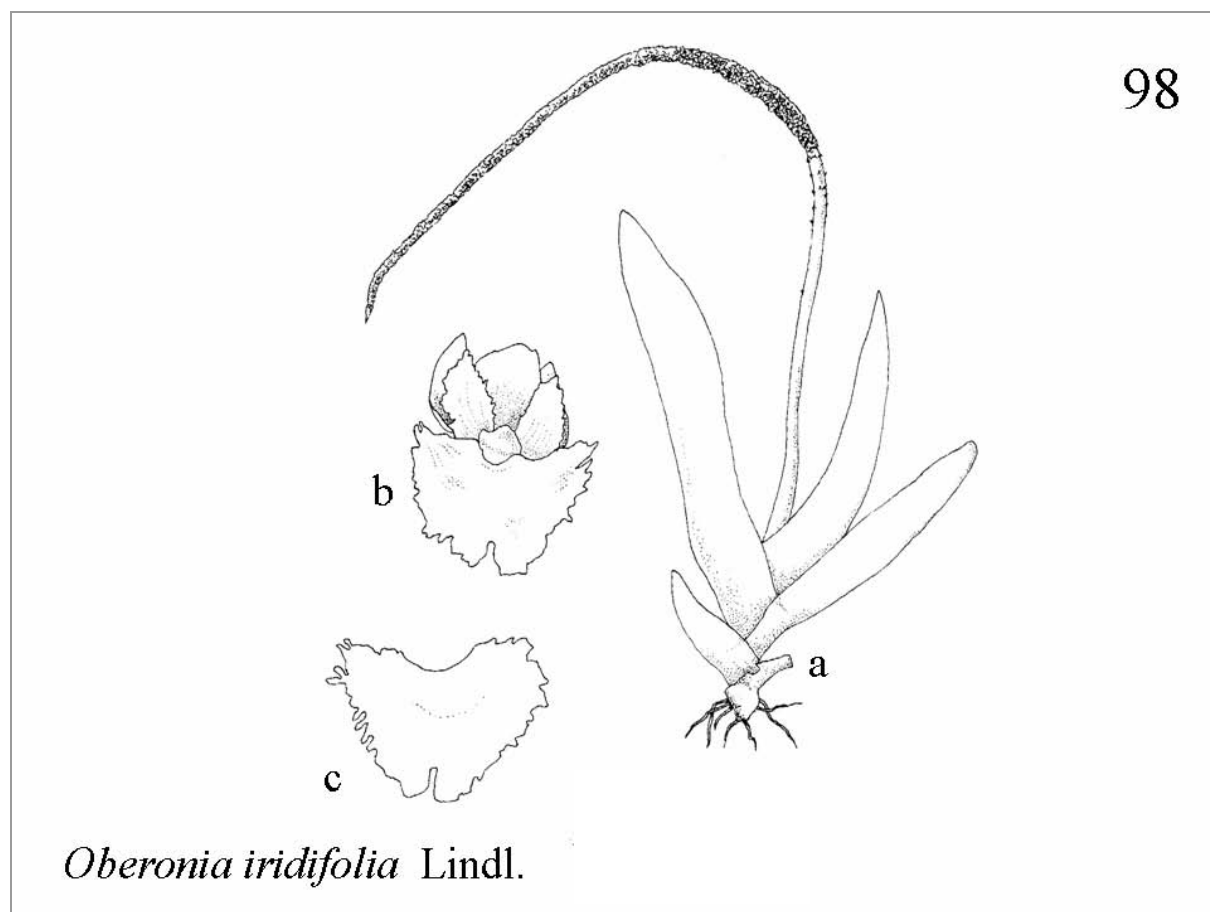


Fig. 98. *Oberonia iridifolia* Lindl. (a) Habit of flowering plant, (b) flower, viewed from front, and (c) flower segment.

ORCHIDACEAE

98

***Oberonia iridifolia* Lindl.**

Synonyms : *Cymbidium iridifolium* Roxb., *Cymbidium iridifolium* Sw. ex Steud., *Iridorchis iridifolia* (Lindl.) Kuntze, *Malaxis iridifolia* (Lindl.) Rchb. f.

Vernacular name(s) : Iris-Like Leaf Oberonia (E)

Description : Epiphyte with a very short stem and (3-)4-6 fleshy, fan-shaped, pointed leaves. Leaves have a faintly curved upper- and an almost straight lower margin, measuring up to 18 by 2 cm. The basal leaves are the smallest. The terminal, many-flowered spikes are drooping, and measure 15-25 cm, including the about 6 cm-long, flat stalk. The pale green or brownish-green flowers are about 2 mm across. They occur in regular, close whorls, more flexible near the top, and are distinctly stalked. Leaflets at the base of the flower are broad, toothed at the tips, and are as long as the individual flower stalk and ovary. Sepals and petals are recurved, while petals are broadly ovate. The lip is nearly quadrangular in outline, shallowly 2-lobed and round, divided into small, pointed and narrow segments.

Ecology : Occurs in teak forests, mixed forests and mangroves, usually up to an altitude of about 100 m, but also once recorded at 1,500 m. Flowering occurs from March to May. Mangrove associate species.

Distribution : From India and the eastern Himalayas throughout Southeast Asia and the Pacific Islands. Recorded from Malaysia and Indonesia. Specimens from southern Peninsular Malaysia are now recognised as being a distinct species: *Oberonia dissitiflora*, not recorded in mangroves.

Abundance : Unknown.

Use(s) : Ornamental.

Source of illustration : Dansk Botanisk Arkiv (1968).

Reference(s) : Ridley (1924), Backer & Bakhuizen van den Brink (1963-8), <http://www.orchidspecies.com/indexo.htm>.

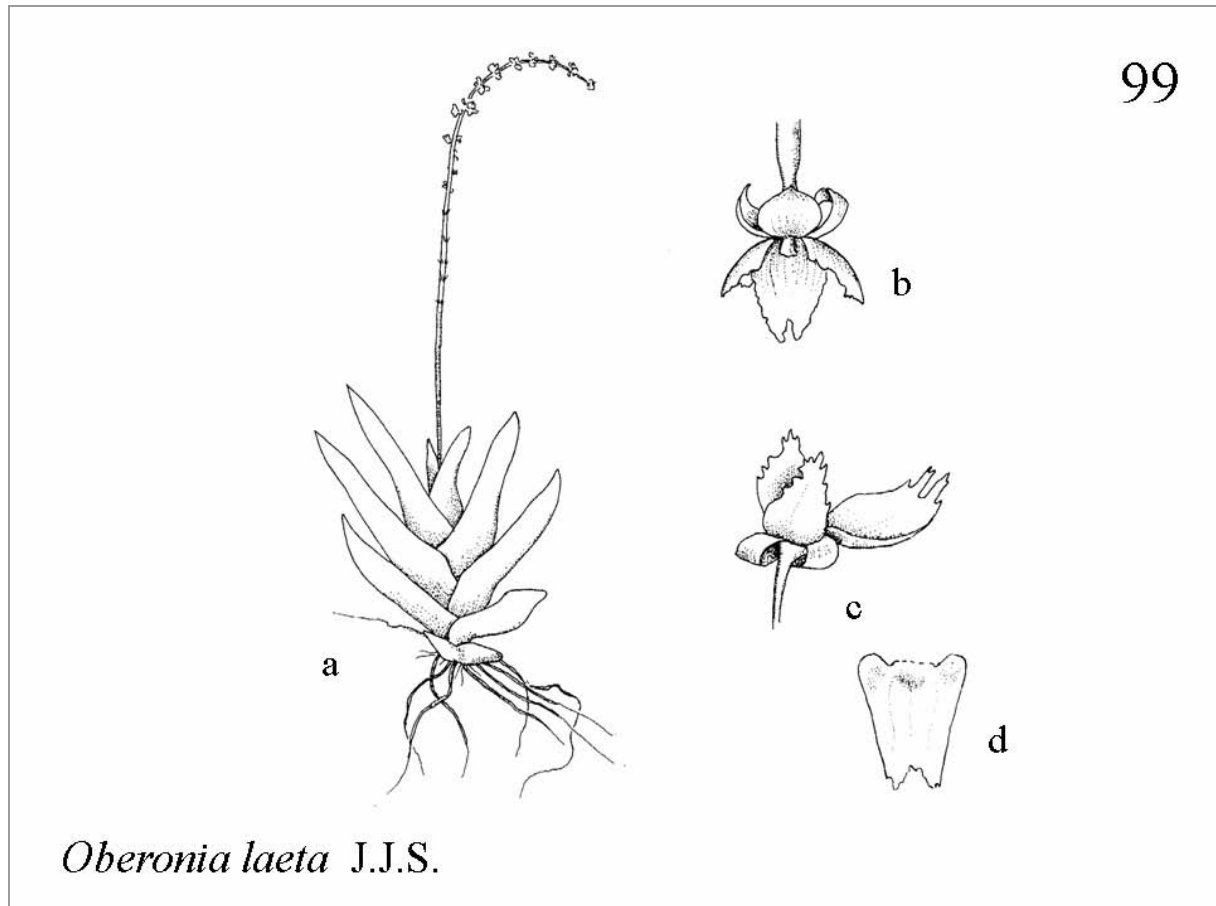


Fig. 99. *Oberonia laeta* J.J.S. (a) Habit of flowering plant, (b) flower, viewed from above, (c) flower viewed from side, and (d) detail of flower segment.

ORCHIDACEAE

99

Oberonia laeta* J.J.S.*Synonyms :** *Oberonia bertoldii*, *Oberonia gracillima***Vernacular name(s) :** Unknown.

Description : Small, epiphytic orchid, 10 cm long, with short stems and about 6-9 unequal, pointed, nearly straight leaves that measure about 3.5 by 0.7 cm. The many-flowered, terminal spike is 8 cm long, including the 2.5 cm stalk. There are many small leaflets at the base of the flower stalk. The tiny, tomato-red flowers are crowded at the lower part of the stalk, whorled at the upper part of the spike and are solitary at the top. The short bracts have irregularly toothed edges. The ovate and pointed sepals, 0.75 mm long, are all recurved. The lip and the petals are spreading. Petals, which have the same colour as the sepals, are elliptic and irregularly toothed or fringed. Lip are deeply coloured and a little longer than the petals, while anthers are yellow.

Ecology : Occurs in lowlands, on mangrove trees and occasionally in orchards. Flowering has been recorded in May (in Java). Mangrove associate species.

Distribution : In Malaysia, Singapore and Indonesia (e.g. Segara Anakan mangroves in Central Java).

Abundance : Probably uncommon to rare.

Use(s) : Unknown.

Source of illustration : Dansk Botanisk Arkiv (1968).

Reference(s) : Ridley (1924); Backer & Bakhuizen van den Brink (1963-8), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

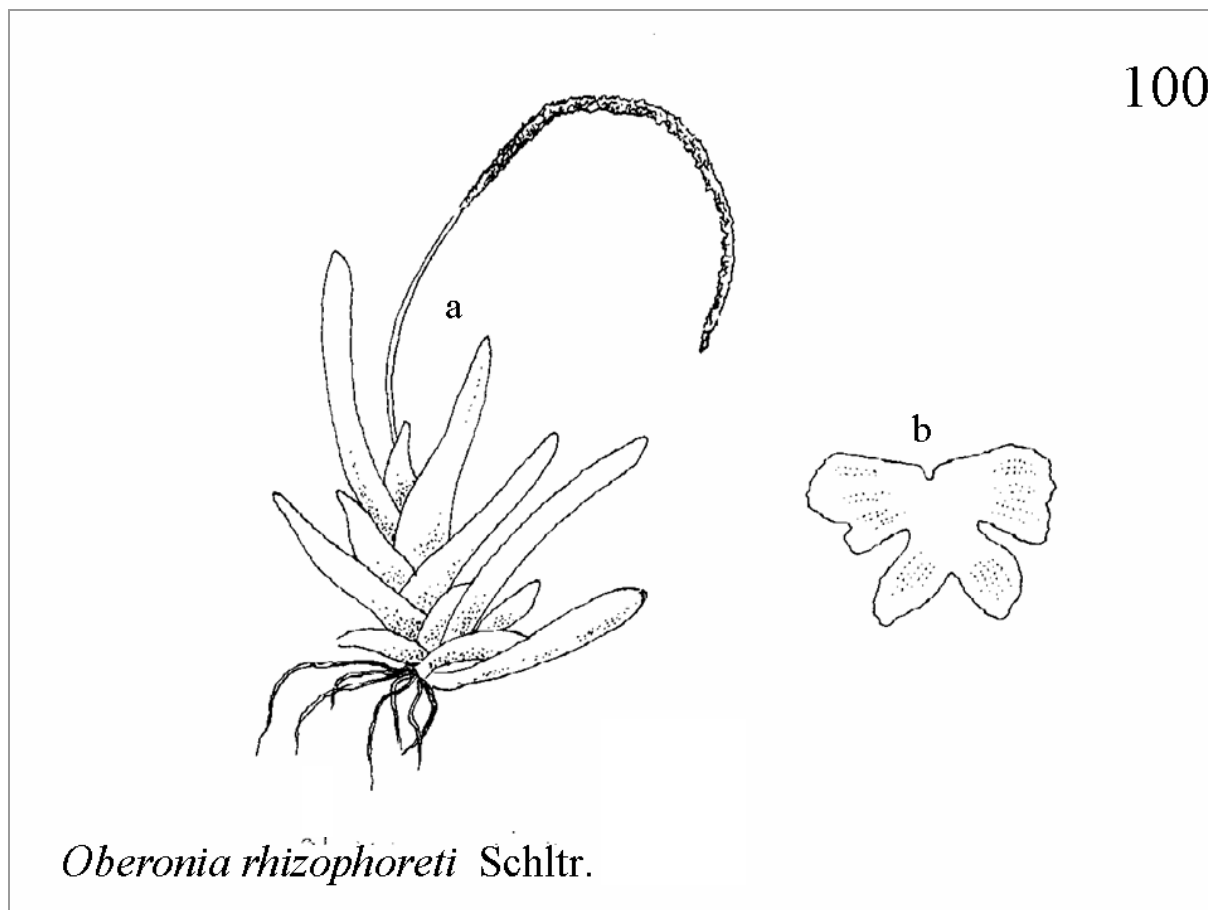


Fig. 100. *Oberonia rhizophoreti* Schltr. (a) Habit of flowering plant, and (b) detail of flower segment.

ORCHIDACEAE

100

Oberonia rhizophoreti* Schltr.*Synonyms :** *Oberonia rhizophoreti* J.J. Sm.**Vernacular name(s) :** Unknown.

Description : Small epiphytic orchid, 8 cm long, with a very short stem and 4-8, pointed, more or less erect, fleshy leaves, 3 by 0.4 cm. The terminal flower spike is up to 8 cm long, including the 1.5 cm long stalk, and has many flowers. Flowers are 1-1.5 mm across and occur in fairly regular whorls of about 8-9 flowers. The top-most ones are solitary. Leaflets at the base of the flower stalk are narrowed and faintly toothed, and are as long as the individual flower stalk and the ovary. The sepals and petals are yellow to orange, the lip is red-brown. The upper sepals and petals are spreading. Petals are elliptic, blunt and slightly toothed. The lateral sepals are curled back and have an incurved top. The 3-lobed lip is a little longer than the sepals. The side lobes are small, spreading, nearly square, with toothed outer edges, while the midlobe widens from a narrow base and is 2-lobed. The small lobes of the flower are rather broad, bluntly pointed, measure less than half the total length of the midlobe, and are separated by a broad indentation.

Ecology : Occurs in mangrove forests, on *Rhizophora*. Flowering recorded in May (in Java). True mangrove epiphyte species, as it is known from this habitat only.

Distribution : Found in Peninsular Malaysia and Indonesia. In Indonesia it is known from Segara Anakan (Central Java) and Sulawesi.

Abundance : Unknown, but probably uncommon to rare.

Use(s) : Unknown.

Source of illustration : Dansk Botanisk Arkiv (1968).

Reference(s) : Ridley (1924), Backer & Bakhuizen van den Brink (1963-8), Chapman, in Snedaker & Snedaker (1984), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

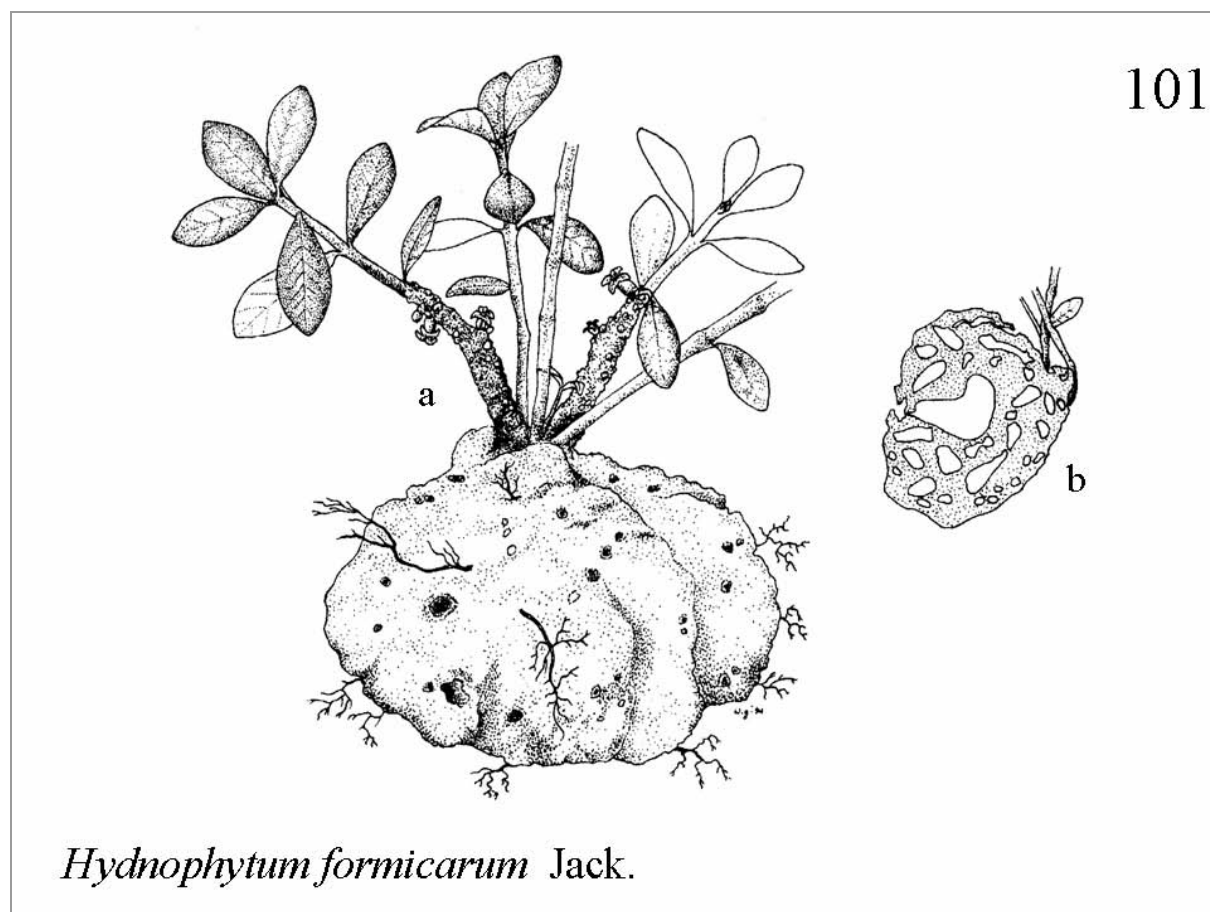


Fig. 101. *Hydnophytum formicarum* Jack. (a) Habit of flowering plant, and (b) cross-section of tuber-like swollen base.

RUBIACEAE

101

Hydnophytum formicarum Jack

Synonyms : *Hydnophytum amboinense* Becc., *Nidus formicarum niger* Rumph.

Vernacular name(s) : Rumah Semut Hitam, Urek-urek Polo, Kepala Berok (Ind.), Ký nam (Viet.)

Description : Epiphyte, with 2-4 erect stems, each up to 60(-100) cm long, and a cylindrical, spherical or flattened tuber-like swollen base, up to 25 cm in diameter. The tubers are usually without spines, and have a hollow labyrinth inside that is covered with scales; cavities are of two types: some produced early are mostly warty and later cavities are smooth or slightly warty. The branchlets are smooth and quadrangular in cross section. The opposite, leathery leaves are elliptic to broadly lanceolate, 4-15 by 2-7 cm; leaf tip blunt or rounded; lateral nerves prominent, 3-9 pairs. Three to five bisexual flowers occur together in shallow, cup-shaped cavities in strongly-thickened nodes of the stem. These cavities are interspersed with scales and hairs. Calyx tube is cup-shaped to shortly tubular (>2 mm long), hairs present or absent; lobes indistinct or almost absent or reduced to minute teeth or a low ridge (<2 mm). The corolla is white, its tube 1-2(-5) cm long, outside smooth, inside hairy. The orange, fleshy fruit is almost round, 6-7 mm in diameter, usually smooth, but occasionally covered with short hairs. The inner part of a dead tuber becomes gossamer-thin, and reportedly causes ulcerations if touched. This species is readily distinguished from the similar *Myrmecodia tuberosa* by the absence of spines on stems and tuber, and by its branching stems (*Myrmecodia tuberosa* does not branch).

Ecology : Occurs in primary and secondary forests, including mangroves, up to an altitude of 1,000 m. Flowering occurs all year round. The plant is named (in Latin and Dutch: 'black ants nest') after the kind of ants that invariably inhabit the labyrinth of the tubers of this epiphyte. Ant species that usually colonise this species are *Iridomyrmex cordatus* (= *Iridomyrmex myrmecodiae*), *Camponotus* spp., *Crematogaster* spp., *Monomorium* spp., *Tapinoma* spp. and *Paratechina* spp. (Hölldobler & Wilson, 1990). Mangrove associate species.

Distribution : Found from Peninsular Malaysia to the Western Pacific. In Southeast Asia recorded in Brunei, Malaysia, Vietnam and Indonesia (Sumatra, Java, Borneo, Sulawesi).

Abundance : Common.

Use(s) : The pith is used to treat swellings and headache.

Source of illustration : Drawn from photograph, and based on Holttum (1954).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), http://www.uni-bayreuth.de/departments/planta2/wgl/delta_ru/www/hydnohy.htm
[http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/\\$FILE/Kynam.htm](http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/$FILE/Kynam.htm).

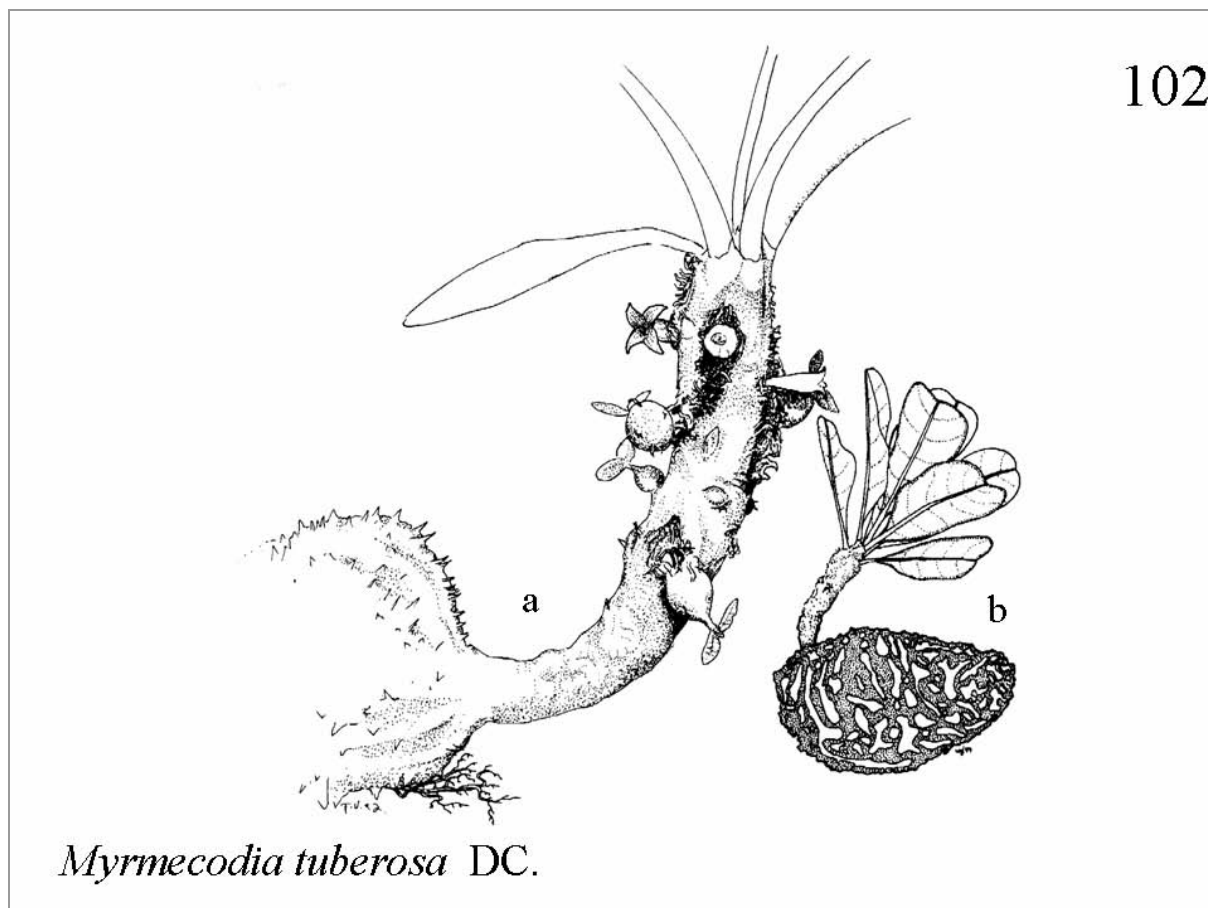


Fig. 102. *Myrmecodia tuberosa* DC. (a) Detail of flowering and fruiting plant, and (b) cross-section of entire plant.

RUBIACEAE

102

***Myrmecodia tuberosa* DC.**

Synonyms : *Lasiosstoma* auct. non Schreber *Myrmecodia echinata*, *Myrmecodia armata*, *Myrmecodia rumphii* Becc., *Nidus formicarum ruber* Rumph.

Vernacular name(s) : Rumah Semut Merah (Mal.), Urek-urek Polo (Ind.)

Description : Succulent epiphyte with a thick, hairless stem that has a tuber-like thickening at the base, with branches that may measure 10-100 cm. This is covered with numerous, usually simple, adventitious roots that may grow into hard, long spines. The cylindrical or spherical tuber is hollow, having a labyrinth that is connected with the outside by several holes; the tuber is covered with spines. The opposite, oblong-lanceolate, thick-leathery leaves measure 12-16(-47) by 4-8(-14) cm; leaf nerves prominent, 4-6 pairs; leaf stalk 5-10 cm long. They are inserted on cushion-shaped, flat thickenings that are surrounded by a ring-shaped wall covered with numerous spines. The stemless, 4-merous flowers are solitary or a few occur together at the bottom of cup-shaped, hairy cavities in the stem. These cavities are always in pairs, next to the leaf base. Both calyx and corolla tube are cylindrical. Calyx tube extremely reduced (<2mm). The transparent lobes of the corolla are irregular, 3-4 mm long. The white corolla tube is less than 1 cm long, and is vertically divided by a dense ring of hairs. The 4-5-stoned, fleshy fruit is sticky and orange when ripe, measuring 2-2.5 cm. The inner part of a dead tuber becomes gossamer-thin, and reportedly causes ulcerations if touched. This species is readily distinguished from the similar *Hydnophytum formicarum* by the presence of spines on stems and tuber, and by its non-branching stems (*Hydnophytum formicarum* branches).

Ecology : Most commonly seen in village-groves and along roadsides, at altitudes of 200-600 m. It also occurs in mangroves. Flowering has been recorded in Java in September. The plant is named (in Latin and Dutch) after the kind of ants that commonly inhabit the labyrinth within the tubers. Ant species that usually colonise this species are *Iridomyrmex cordatus* (= *Iridomyrmex myrmecodiae*), *Iridomyrmex scrutator*, *Camponotus* spp., *Crematogaster* spp., *Pheidole* spp. and *Poecilomyrmex* spp. (Hölldobler & Wilson, 1990). Mangrove associate species.

Distribution : Found from Peninsular Malaysia and Brunei, through the Philippines, Indonesia (Sumatra, Borneo, Java, Sulawesi, Papua) to Papua New Guinea, northern Australia (Cape York) and the Western Pacific (Solomon Islands).

Abundance : Common.

Use(s) : The pith is used to treat swellings and headache.

Source of illustration : Based on photograph in Polunin (1988).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8).
http://www.uni-bayreuth.de/departments/planta2/wgl/delta_ru/.

GROUP E: VINES & CLIMBERS

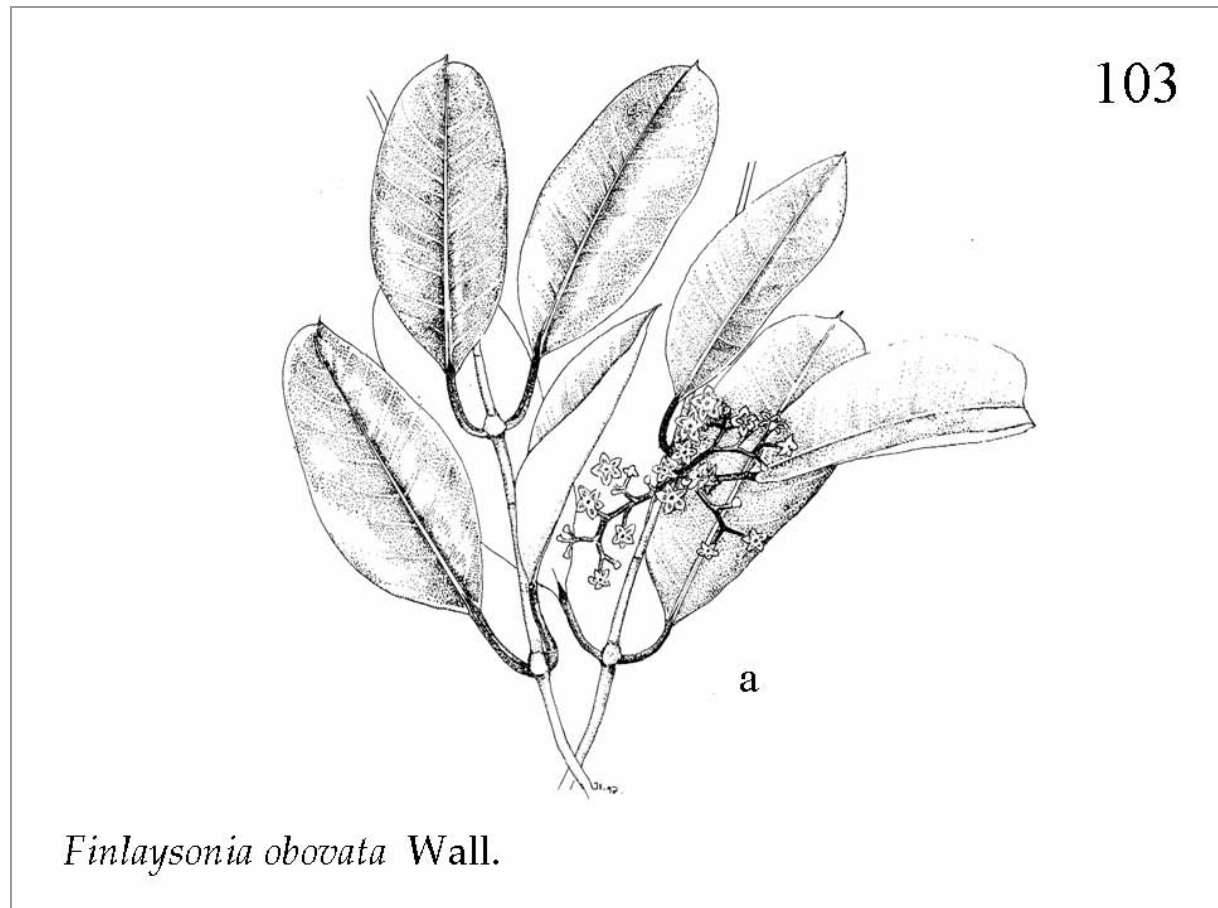


Fig. 103. *Finlaysonia obovata* Wall. (a) Flowering branchlet.

ASCLEPIADACEAE

103

***Finlaysonia obovata* Wall.**

Synonyms : *Finlaysonia maritima* Backer, *Olus crepitans* Rumph., *Secamone maritima* Bl.

Vernacular name(s) : Daun Korpo Laki-laki (Mal.), Kalak Kambing, Oyod Kambing (Jav.), D  y M   (Viet.)

Description : Slender, twining, woody climber, up to 5 m, exuding white latex from broken surfaces, and with a warty, light brown papery bark. The fleshy, shiny-green and smooth leaves are opposite, narrowly lanceolate on young shoots, on older branches egg-shaped, 7-15 by 3.5-8 cm. On drooping branches they are often recurved. The leaf stalk is thick and often red. The noxious-smelling flowers are located between the stalks of a leaf pair, in solitary, stemmed, rather dense clusters located in the leaf axils. The stalks of the flowers are thick, violet, covered with short hairs and elongate during the development of the fruit. The calyx is finely hairy. The corolla is almost 1 cm across, (greenish-) yellow, inside purple or brownish-yellow, with long hairs. The corona scales – located between the corolla and stamens – are white. The ribbed fruits spread widely and have a hooked, pointed top, ovoid in shape and with a narrow base, 7.5-9 by 5 cm. Fruits green and fleshy, in appearance much like two fleshy horns of a buffalo, smooth, and with a short, curled back tuft of hair.

Ecology : In mangroves and on borders of tidal creeks and fishponds. In Java it flowers comparatively rarely. Mangrove associate species.

Distribution : From the Bay of Bengal to the Moluccas. In Southeast Asia recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia, Singapore, Brunei and Indonesia (Moluccas, Java, Bali, South Sulawesi).

Abundance : Uncommon, but locally common.

Use(s) : Young leaves eaten as a vegetable and salad (e.g. in the Moluccas).

Source of illustration : Adapted from photograph by Polunin (1988)

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8),
http://www.rspg.thaigov.net/scbotdat/plantdat/asclepi/fobova_1.htm
<http://mangrove.nus.edu.sg/guidebooks/text/1061.htm>;
http://www.arcbc.org.ph/arcbcweb/wetlands/singapore/sgp_man.htm
[http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/\\$FILE/Muclucl.htm](http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/$FILE/Muclucl.htm)
<http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

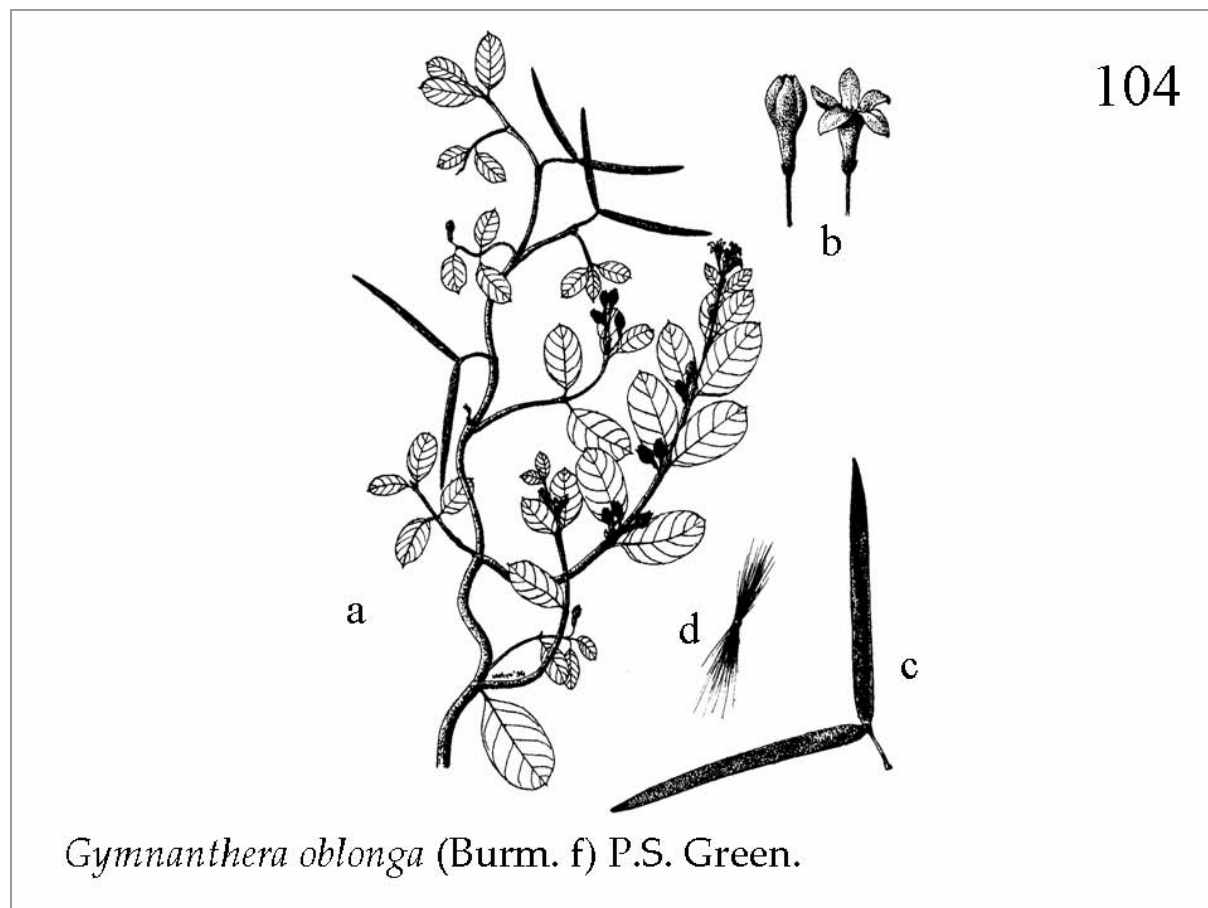


Fig. 104. *Gymnanthera oblonga* (Burm. f) P.S. Green. (a) Flowering and fruiting stem, (b) bud and open flower, (c) fruit, and (d) seed.

ASCLEPIADACEAE

104

***Gymnanthera oblonga* (Burm. f) P.S. Green**

Synonyms : *Dicerolepis paludosa* Blume, *Gymnanthera nitida* R. Br., *Gymnanthera paludosa* (Bl.) K.Schum., *Jasminum oblongum* Burm., *Parechites bowringii* Hance., *Trachelospermum bowringii* (Hance) Hemsl.

Vernacular name(s) : Dây mú (Viet.)

Description : Twining, shrubby climber, 2-4 m, with a stem covered with warts. Most of the plant is hairless, but it usually has short, smooth hairs at the top. The thinly fleshy to papery smooth leaves are elliptic-oblong, 3-5.5 by 1.5-2.5 cm, with a 5-10 mm long leaf stalk. Flowers are located between the stalks of a leaf pair in few-flowered clusters that are less than 2 cm long. Sepals are ovate and measure 1 by 2 mm. The smooth, yellowish-green corolla has a 6-9 mm tube, expanding to 16-18 mm in diameter. Fruits are thin, with a hooked top, 8-12 cm by 5-6 mm. The keeled seeds, 2 by 7 mm, are smooth but have a 2-2.5 cm-long tuft of hairs.

Ecology : The principle habitat for this species is mangrove, but it may also occur in adjacent habitats. Flowering occurs from June-September, fruiting from September to January. Mangrove associate species.

Distribution : Occurs from southern China (Hainan, Guangdong) through Southeast Asia to northern Australia. In Southeast Asia it has been recorded in Cambodia, Malaysia, the Philippines, Thailand, Vietnam, Indonesia (Java and Madura, but probably occurs throughout) and Papua New Guinea.

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Flora of China, Asclepiadaceae (Li Ping-tao *et al.*).

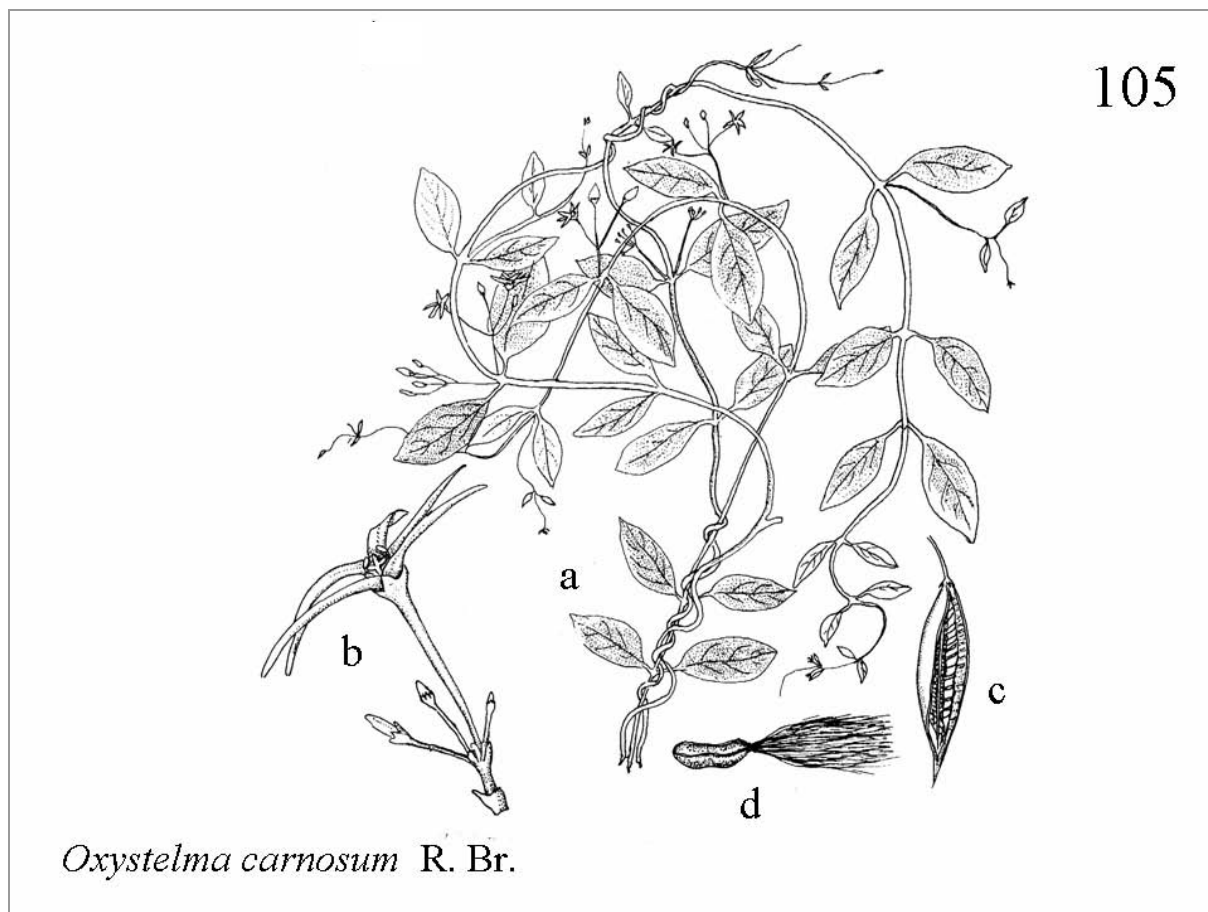


Fig. 105. *Oxystelma carnosum* R. Br. (a) Flowering vine, (b) flower and buds, (c) open fruit, and (d) seed.

ASCLEPIADACEAE

105

***Oxystelma carnosum* R. Br.**

Synonyms : *Cynanchum carnosum* (R.Br.) Schltr., *Cynanchum carnosum* Domin., *Cynanchum carnosum* Merr. & Rolfe., *Ischnostemma carnosum* (Schltr.) Merr. & Rolfe, *Vincetoxium carnosum* (R. Br.) Benth.

Vernacular name(s) : Unknown.

Description : Climber, 1-3 m, with a smooth, green bark, a pale, many-dotted stem with a diameter of 3 cm and clear, abundant latex. The opposite leaves, 2.5-7.5 by 0.5-3 cm, are fleshy to leathery, narrowly to broadly elliptic, occasionally linear-lanceolate and have a sharply pointed tip and a narrowing base. Occasionally the hairy leaf stalk (4-10 cm) and the under surface are tinged dark red. The flower heads occur in the leaf axils. The green, occasionally purple-tinged flowers are bisexual and 5-partite. The scales that form the frill at the mouth of the flower are pointed, smooth and yellowish-white. The many seeds, 3 by 5 mm, are brown, ovate, thin and have sticky, white 15 mm-long hairs on one side.

Ecology : Inhabits landward margins of mangroves, borders of salt lakes and saline localities. May also be found in monsoon vine-forests near the coast. Substrates of mud and sand are preferred. Flowers are produced all year round, though in Australia in lesser quantity, from November to March. In Java the plant flowers from February to April. Fruits are rarely observed. The small green flowers appear suited to both insect or self-pollination. The seeds are suited to dispersal by wind and water. Mangrove associate species.

Distribution : Found from Southeast Asia to northern Australia. In Southeast Asia recorded from Malaysia, the Philippines, throughout Indonesia and Papua New Guinea.

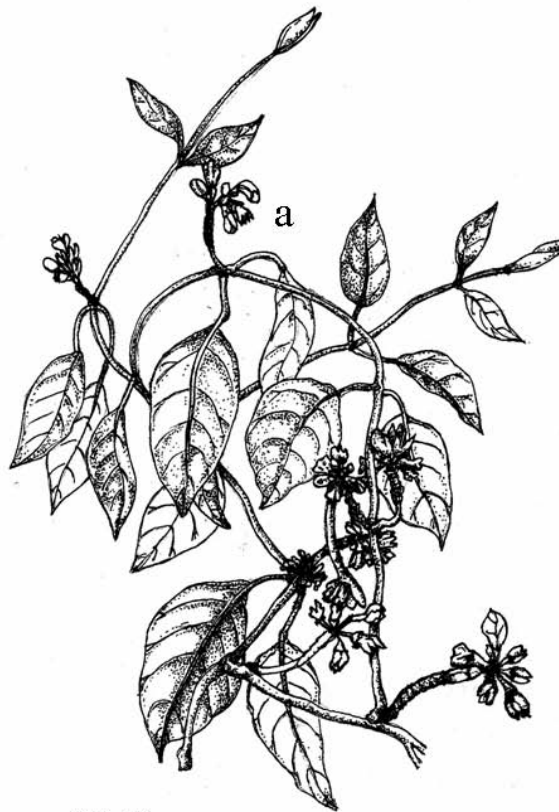
Abundance : Common.

Use(s) : Unknown.

Source of illustration : Wightman (1989)

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Wightman (1989).

106



Sarcolobus carinatus Wall.

Fig. 106. *Sarcolobus carinatus* Wall. (a) Flowering vine.

ASCLEPIADACEAE

106

Sarcolobus carinatus* Wall.*Synonyms :** *Sarcolobus banksii* Roem. & Schult.**Vernacular name(s) :** Unknown.

Description : A twining shrub or liana, with smooth stems and branches. Leaf stalks are 0.4-1 cm long, grooved on the upper surface and lined with hairs. Leaves are elliptic, obovate or linear-oblong, with a triangular base and a (fairly) pointed tip; opposite; leaf blade is 3-6(-8) by 1-1.8 cm, smooth on both sides, but with thinly dispersed, sparse hairs along the edges when young; edges not notched or toothed. Flowers occur in clusters of 3 or 4, on 3-7 mm long stalks, and are smooth. Calyx lobes are ovate-lanceolate, 2 by 1 mm, with blunt tips, thinly covered with hairs. The corolla is shallowly bell-shaped, pale yellow, smooth, with a tube this is as long as the lobes; lobes measure 3-4 by 2 mm. Fruit (a 'follicle') is egg-shaped, 3.5-4 by 2 cm, curved and smooth, with a pointed tip.

Ecology : Found in coastal swamps and mangroves, and is reportedly common on *Excoecaria agallocha*, a common mangrove tree. Mangrove associate species.

Distribution : Extends from the east coast of India and Bangladesh, to Peninsular Malaysia, Myanmar and Thailand.

Abundance : Locally common.

Use(s) : In Peninsular Malaysia and Singapore, the fruit (follicle) peel is used for making preserves, after being steeped in salt water for three days and subsequently boiled in syrup. Also used in making *sambal* (Indonesian red pepper paste). Seeds are reportedly poisonous.

Source of illustration : Rahman & Wilcock (1995)

Reference(s) : Heyne (1950), Rahman & Wilcock (1995).

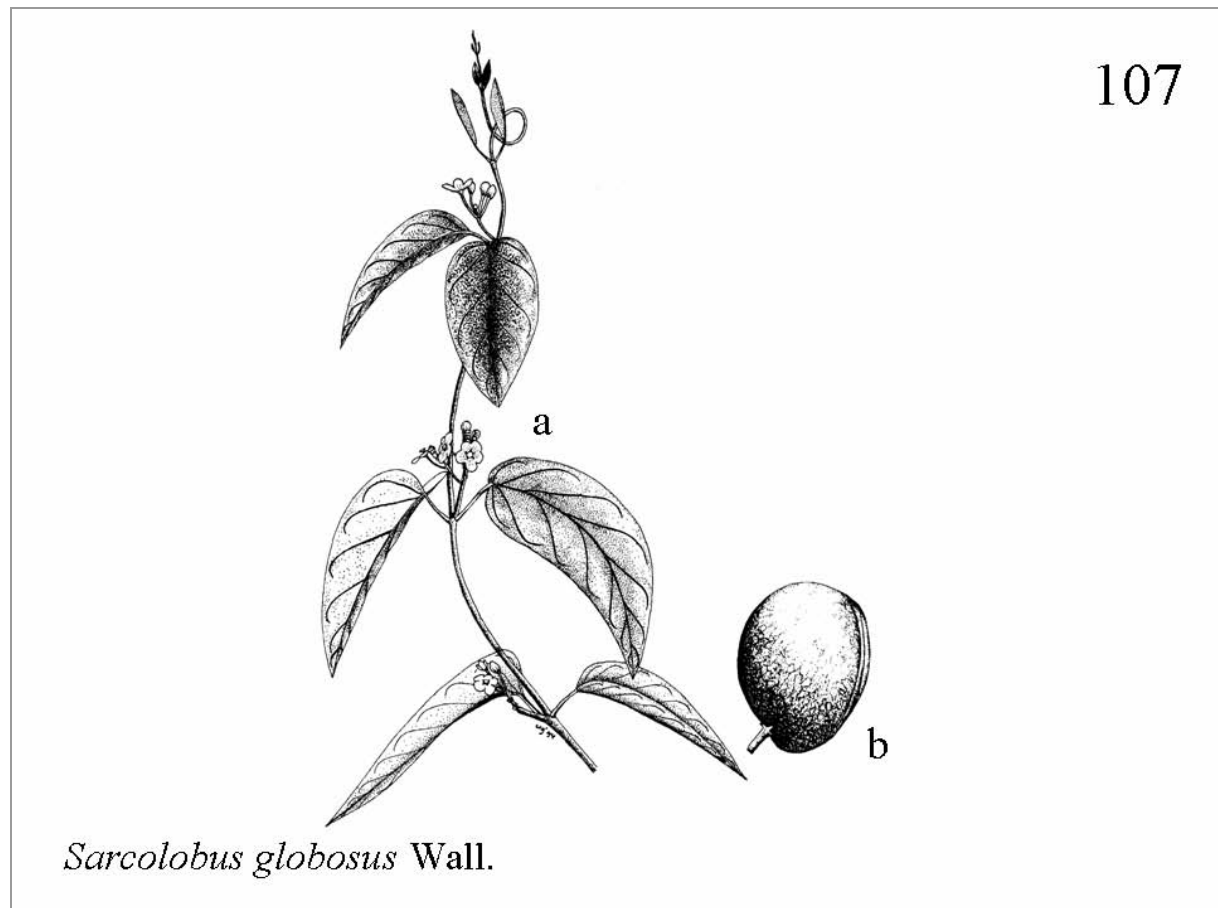


Fig. 107. *Sarcolobus globosus* Wall. (a) Flowering vine, and (b) fruit.

ASCLEPIADACEAE

107

***Sarcolobus globosus* Wall.**

Synonyms : *Sarcolobus banksii*, *Sarcolobus globosa* R. & S., *Sarcolobus globosus* subsp. *globosus*, *Sarcolobus globosus* subsp. *peregrinus* (Blanco) R.E. Rintz.

Vernacular names : Kambing-kambing, Peler kambing (Mal., Ind.) Peler kambing sejuk (Ind.), Dây cám (Viet.)

Description : Twining, shrubby climber, up to 4 m, with a smooth stem. Sparsely covered with hairs on the upper surface of the leaves, especially on the veins. The slightly fleshy leaves are oblong and 4-9 by 3-5.5 cm, while the leaf stalk is 2-30 mm. Five to ten flowers occur in dense clusters on 0.5-2 cm long stalks, located between the stalks of a leaf pair. The 5-partite calyx bears small basal glands on the inside. The fleshy corolla is 5-partite, its tube is 2.5 mm long. Above the tube the corolla spreads to a diameter of 12-14 mm. The flower segments are yellow with longitudinal purple streaks. They are moderately to rather densely covered with short hairs on the inside. Anthers are brown with a blunt, white membrane on the end. The mostly solitary, brown, warty fruits are broadly elliptic with a very unequal base, measuring 8-9 by 7-8 cm. They are strongly keeled along the dorsal midrib and have thick stalks. The thick, fleshy part of the fruit is very rich in milky latex. The very numerous, flat, obovate seeds are surrounded by a thick, wing-like margin and measure 20-25 by 16-18 mm, not including the margin which measures 13-15 by 8-9 mm.

Ecology : Common in muddy mangroves. Flowering occurs throughout the year. Seeds that retain their wing-like margin float on water. After removal of the wing they sink. Mangrove associate species.

Distribution : Found from India and Bangladesh through Southeast Asia, where it has been recorded from Myanmar, Thailand, Vietnam, Malaysia and Indonesia (Java).

Abundance : Unknown.

Use(s) : In Peninsular Malaysia and Singapore, the fruit (follicle) peel is used for making preserves, after being steeped in salt water for three days and subsequently boiled in syrup. Also used in making *sambal* (Indonesian red pepper paste). Seeds are reportedly poisonous.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Rahman & Wilcock (1995), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

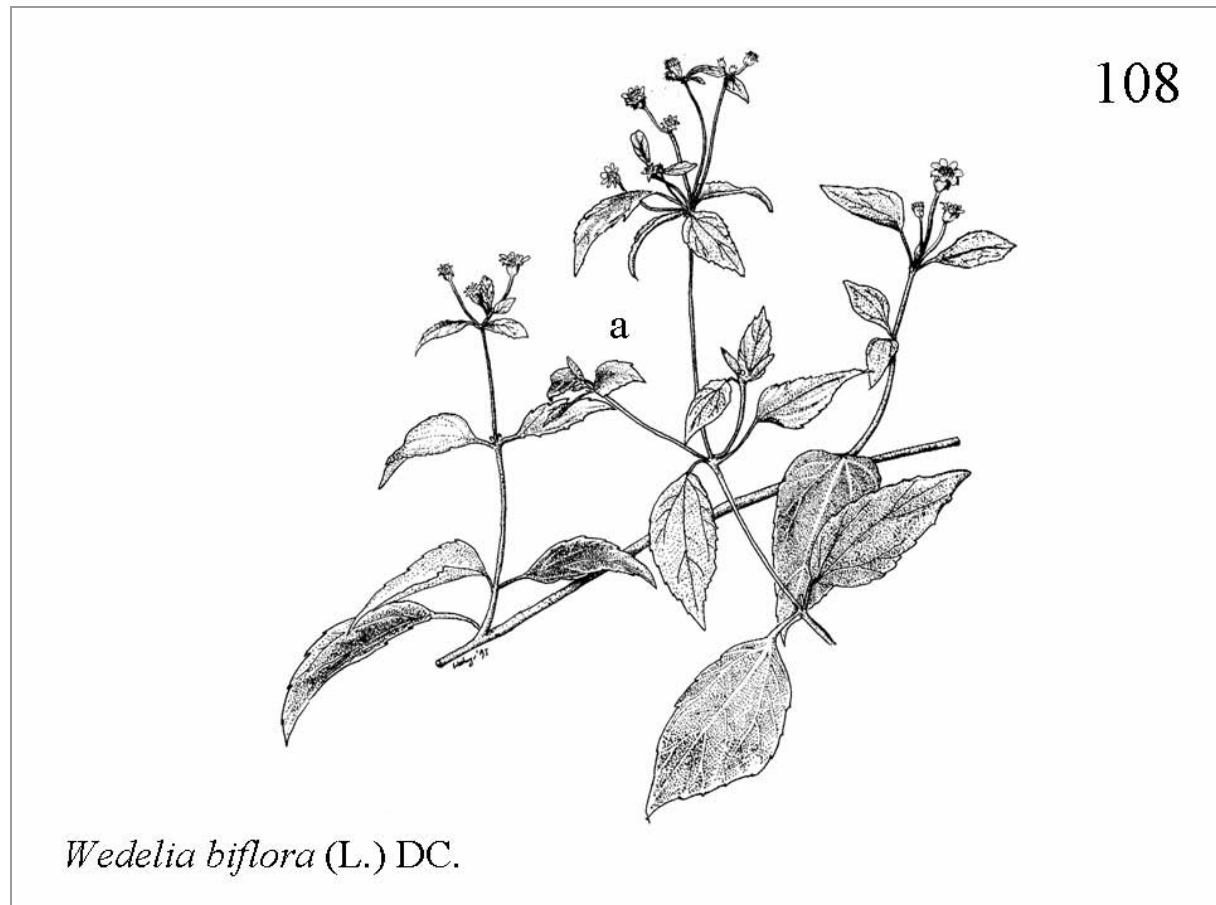


Fig. 108. *Wedelia biflora* (L.) DC. (a) Flowering vine.

ASTERACEAE

108

***Wedelia biflora* (L.) DC.**

Synonyms : *Acmella biflora* L., *Spilanthus acmella* Blanco, *Spilanthus peregrina* Blanco, *Stemmodontia biflora* W.F. Wight, *Verbesina biflora* Linné, *Wedelia glabrata*, *Wollastonia biflora* DC.

Vernacular : Beach sunflower, Wedelia (E), Daun Songa (Mal.), Lalang-kapan, Sernai, Pokok Serunai, Serunai Laut, Seremai, Seruni, Bunga Batang – *Saruni* (Ind.), Agonoi, Agunoi, Anoioi, Hagonoi, Lagoron, Lahunai, Palunag, Palunai, Salonai (Phil.), Rau mui (Viet.)

Description : Straggling to climbing perennial herb, 1.5-5 m long, and with an angular stem. A few hairs occur on both surfaces of leaves and on the stem. Leaves are ovate, opposite and with a toothed edge, 3-17 cm by 1-12 cm, with a leaf stalk measuring 0.5-4 cm. Flower heads are usually solitary, terminal in the upper leaf-axils or sometimes in pairs, 1.5-2.5 cm diameter; flower stalk 1-7 cm, sparsely covered with hairs. Typical 'composite' flower with about eight marginal 'petals' (these are actually separate flag-like flowers) and (female) disk-flowers, numbering 20-30. Flowers are bright yellow.

Ecology : Occurs mainly along or near the coast, on sandy beaches and mangrove edges. It may also occur in coconut plantations, dry rice fields, river banks and in secondary forests. Mangrove associate species.

Distribution : Found from East Africa to the Pacific islands, including in India, Southeast Asia and China. In Southeast Asia it has been recorded in the Philippines, Thailand, Vietnam, Malaysia, Singapore, throughout Indonesia and Papua New Guinea.

Abundance : Common in mangroves.

Use(s) : The leaves have medicinal properties, particularly for external application. Used for treating cuts, insect bites, ulcers, sores, scabies and swellings. The juice of the leaves can be taken internally to treat constipation, stomach pain and to improve healing of the abdomen after childbirth. Roots are used to treat gonorrhoea. The flowers are a violent purgative, and decoction of the roots is slightly purgative. The plant is sometimes cultivated, and is also used as a 'ground-cover' species in plantations to prevent erosion and loss of water. In the Philippines a decoction of the fresh roots is administered as a diuretic. Filipinos used the roots to treat stomach aches, and the leaves as a diuretic, and the plant is used as a substitute for tea. Together with the herb *Blumea balsamifera*, the plant is used for baths. *Wedelia biflora* is also said to be useful in fevers.

Source of illustration : Drawn from live material.

References : Burkill (1935), van Steenis *et al.* (1951), Backer & Bakhuizen van den Brink (1963-8), Perray & Metzger (1980), Afriastini (1988), <http://bpi.da.gov.ph/websitemedicinal/all/h/hagonoi.htm>.

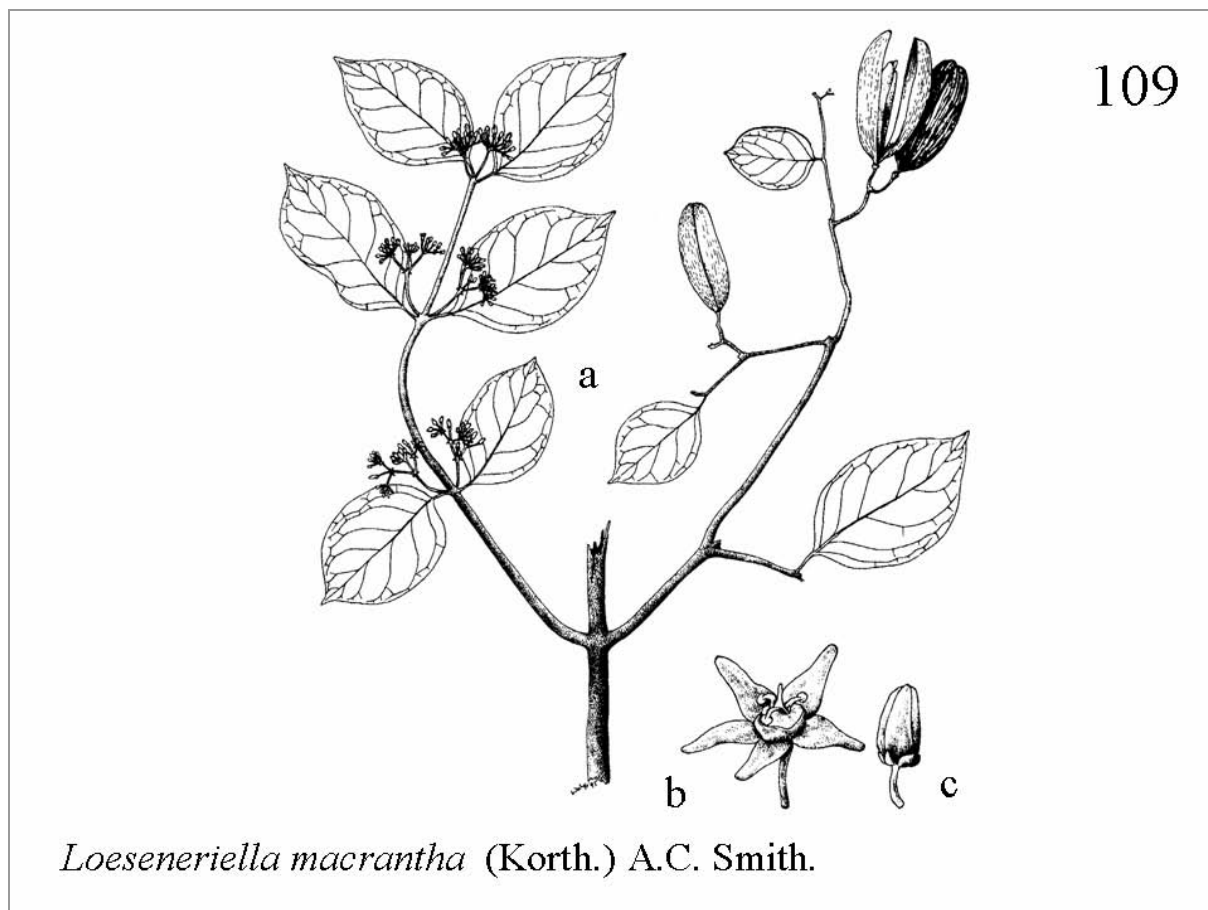


Fig. 109. *Loeseneriella macrantha* (Korth.) A.C. Smith. (a) Branchlet with flowers and fruit, (b) flower, and (c) bud.

CELASTRACEAE

109

***Loeseneriella macrantha* (Korth.) A.C. Smith**

Synonyms : *Hippocratea hasseltiana* Miq., *Hippocratea macrantha* Korth., *Hippocratea trilobulata* Ridl.

Vernacular name(s) : Akar bintong, Akar China, Akar mata pelanduk (Mal.), Gambir ayer, Resak, Akar beting (Ind.)

Description : A liana, up to 5 m long. Scars of leaflets occur at the base of the leaf stalk, and are united in a ring on the older branches. Leaves are papery to thinly leathery, sometimes shiny above, and varying from broadly elliptic to lanceolate, 10-20.5 by 5-8 cm. The flower stalk sometimes branches up to five times and is 1-6 cm long. Flowers occur on young, short shoots in axils that have reduced leaves at their base. Flowers are green or yellowish-green, or rarely yellow. The calyx is soft, covered with short hairs, and is 1 mm long. Petals are hairy inside and on the edges, and measure 4.5-6.5 by 2 mm. The 3-lobed fruit is ovate or elliptic oblong, 5-8 by 2-3.5 cm. The 3-8 seeds measure 3.5-6 by 0.5-1 cm, including the wings.

Ecology : Found in lowland forests up to an altitude of 400 m, but also found in floodplains, along rivers and in mangroves. Flowering in February and March. There are often insect galls on the leaves. Mangrove associate species.

Distribution : Found from Sri Lanka to the west Pacific, including Southeast Asia where it has been recorded in the Malay Peninsula, Singapore, Indonesia (Sumatra, Bangka, West and Central Java, Kalimantan, Sulawesi, the Moluccas and Papua) and Papua New Guinea.

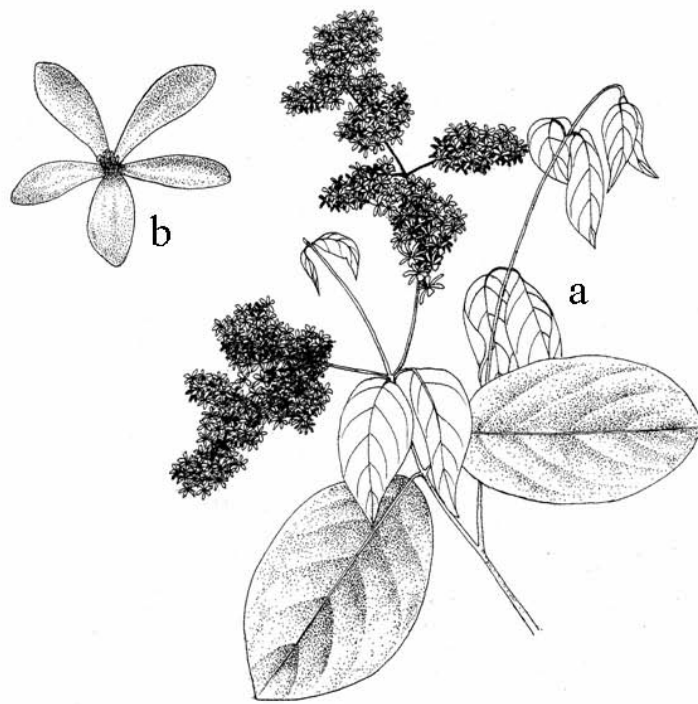
Abundance : In Indonesia it is rare in Java, but elsewhere it is relatively uncommon.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Leiden Herbarium.

Reference(s) : Burkill (1935), Ding Hou (1962), Backer & Bakhuizen van den Brink (1963-8).

110



Calycopteris floribunda (Roxb.) Lamk.

Fig. 110. *Calycopteris floribunda* (Roxb.) Lamk. (a) Flowering branchlet, and (b) flower.

COMBRETACEAE

110

Calycopteris floribunda* (Roxb.) Lamk*Synonyms :** *Calycopteris nutans* Kurz., *Getonia floribunda* Roxb.**Vernacular name(s) :** Pelawas (Mal.)

Description : Large scandent shrub or (more commonly) a woody climber, young branchlets densely covered with fine hairs. Leaves opposite or nearly opposite. Young leaves densely hairy on the upper side, older leaves smooth; underneath densely hairy, with fine net-like venation; ovate to narrowly elliptic, 6-17 by 2-7 cm, with pointed tip; leaf stalk 0.5-1 cm. Flowers 5-merous, grouped in panicles, yellowish-green, (almost) without a flower stalk; lower receptacle (= upper part of stalk upon which flower parts are borne) is covered with short hairs, 4.5 by 2 mm; upper receptacle 3 by 4.5 mm. Calyx lobes narrowly elliptic or lanceolate, 4 by 2 mm, in fruit reaching a length of 1-1.5 cm. Petals are absent; there are 10 stamens, and the style is 5 mm long. Fruit is ellipsoid, densely covered with short hairs, 7-8 by 2-3 mm.

Ecology : Climber in mixed forests, along rivers banks, and in landward edges of mangroves. Mangrove associate species.

Distribution : Endemic to Southeast Asia, and recorded in Myanmar, Cambodia, Thailand and Peninsular Malaysia.

Abundance : Uncommon, and with limited distribution.

Use(s) : Flowers are used in Penang as a poultice for headaches.

Source of illustration : <http://www.ku.ac.th/AgrInfo/plant/plant2/p033.html>

Reference(s) : Exell (1954).

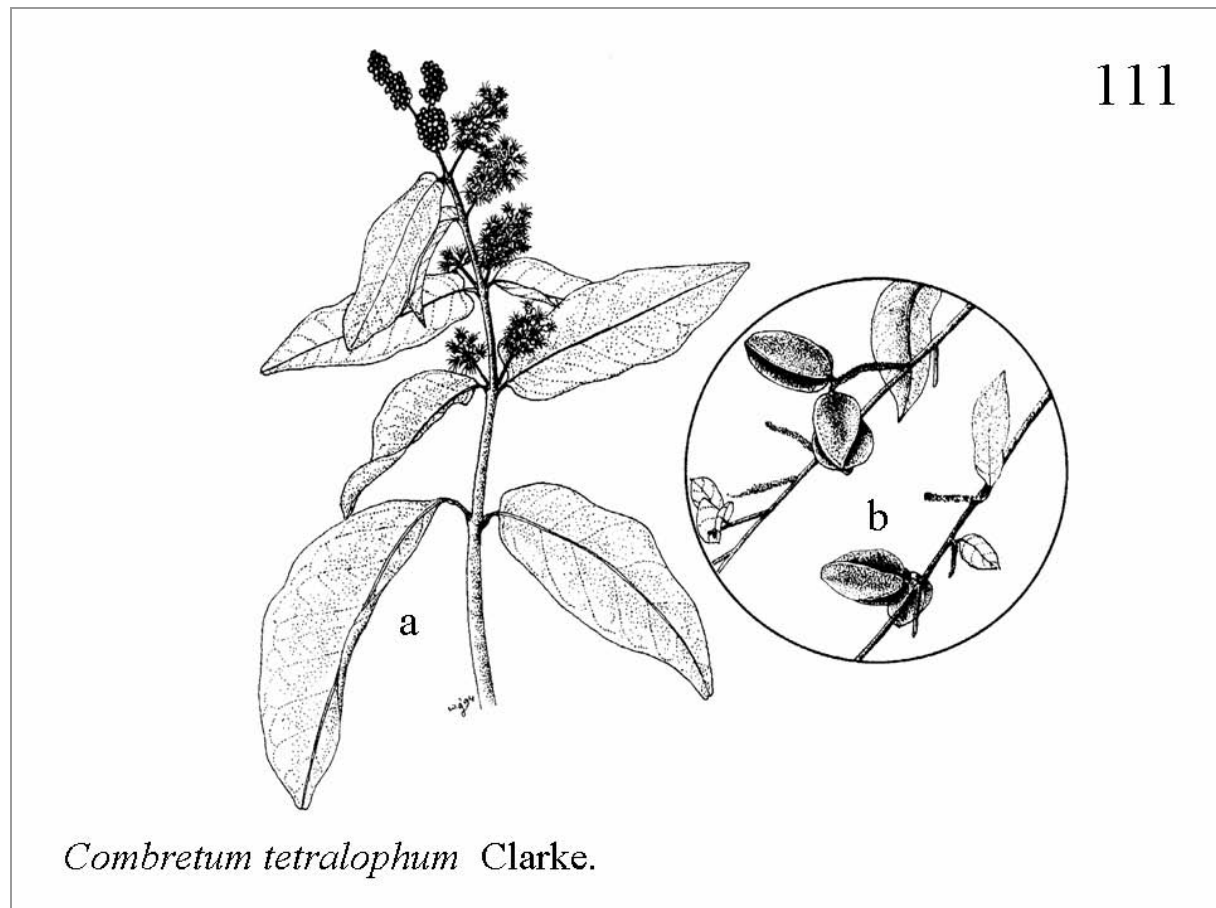


Fig. 111. *Combretum tetralophum* Clarke. (a) Flowering branchlet, and (b) detail of fruiting branchlet.

COMBRETACEAE

111

***Combretum tetralophum* Clarke**

Synonyms : *Combretum acuminatum* (non Roxb.) K. Schum. & Hollr., *Combretum neurophyllum* (non Miq.) Backer, *Combretum tetragonocarpum* (non Kurz.) Koord.

Vernacular name(s) : Akar Aru, Songsong Harus, Susong Harus; Tingting; Sungsung Arus, Susung Arus (Ind.)

Description : Woody liana, climbing to a considerable height, or a scandent shrub. Young branchlets have rust-coloured scales, but these soon become smooth as they mature. The papery to leathery leaves measure 6-20 by 3-11 cm, are elliptic and often shiny above. They are either densely scaly (individual scales not easily distinguished!), or nearly smooth except for some short hairs on the midrib at the base of the lower surface of the leaf. Flower clusters occur at the ends of branches and in axils; they are scaly and covered with short hairs, rarely more than 2-3 cm long, and often gathered in compact, head-like clusters. The flowers are 4-merous, stalk-less, yellow, greenish-yellow or greenish-white, sweet scented and 6-9 mm long. The disk of the flower is covered with very long hairs. The fruit is ovoid or ovoid-ellipsoid, densely scaly, 2.5-4 cm long, with four stiff, narrow, sharp-edged wings or ridges, along which it eventually splits.

Ecology : Occurs in mangroves, riparian forests in lowlands and as brushwood on cliffs. Flowering has been recorded in December, and fruit is probably dispersed by water. Leaf galls, caused by a mite, have been recorded. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Cambodia, Vietnam, Thailand, Malaysia, Brunei, Singapore, East Timor, Indonesia (Sumatra, Java, Kalimantan, Sulawesi and Papua) and Papua New Guinea. Not (yet) recorded in Myanmar and the Philippines.

Abundance : Unknown.

Use(s) : Seeds used to treat internal worm infestations.

Source of illustration : Drawn from herbarium specimen, Herbarium Bogoriense

Reference(s) : Heyne (1950), Exell (1954), Backer & Bakhuizen van den Brink (1963-8).

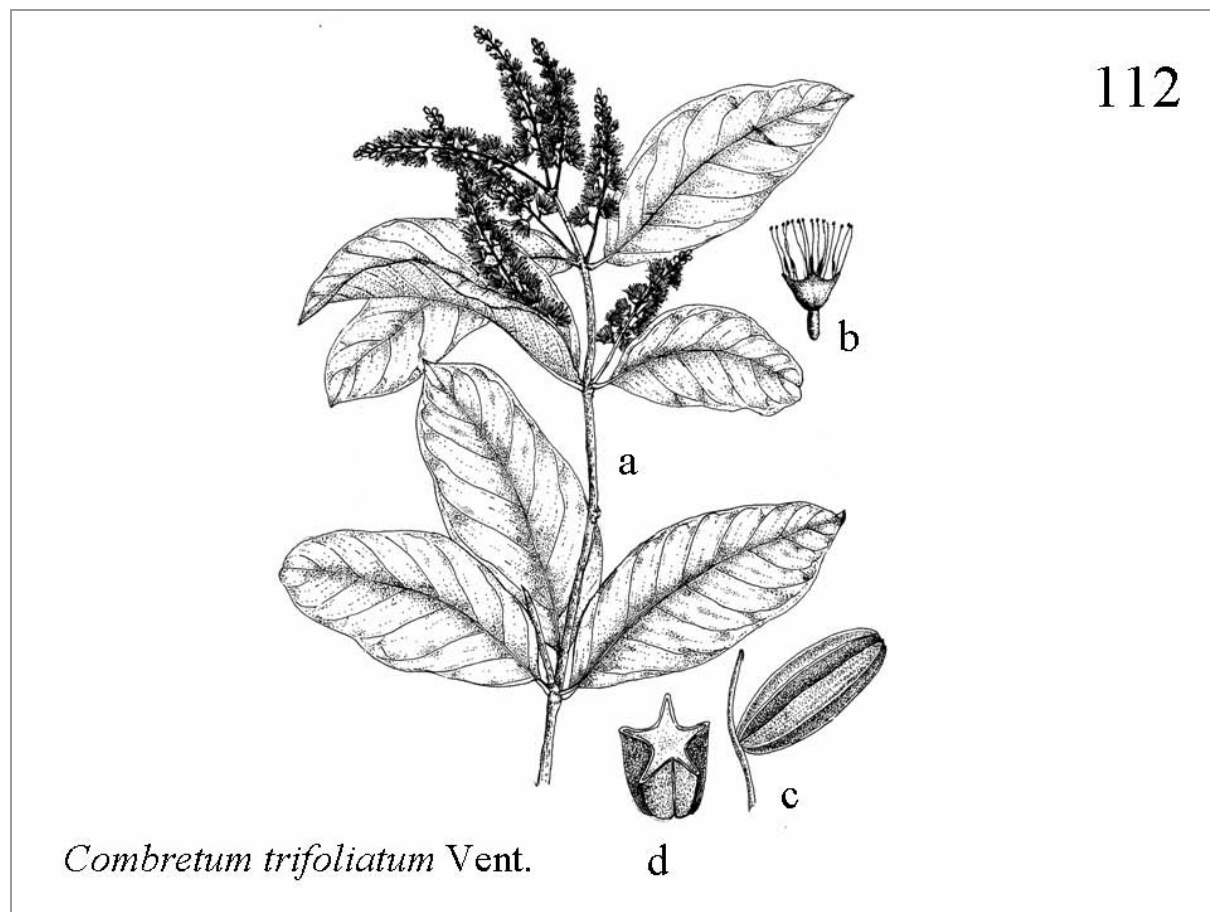


Fig. 112. *Combretum trifoliatum* Vent. (a) Flowering branchlet, (b) flower, (c) fruit, and (d) cross-section of fruit.

COMBRETACEAE

112

***Combretum trifoliatum* Vent.**

Synonyms : *Cacoucia lucida* Hassk., *Cacoucia trifoliata* DC., *Combretum lucidum* Blume, *Embryogonia lucida* Blume,

Vernacular name(s) : Kubaing, Sepang, Akar nangkei, Akar song song harus, Palawan (Ind.), Tew (PNG).

Description : Scrambling or climbing shrub, 2-5 m tall or long. Young branchlets flattened, covered with short, tawny-coloured hairs. Leaves arranged in 3-4(-5) whorls, (sub-) leathery, elliptic to lanceolate, usually smooth, except for a line of hairs along the midrib, 3-5.5 by 8-16 cm, usually with a pointed tip, nerves 6-8 pairs, and a 4-7 mm long leaf stalk. Flower clusters occur at the ends of branches or in axils, 8-20 cm long, with 2-5 cm long flower spikes. Flowers are 5-merous, white or yellowish-white, sweet-scented, mostly arranged in whorls of three. Calyx lobes 5, each 1 by 1.2 mm. Petals 5, narrowly elliptic, densely covered with hairs, 1-1.4 by 0.2-0.4 mm. Stamens 10, filaments 4-5 mm long, anthers 0.5 mm long. Fruit without a stalk, narrowly ellipsoid, smooth, shiny black-brown, 3-3.5 by 1-1.2 cm, with (4-)5(-6) rigid wings, 3-4 mm broad.

Ecology : Occurs in low-lying, frequently flooded areas, along banks of rivers and lakes, in bush or forest, along borders of teak forest, on limestone (Sulawesi) or alluvial river clay, both in humid or seasonal conditions. Fruit is dispersed by water. Also reported from mangroves and beach forests in Myanmar: "In the southern part (Tenasserim portion) of the eco-region, there are some *Heritiera*-dominated brackish and fresh-water habitats along the Tenasserim river. The former is characterized by *Bruguiera parviflora*, *Aquilaria agallocha*, *Sonneratia griffithii*, and *Cynometra mimosoides* and the latter by *Aglaia (Amoora) cucullata*, *Dysophyllum cochinchinensis*, *D. turbinatus*, *Intsia bijuga*, *Barringtonia acutangula*, and *Combretum trifoliatum*." Also occurs in the freshwater flooded forests of Cambodia around the Tonle Sap lake. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia, Indonesia (Sumatra, Borneo, Java, Sulawesi, Papua) and Papua New Guinea.

Abundance : Locally common.

Use(s) : Fruits are used to treat *Ascaris* worm infections, and they reportedly contain a saponin.

Source of illustration : Archive, Royal Botanic Garden, Kew

Reference(s) : Exell (1954),
http://www.worldwildlife.org/wildworld/profiles/terrestrial/im/im0132_full.html
[http://www.mekonginfo.org/mrc_en/doclib.nsf/0/361DBED9D9432D0B87256AE30013DD00/\\$FILE/FULLTEXT.pdf](http://www.mekonginfo.org/mrc_en/doclib.nsf/0/361DBED9D9432D0B87256AE30013DD00/$FILE/FULLTEXT.pdf).

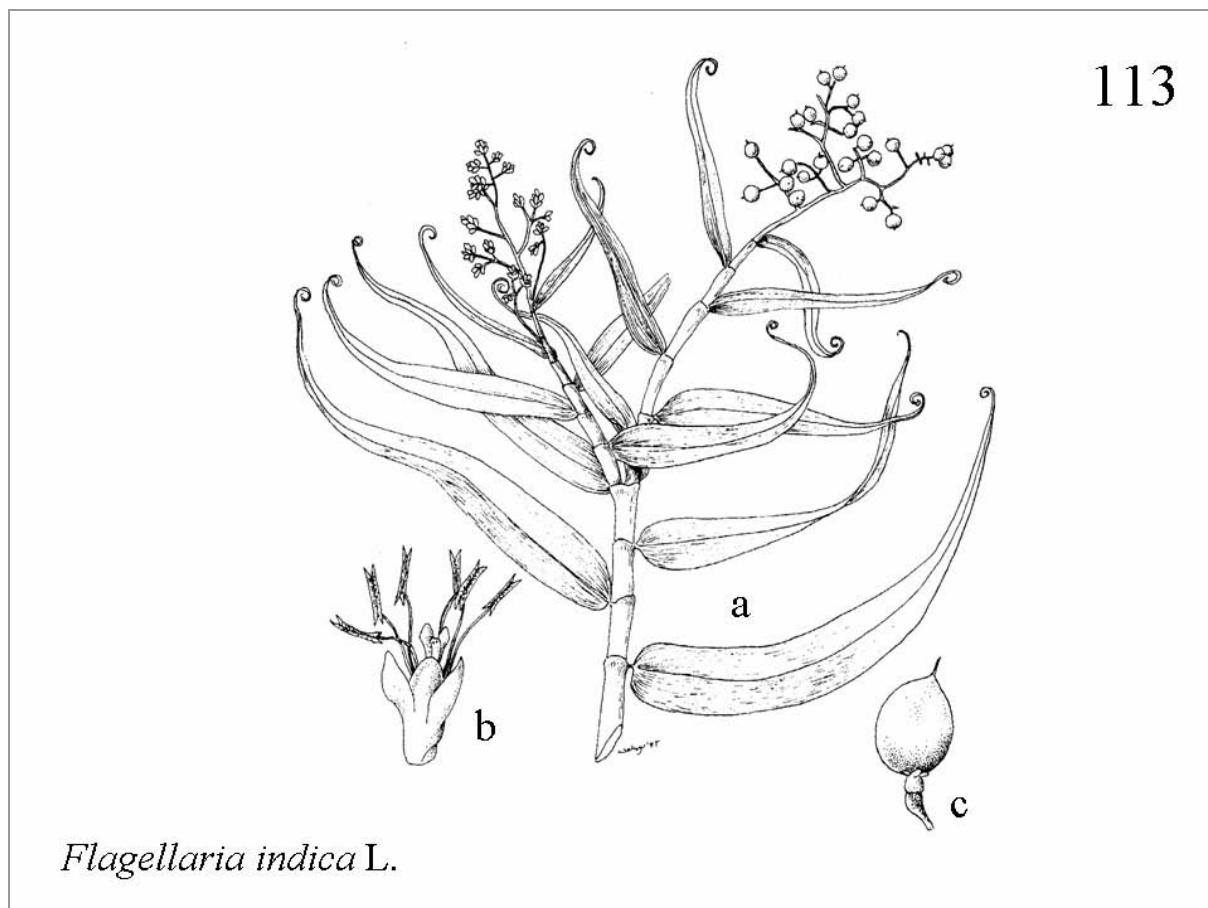


Fig. 113. *Flagellaria indica* L. (a) Flowering and fruiting vine, (b) flower, and (c) fruit.

FLAGELLARIACEAE**113*****Flagellaria indica* L.**

Synonym(s) : *Flagellaria minor* Bl., *Flagellaria philippinensis* Elmer, *Palmijuncus laevis* Rumph., *Flagellaria indica* var. *gracilis* Backer, *Flagellaria indica* var. *minor* (Bl.) Koord.

Vernacular name(s) : Rotan Tikus (Mal.), Lumpui, Owar, Kokrok, Wowo, Rotan Dapit, Rotan Dini, Rotan Kroh, Rotan Laki, Rotan Macik (Ind.), Anudd, Ingual, Audi, Audi-si-gayang, Venagalang (Phil.), Mây nu'óc (Viet.), Pdao ondawk, Vorre (Camb.)

Description : Perennial climber with a 2-15 m long stem that is 1-3 cm thick and woody at the base, but generally less than 1 cm thick, green and herbaceous along most of its length. Leaves are 3-50 by 0.5-6.5 cm and have a 3-10 mm-long petiole that is abruptly flattened. The leaf tip is curled into a tendril that winds around all available props. Flowers are generally grouped in terminal clusters. Individual flowers are solitary, white, with 2-2.75 mm lobes. Fruit is a conspicuous, round, smooth, shiny, pink to orange berry, about 6 mm in diameter, usually with only one fertile seed.

Ecology : Common climber in moist forests, swamp forests, peat swamp forests and riparian forests, from sea level to about 1,600 m altitude. Frequently seen along forest edges, and along stream and river banks. Also found along mangrove margins. In freshwater areas it creeps along the ground if woody vegetation is not present. Mangrove associate species.

Distribution : From Tropical Africa through South Asia (India, Sri Lanka) and Southeast Asia to western Polynesia and northern Australia. Found throughout Southeast Asia.

Abundance : Common, locally very common.

Use(s) : Sometimes used for basket work, but is of inferior quality compared to rattan. Young stems and leaves are used as shampoo to combat baldness, and various medicinal applications have been reported, such as using leaves as a plaster on wounds (Heyne, 1950).

Source of illustration : Backer (1951), Keng (1987).

Reference(s) : Heyne (1950), Backer (1951), Keng (1987), Heywood (1993), Marschke (2000).

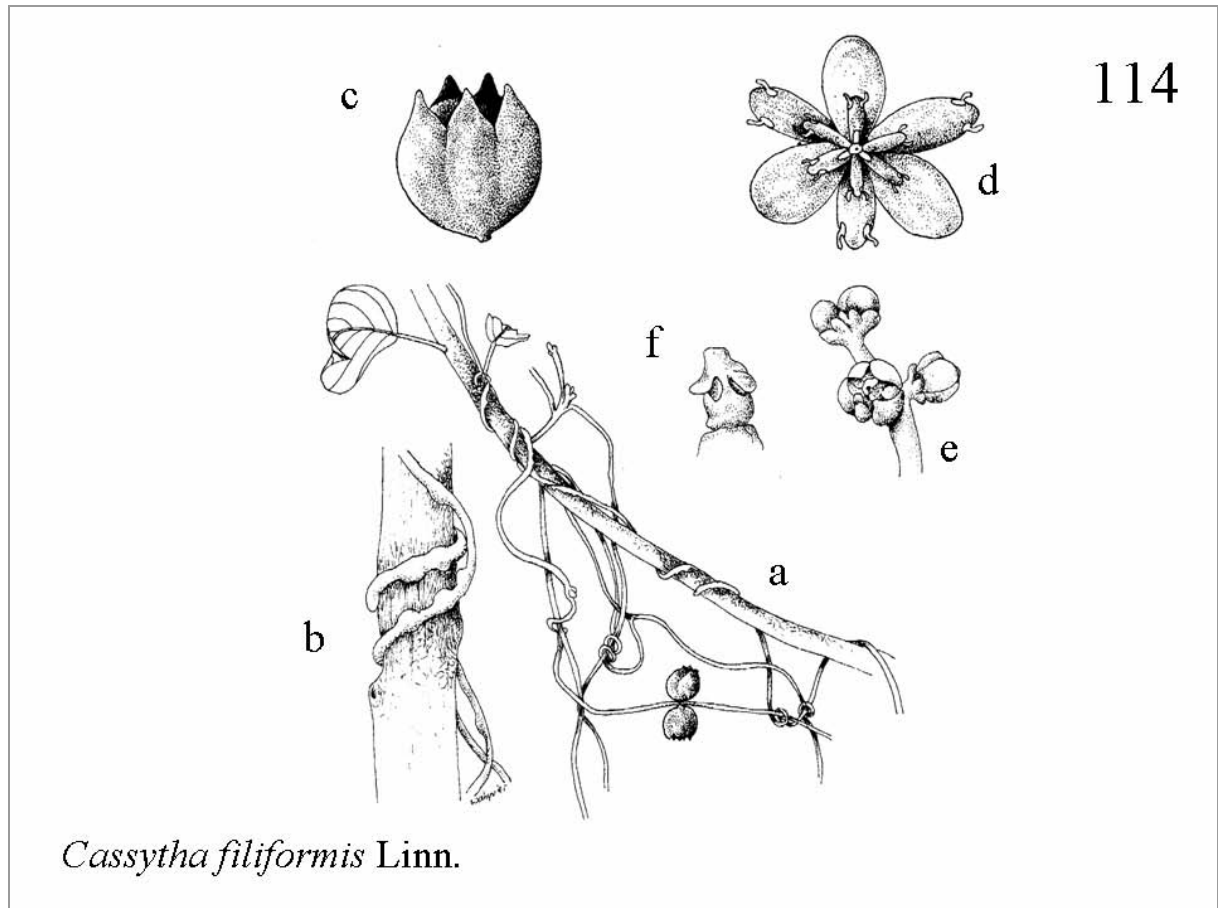


Fig. 114. *Cassytha filiformis* Linn. (a) Habit of fruiting vine, (b) parasitic attachment (sucker) to the host plant, (c) fruit, (d) flower, (e) cluster of flowers, and (f) detail of flower.

LAURACEAE

114

***Cassytha filiformis* Linn.**

Synonym(s) : *Calodium cocinchinensis* Lour., *Cassytha americana* Nees., *Cassytha aphylla* (Forssk.) Raenschel., *Cassytha archboldiana* C.K. Allen, *Cassytha brasiliensis* Mart. ex Nees., *Cassytha dissitiflora* Meisn., *Cassytha filiformis* L. var. *pseudopubescens* Domin., *Cassytha filiformis* L. var. *subpubescens* Meisn., *Cassytha guineensis* Schumach. & Thonn., *Cassytha novoguineensis* Kaeh. & Harusima, *Cassytha timorensis* Gand., *Cassytha zeylanica* Gaertn., *Rumputris fasciculata* Raf., *Spironema aphyllum* (Forssk.) Raf., *Volutella aphylla* Forssk.

Vernacular name(s) : Dodder-laurel, Devil's Gut, Love Vine (E), Cemar, Akar Pengalasan (Mal.), Rambut Putri, Tali Putri, Sangga Langit, Sangir Langit, Gumi Guraci, Mas Semasan – *Tali putri* (Ind.)

Description : Thread- or string-like, semi-parasitic plant that grows in a massive tangle on host plants and does not root. Stems measure 1.5-2 mm, are hollow, round and dark green to reddish-or yellowish-brown, smooth and 3-8 m long. The juice is slimy. There are no (visible) leaves. The vines produce suckers at short intervals along the stem, by which they are attached to the host. Flowers are tiny, measuring 1.5-2 mm across, 3-partite, yellowish-white, with (9-)12 stamens. They occur on 5 cm long auxiliary stalks. It produces small, round, juicy white berries – about 7 mm diameter – that are eaten and dispersed by birds. Sometimes recognised as a separate family, the Cassythaceae. The *Lauraceae* family are occasionally split into two sub-families: *Cassythoideae* and *Lauroideae*. The former includes only a few (semi-) parasitic climbers such as *Cassytha*. In general appearance it is much like the European Dodder *Cuscuta* (Convolvulaceae), which is also semi-parasitic.

Ecology : Sea-side semi-parasite, observed on many shrub and small tree species, including *Excoecaria agallocha* and *Scaevola taccada*. More rarely seen inland, for example in dwarf swamp forests of the Danau Sentarum NP in West Kalimantan (Giesen, 2000). It can sometimes smother the host so densely that the latter is scarcely visible. Mangrove associate species.

Distribution : Pantropical, and occurs throughout Southeast Asia.

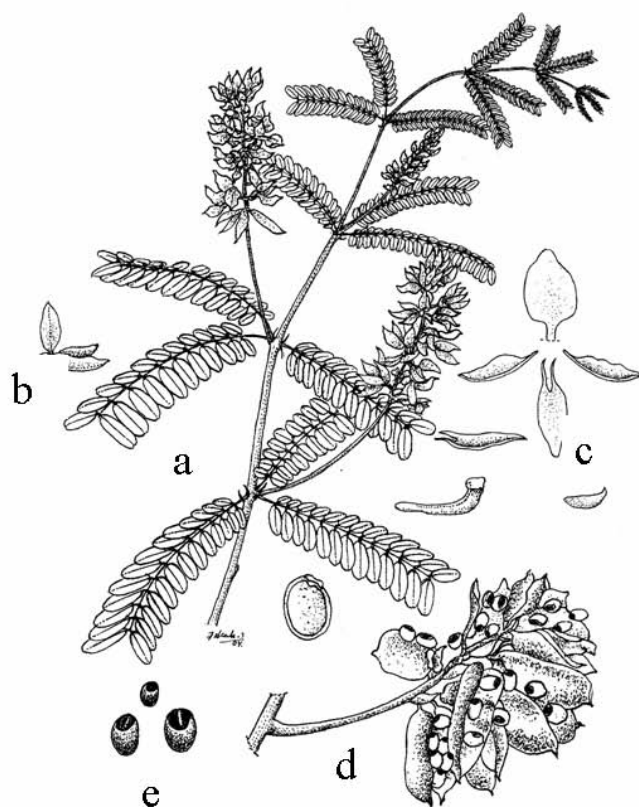
Abundance : Common.

Use(s) : Juice used in tonic shampoo (Ambon, Indonesia), and to treat intestinal worm infestations. Sometimes cultivated for the latter (e.g. North Sulawesi, Indonesia).

Source of illustration : Holttum (1954)

Reference(s) : Heyne (1950), van Steenis, den Hoed & Eyma (1951), Holttum (1954), Afriastini (1988), Polunin (1988), Khan & Hosne-Ara (1989), Giesen (1995), <http://www.plantatlas.usf.edu/main.asp?plantID=2746>.

115



Abrus precatorius L.

Fig. 115. *Abrus precatorius* L. (a) Flowering branchlet, (b) flower, seen from side, (c) flower parts, (d) cluster of opening seed pods, and (e) seeds.

LEGUMINOSAE

115

***Abrus precatorius* L.**

Synonyms : *Abrus abrus* W.Wight, *Abrus cyaneus* R.Vig., *Abrus frutex* Rumphius, *Abrus maculatus* Noronha, *Abrus minor* Desv., *Abrus pauciflorus* Desv., *Abrus precatorius* var. *novo-guineensis* Zipp. ex Miq., *Abrus squamulosus* E. Mey., *Abrus tunguensis* P. Lima, *Abrus wittei* Baker f. *Glycine abrus* L.

Vernacular name(s) : Wild liquorice, Crab's eye creeper, Indian Liquorice, Prayer Beads, Jequirity seeds, Rosary bead, Precatory bead (E), Abrus chapelet (F), Koraalerwt, Paternosterboontjes, Weesboontjes (NL), Daun saga, Saga buncik, Taning bajang, Piling-piling, Pikal, Saghakan – *Saga* (Ind.), *Saga* (Mal.).

Description : Twining shrub to (more commonly a) woody climber, (1)2-4(5) m tall, stems often attaining over 1.5 cm diameter, greenish, smooth or with flattened fine hairs. Leaves 16-34 foliate (8-17 pairs), leaf stalk 0.5-1.8 cm long. Leaflets deciduous, oblong, obovate-oblong or ovate, 3-10 mm by 6-27 mm, smooth on top, finely hairy underneath. Flower clusters curved, thick and robust, 2-7 cm long, flower stalks 1.5-6 cm long. Calyx sparsely covered with hairs, 3 mm long, 5-toothed. Corolla usually pale purple to pink, but variable in colour, from yellow, to white, pink or mauve, 9-15 mm long. Pods are oblong, swollen, 2-4(5) cm long, 1-1.5 cm wide, with a hooked beak and covered with dense, short hairs. (Warty-)pods contain (1)3-6(7) seeds, (3-)5-7 mm by 4-5 mm, rounded to bead-shaped, shiny, scarlet to bright (orange-) red with small black spot at base; seeds occasionally entirely black or yellowish.

Ecology : Both planted and in natural habitats: grasslands, thickets, secondary growth, often rocky places, coastal and lowland areas including beach scrub and landward edges of mangroves, up to about 250m asl (Indonesia) or even 1,350 m (East Africa). Mangrove associate species.

Distribution : Tropical Africa (east and west), tropical Asia, Australia and the Pacific; found throughout Southeast Asia.

Abundance : Locally common.

Use(s) : The raw seeds contain *abrin*, a ribosome inactivating protein that is one of the most poisonous plant toxins known; despite their toxicity, the boiled seeds are ingested as a contraceptive and an aphrodisiac (as are the chewed roots); they are also made into a decoction for use as a diuretic, for sore throat, and for rheumatism; the powdered seeds are taken as a snuff for headache; a poultice of the leaves is said to remove freckles; a decoction of the leaves and roots is used for cough, colds, and colic. Roots and leaves used as alternative for liquorice (*Glycyrrhiza glabra* L.). The seeds, weighing about 1 carat each, have been used in India from very ancient times for the purpose of weighing gold, under the name of Rati.

Source of illustration : Missouri Botanical Garden TROPICOS database (www.mobot.mobot.org)

Reference(s) : Kamerling (1915), Heyne (1950), van Steenis *et al.* (1951), Steentoft-Nielsen (1965), Gillett *et al.* (1971), Afriastini (1988), <http://www.luckymojo.com/redbeans.html>, <http://www.botanical.com/botanical/mgmh/1/liqind33-1.jpg>.

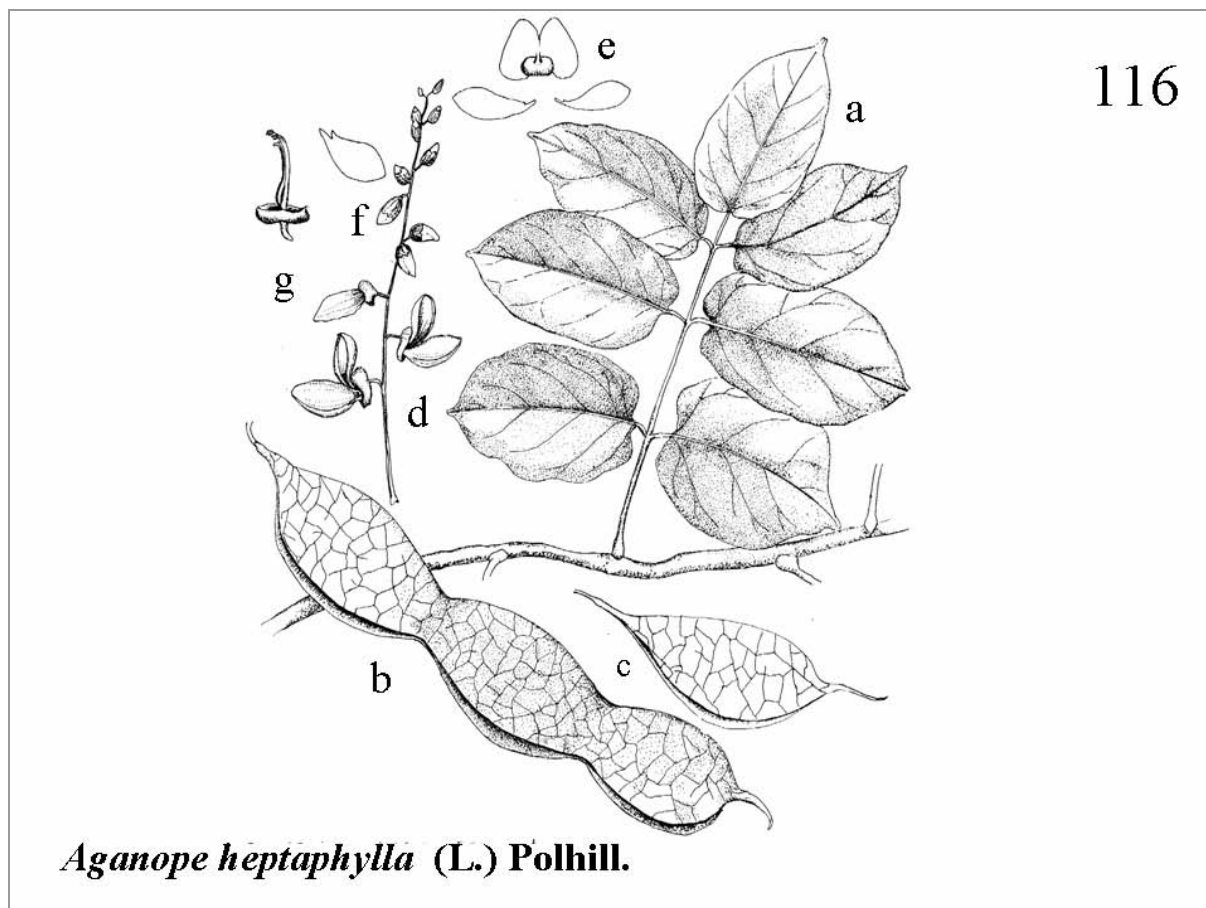


Fig. 116. *Aganope heptaphylla* (L.) Polhill. (a) Section of vine with one leaf (with 7 leaflets), (b) large pod, (c) small pod, (d) flower raceme, and (e, f, g) segments of flower.

LEGUMINOSAE

116

***Aganope heptaphylla* (L.) Polhill**

Synonyms : *Derris heptaphylla* (L.) Merr., *Derris macroloba*, *Derris sinuata* Thwaites, *Funis convolutus* Rumph., *Sophora heptaphylla* L.

Vernacular name(s) : Tali Berkumpul (Mal.); Wali Ahuhun (Ind.).

Description : Erect or climbing shrub, 3-5 (-15) m, with smooth (occasionally hairy) branchlets and hairy young shoots. Leaves are alternate, with a mid-rib that is 12.5-30 cm long and bears 5-7 leaflets. The latter are smooth, leathery, broadly ovate-oval-elliptic and measure 5-20 by 2.5-13 cm. The flower clusters are flattened, covered with brown hairs, and are 20-40 cm long. Flower clusters occur on short, lateral branchlets. The calyx has brown hairs on the top and on the outside. The main part of the standard (see glossary) of the flower is green and smooth, measuring 1.5-2.5 cm in diameter. The other petals are white. The one upper stamen is free, the others are united. The pod is long and flat, with a 2-2.5 mm-wide wing along the ventral midrib, undulating between the seeds. Pods are corky, measuring 6-27 by 2.5-3.5 cm, and are constricted between the 1-6 seeds. It is recorded that it sometimes grows intertwined with *Derris trifoliata*, with which it has been confused. It can be distinguished by the absence of dark red, strongly-ridged younger stems with prominent lenticels. Furthermore, its flowers and fruits are larger and it has smoother leaflets.

Ecology : Occurs in mangrove swamps and associated communities such as littoral creeks and estuaries. It has also been recorded in degraded peat swamp forests and along rivers (both in Brunei). *Aganope heptaphylla* may grow inland, but has a decidedly coastal distribution. Flowering occurs from October to February. Mangrove associate species.

Distribution : Found from Sri Lanka and South Asia (Bangladesh, East India) to South China and through Southeast Asia, where it has been recorded in the Philippines, Malaysia, Singapore, Indonesia and Papua New Guinea.

Abundance : Locally common, but often confused with *Derris trifoliata* and hence seldom recorded.

Use(s) : Young leaves eaten as vegetable. Used as fodder for cattle.

Source of illustration: Icones Rijksherbarium Leiden.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), <http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

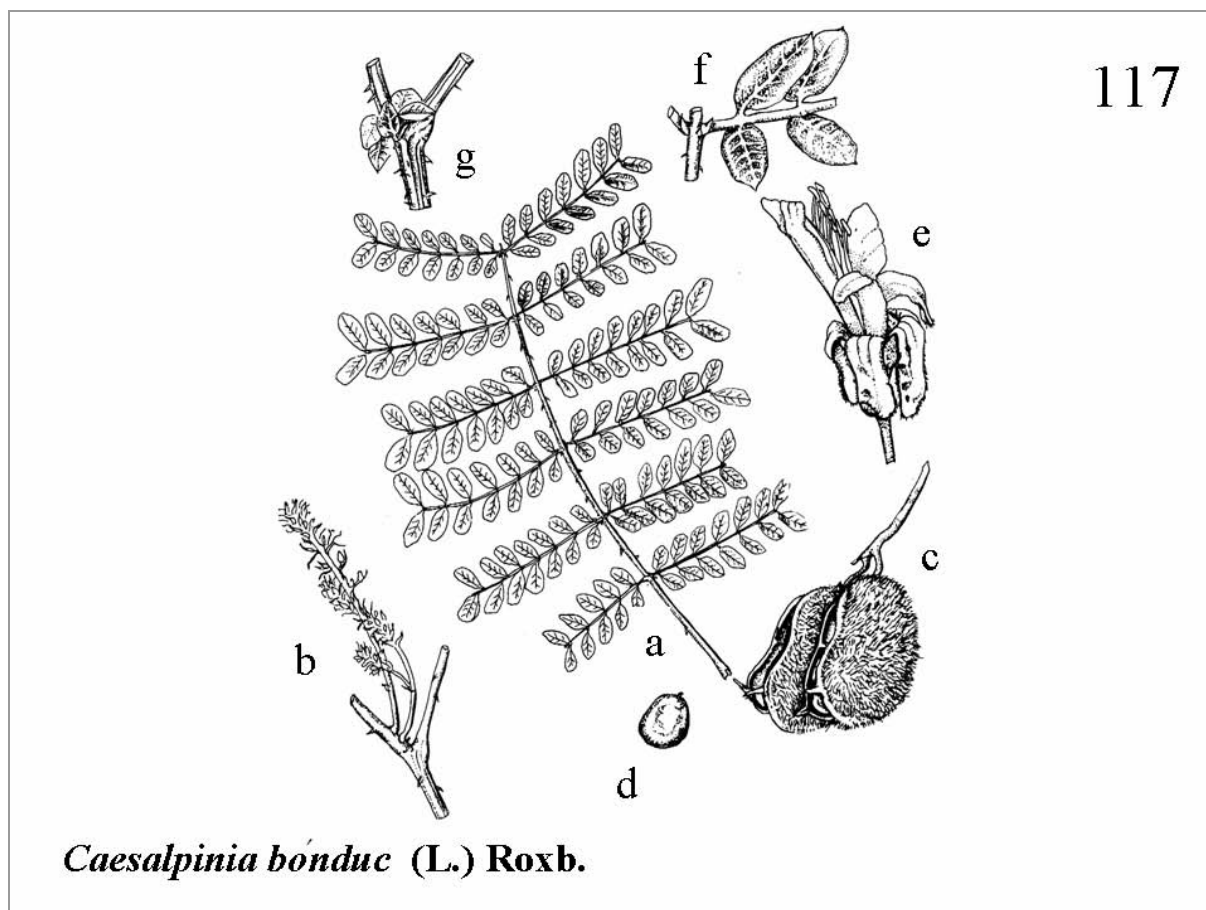


Fig. 117. *Caesalpinia bonduc* (L.) Roxb. (a) Leaf, with primary and secondary leaflets, (b) flower raceme, (c) pod, (d) seed, (e) single flower, and (f-g) leaf insertion and thorns.

LEGUMINOSAE

117

***Caesalpinia bonduc* (L.) Roxb.**

Synonyms : *Caesalpinia jayabo* Maza., *Caesalpinia sogerensis* Baker, *Guilandina bonduc* L.

Vernacular name(s) : Nicker tree (E), Bonduc, Akar Kelinci (Mal.) Kaniker, Sompini, Areuj, Mata Kijang, Kemrounggi, Klengkeng, Kutuk, Aruk, Tuwung, Bagoré, Buwa Goro, Katé-katé (Ind.)

Description : A coarse, climbing vine, 5-15 m long, with leaves up to 1 m long, twice divided into leaflets, and with small leaflets located at the base of the leaf-stalk. Stem, branchlets and leaflet mid-rib are often prickly. The 6-11 pairs of leaflets are 8-20 cm long; the main axis of the leaf may be up to 80 cm. The 12-24 opposite or nearly opposite secondary leaflets, 2-4 cm long, are asymmetric, ovate-oval, densely covered with yellow hairs when young, but gradually become smooth as they mature. The topmost leaflets are largest. The scented flowers occur in simple or branched clusters that are up to 50 cm long and occur in the leaf axils. Flowers are of one sex only, yellow, often with reddish streaks. Flowers have 10 stamens. The ellipsoid pods are 5-7(-9) cm by 3-5 cm long and have rigid thorns, 8-10 mm long, which are easily detached from the ripe pod. The one or two seeds are pearly-grey or olive-green and 2-2.5 cm long.

Ecology : *Caesalpinia bonduc* mainly occurs in dry localities on and close to the beach and on landward margins of mangroves, especially in disturbed sites. It also occurs inland in secondary forests up to an altitude of about 850 m, often forming dense, impenetrable thickets. Seeds can float and retain their viability in water for extended times. Flowers and fruit often occurs together without any apparent periodicity. Mangrove associate species.

Distribution : Pan-tropical. Recorded throughout Southeast Asia, but scarce in Sumatra, Borneo, the Philippines and western New Guinea.

Abundance : Locally common, but listed as rare in Indonesia (Mogea *et al.*, 2001).

Use(s) : Sometimes cultivated as a hedge-plant. Used as an ornamental in local celebrations. Root used to treat stomach pain and to stimulate the appetite.

Source of illustration : Tomlinson (1986).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Hou *et al.* (1996).

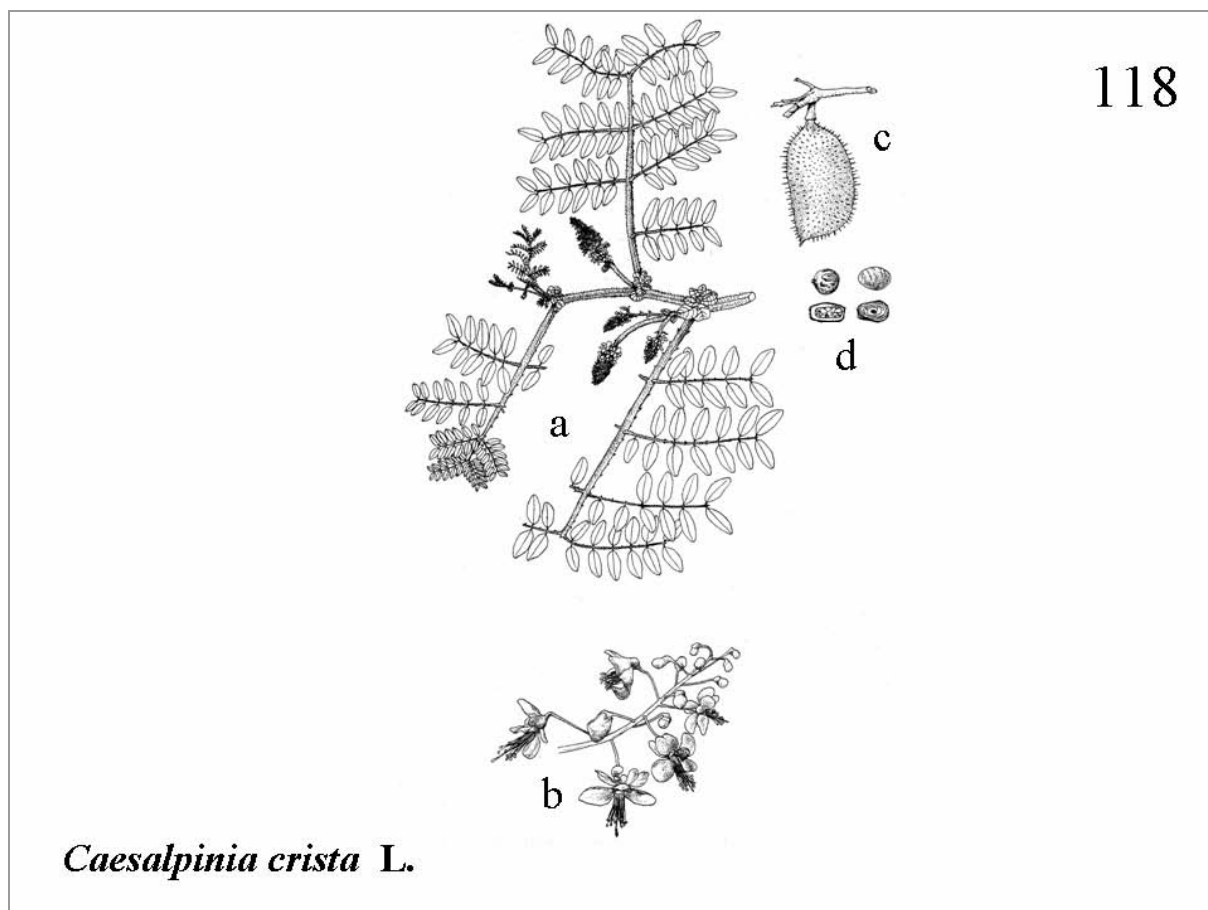


Fig. 118. *Caesalpinia crista* L. (a) Flowering section of vine, (b) detail of flower cluster, (c) pod, and (d) seeds and seed cross-section.

LEGUMINOSAE

118

***Caesalpinia crista* L.**

Synonyms : *Caesalpinia bonducella* Flem., *Caesalpinia laevigata* Perr., *Caesalpinia nuga* L., *Guilandina bonducella* L., *Guilandina nuga* L., *Nugae silvarum* Rumph.

Vernacular name(s) : Bonduc, Akar Kelinci, Kaniker, Sompini, Areuj, Mata Kijang, Kemrounggi, Klengkeng, Kutuk, Aruk, Tuwung, Bagoré, Buwa Goro, Katé-katé.

Description : Liana, 5-20 m long, with leaves up to 30 cm long, that are twice-divided into leaflets, often with obscure, minute leaflets at the base of the leaf stalk. Branches are prickly, at least partially. The main leaf mid-rib is thorny, while the 2-6 pairs of primary leaflets have an unarmed or sparingly prickly mid-rib, 2.5-12 cm long. The opposite, leathery secondary leaflets are ovate-oval-oblong and symmetric, smooth and pale shiny beneath, 2-12.5 by 1-5.5 cm. The scented, bisexual flowers occur in 20-40 cm-long clusters. The petals are bright yellow in full flower, the topmost one veined with red, 9-13 mm. Flowers have 10 stamens that have woolly stalks. The prickly pods are elliptic, unequal at the base, beaked and flat, 2.5-3.5 by 4-7 cm. Pods have one (rarely two) seed(s), black and flat, orbicular or ovoid, 2-2.5 by 1.5-2 cm, 0.5-1 cm thick.

Ecology : Occurs on landward margins of mangroves, river banks, chalk rocks, limestone, rarely on littoral rocks or on sandy beaches. Flowering occurs all year round. Mangrove associate species.

Distribution : Found from India and Sri Lanka through most of Southeast Asia to Australia and New Caledonia. In Southeast Asia recorded in all coastal areas, except from East Sumatra and East Borneo.

Abundance : Locally common, but listed as rare in Indonesia (Mogea *et al.*, 2001).

Use(s) : Seeds are used as marbles by children, and are also used to treat malaria and parasitic worms. Leaves are used to treat Hepatitis A.

Source of illustration : Icones Rijksherbarium Leiden.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Hou *et al.* (1996).

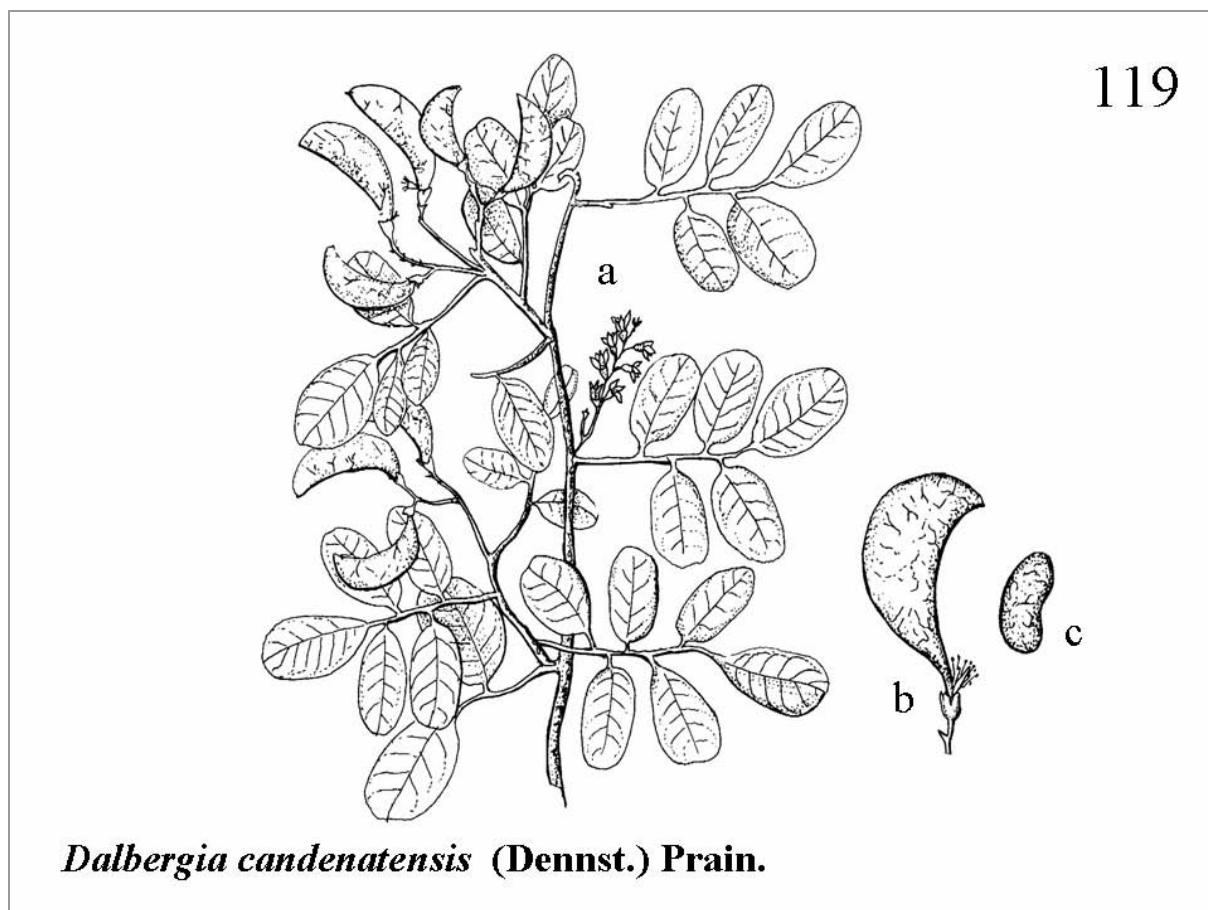


Fig. 119. *Dalbergia candenatensis* (Dennst.) Prain. (a) Flowering and fruiting vine, (b) pod, and (c) seed.

LEGUMINOSAE

119

***Dalbergia candenatensis* (Dennst.) Prain**

Synonyms : *Cassia candenatensis* Dennst., *Dalbergia monosperma* Dalzell, *Dalbergia torta* Graham

Vernacular name(s) : Unknown.

Description : Woody climber, up to 8 m long, with twining stems that often bear many short, lateral branchlets; tip of stem often twisting into a spiralling hook. Bark is dark grey to almost black, smooth, with large, pale lenticels. The alternate leaves are 4-13 cm long, and have 3-7 leaflets with obovate or elliptic blades, occasionally notched at the end, 1.5-3 by 2-4 cm, with short 1.5 mm long stalks. The upper surface of the leaflets is dark green, while the lower surface is shiny and has a distinct, net-like venation. The branched flower-clusters are located in axils, 5-50 mm long and have a stem that is covered with soft hairs. Flowers are bisexual, with white petals and 9-10 stamens. Pods are sickle- or half-moon shaped, compressed, 2-3.5(-4) by 1-1.5 cm, firmly leathery, and have a persistent calyx on a stalk. Pods do not break open when ripe. The 1-2 seeds are kidney-shaped, compressed, about 20 mm long, smooth, and have a net-like venation.

Ecology : Coastal species, grows in silty and sandy substrates on the landward margin of mangroves, or on banks of tidal creeks. It appears intolerant of frequent salt water inundation, preferring areas with perennially high freshwater input. The stem of the liana encircles a support with one or two coils and then continues its growth during some time without further windings. Flowering occurs from October to February. The fruit is adapted to both water and wind dispersal. Mangrove associate species.

Distribution : Found from Sri Lanka and India eastwards to southern China, throughout Southeast Asia (Brunei, the Philippines, Indonesia, Singapore, Malaysia, Thailand, Vietnam) and northern Australia. Also reported from East Africa (see www.uog.edu, below), but this would seem erroneous as it is not recorded in the Flora of East Africa (Gillett *et al.*, 1971).

Abundance : Rather common.

Use(s) : Unknown.

Source of illustration : Wightman (1989)

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Wightman (1989), <http://www.uog.edu/cals/site/POG/dalber.html>, Missouri Botanical Garden TROPICOS database (www.mobot.mobot.org), <http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm> Flora of China: [http://flora.huh.harvard.edu/china/mss/volume10/Fabaceae-MO-Dalbergia edited.htm](http://flora.huh.harvard.edu/china/mss/volume10/Fabaceae-MO-Dalbergia_edited.htm).

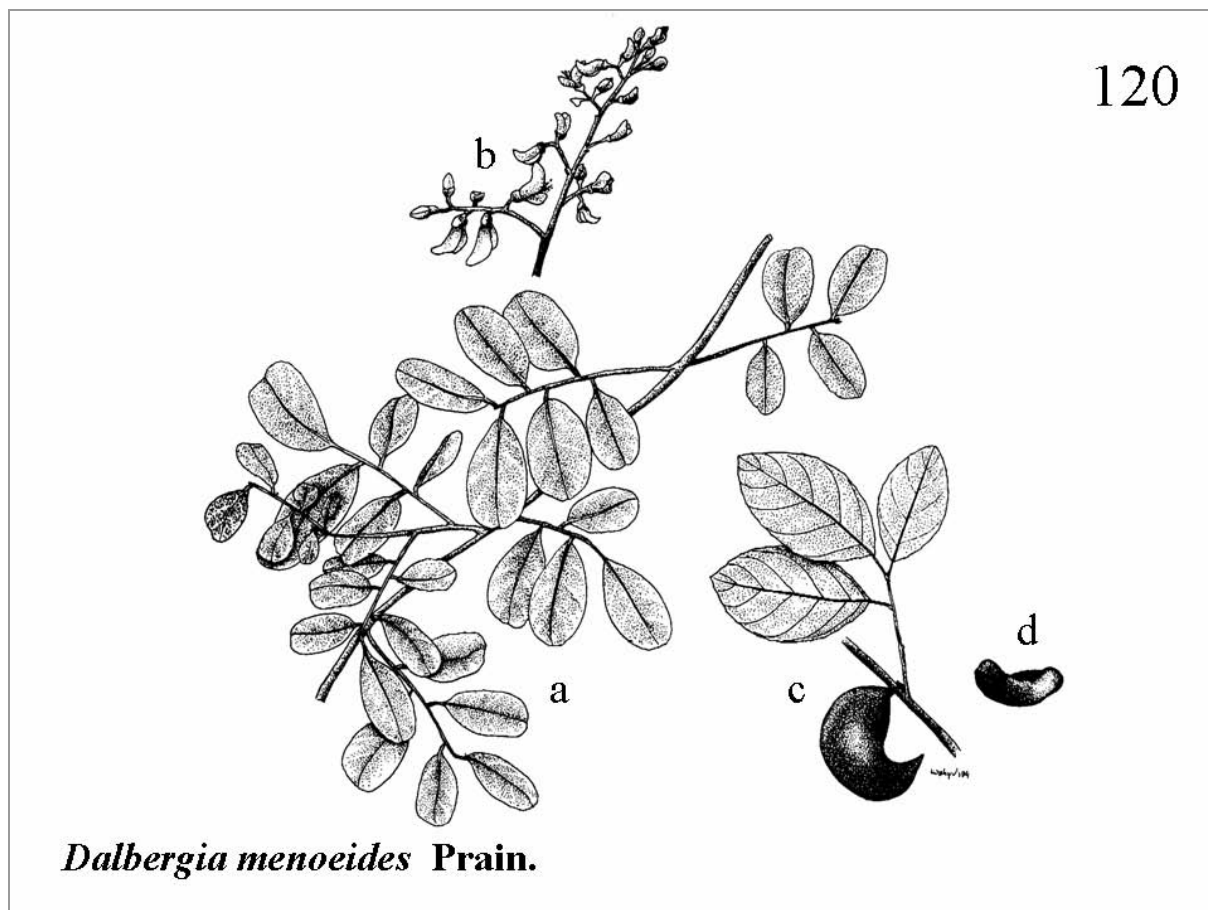


Fig. 120. *Dalbergia menoeides* Prain. (a) Section of vine, (b) flower raceme, (c) leaf with pod, and (d) seed.

LEGUMINOSAE

120

Dalbergia menoeides* Prain.*Synonyms :** Unknown.**Vernacular name(s) :** Unknown.

Description : Liana, up to 3 m long, with light to dark brown branchlets that are flattened, and covered with soft hairs when young. The 3-5 leaflets, 4-10.5 by 2-5 cm, are oblong, and may be either pointed or rather blunt at the tip. Their upper surface is dark green and smooth, the lower surface shiny, with fine and scattered soft hairs. The flowers are white and borne on solitary, 2-8 mm-long clusters in the form of a disk. Pods remains within the calyx on a stalk of 6-8 mm and measure 3-4 by 1.5-2 cm.

Ecology : Occurs on landward margins of mangroves and in adjacent swamp forests. Flowering has been recorded from May to July. Mangrove associate species.

Distribution : Little is known about the distribution of this species, perhaps due to confusion with similar species. In Southeast Asia it has been recorded in Indonesia (Java), but it is probably found elsewhere in Indonesia and in the region.

