

COPYRIGHT NOTICE:

Andrew Henderson: Palms of Southern Asia

is published by Princeton University Press and copyrighted, © 2009, by Princeton University Press. All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher, except for reading and browsing via the World Wide Web. Users are not permitted to mount this file on any network servers.

Follow links for Class Use and other Permissions. For more information send email to: permissions@press.princeton.edu

Introduction

Following the publication of *A Field Guide to the Palms of the Americas* (Henderson et al. 1995), I had in mind a similar volume for the Old World. There are, however, many more species of palms in the Old World, and the area is much larger, including as it does all of Europe, Africa, Madagascar, the islands of the Indian Ocean, Southern and Southeast Asia, New Guinea, Australia, and the islands of the western Pacific. This is too big an area with too many species for a single field guide. Therefore I decided to work first on the Southern Asian palms—the subject of this book.

The region defined in this book as Southern Asia includes all of Afghanistan, Bangladesh, Bhutan, Cambodia, China, India (including the Andaman and Nicobar islands), Japan (including the Ryukyu and Bonin islands), Laos, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Thailand, and Vietnam. This region is hereafter referred to as “our area” (Fig. 1).

Palm Regions in Southern Asia

The area covered in this book is extremely diverse in terms of topography and climate, and comprises several different biogeographic regions. In this section I discuss these as “palm regions,” that is, regions that have similar environmental conditions and a suite of palm spe-

cies. This is obviously a large-scale division of the area and masks a lot of local variation. However, I think it is useful for understanding the diversity and distribution of Southern Asian palms. Starting from the west, brief descriptions of these regions and their palms are given.

I also give notes here on the best places to see palms in those places with rich palm floras. These notes are based either on my own experiences or are taken from articles that have appeared in the journal *Palms* (formerly *Principes*).

Iranian Plateau

The most westerly area covered by this guide comprises the countries of Afghanistan and Pakistan. The mountainous regions of these countries are part of a larger mountain system known as the Iranian Plateau (Fig. 2). This system includes the mountain regions of southwestern Afghanistan and western Pakistan and continues through Iran. The northeastern part of the plateau is continuous with the Hindu Kush, which provides a link between the Iranian Plateau and the western Himalayas. The western limit of the plateau is the Zagros Mountains of western Iran and Iraq.

The area is mostly arid and includes few palms—except of course for the widely cultivated date palm. However, there is one native species of outstanding interest, *Nannorrhops*

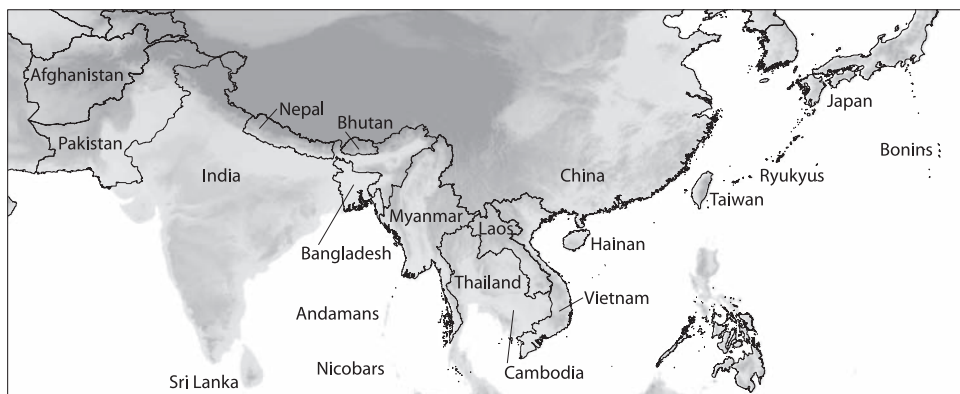


Figure 1. Countries and islands of Southern Asia.

ritchiana, which occurs all along the eastern margins of the Iranian plateau in Afghanistan and Pakistan and continues into southeastern Iran. Gibbons and Spanner (1995a) have given an account of looking for *N. ritchiana* in Pakistan.

Indo-Gangetic Plain

The Indo-Gangetic Plain (Fig. 2) gets its name from two great rivers of the region, the Indus and the Ganges. The plain is a large, low-lying alluvial crescent of land stretching from the Indus Plain in Pakistan through to the Ganges Plain of northern India and Bangladesh, a distance of almost 3000 km. To the west is the Iranian Plateau, to the north are the foothills of the Himalayas, and to the south the Deccan Plateau of India. Between the Indus and Ganges plains are several drier areas of northwestern India; the Great India Desert (also known as the Thar Desert), and a large area of salt marshes known as the Rann of Kutch.

The flat and fertile river plains of the Indus and Ganges are ancient centers of civilization and are densely populated areas. Almost no natural vegetation remains. There is, however, one palm of interest. This, *Hyphaene dichotoma*, is an eastern outlier of an otherwise African and Arabian genus. It occurs in the Indian states of Gujarat and Maharashtra, in arid, low-lying regions.

Western Ghats

The Western Ghats (Fig. 2) are a mountain range running parallel to India's Arabian Sea

coast. They range over a distance of approximately 1600 km, from the boundary of Gujarat and Maharashtra states in the north to the southern tip of India at Cape Comorin. From the narrow coastal plain (historically known as the Malabar Coast), the mountains rise steeply to an average elevation of about 1000 m. The highest peak, in the southern part of the Ghats, is almost 2700 m. The western slopes of the Western Ghats receive the full force of the annual monsoon, from June to September, and rainfall is high. Because of this rainfall the western slopes have a band of tropical rain forest running along their windward slopes. The region is rich in species and is considered one of the world's biodiversity hotspots.

Most of the palms of the Western Ghats occur in the southern, wetter part, from Goa southwards, and most of them are endemic to the region. About 30 species of palm are present, and more than 23 are endemic, while 7 species also occur in Sri Lanka. Notable among the endemics are *Arenga wightii*, *Bentinckia condapanna*, *Pinanga dicksonii*, and 18 species of *Calamus*.

Eastern Ghats and Deccan Peninsula

Mirroring the Western Ghats along India's Arabian Sea coast, the Eastern Ghats (Fig. 2) run along the coast of the Bay of Bengal (historically known as the Coromandel Coast). The Western and Eastern Ghats form the boundaries of the Deccan Plateau (Fig. 2) of south-

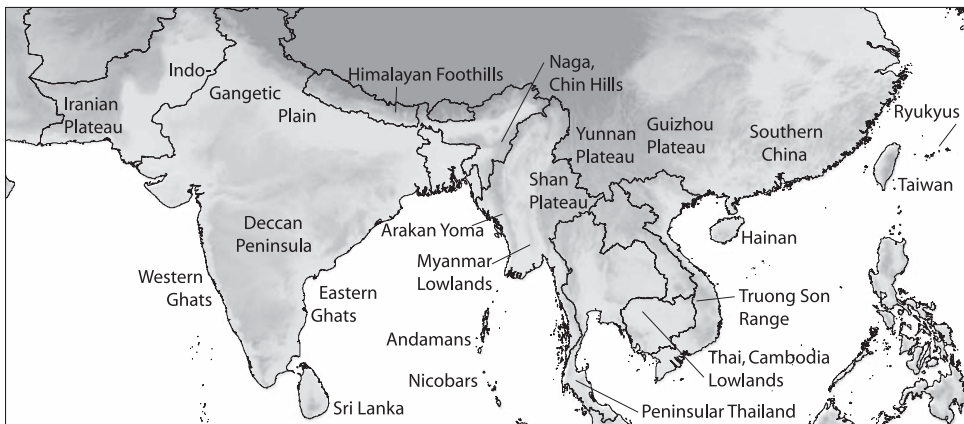


Figure 2. Palm regions in Southern Asia.

central India. The Eastern Ghats extend over a range of approximately 1750 km, from the state of Tamil Nadu in the south through Andhra Pradesh to Orissa in the north. Unlike the Western Ghats, the Eastern Ghats are broken into a series of hills, and these seldom reach 1500 m elevation.