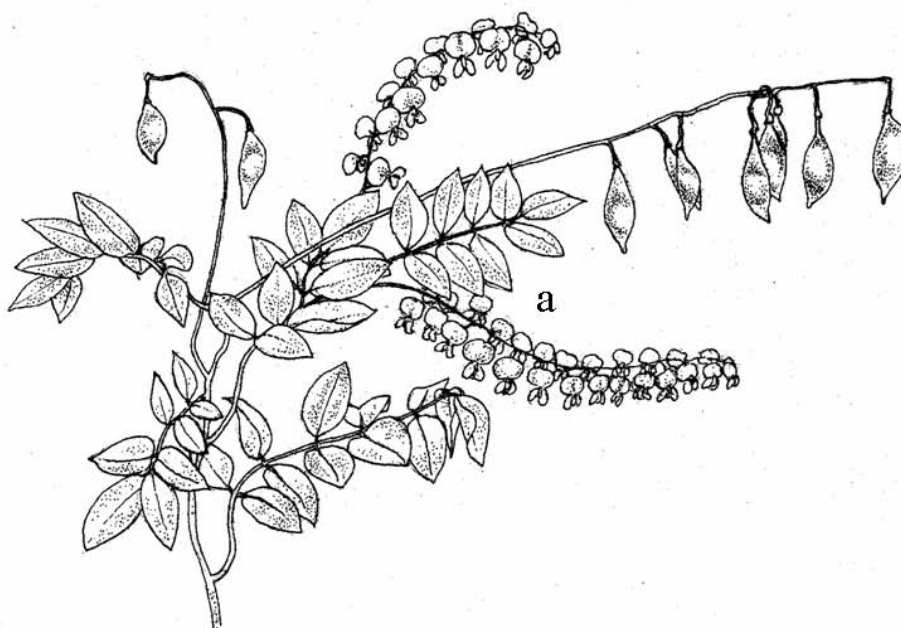
Abundance : Uncommon.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Missouri Botanical Garden TROPICOS database (www.mobot.mobot.org).

121



***Derris scandens* (Aubl.) Pittier.**

Fig. 121. *Derris scandens* (Aubl.) Pittier. (a) Flowering and fruiting branch.

LEGUMINOSAE

121

***Derris scandens* (Aubl.) Pittier**

Synonyms : *Brachypterum scandens* W & A., *Deguelia negrensis* (Benth.) Taub., *Deguelia scandens* Aubl., *Derris guianensis* Benth., *Derris negrensis* Benth., *Derris pterocarpus* (DC.) Killip., *Derris scandens* Benth. J. Linn., *Derris scandens* (Roxb.) Benth., *Lonchocarpa pterocarpus* DC., *Lonchocarpa scandens* (Aubl.) Ducke., *Pterocarpus guianensis* (Benth.) Kuntze., *Pterocarpus negrensis* (Benth.) Kuntze.

Vernacular name(s) : Sea Derris (E), Rambai (Bru.), Malasaga (Phil.), Bendan, Goboel, Sobi, Rabut loteng (Ind.)

Description : Shrubby, evergreen, twining woody climber without tendrils, climbing or creeping, 3-15(-20) m long stems, bark dark-grey to almost black. It has a deep sunken tap root, without aerial roots. Leaves are compound, alternate, odd-pinnate, leaf axis 10-17(-19) cm long, solid and woody. Leaflets opposite, 3-5 pairs; blade of each leaflet elliptic-lanceolate, entire, blunt and smooth, 1-3 by 2-5 cm, with a pointed tip; stalks of individual leaflet is 2-3 mm long; lower pairs smaller than upper pair. Flowers are clustered in a 15-20 cm long pendulous raceme or panicle, located in the leaf axils. Sepals 5, deep purple, tubular. Petals 5, white to pink, corolla consisting of completely separate petals; butterfly-like: banner 5-8 mm long, 2 wing 8-9 mm long, 2 keel 8-9 mm. There are 10 (9+1; the single upper stamen is free, the nine others are united) white stamens, united into two unequal sets by their filaments, 7-8 mm long. The fruit is a dry pod, hairy, flat, oblong, pointed, 2 by 5-10 cm, one margin thicker than other, 1-3 round, flat seeds (3-4 mm) in each pod.

Ecology : Lowland species, found in secondary scrub and monsoon forests. Also regularly found in landward zones of mangroves. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Myanmar, Thailand, Malaysia, Brunei, the Philippines and Indonesia (Java, Borneo, Lesser Sundas).

Abundance : Locally common.

Use(s) : Juice from the stem is used as fish poison (*tuba*), but *Derris scandens* is less effective in this regard than *Derris elliptica* and *Derris trifoliata*.

Source of illustration : Drawn from photo of live specimen.

Reference(s) : Heyne (1950), <http://flora.sut.ac.th/st160.html> ; http://www.rbgekew.org.uk/herbarium/brunei/fams/57_01.htm#DERRIS <http://www.indian-ocean.org/bioinformatics/mangrove/MANGCD/Derris3.htm>.

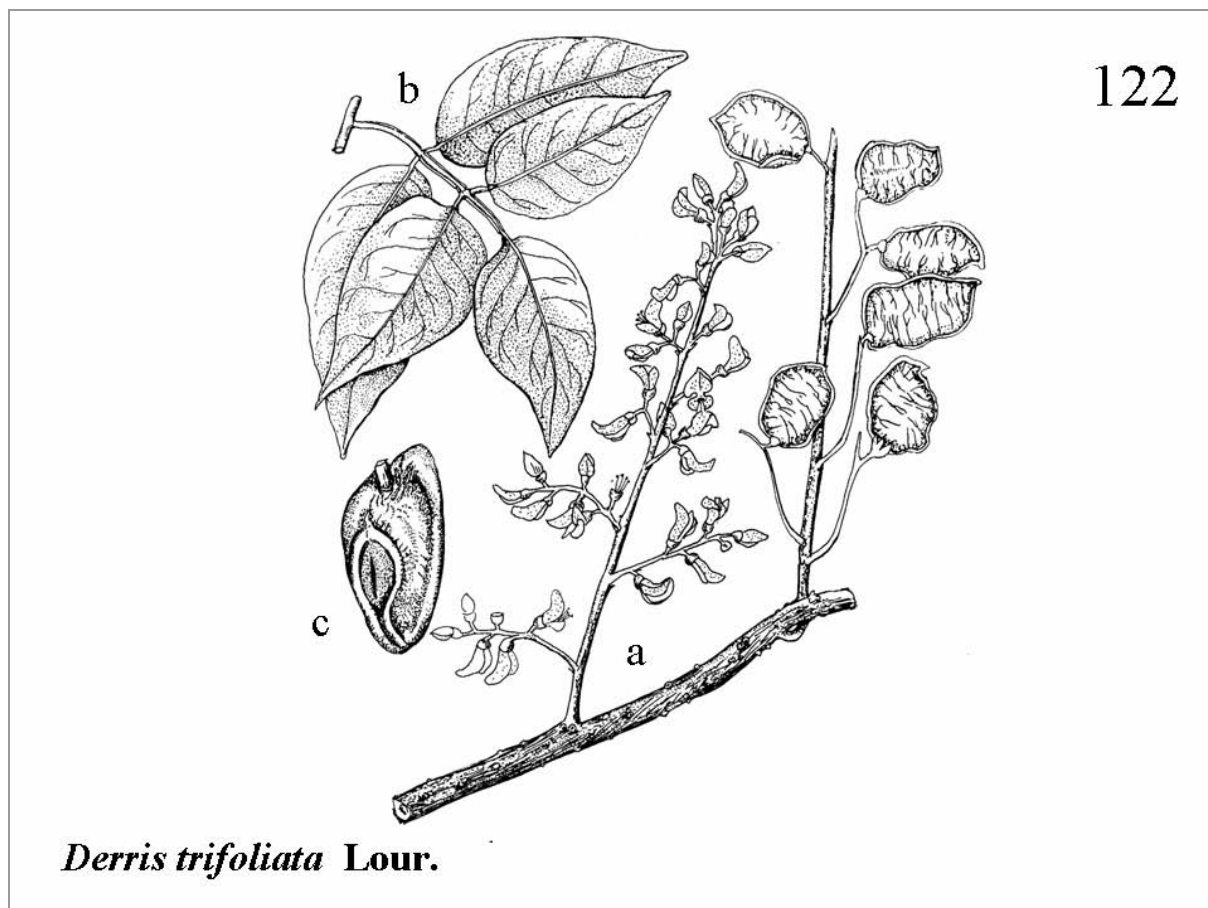


Fig. 122. *Derris trifoliata* Lour. (a) Section of vine with cluster of flowers and cluster of pods, (b) leaf, with 5 leaflets, and (c) seed.

LEGUMINOSAE

122

***Derris trifoliata* Lour.**

Synonyms : *Dalbergia heterophylla*, *Deguelia trifoliata* (Lour.) Taub., *Deguelia uliginosa* (Willd.) Baill., *Derris heterophylla* (Willd.) Backer, *Derris uliginosa* Willd. Benth., *Robinia uliginosa* Willd.

Vernacular name(s) : Tuba Laut, Areuy Ki Tonggeret, Tuwa Areuy, Gadel, Toweran, Kamulut, Tuba Abal (Ind.), Cóc kèn (Viet.)

Description : A woody, often rambling climber, up to 15 m or more in length, with a smooth, dark brown, corky bark with orange lenticels. Young stems are dark red, strongly ridged and have prominent lenticels. The alternate leaves are 9-25 cm long and have 3-7 leaflets that are ovate or elliptic, 6-13 by 2-6 cm, with a glossy-green upper surface and a dull, grey-green lower surface. Flowers occur in drooping clusters that are 7-20 cm long and occur in axils on stems growing horizontally, along the ground. The white or pale pink flowers are bisexual, and each have a 2 mm long stalk. The edges of calyx and leaflets at the base of the leaf-stalk are finely divided. The main part of standard (see glossary) of the flower measures 10 by 9 mm. The single upper stamen is free, the nine others are united. The pod is leathery, oblong or almost round, flat, inflated, 2-4.5 by 2.5-3.5 cm, with a persistent style base. The one or two seeds are wrinkled, almost round, bronze-green when dry, measuring 12 by 11 mm.

Ecology : *Derris trifoliata* grows on muddy and sandy substrates on the landward margin of mangrove habitats. It prefers areas with a high freshwater input, infrequently inundated by tides. Flowers from September to November, and fruits occur in November and December (in Australia). The pods and seeds are adapted to water dispersal. The inflated leathery pod owes its buoyancy to air cavities between the pod and seed. Wind is possibly also an agent of dispersal. Mangrove associate species.

Distribution : Found from South and East Africa, through tropical and subtropical Asia to southern China (Guangdong) and northern Australia. Probably found throughout Southeast Asia, but recorded in Brunei, Cambodia, Malaysia, Singapore, Indonesia, Myanmar, Thailand and Vietnam.

Abundance : Relatively common and widespread.

Use(s) : The fish stupefying and poisoning properties of *Derris* species are well known and documented. The commercial fish poison 'rotenone' or *Derris* dust is derived from the tuberous roots of another South East Asian species, *Derris elliptica*. The stem is very durable and used as rope. In Eastern Indonesia, local communities grow their own varieties with stronger chemical properties to stupefy fish.

Source of illustration : Icones Rijksherbarium Leiden.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963), Gillett *et al.* (1971), Tomlinson (1986), Wightman (1989), Ng & Sivasothi (1999).

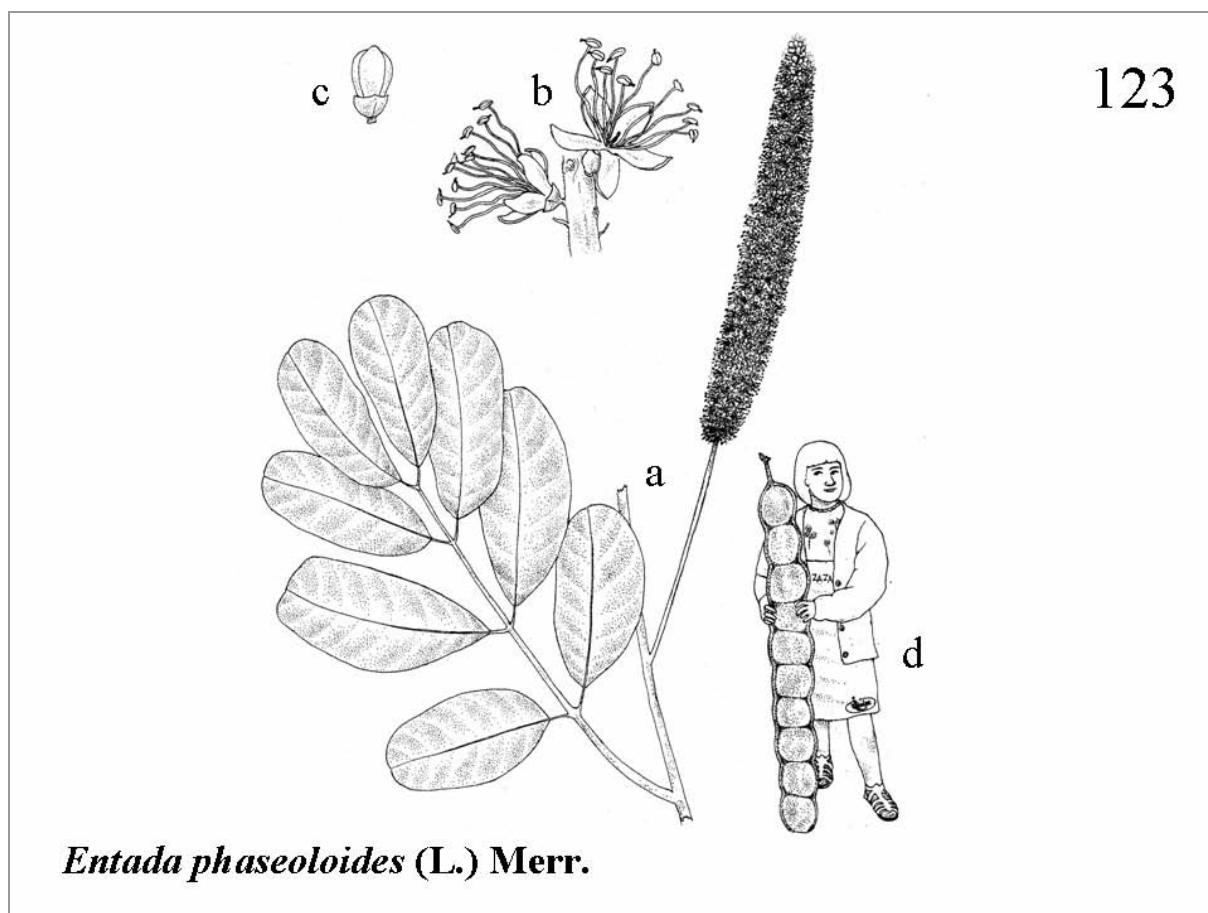


Fig. 123. *Entada phaseoloides* (L.) Merr. (a) Flower spike and leaf, (b) flowers, (c) bud, and (d) large-sized pod.

LEGUMINOSAE

123

***Entada phaseoloides* (L.) Merr.**

Synonyms : *Entada monostachya* DC., *Entada pursaetha* DC., *Entada rumphii* Scheff., *Entada scandens* (L.) Benth., *Faba marina major* Rumph., *Lens phaseoloides* L., *Mimosa scandens* L.

Vernacular name(s) : Matchbox beans (E), St. Thomasbonen (NL), Liane à boeuf (F), akar beluru, bendoh, Bhalang tambal, pikat, simbole, ipus in cawok, makente, bolowereke, kalembemba, cariju, bhalang – *Gandu* (Ind.)

Description : Very large, woody climber without fleshy tubers, often with a flattened and spiral stem. Leaves with 1-2(-4) pairs of leaflets, which like the leaf stalk (6.5-9 cm) may be smooth or hairy; leaflets are elliptic, obovate-elliptic and unequal-sided, 4.5-10 by 1.8-6.3 cm. Flowers clustered in a single spike in the leaf axils, or sometimes in several spikes from short shoots, 13-30 cm, often densely covered with short hairs. Flowers with a very short stalk or without a conspicuous stalk, with sepals and petals in 5-fold. Calyx green, broadly cup-shaped, smooth, 0.8-1.25 mm. Petals green with a reddish base, elliptic to lanceolate, pointed tip, 2.8-3.5 mm. Stamens are 6.5 mm long, white, later turning yellow. Pods straight to slightly curved, up to 100-135 cm by 7-15 cm, segments 6.5-7.5 cm long. Seeds are brown, round and flattened, 4-6 cm in diameter and about 1 cm thick. There are usually about 7-15 beans per pod.

Ecology : Found in a wide variety of habitats, from 0-900(-1700) m asl, including riparian vegetation, rain forest, montane forest dominated by *Castanopsis*, freshwater swamp forest, sandy alluvium along seashores, and along the inner edge of mangroves. Common drift seeds on seashores, and was recorded on Krakatau not long after the 1883 eruption had destroyed all vegetation. Mangrove associate species.

Distribution : Cosmopolitan species of (sub-)tropical regions. In Southeast Asia recorded from Vietnam, Philippines, Malaysia (Sarawak), Indonesia (Sumatra, Java, Kalimantan, Sulawesi, Lesser Sundas, Moluccas, Papua) and Papua New Guinea (including Bismarck Archipelago).

Abundance : Locally common, but with a patchy distribution.

Use(s) : Seeds were hollowed out and used for storing wax matches in former times, hence the common English name. Used as a substitute for soap, as the bark and seeds contain considerable amounts of saponin. In the Philippines it is used to treat scalp diseases. Grows readily from cuttings, and may be cultivated. Juice from cut stem is used to treat stomach disorders. Beans are boiled and eaten, after having been steeped in water for longer than one day to remove the saponin.

Source of illustration :

http://www.csc.pku.edu.cn/botany/disk01/12/DK25_ketengzi0002.JPG

<http://www.hku.hk/ecology/staffhp/rtc/rare/rare-entada.htm>

<http://www.chennaimuseum.org/draft/gallery/05/02/images/escanden.jpg>

<http://www.endemia.nc/plante/fiche.php?code=1649>.

Reference(s) : Heyne (1950), Afriastini (1988), Nielsen (1992).

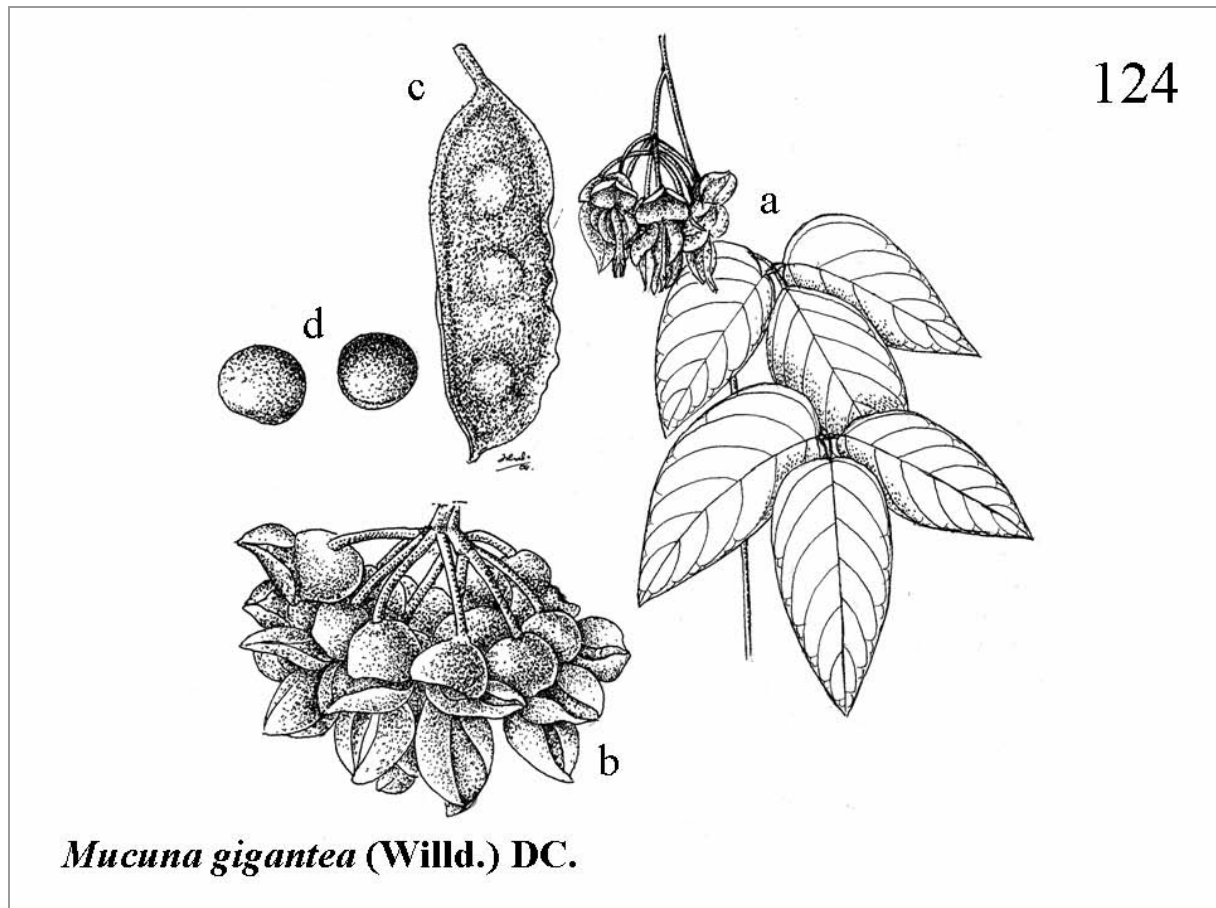


Fig. 124. *Mucuna gigantea* (Willd.) DC. (a) Flowering section of stem, with 2 leaves, (b) flower cluster, (c) pod, and (d) seeds.

LEGUMINOSAE

124

***Mucuna gigantea* (Willd.) DC.**

Synonyms : *Dolichos gigantea* Willd., *Dolichos giganteus* Willd., *Stizolobium giganteum* (Willd.) Sprengel

Vernacular name(s) : Velvet bean, Burney vine, Sea bean, Burny bean (E), Liane Cadoque, Liane Caiman, Mort aux Rats (F)

Description : A large, woody liana, 8-15 m, stems at first covered with stiff, orange-brown hairs, later smooth. The leaves are alternate, trifoliate, dull green and the lateral leaflets are elliptic or ovate, 4.2-11.5 by 2.2-7.5 cm, pointed, and decidedly asymmetrical. The leaf stalk measures 4.7-12 cm. Flowers occur in long, pendulous clusters from leaf axils. They have a pale green, finely hairy calyx and greenish-white (occasionally pale lilac), 2.5-3.5 cm long corolla; the corolla eventually turns black. Flower stalks are covered with silvery hairs. Pods are light brown, 10-15(-30) cm long, flat and have two wings along the suture (margin). The pods are densely covered with orange-brown irritant bristles, which inflame the skin when you handle them, hence the name “burny bean”. The large seeds – which usually number 4 per pod – are light brown to nearly black, often mottled, round or nearly so and about 7-25 mm thick. Seeds are marked with a single black band along the edge that is slightly indented (grooved).

Ecology : Occurs in monsoon forest, open forests and woodlands, riparian, littoral, subtropical and tropical rainforest, and occasionally in mangroves. The woody seeds are well adapted for ocean dispersal. Mangrove associate species.

Distribution : Occurs world-wide in all tropical and subtropical regions. In Southeast Asia it has been recorded in Myanmar, Thailand (pers. comm. M. Silvius, December 2004), the Philippines, Vietnam, Malaysia and Indonesia. Probably occurs throughout Southeast Asia.

Abundance : Locally common.

Use(s) : Powdered bark is mixed with dry ginger and used in rheumatic complaints by rubbing it over the affected parts. In Australia, seeds were eaten by Aborigines after unknown preparation. These vines are regularly planted in gardens to attract butterflies. In Hawaii, the seeds were used medicinally as a violent cathartic and were strung into necklaces.

Source of illustration: <http://www.biologie.uni-hamburg.de/b-online/vascular/fab.htm>
<http://www.alecto.gg/BANKS/im010076.htm>; Gillett *et al.* (1971); also based on line engraving by Gerald Sibelius after Sydney Parkinson and Frederick Polydore Nodder.

Reference(s) : Gillett *et al.* (1971),
<http://www.uog.edu/cals/site/POG/mucuna.html>,
<http://www.brisrain.webcentral.com.au/database/mg.html>.

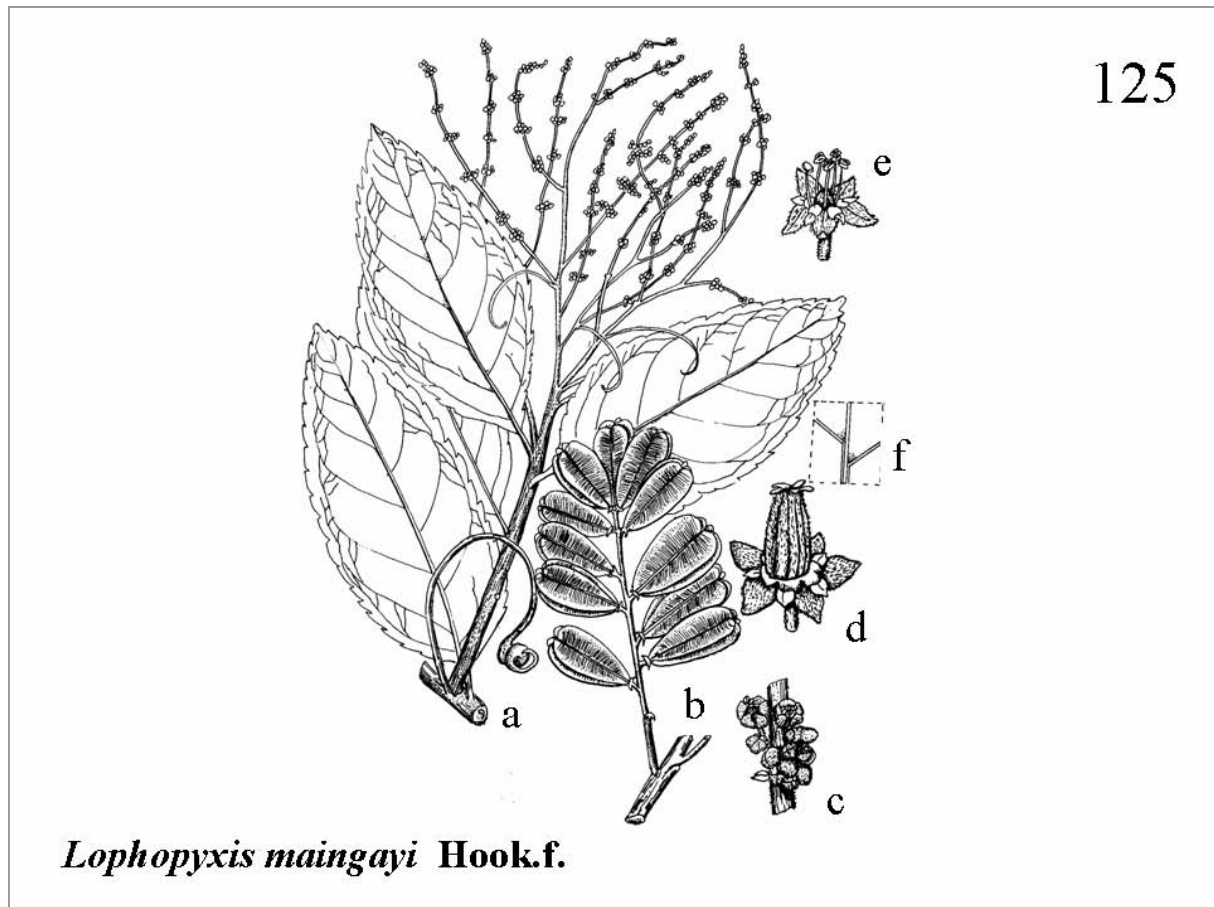


Fig. 125. *Lophopyxis maingayi* Hook.f. (a) Detail of flowering vine, (b) cluster of fruits, (c) cluster of flowers, (d) female flower, (e) male flower, and (f) hairy tufts in the axils of the lateral nerves.

LOPHOPYXIDACEAE

125

***Lophopyxis maingayi* Hook.f.**

Synonyms : *Combretopsis pentaptera* K. Sch., *Homalium gilgianum* Laut., *Lophopyxis combretocarpa* (Boerl.) Engl., *Lophopyxis pentaptera* (K. Sch.) Engl., *Lophopyxis schumannii* Boerl., *Sinapistrum* Rumph., *Treubia combretocarpa* Pierre ex Boerl.

Vernacular name(s) : Simpuru, Taburuh, Tali Sasawi (Ind.)

Description : Vigorous, straggling and woody vine or climbing shrub, up to 8 m, occasionally 30 m in length. Bark is pale to whitish, with elliptic lenticels occurring in grooves. Branches are covered with soft, short hairs. The papery to thin-leathery leaves are ovate to oblong, 8-24 by 4-10 cm, and have hairy tufts in the axils of the lateral nerves. Strong, woody tendrils occur in the axils; they are coiled only at the end, and often bear a bud. The drooping flower clusters are covered with soft hairs, and are loose, composed of a few groups of flowers that are 10-25 cm long located at the ends of branches or in the axils. Flowers may either be solitary or crowded into compact bunches. Leaflets at the base of the flowers are often transformed into a weak, flat, completely coiled tendril. The calyx is greenish-white or yellow, hairy on both sides, and measures 1.5 mm. Petals are thin and 1 mm long, while the disk of the flower is yellowish. The stamens of the male flower are hairy, as is the pale-green, round ovary. The green, later dark brown, fruit is rounded, 2-3.5 by 1.5 cm, with five papery wings, 5-8 mm wide.

Ecology : Occurs in primary, lowland forests, up to an altitude of 300 m, often on alluvial soil, in riparian forests, coastal forests and occasionally in mangroves. Also occurs in disturbed gullies and secondary forests. Mangrove associate species.

Distribution : Mainly a Southeast Asian species, occurring from Peninsular Malaysia to Micronesia (Palau) and a few small islands of the western Pacific. In Southeast Asia it has been recorded in Malaysia (Peninsular, Sabah), Indonesia (Sulawesi, Moluccas, Papua) and Papua New Guinea.

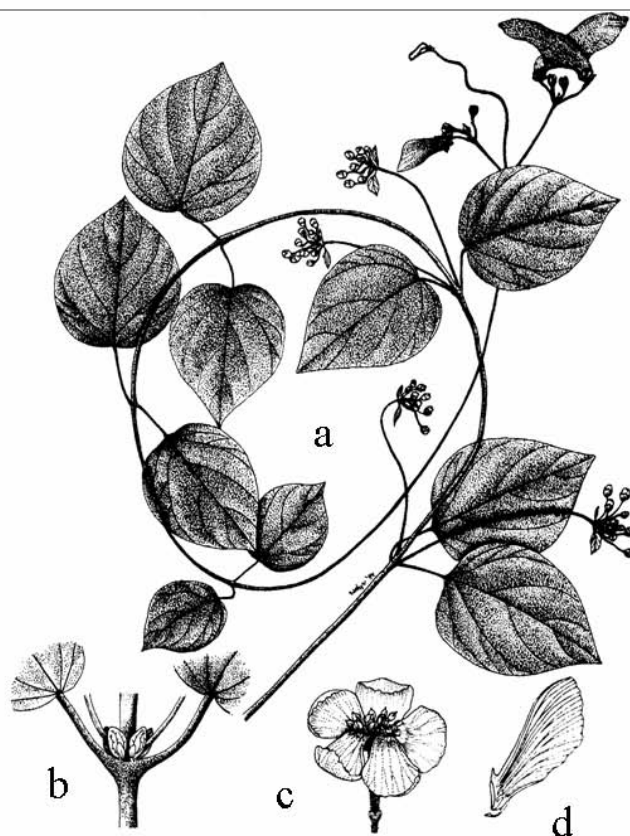
Abundance : Scattered, but may be locally common.

Use(s) : Crushed leaves smell strongly of mustard and are used to cure ulcers.

Source of illustration : Sleumer (1971).

Reference(s) : Sleumer (1971).

126



Ryssopterys timoriensis (DC.) Jussieu.

Fig. 126. *Ryssopterys timoriensis* (DC.) Jussieu. (a) Flowering vine, (b) detail of leaf insertion showing stipules, (c) flower and (d) winged fruit.

MALPIGHIACEAE

126

***Ryssopterys timoriensis* (DC.) Jussieu**

Synonyms : *Banisteria dichotoma* (non L.) Spanoghe, *Banisteria timoriensis* A.P. DC., *Hiraea obscura* Blume, *Hiraea ovata* Blume, *Ryssopterys abutilifolia* Jussieu, *Ryssopterys albida* *Ryssopterys chrysantha* (non Hassk.) Hochr., *Ryssopterys cumingana* Jussieu, *Ryssopterys dealbata* Jussieu, *Ryssopterys intermedia* Hochr., *Ryssopterys microstema* Jussieu, *Ryssopterys timorensis* var. *tiliifolia* (non Vent.) K. Sch. & Laut.

Vernacular name(s) : Raoaimarinu, Kwakatehi, Olas Mea (Ind.), Olas Mea (ET), Bingkit, Bugtung-aha, Lagun, Laumus (Phil.)

Description : A rarely creeping, twining shrub, up to 10 m long. A few lenticels occur on major stems. Young parts are densely covered with greyish, cinnamon-coloured hairs, while older parts are without hairs. The leaflets (stipules) at the base of the leaf-stalk are variable in shape and size, 2-20 by 1-8 mm, and are often accompanied by smaller accompanying leaflets, occurring opposite to the side of the leaves. Leaves are variable in shape, size and hairiness, measuring 5-15 by 4-12 cm. The sparsely hairy to smooth, grooved leaf stalk has two glands at the top and is 1-7 cm long. The scented, yellow flowers occur on a densely hairy stalk that is 1-1.5 cm long, located in the axils. The 2 mm-long sepals of the calyx are (slightly) hairy on the outside, but smooth inside. Petals are 6-11 mm long, rounded and almost without a stalk. The styles are pink, and the stigmas pale yellow. The fruit consists of three 1-seeded parts, each with a wing. Veins in the wing are curled back about 30-60 degrees. Rarely two lateral abortive wings are also visible. A very variable species.

Ecology : Occurs in brushwood or forest edges, often in coastal regions. Occurs on the landward margins of mangroves, often on calcareous soil, but it may also be found in rather dry habitats. Occurs from sea level up to an altitude of 1,500 m. Flowering occurs throughout the year. Mangrove associate species.

Distribution : Found from Taiwan and Micronesia through Southeast Asia to northern Australia (Queensland) and Melanesia. In Southeast Asia it has been recorded in the Philippines, Indonesia (Java, Moluccas, Sulawesi, Lesser Sundas, Papua), East Timor and Papua New Guinea.

Abundance : Unknown.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Jacobs (1955), Backer & Bakhuizen van den Brink (1963-8).

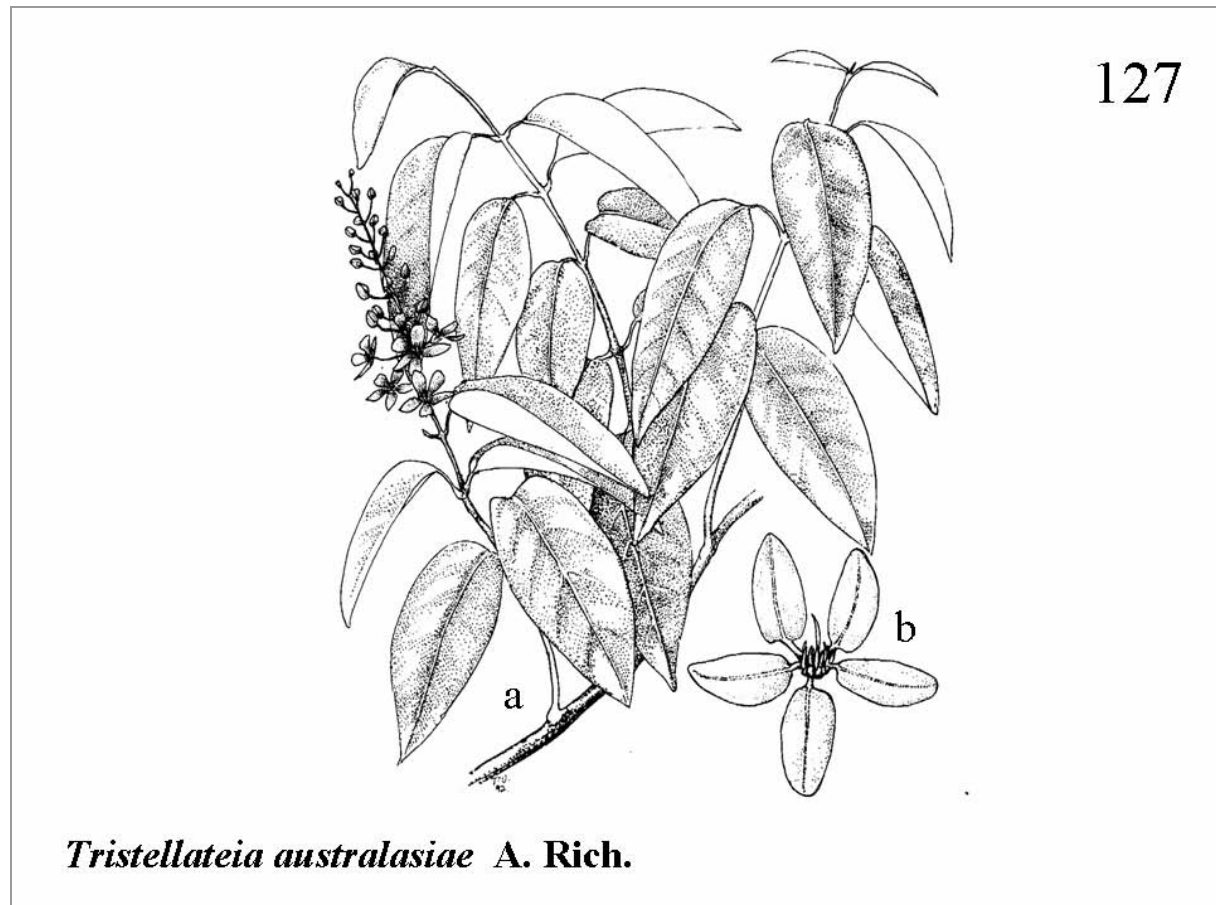


Fig. 127. *Tristellateia australasiae* A. Rich. (a) Flowering vine, and (b) flower.

MALPIGHIACEAE

127

***Tristellateia australasiae* A. Rich.**

Synonyms : *Hieraea reclinata* Blanco, *Tristellatia australasica* Miq., *Tristellatia australis* Jussieu, *Tristellatia malintana* Blanco

Vernacular name(s) : Bagu, Bejau (Brunei), Bahau, Angasin, Bagnit, Bagit, Binusisi (Phil.), Puang Tawang, Cempaga (Ind.)

Description : Liana, 3 - 6 m long, with a warty stem. Leaves are opposite, entire, smooth, ovate or ovate-elliptic and measure 3.5-12 cm by 2-6.5 cm. Usually leaves have two small glands near the base. The leaf stalk measures 1-1.5 cm, and the leaflets at its base are minute. Flowers occur at the end of branches and in the upper leaf-axils, in 4-30 cm-long clusters. Flower-stalks are 2-3 cm long, jointed below the middle and thickened above the joint. The calyx is erect and blunt. Petals are widely spreading, slightly unequal in size, bright yellow and 1-1.5 cm long. The stalk of the stamen, supporting the anther, is at first yellow, then red, and persists after the anthers are shed. Fruits usually consist of three parts.

Ecology : Occurs near the coast, including in mangroves. Found in brushwood and rainforest on and beyond the sea shores, in the *Barringtonia* formation, and in the transitional zone between rainforest and mangrove, in tidal swamps and along littoral creeks. In landward areas it is sometimes cultivated. Mangrove associate species.

Distribution : Found from Taiwan through Southeast Asia eastwards to New Caledonia and northern Australia (Queensland). In Southeast Asia recorded from Cambodia, Vietnam, Thailand, the Philippines, Malaysia, East Timor, Brunei, Indonesia (Java, Lesser Sundas, Sulawesi, Papua) and Papua New Guinea.

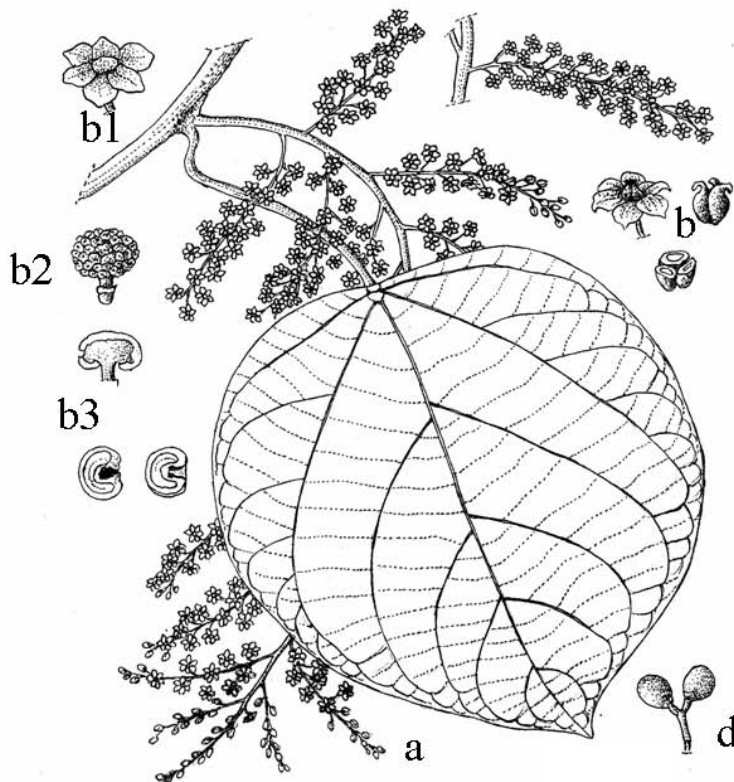
Abundance : Locally abundant.

Use(s) : Ornamental plant grown in gardens and along hedges.

Source of illustration : Keng (1987).

References : Backer & Bakhuizen van den Brink (1963-8).

128



***Anamirta cocculus* L. Wight & Arn.**

Fig. 128. *Anamirta cocculus* L. Wight & Arn. (a) Part of vine with leaf and flower clusters, (b) male flower with 3 stamens (right) and cross-section of stamens, (c) female flower, with embryos, and (d) fruit.

MENISPERMACEAE

128

***Anamirta cocculus* L. Wight & Arn.**

Synonyms : *Anamirta jucunda* Miers., *Cocculus populifolius* Dc., *Menispermum cocculus* L., *Menispermum lacunosum* Lamk., *Tuba baccifera* Rumph.

Vernacular name(s) : Tuba biji, oyod peron, waran pisang, kruppe – *Oyod peron* (Ind.), array, lagtang, ligtang (Phil.)

Description : Large liana, 5-15 m, smooth, stem up to about 10-15 cm thick. Young stems and leaf stalks usually drying pale grey to straw coloured. Leaves spirally arranged, palmately nerved at the base, with smooth leaf stalks 6-18(-26) cm, swollen at both ends, and with a knee-like bent at the base. Leaf blade broadly heart-shaped at base, 16-28 by 10-24 cm, with a pointed tip and 3-5(-7) nerves at the base and 4-5 pairs of lateral nerves. Flower clusters 16-40 cm, with lateral branches 2-5 cm, smooth. Male flowers with white, yellow or green sepals, outer sepals 2, barely 1 mm long, inner sepals 6, broadly elliptic 2.5-3 by 2 mm. Female flowers like the male ones, but with 6 minute staminoides, 0.25 mm. Fruiting branchlets up to 15 cm. Fruits white, 9-11 mm long, smooth.

Ecology : Lowland species (<300 m asl) found in a variety of habitats, including river and stream banks, coastal forests, savannas, rain forest, and occasionally landward margins of mangroves. Has a preference for seasonal conditions, and is more common in monsoon forests. Mangrove associate species.

Distribution : Found from India and Sri Lanka eastwards to Papua New Guinea. In Southeast Asia found in Myanmar, Cambodia, Vietnam, Thailand, Philippines, Indonesia (Sumatra, Java, Lesser Sundas, Sulawesi, Papua) and Papua New Guinea.

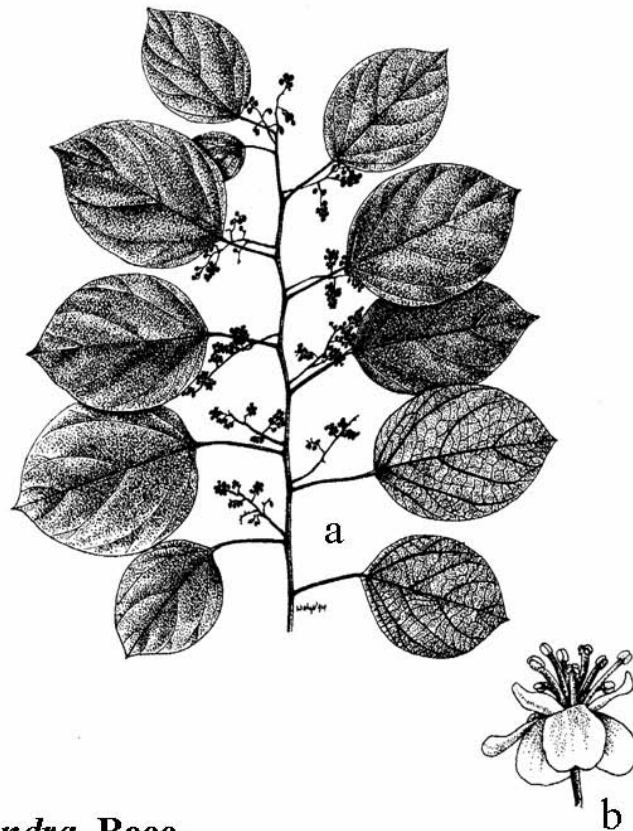
Abundance : Fairly uncommon to locally common, widespread, rare in Sumatra and Java (both once collected).

Use(s) : Fruits are used as fish poison, and to kill lice. Source of *picrotoxin*, which is a violent convulsant poison. Known in 16th century European herbals as *Cocculus indicus* as a medicine for treating lice.

Source of illustration : <http://www.tripease.org/te4.html>

Reference(s) : Heyne (1950), Forman (1986), Win Maung (2003).

129



Hypserpa polyandra Becc.

Fig. 129. *Hypserpa polyandra* Becc. (a) Flowering vine, and (b) flower.

MENISPERMACEAE

129

***Hypserpa polyandra* Becc.**

Synonyms : *Hypserpa latifolia*, *Hypserpa monilifera*, *Hypserpa raapii*, *Hypserpa selebica*, *Limacia monilifera*

Vernacular name(s) : Unknown.

Description : Climbing shrub or woody climber up to 40 m long, with branchlets and leaves that are either smooth or covered with short, soft, yellowish hairs. Leaves are stiffly paper-like or leathery, ovate to ovate-elliptic, measuring 6-17 by 4-11 cm, with a leaf stalk of 2-4.5(-6) cm, 5-7 nerved. The yellowish-green flower clusters are triangular in shape, measuring 2.5-11 by 1.5-5 cm, and are covered with short, soft hairs. Flowers are yellow, either male or female, covered with short, soft hairs, and are 2-3 mm long. The white or red berries are round to obovate, 7-8 by 4-6 mm.

Ecology : Occurs in mangrove swamps and lowland mixed rain forests up to 1,200 m. Flowering occurs from March to November, and fruits are found from July to November. Mangrove associate species.

Distribution : Found from Southeast Asia eastward through northern Australia (Queensland), Solomon Islands and the Carolines. In Southeast Asia recorded from East Timor, Indonesia (West Sumatra, the Lesser Sunda Islands, the Moluccas, Papua) and Papua New Guinea.

Abundance : Not recorded in references, but probably locally common.

Use(s) : Bark after being pounded and powdered is applied to the head as a treatment for headaches in Bougainville Island.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Forman (1986).

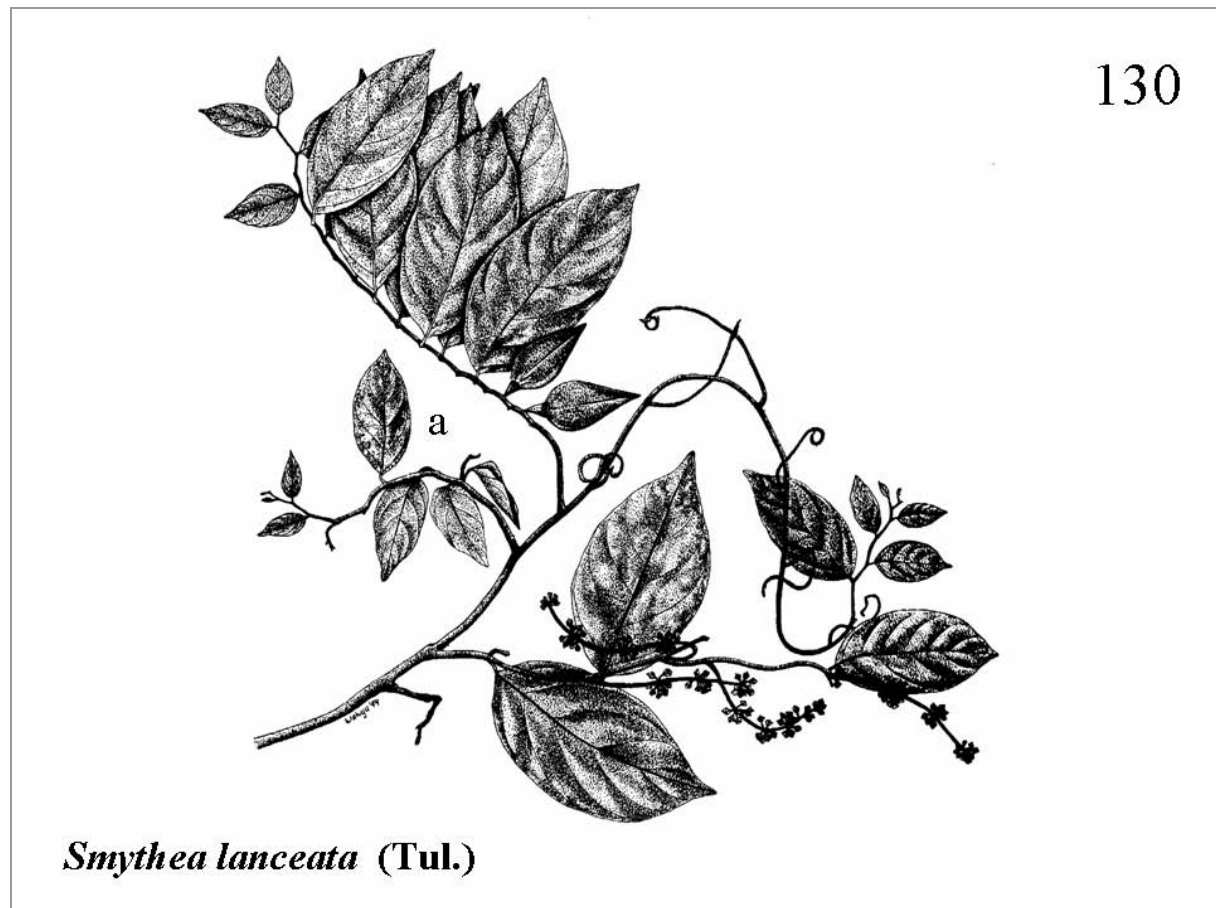


Fig. 130. *Smythea lanceata* (Tul.) Summerh. (a) Flowering vine.

RHAMNACEAE

130

Smythea lanceata* (Tul.) Summerh.*Synonyms :** *Smythea pacifica* Seem**Vernacular names :** Unknown.

Description : Thornless liana, up to 5 m long, with leathery, almost smooth, ovate-oblong leaves that measure 6-13.5 by 2.5-5.5 cm. Leaf edges may be either shallowly toothed or entire and undulating. The leaf-stalk measures about 3 mm. Flowers are bisexual, measuring 4-5 mm across, and occur in clusters in the axils. The upper clusters may sometimes be combined into a widely branched bunch. The individual flower stalks are 2-3 mm long and covered with soft hairs. The calyx tube is shortly funnel-shaped and sparsely covered with soft hairs. During full flowering the tube is less than 1 mm long. Petals are hood-like, notched at the end, and greenish-yellow, about 0.5 mm long, with a spur about 0.25 mm long. The ovate fruit, 3.5-4.5 cm long, is single-seeded and has a flat, pointed end that is tipped by what remains of the style.

Ecology : Occurs near the coast, especially in mangroves. Flowering occurs from April to December. Mangrove associate species.

Distribution : Occurs from Micronesia through Southeast Asia eastwards to Micronesia and Fiji. In Southeast Asia it has been recorded from Brunei, Malaysia, Indonesia (islands in the Sunda Straits and Java Sea, Central Java) and Papua New Guinea.

Abundance : Locally common, but on the whole uncommon.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8),
http://www.rbgekew.org.uk/herbarium/brunei/fams/49_01.htm

GROUP F: PALMS, CYCADS & PANDANS

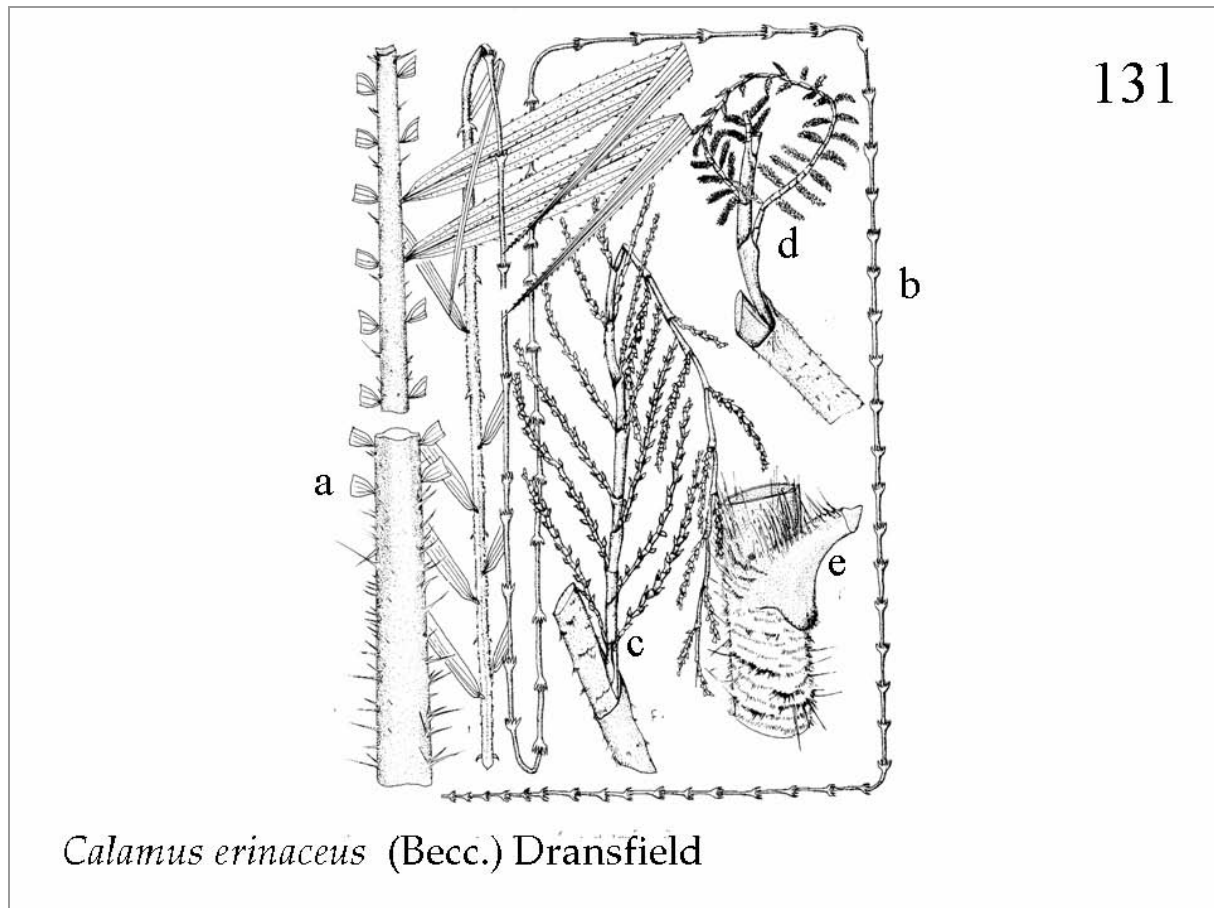


Fig. 131. *Calamus erinaceus* (Becc.) Dransfield. (a) Leaf axis, with two leaflets still attached, (b) whip-like, hooked leaf-tip, (c) female inflorescence, (d) male inflorescence, and (e) base of leaf (leaf sheath) , showing insertion of spines.

ARECACEAE

131

Calamus erinaceus* (Becc.) Dransfield*Synonyms :** *Calamus aquatilis*, *Daemonorops erinaceus*, *Daemonorops leptopus***Vernacular name(s) :** Rotan Bakau (Mal., Ind.)

Description : A robust, multiple-stemmed climbing palm (rattan) with whip-like hooks at the tips of its leaves. The stems climb up to 15-30m (or more), are 2-3.5 cm in diameter, but may be up to 6 cm wide if the enclosing sheaths are included. The sheaths are orange to yellowish-green, and are very densely armed with horizontal or slanted greyish-brown spines that are 2-35 mm long. The spines and the sheath epidermis are densely covered with fine grey scales. The 5-9 spines around the mouth of the leaf sheath point upward and are up to 6 cm long. The leaves are about 4.5 m long with numerous greyish-green leaflets that measure 2 by 40 cm; the leaf stalk is 20 cm. These are very regular, closely grouped, and hang laxly. They are armed with short bristles along the margins and on the veins on the underside of the leaflet. The lower surface also has minute brown scales and a thin layer of pale wax. The leaf axis is extended into a thin, spiny, whip-like extension that is about 2 m long. The flower clusters are 75-150 cm long and consist of lateral panicles sprouting from the axils of the uppermost leaves. Fruits are round, about 1 cm in diameter and covered with about 12 vertical rows of triangular, straw-coloured scales. This species is referred to as *Daemonorops leptopus* in Watson (1928).

Ecology : A rattan, forming thickets on the landward margin of mangroves or on the landward side of coastal sandbars. The plant climbs by means of its hooks. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Southern Thailand, the Philippines, Malaysia (Peninsular, Sarawak), Brunei, Singapore and Indonesia (Borneo, Java, Sumatra).

Abundance : Locally abundant (e.g. along the coast of Sabah) along the coast, but very rare in inland habitats.

Use(s) : The canes of this species have little commercial use, as they are too stiff and hard (Verheij & Coronel, 1992).

Source of illustration : Dransfield (1984)

Reference(s) : Watson (1928), Dransfield (1984), Tomlinson (1986), Leiden Herbarium, <http://www.nationaalherbarium.nl/>, http://www.arcbc.org/arcbcweb/climbing_palms/climbing_palmspage2.htm.

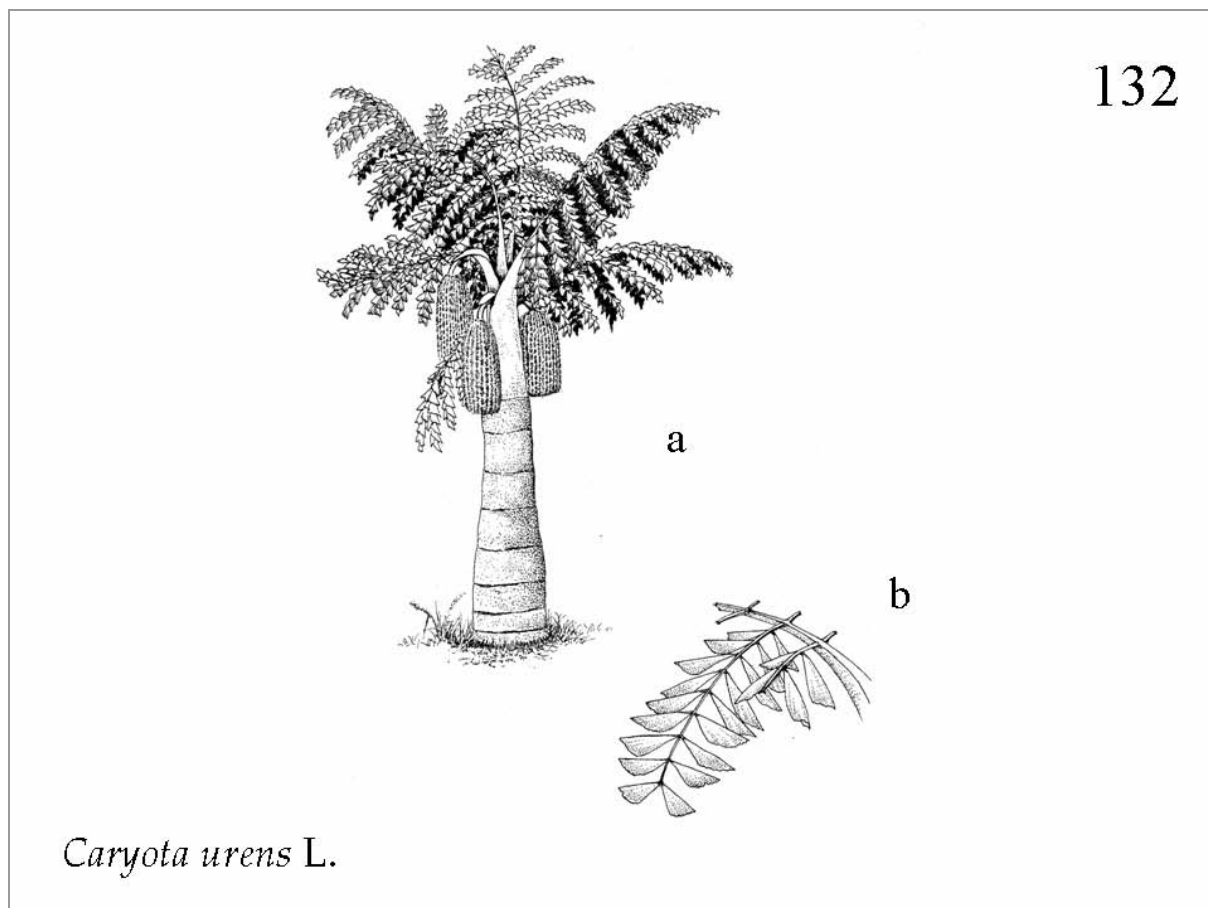


Fig. 132. *Caryota urens* L. (a) Habit of fruiting palm, and (b) detail of leaf, showing shape of leaflets.

ARECACEAE

132

Caryota urens* L.*Synonyms :** Unknown.**Vernacular name(s) :** Solitary fishtail palm, Toddy palm, Jaggery palm, Kitul palm (E), Tao rang (Thai)**Description :** Tall palm exhibiting an erect single trunk, usually 10-12 m tall, but may be up to 30 m tall, bearing ringed scars left by fallen leaves. The trunk reaches its maximum height just before the plant begins blooming. Leaves are twice divided into leaflets, up to 7 m long, but usually 3-5 m, bearing wedge-shaped, marginally toothed leaflets somewhat shaped like a fish tail, 10-20 cm by 9-10 cm, dark green. Flowers are either male or female, both borne on the same plant, alternating on branched flowering clusters, up to 2 m long, enveloped by 2 keeled, marginally fibrous leaflets. Fruits are round when ripe, reddish pink, 2-3.5 cm diameter with 1-3 smooth black seeds. Avoid contact with the red fruit produced by this palm: it contains oxalic acid which is toxic when ingested, and contact with skin may result in severe chemical burns.**Ecology :** Occurs in moist, flat lowlands to montane rainforest up to 1000. Common in lowland rainforest of varying soil types, including sandy, basaltic, granitic and alluvial, on a range of aspects from flat to steep slopes. Also occurs in semi-deciduous vine forests, broad-leaved swamp forests, (landward fringes of) mangroves and freshwater swamps. Occurs as infrequent to frequent scattered individuals or small to large groups, apparently never forming stands. Pollination is by insects, seed dispersal by flood, birds or mammals. Two closely related fishtail palm species – *Caryota mitis* and *Caryota obtusa* – occur in Malaysia and Indonesia. *Caryota urens* dies soon after flowering/fruitletting, which is usually after 20-25 years of growth. Mangrove associate species.**Distribution :** Found from India and Sri Lanka eastwards to Myanmar, Cambodia and Thailand.**Abundance :** Locally common.**Use(s) :** The sap of this palm is very rich in simple sugars. In India and other Asian countries, the palm is tapped for its syrup which is often fermented into an alcoholic beverage called toddy. The syrup is also processed into a granular sugar called "jaggery". Planted as an ornamental in other Southeast Asian countries (e.g. Malaysia) and Australia.**Source of illustration :** Authorhttp://www.plantapalm.com/vpe/photos/Species/caryota_urens.htm<http://www.pacsoa.org.au/palms/Caryota/urens.html>**Reference(s) :** Whitmore (1979), Maung (2003)http://www.palmdoctor.com/Palm_Of_The_Month/Caryota_urens.htmhttp://gmr.landfood.unimelb.edu.au/Plantnames/Sorting/Palms_Thai_index.htmlhttp://www.panda.org/about_wwf/where_we_work/ecoregions/global200/pages/regions/region035.htm

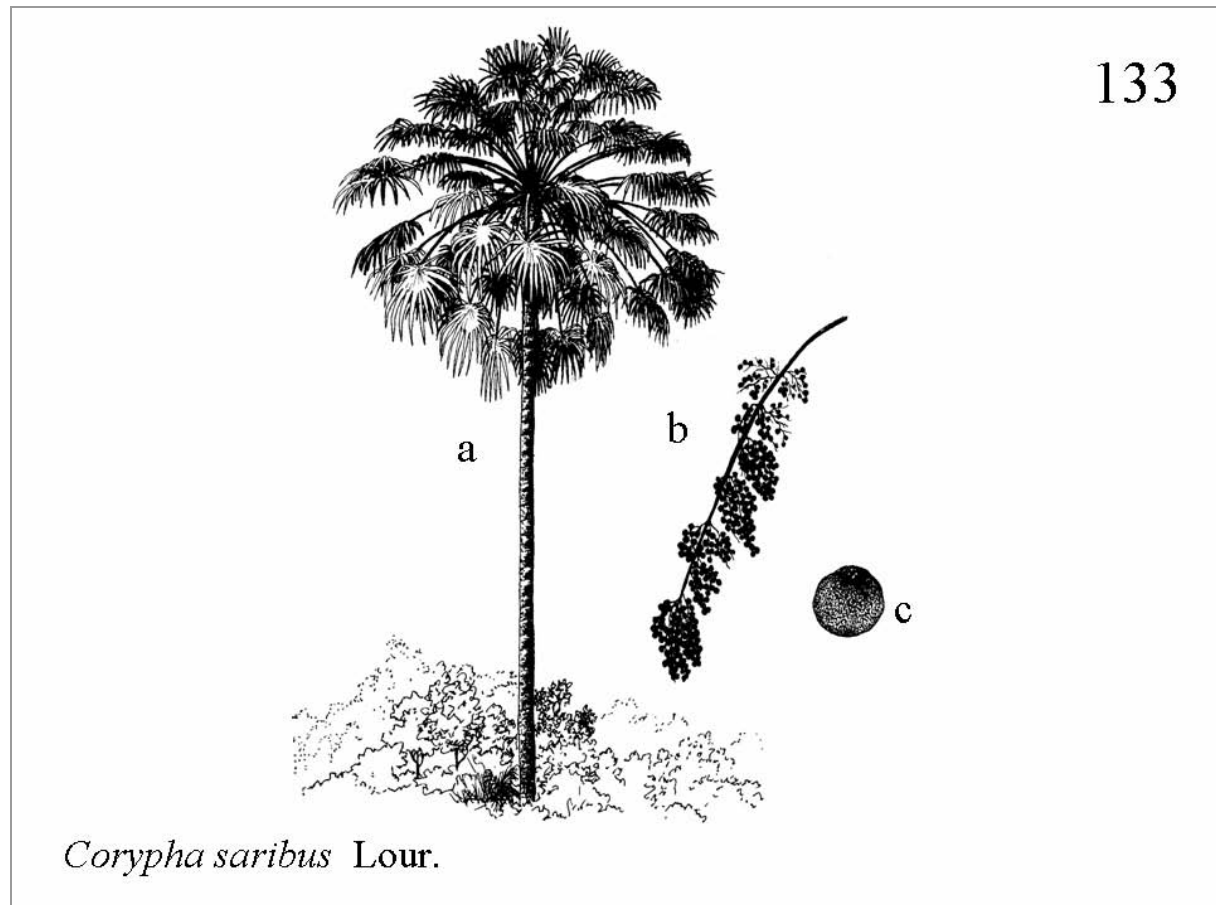


Fig. 133. *Corypha saribus* Lour. (a) Habit, (b) cluster of fruit, and (c) fruit.

ARECACEAE

133

***Corypha saribus* Lour.**

Synonyms : *Livistona cochinchinensis*, *Livistona saribus* (Lour.) Merr. ex Chev.

Vernacular name(s) : Taraw palm (E), Serdang (Mal.), Sariboe, Serdang (Ind.), Rock (Thai.), Kè (Viet.)

Description : Palm tree, 12-30 m tall. Leaves are fan-shaped, about 1 m diameter, with many principal veins. Leaves are irregularly divided by shallow to deep splits, and the tips of the leaflets are sometimes pendulous. Leaf stalks are orange-yellow, 1.5-2.5 m long and with dark spines at the base. Leaf sheaths are dark, chocolate-brown and fibrous. Flowers are borne on stalked, branching clusters that emerge from between the leaf stalks. Fruits are round, 1.5-2 cm diameter, occasionally broader than long, with a thin, fleshy, blue-green skin that is green with white spots when unripe. It is immediately distinguishable from all other species of the related fan palm genera (*Corypha* and *Livistona*) by the combination of blue-green fruit with a leaf that is irregularly divided by shallow and deep splits. All other *Corypha* and *Livistona* species, apart from the minute *Livistona exigua* of Brunei, have leaves that are regularly divided. In most of the literature in the region it is known as *Livistona saribus*.

Ecology : A species of lowlands, especially lowland swamps on the landward side of mangroves. Forms extensive forests on coastal hills. Grows both in tall forests and in low shrub/grass vegetation, including seasonally swampy *Melaleuca* wooded grasslands. Mangrove associate species.

Distribution : Southeast Asian species, found in the Philippines, Cambodia, Thailand, Vietnam, Malaysia (Peninsular, Sabah) and Indonesia (W. Java, Borneo, Sumatra, Moluccas, Sulawesi).

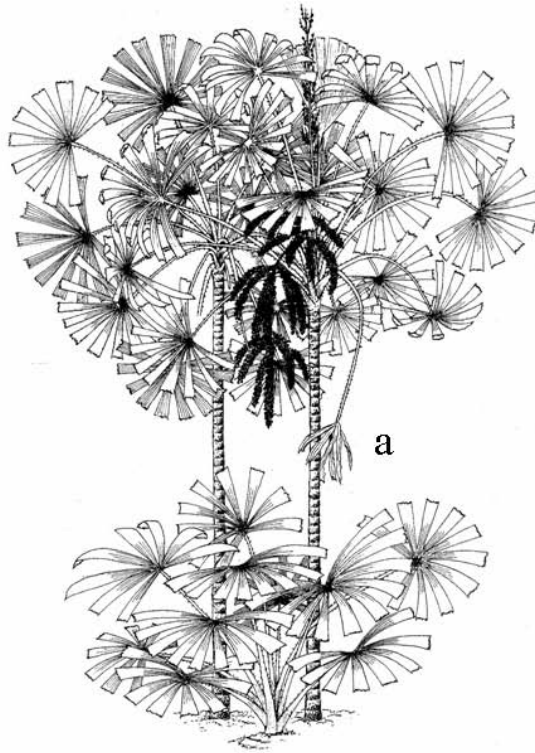
Abundance : Locally abundant, but found only in low densities in mangroves.

Use(s) : The palm cabbage, fruits and seeds are edible. Timber used in construction. Stems are used as masts for sailing vessels (South Borneo).

Source of illustration : Whitmore (1973) and live material, Botanical Garden, Bogor.

Reference(s) : Whitmore (1973), Said (1990), Dransfield (pers. comm. 1994), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org/>).

134



Licuala spinosa Wurm.

Fig. 134. *Licuala spinosa* Wurm. (a) Fruiting palm.

ARECACEAE

134

***Licuala spinosa* Wurm.**

Synonyms : *Licuala horrida*, *Licuala spinosa* Poir., *Licuala spinosa* Thunb., *Licuala spinosa* var. *cochinchinensis* Becc.

Vernacular name(s) : Spiny licuala palm, Mangrove fan palm, Good luck palm (E), Palas, Palas duri (Mal.), Palas – *Palas duri* (Ind.), Kha pho (Thai)

Description : A medium-sized, coarse palm, forming dense, compact (to wide-spreading) clumps with several 7-8 cm thick stems to 4-5(-6) m. Leaves are hand-shaped and have a radius of 45-60 cm; leaflets about 7-8 cm wide, with squared-off ends. The leaf stalks are quite heavily armed with short spines. Flowering stalks occur arching out from the leaf base up to 3(-4) m, usually with 4-5 sprays of 15 cm long spikes. Fruits are round, 10-12 mm diameter, bright orange to reddish, and very showy.

Ecology : Occurs in open, swampy ground and river banks in coastal areas. In Peninsular Malaysia it is found in swampy depressions in open sandy country, especially along the east coast. Also occurs on landward margins of mangroves. Differs markedly from the typical *Licualas* in that it is cold tolerant, and prefers full sun. Mangrove associate species.

Distribution : Southeast Asian species, occurring in Myanmar, Cambodia, Vietnam, Thailand, the Philippines, Malaysia, Singapore, Brunei and Indonesia (Sumatra, Java, Borneo). Cultivated world-wide in the tropics, sub-tropics and temperate regions.

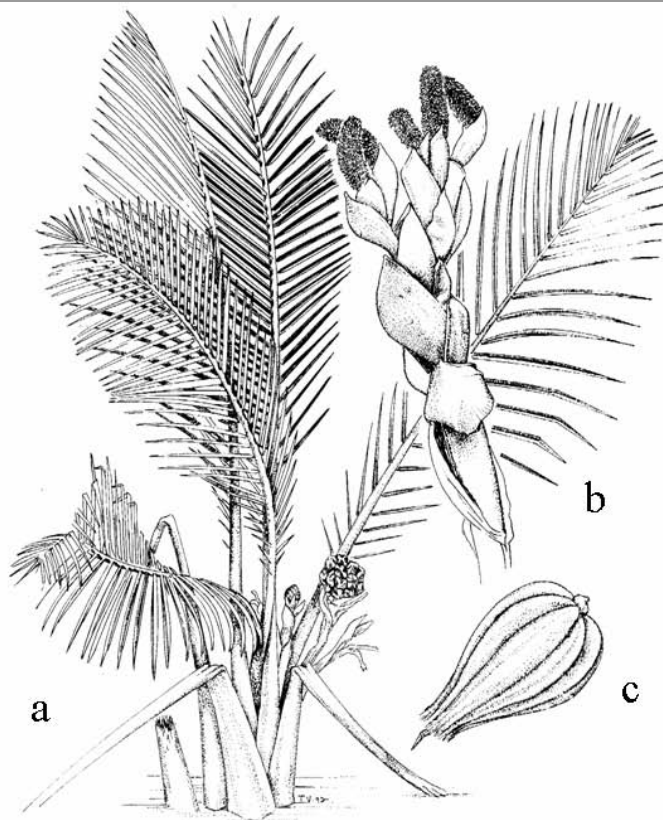
Abundance : Common.

Use(s) : Often cultivated in parks, worldwide. *Licuala* leaves are collected as food wrappers in Malaysia and Indonesia, and a royalty fee used to be paid for this to the Malaysian Forestry Department. The young leaves of *Licuala spinosa* are collected to make *ketupat* (square parcels of woven strips of palm leaf in which rice is boiled and served) for local use. Leaves are sold on local markets for the latter.

Source of illustration : <http://www.pacsoa.org.au/palms/Licuala/spinosa.html>

Reference(s) : Whitmore (1979), Afriastini (1988), Kiew (1989),
<http://www.pacsoa.org.au/palms/Licuala/spinosa.html>.

135



Nypa fruticans Wurm.

Fig. 135. *Nypa fruticans* Wurm. (a) Habit, with maturing fruit, (b) inflorescence, and (c) individual fruit.

ARECACEAE

135

Nypa fruticans Wurm.

Synonyms : *Cocos nypa* Lour., *Nypa fruticans* Thunb.

Vernacular name(s) : Nypa (E), Nipah (Mal.), Nipah, Tangkal Daon, Buyuk, Bhunjok, Lipa (Ind.), Chaak (Thai.), Apung (Bru.), Nipa, Sapsap, Sasa (Phil.), Dúa nu'óc (Viet.), Chaak, Chak (Thai.), Chark (Camb.)

Description : Clump-forming, stemless palm with underground, robust, forking stems that root from the lower surface. The leaves are erect, slightly recurved, 4-9 m long. The stout leaf stalk is 1-1.4 m long and strongly flanged at the base. There are 100-120 leaflets per leaf, each 60-130 by 5-8 cm, with a shiny-green upper surface and a somewhat powdery lower surface. The midrib is regularly marked by linear, brown scales that are up to 2 cm long. The bisexual flower clusters sprout from near the top of the stem on a 1-2 m-long stalk. The female flowers form a spherical head, 25-30 cm in diameter. The bright yellow male flowers are catkins, located below the female head of flowers. The fruiting body is spherical, 45 cm in diameter; the individual brown fruits are obovate, angular and fibrous, 10-15 by 5-8 cm. There is one 4-5 cm white, egg-shaped seed per fruit. *Nypa* pollen has been found dating from the upper Cretaceous period, 65-70 million years ago. *Nypa* has been well represented in the Australian flora since the early Tertiary period. Monotypic genus.

Ecology : Occurs on soft, fine-grained substrates fringing the upper limits of tidal waterways. A perennial (high) input of freshwater is required. Rarely occurs beyond the littoral zone. It usually occurs in pure stands. *Nypa* has a massive, dense root system that is better adapted to resist swift running water than are most other mangrove species. Its pollen is sticky and pollination appears to occur via *Drosophila* flies. Fruits are fibrous and air cavities in the seed coat and fruit coat aid water dispersal, during which time the seedling sprouts. Occasionally the plant is viviparous. True mangrove species.

Distribution : Found from Sri Lanka and the Bay of Bengal eastwards to northeast Australia and the Western Pacific (Solomon Islands, Marianas). Found throughout Southeast Asia.

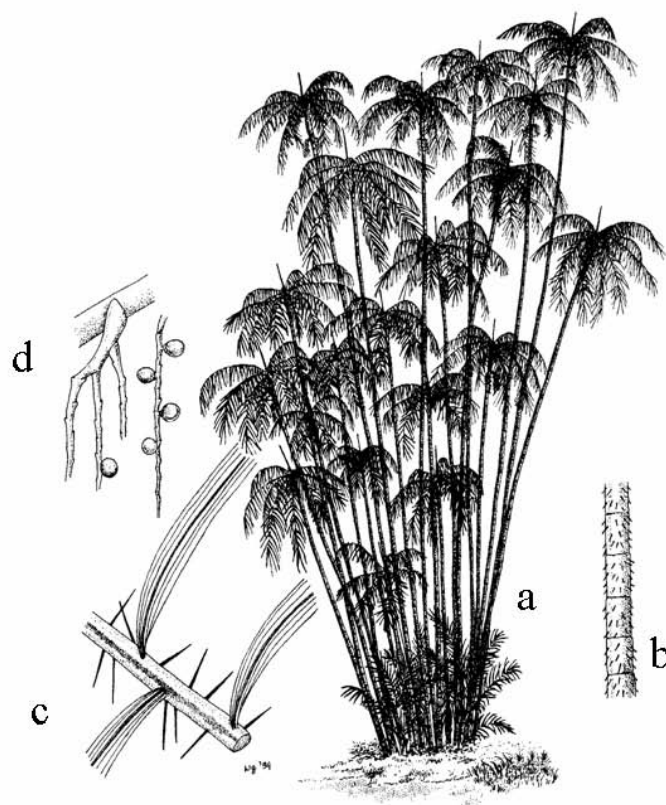
Abundance : Common, locally very common.

Use(s) : A sweet syrup can be extracted from the stem in large quantities if the flowers are removed at the proper time. It is used in the production of alcohol (including 'toddy'), sugar and vinegar, and is planted for this purpose (e.g. West Borneo). If well-managed, sugar production is higher than that of sugar cane or beet, and the sugar has a higher sucrose content. Fronds are used for thatch, umbrellas, hats, mats, baskets and cigarette papers. The seed is edible. After preparation, leaf steam fibres are used to produce rope, brooms and brushes.

Source of illustration : Adapted from photograph by Polunin (1988) and live material.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Whitmore (1979), Wightman (1989), Aksornkoae (1993), Yao (2000), Marschke (2000) <http://www.fao.org/DOCREP/005/AB598E/AB598E23.htm>.

136



Oncosperma tigillarium (Jack.) Ridl.

Fig. 136. *Oncosperma tigillarium* (Jack.) Ridl. (a) Small grove of palms, (b) detail of trunk, showing spines, (c) detail of spines and leaflets along leaf axis, and (d) inflorescence with fruit.

ARECACEAE

136

***Oncosperma tigillarium* (Jack.) Ridl.**

Synonyms : *Areca tigillaria* Jack., *Oncosperma filamentosa* Blume, *Oncosperma filamentosum* Blume, *Oncospermum tigillaria* (Jack.) Ridl..

Vernacular name(s) : Nikong, Nibung (Mal.), Nibung, Libung, Nibong (Ind.), Lao cha own, Lao cha on (Thai), Nhum (Viet.)

Description : Erect, often several-stemmed, very spiny, 9-25 m tall palm forming clumps of up to 7 m across. Stem has 2.5-6.5 (or more) cm long, sharp thorns between the scars left by the leaf stalks. Stem 10-15(-25) cm diameter. The leaf stalk is brown-scaly and very thorny. The leaf blade is 180-360 cm long. Leaflets are initially densely covered with scales, and strongly drooping. They are pointed, many-nerved, measure 60-105 cm by 2-3 cm, and have a midrib that does not have spines. Flower clusters are bisexual and located below the leaf-crown, 30-60 cm long, and simply branched. The flower stalk is flattened and 11-22 cm long. The lower, lateral branchlets of the flower cluster bear 2-3 groups of flowers, the others bear one group of flowers each. Flower groups are up to 40 cm long, and the males are thicker and shorter than the females. Male flowers are yellow, with united calyx lobes that are about 3 mm long; individual lobes are ovate to heart-shaped, with a short point and a keel. Petals are free, oblong, pointed and about 8-10 mm long. There are 6 stamens, about 5 mm long. In female flowers, both petals and sepals are almost round, while the corolla is slightly larger than the calyx, measuring about 3-4 mm. Fruit is round, with a remnant of the style occurring on the middle. Fruit is at first dark green, later becoming very dark purple, about 1 cm in diameter. The slightly greyish leaves give the palm a silvery appearance.

Ecology : Occurs exclusively near the sea-shore, often on the landward margin of mangroves, in the transition zone between mangroves and freshwater swamp forest. Mangrove associate species. Hollow stems are often inhabited by small bat species. Mangrove associate species.

Distribution : Southeast Asian species, found in Cambodia, Thailand, Malaysia, Singapore, the Philippines, Brunei and Indonesia (Sumatra, Borneo, Java).

Abundance : Often locally abundant; occasionally (semi-)cultivated.

Use(s) : *Nibung* is an economically very important plant. The timber is hard and resistant to sea water, wood borers and termites. It is often in coastal construction, including the stakes of large traps (*bagan* in Indonesia and Malaysia) and the poles supporting stilted coastal villages (*kampung laut* in Indonesia and Malaysia). Split into strips it is used for flooring. The tall clumps of splaying trunks with their fine, feathery crowns make *Nibung* a desirable ornamental for a large park. Such clumps may be seen in the Botanical Garden (*Kebun Raya*) in Bogor. Occasionally cultivated.

Source of illustration : Whitmore (1973) and live specimens in the Bogor Botanical Garden

References : Backer & Bakhuizen van den Brink (1963-8), Whitmore (1973), Aksornkoae (1993), http://www.panda.org/about_wwf/where_we_work/ecoregions/global200/pages/regions/region035.htm.

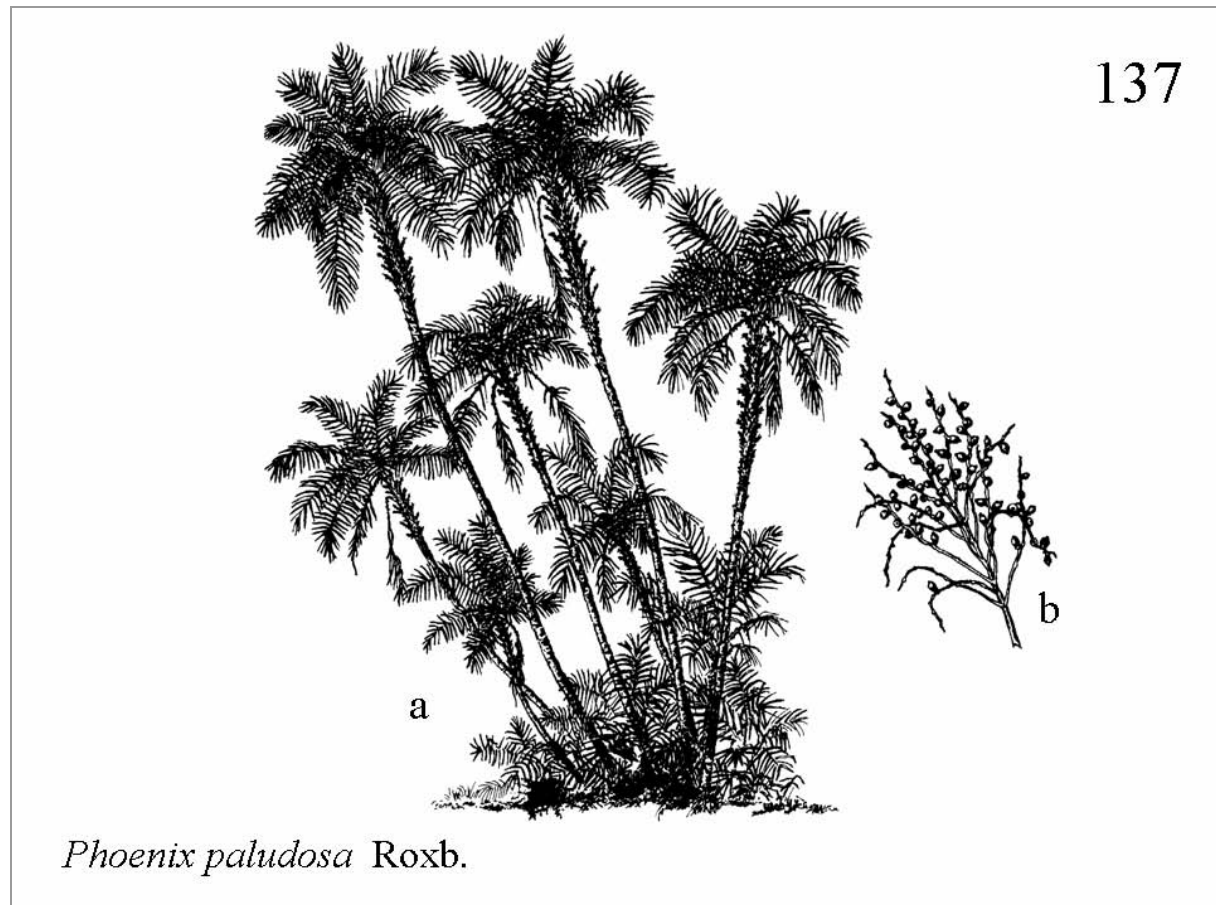


Fig. 137. *Phoenix paludosa* Roxb. (a) Small grove of palms, and (b) inflorescence with fruit.

ARECACEAE

137

Phoenix paludosa* Roxb.*Synonyms :** Unknown.**Vernacular name(s) :** Mangrove Date Palm (E), Dangsa, Korma Paya (Mal.), Dangsa, Korma Rawa (Ind.), Peng, Peng tha le (Thai), Chà là (Viet.), Peng (Camb.)**Description :** Palm, up to 6 m tall, but often much shorter. The slender, grey stems have persistent spiny leaf stalks, fibrous leaf sheaths and diamond-shaped leaf scars. The numerous bright green, sometimes yellowish leaves persist near the top of the stem and are pale grey underneath. The leaves curve slightly, are inserted on the trunk so that they point upward, and are rather short, measuring up to 150 by 45 cm. The stiff leaflets are directed towards the end of the leaf, but their tips droop. *Phoenix paludosa* is unisexual, i.e. each specimen has either male or female flowers. The unisexual flower cluster looks like a stiff brush, and is located between the leaves on an erect stalk of 60 cm. Numerous clustered, slender, straight groups of flowers occur; they are aimed upward at a slight angle. The orange berries are oval, and about 1 cm long. The seeds have a lateral embryo, unique in *Phoenix*.**Ecology :** Occurs on the landward margin of mangroves, forming extensive, dense, leafy clumps with stems of all heights. Also growing as rosettes in open places. At first sight the mangrove is a surprising place to find a species of a genus normally associated with dry climates (e.g. Date Palm). However, the characteristics that the habitats have in common is that water is not freely available to plant roots. Mangrove associate species.**Distribution :** East Africa (Zanzibar), India (Ganges delta), Andaman Islands, Myanmar, Vietnam, Cambodia, Thailand, Malaysia (Peninsular) and Indonesia (Sumatra).**Abundance :** Locally common, but listed as rare in Indonesia (Mogea *et al.*, 2001).**Use(s) :** Palm cabbage and fruits are eaten. Leaves are used for temporary fencing.**Source of illustration :** Sastrapradja *et al.* (1978).**Reference(s) :** Burkill (1935), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1973), Tomlinson (1986), Said (1990), Aksornkoae (1993), Marschke (2000)
<http://www.forestry.gov.my/isu300.html>
<http://gmr.landfood.unimelb.edu.au/Plantnames/Sorting/Phoenix.html>
http://www.wetlands.org/RDB/Ramsar_Dir/Cambodia/KH002D02.htm

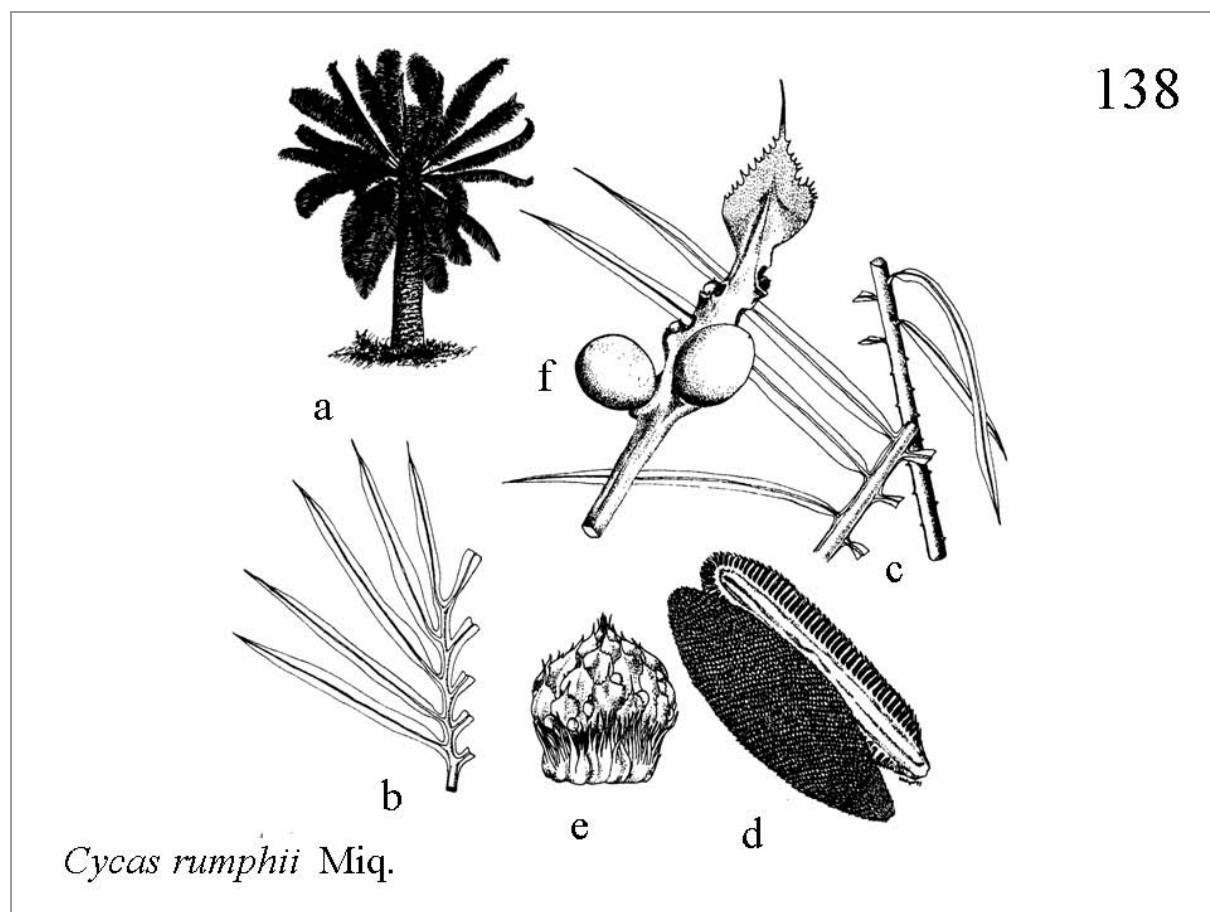


Fig. 138. *Cycas rumphii* Miq. (a) Habit, (b, c) detail of leaf, (d) male cone, (e) female cone, and (f) 2 fruit on stem.

CYCADACEAE

138

Cycas rumphii Miq.

Synonyms : *Cycas celebica* Miq., *Cycas circinalis* L., *Cycas corsoniana* D. Don., *Cycas recurvata* Blume ex J. Schuster, *Cycas sundaica* Miq. ex J. Schuster, *Olus calappoides* Rumph., *Zamia corsoniana* G. Don.

Vernacular name(s) : Queen sago, Sea cycad, Bread palm (E), Paku laut, Paku gajah, Paku haji (Mal.), Pakis Haji, Pakis Laut, Pakis Gajah, Pakis Raja, Pakis Dongol, Patuku, Ukayu Datu, Papa Blung, Gogopoa, Siba-siba, Sayur Kelapa – *Paku haji* (Ind.), Pitogo, Bait, Sauang (Phil.), Mong-tain (Myan.), Prong, Prong-tha-le, Maphrao-sida (Thai.), Thien tue (Viet.)

Description : Gum-containing palm-like or tree fern-like tree, up to 6(-7) m tall. It has a well-developed, mostly not branching stem that is armed with the semi-persistent remains of the leaf stalks. The leathery leaves are once-divided into leaflets, developing in groups. Leaves are arranged in a dense terminal whorl, up to 2.5 m long, with 50-150 pairs of leaflets. The leaf bundles alternate with groups of scales. The leaf stalk is spiny, and middle leaflets are 20-35 cm long. The bright yellow, strongly smelling clusters of female flowers measure 30-70 by 12-17 cm, and are stemless, occurring on the end of the leafy stem. These female flowers have numerous large spore-bearers that are densely hairy and have 2-4 ovules. Normal leaves develop above the female flowers. Male flowers are cone-like. Seeds are borne on the edges of a flattened organ, and are ellipsoid, orange-brown, and measure 4-6 by 3-5 cm.

Ecology : Occurs on the landward margins of mangrove swamps, but also far inland on dry places in the hills, up to altitudes of 450 m, but usually below 100 m asl.. In the littoral forests it is often an inhabitant of rocky shores rather than mangrove. Flowering occurs all year round. The seeds float and are carried long distances by ocean currents. Mangrove associate species.

Distribution : From India and Sri Lanka through Southeast Asia to Micronesia. In Southeast Asian recorded from Myanmar, Vietnam (endangered), the Philippines, Thailand, Malaysia (Peninsular, Sarawak, Sabah), Indonesia (Sumatra, Java, Sulawesi, South Borneo, Moluccas, Papua, Lesser Sundas), East Timor and Papua New Guinea. Cultivated.

Abundance : Uncommon, but may be locally fairly common. Listed as threatened in parts of its range (e.g. Vietnam), due to over-exploitation (collection in wild) and habitat changes.

Use(s) : Ornamental tree in gardens and cemeteries. The seeds are edible, after a special treatment, as fresh seeds are poisonous. Young leaves are eaten as vegetable (*sayur lodeh* in Indonesia) or salad (*lalab*). A kind of sago can be prepared from the trunk. A poultice of seeds or bark is used to cure ulcers and other skin complaints. Latex of the leaf stalks was used in colonial times as a glue to repair pottery and glassware. Stem latex is used in the treatment of abscesses, and for detoxification.

Source of illustration : Ochse & Bakhuizen van den Brink (1977).

Reference(s) : Heyne (1950), Watson (1928), Backer & Bakhuizen van den Brink (1963-8), Sastrapradja *et al.* (1980), Afriastini (1988), Verheij & Coronel (1992), Aksornkoae (1993), <http://plantnet.rbgsyd.gov.au/cgi-bin/taxon.pl?name=Cycas+rumphii>; <http://ratree.psu.ac.th/~bnoparat/MANGROVE.html>.

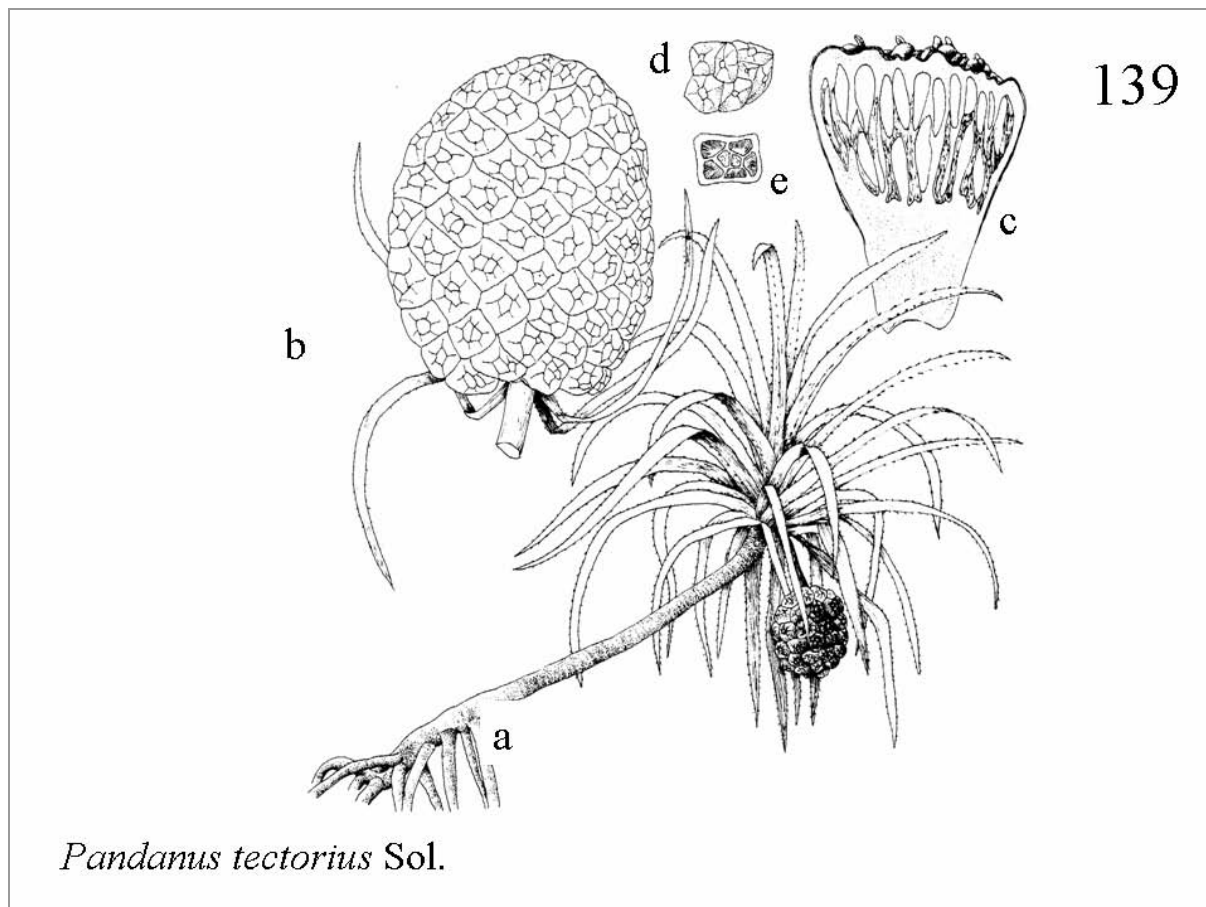


Fig. 139. *Pandanus tectorius* Sol. (a) Habit, (b) fruit cluster, (c) individual fruit (longitudinal section), (d) fruit, seen from above, and (e) cross-section of fruit.

PANDANACEAE

139

***Pandanus tectorius* Sol.**

Synonym(s) : *Pandanus fascicularis*, *Pandanus foetidus*, *Pandanus inermis* Reinw., *Pandanus laevis* Kunth., *Pandanus littoralis* Jungh., *Pandanus moschatus* Miq., *Pandanus odoratissimus* Park., *Pandanus odoratus* Salisb., *Pandanus odorifer* (Forssk.) Kuntze, *Pandanus versus*, *Marquartia leucacantha*

Vernacular name(s) : Common Sea-shore Screwpine (E), Pandan laut (Mal.), Pandan nipah, Mengkuang – *Pandan pudak* (Ind.), Rhumjeik-samot (Camb.), Toei thale (Thai)

Description : A gregarious shrub or small tree, widely branching, sometimes with several trunks, often with stilt roots around the stem, and aerial roots emerging from the branches; 3-7 m tall. Stilt roots with 'warts' and conspicuously large root 'caps'. Leaves long and strap-like, 70-250 cm by 3-9 cm, with a triangular, pointed tip, arranged in close spirals, spiny along the edges and midrib; usually bluish-green, occasionally pale green or variegated. Male flower heads arranged singularly, in a pendulous 'cone', 25-60 cm long, with 10-20 branched side-branches; stamens arranged in bunches on short side-branches; leaflets around the male flowers are linear-lanceolate, keeled, yellowish-white, and emit a pleasant odour. Female flower heads also singularly arranged, with 5-18 styles; fruit pendulous and rounded, each fruit egg-shaped, 4-7.5 by 2-6.5 cm, turning orange-yellow. As many as 28 varieties have been described (Heyne, 1950), some of the more common ones being *Pandanus tectorius* var. *littoralis*, var. *borneensis*, var. *javanicus*, var. *timorensis* and var. *sumbavensis*.

Ecology : Occurs along beaches and occasionally on margins of mangroves, but also inland, up to an altitude of 800 m. The latter is due to planting. Probably the most widespread *Pandanus* species. Mangrove associate species.

Distribution : Pantropical, found throughout Southeast Asia.

Abundance : Common.

Use(s) : Used for weaving mats, hats and baskets, often cultivated for this purpose. Fruit is edible. Leaves yield a strong fibre which is used for making rope. The tender leaves are eaten, raw or cooked. Scented water is prepared from the male flowers. Male flowers also used to scent clothes, and to prepare scented oils. Leaves used for weaving hats and mats. The sharp serrated leaves of the plant can cause lacerations. Male flowers may also be used to adorn the hair. The outer part of the flower and the blossoms yield an essential oil. The flowers and leaves can cause dermatitis to cooks and florists.

Source of illustration : Based on Backer (1920) and Polunin (1988).
<http://www.bogos.uni-osnabrueck.de/expo/alle/Pandanus%20tectorius.htm>
http://www.botany.hawaii.edu/faculty/carr/images/pan_tec_fr.jpg

Reference(s) : Backer (1920), Heyne (1950), van Steenis *et al.* (1951), Afristini (1984), Polunin (1988), Heywood (1993), Khan & Alam (1996),
<http://bodd.cf.ac.uk/BotDermFolder/BotDermP/PAND.html>

GROUP G: TREES & SHRUBS

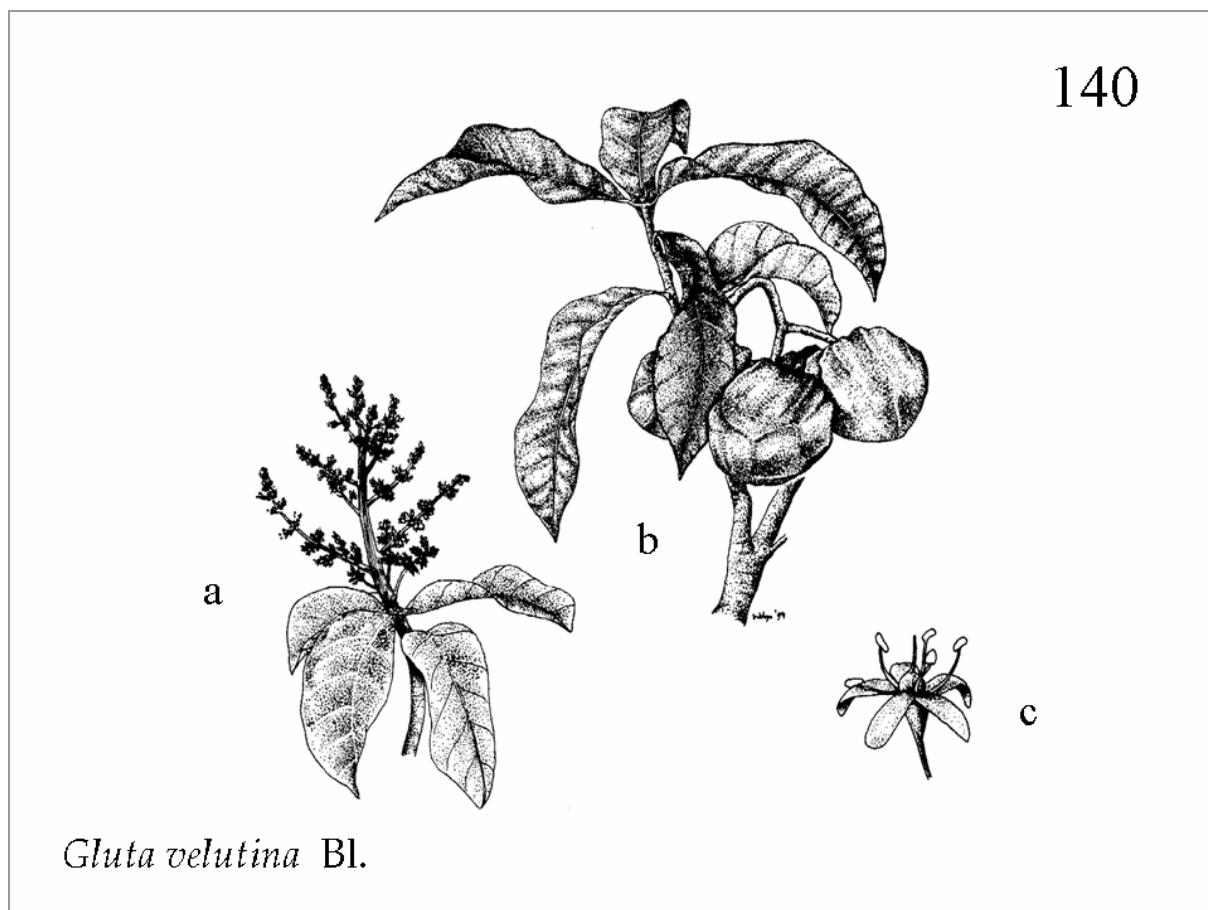


Fig. 140. *Gluta velutina* Bl. (a) Flowering branchlet, (b) fruiting branchlet, and (c) flower.

ANACARDIACEAE

140

***Gluta velutina* Bl.**

Synonyms : *Gluta coarctata* Hook., *Syndesmis coarctata* Griff.

Vernacular name(s) : Pong-pong, Rengas, Rengas Ayer, Rengas Pantai (Mal. & Ind.), Rengas Pendek (Ind.)

Description : Large shrub or small tree up to 10 m tall, sometimes with numerous, branched stilt roots that may be up to 1 m long. Its bark is pinkish-brown, rather smooth, and exudes a clear sap that rapidly turns black after exposure to the air. The leathery, smooth leaves are elliptic-oblong, narrowly elliptic or oblong-lanceolate, measuring 12-32 by 5-8 cm. Veins are slightly raised on both surfaces of the leaf. Finer veins are net-like, distinct below and rather faint above. Older leaves become black-spotted. The flower clusters are 5-12 cm long, and are located at the ends of branches. The calyx is 2 mm long, and is covered with short hairs. Petals are without hairs, white, with some pink along the edges, and measure 7-9 by 2-3 mm. The pale brown, stalked, 1-seeded fruit has irregular tuber-like ridges, especially near the base, and measures 4.5-7.5 cm across.

Ecology : Occurs along banks of tidal rivers on submerged mud bars in the freshwater or slightly brackish zone. Often located standing in the water with its trunk submerged, except at low tide. It is a characteristic tree of the tidal reaches of rivers, just on the landward/freshwater side of the *Nypa* palm stands. Flowering occurs all year round. The clear, irritating sap exudes readily. On exposure to air, this sap rapidly turns black, and, as with other *rengas* trees, the trunk is usually stained with black marks. Trees are often infested with *Crematogaster* ants. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Myanmar, Thailand, Vietnam, Peninsular Malaysia and Indonesia (Sumatra, Borneo and West Java).

Abundance : Common.

Use(s) : Timber. The sap of the *Gluta velutina* is known to cause blisters and blindness. Any tree that has a black-stained trunk should be avoided because it usually indicates a member of the Anacardiaceae. The sap of these species is often irritant and toxic.

Source of illustration : Drawn from live specimen.

Reference(s) : Burkill (1935), Ding Hou (1978), Tomlinson (1986), Corner (1988).

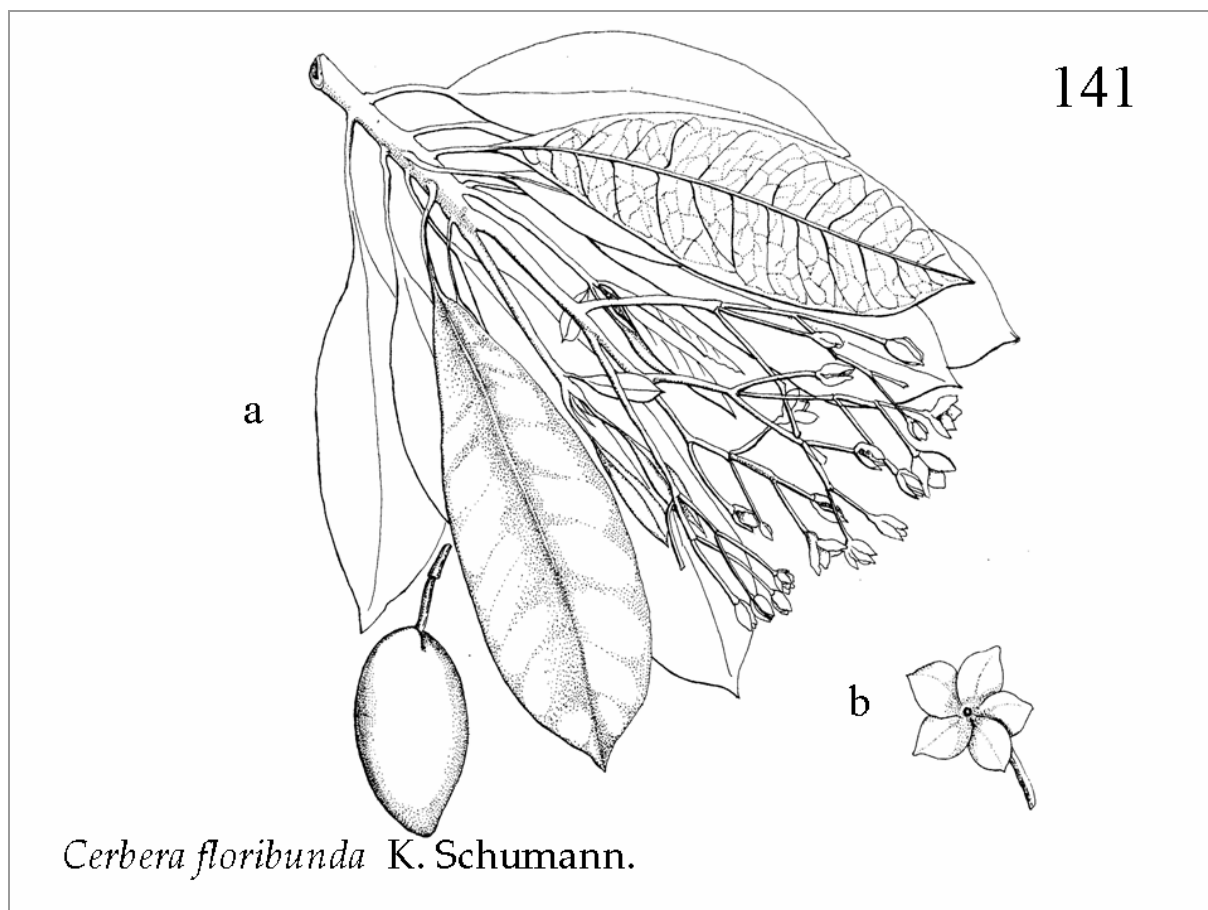


Fig. 141. *Cerbera floribunda* K. Schumann. (a) Branchlet with flowers and fruit, and (b) flower.

APOCYNACEAE

141

Cerbera floribunda K. Schumann

Synonyms : *Cerbera micrantha* Kanehira

Vernacular name(s) : Unknown.

Description : Tree, up to 36 m tall, with a fissured, grey to dark brown or black bark that has lenticels. *Cerbera floribunda* has milky white latex. It has roots that run along the surface of the soil, but lacks aerial roots and pneumatophores. The pointed leaves measure 9-28 by 2.5-5 cm, and are crowded together at the ends of the branches. They are lanceolate, dark, glossy green above and pale green below. Lateral veins are not or only slightly curved and joined. There are usually more than 50 flowers per flower cluster. The 1.5-3 cm-long corolla is hairless and completely white. Sometimes the centre may be tinged pink or yellow. The stigma is elongated. Fruits are egg-shaped, purple, fleshy, fibrous inside and 5-8 cm long. There is clear layering in the fruit, with a thick skin, a fleshy part, a fibrous section and a central pip.

Ecology : Occurs widely, from coastal swamp forest and landward margins of mangroves, up to an altitude of at least 1,800 m. It is usually but not exclusively associated with wet patches in forests. Mangrove associate species.

Distribution : Limited range, from Papua and Papua New Guinea, eastwards to the Solomon Islands.

Abundance : Unknown, but probably relatively common.

Use(s) : Oil extracted from the seeds is rubbed on the skin to cure itches and common colds. It is also used to kill fish. The bark is used as a purgative. See also *Cerbera manghas*.

Source of illustration : Redrawn from Percival & Womersley (1975).

Reference(s) : Percival & Womersley (1975) Tomlinson (1986).

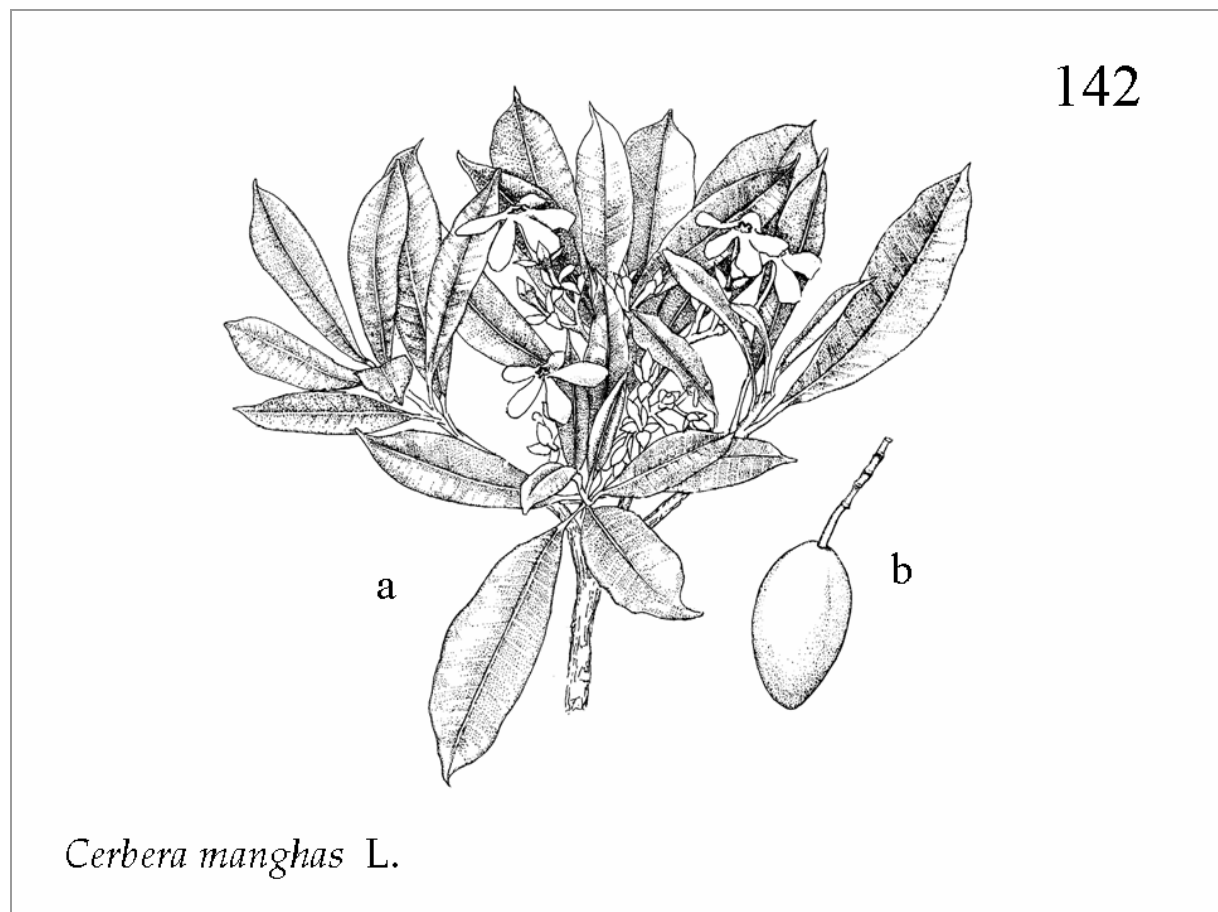


Fig. 142. *Cerbera manghas* L. (a) Flowering branchlet, and (b) fruit.

APOCYNACEAE

142

Cerbera manghas L.

Synonyms : *Cerbera forsteri* Seem., *Cerbera lactaria* Hamilton, *Cerbera linneai* Montr., *Cerbera odallam* Bl., *Cerbera tanghina* Hook., *Cerbera venenifera* A.J.M., *Cerbera venenifera* (Poir.) Steud., *Elcana seminuda* Blanco, *Tabernaemontana obtusifolia* Poir., *Tanghinia manghas* (L.) G. Don.

Vernacular name(s) : Pink-eyed Cerbera (E), Pong pong, Buta buta, Nyan (Mal.) Bintan, Buta-butua Madang, Goro-goro, Kayu Susu, Kayu Kurita, Bintaro, Kadong, Mangga Brabu, Waba, Jabal, Bilu Tasi – *Buta badak* (Ind.), Arbon, Barabai, Batano, Buta-buti, Dita, Duñgas, Kaliptan, Lipata, Magkanai, Maraibai, Panabulon, Toktok-kalau, Tabau-tabau – *Barabai* (Phil.), Teenped saai, Tin pet (Thai.)

Description : Tree or shrub, up to 20 m but usually much smaller (4-6m), with a fissured, flaky, grey to brown bark with lenticels and a milky white sap. It has roots that run along the surface of the soil, but lacks aerial roots and pneumatophores. The pointed leaves measure 10-28 by 2-8 cm, and are crowded together at the end of the branches. Leaves are oblong or lanceolate, dark, glossy green above and pale green below. The lateral nerves are curvedly joined. There are usually 20-30 flowers per cluster. The calyx is white to cream-coloured. The corolla is white with a purple to orange-red 'eye', has a pubescent throat and is 2-5 cm long. The stemless stamens are inserted at the mouth of the tube. A hairy, spur-like extension of each stamen more or less closes the throat of the corolla tube. The fruit is oval/oblong, reddish, often paired, smooth, fleshy and 6-8 cm long. In appearance it is shaped much like a mango (hence the scientific name).

Ecology : A tree of coastal swamp forests or beach vegetation, preferring well-drained sandy soils, exposure to sea breezes and places not regularly inundated by tides. According to Whitmore (1972d), a species of sandy and rocky coasts. Flowering occurs all year round (Philippines). Occurs on landward margins of mangroves. Mangrove associate species.

Distribution : A Southeast Asian species that extends into China (Hainan, Guangdong), Taiwan, Japan and eastwards to the Bismarck Archipelago, Australia, and throughout the Solomon Islands. In Southeast Asia recorded from Cambodia, Myanmar, Thailand, Vietnam, Malaysia, the Philippines, East Timor and Indonesia (Java, Sumatra, Sulawesi, Moluccas, Papua) and PNG.

Abundance : Relatively common, but less so than *Cerbera odollam*.

Use(s) : Oil extracted from the seeds and young fruits is rubbed on the skin to cure itches, rheumatism, and also to cure common colds. Seed oil is poisonous and used to kill fish; in Myanmar used as insecticide. The bark, sap and leaves are used as a purgative, and for inducing abortion. Wood used for fuel and charcoal. Green fruit is used to kill dogs. The red fruit, when fresh, is used to rub on the legs in cases of rheumatism. The latex produces blindness when dropped into the eyes. The kernel of the fruit is an irritant poison, producing, when taken internally; vomiting and purging soon followed by collapse and death. Potential pharmacological drug because of the cardiovascular effect (see *Cerbera odollam*).

Source of illustration : Redrawn from *The Common Littoral Plants of Taiwan*.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1972d), Percival & Womersley (1975), Tomlinson (1986), Said (1990), Aragones *et al.* (1998).

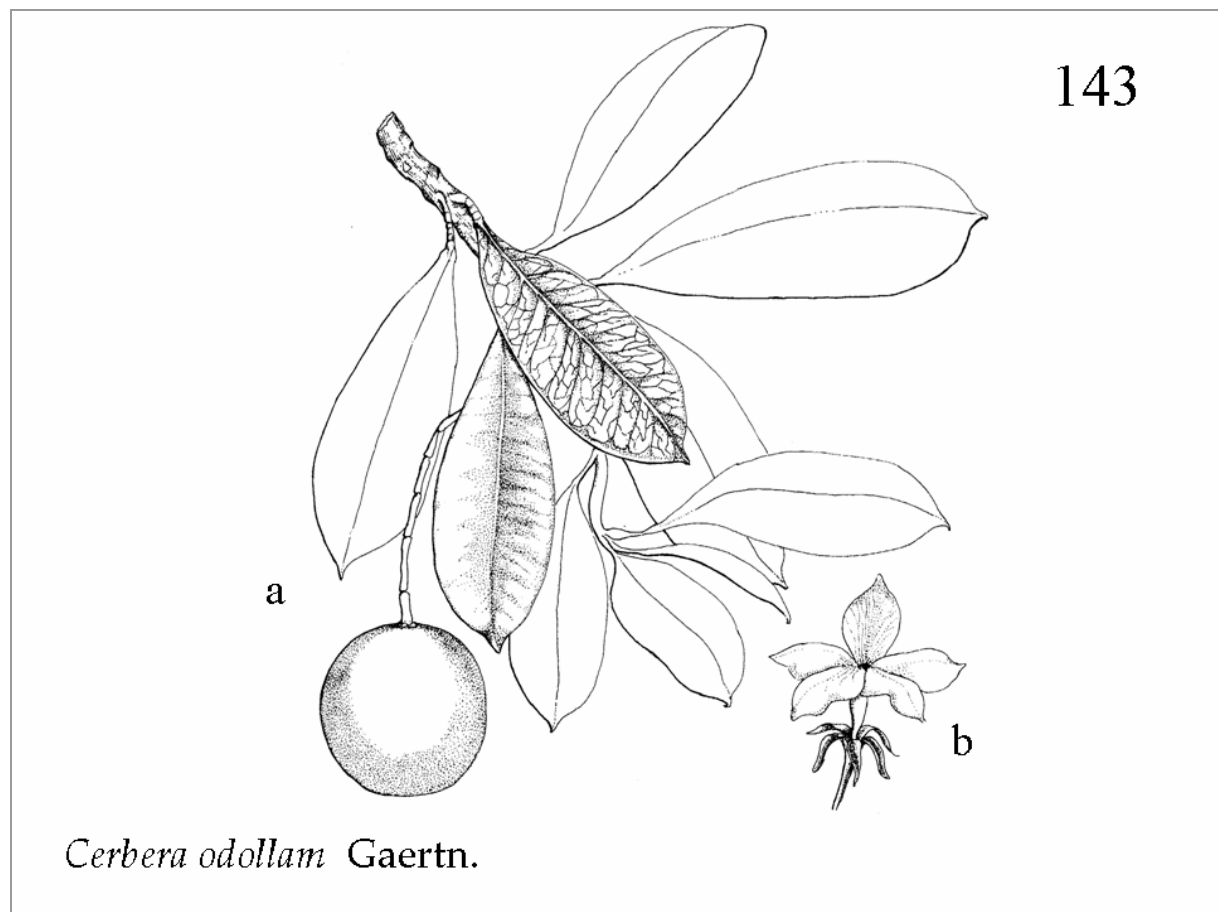


Fig. 143. *Cerbera odollam* Gaertn. (a) Branchlet with fruit, and (b) flower.

APOCYNACEAE

143

Cerbera odollam Gaertn.**Synonyms :** Unknown.

Vernacular name(s) : Yellow-eyed Cerbera (E), Pong pong, Buta buta, Nyan (Mal.) Bintaro, Bintan, Buta-butua Madang, Badak, Goro-goro, Kayu Susu, Kayu Kurita, Kenyeri Putih, Kadong, Koyandan, Mangga Brabu, Waba, Jabal, Kenyen Putih, Bilu Tasi (Ind.), Muóp xác vàng (Viet.), Chompouprey Dawm cheungtia, Pilpicht (Camb.), Teenped thale (Thai)

Description : Small tree or shrub, up to 17(-20) m tall, but usually not more than 8 m, with a fissured, flaky, grey to brown bark with lenticels and a milky, white sap; trunk may be up to 45 cm diameter. It has roots that run along the surface of the soil, but lacks aerial roots and pneumatophores. The fine-pointed, leathery leaves measure 10-28 by 2-8 cm, and are crowded together at the ends of the branches. Leaves are oblong or lanceolate, dark, glossy green above and pale green below; withering to orange brown. The lateral veins occur at right angles to the midrib and terminate in a fine, marginal connecting band. There are 20-30 fragrant (and usually ephemeral) flowers per cluster. The calyx is white to cream-coloured. The tube of the trumpet-shaped corolla is swollen at the middle because of the stamens; the tube does not extend (much) beyond the calyx. The corolla is green or white with a yellow centre and is 2-3.5 cm long. The mouth of the corolla tube is open. The fruit is round, solitary, 5-10 cm diameter, without clearly distinguishable layers; green, later turning pink, finally dark purple.

Ecology : In coastal forest and landward margins of mangrove. It has a limited salt tolerance, and occurs on clays or sandy soils. *Cerbera odollam* also occurs in riparian vegetation, especially in tidal areas with limited intrusion of seawater. Typical lowland species, found up to an altitude of 10 m asl. Reportedly fast growing. Mangrove associate species.

Distribution : From Southern India and Sri Lanka through Southeast Asia eastwards to western Polynesia (Fiji).

Abundance : Common.

Use(s) : Sometimes cultivated and its range may have been extended artificially. It is a common roadside tree in Singapore and Kuala Lumpur. Seeds, latex and leaves are toxic, and the active ingredient is a bitter tasting glycoside called cerberin. It is reportedly used to treat intestinal worms. Timber is white to greyish, light, and of poor quality. According to Randerson (2004) the tree is used in South and Southeast Asia 'by more people to commit suicide than any other plant, the toxicologists say'. Cerberin is similar in structure to digoxin, found in foxglove, which kills by blocking calcium ion channels in heart muscles and disrupting the heartbeat. More ominously, it is also suspected of being used in an increasing number of murder cases (Randerson, 2004). After the flesh of the fruit has rotted and disappeared, an intertwined mesh of fibres remains – these retain the shape of the original fruit and are used in Western countries to make dried flower arrangements.

Source of illustration : Redrawn from Tomlinson (1986).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Whitmore (1972d), Sastrapradja *et al.* (1979), Tomlinson (1986), Corner (1988), Aksornkoae (1993), Marschke (2000).

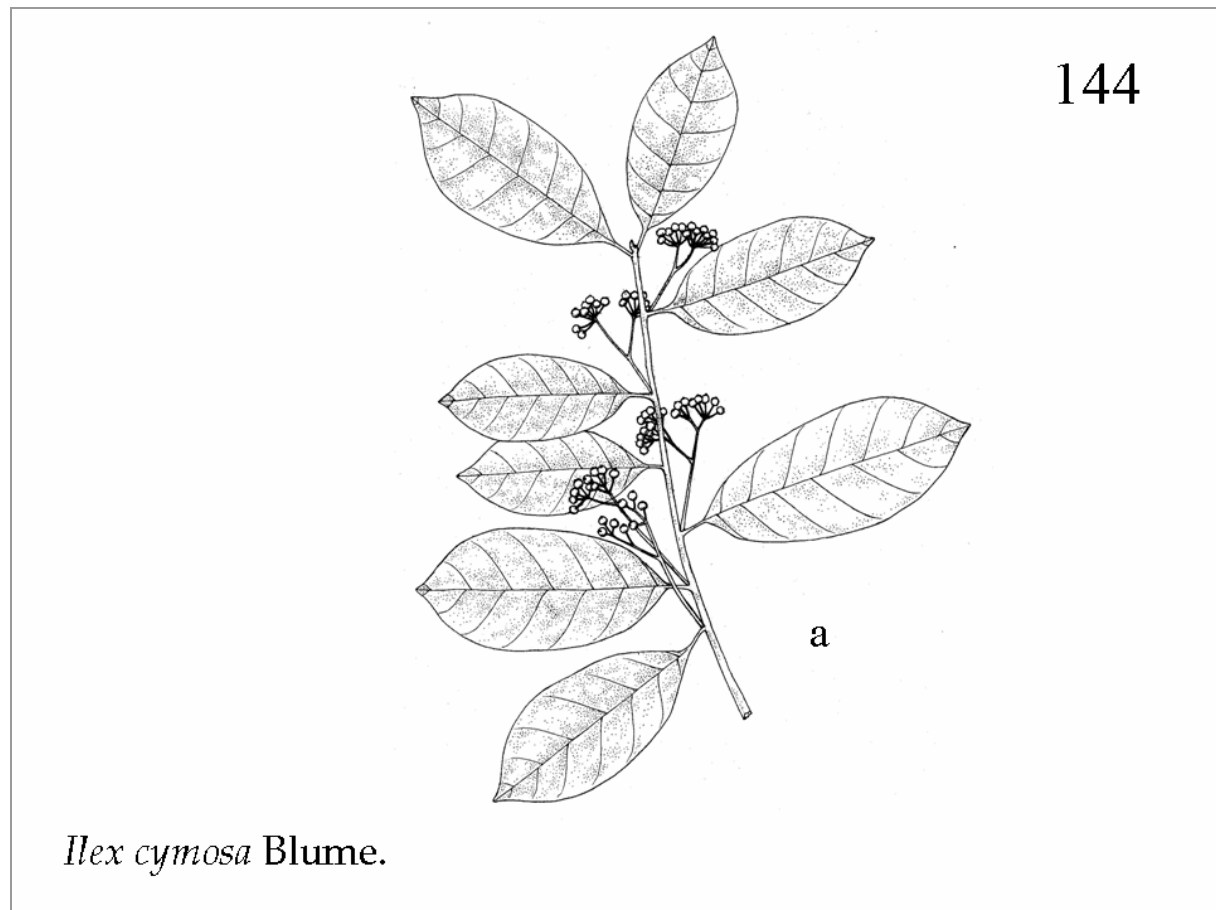


Fig. 144. *Ilex cymosa* Blume. (a) Fruiting branch.

AQUIFOLIACEAE

144

Ilex cymosa Blume

Synonyms : *Ilex singaporeana* Wall.

Vernacular name(s) : Marsh holly (E), Mensirah, Timah-timah, Bubpuk (Mal.)

Description : Small, smooth, evergreen tree up to 16(-25) m tall, rarely with buttresses, bark white or light grey, smooth or pimply because of lenticels, inner bark thick, ochre-brown, and coarsely gritty; wood pink or cream. Young twigs conspicuously white and lenticellate. Leaves entire, alternate, 2.5-6.3 by 5-10(-14) cm, elliptic with a blunt tip, dark green and glossy above, pale beneath, thinly leathery, with 6-8 pairs of side veins; leaf stalk 1-1.5 cm long. Young leaves white or magenta. Flowers 2-3 mm across, greenish-white, in small, rather loose clusters with numerous flowers, located in the axils. Male flowers with 4-5 sepals and petals, stamens 4. Female flowers with 5-6 sepals, 6-8 petals. Fruit an egg-shaped berry, 4(-5) mm long and 3-4 mm wide, pinkish-purple, then black, like small currants, with about 8-10 seeds; fruit stalk 3-6 mm. Fruit is ridged when dry.

Ecology : Lowland forest, secondary forest, especially in swamps; also on rice fields, coastal forest, and on landward margins of mangroves. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Vietnam, Malaysia (Peninsular, Sarawak), the Philippines, Thailand, Indonesia (Sumatra, Borneo, Java, Sulawesi, Moluccas), Singapore and Brunei.

Abundance : Common.

Use(s) : No known use.

Source of illustration : Kiew (1978)

Reference(s) : Kiew (1978), Corner (1988)

http://www.nparks.gov.sg/nursery/spe_by_search_details.asp?specode=7071&searchdetail=detail
http://birdlifeindochina.cong-ty.com/source_book/source_book/Mekong%20Delta/SB%20Vo%20Doi.htm.

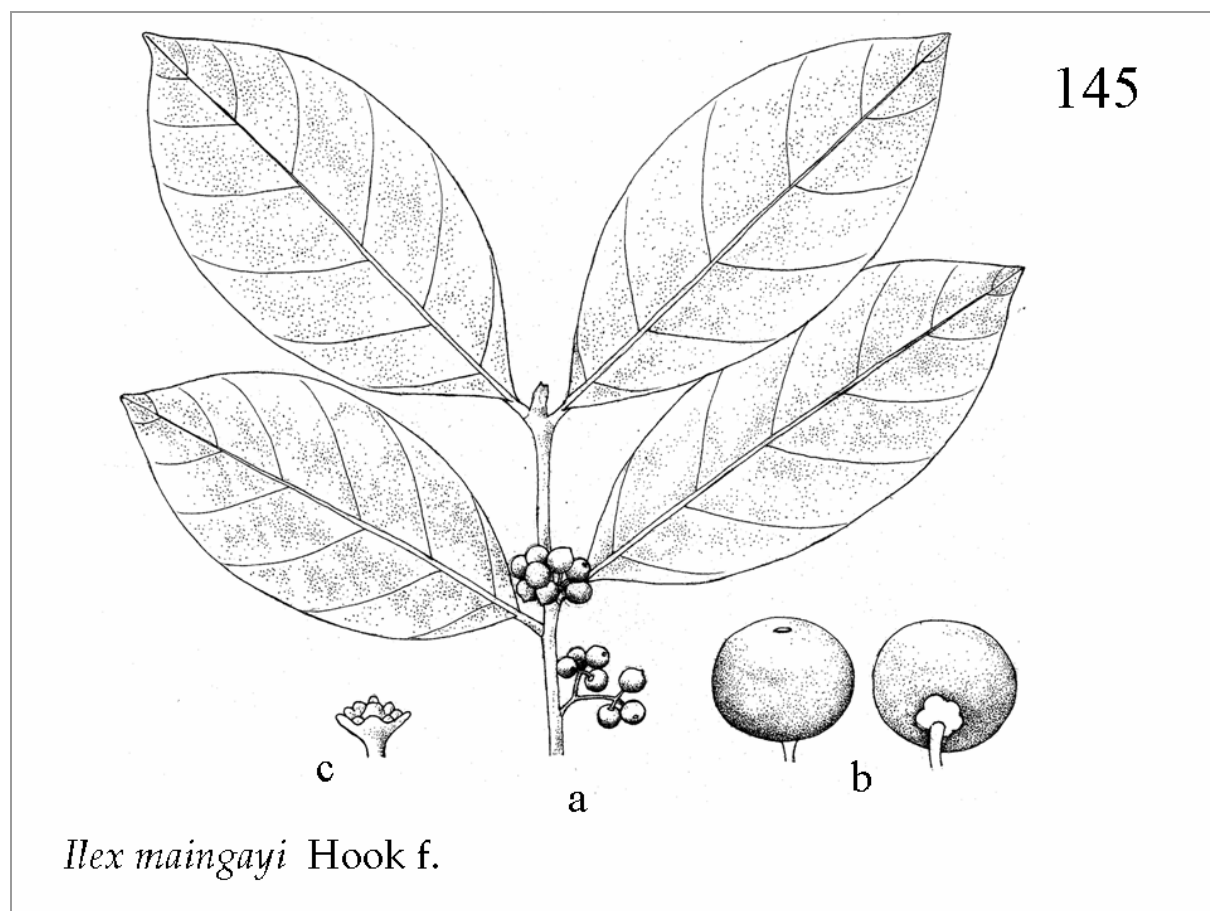


Fig. 145. *Ilex maingayi* Hook f. (a) Fruiting branch, (b) detail of fruit, and (c) flower.

AQUIFOLIACEAE

145

Ilex maingayi Hook f.**Synonyms :** Unknown.**Vernacular name(s) :** Glaucous holly (E)

Description : Small to medium sized tree, 6-15 m tall, bark grey or brown; young twigs also grey or brown. Leaves alternate, leaf edge entire, blade elliptic to obovate, 9-11(-17) by 4.5-6.5 cm, tip pointed, base tapering, dark glossy green above, yellowish-green below, leathery, midrib conspicuously projecting below, 7-9 pairs of nerves. Male flower cluster a panicle located in the axils, main stalk stout, 2.5-3 cm long, and branches 1 cm long, bearing minute, crowded flowers. Female flower clusters on a stout stalk, 2.5-3 cm long, drying black; flowers 4-6 merous, female flowers 5 mm across. Fruit round, 6-7 mm diameter, greenish-yellow, ripening deep red, drying ridged; fruit stalk 5-7 mm, with 5-6 seeds.

Ecology : Lowland forest in swampy areas, including peat swamp forest and mangrove edges. Also found on rich limestone soil. Mangrove associate species.

Distribution : Endemic to Peninsular Malaysia.

Abundance : Uncommon, but widely distributed in Peninsular Malaysia. .

Use(s) : Unknown.

Source of illustration : Kiew (1978), Corner (1988)

Reference(s) : Kiew (1978), Corner (1988).

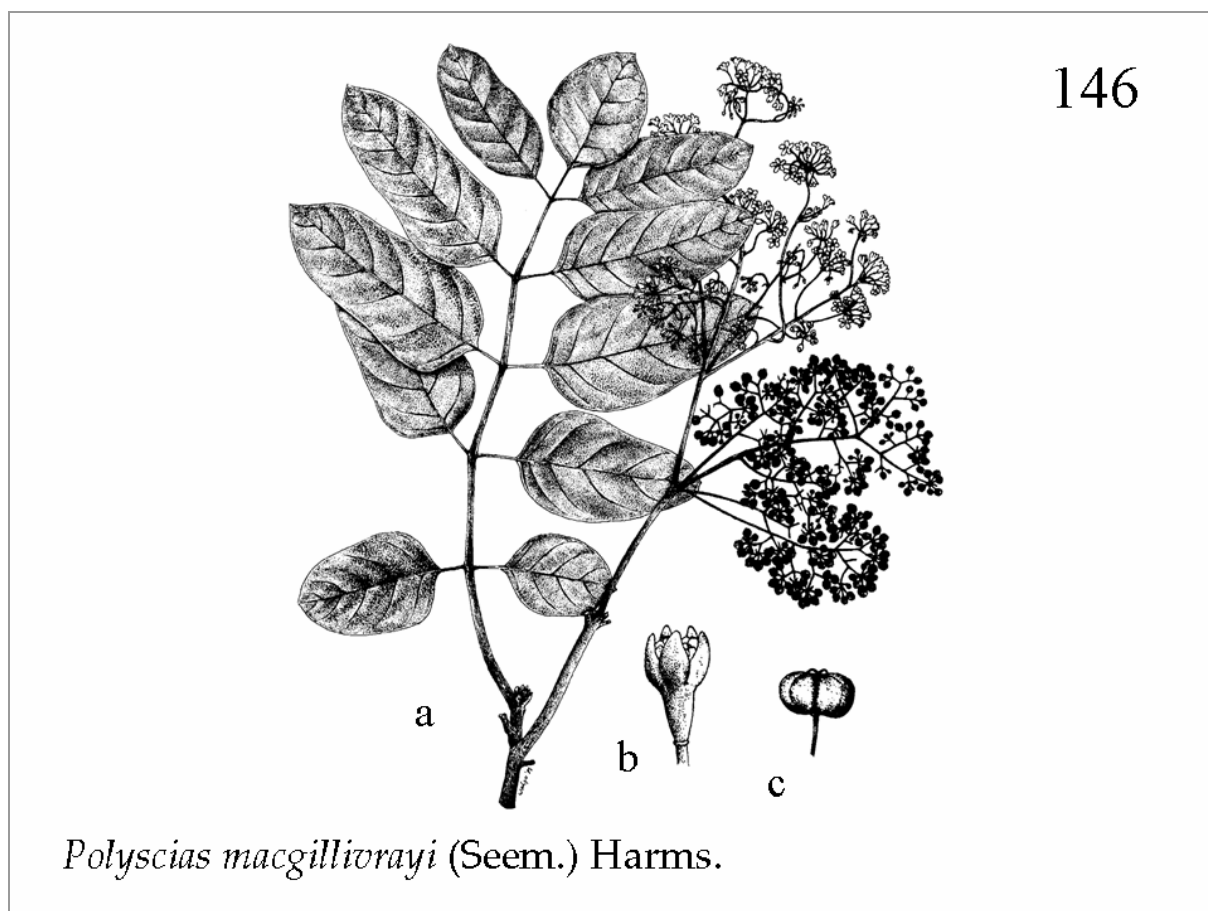


Fig. 146. *Polyscias macgillivrayi* (Seem.) Harms. (a) Branchlet with flowers and fruit, (b) flower, and (c) fruit.

ARALIACEAE

146

***Polyscias macgillivrayi* (Seem.) Harms.**

Synonym(s) : *Nothopanax macgillivrayi* Seem., *Panax grandifolia* Volkens, *Panax macgillivrayi* (Seem.) Benth., *Tieghemopanax macgillivrayi* Viguier

Vernacular name(s) : Aikove, Gambou, Raumonas, Naikaigwoo (PNG)

Description : Shrub or small tree, up to 15 m tall, with a few branches bearing clusters of large leaves. Leaves have a total length of up to 1m. Leaf stalks measure 15 cm, with a sheath around the base that extends up to 6-10 cm along the stalk. Leaflets are oblong, about 20-25 by 8-10 cm, and succulent. Leaf margins are entire, or occasionally slightly toothed, with a rounded tip that has a short point. Stalk of each leaflet measures 10-15 mm. There is one, unpaired, terminal leaflet. Middle and lateral veins are clearly visible. Flowers are borne in a large cluster, with a stout primary stalk, 3-10 cm long, that often bears reduced leaves. Lateral branches of the flower cluster measure 40-50 cm, and the secondary branches are 6-12 cm long. The calyx consists of a minute rim, while the five petals are 2.5 mm long. There are five stamens. Fruits are fleshy, black and compressed, 5 by 6 mm, with a persistent style.

Ecology : Occurs in beach vegetation and in coastal, lowland rain forest, and landward margins of mangroves. Mangrove associate species.

Distribution : Indonesia (Papua), Papua New Guinea, Micronesia, Solomon Islands and Queensland (Australia). Recorded in beach forest near Manokwari in Papua, Indonesia, by first author (Giesen) in May 1997.

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Rijksherbarium Leiden.

Reference(s): Philipson (1979).

147



Calotropis gigantea (L) R.Br.

Fig. 147. *Calotropis gigantea* (L) R.Br. (a) Terminal branch with flowers.

ASCLEPIADACEAE

147

Calotropis gigantea (L) R.Br.

Synonyms : *Asclepias gigantea* L., *Calotropis gigantea* (Willd.) Dryand.

Vernacular name(s) : Sodom's Apple (E), Widuri (Ind.)

Description : Small shrub or tree, up to 1.5 m tall. Stems are slightly woody and much branched at the base, bark greyish, longitudinally cracked. Young stems and leaves are densely covered with white, cottony hairs on the lower side. Leaves are simple, opposite, without stalk or with a very short stalk; blade is 9.5-18cm long by 6-9 cm wide, broadly ovate or ovate-oblong, fleshy, with 6-7 lateral nerves. All parts abound in copious amounts of white juice, that exudes from the plant when cut or otherwise damaged. Flowers usually hang in flat topped or round topped clusters, there usually being only one cluster per stem node. Flower stalks are 6-10 cm long. Calyx lobes are broadly ovate, 4-6 by 2-3 mm, covered with white cottony hairs. The corolla is smooth, white, lilac or purple, with a short tube and wide, ovate-lanceolate lobes with pointed tips, 1-1.5 by 0.5-0.8 cm. The fruit is an inflated vessel, rounded to boat-shaped, greenish, 6.5-8 by 3-5 cm. Seeds are rounded, and covered with many soft, long, silky hairs. It is very similar to *Calotropis procera* (Aiton) R.Br., which occurs from East Africa eastward to Bangladesh, and has been introduced to Australia.

Ecology : Flowering and fruiting occurs throughout the year. Occurs as a weed on open waste ground, along roadsides and railway lines, drier localities, in beach and dune vegetation, and occasionally in mangroves. The juice is an irritant and can cause blindness. Mangrove associate species.

Distribution : From India eastward to Southeast Asia, including Myanmar, Peninsular Malaysia, Thailand and western Indonesia (Java).

Abundance : Common throughout its range.

Use(s) : A fibre is obtained from the stem, and floss from the seeds is used to stuff pillows. Used for medicinal purposes: i) fresh leaves are used for treating swellings and rheumatic pains; ii) extract from the roots is used as a tonic, and iii) milky juice is used as a remedy for leprosy, as a purgative, treating worm infections, or used as a disinfectant to treat wounds.

Source of illustration : Ahmed (1997)

Reference(s) : Afriastini (1988), Rahman & Wilcock (1995).

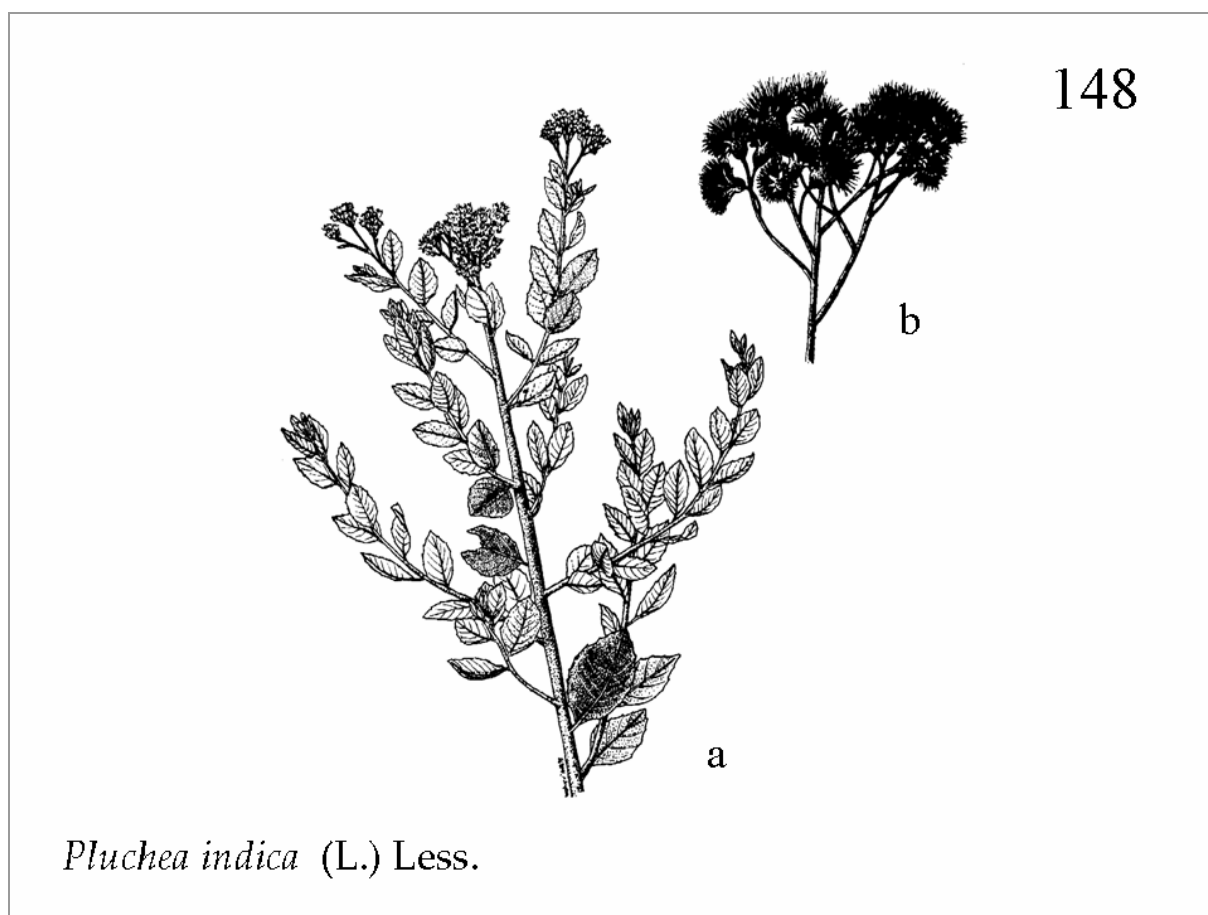


Fig. 148. *Pluchea indica* (L.) Less. (a) Branches with terminal flower clusters, and (b) flower cluster.

ASTERACEAE

148

Pluchea indica (L.) Less.**Synonyms :** *Baccharis indica* L., *Erigeron denticulatum* Burm. f.**Vernacular name(s) :** Indian fleabane, Indian Pluchea, Indian camphorweed (E), Beluntas (Mal.), Beluntas, Lamutasi, Lenabou – *Beluntas* (Ind.), Khluu (Thai), Lú'c cây (Viet.)**Description :** Erect shrub or shrublet, up to 2 m, rarely taller, covered with short, soft hairs, later becoming smooth. It has ribbed, finely crispy, hairy branches. The very short-stalked or almost stemless pale green leaves are arranged alternatively. Leaves are obovate with a tapering base, 2.5-9 by 1-5.5 cm. They have a few small, inconspicuous glands, are very aromatic (especially when crushed) and have a sharp, fine-toothed edge. The flat-topped flower heads are 2.5-12.5 cm wide, and are located at the ends of branches or in the axils; the dense, flowering branchlets are directed upwards. The narrowly-cylindrical flower heads occur on a stalk or are almost stemless, up to 5-6 mm long. The base of the flower head is flanked by several leaflets in 6-7 rows. The outer leaflets are ovate in shape, green, persistent, with fine, crispy hairs. The inner ones are membranous, with a surface covered with fine hairs, lanceolate in shape, and are shed together with the many ripe fruits. There are numerous, violet (with a pale base), thread-like marginal flowers, 3-3.5 mm long, occurring in many rows. There are 2-6 disk-shaped flowers with a violet, 3-5 mm long, tubular corolla with a 5-lobed, outwardly-spreading part at the top. Anthers are also violet and extend beyond the petals. Fruits are top-shaped, brown with pale angles, 1 mm long. The ring of hairs around the top of the fruit is white, 3-3.5 mm long.**Ecology :** Occurs on clayey, often saline soils. Never in the centre of the mangroves, but often on bunds and low ridges crossing it (e.g. those of brackish water fishponds) or on the landward margins of mangroves. Occurs in sunny or slightly shaded localities. Flowering occurs throughout the year. The species is confined to lowland habitats, particularly wetlands and fishponds, and may affect water bird habitats as it crowds out more desirable species. Often found in brackish marshes and other saline habitats including mangroves; occasionally found in forested land at low elevations. Mangrove associate species.**Distribution :** Occurs from India to southern China and Taiwan, throughout Southeast Asia south to Australia and through Polynesia, including Guam, Kiribati and Hawaii. Not (yet) recorded in Brunei.**Abundance :** Common.**Use(s) :** Sometimes cultivated as a medicinal or as a hedge plant. Used for lowering fevers, as a tonic against ulcers, diuretic ingredient for herbal baths. Juice of leaves is used for treating dysentery. There are many more medical applications.**Source of illustration :** Drawn from a live specimen.**Reference(s) :** Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Afriastini (1988), Said (1990), Aksornkoae (1993), Peng (1998).

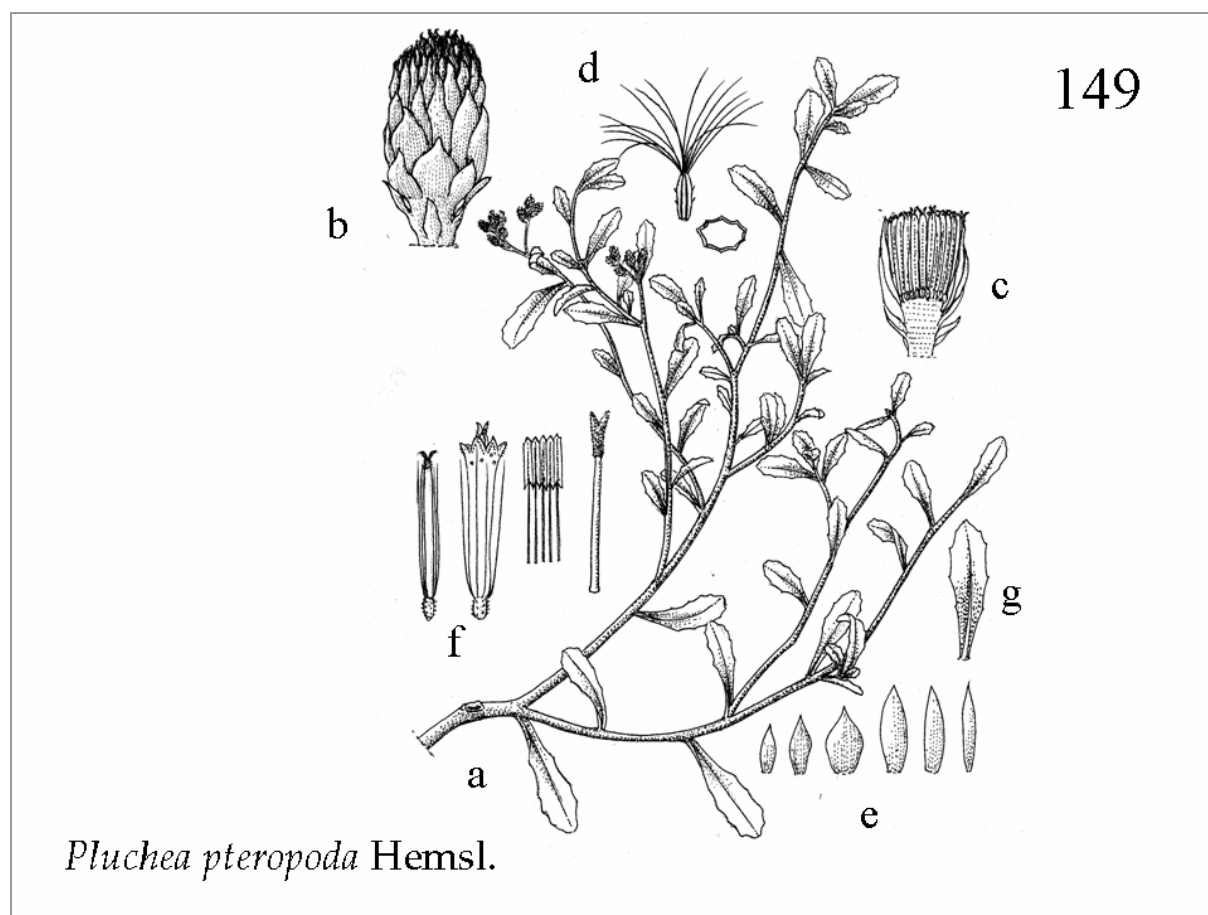


Fig. 149. *Pluchea pteropoda* Hemsl. (a) Flowering plant, (b) flower head, (c) longitudinal section of flower head, (d) seed, (e) outer flower parts, (f) inner flower parts, and (g) leaf.

ASTERACEAE

149

Pluchea pteropoda Hemsl.

Synonyms : *Pluchea leptophylla* Hong & Chen

Vernacular name(s) : (Cây Lú'c) Có sài hô' (Viet.)

Description : A much branched shrub or shrublet, sprawling to ascending, stems smooth or (rarely) sparsely covered with hairs; branches ascending; up to about 1.5 m tall. Leaves are simple, alternate, obovate to oblong-lanceolate, 3-5 cm by 0.7-1.7 cm, with a blunt to rounded leaf tip; apparently without a stalk, leaf edges irregularly and sparsely toothed, leaf blade smooth on both sides; upper leaves smaller and narrower. Flower head 6-8 mm diameter (when fresh) or 10 mm (dried specimens), 7 mm long and with a short flower stalk, occurring in dense, terminal clusters. Each flower head consists of numerous 'florets', reddish brown, with pale ribs. The circle of leaflets at the base of each flower head is more-or-less round to widely bell-shaped, and each leaflet is smooth, arranged in fives or sixes, the outer broadly ovate, the tips blunt to rounded, 2.5-4 mm by 2-3 mm; the inner linear to lanceolate, tips pointed, 4-5 mm by 0.5-1 mm. The top of the flower head is flattened. Outer small florets are numerous, corolla threadlike, narrowed towards the tip, 3.5-4 mm long. Central florets number 18-22, corolla 4-5 mm long, 5-lobed at tip, lobes triangular.

Ecology : Occurs in a wide variety of habitats, including sand dunes, dikes along the coast, abandoned fields, (degraded) mangroves, and ruderal areas. In Thailand, mangrove forests degraded by cattle grazing, are gradually taken over by salt-loving grasses such as *Cynodon dactylon* and *Sporobolus virginicus*, along with *Pluchea pteropoda* and sedges such as *Scirpus* species or *Cyperus stoloniferus*. Mangrove associate species.

Distribution : East and Southeast Asia. Recorded in Southeast Asia in Thailand and Vietnam.

Abundance : Locally common.

Use(s) : Medicinal plant, with a variety of active ingredients.

Source of illustration : Peng *et al.* (1998)

Reference(s) : Peng *et al.* (1998), Luger *et al.* (2000)
<http://ratree.psu.ac.th/~bnoparat/MANGROVE.html>.

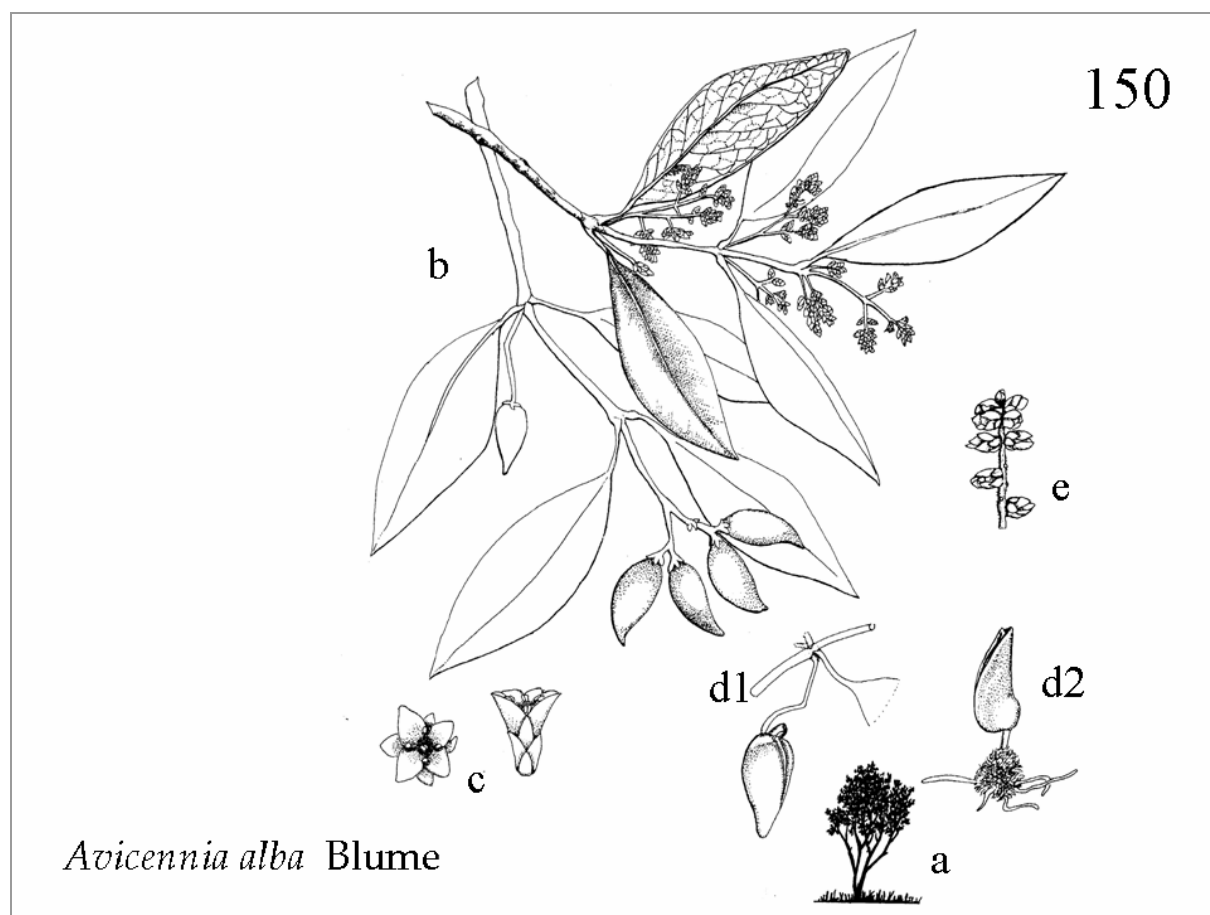


Fig. 150. *Avicennia alba* Blume. (a) Habit, (b) branch with flowers and fruit, (c) flower, seen from top and side, (d) fruit, and (e) buds.

AVICENNIACEAE

150

Avicennia alba Blume

Synonyms : *Avicennia marina* (Forssk.) Vierh. var. *alba* (Blume) Bakh.

Vernacular name(s) : Api-api (Mal.), Api-api, Mangi-mangi Putih, Boak, Koak (Ind.), Api-api, Kachuchis, Piapi, Pundung – *Bungalon-puti* (Phil.), Mâ'm lu'ôi dồ'ng (Viet.), Kbagsor, Mouroujsrotorb, Sman (Camb.), Samae khao (Thai)

Description : Spreading shrub or tree, up to 10 m, occasionally even 25 m, tall. It produces a complex system of horizontal roots and pneumatophores. The latter are thin, finger-like (or asparagus-like) and covered with numerous lenticels. The outer bark is greyish or brownish, and may be either warty or smooth. On older stem parts a pale, powdery mould often occurs. Trunk may attain a diameter of 50 cm at breast height. The pointed leaves are oblong or lanceolate, rarely elliptic, smooth, glossy-green above and very pale beneath, measuring up to 16 by 5 cm. The upper surface is covered with numerous sunken, glandular dots. The yellow to orange flowers measure 3-4 mm across, and occur in 10-30-flowered clusters that are 1.5-3 cm long. The lowest pair of flowers is somewhat distantly located from other flowers of the cluster. Usually only the upper half of the ovary is hairy, while the style is absent. The conical, greyish-green fruit is gradually narrowed to an extended beak-like tip, and can measure up to 4 cm. Sometimes included in the Verbenaceae.

Ecology : Pioneering species of mangrove swamps on sheltered shores, also in the more saline parts, along tidal river banks and along the seashore. It prefers the entrance of bays. Their roots reportedly aid sediment accretion and accelerate the land-building process. Flowering occurs all year round. The genus is sometimes viviparous, with fruit (partly) germinating while still on the tree. Mangrove species.

Distribution : Occurs from India to Southeast Asia, where it has been recorded in Myanmar, Cambodia, Malaysia (Peninsular, Sarawak), Singapore, Brunei, throughout Indonesia, the Philippines, Papua New Guinea and tropical Australia.

Abundance : Abundant.

Use(s) : Firewood and low quality construction timber; sap used to prevent pregnancy. Seedlings are cooked and eaten as a vegetable. Seeds are a source of resin and ointment for treating skin diseases and wounds.

Source of illustration : Based on Percival & Womersley.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

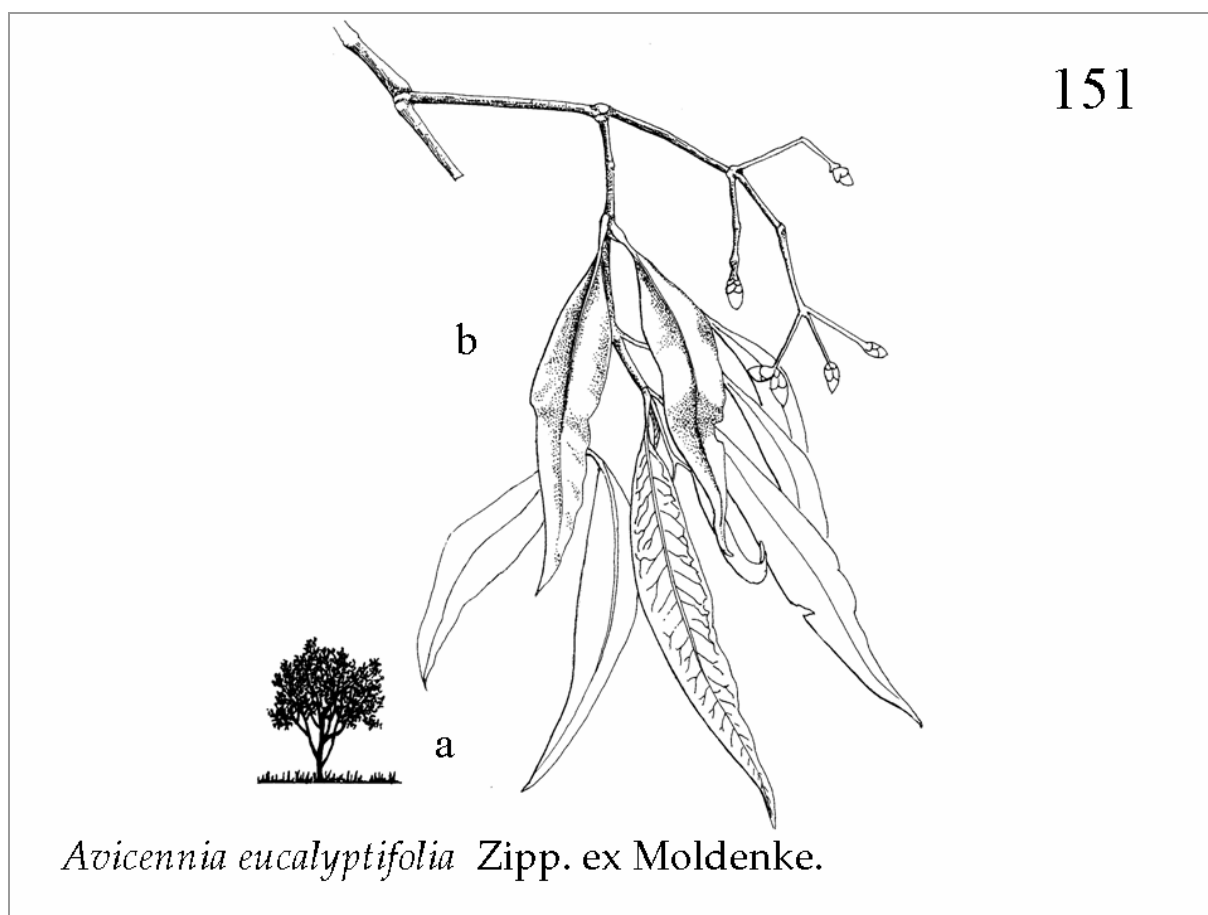


Fig. 151. *Avicennia eucalyptifolia* Zipp. ex Moldenke. (a) Habit, and (b) branchlet with fruit.

AVICENNIACEAE

151

Avicennia eucalyptifolia Zipp. ex Moldenke

Synonyms : *Avicennia eucalyptifolia* (Zipp. ex Miq) Moldenke, *Avicennia marina* subsp. *eucalyptifolia* (Zipp. ex Moldenke) J. Everett, *Avicennia marina* var. *eucalyptifolia* (Zip.. ex Moldenke) N.C. Duke, *Avicennia officinalis* var. *eucalyptifolia* Valet.

Vernacular name(s) : Api-api (Mal./Ind.), Api-api, Kachuchis, Piapi, Pundung – *Bungalon-sahing* (Phil.)

Description : Shrub or small tree up to 16.5 m tall and a diameter at breast height of up to 46 cm; trunk often crooked or bent. The smooth outer bark is mottled, yellowish-brown, or green, peeling off in thin flakes. The inner bark is straw-coloured to pale brown. Wood is white to straw-coloured. Leaves are pointed, lanceolate or narrow-lanceolate, measuring 4-16 cm by 1-4 cm, light to dark green or brownish-green above, greenish-yellow below. The flower cluster is enlarged at the end, and up to 2.5 cm long. Flowers are 3-4 mm in diameter, with a white, yellow or orange corolla, lobes 3-4 mm long and tube 1-2 mm long. The calyx is pale green, 2-5 mm long, covered with short hairs on the outside and smooth on the inside. The upper half of the ovary is usually hairy. Stamens are deep purple to brown. The greenish-yellow fruit has no conspicuous beak and is shorter than 3 cm. Regarded by some authors as a Papuan variety or subspecies of *Avicennia marina*. Sometimes included in the Verbenaceae.

Ecology : Occurs on off-shore (coral) islands, in the vicinity of coral reefs, and also on the landward margin/middle of mangrove swamps. As with other members of this genus, it is sometimes viviparous, with fruit (partly) germinating while still on the tree. Mangrove species.

Distribution : Recorded eastern Indonesia (Papua), the Philippines and Papua New Guinea.

Abundance : Common.

Use(s) : Used for timber and as firewood.

Source of illustration : Based on Percival & Womersley.

Reference(s) : Burkill (1935), Percival & Womersley (1975), Johnstone & Frodin (1982), Tomlinson (1986).

152

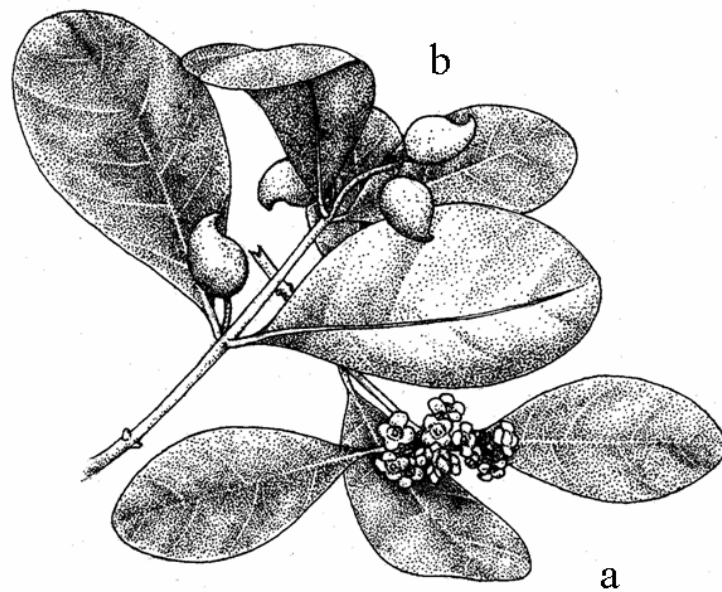
*Avicennia lanata* Ridley

Fig. 152. *Avicennia lanata* Ridley. (a) Branchlet with flowers, and (b) branchlet with fruit.

AVICENNIACEAE

Avicennia lanata Ridley

152

Synonyms : *Avicennia officinalis* var. *spathulata* Kuntze, *Avicennia rumphiana*

Vernacular name(s) : Api-api (Ind.), Api-api berbulu, Api-api bulu (Mal), Mâ'm quân (Viet.)

Description : Tree, up to 30 m tall and 3 m girth, but usually much smaller. Stem not buttressed but cylindrical, with a straight trunk when growing in a closed stand. Bark is dark grey and smooth. Roots have pencil-like pneumatophores emerge above ground from long shallow underground roots. Twigs are quadrangular but rounded, and when young they are covered with dense tawny coloured hairs. Leaves are simple, opposite, ovate or elliptic, sometimes a bit pointed, 10 by 6 cm, thick, entire, with non-curved edges, dark green above, covered with dense, flannel-like tawny (or yellowish-white), powdery hairs beneath. Midrib of leaf is prominent beneath, covered with hairs like the rest of the underside. Leaf stalk about 18-20 mm long, slender. Fragrant flowers clustered in three-branched heads, all parts densely covered with very fine hairs; flower stalks quadrangular; flowers small, 4-lobed, orange-yellow, fragrant. Corolla smooth inside, densely hairy outside, lobes strongly recurved. Fruit broadly ovoid, compressed, not more than about 18 mm in length, as broad as long, covered with dense woolly hairs. Woolly flat capsule containing one seed, green to yellowish brown. The vernacular name *berbulu* refers to the hairy state of the plant. Sometimes included in the Verbenaceae.

Ecology : Gregarious on the east coast of Peninsular Malaysia, where it replaces *Avicennia marina* on soils that are on the whole sandier than on the west coast. The largest of the *Avicennia* species, according to Watson (1928). The felt-like hairs on the leaves conserve water by trapping a layer of insulating air and thus reduce water loss through evaporation. Mangrove species.

Distribution : Endemic to Southeast Asia, occurring along the east coast of Peninsular Malaysia, sporadically occurring in Singapore (old records; possibly now locally extinct), western Sarawak, the Philippines (Aurora Province), Vietnam, Papua New Guinea and Indonesia (Bunaken, North Sulawesi). Probably also occurs in Thailand and western Indonesia (Kalimantan, Sumatra). Reports from Bali and Lombok are questionable.

Abundance : Locally common to very common, but with a restricted range.

Use(s) : Firewood and building material. The seeds are boiled and eaten, in some places, they are sold in markets as vegetables. The fragrant flowers produce nectar and are pollinated by insects; produces some of the best honey. This fast growing mangrove tree is among the few used in replanting mangroves to protect coastlines (the others are *Sonneratia* and *Rhizophora*). It is rarely used to make charcoal and is used as firewood only to smoke fish or rubber.

Source of illustration : Re-drawn from live specimen.

Reference(s) : Watson (1928), Kochummen (1978b), Tomlinson (1986), Hong & San (1993), Davie *et al.* (1996), Wilkie (1996), www.arcbc.org.ph/archcweb/wetlands/singapore/sgp_man.htm.

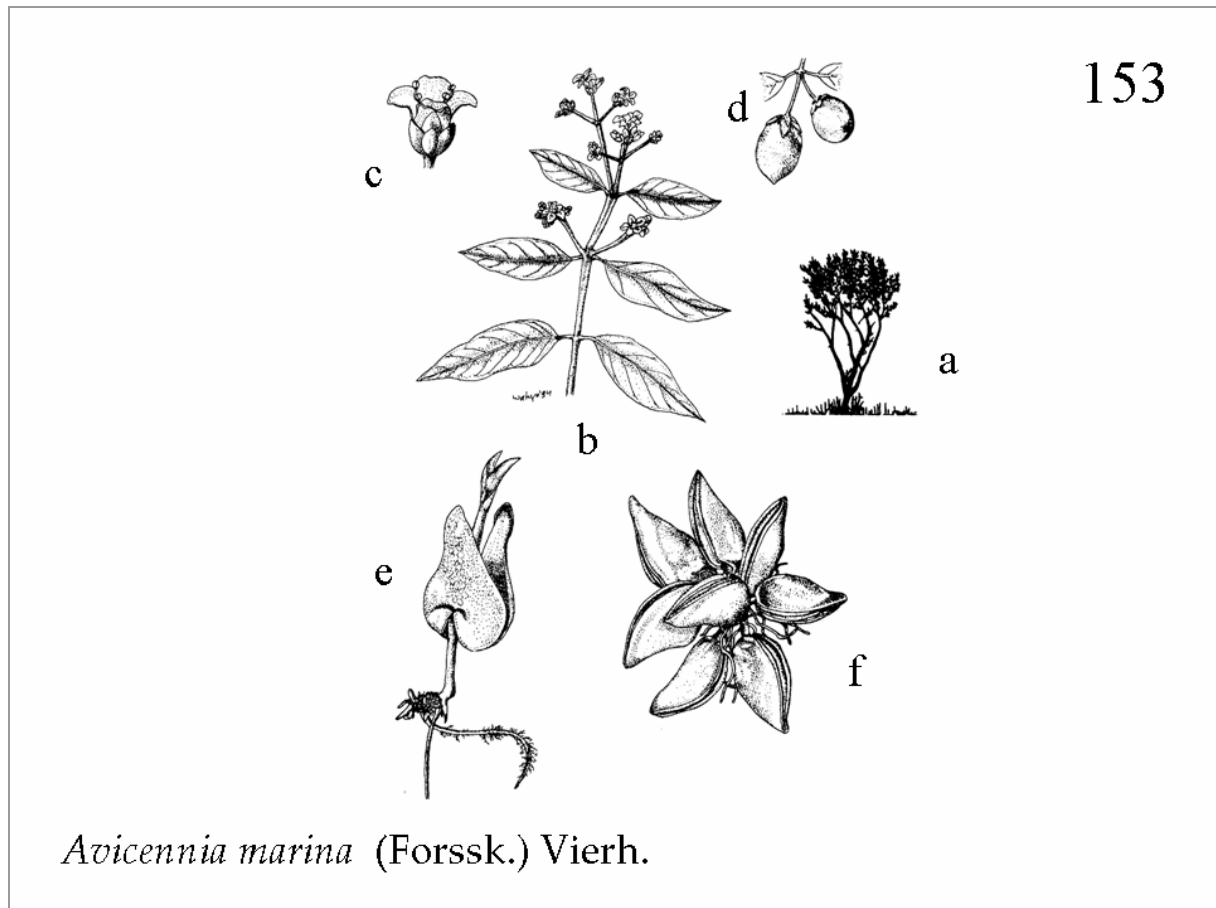


Fig. 153. *Avicennia marina* (Forssk.) Vierh. (a) Habit, (b) branchlet with flowers, (c) flower, (d) fruit, (e) germinating fruit, and (f) cluster of fruit tangled together (regularly found like this washed up along the shoreline).

AVICENNIACEAE

153

Avicennia marina (Forssk.) Vierh.

Synonyms : *Avicennia intermedia* Griff., *Avicennia marina* var. *acutissima* Stapf & Moldenke, *Avicennia marina* var. *anomala* Moldenke, *Avicennia marina* var. *australasica* (Walp.) J. Everett, *Avicennia marina* var. *intermedia* (Griff.) Bakh., *Avicennia marina* var. *marina*, *Avicennia marina* var. *resinifera* (Forst.) Bakh., *Avicennia marina* var. *rumphiana* (Hall. f.) Bakh., *Avicennia marina* var. *typica* Bakhuisen, *Avicennia mindanaense* Elmer, *Avicennia officinalis* L., *Sceura marina* Forssk.

Vernacular name(s) : Api-api puteh (Mal.), Api-api Putih, Api-api Abang (Ind.), Api-api, Buñgalon, Buñgalu, Kalapini, Kalapini-mañgitit, Kalapini-maputi, Lulasi, Kuyapi, Liñgog, Mabaran, Miapi, Piapi, Piksik, Pipisig, Pipisik, Sagarai – *Buñgalon* (Phil.), Mâ'm ô'i (Viet.), Samae, Samae thale (Thai.), Kbagn, Mouroujsrotorb, Sporn (Camb.)

Description : Erect or spreading shrub or tree, usually up to 10 m, occasionally even 30 m. It has a complex system of horizontal roots and pencil-like (or asparagus-like), thin, erect pneumatophores with numerous lenticels. The smooth bark is green-grey mottled and peeling in patches. The young twigs, leaf stalks, midrib, the lower surface of the leaves and the upper surface of the expanding leaves are yellow, but not hairy. The elliptic-oblong or oblong-obovate leaves with a round tip have a pale green lower surface and measure up to 9 x 4.5 cm. The upper surface is covered with numerous, sunken, glandular dots. The terminal flower clusters have 2-12 flowers. The lowest pair of flowers is sometimes distant from the others. The regular, (dark) orange flowers are small (5-8 mm), waxy, have a strong odour not unlike that of rotten fruit, and abundant nectar. The corolla has four equal lobes. The ovary has a short style and a median ring of hairs that do not obscure the stigma. The fleshy, greyish-green, never yellowish fruit measures about 2 cm across and is round or heart-shaped. At the top it is rounded or at most has a short-beaked tip, with persistent leaflets at the base of the stalk and a persistent calyx. Sometimes included in the Verbenaceae.

Ecology : Pioneer on sheltered shores, capable of colonising many tidal habitats, even very saline ones. It is one of the most common members of the intertidal flora. Roots reportedly aid accretion of sediment and accelerate land-building processes. It may also form single-species stands. Flowering occurs all year round. As with other members of this genus, it is sometimes viviparous, with fruit (partly) germinating while still on the tree. The fruit opens when ripe via the upper suture (seam), either after absorption of water, or due to consumption by ants. Mangrove species.

Distribution : Wide ranging pantropical and subtropical species, found in mangroves of Africa, Asia, South America, Australia and Polynesia. Occurs throughout Southeast Asia.

Abundance : Abundant.

Use(s) : Leaves are used to treat burns. Bark resin is used as a contraceptive. The fruit is edible. Wood produces a good-quality pulp for paper production, as the hollocellulose content is almost 70%, while lignin and pentosan contents are low. Leaves used for fodder.

Source of illustration : Percival & Womersley (1975), Tomlinson (1986), Wightman (1989).

Reference(s) : Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

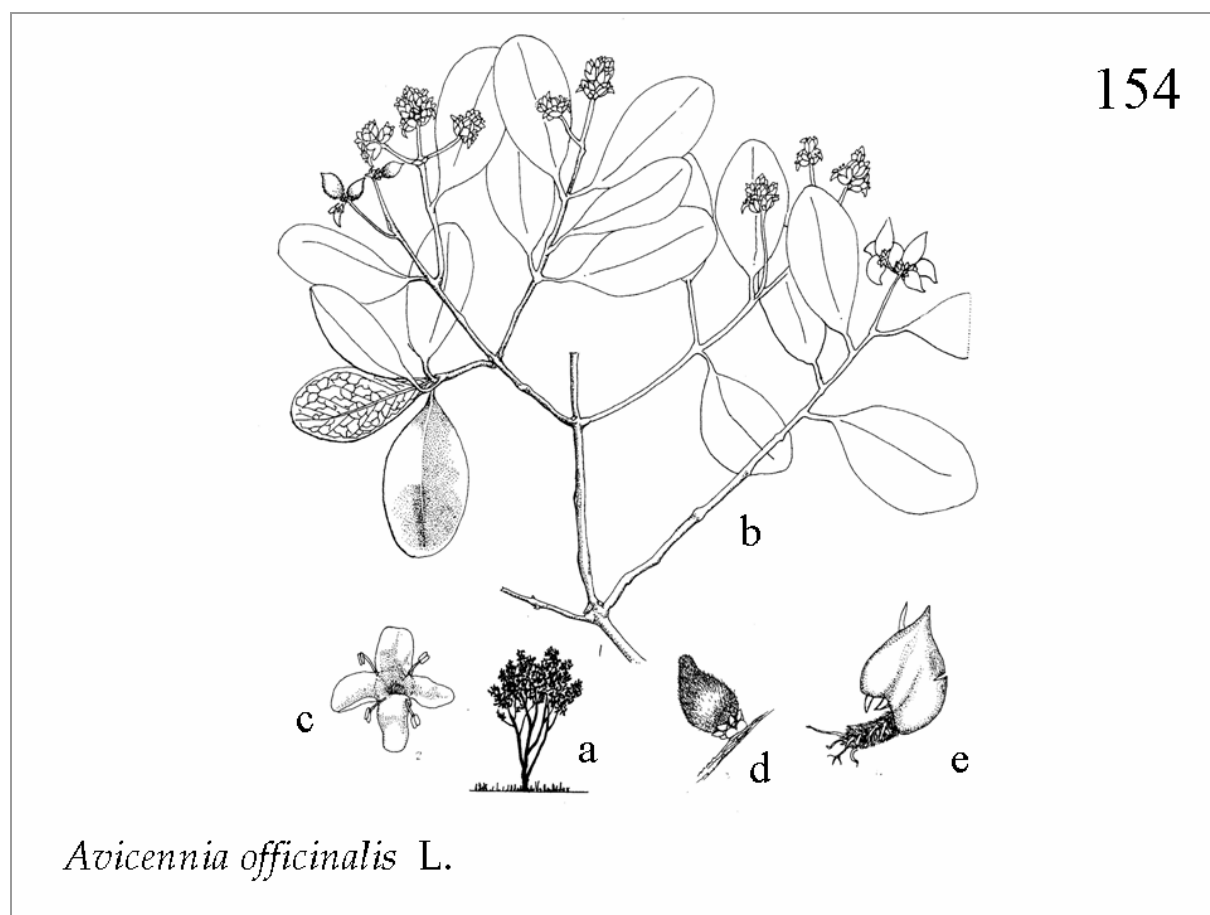


Fig. 154. *Avicennia officinalis* L. (a) Habit, (b) branchlet with flowers and fruit, (c) flower, (d) fruit, and (e) germinating fruit.

AVICENNIACEAE

154

Avicennia officinalis L.

Synonyms : *Avicennia tomentosa* Willd.

Vernacular name(s) : Api-api (Mal.), Api-api Daun Lebar, Api-api Ludat (Ind.), Thame (Myan.), Mâ'm den (Viet.), Samae, Samae dam (Thai.), Kbagmkmao, Spong (Camb.)

Description : Tree, usually up to 12 m, occasionally up to 22.5 m tall. Unlike other species of the genus often develops stilt roots; it always has pneumatophores that are thin, finger-like (or asparagus-like) and covered with numerous lenticels. The smooth, outer bark is yellowish-green to brownish-grey and also has lenticels. Leaves have a rounded top, and are obovate, oblong-obovate or elliptic-oblong. They gradually narrow into the leaf stalk, are dark green above and yellowish-green or bluish-grey beneath, measuring up to 12.5 by 6 cm. The upper surface is covered with numerous, sunken, glandular dots. The flower heads are rather short, 1-1.5 by 0.5 cm, more or less round, and with 2-12 flowers. The lowest pair is often distant from the other flowers. Leaflets surrounding the base of the flower stalk are black-tipped and have a fringed margin. The flowers themselves are large, 10-15 mm across, rancid-smelling, orange-yellow, and covered with short, soft hairs on both surfaces. The tips of the petals unfold in an irregular way and blacken somewhat with age. Stamens are longer than the corolla. The ovary is entirely covered with short, dense hairs, except the tip of the well-developed style. Fruit is densely covered with short hairs, measures about 3 cm, and is broadly ovate with a short beak. Sometimes included in the Verbenaceae.

Ecology : Occurs on the landward margins of mangrove swamps, especially along tidal river banks and river mouths. Flowering occurs all year round. Near sea level, but recorded to levels of 50 m asl. in Papua. Mangrove species.

Distribution : Occurs from East Pakistan, southern India, Tanasserim (Myanmar), Andaman Islands, and Sri Lanka through coasts of Vietnam, Thailand, and Peninsular Malaysia to the Philippines, Sumatra, Madura, Java, Borneo, Celebes, Sunda Islands, Molucca Islands, and New Guinea; south in Australia to New South Wales. Found throughout Southeast Asia, but not (yet) reported from Brunei.

Abundance : Common.

Use(s) : Fruits edible. Wood used as fuel. Resin in bark used as contraceptive.

Source of illustration : Drawn from herbarium material, Herbarium Bogoriense.

Reference(s) : Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Said (1990), Aksornkoae (1993), Marschke (2000)

<http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>

http://www.hort.purdue.edu/newcrop/duke_energy/Avicennia_officinalis.html.

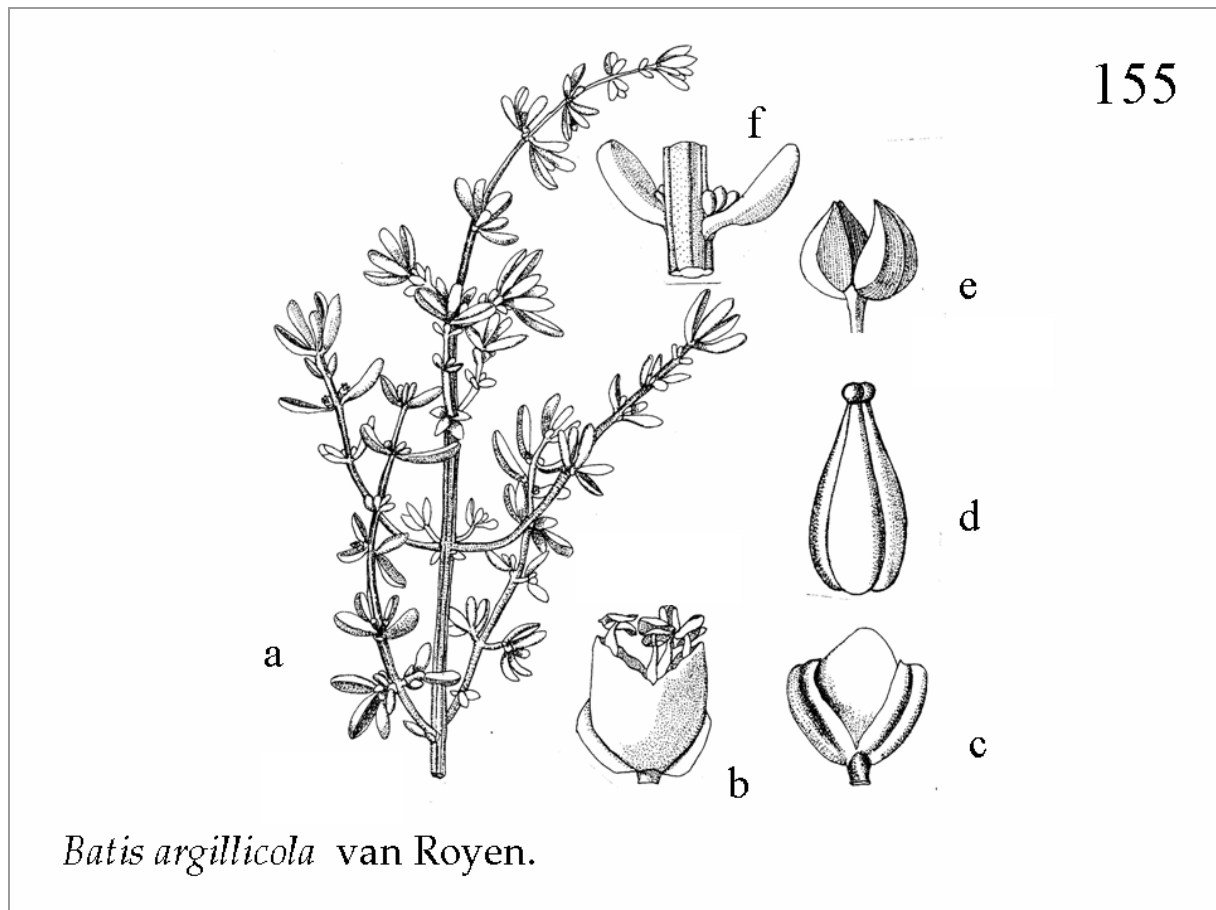


Fig. 155. *Batis argillicola* van Royen. (a) Flowering stem, (b) male flower still enclosed by two bracts, (c) juvenile male flower, (d) female flower, (e) two immature fruits and (f) leaves with flower buds.

BATIDACEAE

155

Batis argillicola van Royen**Synonyms :** Unknown.**Vernacular name(s) :** Saltwort (E), Haha (Ind.), Ahake (PNG)

Description : Small, succulent and smooth shrub, up to 70 cm tall, with thick, woody roots, a woody base and fibrous, grey bark. Leaves are linear to rounded/egg-shaped, 4-15 mm long. This species has both male and female flowers on the same individual plant. Flowers and fruits are solitary, occurring in the axils of leaves or at the end of branches. It has leaflets surrounding the base of the flower stalk. The small leaflets partially enveloping male flowers consist of two membranous, fused parts. The female flower mainly consists of a naked ovary. The fruit is a 9-11 by 4-5 mm berry, which when ripe opens into two compartments. Seeds are oblong, measuring 5-5.5 by 1.2 mm.

Ecology : Occurs on saline, clayey plains that are rarely flooded by seawater, and on the landward margins of mangroves. Usually either solitarily on landward margins of mangroves, or gregariously on mudflats and in tidal marshes. It is also found on sandy banks of small creeks, in open connection with the sea but out of reach of normal high tide. Flowering occurs from August to October, and fruiting from December to January (in Australia). The flower is probably pollinated by insects, and the fruit is well adapted to water dispersal. Differences have been reported between material from Papua and from Australia in leaf, stamen and flower cluster characters. This genus consists of two species that display a remarkably discontinuous distribution. *Batis maritima* is confined to Hawaii, the Galapagos islands and the America's, where it is found on saline clayey plains, regularly inundated by tides. Distribution of *Batis argillicola* is still insufficiently known. In 1994, *Batis argillicola* was reported to be expanding along the coast near Wasur National Park in Papua (pers. comm. Kristyo Budi Asmoro). This expansion was apparently occurring at the expense of *Rhizophora*, with even large seedlings of the latter dying off, perhaps due to allelopathy. Batidaceae is a small family – related to Amarantaceae and Chenopodiaceae – with only one genus and two disjunctive, restricted range species. Mangrove associate species.

Distribution : Eastern Indonesia (southern Papua, near Merauke), Papua New Guinea and tropical Australia (Queensland).

Abundance : Locally common.

Use(s) : Locally used in salads.

Source of illustration : Based on van Royen (1957), Wightman (1989).

Reference(s) : van Royen (1957), Wightman (1989), Heywood (1993).

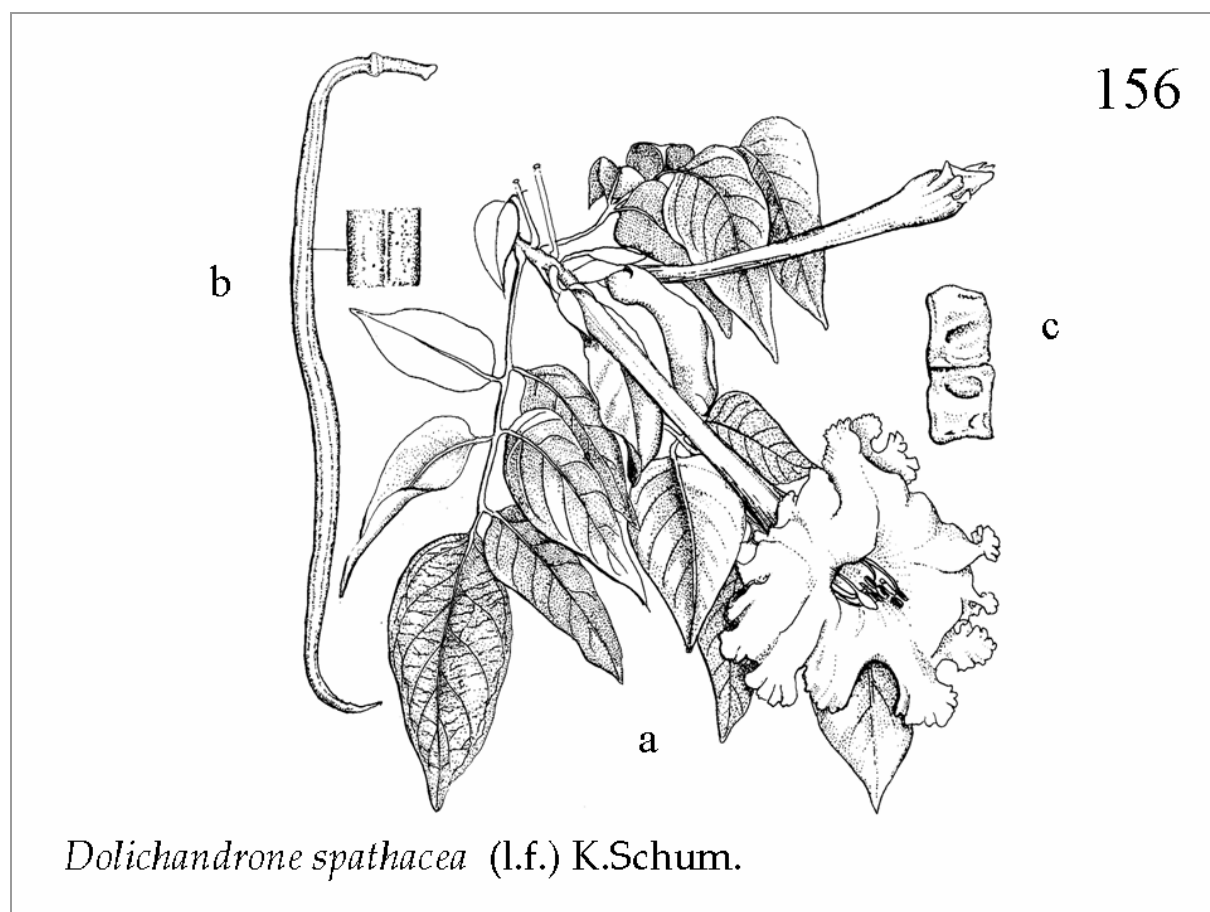


Fig. 156. *Dolichandrone spathacea* (l.f.) K.Schum. (a) Branch with two flowers, (b) fruit, and (c) two seeds (of the many enclosed in the fruit).

BIGNONIACEAE

156

Dolichandrone spathacea (L.f.) K.Schum.

Synonyms : *Bignonia javanica* Thunb., *Bignonia longiflora* Willd. ex DC., *Bignonia longissima* Lour., *Bignonia spathacea* L., *Dolichandrone longissima* K. Sch., *Dolichandrone rheedii* Seem., *Lignum equinum* Rumph. *Pongelia longiflora* Rafin., *Spathodea diepenhorstii* Miq., *Spathodea longiflora* Vent. Choix., *Spathodea loureiriana* DC., *Spathodea luzonica* Blanco, *Spathodea rheedii* Spreng.

Vernacular name(s) : Poko kulo, Tuj (Mal.), Kayu Jaran, Ki Jaran, Tuwe-ej, Kudo-kudo Uwi, Kuda-kuda, Ki Arak, Jarang, Jaran Pelok, Jaranan, Kajeng Kapal, Kaju Pelok, Kapal, Kayu Jiharan, Kayu Jaran Binek, Kelaju, Tuw, Fojet, Kaju Pelumping, Sangi, Tomana, Kayu Kuda, Kati-kati (Ind.), Pata, Stanghas, Tañgas, Tanhas, Twei, Tiwi, Tua - *Tui* (Phil.), Latiu (PNG), Khale thale (Thai), Quao nu'óc (Viet.)

Description : Evergreen, smooth tree, 5-20 m with a trunk that is cylindrical, short, often crooked, and usually measures no more than about 30 cm diameter at breast height. Bark is grey to dark brown and somewhat fissured in older trees. Young parts are often red and somewhat sticky. There are usually 3-4 pairs of leaflets on a leaf, which measures 15-35 cm. Leaflets are thin, ovate-oblong to lanceolate, unequal-sided and long-tipped, 6-16 by 3-7 cm, with hairy domatia (hollows for ants/insects) underneath. Flowers are large, conspicuous, trumpet-shaped, white to greenish-white or yellow. The flower clusters bear 2-8 fragrant flowers that open one at a time. The greenish-white calyx measures 3-6 cm across, is leathery, beaked and has many glands. The large, trumpet-shaped corolla is 12-18 cm long and 7-12 cm in diameter. The five lobes, 2.5-3 cm, are broad, frilled around the edge and have large glands. The long, horn-like fruit measures 25-70 by 2-3 cm and has hard, leathery partitions. The dark grey seeds are very numerous, rectangular, arranged in many rows, each measuring 12-18 by 6-8 mm, including the thick, corky wings.

Ecology : Confined to the landward margin of mangroves, banks of tidal rivers and estuaries, and beach vegetation. Flowering occurs all year round. At times the tree is nearly leafless. In Central and East Java it fruits in the dry season (June-August). The very fragrant flowers open at dusk and drop before sunrise. They are apparently pollinated by hawkmoths, which are equipped with very long tongues. Self pollination occurs. The corky seeds float readily and are dispersed by seawater. In this respect it is strange that this species is not found in Australia and Polynesia. Mangrove associate species.

Distribution : From the coast of Malabar (India) throughout tropical Southeast Asia to the west-Pacific and the Solomon Islands. Not recorded in Australia and Polynesia.

Abundance : Common.

Use(s) : Of little use other than firewood. The wood is not durable, but light and easy to work, usually for making small household utensils. Requires rapid drying to prevent blue stain. Sometimes the wood is used for floats of fishing nets in East Java. In Madura it is used for making traditional *wayang orang* masks. Tea brewed from the leaves is used to treat mouth infections.

Source of illustration : Based on Percival & Womersley (1975) and Tomlinson (1986).

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), van Steenis (1977), Tomlinson (1986), Aksornkoae (1993), Aragones *et al.* (1998).

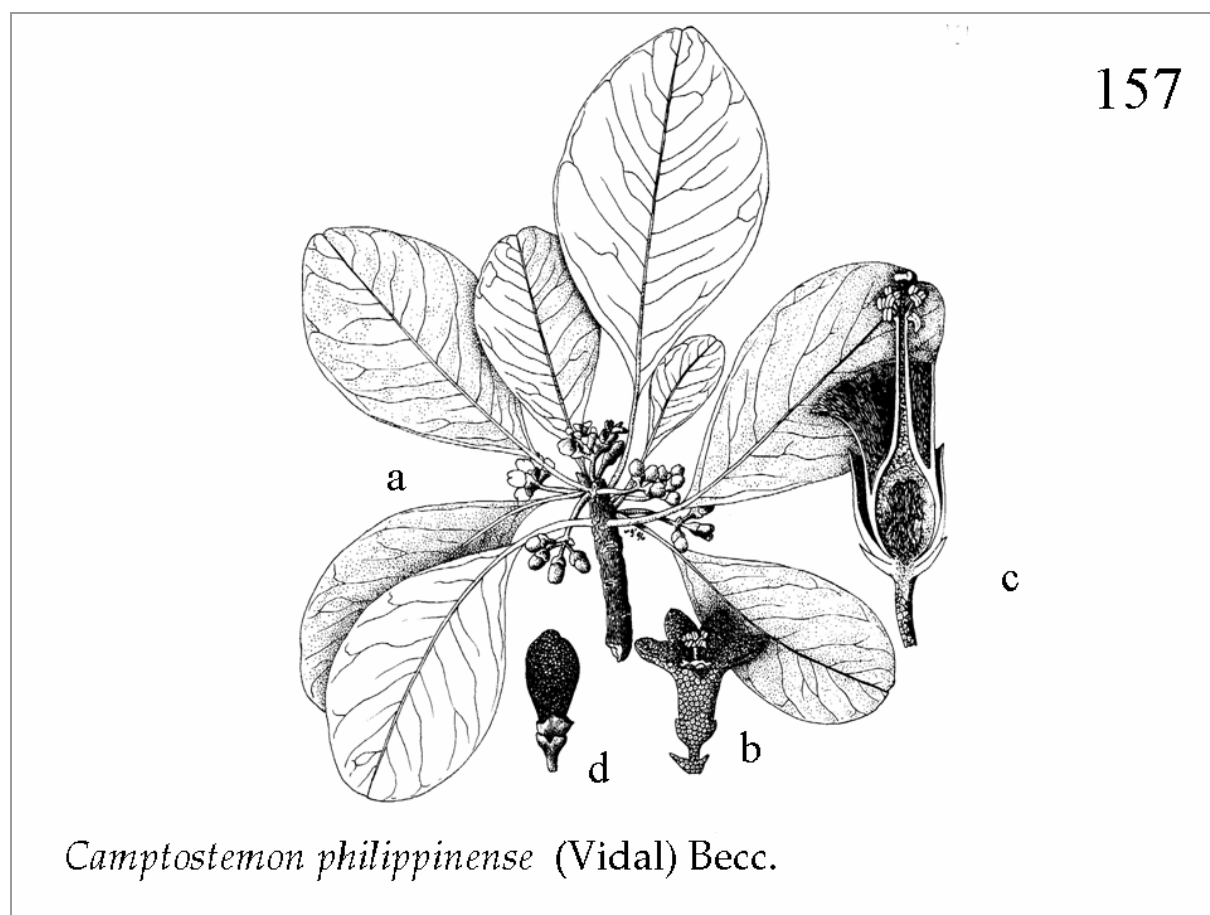


Fig. 157. *Camptostemon philippinense* (Vidal) Becc. (a) Branchlet with flowers and fruit, (b) flower, (c) cross-section of flower, and (d) fruit.

BOMBACACEAE

157

***Camptostemon philippinense* (Vidal) Becc.**

Synonyms : *Cumingia philippinensis* Vidal, *Neesia altissima* (non Bl.) F.Vill.

Vernacular name(s) : Baluno, Buñgalon, Dandulit, Lapa-lapa, Libatong-puti, Nigi-puti – *Gapas-gapas* (Phil.)

Description : Soft-wooded, evergreen shrub or tree, usually 6-10 m, occasionally up to 30 m, with a grey bark that has longitudinal fissures and a fluted stem base. The roots spread along the surface of the soil, and may bear knobbly pneumatophores. Twigs have round leaf scars. The leaves, 6-9 by 2-4 cm, are elliptic lanceolate, scaly on both sides, have a rounded point and a narrow base. The flower clusters are crowded and occur in leaf and stem axils, on short (1-2 mm) stalks. The calyx is bell-shaped, with irregular limbs, 2-5 lobes. The corolla is scaly, covered with short hairs, white, with 5 petals and 5 stamens that are united at the base; flowers are about 5-6 mm across. The round fruit is a small, pear-shaped capsule, 1-1.5 cm long, scaly, and has a persistent calyx and epicalyx. The fruit contains two (occasionally 3 or 4) 9 mm-long, densely woolly seeds. Differs from *Camptostemon schultzei* by the presence of small, scurfy scales on both sides of the leaves, which are absent in *Camptostemon schultzei*. The two species are said by Bakhuizen van den Brink to differ in leaf shape (elliptic in *Camptostemon schultzei*, obovate-oblong to lanceolate in *Camptostemon philippinense*), but they both have a similar range in leaf size. According to Tomlinson (1986), bark of this species is scaly and without fissures.

Ecology : The species is usually observed on the inner edges of the mangrove forest, often reaching the margins and bordering the tidal streams. True mangrove species.

Distribution : Southeast Asian species, found in the Philippines and Indonesia (Borneo and Sulawesi). Geographic range does not overlap with that of *Camptostemon schultzei*.

Abundance : Uncommon to locally common.

Use(s) : The wood is moderately soft but fairly strong; seasons well with negligible checking and warping. It is easy to work and fairly durable for interior work, though not lasting when exposed to the weather. Has potential for pulp and paper production, owing to the high holocellulose and low lignin content. Used for household utensils, carvings and inlays.

Source of illustration : Based on Bakhuizen van den Brink (1924).

Reference(s) : Bakhuizen van den Brink (1924), Tomlinson (1986), Aragonés *et al.* (1998).

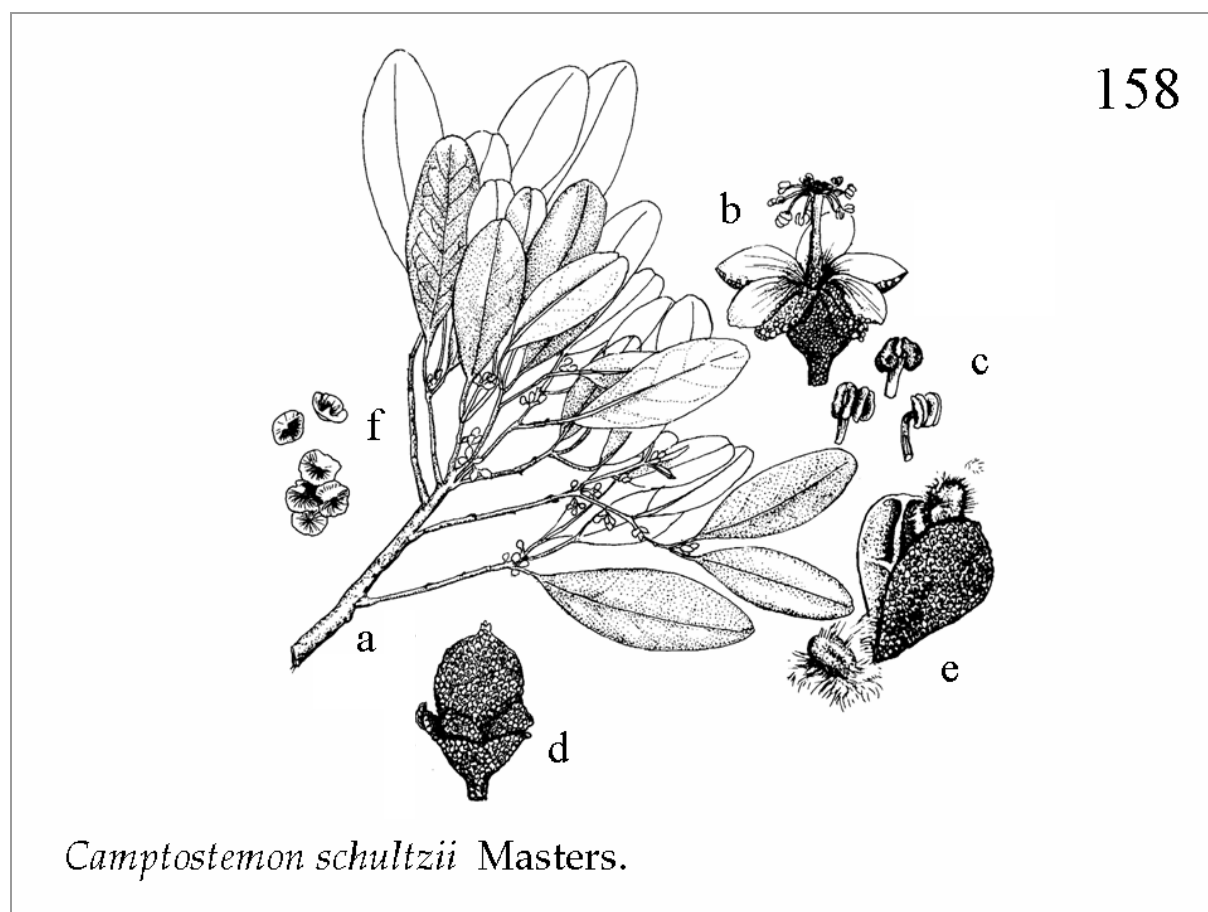


Fig. 158. *Camptostemon schultzei* Masters. (a) Branchlet with buds, (b) flower, with (c) extra stamens drawn separately, (d) fruit, (e) fruit with woolly seeds emerging, and (f) detail of scales on leaf.

BOMBACEAE

158

Camptostemon schultzei Masters

Synonyms : *Camptostemon aruense* Becc.

Vernacular name(s) : Unknown.

Description : Soft-wooded, evergreen shrub or tree, occasionally to 30(-33) m and with a stem diameter of up to 60 cm. It has pale yellow or brownish inner bark, and dark greyish-brown bark with longitudinal fissures and lenticels, and a fluted base of the trunk. The roots run along the surface of the soil and may bear knobbly pneumatophores. Twigs have rounded scars left by the leaf stalks. Leaves occur in tufts at the end of the branches, spirally arranged, and are elliptic-lanceolate, 6-16 by 2-5 cm, scaly below, smooth above, with a rounded point and a narrow base. Leaf stalk is 2-3 cm long. The flower clusters – usually in groups of 3-6 flowers each – occur in leaf- and branch axils, on 4-8(-15) mm long individual stalks. The corolla is scaly, 5-petalled and covered with short hairs; petals are white, with greyish scales on the outside, 3 by 5 mm. The calyx is 6 mm long, and the epicalyx 2-3 mm. Flowers have 20 anthers, each with two thecae (containing pollen). The fruit is a round capsule, 1 cm long, scaly, with a persistent, scaly calyx and outer calyx. The fruit contains two densely woolly, 9 mm-long seeds. According to Tomlinson (1986), bark is scaly and without fissures.

Ecology : The species is more characteristic of open rocky shores than of estuarine mangroves, and commonly described as occurring on sandy beaches within the tidal range. It is probably pollinated both by insects and wind. Flowers occur from June to October, with mature fruit appearing between October and February (in Australia). Fruits are capable of medium range water dispersal, while the woolly seeds are capable of both water and wind dispersal. Mangrove species.

Distribution : Recorded from Indonesia (Borneo, the Molluccas), Papua New Guinea and northern Australia. Geographic range does not overlap with that of *Camptostemon philippinense*.

Abundance : Relatively common.

Use(s) : Sulphate-paper pulps with good strength properties can be produced from the wood.

Source of illustration : Based on Percival & Womersley (1975) and Tomlinson (1986).

Reference(s) : Bakhuizen van den Brink (1924), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989).

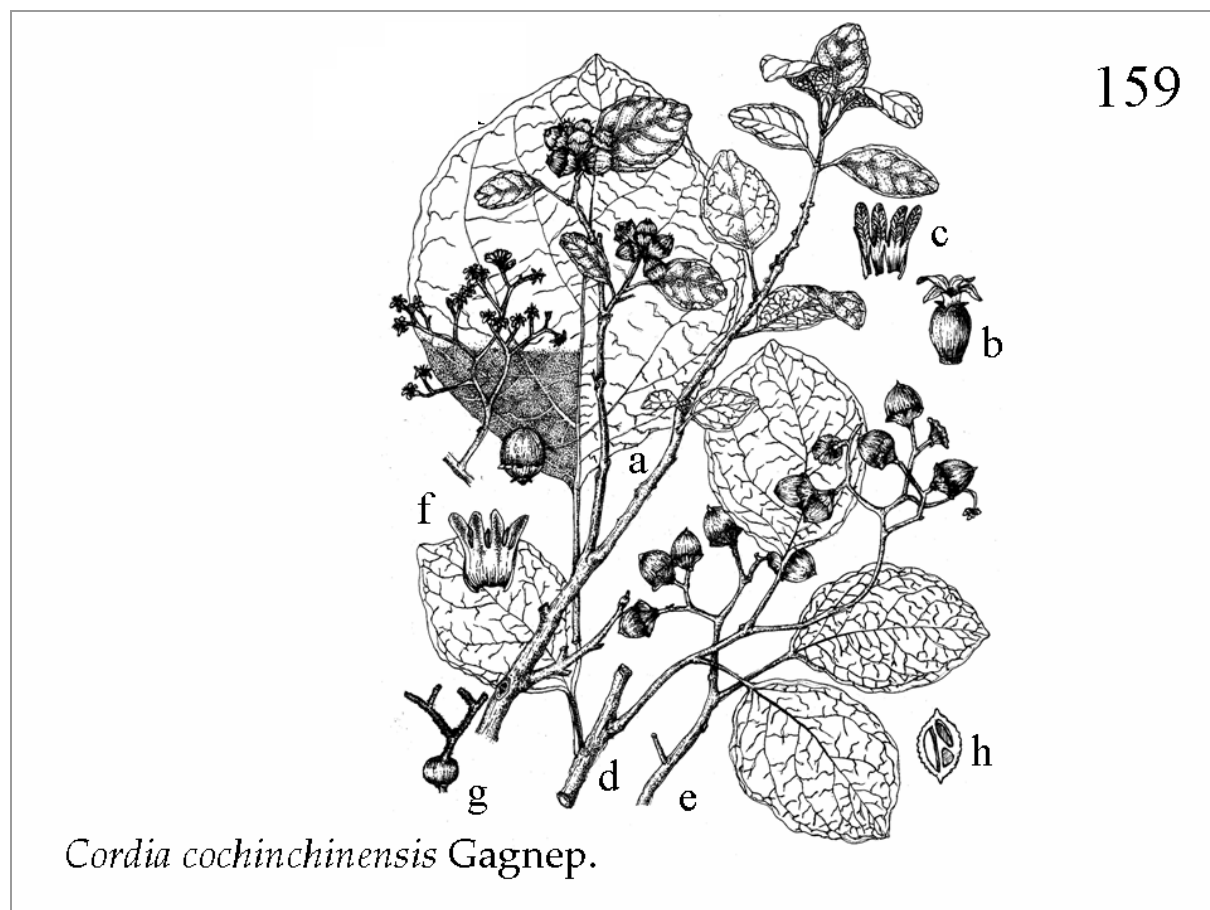


Fig. 159. *Cordia cochinchinensis* Gagnep. (a) Fruiting branch, (b) flower, (c) opened corolla showing stamens, *Cordia dichotoma* (d, e) fruiting branch, (f) opened corolla, (g) pistil, and (h) cross-section of fruit.

BORAGINACEAE

159

Cordia cochinchinensis* Gagnep.*Synonyms :** *Cordia premnifolia* Ridl.,**Vernacular name(s) :** Dyerehatt (Camb.), Tân môc lang (Viet.)

Description : Small tree, 2-4(-12) m, or sometimes a scrambling shrub. Even young branches are woody, at first dark reddish brown, later pale yellowish to greyish brown, without hairs. Leaf stalks are 1.5-2(-4) cm long. Leaves simple, alternate, crowded towards the ends of branches. There are two types of leaves: those far from the ends of branches are broader, 9-12 cm by 6-9 cm, 5 nerves on each side; those near the tips of branches are 5-11 cm by 2.5-5.5 cm, about 8 nerves on each side. Nerves forming a dense network on the underside; a few hairs along the primary nerves, otherwise smooth. Flowering branchlets are dichotomously branched, each flower cluster with 2-5 bisexual flowers, terminal, rarely lateral on short branches. Calyx 3 mm long and wide, immediately after flowering; 8-10 mm long and 10-15 mm wide in fruit; 4-5 lobes. Corolla elongate, white, cream or greenish, 15 mm long, tube 8 mm, straight, often broadening towards the base; 4 lobes, ovate-lanceolate, 3 mm long and recurved; 4 stamens. Fruit an ovoid berry, up to 30 mm long and 22 mm diameter (more usually 8-10 mm diameter), tapering towards the tip, and surrounded by the persistent calyx. Recorded by Ng (1989) as a synonym of *Cordia dichotoma* Forster f., but according to Riedl (1997) the two differ in at least the following: fruit size (20-30 mm long in *Cordia cochinchinensis*, and up to 15 mm long in *Cordia dichotoma*) and calyx (smooth and bell-shaped in *Cordia cochinchinensis*, often hairy and cup-shaped in *Cordia dichotoma*).

Ecology : Occurs in woods along beaches, on arid, sandy hills, and landward margins of mangroves. Fruiting has been recorded in southern China as occurring in August-December. Mangrove associate species.

Distribution : Occurs in southern China (Hainan) and Southeast Asia, where it has been recorded in Cambodia, Vietnam, Thailand and Peninsular Malaysia.

Abundance : Little information available, and possibly uncommon.

Use(s) : Edible fruit (Cambodia). Gummy resin occasionally used as glue (Malaysia).

Source of illustration : Flora of China

Reference(s) : Ng (1989), Riedl (1997), Nguyen *et al.* (2000), Marschke (2000), Maung (2003).

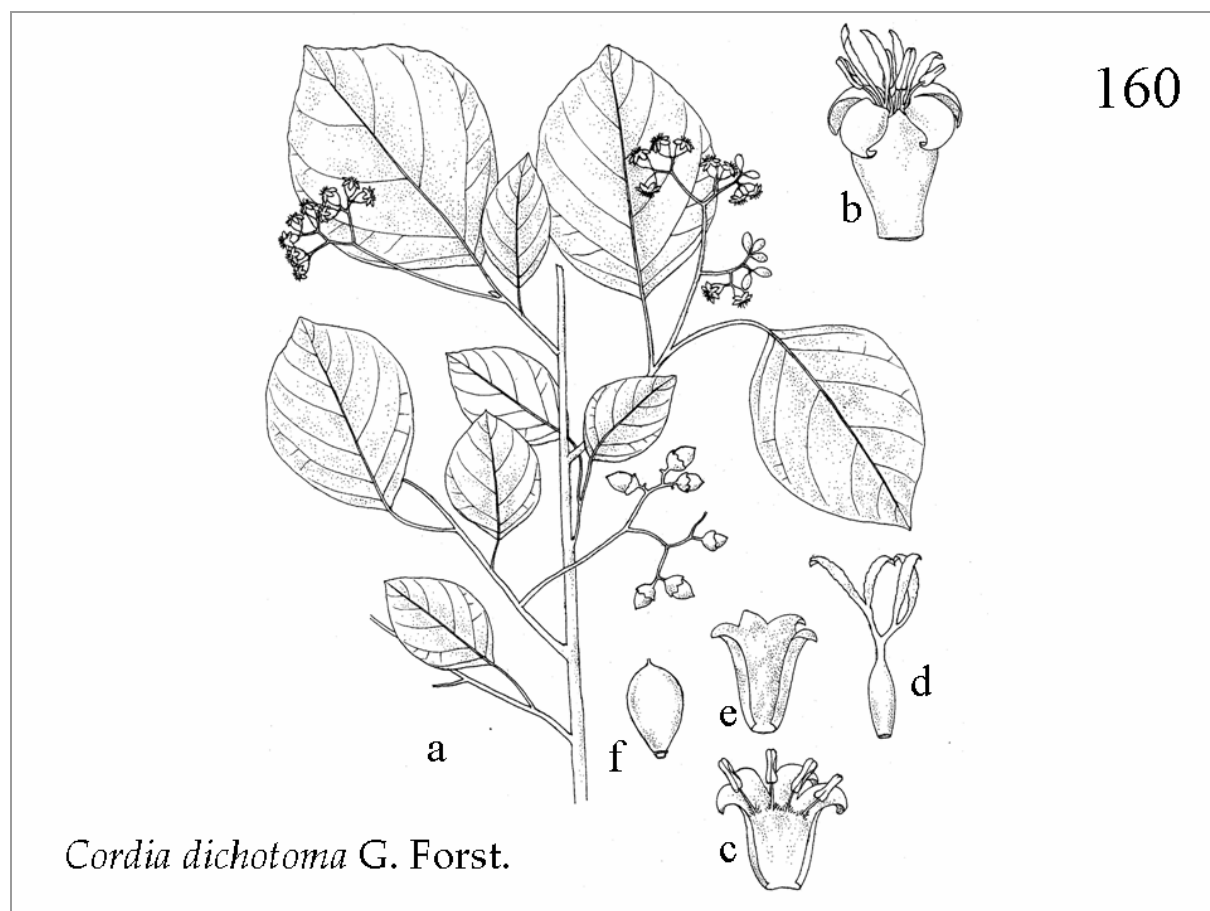


Fig. 160. *Cordia dichotoma* G. Forst. (a) Fruiting and flowering branch, (b) flower, (c) opened flower showing the stamens, (d) pistil, (e) opened corolla, and (f) fruit.

BORAGINACEAE

160

Cordia dichotoma G. Forst.

Synonyms : *Arbor glutinosa* Rumphius, *Cordia blancoi* Vid., *Cordia griffithii* C.B. Clarke, *Cordia myxa* auct. non. L., *Cordia obliqua* auct. non. Willd., *Cordia suaveolens* Bl., *Cordia suaveolens* Vidal, *Cordia subdentata* Miq., *Varronia sinensis* Loureiro.

Vernacular name(s) : Cordia tree (E), Nona burung, Petekat, Sekendal, Sekendai (Mal.), Anuanga, Cena, Kanonang, Kendal, Knadate, Lantolo, Mampapu, Manonang, Nonang, Nunang, Onunang, Temampapu, Teo-teo, Tomatangtang, Toteo (Ind.)

Description : Tree or shrub, 6-20(-27) m tall, trunk up to 60 cm diameter at breast height, crown conical, cylindrical, later rounded, the branches drooping at the ends. Younger branches grey, greyish brown to brownish, smooth; bark shallowly fissured. Leaves simple, spirally arranged, variable in shape from ovate, to ovate-lanceolate, broadly ovate, or rarely almost round, 2-11 by 1.2-10 cm, leaf edge entire, papery to slightly leathery, base rounded, tip pointed, (3-)4-5(-6) secondary nerves on each side, prominent below, mostly whitish; leaf stalk 1-4.5(-5) cm, slender or robust. Leaves of saplings are strongly toothed along the edge. Flower clusters consist of branching corymbs, 4-11 cm long, forking repeatedly (hence 'dichotoma') located at the ends of branches on slender lateral branches, with a variable number of flowers (10-many). Flowers male or bisexual. Calyx cup-shaped, expanded in fruit from a narrow base, 3-5 mm long; 3-4 mm wide in flower, 6-10 mm wide in fruit; with short, dense hairs in flower, later smooth; calyx lobes recurved, shortly triangular. Corolla cylindrical, bell-shaped, white, cream or green, 5-6(-8) mm long, tube 3 mm, expanded parts of petal 5 mm diameter, lobes (4-)5(-6), oblong, recurved, 2 by 1 mm. Stamens long and projecting beyond the corolla. Fruit an egg-shaped drupe, smooth, shiny, white, pale green, pink, orange or yellow; containing a sticky, slimy pulp, about 10(-15) mm long, 8(-10) mm diameter, containing a single-seeded stone. Very variable in shape and size, especially of vegetative features. Ng (1989) incorrectly lists *Cordia premnifolia* as a synonym.

Ecology : Mainly at low altitudes from sea level upwards to about 500m altitude. Also occurs on inward (dry) side of mangroves, coastal hills below 100m, inland forests along rivers, and on limestone. Open woods on slopes, mountain streamsides. In southern China, flowering from February to April, and fruiting from June to August. Trees may be so full of fruit that the branches droop under the weight. Mangrove associate species.

Distribution : Wide ranging, from India, Pakistan to south China and Japan, through Southeast Asia to Australia, New Caledonia and western Polynesia. In Southeast Asia it has been recorded from Myanmar, Vietnam, Cambodia, Thailand, Malaysia (Peninsular), Singapore, the Philippines, Indonesia (Borneo, Sumatra, Java, Sulawesi, L.Sundas, Moluccas), E. Timor and PNG.

Abundance : Sporadic, but locally common.

Use(s) : Fruit contains a sticky gum and is used as glue (e.g. paper, kites). Planted in villages in Malaysia. The seeds contain oil, the fruit is used for medicine, and the wood is used for house construction and farm tools (e.g. ploughs, Bali). Bark used as rope, for treating headaches and fevers.

Source of illustration : Riedl (1997),
http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200018953

Reference(s) : Heyne, (1950), Corner (1988), Ng (1989), Riedl (1997), Flora of China:
http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200018953.

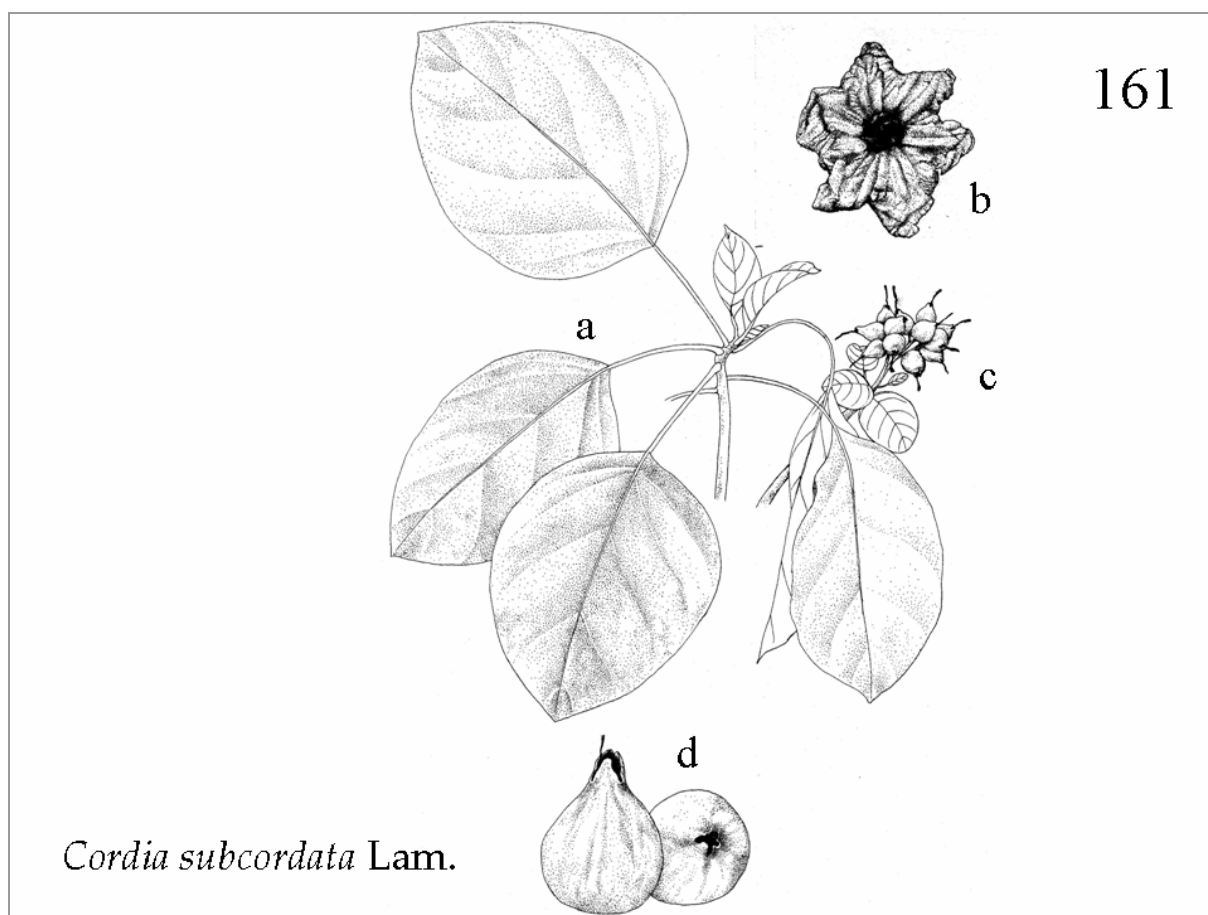


Fig. 161. *Cordia subcordata* Lam. (a) Terminal branch, (b) flower, (c) cluster of fruit, and (d) two fruits.

BORAGINACEAE

161

Cordia subcordata Lam.

Synonyms : *Cordia banalo* Blanco, *Cordia moluccana* Roxb., *Cordia rumphii* Blume, *Novella nigra* Rumph.

Vernacular name(s) : Sea trumpet (E), Salimolé, Klimasada, Murmasada, Purnamasada, Bara laut, Kena, Ama, Nonwai tasi, Fala, Fana (Ind.), Balu, Alagot-ot (Phil.)

Description : Small tree, 2-6(-15) m tall, with a dense, round crown, bark brown or grey, shallowly and irregularly fissured and flaky. Usually low, with crooked branches emerging just above the ground. Branches grey to light brown, inner bark whitish, wood orange. Leaves are simple, alternate, thinly leathery, with a 2-8 cm long leaf stalk, blade ovate to elliptic, 5-15 by 8-20 cm, sometimes with a few small teeth along the edges, base usually rounded or heart-shaped, tip blunt or rounded, rarely pointed, with 4-5(-6) pairs of primary nerves on each side, upper side with shortly flattened hairs; on the underside a fine net-like pattern is discernible. Flowers are located at the end of branchlets, arranged in clusters of 6-20 flowers, each on a short 3-6 mm long stalk. Calyx cylindrical, 8-13(10-20) mm long, 4-8 mm wide, smooth or with a few short rigid hairs, and 3 short, triangular lobes that remain and eventually envelop the fruit. The corolla is large and trumpet-shaped, 3.5-5 cm long, clear orange or pinkish orange, the rounded lobes (5-)6-7 spreading out 2-3.5(-4.5) cm across; throat max. about 4 cm wide. Fruit an egg-shaped to nearly round nut, 20-30 mm long, 15-25 mm diameter, completely and tightly enclosed by the enlarged, thin-walled calyx; green, ripening yellow, with 4 cells embedded in a hard stone of irregular outline, the surface depressions being filled with tissue that is succulent when ripe, but turns corky as the fruit dries. Usually only 2(-3) cells develop and bear one seed each. Similar in habit to *Thespesia* and *Hernandra*, but the flower and fruit are unmistakable.

Ecology : Strand flora tree. Sandy or gravelly beaches, sandy, open woodland, beach forests and landward edges of mangroves. The corky, buoyant fruits are adapted for dispersal by ocean currents. Flowering has been recorded in June (southern China). Mangrove associate species.

Distribution : From the east coast of Africa (Tanzania) and the Indian Ocean (Madagascar, Comoros) through India to Southeast Asia, southern China (Hainan) and the Pacific Islands (Hawaii). In Southeast Asia it has been recorded in Cambodia, Vietnam, Thailand, the Philippines, Malaysia, Indonesia (Borneo, Java, Sulawesi, Lesser Sundas, Moluccas, Papua), East Timor and Papua New Guinea.

Abundance : Locally common.

Use(s) : Wood is highly decorative, tough and used for making rifle butts in the Moluccas; also used for house construction (highly durable, although small), and for medicinal purposes. Leaves used to treat stings and bites of fish.

Source of illustration : Ng (1989)

Reference(s) : Heyne (1950), Corner (1988), Ng (1989), Riedl (1997), Missouri Botanical Garden TROPICOS database (<http://mobot.mobot.org>), Flora of China (online).

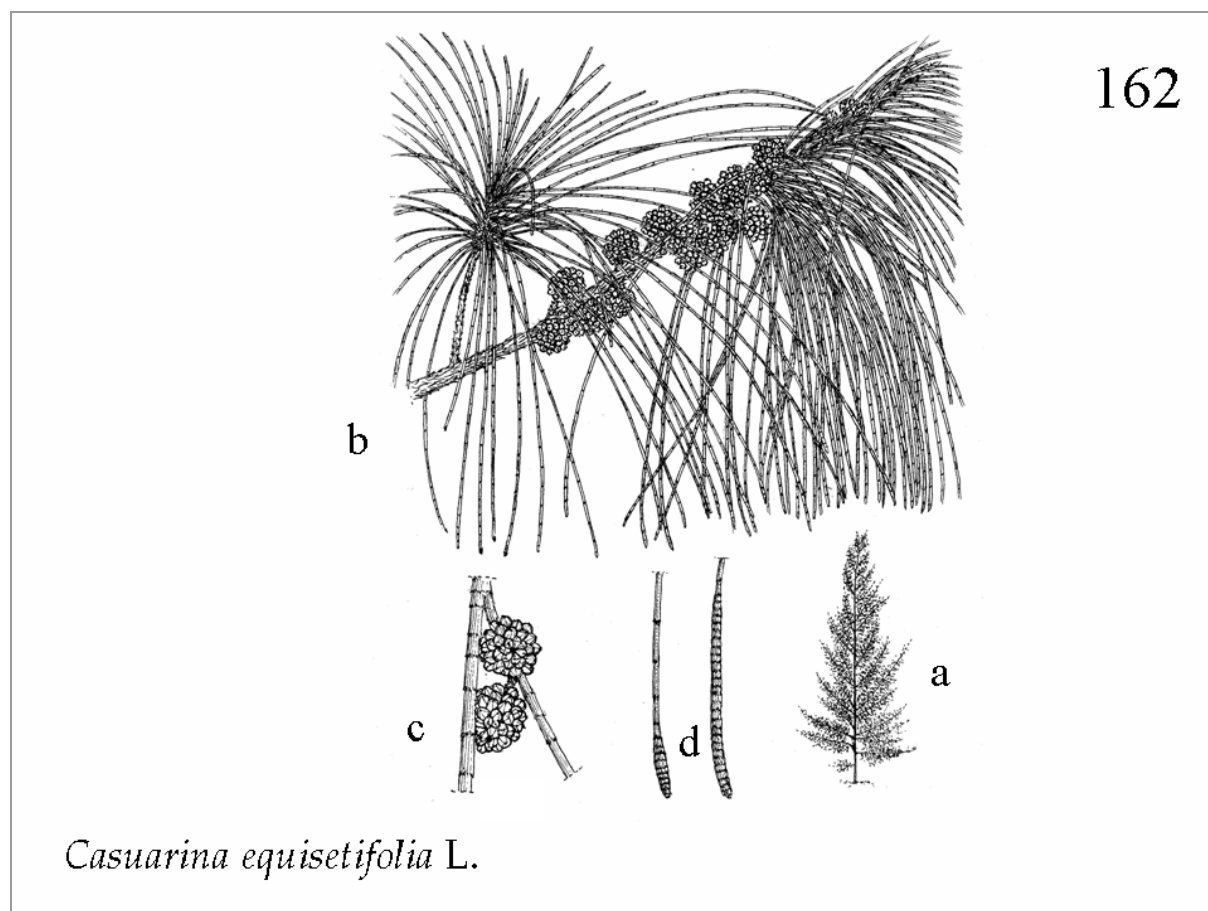


Fig. 162. *Casuarina equisetifolia* L. (a) Habit, (b) branch with female cones, (c) detail of female cone, and (d) male flower spikes.

CASUARINACEAE

162

Casuarina equisetifolia L.

Synonyms : *Casuarina equisetifolia* J.R. & G. Forst., *Casuarina equisetifolia* subsp. *equisetifolia*, *Casuarina equisetifolia* subsp. *incana* (Benth.) L.A.S. Johnson, *Casuarina equisetifolia* var. *equisetifolia*, *Casuarina equisetifolia* var. *incana* Benth., *Casuarina equisetifolia* var. *microcarpa* F. Muell., *Casuarina litorea* L. ex Fosberg & Sachet, *Casuarina muricata* Roxb.

Vernacular name(s) : Horsetail, Coast She-oak, Australian oak, Whistling pine (E), Agoho (Phil.), Aru, Ru, Waru (Mal), Aru, Ru, Waru – *Cemara laut* (Ind.), Phi lao, Ho dâu (Viet.), Son thale (Thai.)

Description : Large tree, up to 50 metres tall and with a girth of up to 300 cm. Bark is brown, ridged and fissured, flaky in oblong pieces. Leaves reduced to tiny, pointed scales arranged in whorls of 6-10 (mostly 7-8) at the joints of the twigs; beginning with 2, then 4 leaf scales at the basal nodes of each needle twig. Greenish, needle-like young twigs give the tree the appearance of a conifer because of the absence of conspicuous (broad) leaves. Flowers unisexual, male and female flowers on separate trees; male flowers borne on 1.4-3 cm long terminal spikes on short, lateral branches; female flowers borne in dense, spherical cone-like heads on the twigs, and can be recognised by the reddish styles. Fruiting cones are cylindrical, woody, up to 1.8 by 1.5 cm, first green, then brownish. Bracts are persistent on the cone, opening up on maturity, releasing the small nuts. Four *Casuarina* species are native to lowland Southeast Asia, but only *Casuarina equisetifolia* occurs in coastal habitats. It can further be distinguished from the other species by its combination of mostly unbranched needle twigs (*Casuarina rumphiana* and *Casuarina sumatrana* are branched), that are very narrow (0.5 mm wide, while *Casuarina glauca*'s needle twigs are 1-1.5 mm wide).

Ecology : Common on sandy coasts and low dunes, but also in sandy mangrove areas, in narrow belts on beach swales. Also commonly planted in inland areas. The species is very light demanding, and seedlings suffer if over-watered or kept under shade for too long. Growth is rapid. The roots have root nodules containing nitrogen-fixing bacteria. Needle-twigs have taken over photosynthesis from the greatly reduced and vestigial leaves. Flowers are wind-pollinated. Wide distribution owed to the ease with which cones are transported by the sea. Capable of flowering year-round and can produce tremendous numbers of small, winged seeds which are dispersed by wind. Mangrove associate species.

Distribution : Naturally occurring from the Bay of Bengal to the Pacific Islands and northeastern Australia; found throughout Southeast Asia. Introduced to many countries: arriving in India by 1868, 1900 in Florida, and before that in East and South Africa. It has been introduced to southern China, Yemen, Mauritius, the Seychelles, Hawaii, Caribbean islands and West Africa.

Abundance : Common along sandy coasts; rarely occurring in mangroves.

Use(s) : The timber is very heavy and hard, making excellent firewood and charcoal, but is otherwise lowly regarded, although timber is occasionally used as beams. Young trees may be trimmed to form a hedge, and they can reportedly be propagated by cuttings. All species of *Casuarina* are of outstanding ornamental value because of their plume like foliage of needle-twigs. Bark yields a good resin useful for tanning.

Source of illustration : Corner (1988)

Reference(s) : Khan & Huq (1972), Ng (1978), Afriastini (1988), Corner (1988).

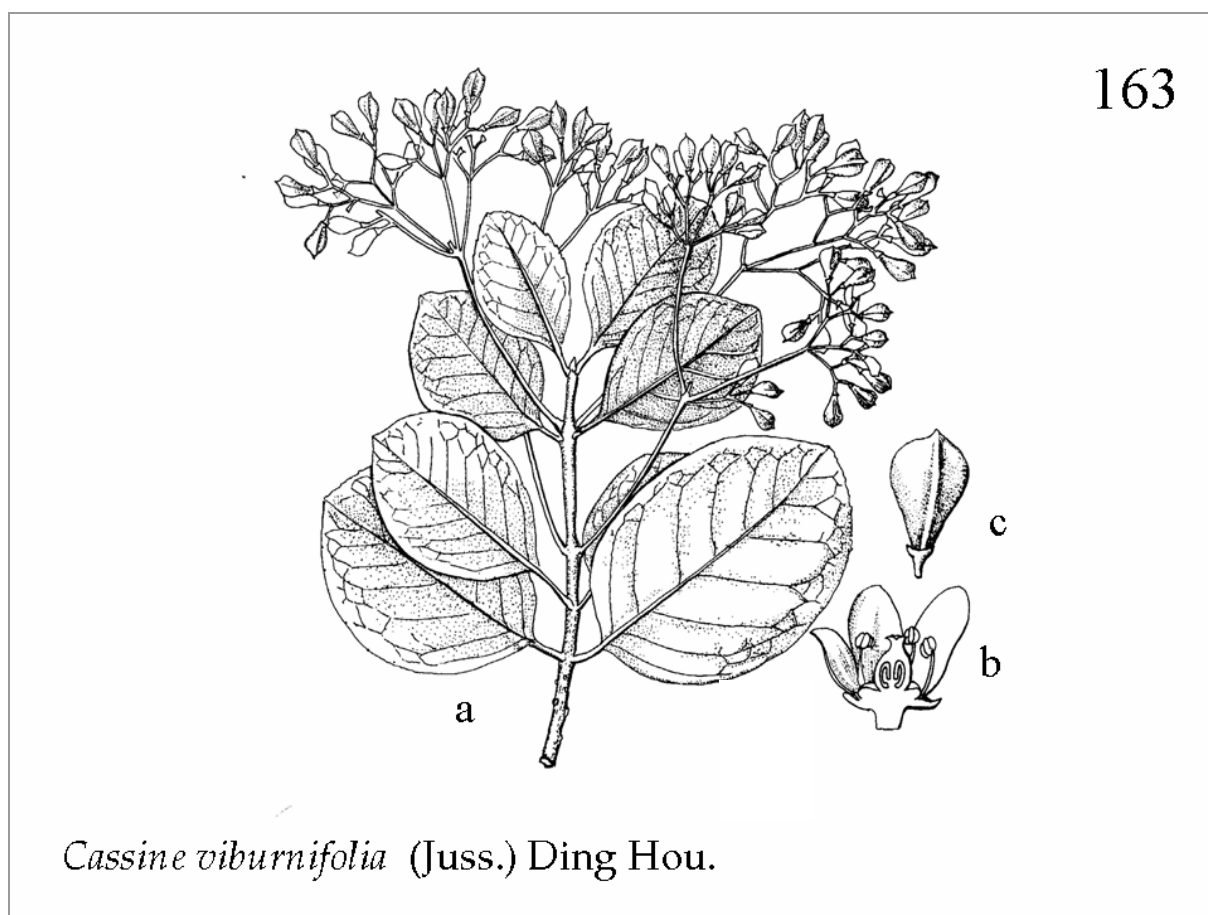


Fig. 163. *Cassine viburnifolia* (Juss.) Ding Hou. (a) Branchlet with fruit, (b) cross-section of flower, and (c) fruit.

CELASTRACEAE

163

Cassine viburnifolia (Juss.) Ding Hou

Synonyms : *Aegiphila viburnifolia* Juss., *Euonymus cochinchinensis* Merr., *Euonymus viburnifolius* Merr., *Elaeodendron subrotundum* King., *Elaeodendron viburnifolium* Merr.

Vernacular name(s) : Barak Laut, Barat Barat, Landing-landing, Mempenai, Meta Pelandok, Rambai Laut (Ind.), Pungsu (Bru.), Jojo saffranhout (Phil.)

Description : A small tree or shrub, up to 10 m tall, with a smooth, grey bark. The short-stalked leaves are obovate, 4-10 by 2-6 cm, with a light green, shiny under surface and a slightly notched leaf edge that initially has glands in each notch. The long-stalked flower clusters are up to 11 cm across, and occur in axils of leaves and/or branches, mainly towards the ends of the branches. Each cluster has four or more white 4-merous flowers that measure 2-3 mm across; calyx and corolla are free. The somewhat corky, yellow berry is 1-seeded, narrowed at the base, and about 1 cm long; the style remains prominent at the tip of the fruit.

Ecology : Occurs in wet, coastal communities, including mangroves and along tidal rivers. According to Aragones *et al.* (1998) it occurs almost exclusively on the borders of mangrove forests. The fruit is adapted to water dispersal. Mangrove associate species.

Distribution : From Thailand and the Andaman Islands through Peninsular Malaysia, Singapore and Brunei to Indonesia (northern Sumatra, Kalimantan, Sulawesi) and the Philippines.

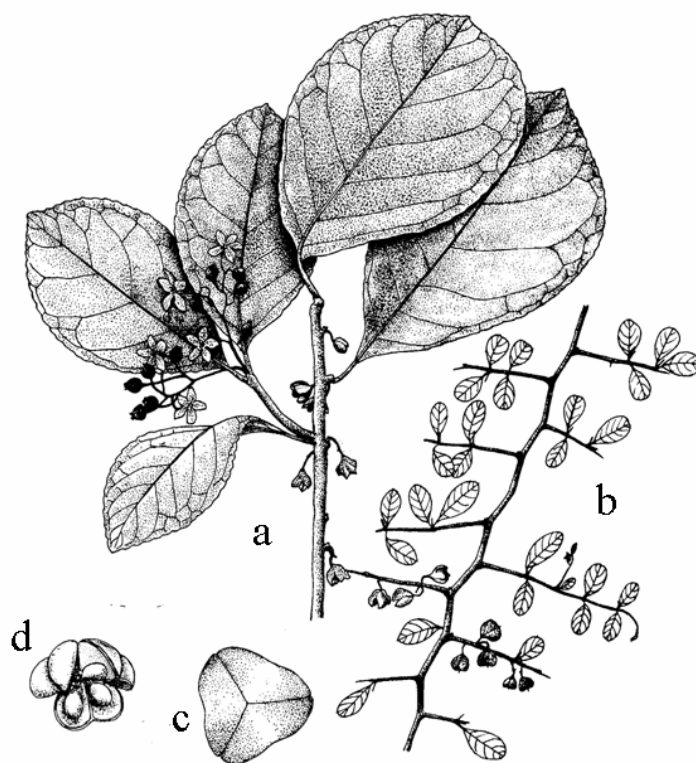
Abundance : Uncommon to rare.

Use(s) : The husk of the fruit is said to be used to stupefy fish. Firewood.

Source of illustration : Ding Hou (1962).

Reference(s) : Ding Hou (1962), Tomlinson (1986), Aragones *et al.* (1998).

164



Maytenus emarginata (Willd.) Ding Hou.

Fig. 164. *Maytenus emarginata* (Willd.) Ding Hou. (a) Branchlet with flowers, (b) branchlet with fruit, showing spines, (c) opened fruit, and (d) closed fruit.

CELASTRACEAE

164

Maytenus emarginata (Willd.) Ding Hou

Synonyms : *Catha montana* G.Don., *Celastrus emarginatus* Willd., *Celastrus montanus* Roth., *Celastrus semiarillata* Turcz., *Cupania spinosa* Blanco., *Elaeodendron horizontale* Turcz., *Gymnosporia ambigua* Vidal., *Gymnosporia emarginata* Thw., *Gymnosporia inermis* Merr. & Perry., *Gymnosporia montana* Benth., *Gymnosporia spinosa* (Blanco) Merr. & Rolfe.

Vernacular name(s) : Unknown.

Description : Rigid, often spiny, erect shrub, up to 4 m tall. Its short shoots and/or axillary shoots terminate in a spine or are unarmed. The young parts sometimes have short, soft hairs. The papery to leathery leaves are usually obovate to almost spoon-like in shape, sometimes elliptic to elliptic-oblong, very rarely nearly round, and measure 2.5-14.5 by 1-9 cm. They often grow in bundles on short side-shoots. The leaf margin may be either distinctly wrinkled or entire. The flower clusters occur in axils and measure up to 3.5 cm across, and are either simple or occur in groups in the leaf axils. Flower clusters are sometimes crowded at the top of the short, axillary shoots. Each cluster has 2-7 flowers that are pale green and whitish along the margins, or are entirely white. The calyx lobes are sometimes sparsely bordered with fine hairs, 0.5 mm long. Petals measure 2-3.5 by 1-1.5 mm. The disk and ovary are green at first, later turning purple. The 3-valved fruits are broadly round, 10-12 by 8-9 mm. The 1-4 red, ellipsoid, leathery seeds are 2.5-3.5 by 2-3 mm, and bear a white, fleshy aril at the base, 2-2.5 mm long. The species is very variable, especially in its vegetative characters, probably due to variable environmental conditions. This accounts for the many synonyms.

Ecology : Occurs in dry thickets at low altitudes, in coastal areas directly behind beaches, or on the landward side of mangroves. Flowering occurs throughout the year. Mangrove associate species.

Distribution : From Sri Lanka throughout Southeast Asia to tropical Australia. In Southeast Asia recorded from the Malay Peninsula, the Philippines, Indonesia (throughout Java, Southeast Sulawesi, the Moluccas and Papua) and Papua New Guinea.

Abundance : Probably common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Ding Hou (1962), Backer & Bakhuizen van den Brink (1963-8).

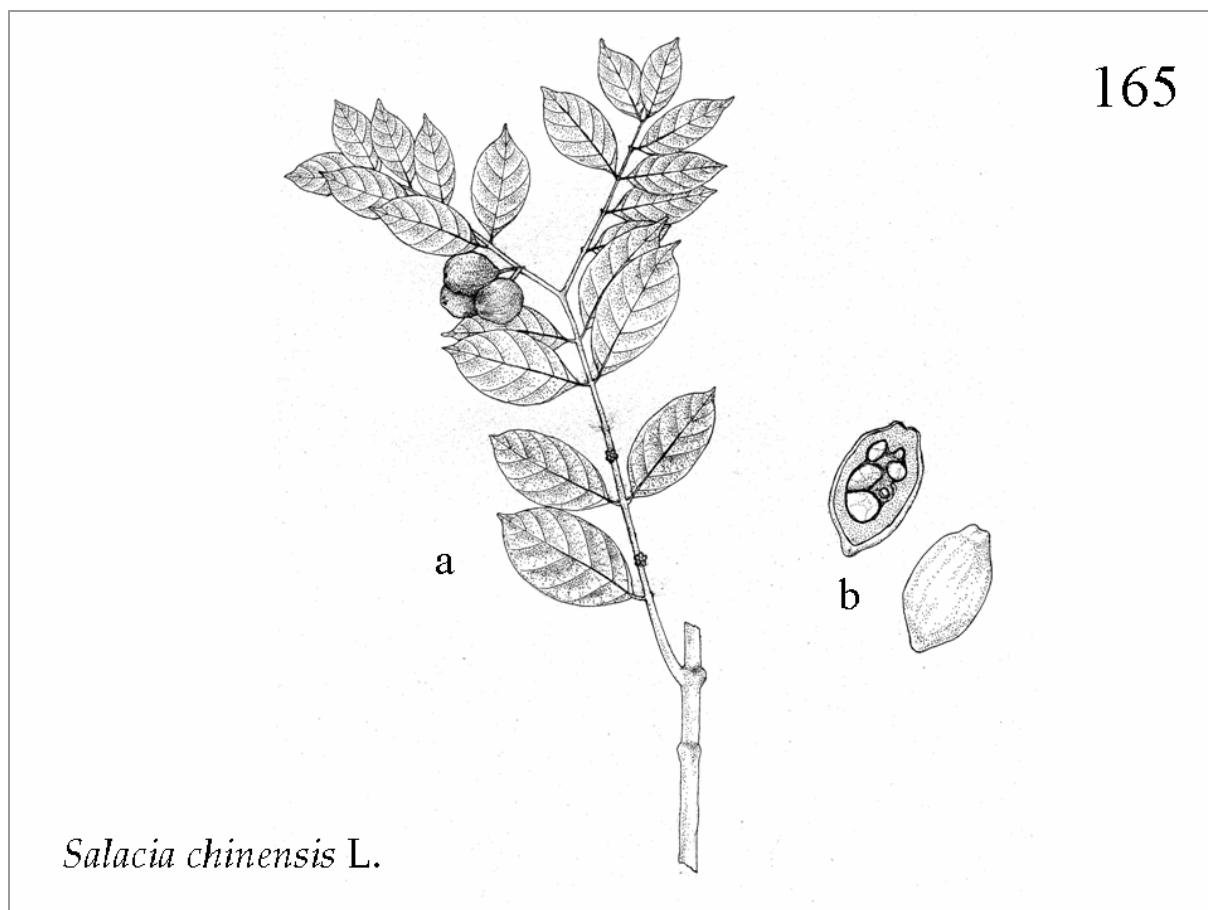


Fig. 165. *Salacia chinensis* L. (a) Fruiting and flowering branchlet, and (b) fruit.