The Eastern Ghats and the Deccan Plateau are drier than the Western Ghats and consequently have fewer palms. Only a few species occur there, including *Calamus rotang* and *C. viminalis*. In the northern parts of the Eastern Ghats, where rainfall allows the development of tropical semievergreen forest, a more interesting palm flora occurs. Such species as *Licuala peltata*, *Calamus guruba*, and *C. nambariensis* are found there. There is a possibility that *Caryota maxima* and *Wallichia disticha* also once occurred there.

Sri Lanka

The pear-shaped island of Sri Lanka (Fig. 2), lying just off the southeast coast of India, is about 500 km long and 220 km wide in its widest part. A large upland area, the Central Highlands, occurs in the central-southern part of the country, with elevations reaching 2500 m. The climate of Sri Lanka is tropical, with the southwestern regions, especially the windward slopes of the Central Highlands, receiving the highest rainfall.

The flora of Sri Lanka contains a high number of endemics and also has strong affinities with that of the Western Ghats. The palm flora reflects this. Of the 18 native species of palm found on the island, 10 are endemic including the genus *Loxococcus*, 7 are also found in the Western Ghats, and 4 are widespread.

The best place to see native palms in Sri Lanka is undoubtedly the Sinharaja Forest Reserve, situated in the southwest of the country. Here there are beautiful stands of the endemic *Loxococcus rupicola*, as well as *Oncosperma fasciculatum*, and at least three species of *Calamus*. In nearby areas one can see *Corypha umbraculifera*, *Caryota urens*, *Phoenix pusilla*, as well as the ubiquitous *Borassus flabellifer*, *Areca catechu*, and *Cocos nucifera*.

Himalayan Foothills

The great mountain chain of the Himalayas forms a huge arc in northern India, Nepal, and

Bhutan, from the Hindu Kush in the west to the Yunnan Plateau in the east. The mountains rise to great heights, with Everest reaching 8848 m elevation. Along the foothills of the Himalayas (Fig. 2), from just above sea level to almost 2000 m elevation, there is a band of lowland and montane rain forest.

These forests of the Himalayan foothills are rich in palms, especially the genera *Calamus*, *Caryota*, *Phoenix*, *Pinanga*, *Plectocomia*, *Trachycarpus*, and *Wallichia*. Many species in these genera are endemic to the region, for example, *Phoenix rupicola*, *Pinanga gracilis*, *Wallichia oblongifolia*, and several species of *Trachycarpus*. Another species of *Phoenix*, *P. acaulis*, occurs in lower foothills, and Dhar (1998) has described and illustrated a population near Dehra Dun in India.

The Tibetan Plateau occurs north of the Himalayas. From here rise several of the great rivers of Southern Asia—the Ayeyarwaddy, Brahmaputra, Ganges, Indus, Mekong, Salween, and Yangtze. Very few species of palm are found on the Tibetan side of the Himalayas, and these occur in deep, moist valleys formed by these rivers and their tributaries. Examples are *Arenga micrantha*, *Pinanga gracilis*, *Wallichia triandra*, and a couple of species of *Calamus*, all of which occur in the valleys of the Brahmaputra and its tributaries.

There are more palm species in the eastern part of the Himalayan Foothills than in the western part. In the Indian states of Arunachal Pradesh and Assam there are still large areas of forest, and it is possible to see many palms from roadsides. However, access to several states of the region requires special permission.

Naga Hills, Chin Hills, and the Arakan Yoma

This area includes a long, curving range of mountains, approximately 950 km in length, that stretches from the Himalayan Foothills of Arunachal Pradesh in northeastern India southwards to Myanmar's west coast along the Bay of Bengal. The northern parts of this range are known as the Naga Hills and Chin Hills (Fig. 2), and the southern part as the Arakan Yoma (Fig. 2). The highest point is Mount Victoria in Myanmar, at 3000 m elevation. Also included here are the hills of the Assam Range (Garo,

Khasi, and Jaintia hills), mostly in Meghalaya State in northeastern India. These mountains have large areas of montane rain forest.

Few palms are endemic to these mountains, although *Pinanga griffithii* and *Wallichia nana* are confined to the northern parts of the ranges. However, the mountains provide a high-elevation corridor so that several species from the more northerly ranges of the Himalayan Foothills occur farther to the south along these hills, such as *Caryota maxima* and *Wallichia disticha*. Conversely, some southern species reach northwards along this range, such as *Calamus longisetus*.

Henderson et al. (2005) have described the palms of northern Myanmar, on the eastern slopes of the Naga Hills, and Hodel (2004) has described a visit to see the palms of the Chin Hills and Arakan Yoma, including Mount Victoria. Gibbons and Spanner (1994) gave an account of a visit to see the palms, principally *Trachycarpus martianus*, of the Khasi Hills in India.

Andaman and Nicobar Islands

The Andaman and Nicobar islands (Fig. 2) represent, geologically, a continuation of the Arakan Yoma. They are a volcanic island chain stretching from north to south in the Bay of Bengal for approximately 800 km. The Andamans are about 350 km long, and consist of several hundred small islands. The main islands are the Greater Andamans and Little Andamans. The Nicobars are about 300 km long and consist of fewer islands, the largest of which is Great Nicobar.

The climate of the Andaman and Nicobar islands is tropical, and the islands were mostly covered by lowland rain forest. The most northerly Andamans are less than 200 km from the coast of Myanmar, and their flora is essentially a continuation of Myanmar's. On the other hand, the most southerly of the Nicobars are only about 150 km from Sumatra, and their flora is a continuation of the Sumatran one. This division is reflected by the palms.

Twenty native species of palm occur in the Andaman Islands, and 11 in the Nicobars. Only four or five species are shared by both island groups. Remarkable is the diversity of

Daemonorops—five species in the Andamans—a genus absent from the Nicobars.

Access to the Nicobar Islands is currently restricted, but the palms of the Andamans can be seen around Port Blair. Mathew and Abraham (1994) have described the palms of the Andamans and Nicobars.

Myanmar Central Lowlands

The central lowlands of Myanmar (Fig. 2), running through the central part of the country from north of Mandalay to Yangon, are mostly low-lying areas with a highly seasonal climate, giving rise to deciduous forests. The only higher-elevation area is the Pegu Yoma, a low mountain system running north–south and reaching almost to Yangon (the Shwedagon Pagoda is built on one of the most southerly outliers of the Pegu Yoma).

There are few palms in the central lowlands, except for huge numbers of *Borassus flabellifer*. However, the Pegu Yoma, famous for its teak forests, now highly disturbed, is quite rich in species, including such endemics as *Pinanga hexasticha* and *Wallichia lidiae*. *Calamus arborescens* is also abundant there.

Shan, Yunnan, and Guizhou Plateaus

This large mountainous area, centered on the Chinese provinces of Yunnan and Guizhou, also includes all Shan State, Myanmar, and parts of northern Thailand, northern Laos, and northwestern Vietnam. The Shan, Yunnan, and Guizhou plateaus (Fig. 2) are actually a highly dissected mountain system, with many of the valleys running in a north–south direction. In Guizhou there are large areas of karst limestone, giving rise to spectacular scenery.

In southwestern China, in the province of Yunnan, there are about 35 palm species. The best place to see these is in the most southerly prefecture of Xishuangbanna. The Xishuangbanna Tropical Botanical Garden is a good base from which to visit various nature reserves in the area, including the Xishuangbanna National Nature Reserve. A few palms of interest occur farther north in Yunnan, especially species of *Trachycarpus*. Gibbons and Spanner (1993) have described a journey in search of *Trachycarpus nanus* in central Yunnan, and another trip (Gib-

bons & Spanner 1995b) to see *T. princeps* in western Yunnan. Another palm of the Yunnan Plateau is *Phoenix roebelinii*. Although one of the most commonly cultivated ornamental palms, in the wild it has a highly fragmented and local distribution along the banks of the Mekong, Nu Jiang (Salween), and Lancang Jiang rivers.