CELASTRACEAE

165

Salacia chinensis L.

Synonyms : *Comocladia serrata* Blanco, *Salacia kraemeri* (non Loes.) Kanehira, *Salacia latifolia* Wall., *Salacia littoralis* Back., *Salacia naumannii* Engl., *Salacia patens* Decne., *Salacia prinoides* D.C., *Salacia socia* Craib., *Tonsella chinensis* (L.) Spreng., *Tonsella prinoides* Willd.

Vernacular name(s) : Akan pelanduk, daun puyu (Ind.)

Description : Scandent shrub or liana (3-10 metres long), rarely a small tree. Leaflets at the base of the leaf stalk are triangular or kidney-shaped, <0.5 mm long. Leaves simple, opposite, ovate to broadly elliptic or obovate-oblong, 4-17 by 1.75-9.5 cm; tip pointed, and edge entire; 4-10 pairs of veins. Flowers yellowish or yellowish-green, numbering few to many, occurring in bundles on axillary twigs. Calyx lobes triangular, 0.5-0.7 mm long; petals broadly elliptic, ovate, obovate or rounded, 3-4 by 2.5-4 mm, blunt, with reddish-brown pigment in the tissue of the central part. Fruit round, sometimes broadly elliptic, 1.5-2 cm diameter, red to orange-red when ripe, usually containing one (to several) seeds. Seeds are round, 1-1.5 cm diameter.

Ecology : In coastal forests, sandy rivers banks, lowland rain forest up to 450 m asl. Also occasionally occurring in sandy mangrove forests. Mangrove associate species.

Distribution : From western India and Sri Lanka, to Hainan (PR China), Papua New Guinea, northern Australia and Fiji. Recorded throughout Southeast Asia, including Myanmar, Thailand, Peninsular Malaysia, Cambodia, Vietnam, Singapore, Philippines, Brunei, Indonesia (Sumatra, Kalimantan, Java, Lesser Sundas, Moluccas, Papua), East Timor and Papua New Guinea.

Abundance : Widely distributed but scattered; on the whole relatively common.

Use(s) : Fruit is edible and reportedly sweet. Stems used for binding material (esp. fencing), and leaves are boiled to a paste and used to treat skin disorders. Used in traditional herbal medicine, and has been found to contain a host of active compounds (roots found to contain di-ketones, fatty matter, rubber, dulcitol, etc...), including ingredients for treating diabetics. Anti-diabetic properties have been confirmed by clinical trials. Also used to treat venereal diseases. Fruit used as food in northern Australia and Papua.

Source of illustration : British Museum; from an album of 40 water colour drawings of plants made by Chinese artists at Bencoolen (Bengkulu), Sumatra, for Sir Stamford Raffles.

Reference(s) : Heyne (1950), Ding Hou (1964), Anon. (2001), Yoshikawa *et al.* (2003), Hardwick (2004), database Netherlands National Herbarium (<http://www.nationaalherbarium.nl/virtual/>).

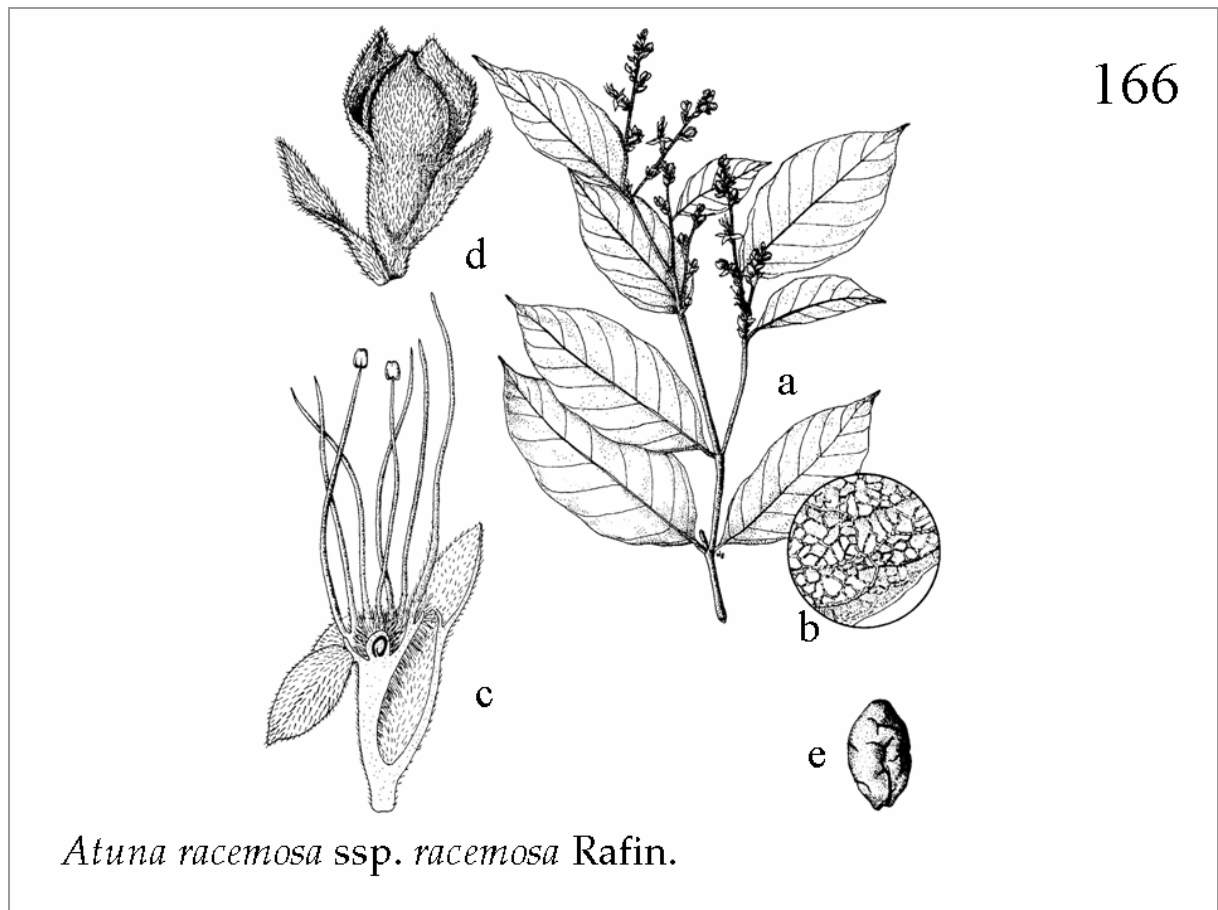


Fig. 166. *Atuna racemosa* ssp. *racemosa* Rafin. (a) Branchlet with flowers, with (b) detail of leaf lower surface (inset) (c) cross-section of flower, (d) flower bud, and (e) fruit.

CHRYSOBALANACEAE

166

Atuna racemosa ssp. *racemosa* Rafin.

Synonyms: *Atuna alba* Rumph., *Atuna elata* (King.) Kosterm., *Atuna scabra* (Hassk.) Kosterm., *Cyclandophora elata* (King.) Kosterm., *Cyclandrophora glaberrimima* Hassk., *Cyclandrophora scabra* (Hassk.) Kosterm., *Ferolia glaberrima* (Hassk.) O. Ktze., *Ferolia scabra* (Hassk.) O. Ktze., *Parinarium amboinense* Teijsm. & Binn., *Parinarium curranii*, *Parinarium elatum* King., *Parinarium glaberimum* Hassk., *Parinarium hahlui* Warb., *Parinarium lanceolatum* Teijsm., *Parinarium laurinum* A. Gray., *Parinarium macrophyllum* T. & B., *Parinarium margarata* A. Gray, *Parinarium mindanaense* Perk., *Parinarium scabrum* Hassk., *Parinarium warburgii* Perk. ex Merr., *Petrocarya glaberrima* (Hassk.) Miers., *Petrocarya scabra* (Hassk.) Miers..

Vernacular name(s): Jangon, Membatu (Mal.), Kisokka, Belibu, Senumpol, Lomo (Ind.), Aluma, Botabon, Butabul, Getabon, Botga, Tabon-tabon (Phil.), Asikua, Asista, Saki, Bata-bata, Latita (PNG).

Description: Large trees, up to 45 m tall, often with a fluted trunk. Young branches are smooth. Leaves are leathery, alternate, broadly ovate, elliptic, oblong or even lanceolate, measuring 10-25 cm (occasionally 35 cm) by 3.5-11 cm, smooth on both surfaces when mature and with a long, pointed tip. Primary leaf veins occur in 10-13 pairs. Leaf stalks are thick and 3-7 mm long. Leaflets at the base of the leaf stalk do not easily detach, are stiff and up to 20 mm long. Flowers occur in clusters in the axils. The main flower stalk is 5-15 cm long, while secondary stalks are covered with soft hairs. Leaflets at the base of the flower stalk are ovate and up to 8 mm long. Individual flower stalks are 0.5-1 mm long, and the whole flower measures 10-17mm. Calyx lobes are 4-7 mm long and densely hairy on both sides. Petals are up to 10 mm long, and either bluish or white. Stamens number 15-20 and are pale blue. The ovary is densely hairy, while the stigma is small. Fruit is ellipsoid to round, up to 7.5 cm in diameter, with a brittle texture on the outside.

Ecology: Usually occurs in well-drained lowland forest or hill forest up to 600 m, but it also occurs in freshwater swamp forest, brackish water swamps and mangroves. Note: the closely related species *Atuna racemosa* ssp. *excelsa* (Jack.) Prance occurs in well drained lowland forests: leaves of this species are much smaller, being only 4.5-12 cm long. Mangrove associate species.

Distribution: A wide-ranging species found from Southeast Asia to the Pacific. In Southeast Asia it has been recorded from Thailand, Malay Peninsula, Singapore, the Philippines, Brunei, Indonesia (Sumatra, Kalimantan, Sulawesi, Ambon, Ternate, Ceram and Papua) and Papua New Guinea.

Abundance: Probably relatively common.

Use(s): The fruit is grated and widely used in the Pacific Islands for producing a putty for caulking canoes. Timber is used for domestic construction, but is not of good quality. Seeds are grated and mixed with fish, ginger, lime and other spices as a snack. Paste made from seeds is applied to stop wood rot. Seeds contain 31% oil.

Source of illustration : Based on Prance (1989).

Reference(s): Heyne (1950), Prance (1989).

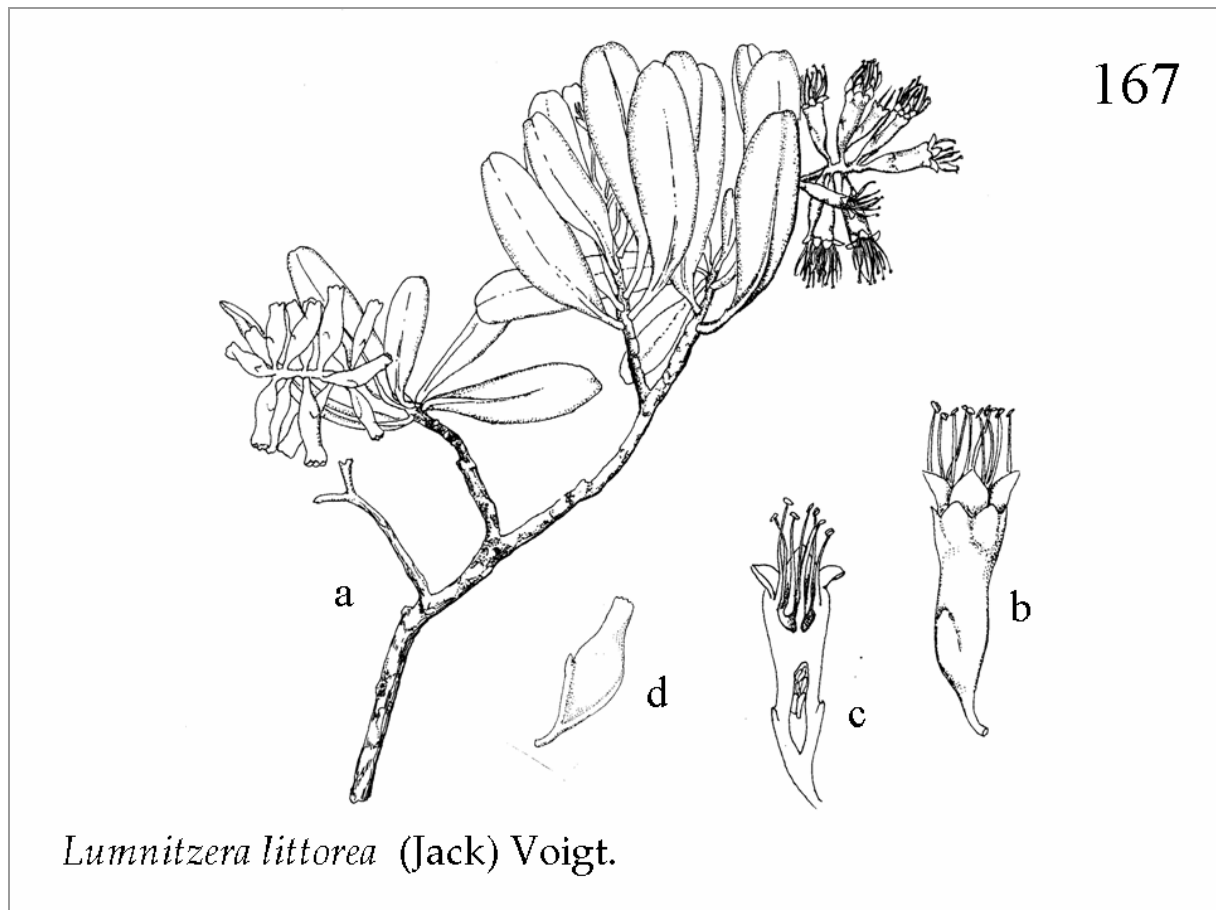


Fig. 167. *Lumnitzera littorea* (Jack) Voigt. (a) Branchlet with flowers (right) and fruit (left), (b) flower, (c) cross-section of flower, and (d) fruit.

COMBRETACEAE

167

Lumnitzera littorea (Jack) Voigt.

Synonyms : *Laguncularia purpurea* Gaud., *Lumnitzera coccinea* W. & A., *Lumnitzera purpurea* Presl., *Petaloma coccinea* Blanco, *Problastes cuneifolia*, *Pyrrhanthus littoreus* Jack.

Vernacular name(s) : Teruntum (-Merah) (Mal.) Api-api Uding, Sesop, Sesak, Geriting, Randai, Riang Laut, Taruntung, Duduk Agung, Duduk Gedeh, Welompelong, Posi-posi, Ma Gorago (Ind.), Agnaa, Aguia Anilai, Bakting, Banting, Bating, Bulokbulok, Dalunu-babae, Dulok-dulok, Kalapini, Karifurong, Kulasi, Libato, Libatu-pula, Linas, Magalolo, Maoro, Panting-panting, Papasil, Sagasa, Salasa, Santing, Supsupun, Talau – *Tabau* (Phil.), Cóc dó (Viet.), Faad daeng, Fat (Thai.), Krognyep krohom, Krognyep-pka-krohom (Camb.)

Description : A spreading, evergreen tree, up to 25 m tall, but usually smaller, with slender, knee-shaped pneumatophores and dark brown, longitudinally fissured bark, and a trunk with a diameter at breast height of up to 50 cm. The slightly fleshy, leathery leaves are narrowly obovate-elliptic, measuring 2-8 by 1-2.5 cm, and are usually crowded towards the end of the twigs. The leaf stalk is up to 5 mm long. The bisexual, red flowers occur in a terminal cluster, are strongly scented, abounding in nectar. The flower stalk is up to 3 mm long, and stamens are twice as long as the petals. The persistent calyx tube is slightly compressed, 8-12 mm long, bearing two 1 mm-long ovate leaflets at the base. Calyx lobes are broadly ovate, 1 mm long. The elliptic, smooth corolla lobes measure 4-6 by 1.5-2 mm. The ellipsoidal, somewhat corky fruit is slightly compressed and ribbed, measuring 9-20 by 4-5 mm.

Ecology : Prefers a soft, muddy substrate at the landward margin of mangroves, where tidal inundation is rare. It also occurs along waterways that have a permanent and strong input of freshwater. Flowering occurs all year round. Nectar production, flower colour, morphology and location suggest bird pollination. The corky, buoyant fruit is well suited to water dispersal. Though occurring throughout Malaysia and Indonesia, *Lumnitzera littorea* and *Lumnitzera racemosa* practically exclude each other in habitat and have never been collected in exactly the same stand. The exact cause of this different ecological behaviour is not yet known. Mangrove species.

Distribution : From East Africa through tropical Asia; throughout Southeast Asia to northern Australia and Polynesia. In Southeast Asia recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia, Singapore, the Philippines, East Timor, Brunei, Indonesia and Papua New Guinea. In Indonesia, apparently absent or very rare on the coasts of the Java Sea.

Abundance : Locally abundant, and occasionally occurring gregariously.

Use(s) : The timber is valued for its extreme durability. The wood is reportedly free from decay after 50 years submersion in salt water, especially when the bark is not removed; used for bridges, wharves, cart axles, flooring and sleepers. A rose-like scent and its attractive appearance enhance its suitability as a cabinet timber. However, large-sized timber is rare.

Source of illustration : Based on Percival & Womersley (1975).

Reference(s) : Exell (1954), Backer & Bakhuizen van den Brink (1963-8), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Ng & Sivasothi (1999), Marschke (2000).

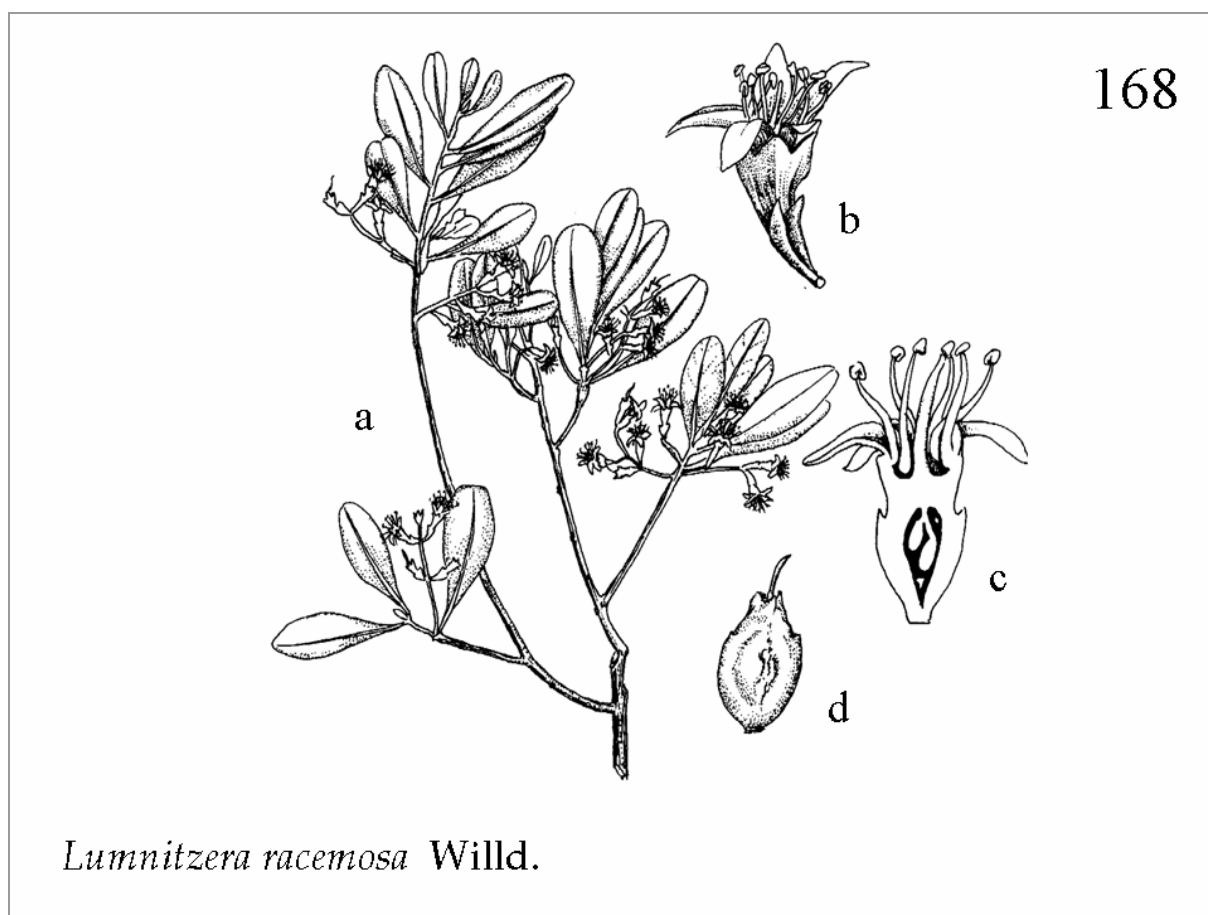


Fig. 168. *Lumnitzera racemosa* Willd. (a) Flowering branchlet, (b) flower, (c) cross-section of flower, and (d) fruit.

COMBRETACEAE

168

***Lumnitzera racemosa* Willd.**

Synonyms : *Languncularia rosea* Gaud., *Lumnitzera racemosa* var. *lutea* Gaud., *Lumnitzera racemosa* var. *pubescens* Koord. & Vahl., *Lumnitzera racemosa* var. *racemosa* Willd., *Lumnitzera rosea* Presl., *Petaloma alba* Blanco

Vernacular name(s) : Api-api Balah, Duduk Laki-laki, Api-api Jambu, Teruntum, Adu-adu, Duduk, Knias (Ind.), Agnaya, Kulasi, Solasi, Tabao – *Kulasi* (Phil.), Cóc trắ'ng (Viet.), Faad khao, Fat (Thai.), Krognyp sor, Krognyp-pkasor (Camb.)

Description : Evergreen shrub or small tree, up to 8(-9) m tall, with a reddish-brown, longitudinally fissured rough bark, and without pneumatophores. Young branchlets are reddish or grey, sometimes slightly hairy at first, later smooth. The slightly fleshy, leathery leaves are narrowly obovate, 2-10 by 1-2.5 cm, and have a small notch at the tip. Leaves are crowded towards the ends of twigs and have a leaf stalk of up to 10 mm. The bisexual, stalkless white flowers occur in a clusters located in the axils, 2-7 cm long. Flowers are weakly scented, but abound in nectar and have five petals. The persistent calyx tube is strongly compressed, 6-8 mm long, and bears two broadly-ovate, 1.5 mm-long leaflets at the base. The occasionally gland-tipped calyx lobes are broadly ovate and 1 mm long. The elliptic corolla lobes measure 4 by 2 mm. Stamens 10, and are as long as, or extend slightly beyond the petals. The ellipsoidal, fibrous and woody fruit is distinctly compressed, measuring 10-12 by 3-4 mm. Though occurring throughout Malaysia and Indonesia, *Lumnitzera littorea* and *Lumnitzera racemosa* practically exclude each other in habitat and have never been collected in exactly the same mangrove stand. The exact cause of this different ecological behaviour is not yet known. Gland-tipped calyx lobes are to be found in Papua, Papua New Guinea and the Philippines.

Ecology : Occurs on the landward fringe of many mangrove vegetations, usually preferring sandy portions. A substrate of consolidated mud is preferred. It also occurs along waterways with a distinct freshwater influence. The white, slightly scented and nectar-rich flowers are pollinated by insects. The fibrous fruit is adapted to water dispersal. Mangrove species.

Distribution : From eastern tropical Africa and Madagascar, through South Asia to Malaysia, throughout Southeast Asia, to southern China, northern Australia and Polynesia. In Southeast Asia it is almost absent from shores facing the Indian Ocean.

Abundance : Rather common.

Use(s) : The timber is hard and durable, and therefore is suitable for many construction purposes such bridges, ship building, furniture and so on. The dimensions are even smaller than in *Lumnitzera littorea*, so large timber is scarce. The bark is sometimes used for tanning purposes. Good firewood.

Source of illustration : Based on Exell (1954) and Wightman (1989).

Reference(s) : Exell (1954), Backer & Bakhuizen van den Brink (1963-8), Wickens (1973), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

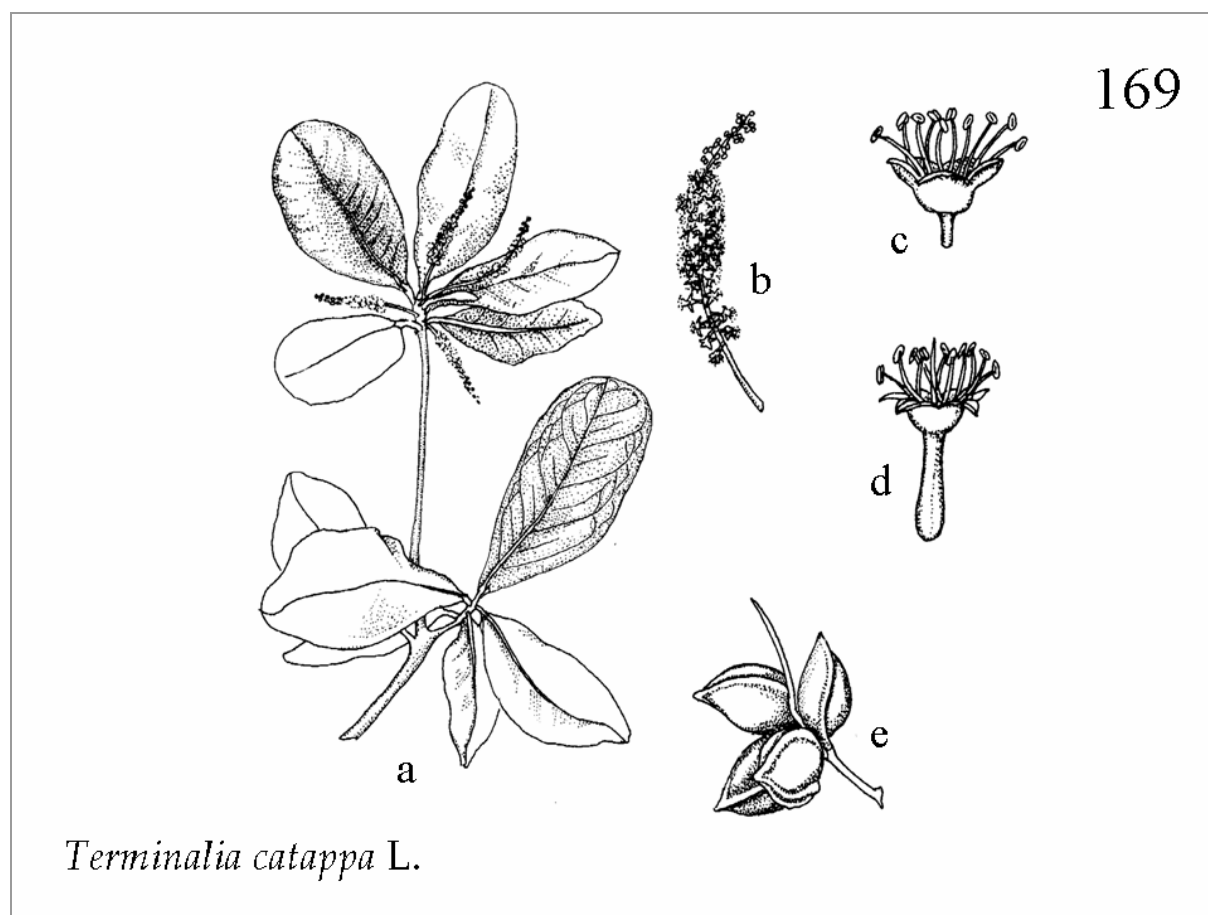


Fig. 169. *Terminalia catappa* L. (a) Branchlet with cluster of flowers, (b) raceme of flowers, (c, d) flowers, and (e) group of fruits.

COMBRETACEAE

169

Terminalia catappa L.

Synonyms : *Myrobalanus catappa* Kuntze, *Terminalia catappa* var. *chlorocarpa* Hassk., *Terminalia catappa* var. *macrocarpa* Kassk., *Terminalia catappa* var. *rhodocarpa* Hassk., *Terminalia latifolia* Blanco, *Terminalia mauritiana* (non Lamk.) Blanco, *Terminalia moluccana* Lamk.

Vernacular name(s) : Indian or Singapore Almond (E), Ketapang (Mal.), Beowa, Kilaula, Ketapas, Klihi, Lisa, Wewa, Sabrise, Sarisei, Talisei, Dumpajang, Luumpoyang, Sadina, Sarisa, Sirisal, Lisa, Tasi, Klis, Tiliho – *Ketapang* (Ind.), Talisai, Almendras, Almendro (Phil.), Kalis, Kris, Runge (PNG), Hu kwang (Thai.)

Description : Medium-sized to tall tree, 10-35 m tall. Deciduous, leaves shed twice a year (in Java, Indonesia), turning (orange-)reddish before dropping, giving the tree a colourful appearance. Young branchlets are thickened and densely covered with hairs that are later shed. The crown of the tree is horizontally layered, a phenomenon which is particularly conspicuous in younger trees. Leaves are spirally arranged, typically oval-obovate, 8-25 by 5-14 cm. Leaves usually with 6-9 pairs of widely-spaced veins, and with a gland located on either side of the base of the midrib. Flowers are white or pale green, stemless, and occur in 8-16 cm-long clusters located in the axils. The majority of the flowers are male, either without, or with a very short style. Calyx lobes are smooth inside. The stalk of the flower cluster is covered with soft hairs. Fruit is 2-angular, somewhat flattened, 5-7 cm by 4-5.5 cm, hard, green, and later turning dark red.

Ecology : Occurs on sandy or rocky beaches and on the landward margin of mangroves. Usually below 100 m asl, but may occur up to 800 m asl. – often planted in gardens as an ornamental or shade tree. Dispersal of fruit occurs via fruit eating bats, monkeys and by water. Trees shed their leaves all at once, usually twice a year (in Java, January or February and July or August), with leaves colouring vivid (orange-)red. Mangrove associate species.

Distribution : Occurs from tropical Asia through Southeast Asia to northern Australia and Polynesia. In Southeast Asia it occurs throughout, but is rather rare on Sumatra and Borneo.

Abundance : Common, often dominating the beach vegetation.

Use(s) : Often planted as a shade-tree. The timber is reddish and of good quality, being used for house- and boat building and planks. The kernel of the fruit is edible and contains a colourless, fatty oil similar to almond oil. Tannin of the bark used as an astringent to treat dysentery, and for tanning leather. Leaves are applied to treat rheumatic joints.

Source of illustration : Excell (1954).

References : Excell (1954), Backer & Bakhuizen van den Brink (1963-8), Sastrapradja *et al.* (1980), Afriastini (1988).

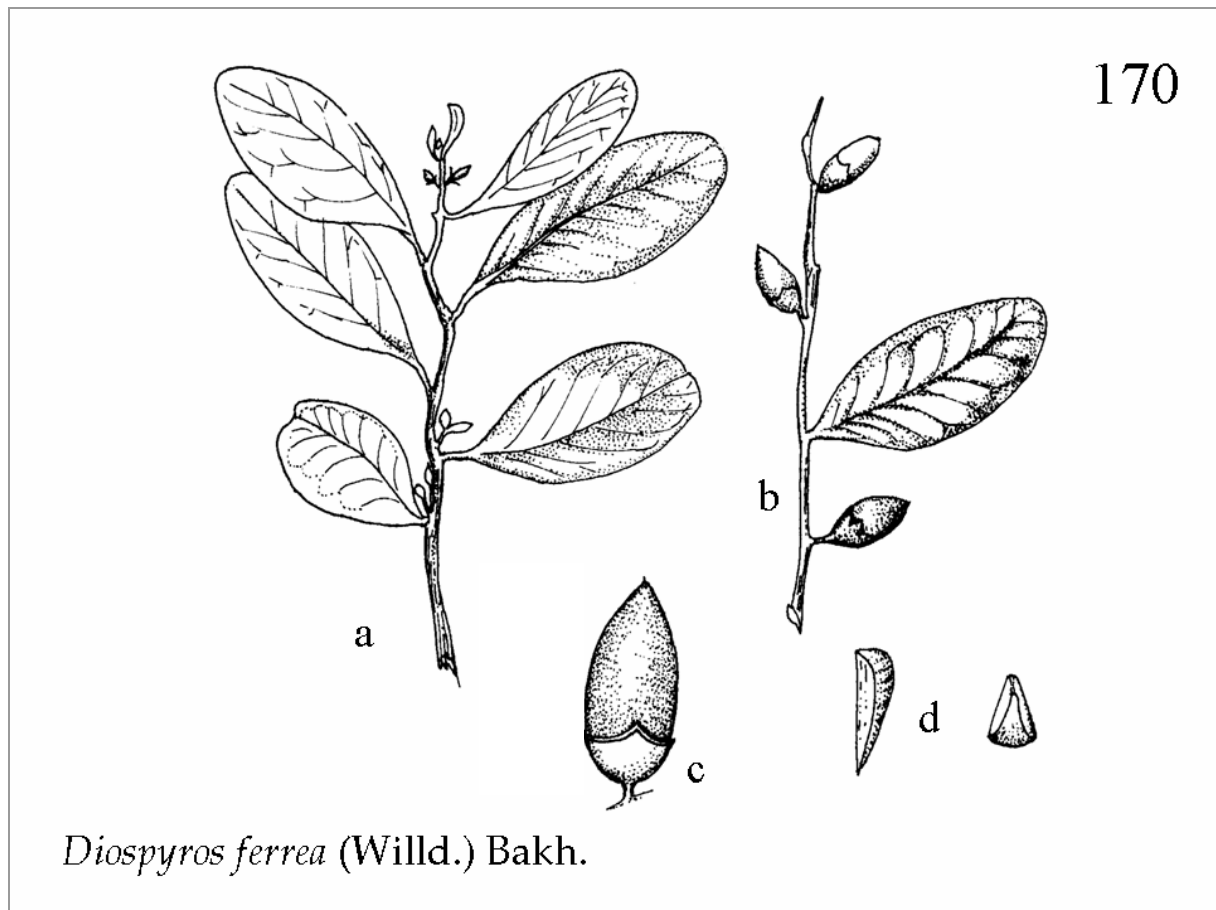


Fig. 170. *Diospyros ferrea* (Willd.) Bakh. (a) Branch with buds, (b) fruiting branch, (c) fruit, and (d) seed, seen from side and end.

EBENACEAE

170

Diospyros ferrea (Willd.) Bakh.

Synonyms : *Diospyros abyssinica* (Hiern.) F.White, *Diospyros ferrea* var. *buxifolia* (Rottb.) Bakh., *Diospyros ferrea* var. *littorea*, *Diospyros ferrea* var. *guineensis* (Schumach. & Tonn.) Bakh., *Diospyros ferrea* var. *reticulata*, *Diospyros ferrea* var. *madagascarensis* (A.DC.) Bakh., *Diospyros littorea* (R.Br.) Kostermans, *Ebenus buxifolius* (Rottb.) Kuntze, *Ebenus parvifolius* Rumphius, *Ehretia ferrea* Willd., *Ferreola guineensis* Schumach. & Tonn., *Maba buxifolia* (Rottb.) Juss., *Maba buxifolia* Pers., *Maba ebenus* Spreng., *Maba ferrea* (Willd.) Aubév., *Maba guineensis* (Schumach. & Thonn.) A.DC., *Maba madagascarensis* A.DC., *Maba smeathmannii* A.DC., *Pisonia buxifolia* Rottb.

Vernacular name(s) : Sea ebony, Philippine ebony (E), Sechirik laut (Mal.), Batulinao (Phil.), Lambit thale (Thai)

Description : Small tree, up to 15(-25) m tall, occasionally multi-stemmed and procumbent, with a mottled charcoal grey to black, smooth to scaly bark, (rarely) with finger-like pneumatophores. Trunk up to 60 cm diameter; branches greyish, covered with hairs. The plant is dioecious, with male and female flowers occurring on different individual trees. Leaves are narrowly elliptic to oblong-elliptic, with a somewhat dull upper surface and an inconspicuous net-like venation, measuring 6-25(-45) mm by 36-65(-95) mm. The leaf tip is blunt, sometimes notched, while the leaf stalk is very short (4-5 mm) or absent. Flowers are white or pale yellow. Male flowers are borne in clusters located in the axils, usually in groups of (1-)3. The calyx is 3-lobed, 4 mm long and loosely attached to the 6 mm long, also 3-lobed corolla, which is covered with dense, soft hairs. The female flowers are without stalk and solitary, occurring in axils, and resemble the male flowers. The orange-red to purple (when ripe) berry is oval-elliptic, 8-10 (15) mm across, and occurs solitary; may be either covered with short hairs or smooth. The calyx-cup is still present on the fruit, as its lobes surround the berry, but are not attached to it. The (1-)3-5(-6) dark brown to almost black, wrinkled seeds are semi-circular and wedge-shaped, 3.5 by 8 mm. Often recorded in mangroves under the synonym *D. littorea*.

Ecology : Occurs on the landward margin of mangroves. It is a coloniser of sandy and muddy substrates, but also occurs in monsoon vine forests, evergreen broadleaved forests, and in coastal, non-mangrove vegetation. From 0-500 m asl. In Australia, flowering occurs from October to December, while fruit may be found throughout the year, peaking in November to May. In southern China fruiting occurs in September. Flowers are pollinated by insects, but relatively few flowers mature into fruit. Reportedly common on rocky and sandy sea coasts, in the *Terminalia* (beach) zone, in mangroves, and on limestone hills. Mangrove associate species.

Distribution : Occurs from West Africa through India to Taiwan, Japan, Australia and Polynesia. In Southeast Asia recorded in Myanmar, Thailand, Cambodia, Vietnam, the Philippines, Malaysia (Peninsular), Indonesia (throughout, except Borneo) and Papua New Guinea.

Abundance : Widespread and common along coasts, rarer inland.

Use(s) : Wood can be very dark, and is used for furniture, handles of knives and so on, but may cause skin irritation during processing. Wood may be ground to a fine paste and used to treat an upset stomach. In the Philippines it is regarded as an ornamental and cultivated for sale (in bonsai form) to Taiwan. In Taiwan, wood is used for walking sticks & ornamental carvings.

Source of illustration : Based on Wightman (1989).

Reference(s) : Heyne (1950), Ng (1978), Tomlinson (1986), Corner (1988), Wightman (1989), Aksornkoae (1993), Yao (2000), Flora of China vol.15 p.234.

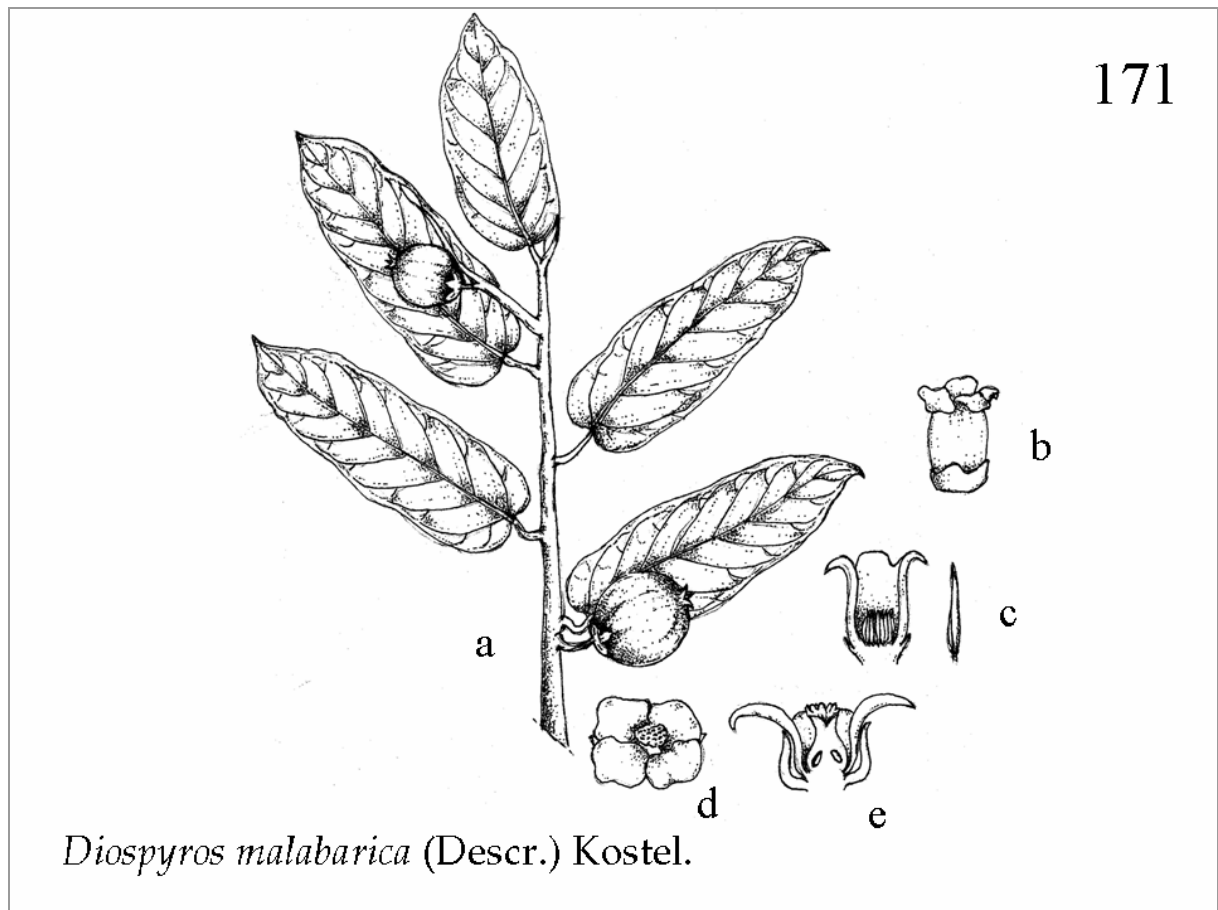


Fig. 171. *Diospyros malabarica* (Descr.) Kostel. (a) Fruiting branch, (b) male flower, (c) longitudinal section of male flower showing stamens, and individual stamen, (d) female flower, and (e) longitudinal section of female flower showing stigma and embryo.

EBENACEAE

171

***Diospyros malabarica* (Descr.) Kostel.**

Synonyms : *Diospyros embryopteris* Pers., *Diospyros embryopteris* var. *siamensis* (Hochr.) Phengklai, *Diospyros glutinosa* Koenig. & Roxb., *Diospyros malabarica* var. *malabarica*, *Diospyros melanoxyton* Hassk., *Diospyros peregrina* Guerke., *Diospyros peregrina* f. *javanica* (Gaert.) Guerke., *Diospyros siamensis* Hochr., *Diospyros siamensis* Ridl., *Garcinia malabarica* Desr.

Vernacular name(s) : River ebony, Indian persimmon, Mountain ebony, Malabar ebony (E), Komoi, Kumun (Mal.), Culiket, Klega, Kleca, Toyokuku, Makusi (Ind.), Tako suan (Thai)

Description : Evergreen dioecious tree with male and female flowers occurring on different trees, medium to large sized, up to 37 m tall. The trunk may have a girth of up to 2 m and is often fluted at the base; bark is almost black. Leaves are simple, alternate, leathery, 3-6(-10) cm by 10-20(-24) cm, oblong, 6-8 side veins, sunken mid-vein, and often with a pointed tip. Leaf stalk 10-12 mm long. Young leaves are reddish. Flowers are whitish. Male flower clusters have 3-5 flowers, 4-merous, each up to 6 mm wide, with valve-like calyx lobes and 24-47 stamens. Female flowers are solitary in leaf axils, 18-25 mm wide, with a 1 cm long stalk; 4- or 5-merous. Fruit is round or egg-shaped, 4-5 cm long, 3.5 cm diameter, yellowish to rusty brown, 6-8 partitions, with 3-8 seeds. Fruit is at first densely hairy, later becoming smooth; 4 calyx lobes are hairy and remain attached to fruit. Fruit pulp is glutinous.

Ecology : Often cultivated in homestead gardens. On Java the species rarely occurs below an altitude of 400 m asl. Grows on all soil types, preferring moist, shady places along watercourses and can stand periodic flooding. Mangrove associate species.

Distribution : From India and Sri Lanka through Southeast Asia. In Southeast Asia recorded in Myanmar, Thailand, Cambodia, Malaysia (Peninsular) and Indonesia (Java, Sulawesi).

Abundance : Common in South Asia, uncommon in Southeast Asia apart from in gardens.

Use(s) : Wood occasionally used for timber. Young fruit used for extracting a glue-like gum, used for book binding. Ripe fruit eaten raw, and are reportedly tasty (Heyne) or astringent (Khan & Alam, 1996) – planted for this purpose in homestead gardens. Infusion of pulp used for dyeing fishing nets and making them more durable, and for caulking of boats. Bark and seeds used in medicine, for treating ulcers and wounds, and as a gargle for sore throats. Propagated from seeds.

Source of illustration : Corner (1988), Flora of China, Khan and Alam (1996)

Reference(s) : Heyne (1950), Ng (1978), Corner (1988), Khan & Alam (1996).

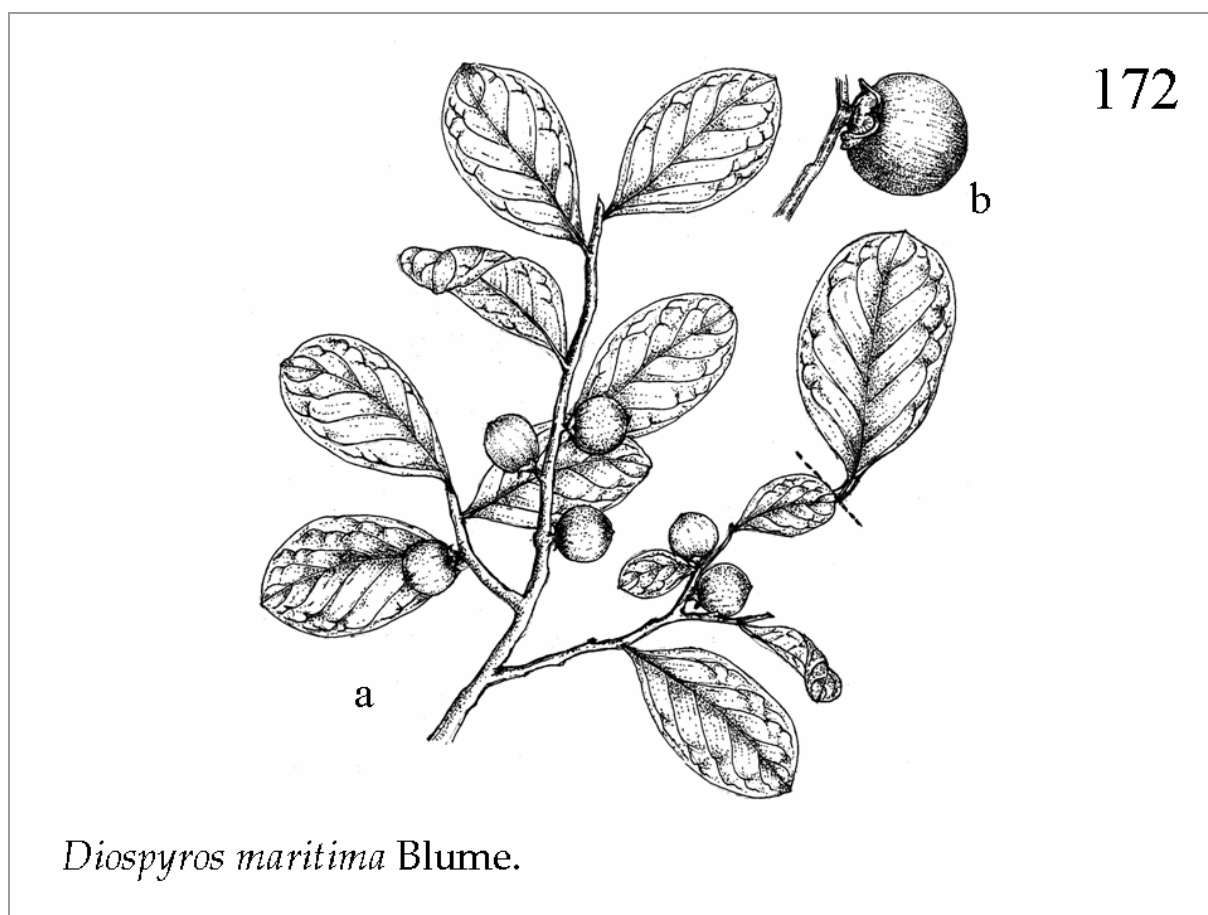


Fig. 172. *Diospyros maritima* Blume. (a) Fruiting branch, and (b) fruit.

EBENACEAE

172

Diospyros maritima Blume

Synonyms : *Diospyros kusanoi* Hayata, *Diospyros liukiensis* Makino, *Diospyros maritima* var. *transita* (Bakh.) Kosterm, *Maba cumingiana* A.DC. *Maba papuana* (R.Br.) Kosterm.

Vernacular name(s) : Broad leaved ebony (E)

Description : Evergreen, dioecious (with separate male or female) trees or shrubs, 4-8 m tall. Branchlets smooth. Leaves are simple, alternate, leathery, with a 4-10 mm long, smooth leaf stalk. Leaf blade elliptic to widely elliptic, 3-7 cm by 5-15 cm, leaf tip blunt or rounded, smooth on both surfaces, upper surface with a depressed midrib, lower surface with a prominent raised midrib and 5-8 pairs of raised lateral nerves. Female flowers are solitary in the leaf axils, with a very short stalk, 4 or 5 small scales at base, and with a fertile pistil and about 8 sterile stamens. Male flowers grouped in 2 or 3, clustered in leaf axils with a very short stalk; with 4 or 5 small scales at the base. The calyx is bell-shaped, silky white, about 3 mm long and deeply 4-lobed in male flower; about 4 mm long and shallowly 4-lobed in female flowers; female flower lobes are widely triangular, recurved at the tip. Corolla shaped like a salver, white, with a 10 mm long tube that measures 4 mm across and is dilated at base, densely white silky outside, smooth inside, 4-lobed; lobes recurved, oblong, rounded, and about 8 mm long and 4 mm wide. Stamens number about 16, with short filaments (about 1 mm long), smooth; anthers lanceolate and pointed, about 3 mm long in male flowers and much reduced in female flowers. Fruit a berry, round, but flattened from above, 2.5-3 cm in diameter, silky when young, later smooth, orange-yellow, 6 to 8-seeded. Seeds elliptic, laterally flattened, blunt at both ends, surrounded by a belt on edge, about 8 mm long, 5 mm wide, blackish and smooth.

Ecology : Occurs in coastal lowlands; recorded in evergreen “notophyll” vine forests on beach ridges of eastern Australia. Flowers from May to June. Mangrove associate species.

Distribution : From Southeast Asia to the Ryukyus and Taiwan, to Australia. In Southeast Asia recorded in the Philippines, Indonesia (Java, Papua) and Papua New Guinea.

Abundance : Locally common, but on the whole uncommon.

Use(s) : The bark and roots of this species have been reported to contain plumbagin and other monomeric and dimeric naphthoquinones.

Source of illustration : Flora of China vol. 15 fig. 161 (3-5).

Reference(s) : <http://bodd.cf.ac.uk/BotDermFolder/BotDermE/EBEN.html>,
<http://foj.c.u-tokyo.ac.jp>

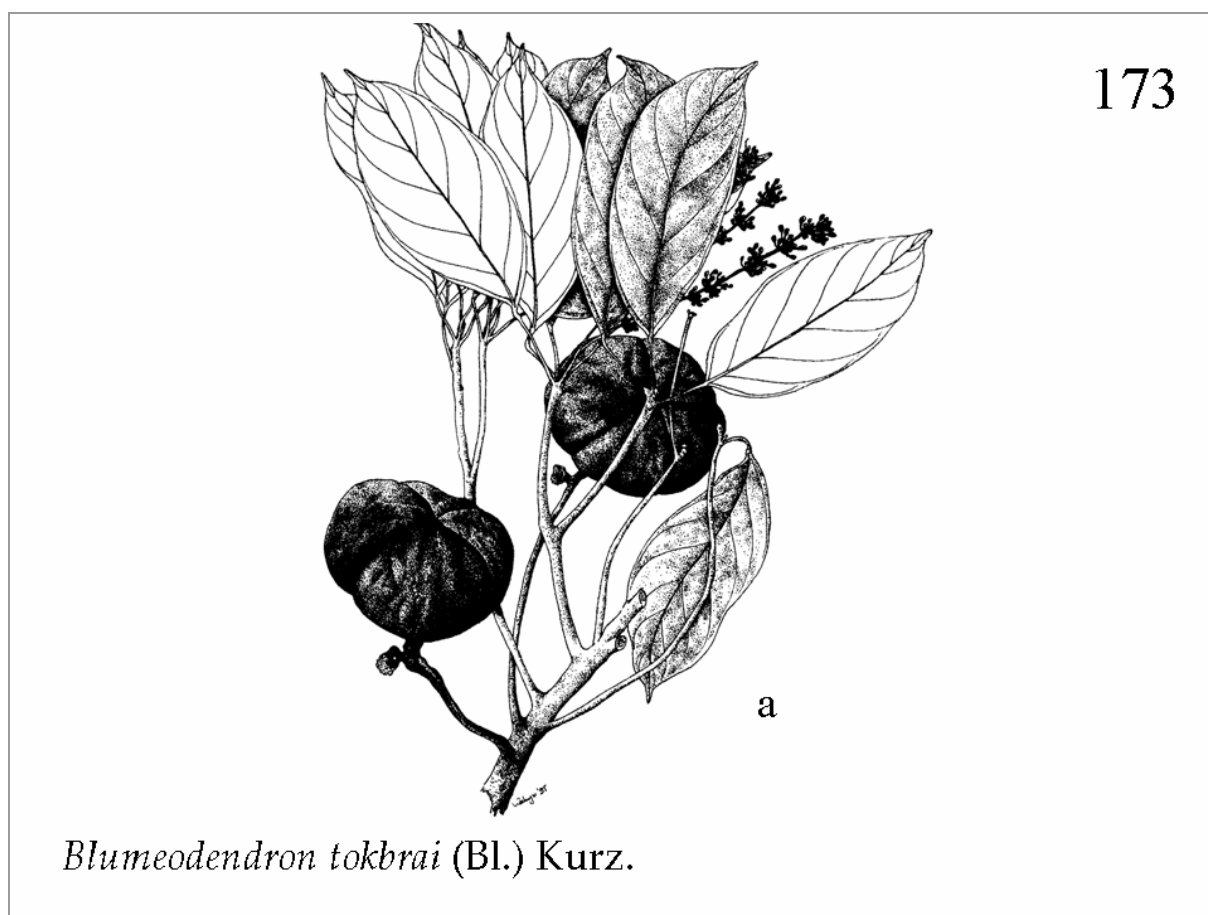


Fig. 173. *Blumeodendron tokbrai* (Bl.) Kurz. (a) Terminal branchlet with cluster of flowers and two fruits.

EUPHORBIACEAE

173

***Blumeodendron tokbrai* (Bl.) Kurz.**

Synonym(s) : *Blumeodendron elateriospermum* J.J. Smith, *Blumeodendron paucinervium* (Elm.) Merr., *Blumeodendron tokbrai* (Bl.) J.J. Smith, *Blumeodendron vernicosum* (Hk. f.) Gage, *Elateriospermum paucinervia*, *Elateriospermum tokbrai* Bl., *Mallotus tokbrai* (Bl.) Muell., *Mallotus vernicosus* (Hook. f.) Gage, *Rottlera tokbrai* (Bl.) Scheff.

Vernacular name(s) : Keretung (Mal.) Tokbrai, Batin-batin, Tekurung, Keterung, Siureuh, Kecipir (Ind.)

Description : Small to medium sized tree, up to 24 m (rarely 38 m) tall, 90 cm girth. The trunk is often fluted and may have small buttresses. In peat swamps it strongly develops 1 m-tall stilt roots. The crown is dense and small. Bark is orange-brown, smooth, sometimes marked with eye-like patterns. Wood is hard, yellow-brown (pink, according to Heyne, 1950), with fine radial lines. Young leaves are purplish, with a 2.5-5 cm stalk; blades are elliptic, 3.7-11.3 by 7.5-17 cm, with a narrow, long tip. The leaf margin is often whitish when the leaf is fresh and dry. There are six pairs of secondary nerves. Flowers occur on 5-7 cm-long clusters, each individual flower stalk being 2 mm long. Sepals 3-5, not overlapping; petals absent; stamens 14-35. Fruits are round, slightly flattened, about 3.2 cm across, (faintly) 3(-4)-shouldered, and orange when ripe. Seeds are black, enclosed in a cream jacket. Very variable species.

Ecology : Found in mangroves, primary peat swamp forest, *kerangas* (heath forest), lowland mixed Dipterocarp forest, hill forest and submontane moss forest, from sea level to 1,680 m (on Mt. Kinabalu, Sabah). Mangrove associate species.

Distribution : Southeast Asian species, recorded from Peninsular Malaysia, Brunei, Indonesia (Sumatra, Java, Borneo, the Moluccas and Papua) and Papua New Guinea.

Abundance : Uncommon.

Use(s) : The fruit is possibly edible (conflicting evidence regarding this). Timber splits easily, but is used for interior construction.

Source of illustration: Based on Whitmore (1972) and herbarium material of Rijksherbarium Leiden, the Netherlands.

Reference(s) : Heyne (1950), Whitmore (1973), Airy Shaw (1975).

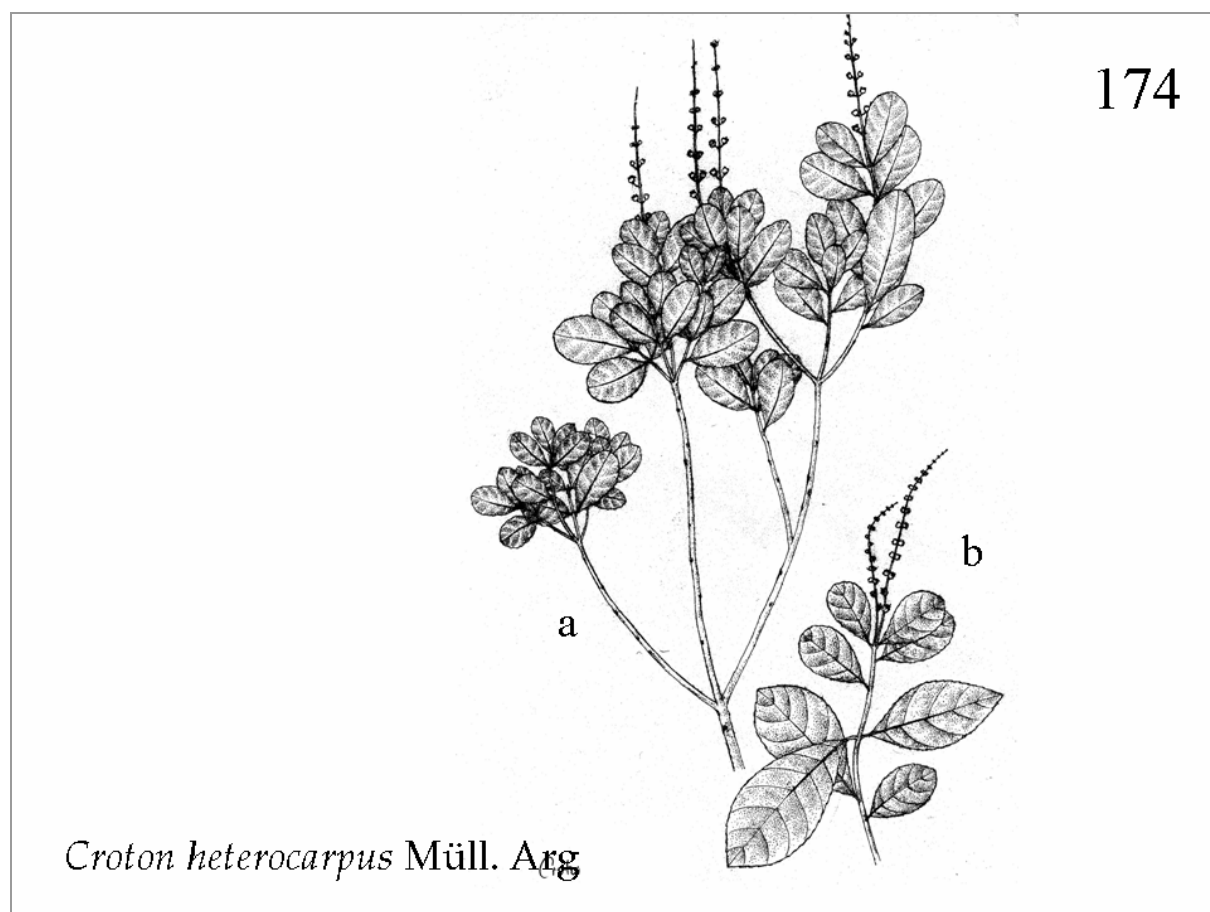


Fig. 174. *Croton heterocarpus* Müll. Arg. (a) Flowering terminal branches of small-leaved specimen, and (b), same, of large-leaved specimen.

EUPHORBIACEAE

174

***Croton heterocarpus* Müll. Arg.**

Synonyms : *Croton ardisioides* Hook. f., *Croton heteropetalum* (Sphalm.) Ridl.

Vernacular name(s) : Rat-tailed Croton (E), Melokan, Sari pelanduk, (Mal.), Lagarteiro, Sapokei, Tamu (Mal., Sabah), Margimaly (Mal., Sarawak), Darah-darah (Phil.), Patakoana, Wariemierie (Brun.)

Description : Small tree, 4-8(-12) m tall, with a clear bole up to half of this height, dbh up to 35 cm, usually much smaller. Bark smooth, grey to chocolate or reddish-brown, sometimes cracked and uneven; inner bark yellowish-green, sapwood pale orange, yellowish or whitish; occasionally with small buttress. Leaves are smooth, simple, spirally arranged, elliptic to obovate, 2-5 by 4-11 cm, simply pointed or blunt; leaf edge strongly wavy, with rounded teeth along upper part; wedge-shaped at base; leaf stalk 3-25 mm long. Leaves withering bright orange-red. Two conspicuous little glands at the base of the leaf blade, on the underside. Flowers are clustered in erect spikes at the ends of branches, 10-25 cm long, slender, either solitary or several spikes together. Flowers are pale green, whitish or slightly pink, 5(-6)-merous, 3.75 mm wide, with 5 overlapping sepals and 5 petals, shorter than the sepals, densely hairy within; anthers and stamens green. Fruit a round, green, bluish-green to yellowish capsule, 6 mm diameter, faintly three shouldered, set many along the (in fruit) drooping spikes like rats' tails.

Ecology : Primary forest near the coast, peat swamp, freshwater swamp forests, but especially along tidal creeks and rivers (e.g. in *Nypa* vegetation, or alongside *Gluta velutina*), and inland edges of mangroves. Occasionally in primary forest on hillsides. Mangrove associate species.

Distribution : Southeast Asian species, occurring in Singapore, Malaysia (Peninsular, Sarawak, Sabah), Brunei, the Philippines (Palawan) and Indonesia (Sumatra, Borneo).

Abundance : Uncommon.

Use(s) : Reported to be host plant for the lac insect; root is used in indigenous medicine in Sabah (collections by Goklin, 1962 and A. Mail in 1937).

Source of illustration : Holotype specimen (L0234540) collected by Zollinger in Lampung, Sumatra (undated), held at Leiden Herbarium.

Reference(s) : Whitmore (1972h), Airy Shaw (1975), Corner (1988)
http://www.sabah.gov.my/htan_caims/Vegetation/Fox%20Classification/Swamps/Mangroves.htm
http://www.rbgekew.org.uk/herbarium/brunei/lists/mangrove/151_01ls.htm

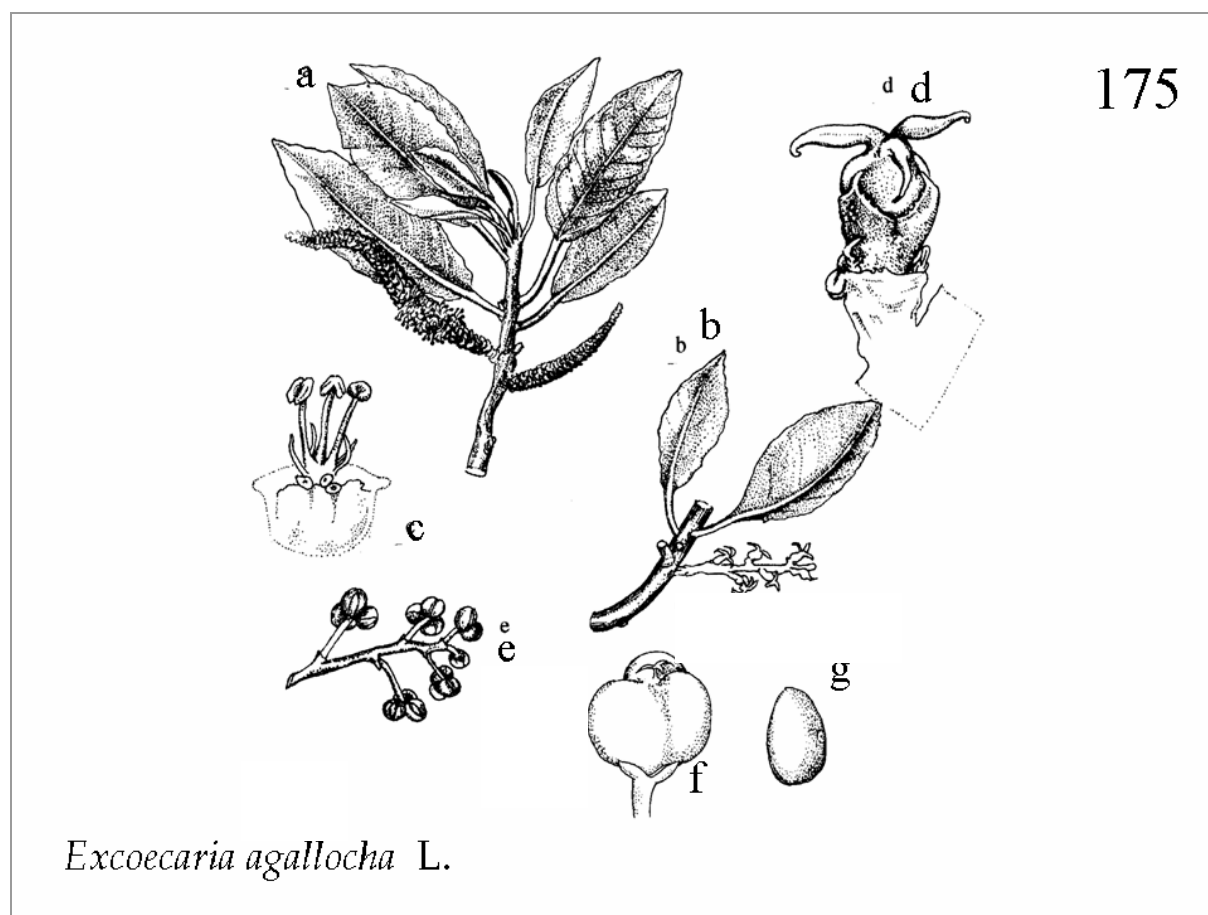


Fig. 175. *Excoecaria agallocha* L. (a) Branchlet with male flowers, (b) branchlet with female flowers, (c) male flower, (d) female flower, (e) cluster of fruit, (f) fruit, and (g) seed.

EUPHORBIACEAE

175

Excoecaria agallocha L.**Synonyms :** *Commia cochinchinensis* Lour., *Stillingia agallocha* (L.) Baill.**Vernacular name(s) :** Blind-your-eye, Milky mangrove (E), Buta-Buta, Kayu buta-buta (Mal.), Buta-buta, Menengan, Kayu Wuta, Sambuta, Kalapinrang, Mata Huli, Makasuta, Goro-goro Raci – *Kayu buta* (Ind.), Alipata, Batano, Bota-bota, Buta, Dipodata, Gumaingat, Himbabau, Iiñgi, Lipata, Lipatang-buhai, Siak – *Buta-buta* (Phil.), Thayaw (Myan.), Giá (Viet.), Taatum thale, Tatum (Thai.), Chheu chhor, Tatom (Camb.)**Description :** Small deciduous tree up to 10 m tall, with a smooth, but somewhat warty, grey bark, trunk diameter at breast height about 15 cm in larger specimens. The crown is irregular. Its roots run along the surface of the soil, are often knotted and covered with lenticels. Copious amount of highly irritating white latex is present in trunk, stems and leaves. Leaves are ovate or elliptic, measuring 6.5-10.5 by 3.5-5 cm, and have a toothed margin. There are two glands at the base of the leaf. Leaves turn orange to a bright shade of red before they are shed, and this gives the entire tree a reddish appearance. Trees bear either male or female flowers, never both. The stemless, tiny flowers are spirally arranged on erect, catkin-like, elongated clusters located in the axils. The diffuse, very scented male flower cluster is green and up to 11 cm long. The three flower lobes of the male flower measure 1 by 0.5 mm. The female flower clusters are much smaller, measuring up to 3 cm. The 3-lobed fruit (a capsule) is up to 14 mm wide, and contains dark brown seeds that are streaked and 5 mm in diameter.**Ecology :** Requires freshwater input for a large part of the year. It is commonly found on the landward margin of mangroves, on beach swales or occasionally above the high tide mark, occasionally up to an elevation of 400 m asl.. Also occurs along the banks of the saline (90% seawater) lake in the volcanic island of Satonda, off northern Sumbawa, Indonesia. It is particularly common as a regenerating species in some logged-over forests (e.g. Karang-Gading Langkat Timur Laut Reserve near Medan in North Sumatra) or forests with a long history of human influence (e.g. Sunderbans, Bangladesh). Flowering occurs intermittently all year round. Pollination by insects, especially bees, is suspected because of the sticky pollen and the presence of nectar producing glands at the end of the leaflets below the flowers. Mangrove species.**Distribution :** Occurs in the Asian tropics, from India and Sri Lanka throughout Southeast Asia, to southern China, Taiwan, Southern Japan, Australia and the west Pacific.**Abundance :** Locally abundant. Uncommon in Singapore.**Use(s) :** Toothache and swellings are treated with the roots of this plant. The timber is useful for carving. Not used for firewood because of the unpleasant smoke. Sulphate-paper pulp with good properties can be produced from the wood. Wood used for making matchsticks (Philippines). The sap is used to kill fish. The wood is sometimes aromatic enough to be sold, but it loses its scent after a few years. The white sap is poisonous, causing blistering and (temporary) blindness. The common Indonesian name *buta-buta* refers to the latter characteristic.**Source of illustration :** Based on Wightman (1989).**Reference(s) :** Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1973), Airy Shaw (1975), Percival & Womersley (1975), Wightman (1989), Said (1990), Giesen & Sukotjo (1991), Aksornkoae (1993), Giesen & Rudyanto (1994), Aragones *et al.* (1998), Ng & Sivasothi (1999), Marschke (2000), <http://www.uc.pt/timor/florafauna.html>.

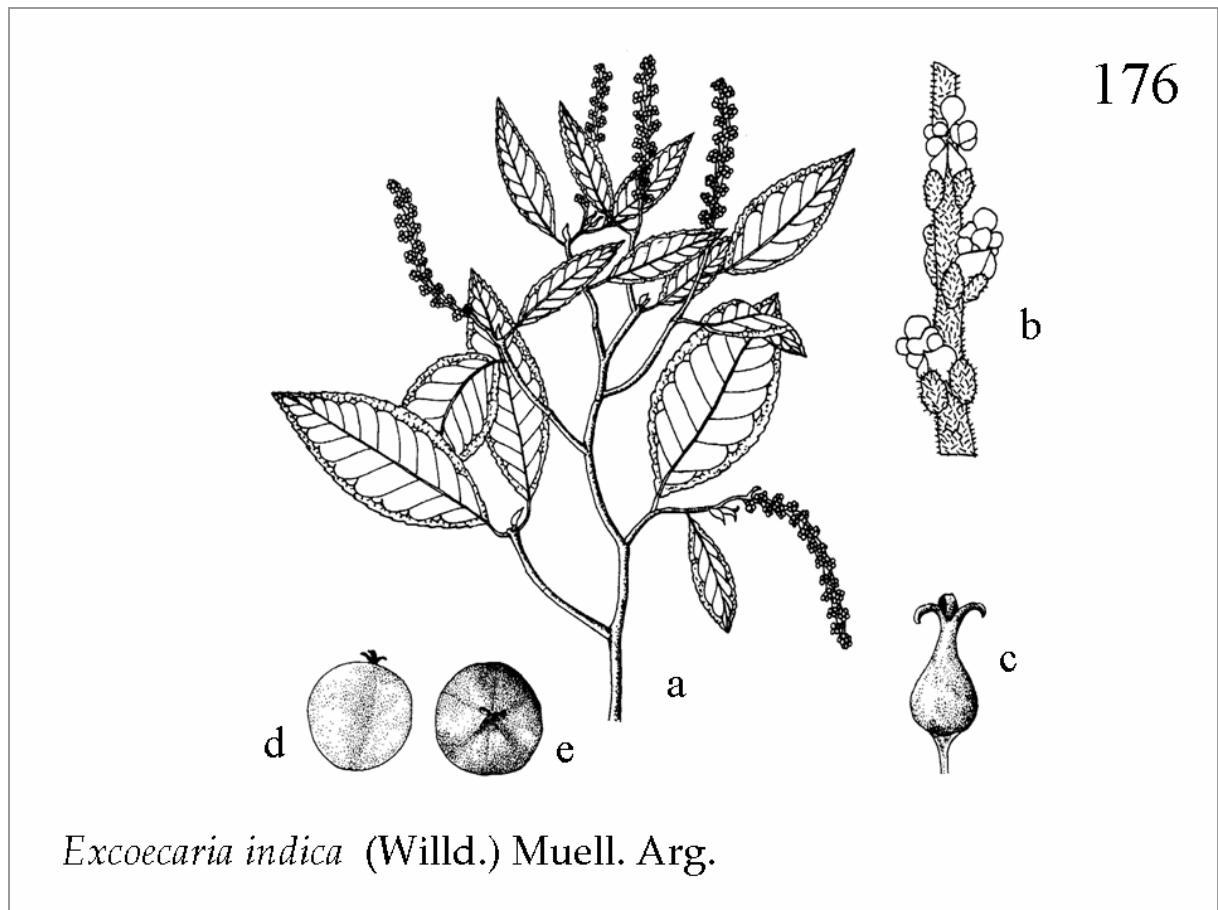


Fig. 176. *Excoecaria indica* (Willd.) Muell. Arg. (a) Terminal branchlet with clusters of flowers, (b) detail of flower cluster, (c) female flower, and (d, e) fruit, seen from side and above.

EUPHORBIACEAE

176

***Excoecaria indica* (Willd.) Muell. Arg.**

Synonyms : *Ichthyoctonos litorea* Rumph., *Sapium indicum* Willd., *Stillingia diversifolia*, *Stillingia indica* (Willd.) Baill.

Vernacular name(s) : Mock Willow (E), Gurah (Mal.), Ai Tui, Ai Tohi, Ai Pue (Ind.), Samothale (Thai)

Description : A small tree, up to 18 m tall, usually less than 10 m, smooth and containing white latex. The trunk is short, not buttressed, with greyish, shallowly fissured bark. The crown is bushy, usually with upright branches and more or less drooping twigs. Leaves are elliptic or lanceolate, measuring 5-12 by 2-4 cm, finely toothed, with two small glands at the base of the blade. The leaf stalk is 7-20 mm long and reddish. Flowers occur in terminal, about 5 cm long, elongated clusters. Male flowers are numerous, each with three stamens. Female flowers are solitary, with three long styles. Fruit is a round, woody capsule, 2.5-3 cm in diameter, almost black, 3-seeded.

Ecology : Occupies primary *Nypa* forest in sea water, tidal river banks and sea shores. Also occurs in freshwater swamp forests, along rivers and in evergreen lowland forest up to an altitude of 250 m. Mangrove associate species.

Distribution : From south and east India throughout Southeast Asia to the Solomon Islands. In Southeast Asia so far not (yet) recorded in the Philippines.

Abundance : Locally common.

Use(s) : Leaves are used to prepare a black dye to colour yarn and rattan. Young fruits, containing aesculetin in the latex, are used as fish poison. The ripe seeds are used as a vegetable or condiment, after removal of the fruit-wall (the latex of the wall blisters the skin). The hard, round seeds are used by children as marbles (Indonesia). Wood used only for fuel. Leaves are applied to the abdomen to cure fevers; a decoction of the root bark has purgative properties.

Source of illustration : Based on Lemmens & Wulijarni-Soejipto (1991).

Reference(s) : Heyne (1950), Airy Shaw (1975), Tomlinson (1986), Aksornkoae (1993), Ng & Sivasothi (1999).

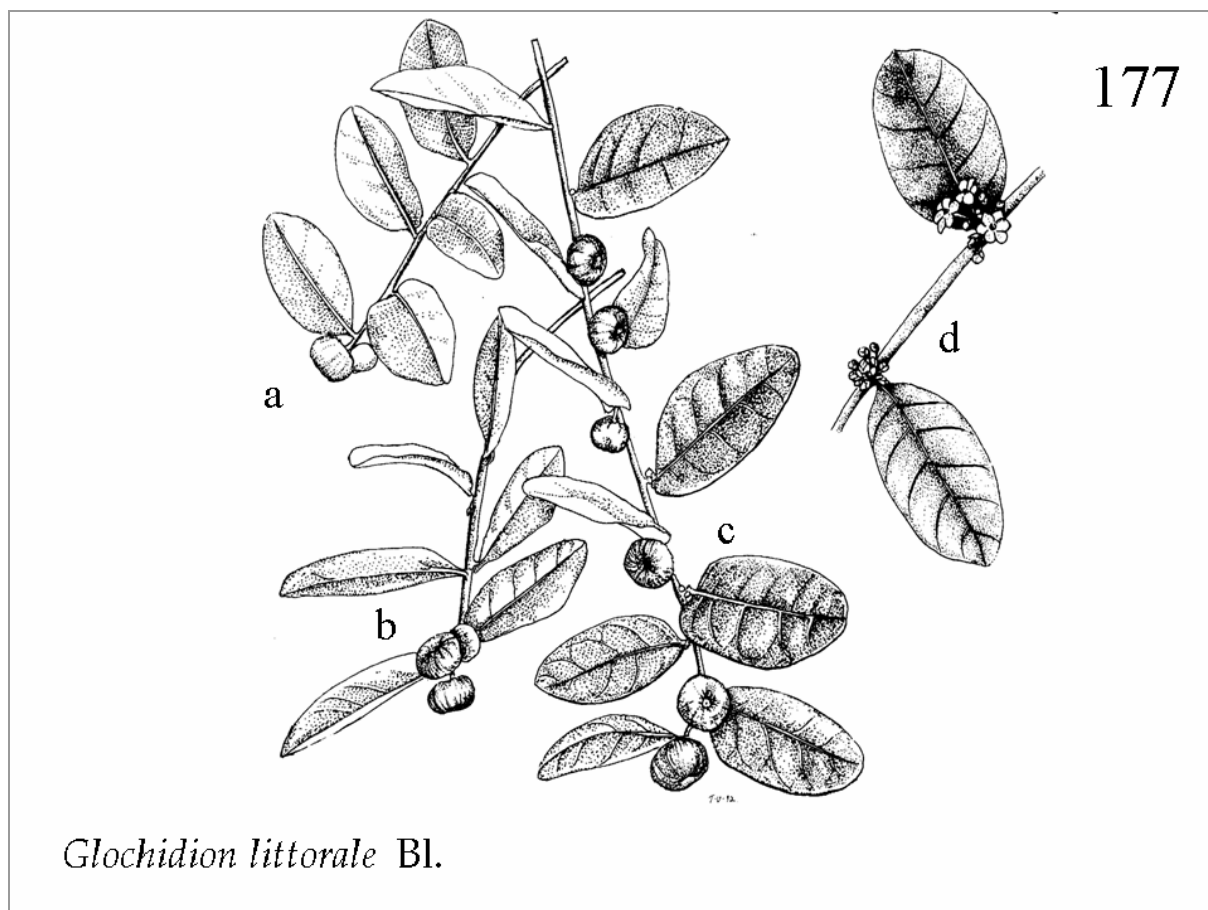


Fig. 177. *Glochidion littorale* Bl. (a, b, c) branchlets with fruit, and (d) branchlet with flowers.

EUPHORBIACEAE

177

Glochidion littorale Bl.

Synonyms : *Glochidion littoralis*, *Phyllanthus litoralis* [sic] (Bl.) Muell.

Vernacular name(s) : Monkey apple (E), Jambu kera, Selensur (Mal.) Kapo-kapo, Ketumbang, Dempul, Dempul Lelet Gajah, Jeraman – *Dempul* (Ind.), Bagnang-lalake, Kayongkong, Nigad, Padi-padi, Sagasa, Tabaño – *Kayong* (Phil.), Múi (Viet.)

Description : Erect shrub or small tree, 3-6(-8) m tall, with brown or grey, smooth twigs, and a stem diameter of 10-15 cm at breast height. The leaves are leathery, shiny and simple, oval-ovate or almost round, measuring 3.5-8.5 by 2.5-6.5 cm. The small, often green or yellowish-green flowers occur in clusters located in the axils. They do not have a corolla or disk. The fruit is red and smooth or partly covered with fine hairs; it is crowned by the (remains of the) style-column. Fruit measures 1 by 1.5 cm, slightly compressed at the top, up to 14-lobed, with longitudinal grooves; pinkish-white to reddish. The shrub is highly variable, and at least three varieties have been recognised (*littorale*, *culminicola* and *caudatum*).

Ecology : Occurs in coastal brushwoods and open forests, on tidal river banks, sea cliffs and peat swamp forest, up to altitudes of about 90 m. Flowering occurs all year round. Mangrove associate species. According to Airy Shaw (1975), there are three varieties: the coastal *Glochidion littorale* var. *littorale* (described here), *Glochidion littorale* var. *culminicola*, endemic to Sarawak, occurring in elfinwood or pygmy forest at altitudes of 240-1,800 m, and *Glochidion littorale* var. *caudatum*, also endemic to Sarawak, and occurring in peat swamp forests. Mangrove associate species.

Distribution : Occurs from India and Sri Lanka through Southeast Asia. In Southeast Asia it has been recorded in Cambodia, Peninsular Malaysia, the Philippines, Vietnam, Thailand, Singapore and Indonesia (Java, Sumatra and Borneo).

Abundance : Locally common.

Use(s) : Leaves used as medicine to treat blood in the stools, dysentery and tonsillitis. A concoction of leaves is used to treat stomachache. Fruit said to be edible. A preparation of the plant is used for bathing after childbirth. Wood is used for firewood, fencing and poles.

Source of illustration : Based on Polunin (1989).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1973), Airy Shaw (1975), Tomlinson (1986), Aragones *et al.* (1998), Ng & Sivasothi (1999), Hong (2000).

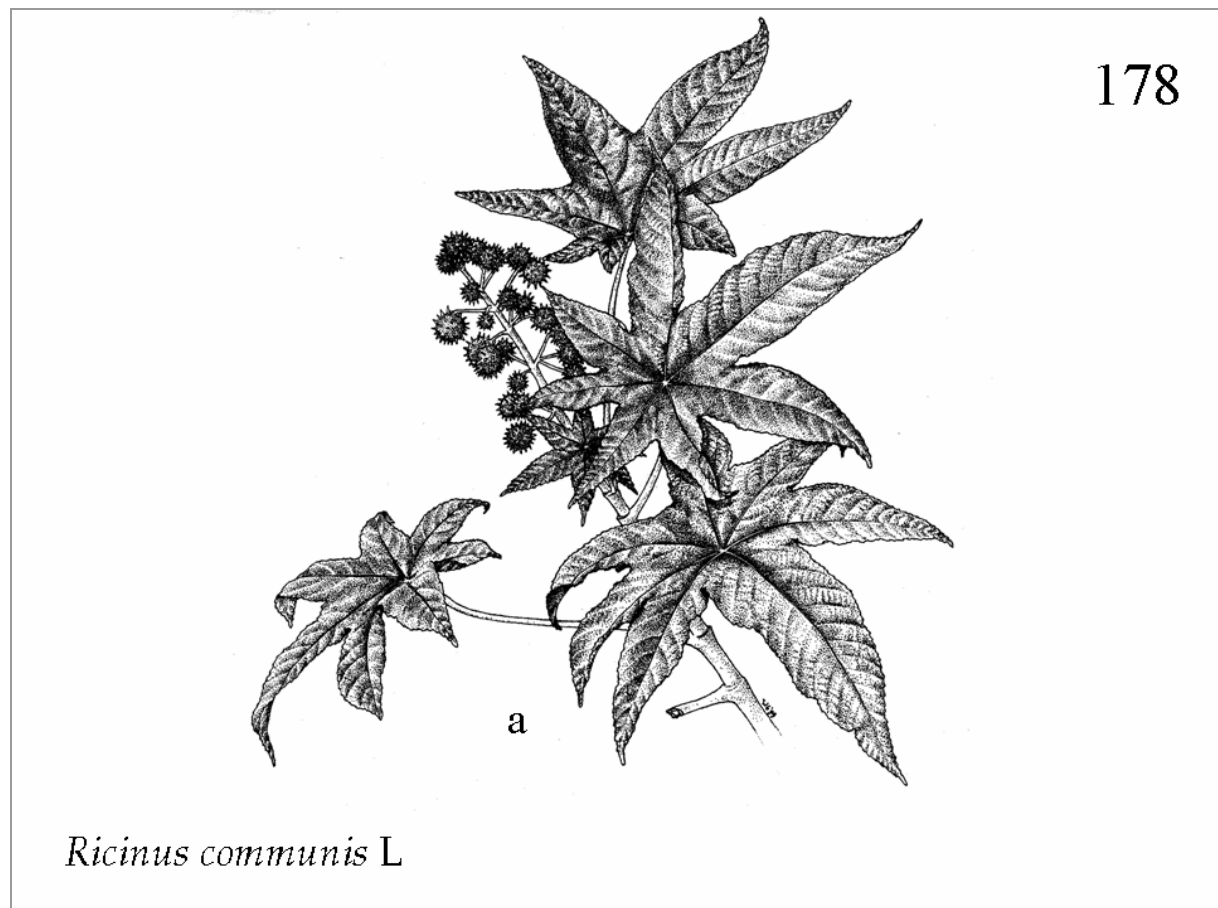


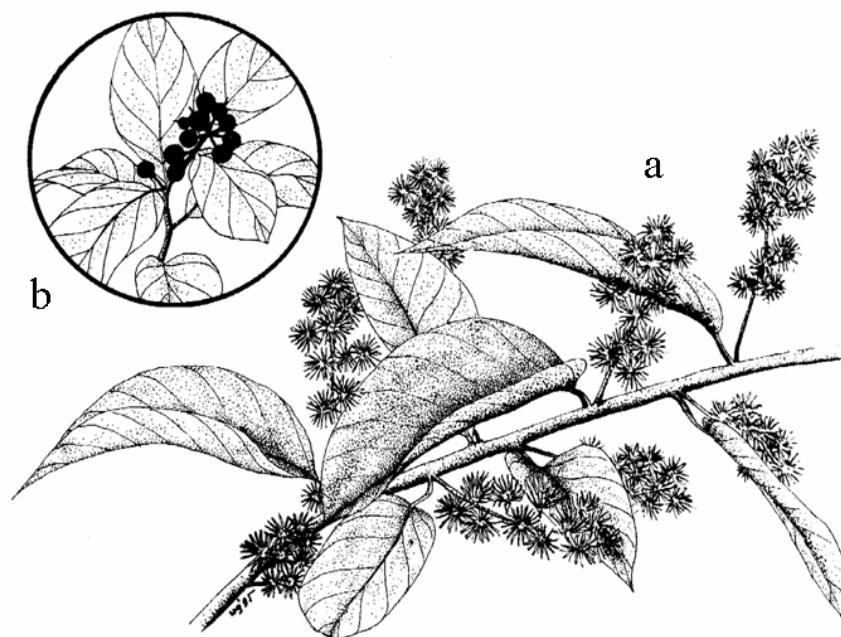
Fig. 178. *Ricinus communis* L. (a) Terminal branch with fruit.

EUPHORBIACEAE

178

Ricinus communis L.**Synonyms :** *Ricinus inermis* Mill., *Ricinus spectabilis* Bl.**Vernacular name(s) :** Castor oil plant (E), Wonderboom (NL), Jarak (Mal.), Gloah, Lulang, Jarak, Kalikih alang, Jarang, dulang jai, Lana-lana, Lutur bal, Luluk, Paku ton, Ketowang – *Jarak kosta* (Ind.)**Description :** A large, smooth, woody herb or small tree, reaching a height of about 2m after 1 year, but may eventually attain 3-4(-8) m. Leaves are simple, alternate, hand-shaped, with 5-9 lobes, with pointed tips and serrated edges, 15-30(-40) cm in diameter, and with a 30 cm long stalk that has conspicuous glands at the base. Leaves and stems are often reddish green. Flower spikes are borne in the axils of the upper leaves and are 15-30 cm long, with female flowers in the lower part and male flowers above. Neither type of flower has petals; the male has numerous, cream-coloured stamens and the female 3 red stigmas. Fruits are spherical capsules, at first green, later turning brown, covered with soft spines, 12-18 mm across, splitting open when ripe to release 3 large seeds, pale-silvery coloured and marked with many black lines and stripes.**Ecology :** Flowering and fruiting occurs all year round. Found on a wide variety of soils, but generally not in waterlogged areas, from sea level to about 2500 m asl. Occurs on landward margins of mangroves, and as a weed of waste ground. Seed coat is poisonous to birds and mammals. Mangrove associate species.**Distribution :** Indigenous to tropical and subtropical Africa (or perhaps only Somalia and northeast Kenya), planted world-wide, including Southeast Asia where it now occurs throughout.**Abundance :** Locally common.**Use(s) :** Grown as a crop throughout the tropics for the production of castor oil, which is used as a lubricant and as a purgative. Oil cake is used as fertiliser (contains 4.8% nitrogen and 1.6% phosphorous). Leaves are used as fodder. The plant has many medicinal uses: leaves are used to treat headaches, as a poultice for boils, and as a cure for rheumatism. Leaves are also used as a feed for silkworms. Seeds contain a potent poisonous protein called ricinin.**Source of illustration :** Drawn from live specimen.**Reference(s) :** Heyne (1950), Ivens (1972), Airy-Shaw (1975), Afriastini (1988), Corner (1988), Khan & Alam (1996).

179



Scolopia macrophylla (W. & A.) Clos.

Fig. 179. *Scolopia macrophylla* (W. & A.) Clos. (a) Flowering branchlet, and (b) fruiting branchlet.

FLACOURTIACEAE

179

Scolopia macrophylla (W. & A.) Clos

Synonyms : *Phoberos macrophylla* W. & A., *Phoberos maritima* Miq., *Phoberos rhinanthera* Benn. & Br., *Rhinanthera blumei* Steud., *Rhamnicastrum rhinanthera* O. Ktze, *Scolopia crenata* [non (Wall.) Clos.] King, *Scolopia maritima* Warb., *Scolopia rhinanthera* Clos.

Vernacular names : Pokok rukam gajah, Rukem Laut, Damak-damak (Mal.), Marong, Rukam laka, Rukem Betina, Api, Belangan (Ind.), Bó'm Bà (Viet.)

Description : A small tree, up to 10 m tall, with a smooth, greyish-pink bark, often with a spiny trunk and branches. Spines may be up to 3 cm long. The ovate, leathery leaves, 5-16 by 3-8 cm, are red when young and spirally arranged; leaf edges are minutely and regularly toothed. Usually there are two orange glands at the insertion of the blade. Similarly, there are two such glands on the flower disk opposite each petal. The slender leaf stalk is reddish-pink, 5-10 by 1 mm. The bisexual, slightly scented flowers occur in elongated clusters located in the axils, or occasionally in loose clusters located at the ends of branches, 2.5-10.5 cm long. The greenish-white or yellowish-white flowers measure 4 mm across and are hairy along the margins. The 4 mm long style, the numerous stamens and the lobes of the calyx are persistent – i.e. they remain visible on the fruit. The orange, round berry is 6-7 mm long and 2-6 seeded.

Ecology : Occurs in moist or marshy soil on the landward margin of mangroves, or further inland on river banks, along swampy creeks, at the margins of pools and along marshes in teak-forest. Usually on temporarily inundated soils, up to altitudes of 15 m, rarely inland up to 90-150 m altitude. Near Lake Toba in Sumatra it has been recorded at 900 m, but this is exceptional. Flowering occurs from August to October. Mangrove associate species.

Distribution : Southeast Asian species, recorded from Cambodia, Thailand, Vietnam, Malaysia and Indonesia (Sumatra, Borneo, Java).

Abundance : Localities at which it has been recorded are widely scattered, but the species is sometimes locally relatively common. Generally it is uncommon.

Use(s) : Small construction timber.

Source of illustration : From herbarium specimen at Herbarium Bogoriense.

Reference(s) : Sleumer (1954), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1972d), Tomlinson (1986), Corner (1988), Said (1990)
[http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/\\$FILE/Bomba.htm](http://www.mekonginfo.org/mrc_en/contact.nsf/0/8902A71A698A3DE1802566860066E546/$FILE/Bomba.htm).

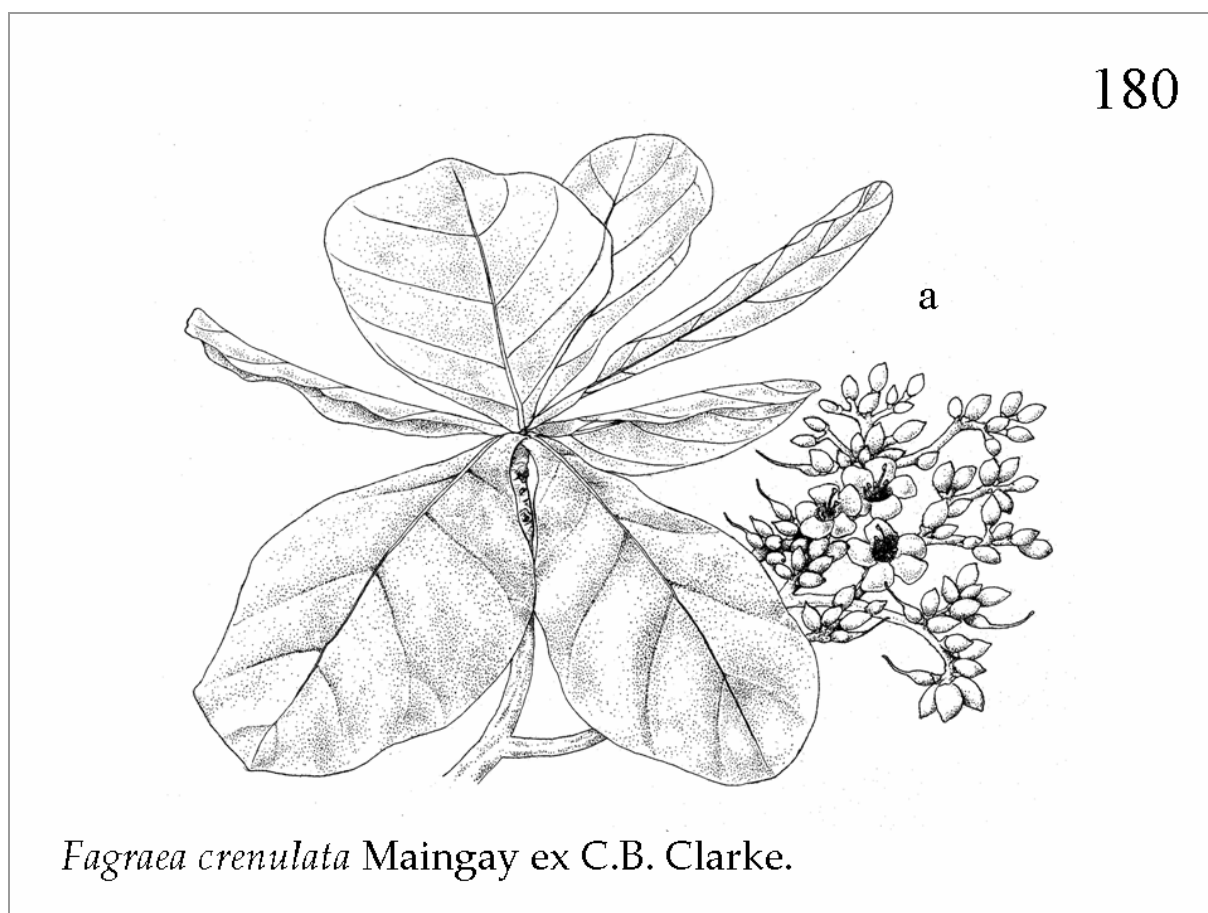


Fig. 180. *Fagraea crenulata* Maingay ex C.B. Clarke. (a) Flowering branch.

GENTIANACEAE

180

Fagraea crenulata Maingay ex C.B. Clarke

Synonyms : *Fagraea fastigiata* (non Bl.) Ridl.

Vernacular name(s) : Cabbage Tree (E), Melabira (Thai.), Bàng nu'ố'c (Viet.), Malabera (Mal.), Bebira, Bira bira, Bubira, Malabira, Melabira, Kayu Bulan (Ind.)

Description : A large tree reaching a height of 17-23(-25)m with tiers of radiating branches like that of *Terminalia catappa* (Sea Almond or Ketapang). The trunk and branches are covered with short thorns that often disappear as the tree matures. The bark is light grey in colour that darkens with age and is deeply ridged and fissured. Leaves are simple, opposite, broadly obovate, crowded in a terminal whorl; leaves large, 14-25 by 18-45 cm, with rounded apex and narrow base which clasp the twig; leaf edge has tiny, rounded teeth (= 'crenulations', hence the name). Veins, 5-7 pairs, are raised and prominent on the lower side of the leaf. Leaf stalks (virtually) absent. Flowers are in large terminal bunches, 25 cm long, cream coloured turning yellow with age and are fragrant; calyx 1 cm long, divided to near the base; corolla tube funnel-shaped, 1.75-2 cm long. Flowering occurs in March or April with the flowering branches losing their leaves. Fruits are green, oblong, 2.5 cm or longer. They are fleshy with many small seeds. The Cabbage Tree tends to be mistaken with the Ketapang due the tier-like branching and large leaves. The difference between the two is that the Ketapang has no thorns. Recent taxonomic revisions have resulted in the genus *Fagraea* being moved from the Loganiaceae to the closely related Gentianaceae (Struwe & Victor, 2000).

Ecology : Occurs in wet lowland habitats, tolerating full-strength sea water. Usually occurs in permanent or seasonal freshwater swamps, on banks of tidal rivers, and is occasionally recorded in mangroves. Up to an altitude of 10 m asl. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Thailand, southern Vietnam, Malaysia (Peninsular and Sarawak), Singapore and Indonesia (Sumatra and Borneo).

Abundance : Common.

Use(s) : Planted as a roadside tree in Singapore and Malaysia. Used for afforestation of tin tailings in Malaysia, as it is tolerant of high levels of heavy metals and acidity. It is used for making walking sticks. Furnishes a good, though cross-grained timber. Wood very valuable for piling, as it resists *teredo* borers when used with the bark still present. Also used as firewood. Planted in Bengkalis (Riau Province, Sumatra).

Source of illustration : <http://biodiversity.uno.edu/delta/wood/en/www/logfafra.htm>

Reference(s) : Leenhouts (1962), Aronson (1989); Ang & Ho (2002),
<http://biodiversity.uno.edu/delta/wood/en/www/logfafra.htm>
<http://www.nparks.gov.sg/plants/tre/pla-tre-fag.shtml>
<http://www.ussl.ars.usda.gov/pls/caliche/Halophyte.query?k=Genus&q=Fagraea>.

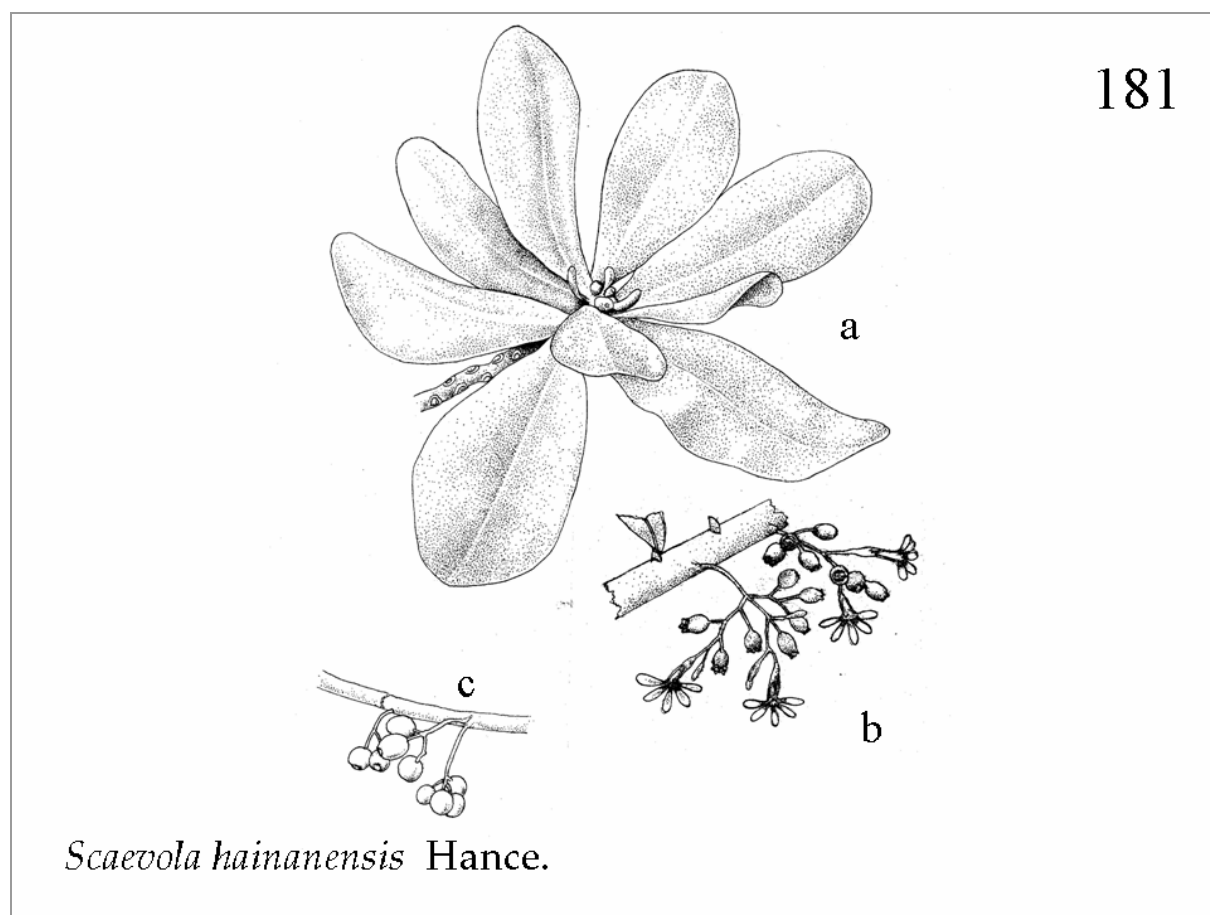


Fig. 181. *Scaevola hainanensis* Hance. (a) Terminal branch, (b) cluster of flowers and fruit, and (c) fruit clusters.

GOODENIACEAE

181

Scaevola hainanensis Hance**Synonyms :** *Crossotoma hainanensis***Vernacular name(s) :** Fan flower (E)

Description : A stiff, rigid, low growing shrub, 1.5-2 m, branches covered with short stiff, greyish-white hairs. Leaves are fleshy, alternate and bright green, varying in shape from narrow to spatula-shaped (rounded and gradually narrowing to the base) 1-1.5 by 6-7 cm. They are arranged in clusters along the branches and have woolly leaf axils. Flowers are (almost) without a stalk. There are five calyx lobes, the lower parts of which are united into a tube and joined to the ovary. Five petals are winged and united at the base, arranged in a one-sided manner like an outstretched hand or fan; densely hairy on the inside, smooth on the outside, 4-5 cm long; white, with purplish marking inside. There are five free stamens. Fruit is a white fleshy berry, 5-8 mm diameter, to which the persistent calyx remains attached; contains two seeds.

Ecology : Not recorded in the original description by Hance, and not yet described in the Flora of China. Judging from photographs and from the records from Vietnam, it may be (predominantly) a coastal species. In Vietnam, the species is recorded along with *Suaeda australis* and *Acrostichum aureum* on landward margins of mangroves on a gravelly substrate at several localities. In southern China (Guangdong) it is common on sandy soils, especially on sandy beach ridges (Howes *et al.*, 2004). Mangrove associate species.

Distribution : Mainly an East Asian species, first recorded in southern China (Hainan Island), but also found elsewhere in southern China and Taiwan. In Southeast Asia it has been recorded in Vietnam only.

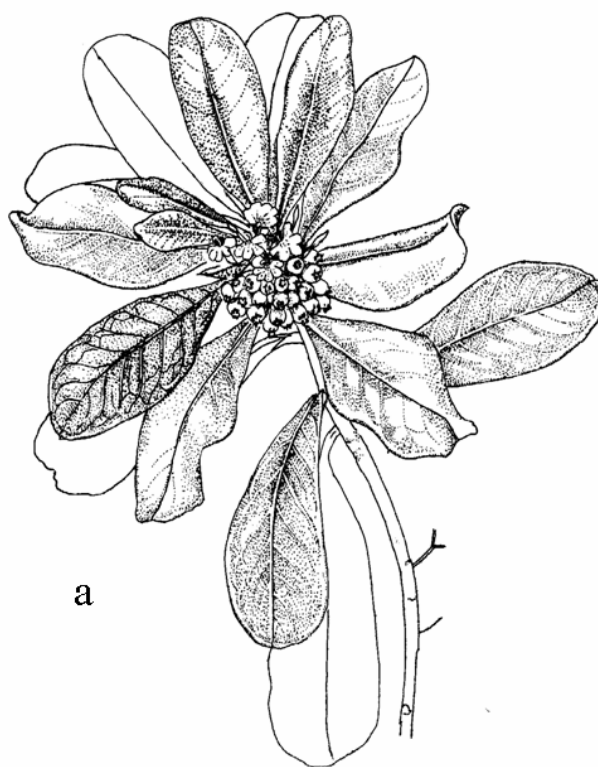
Abundance : Uncommon to rare.

Use(s) : Potential as ornamental.

Source of illustration : Taiwanese websites.

Reference(s) : Hance (1878), Chau *et al.* (2000),
<http://www.dec.ctu.edu.vn/sardi/htqt/english/succession.htm>.

182



Scaevola taccada (Gaertn.) Roxb.

Fig. 182. *Scaevola taccada* (Gaertn.) Roxb. (a) Branchlet with flowers and fruit.

GOODENIACEAE

182

Scaevola taccada (Gaertn.) Roxb.

Synonyms : *Buglossum litoreum* Rumph., *Lobelia frutescens* Mill., *Lobelia plumieri* (non L.) Burm., *Lobelia taccada* Gaertn., *Scaevola frutescens*, *Scaevola koenigii* Vahl., *Scaevola leschenaultii* DC., *Scaevola lobelia* Murr., *Scaevola macrocalyx* de Vriese, *Scaevola piliplena* Miq., *Scaevola plumieri* (non Vahl.) Bl., *Scaevola sericea* Vahl., *Scaevola velutina* Presl.

Vernacular names : Sea-lettuce Tree (E), Strand ossetong (NL), Ambong-ambong, Merambong, Pelampong (Mal.) Ambung-ambung, Beruwas Laut, Gabusan, Kaju Ambong, Subang-subang, Cilekle, Babakoan, Baba koan Lelaki, Gagabusan, Niangka, Porang, Dudulan, Gabus, Gabus Cina, Pohodo'elang, Klindo, Pelenda Laut, Bojo, Batang Lampung, Bawuntulon, Bojolo, Bukolako, Kokole, Panimburang, Papaceda, Wintungtasi, Anas, Boppa Ceda, Gilitopa, Hokal, Mokal, Panimburana, (Pa)Paceda – *Subeng-subeng* (Ind.), Dodogo kubar, Kaikikira, Paimenh (PNG), Balak-balak, Balok-Balok, Bokabok, Bosboron, Boto, Linu, Mosboron, Boto (Phil.), Rak thale (Thai.)

Description : Robust, erect or spreading shrub, up to 3 m tall. Occasionally develops into a small tree up to 7 m, with slender white branchlets that have a white pith. Leaf scars are conspicuous and have hairs along their edge. The succulent, spirally arranged or opposite, oblong-obovate leaves are often densely crowded at the ends of the branches. Leaves measure 15-25 by 6-12 cm, tapering into a short, broad leaf stalk. Tufts of stiff, white hairs occur in the leaf axils. The conspicuous white or pale yellow bisexual flowers are 2-2.5 cm long, and occur 4 cm long clusters located in the axils on a 1 cm long stalk. Flowers are covered with fine, white hairs. The calyx segments are about 0.5 cm long. The petals often have violet stripes on the inside and an undulating margin. The corolla tube, 10-15 mm long, is split completely down one side, exposing the curved style. The fleshy, white fruits are 1 cm long, with 1-2 corky seeds.

Ecology : Typical of beach communities, especially sand dunes, where it can form extensive colonies, apparently by subterranean branching of the roots. It also occurs on rocky beaches, and in mangrove communities, but only in sandy, well-drained areas. Flowering occurs throughout the year. Large bees pollinate the flowers, but self-pollination also seems to occur. Fruits are probably dispersed by birds. Mangrove associate species.

Distribution : From Madagascar to Southeast Asia, through tropical Australia and the South Pacific, up to Hawaii. Recorded throughout Southeast Asia.

Abundance : Common, and locally very abundant.

Use(s) : Several parts of this plant are used in native medicine. The wood is small, but resistant against sea water and used for making nails for canoes. The thick, soft pith of the young twigs is used in microscopy, replacing elder-pith. As this pith can easily be cut and painted, ornaments, such as small flowers, small birds, fruits etc... are carved from it (e.g. in the Moluccas).

Source of illustration : Based on Polunin (1988).

Reference(s) : Leenhouts (1957), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Afriastini (1988), Corner (1988), Aksornkoae (1993).

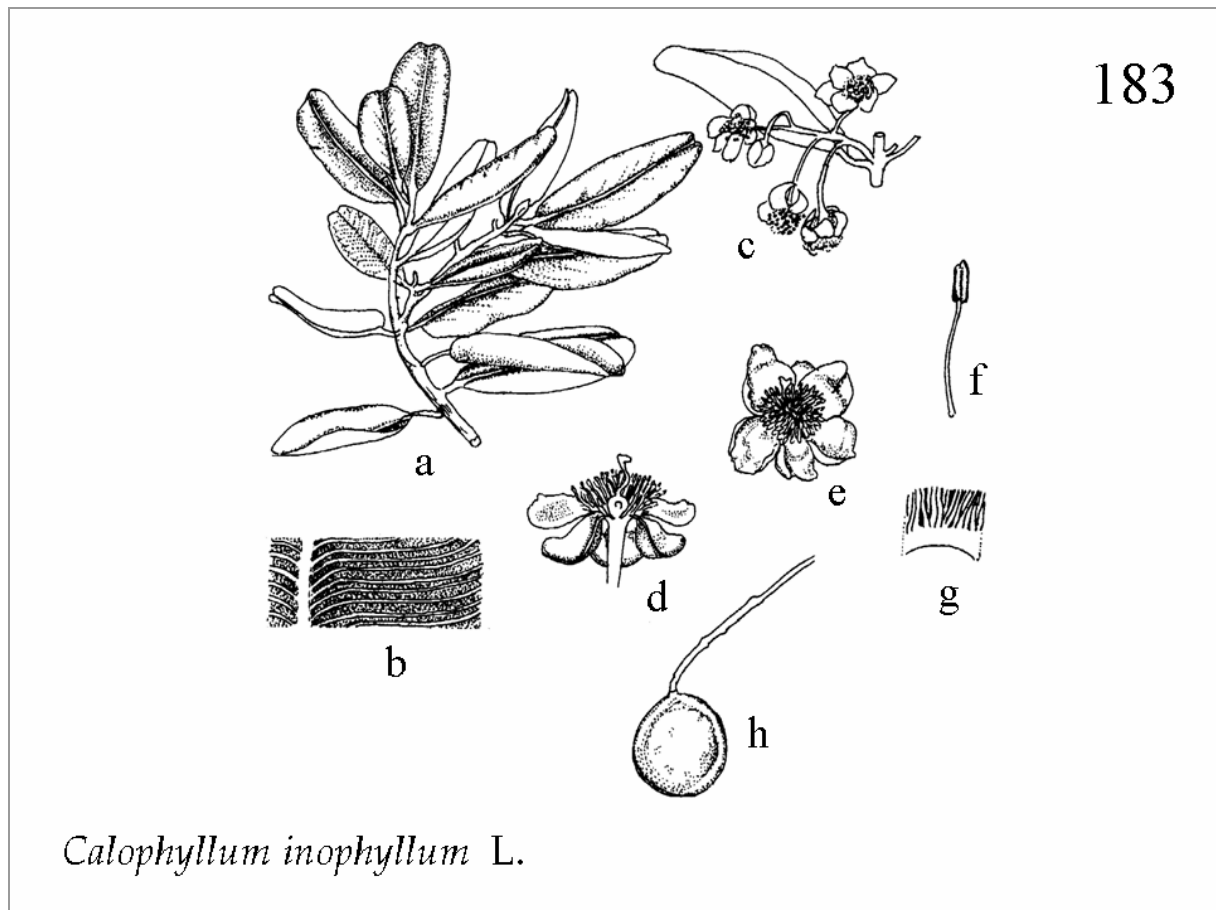


Fig. 183. *Calophyllum inophyllum* L. (a) Branchlet with leaves, (b) detail of leaf venation, (c) branchlet with several flowers, (d) longitudinal section of flower, (e) flowers seen from above, (f) stamen, (g) fused bases of stamens, and (h) fruit.

GUTTIFERAE

183

Calophyllum inophyllum L.

Synonyms : *Bintangur maritima* Rumph.

Vernacular name(s) : Alexandrian Laurel (E), Benaga, Bintangur Laut, Penaga laut, Paku achu, Menaga, Naga (Mal.), Nyamplung, Punaga, Calpong, Punaga, Dingkaran, Lingkaren – *Nyamplung* (Ind.), Mù u (Viet.), Krathing (Thai.)

Description : A dense, dark tree, 10-30 m tall, that is usually crooked, leaning or even growing along the ground. Has a sticky, yellow or white latex. Stems are angular. The elliptic to oblong, rounded or notched leaves have very numerous, fine, parallel lateral veins (hence the scientific name 'calophyllum', meaning 'beautiful leaf'). Leaves measure 10-21.5 by 6-11 cm, and are shiny, dark green above, with a pale midrib. Flower clusters occur in the axils and are up to 15 cm long, solitary and usually have 5-15 flowers. Three flowers at the end of the elongated cluster are pendulous. The white, bisexual, sweet-scented flowers measure 2-3 cm across, have four petals, four sepals and numerous stamens. Two of the four sepals are white. The fruit is a round, 1-seeded berry, 2.5-4 cm in diameter.

Ecology : Occurs on non-swampy, sandy beaches and bordering areas, up to an altitude of 200 m. Occasionally it occurs in mangroves, usually in transitional habitats. Also recorded inland, e.g. in Sumatra along Lake Singkarak at 386 m. Flowering seems to be continuous throughout the year, with one or more peaks. Pollination is almost certainly by insects. Fruit is dispersed by sea current as it floats for extended periods, or by bats that eat the fleshy outer layers. In Singapore the tree flowers twice a year, in April-June and again in October-December. Mangrove associate species.

Distribution : From East Africa through India, Sri Lanka and Southeast Asia to the Polynesia. Introduced in the Pacific area. Probably occurs throughout Southeast Asia; in Indonesia it has been recorded from Sumatra, Java, Kalimantan and Papua.

Abundance : Common.

Use(s) : Immature fruit is salted as a snack. It is a source of dye, oil, timber (boats) and medicine. In Australia, Indonesia and Malaysia it is often cultivated as a shade tree. All parts of this tree have traditional medicinal uses, of an astonishing range.

Source of illustration : Tomlinson (1986).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1972), Tomlinson, (1986), Corner (1988).

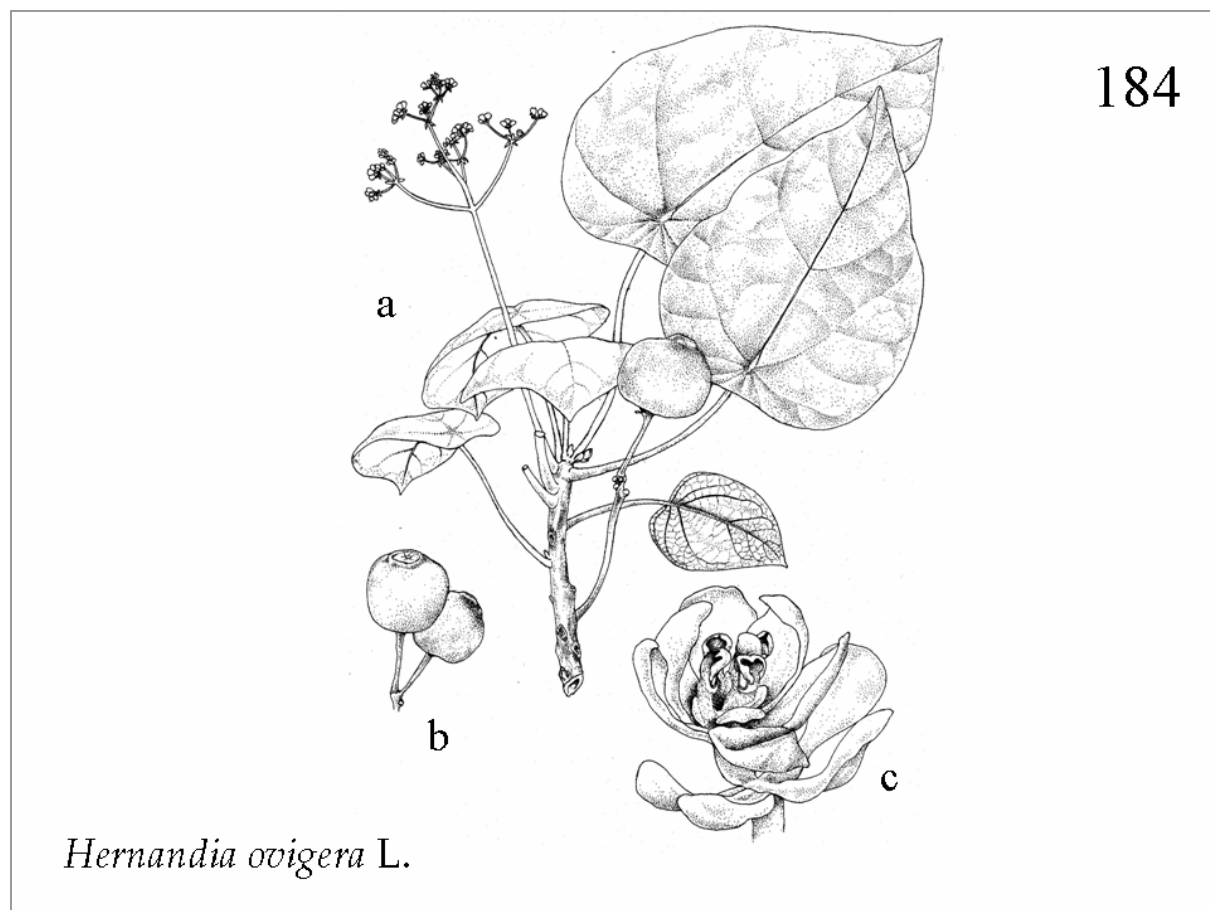


Fig. 184. *Hernandia ovigera* L. (a) Flowering and fruiting branch, (b) two fruits, and (c) detail of flower.

HERNANDIACEAE

184

Hernandia ovigera L.

Synonyms : *Arbor ovigera* Rumph., *Hernandia guianensis* Aubl., *Hernandia javanica* Tuyama, *Hernandia nymphaeifolia* (Presl.), *Hernandia papuana* C.T. White, *Hernandia peltata* Meisn., *Hernandia peltata* Sessé & Moc., *Hernandezia sonora* (L.) Hoffman, *Hernandia sonora* L.

Vernacular name(s) : Sea Hearse, Jack-in-the-box tree (E), Eierboom (NL), Bengkak, Mahandap, Mapopo, Mawiao, Machlana, Hapo-hapo, Mata ikan, Binong laut, Kampis, Nawoko ma lako, Nyalu, (Ind.), Buah keras laut (Mal.), Banung-kalauai, Habag, Kolon-kogon, Kolinkogun, Kolung-kolung, Koron-koron, Kung-kung, Malat-antañgan, Pantog-lubo, Tabataba (Phil.)

Description : Tree, attaining a height of 10-20(-40) m, diameter at breast height of 50-100 cm, bark silvery-grey buff and pimply, trunk becoming shortly buttressed as the base. The leaves are simple, alternate (or spirally arranged), smooth, somewhat leathery, shining, peltate (i.e. stalk borne on lower surface of leaf rather than on edge), ovate, (6-)8-10(-21) by (10-)15-18(-40) cm, pointed at the tip, and broad and rounded at the base, on leaf stalks 7-19(-25) cm in length. The leaf blade is 5-7(-9) nerved. The flower clusters are terminal or located at the axils of the leaves, 15 to 30 cm in length (including the 6-18 cm long stalk). The flowers are 3-merous (male) or 4-merous (female), hairy, creamy-white, fragrant, and about 8 mm wide. Male flowers have a 4-5 mm stalk, tepals 7 mm long, 3 stamens. Female flowers have a short 1.5 mm stalk, tepals 4-5 mm long, style 5 mm long. The fruit consists of a hard seed enveloped by a fleshy exterior, ellipsoid or round, somewhat flattened, and 2-2.5 by 1.7-2.2 cm, dark brown or black, longitudinally faintly 8 ribbed, with a 2-6 mm long stalk. *Hernandia nymphaeifolia* and *Hernandia ovigera* are treated as separate species by Duyfjes (1996).

Ecology : Tree from lowland rainforest on coastal plains and alluvial flats, often on river banks or ridges, old secondary forest, hill forest; recorded from peat, clay and sandy soils. Especially found along seashore, in the *Barringtonia* formation, sometimes immersed by seawater, and on landward margins of mangroves. Occasionally extending inland on slopes at low altitude, although recorded up to an altitude of 1000 m asl. Mangrove associate species.

Distribution : Tropical East Africa, Madagascar, Sri Lanka, Taiwan, through Southeast Asia to tropical Australia and Polynesia. In Southeast Asia recorded from Thailand, Cambodia, the Philippines, East Timor, Indonesia (Sumatra, Java, Borneo, Sulawesi, Moluccas, Papua) and PNG.

Abundance : Locally common.

Use(s) : Wood sometimes used for constructing canoes. Lamp oil is extracted from the fruit, and this is sometimes also used to make candles. Seeds (without the fleshy pericarp) contain 51% oil. The oil is red brown; it is feebly drying oil, which contains stearin. Seed contains an alkaloid. The wood can cause dermatitis in wood-workers, possibly from its content of podophyllotoxin acetate. According to some sources, the leaf juice has a hair removing effect, but according to Heyne (1950) this is based on a misidentification by Rumphius, who confused this species with a Euphorbiaceae. The fruit contains an alkaloid 0.7 per cent resembling berberine. Filipinos use the oil as a hair restorer and dandruff removers. Heartwood is used in the Moluccas for treating haemorrhages.

Source of illustration : Duyfjes (1996)

Reference(s) : Heyne (1950), Ng (1972), Corner (1988), Duyfjes (1996)
<http://bodd.cf.ac.uk/BotDermFolder/BotDermH/HERN.html>,
<http://bpi.da.gov.ph/websitemedicinal/all/k/koron-koron.htm> ,
<http://www.uc.pt/timor/florafauna.html>.

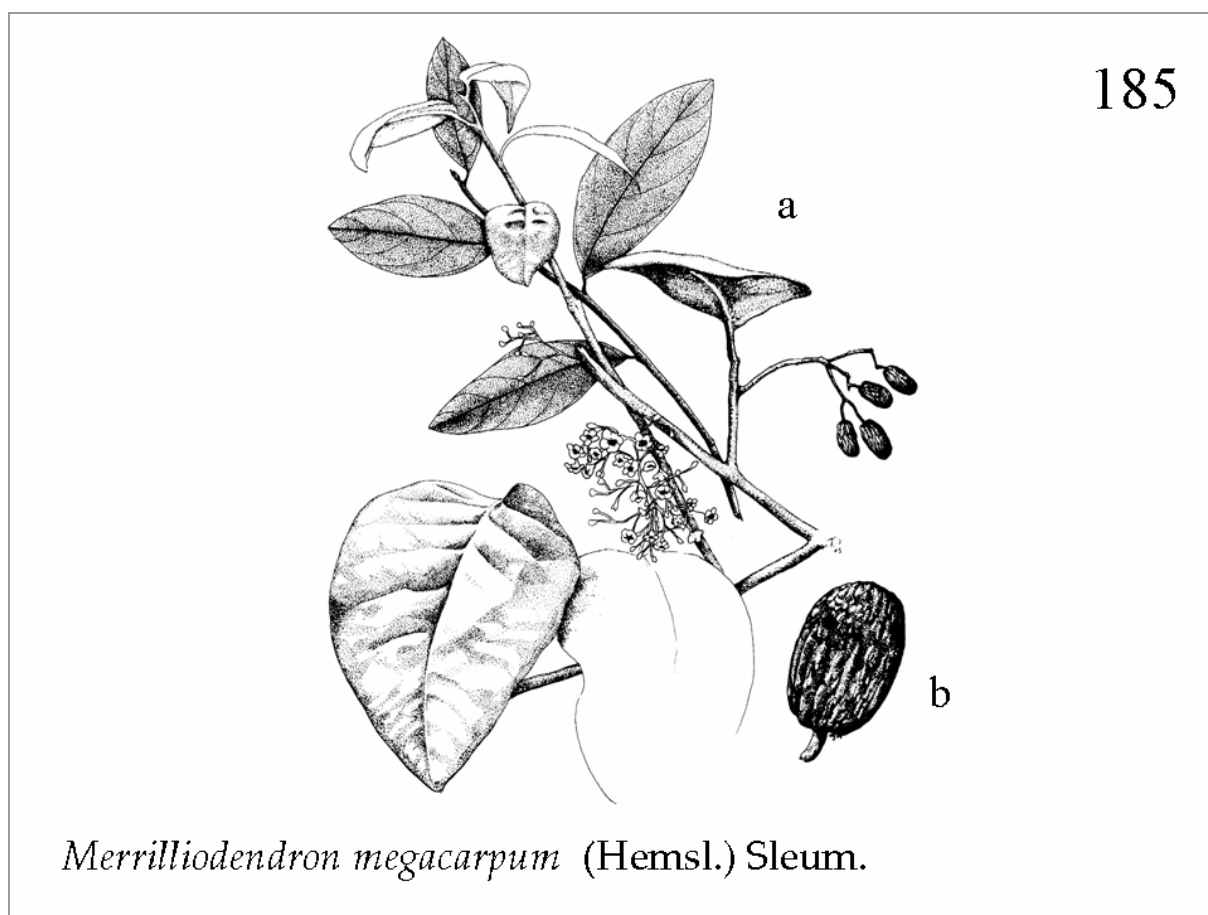


Fig. 185. *Merrilliodendron megacarpum* (Hemsl.) Sleum. (a) Branchlet with flowers and fruit, and (b) mature fruit.

ICACINACEAE

185

***Merrilliodendron megacarpum* (Hemsl.) Sleum.**

Synonyms : *Mangifera xylocarpa* Laut., *Merrilliodendron rotense* Kanehe, *Peckeliodendron missionariorum* Sleum.