In Myanmar, the palms of the Shan Plateau remain almost completely unknown. Much of Myanmar is currently restricted for foreigners, and it remains difficult to see the rich and diverse palm flora of this part of the country.

Southern China

This area includes all the Chinese provinces of Guangxi and Guangdong, and adjacent areas of Hunan, Jiangxi, and Fujian (Fig. 2). Also included here is the island province of Hainan. The southwest boundary of this region is the Red River in northern Vietnam, and so the region includes part of northeastern Vietnam.

Several palms occur in Guangxi and Guangzhou, but they tend to be few and far between, although the area is famous for its spectacular limestone scenery. However, there is one notable palm here, *Guihaia*, and both species can be seen in Guangxi. Perhaps the city of Guilin, the namesake of the genus, is the best place to see *G. argyrata*, which grows on limestone outcrops right in the city center (Dransfield et al. 1985).

There are about 26 native species of palm in Hainan, including 10 endemic species. The palm flora of Hainan is closely related to that of northern and central Vietnam, and there are some closely related pairs of species. Examples are *Chuniophoenix humilis* in Hainan and *C. nana* in Vietnam; *Licuala hainanensis* in Hainan and *L. centralis* in Vietnam; and *Licuala fordiana* in Hainan and *L. radula* in Vietnam. There are several major forest reserves in Hainan where palms can be seen, for example, the Bawangling National Nature Reserve, the Diaoluoshan National Forest Park, and the Jianfengling National Forest Park. The palms of Hainan have been described by Henderson and Guo Lixiu (2008).

Taiwan

The island of Taiwan (Fig. 2), lying off the southeast coast of China, is almost 400 km

long and 140 km wide at its widest point. Most of the eastern part of the island is mountainous, with peaks reaching almost 4000 m. Taiwan is dissected almost in half by the Tropic of Cancer, so much of the island is outside of the tropics. This is reflected by the flora—most of the plants from the central and northern parts of the island have affinities with temperate floras, especially with those of China and Japan. The plants of the southern parts, particularly the Hengchun Peninsula and the islands of Lanyu and Lutaotao, have affinities with the tropical flora of the Philippines.

Just seven species of palm occur in Taiwan, with three of them endemic (*Arenga engleri*, *Calamus beccarii*, and *C. formosanus*). Two species, *Calamus siphonospathus* and *Pinanga tashiroi*, occur only on the island of Lanyu, off the southwest coast of the main island, and represent the northernmost extension of the Philippine flora. Of the other two species, *Livistona chinensis* just makes it to Taiwan, occurring off the west coast on Chishan Island, and *Phoenix loureiroi* is widespread.

Ryukyu Islands

The Ryukyus (Fig. 2) are an island chain running for about 1000 km in a great arc from the northeastern tip of Taiwan to the southwestern tip of Japan, forming the eastern boundary of the East China Sea. They represent the exposed summits of submarine mountains, most of which are volcanic in origin. The largest island is Okinawa. The islands are outside of the tropics and have a subtropical climate with high rainfall.

Four species of palm occur on the Ryukyus, including the endemics *Arenga ryukyuensis* and *Satakentia liukuensis*. *Livistona chinensis* also occurs there, and just reaches southern Japan, and an isolated population of *Nypa fruticans* occurs on Iriomote, hundreds of kilometers from its nearest neighbors in the Philippines. Pintaud and Setoguchi (1999) have described and illustrated *Satakentia liukuensis* on Ishigaki, one of the Ryukyu Islands.

Bonin Islands

The Bonin Islands (Fig. 1), also known as the Ogasawara Islands, are a group of about 30 small, remote islands occurring in the western

Pacific. They are about 1000 km south of Tokyo and are administered by Japan.

Two species of palm occur on the Bonin Islands, both endemic, *Livistona boninensis* and *Clinostigma savoryanum*.

Lowlands of Thailand, Laos, Cambodia, and Vietnam

This area includes the low-lying areas of southern and eastern Thailand, southern Laos, almost all of Cambodia, and the southern part of Vietnam (Fig. 2). Also included here are the deltas of two large rivers, the Chao Phraya in Thailand and the Mekong in Vietnam, and the Cardamon and Elephant mountain systems of southern Cambodia. Much of the low-lying area of this region is covered in semievergreen or dry deciduous forest, and consequently has few palms. However, there are exceptions.

There are several nonclimbing rattans in this region. In southern Laos, *Calamus harmandii* is endemic, and its recent rediscovery was described by Evans (2000). The enigmatic *Areca laosensis* occurs in the same area. Also in southern Laos and reaching across into eastern Thailand is *Calamus acanthophyllus*, which occurs in areas subject to burning. Its habitat is described by Evans and Sengdala (2001). In the Mekong Delta, *Calamus salicifolius* occurs along the main river and its tributaries, scrambling in scrub forest along river margins. *Corypha lecontei* is widespread in this region. Along Cambodia's coast, and just reaching into adjacent Thailand and Vietnam, there is a rich "mangrove" palm flora, including *Calamus erinaceus*, *Licuala paludosa*, *Nypa fruticans*, *Oncosperma tigillarum*, and *Phoenix paludosa*.

This low-lying, relatively dry region of Thailand, Laos, Cambodia, and Vietnam separates two major centers of palm diversity in Southern Asia—central and southern Vietnam, and Peninsular Thailand.

Truong Son Range

The Truong Son Range (Fig. 2), often referred to as the Annamites, is a mountain range running for almost 1200 km along central and southern Vietnam's border with Laos and Cambodia. The range varies from 50 to 75 km wide and is generally less than 2000 m in elevation.

The Truong Son Range is not continuous but comprises three separate upland areas. In the north a relatively narrow range runs along the border between Vietnam and Laos, from the Ca River in the north to Khe San in the south. This is made up of mostly low mountains, seldom reaching above 1300 m elevation. Here there are large areas of karst limestone. The central part of the Truong Son Range comprises a broader, higher range, running from Khe San south through the Kon Tum and Play Ku plateaus. In the northern part of this central section a spur of mountains runs from west to east, to the coast just north of Da Nang. This range marks the boundary between the more seasonal northern part of Vietnam and the more tropical southern part. The southern part of the Truong Son comprises three large upland areas—the Da Lat, Di Linh, and Dac Lac plateaus.

The Truong Son Range has a diverse but still poorly known palm flora. The three upland areas each have their own endemic palms. In the northern ranges two species of *Rhapis* are endemic, *R. puhuonensis* and *R. vidalii*. The discovery of the former has been described by Trudgen et al. (forthcoming) and the latter by Averyanov et al. (2006). In the central part of the range, several species of *Licuala*, as well as *Nenga banaensis* and *Caryota sympetala*, are endemic. In the southern parts there are also endemic *Licuala* and *Pinanga* species, as well as several rattans. The central and southern parts of the Truong Son Range represent a previously unsuspected center of palm diversity. Many new species have recently been described from there (Henderson et al. 2008a, 2008b, 2008c), and many remain to be described. With about 75 known species and more to come, this area may eventually rival Peninsular Thailand in its palm diversity.

Probably the best place to see palms in the Truong Son Range, at least in the central part, is Bach Ma National Park near Hue. Here there are about 27 species of palm. In the northern part of the Truong Son Range there are fewer palms, but a good place to see these is Cuc Phuong National Park, with about 17 species. In the southern part of Truong Son Range, Cat Tien National Park is rich in palms, with about 20 species.

Peninsular Thailand and Myanmar

The southern part of Thailand and adjacent Myanmar is essentially a peninsula (Fig. 2), running north–south from just south of Bangkok, and continuing into Peninsular Malaysia. This peninsula, approximately 800 km long, is bounded on the western side by the Andaman Sea and on the eastern side by the Gulf of Thailand. The peninsula has a low mountain backbone, divided into several distinct ranges. The peninsula narrows near the southernmost border of Myanmar, in a region sometimes called the Isthmus of Kra.