Vernacular name(s) : Pake Saukatibu (Ind.), Vabilisi, Manggaresi (PNG)

Description : A shrub or more commonly a tree, up to 15 m tall, occasionally even up to 25 m, with a straight, sometimes fluted trunk, up to 55 cm in diameter. The green-grey to light brown bark is smooth, and shed in irregular, soft flakes. Leaves measure 15-30 by 7-16 cm, are oblong to oblong-ovate, thin-leathery and smooth. When held to the light, numerous minute, transparent points can be observed. The flower clusters are 7-20 cm long, and are composed of soft, flexible, many-flowered lateral groups of flowers. The clusters occur in groups of 1-3 in leaf axils or sprout directly from older branches or the trunk. The lobes of the calyx are 1-1.5 mm. The dull cream or yellow to purplish petals are a little fleshy, 3-4 by 1.5 mm, smooth and hairless outside and densely covered with yellow hairs on the inside. The leathery, drooping berry is round to somewhat elongated, slightly laterally or nearly quadrangularly compressed. It measures 4-10 by 2-6 cm and is white or yellow to purple when fresh and ripe, turning purple to black in older stages. The starchy seed measures 4-6 by 2-2.5 cm.

Ecology : Generally in coastal lowlands and partly swampy rainforest, up to altitudes of 30 m. On Japan Island it reportedly occurs at 700 m. In mangroves it usually occurs on the landward margins. It also occurs on sandy or coral beaches, and volcanic soil, in moist places, often near streams or in freshwater swamp forest. The corky or spongy fruit is buoyant and adapted for water dispersal. Mangrove associate species.

Distribution : Occurs in Melanesia, Solomon Islands, Micronesia and the eastern part of Southeast Asia, where it has been recorded in Indonesia (Southeast Sulawesi, northern Papua), Papua New Guinea and the Philippines (Palawan).

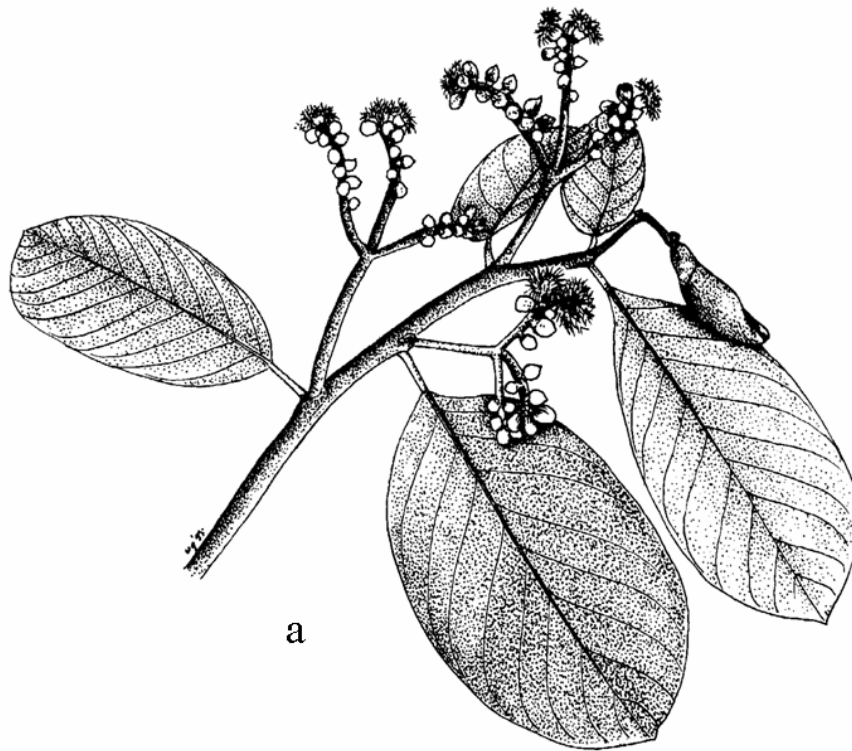
Abundance : In general it is uncommon, although locally it may be relatively common. It has a rather scattered distribution.

Use(s) : Fruit is reportedly edible.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Sleumer (1971).

186



Stemonurus ammui (Kaneh.) Sleum.

Fig. 186. *Stemonurus ammui* (Kaneh.) Sleum. (a) Branchlet with flowers and fruit.

ICACINACEAE

186

***Stemonurus ammui* (Kaneh.) Sleum.**

Synonym(s) : *Stemonurus ellipticus* (Schellenb.) Sleum., *Urandra ammui* Kaneh., *Urandra elliptica* Schellenb.

Vernacular(s) : Aikanu, Ailalo, Aimarako, Ainunura, Mala Sata, Ammui (PNG)

Description : Tree, 10-24 m tall, sometimes with buttresses or slender, cylindrical pneumatophores. Bark is smooth or with fine, longitudinal fissures or blister-like growths, pale grey to pale or dark brown. Leaves are leathery, oblong- to obovate-elliptic, measuring 9-16 by 4-8 cm, with a 1-2 cm pointed tip. Veins occur in 12-14 (occasionally up to 18) slightly curved pairs. Leaf stalks measure 1.5-2 cm. Flowers occur in clusters with a flattened top, with a main stalk of 3-5 cm bearing 5-7 (rarely up to 9) branches of flowers. The calyx is cup-shaped, 2 mm broad and shallowly lobed. Petals measure 5 by 2 mm, slightly keeled outside, yellowish-white, with a strong lemon scent. The flower disk is low and slightly lobed. Fruit is an elongated berry, measuring about 4-5 cm by 1.5-1.7 cm.

Ecology : Occurs in primary forest, generally on well-drained, hilly slopes up to an altitude of 200 m, occasionally in freshwater swamp forest or mangroves. Flowering occurs all year round. Mangrove associate species.

Distribution : Occurs in Micronesia, Melanesia, Solomon Islands and the eastern part of Papua New Guinea. May also occur in Indonesian Papua, but as yet it has not been recorded.

Abundance : Unknown.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

References : Sleumer (1971).

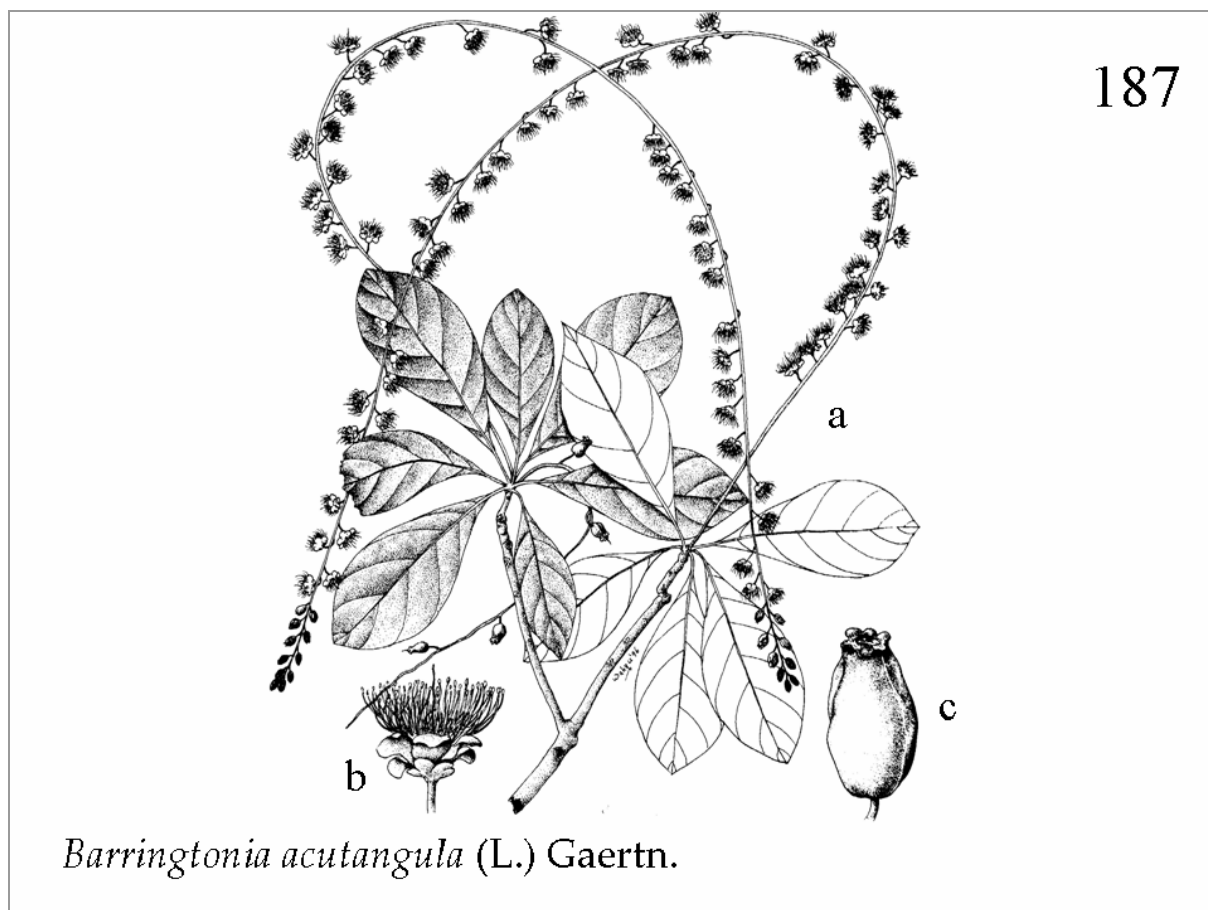


Fig. 187. *Barringtonia acutangula* (L.) Gaertn. (a) Two terminal branchlets with two racemes of flowers, (b) flower, and (c) fruit.

LECYTHIDACEAE

187

***Barringtonia acutangula* (L.) Gaertn.**

Synonym(s) : *Barringtonia acutangula* subsp. *spicata* (Bl.) Payens, *Barringtonia edaphocarpa* Gagn., *Barringtonia spicata* Blume

Vernacular name(s) : Indian Putat (E), Putat, Langkong, Jempalang (Mal.), Putat, Salinsa, Alakang (Ind.), Chiê'c (Viet.)

Description : Small tree, 2-13(-25) m tall, stem 20-90 cm in diameter, bark light brown, smooth. Almost sessile leaves spirally arranged in terminal clusters, each leaf measuring 3-9 by 8-28 cm, finely toothed along edges and with a pointed tip. Flowers have 0.5-1 cm long individual stalks, arranged along a drooping string-like stalk, 30-65 cm long. Flowers measure 5 cm across the stamens, that are pinkish to red. Fruit is oblong and bluntly 4-angled, 2 by 7 cm, pale yellowish brown and hard. Although now commonly treated as synonyms, Corner (1988), is not convinced and recognises the following differences between *Barringtonia acutangula*, '*spicata*' and '*edaphocarpa*' :

	<i>B. acutangula</i>	<i>B. spicata</i>	<i>B. edaphocarpa</i>
Flower stalk	6-12 mm	(almost) sessile	sessile
Fruit	sharply 4-angled	bluntly 4-angled	round with 8 grooves, 4 deep, 4 shallow

Ecology : Lowland swamp forests, along streams and margins of mangroves. As with other *Barringtonia*'s this species flowers at night, often in great profusion, and is probably pollinated by moths. Flowers are usually dropped in the morning, and can be seen as pink flotsam under the trees. Fruit is buoyant and water dispersed. In deeply flooded swamp forests, hair-like tassels of roots spread from the trunk of larger trees; occasionally these may cover the entire base of the trunk, together with tangles of prop roots. In West Borneo, Giesen (1995) found that immature specimens of *Barringtonia acutangula* could withstand being totally submerged for 10-11 months per year. Mangrove associate species.

Distribution : From Afghanistan, India and Bangladesh through Southeast Asia to Australia. Recorded from Myanmar, Thailand, Vietnam, Cambodia, Malaysia, Brunei, Indonesia (Sumatra, Borneo, Sulawesi, Papua, but not in Java or the Moluccas) and Papua New Guinea.

Abundance : Common, locally very common.

Use(s) : Regarded as important to floodplain fisheries in Bangladesh. Wood sometimes used for parts of boats and rice pestles.

Source of illustration : Based on Corner (1988) and photographs.

Reference(s) : Heyne (1950), Whitmore (1972c), Corner (1988), Whitmore, Tantra & Sutisna (1989 & 1990), Hong & San (1993), Giesen (1995),
<http://www.rbghkew.org.uk/herbarium/brunei/bclhome.htm>.

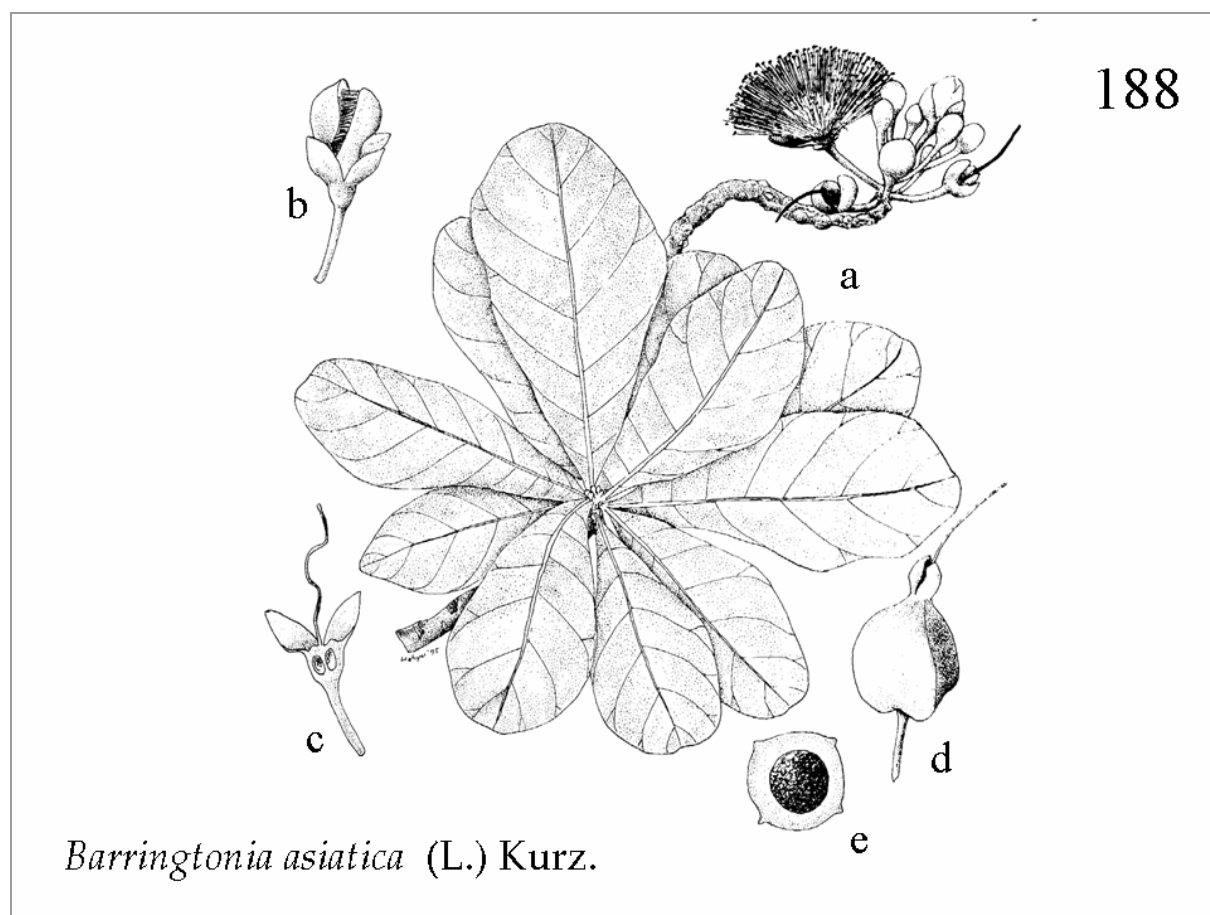


Fig. 188. *Barringtonia asiatica* (L.) Kurz. (a) Terminal branchlet with flowers, (b) flower bud, (c) longitudinal-section of flower, (d) fruit, and (e) cross-section of fruit.

LECYTHIDACEAE

188

Barringtonia asiatica (L.) Kurz

Synonym(s) : *Agasta asiatica* Miers., *Barringtonia butonica* Forster, *Barringtonia speciosa* J. R. & G. Forster, *Butonica rumphina* Miers, *Mammea asiatica* Linne

Vernacular name(s) : Sea Putat (E), Butong, Butun, Pertun, Putat Laut (Mal.), Bitung, Talise, Butun, Hutu, Wutunu, Keben-keben, Keptun, Moju, Miju, Jaga – *Butun* (Ind.), Chik an, Chik le, Chik nam (Thai.), Bitoon (Phil.), Chiềc vàng (Viet.)

Description : A small to medium sized tree 7-20(-30) m tall, with a diameter of 25-100 cm. The crown is large-leaved and shiny, bark pinkish grey, smooth. Twigs are thick. Young leaves are pinkish olive with pink veins, while old leaves wither to yellow or pale orange. Leaves are spirally arranged in rosettes, each blade obovate, blunt, rather thick and leathery, 15-45 by 9-20 cm, with an entire edge. Flowers occur in short, erect raceme, very large, measuring 10(-15) cm across the stamens, which are white, tinged pink at the ends; petals are 7.5 cm long and greenish-white. Flowers are very sweet scented and more or less hang upright. Fruit is 10-15 cm wide, cubic, with a broad square base, tapering towards the tip like a truncated pyramid, first green, then going brown; has two persistent calyx lobes. They contain one large seed and a tough, corky-fibrous husk to which it owes its buoyancy. In general vegetative appearance, this species may be mistaken for *Terminalia catappa* or *Fagraea crenulata*. However, *Barringtonia asiatica* has fleshier, shinier and more pointed leaves than *Terminalia catappa*, which withers to a red, rather than yellow or orange. *Fagraea crenulata* has leaves arranged in pairs, and has short spines along the trunk.

Ecology : Coastal forest, sea shores, beaches, sandy coasts, rocky shores and occasionally in mangroves. It does equally well when planted inland. Fruit has a cork brown husk and can often be seen along beaches; they float and may germinate after floating a great distance. Flowers open after sunset and drop early in the morning, being open only one night. Pollination is probably by large moths. The tree and seeds contain saponins, used as fish poisons. The large fruits are commonly stranded on the beach, the brown husk having been worn away to a fibrous basket which surrounds the seed. Characteristic beach tree of the Indo-Malayan and Polynesian region. Mangrove associate species.

Distribution : Occurs from Madagascar and the Comoros in the Indian Ocean though South Asia and Southeast Asia to the West Pacific. It is common throughout Southeast Asia, having been recorded in Thailand, Cambodia, Malaysia, Vietnam, Brunei, Singapore, the Philippines, Indonesia (Sumatra, Borneo, Java, Sulawesi, the Lesser Sundas and the Moluccas, Papua) and Papua New Guinea. Likely to also occur in Myanmar and East Timor, but there are no reliable records so far. Collections of the NY Botanical Garden suggest that this species also occurs in Martinique and Puerto Rica.

Abundance : Generally common, but uncommon in PNG and Indonesian Papua.

Use(s) : Occasionally Reddish oil can be obtained by heating and crushing the seeds; this oil can be used for burning only. Juice from seeds is used to seal paper umbrellas (Java), and to kill ecto-parasites such as lice.

Source of illustration : Based on Keng (1987), Corner (1988) and Polunin (1988).

Reference(s) : Heyne (1950), Whitmore (1972c), Corner (1988), Polunin (1988), Whitmore, Tantra & Sutisna (1990), Hong & San (1993), Aksornkoae (1993), Nguyen *et al.* (2000).

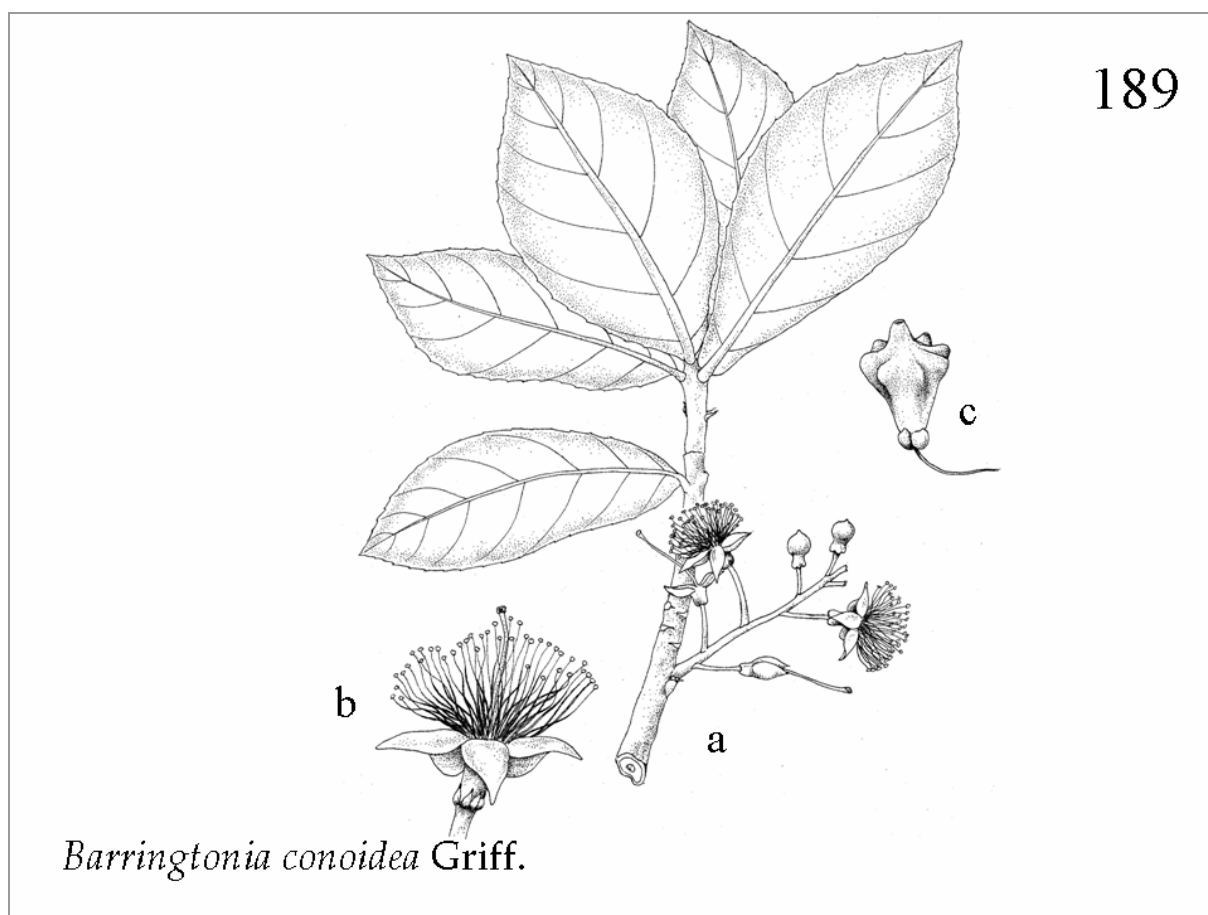


Fig. 189. *Barringtonia conoidea* Griff. (a) Flowering branch, (b) flower, and (c) fruit.

LECYTHIDACEAE

189

Barringtonia conoidea Griff.**Synonyms :** Unknown.**Vernacular name(s) :** River Putat (E), Putat Ayer (Mal.)

Description : A dense bush or short, stout, scarcely branched treelet, up to 4m tall. Leaves spirally arranged in rosettes. Leaf blade 6-18 by 20-35 cm, large, elliptic, narrowly heart-shaped at the base, and without a leaf stalk. Flowers 7.5-8 cm wide across the stamens, white, only the style pink, distinctly stalked (1.2 cm), in short, scarcely hanging, few flowered spikes, 5-10 cm, from below the leaves. Fruit conical shaped, 5-7.5 cm long, 3.7-5.0 cm wide, with 8 projecting basal flanges, tapering to the 2(-3) blunt sepals. Leaves of *Barringtonia conoidea* wither yellow, whereas those of *Barringtonia racemosa* wither red.

Ecology : Riparian species, but also found in brackish and tidal estuaries and estuarine mangroves. Generally on submerged mud banks, standing in water at high tide. Often occurring in the same association as *Gluta velutina*. Fruits are often found on the beach as fibrous skeletons enclosing the seed. Fruits specialised for floating in water. Most *Barringtonia* flowers are pollinated by moths and flower only during the night, falling to the ground in the morning. *Barringtonia conoidea* is an exception, however, as its flowers remain open until midday or later. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Myanmar, Peninsular Malaysia, Brunei and Indonesia (Banka, Sumatra). Formerly also in Singapore, but now extinct.

Abundance : Locally common.

Use(s) : Most *Barringtonia*'s, including *Barringtonia conoidea*, contain saponins and on that account are fish poisons, and the seeds, bark or roots are occasionally used for that purpose, often in combination with *Derris* (tuba).

Source of illustration : Archive, Royal Botanic Garden, Kew.

Reference(s) : Tomlinson (1986), Whitmore (1972c), Corner (1988)
http://www.rbgekew.org.uk/herbarium/brunei/fams/67_02.htm.

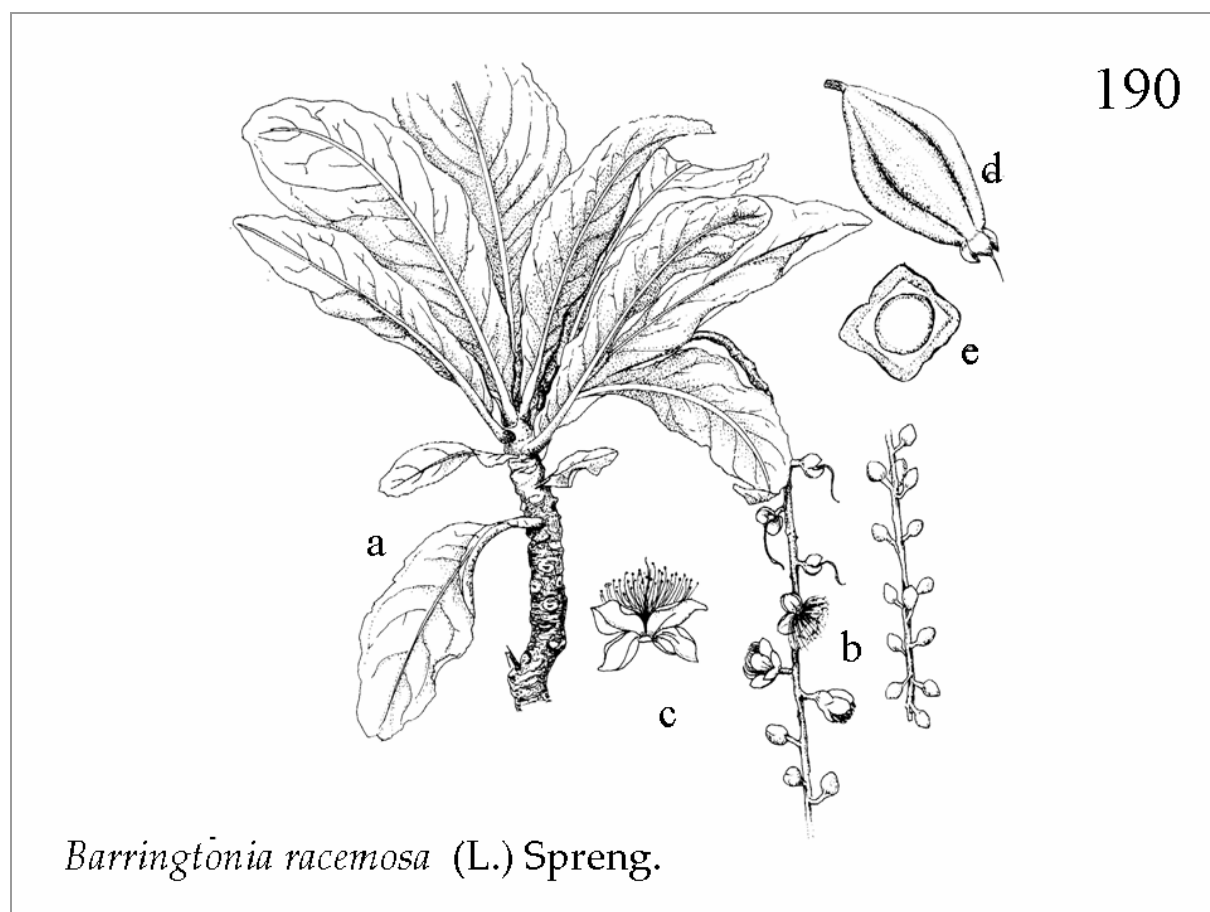


Fig. 190. *Barringtonia racemosa* (L.) Spreng. (a) Terminal branchlet with raceme of flowers, (b) raceme of buds, (c) flower, (d) fruit, and (e) cross-section of fruit.

LECYTHIDACEAE

190

***Barringtonia racemosa* (L.) Spreng.**

Synonyms : *Barringtonia racemosa* (L.) Bl. ex DC., *Barringtonia rubra* Blume, *Barringtonia stravadarium* Blanco, *Butonica rosata* Miers., *Butonica terrestris rubra* Rumph., *Eugenia racemosa* L.

Vernacular name(s) : Comon putat (E), Putat ayam (Mal.), Butun Darat, Putat, Putat Sungai, Alakang, Penggung, Malegai, Alakang, Sesiil, Kungkungan (Ind.), Kasouai, Kutkut-timbalon, Nuling, Paling, Potat, Putad, Tuba-tuba – *Putat* (Phil.), Tim lang (Viet.), Dawm trojiekbres, Pchek tekbray (Camb.), Chik suan (Thai)

Description : Shrub, or more usually a small tree, 5-15 m tall, with greyish-brown young stems. Leaves measure 17.5-43 by 5-16 cm, usually with a toothed margin, and are oblong-obovate. They taper into a short, somewhat fleshy leaf stalk that measures scarcely 1 cm. Leaves are clustered at the ends of the branches. The 20-80 cm long, pendulous, many-flowered clusters occur at the ends of branches or in axils of fallen leaves. Flowers are large, have a very strong, fragrant scent and measure 7-10 wide across the stamens. Individual flower stalks measure 5 cm at most. Calyx smooth; petals are green or pale, rose-coloured, their edges recurved and pale pink, 1.75-3 cm. Flowers have a large number of long, white stamens, that may be tipped with either red, white or yellow. The 4- to 6-angled fruit is usually 5-7(-9) by 3-4(-5) cm, oblong or pear-shaped, crowned by 2-3 blunt sepals. Occasionally 4-angled specimens may measure up to 10-12 cm along one rib. Fruits have a fleshy-fibrous outer part and a woody-fibrous inner part. They contain one seed only.

Ecology : Occurs in mangroves, along tidal rivers and in areas subject to tide and regular input of sea water. Also in beach vegetation, freshwater swamps, along rivers, on the edge of peat swamp forests and on hillsides to altitudes of 200(-1000) m. Flowering occurs all year round. The flowers open at night and are pollinated by small bats and moths. By morning, petals and stamens of flowers that opened during the previous evening have usually already dropped off. Fruits are very buoyant and may be transported by seawater for many months. Mangrove associate species.

Distribution : From East and South Africa eastwards though Southeast Asia to Polynesia (Samoa, Fiji). In Southeast Asia recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia, Singapore, the Philippines, Brunei and Indonesia (throughout).

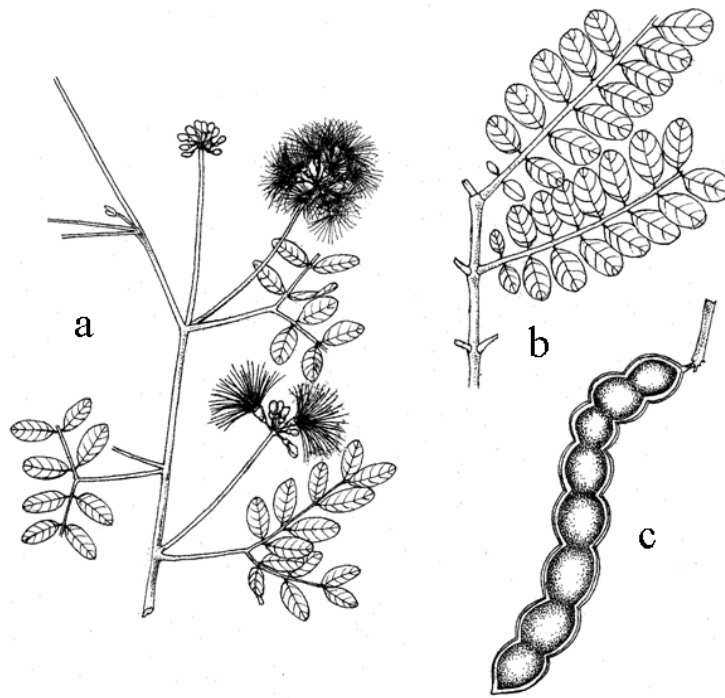
Abundance : Common, but scattered.

Use(s) : The bark and the fruits contain saponins and are used as fish poison. Young leaves are edible and eaten as salad or as a vegetable. Firewood.

Source of illustration : Based on Walker (1976).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Whitmore (1972c), Tomlinson (1986), Said (1990), Hong & San (1993), Aksornkoae (1993), Aragones *et al.* (1998), Nguyen *et al.* (2000), Hong (2000), Marschke (2000), Maung (2003), www.unepscs.org/ProjectComponents/Mangroves/mangroves.htm, <http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

191



Cathormion umbellatum (M.Vahl.) Kosterm.

Fig. 191. *Cathormion umbellatum* (M.Vahl.) Kosterm. (a) Flowering branchlet, (b) detail of two leaves (each with 8 pairs of leaflets), and (c) pod.

LEGUMINOSAE

191

***Cathormion umbellatum* (M.Vahl.) Kosterm.**

Synonyms : *Feuilleea umbellata* (Vahl.) Kuntze, *Inga corcondiana* DC., *Inga umbellata* (Vahl.) Willd., *Mimosa corcondiana* Roxb., *Mimosa umbellata* Vahl., *Pithecellobium malayanum* Pierre, *Pithecellobium moniliferum* Miq., *Pithecellobium umbellatum* (Vahl) Bth.

Vernacular name(s) : Lambaran, Lom, Aram Aron, Hirang Krama, Kiu Tasi (Ind.)

Description : Tree, up to 15 m tall, often with spines in the axils, especially on the young shoots, that are often branched and 2-15 cm long. There are 1-2 pairs of main leaflets per leaf, the upper ones being the largest. Main leaflets are subdivided into 3-8 pairs of shiny, dark green secondary leaflets that are oval-oblong or almost obovate with an unequal base, 0.75-5 by 0.5-2.5 cm. Again, the topmost leaflets are the largest. Leaves have one or more glands on the main vein and on the veins of the main leaflets. Usually 1-4 flower heads are located in the leaf axils, but sometimes they form elongated clusters. Flower head stalks measure 2-4.5 cm. Single flowers occur on short 3-4 mm long stalks. The calyx is 2-3 mm long, the corolla is funnel-shaped and 6-8 mm long. Numerous white stamens extend from the corolla. The 10-20 by 2-3 cm, thick pods are curved but not rolled on an axis. They are constricted along both sutures and break up into sections. Pods contain 5-13 seeds. In Southeast Asian literature, *Pithecellobium umbellatum* is the most commonly used (but incorrect) scientific name.

Ecology : Occurs almost exclusively in the beach vegetation and in mangroves. Flowering occurs throughout the year. Mangrove associate species.

Distribution : It's exact distribution remains uncertain. In Southeast Asia it has been recorded in Thailand, Indonesia (Java, Madura, the Moluccas) and East Timor.

Abundance : Locally relatively common.

Use(s) : Used for construction, but is not very durable.

Source of illustration : Drawn from live specimen.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8).

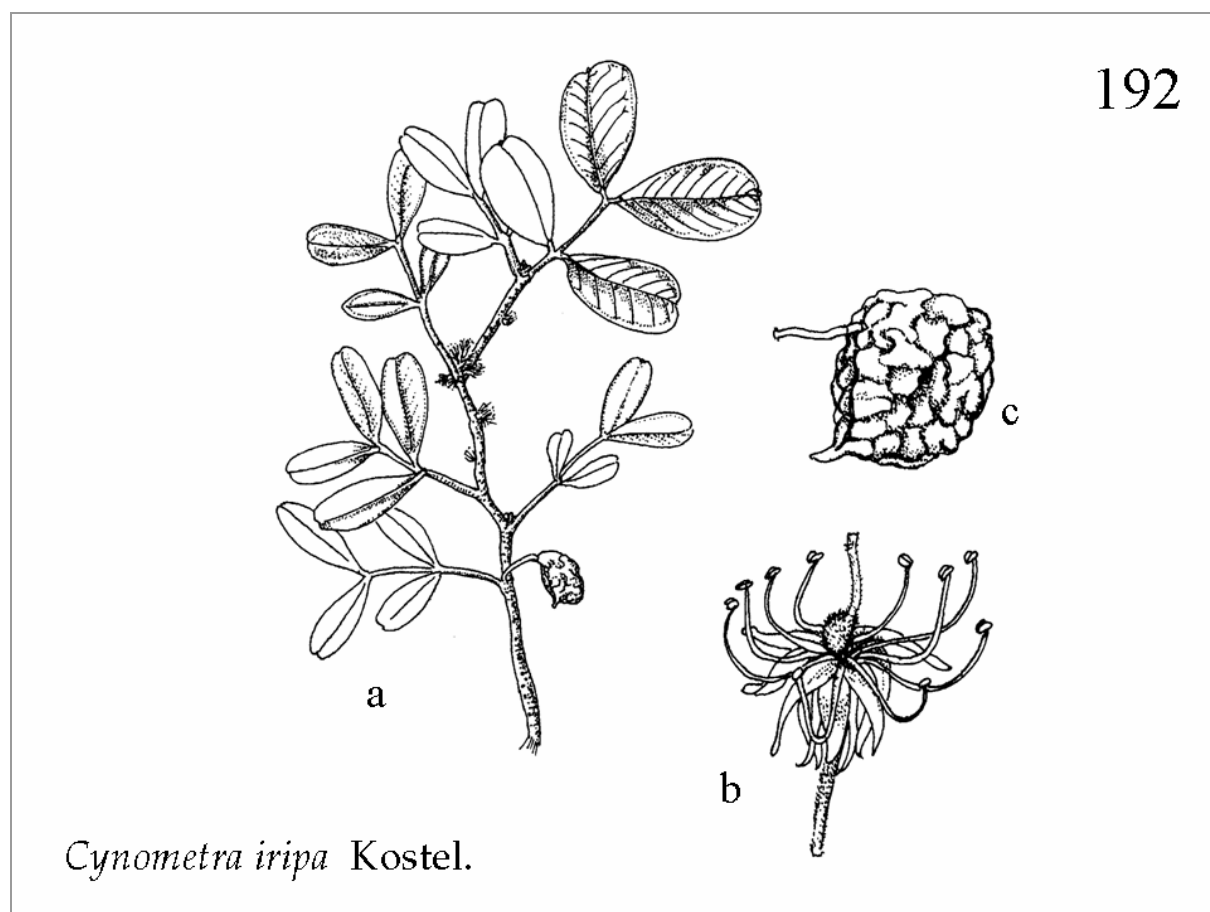


Fig. 192. *Cynometra iripa* Kostel. (a) Branchlet with flowers and fruit, (b) flower, and (c) fruit.

LEGUMINOSAE

192

***Cynometra iripa* Kostel.**

Synonyms : *Cynometra bijuga* var. *mimosoides* Merr., *Cynometra ramiflora* var. B Wight & Arn., *Cynometra ramiflora* var. *mimosoides* Baker

Vernacular name(s) : Kateng, Katong laut (Mal.), Namu-namu utan, Kateng, Kepel, Wunut, Kayu pel (Ind.)

Description : Small tree or shrub, 3-8 m tall, with smooth, brown bark that has numerous lenticels. Leaves measure 4.5-5.5 by 2-3 cm and occur in pairs. The glossy-green, lowest pair of leaflets is smaller (2-3 by 1-1.5 cm) than the upper pairs. Occasionally there is only one pair of opposite leaflets. Leaflets are asymmetrically elliptic, with a minute point in the notched leaf tip. Flower clusters are stemless and simple, and located in the axils. In the bud they are densely contracted and almost globular, clothed in covering leaflets. The white flowers are bisexual. Sepals are recurved, almost towards the end when in full flower. Ovaries are densely hairy, and the style is bent. This bent style later becomes the prominent, lateral beak of the fruit. The irregular 'pod' measures 2 by 6 cm and is woody, brown, almost globular with a distinct beak. Its surface is deeply wrinkled and covered with short hairs.

Ecology : Found in mangroves, littoral scrub, on or near the beach, but also up to an altitude of 500 m asl. Occurs at the landward margin of mangroves, in areas that receive perennial freshwater input. It may also occur in areas above the high tide mark. The fruit is capable of floating for up to two months due to the buoyant tissue in the fruit wall. However, this species rarely produces viable mature seed in spite of prolific flowering. Mangrove associate species.

Distribution : Occurs from Sri Lanka and India through Southeast Asia to northern Australia and the western Pacific. In Southeast Asia recorded in Myanmar, Thailand, the Philippines, Malaysia (Peninsular) and Indonesia (Java, Madura, Moluccas).

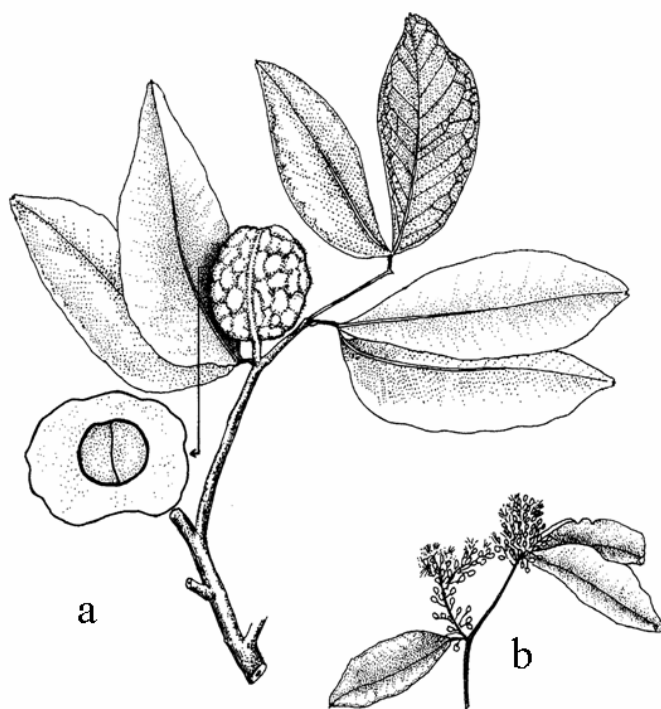
Abundance : Locally common, but listed as rare in Indonesia (Mogea *et al.*, 2001).

Use(s) : (Small) construction timber, but the wood is reportedly not very durable. Seeds and leaves used for medicinal purposes.

Source of illustration : Based on Tomlinson (1986), Wightman (1989).

Reference(s) : Heyne (1950), Tomlinson (1986), Corner (1988), Wightman (1989), Said (1990), Hou *et al.* (1996).

193



Cynometra ramiflora L.

Fig. 193. *Cynometra ramiflora* L. (a) Branchlet with fruit, with cross-section of fruit (inset), and (b) branchlet with flowers.

LEGUMINOSAE

193

Cynometra ramiflora L.

Synonyms : *Cynometra bijuga* Span. ex Miq., *Cynometra polyandra* auct. non Roxb., *Cynometra schumanniana* Harms., *Cynometra whitfordii* Elmer, *Cynomorium silvestre*.

Vernacular name(s) : Kateng, Katong laut (Mal.), Kateng, Kepel, Wunut, Kayu Pel, Namu-namu Utan (Ind.), Myinga (Myan.), Komon, Odling, Ula, Ulud – *Balitbitan* (Phil.), Lá lua (Viet.)

Description : Tree or shrub, 4-12(-26) m tall, with a smooth, grey bark, numerous lenticels and a somewhat fluted trunk that may have a diameter at breast height of 30 cm. Leaf is 4.5-5.5 by 2-3 cm (occasionally 10-13 by 4-6 cm) and occurs in pairs. The glossy-green, lowest pair of leaflets is smaller (2-3 by 1-1.5 cm) than the upper pair. Often, however, there is only one pair of opposite leaflets. Young leaflets are white or red. Leaflets are asymmetrically elliptic, with a minute point in the notched leaf tip. The flower clusters are stemless, hairy, simple and located in the axils. In the bud they are densely contracted, almost globular and clothed in covering leaflets. The bisexual flowers are white, soon turning brown, and have sepals that do not curve towards the end when in full flower. The ovary is smooth, with a straight style. The 'pod' is woody, brown, elliptic to slightly circular, 1.3-4 by 2.2-5(-7) cm. Its surface is deeply wrinkled, often covered with short hairs, and it does not (immediately) drop off the tree when ripe. The species is somewhat variable, and a number of varieties are recognised.

Ecology : Occurs on landward margins of mangroves, but also inland up to an altitude of 400 m. Often on heavy, firm soil. Flowering occurs from August to October. Fruit is distributed by water. Young shoots develop from buds that are covered with rather small scales. In a short time they produce 1-7 internodes, after which the growth rate slows down considerably. Mangrove associate species.

Distribution : From India through Southeast Asia to the Pacific. In Southeast Asia it is recorded throughout, except in Cambodia and Vietnam. Not found in Australia.

Abundance : Locally common, but on the whole uncommon and listed as rare in Indonesia (Mogea *et al.*, 2001).

Use(s) : Sometimes used as construction timber. Cultivated as an ornamental. The wood is heavy, hard and strong, but not durable when exposed to the weather. It has a lasting property for interior works as it is not easily damaged by insects. Suitable for house building, tool handles, woodcraft and interior framing.

Source of illustration : Based on Tomlinson (1986).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Hou *et al.* (1996), Aragonés *et al.* (1998).

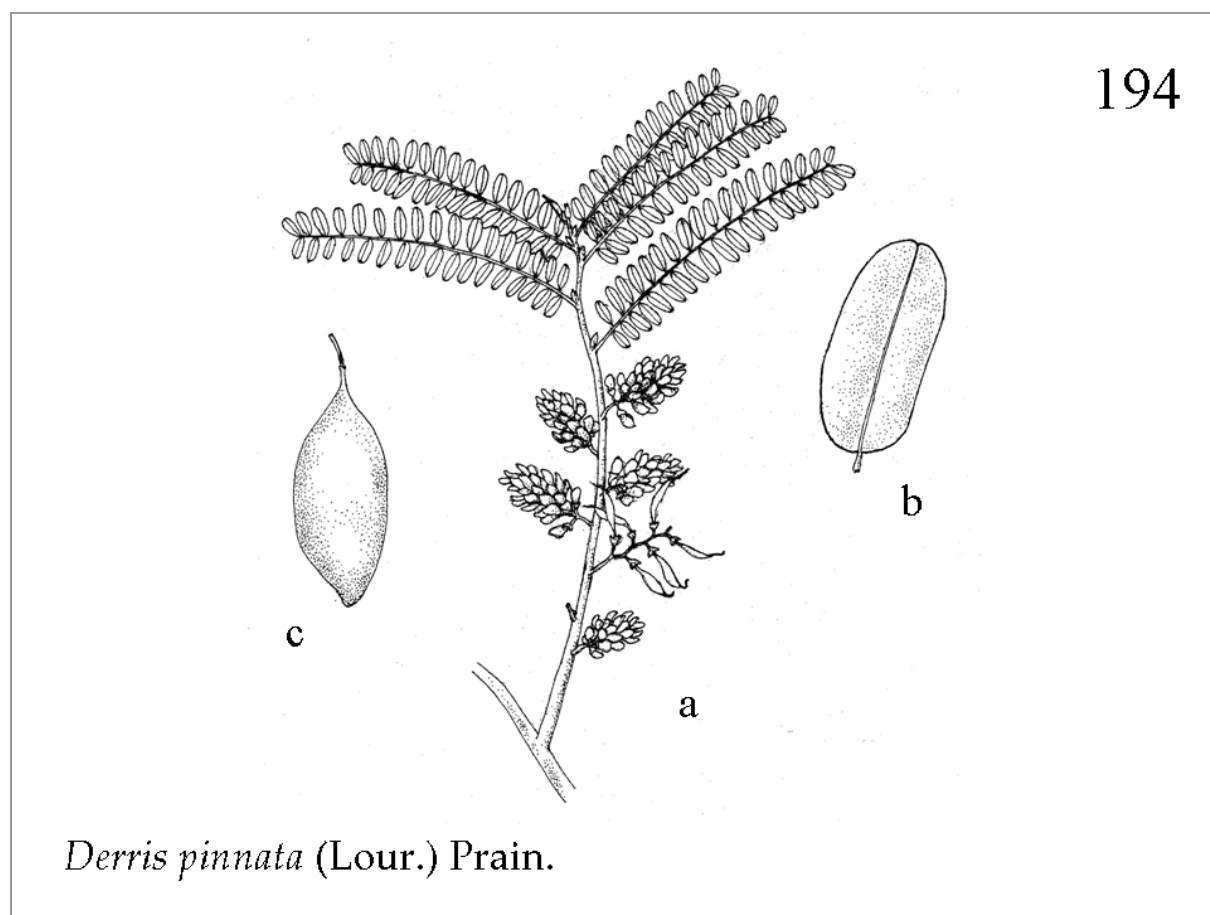


Fig. 194. *Derris pinnata* (Lour.) Prain. (a) Branchlet with 5 leaves, flower clusters and immature pods, (b) leaflet, and (c) mature pod.

LEGUMINOSAE

194

***Derris pinnata* (Lour.) Prain**

Synonyms : *Dalbergia pinnata* (Lour.) Prain., *Dalbergia tamarindifolia* Roxb., *Derris pinnata* Lour.

Vernacular name(s) : Java polisander (NL), Areuy ki loma, Areuy ki menter, Areuy munding serakit, Jampak luyak, Oyod sambang, Sana keling, Sana sungu – *Sono keling* (Ind.)

Description : Small trees or sometimes shrubby climbers, 1-10 m tall, with long, drooping branches, young branchlets covered with short hairs. Leaves 12-15 cm, imparipinnate (odd in number, with an end, unpaired leaflet), leaf stalks densely hairy; leaflets at the base of the stalk are lanceolate, hairy and about 5 mm long; leaflets are small, 5-7.5 by 12-18 mm and number 21-42, firmly papery and trapezoid-oblong in shape, asymmetrical at the base, (slightly) hairy on both surfaces. Flowers gathered in panicles in the axils on short, densely hairy stalks. Flowers are small, about 6 mm long; the calyx is bell-shaped, about 3 mm long, either hairy or smooth on the outside, with ovate teeth; corolla white; stamens 9-10. Pods are thin, oblong to tong-shaped, pointed, base tapering to the long, slender stalk, 1-1.4 by 2.5-6 cm, smooth, bright-brown when dry, uniformly covered with a fine net-like venation. Seeds are narrow, about 4 by 18 mm, numbering 1-4 per pod.

Ecology : Found in dense forests, below 1400 m; occasionally on landward edges of mangroves. Flowering reported in January-February (southern China). Mangrove associate species.

Distribution : Southeast Asia and southern China (Hainan, Guangxi, Yunnan, Xizang). In Southeast Asia recorded from Myanmar, the Philippines, Malaysia (Peninsular) and Indonesia (Java).

Abundance : Locally common.

Use(s) : Leaves are reportedly “ideal for treating varices and typhus”. In Indonesia it is used to cure skin disorders.

Source of illustration : Archive, Royal Botanic Garden, Kew.

Reference(s) : Heyne (1950), Afriastini (1988)
http://flora.huh.harvard.edu/china/mss/volume10/Fabaceae-MO-Dalbergia_edited.htm;
http://www.arcbc.org/arcbcweb/medicinal_plants/medicinal_plants_page3.htm.

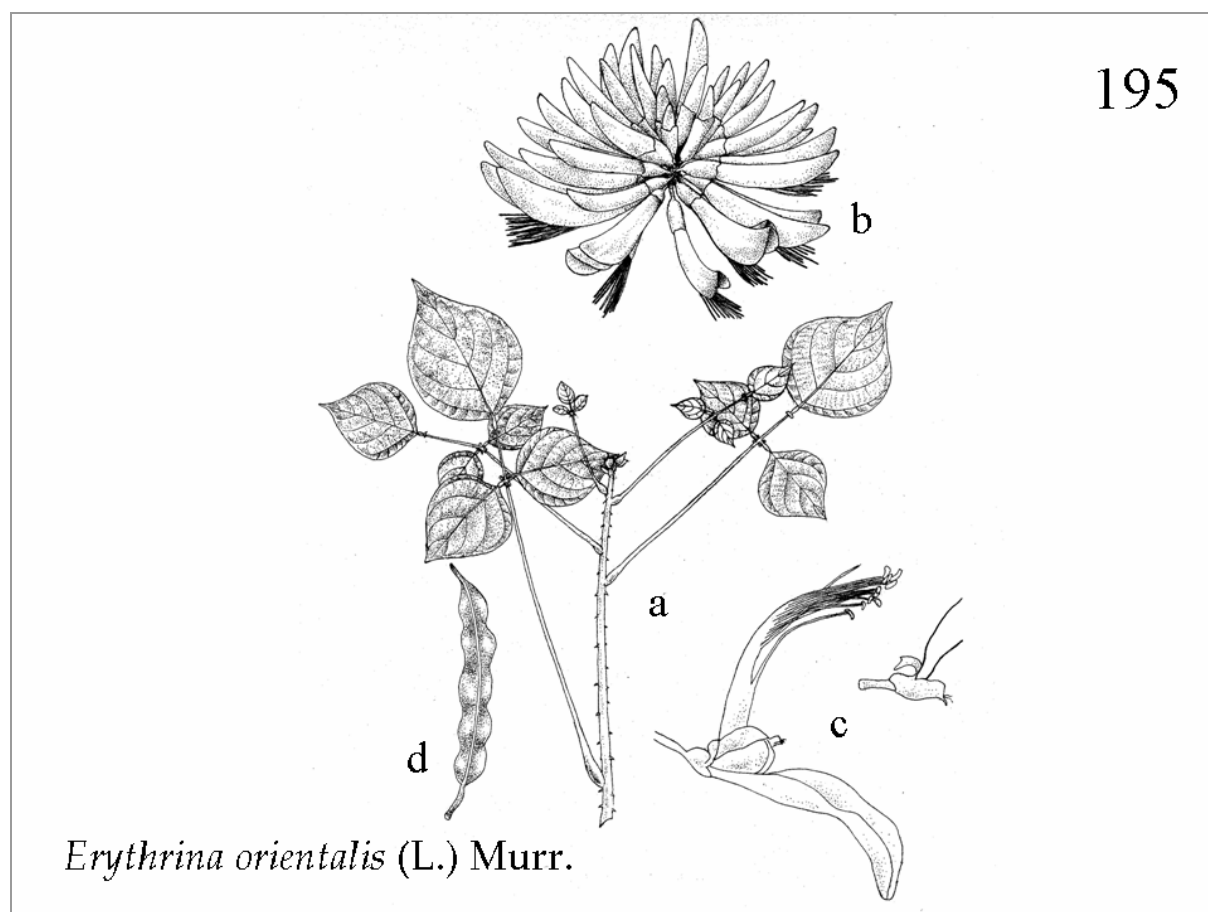


Fig. 195. *Erythrina orientalis* (L.) Murr. (a) Branch with trifoliate leaves, (b) cluster of flowers, (c) detail of single flower, and (d) pod.

LEGUMINOSAE

195

Erythrina orientalis (L.) Murr.

Synonyms : *Erythrina corallodendrum* L. var. *orientalis*, *Erythrina indica* Lamk., *Erythrina indica* Zoll., *Erythrina indica* var. *alba* W.S. Millard & E. Blatter, *Erythrina indica* var. *fastigiata* Guillaumin, *Erythrina indica* var. *marmorata* (Planchon) B.& M., *Erythrina indica* var. *picta* (L.) B.&M., *Erythrina variegata* L., *Erythrina variegata* var. *orientalis* (L.) Merr., *Gelala litorea* Rumphius (=type)

Vernacular name(s) : Indian Coral Tree, Tiger's claw (E), Dedap, Derdap, Dadap (Mal.), Dadap, Gelala, Galala, Ngoa (Ind.), Bông nem (Viet.)

Description : Fast growing, medium-sized tree, (6-)12-15(-25) m tall, with a round deciduous crown, greenish grey smooth bark, marked with pale longitudinal stripes. Trunk 40-60 cm diameter. Armed with short, blackish spines along the stout twigs. Leaves three-lobed, leaflets generally broader than long, rhomboid in shape, about 10-15 cm, with a very broad base; with leaf stalk up to 40 cm long. Flowers are bright scarlet, in dense terminal clusters up to 25-40 cm long, often flowering before the tree is in leaf; flowers 6-8 cm long; calyx 2.5-3 cm long, corolla 4.5 cm wide; stamens red. Flower stalks are 0.5-1.0 cm long. Fruit a pod, 15-30(-40) cm long, 2-3 cm wide, with 1-8(-13) pinkish or purplish-red, 2 cm long oblong or oblong-ellipsoid seeds; often jointed between the seeds; stalk of pod 1.5-3.0 cm long. In the variegated form, the leaflets have a broad yellow stripe along the midrib and secondary nerves; flowers are orange-red.

Ecology : Found on sandy, advancing beaches along the coast and in marshy places and landward margins of mangroves. Also in coastal bush on the landward edge of *Avicennia* mangroves and other associations just above the high water mark. Planted in homestead gardens and along roads up to an altitude of 1200 m asl in Indonesia. Tolerant of salt and periodic flooding. Sheds its leaves in the beginning of the drier months (e.g. Jan.-Feb. in Peninsular Malaysia). Older trees become umbrella-shaped. Fruiting time usually August-September in monsoon areas. Flowering and fruiting from May-October in Indonesia. Flowers attract sunbirds. Seeds are sea dispersed. Mangrove associate species.

Distribution : From East Africa (Tanzania), the Seychelles and India eastwards to southern China, Taiwan and the Pacific (Fiji, Samoa). In Southeast Asia it has been recorded in Myanmar, Vietnam, Malaysia, Indonesia (Java, Moluccas) and East Timor.

Abundance : Common in South Asia, uncommon in Southeast Asia.

Use(s) : Propagated by cuttings and from seeds; coppices well. Branches planted as live fences; leaves used as cattle fodder. The fibre of the bark is used as cordage; bark is also used to treat dysentery. Leaves used to treat pain in the joints. The wood is light and is used for frames of sieves. Leaves and seeds can be eaten when cooked, but the raw seeds are poisonous. Leaves used to induce sleep, and to increase lactation.

Source of illustration : Corner (1988), Khan and Alam (1996).

Reference(s) : Heyne, (1950), van Steenis *et al.* (1951), Gillett *et al.* (1971), Whitmore (1972a), Corner (1988), Khan and Alam (1996), Nguyen *et al.* (2000).

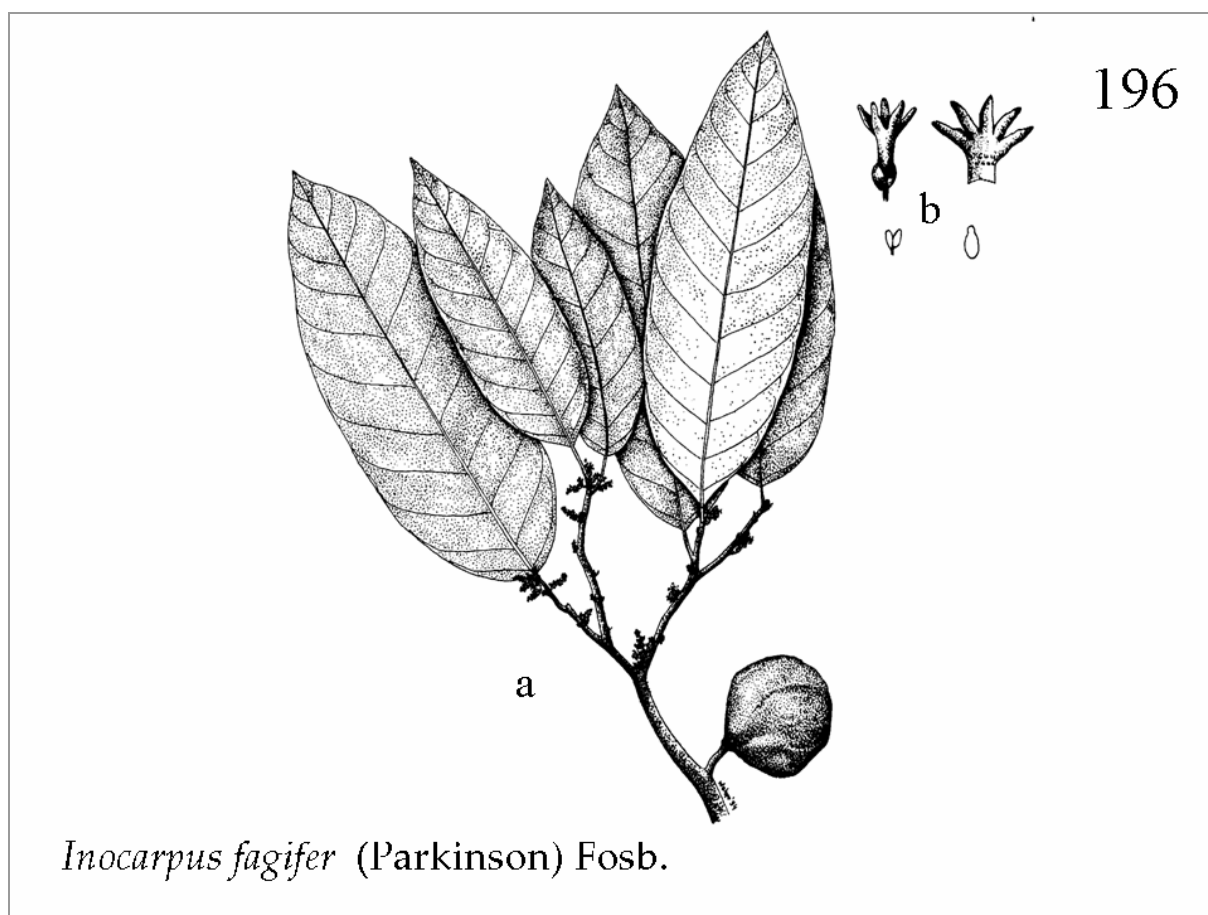


Fig. 196. *Inocarpus fagifer* (Parkinson) Fosb. (a) Branchlet with flowers and fruit, (b) details of flower.

LEGUMINOSAE

196

***Inocarpus fagifer* (Parkinson) Fosb.**

Synonyms : *Inocarpus edulis* J.R. & G. Forst., *Inocarpus fagiferus* (sic), *Inodaphnis lanceolata* Miq.

Vernacular name(s) : Tahitian Chestnut (E), Kerepit, Kapit, Benjek, Bosua (Mal.), Gajam, Gajang, Pandaram Boheng, Gasep, Tolok, Ain Hual, Angkaeng, Gayamu (Ind.)

Description : Tree, up to 30 m tall, with a fluted stem that exudes a red sap from cut surfaces. The terminal branchlets are thin and often drooping. The shiny, leathery leaves are oblong to oblong-lanceolate, 20 by 7 cm, sometimes 30 cm or longer. The scented flowers occur in elongated clusters located in the axils that are up to 12 cm long. Flower groups occur either singularly, or in clusters on a common stalk, especially on larger branches. The calyx is pinkish white; the recurved, almost equal petals are white or yellow and 1-1.5 cm long. Fruit is yellow, irregular, but more-or-less round or slightly flattened, 5-10 by 5-7 cm, 1-seeded, and may either be variously keeled or ribbed, or smooth altogether. The fruit is not readily shed after ripening and may be retained on the tree for some time.

Ecology : Occurs on river banks subjected to tidal influence, brackish swamps, landward margins of mangroves and sandy foreshores. However, it is essentially a lowland swamp forest species, occurring up to an altitude of 500 m. Flowering has been recorded from January to June and in September (Indonesia). Mangrove associate species.

Distribution : Occurs from Southeast Asia through the Pacific. In Southeast Asia it has been recorded in Malaysia, Indonesia (Borneo, Java, Sumatra, Nusa Tenggara, Sulawesi, the Moluccas and Papua), and Papua New Guinea. Its range may have been artificially extended through cultivation.

Abundance : Relatively common.

Use(s) : It is one of the few examples of a plant in the mangrove association that readily provides human food. The roasted or boiled seeds are eaten. Also the young leaves are said to be edible. Wood is used for light construction, especially of furniture. Foliage is used for fodder. The tree is often planted, mostly along roads.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Corner (1999).

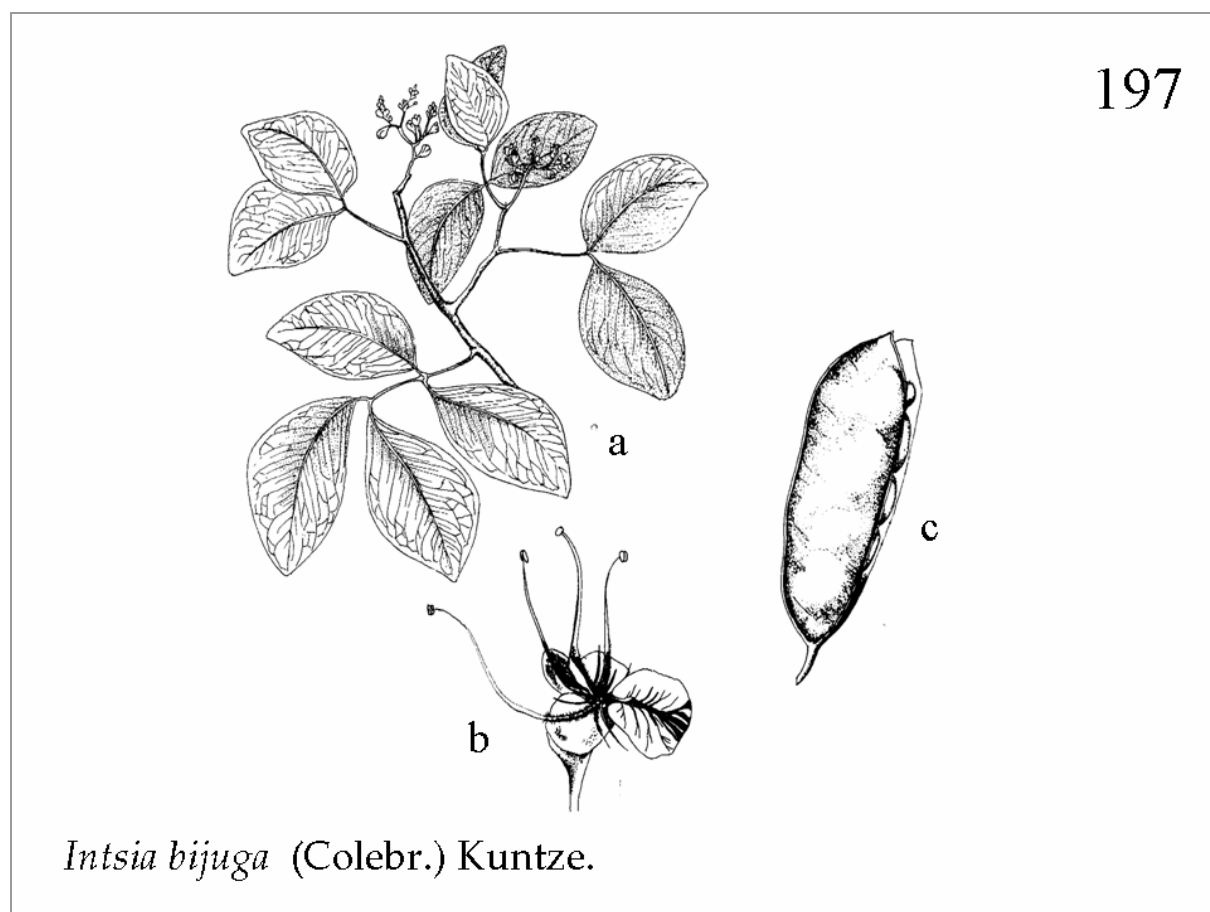


Fig. 197. *Intsia bijuga* (Colebr.) Kuntze. (a) Branchlet with buds, (b) flower, and (c) pod.

LEGUMINOSAE

197

Intsia bijuga (Colebr.) Kuntze

Synonyms : *Afzelia bijuga* A. Gray, *Afzelia retusa* Kurz., *Eperua decandra* Blanco, *Intsia amboinensis* Thouars., *Intsia madagascariensis* Thouars ex DC, *Intsia retusa* Colebr., *Macrolobium amboinensis* Teijsm. ex Hassk., *Macrolobium bijugum* Colebr., *Outea bijuga* DC.

Vernacular name(s) : Merbau ipil (Mal.) Kayu Besi Ambon, Merbau, Ipil, Sira, Ipilo, Bajang, Ipi, Baibui, Wesele – *Merbau cangkat* (Ind.), Ipil-lalao, Itil, Labnig, Mulato, Nala, Taal, Tigel – *Ipil* (Phil.), Gõ nu'ó'c (Viet.), Ngon gai, Lumpo thale (Thai.), Krognungteukbray, Krokosteukpray (Camb.)

Description : A deciduous tree up to 40 m tall, with a long, slightly buttressed trunk, up to 1 m diameter and spreading crown. The leathery leaves have 2-6 (usually 4) leaflets that are ovate, hairy on the lower midrib, and measure 5-20 by 4-12.5 cm. There is no terminal leaflet. Numerous flowers occur in dense, terminal, finely hairy, elongated clusters that are 5-18 cm long. The four unequal sepals are smooth, or densely covered with short hairs, and up to 10 mm long. The 2-3 cm long solitary petal is clawed, white at first but later turning red or orange. The leathery fruit is flat pod, oblong, measuring 4-5(-7.2) by 8.5-15(-28) cm, with a white, fleshy stalk that turns brown. Seeds measure 2-3.5 cm, and 8 mm thick. In earlier Philippine literature it was referred to as 'ipil laut' *Intsia retusa*, but this was found to be the same species as *Intsia bijuga*.

Ecology : Occurs in mangroves and on sandy beaches, often on coral. Marginal mangrove species, mostly occurring on drier portions of the swamp. Flowering in Indonesia has been recorded in January, February and October. Mangrove associate species.

Distribution : Occurs from Madagascar and the islands in the Indian Ocean, through tropical Asia to northern Australia, Melanesia and Micronesia. Recorded throughout Southeast Asia. In Indonesia recorded from Sumatra, Kalimantan, Java, Sulawesi, the Lesser Sundas and the Moluccas.

Abundance : Relatively common, and often cultivated.

Use(s) : Very hard, good quality timber, with little shrinkage or warping, used for houses and bridges. Very durable, resistant to insects and weather. Often used for making house posts. Important source of 'merbau' timber. Bark and leaves used as medicine to treat diarrhoea. Seeds are fried, soaked for 3-4 days, then boiled and eaten.

Source of illustration : Based on Walker (1976).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Afriastini (1988), Hou *et al.* (1996), Aragones *et al.* (1998), Marschke (2000).

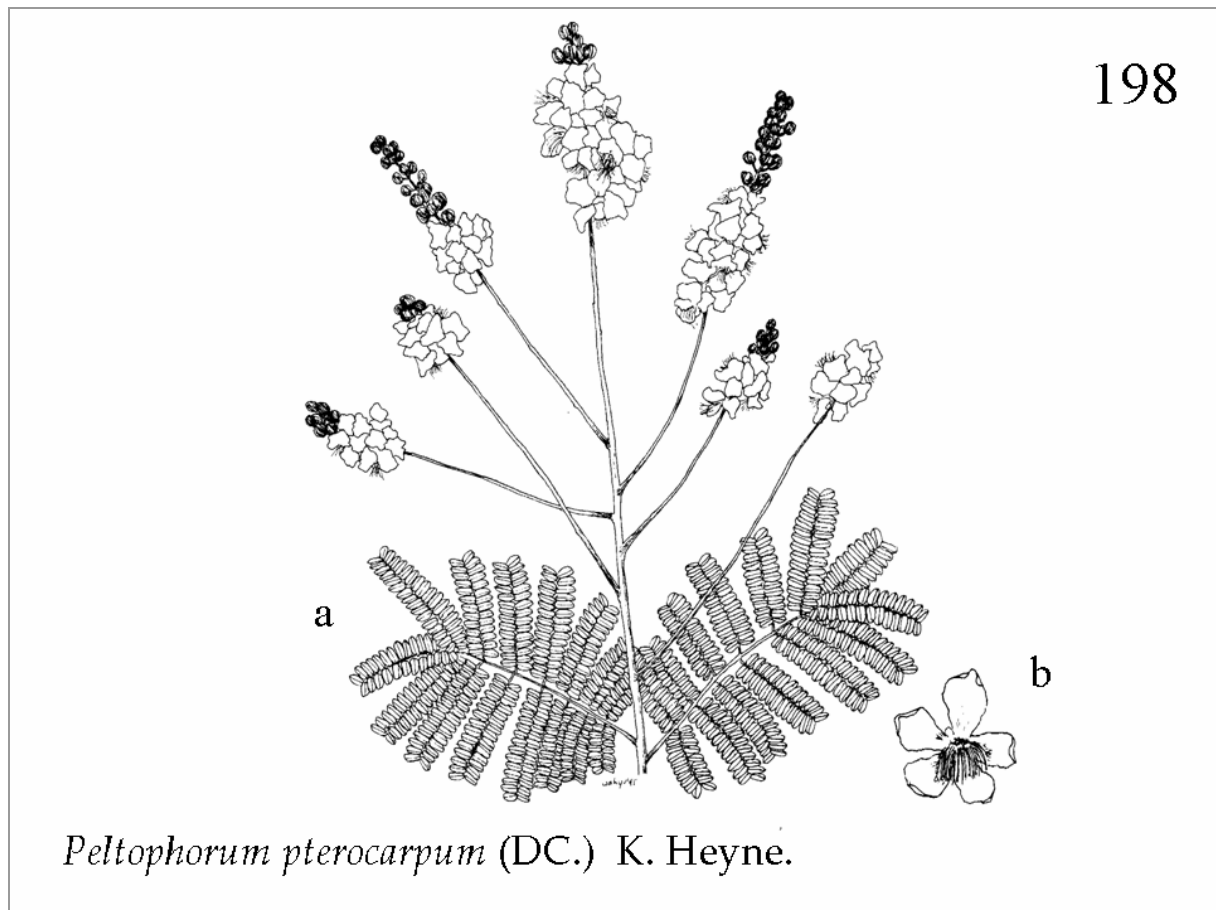


Fig. 198. *Peltophorum pterocarpum* (DC.) K. Heyne. (a) Terminal flower clusters (emerging from canopy), and (b) flower.

LEGUMINOSAE

198

Peltophorum pterocarpum (DC.) K. Heyne

Synonym(s) : *Caesalpinia arborea* Zoll. ex Miq., *Inga pterocarpa* D.C., *Peltophorum ferruginea* Decne., *Peltophorum ferrugineum* (Decne.) Benth., *Peltophorum inerme* Nav., *Peltophorum inermis* Roxb., *Peltophorum pterocarpum* (DC.) Backer ex Heyne

Vernacular name(s) : Yellow Flame (E), Jemerlang Laut (Mal.), Pohon Soga, Batai, Batai Laut, Soga, Kayu Juwok, Hau Kolo (Ind.), Non see (Thai)

Description : Small to medium sized tree, up to 25(-35) m tall, with an umbrella-shaped crown and light grey bark. Trunk girth up to 60(-100) cm; young twigs are covered with short brown hairs. Leaves are 15-40 cm long, divided into 5-11 primary leaflet pairs; these are further subdivided into another 9-20 secondary leaflet pairs. Individual secondary leaflets measure 12-15 by 8 mm, with a notched or very minutely pointed tip, and an uneven base. Secondary leaflets are virtually without a stalk. Flowers occur in large terminal clusters, 30-45 cm long, on red-brown stalks that protrude from the foliage. Flowers measure almost 4 cm across, are sweet scented and bright golden yellow with deep orange pollen. Petals are crinkled and wavy, with brown hairs towards the base on both sides. Fruit is a purplish-brown pod, 6-14 by 2.5 cm, and winged (2-5 mm wide) all the way around. The pods do not open readily. Each pod bear 1-5(-6) yellowish to reddish-brown, flattened, very hard seeds that are shaped like sun-flower seeds, 5 by 10-12 mm.

Ecology : Found on rocky and sandy shores, occasionally along margins of mangroves or on limestone. Occurs from sea level up to about 100 m asl. A quick growing species, that does well along roadsides. Strictly seasonal, shedding its leaves after a dry spell; in many parts of its range this is twice annually. It may be bare for about two weeks, then develops new shoots for its terminal flower clusters. Flowering continues for several weeks. Seeds take several months to germinate, but this can be hastened by filing though one end of the hard coat, or by softening in dilute acid or immersion in boiling water for two minutes. Mangrove associate species.

Distribution : From Sri Lanka through Southeast Asia to Australia. In Southeast Asia it has been recorded in Thailand, Cambodia, Vietnam, the Philippines, Malaysia, East Timor and Indonesia (Java, Flores, Borneo and Sumatra).

Abundance : Common in natural habitats; very common as an ornamental and as a planted shade tree.

Use(s) : Often planted as an ornamental or shade tree, especially along roadsides and in gardens. The bark contains a yellow-brown dye used in Java for dying batik cloth – hence the common name for this species in Indonesia: *Pohon Soga*. Used to treat gastric disorders, and compresses are used to treat sprains. Leaves are fed to goats and cattle (Madura, Indonesia).

Source of illustration : Sastrapradja *et al.* (1980).

Reference(s) : Heyne (1950), Whitmore (1972), Sastrapradja *et al.* (1980), Corner (1988), Whitmore, Tantra & Sutisna (1990), Aksornkoae (1993), Hou *et al.* (1996).

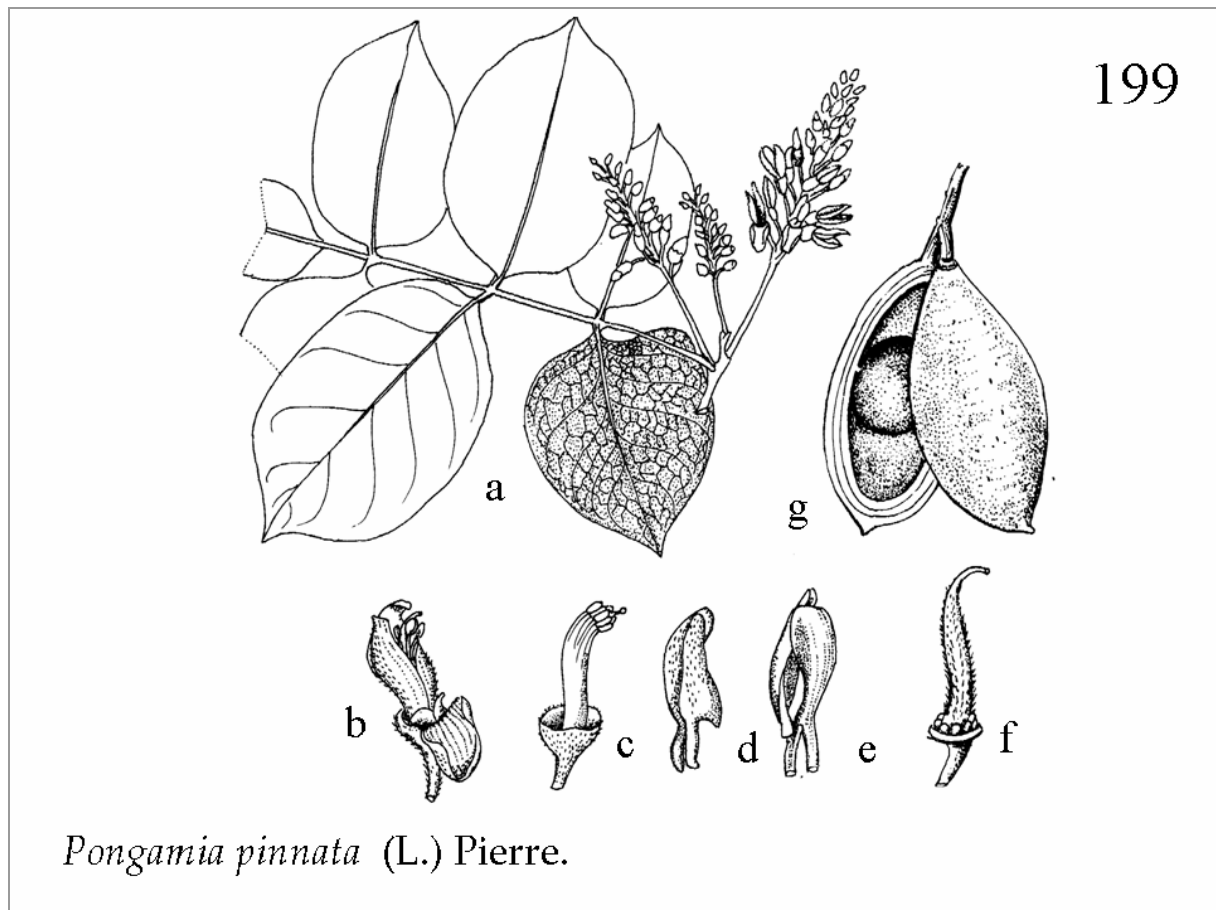


Fig. 199. *Pongamia pinnata* (L.) Pierre. (a) Leaf (with 7 leaflets) and flower clusters, (b) flower, (c-f) details of flower, and (g) pod.

LEGUMINOSAE

199

Pongamia pinnata (L.) Pierre

Synonyms : *Caju pinnatum* O. Kuntze., *Cytisus pinnatus* Linn., *Dalbergia arborea* Willd., *Derris indica* (Lam.) Bennet., *Galedupa indica* Lam., *Galedupa maculata* Blanco, *Galedupa pinnata* Taub., *Millettia pinnata*, *Pongamia glabra* Vent., *Pongamia mitis* Merr., *Pterocarpus flavus* Lour., *Robinia mitis* Linn.

Vernacular name(s) : Indian Beech (E), Kacang Kayu Laut (Mal.), Ki Pahang Laut, Bangkong, Kranji, Asawali, Awakal, Marauwen – *Kacang kayu laut* (Ind.), Bagnei, Balikbalik, Balu-balu, Balok, Balok-balok, Balu-balu, Baluk-baluk, Balut-balut, Banit, Baobao, Bayok-bayok, Butong, Kadel, Magit, Manlok-balok, Amarok-barok, Maruk-baruk, Marobahai – *Bani* (Phil.), Yee thale, Yi thale (Thai.)

Description : Tree, up to 6-15(-20) m tall, with branches that are generally without hairs or scales, and have wart-like scars left by leaflets at base of leaf stalks. Crown is irregular in shape, shaggy and dense. Bark is smooth in young trees, becoming shallowly fissured with maturity, greyish-brown or dull-brown to pinkish-brown; exuding strongly crushed bean pod odour. The compound leaves occur in two rows, and there are 3-7 opposite, shiny, dark green leaflets that are ovate, oval or oblong, 5-22,5 by 2.5-15 cm. Flowers are purplish to pinkish-white, and occur in pairs along the stalks of flower clusters that are 6-27 cm long, located in the axils. The 7-15 mm flower stalk is covered with fine, short hairs, and has 2 minute leaflets above the middle. The 4-5 mm long calyx is covered with fine, short hairs, is cup-shaped, and has very short, blunt teeth. The main lobe of the standard of the flower is broadly obovate, 11-18 mm long, white or pale violet. The lower half has a green central spot and it is covered with fine, brown hairs on the back. The wings adhere to the keel. The beaked, thickly leathery pod, 5-7 by 2-3(-5) cm, has a short stalk above the corolla-scar, is compressed and contains 1 seed, 3.5-5 cm long. Pods remain closed.

Ecology : Occurs on non-swampy beaches, and occasionally on landward margins of mangroves. Flowering occurs all year round. Flowers are very frequently transformed into round galls which might be mistaken for fruits. Mangrove associate species.

Distribution : Occurs in the Mascarene Islands, and in tropical Asia, through Southeast Asia to Australia, and in Polynesia. Recorded throughout Southeast Asia. In some localities it extends inland (e.g. Laguna de Bay in the Philippines) near the borders of lakes. In Myanmar it is recorded as *Derris indica*.

Abundance : Common.

Use(s) : Leaves are used for fodder. Seeds are poisonous. It is commonly planted elsewhere in the tropics in coastal areas, because it is resistant to salt and exposure. Sometimes it is planted as a shade tree along roads. The bark is used for making strings and ropes. The seeds yields a red-brown, thick oil known as pongam oil. *Pongamia* oil (called pongamol or hongay oil) is employed for illuminating and for medicinal purposes and should also be useful for the manufacture of soap and candles. The roots and seeds are used as a fish poison in Australia and Madura (Indonesia). In the Philippines a decoction of the leaves is given to a children with cough. The juice of the leaves is used against itches, herpes and gonorrhoea. Bark is used as an abortive by the natives of the Islands of Guimaras. In the Philippines, young shoots are used to treat rheumatism.

Source of illustration : Based on Tomlinson (1986)

References : Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Afriastini (1988), Aksornkoae (1993), Aragones *et al.* (1998).

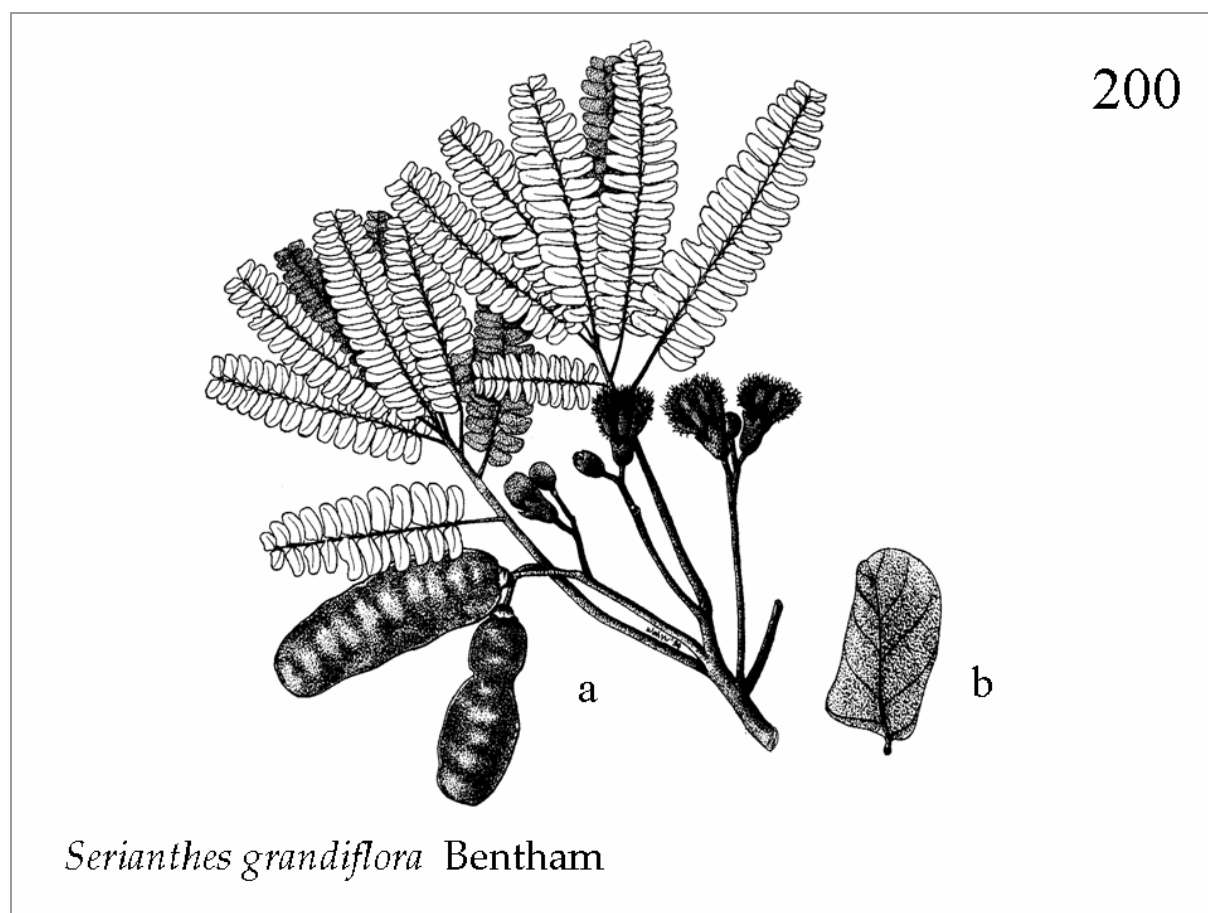


Fig. 200. *Serianthes grandiflora* Benth. (a) Terminal branchlet with flower clusters and pods, (b) single leaflet, showing the typical asymmetry.

LEGUMINOSAE

200

***Serianthes grandiflora* Benth.**

Synonyms : *Albizia grandiflora* (Benth.) F. Muell., *Feuilleea serianthes* Kuntze, *Serianthes dilmyi* Fosberg

Vernacular names : Unknown.

Description : Tree, up to 30 m tall, with young branchlets that are densely covered with short, brown hairs. Leaves have a main vein that has several glands, and are subdivided into 3-9 pairs of main leaflets, each with 12-36 nearly stemless, oblong, smooth, secondary leaflets. Secondary leaflets are alternate, for the greater part, and have a very unequal leaf base. They are broadly rounded or very blunt, measuring 1-3 by 0.5-2 cm. The flower heads are stalked and located in the axils, their end branchlets resembling elongated clusters, each bearing 2-5 flowers. The 5-merous flowers have a 5 mm-thick stalk and a bell-shaped, 5-lobed calyx that is very densely covered with hairs on the outside and 1-2 cm long. The 3.5-4.5 cm-long corolla is yellowish-white, funnel-shaped, divided for more than half its length, and densely covered with hairs on the outside. The very numerous, yellowish-white stamens extend beyond the corolla; they are connected at the base into a tube that includes the ovary. The 10-15 by 5-6 cm, woody pod is stemless above the corolla scar, flat but swollen. The pod does not open when ripe. The 4-8 oblong seeds measure 10-15 by 5-6 mm.

Ecology : Occurs in all coastal vegetation types, including mangroves. Mangrove associate species.

Distribution : Southeast Asian species, known from Malaysia, Singapore, the Philippines, Indonesia (Sumatra, Java, Sulawesi, Borneo, the Moluccas, Papua) and Papua New Guinea.

Abundance : Unknown.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8).

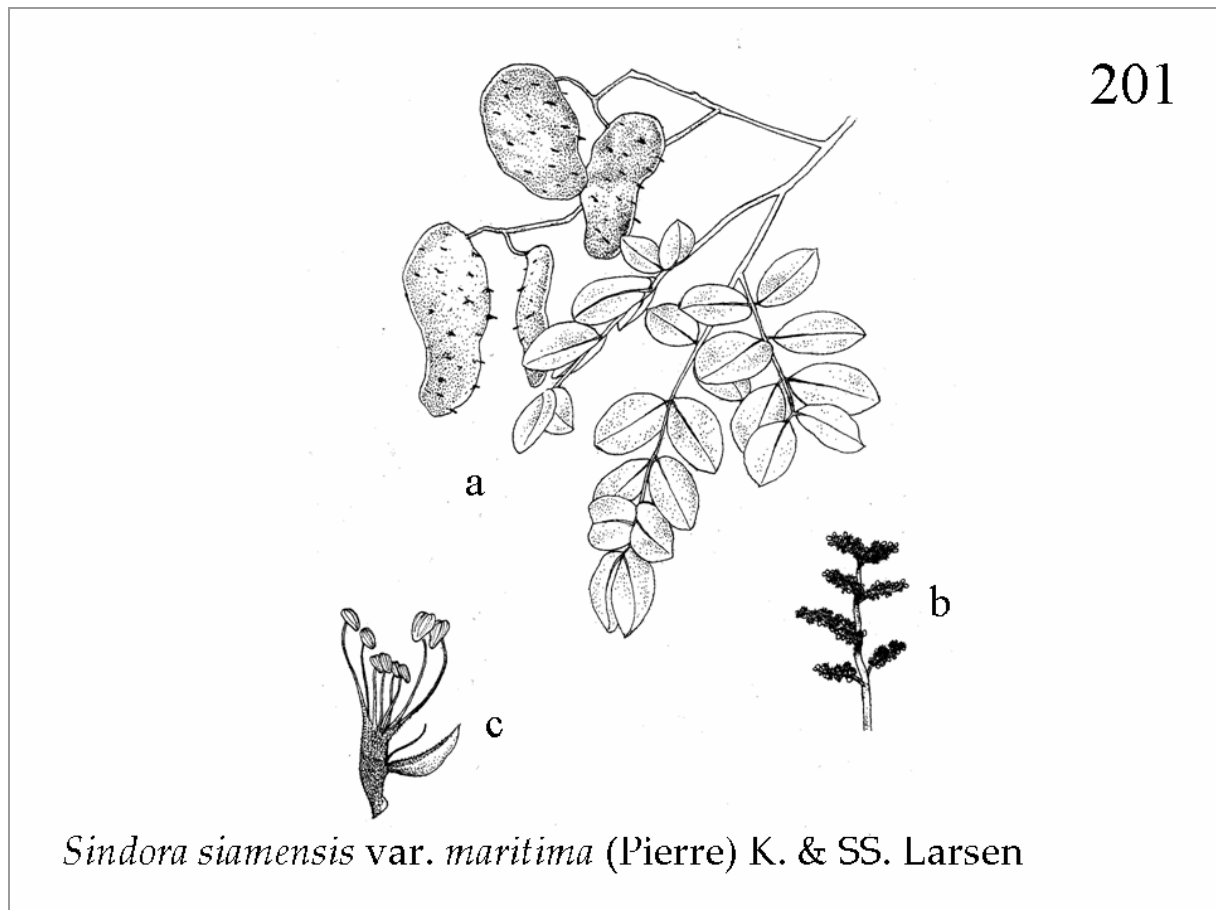


Fig. 201. *Sindora siamensis* var. *maritima* (Pierre) K. & SS. Larsen. (a) Fruiting branchlet, (b) flower cluster, and (c) detail of flower.

LEGUMINOSAE

201

Sindora siamensis var. *maritima* (Pierre) K. & SS. Larsen

Synonyms : *Sindora conchinchinensis* Baillon, *Sindora maritima* Pierre, *Sindora siamensis* Teijsm. ex Miq., *Sindora siamensis* Teysm. ex Miq., *Sindora wallichii* var. *siamensis* (Teijsm.) Bak.

Vernacular name(s) : Ma-kba-ling (Thai.), Sepetir mempelas (Mal.)

Description : Tree, 10-15 m tall, deciduous, with brownish bark. Leaves alternate, with 3(-5) pairs of opposite leaflets (no terminal leaflet); leaflets oblong-ovate, rounded tip or with a slight notch at the tip, 6-15 cm by 3-8 cm; main axis of compound leaf (7-)8-15(-20) cm long; petiole 3-7 mm long. Upper surface of leaflet is dull, the veins very thinly velvety, faint net-like lines on both surfaces. Flowers densely clustered in a compound terminal panicle, 10-17(-35) cm long, stalks golden coloured, finely hairy. Flowers are bisexual and have a short, 2-3 mm long stalk; flowers small, 3-5 mm by 3-5 mm, with leaflets at the base. Sepals 4, separate, green, ovate, 3-3.5 by 7.5-9 mm long, outside hairy, often warty, with a few spines on the ends. Petals 1, boat-shaped, variable in colour from light yellow to red or brown, 2.5-3 by 7-9 mm, woolly outside, smooth inside. Stamens 10 (9+1), pink, fused unevenly, with curved filaments, pink, 3-5 mm long; style 10-12 mm; 5 stigmas. Fruit consists of a pod, which is flat, irregularly round or ovate, rather diffusely spiny (spines up to 4 mm), 5-7 by 6-10 cm; stalks are very short. Seeds number 1-3 and are ovate, 10-15 mm. Two varieties of *Sindora siamensis* are recognised: var. *siamensis*, which has a hairy upper surface of the leaflet, and var. *maritima*, which has a smooth leaflet.

Ecology : Lowland forest species, up to 400 m asl (in Thailand). Pollination is carried out by flies. Also in beach forests and occasionally on landward margins of mangroves. Mangrove associate species.

Distribution : Southeast Asian species; recorded from Cambodia, Laos, Thailand, Vietnam (endangered) and the Malay Peninsula (Kelantan, collected once). The mangrove associate variety *maritima* is known from Cambodia, Thailand and Vietnam only.

Abundance : Uncommon to rare.

Use(s) : Planted as ornamental, for example, in Singapore Botanic Garden. Wood is used for planking.

Source of illustration : <http://www.ku.ac.th/AgrInfo/plant/plant1/p23.html>

Reference(s) : Whitmore (1972a), Hou *et al.* (1996),
<http://www.wcmc.org.uk/infoserv/countryp/vietnam/app5.html>
http://www.wildlifefund.or.th/07_Habitats/02_beach_forest/beach_forest00.html
<http://flora.sut.ac.th/st154.html>

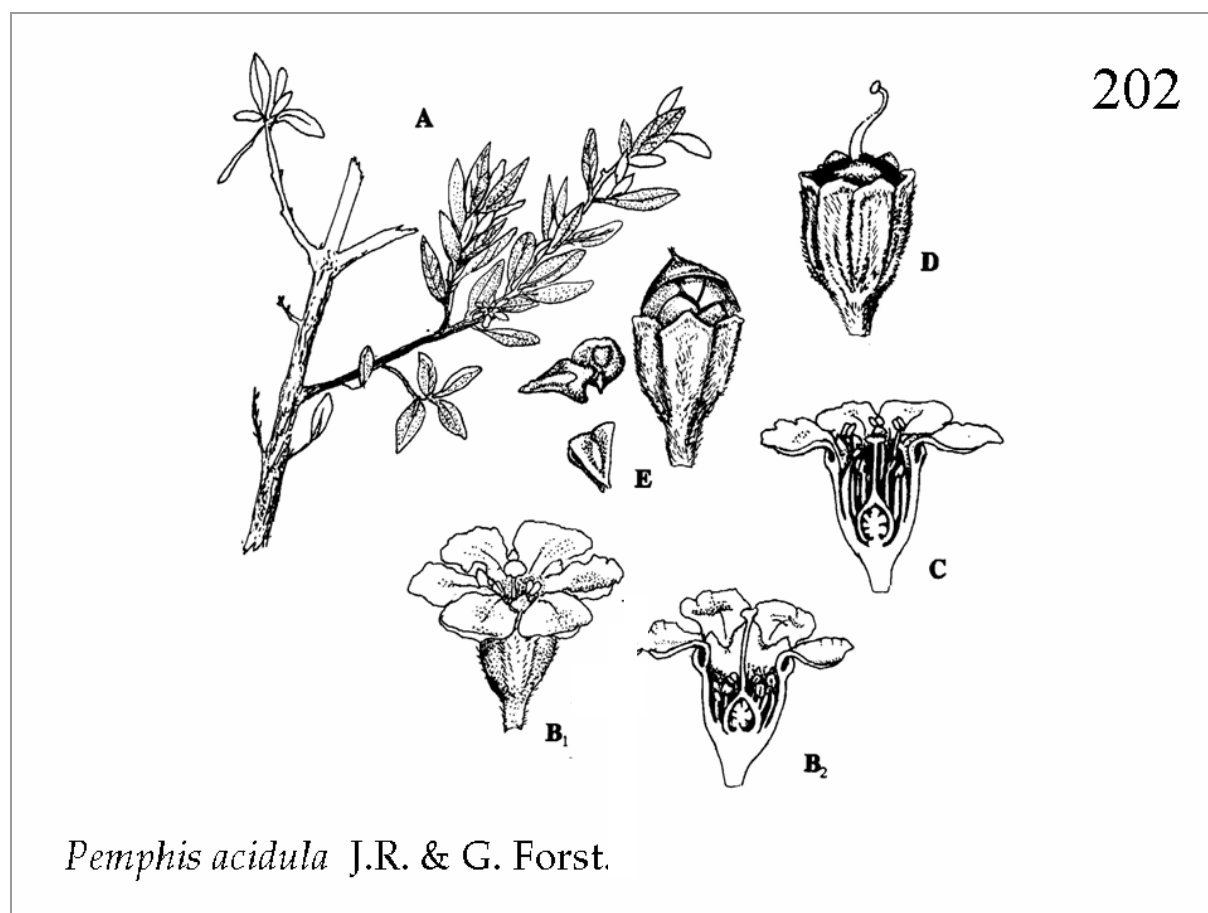


Fig. 202. *Pemphis acidula* J.R. & G. Forst. (a) Branchlet, (b1) flower, (b2, c) longitudinal sections of flower (long-styled and short-styled, respectively), (d) fruit, and (e) fruit with seeds emerging.

LYTHRACEAE

202

Pemphis acidula J.R. & G. Forst.

Synonyms : *Lythrum pemphis* L., *Mangium ferreum* Rumph., *Mangium procellanicum* Rumph., *Melanium fruticosum* Spreng., *Millania rupestre* Zipp., *Pemphis angustifolia* Roxb., *Pemphis setosa* Blanco

Vernacular name(s) : Bungor (Mal.), Kayu sentigi, Cantinggi, Mentigi, Wakat Besi, Cantigi, Sentigi, Keneas, Silu Tasi (Ind.), Kabantigi, Ligad, Ligat, Palupa, Pantigi, Pilit, Uaduat – *Bantigi* (Phil.), Thian le (Thai)

Description : Evergreen shrub or small tree, up to 2-4(-8) m tall, often spreading. It has a light grey to brown bark that is fissured in older specimens. Stems may measure up to 20 cm diameter at breast height and are usually short and crooked. Leaves are densely covered with silky hairs and slightly acidic (taste!); leaves alternate, ovate to obovate, occasionally fleshy, 9-20 by 4-8 mm, with a 1-2 mm long leaf stalk. The bisexual flowers are solitary and of two different morphological types, both located in the axils. The more common 'pin' flowers are short-styled (1 mm long) and the stamens enclose the stigma. The so-called 'thumb' flowers are long-styled (3-4 mm long) and the stamens extend beyond the stigma. The densely hairy base of the calyx is tubular, 6-8 mm long, 12-angled, and green to yellow or green, with red or purple tips. The persistent calyx lobes are triangular, 1 mm long, with accessory lobes alternating with clefts. The crumpled, obovate petals are white, 6 by 5 mm, located at points that alternate with the calyx lobes. The fruit is reddish (to brown on maturity), round, 4-5 mm across, enveloped by the persistent calyx and topped by the style. Each fruit has 10-20 seeds that are circular and flattened, with a corky margin or wing.

Ecology : Coastal, occurs at the landward margin of mangroves, often above the high tide level, and on beaches. Occurs on sand, laterite, limestone and gravel; rocky outcrops above normal tidal influences are often colonised. Flowers and fruits are produced all year round. Flowers are pollinated by bees. The corky margin of the seed aids buoyancy and hence water dispersal. It shows a high degree of variation depending upon habitat. The species varies from low, spreading shrubs to trees with a single straight trunk. Leaves vary from nearly orbicular, small and fleshy to larger, obovate and non-fleshy. Mangrove associate species.

Distribution : From East Africa (Tanzania, Zanzibar) through South and Southeast Asia to Hong Kong, tropical Australia and the western Pacific. In Southeast Asia recorded from Thailand, Malaysia (Johore), Singapore, the Philippines, Indonesia (Papua, Sumatra, Moluccas, Java, Madura) and Papua New Guinea. Perhaps overlooked elsewhere in Southeast Asia.

Abundance : Uncommon, but locally abundant (e.g. in Java); widespread in Australia.

Use(s) : Favoured for its very hard, durable wood, which is used for hand tools, anchors, walking canes, fence posts and novelties. The wood is extremely heavy, very hard and very strong. It seasons well with very little checking or warping; it is very difficult to work, but takes a high finish.

Source of illustration : Based on Wightman (1989).

Reference(s) : Heyne (1950), van Steenis *et al.* (1951), Backer & Bakhuizen van den Brink (1963-8), Everett & Whitmore (1972), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998).

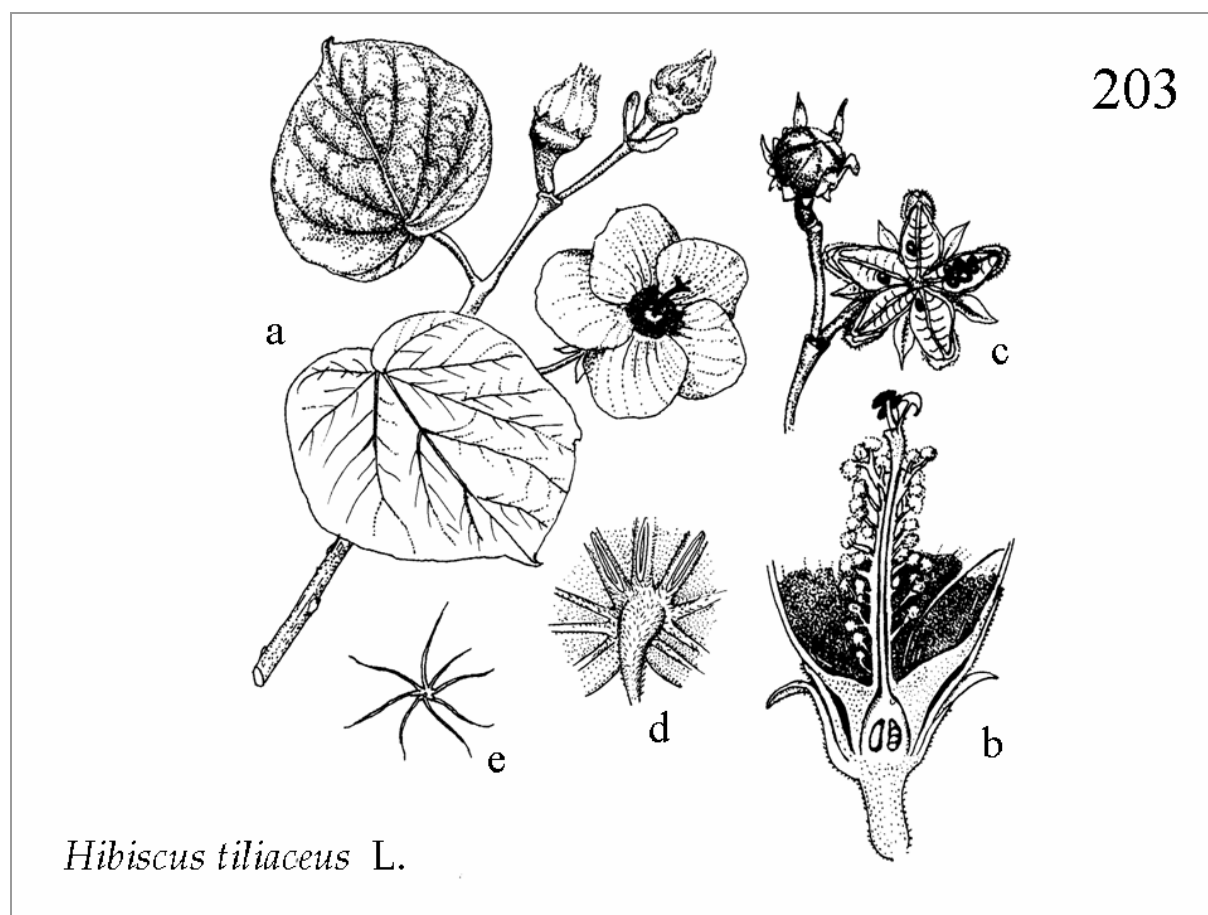


Fig. 203. *Hibiscus tiliaceus* L. (a) Branchlet with buds and flower, (b) longitudinal section of flower, (c) fruit, ripe and open, (d) base of leaf, and (e) stellate hair from leaf.

MALVACEAE

203

Hibiscus tiliaceus L.

Synonyms : *Hibiscus abutiloides* Willd., *Hibiscus celebicus* Koord., *Hibiscus cuspidatus* Sol. ex Park., *Hibiscus elatus* (non Sw.) Miq., *Hibiscus hastatus* L., *Hibiscus similis* Blume, *Hibiscus tricuspidatus* Sol. ex Park., *Novella repens*, *Novella rubra*, *Paritium tiliaceum* (L.) St. Hil.

Vernacular name(s) : Sea Hibiscus (E), Baru, Baru-baru, Bebaru, Bebaru bulu (Mal.), Waru Laut, Siron, Waru Lot, Waru Lenga, Waru Lengis, Baru, Kabar, Bahu, Molowahu, Fau, Kasjanaf, Iwal, Wakati – Waru (Ind.), Bago, Balabago, Balibago, Bauan, Dangliu, Danglog, Hanot, Laogo, Lambagu, Malibago, Marakapas, Mayambago, Ragindi - *Malubago* (Phil.), Tra nhó't (Viet.), Pho thale, Po thale (Thai.), Dawm-beus, Kab-baspreyteukbray (Camb.)

Description : A spreading tree, up to 15(-30) m tall, with a greyish-brown, mottled, smooth bark and a trunk that may measure up to 30 cm diameter at breast height. The leathery leaves, 7.5-15 by 7.5-14.5 cm, are usually densely covered with short hairs underneath. They have 1-3 glands and large (1-6 cm), broad leaflets at the base of the leaf stalk. Flowers occur singly or in groups of 2-5 in the axils of leaves. The base of the elongated flower cluster stalk is enclosed by a pair of enveloping leaflets that later fall and leave a conspicuous, ring-like scar. The bisexual flowers are typically 'hibiscus-like', with the surfaces of the petals, stamen tube and style covered with glandular hairs. The (pale) yellow flowers have a dark brownish-purple centre, and are large (5-7.5 cm across) and showy. They are yellow on the evening they open but turn purple at the end of the following day, when they fall off before withering. Flowers have a conspicuously 5-toothed calyx, the remains of which occur on the shortly-beaked fruit. Fruit measures about 2 cm across, splits open into five segments, and has minutely hairy seeds. Differences between the two mangrove Malvaceae are given on the next page, with the description of *Thespesia populnea*.

Ecology : Characteristic of tropical seashores and often associated with mangroves. Common on all sandy and rocky shores in Southeast Asia. Also common along riverbanks in the lowlands. Flowering occurs all year round. The seed is buoyant due to an air cavity and is capable of germination after seawater immersion. In old leaves the sugar-excreting glands are often black because they are invaded by a fungus. Sometimes a coastal subspecies is recognised: *Hibiscus tiliaceus* subspecies *tiliaceus*. Mangrove associate species.

Distribution : Pantropical, at least in cultivation, and occurs throughout Southeast Asia. Its precise natural ecological and geographic distribution is uncertain.

Abundance : Widespread and common.

Use(s) : Planted as a shade tree in gardens and timber yards. Roots are used as medicine to treat fever. Fibre of bark used to produce rope, and for caulking of boats. Leaves are sometimes used for fodder. Timber used to make inner parts of boats (Lombok, Indonesia). Lopped forms often occur near villages, and cuttings are planted to make living fences. Wood is soft and weak, but seasons well, finishes highly and is easy to work. Used for utensils and musical instruments.

Source of illustration : Based on Tomlinson (1986) and Wightman (1989).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), van Borssum Waalkes (1966), Kochummen (1972), Tomlinson (1986), Afriastini (1988), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

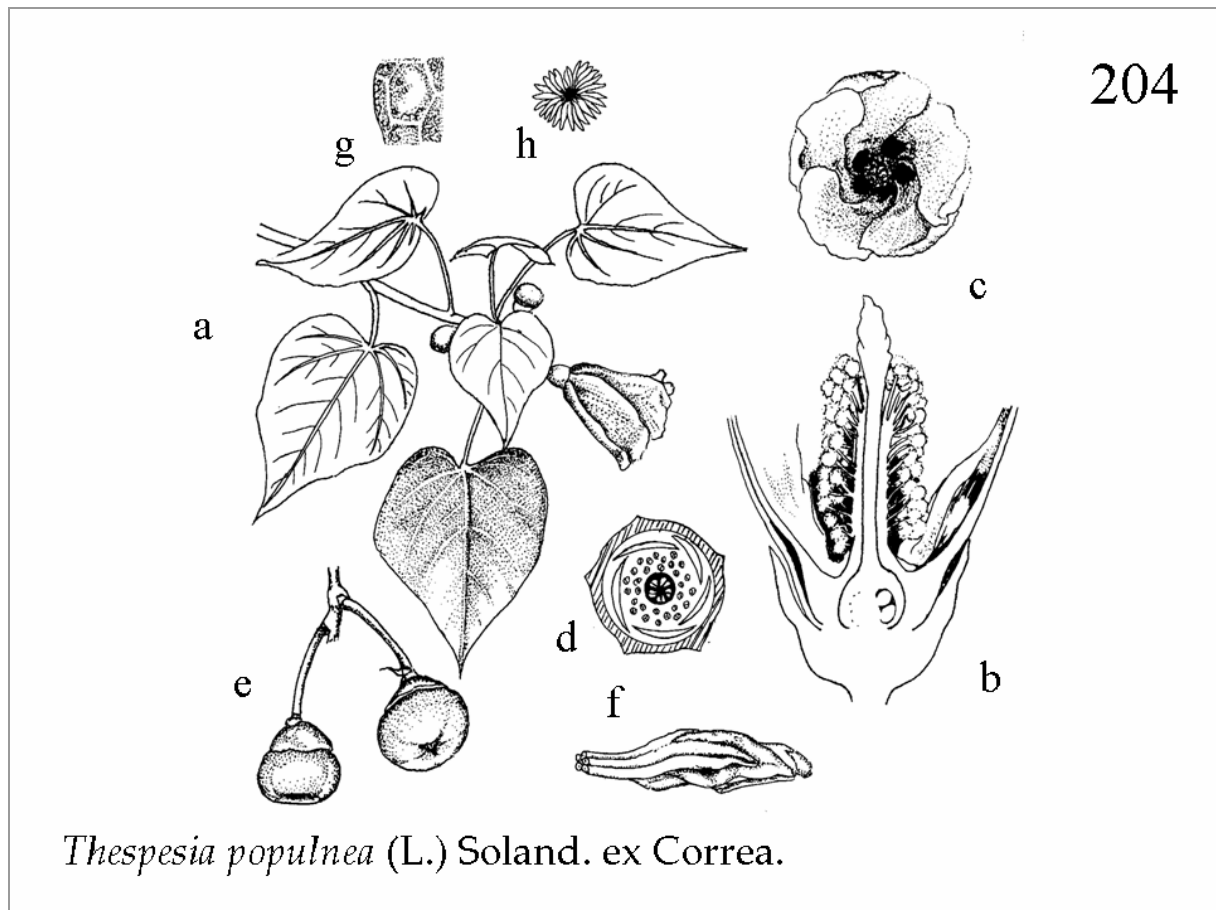


Fig. 204. *Thespesia populnea* (L.) Soland. ex Correa. (a) Branchlet with buds and flower, (b) longitudinal section of flower, (c) flower, (d) flower diagramme, (e) fruits, (f) stigma, and (g) detail of leaf surface, with (h) enlarged, star-shaped scale.

MALVACEAE

204

Thespesia populnea (L.) Soland. ex Correa

Synonyms : *Bupariti populnea* (L.) Rothmaler, *Hibiscus bacciferus* Forster, *Hibiscus macrophyllus* (Bl.) Oken, *Hibiscus populneus* L., *Malvaviscus populneus* (L.) Gaertn., *Novella litorea* Rumph., *Thespesia banalo* Blanco, *Thespesia howii* Hu, *Thespesia macrophylla* Blume, *Thespesia populneoides* Roxb.

Vernacular name(s) : Bebaru (Mal.), Waru Laut, Waru Pantai, Waru Lot, Salimuli – *Baru laut* (Ind.), Balu, Banag, Banago, Banaro, Bango-pula, Ba-ot, Iden, Tuba-tuba, Valo - *Banalo* (Phil.), Tra bô' dê (Viet.), Porhteukprey (Camb.), Pho thale (Thai)

Description : Tree, 2-10(-20) m tall, with a trunk that may attain a diameter at breast height of about 15 cm. Leaves are spirally arranged and initially densely covered with brown scales that are later shed. Older leaves are thus smooth, and glandless on midrib of the under surface, but often having small hollows (that may house ants) between the main veins at the base of the leaf. Leaves are leathery, without lobes, ovate to heart-shaped, occasionally with a pointed tip, and measuring 7-24 cm by 5-16 cm. Leaf stalks measure 6-16 cm. Flowers are solitary, with a scaly stalk of 2.5-10 cm. The corolla is 6-7 cm, bell-shaped, light yellow with a purple centre. Flower buds and young fruit contain a yellow, milky juice that turns red. Ovaries also have a yellow latex. There are 3-8 minute leaflets on the outer calyx. Fruit is compressed round to broadly egg-shaped, 2.5-4.5 cm across; fruit does not usually open while still on the tree. There are 3-4 seeds, covered with dense, short hairs, in each compartment of the fruit. In the Philippines literature (e.g. Aragones *et al.*, 1998), *Thespesia populneoides* is often still recognised as a separate species (in contrast to *T. populnea*, it has coppery leaves and smooth branches). Differences between the two mangrove Malvaceae are:

<i>characteristic:</i>	<i>Hibiscus tiliaceus</i>	<i>Thespesia populnea</i>
<i>calyx</i>	5-lobed	not lobed
<i>leaf pubescence</i>	usually present	absent
<i>main veins on leaf</i>	9-11, indistinct	7, distinct & yellowish
<i>brown scales on young leaves</i>	absent	present
<i>fruit readily opening while on tree</i>	yes	no

Ecology : Occurs on beaches, sandy and rocky coasts, in the *Barringtonia* formation and the landward margin of mangroves. Wide distribution due to floating seeds that can stay alive in seawater for many months (tested up to 12 months). May be found inland, where it has been planted. Mangrove associate species.

Distribution : Pan-tropical; occurs throughout Southeast Asia.

Abundance : Common.

Use(s) : Light timber; bark in the past used as a source of fibre. Leaves and fruits used as medicine. Planted as roadside tree or in villages.

Source of illustration : Based on Tomlinson (1986) and Wightman (1989).

References : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), van Borssum Waalkes (1966), Kochummen (1972), Tomlinson (1986), Afriastini (1988), Wightman (1989), Said (1990), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

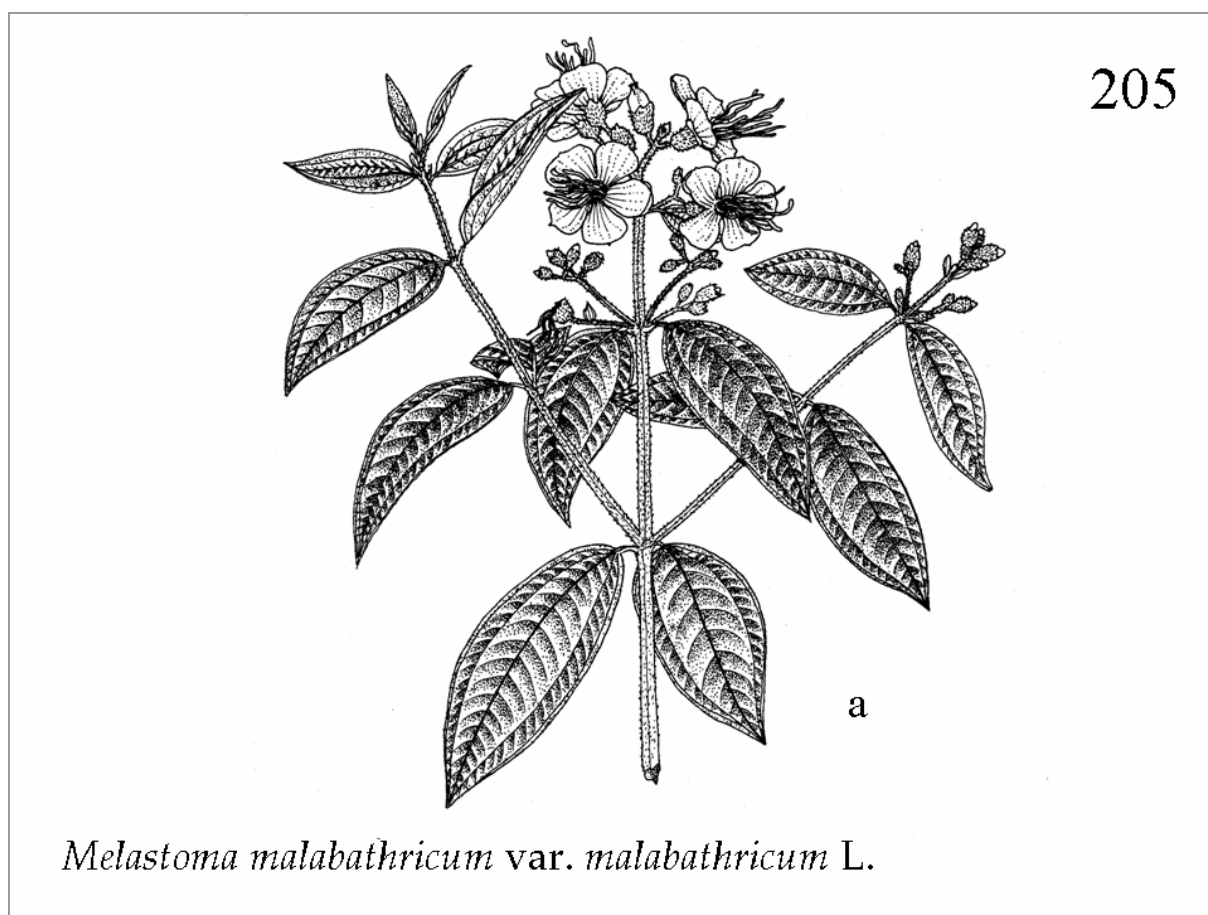


Fig. 205. *Melastoma malabathricum* var. *malabathricum* L. (a) Terminal branch with flowers and immature fruit.

MELASTOMATACEAE

205

Melastoma malabathricum var. *malabathricum* L.

Synonyms : *Fragarius niger* Rumph., *Melastoma adpressum* Wall., ex Triana, *Melastoma affine* D.Don., *Melastoma asperum* Bl., *Melastoma baumianum* Naud., *Melastoma candidum* D.Don., *Melastoma imbricatum* var. *longipes* Craib., *Melastoma malabathricum* var. *grandiflorum* Craib. *Melastoma malabathricum* var. *polyanthum* (Bl.) Benth., *Melastoma oliganthum* Naud., *Melastoma polyanthemum* (Bl.) G.Don., *Melastoma polyanthum* Blume, *Melastoma polyanthum* Burm., *Melastoma pusillum* Bl., *Melastoma royeri* Bl., *Melastoma scabrum* Ridl., *Melastoma setigerum* Bl., *Melastoma tondanense* Bl., *Osbeckia royeri* (Bl.) Miq.

Vernacular name(s) : Singapore Rhododendron (E), Senduduk (Mal.), Senduduk, Kluruk, Senggani, Harendong, Kemanden (Ind.), Mua (Viet.)

Description : Shrub, often much branched, 0.5-1.5 m, rarely up to 3(-4) m tall. Branches (slightly) quadrangular, or (rarely) round, covered with small scales, and covered with bristles on the nodes, up to 2 mm long. Leaves simple, opposite, very variable in shape and degree of hairiness, opposite or rarely in threes, oblong-lanceolate, ovate-oblong, elliptic or almost rhomboid, 0.8-8.5 by 2-19(-20) cm, rounded to pointed at the base, hairy on both sides, either 5-nerved or 3-nerved with 2 thin marginal ones; leaf stalk 7-35 mm. Flowers more than 10 grouped together in a 2-3 cm long panicle; flower stalks 8 mm long. Calyx tube bell-shaped, 7 mm long, covered with 1-2 mm long scales, with 5 teeth, triangular, 1-4 by 3-7 mm. Petals 5, narrowly to broadly obovate, 5-20 by 10-24 mm, purple, pink or white. Stamens 10, unequal; the larger ones with 4-8 mm long filaments and linear, shortly beaked 6-9 mm long anthers, provided with a 6-12 mm long connective; the shorter ones with 3-7 mm long filaments. Berry widened at the top, (4-)8-9(-10) mm long, stalk 5-20 mm long, turning a very deep (almost black) purple when ripe. An extremely variable species, with many subspecies, varieties and forms recognised.

Ecology : From sea level to about 1650 m asl., in sunny and moist locations. Found in many ruderal and disturbed areas, secondary scrub, river banks and landward margins of mangroves. Mangrove associate species.

Distribution : Found from Madagascar and India through Yunnan and Southeast Asia to Australia. In Southeast Asia it is common throughout.

Abundance : Very common.

Use(s) : A poultice of the leaves is used to treat burns. Leaves are also used to treat diarrhoea and vaginal infections. Young leaves eaten as vegetable, and fruit is reportedly tasty and fit for human consumption. Roots are used to treat rheumatism and arthritis.

Source of illustration : Drawn from live specimen.

Reference(s) : Heyne (1950), Bakhuizen van den Brink (1943-45), Corner (1988), Hong (2000).

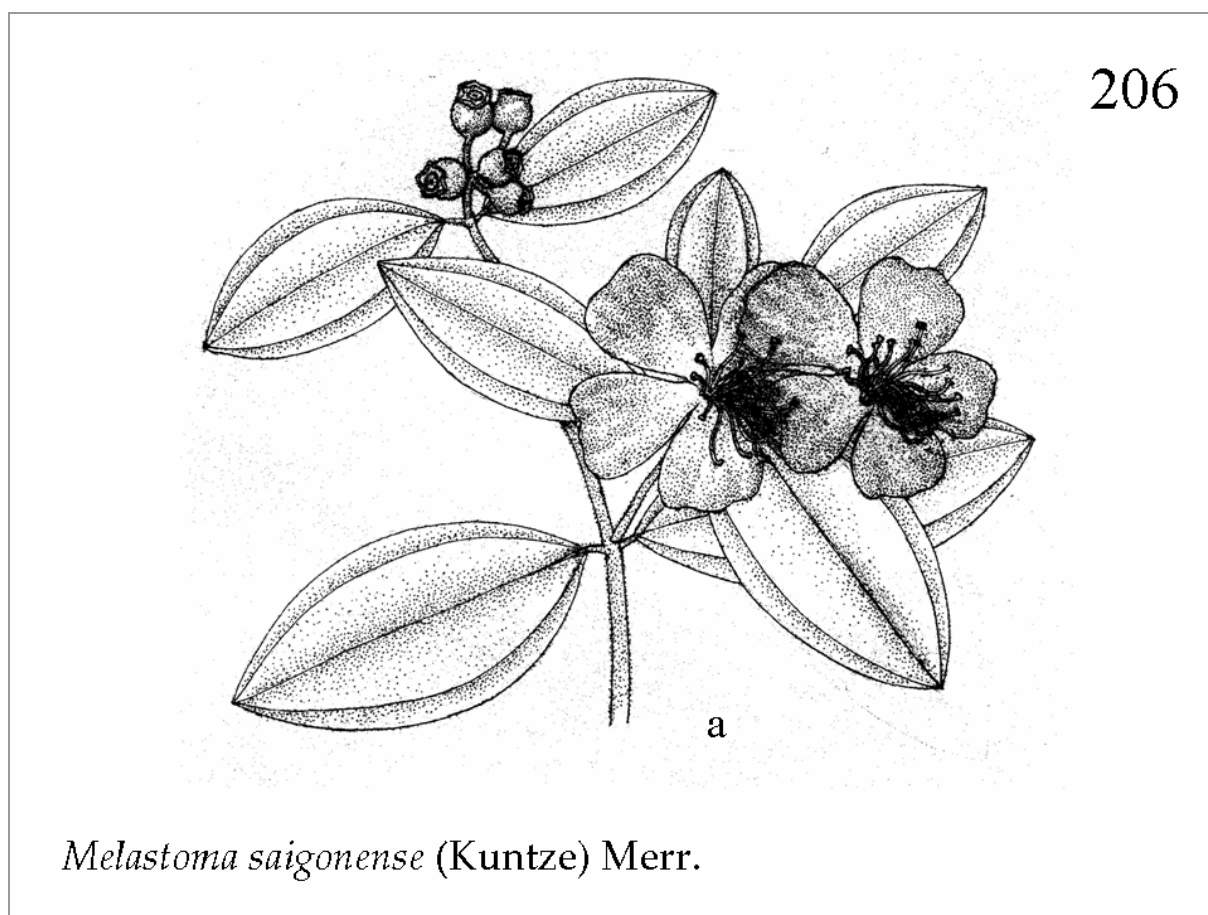


Fig. 206. *Melastoma saigonense* (Kuntze) Merr. (a) Flowering and fruiting terminal branchlet.