This last of our palm regions is also the richest in terms of number of species. Many species from Peninsular Malaysia have their northernmost populations here. Rainfall is high in Peninsular Thailand and adjacent Myanmar, but falls off rapidly around the Isthmus of Kra. The palm flora north of the isthmus is much less diverse than that to the south. As many as 100 species of palm are confined to this peninsular region, almost one-third of all Southern Asian palms.

Although many of the palm species in Peninsular Thailand are Malaysian species that reach their northern limit in southern Thailand, there also appears to be a center of endemism in the central part of Peninsular Thailand and southern Myanmar. Such species as *Calamus platyspathus*, *Caryota kiriwongensis*, *Iguanura tenuis*, *Kerriodoxa elegans*, *Licuala distans*, *L. merguensis*, *Pinanga fractiflexa*, *P. watianiana*, and *Wallichia marianneae* are all restricted to this area, mostly on the western side of the peninsula, possibly associated with limestone soils.

Thailand has a well-developed system of national parks and other protected areas, and these are the best places to see palms in the wild. Unfortunately the most extreme southern part, adjacent to the border with Malaysia, has been politically unstable recently. However, the middle parts of the peninsula are rich in palms. Phuket, an easy flight from Bangkok, is a good place to start, and the Ton Sae Waterfall in Khao Pha Kaeo National Park is home to spectacular stands of *Kerriodoxa elegans* and many other species of palms (Dransfield 1983). Not far from Phuket, also in the central part of the peninsula, is Khao Sok National Park, where at least 26 spe-

cies of palms may be seen, including a second population of *Kerriodoxa*. Khao Chong National Park near Trang and Raksa Warin near Ranong are also rich in palms.

For Myanmar, by far the richest area for palms is the southern part of the country, in Tanintharyi Division, again much of it off limits to foreigners. The islands of the Myeik Archipelago are very diverse. The best places to see palms are often the areas surrounding holy sites. For example, in the forests surrounding the Golden Rock one can see at least 10 species of palms. Hodel (2004) has described a visit in search of palms of Tanintharyi Division.

Layout of the Book

Forty-three genera are included in this book. This number includes all the naturally occurring genera in our area, as well as the commonly cultivated coconut, *Cocos*. A few other economically important palms are introduced into some places in Southern Asia (e.g., *Elaeis guineensis* and *Metroxylon sagu*), and many other ornamental palms are cultivated in parks and gardens, but these are beyond the scope of this guide.

A key is given to all the naturally occurring genera in our area as well as *Cocos*. Note that the characters used in this key apply only to the species in our area—and so the key may not work for species from outside the area.

Genera are arranged in alphabetical order. Accepted generic names are capitalized and in boldface, and are followed by generic synonyms. Each generic name is followed by its author, using abbreviations given in Govaerts and Dransfield (2005). Generic descriptions are based mostly on Uhl and Dransfield (1987), but emphasize nontechnical characters. Descriptions apply to the whole genus, even if certain features are not found in species in our area. Derivations of generic names are given for all genera, and in many cases are taken from a series of articles by Harold Moore (“What’s in a name”), published in the journal *Principes* in the 1960s and 1970s.

Numbers of species in each genus are taken from Govaerts and Dransfield (2005), with some modifications. The number of species recognized in each genus is based on my own

interpretation and may not necessarily correspond with the reference works cited. The most recent references to the taxonomy of the genus are given, and these are usually the basis of the species I recognize. A total of 352 species are included in the book.

Keys are given to species in all genera with two or more species. An attempt has been made to use only those characters that are apparent to an observer in the field. Geography is used extensively in the keys, so they may not work for palms in cultivation of unknown origin.

Species within genera are arranged in alphabetical order. Accepted species names are in boldface, followed by their author.