MELASTOMATACEAE

206

Melastoma saigonense (Kuntze) Merr.**Synonyms :** *Melastoma villosum* Sims [non Aublet], *Osbeckia saigonense* Kuntze**Vernacular name(s) :** Khlongkleng khon, Klong-kleng, Eng-air, Ti tang (Thai)**Description :** Shrub, up to 3m tall, with quadrangular branchlets that are densely covered with reddish-brown stiff hairs. Leaves are simple, opposite, elliptical to lanceolate, 3-9 by 1.3-2.5 cm, base rounded, with a short pointed tip and a blade with (1-) 2 pairs of lateral primary veins; densely hairy on both sides, with a 6-20 mm long leaf stalk. Flowers are 4- or 5-merous, hairy on the outside; leaflets at base of flower stalk about 5 mm long. The hypanthium (a cup shaped base of the flower formed by the fusing of the calyx and petals) is 9-13 mm long and densely covered with star-shaped bristles. Calyx lobes triangular, about 7 mm long. Petals 15-20 mm long, purple. Stamens (8-) 10; outer anthers 9-10 mm long, purple, with a 9-10 mm long connective prolongation; inner anthers about 9 mm long, yellow, connective not prolonged. Fruit a reddish-purple capsule, 12-14 mm long.**Ecology :** Common in scrubby vegetation in wet places, but also in evergreen or deciduous forests. Occasionally recorded on landward margins of mangroves. Mangrove associate species.**Distribution :** Southeast Asian species, recorded from Myanmar, Laos, Thailand, Cambodia and southern Vietnam.**Abundance :** Locally common.**Use(s) :** Unknown.**Source of illustration :**http://www.dld.go.th/nutrition/exhibition/native_grass/other/Melastoma%20%20saigonense.htm**Reference(s) :** Aksornkoae (1993), Larsen & Nielsen (2001).

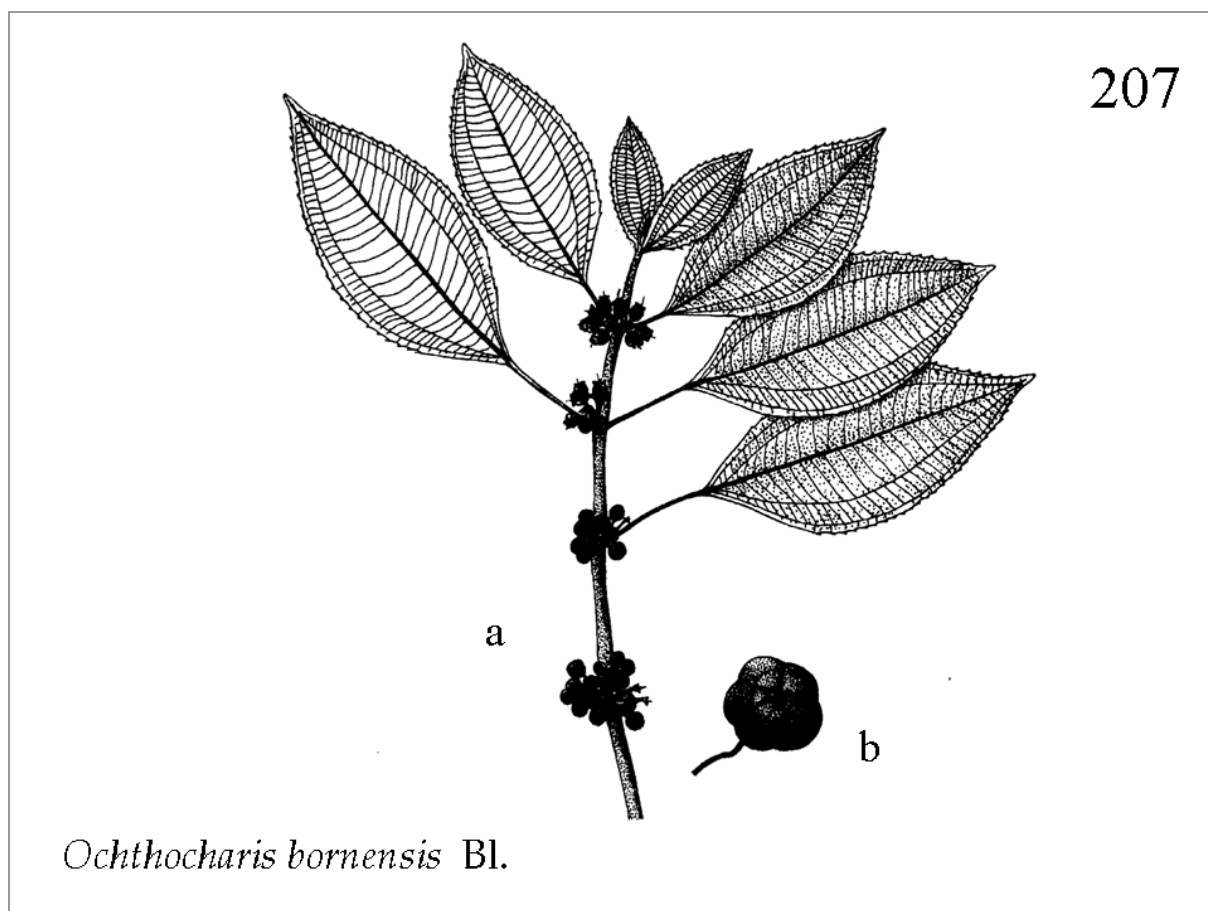


Fig. 207. *Ochthocharis bornensis* Bl. (a) Flowering and fruiting branchlet, and (b) fruit.

MELASTOMATACEAE

207

Ochthocharis bornensis Bl.

Synonyms : *Ochthocharis attenuata* Backh. f., *Ochthocharis buruensis* T. & B., *Ochthocharis javanica* (haud Bl.), *Ochthocharis borneensis* (sic)

Vernacular name(s) : Karamunting, Sendudok Air (Mal., Ind.)

Description : A sparsely-branched, erect shrub, up to about 1.5 (-6) m tall, branches rounded-quadrangular, younger ones covered with short, brownish hairs. Leaves are opposite, ovate to narrowly-ovate or lanceolate leaves that measure 5-10(-14) by 2-4(-6) cm, rounded at the base and with a pointed tip. Like most other members of this family it has five conspicuous principal veins (three central, two along leaf margin) connected by numerous transverse, parallel, secondary veins. The leaf stalk is slender, 1-5(-6.5) cm long. Flower clusters are without a stalk, or with only a very short stalk. The 5-merous flowers are small, only 3 mm across, and are located in the axils. The calyx tube is 1.5 mm long, smooth, with five short (0.2 mm) triangular lobes. Petals are ovate, 1 by 2 mm, white with pink tips. The 10 stamens are spurred. The spherical fruits are light green, with the calyx persisting as a rim, 3-4 mm across, and with 10 longitudinal ribs. The 3-sided seeds are irregularly keeled. The name is often incorrectly written as *Ochthocharis 'borneensis'*. Note that '*Karamunting*' is the generic Malay/Indonesian name for many members of Melastomataceae.

Ecology : Occurs on landward margins of mangroves. Mangrove associate species. In adjacent communities there may be other members of the family, that are often present as 'weed' species. Most notably these may be *Melastoma malabathricum* L. with much larger, reddish-purple flowers and bright-yellow stamens. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Brunei, Cambodia, Thailand (as *Ochthocharis javanica*), throughout the Malay Peninsula and in Indonesia (Sumatra, Bangka, Borneo and the Moluccas). Used to occur in mangroves of Singapore, but is now extinct. Also reported from Thailand, the Philippines and Papua New Guinea (www.rbgekew.org/herbarium/brunei/fams/68.htm), but this appears to be erroneous.

Abundance : Uncommon.

Use(s) : Both leaves and fruit (berries) are sour but eaten raw are prepared as a vegetable.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Heyne (1950), Bakhuizen van den Brink (1943-5), Tomlinson (1986), Ng & Sivasothi (1999), http://www.forest.go.th/Botany/Flora/species%20list/volume7_3/Melastomataceae.htm.

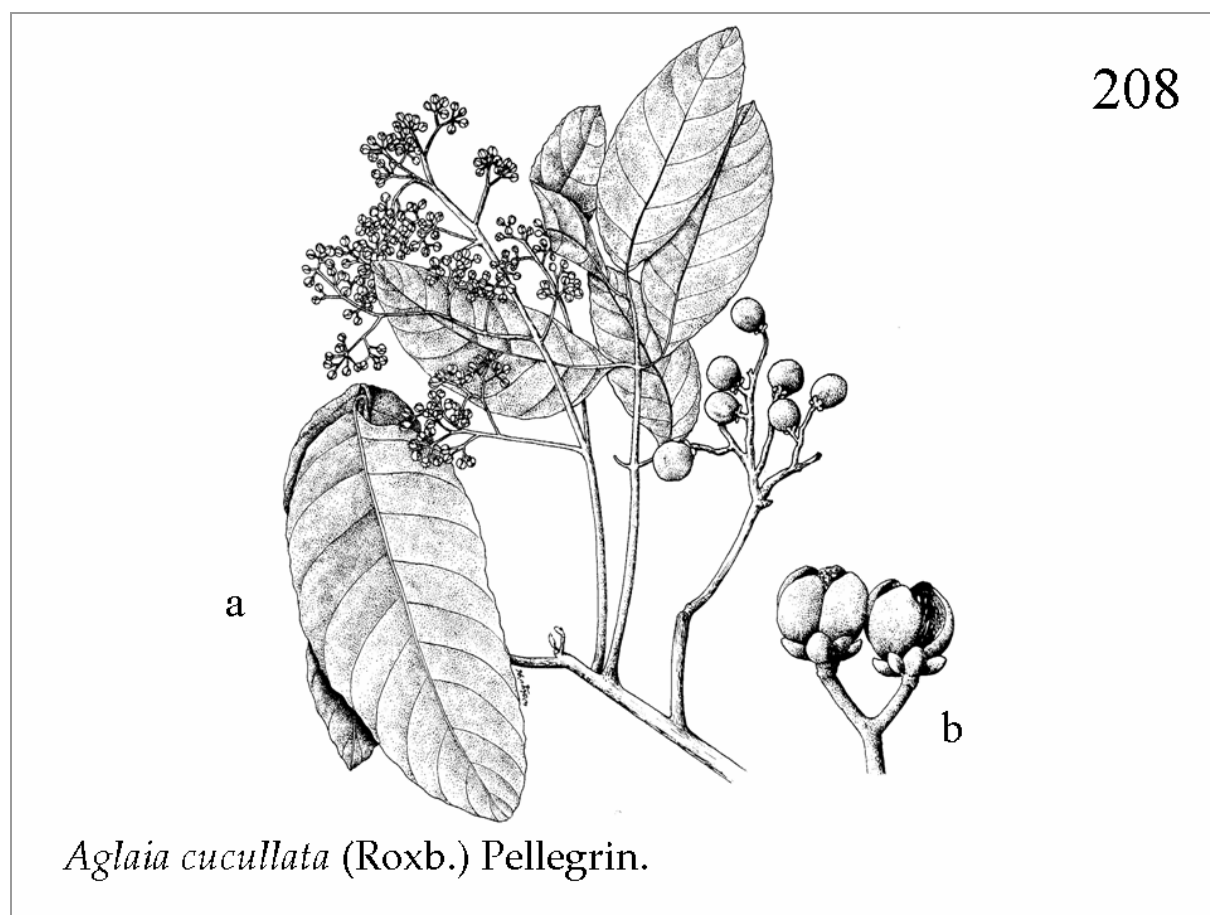


Fig. 208. *Aglaia cucullata* (Roxb.) Pellegrin. (a) Branchlet with flowers and fruit, (b) flowers.

MELIACEAE

208

Aglaia cucullata (Roxb.) Pellegrin

Synonym(s) : *Aglaia conduplicifolia* Elmer, *Aglaia tripetala* Merr., *Amoora aherniana* Merr., *Amoora auriculata* Miq., *Amoora cucullata* Roxb., *Andersonia cucullata* Roxb.

Vernacular name(s) : Dái ngu'a nu'ó 'c (Viet.), Daeng nam (Thai)

Description : Small to medium sized tree up to 15 m tall and 130 cm girth; sometimes with plank buttresses. In muddy, tidal areas pneumatophores emerge from the mud. Bark is smooth, brown or pale orange, sometimes flaking in small brittle scales. Wood is pale yellowish brown to orange-brown, with white latex. Twigs are slender, and towards their tips they have pale brown to almost white scales. Leaves are up to 45 cm long with 5-9 leaflets that measure 7-20 by 3-6 cm. Leaflets are asymmetrical and may be sickle-shaped. Flowers are arranged in clusters in leaf and branch axils. Each cluster usually has numerous small, yellowish flowers, with three petals, that measure 1.5 mm across, and with 6 slightly protruding anthers. Fruits are round, measuring 6 by 7 cm, with a leathery skin. The fruit splits into three parts, each with one seed surrounded by a shiny red aril.

Ecology : Lowland forests and tidal river banks; first recorded in Ganges Delta. Terminal leaflets are sometimes developed into a 'pouch' occupied by ants. The fleshy aril of the fruit suggests that it might be distributed by animals (probably birds). It is the only species of the genus that occurs in mangroves and has pneumatophores. Mangrove associate species.

Distribution : Recorded from India, Nepal and Bangladesh through Southeast Asia, where it has been recorded in Vietnam, Thailand, Myanmar, the Philippines, Malaysia, Singapore, Brunei and Indonesia (Borneo, Sumatra, Java, Papua) and Papua New Guinea.

Abundance : Scarce to rather common.

Use(s) : Wood used for posts and firewood, plus boat-building (Brunei, Papua). Resinous outer fruit used for lamps in the Philippines.

Source of illustration : Whitmore, Tantra & Sutisna (1990)

Reference(s) : Mabberly & Pannell (1989), Whitmore, Tantra & Sutisna (1990), Hong & San (1993), Aksornkoae (1993), Mabberley *et al.* (1995), Maung (2003).

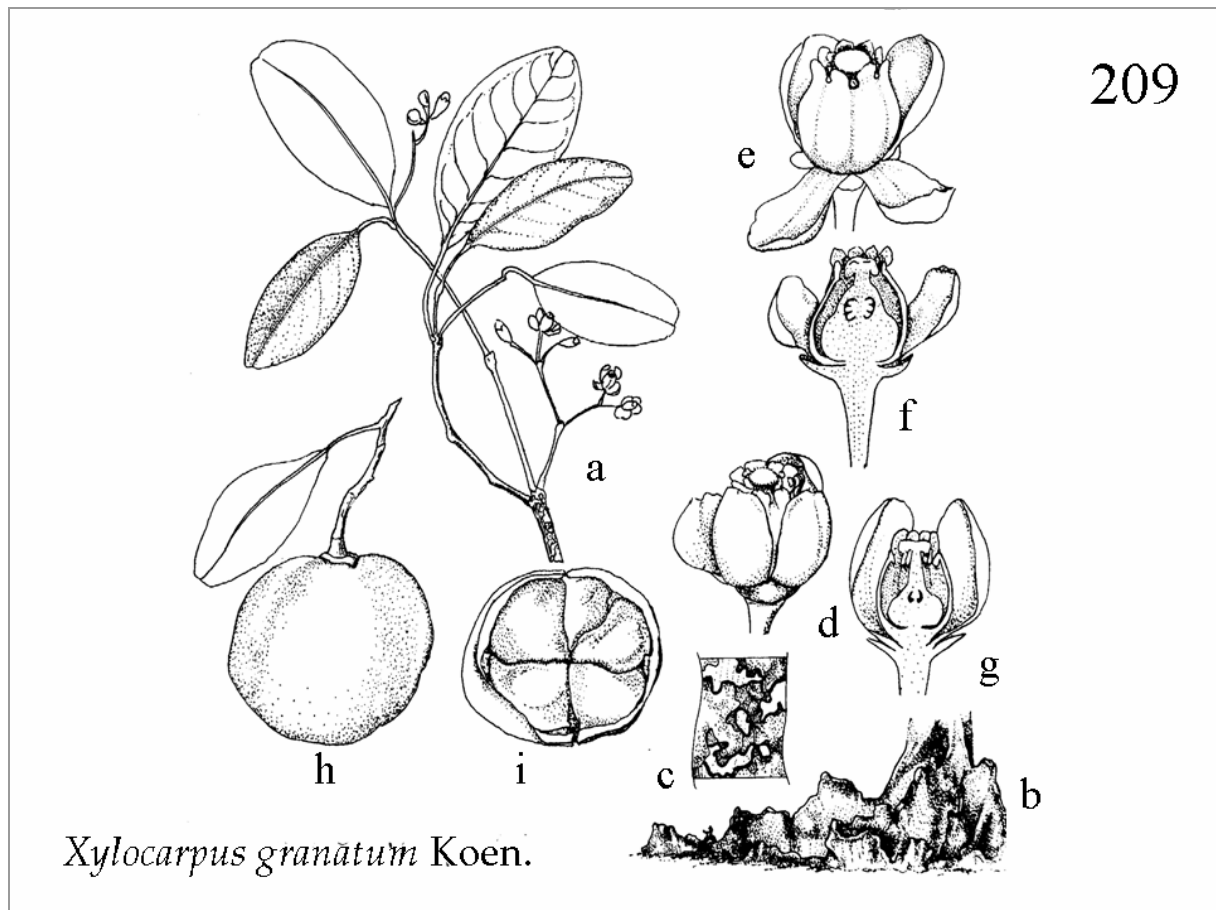


Fig. 209. *Xylocarpus granatum* Koen. (a) Branchlet with flowers, (b) base of tree trunk, showing roots raised above the soil, (c) detail of bark, (d,e) flowers, (f, g) longitudinal sections of flowers, (h) fruit, and (i) opened fruit showing the seeds.

MELIACEAE

209

Xylocarpus granatum Koen.

Synonyms : ?*Amoora salomoniensis* C. DC., *Carapa granatum* (Koen.) Alston, *Carapa indica* A. Juss., *Carapa moluccensis* auct. non Lam., *Carapa obovata* Blume, *Granatum littoreum parvifolium* Rumph., *Granatum obovatum* (Blume) Kunzke, ?*Guarea oblongifolia* Griff., *Monosoma littorata* Griff., *Xylocarpus bednadiensis* Mattei, *Xylocarpus carnulosus* Zoll. & Mor., *Xylocarpus minor* Ridley, *Xylocarpus moluccensis* auct. non M. Roem., *Xylocarpus obovatus* (Blume) A. Juss.

Vernacular name(s) : Niri, Nyireh, Nyiri, Nyireh Bunga, Nyireh hudang (Mal.), Nyiri Udang, Nyiri Hutan, Pohon Kira-kira, Jomba (Ind.), Awol, Ecahi, Kaav, Mokkemoffe (PNG), Kyana (Myan.), Bigi, Binoil-ure, Kalimbabau, Kolimbauing, Lubanayong, Nigi, Pagatpat-babae, Piagao, Pulit, Tambo-tambo, Tambubunot, Tangi, Tangile, Tangkuyon – *Tabigi* (Phil.), Su ô'i (Viet.), Ta bun khao (Thai.), Tabonsor (Camb.).

Description : Tree, usually (1-)6-20 m tall, with horizontal pneumatophores (aerial roots) that are saucer-shaped and raised above the soil. Trunks are often hollow, especially in older trees, and may be up to 80 cm diameter at breast height. Bark is (yellowish-) light brown, thin and flaking, while on young stems it is wrinkled. Branching is low, often beginning at 2-5 m above the ground. Leaves are compound, spirally arranged, with 1-2 (rarely 3) pairs of leaflets, no terminal leaflet (=paripinnate). Leaflets are usually round to egg-shaped, thick and leathery, measuring 4.5-17 cm by 2.5-9 cm. Leaf tips are usually rounded to very blunt; rarely with a short point. Stalks of leaflets are 2-9 mm long. Flowers occur in clusters that are 2-7 cm long, located in the axils, and bearing flowers of both sexes or female only. The calyx is tinged with red, flat and deeply 4-lobed. It is 4-petalled, with eight stamens and a 2 mm long style. Individual flower stalks are 4-8 mm long. Calyx lobes are rounded, up to 3 mm long, with a very short, blunt point. Petals are oval-shaped, white and 5-7 mm long, while stamen tubes are 3-5 mm long. Fruits are large, very woody and round, usually 10-25 cm in diameter and yellowish-green in colour. The fruit has four compartments filled with large, tetrahedrally-shaped, woody seeds. To the distress of those trying to establish a herbarium collection, the fruit breaks up upon drying.

Ecology : A true mangrove species, that also occurs along banks of tidal creeks, landward margins of mangroves, and other brackish-water environments that are not too saline. Often fairly gregarious. Older specimens may abound in epiphytes. Mangrove species.

Distribution : Found throughout Old World mangroves and in Australia (rare), from East Africa to the Tonga islands. Found throughout Southeast Asia.

Abundance : Locally abundant, in particular after mangrove forest exploitation and other disturbance has eliminated competing species.

Use(s) : Timber only available in small sizes; sometimes used for parts of boats. Wood is comparatively heavy, moderately hard, but prone to splitting. Used for high grade furniture and cabinet works. Bark is collected for its high tannin content (> 24% dry weight) and red dye. Oil may be obtained from the seed for use as lamp oil and in hair grooming. Bark used to treat cholera, while fruit and seed are used to treat diarrhoea.

Source of illustration : Based on Tomlinson (1986) and Wightman (1989).

References : Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963), Tomlinson (1986), Wightman (1989), Mabberley *et al.* (1995), Aragonés *et al.* (1998), Marschke (2000).

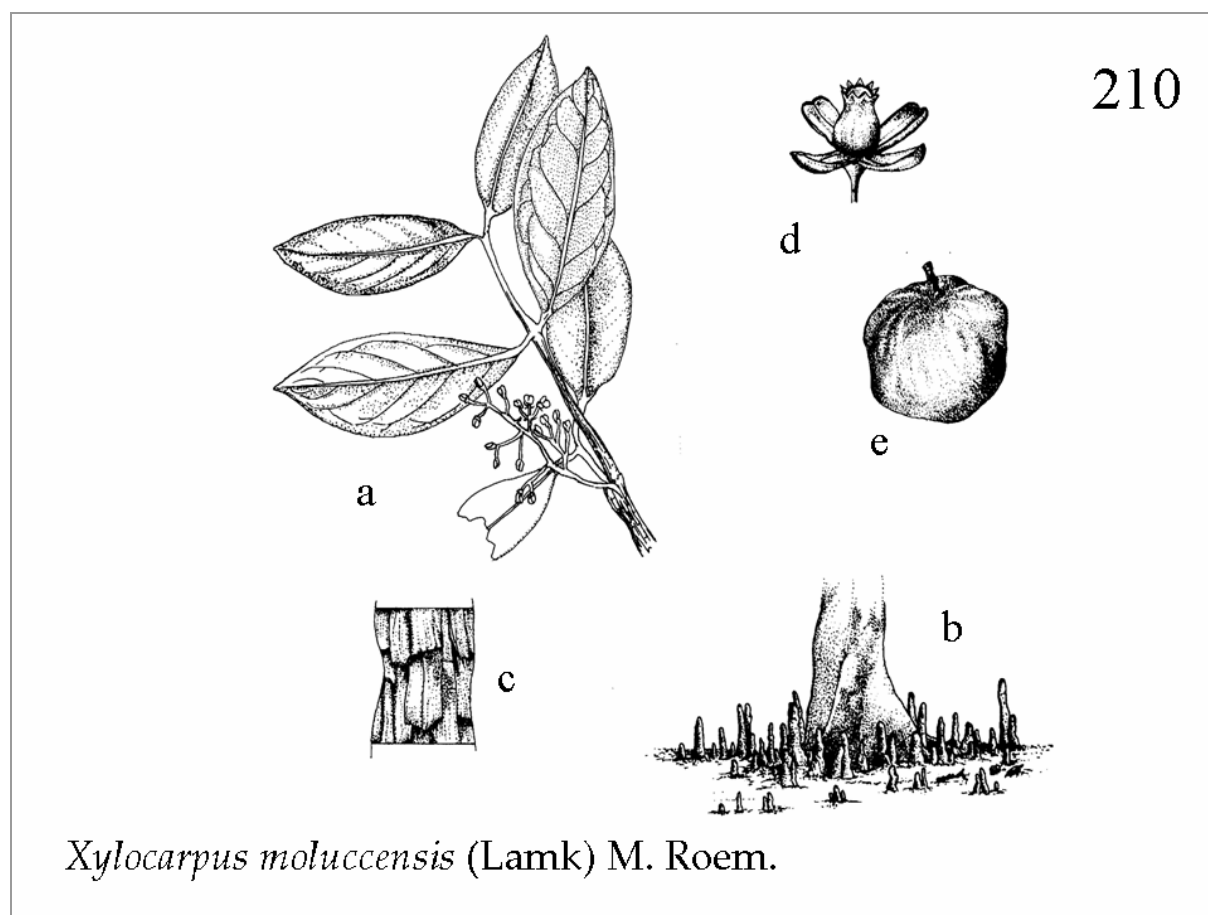


Fig. 210. *Xylocarpus moluccensis* (Lamk) M. Roem. (a) Branchlet with flowers, (b) base of tree trunk, showing the pneumatophores, (c) detail of bark, (d) flower, and (e) fruit.

MELIACEAE

210

***Xylocarpus moluccensis* (Lamk) M. Roem.**

Synonyms : *Carapa borneensis* Becc., *Carapa mekongensis* (Pierre) Pellegr., *Carapa moluccensis* Lam., *Carapa obovata* auct. non Blume, *Granatum litoreum parvifolium* Rumph., *Granatum moluccensis* (Lam.) Kuntze, *Xylocarpus australiasicus* Ridley, *Xylocarpus gangeticus* (Prain.) C.E. Parkinson, *Xylocarpus mekongensis* Pierre, *Xylocarpus parvifolius* Ridley

Vernacular name(s) : Nyireh batu (Mal.), Niri Batu, Raru, Nyiri Gundik, Nyuru, Mojong Tihulu, Pamuli, Loleso (Ind.), Lagut-ut, Pindak, Puyugan, Sangkuyong, Tabigi, Tibigi – *Piagau* (Phil.), Su sú'ng (Viet.), Ta bun dam (Thai.), Tabonkmao (Camb.)

Description : Tree, 5-20(-30) m tall, with small buttresses and a trunk up to 70(-210) cm diameter. Many pointed, conical- and saucer-shaped pneumatophores. Leaves are spirally arranged, and have 2-3 pairs of leaflets (rarely 1 or 4), each leaflet measuring 4-12 by 2-6.5(-7) cm; leaflets paired (=paripinnate). They are usually oval to egg-shaped, thin-leathery, with a broadly rounded to sharply tapered base. Stalks of leaflets are 1-3 mm long, while the leaf stalk and rachis measures up to 10 cm. Bark of branchlets is smooth, while that of the main trunk has a deeply fissured surface. Flowers occur in clusters located in the axils, and are either bisexual or female. Flower clusters are 6-18.5 cm long with a 2-10 mm-long stalk. The calyx is flat and deeply 4-lobed, lobes 1-1.7 mm long; four petals, eight stamens and a 2 mm-long style. Calyx lobes are rounded, white and about 1.5 mm long. Petals are yellowish, oblong to egg-shaped, and 2-3 by 3.5-4 mm long. Fruit is broadly ellipsoid, brown, and (6-)8-11(-15) cm in diameter, with 5-10 seeds, 4-6.5 cm long.

Ecology : Occurs in tidal forests, banks of tidal creeks, and along coastal fishponds. Often found along oepn shores. A true mangrove species.

Distribution : Tropical Asia, from India (Sunderbans) to Southeast Asia and northern Australia. In Southeast Asia recorded from Cambodia, Thailand, Malay Peninsula, Singapore, the Philippines, Singapore, Vietnam, Indonesia (Sumatra, Java, Moluccas) and Papua New Guinea.

Abundance : Locally common.

Use(s) : Construction wood for houses and boats, but also for small tools such as handles for the famous 'Kris' (Java). Also used as firewood. Seeds are used as medicine to treat stomachaches. Fruits used in the Indonesian 'Jamu' (traditional medicine) for womb contraction, and to increase the appetite. Bark tannin is used to treat fishing nets, but also as medicine to treat intestinal problems. Wood is moderately light, soft, but moderately strong and seasons well.

Source of illustration : Based on Walker (1976).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Mabberley *et al.* (1995), Aragones *et al.* (1998), Ng & Sivasothi (1999), Marschke (2000), Maung (2003).

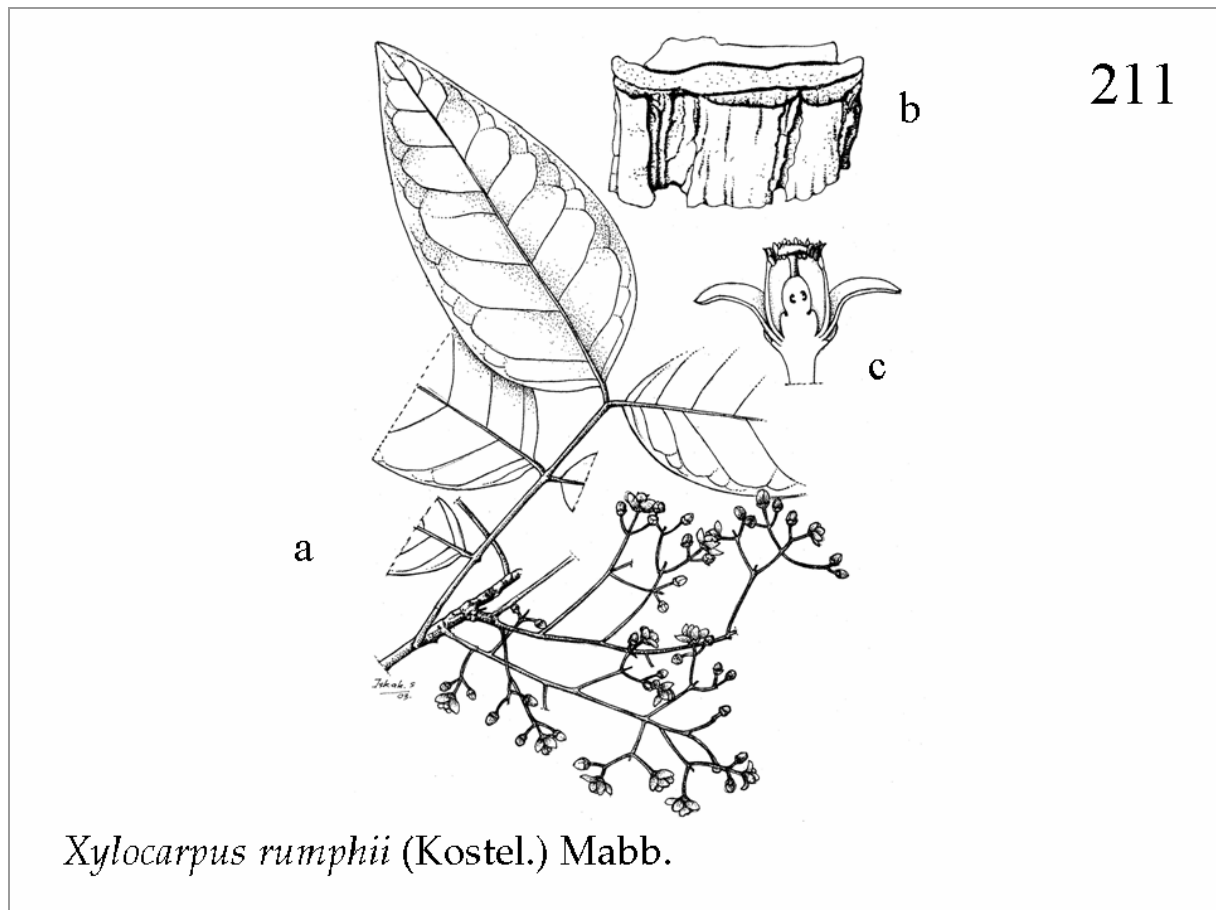


Fig. 211. *Xylocarpus rumphii* (Kostel.) Mabb. (a) Flowering branch, with one leaf (leaflets partially removed), (b) detail of bark, and (c) longitudinal section of flower.

MELIACEAE

211

***Xylocarpus rumphii* (Kostel.) Mabb.**

Synonyms : *Aglaia zollingeri* C.DC., *Amoora naumannii* sensu C.DC., *Amoora zollingeri* (C.DC.) Koord., *Carapa moluccensis* auct. non. Lam., *Carapa rumphii* Kostel., *Xylocarpus forstenii* Miq., *Xylocarpus granatum* auct. non. Koen., *Xylocarpus moluccensis* auct. non M. Roem.

Vernacular name(s) : Niri, nyireh (Mal, I), pigau (P), kabahai, tawihi, wadawada (PNG), Tabann (Camb.)

Description : Tree, 4-12 (-18) m, with neither conspicuous buttresses nor pneumatophores. Trunk up to 50 cm diameter, frequently of poor form. Bark finely fissured, greyish, inner bark bright pink to red. Leaf stalk (including the rachis) up to 22 cm, leaflets in 2-4(-5) pairs, 5-10(-16) by (2-)3-5(-9.5) cm, ovate to heart shaped, with pointed tip; venation prominent on both sides; stalk of leaflet 1-3(-5) mm; leaflets paired (=paripinnate). Flower clusters 10-18 (-28) cm long, lax and hanging. Calyx 4 lobes 1-1.5 mm long. 4 petals 3.5-6 by 2-2.5 mm, elliptic-oblong, creamy white. Fruit 6-8 cm diameter, round. Seeds 8-16, 3.6-7 cm long.

Ecology : Exposed shores, rocky cliffs, often near the surf, and sandy substrates above the high water mark. Mangrove species.

Distribution : From East Africa to Tonga, and found throughout Southeast Asia. So far not recorded in Borneo.

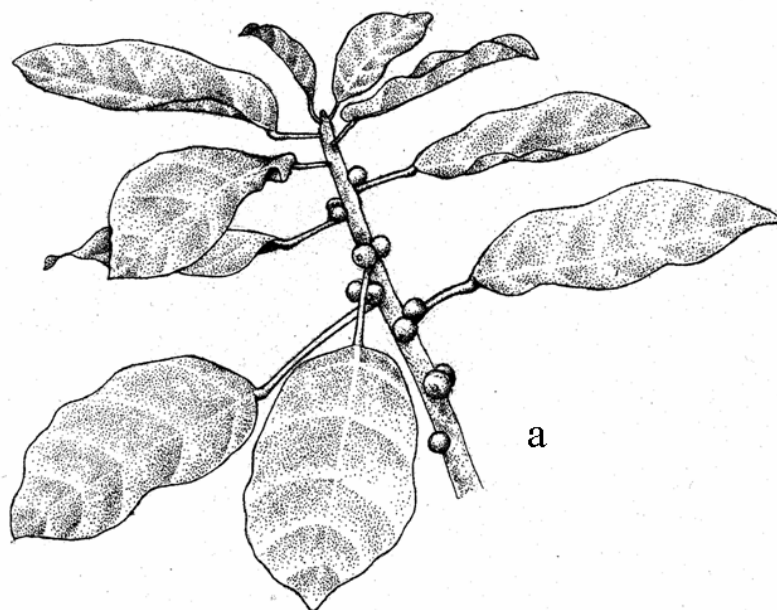
Abundance : Locally common but scattered; rare in Sumatra, absent in Borneo.

Use(s) : Patterned wood used for handles of traditional knives (*kris*). Bark used for tanning and for dyeing cloth. Kernel of seeds used to treat stomach aches. Wood used for boat building.

Source of illustration : Mabberly *et al.* (1995)

Reference(s) : Heyne (1950, Mabberly & Pannell (1989), Mabberly *et al.* (1995), Marschke (2000).

212



Ficus curtipes Corner

Fig. 212. *Ficus curtipes* Corner. (a) Terminal branch with fruit.

MORACEAE

212

Ficus curtipes Corner

Synonyms : *Ficus obtusifolia* Roxb., *Urostigma obtusifolia* (Roxb.) Miq.

Vernacular name(s) : Da-ba (Viet.).

Description : Trees, 5-10 m tall, stems often basally many branched, epiphytic when young; may also be scrambling or climbing. Bark pale greyish, smooth. Branchlets green, 5-8 mm in diameter, smooth. Stipules lanceolate to ovate-lanceolate, 1-2 cm. Leaves thick and leathery, (narrowly-) elliptic-oblong to obovate, 5.5-7 by 10-17.5 cm, tip squared as if cut off or rounded, base wedge-shaped; secondary nerves numerous (8-12), faint, tri-nerved at the base, joining at the leaf edge to form a distinct nerve running parallel to the leaf edge; leaf stalk stout, 1.25(1.5-2.0) cm long. Figs occur in pairs in the axils on leafy branchlets, without a visible stalk, round, yellow or yellow-tinged pink, dark red to purplish-red when mature, (7-) 10-15 mm across, round to flattened/globular, with three persistent leaflets at the base, 3-4 mm.

Ecology : In China and Vietnam it is usually recorded from limestone hills (500-1400m). Recorded from landward edge of mangrove in Myanmar. Fruiting occurs late autumn to early winter in southern China. Mangrove associate species.

Distribution : Found from Northeast India to Yunnan (China). In Southeast Asia is has been recorded in Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia and Indonesia (Sumatra, Borneo).

Abundance : Uncommon to rare.

Use(s) : This species may be cultivated as an ornamental tree (China).

Source of illustration : Missouri Botanical Garden TROPICOS database (www.mobot.org)

Reference(s) : Corner (1959), Kochummen (1978a); Flora of China database (<http://flora.huh.harvard.edu/china/>) <http://users.bart.nl/~edcolijn/florapalung.html>.

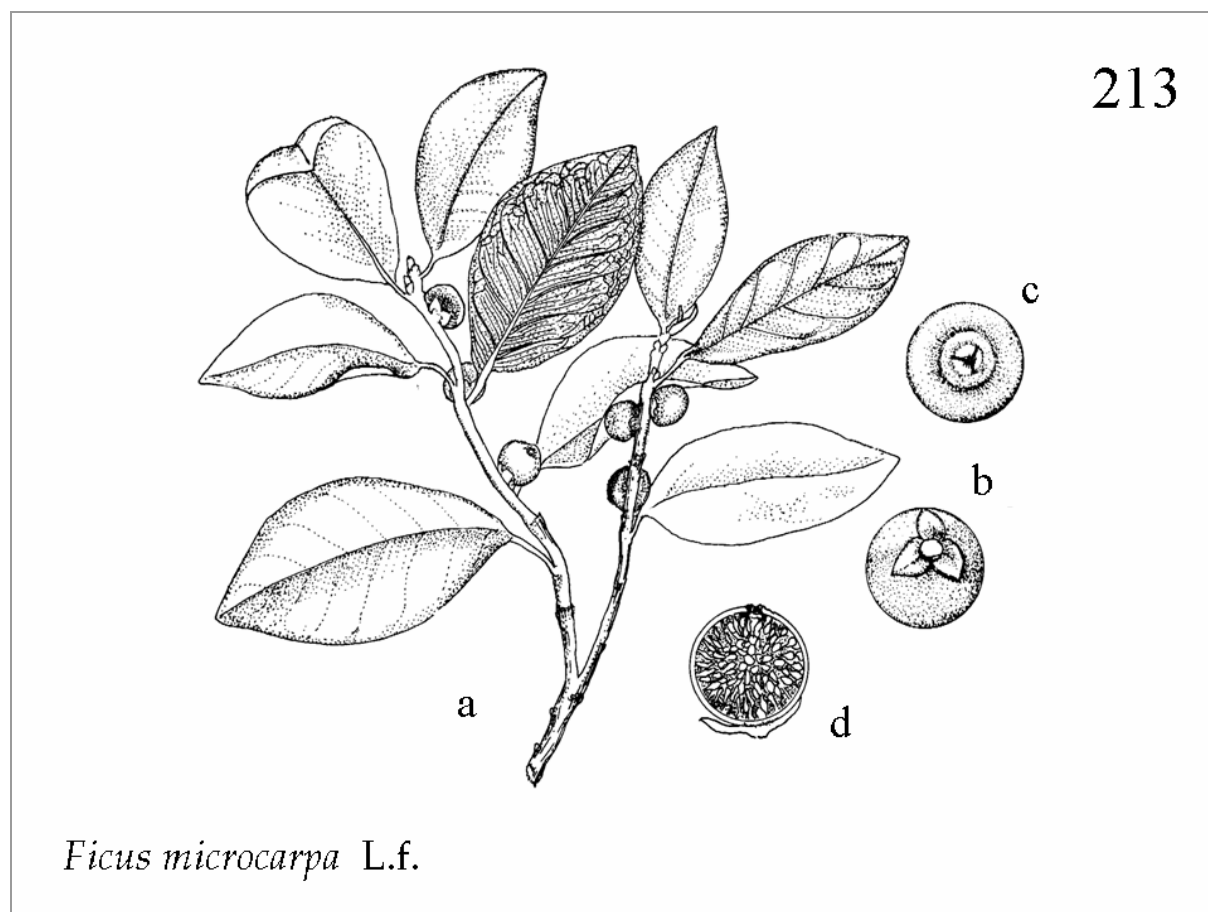


Fig. 213. *Ficus microcarpa* L.f. (a) Branchlet with fruits, (b) fruit seen from stem, (c) fruit seen from bottom, and (d) cross-section of fruit.

MORACEAE

213

Ficus microcarpa L.f.

Synonyms : *Ficus retusiformis* H. Lév, *Urostigma microcarpum* (L.f.) Miq.

Vernacular name(s) : Malayan banyan (E), Jawi jawi, Jejawi, Lunok (Mal.), Jejawi, Fikus, Jabai (Ind.), Sai yoi bai thuu (Thai), Gú'a (Viet.)

Description : Medium sized strangler tree, up to 30 m tall, and with a crown that may spread up to 60 m diameter. In a young stage it is epiphytic, and in older stages it is usually multi-stemmed, the original stem sometimes disappearing in very old trees. The tree often has a spidery appearance, with no real main trunk being discernable. At an early stage, the trunk is divided into upwardly curved branches, with many drooping, tasselled aerial roots, often hanging in festoons. These aerial roots may later develop into pillar roots. The leathery, smooth and hairless leaves are soft and flexible; measure 3-10 by 1.5-5 cm, are elliptic to egg-shaped, and droop. They are densely covered with fine, transverse, upwardly directed lines, in 7-9 pairs of distinct nerves; sometimes leaves may have a reddish tinge. The almost stemless figs (fruits) are small and round, located in the axils of leaves or recently fallen leaves. They are at first pale green, later turning bluish-black, and measure 3-7 mm (up to almost 1 cm) across. Often confused with *Ficus retusa* (a distinct and separate species), especially in the older literature. *Ficus retusa* is a small strangler fig occurring in swamp forests that has 'retuse' leaves, i.e. with a small notch in the rounded or blunt leaf tip; this is not or only very rarely the case with *Ficus microcarpa*.

Ecology : In swamp forest, riparian forest, coastal swamps or along the landward margin of mangroves. Up to 1,200 m but more frequently in lowlands below 100 m. Flowering occurs all year round. On rocky headlands the species may be dwarfed and take on a creeping habit. In Southeast Asia, the fig wasps are *Blastophaga (Parapristina) verticillata*. Mangrove associate species.

Distribution : From India and Sri Lanka to South China, the Marianas and Australia (New South Wales). Throughout Southeast Asia, recorded from the Philippines, Malaysia, Thailand, Vietnam, Brunei, Indonesia (Sumatra, Java, Borneo, Papua) and Papua New Guinea.

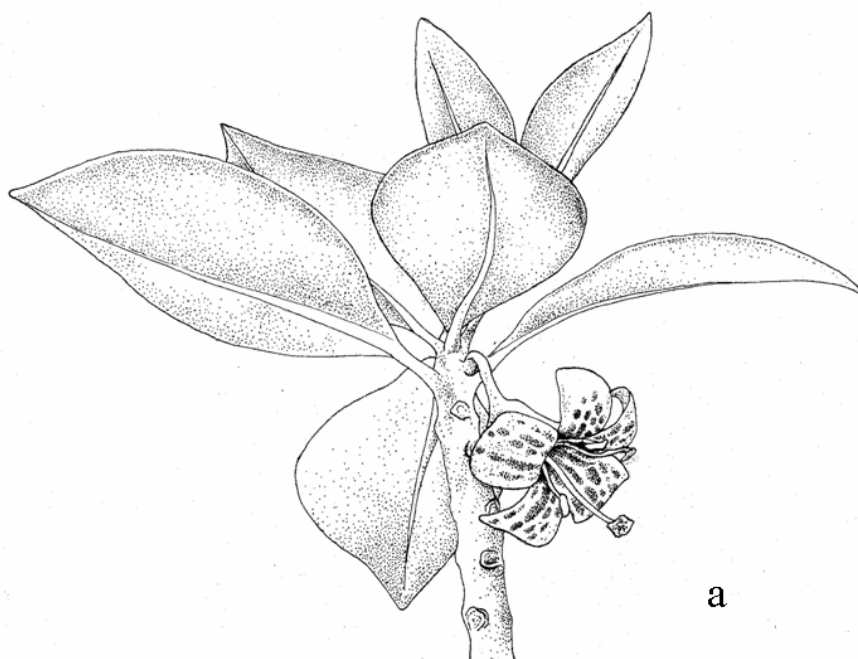
Abundance : Common.

Use(s) : Often cultivated and planted as an ornamental. Burkill (1935) reports that in India the tree has a wide medical application, including treatment of toothache (roots), headache (bark and leaves), and the juice of the leaves used externally to treat colic.

Source of illustration : Based on Sastrapradja & Afriastini (1984).

Reference(s) : Burkill (1935), Backer & Bakhuizen van den Brink (1963-8), Kochummen (1978a), Primack (1983), Sastrapradja & Afriastini (1984), Corner (1988), Aksornkoae (1993), http://www.mekonginfo.org/mrc_en/contact.nsf.

214



Myoporum bontioides (Siebold & Zucc.) A. Gray.

Fig. 214. *Myoporum bontioides* (Siebold & Zucc.) A. Gray. (a) Detail of flowering branchlet.

MYOPORACEAE

214

Myoporum bontioides (Siebold & Zucc.) A. Gray

Synonyms : *Pentacoelium bontioides* Sieb. et Zucc.

Vernacular name(s) : Unknown.

Description : Evergreen erect shrubs about 1 m tall, smooth throughout. Branches round and fleshy, with swollen leaf scars. Leaves simple, alternate, leathery, fleshy, with a 1-2 cm long leaf stalk; leaf blade oblong to elliptic, 2-4 by 5-12 cm, with a pointed tip; leaf base gradually tapering into the leaf stalk; leaf blade entire, upper surface lustrous, midrib slightly raised on lower surface, lateral nerves obscure. The flowers are grouped in clusters of 2-4 located in the leaf axils. The flower stalk is slender, about 2 cm long when in full flower, and up to about 3 cm long in fruit. Calyx bell-shaped, about 10 mm long, deeply 5-lobed; lobes lanceolate, pointed, about 5 mm long. Corolla bell-shaped to funnel-like, white, with purple spots, 2-2.5 cm long, more or less fleshy; tube stout, 10-15 mm long, 5-lobed; lobes elliptic, obtuse or pointed, about 10 mm long and recurved. Stamens 2-4 pairs of unequal length and projecting beyond the rest of the flower, 18-25 mm long. Style thread-like, also projecting beyond the rest of the flower, 18-25 mm long. Fruit fleshy and non-opening, egg-shaped to round, pointed, 10-15 mm long, 8-10 mm across, reddish brown when ripe.

Ecology : In Vietnam it is regularly recorded in mangroves; otherwise it is recorded along (sandy) seashores. In Vietnam it is particularly found in mangroves of the northeastern zone, where it may be recorded along with *Scyphiphora hydrophyllacea* under the canopy of other trees (Hong, 1993). Flowers from January to May. Mangrove associate species.

Distribution : South Japan, Taiwan, Central to Southern China and northern Vietnam.

Abundance : Uncommon.

Use(s) : Unknown.

Source of illustration :

http://www.city.himi.toyama.jp/~35210/tokusyu/toku_hamajintyo/hamajintyo_tokusyu.htm

Reference(s) : Hong (1993), Flora of Japan (website: <http://foj.c.u-tokyo.ac.jp>).

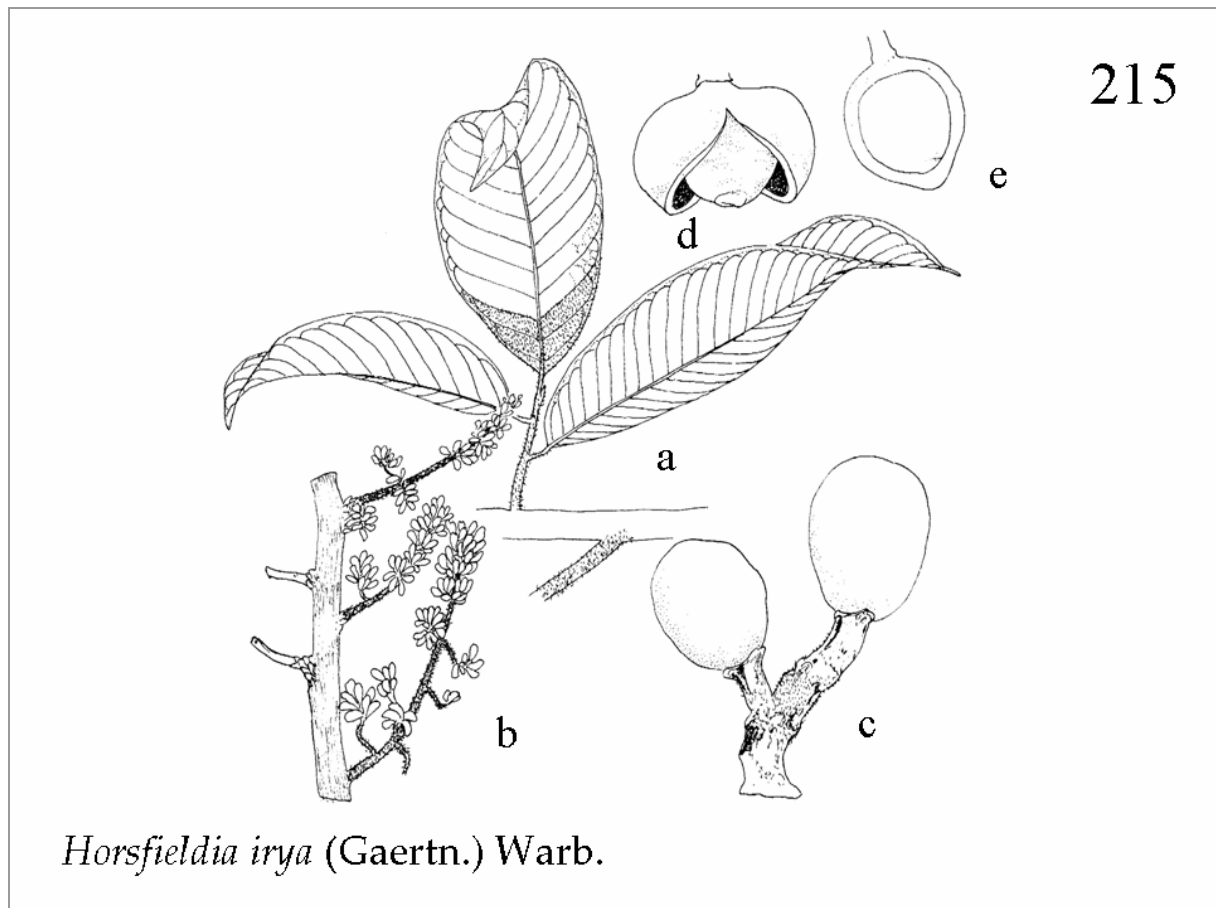


Fig. 215. *Horsfieldia irya* (Gaertn.) Warb. (a) Branchlet with leaves, (b) inflorescence, (c) two fruits, (d) ripe fruit opening, and (e) longitudinal section of fruit.

MYRISTICACEAE

215

***Horsfieldia irya* (Gaertn.) Warb.**

Synonym(s) : *Horsfieldia acuminata* Merr., *Horsfieldia amklaal* Kaneh., *Horsfieldia congestiflora* A.C. Sm., *Horsfieldia labillardieri* Warb., *Horsfieldia lemanniana* (A.DC.) Warb., *Horsfieldia nunu* Kaneh., *Horsfieldia subglobosa* (Miq.) Warb., *Myristica globularia* Blume, *Myristica irya* Gaertn., *Myristica javanica* Blume, *Myristica lemanniana* A. DC., *Myristica micrantha* Wall., *Myristica sphaerocarpa* Wall., *Myristica subglobosa* Miq., *Myristica vrieseana* Miq.

Vernacular name(s) : Pianggu, Penggu (Mal.), Penarahan, Lempoyan Paya, Simaralah, Peredah Burung, Kalapa tiyung (Ind.), Kruai (Thai)

Description : Medium sized to tall tree, up to 10-25(-40) m tall, girth up to 2 m, often with a fluted trunk, steep buttresses, and occasionally with stilt roots. Produces aerial knee-roots, especially in tidal areas. The crown often has drooping limbs. Bark is brown or grey, smooth to slightly fissured, marked by diamond-shaped short fissures. Twigs are slender, dark brown to almost black, with pale lenticels. Leaves are arranged in two rows. Leaves have a 5-7 mm stalk, flattened or grooved above, oblong-lanceolate to narrowly oblong, 4.5-5.5 by 16-21 cm, with a pointed tip. Flower clusters, measuring 10-13 cm, are located between and behind the leaves. Flowers are very small, 1mm across, bright orange-yellow and sweet lemon-scented. Fruit is round, up to 2.5 cm across, smooth, with a 5-10(20) mm stalk; 2-8 fruits per cluster. Fruit is at first ochre yellow, then bright pinkish orange or reddish, pink inside, with a bright red aril (=tissue between the seed and the skin of the fruit).

Ecology : Occurs along rivers and near the coast, especially in swampy places and in the tidal zone and margins of mangroves. Also grows well in well-drained areas. Primary and (old) secondary forest, most frequently in swampy coastal or riparian habitats, on alluvial (sandy, loamy or clayey) soils. Seeds contain an air chamber and float. From sea level up to an altitude of 450 m. Fruits are eaten by monkeys. Mangrove associate species.

Distribution : Occurs from India, Sri Lanka and the Andaman Islands to Southeast Asia and the Solomon Islands. In Southeast Asia recorded from Cambodia, Myanmar, Thailand, Malaysia, Singapore, the Philippines, Indonesia (Borneo, Sumatra, Moluccas, Papua) and Papua New Guinea.

Abundance : Common, but never gregarious.

Use(s) : Wax extracted from fruit, and found suitable for making candles. Timber is attractive dark olive green and hard, but not durable and thus seldom used.

Source of illustration : Based on Whitmore (1972), Corner (1988), Polunin (1988), de Wilde (2000)

Reference(s) : Heyne (1950), Whitmore (1972), Corner (1988), Polunin (1988), Hong & San (1993), Aksornkoae (1993), De Wilde (2000).

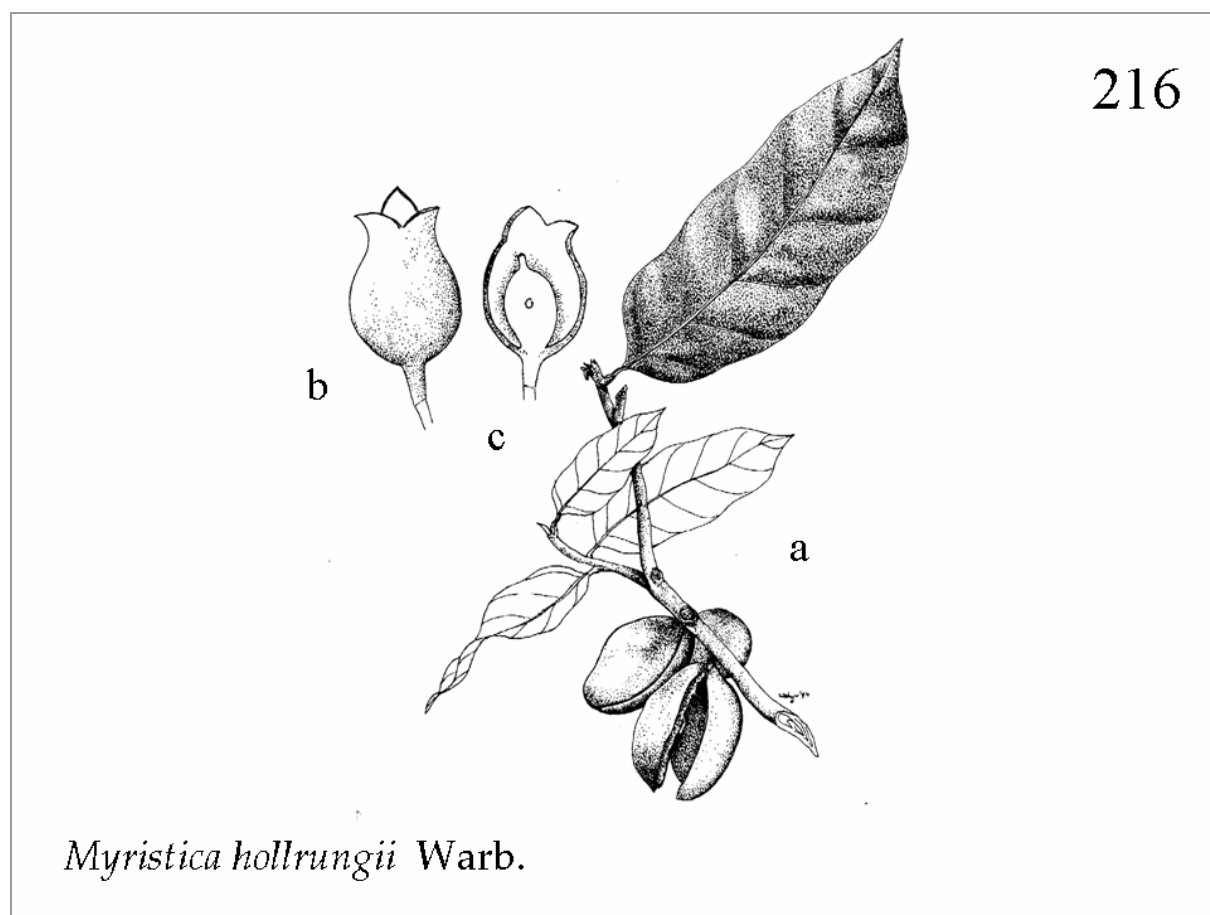


Fig. 216. *Myristica hollrungii* Warb. (a) Branchlet with three fruits, one ripe and open, (b) flower, and (c) longitudinal section of flower.

MYRISTICACEAE

216

***Myristica hollrungii* Warb.**

Synonyms : *Myristica albertisii* Warb., *Myristica euryocarpa* Warb., *Myristica heterophylla* K. Schum.

Vernacular name(s) : Unknown.

Description : A large tree, 6-36(-42) m tall, with a diameter of up to 113 cm. Usually with stilt roots, a copious red sap and a dark grey to reddish-brown, smooth, or finely fissured, flaking bark. The oblong to oblong-lanceolate leaves measure 9-35 by 3-13 cm, are smooth and green above, and smooth, shiny, pale green below. The flower clusters occur in the axils of (fallen) leaves. They are short, thick, scar-covered, woody and 2-5 branched. The female flower clusters are often shorter than the male clusters. Male flowers are 4-10 mm long, leathery, nearly round or egg-shaped, pale yellow and hairy on the outside, white and hairless on the inside; tips flushed pink. Female flowers are similar, but smaller. The yellow to orange fruit is oblong or oblong-egg-shaped, sometimes hairy, and 3-5 cm across. The single dark brown seed has a white (unripe) to red (ripe) aril (=tissue between the seed and the skin) of the fruit.

Ecology : It usually occurs in the (slightly) brackish regions of mangrove swamps, on muddy river banks near the sea, sago swamps, and along frequently inundated beaches, 0-500 m. In alluvial coastal forest with *Barringtonia*. Flowering and fruiting throughout the year. One of the commonest wild nutmegs in the region. Mangrove associate species.

Distribution : Throughout Papua New Guinea, Indonesian Papua and the Bismarck Archipelago.

Abundance : Locally common.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Percival & Womersley (1975), de Wilde (2000).

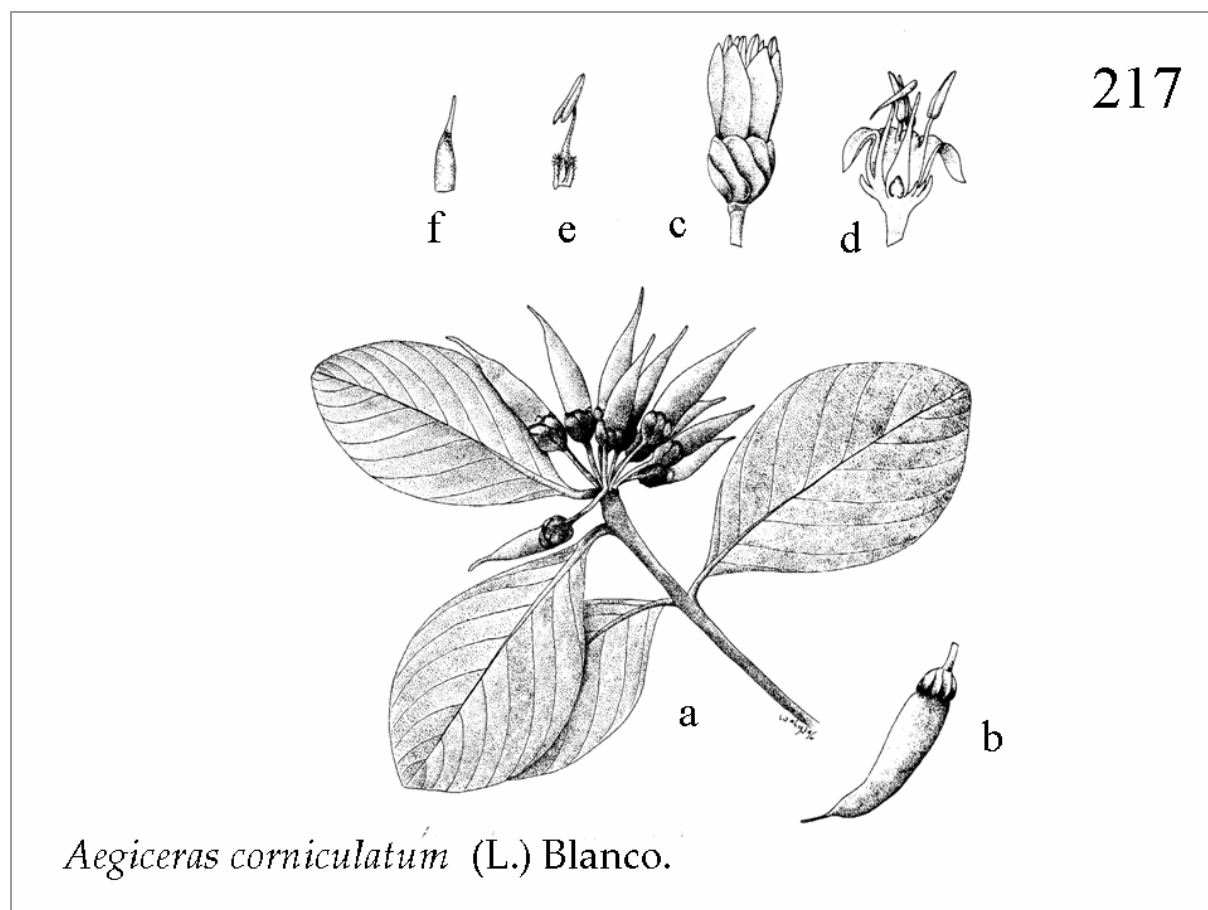


Fig. 217. *Aegiceras corniculatum* (L.) Blanco. (a) Branchlet with cluster of fruits, (b) fruit, (c) flower, (d) longitudinal section of flower, (e) stamen, and (f) stigma.

MYRSINACEAE

217

Aegiceras corniculatum (L.) Blanco

Synonyms : *Aegiceras fragrans* König, *Aegiceras majus* Gaertn., *Aegiceras malaspinaea* A.DC., *Malaspinae lamifolia* Presl., *Rhizophora corniculata* L., *Umbraculum corniculatum* (L.) Kuntze.

Vernacular name(s) : Kachang kachang (Mal.) Teruntun, Gigi Gajah, Perepat Tudung, Perpat Kecil, Tudung Laut, Duduk Agung, Teruntung, Kayu Sila (Ind.), Kaya (Myan.), Batag-batag, Bulali, Dumanai, Kindug-kindug, Pagatput, Pilapil, Pipisik, Saging-saging, Sulasig, Tayokon, Timbabukis, Tindok-tindok, Tinduk-tindukan – *Saging-saging* (Phil.), Sú (Viet.)

Description : Erect, evergreen shrub or small tree, up to 6 m tall, with roots running along the soil surface. Outer bark is grey to brown, to almost black, fissured, and has numerous lenticels. The 7.5-11 cm long, rounded-notched leaves are spirally arranged and leathery. They are bright, glossy green above and a paler green below, often with a slightly red, prominent midrib below. Salt-excretion glands are located on the leaf surface and stalk, which may be whitish and covered with salt. The flower cluster is umbrella-shaped, with a short stalk that is at most 5 mm long. Flowers are located on first-order branches only. They are very sweet-scented, white, rich in nectar, and with protruding anthers; flower stalks are 8-12 mm long. The persistent calyx is white to green. The white corolla tube is covered with short, soft hairs, 5-6 mm long, and its mouth has a dense tuft of fine hairs. Fruit is green to red, strongly curved and pointed like two miniature bananas or horns (hence the scientific name), 5-7.5 cm long, with a single, elongated seed. It is surrounded at the base by the persistent calyx. Fruit is rapidly shed after ripening.

Ecology : Tolerant of a wide range of salinity, soil and light conditions. It most commonly occurs along the landward margins of mangroves that are inundated by normal high tides, and fringes of seasonally brackish waterways. Prefers sandy substrates. Flowering occurs all year round in Indonesia (October-March in Philippines), and flowers are probably pollinated by insects. Seeds develop semi-viviparously, with the embryo projecting through the skin of the fruit when the enlarged fruit is shed. There is usually a dense group of seedlings immediately under the mature plant. Fruits and seeds are well adapted to water dispersal. Mangrove species.

Distribution : From India and Sri Lanka through Southeast Asia – where it is found throughout – to Southern China, Australia, Polynesia and the Solomon Islands.

Abundance : Common, in many localities rather numerous, often growing gregariously.

Use(s) : The saponin-containing bark is used to stupefy fish. Flowers are used as ornamentals because of their fragrance. Wood used for charcoal production. Young leaves are edible. The flowers of this species are an important source of nectar, and may be important for local honey industries (Howes *et al.*, 2004).

Source of illustration : Based on Tomlinson (1986) and Wightman (1989).

Reference(s) : Burkill (1935), Backer and Bakhuizen van den Brink (1963), Percival & Womersley (1975), Tomlinson (1986), Corner (1988), Wightman (1989), Said (1990), Aragones *et al.* (1998), Missouri Botanical Garden TROPICOS database (www.mobot.org).

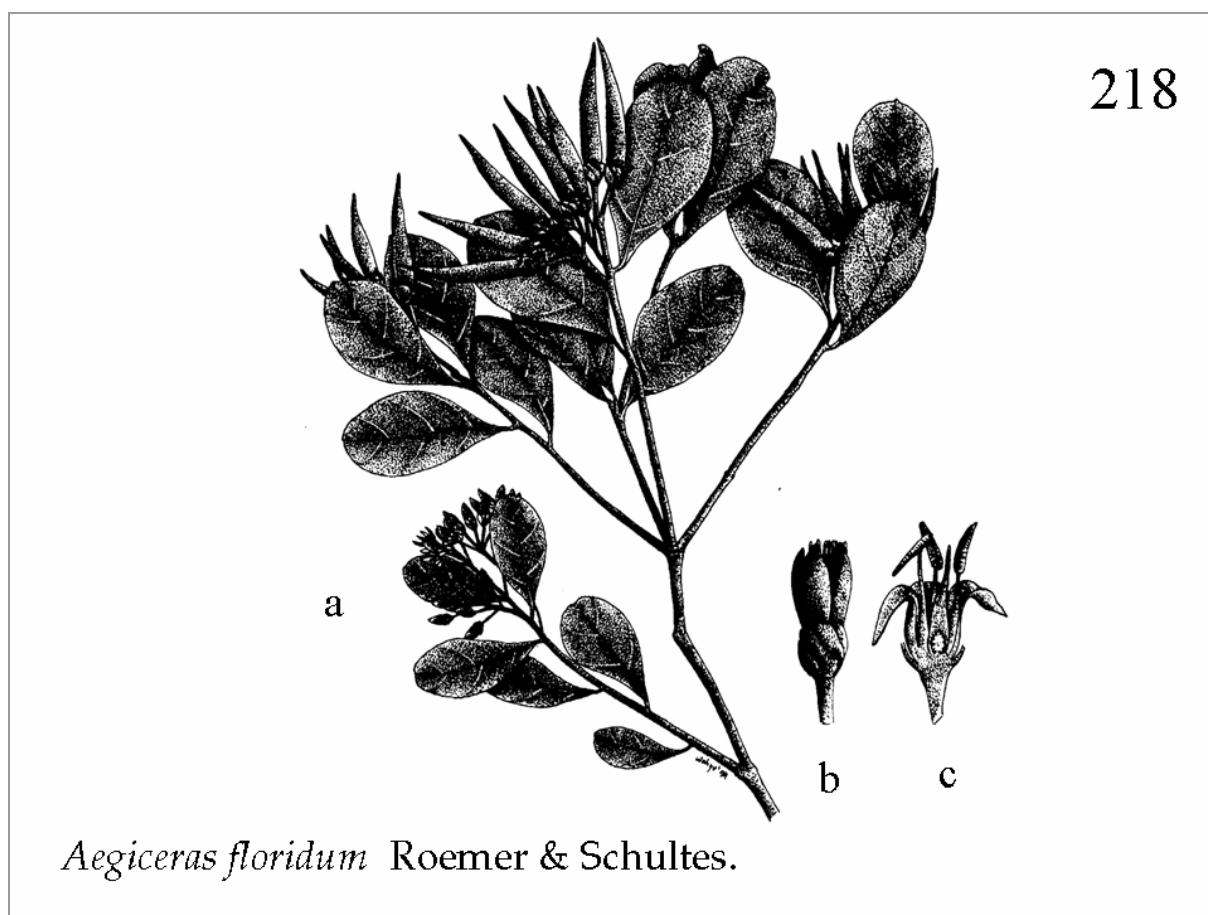


Fig. 218. *Aegiceras floridum* Roemer & Schultes. (a) Branchlet with fruits, (b) flower (half closed) and (c) longitudinal section of flower.

MYRSINACEAE

218

Aegiceras floridum Roemer & Schultes

Synonyms : *Aegiceras ferreum* Blume, *Aegiceras nigricans* A. Rich.

Vernacular name(s) : Teruntun (Ind.), Batag-batag, Bulali, Dumanai, Kindug-kindug, Pagatput, Pilapil, Pipisik, Saging-saging, Sulasig, Tayokon, Timbabukis, Tindok-tindok, Tinduk-tindukan – *Saging-saging* (Phil.)

Description : Erect, evergreen shrub or small tree, up to 4 m, with roots running along the soil surface. Outer bark grey to brown, fissured and with numerous lenticels. The broadly rounded or abruptly terminated leaves are spirally arranged, leathery, a bright, glossy green above and a paler green below with an often slightly red, prominent midrib below, 3-6 cm long. Salt excretion glands are located on the leaf surface and stalk and excreted salt give the leaf a pale appearance. The larger flower clusters are elongated, while the smaller ones are nearly umbrella-shaped and located at the top of second-order branches. Stalks of the flower clusters are up to 2 cm long, while those of the individual flowers are 4-6 mm. Flowers have a sour odour and are white; the persistent calyx is white to green; corolla tubes are about 4 mm long and have a thin tuft of hairs at its mouth. Fruit is green to red, only slightly curved, and 3 cm long. It is rapidly shed and contains one elongated seed. Similar to *Aegiceras corniculatum*, but differs with its smaller leaves (3-5 cm long, versus 7.5-11 cm) and its branched (compound) flower clusters and only slightly curved fruit.

Ecology : In mangroves, and has been recorded on rocky or gravelly substrates. Little is known about this species. Flowering occurs all year round. Mangrove species.

Distribution : Southeast Asian species, recorded in Malaysia (Sabah), Indonesia (Java, the Moluccas, Sulawesi, Borneo, Papua), Cambodia, Vietnam, the Philippines and Papua New Guinea

Abundance : Uncommon, with a scattered distribution.

Use(s) : Wood as construction materials and fuel wood.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Aragonés *et al.* (1998), www.unepscs.org/ProjectComponents/Mangroves.htm; ARCBC BISS species database (<http://arcbc.org>).

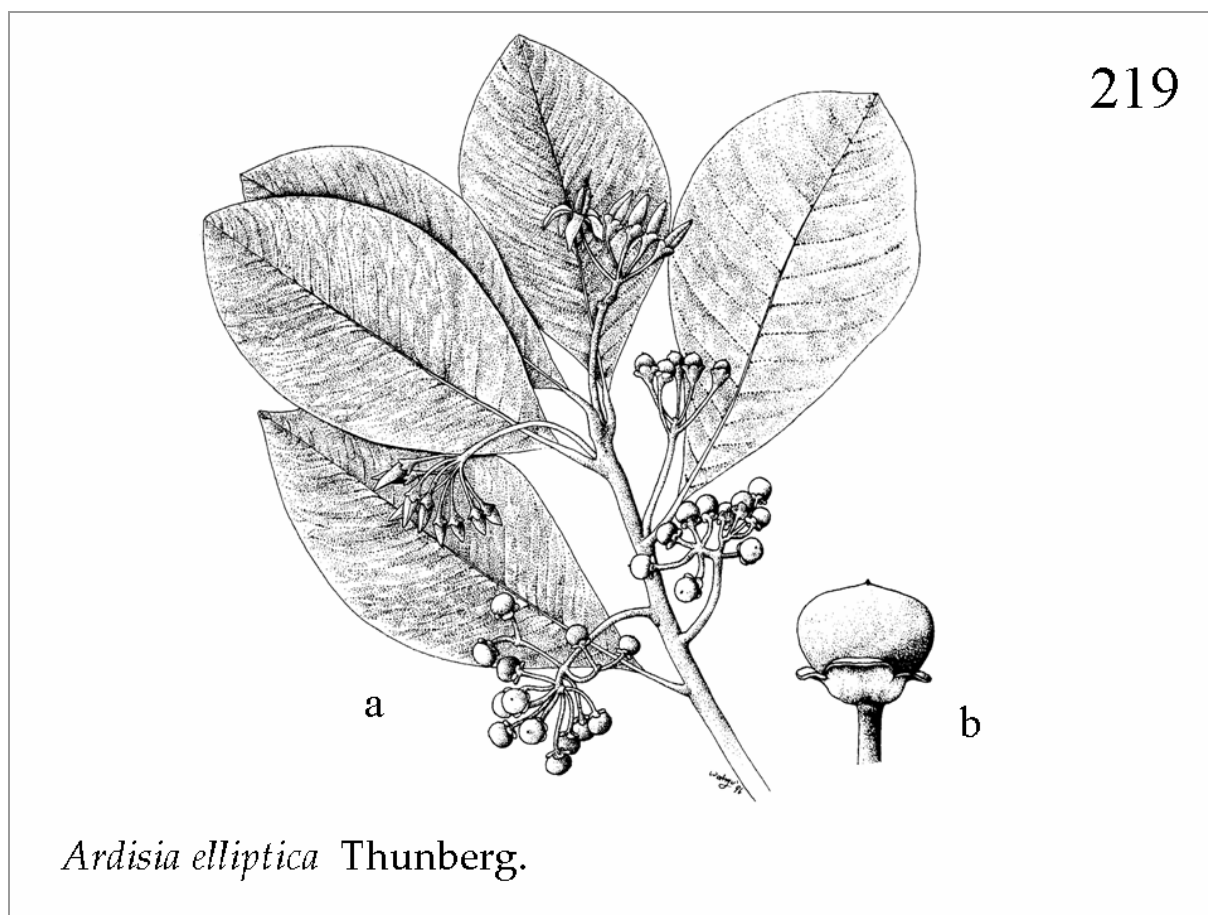


Fig. 219. *Ardisia elliptica* Thunberg. (a) Branchlet with flowers and fruit, and (b) fruit.

MYRSINACEAE

219

Ardisia elliptica Thunberg

Synonyms : *Ardisia humilis* Vahl., *Ardisia kotoensis* Hayata, *Ardisia littoralis* Andr., *Ardisia squamulosa* C. Presl., *Bladhia kotoensis* (Hayata) Nakai, *Climacandra obovata* Miq., *Climacandra salicifolia* Miq., *Tinus squamulosa* (C.Presl.) Kuntze

Vernacular name(s) : Sea-shore Ardisia (E), Jambulan pantai, Mata pelanduk, Mata itek, Mata ayam, Penah, Periah (Mal.), Rampansi, Lampeni, Lempeni, Fanasa, Buah letus, Kayu lampiko (Ind.), Co'm nguôi (Viet.), Raamyai (Thai)

Description : A shrub, up to 5 m tall, with twigs that are swollen at the base and are easily detached. The elliptic to obovate, somewhat fleshy leaves are 2.5-5 cm by 8-12 cm and are spirally arranged. At the base they are narrowed and gradually taper to a short, 1 cm long stalk. Flowers measure about 1 cm across, and have five petals and five calyx lobes. They are located in umbell-shaped or condensed clusters located in the axils, with flowers arranged in groups of 8. The calyx has rounded, overlapping lobes, and the pointed petals are white or pink. There are five stamens, and the anthers are many-chambered. Flowers are not fragrant. The ovary is round and has a simple style. The round, few-seeded berry measures about 5-12 mm across, first reddish-purple, turning black when ripe. Most commonly recorded as *Ardisia littoralis* in mangrove literature.

Ecology : Shrubs of tidal, semi-mangrove and estuarine habitats. Common on all sandy and muddy coasts in Peninsular Malaysia. Occurring in plant communities only occasionally inundated by the highest tides. Mangrove associate species.

Distribution : From Sri Lanka, southern India to Southeast and East Asia (Southeast China). In Southeast Asia recorded in Myanmar (as *Ardisia littoralis*), Thailand, the Philippines, Singapore, Malaysia (Peninsular), Brunei and Indonesia (Java, Kalimantan, Sulawesi). Possibly also in Cambodia and Vietnam, but not recorded to date.

Abundance : Locally common.

Use(s) : Used medicinally to treat scabies (leaves) and intestinal worms (fruit).

Source of illustration : Corner (1988), Stone (1989).

Reference(s) : Burkill (1935), Heyne (1950), Tomlinson (1986), Corner (1988), Stone (1989), Said (1990), Aksornkoae (1993), Maung (2003),
<http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

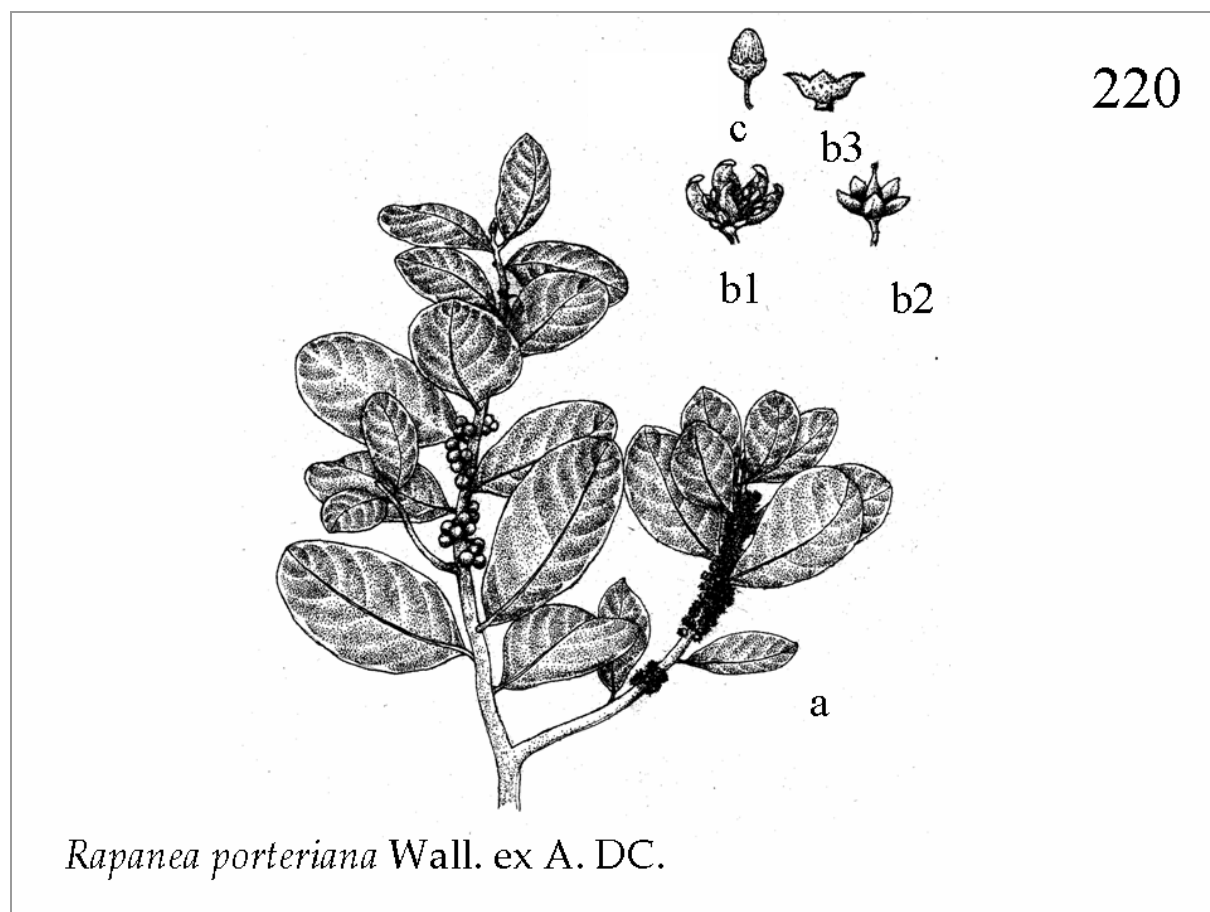


Fig. 220. *Rapanea porteriana* Wall. ex A. DC. (a) Flowering and fruiting branches, (b) flowers, and (c) fruit.

MYRSINACEAE

220

Rapanea porteriana Wall. ex A. DC.

Synonyms : *Myrsine avensis* (Blume) Mez., *Myrsine porteriana* Wall. ex A. DC., *Myrsine umbellulata* A. DC.

Vernacular name(s) : Dedahruang (Mal.)

Description : Shrub or small tree, 7-10 m tall. Leaves spirally arranged, simple, leaf blades stiff, with a leathery texture, narrowly elliptic to ovate-elliptic, 12-25(-30) by 36-80 mm, tapering to the 5-6 mm long leaf stalk, dark green, pointing upward and with the sides slightly recurved, veins more or less invisible; leaf tip rounded. Flowers are located in axils of present or fallen leaves, tiny, 3(-5) mm wide, hairy at the mouth, 5-merous, sepals free or shortly fused; petals white, ephemeral, shortly fused at the base. Fruit a 1-seeded berry, clustered on the older wood, well below the leaf-bearing portion of the shoot, 5-6 mm wide, pale green, turning pinkish purple.

Ecology : Found in diverse habitats, including coastal mud (mangroves), coastal heath, rocky headlands, open swamps, limestone hills and crests of hills and mountains up to 1700 m asl. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Thailand, Malaysia (Peninsular and Sarawak), Brunei and Indonesia (Sumatra, Borneo).

Abundance : Locally common, but with a limited distribution.

Use(s) : Unknown.

Source of illustration : Archive, Royal Botanic Garden, Kew.

Reference(s) : Tomlinson (1996), Corner (1988), Stone (1989)
<http://www.forest.go.th/Botany/Flora/species%20list/volume6/Myrsinaceae.htm>
<http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

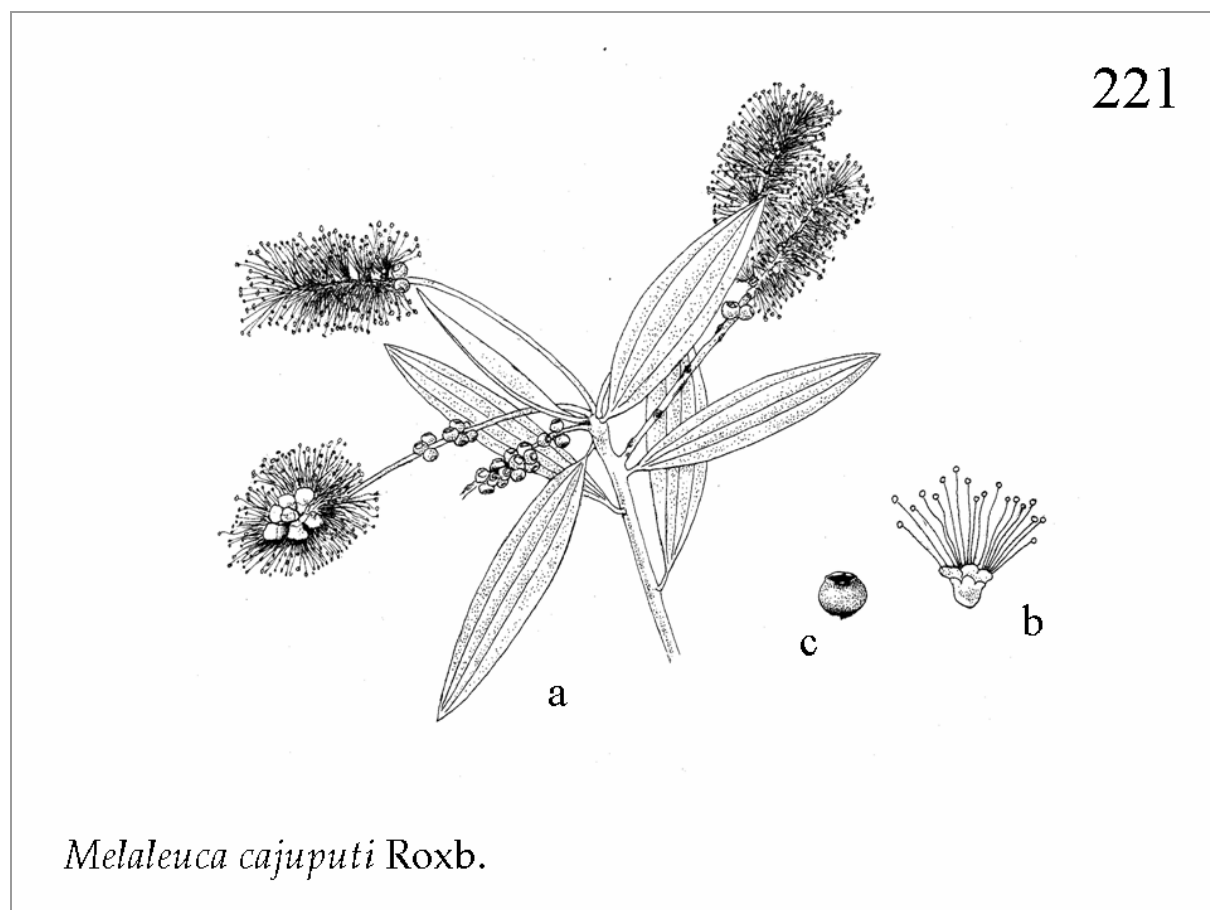


Fig. 221. *Melaleuca cajuputi* Roxb. (a) Branchlet with flower and fruit clusters, (b) flower, and (c) fruit.

MYRTACEAE

221

***Melaleuca cajuputi* Roxb.**

Synonyms : *Melaleuca cajuputi* subsp. *cajuputi* Roxb., *Melaleuca cajuputi* subsp. *cumingiana* (Turcz.) Barlow, *Melaleuca leucadendra* L., *Melaleuca leucadendron* (sensu lato)

Vernacular name(s) : Paperbark tree, White-wood, Melaleuca (E), Gelam, Kayu Puteh (Mal.), Gelam, Kayu puti, Inggolom, Baru galang, Waru galang Iren, Bus, Irono Ngelak, Sakelan, Ai kelane, Ai elane (Ind.), Kayu gelang (ET), Samed (Thai), Tràm (Viet.)

Description : Large shrub to tall evergreen tree, up to 24 m tall but usually 5-15 m, with a narrow, dense, greyish-green bushy crown and a stout, often twisted trunk. Bark whitish to light grey or greyish-brown, often tinged with orange-brown, fissured and papery flaky in coarse elongate shaggy pieces. Young twigs covered with silky hairs. Leaves spirally arranged, leaf stalk 6-12.5 mm long, leaf blade 5-12.5 by 1.25-3.75 cm, greyish-green, lanceolate, often slightly curved, base tapered, with 5-7 longitudinal nerves, young leaves silky hairy. Flowers white, without a stalk, arranged in groups of three along a terminal spike, 7.5-15 cm long, fluffy because of the many stamens, fragrant; petals 5, stamens numerous. Fruit a small, 3 mm wide woody capsule, without a stalk, cushion-shaped, greyish-brown, with a narrow groove round the top surrounding a small crater-like cup marked with 5 radial grooves, long persistent on the twigs. Seeds: many and tiny. The terminal 'spike' is really the leafless part of an axillary shoot, and after flowering the end bud continues growth to produce a flush of leaves before dropping. Leaves have a high content of highly aromatic cajuput oil (*minyak angin* in Malaysia and Indonesia).

Ecology : On swampy ground near the coast, but also planted on roadsides. Occurs on heavy, deeply flooded acid sulphate soils (e.g. in Mekong Delta in Vietnam; Ogan-Komering floodplain in South Sumatra, and Negara River floodplain in South Borneo), coppices readily, and can withstand repeated fires. As a result, dense stands dominated by this species may be formed. Insect pollinated. Also occurs on landward margins of mangroves. Mangrove associate species.

Distribution : From Myanmar (Tenasserim) eastwards to Thailand, Cambodia, Vietnam, Malaysia, Singapore, Indonesia (Sumatra, Borneo, Java, Lesser Sundas, Moluccas), East Timor, PNG and northern Australia. Absent from the Philippines and Brunei.

Abundance : Locally common to very common.

Use(s) : Wood is considered excellent fuel wood. Poles used for construction, as they last well in moist conditions and are not readily attacked by termites. Papery bark is used for caulking boats. Leaves yield cajuput oil, which is commercially exploited. Timber is moderately hard to hard, heavy (sinker), and the sapwood is light pink-brown. Reportedly good for honey production.

Source of illustration : Drawn from live specimen.

Reference(s) : Blake (1968), Heyne (1950), Kochummen (1978c), Corner (1988), Doran & Gunn (1994), <http://www.uc.pt/timor/florafauna.html>.

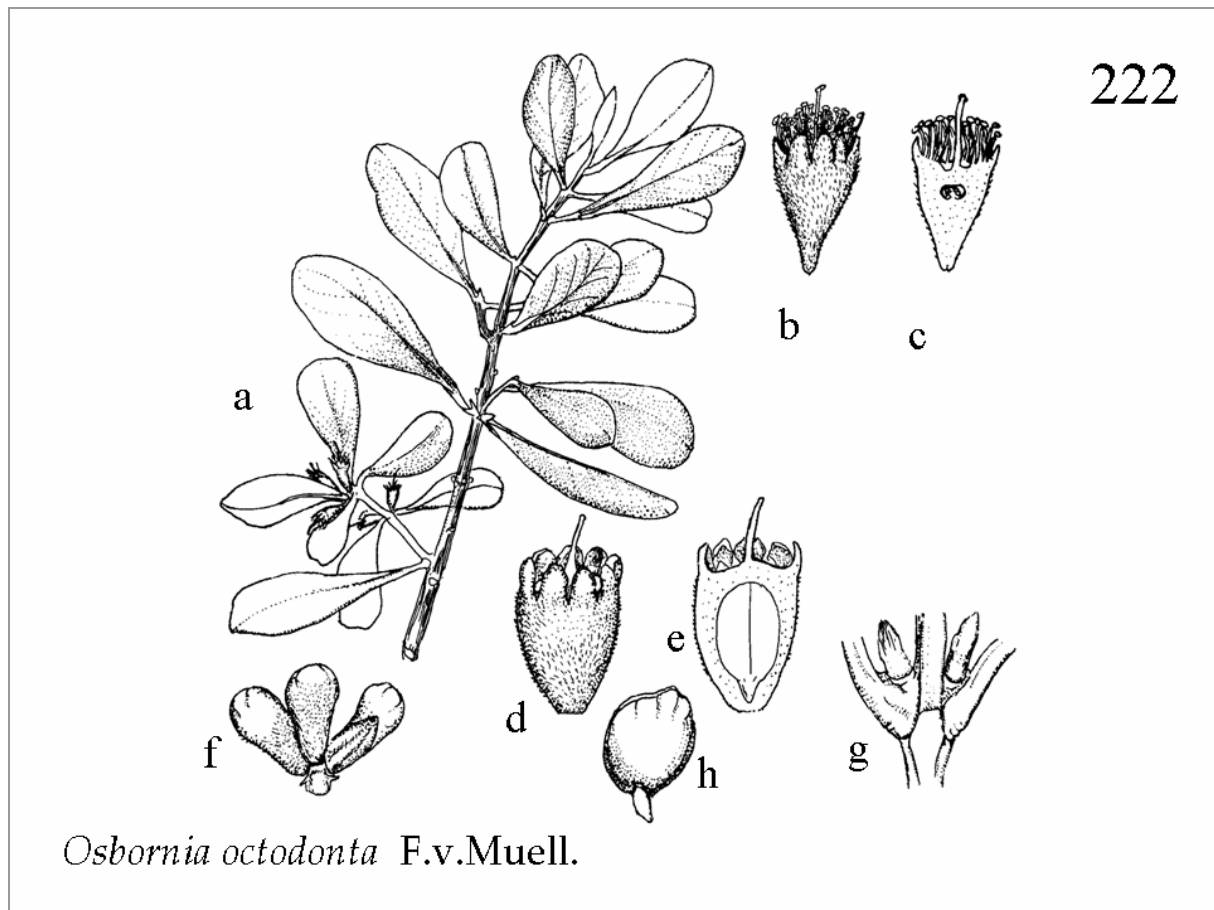


Fig. 222. *Osbornia octodonta* F.v.Muell. (a) Branchlet with flowers, (b) flower, (c) longitudinal section of flower, (d) fruit, (e) longitudinal section of fruit, (f) cluster of 3 buds, (g) node with axillary flower buds, and (h) embryo.

MYRTACEAE

222

Osbornia octodonta F.v.Muell.**Synonyms :** Unknown.**Vernacular name(s) :** Myrtle mangrove (E), Monot-bonot, taualis, dulok-dulok (Ind.), Dik-duk, Dulok-dulok, Gumilum, Gullum, Kulasi, Manotbonot, Maligang, Sagasa, Tiuyayos, Toauis, Tuauis – *Taualis* (Phil.)**Description :** Single or multi-stemmed evergreen tree or, more usually, a shrub, up to 7 m tall; roots may run along the surface. Does not have a regular form; occasionally it has pneumatophores, but usually these are absent. *Osbornia octodonta* has a fibrous, stringy, grey or brown bark and smooth, pale-grey twigs, quadrangular when young; larger specimens have a fluted stem. The opposite, thin-leathery leaves are aromatic when crushed, and have an obovate blade measuring 2.5-5 by 1-3 cm. These are marked by small, translucent oil glands and a swollen, 2 mm long leaf stalk, both occasionally tinged red. Flowers are located in groups of 1-3 in the axils, and have two elliptic leaflets, 6 mm long, at the base of the flower stalk; these leaflets are later shed. The stalk of the flower cluster is 5 mm long. Individual flowers are stemless, bisexual, about 5 mm long, with two soft, hairy, 3 mm long leaflets at their base. The silky, bell-shaped calyx is 3-6 mm long with a spirally-rolled tube. The eight obovate calyx lobes (hence the name *octodonta*) are 1-3 mm long, and white. There are no petals. The numerous yellow stamens are longer than the calyx lobes. The fruit, 5-10 mm across, is enclosed by the calyx tube and does not open when ripe. The 1-2 seeds are obovate and flat, measuring 7 by 5 mm. This tree belongs to the same family as the eucalypts (Myrtaceae), and its crushed leaves have the same distinctive smell; this is a good way to positively identify the species as it is the only true mangrove species having this characteristic.**Ecology :** Occurs on exposed sites on landward margin of mangroves or fringing tidal waterways. It appears to be non-specific to substrate and is found on soft mud, rock, sand and calcareous dunes. However, it is absent from areas frequently flooded by fresh water. Often associated with *Avicennia* and *Sonneratia* species, usually on sandy or gravelly shores. Flowering (in Australia) from June to December with a peak in November. Fruit occurs in February. The small flowers with protruding stamens are insect-pollinated. The fruit is adapted to water dispersal because of its silky hairs, which trap air and give it its buoyancy. Mangrove species.**Distribution :** Has a disjunctive distribution, being found in the Philippines, Malaysia (Sabah), Indonesia (Borneo, Java, Sulawesi), Papua, Papua New Guinea and tropical Australia.**Abundance :** Uncommon.**Use(s) :** Fisherman use the crushed leaves as insect repellent. The bark is sometimes used for caulking wooden boats. The timber is durable and extremely heavy, very hard and strong. Difficult to work because of its hardness, but finishes well. Durable, even in contact with soil, and used as railroad sleepers, posts and housing construction. Bark used for caulking boats. Used to treat toothache, and as a cooking herb.**Source of illustration :** Based on Tomlinson (1986) and Wightman (1989).**Reference(s) :** van Steenis (1936), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), <http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-3435.html>.

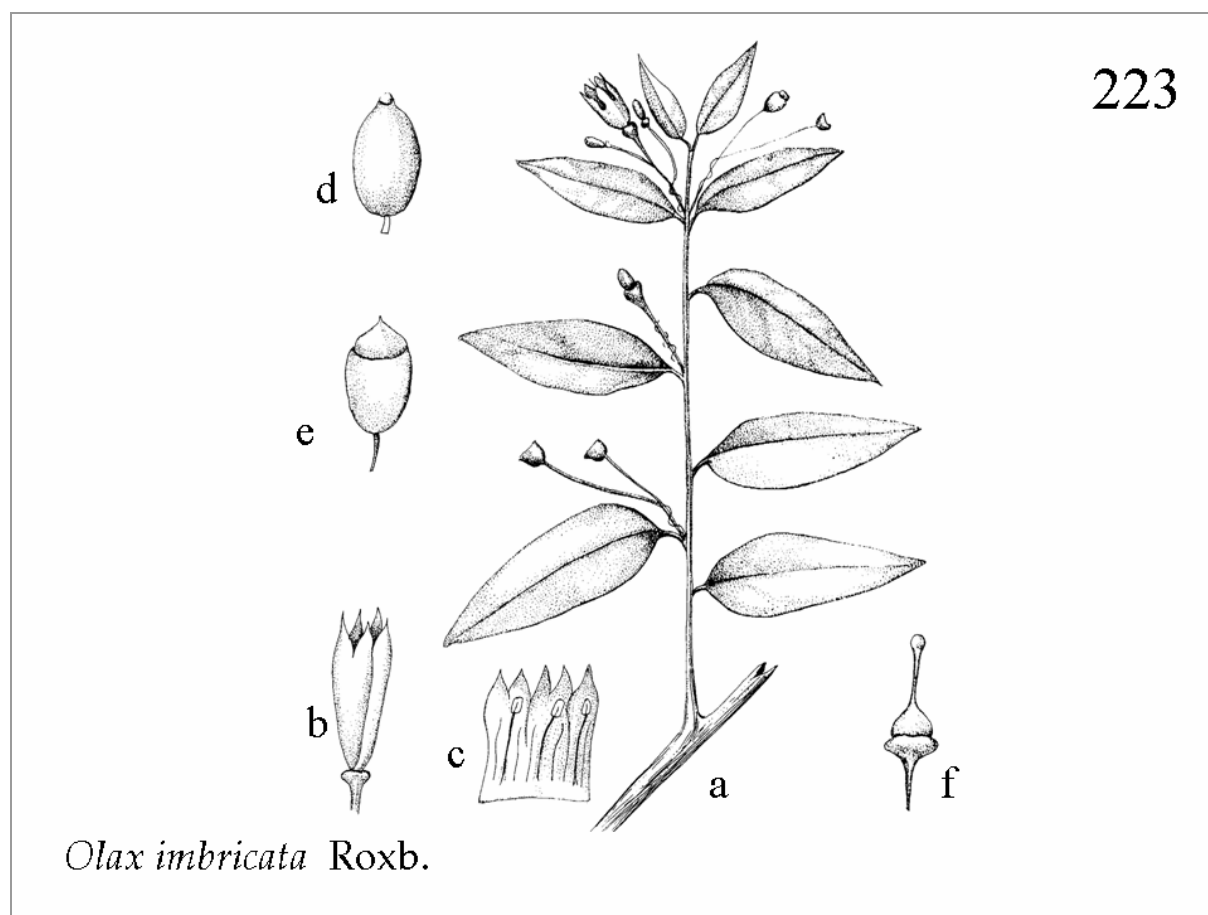


Fig. 223. *Olax imbricata* Roxb. (a) Branchlet with flowers, buds and fruit, (b) flower, (c) corolla (opened, to reveal stamens), (d, e) fruit, and (f) stigma.

OLACACEAE

223

***Olax imbricata* Roxb.**

Synonyms : *Olax laxiflora* Ridl., *Olax multiflora* A. Rich., *Olax multiflora* Ridl., *Olax rosea* Ridl., *Olax semiinfera* Valet., *Olax wightiana* Wall. ex Wight & Arn., *Pseudaleia imbricata* (Roxb.) Hassk., *Pseudaleia longistylis* Hassk., *Ximenia olacoides* Wight & Arn.

Vernacular name(s) : Lenteng, Kaya Kil (Ind.), Balagon, Labnot, Biton, Malabagio, Malabutong, Ubet-ubet (Phil.), Kodak acing, Meribut (Mal.), Lumnok (Thai), Du'ong dâu kêt ho'p (Viet)

Description : Shrub, often climbing, up to 10 m, with finely grooved, initially somewhat hairy, but later practically smooth branchlets. Thorns and spines are absent. The latter are dark reddish-brown when dry and have lenticels. The leathery, smooth leaves are ovate- to elliptic-oblong, shiny above, and measure 4-18 by 2-7.5 cm. Leaves have (4-)6-9 pairs of nerves that are a little raised on the underside of the leaf. The wrinkled leaf stalk is 5-10 mm long. The many-flowered clusters measure 0.5-3.5 cm, are branched from the base and are densely covered with short hairs. The calyx is very small. The 3 linear-oblong petals are white or pinkish and 10-12 mm long. The round berry measures 1.7-2.5 cm in diameter, and is almost completely covered by the thin, orange calyx, which grows in size with the berry.

Ecology : In primary and secondary forests, in dry brushwood, on coral limestone, but also in mangroves and peat swamps. Occurs at low elevations, and rarely up to 900 m. Mangrove associate species.

Distribution : From India, Sri Lanka and the Andaman Islands eastwards through Southeast Asia to Micronesia and the Solomon Islands, and northeast to South China and Taiwan. In Southeast Asia recorded from Myanmar, Thailand, Malaysia, the Philippines, Indonesia (Sumatra, Java, Madura, Borneo, Sulawesi, the Lesser Sunda Islands, the Moluccas and Papua), East Timor and Papua New Guinea.

Abundance : Locally common, but on the whole rare or uncommon.

Use(s) : Edible fruit.

Source of illustration : Icones Rijksherbarium Leiden.

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Sleumer (1984), Verhey & Coronel (1991).

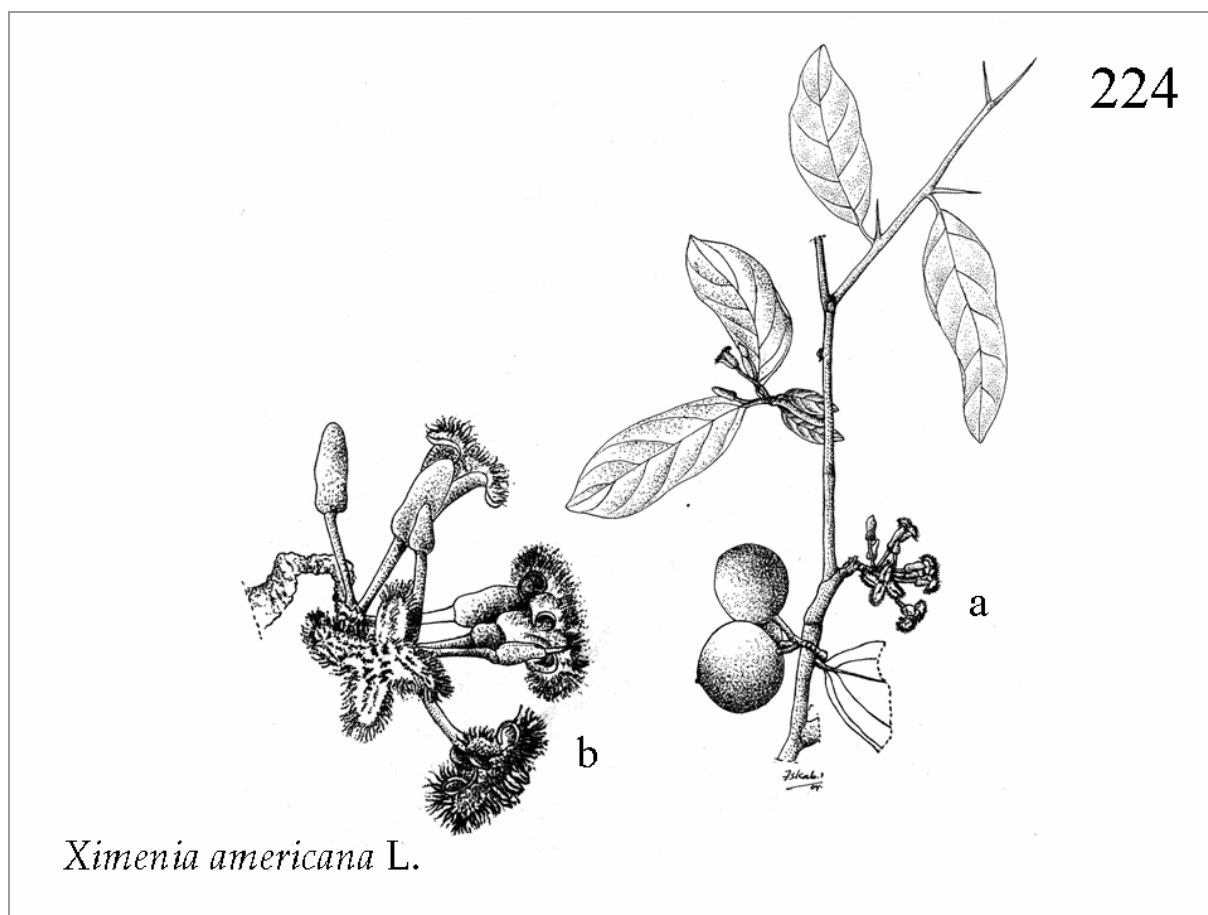


Fig. 224. *Ximения americana* L. (a) Flowering and fruiting branch, and (b) detail of flower cluster.

OLACACEAE

224

Ximenia americana L.

Synonyms : *Amyris arborescens* P. Browne, *Heymassoli inermis* Aubl., *Heymassoli spinosa* Aubl., *Pimecaria odorata* Raf., *Vidara littorea* Rump., *Ximenia aculeata* Crantz, *Ximenia americana* fo. *inermis* (Aubl.) Engl., *Ximenia americana* var. *ovata* DC., *Ximenia arborescens* Tussac ex Walp., *Ximenia fluminensis* M.Roem., *Ximenia inermis* L., *Ximenia loranthifolia* Span., *Ximenia montana* Macfad., *Ximenia multiflora* Jacq. *Ximenia oblonga* Lam. ex Hemsl., *Ximenia spinosa* Salisb., *Ximenia verrucosa* M. Roem., *Zizyphus littorea* Teysm.

Vernacular name(s) : Tallow wood (E), Prunier de mer (F), Bedara laut, bidari, pidaroh (Mal.), Bidaro, Wama-wama, Bidara – *Bidara laut* (Ind.), Bo-o, Bual (Phil.), Pin-lay-see (Myan.), Phutsa-tha-le (Thai.)

Description : Thorny shrubs or small trees, 2-4(-10) m tall, low branching, smooth, sometimes sprawling, with thorns in the leaf axils. Bark greyish brown. Branchlets usually spiny, covered with red cork and rounded lenticels. Leaves simple, spirally arranged, 2.5-5(-10) cm by 1.2-2.5(-6) cm, usually elliptic but variable in shape, with a short, 3-5(-7) mm stalk; leaf nerves 3-5(-7) pairs. Flowers small, greenish-white in shortly stalked (up to 1.5 cm) clusters or panicles, located in the axils, with 3-9 flowers. Calyx is cup-like with 4-5 teeth, 0.5-1.5 mm; petals 4(-5), recurved, (5-)8-10(-12) mm by 1.5-2 mm, thickly hairy on the inside; stamens 8(10). Fruit a plum-like drupe, rounded, pulpy and with a hard stone, yellow to orange (occasionally bright red or scarlet), with green flesh, 15-25(-35) mm by 12-20(-30) mm.

Ecology : In thickets immediately behind the beach, along the sea-shore (*Barringtonia asiatica* formation). Also in dry savannah or forest, sometimes in light rain forest, scattered, on stony or sandy ground, and at landward edges of mangroves on sandy soil. Occasionally a root parasite, also on its own species (auto-parasitic). Seeds are distributed by birds and by sea currents. Numerous local forms exist. Mangrove associate species.

Distribution : Pan-tropical and subtropical. Found throughout Southeast Asia.

Abundance : Locally common, but with a scattered distribution.

Use(s) : Wood is hard and close grained, and used as a substitute for white Sandalwood because of its yellowish-brown colour, and pleasant smell when freshly cut. The sour pulp of the fruit is eaten. Sometimes the skin is removed and steeped in brine, to be eaten with rice. The kernels contain 67% oil and are purgative, a fact already stated by Rumphius. Kernels taste of hazelnut, but because of purgative property only 2-3 can be consumed. If boiled and steeped in water for 1-2 days, it loses this characteristic. Root used to treat colic. Leaves used as vegetable.

Source of illustration : Based on photograph by Tim Motley (Missouri Botanical Garden TROPICOS database (www.mobot.org)).

Reference(s) : Heyne (1950), Sleumer (1984), Afriastini (1988), Corner (1988), Verhey & Coronel (1991), Missouri Botanical Garden TROPICOS database (www.mobot.org).

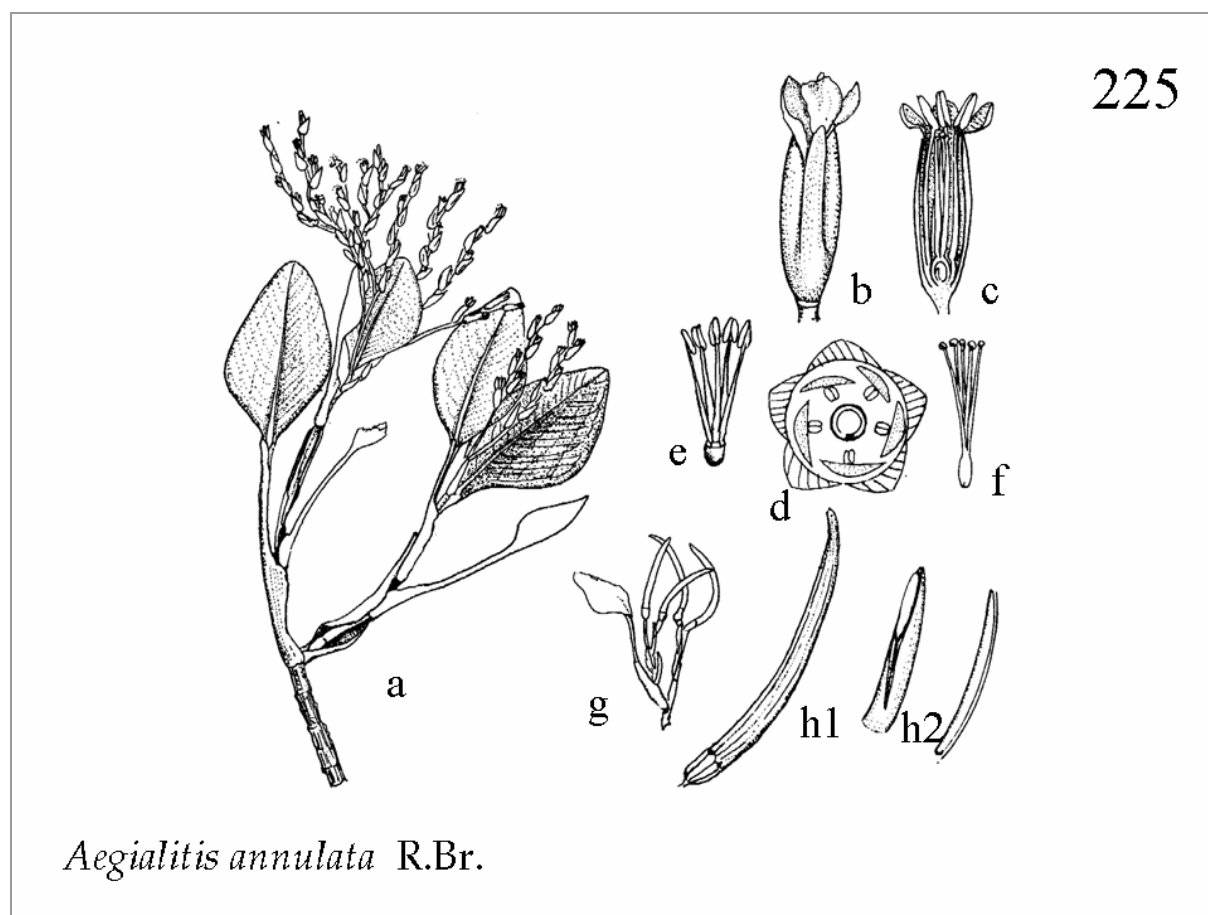


Fig. 225. *Aegialitis annulata* R.Br. (a) Branchlet with flowers, (b) flower, (c) longitudinal section of flower, (d) flower diagramme, (e) stamens, (f) stigma, (g) cluster of fruit, and (h-j) fruit.

PLUMBAGINACEAE

225

Aegialitis annulata R.Br.

Synonyms : *Aegialites annulata* (sic), *Aegianilites* Presl.

Vernacular name(s) : Club mangrove (E)

Description : Slender shrub, up to 1.5-3 m tall, occasionally to 7 m, usually with spreading roots which run along the soil surface, and twigs with conspicuous, ring-shaped leaf scars. Occasionally with stilt roots. The outer bark is black, smooth, fissured or flaking with age. The stem is up to 20 cm diameter, swollen at the base and with a very spongy texture. Leaves are spirally arranged, clustering terminally on the shoots, winged and sheathing the stem. Leaf blades, 6-9 by 2-5 cm, are marked by longitudinal depressions and salt glands. Leaf stalks are 8 cm long. The asymmetrical flower clusters have many white (occasionally pale blue) flowers, and are located at the ends of branches. The tubular, fluted calyx is 7-8 mm long, persistent and has five lobes. The five overlapping, 5-8 mm long petals form a tube with 9-10 lobes. The fruit is a curved capsule, 5-angled and about 3-5 by 4-5 cm, dull reddish when mature. *Aegialitis annulata* and *Aegialitis rotundifolia* have a discontinuous distribution. *Aegialitis rotundifolia* occurs in India, Bangladesh, Myanmar, Thailand and the Andaman Islands, in low mangroves on muddy substrate, while *Aegialitis annulata* is found to the east (see below).

Ecology : Occurs in open mangrove as isolated specimens or in small groups. Also occurs on more sandy and rocky places inundated by waters with a salinity that is at least that of seawater (at the end of dry season). Pollination is reportedly mediated by ants. In Australia, flowering occurs from September-November, and mature fruit appears in January-March. They have rather unimportant differences in characteristics of the flower. Mangrove species.

Distribution : Found in eastern Indonesia and East Timor to northern Australia and Papua New Guinea. In Indonesia it has been recorded from the Lesser Sunda Islands, the Moluccas and Papua.

Abundance : Locally common, but listed as rare in Indonesia (Mogea *et al.*, 2001; recorded as *Aegialitis 'angulata'*).

Use(s) : Has a very high tannin content, but use has not been recorded (Burkill, 1935).

Source of illustration : Based on Tomlinson (1986) and Wightman (1989).

Reference(s) : Burkill (1935), van Steenis (1949), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Prakash & Lim (1995).

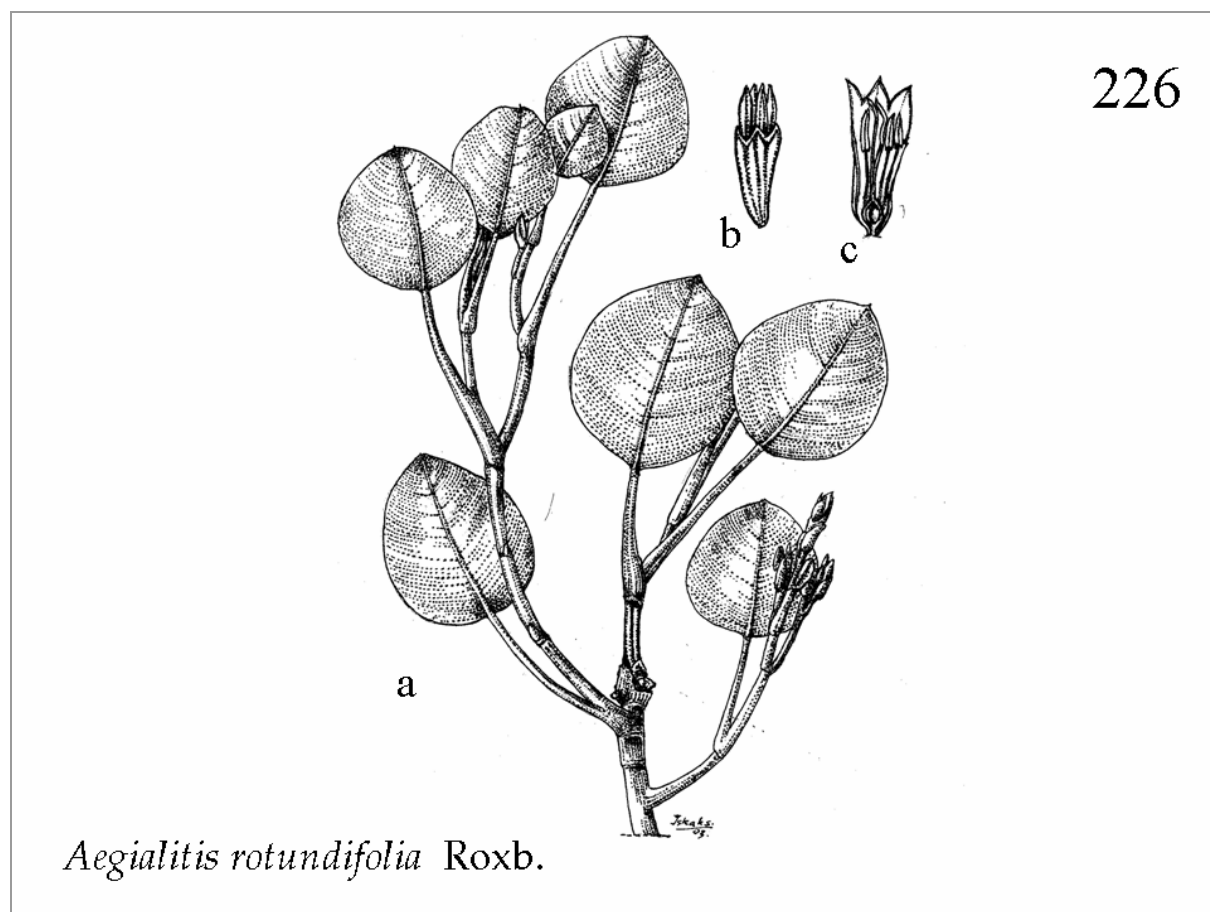


Fig. 226. *Aegialitis rotundifolia* Roxb. (a) Flowering terminal branch, (b) flower, and (c) opened flower, revealing the stamens.

PLUMBAGINACEAE

226

Aegialitis rotundifolia Roxb.

Synonyms : *Aegialites annulata* var. *rotundifolia*, *Aegianilites rotundifolia*

Vernacular name(s) : Samae (Thai)

Description : Shrub or under-shrub, up to 3 m tall, branches more or less spongy and bearing annular leaf scars, stem base usually swollen. Leaves are spirally arranged, orbicular and entire, clasping the stem, shiny above, with parallel nerves and prominent net-like markings, 4-8 by 4-8.5 cm, base rounded to truncate, apex rounded to shortly pointed, leaf stalk (4)5-7.5 cm, winged, clasping the stem. Bract 10-11 mm, bracteoles 8-9 mm. Flowers with pedicels of up to 13 mm length. Sepals 13 mm long, tubular, lobes narrowly triangular and pointed. Petals white, 12-lobed, 5-7 mm longer than the sepals. Anthers 3 mm, stamens 13-18 mm, styles 9-10 mm. Fruit a capsule, 8-10 by 0.5 cm, 5-angular, pale brown, more or less shining, with a short pointed tip. Leaf stalks and leaflets exude a viscose fluid. *Aegialitis annulata* and *Aegialitis rotundifolia* have a discontinuous distribution. *Aegialitis annulata* occurs in Lesser Sunda Islands, the Moluccas, New Guinea and northern Australia, in low mangroves on sandy and rocky substrate, while *Aegialitis rotundifolia* is found further west. They have rather unimportant differences in characteristics of the flower.

Ecology : Occurs in 'low muddy mangrove' (van Steenis, 1949) or 'maritime swamps and littoral forests, usually in open situations' (Khan & Khan, 1989) including rocky beaches and exposed shorelines, on the outermost mangrove belt, on sandy soil but also in muddy locations. Locally occurring in pure groves. Less common in landward mangrove zones. Characteristic mangrove associate, but like *Aegialitis annulata* does not occur within closed mangrove communities, preferring exposed muddy sites (Tomlinson, 1986). Mangrove species.

Distribution : Occurs in India (West Bengal and Andaman Islands), Bangladesh, Myanmar, Cambodia and Thailand. Not yet recorded, but possibly occurs in Peninsular Malaysia, Vietnam and perhaps northern Sumatra.

Abundance : Patchy distribution, but locally common.

Use(s) : As *Aegialitis annulata*, this species has a very high tannin content, but use has not been recorded (Burkill, 1935).

Source of illustration : Based on Khan & Khan (1989).

Reference(s) : Burkill (1935), van Steenis (1949), Tomlinson (1986), Khan & Khan (1989), Aksornkoae (1993).

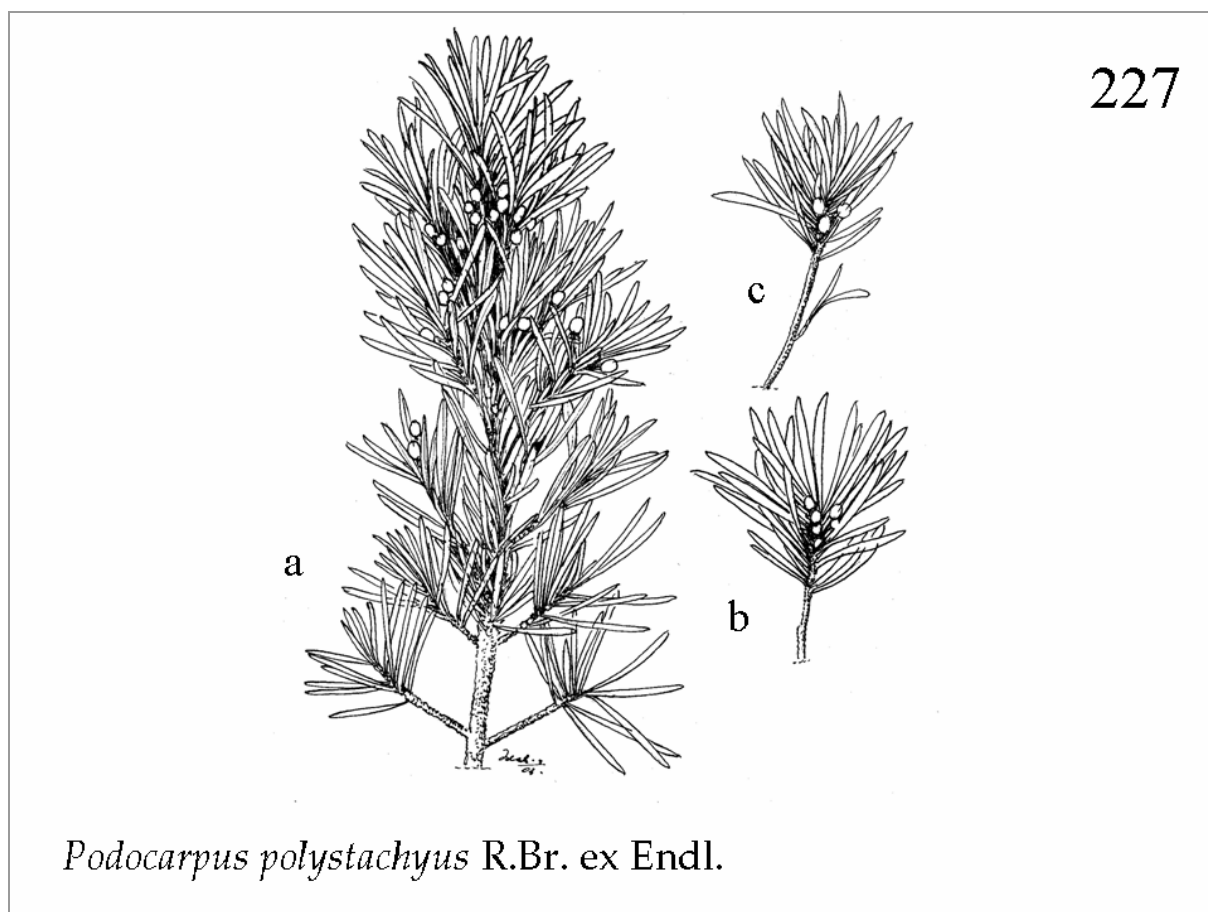


Fig. 227. *Podocarpus polystachyus* R.Br. ex Endl. (a, b, c) Fruits, near the ends of branches.

PODOCARPACEAE

227

***Podocarpus polystachyus* R.Br. ex Endl.**

Synonyms : *Nageia polystachyus* (R.Br. ex Endl.), *Nageia thevetiaefolia* (Blume) F.v.M., *Podocarpus neriifolius* D.Don., *Podocarpus thevetiifolia* Blume, *Podocarpus thevetiifolius* D.Don.

Vernacular name(s) : Podo laut, jati bukit (Mal), kayu keramat, mayu serai – *Ki putri* (Ind.)

Description : Shrub or small tree, 1-20 (very occasionally 40) m tall, commonly about 6m, trunk 30-45 cm diameter, sometimes with buttresses 1 by 1.5 m. The trunk is sometimes fluted. Crown domed, often irregular. Leaves are spirally arranged, often crowded at the twig tips. Young leaves are linear to linear-lanceolate, pointed; mature leaves linear to oval, 3-10 by 6-13 mm, pointed, with a 1-3 mm leaf stalk. Pollen cones are 2-4 cm long, clustered in groups of up to at least five (or 3-5). The seed-bearing structure occurs on a 1-6 mm stalk. Seeds (with covering) measure 7-9 by 5-7 mm.

Ecology : Principle habitat is described as being sandy beaches, where it often occurs gregariously at the high tide mark. Also occurs on sandy coastal bluffs and low outcrops, swampy forest, and sandy ridges or inland edges of mangrove areas. On coastal granites and limestone the trunks are gnarled. It also occurs in coastal heath forests (on poor sandy soils, in *kerangas* vegetation), and limestone hills inland. Mangrove associate species.

Distribution : Endemic to Southeast Asia. Occurring in southern Thailand, Philippines, Malaysia (Peninsular Malaysia, Sarawak, Sabah), Brunei and Indonesia (Kalimantan, Lingga, Sulawesi, Moluccas, Papua). Planted in Sumatra (Medan).

Abundance : Locally common.

Use(s) : Cultivated in gardens. Excellent timber, used for furniture and house interior.

Source of illustration : Keng (1972), Corner (1988)

Reference(s) : Keng (1972), Afriastini (1988), Corner (1988), de Laubenfels (1988).

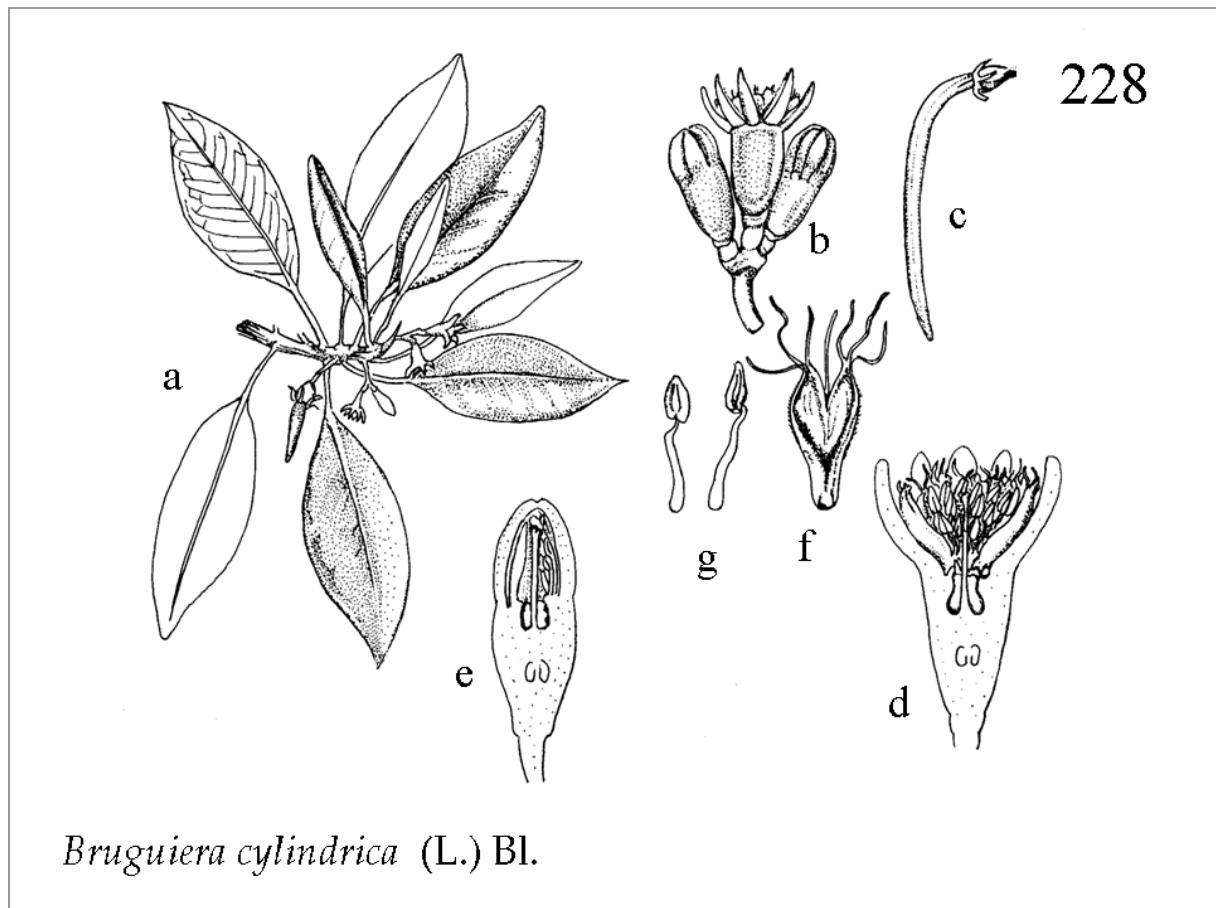


Fig. 228. *Bruguiera cylindrica* (L.) Bl. (a) Branchlet with flowers and immature 'fruit' (hypocotyl), (b) cluster of three flowers, (c) hypocotyl ('fruit'), (d) longitudinal section of flower, (e) longitudinal section of bud, (f) petal, and (g) stamens.

RHIZOPHORACEAE

228

***Bruguiera cylindrica* (L.) Bl.**

Synonyms : *Bruguiera caryophylloides* Bl., *Bruguiera malabarica* Arn., *Kanilia caryophylloides* Bl., *Mangium caryophylloides* Rumph., *Mangium minus* Rumph., *Rhizophora caryophylloides* Burm., *Rhizophora ceratophylloides* Gmel., *Rhizophora cylindrica* Linné

Vernacular name(s) : Bakau belukap, Bakau berus, Bakau puteh, Bakau kecil, Bosang (Mal.), Burus, Tanjung, Tanjung Sukim, Lindur (Ind.), Bakauan, Biris, Biuis, Bius, Busain, Kalapinai, Langarai, Magtangud, Magtongog, Pototan, Pututan, Tangalan, Tangal-babae, – *Pototan lalaki* (Phil.), Vet thâng (Viet.), Thua khao (Thai.), Basac, Omlann (Camb.)

Description : Small-buttressed, evergreen tree up to 15 m, occasionally to 23 m tall, with a grey bark that has a few small, corky lenticels. The pointed leaves are thin and elliptic, measuring 7-17 by 2-8 cm. The calyx tube is smooth, 4-6 by 2 mm, with eight lobes that are as long as the tube. The flower cluster consists of groups of three flowers, which are greenish and 10-12 mm long. Petals are 3-4 mm long, each lobe having 2-3 bristles at the top; they are white, but rapidly turn brown with age. The outer margins of the flowers are usually fringed with white hairs along the lower part. The hypocotyl (often mistaken for the 'fruit') is cylindrical, often curved, 8-15 cm long and 5 mm wide.

Ecology : Grows gregariously, usually on firm clay behind the *Avicennia* zone, on the seaward side of mangrove vegetation. It gives way to other species on better-drained soils, and has the ability to grow in newly-formed soils that are unsuitable for other mangrove species. The firm clay makes the tree more than usually dependent on its pneumatophores for an adequate supply of oxygen, and is therefore particularly susceptible to prolonged submer-sion. It is an abundant seed bearer with a high regeneration potential, but growth is slow. Flowering occurs all year round. Mangrove species.

Distribution : Found from Southeast Asia to northern Australia. It is recorded throughout Southeast Asia.

Abundance : Usually common, although rare in Singapore and uncommon in the Philippines.

Use(s) : Used as firewood. Wood is heavy, reddish and cross-grained. The young roots of the embryos are eaten with sugar and coconut in some areas. Fisherman do not use the wood for making fish traps, reportedly because it has a peculiar odour that repels fish.

Source of illustration : Based on Ding Hou (1958) and Tomlinson (1986)

Reference(s) : Heyne (1950), Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Aksornkoae (1993), Aragones *et al.* (1998), Ng & Sivasothi (1999), Yao (2000), Marschke, M. (2000).

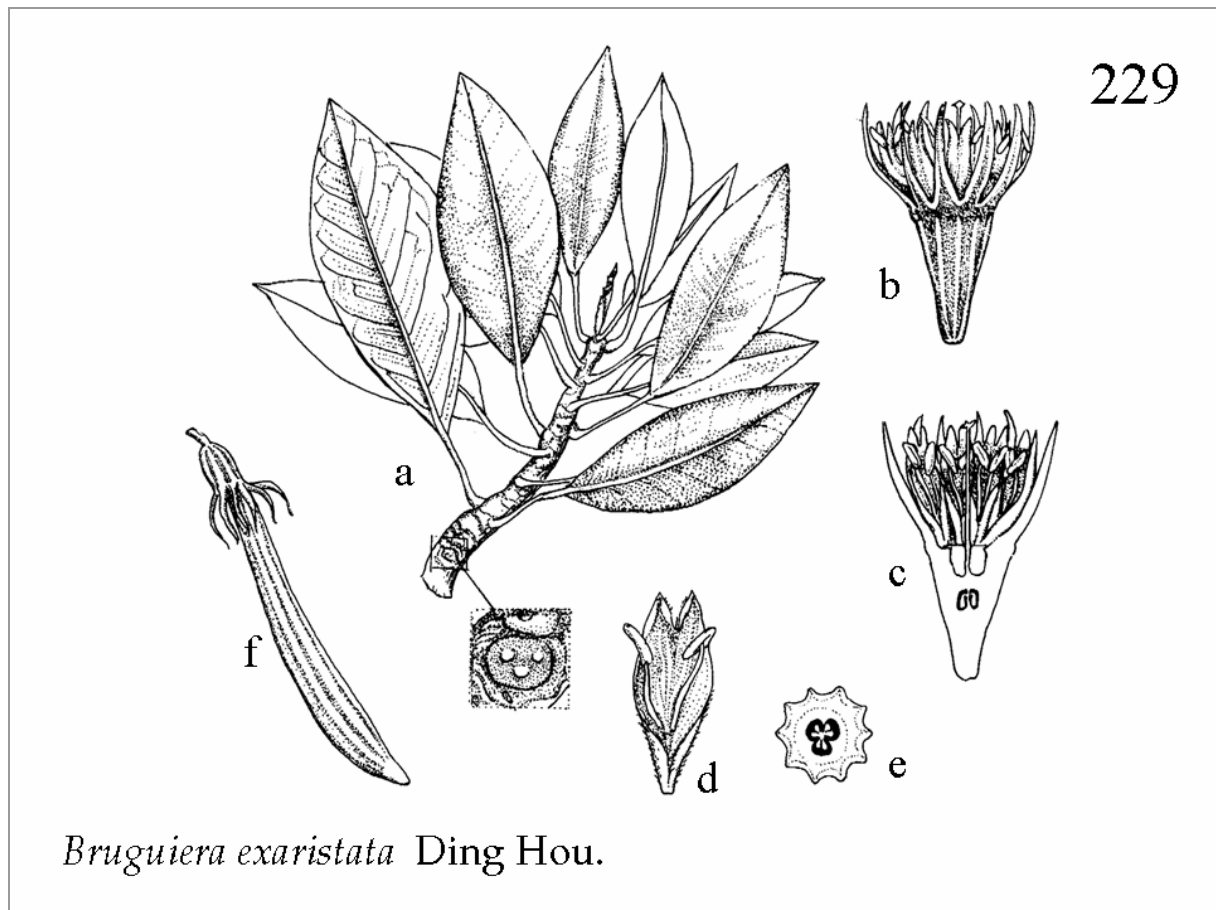


Fig. 229. *Bruguiera exaristata* Ding Hou. (a) Branchlet showing leaf scars (inset), (b) flower, (c) longitudinal section of flower, (d) petal and two stamens, (e) cross section of stigma and embryo, and (f) hypocotyl ('fruit').

RHIZOPHORACEAE

229

Bruguiera exaristata* Ding Hou*Synonyms :** Unknown.**Vernacular name(s) :** Bakau (Mal./Ind.)

Description : Evergreen shrub or tree, up to 10 m tall, with a dark grey, cracked bark, a flanged stem base and numerous knee-like pneumatophores. The pointed, obovate leaves, 5.5-11.5 by 2.5-4.5 cm, are black dotted beneath and often have in-rolled margins. Flowers occur solitarily in axils, hanging downwards. The 8(-10) calyx lobes are 10-15 mm long. The 8-10 petals, 10-13 mm long, are bilobed, having hairy margins and a hairy base. Flowers are yellowish-green, while petals have whitish hairs and are soon shed. The fruit is spirally coiled and about 1.5 cm long. The blunt hypocotyl (often mistaken for the 'fruit') is cylindrical and slightly ridged, 5-7 cm long and 6-8 mm wide. *Bruguiera sexangula* has been confused with this species in the past.

Ecology : Occurs along tidal waterways or towards the back of mangroves. Occasionally mono-specific stands are formed. Suitable substrates include clay-loams, sands and gravels. Very high salinities are tolerated. The hypocotyl/fruit is relatively small and is easily dispersed by tide or flood. Seedlings appear to perish under shaded conditions. This species flowers and fruits throughout the year. Mangrove species.

Distribution : Limited distribution, known only from East Timor, Indonesia (southern Papua), Papua New Guinea and northern Australia.

Abundance : Locally common, but on the whole uncommon to rare, and listed as rare in Indonesia (Mogea *et al.*, 2001).

Use(s) : Fuelwood and construction.

Source of illustration : Based on Ding Hou (1958), Wightman (1989).

Reference(s) : Ding Hou (1958), Wightman (1989).

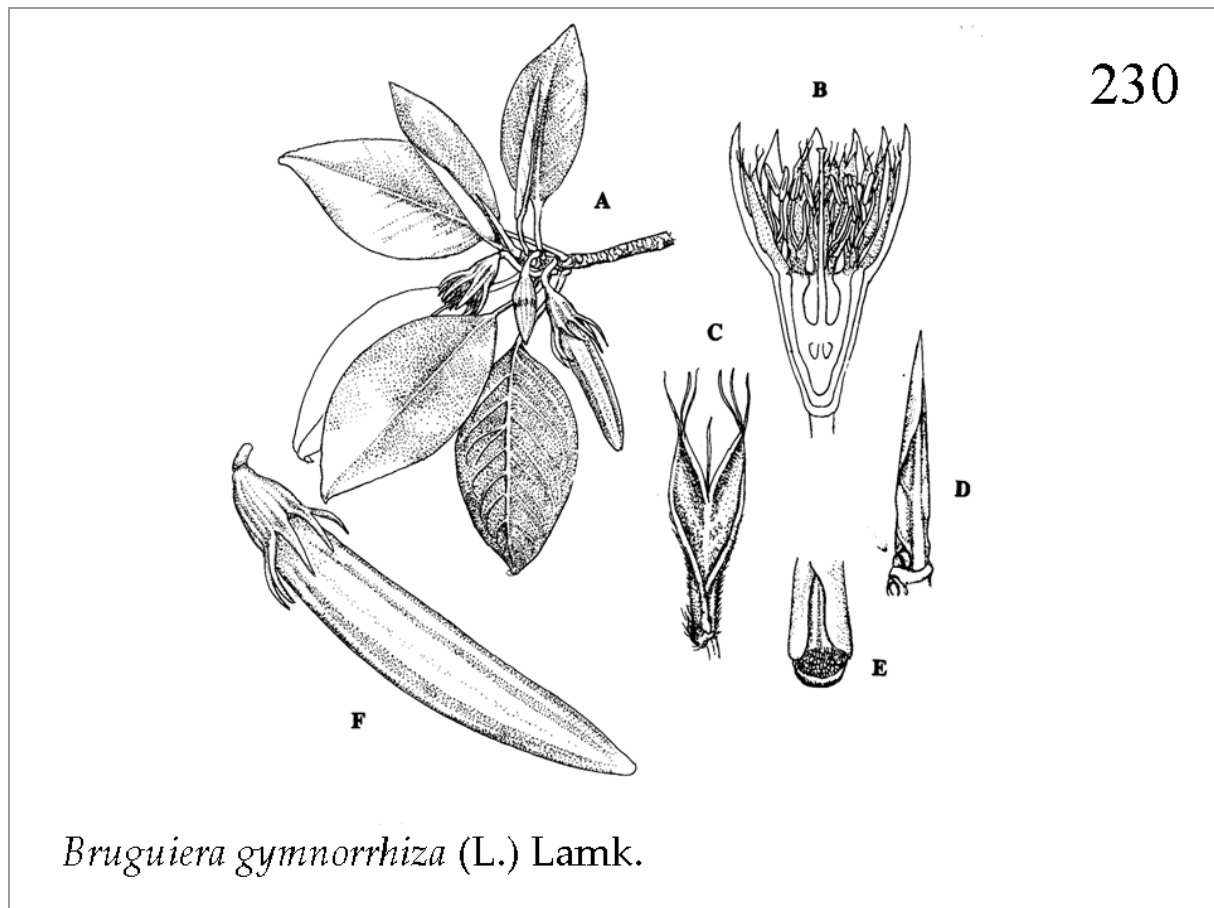


Fig. 230. *Bruguiera gymnorrhiza* (L.) Lamk. (a) Branchlet with flowers and immature 'fruit', (b) longitudinal section of flower, (c) petal, (d) terminal bud with stipules, (e) detail of stipule (detached) from inside, and (f) hypocotyl ('fruit').

RHIZOPHORACEAE

230

Bruguiera gymnorrhiza (L.) Lamk.

Synonyms : *Bruguiera capensis* Bl., *Bruguiera conjugata* (non *Rhizophora conjugata* L.) Merr., *Bruguiera cylindrica* (non Bl.) Hance, *Bruguiera gymnorrhiza* (with one 'r'), *Bruguiera rheedii* Bl., *Bruguiera rumphii* Bl., *Bruguiera wightii* Bl., *Bruguiera zippelii* Bl., *Mangium celsum* Rumph., *Mangium minus* Rumph., *Rhizophora gymnorrhiza* L., *Rhizophora palun*, *Rhizophora rheedii* Steud., *Rhizophora tinctoria* Blanco

Vernacular name(s) : Bakau besar, Betut, Tumbus, Tumu, Tumus (Mal.), Pertut, Taheup, Tenggel, Putut, Tumu, Tomo, Kandeka, Tanjang, Lindur, Sala-sala, Dau, Tongke (Ind.), Bakau, Bakauan, Busiin, Patotan, Petutan, Pototan, Pututan – *Busaing* (Phil.), Arara, Mapeke (PNG), Vet dù bông dó (Viet.), Prasak, Pangka hua sum dok khao (Thai.), Basac kroahom (Camb.)

Description : Column-shaped, evergreen tree up to 15 m, occasionally up to 30 m, with a dark grey to brown, chequered, usually smooth, lenticelled bark. The stem base is buttressed, and knee roots are numerous. Leaves are leathery, 4.5-7 by 8.5-22 cm, elliptic to elliptic-lanceolate, black dotted beneath, and with a pointed tip; often reddish beneath; stipules may also be reddish. Flowers occur singularly on a pendulous flower stalk, 9-25 mm long, light to bright red, covered with 'powder'. Calyx lobes number 10-14(16) and are pink to red. Under sunny conditions the calyx may be bright red. The 10-16 white petals are 13-16 mm long and have 2-3 white bristles, 3 mm long, on the apex of the lobes and one conspicuous bristle in the notch. Their margins and base are shaggy. Petals soon turn brown with age. Fruit is spirally-rolled, round in cross-section and 2-2.5 cm long. The straight, blunt hypocotyl (often mistaken for the 'fruit') is 12-25 cm long, 1½-2 cm wide, round in cross-section or slightly ridged.

Ecology : Often dominating in tall mangrove forest, marking the final stage in the development of the littoral forests and the beginning of the transition to inland vegetation types. Occurs in areas of low salinity and on somewhat dry, well-aerated soil; it can tolerate both shaded and sunny sites. It also occurs at the landward margin of mangroves, along coastal fish ponds and brackish, tidal rivers. It is found directly along the coastline only following erosion. Substrates on which it is found include mud, sand and occasionally black, peaty soils. Occasionally this species has been found growing at elevations above the tidal influence in riparian situations, the propagules probably dispersed by storm surges. Regeneration is often very restricted. Flowers and fruit are present throughout the year. The relatively large flowers, which have a reddish calyx, are pendulous and attract birds for pollination. Mangrove species.

Distribution : From South and East Africa and Madagascar through Sri Lanka and Southeast Asia to tropical Australia and the west Pacific region. Found throughout Southeast Asia.

Abundance : Common and widespread.

Use(s) : A sweet-meat (*manisan kandeka* in Indonesia) made of the inner hypocotyl flesh plus sugar is eaten. The hard, red timber is used for foundation piling, mine timbers, house posts, furniture and cabinet works; also as firewood and for making charcoal.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986), Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Marschke, M. (2000).

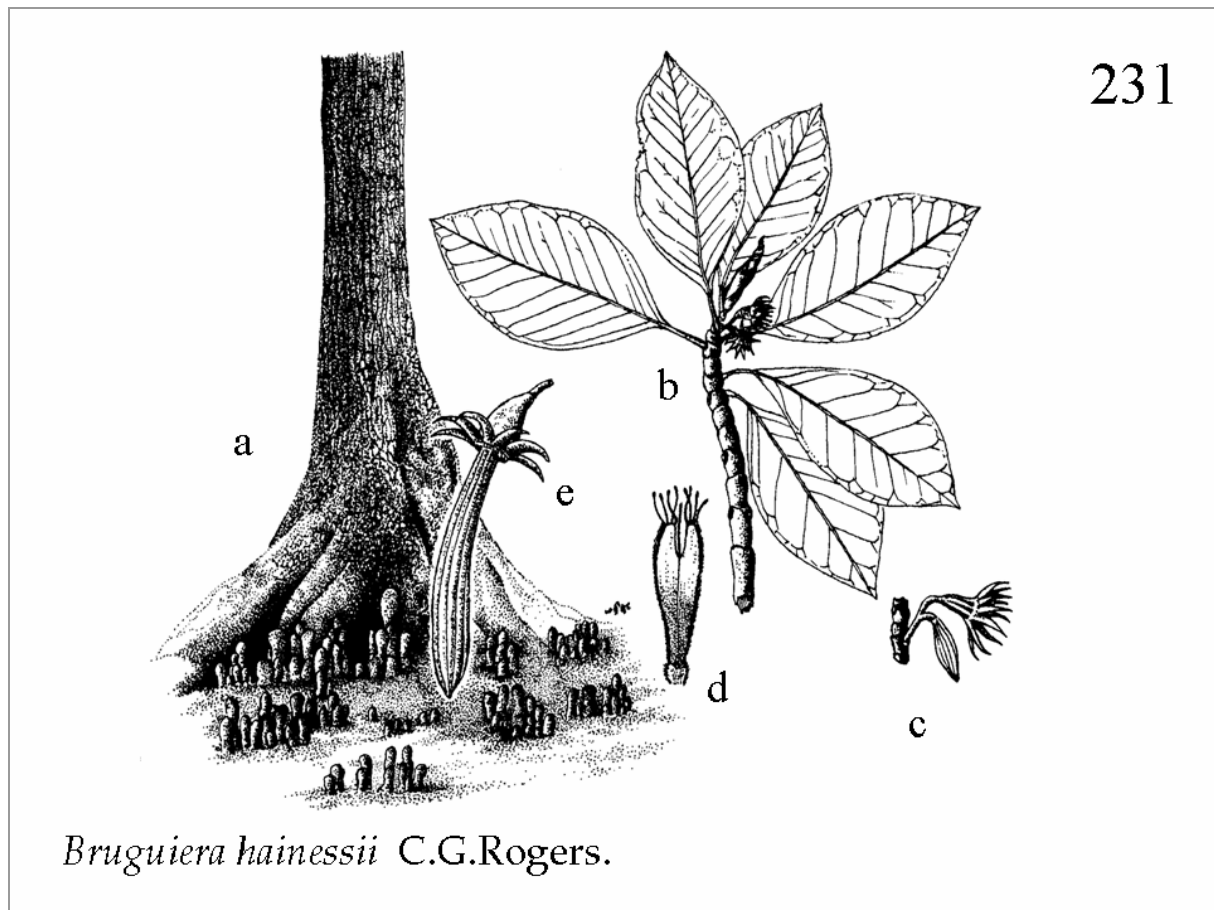


Fig. 231. *Bruguiera hainessii* C.G.Rogers. (a) Base of tree trunk showing the pneumatophores, (b) branchlet with flowers and immature 'fruit', (c) flower and bud, (d) petal, and (e) hypocotyl ('fruit').

RHIZOPHORACEAE

231

Bruguiera hainessii* C.G.Rogers*Synonyms :** *Rhizophora caryophylloides* (non Burm. f) Griff.**Vernacular name(s) :** Berus Mata Buaya (Mal.)

Description : Evergreen tree up to 33 m tall, with a trunk of up to 70 cm in diameter. Bark is brown to grey, with large, corky, yellowish-brown lenticels from base to top. The pointed leaves are elliptic-oblong, 9-16 by 4-7 cm. The flower cluster is 2-3-flowered, and flowers are 18-22 mm long when fully expanded. The calyx is pale green, 10-lobed, with a 5 mm wide tube, and lobes the same length as the tube. Petals are white, 7-9 mm long, hairy on the lower margins and only slightly so on the upper part of the lobes. Lobes have 2-4 bristles at the tip and the bristle in the notch far exceeds the length of the tip of the lobe. The hypocotyl (often mistaken for the 'fruit') is cigar-shaped or slightly thickened towards the end, slightly curved, up to 1.1 by 9 cm.

Ecology : Occurs on the landward margins of mangroves, in relatively dry areas that are inundated for a only a few hours a day during spring tides. Mangrove species.

Distribution : From India through Southeast Asia, where it has been recorded from Myanmar (Mergui), Thailand, Malaysia, Indonesia and Papua New Guinea.

Abundance : Rather uncommon.

Use(s) : Fuelwood and construction.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986).

Reference(s) : Ding Hou (1958), Tomlinson (1986).

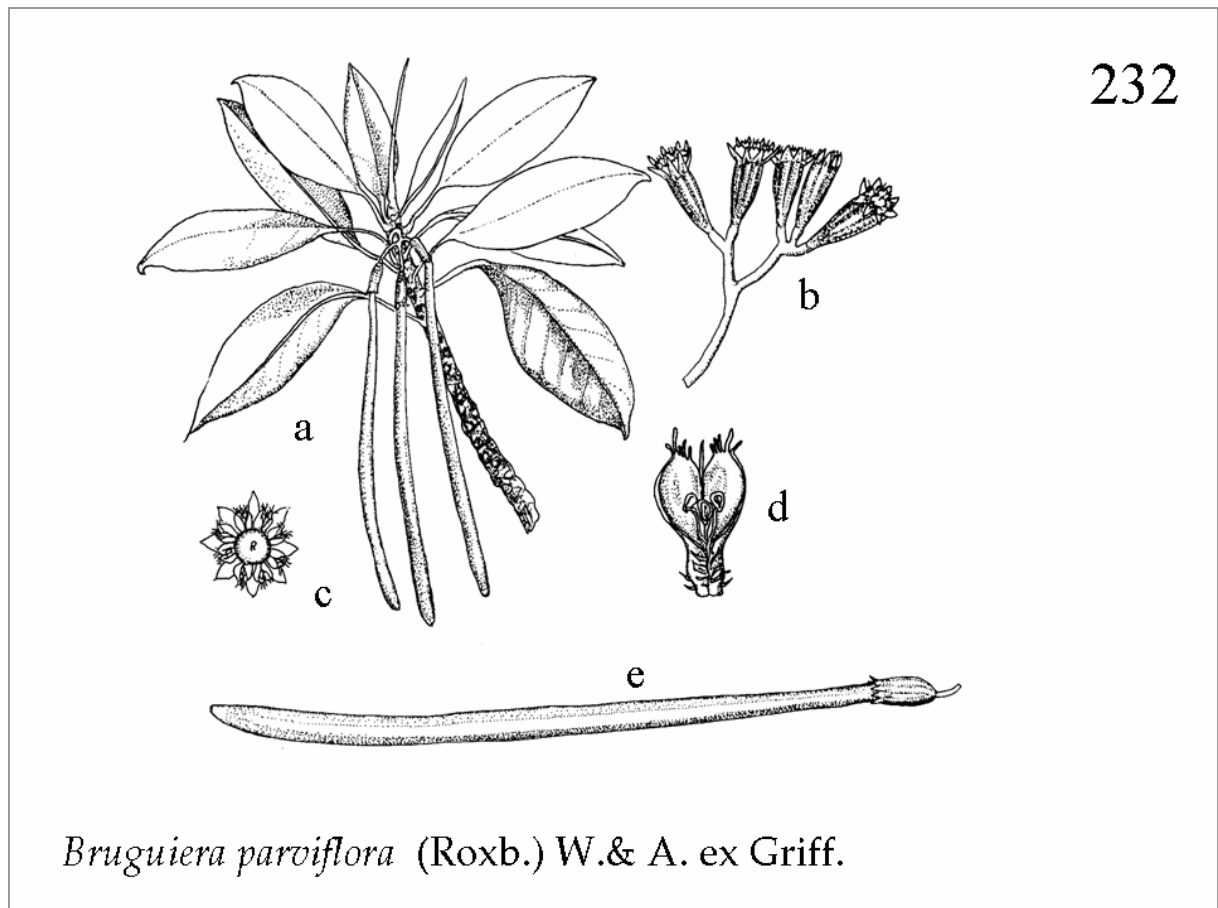


Fig. 232. *Bruguiera parviflora* (Roxb.) W.& A. ex Griff. (a) Branchlet with hypocotyls ('fruits'), (b) cluster of five flowers, (c) flower seen from above, (d) petal, and (e) hypocotyl ('fruit').

RHIZOPHORACEAE

232

Bruguiera parviflora (Roxb.) W.& A. ex Griff.

Synonyms : *Bruguiera ritchiei* Merr., *Kanilia parviflora* Bl., *Rhizophora cylindrica* (non L.) Roxb., *Rhizophora parviflora* Roxb.

Vernacular name(s) : Lenggadai, Lenggadis, Mengkadai (Mal.), Langgade, Mengelangan, Lenggadai, Tanjung (Ind.), Bakauan-lalaki, Bubutigan, Biosan, Hangalia, Hangarai, Langarai, Langari, Magalai, Pototan – *Langarai* (Phil.), Vet tách (Viet.), Thua dam (Thai.)

Description : Slender evergreen shrub or small tree, up to 5 m (rarely even up to 24 m) tall, with a grey, fissured bark and a slightly flanged base. The trunk may attain a diameter at breast height of up to 50 cm. The knee roots may be up to 30 cm tall. Leaves are pointed, 5.5-13 by 2-4.5 cm, elliptic, black dotted beneath and turning yellowish-green with age. The flower cluster consists of a 3-7(-10) flowered group. Calyx tubes are ridged, 7-9 mm long, 8-lobed, each lobe about 1/4 to 1/5 of the length of the tube; calyx lobes are straight, not curved. The 8 oblong, yellowish-green petals are 1.5-2mm long and have three bristles on each lobe and one bristle in the notch that far exceeds the length of the lobes. The fruit is narrowly, spirally-rolled and 2 cm long. The hypocotyl (often mistaken for the 'fruit') is cylindrical, smooth, curved 8-15 cm long and 0.5 cm wide.

Ecology : This species typically forms single species stands in areas that are infrequently inundated. Isolated individuals also occur along tidal waterways and coastal fish ponds. Often found in solid stand in the interior of mangroves, inhabiting mostly firm mud flats. It is often associated with *Rhizophora* species. *Bruguiera parviflora* increases as a result of exploitation of immature mangrove vegetation. Suitable substrates include consolidated mud, sands, calcareous sands, brackish and hypersaline soils. In Australia, flowering has been recorded from June to September, and fruiting from September to December. The light hypocotyls are easily dispersed in water, and seem to establish themselves better in areas receiving much to moderate sunlight. Day-flying insects such as butterflies pollinate its small, erect flowers. The leaves are characteristically scalloped due to predation by insects. Can be very common in logged-over areas (e.g. Karang Gading-Langkat Timur Laut reserve in North Sumatra; Giesen & Sukotjo, 1991). Mangrove species.

Distribution : From India and Bangladesh eastwards to Samoa, Solomon Islands and northern Australia; found throughout Southeast Asia. Introduced in Hawaii.

Abundance : Scattered, but locally abundant.

Use(s) : The wood is heavy to very heavy, and hard and strong, but as it checks and shrinks more than other timbers. It is easily worked and finishes well, but is perishable when exposed to weather or when in contact with the ground. Produces good charcoal, firwood and pulp. Because of its small size, its timber is usually not of much use except for firewood, mining- and fishing-stakes. The germinating seedling is sometimes used as a vegetable.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Tomlinson, (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), <http://www.uc.pt/timor/florafauna.html>.

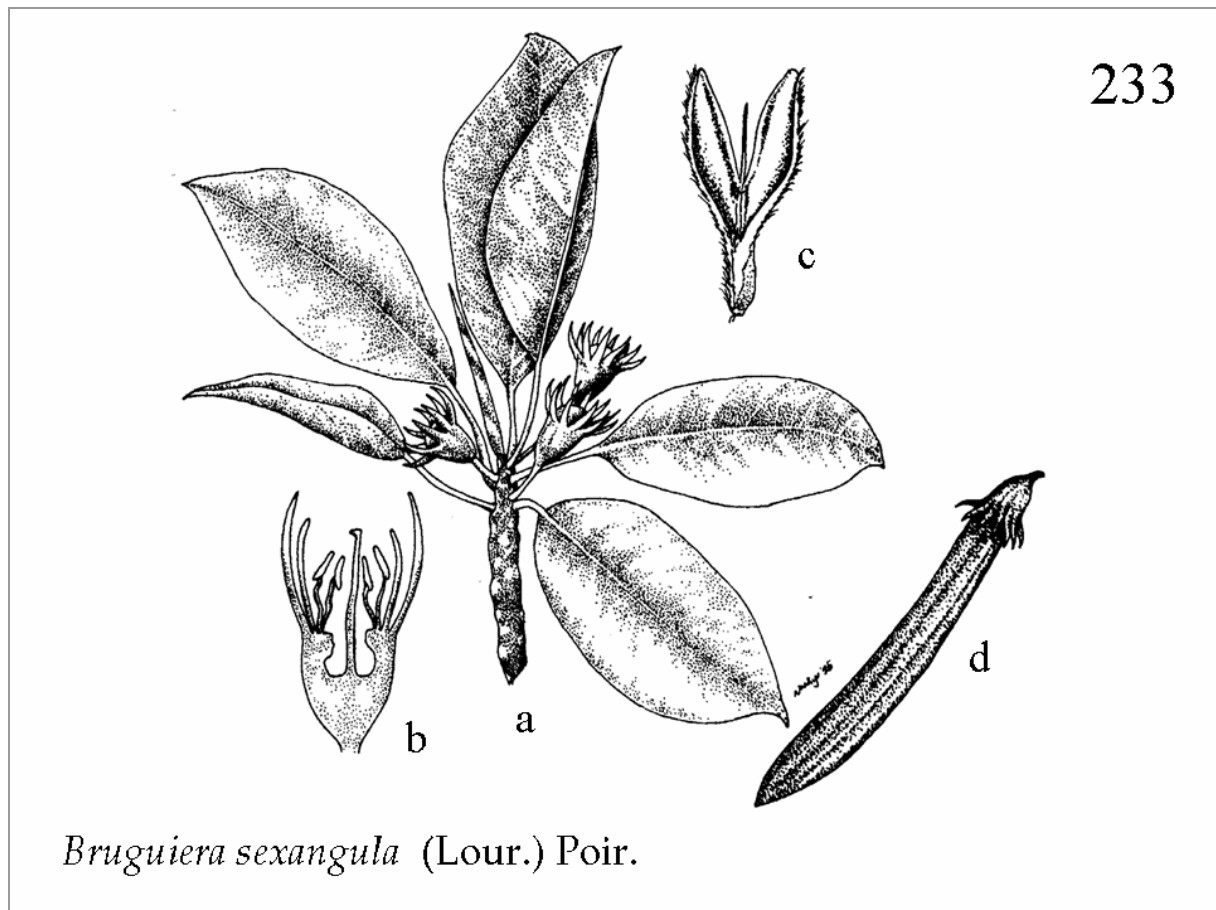


Fig. 233. *Bruguiera sexangula* (Lour.) Poir. (a) Branchlet with three flowers, (b) longitudinal section of flower, (c) petal, and (d) hypocotyl ('fruit').

RHIZOPHORACEAE

233

Bruguiera sexangula (Lour.) Poir.

Synonyms : *Bruguiera angulata* Griff., *Bruguiera australis* A. Cunn., *Bruguiera cylindrica* (non *Rhizophora cylindrica* L.) Bl., *Bruguiera eriopetala* W. & A. ex Arn., *Bruguiera malabarica* (non Arn.) F.-Vill., *Bruguiera oxyphylla* Miq., *Bruguiera parietosa* Griff., *Bruguiera sexangularis* Spreng., *Mangium digitatum* Rumph., *Rhizophora angula* Lour., *Rhizophora australis* Steud., *Rhizophora eriopetala* Steud., *Rhizophora plicata* Blanco, *Rhizophora polyandra* Blanco, *Rhizophora sexangula* Lour.

Vernacular name(s) : Tumu berau, Tumu mata buaya, Busing (Mal.), Busing, Busung, Mata Buaya, Tumu, Bakau Tampusing, Tanjang, Lindur, Ting, Tongke Perampuan, Ai Bon (Ind.), Alai, Bakauan, Bakauan lalaki, Balinsarayan, Busain, Busaing, Kalabayuan, Lagasak, Langari, Pototan, Pututan, Sagasa, Sagasak, Tagasa – *Pototan* (Phil.), Vet dù (Viet.), Prasak nu, Pangka hua sum dok khao (Thai.), Basacsor (Camb.)

Description : Evergreen tree, up to 12 m tall, occasionally to 30 m, with a smooth, light brown-grey bark with a few large, corky lenticels, and an often flanged stem base. The trunk may have a diameter of up to 80 cm at breast height. Knee roots, and occasionally also stilt roots, occur. The leathery leaves measure 8-16 by 3-6 cm, are narrowly elliptic to elliptic and black-dotted beneath. Flowers are located solitary, on single-flowered stalks. The calyx is 10-12 lobed, yellow, yellowish-brown or reddish, with a tube 10-15 mm long. The 10-11 petals are 15 mm long, have a blunt tip with 1 or 2 short bristles, or are hairless altogether. The bristle in the notch does not exceed the length of the lobe. The margins and base of the lobes are covered with soft hairs. Petals are white, but rapidly turn brown with age. The fruit is spirally-rolled and ridged. The angular hypocotyl (often mistaken for the 'fruit') measures 1.5 by 6-12 cm, and is narrowed at both ends. Similar to both *Bruguiera exaristata* and *Bruguiera gymnorhiza*, and has been confused with them in the past. Safest identification is via the petals.

Ecology : Occurs along tidal waterways and coastal fish ponds, on a variety of substrate types that are infrequently submerged. Usually in wetter conditions than *Bruguiera gymnorhiza*. Occasionally occurs on mixed, sandy shores. Salinities tolerated vary from fully saline to brackish and freshwater. Flowering occurs all year round. The large, downward pointing flowers are pollinated by birds. The hypocotyls are dispersed by water. Mangrove species.

Distribution : From Sri Lanka and India eastward throughout Southeast Asia to northern Australia and New Caledonia; introduced to Hawaii.

Abundance : Common.

Use(s) : The wood is heavy to very heavy, hard and strong, but checks and shrinks more than ordinary wood. Use for firewood, poles and charcoal. Fruit is said to be used in an application for shingles (*herpes* virus disease), and root and leaves are used to treat burns. In Sulawesi (Indonesia) the fruits are eaten after having been soaked and boiled.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Yao (2000), Marschke (2000).

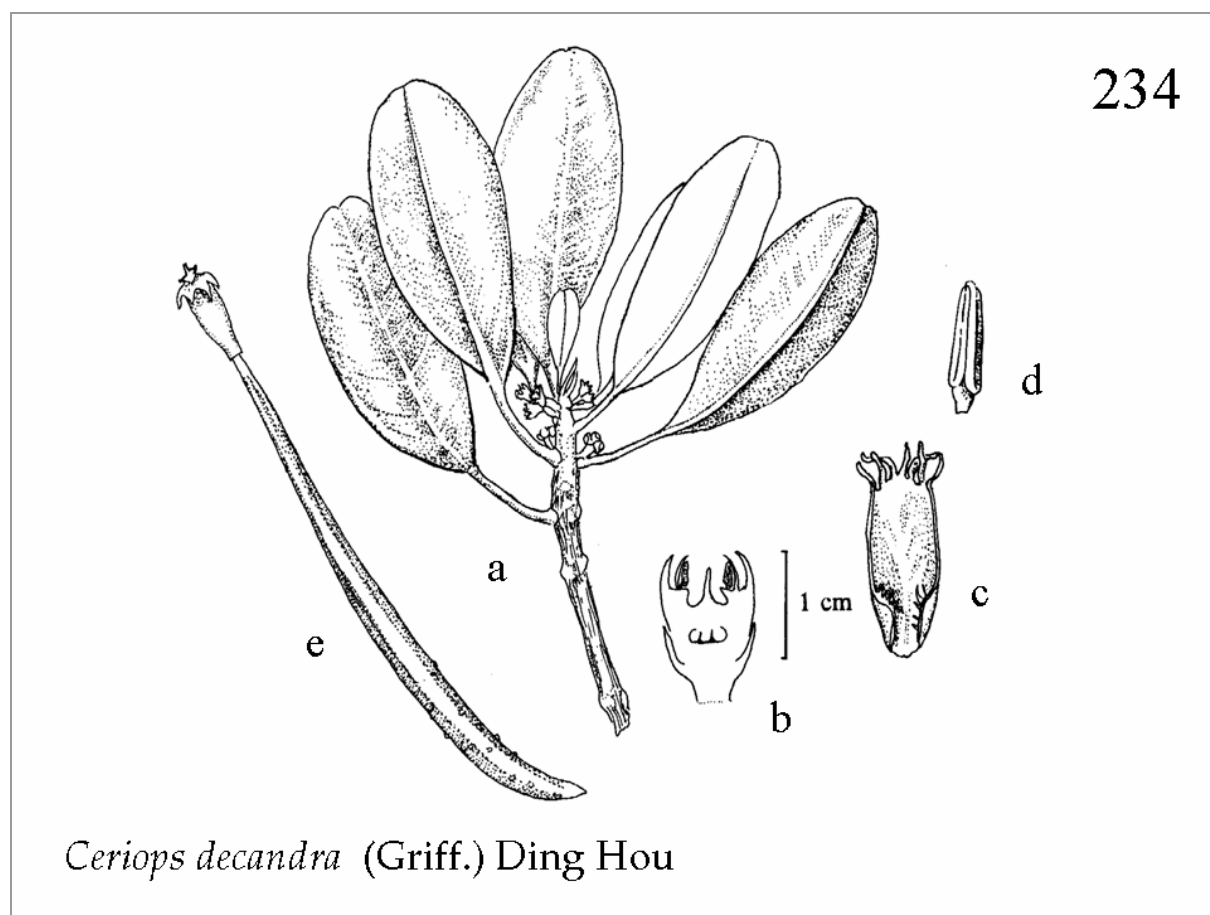


Fig. 234. *Ceriops decandra* (Griff.) Ding Hou. (a) Branchlet with flowers, (b) longitudinal section of flower, (c) petal, (d) stamen, and (e) hypocotyl ('fruit').

RHIZOPHORACEAE

234

***Ceriops decandra* (Griff.) Ding Hou**

Synonyms : *Bruguiera decandra* Griff., *Ceriops roxburghiana* Arn., *Ceriops zippeliana* Bl., *Rhizophora decandra* Roxb., *Rhizophora glomerulata* Zipp. ex Bl.

Vernacular name(s) : Tengal, Tengar, Landing-landing (Mal.), Tingi, Palun, Parun, Bido-bido (Ind.), Bakauan, Bulubadiang, Matangal, Tangal, Tungug, Tungung – *Malatangal* (Phil.), Madame (Myan.), Đà quánh (Viet.), Prong, Prong khao (Thai.), Smairsor (Camb.)

Description : Small tree or shrub up to 5 m tall, occasionally to 15 m, with a brown, rarely grey or cream, smooth to flaky bark and a flanged stem base. The trunk may attain a diameter of 15-20 cm at breast height. The rounded, glossy-green leaves measure 3-10 by 1-4.5 cm and are elliptic-oblong to slightly bifacial. The condensed flower head, up to 10 mm by 3-4 mm, has 2-4 sessile flowers and a short, stout, angular stalk located in the axils of the upper parts of branches. The corolla is 2.5-4 mm long, white, and has a fringe of 0.75 mm long hairs. The corolla quickly ages and turns a brownish colour. Stamens have a short filament, equal to or shorter than the anther, which ends in an appendage. The fruit is 1-1.5 cm long, with a distinctly rounded tip, and erect or ascending sepals. The calyx is covered with lenticels or is warty. The slender hypocotyl (often mistaken for the 'fruit') is sharply ridged, only warty towards the tip, measuring 9-15 cm. Leaf shape and size are highly variable depending on the light and water regimes experienced by individual plants.

Ecology : Occurs scattered throughout tidal forests, but more commonly towards the landward margins of tidal waterways and bordering coastal ponds. Sand or mud substrates are preferred. Flowering occurs all year round. Mangrove species.

Distribution : From India to Southeast Asia and Australia. In Southeast Asia it has been recorded in Cambodia, Myanmar, Malaysia, the Philippines, Brunei, Thailand, Vietnam, Indonesia (Banka, Java, Borneo, Sulawesi, the Mollucas, Papua) and Papua New Guinea. Possibly occurs in East Timor, but not reported.

Abundance : Relatively common, but less so than *Ceriops tagal*.

Use(s) : *Ceriops* species are the most durable of all the mangroves and are used for house construction, railway sleepers, paving blocks and tool handles. Also used for firewood. The bark is a good source of tannin and a dye is also obtained from it – this is used to tint rice and a local wine in the Philippines called 'tuba'. The bark is also used as a substitute for quinine.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989)

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragonés *et al.* (1998), Marschke (2000).

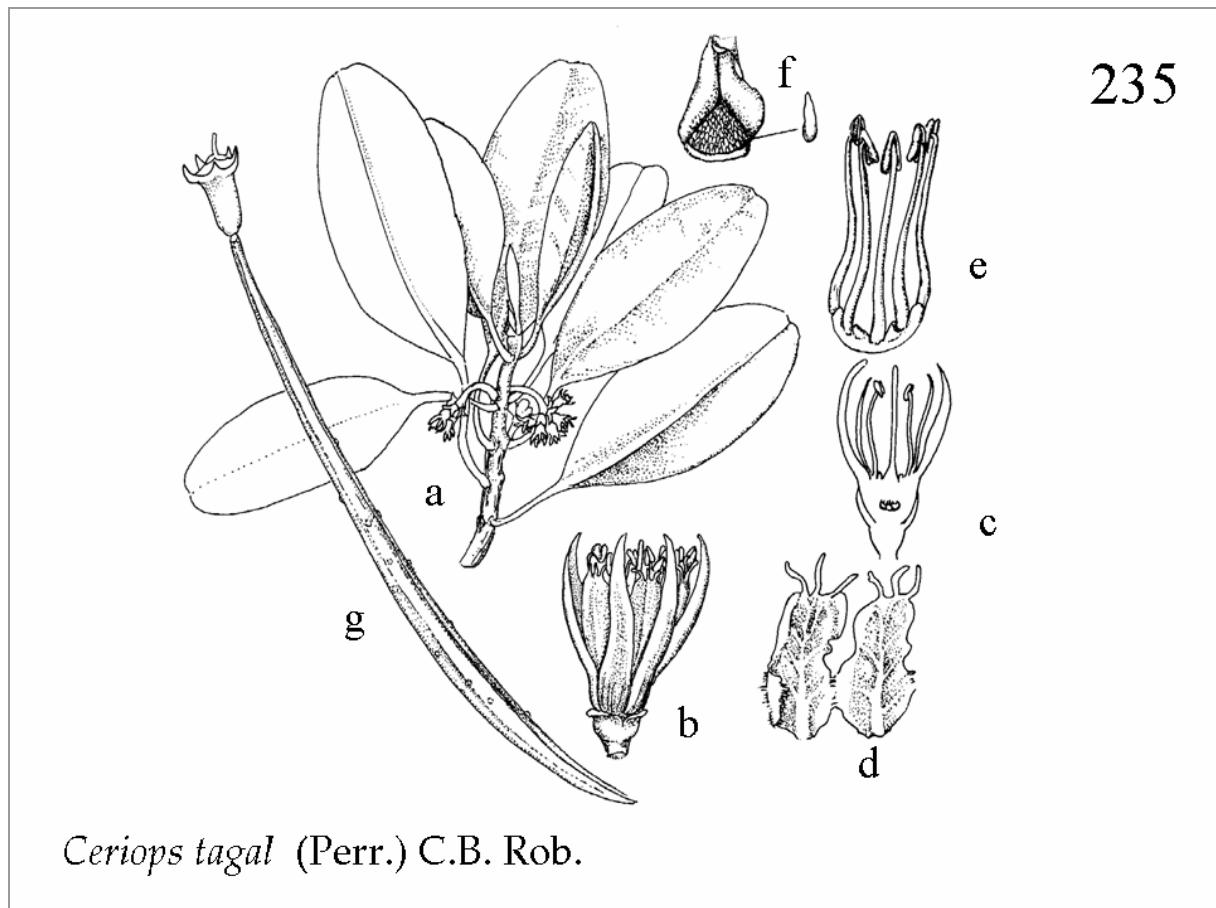


Fig. 235. *Ceriops tagal* (Perr.) C.B. Rob. (a) Branchlet with flowers, (b) flower, (c) longitudinal section of flower, (d) petals, (e) stamens, (f) stipules, from within, and (g) hypocotyl ('fruit').

RHIZOPHORACEAE

235

***Ceriops tagal* (Perr.) C.B. Rob.**

Synonyms : *Ceriops australis* White, *Ceriops boiviniana* Tul., *Ceriops candolleana* Arn., *Ceriops candolleana* var. *sasakii* Hayata, *Ceriops candolleana* var. *spathulata* Blume, *Ceriops forsteniana*, *Ceriops lucida* Miq., *Ceriops pauciflora* Benth., *Ceriops somalensis* Chiovenda, *Ceriops tagal* var. *australis* White, *Ceriops timoriensis* Domin, *Mangium caryophylloides* Rumph., *Rhizophora candel* (non L.) Blanco, *Rhizophora tagal* Perr., *Rhizophora timoriensis* DC.

Vernacular name(s) : Tengar, Tengah (Mal.), Tangar, Tingih, Palun, Parun, Bido-bido (Ind.), Magtongod, Pakat, Rungon, Tagasa, Tangal, Tanggal, Tangal lalaki, Tigasan, Tungod - *Tangal* (Phil.), Madame (Myan.), Đà vôi (Viet.), Prong, Prong daeng (Thai.), Smerkrohorm (Camb.)

Description : Small tree or shrub up to 6 m tall, occasionally to 15(-25) m, with a grey, occasionally brown, smooth bark and with a flanged stem base. The tree often has small stilt roots. The rounded, glossy-green leaves measure 5.5-10 by 2-3.5 cm, are obovate-elliptic and often have an inwardly-curved margin. The 5-10 flowered, pendulous flower head measures 2 by 10-20. It has a long, slender stalk, is resinous and occurs at the ends of new shoots or in the axils on older ones. Calyx lobes are erect in flower, recurved in fruit, 4-5 mm long, with a 2 mm long tube. Flowers are white and soon turn brown. Petals are linked via marginal hairs and have a top that bears three trumpet-shaped lobes, 0.5 mm across. The stamens have long, slender filaments that extend far beyond the blunt anthers. Fruit is 1.5-2 cm long, with recurved, persistent sepals. The warty hypocotyl (often mistaken for the 'fruit') is smooth or slightly ridged, angular, slender and often rather short, 4-25 cm long. Variable species, and as a result a number of subspecies have been described, including: *Ceriops tagal* var. *australis*, found in northern Australia and Papua New Guinea (often recorded as *Ceriops australis*).

Ecology : Forms dense shrublands on the landward edge of tidal forests, in areas inundated by spring tides with well-drained soils. Also occurs along brackish-water fish ponds. It prefers clay substrates, and may coexist with *Ceriops decandra* though usually more abundant. Flowering occurs all year round. The species degenerates into a bushy shrub under unfavourable growth condition. Mangrove species.

Distribution : From Mozambique and East Africa to the Western Pacific, though northern Australia and Southeast Asia, and in Taiwan, Southern China (where it is rare) and New Caledonia. In Southeast Asia recorded from Myanmar, Cambodia, Thailand, Vietnam, the Philippines, Malaysia, Brunei, Singapore, Indonesia and Papua New Guinea.

Abundance : Common.

Use(s) : An extraction of the bark is used in obstetrical and haemorrhage cases. Tannin is produced from the bark. Dye is obtained from the wood and bark, and used in the 'batik' industry in Malaysia and Indonesia. The wood is heavy, very hard and very strong; does not check badly but shrinks excessively. Easy to split and work. The timber is useful for house construction, railway sleepers, paving blocks and tool handles, due to its longevity when immersed in salt water. It is one of the most durable of all the mangrove timbers, and is excellent firewood.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Marschke (2000).

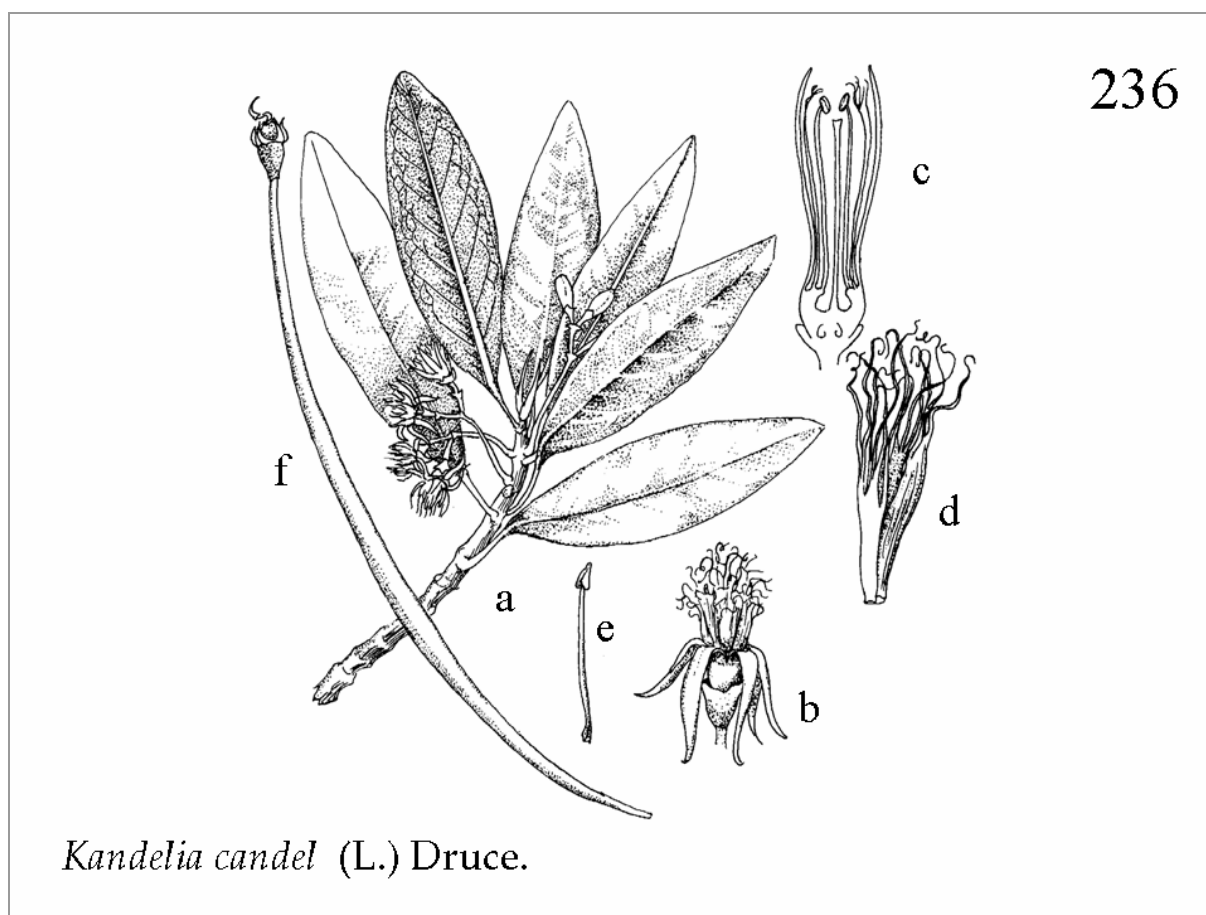


Fig. 236. *Kandelia candel* (L.) Druce. (a) Branchlet with buds and flowers, (b) flower, (c) longitudinal section of flower, (d) petal, (e) stamen, and (f) hypocotyl ('fruit').

RHIZOPHORACEAE

236

Kandelia candel (L.) Druce

Synonyms : *Kandelia rheedei* Wight & Arn., *Rhizophora candel* Linné

Vernacular name(s) : Berus-berus, Beras-beras, Pulut-pulut, Mempisang, Pisang-pisang laut (Mal.), Beus, Pulut-pulut, Pisang-pisang laut (Ind.), Pulut-pulut (Bru.), Bakauan baler (Phil.), Rang ka thae (Thai), Trang (Viet.)

Description : Shrub or small tree, up to 7 m tall, with a thickened stem base. Generally without proper buttresses or pneumatophores; roots may appear braided at the base of the trunk. The greyish to reddish-brown bark is smooth and has lenticels. Leaves measure 6-13 by 2.5-6 cm, are elliptic-oblong to narrowly so, or obovate-oblong, with a margin that is usually curled inward; leaf stalk 1-1.5 cm. The dichotomously branched flower cluster has 4 to sometimes 9 white flowers that are 1.5-2 cm long; petals are 14 mm long; calyx lobes number 5(-6). The calyx tube exceeds the ovary and has linear lobes that are recurved after the flower has fully expanded. The green fruit is ovoid, 1.5-2.5 cm long. The long, cylindrical hypocotyl (usually mistaken for the 'fruit') is club-shaped and 15-40 cm long and may have a reddish tint.

Ecology : Occurs sporadically on banks of tidal rivers among other mangroves, obviously (because of its rarity) occupying a narrow niche. Mangrove species.

Distribution : Occurs from India eastwards to Southeast Asia, Hong Kong, Guangdong (southern China), southern Japan and Taiwan. In Southeast Asia it has been recorded from Malaysia, Thailand, Myanmar, the Philippines, Cambodia, Vietnam, Brunei, Singapore and western Indonesia (north Sumatra and West Borneo).

Abundance : In Southeast Asia it occurs only very locally and is uncommon; it is listed as rare in Indonesia (Mogea *et al.*, 2001). In Southern China (Zhanjiang, Hong Kong), however, it is one of the more common mangrove species and it is often planted by the Forestry Bureau.

Use(s) : Mainly for firewood.

Source of illustration : Based on Ding Hou (1958).

Reference(s) : Burkill (1935), Ding Hou (1958), Said (1990), Aksornkoae (1993), Wilkie (1996), Ng & Sivasothi (1999), Yao (2000), Maung (2003).

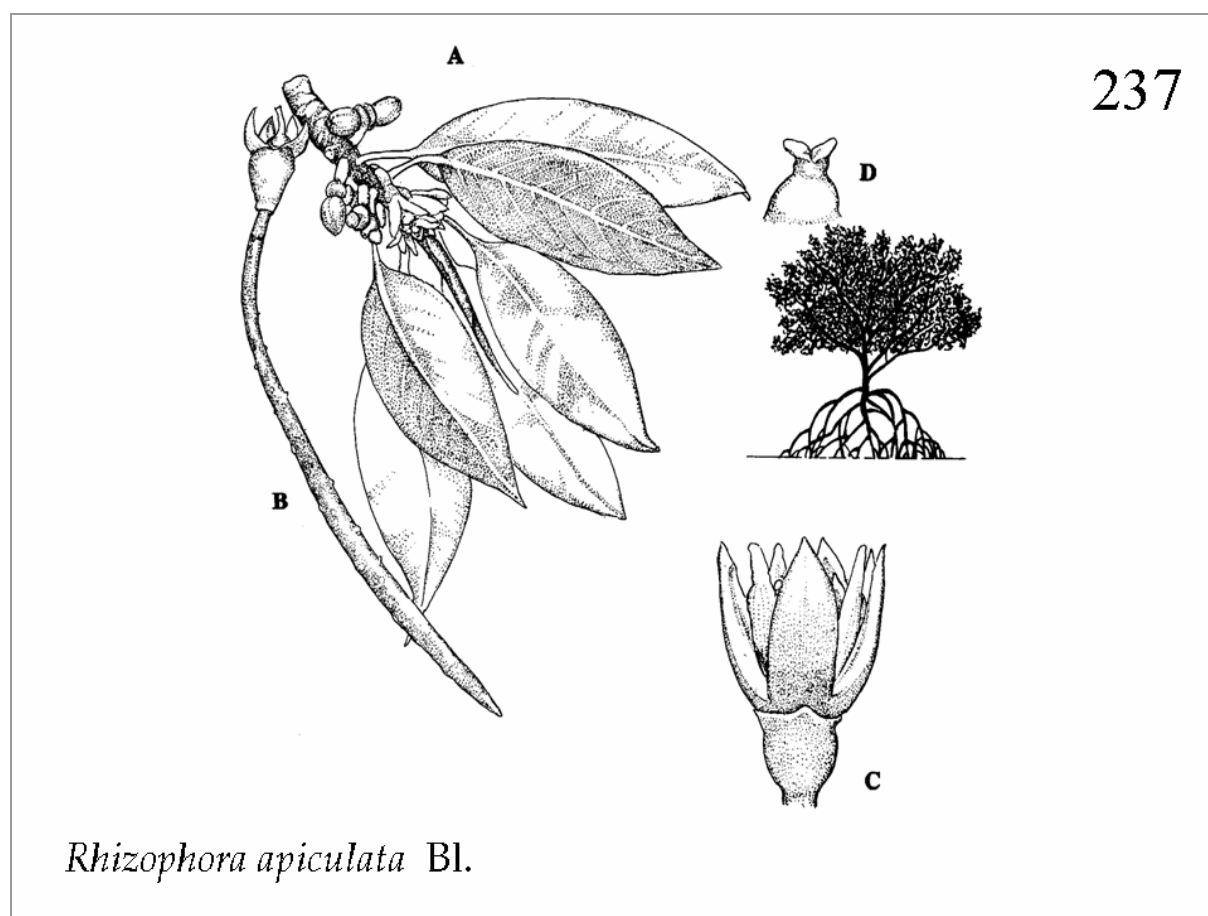


Fig. 237. *Rhizophora apiculata* Bl. (a) Branchlet with buds and flowers, (b) hypocotyl ('fruit'), (c) flower, (d) style, and (e) habit.

RHIZOPHORACEAE

237

Rhizophora apiculata Bl.

Synonyms : *Mangium candelarium* Rumph., *Rhizophora candelaria* DC., *Rhizophora conjugata* (non Linné) Arn., *Rhizophora lamarckii*, *Rhizophora mangle* (non Linné)

Vernacular name(s) : Bakau minyak, Bakau tandok, Bakau akik, Bakau puteh, akik (Mal.), Bangka Minyak, Donggo Akit, Jankar, Abat, Bangkita, Kalumagus, Kailau, Parai (Ind.), Bakauan lalaki, Bakauan, Bakau, Uakatan Bakad, Bakhau, Bakhaw, Lupa pula, Uakatan – *Bakauan-lalake* (Phil.), Du''o'c (Viet.), Kongkang, Kongkaang bai leu (Thai.), Kongkang-slektoch (Camb.)

Description : Erect tree to over 30 m tall, with a trunk that can be 50 cm in diameter. It has very conspicuous, arching stilt-roots extending up to 5 m up the stem, and occasionally has aerial roots from the branches. Bark is dark grey and chequered. The trunk may be clear for the first 10-12 m. The narrowly elliptic, leathery leaves measure 7-19 by 3.5-8 cm. They are dark green with a distinct light green zone along the midrib, which is tinged reddish underneath. The leaf stalk is 17-35 mm long, tinged reddish, and is flanked by leaflets at its base that measure 4-8 cm. Flower heads occur in the axils of leaf scars, each bearing two bisexual, yellowish flowers on a stalk that can be up to 14 mm long. Buds are broadly elliptic and finely fissured. Just below the buds are two fused, cup-shaped, fissured, bulbous leaflets. The four brownish-yellow to reddish sepals are persistent, and occur in a recurved form on the end of the fruit. The four yellow to white petals are membranous, flat and hairless, 9-11 mm long. There are 11-12 stemless stamens, and the style is 0.8 mm long. The oblong to pear-shaped, brown fruits are rough, 2-3.55 cm long, and contain one fertile seed. The cylindrical hypocotyl (often mistaken for the 'fruit') is green with purple, club shaped, 18-38 by 1-2 cm. A sterile hybrid between *Rhizophora apiculata* and *Rhizophora stylosa* exists, originally recognised as a separate species "*Rhizophora lamarckii*" (now *Rhizophora* X *lamarckii*).

Ecology : Occurs on deep, soft, muddy soils that are flooded by normal high tides. Avoids firmer substrates mixed with sand. Dominant: may form up to 90% of the vegetation at a site. Tidal waterways with strong freshwater input on permanent basis are also preferred. Branching of the stilt roots may be abnormal and caused by a beetle damaging the root tips. Crabs may hamper regrowth by devouring or removing the bark of seedlings until they are completely girdled or even bitten right through. Grows slowly, but flowers all year round. Mangrove species.

Distribution : From Sri Lanka throughout Southeast Asia to tropical Australia, Micronesia and the west Pacific Islands.

Abundance : Abundant in Southeast Asia; sparsely distributed in Australia.

Use(s) : The wood is very heavy to extremely heavy, and very hard. It requires careful seasoning to prevent splitting, but works and finishes well. Used for foundation piles, beams, and outriggers of dugout canoes. Also used for interior timber, furniture, firewood and the making of charcoal. The bark contains up to 30% tannin (per cent dry weight). Branched stilt roots are used for making anchors, after being weighted by a stone. In Java it is sometimes planted along fishponds to protect dikes and bunds. Used in mangrove rehabilitation and plantation forestry.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Yao (2000), Marschke (2000).

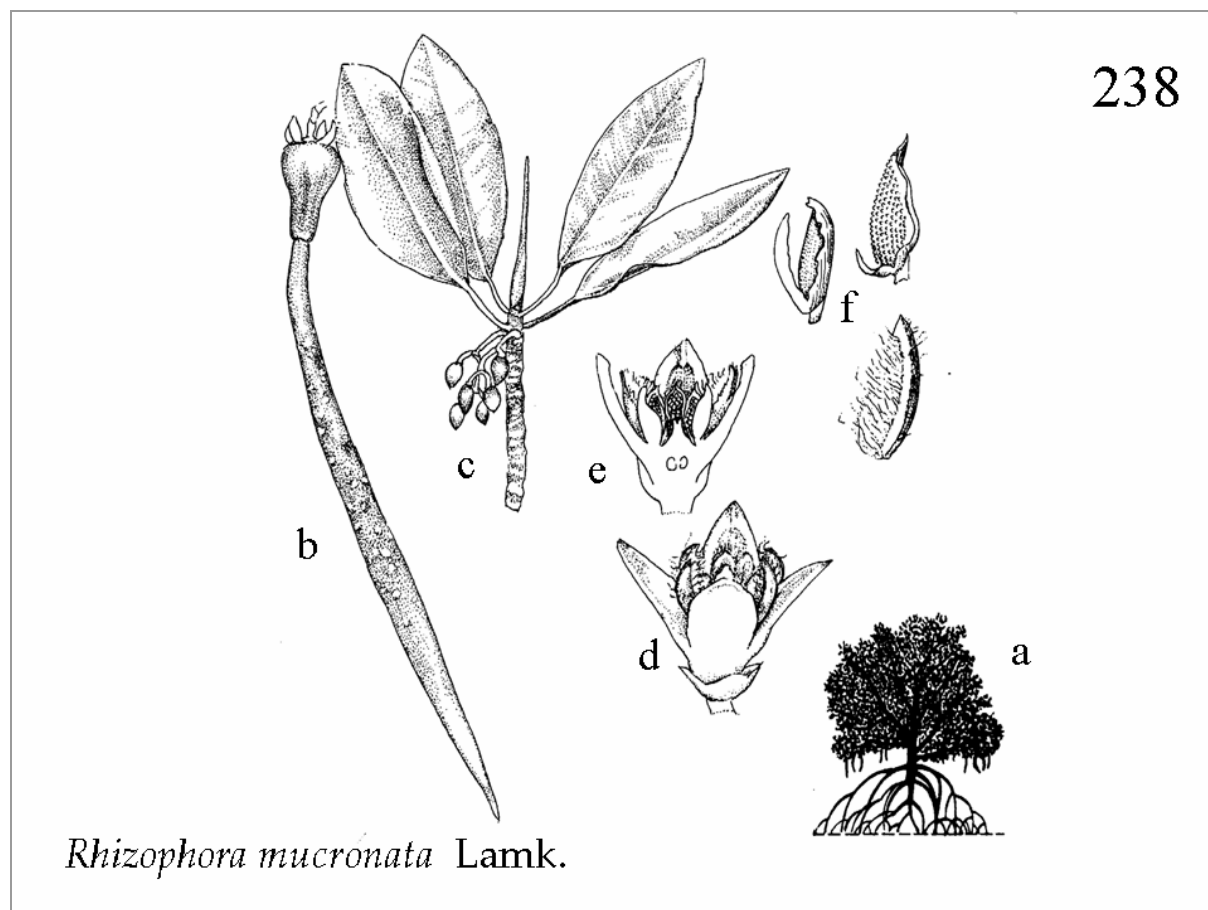


Fig. 238. *Rhizophora mucronata* Lamk. (a) Habit, (b) hypocotyl ('fruit'), (c) branchlet with buds, (d) flower, (e) longitudinal section of flower, and (f) stamens.

RHIZOPHORACEAE

238

***Rhizophora mucronata* Lamk.**

Synonyms : *Mangium candelarium* Rumphius, *Rhizophora candelaria* Wight & Arn., *Rhizophora latifolia* Miq., *Rhizophora longissima* Blanco, *Rhizophora macrorrhiza* Griff., *Rhizophora mangle* (non Linné) Roxb., *Rhizophora mucronata* var. *typica* Schimp.

Vernacular name(s) : Bakau belukap, Bakau gelukap, Bakau jankar, Bakau hitam, Bakau kurap (Mal.) Bangka Itam, Dongoh Korap, Bakau Hitam, Bakau Korap, Bakau Merah, Jankar, Lenggayong, Belukap, Lolaro (Ind.), Bakau, Bakauan-babae, Bakhau, Bakhaw, Bangkau – *Bakauan-babe* (Phil.), Koriki, Pabo, Togo, Tortor, Totoa (PNG), Đung (Viet.), Kongkaang bai yai, Kongkang (Thai.)

Description : Erect tree, up to 27 m tall, rarely over 30 m, trunk up to 70 cm in diameter with a dark, almost black bark that is horizontally fissured. It has both stilt roots and aerial roots growing from lower branches. Leaves are broadly elliptic to oblong, usually 11-23 by 5-13 cm, and leathery. The green leaf stalk is 2.5-5.5 cm long, and the leaflets at the base of the leaf stalk are 5.5-8.5 cm. Stalks of flower heads are forked 2-3 times, and usually have 2-5 (up to 12) bisexual flowers, each on a 2.5-5 cm long individual stalk. The buds are widest near the base and have two 2-lobed leaflets near the base. The calyx is deeply lobed and pale yellow, 13-19 mm long. The four white petals have densely hairy margins, are sparsely hairy on the back and are about 9 mm long. There are eight stemless stamens, and the style is 0.5-1.5 mm long. The dull, brownish-green fruit is elongated to egg-shaped, often rough at the base, single seeded and 5-7 cm long. The cylindrical hypocotyl (often mistaken for the 'fruit') is rough and warty, 36-64 cm long and up to 2 cm wide.

Ecology : In similar localities to *Rhizophora apiculata*, but more tolerant of sandy and firmer substrates. Generally growing in groups near or on the banks of tidal creeks and in estuaries, seldom far from tidal water. Optimal development occurs in deeply inundated areas, on reasonably firm soils rich in humus. It is one of the most important and widespread mangrove species. Flowering occurs all year round. The seedlings are often predated on by crabs, preventing their establishment. Seedlings that have been dried in the shade for several days before planting are more or less avoided by crabs; the process possibly causes an accumulation of protective tannin in the tissues. Mangrove species.

Distribution : From East Africa, Madagascar and Mauritius to Southeast Asia, Australia, Melanesia and Micronesia. Introduced in Hawaii. In Southeast Asia it is found throughout.

Abundance : Very common.

Use(s) : The wood is very heavy to extremely heavy, very hard and strong; shrinks excessively and is rather difficult to work because of its hardness. Used for fuel and charcoal. The tannin in the bark is used for tanning and dyeing, especially of fishing lines and ropes. Occasionally used for treating cases of haematuria (blood in urine). May be planted along coastal fish ponds to protect dikes and bunds, and use for making fish traps.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragones *et al.* (1998), Yao (2000).

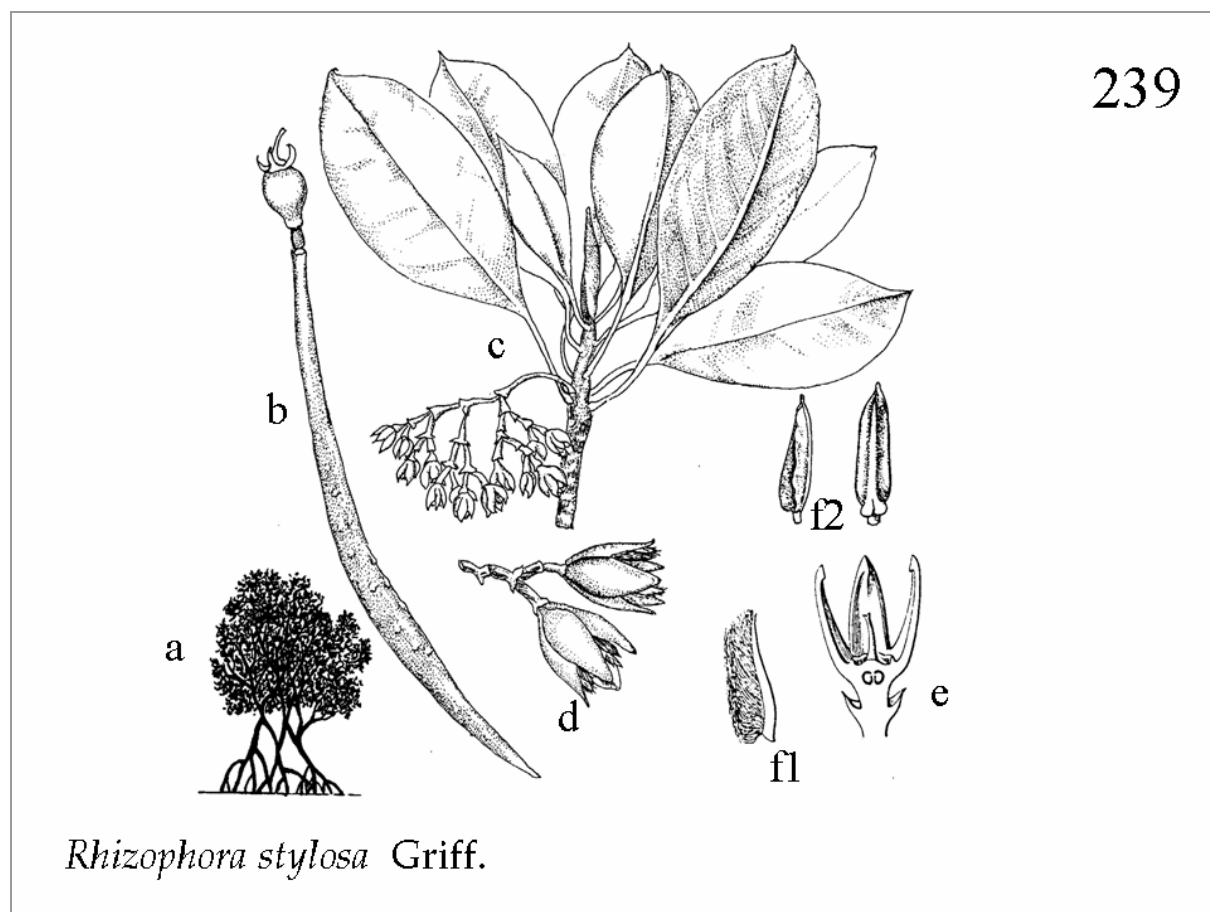


Fig. 239. *Rhizophora stylosa* Griff. (a) Habit, (b) hypocotyl ('fruit'), (c) branchlet with flowers, (d) pair of flowers, (e) longitudinal section of flower, and (f) stamens.

RHIZOPHORACEAE

239

Rhizophora stylosa Griff.

Synonyms : *Rhizophora lamarckii*, *Rhizophora mucronata* var. *stylosa* Schimp.

Vernacular name(s) : Generally the same names as for *Rhizophora mucronata* (Bakau in Malaysia and Indonesia); Bakauan bato, Bakhaw – *Bangkau* (Phil.).

Description : Multi- or single-trunked small tree, up to 10 m tall, with a smooth, grey to black, fissured bark; trunk may measure 10-15 cm diameter at breast height. It has stilt-roots that are up to 3 m long, and aerial roots emerging from the lower branches. Leaves are broadly elliptic, 6.5-12.5 by 3-7.5 cm, leathery, with a regularly-spotted lower surface and a pointed tip. The green leaf stalk is 1-3.5 cm long, with 4-6 cm long leaflets at its base. The flower heads are located in the axils and forked 3-5 times, with 5-8 (up to 32) bisexual flowers, each on a 2.5-5 cm long stalk. The buds are widest near the base, below which are two leaflets. The four pale-yellow calyx lobes remain present on the fruit, but are then recurved. The four yellowish to whitish petals are 8 mm long, and have densely woolly margins. Each flower has eight stamens and a 4-6 mm long style. The elongated, pear-shaped, brown fruit contains one fertile seed and is 2.5-4 cm long. The cylindrical hypocotyl (often mistaken for the 'fruit') is 20-35 cm, sometimes up to 1-2 by 54 cm. A sterile hybrid between *Rhizophora apiculata* and *Rhizophora stylosa* exists, originally recognised as a separate species "*Rhizophora lamarckii*" (now *Rhizophora* X *lamarckii*).

Ecology : Grows in a variety of tidal habitats on mud, sands, coarse grits and rock, preferring banks of tidal rivers, but also as a pioneering species in coastal environments or on landward margins of mangroves. One typical niche it may occupy is in the fringing mangroves of small 'coral' islands, growing on coral substrate. It produces flowers and fruit throughout the year. Probably pollinated by wind. Mangrove species.

Distribution : Apart from occurring in Taiwan and northern Australia, *Rhizophora stylosa* occurs primarily in Southeast Asia, where it has been recorded in Malaysia, the Philippines, Singapore, Vietnam, throughout Indonesia, Papua New Guinea and tropical Australia.

Abundance : Fairly common to common.

Use(s) : As timber, firewood and for the production of charcoal. Australian Aborigines use it to make boomerangs, spears and ceremonial objects. Light wine and a concoction to cure haematuria (blood in urine) are made from the fruit.

Source of illustration : Based on Ding Hou (1958), Tomlinson (1986) and Wightman (1989).

Reference(s) : Ding Hou (1958), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Wightman (1989), Aragones *et al.* (1998), Yao (2000).

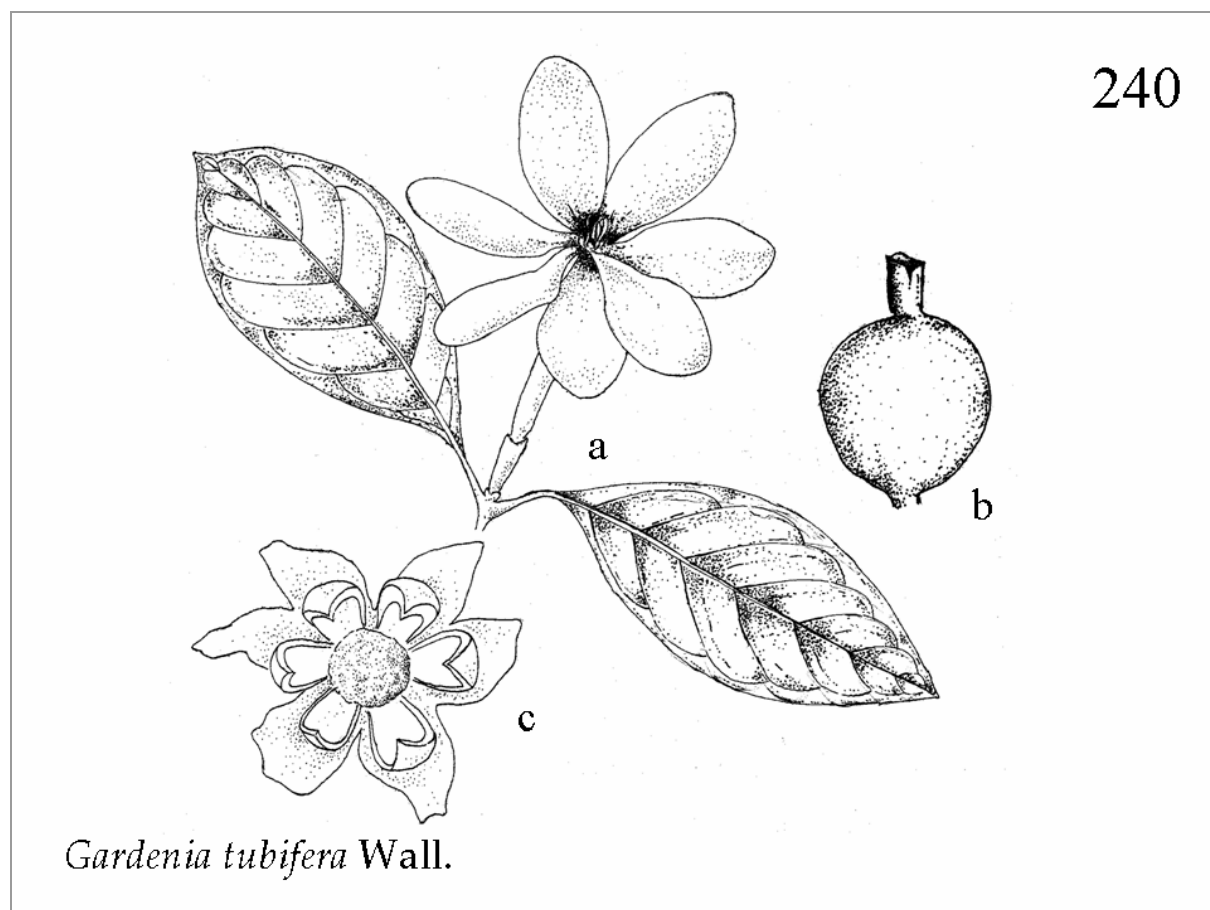


Fig. 240. *Gardenia tubifera* Wall. (a) Pair of leaves with flower, (b) fruit seen from side, and (c) ripe opened fruit, exposing the pulpy interior.

RUBIACEAE

240

Gardenia tubifera Wall.

Synonyms : *Gardenia elata* Ridl., *Gardenia gumnifera*, *Gardenia lucida* Roxb., *Gardenia resinifera* Korth., *Gardenia speciosa* (Hk.) Hk. f.

Vernacular name(s) : Water Gardenia, Canbi resin tree (E), Sugang, Sulang-sulang (Bru.), Chempaka utan, Pekan heran, Mentiong (Mal.), Piuweh, Medang geliser, Delima hutan, Cempaka hutan, Kayu tulak (Ind.)

Description : A shrub or tree, 8-15(-25) m, and 75 cm girth, with a tendency towards *Terminalia*-like branching. Bark pale grey or grey-brown, smooth, to finely cracked or slightly scaly, buds and twigged varnished with pale yellow resin; inner bark pale brown, sapwood pale yellow. Leaves smooth, (slightly) obovate to elliptic, shortly tipped, rather light green, strongly ribbed, drooping, with upwardly curled edges, 3-10(-12) by 5-26(-30) cm; leaf stalk 1-2.5(-3.5) cm; resinous. Flowers 3-9 cm across, variable in size on different plants, at first creamy white, later orange-yellow, (very) fragrant; calyx tube 6-25 mm, smooth or slightly ribbed, often shortly split; corolla tube 3.5-10 cm long, petals number 6-9(-10), edges recurved. Fruit 2.5-5 cm wide, nearly round, pale apple green, crowned with the calyx tube, splitting open to reveal the orange-red interior, gaping widely; the inside of the fruit mealy, orange-yellow, with 6-8 very bony shells around the tomato-red seed mass. *Gardenia tubifera* forma *tubifera* has smaller leaves, not exceeding 6 cm in width, veins below are smooth, calyx tube 0.8-2 cm long, corolla tube 2.5-7.5 cm long, fruit up to 3.5 cm across. In Southeast Asian mangrove literature often described as *Gardenia lucida*.

Ecology : In lowland and hill forests. Form *tubifera* is usually found in lowland sites near the coast, in swamp areas or (occasionally, e.g. in Vietnam and Myanmar) on the landward margins of mangroves. Flowers open at dusk and last for three nights; they are creamy white on the first night, chrome-buff on the second, and intensely orange on the third day when they fall off. Birds, squirrels and musang are attracted by the brightly coloured seed mass for food. Mangrove associate species.

Distribution : From South to Southeast Asia, where it has been recorded in Myanmar, Thailand, Vietnam (as *Gardenia lucida*), Malaysia, Singapore, Brunei and Indonesia (Sumatra, Java, Borneo).

Abundance : Common.

Use(s) : Cultivated in Java. Wood used for construction of house interior. Resin is used to prepare mosquito repellent sticks in South Asia. Gum is used in the Indian system of medicine. Ornamental species, sold world-wide (as a botanical rarity).

Source of illustration : Corner (1988)

Reference(s) : Heyne (1950), Corner (1988), Wong (1989), Hong (2000), Maung (2003), http://botanical.com/site/column_poudhia/30_one_night.html.

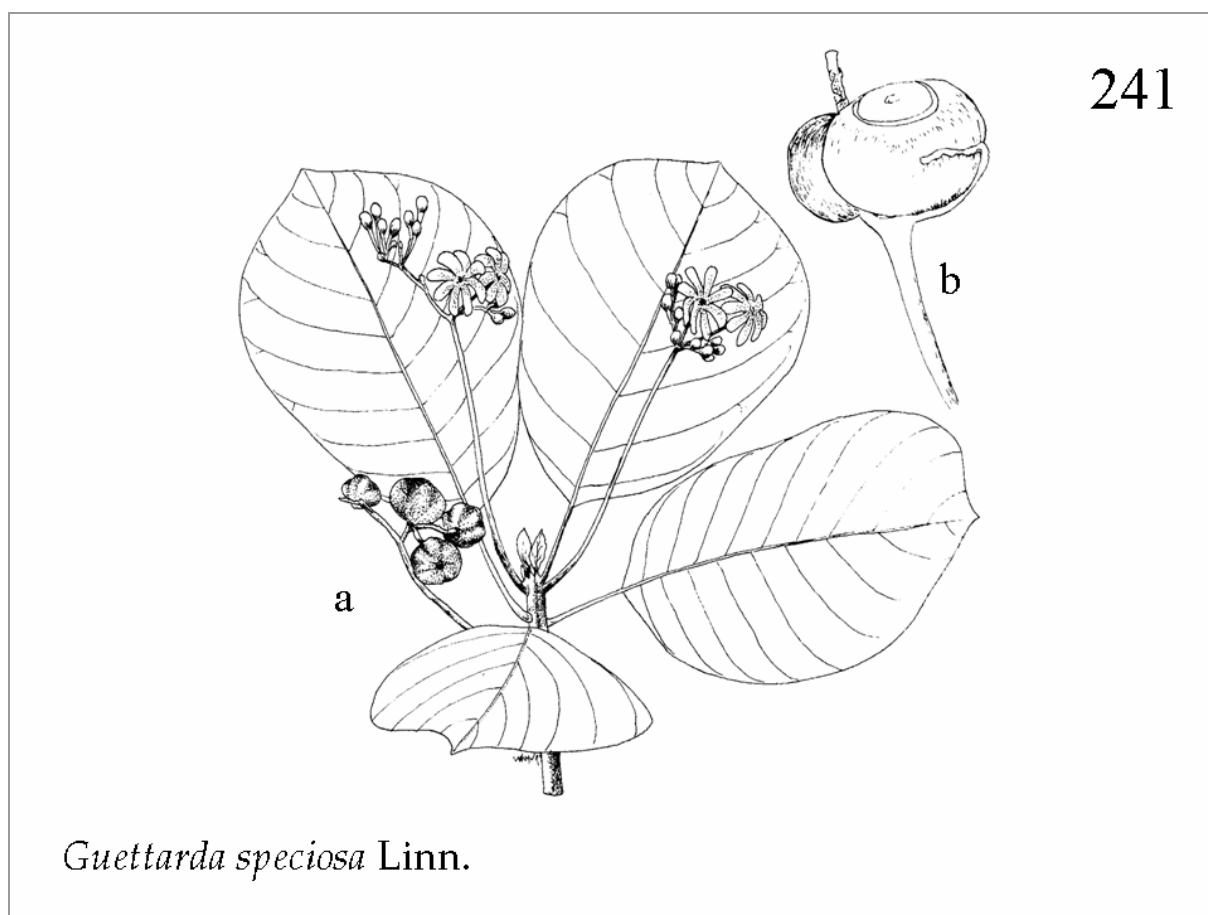


Fig. 241. *Guettarda speciosa* Linn. (a) Branchlet with flowers and fruit, and (b) two mature fruit.

RUBIACEAE

241

Guettarda speciosa Linn.

Synonym(s) : *Guettarda vermicularis* Blanco, *Nyctanthes hirsuta* Linn., *Tittius litorea*

Vernacular name(s) : Sea Randa, Beach Gardenia (E), Selar Makan (Mal.) Jati Pasir, Titi Laut, Kenyang-kenyang, Haruna, Tasi (Ind.), Banaro, Bagaolan, Balangigan, Balibagan, Kalumpangin, Kapagan, Lagbangan, Lambon, Malasurut, Tabon-tabon, Tabug, Tambon, Tulatalisai (Phil.)

Description : Spreading shrub or small tree, usually 4-10(-15) m tall, frequently many-stemmed, crooked, with a rounded crown. Bark is smooth and grey-brown. Twigs are thick, with large leaf scars. Leaves are opposite, broadly ovate or obovate, 9-24 by 6-20 cm, coarse below, and with hairs on both sides (or only below), rounded or heart-shaped at the base. Secondary veins occur in 8-11 pairs, while tertiary veins are ladder-like; leaf tips are blunt, while bases are rounded to heart-shaped; leaf stalks are 15-40 mm long. Flowers occur in clusters in the leaf axils; cluster stalks are 6-9 cm, while individual flowers occur almost stalkless on this common cluster stalk. Flowers are tubular, white and fragrant. The calyx is small and cup-shaped, while the corolla is trumpet-shaped, white on the outside with short, velvety hairs. The yellowish corolla tube is 17-35(-50) mm long and has 4-9 lobes. Fruits are without a stalk, flattened and round, 15-30 mm across, smooth, with a hard stone, green, then whitish or pinkish, closely (faintly) ribbed (4-6 grooves, corresponding with the 4-6 cells) when dried. Each cavity has one seed. Because of its large leaves one might mistake it for a *Barringtonia asiatica* or *Terminalia catappa*, but the leaves are set differently.

Ecology : Occurs on both rocky and sandy sea shores (Corner, 1988) and margins of mangroves (Hong & San, 1993), flowering throughout the year. The fragrant flowers are pollinated by moths, as they (usually 1-2 per axil) open an hour after sunset, and the corolla fall off the following morning. The tree flowers throughout the year. Fruits are buoyant and are probably dispersed by water. Mangrove associate species.

Distribution : Pantropical, and found throughout Southeast Asia. Not (yet) recorded in Brunei.

Abundance : Common.

Use(s) : Bark used to treat dysentery. The flowers are very fragrant, and women put them in their hair or string them into necklaces. They open in the evening, and fall before dawn. Bark is applied to wounds and abscesses.

Source of illustration : Based on Polunin (1988) and Wong (1989).

Reference(s) : Heyne (1950), Corner (1988), Polunin (1988), Wong (1989), Hong & San (1993), <http://farrer.riv.csu.edu.au/ASGAP/g-spe.html>, <http://bpi.da.gov.ph/websitemedicinal/all/b/banaro.htm>.

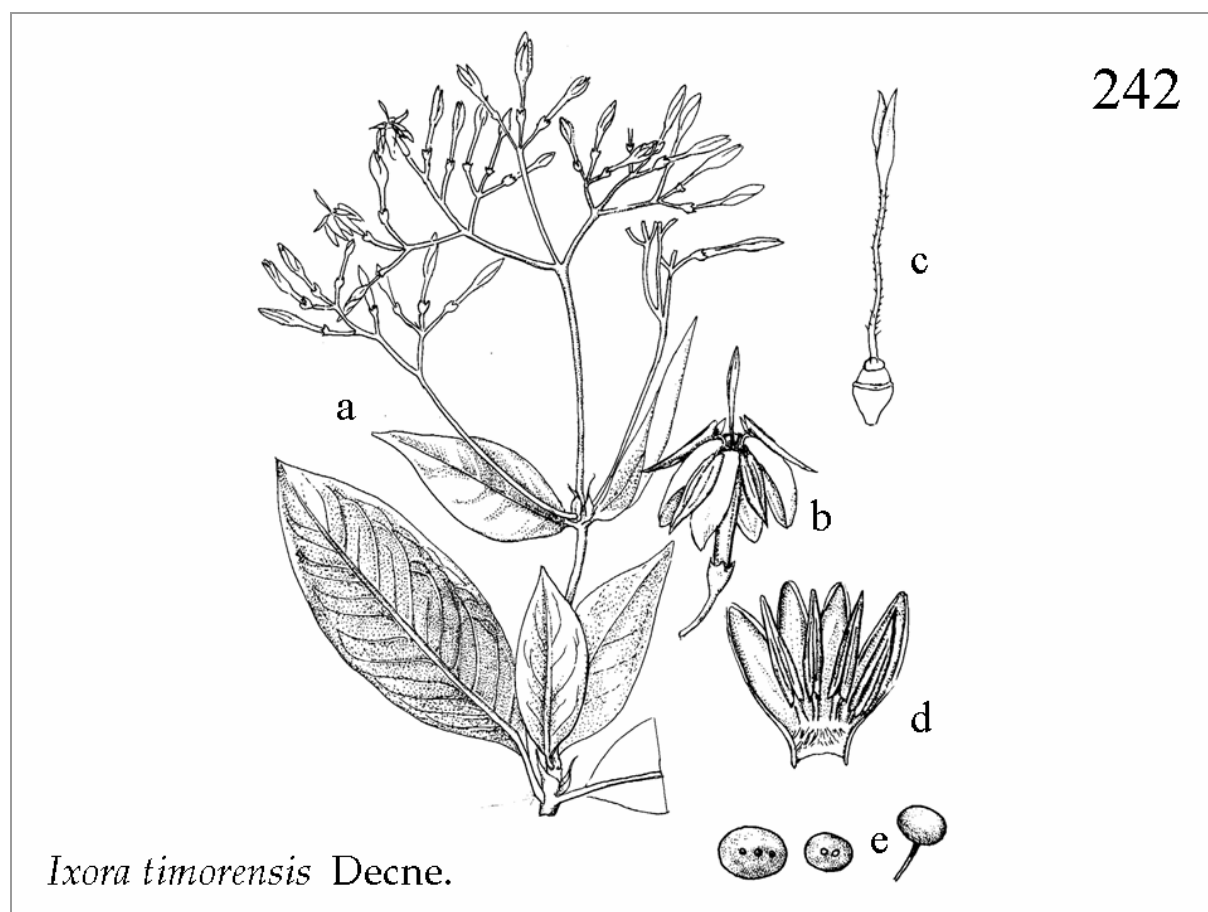


Fig. 242. *Ixora timorensis* Decne. (a) Branchlet with flowers, (b) flower, (c) stigma, (d) opened corolla exposing the stamens, and (e) fruit.

RUBIACEAE

242

Ixora timorensis Decne.**Synonyms :** Unknown.**Vernacular name(s) :** Unknown.

Description : Erect shrub or small tree, up to 6 m tall, with thin, leathery, lanceolate-oblong or almost round leaves, 3.5-7.5 by 10-17 cm; leaflets at the base of the leaf stalk (=stipules) are 6-7 mm long and pointed. Young twigs are reddish brown, square in cross-section. The flower heads are widely branched and have a stalk of 0.5-4 cm. The bisexual flowers have a strong, sweet scent and are white with a greenish tube, and a red style, 1-1.5 cm long. After several days the flowers turn pale brown, later turning black. The corolla is trumpet-shaped; its tube is tufted and hairy on the inside. Pollen becomes attached to the thickened upper part of the style while it is still in bud. In the opened flower the pale brown stamens hang down between the petals; at this point the anthers are empty. The hard berry is almost dry, greyish green but later red, and measures 6-7 mm across.

Ecology : Occurs on landward margins of mangroves. Rarely further inland, recorded to an altitude of 200 m asl on Java. Mangrove associate species.

Distribution : Southeast Asian species with a (very) limited distribution, found only in East Timor and Indonesia (Java northern coast, Bawean, Madura; October 1996 discovered by one of the authors [WG] in brackish lower reaches of the Sebangau Kecil river in Central Kalimantan, Indonesian Borneo).

Abundance : Locally common, but uncommon on the whole.

Use(s) : Unknown.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Backer & Bakhuizen van den Brink (1963-8).

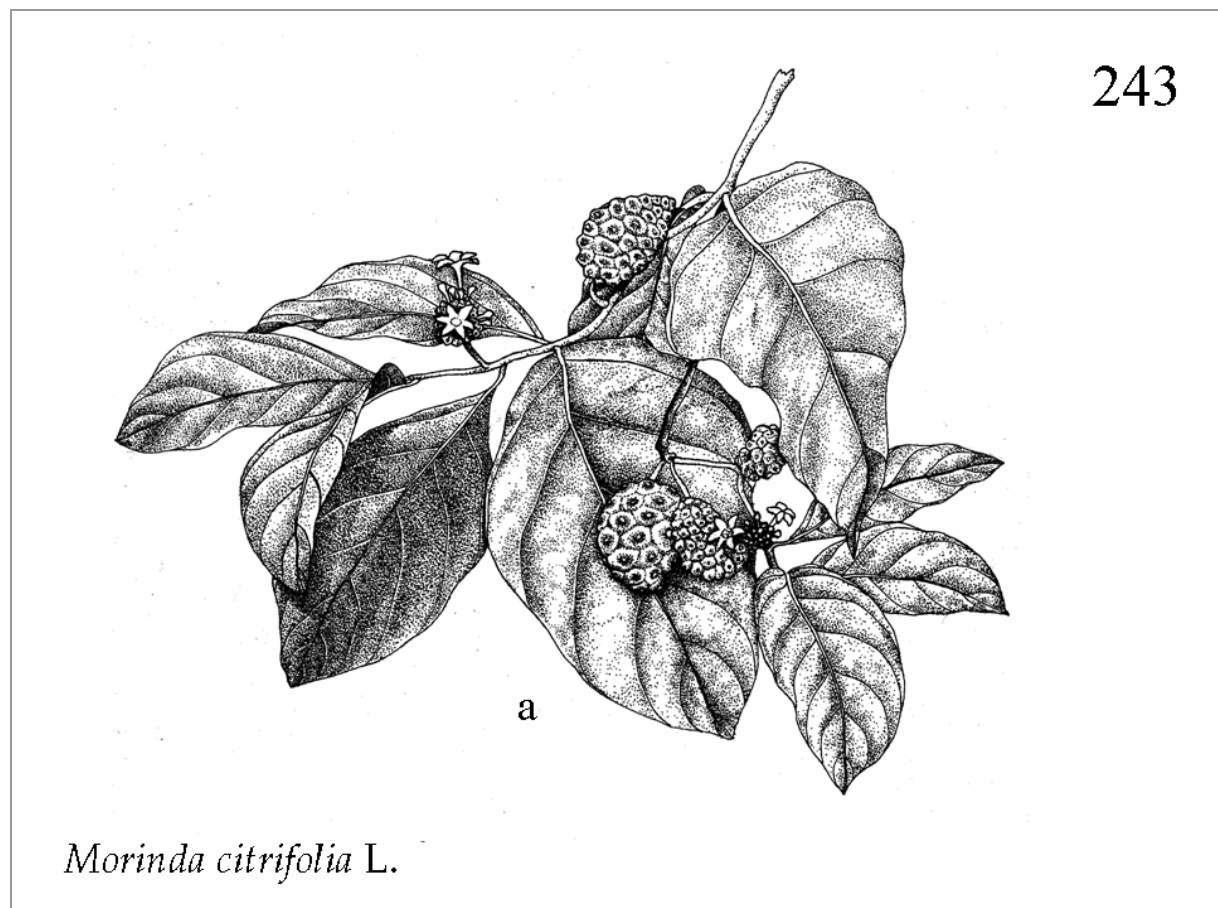


Fig. 243. *Morinda citrifolia* L. (a) Branchlet with flowers and fruit.

RUBIACEAE

243

Morinda citrifolia L.

Synonyms : *Bancudus latifolia* Rumph., *Morinda citrifolia* Hunter

Vernacular name(s) : Great Morinda, Indian Mulberry (E), Mengkudu besar, Mengkudu daun besar, Kemedu (Mal.), Bengkudu, Mengkudu, Mekudu, Cangkudu – *Mengkudu* (Ind.), Bakulu (ET)

Description : Small evergreen tree, 5-8 (-9)m, with a conical crown. Bark pale greyish-brown, shallowly fissured, smooth. Leaves opposite, arranged in alternating pairs, broadly elliptic, 10-30(-40) by 5-14(-17) cm, fleshy, secondary veins 5-8 pairs, with large, persistent leaflets at the base of the 1cm-long leaf stalk. Flower heads are produced on the upper sides of lateral branches, and appear to be leaf opposed because the leaves from the axils in which they appear are underdeveloped. Flower heads are solitary, 0.8-3.0 cm across, stalks 0.5-2.0 cm long, flowers white, corolla tube 10-12 mm long, smooth outside, hairy at the throat inside, corolla lobes 4 or 5, each 5-6 mm long, slightly fragrant. Fruiting heads oblong to ovoid, 1.2-5.5(-10) cm long, ripening whitish to yellowish, containing many seeds.

Ecology : Tolerant of a very wide range of habitats, from wet to dry, poor to rich soils, up to an altitude of 300 m asl. Cultivated in lowland areas throughout its range, commonly found wild along the coast, including rocky coasts and landward margins of mangroves. Often infested with the large red weaver ants *Oecophylla smaragdina* that fabricate nests from the large leaves of this species and attack with a frenzy if disturbed. The ripe fruit rots very readily, thereby spreading a terrible stench. Mangrove associate species.

Distribution : Possibly native to Southeast Asia and northern Australia, but now pantropical and subtropical, and especially common on the Pacific Islands. Type specimen from India (18th century), where it may have been introduced. Found throughout Southeast Asia.

Abundance : Common.

Use(s) : Wood is hard and has a fine and even texture. The dye morindin (yellow to deep orange) is obtained from the root bark, but this use has largely been displaced by cheap synthetic dyes. Leaves are used in combination with coconut oil and rubbed on the skin to treat stomach disorders and provide relief after childbirth. The fruits are used to treat wounds and are taken as an anti-diuretic; unripe fruits eaten as 'rujak' in Indonesia, but the bitter tasting ripe fruits are not eaten. The fruits are eaten as a famine food, and in some Pacific islands, are even a staple food of choice (Raratonga, Samoa, Fiji), where they were eaten raw or cooked. Elsewhere, the fruit is eaten raw with salt (Indochina, Australian Aborigines); or cooked as a curry. The fruits may also be fed to pigs. Young leaves can also be eaten as a vegetable and contain protein (4-6%). Seeds may be roasted and eaten.

Source of illustration : Drawn from live specimen.

Reference(s) : Heyne (1950), Afriastini (1988), Corner (1988), Wong (1989)
<http://www.naturia.per.sg/buloh/plants/morinda.htm>,
<http://www.agroforestry.net/pubs/tti/morinda.pdf>

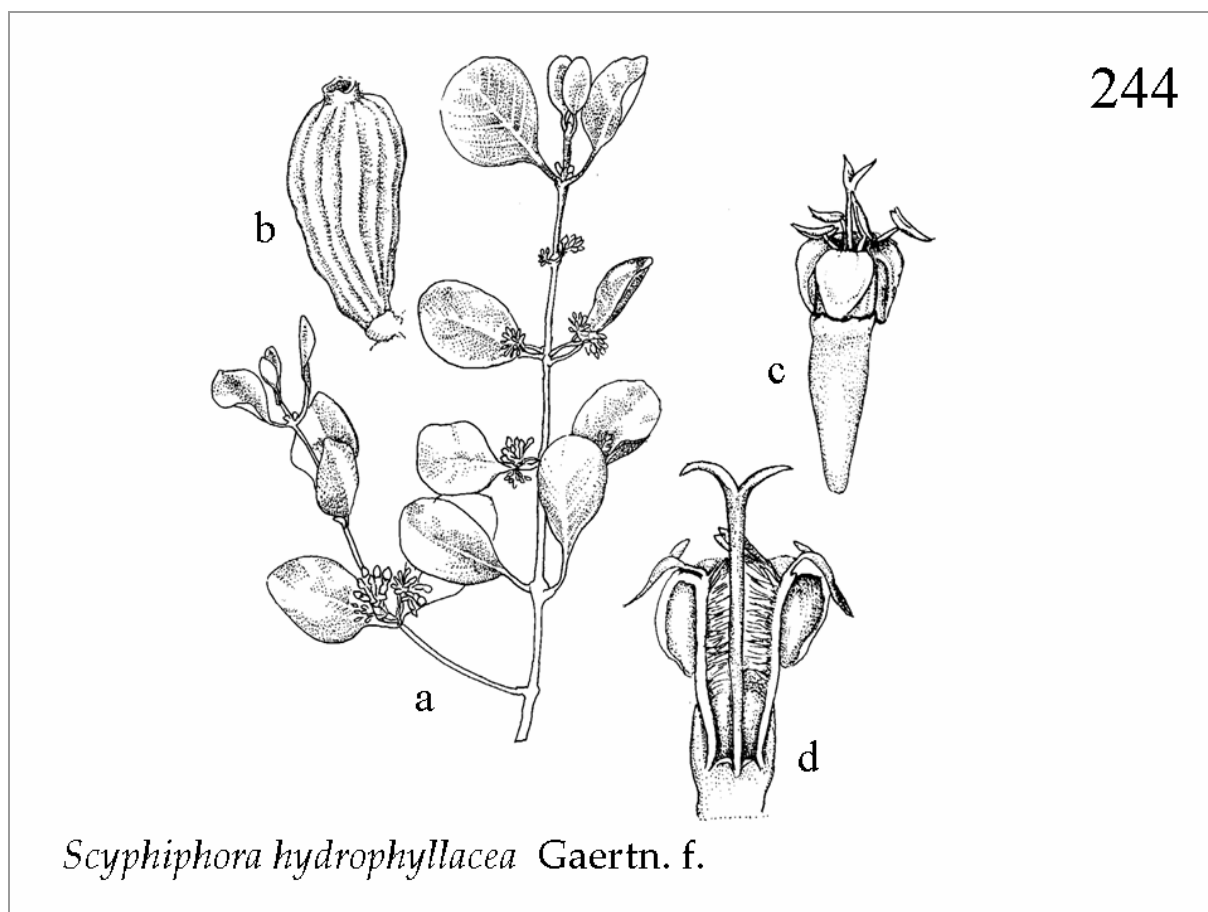


Fig. 244. *Scyphiphora hydrophyllacea* Gaertn. f. (a) Flowering branchlet, (b) fruit, (c) flower, and (d) longitudinal section of flower.

RUBIACEAE

244

Scyphiphora hydrophyllacea Gaertn. f.

Synonyms : *Ixora manila* Blanco, *Scyphiphora hydrophyllacea* (sic)

Vernacular names : Perepat Lanang, Cingam, Duduk Perempuan, Dudul Rayap, Dandulit (Ind.), Agnaya, Aranaya, Arinaya, Balasiai, Hanbulali, Kulasi, Landing, Nilad, Nilar, Sabasa, Sagasa, Tabau, Tagsiak, Tugsiak, Unas – *Nilad* (Phil.), *Côi* (Viet.), *See ngam* (Thai)

Description : Erect, evergreen, often much-branched shrub or small tree, up to 3 m tall but rarely exceeding 2m, with rough, brown bark, resinous young shoots and, occasionally, with prop-roots in larger specimens. The glandular leaflets at the base of the leaf stalk form a hairy sheath. The slender leaf stalk is up to 13 mm long. Leaves are simple, leathery, glossy and obovate, measuring 4-9 by 2-5 cm. The bisexual, almost stemless, usually white flowers occur in dense clusters in leaf axils on stalks that measure up to 15 mm. The calyx tube is coiled and 5 mm long; the end of the tube is cup-shaped, 1 mm long, and crowned by four minute teeth. The cylindrical corolla tube is sometimes tinged with red, 2-4 mm long, with a rough-hairy mouth; the broadly elliptic petals measure 2 by 2.5 mm. Fruit is cylindrical, green and ribbed along its length (appearing 6-8 angular), corky inside, 8 mm long, and tipped with the remnants of the calyx. It does not open when ripe. Fruits contain four cylindrical seeds that each measure 1 by 2 mm. The shrub resembles *Lumnitzera*, which when sterile can be distinguished by its spirally-arranged leaves.

Ecology : Occurs on mud, sand and rocky substrates on the landward margin of mangroves or on the banks of tidal waterways. It appears intolerant of lengthy periods of freshwater inundation and usually occupies sites that are frequently inundated by the tide. It is reported to occur on sites that are unsuitable for colonisation by other mangrove species. Flowering occurs throughout the year. Flowers may be insect- or self-pollinated. Fallen fruit float and land along the shores in large quantities. Nectar is produced by a glandular disc at the base of the corolla. Produces a lot of fruit, but seed germination levels are relatively low. The fruit is well adapted to water dispersal because of the corky and buoyant fruit wall. Mangrove species.

Distribution : Occurs from southern India and Sri Lanka through Southeast Asia to northern Australia and western Polynesia (Solomon Islands). In Southeast Asia it has been recorded in Thailand, Vietnam, Cambodia, the Philippines, Malaysia, Brunei, Singapore, throughout Indonesia and Papua New Guinea.

Abundance : Scattered and locally common, but on the whole relatively uncommon.

Use(s) : Wood may be used to make utensils, such as spoons. Larger specimens used for fence posts and firewood. Contain high amounts of tannin and dye. A medicine is prepared from the leaves to treat stomach problems.

Source of illustration : Based on Tomlinson (1986), Wrightman (1989).

Reference(s) : Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Wrightman (1989), Said (1990), Aksornkoae (1993), Aragones *et al.* (1998).

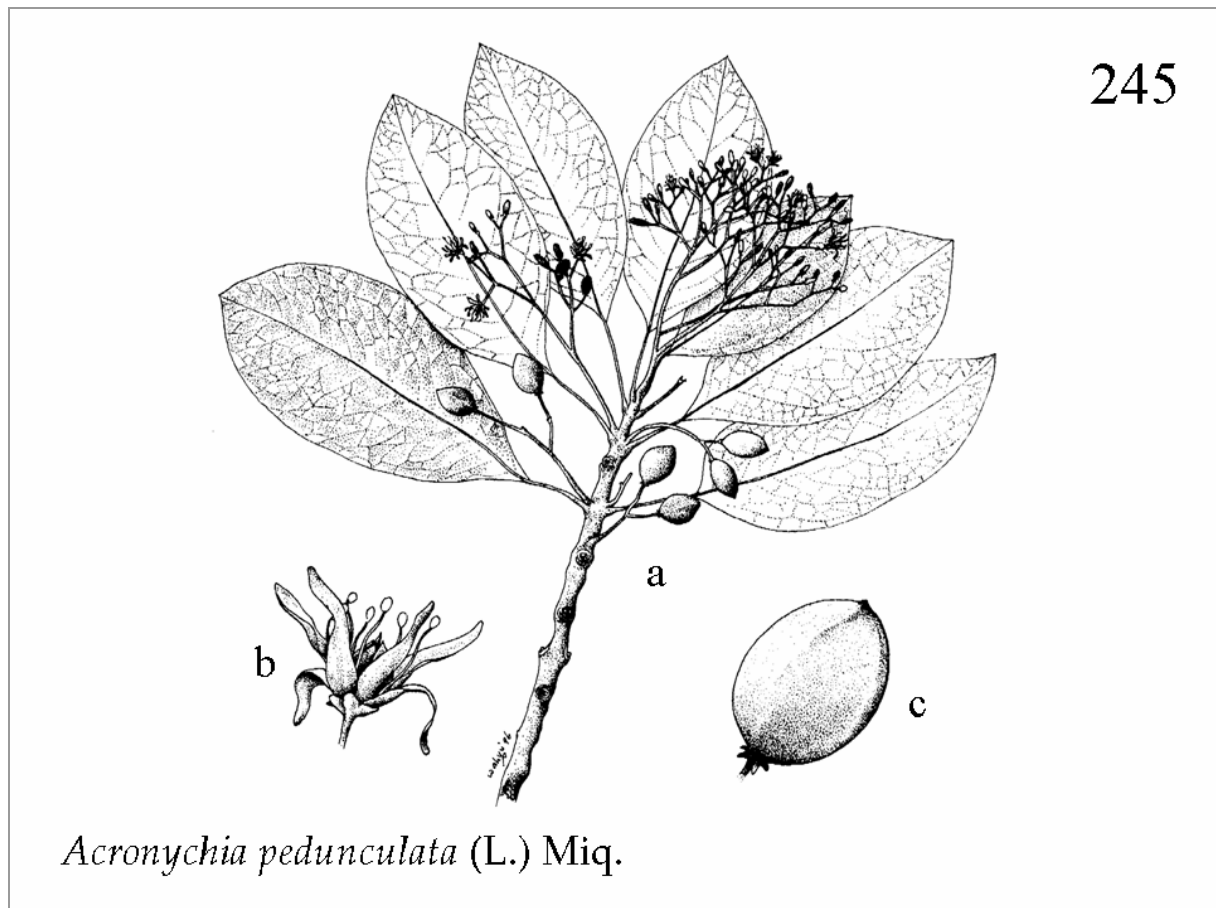


Fig. 245. *Acronychia pedunculata* (L.) Miq. (a) Branchlet with flowers and fruit, (b) flower, and (c) fruit.

RUTACEAE

245

Acronychia pedunculata (L.) Miq.

Synonym(s) : *Acronychia arborea*, *Acronychia laurifolia* Blume, *Cyminosma pedunculata* DC., *Gela lanceolata* Lour., *Jambolifera pedunculata* L.

Vernacular name(s) : Kayu Semidra, Sarirah, Serilang, Sesira, Jerukan, Salira – *Ki salira* (Ind.)

Description : Small to large tree, 12-38 m, with a girth of up to 1.25 m. More usually 3-10 m tall. Twigs and leaf stalks are brown, the latter measuring 12-16 mm. Leaves are elliptic to oblong-elliptic, 3-6 by 5-15 cm, thinly leathery, with a net-like network of veins prominent on both sides; secondary nerves number 14-18 pairs. Leaves are opposite, simple and entire. Flowers are mainly 4-merous, with triangular sepals, petals that are lanceolate and hairy on the inside, and have eight stamens. Flowers measure 8-20 mm across. Fruit is round, green or cream-coloured, usually less than 1 cm across. Commonly called *Acronychia laurifolia* in Southeast Asian literature.

Ecology : Reported from primary and secondary lowland forest and margins of mangrove. From sea level up to 2,400 m on Java. Mangrove associate species.

Distribution : From Sri Lanka and India, to southern China, through Southeast Asia to western Polynesia. In Southeast Asia recorded from Malaysia, Brunei, Vietnam, Thailand, Indonesia (Sumatra, Java, Sulawesi and Papua).

Abundance : Locally common, but on the whole uncommon.

Use(s) : Sometimes used for internal construction timber, but it is not very durable. Very good for charcoal production. Young leaves are consumed as a vegetable. Leaves contain up to 0.06% etheric oils. Fruits are edible, and fruit dropped on the ground is often consumed locally. The fruit is also a favourite of monkeys and other wildlife.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium.

Reference(s) : Heyne (1950), Stone (1972), Whitmore, Tantra & Sutisna (1990), Hong & San (1993), Missouri Botanical Garden TROPICOS database (www.mobot.mobot.org), http://www.rspg.thaigov.net/scbotdat/plantdat/rutaceae/apedun_1.htm.

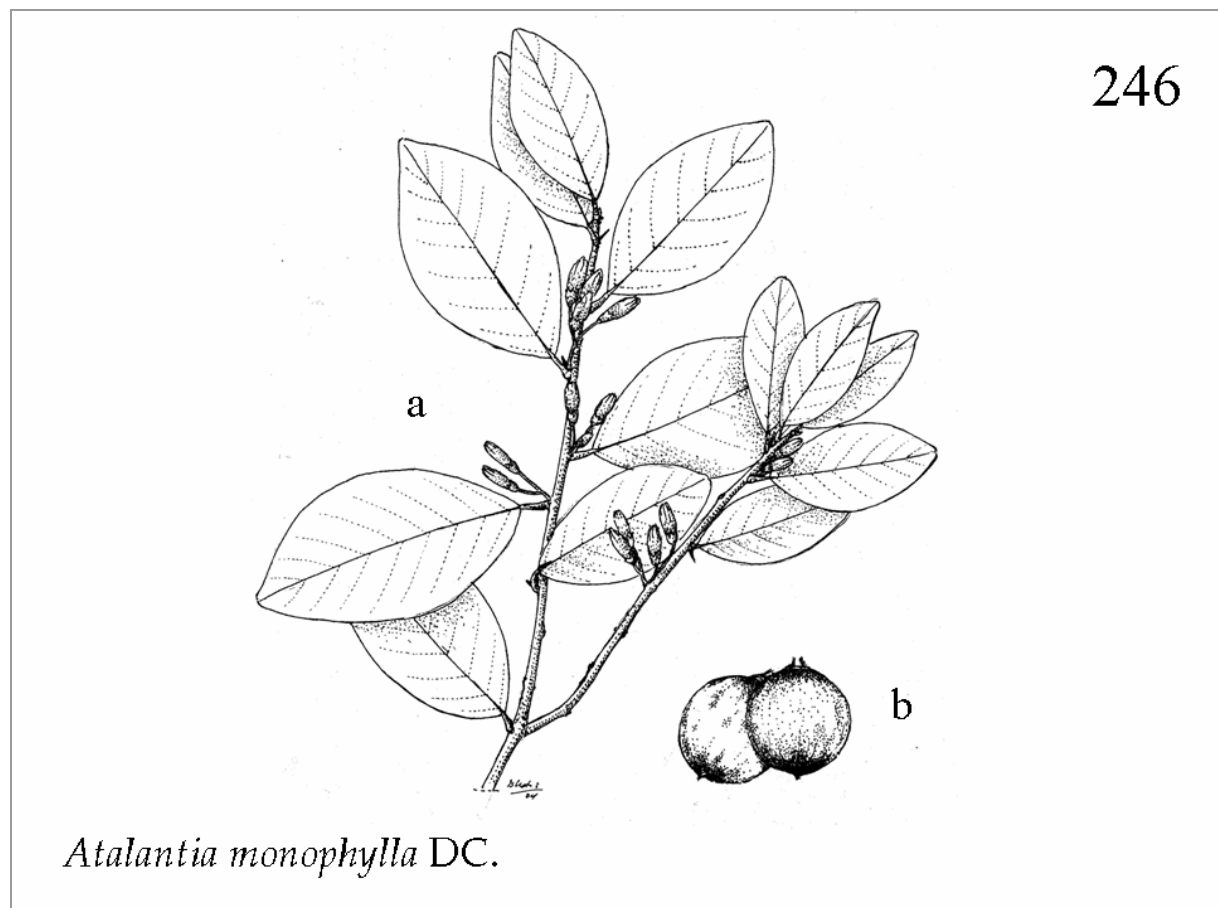


Fig. 246. *Atalantia monophylla* DC. (a) Flowering branchlet, and (b) fruit.

RUTACEAE

246

Atalantia monophylla DC.

Synonyms : *Atalantia spinosa* Tanaka

Vernacular name(s) : Sea Lime (E), Merlimau, Limau Hantu (Mal.), Malarayap (Phil.)

Description : A very spiny evergreen shrub or small tree, up to 6(-12) m, stem rather deeply fluted from the base and set with many short, stiff, thorny twigs; bark greyish brown and smooth; stem rarely more than 8 cm diameter; twigs more or less angular when young, usually armed with short, solitary, sharp spines in the leaf axils. Leaves are alternate, simple and wingless (unlike many other Rutaceae species). Leaf blade elliptic, 3.5-6.5(-11) cm by 3-4(-6.5) cm, rather leathery, smooth, notched at the tip; leaf stalk 0.5-1.0 cm long. The leaf blade is indented/notched and marked by a whitish spot. Flowers 12 mm wide and 10-13 mm long, white or tinged with pink, in small clusters located at the ends of branchlets or in axils; calyx splitting into 2 irregular lobes; petals 5, stamens 6-10, joined in a tube. Fruit rounded oblong, green, 12-19 mm wide. In habit the tree looks very much like a citrus, with its leaves standing stiffly erect; leaves smell like citrus when crushed.

Ecology : Recorded from rocky and sandy coasts, in dry open country, and along landward margins of mangroves. Mangrove associate species.

Distribution : From India eastwards to Southeast Asia, where it has been recorded in Myanmar, the Philippines, Peninsular Malaysia, Thailand and Cambodia.

Abundance : Locally common, but on the whole uncommon.

Use(s) : Wood used for making handles. The root and bark of *Atalantia monophylla* is dried, ground and used as a poultice to treat sprains and fractures.

Source of illustration : Redrawn from photograph obtained via Missouri Botanical Garden TROPICOS database (www.mobot.org)

Reference(s) : Stone (1972), Corner (1988), Marschke (2000), Yao (2000).
<http://www.mssrf.org/fris9809/fris1031.html>.

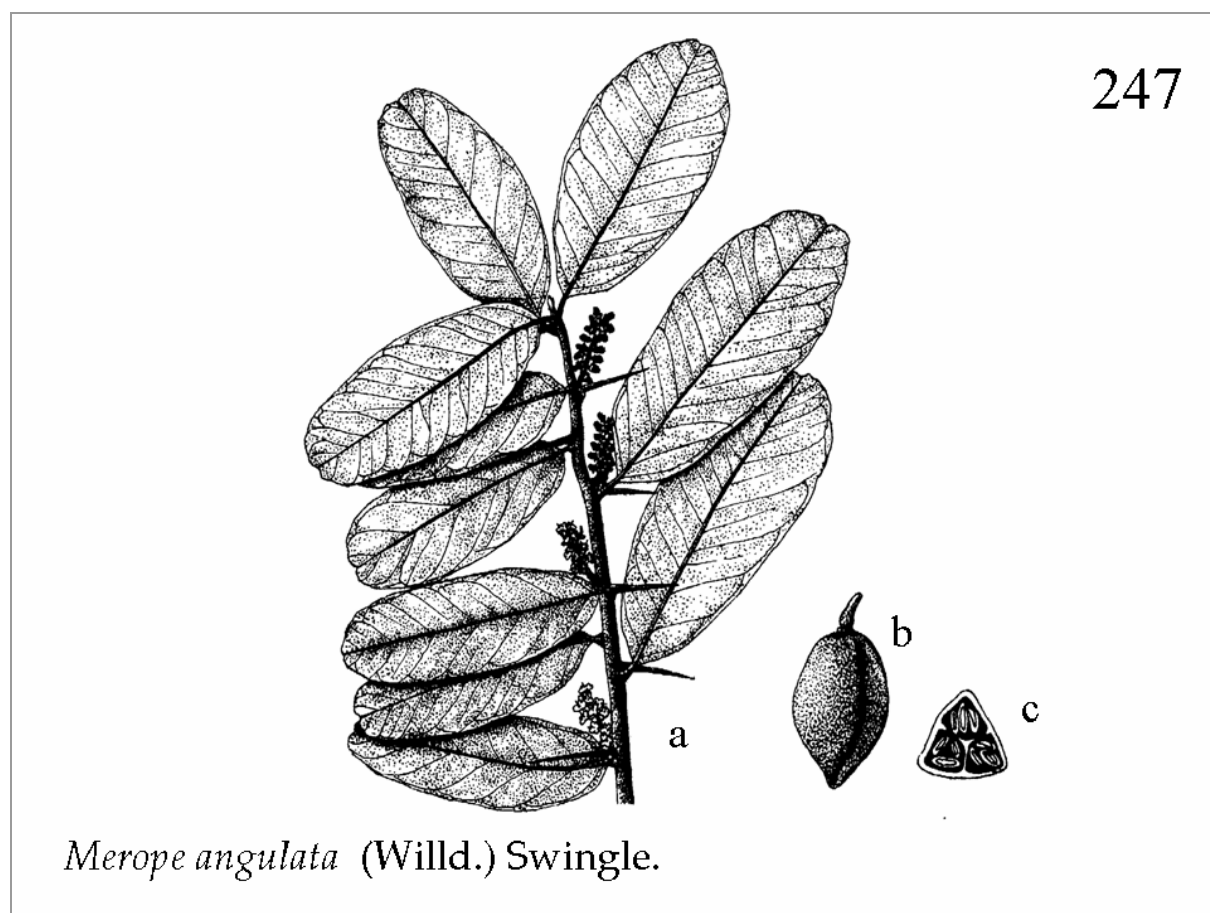


Fig. 247. *Merope angulata* (Willd.) Swingle. (a) Flowering branchlet, with spines, (b) fruit, and (c) cross-section of fruit showing seeds.

RUTACEAE

247

***Merope angulata* (Willd.) Swingle**

Synonyms : *Merope spinosa*, *Paramignya angulata* (Willd.) Burkill, *Paramignya longispina* Hk., *Sclerostylis spinosa*

Vernacular name(s) : Mangrove lime (E), Limau Lelang, Lemau lilang (Mal.)

Description : A broadly-branching, shrubby, occasionally scrambling, low tree, up to 3 m tall. It has (often paired) woody spines located in the axils and are 1.5-3.5(-5) cm long. The alternate, thickly leathery, aromatic leaves have transparent dots and measure 4.5-16 by 2-7 cm; the leaf stalks are unwinged; leaf edges are slightly notched; leaf tip blunt or slightly pointed. Leaves are covered with minute glands (visible as translucent dots when held to the light) and have a resinous, lime-like odour if bruised. The white, bisexual flowers are 5-merous, about 2 cm long, fragrant, solitary, and occur in leaf axils either in pairs or clusters of only a few flowers; stamens 10; petals are 7-9 mm long. The strongly smelling berry-like fruits are yellow, oblong or ovoid triangular, lemon-like, 2-5 cm long, with 3 flattened sides so that the fruit is triangular in cross-section; has 3 (4) chambers which each contain 1 large, long, flattened seed, 38 by 14 by 4 mm, contained in slime; tip is pointed.

Ecology : Restricted to landward margins of mangroves and along river banks. In Java, flowering has been recorded in March, May, November and December. Mangrove associate species.

Distribution : From West Bengal (India) eastwards through Southeast Asia, where it has been recorded from Myanmar, Malaysia, Singapore (where it is rare), Indonesia (Java), and Papua New Guinea.

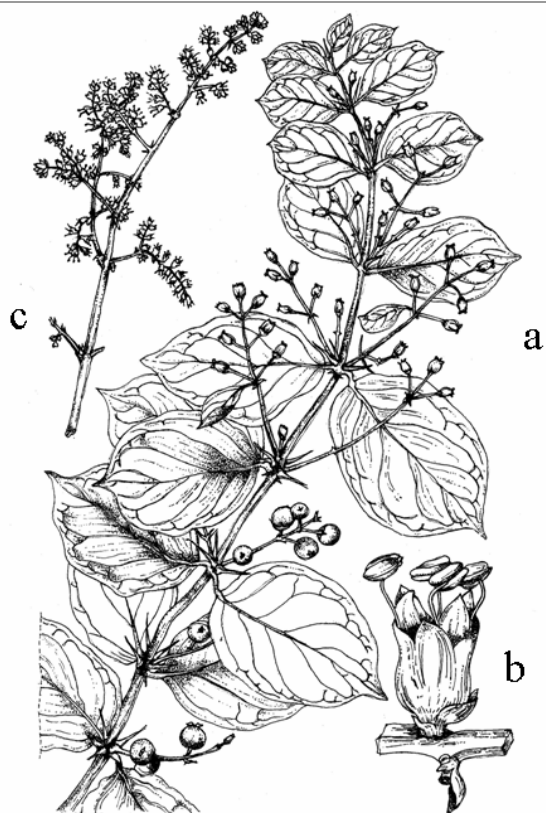
Abundance : Rather scattered, but locally abundant.

Use(s) : Burkill (1935) reported the use of this plant to treat abdominal complaints and assist womb contraction after childbirth. Interesting for horticulture, as it may provide a salt-tolerant root stock for *Citrus*.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium; Corner (1988)

Reference(s) : Burkill (1935), Backer & Bakhuizen van den Brink (1963-8), Stone (1972), Tomlinson (1986), Maung (2003), <http://www.sbwr.org.sg/wetlands/text/101-03.htm>.

248



Azima sarmentosa (Bl.) B. & H.

Fig. 248. *Azima sarmentosa* (Bl.) B. & H. (a) Branchlet with female flowers and fruit, (b) male flower, and (c) male flower cluster.

SALVADORACEAE

248

***Azima sarmentosa* (Bl.) B. & H.**

Synonyms : *Actegeton sarmentosum* Bl., *Azima nova* Blanco, *Monetia barlerioides* (non L'Hér) Miq., *Monetia sarmentosa* Baill.

Vernacular name(s) : Papajaran, bulangan (Ind.), Chùm lé (Viet.)

Description : An erect shrub, often with drooping or rambling branches, 2-4 m, usually smooth and free of hairs. Leaf axils often with 1-2 thin, straight and very sharp 2-16 mm long spines that can easily break off. There are 2 leaflets at the base of each leaf stalk, that are persistent. Leaves are simple, opposite, variable: ovate, elliptic, oblong, oval, sub-orbicular or obovate, abruptly tipped with a triangular point; thinly leathery, with strong mid-rib, shining, 2-6.5 cm by 1.5-6.6 cm; leaf stalk 3-7 mm. Flowers in clusters of 1-25 cm long. Both calyx and corolla 4-merous. Male flowers crowded and (almost) without a stalk; calyx more or less deeply divided into obtuse erect segments, 2-2.5 mm long; petals somewhat longer than the calyx, oblong, green, 2-2.5 mm long. Female flowers on 1-8 mm long stalks, calyx 1.25-1.5 mm long, corolla as in male flower, but only 1.5-2 mm long. Fruit is an imperfectly 4-celled round berry, white, 6 mm diameter, each with (1-)2-3 seeds. The crushed branches and leaves emit an offensive smell.

Ecology : Dry coastal regions, from coast up to about 160 m asl. In periodically very dry localities, thickets, hedges, field and forest borders. Small family (3 genera, 11 species world-wide), generally confined to arid, hot and saline environments. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Myanmar, Cambodia, Thailand, Vietnam, Peninsular Malaysia and Indonesia.

Abundance : Locally abundant, but with scattered distribution.

Use(s) : Unknown.

Source of illustration : Backer (1951)

Reference(s) : Backer (1951), Heywood (1993), Nguyen *et al.* (2000).

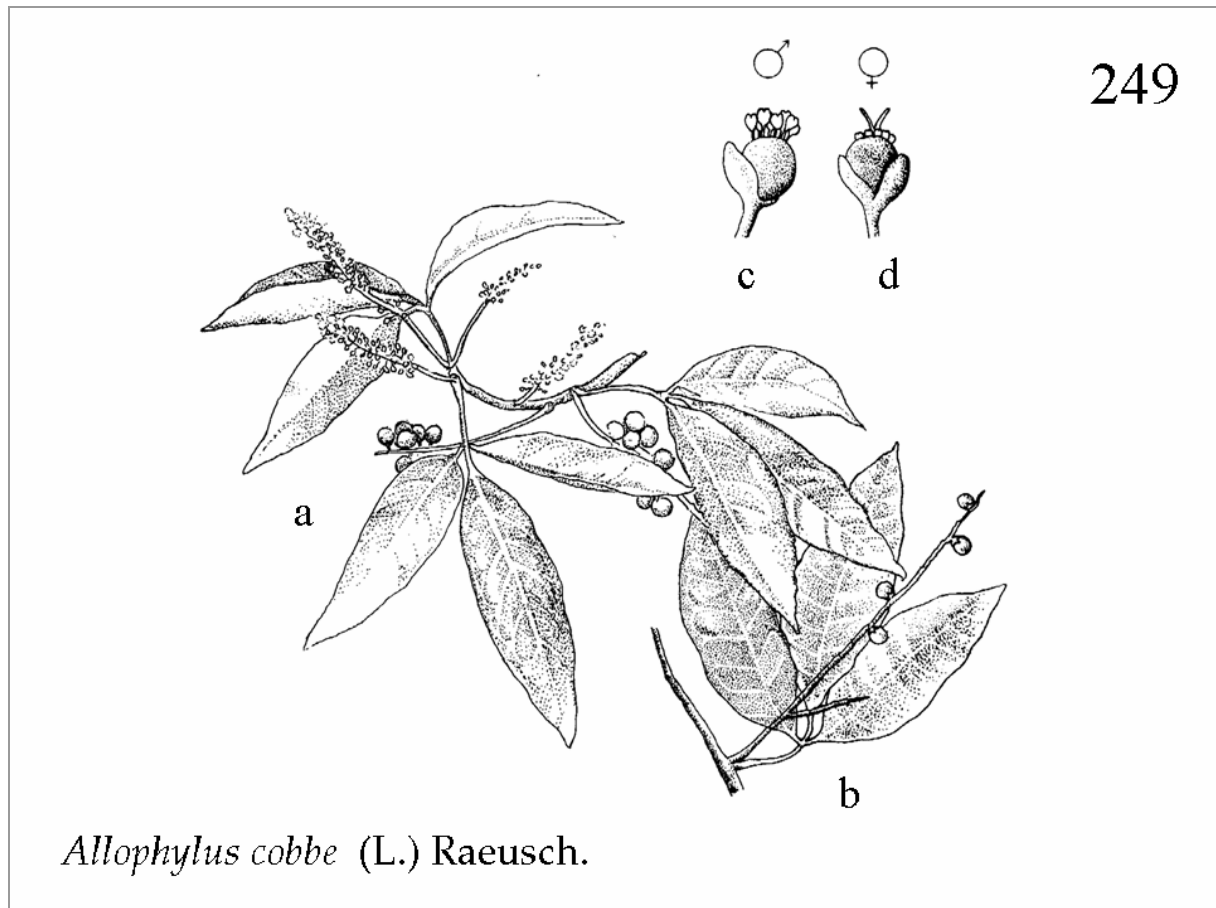


Fig. 249. *Allophylus cobbe* (L.) Raeusch. (a) Branchlet with flowers and fruit, (b) branchlet with fruit, (c) male flower, and (d) female flower.

SAPINDACEAE

249

Allophylus cobbe (L.) Raeusch.

Synonyms : *Allophylus amboinensis* Blume, *Allophylus apiocarpus* Radlk., *Allophylus blancoi* Blume, *Allophylus cambessedei* Blume, *Allophylus celebicus* Blume, *Allophylus chlorocarpus* Radlk., *Allophylus cobbe* (L.) Raeuschel., *Allophylus dimorphus* Radlk., *Allophylus filiger* Radlk., *Allophylus fulvoinervis* (Blume) Blume, *Allophylus glaber* Boerl., *Allophylus integrifolius* Blume, *Allophylus javensis* (Blume) Blume, *Allophylus leptococcus* Radlk., *Allophylus ligustrina* Blume, *Allophylus littoralis* (Blume) Blume, *Allophylus macrostachys* Radlk., *Allophylus micrococcus* Radlk., *Allophylus quinatus* Radlk., *Allophylus rufescens* Blume, *Allophylus rugosa* Blume, *Allophylus setulosus* Radlk., *Allophylus sumatranus* Blume, *Allophylus sundanus* Miq., *Allophylus ternatus* Lour., *Allophylus timoriensis* (DC.) Blume, *Allophylus unifoliolatus* Radlk., *Allophylus villosus* (Roxb.) Blume, *Allophylus zeylanicus* L., *Ampactus litorea* Rumph., *Aporetica penicellata* Blanco, *Aporetica ternata* Forst. & Forst., *Gmella trifolia* Lour., *Ornitrophe integrifolia* Willd., *Ornitrophe glabra* Roxb., *Ornitrophe repanda* Roxb., *Ornitrophe villosa* Roxb., *Paulinia seriana* auct. non L.: Burm F., *Rhus cobbe* L., *Schmidelia bantamensis* Blume, *Schmidelia cobbe* (L.) DC., *Schmidelia fulvoinervis* Blume, *Schmidelia glabra* (Roxb.) Steud., *Schmidelia grossedentata* Turcz., *Schmidelia javensis* Blume, *Schmidelia leptostachya* Blume, *Schmidelia ligustrina* Blume ex Teijsm., *Schmidelia littoralis* Blume, *Schmidelia macrophylla* Zipp. ex Span., *Schmidelia mutabilis* Bl., *Schmidelia obovata* A. Gray, *Schmidelia parviflora* Zipp. ex Span., *Schmidelia racemosa* L., *Schmidelia ternata* (Forst. & Forst.) Cambess., *Schmidelia timoriensis* DC., *Schmidelia tormentosa* Hook.f. *Usubis triphylla* Burm. f. (250 synonyms are known)

Vernacular name(s) : Tit-berry (E), Keneras, Sijangè, Sicancang, Cukilan, Asa-Asa (Ind.), To sai (Thai)

Description : Erect or scrambling shrub, 2-4 m tall. Vegetative parts may be smooth or very densely covered with short hairs, especially on the veins. The leaves are three-lobed and have a stout, woody stalk that is 1-13 cm long. The ovate leaflets have incised margins and measure up to 26 by 13 cm. The slender flower heads measure 3.5-27 cm, are located in the leaf axils, and may be either smooth or densely covered with short hairs. Flowers are white and small, about 2 mm long. Fruits measure 12.5 by 7.5 mm, hang in bunches and are juicy, bright orange to red and (almost) smooth. Corner (1988) recognises five varieties, of which *Allophylus cobbe* var. *limosus* with small leaflets (2-7 by 5-14 cm) and a shrubby habit is found in mangroves and along muddy coasts.

Ecology : Occurs in mangroves, sea-shores, secondary forest, brushwood and hedges. Flowering occurs all year round, but especially during the west-monsoon. Mangrove associate species.

Distribution : Pantropical, found in South America, South Africa, Madagascar, India, Sri Lanka, throughout Southeast Asia, where it has been recorded in Brunei, Cambodia, East Timor, Thailand, Singapore, Malaysia, Indonesia and Papua New Guinea.

Abundance : Locally relatively common.

Use(s) : Poor quality wood, only used for roofing and sometimes as firewood. Edible fruit. Leaves used to make a mouth wash.

Source of illustration : Adema, Leenhouts & van Welzen (1994)

Reference(s) : Burkill (1935), Heyne (1950), Backer & Bakhuizen van den Brink (1963-8), Tomlinson (1986), Corner (1988), Aksornkoae (1993), Adema, Leenhouts & van Welzen (1994).

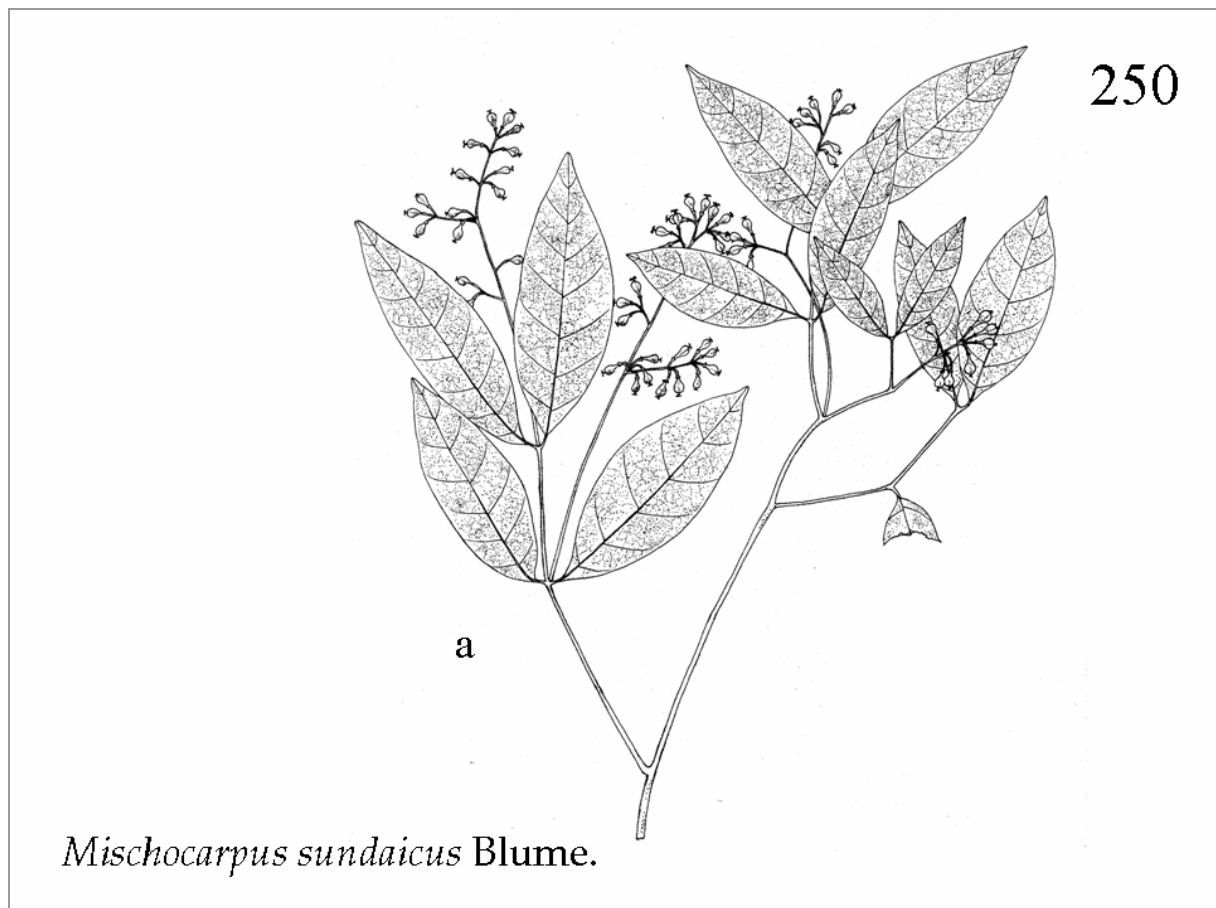


Fig. 250. *Mischocarpus sundaicus* Blume. (a) Fruiting branches.

SAPINDACEAE

250

Mischocarpus sundaicus Blume

Synonyms : *Cupania erythrorhachis* Miq., *Cupania lessertiana* Cambess., *Cupania mischocarpus* Steud., *Cupania revoluta* Turcz., *Mischocarpus lessertianus* Ridley, *Mischocarpus oppositifolius* auct. non (Lour.) Merr., *Mischocarpus pyriformis* auct. non Radlk., *Mischocarpus vulcanicus* Elmer ex Merrill, *Pedicellia sundaica* Pierre

Vernacular name(s) : Pulas laut, Sugi (Mal.), Bintit, Bungkangan, Goleng, Kayu urum, Ki howe, Penjalinan, Pulas laut, Regil, Walik elar, Wegil (Ind.)

Description : Shrub or tree, 3-10(-30) m tall, young parts and flower clusters covered with short hairs; twigs 1.5-5 mm in diameter are usually reddish-brown or darkish-red. Leaves compound, in 1-3(-4) pairs, leaflets almost opposite/paired (=paripinnate); leaf stalk 1-11(-20) cm; stalks of leaflets 3-8(-10) mm. Leaflets are entire, ovate to elliptic, 4-17(-26) by 1.5-7(-10) cm, parchment-like to somewhat leathery, base rounded or angular, tip with short point, domatia usually present in the axils of the nerves below; midrib prominent above; nerves 8-15 per side, moderately curved; upper sides glossy, light to dark brown. Young leaflets are pinkish. Flower clusters are located in the axils or near the ends of branches, 1.5-25 cm long, branched; stalks of flowers are 1-3 mm long. Flowers are small, about 1.5 mm in diameter, and yellowish-green to greenish. Calyx fused along lower $\frac{1}{4}$ - $\frac{1}{3}$, lobes triangular, 0.65-2 by 0.5-1 mm; leaflets triangular, up to 1.5 mm long; outside covered with short hairs, inside smooth. Petals usually absent, occasionally up to 3, up to 1.5 mm long. Stamens (6-)(8-)(9), up to 4 mm long. Fruit 7-9(-20) mm high, smooth or very sparsely covered with hairs; at first sharply 3-angled, ripening red; contains red seed pulp; stalk 2-2.5 mm. Seeds round to elliptic, up to 7 mm long, 1 per fruit. Two forms can be recognised: one from sandy coasts with pale-coloured leaflets; the second from swamps and edges of mangroves with deep brown leaflets.

Ecology : Primary and secondary forest in lowland and coastal regions, from sea level up to 800(-1600) m altitude. Flowering mostly January-August; fruiting mostly May-December. In southern China, flowering October-November, fruiting from spring to summer. Mangrove associate species.

Distribution : From India and southern China (Guangxi, Hainan) and throughout Southeast Asia, where it has been recorded from Thailand, Vietnam, Malaysia, Singapore, the Philippines and Indonesia (Sumatra, Borneo, Java, Flores). According to Corner and Yap, this species occurs in Australia, but this is disputed by Adema *et al.* (1994), and Queensland Herbarium, who confirm that this is *Mischocarpus australis*.

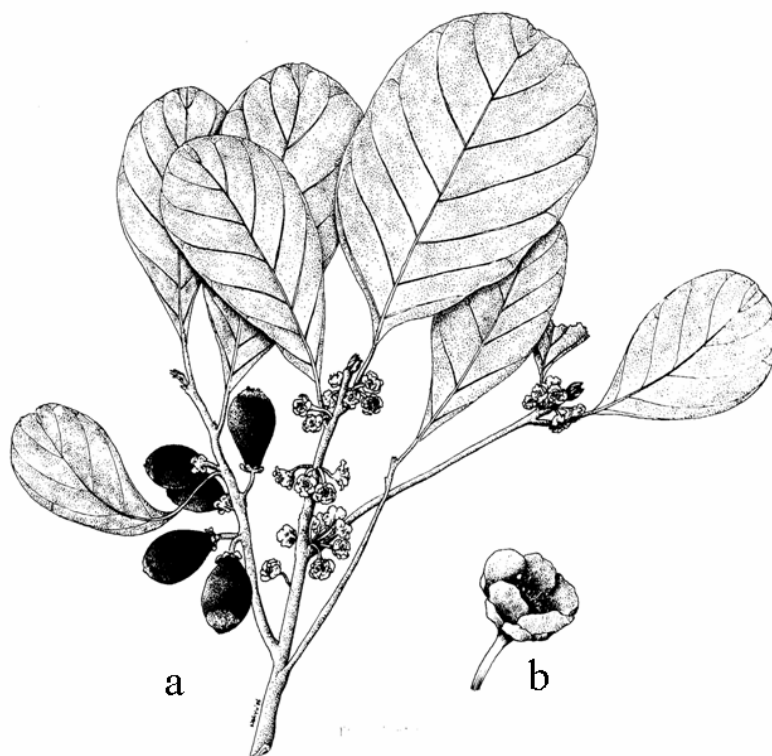
Abundance : Relatively common.

Use(s) : Young shoots are consumed as vegetable. Produces good charcoal. Some reports of it being poisonous.

Source of illustration : Herbarium specimens Leiden Herbarium.

Reference(s) : Heyne (1950), Corner (1988), Yap (1989), Adema *et al.* (1994), <http://www.brisrain.webcentral.com.au/namechange.html>
http://flora.huh.harvard.edu/china/mss/volume12/Sapindaceae-US_original.htm.

251



Planchonella obovata (R.Br.) Pierre.

Fig. 251. *Planchonella obovata* (R.Br.) Pierre. (a) Flowering and fruiting branchlet, and (b) flower.

SAPOTACEAE

251

***Planchonella obovata* (R.Br.) Pierre.**

Synonym(s) : *Pouteria obovata* (R. Br.) Baehni., *Sersalisia obovata* R. Br., *Sideroxylon argentatum*, *Sideroxylon bancanum*, *Sideroxylon chrysophyllum*, *Sideroxylon ferrugineum* Hook. & Arn., *Sideroxylon indicum*, *Sideroxylon microcarpum* Burck., *Sideroxylon nodosum*, *Sideroxylon obovatum*

Vernacular name(s) : Sea Gutta (E), Menasi, Misi (Mal.), Binasi, Balam Timah, Jengkok, Pancal, Arnana, Sambiring, Nyatoh labar, Nyatoh lambur (Ind.), Ngaa sai (Thai)

Description : Small to medium sized shrub or tree, up to 30 m (-40 m) tall and 1.5 m girth, but usually much smaller. The trunk is usually fluted and twisted, leaning, and with exposed roots, while older trees may develop symmetrical plank buttresses. Profuse white latex is present in trunk and branches. The crown is dense, bushy and coppery, while the bark is smooth to slightly scaly or fissured. Leaf stalks are 0.5-2.5 cm, scurfy, flat on top, while the leaves are obovate to elliptic, 2-10 by 3.5-25 cm, with a rounded tip and a tapered base. Leaves are alternate or opposite, usually velvety below and smooth above; when dry they are papery to leathery. Up to twelve greenish-white flowers occur in the leaf axils, or in the axils of leaf scars (where leaves formerly occurred). Flowers bisexual or seldom unisexual, solitary or several in clusters located in the axils, usually subtended by leaflets, (4- or)5(or 6)-merous, with 10 stamens. They measure 4-12 mm across and have a 1-4 mm stalk. The corolla is about 2.5 mm long, and sepals measure 1.2 by 2.5 mm. There are 5 stamens, inserted in the throat and opposite corolla lobes. Fruit is a berry, sometimes woody, 1-6-seeded, elongate to round, 7.5 by 12 mm, smooth, with 5 persistent sepals attached to the base. Seeds are compressed ellipsoid. Some authors find that *Planchonella* may not be sufficiently distinct from *Pouteria* to merit it being a separate genus.

Ecology : Common on rocky and sandy sea coasts, inland sandy heaths, limestone hills, secondary forests and occasionally in margins of mangroves. The coastal form is rarely taller than 10-13m. Always occurs scattered, and nowhere really common. Found up to 1,600 m on Flores. Mangrove associate species.

Distribution : From India to Hainan (China), Taiwan, throughout Southeast Asia to northern Australia. Recorded in Southeast Asia from Cambodia, Thailand, Vietnam, Malaysia, Singapore, Indonesia (Sumatra, Java, Borneo, the Lesser Sundas and Sulawesi) and Papua New Guinea.

Abundance : Uncommon to locally fairly common.

Use(s) : Timber of taller and straighter upland specimens may occasionally be used, but it easily cracks and is not very durable.

Source of illustration : Based on Ng (1972).

Reference(s) : Heyne (1950), Ng (1972), Corner (1988), Whitmore, Tantra & Sutisna (1990), Flora of China, vol. 15, p. 211 *Planchonella*, Aksornkoae (1993), Ng & Sivasothi (1999).

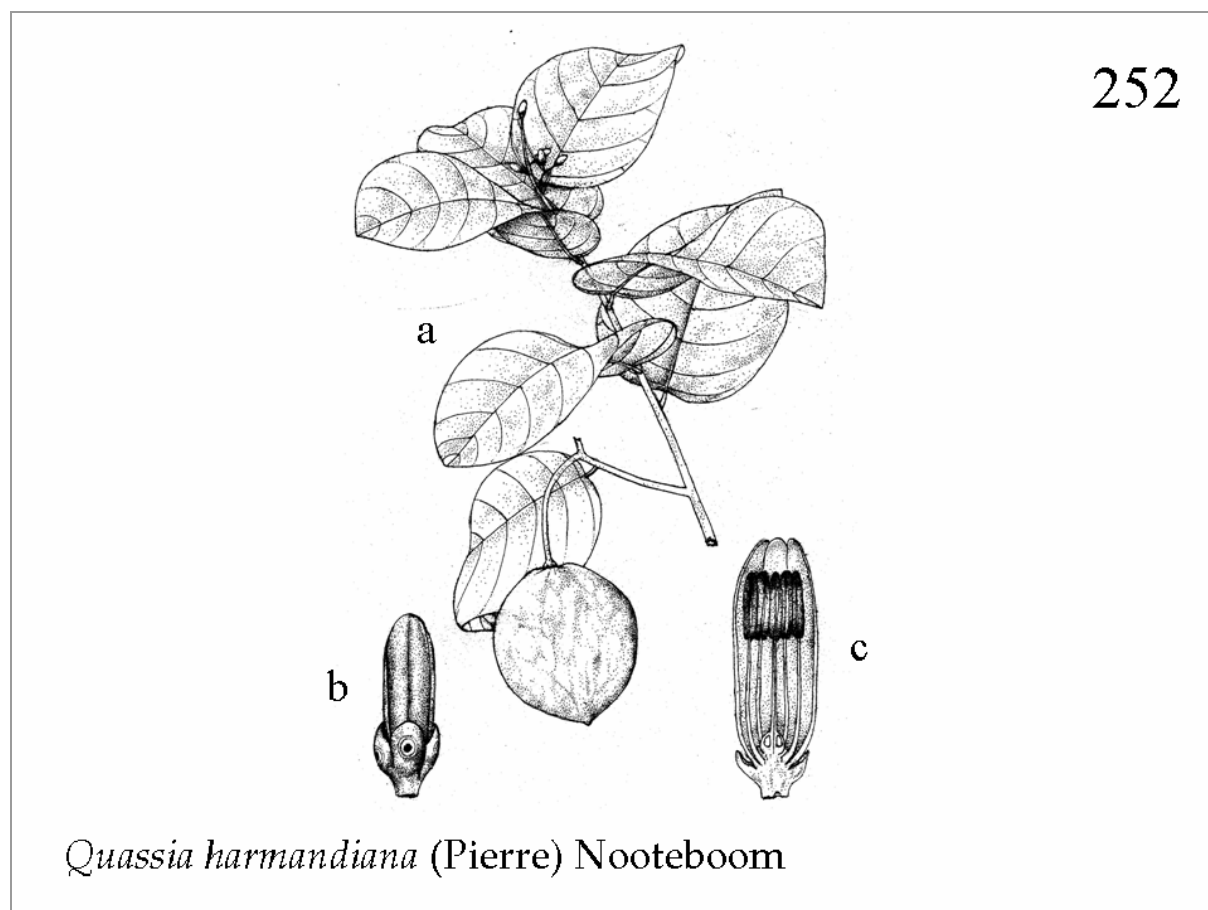


Fig. 252. *Quassia harmandiana* (Pierre) Nootboom. (a) Fruiting branchlet with flower buds, (b) flower bud, with glands on the calyx, and (c) opened flower revealing stamens.

SIMAROUBACEAE

252

***Quassia harmandiana* (Pierre) Nootboom**

Synonyms : *Eurycoma harmandiana* Pierre, *Locandia harmandii* Pierre, *Samadera harmandiana* Pierre, *Samadera harmandiana* (Pierre) Greshoff, *Samadera harmandii* Engl., *Samandura harmandiana* Pierre, *Samandura harmandii* Pierre

Vernacular name(s) : Unknown.

Description : Shrub to dwarf tree, 1-2 (rarely 8) m tall. Leaves compound, imparipinnate (odd in number, with an end, unpaired leaflet) 8-18 cm long; leaflets opposite or sub-opposite, linear, up to 3-5 mm by 3-7 cm, hard and leathery. Flowers small, occurring in large, pendulous panicles, up to 15 cm long, without glandular hairs. Calyx 5-merous, calyx lobes 1-1.5 mm. Petals 5 (rarely 6)-merous, lobes 1-1.5 by 3-3.5 mm, hairy on both sides; anthers 0.75 mm long. Ovary reduced, pubescent (only male flowers seen). Note that other *Eurycoma* species in the region such as *Eurycoma longifolia* have panicles with glandular hairs.

Ecology : Dwarf shrub found in open places in forest, riparian forests and scrub, but also recorded in mangroves. Mangrove associate species.

Distribution : Southeast Asia species, recorded from eastern Thailand, Cambodia and Laos PDR.

Abundance : Uncommon.

Use(s) : Root used in a bitter tonic, as well as an aphrodisiac, anti cancer medicine, and as an anti malarial. Roots contain alkaloids (Kanchanapoon, 2001a), and the leaves contain other active ingredients used in traditional medicine (Kanchanapoon, 2001b).

Source of illustration : Archive, Royal Botanic Garden, Kew; Netherlands National Herbarium <http://www.nationaalherbarium.nl/virtual/>

Reference(s) : Nootboom (1962), Kanchanapoon (2001a,b), Netherlands National Herbarium (<http://www.nationaalherbarium.nl/virtual/>).

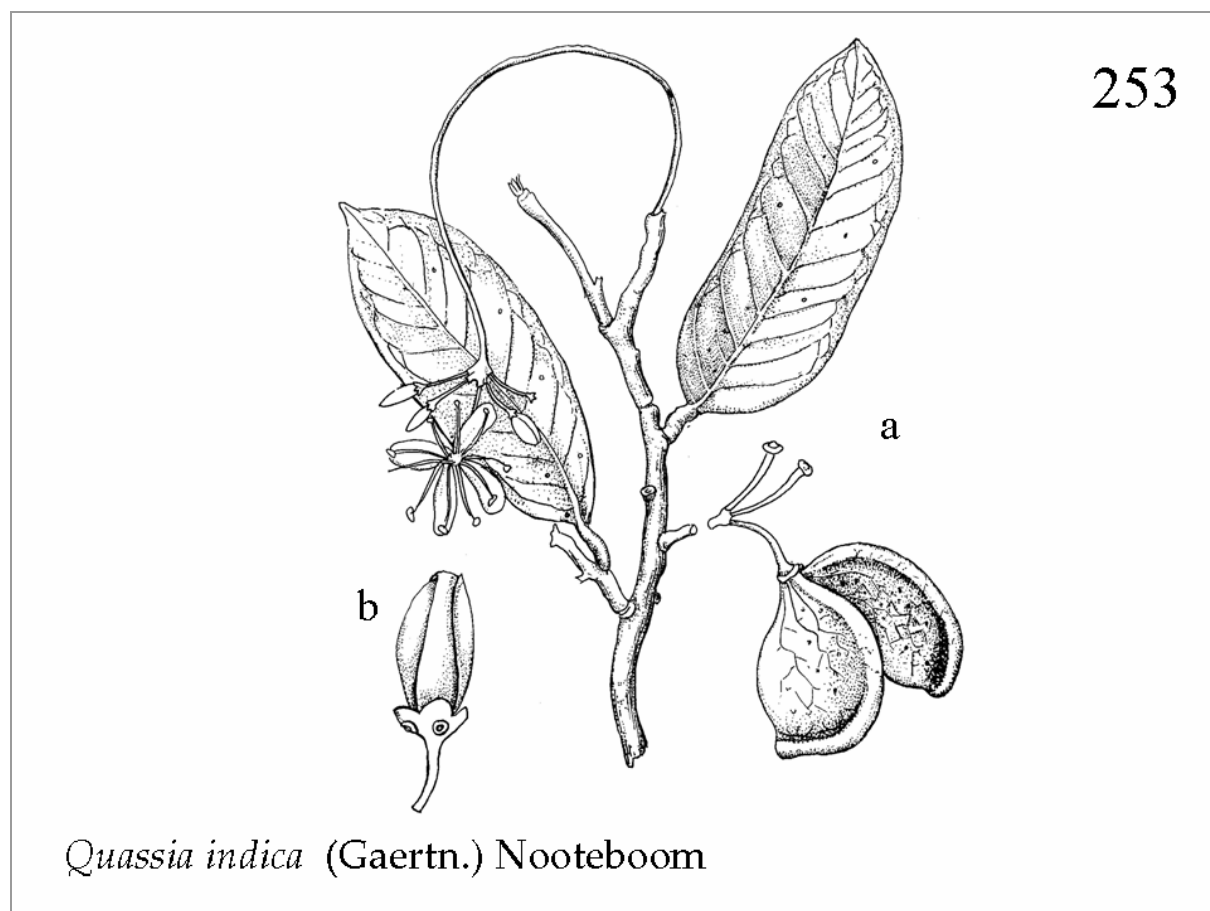


Fig. 253. *Quassia indica* (Gaertn.) Nootboom. (a) Branchlet with flowers and fruit, and (b) flower bud, with glands on the calyx.

SIMAROUBACEAE

253

***Quassia indica* (Gaertn.) Nooteboom**

Synonyms : *Locandia glandulifera* Pierre, *Locandia indica* O.K., *Locandia madagascariensis* O.K., *Locandia mekongensis* Pierre, *Locandia merguensis* Pierre, *Locandia pendula* Pierre, *Manungala pendula* Blanco, *Mauduita penduliflora* Comm., *Niota commersonii* Pers., *Niota lamarckiana* Bl., *Niota lucida* Wall., *Niota pentapetala* Poir., *Niota tetrapetala* Poir., *Samadera brevipedata* Scheff., *Samadera glandulifera*, *Samadera indica* Gaertn., *Samadera madagascariensis* A. Juss., *Samadera madagascariensis* Gaertn., *Samadera mekongensis* Pierre, *Samadera pentapetala* G. Don., *Samadera tetrapetala* (Poir.) G. Don., *Samandura indica* Baill., *Vitmannia elliptica* Vahl.

Vernacular name(s) : Rapus, Kelepis, Kayu Pahit, Gatep Pahit, Onne (Ind.), Daraput, Linatog-anat, Linton-gamai, Mabingdato, Palagarium, Palagium, Ponoan (Phil.)

Description : Smooth, evergreen, shrub or tree, up to 20 m tall. The base of each shoot has several stiff, persistent scales. The elliptic-oblong to lanceolate leaves measure 12-30 by 4-12 cm, and have a conspicuous venation on both surfaces. Leaves usually have two pitted glands at the base of the lower side; similar glands occur randomly on the surface. The leaf stalk measures 1-2.5 cm. The umbell-shaped flower head droops, is smooth or covered with short, soft hairs, and has up to 20 or more bisexual flowers. The stalk is 1-30 cm long, more or less flattened and thickened at the end, located at the end of branches or in axils. The individual flower stalks, 0.5-2.5 cm, are jointed in the lower half. The calyx is 2-3 mm long, covered with soft hairs, and has four (3-5) lobes that are about as long as the tube or longer. The four (3-5) free, creamy-green to violet, purplish or brownish petals are covered with soft hairs underneath. They are narrowed towards the base and measure up to 3 by 1 cm. Fruits usually occur in groups of 1-4, each measuring 4-9 by 2.5-5 cm. They are flattened, with a straight inner and a semi-circular outer margin. The wall of the fruit has glands that are similar to those on the leaf. The seed measures up to 3.5 by 2.5 cm. All parts of the tree are reportedly very bitter.

Ecology : Occurs in wet places in lowland forests, at altitudes below 150 m, sometimes in localities that are periodically inundated by freshwater or sea water. Also occurs on landward margins of mangroves. In eastern Sabah (Malaysia) it is common in young swamp forests on the landward margin of mangroves. Flowering occurs all year round. Mangrove associate species.

Distribution : Found from the western Indian Ocean, Madagascar, Sri Lanka, and India to Southeast Asia and the Bismarck and Solomon islands. In Southeast Asia it has been recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia, the Philippines, Indonesia (not recorded in Sumatra and the Lesser Sunda islands) and Papua New Guinea.

Abundance : Usually very rare, but locally rather common in the eastern part of its range.

Use(s) : Cultivated in Java and elsewhere. The seeds are given as an emetic and purgative, and sometimes for bilious fevers. The plant is also used as a tonic and as an insecticide, especially against ants. The seeds contain oil to the extent of one third of their weight, but as it is difficult to obtain in large quantities it is not exploited commercially. Timber used for domestic purposes. In the Philippines chips of wood are put in coconut oil which is drunk as a purgative. The same oil is used as a liniment for rheumatism and bruises.

Source of illustration : Based on Nooteboom (1962).

Reference(s) : Nooteboom (1962), Backer & Bakhuizen van den Brink (1963-8), Said (1990).

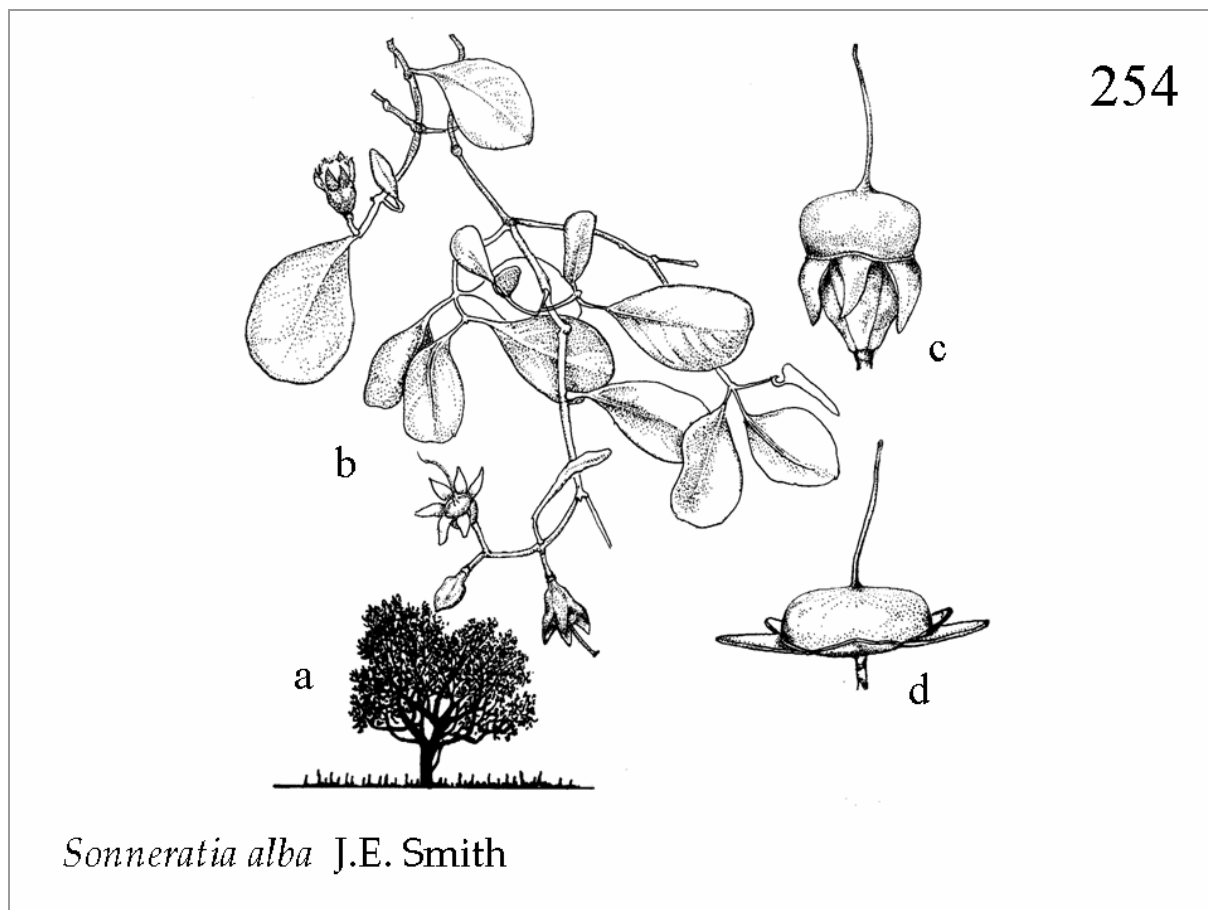


Fig. 254. *Sonneratia alba* J.E. Smith. (a) Habit, (b) branchlet with flowers and immature fruit, (c) fruit with typical reflexed sepals, and (d) fruit with sepals in horizontal plane (less typical).

SONNERATIACEAE

254

Sonneratia alba J.E. Smith

Synonyms : *Chiratia leucantha* Montr., *Mangium caseolare album* Rumph., *Rhizophora caseolaris* Linné, *Sonneratia acida* Benth., *Sonneratia alba* F.Vill., *Sonneratia caseolaris* Engl., *Sonneratia griffithii* (non Kurz) Watson, *Sonneratia iriomotensis* Masamune, *Sonneratia mossambicensis* Klotzsch ex Peters

Vernacular names : Mangrove apple (E), Pedada, Perepat, Pidada (Mal.), Pedada, Perepat, Pidada, Bogem, Bidada, Posi-posi, Wahat Putih (Ind.), Bunayon, Buñgalon, Hikau-hikauan, Ilukabban, Lukabban, Pagatpat, Palalan, Palatpat, Patpat, Payan – *Pagatpat* (Phil.), Bân đâng (Viet.), Ampouthmar, Rompea-chheu (Camb.), Lampoo thale (Thai)

Description : Evergreen, spreading, hairless tree, usually 3-15 m, occasionally up to 20 m tall. Bark is cream-coloured to brown, with smooth, fine, longitudinal fissures. Thick, underground cable roots spread radially and arise in conical, stout, 25 cm-tall pneumatophores. Leaves are simple, opposite, leathery, obovate-ovate, measuring 5-12.5 by 3-9 cm, and bear vestigial glands at the base of the leaf stalks. Leaf stalks are 6-15 mm long. The bisexual flowers occur either solitarily or in groups of three, terminally on small branches, and have a stout, up to 1 cm-long stalk. The ellipsoid buds are 2-3 times as long as broad, including the coiled base. The bell-shaped and leathery calyx tube is often ribbed. The 6-7 persistent sepals are green outside, red inside and 2-2.5 cm long. The narrow, white, often in the lower part reddish petals measure 13-20 by 0.5-1.5 mm. These are soon shed, or occasionally are lacking altogether. The numerous, long, white stamens are also soon shed. The flattened, round berry does not open when ripe. It measures 3 by 4 cm, contains many seeds, and bears the persistent sepals at its base. These are usually reflexed, but may also be flattened into a plane. Exhibits a great deal of morphological variation. Hybrids are also known, and the hybrid between *Sonneratia alba* and *Sonneratia caseolaris* is described as *Sonneratia* X *gulngai* (in PNG).

Ecology : A pioneering species in the mangrove habitat, intolerant of long periods of exposure to fresh water. Preferred soils are consolidating mud and sands, occasionally rock, coral and gravel. It is frequently found in coastal locations that are sheltered from strong wave action, also in estuarine areas and around offshore islands. Where other tree species have been removed (e.g. for fuel), it may form dense stands. Flowering occurs all year round. Flowers are ephemeral and nocturnal, pollinated by hawk-moths, birds and fruit-eating bats. On rocky coastlines it spreads vegetatively. Fireflies congregate on the trees at night. Fruit buoyancy is due to the air-bearing tissue in the seed. Pneumatophores are absent when the tree occurs on a solid substrate. Mangrove species.

Distribution : From East Africa, the Seychelles and Madagascar, throughout Southeast Asia, to tropical Australia, New Caledonia, the west Pacific islands and Southwest Oceania.

Abundance : Common. Locally abundant.

Use(s) : The somewhat sour fruit is edible and a haemorrhage-checking compress is made from it. The timber is used for boat and house construction in Sulawesi (Indonesia), flooring, bridge and wharf construction, and as fuel in periods of shortage. Generally considered a strong construction material for all kinds of interior work, furniture, musical instruments, cabinet making, but requires bronze nails. Pneumatophores are used by the Papuans for corks and floats.

Source of illustration : Backer & van Steenis (1951), Tomlinson (1986) and Wightman (1989).

Reference(s) : Heyne (1950), Backer & van Steenis (1951), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Duke (1984), Tomlinson (1986), Wightman (1989), Aksornkoae (1993), Aragonés *et al.* (1998), Marschke (2000).

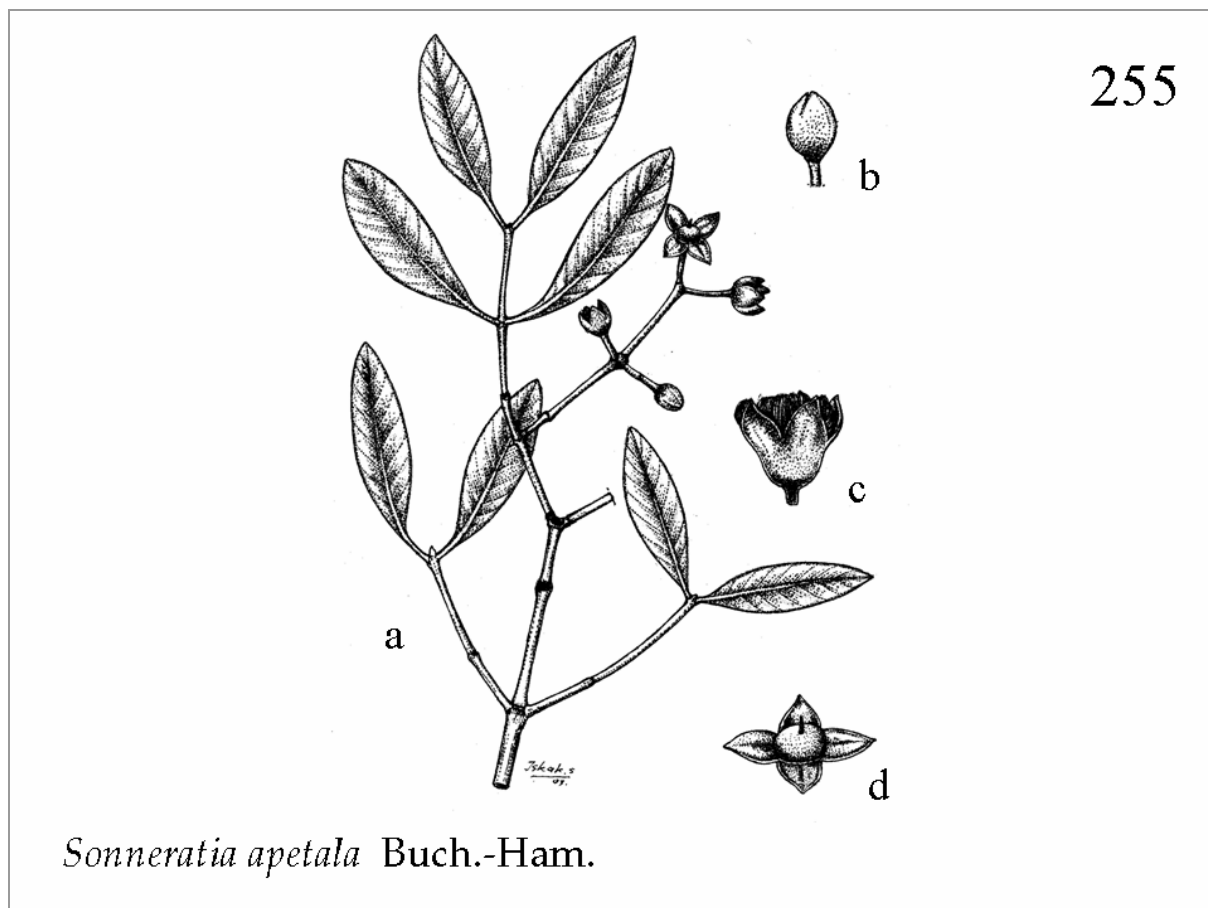


Fig. 255. *Sonneratia apetala* Buch.-Ham. (a) Fruiting and flowering branch, (b) bud, (c) flower, and (d) fruit.

SONNERATIACEAE

255

Sonneratia apetala* Buch.-Ham.*Synonyms :** *Blatti apetala* O.K., *Kambala apetala* Rafin.**Vernacular names :** Mangrove apple (E)

Description : Small tree, up to 12-15 (-20) m tall with drooping branches and branchlets. Bark smooth, with horizontal lenticels. Leaves are simple, opposite, sparse, long and thin, 5.5-13 by 1.5-3.75 cm, gradually tapering towards the apex, attenuating at the base; nerves and veins indistinct; leaf stalk 5-10 mm. The canopy of mature trees is often very open and the branches tend to droop. Flowers usually grouped in 3's. Buds oblong, 1.5 cm long. Calyx – including tube and lobes – in flower about 1.5-2 cm long, smooth, not ribbed; calyx lobes up to twice as long as the tube. Calyx lobes – usually numbering 4 – lie flat in the ripe fruit (as in *Sonneratia caseolaris*), either horizontally expanded or curled back. Fruit pale, broader than high, broadly rounded, about 22 mm in diameter, by 12-18 mm; thin-walled. Other *Sonneratia* may at times also be without petals, so the name is not entirely fitting (Tomlinson, 1986). $2n = 18$ (Fedorov, 1969, in Khan, 1980). Fruit bunches may grow directly on the tree stem (i.e. cauliflorous).

Ecology : Found in mangrove forests, forming pure stands, especially in the inland, less saline zones. As with other *Sonneratia* species the flowers open at night and are pollinated by bats and moths. Mangrove species.

Distribution : From India and Sri Lanka eastwards up to southern Myanmar. Not found elsewhere in Southeast Asia. Reportedly planted in southern China (Guangdong Province; pers. comm. Tom Dahmer, September 2004) after introduction from Bangladesh, and has become common in the Zhanjiang NNR.

Abundance : Generally rarer than other *Sonneratia* species, but locally common. Common in the Sunderbans mangroves of Bangladesh and India. Very rare in Sri Lanka, where a population of six trees have been recorded at Muttur (near Trincomalee; Tomlinson, 1986).

Use(s) : Wood is good for planks, oars, boxes, bobbins for textile mills, and as firewood. Tender young leaves are favoured by deer. Flowers are locally an important source of honey.

Source of illustration : Based on Khan (1980).

Reference(s) : Backer & van Steenis (1951), Khan (1980), Tomlinson (1986).

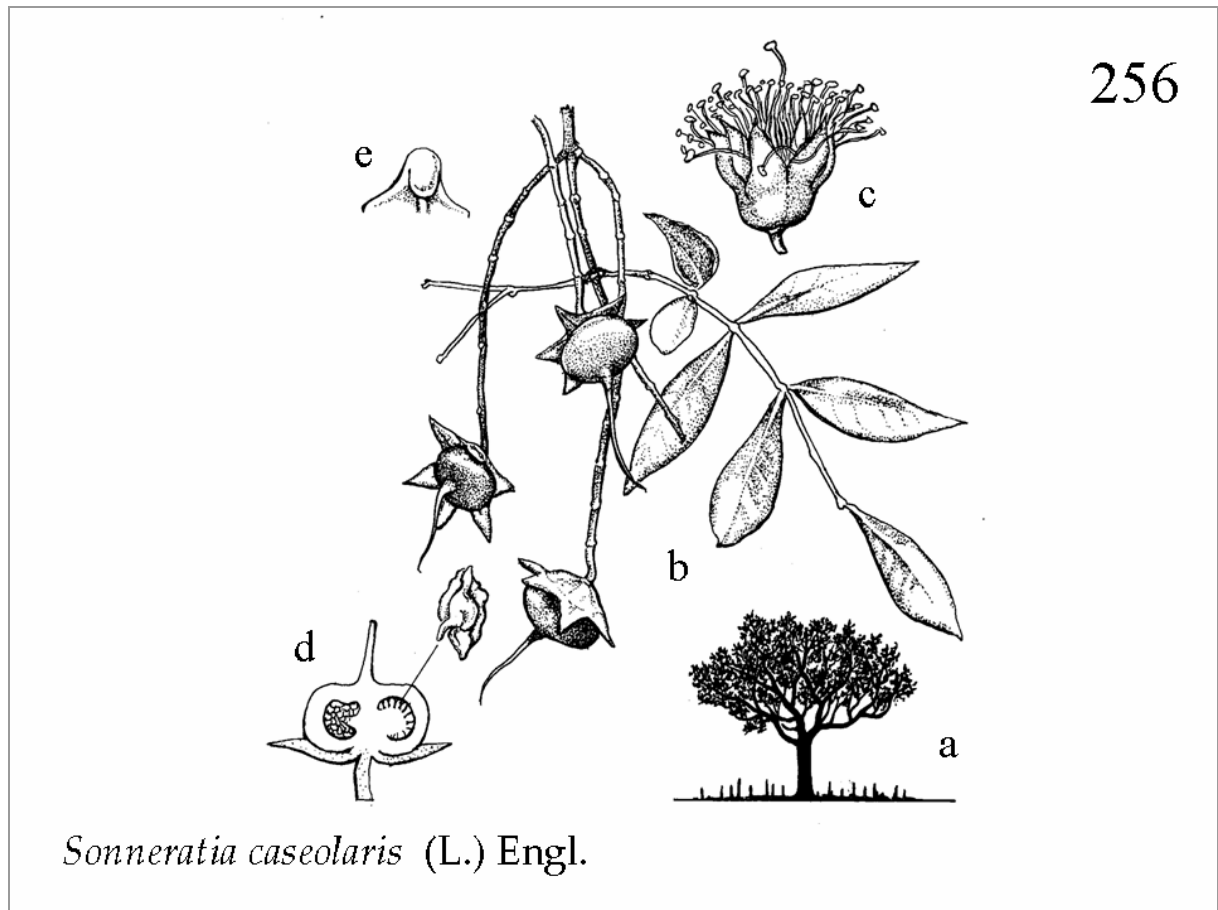


Fig. 256. *Sonneratia caseolaris* (L.) Engl. (a) Habit, (b) branchlet with fruit, (c) flower, (d) longitudinal section of fruit, with detail of seed (inset) and (e) detail of leaf tip, with recurved point.

SONNERATIACEAE

256

Sonneratia caseolaris (L.) Engl.

Synonyms : *Aubletia caseolaris* Gaertn., *Blatti acide* Lamk., *Blatti caseolaris* O.K., *Blatti pagatpat* Niedenzu, *Mangium caseolare rubrum* Rumph., *Rhizophora caseolaris* L., *Sonneratia acida* Linné, *Sonneratia evenia* Bl., *Sonneratia lanceolata* Bl., *Sonneratia neglecta* Bl., *Sonneratia obovata* Bl., *Sonneratia ovalis* Korth., *Sonneratia pagatpat* Blanco, *Sonneratia rubra*.

Vernacular names : Mangrove apple (E), Berembang (Mal.), Pedada, Perepat, Pidada, Bogem, Bidada, Rambai, Wahat Merah, Posi-posi Merah (Ind.), Hikau-hikauan, Ilukabban, Pagatpat, Palapat, Palata, Payar – *Pedada* (Phil.), Bân sê (Viet.), Lam phu, Lampoo (Thai.), Ampou-krohom (Camb.)

Description : Small to medium-sized tree, up to 15 m, rarely up to 20 m tall, with many, often very strong, vertical pneumatophores and a rather lax crown, much like a (weeping) willow tree. Crown rounded, spreading, not dense. The ends of the branches droop, and are quadrangular when young. Leaves are simple, opposite, variable in size, measuring 5-13 by 2-5 cm. Tip of most leaves has a minute, recurved point (see illustration). The leaf stalk is broad and very short. Flowers occur in groups of 1-3 together at the ends of stems. The flower buds are broadly oval, less than twice as long as broad. When in full flower, the calyx tube is shallowly cup-shaped and smooth, usually without ribs. The calyx lobes (6, rarely 7 or 8) are usually distinctly longer than the tube, green outside, greenish- or yellowish-white inside. The narrow petals measure about 17-35 mm by 1.5-3.5 mm and are dark red. The numerous stamens are 2.5-3.5 cm long and are soon shed; filaments carmine below, white above. They are red in their lower part, and white in their upper part. The green fleshy fruit occurs on the flattened calyx tube with its nearly horizontally-spreading lobes. It is flattened-round, measuring 3-4 by 5-7.5 cm. Hybrids are also known, and the hybrid between *Sonneratia alba* and *Sonneratia caseolaris* is described as *Sonneratia* X *gulngai* (in PNG).

Ecology : Occurs in less saline parts of mangrove forests on deeply muddy soil, along tidal creeks with slow-moving water, never on coral banks. Found along rivers, occurring upstream to where the tidal influence is still felt, also in areas that are predominantly freshwater. It is intolerant of shade. When fully flowering, flowers contain abundant nectar. As with other *Sonneratia* species the flowers open at night and are pollinated by bats and moths. Flowering occurs throughout the year. Seeds are buoyant. During heavy rains the inclination of the leaves may shift from horizontal to vertical. Mangrove species.

Distribution : From Sri Lanka, throughout Southeast Asia, to tropical Australia, the Solomon Islands and the New Hebrides. In Southeast Asia recorded from Cambodia, Vietnam, Thailand, Malaysia, Singapore, the Philippines, Brunei, East Timor, Indonesia (throughout) and Papua New Guinea. Introduced to southern China (Guangdong; (Howes *et al.*, 2004)

Abundance : Common, and locally abundant.

Use(s) : The sour young fleshy fruit is edible. Poor quality timber, but occasionally used to salt-water piling. When better firewood is not available, this wood is used. After having been boiled in water, the pneumatophores are an inferior substitute for cork. Pneumatophores are also used for making wooden soles of shoes. The bark contains a moderate amount of tannin.

Source of illustration : Backer & van Steenis (1951), Tomlinson (1986) and Wightman (1989).

Reference(s) : Watson (1928), Heyne (1950), Backer & van Steenis (1951), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Khan (1980), Duke (1984), Tomlinson (1986), Aksornkoae (1993), Aragones *et al.* (1998), Ng & Sivasothi (1999), Marschke (2000).

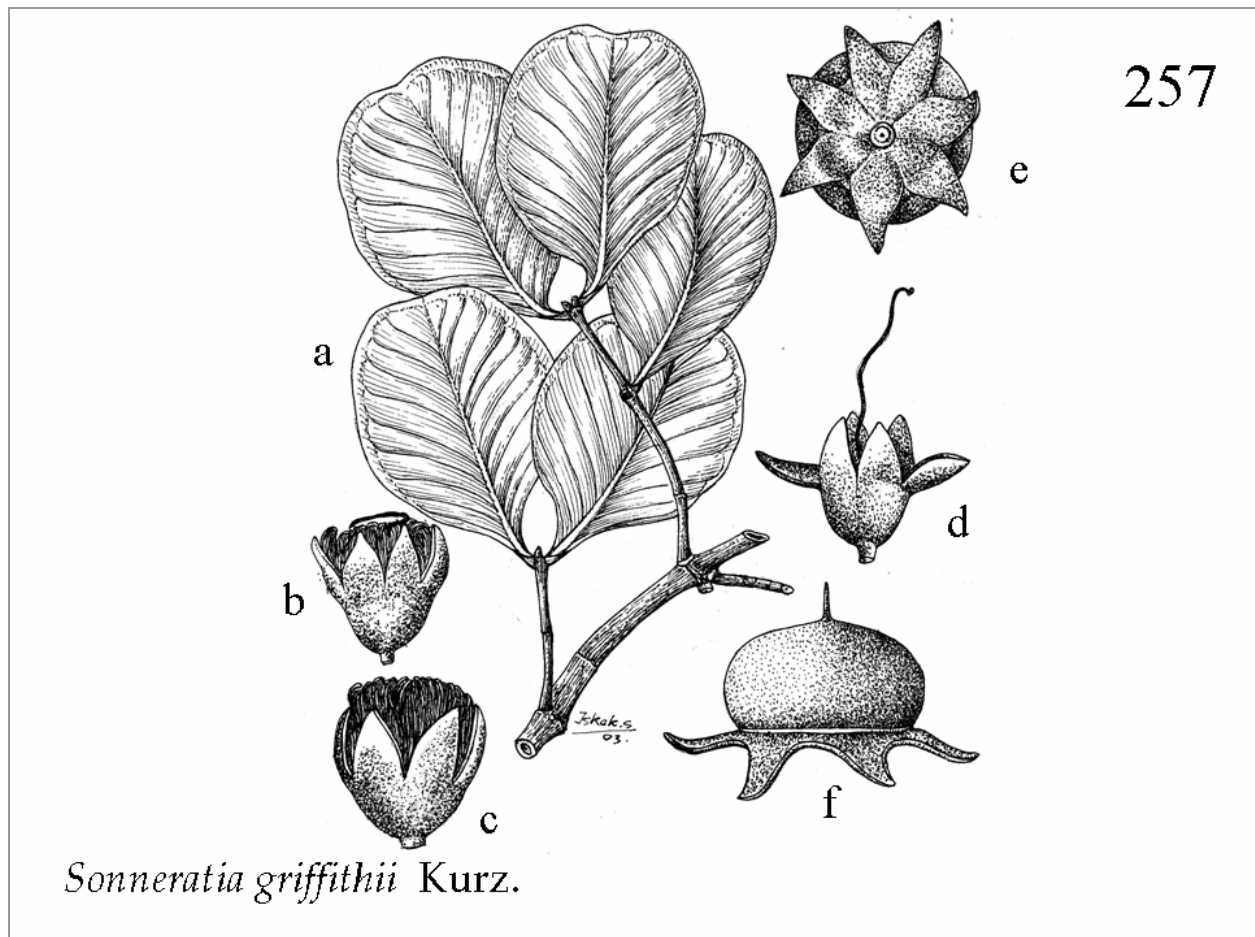


Fig. 257. *Sonneratia griffithii* Kurz. (a) Part of branch, (b) flower, partly opened, (c) flower, opened, (d) flower, with style extended, (e) fruit, seen from stalk, and (f) fruit, seen from side.

SONNERATIACEAE

257

***Sonneratia griffithii* Kurz.**

Synonyms : *Sonneratia acida* var. *griffithii* King., *Sonneratia alba* (non SM) Griff.

Vernacular names : Mangrove apple (E), Pedada (Mal.), Lampaen thale, Lam phaen (Thai.), Ampea (Camb.)

Description : Tree, up to 20 m tall, with a trunk up to 100 cm diameter. Leaves are simple, opposite, thick, 7-10.5 by 5.5-9 cm, obovate to almost round, base rounded, contracted into a short leaf stalk; tip is usually broadly rounded. (9-)10-14 leaf nerves distinct, prominent on the upper side of the leaf, ascending at an angle. Mature flower bud 2.5-3 cm long. Flowers are generally greenish-white. Calyx tube 3-3.5 cm long, widely bell-shaped, in fruit expanded together with the lobes horizontally up to 6.5 cm diameter. Calyx lobes number 6-7, and do not envelope the base of the fruit. Fruit 2.5-3 cm high, 4-5.5 cm diameter, thick, style less persistent than in *Sonneratia caseolaris*. Reportedly common, but scarce in herbaria (Backer & van Steenis, 1951). Closely related to *Sonneratia caseolaris*, from which it can be distinguished by the prominent leaf veins and the absence of petals.

Ecology : Flowering recorded from January (Thailand) to March (Myanmar), fruiting in January (Thailand). Mangrove species.

Distribution : From Myanmar, Thailand and Peninsular Malaysia westward up to southeast Bangladesh (Chittagong) and the Andaman Islands. Possibly also in Sumatra, but not yet recorded.

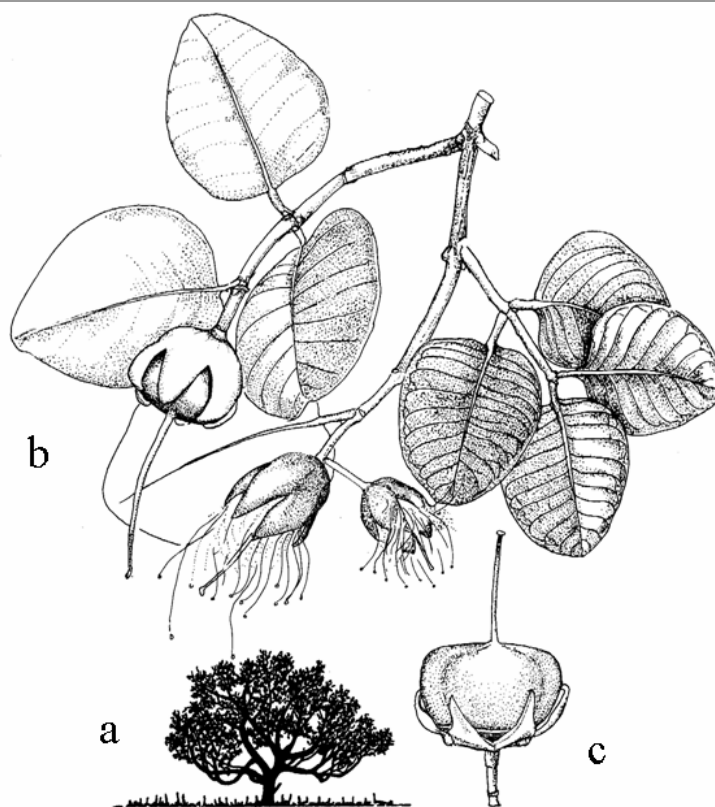
Abundance : Reportedly common (Backer & van Steenis, 1951), but not often recorded. Possibly often confused with other species.

Use(s) : Unknown.

Source of illustration : Based on Backer & van Steenis (1951) and Khan (1980).

Reference(s) : Backer & van Steenis (1951), Khan (1980), Tomlinson (1986), Aksornkoae (1993), Marschke (2000).

258



Sonneratia ovata Back.

Fig. 258. *Sonneratia ovata* Back. (a) Habit, (b) branchlet with flowers and fruit, and (c) fruit, with enveloping sepals.

SONNERATIACEAE

258

Sonneratia ovata Back.**Synonyms :** *Sonneratia alba* auct. plur. Watson**Vernacular names :** Mangrove apple (E), Bogem, Kedabu (Ind.), Gedabu (Mal.), Pagatpat, Pagatpat baye (Phil.), Bả'n ô'i (Viet.), Ampea (Camb.), Lampaen (Thai)**Description :** Small or medium-sized tree, usually up to 5 m, occasionally up to 20 m tall, with quadrangular young branches and vertical pneumatophores. Leaves are simple, opposite, broadly ovate, oval or almost round, measuring 4-10 by 3-9 cm. The leaf stalk is 2-15 mm long. Flowers are solitary or occur in groups of three at the tops of stems. The slender flower stalks are 1-2 cm long, or occasionally absent. The flower buds are broadly oval, less than twice as long as broad, and covered with small warts. The calyx is 2.5-4.5 cm long, with a tube that is broadly cup-shaped and arises from a sharply contracted, short, stalk-like base. There are usually six calyx lobes, which are as long as the tube or slightly longer when fully open. Their inner surface is strongly tinged with red. They remain occur on the fruit, enveloping the berry. Petals are absent. The numerous stamens, which fall off quickly, are white. The ripe berry measures 3-5 by 2.5-3.5 cm.**Ecology :** Occurs on the landward margin of mangroves, in less saline areas, on muddy soils and along tidal creeks. It never occurs on coral reefs. Flowering occurs throughout the year. Mangrove species.**Distribution :** From Southeast Asia to northern Queensland, Australia. In Southeast Asia it has been recorded in Cambodia, Thailand, Vietnam, the Philippines, Malaysia, Singapore, Indonesia (Riau Archipelago, Sumatra, Java, Borneo, Sulawesi, the Moluccas, Papua) and Papua New Guinea. First record for Borneo October 1996 by the first author (Giesen) in brackish lower reaches of the Sebangau River in Central Kalimantan, Indonesia.**Abundance :** Locally common, but on the whole rather rare.**Use(s) :** Firewood. Young fruits eaten as 'rujak' in Indonesia.**Source of illustration :** Based on combination of photographs and Backer & van Steenis (1951).**Reference(s) :** Backer & van Steenis (1951), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Giesen (1991), Ng & Sivasothi (1999), Yao (2000), Marschke (2000).

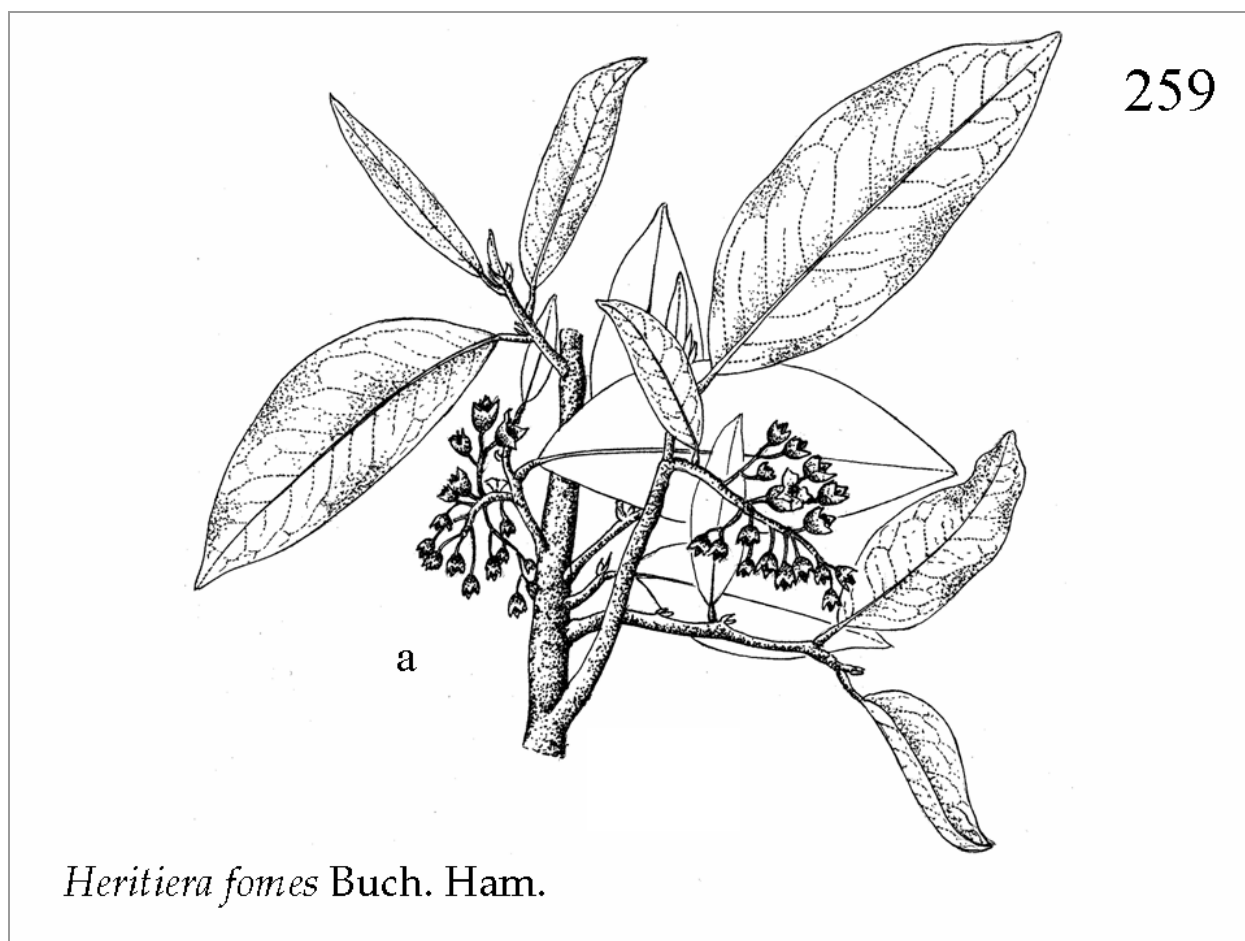


Fig. 259. *Heritiera fomes* Buch. Ham. (a) Flowering branch.

STERCULIACEAE

259

Heritiera fomes Buch. Ham.**Synonyms :** Unknown**Vernacular name(s) :** Sundari, Sundri (Bangla), Kanazo (Myanmar)

Description : Medium-sized tree, up to 25 m, with many erect, pointed pneumatophores. Leaves alternate, simple, with leaflet at the base of each leaf stalk 1 cm long, round, grey, slightly woody. Leaf blade elliptic lanceolate, entire, pointed, thick and slightly hard, about 10-20 by 5-10 cm. Upper surface pale green and smooth, lower surface whitish grey and rough, with very short, scurfy hairs and net-like venation. Flower clusters are pendulous and much branched. Flowers are unisexual, small, creamy-coloured to pale brownish, and with a 6.5 mm, hairy flower stalk. Sepals number 4-5, and are rounded or cup-shaped, with a tube beneath, and 4-5 lobes. Calyx lobes are ovate, pointed, hairy, and both the inner and outer surface are leathery. Petals are absent. the male flower has 5 stamens that are fused together. The female flower has 4-5 carpels that are loosely attached and are 2.5 mm long. The style is terminal, long, white but after maturation it becomes brown. The fruit consists of a cluster of woody, indehiscent, keeled or winged ripe carpels, knobbly with a ridge underneath, together with a transverse, circular ridge, 2-4 cm. Seeds are solitary and do not exhibit vivipary, but are buoyant.

Ecology : Gregarious species. In the Sundarbans (India, Bangladesh) this species has been affected by a 'top-dying' disease since at least the late 1980s, which has been attributed to a combination of changes in hydrology, fungal disease and insect pests. It is a species of the landward edges of mangroves and along brackish tidal streams. Mangrove species.

Distribution : South to Southeast Asian species, recorded from India, Sri Lanka, Bangladesh and Myanmar (Ayeyarwady delta).

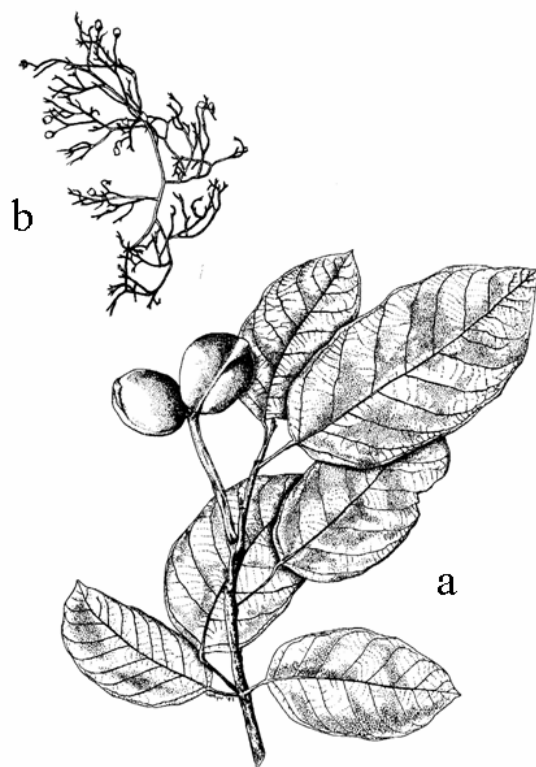
Abundance : Locally very common and abundant, but with a limited overall distribution.

Use(s) : Timber is similar to teak and used for boat building and furniture. It checks soil erosion in the tidal forests and loosely consolidated, silted up soil.

Source of illustration : Flora of Bangladesh.

Reference(s) : Tomlinson (1986).

260



Heritiera globosa Kostermans

Fig. 260. *Heritiera globosa* Kostermans. (a) Branchlet with ripe fruit, and (b) inflorescence with diminutive flowers.

STERCULIACEAE

260

Heritiera globosa Kostermans**Synonyms :** Unknown.**Vernacular name(s) :** Dungun besar (Mal.)

Description : Evergreen tree up to 25 m tall, with a buttressed trunk and dark or grey, fissured bark. Individual trees bear either male or female flowers. The buttresses are well developed and snake-like, and extending 2-4 m from the base of the trunk. The stiff, leathery leaves are grouped towards the ends of the branches. They are oblong or ovate-elliptic, and measure 10-20 by 5-10 cm, sometimes even 30 by 15-18 cm. The leaf stalk is longer than 2 cm, and may be up to 4 cm long. Leaves are dark green above and greyish-white beneath because of a layer of overlapping, star-shaped scales. Flowers are unisexual and occur in complex, hairy clusters that mainly occur in the axils of leaves at the ends of branches. They may also occur immediately below the resting terminal bud. The flowers are 4-5 mm long, with a cup-shaped calyx that is reddish and hairy inside, and green and hairy outside. There are no petals. Male flowers are more numerous, but smaller than the female flowers (on different trees!). The woody, rounded, shiny-brown fruit measures about 4-6 cm diameter, with a shallow ventral crest that is extended at the far end into a beak or wing, with the wing always slightly recurved in a characteristic manner. It matures in hanging clusters and is 1-seeded. Very much like *Heritiera littoralis* (see next description), from which it can be distinguished by its round fruit and longer leaf stalk.

Ecology : Occurs behind the tidal zone of the mangrove belt, but has also been collected 70 km from the sea in tidally influenced, freshwater river systems. Mangrove associate species.

Distribution : Limited distribution, known only from Eastern Malaysia (Sarawak, Sabah), Brunei and Indonesian Kalimantan (Borneo), but may have a wider distribution range.

Abundance : Locally relatively common.

Use(s) : A heavy and hard timber.

Source of illustration : Based on Kostermans (1959).

Reference(s) : Kostermans (1959), Tomlinson (1986),
<http://www.rbgekew.org.uk/herbarium/brunei/bclhome.htm>.

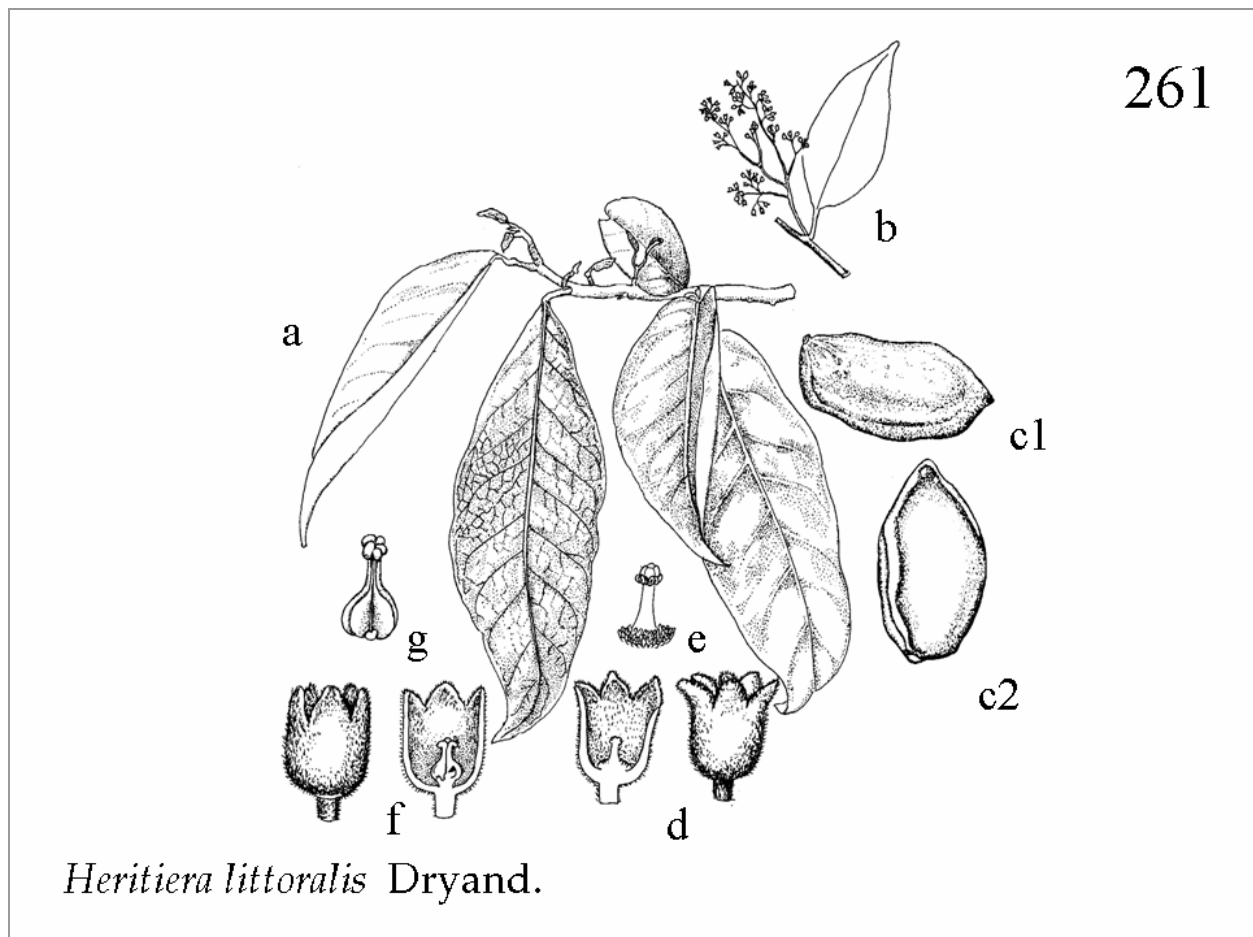


Fig. 261. *Heritiera littoralis* Dryand. (a) Branchlet with leaf buds, (b) branchlet with flowers, (c) winged, woody fruit, (d) male flower, (e) stamen column and disk, (f) female flower, and (g) stigma, subdivided into carpels.

STERCULIACEAE

261

Heritiera littoralis Dryand.

Synonyms : *Balanopteris minor* Gaertn., *Balanopteris tothila* Gaertn., *Helicteres apetala* Blanco, *Heritiera littoralis* Dryand. ex W.Ait., *Heritiera minor* Lam., *Sterculia cymbiformes* Blanco

Vernacular name(s) : Looking-glass tree (E), Dungun, Dungun laut (Mal.) Dunggu, Dungun, Dungun laut, Atung Laut, Lawanan Kete, Rumung, Balang, Pasisir, Lawang, Cerlang Laut, Lulun, Rurun, Belohila, Blakangabu (Ind.), Basit, Baut, Bayag-kabayo, Dungon, Magayao, Malarungon, Palingapoi, Palugapig, Paronapin, Paunapin – *Dungon-late* (Phil.), Pinle-kanazo (Myan.), Cui bien, C[aa]y cui, Cui (Viet.), Ngon kai, Ngonkai thale (Thai.), Dawm-klai, Kann-kai, Semornsakmot (Camb.)

Description : Evergreen tree up to 15-25 m tall, with a buttressed trunk and dark or grey, fissured bark. The trunk normally attains a diameter of about 35 cm at breast height. Individual trees bear either male or female flowers. The stiff, leathery leaves are bunched towards the ends of the branches. They are oblong or ovate-elliptic, and measure 10-20 by 5-10 cm, sometimes even 30 by 15-18 cm. Leaf stalks measure 0.5-2 cm. Leaves are dark green above and greyish-white beneath because of a layer of overlapping, star-shaped scales. Flowers are small (4-5 mm) and indistinct, unisexual and occur in complex, hairy clusters that mainly occur in the axils of leaves at the ends of branches. They may also occur immediately below the resting terminal bud. Flowers have a cup-shaped calyx that is reddish and hairy inside, and green and hairy outside. There are no petals. Male flowers are more numerous, but smaller than the female flowers (on different trees!). Flowers described by Corner as 'dull-purple bells with 4-6 teeth, hanging in yellowish tassels, 5-17 cm long'. The woody, shiny-brown to purplish fruit measures 5-6 by 6-8(-10) cm and has a keel or short flange along one side. It matures in hanging clusters and is 1-seeded. Very much like *Heritiera globosa* (see previous description), from which it can be distinguished by its elongated, larger fruit and shorter leaf stalk.

Ecology : Very frequently found on the landward margins of mangroves, and may also occupy the fringes of adjacent lowland forest, or rocky shores. It seems intolerant of high salinities and does not occur in very exposed or poorly drained sites. Occasionally associated with *Excoecaria*, *Avicennia* and *Xylocarpus*. Flowering occurs all year round. The curious boat-like fruits are commonly found along shorelines – they can float for weeks and germinate when they are stranded at high tide. Mangrove associate species.

Distribution : Occurs from East Africa and Madagascar to southern China (Guangdong, where it is rare), Australia and the Pacific as far as New Caledonia. Found throughout Southeast Asia.

Abundance : Common.

Use(s) : The wood is heavy and very durable, used for canoes, house posts, telegraph poles and masts, wharf decking, boat planking, and so on. Produces good firewood, and is a good raw material for wrapping and printing paper. The bark contains tannin and is used to treat rope and nets. Fruits/seeds are used for treatment of diarrhoea and dysentery. Seeds are used in fish dishes. Roots are used as fish poison.

Source of illustration : Based on Kostermans (1959), Percival & Womersley (1975), Tomlinson (1986).

Reference(s) : Heyne (1950), Kostermans (1959), Backer & Bakhuizen van den Brink (1963-8), Percival & Womersley (1975), Tomlinson (1986), Corner (1988), Aksornkoae (1993), Aragones *et al.* (1998).

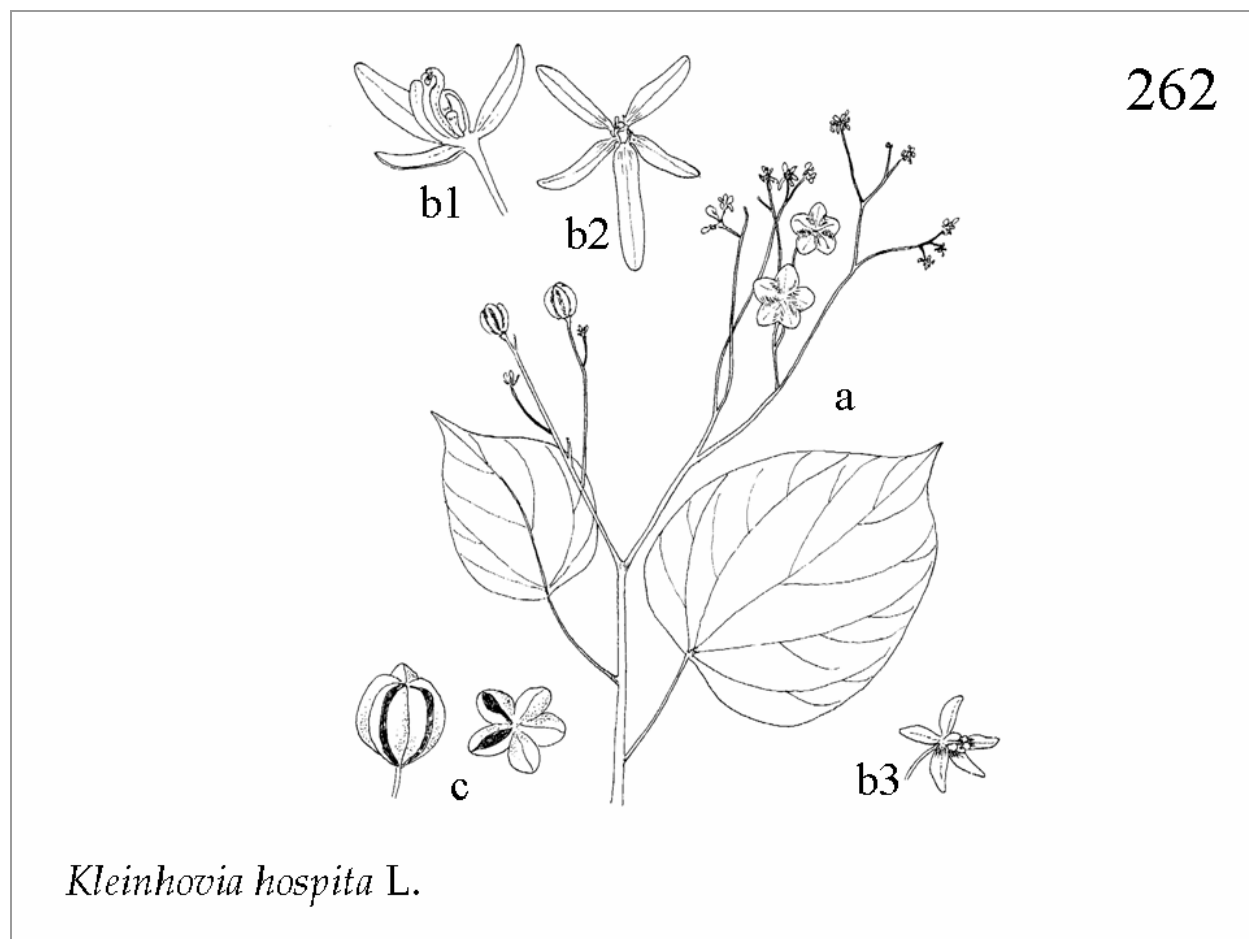


Fig. 262. *Kleinhovia hospita* L. (a) Branchlet with flowers and fruit, (b) flowers, and (c) fruit.

STERCULIACEAE

262

Kleinhovia hospita L..

Synonym(s) : *Cattimarus* Rumph. , *Grewia meyeniana* Walp., *Kleinhovia serrata* Blanco

Vernacular name(s) : Guest Tree (E), Temahau (Mal.), Mahar, Temahau, Katimahar, Mangar, Tangkele, Kayu Tahun, Katimaha, Bintangar, Bintana, Wintangar – *Katimaga* (Ind.), Apung-apung, Balansi, Bantana, Bignon, Biknong, Biluan, Binong, Bitanag, Bitnong, Hamitanago, Lapuis, Marakapas, Pampas, Panampat, Taag, Tagnag, Tamanag, Tan-ag, Tanak, Tangag, Toloktok, Unapong (Phil.)

Description : Small to medium sized tree, usually less than 20 m tall, but occasionally up to 30-40 m, with a girth of up to 90 cm (-120 cm). The crown is deep and dense, with ascending, spreading limbs, and the trunk forks low, coppicing from old stumps. Bark is fawn-grey, with fine, fibrous fissures and a powdery surface. Wood is soft, pale yellow, while timber is a pinkish buff colour. Twigs are covered with soft hairs. Leaf stalks are 2.5-10 cm, slender, while leaves are hairy, ovate or heart-shaped, 5-15 by 3.7-12.5 cm, with a pointed tip, entire margins and a palm-nerved base. Leaves are usually light green. Flowers occur in terminal clusters that protrude from the canopy. Individual flowers are 1 cm across and 5-merous. Sepals are pink and petals are much smaller and inconspicuous, the upper ones being yellowish. Fruit is a 5-ribbed, rounded, inflated capsule, 20-25 cm across, with thin, pink walls; five chambers, each containing 1-2 whitish seeds. The only species in the genus.

Ecology : Occurs in open country and along river banks, including tidal areas and landward margins of mangroves. Found in primary lowland forest, coastal forest and well developed secondary forest. From sea level up to about 500 m asl. According to Kochummen (1972) the species is restricted to regions with a pronounced dry season; however, the main author of this publication has observed *Kleinhovia hospita* doing very nicely in always humid parts of West and South Kalimantan. In habit the tree looks similar to *Hibiscus tiliaceus*, except for its protruding pink flowers and inflated fruits. Mangrove associate species.

Distribution : From the Mascarene Islands (east of Madagascar) and tropical East Africa to Polynesia. Occurs throughout Southeast Asia.

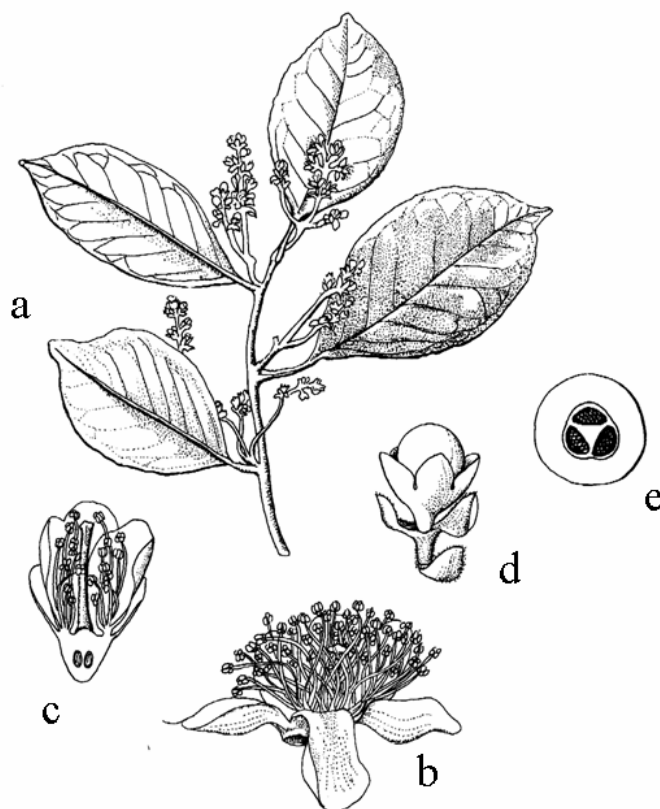
Abundance : Common.

Use(s) : Bark and leaves are poisonous and used for removing ecto-parasites; the bark produces a weak fibre. Some finely patterned wood is used for making much-prized handles of Javanese *kris* (ritual knives). The seeds are reportedly very poisonous.

Source of illustration : Based on Keng (1987).

Reference(s) : Heyne (1950), Kochummen (1972), Sastrapradja *et al.* (1979), Afriastini (1988), Corner (1988), <http://bpi.da.gov.ph/websitemedicinal/all/t/tan-ag.htm>.

263



Symplocos celastrifolia Griff. ex Clarke

Fig. 263. *Symplocos celastrifolia* Griff. ex Clarke. (a) Flowering branchlet, (b) flower, (c) longitudinal section of flower, (d) fruit, and (e) cross-section of fruit.

SYMPLOCACEAE

263

Symplocos celastrifolia Griff. ex Clarke

Synonyms : *Eugeniodes celastrifolius* O.K., *Symplocos candicans* Brand., *Symplocos hutchinsonii* Brand., *Symplocos nigricans* Brand., *Symplocos peninsularis* Brand.

Vernacular names : Kayu Tanyong, Kulimbabok, Tanjong Jawa, Tanjong-tanjong, Kendung, Krunjing, Adad, Bintangur Pantai, Mangkinang Tikus, Tawi (Ind.)

Description : Shrub or small tree, usually less than 12 m, rarely up to 30 m tall, with smooth twigs and trunk attaining a girth of up to 2 m. The elliptic leaves, 5.5-15 by 2-6 cm, are smooth, or (rarely) sparsely covered with fine hairs on the midrib and veins underneath. Secondary nerves 5-7 pairs, faintly visible on both sides. Often the upper surface of the leaf is very dark, and the lower surface is olive-brown. The leaf stalk is 3-15 mm long. Flowers are scented, creamy-coloured to whitish. The flower cluster is often branched at the base, 3-12 cm long, and its stalks are covered with fine hairs. The calyx is smooth, 1.5-2.5 mm, with lobes that have a fringe of hairs along the edge. The corolla is 4-6 mm long, and there are numerous stamens. Fruit is round and pink, green, yellow or dark blue, 4-10 by 3-8 mm. The smooth pip has three cells, but usually only one (the smallest) contains a viable seed. Seed and embryo are U-shaped.

Ecology : Usually occurs in coastal, either primary or secondary lowland forests, especially in the transition zone between mangrove (especially *Nypa*) and freshwater swamps. Usually in deep, swampy, sandy soils, but also in a variety of other habitats such as sandy beaches, sandbanks near the sea, heath forest, *Casuarina* peat swamp, *Shorea laevifolia* forest, dry bamboo ridges and red or yellow sandy loams, at altitudes of up to 750 m, and in exceptional cases, even 1,900 m. Flowering occurs from March to May and fruiting from June to August. Fruits are buoyant, because the sterile cells are filled with air. Mangrove associate species.

Distribution : Southeast Asian species, recorded in Thailand, Malaysia, Singapore, the Philippines, Indonesia (throughout, but not (yet) recorded in Java and the Lesser Sunda Islands) and Papua New Guinea.

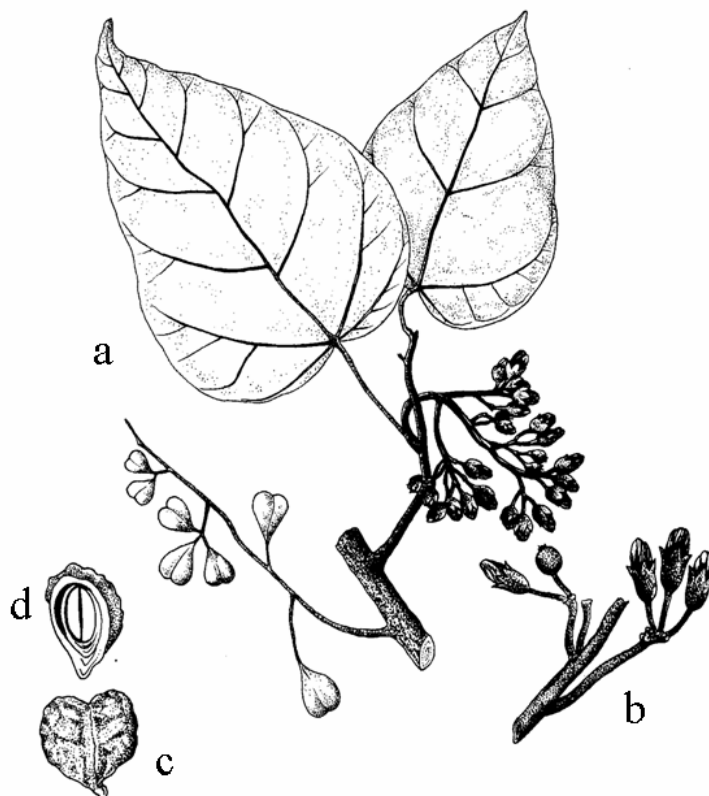
Abundance : Locally relatively common.

Use(s) : Unknown.

Source of illustration : Based on Nooteboom (1977).

Reference(s) : Nooteboom (1977), Kochummen (1978d).

264



Brownlowia argentata Kurz.

Fig. 264. *Brownlowia argentata* Kurz. (a) Flowering and fruiting branchlet, (b) flowers, (c) fruit, and (d) right half of fruit.

TILIACEAE

264

Brownlowia argentata Kurz.**Synonyms :** *Brownlowia lepidota*, *Brownlowia riedelii* Hemsl.**Vernacular name(s) :** Dungun, Durian laut (Mal.), Kiei, Ai, Pemandum, Migin, Pribo (Ind.)

Description : Shrub or small tree, up to 10 m (rarely 20 m) tall and 10 (-15) cm in diameter. Much-branching, with a greyish-brown or grey-mottled, cracked or thin, flaky, smooth bark. Leaves are stiff but thin, ovate, 8-25 by 6-17 cm, with a heart-shaped, or rarely abruptly tapered base and a pointed tip. The upper surface of the leaf is glossy and rather smooth, while the lower leaf surface and the twigs are covered with a dense, flattened layer of tiny, hairy scales, brownish. The slender leaf stalk is 4-6 cm long, and ends in a fleshy or corky swelling just below the leaf. The terminal flower head is erect, rather narrow and lax. The 5-lobed calyx is scaly. The corolla is 5-8 mm long, pale orange to salmon pink, and has numerous yellow stamens. The fruit is a woody capsule or nut, scaly, bilobed or heart-shaped (alternatively: shaped like a golf putting-club), up to 2 cm long, on a (max.) 1 cm long thick stalk. The tree is similar to *Heritiera littoralis*, which is also called 'dungun' in Malaysia and Indonesia, and also has brownish undersides to the leaves. But the leaves of *Heritiera* are also silvery beneath and they are not heart-shaped. The leaves of *Brownlowia* resembles those of *Hibiscus tiliaceus* and *Thespesia populnea* in shape, and as all three may be found growing together in Southeast Asia some care is needed in distinguishing them. The leaves of *Hibiscus* are rather ashen white underneath, while those of *Brownlowia* brownish and those of *Thespesia* green.

Ecology : Occurs in the landward margins of mangroves, or along brackish rivers, often trailing in water. True mangrove species.

Distribution : Occurs from Southeast Asia to the West Pacific (Solomon Islands). In Southeast Asia recorded from Myanmar, the Malay Peninsula, Singapore, the Philippines, throughout much of Indonesia (not yet recorded from Java and the Lesser Sunda Islands) and Papua New Guinea.

Abundance : Locally common, but on the whole uncommon.

Use(s) : Timber.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium, and partially based on Kostermans (1961) & Ashton (1988).

Reference(s) : Kostermans (1961), Kochummen (1978e), Tomlinson (1986), Ashton (1988), Corner (1988), Ng & Sivasothi (1999).

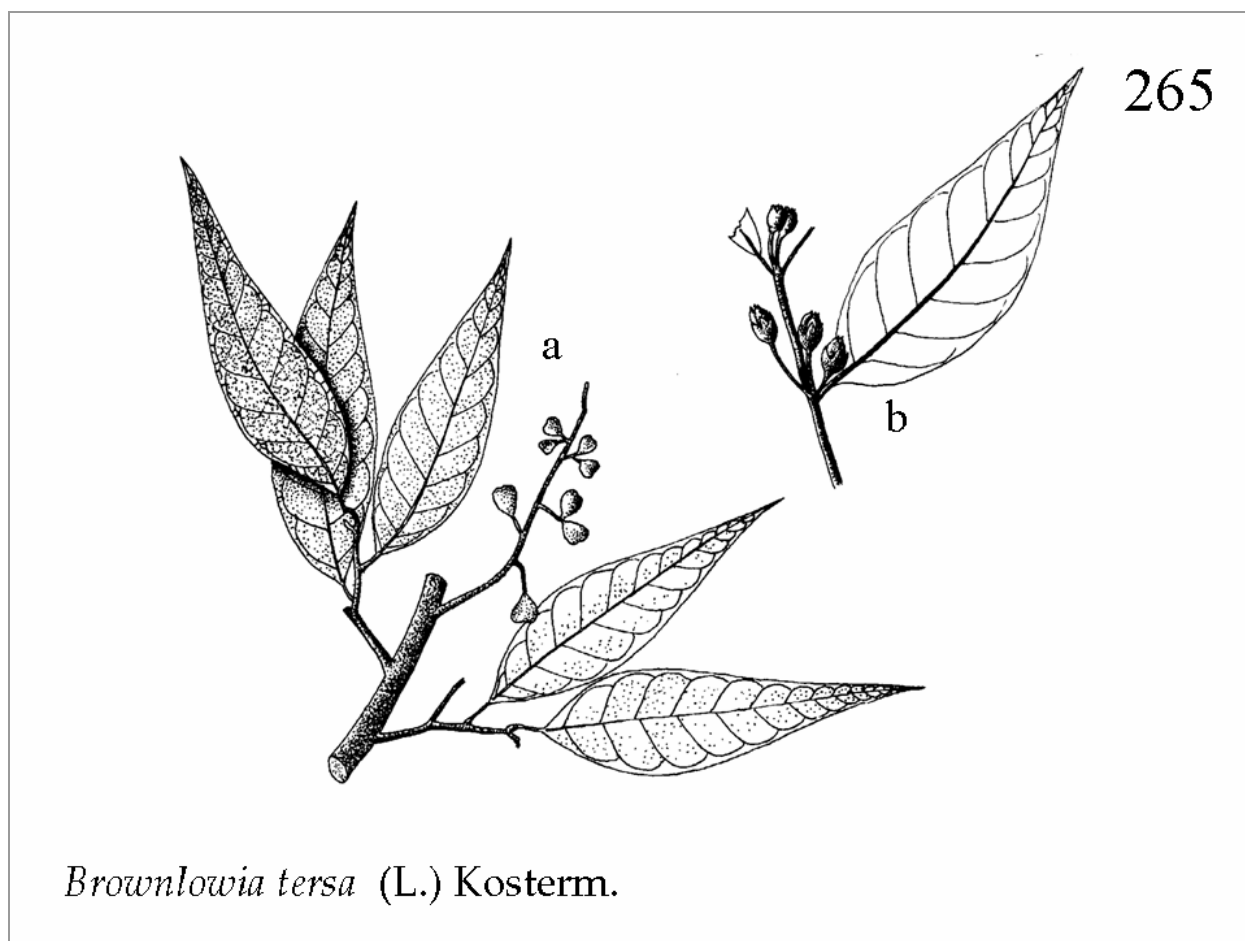


Fig. 265. *Brownlowia tersa* (L.) Kosterm. (a) Fruiting section of branch, and (b) flowering branchlet.

TILIACEAE

265

***Brownlowia tersa* (L.) Kosterm.**

Synonyms : *Brownlowia beccarii* (Mast.) Pierre, *Brownlowia lanceolata* Benth., *Dialycarpa beccarii* Mast., *Glabraria tersa* Linné, *Heritiera attenuata*, *Heritiera lanceolata*, *Litsea tersa*, *Malapoenna tersa*, *Niota polyandra*, *Tetranthera tersa*, *Vittmannia polyandra*

Vernacular name(s) : Dungun (Mal.), Dungun air (Ind.), *Maragomon* (Phil.), Nam nong (Thai)

Description : Shrub, usually 1.5-2 m (rarely 5 m) tall. The smaller branches are covered with a dense layer of minute, flattened scales. Branches are grey, smooth and marked with lines and grooves along their length. The narrow, lanceolate to elliptic-lanceolate leaves are rigid and thin or leathery, 2-5 by 6-20 cm, with a rounded base and a pointed tip. The upper surface is glossy and smooth, while the lower surface is grey-green and covered with a dense layer of tiny, hairy scales. The leaf stalk is 1-2 cm long. The flower heads occur in axils or at the ends of branches, few-flowered, and are up to 4 cm long. The calyx is bell-shaped and 5 mm long, with 3-5 lobes. The corolla is pink with a yellow base, slightly longer than the calyx (about 6 mm), with 5 petals. Fruit is a woody capsule or nut, 15 mm long, bilobed or heart-shaped (alternatively: shaped like a golf putting-club), and is pale greyish-green, covered with small, brown warts. It is often confused with *Camptostemon* because both have a scaly leaf. It can be distinguished by the shape of its fruit and the flowers, which occur in clusters.

Ecology : Occurs in relatively sunny locations in mangrove swamps, and along creeks where mud is accreting. Often found on sandy shores or firm mud, along with *Nypa*. Gregarious species. True mangrove species.

Distribution : From India (Orissa) to Southeast Asia, where it has been recorded in Myanmar, Cambodia, Thailand, Malaysia, Brunei, Singapore, the Philippines, Indonesia (Sulawesi, Borneo, Sumatra, the Moluccas).

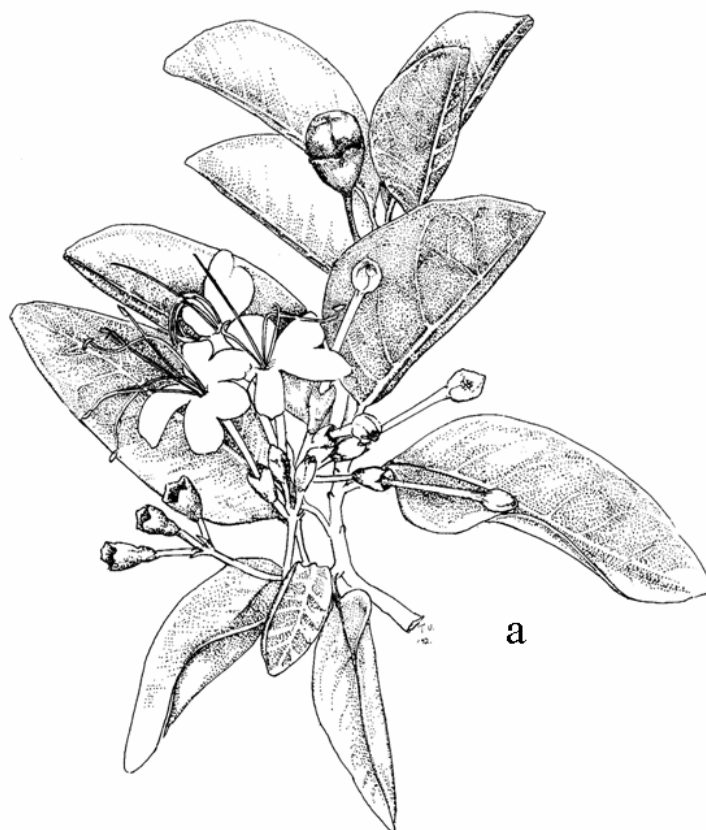
Abundance : Locally abundant, but on the whole rather rare.

Use(s) : Sometimes used for fencing or as fuelwood.

Source of illustration : Drawn from herbarium specimen, Bogor Herbarium, and partially based on Kostermans (1961), Ashton (1988).

Reference(s) : Burkill (1935), Kostermans (1961), Kochummen (1972e), Tomlinson (1986), Ashton (1988), Corner (1988), Giesen & Sukotjo (1991), Aksornkoae (1993), Aragones *et al.* (1998), Ng & Sivasothi (1999), Maung (2003).

266



Clerodendrum inerme (L.) Gaertn.

Fig. 266. *Clerodendrum inerme* (L.) Gaertn. (a) Flowering and fruiting branchlet.

VERBENACEAE

266

Clerodendrum inerme (L.) Gaertn.

Synonyms : *Clerodendrum buxifolium* (Willd.) Spreng., *Clerodendrum capsulare* Blanco, *Clerodendrum commersonii* Spr., *Clerodendrum nereifolium* (Roxb.) Schauer., *Jasminum litoreaum* Rumph., *Volkameria buxifolia* Willd., *Volkameria inermis* L., *Volkameria neriifolia* Roxb.

Vernacular name(s) : Wild Jasmine, Seaside Clerodendrum, Indian Privet, Glorybower (E), Gambir laut (Mal.), Gambir laut, Ketuwer, Manor utan, Kembang bugang, Biring jene, Wiri salo, Manuru dowongi, Koi a koi, Rappae-rappae, (Ind.), Dây chùm gọng (Viet.), Sam ma ngaa (Thai)

Description : Erect, drooping or straggling shrub, sometimes climbing or a small tree, usually 0.5-3 m (occasionally up to 10 m), stems woody and smooth, with drooping branches and purplish young twigs that are densely covered with short hairs. Leaves opposite, ovate to elliptical, thinly fleshy and smooth, measuring 1.5-14 by 0.7-5(-8) cm, with a pointed tip and with obvious leaf stalk. On the lower surface the leaves have dark green dots and near the base of the stalk they often have a few large, sunken glands. Leaves are smooth on both sides and have 5-8 pairs of nerves. The flower clusters are 3(-7) flowered, joined at a common base point, located in the axils; upper clusters appear terminal. Calyx is bell- or cup-shaped, purple-edged, 5 mm long and with 5 teeth-shaped lobes, often 5-ribbed, and has many glands on the outside; smooth to densely hairy. The 5 corolla lobes are ovate, rounded, smooth and white, while the tube, 1.5-3.5 cm, is pale lilac; may be either smooth or hairy. The 4 reddish to purple stamens protrude about 2 cm from the rest of the flower and curve upwards. The fruit is egg-shaped to round, with flattened top; green, but when ripe they are black and dry, 1.5 cm across, and breaking into 4 lobes each bearing a thick, corky wall.

Ecology : Mainly (according to Heyne, exclusively) in or near brackish or saltwater, in marine or maritime localities, including mangroves. Potentially invasive species, especially in Hawaii where it has been introduced as an ornamental. Variable species, with most variation in habit, leaf form, degree of hairiness of the calyx, and form of the flower clusters. Mangrove associate species.

Distribution : Occurs from India and Sri Lanka through Southeast Asia to southern China, Australia and Polynesia. In Southeast Asia recorded in Myanmar, Cambodia, Thailand, Vietnam, the Philippines, Malaysia, Singapore, Indonesia (Borneo, Sumatra, Java). Cultivated in Hawaii, Australia, and the West Indies and probably elsewhere in warm climates.

Abundance : Locally common.

Use(s) : Particularly the seeds, but also the roots, are used as an effective medicine to treat poisoning from fish or other marine animals. A concoction from the leaves is used to treat wounds. Used in Indonesian appetizer dish. Fruit used in Java to treat dysentery. Cultivated as an ornamental.

Source of illustration : Kochummen (1978b), and partially from photograph.

Reference(s) : Lam (1919), Heyne (1950), van Steenis *et al.* (1951), Backer & Bakhuizen van den Brink (1963-8), Kochummen (1978b), Aksornkoae (1993), Maung (2003), www.unepscs.org/ProjectComponents/Mangroves/mangroves.htm.

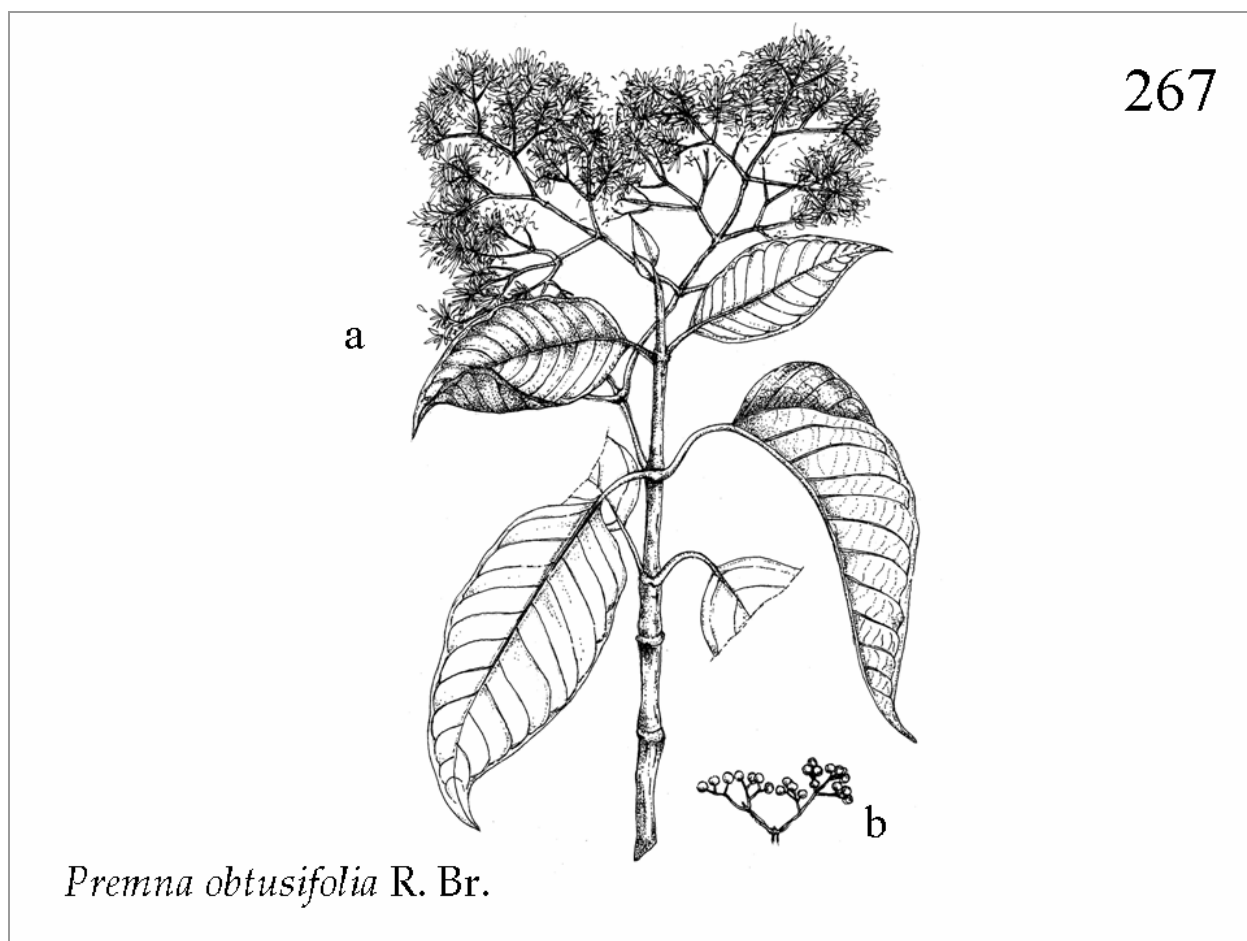


Fig. 267. *Premna obtusifolia* R. Br. (a) Flowering branch, and (b) fruit cluster.

VERBENACEAE

267

***Premna obtusifolia* R. Br.**

Synonyms : *Premna abbreviata* Miq., *Premna corymbosa* (Burm. f.) Rottl. & Willd., *Premna cyclophylla* Miq., *Premna foetida* Reinw. ex Blume, *Premna gaudichaudii* Schau., *Premna integrifolia* L., *Premna laevigata* Miq., *Premna littoralis* K. & G., *Premna nitida* K.Schum., *Premna opulifolia* Miq., *Premna ovalifolia* Wall., *Premna ovata* R.Br., *Premna sambucina* Wall., *Premna scandens* Boj., *Premna serratifolia* Blanco, *Premna serratifolia* L., *Premna subcordata* Turcz.

Vernacular name(s) : Daun kambing, Sayur kambing (Ind., Mal.), Chaa luead (Thai)

Description : A small to medium sized tree, occasionally climbing or straggling shrub, up to 10 metres, trunk up to 40 cm diameter. On sea shores it may assume a creeping or low shrub habit. Leaves simple, entire, opposite, with a variable shape (ovate, ovate-oblong, elliptic), 8-25 by 4-10 cm, pointed tip, with (4-)7-12 lateral veins on either half (4-5 on smaller leaves; more on larger leaves); star-shaped hairs underneath; leaf stalk 7-65 mm long. Leaves have a foetid smell when crushed. Flowers are very small (<5mm), 4-5 lobed, greenish-white or yellow, in large, terminal, bunched clusters. Fruit is a small, round, reddish to black berry, 5-6 mm. Highly variable species, with major variations in leaves, habit and flower clusters; as a result described under many scientific names. The description by King and Gamble (*Premna littoralis*) is of a coastal specimen from Perak (Malaysia), but regarded by Lam (1919) as being unreliable in its diagnostics.

Ecology : Grows in a wide range of soils, but preferring most, well-drained soils. Usually found near the sea, according to Lam (1919). In coastal lowlands (<500m asl), sandy beaches, but also occurring in mangroves on occasion. Branches easily take root when planted. Larger tree trunks are often hollow. Mangrove associate species.

Distribution : From East Africa, Madagascar, Mauritius, the Indian Sub-continent to Southeast Asia, Southern China, Australia and Polynesia. In Southeast Asia it has been recorded in Myanmar, Cambodia (uncommon), Thailand, Peninsular Malaysia, the Philippines, Indonesia (Sumatra, Borneo, Java, Lesser Sundas, Sulawesi, Moluccas), East Timor and PNG. Probably found throughout the region.

Abundance : Locally common; also planted.

Use(s) : Planted as hedges (branches easily take root). Wood is very hard and durable, and has an attractive pattern; used for machete handles. Bark used as twine. Leaves used to improve lactation. Used as fodder for sheep and goats (hence the common name in Malay). Boiled leaves used to relieve itchiness.

Source of illustration : Khan & Alam (1996)

Reference(s) : Lam (1919), Heyne (1950), Kochummen (1978b), Aksornkoae (1993), Khan & Alam (1996), Marschke (2000).

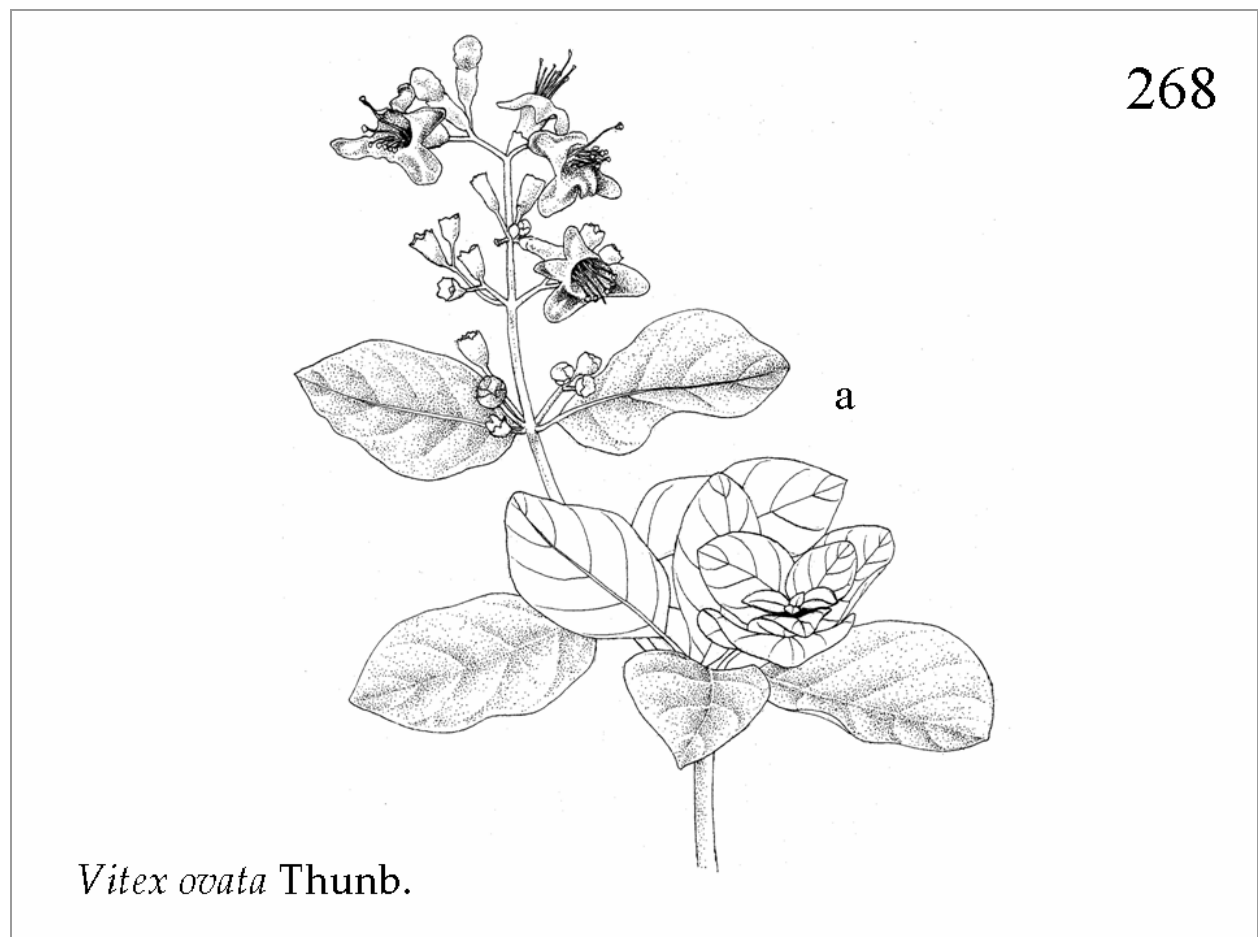


Fig. 268. *Vitex ovata* Thunb. (a) Flowering and fruiting terminal branch.

VERBENACEAE

268

Vitex ovata Thunb.

Synonyms : *Lagondium vulgare* Rumph., *Vitex rotundifolia* L. f., *Vitex trifoliata* var. *ovata* (Thunb.) Makino, *Vitex trifolia* var. *simplicifolia* Chamisso, *Vitex trifolia* var. *unifoliolata* Schauer.

Vernacular name(s) : Chaste Berry, Vitex, Chasteberry, Monk's pepper, Cloister pepper (E), Lenggundi, Lagundi, Lemuning, Muning, Demundi (Mal.), Lagundi, Lilegundi, Dunuko, Galumi, Al tuban, Sangari, Lawarani, Rala (Ind.)

Description : Prostrate shrubs, with prostrate to creeping stems, rooting at nodes; occasionally a small tree, 1-3m; branchlets covered with silky hairs when young. Entire plant – but especially the leaves – is strongly aromatic. Leaves mostly 1-3-foliolate, without stalks or with only a very short stalk, 1.5-5 (rarely 30) mm; leaf blade obovate to spoon-shaped, ovate-elliptic, broadly oblong-elliptic, or circular, 1.5-3 by 2.5-5 cm, velvety to minutely covered with silky hairs, usually pale dull green, base tapering to rounded, margin entire, tip abruptly pointed to rounded. Flowers in compact terminal cylindrical or ovate clusters, 1-2.5 by 3-10 cm. Calyx cup-shaped, 4-5 mm, slightly 2-lipped, with 5 teeth, outside covered with minute silky hairs and glands, inside smooth. Corolla purplish mauve to lilac blue, a thin tube abruptly fanning out at the end, outside covered with minute silky hairs and glands, long shaggy hairs in tube and inside on lower half of large front lobe of lower lip. Stamens and style protruding. Fruit dark (reddish) brown when dry, round, 6 mm long. Highly variable species.

Ecology : Beach vegetation, sandy dunes, and sandy landward edges of mangroves; usually coastal, but on Java it has been planted up to an altitude of 1,000 m asl. Common in gardens and villages in Malaysia and Indonesia. Flowering from July to September, fruiting from September to November. Mangrove associate species.

Distribution : Found along most of the Chinese coast, from Shandong south to Guangdong; further in Taiwan, Korea, Japan, through Southeast Asia; extending westwards to Mauritius and India, eastwards to Polynesia and Hawaii. In Southeast Asia recorded from Myanmar, Thailand, Cambodia, Malaysia, the Philippines and Indonesia (Sumatra, Java, Sulawesi, Moluccas).

Abundance : Common.

Use(s) : *Vitex ovata* has been used since ancient times as a female remedy. One of its properties was to reduce sexual desire, and it is recorded that Roman wives whose husbands were abroad with the legions spread the aromatic leaves on their couches for this purpose. It became known as the chasteberry tree. During the Middle Ages, Chasteberry's supposed effect on sexual desire led to it becoming a food spice at monasteries, where it was called "Monk's pepper" or "Cloister pepper." In tradition, it was also known as an important European remedy for controlling and regulating the female reproductive system. Several studies indicate that *Vitex* can help control acne. In Indonesia leaves are kept in cupboards to deter cockroaches.

Source of illustration :

http://www.hear.org/starr/hiplants/images/thumbnails/html/vitex_rotundifolia_thumbnails.htm

Reference(s) : Lam (1919), Heyne, (1950), Kochummen (1978b), Corner (1988), Maung (2003),

<http://www.australianplants.org/fsdfour.htm>,

<http://www.holistic-online.com/Herbal-Med/Herbs/h211.htm>,

<http://www.whitley-award.org/Articles/projects/rufford/TruongQuangTam.html>