Following the species Latin name, common names are given. These are taken from various sources—monographs, floras, herbarium specimen labels, and from local informants. These are only a selection of the many common names in use in the region, and a given common name is in no way an indication that this is the standard name. Common names need to be used with much caution. Because there are so many local languages and dialects in the area covered by this book, common names may not be recognized by local inhabitants throughout the area where a palm occurs. The same species may have many different common names, even within one country. I have made no attempt to add accents to common names, especially those of Vietnam. Country or region abbreviations following common names are based on Brummitt (2001): (And)=Andaman Islands, (Ban)=Bangladesh, (Bhu)=Bhutan, (Cbd)=Cambodia, (Chi)=China, (Ind)=India, (Jap)=Japan including the Ryukyu and Bonin Islands, (Lao)=Laos, (Mya)=Myanmar, (Nep)=Nepal, (Ncb)=Nicobar Islands, (Pak)=Pakistan, (Srl)=Sri Lanka, (Tai)=Taiwan, (Tha)=Thailand, (Vie)=Vietnam.

Species descriptions are based on two sources. First, on botanical monographs or floras cited after each genus description, and second on my own experiences with the palms in the herbarium or field. Characters that will enable one to identify a palm in the wild are given priority. For numbers, such as number of leaflets or number of flowering branches, ranges are usually given. For lengths and diameters, the maximum value is usually given.

Following the species description is a section on range and habitat. For range, political divisions (states or provinces) of countries or islands are given. In Laos, Thailand, and Vietnam, where there are many small provinces, larger, nonpolitical divisions are used (e.g., Northern, Central, and Southern for Laos and Vietnam, and North, Northeast, East, Southeast, Central, Southwest, and Peninsular for Thailand).

The most important uses are given. There are so many uses of palms that only a brief selection is possible.

Under synonyms I have included all the synonyms (even if from outside our area) listed in Govaerts and Dransfield (2005), with some minor modifications. Each name is followed by its author, using abbreviations in Govaerts and Dransfield. Illegitimate and invalidly published names, as well as names without descriptions, are excluded.

The maps are designed to show the natural distribution of each species. Dot maps are used, and each dot represents one or more herbarium specimens that I have examined. The data for these maps come from a database containing more than 4400 specimen records. In a few cases, sight records are included, or records from reliable monographs and floras. As can be seen, all palms have patchy distributions. This is most likely a result of uneven collection density, but may also represent real distributions. Deforestation and habitat disturbance are so severe in many areas covered by this guide that many palms that formerly occurred in some area probably no longer do so. In the range and habitat section, political divisions may be given although no dot occurs in that division on the map. Such records are based on reliable literature reports. Dot maps are not given for introduced, cultivated species (*Arenga pinnata*, *Cocos nucifera*, and *Phoenix dactylifera*) or for other widespread species (e.g., *Areca catechu*, *Borassus flabellifer*, and *Trachycarpus fortunei*), or for a few other species with no specimens from our area.

There is at least one color image for each genus, and the number of images per genus is approximately proportional to the number of species. I have tried to illustrate species from countries other than Thailand, especially

Table 1 Position of Southern Asian genera within the classification of Dransfield et al. (2005)

Subfamily	Tribe	Subtribe	Genus	
Calamoideae	Eugeissoneae		<i>Eugeissona</i>	
	Calameae	Korthalsiinae	<i>Korthalsia</i>	
			<i>Eleiodoxa</i>	
			<i>Salacca</i>	
		Plectocomiinae	<i>Plectocomia</i>	
			<i>Myrialepis</i>	
			<i>Plectocomiopsis</i>	
			Calaminae	<i>Calamus</i>
		<i>Daemonorops</i>		
		<i>Ceratolobus</i>		
Nypoideae			<i>Nypa</i>	
Coryphoideae	Phoenixeae		<i>Phoenix</i>	
		Livistoneae	Raphidinae	<i>Guihaia</i>
	<i>Trachycarpus</i>			
	<i>Maxburretia</i>			
	<i>Rhapis</i>			
	<i>Livistona</i>			
	Livistoninae		<i>Licuala</i>	
			<i>Johannesteijamannia</i>	
			<i>Pholidocarpus</i>	
			Chuniophoeniceae	<i>Chuniophoenix</i>
				<i>Kerriodoxa</i>
	<i>Nannorrhops</i>			
	Caryoteae	Caryoteae	<i>Caryota</i>	
			<i>Arenga</i>	
			<i>Wallichia</i>	
		Corypheae		<i>Corypha</i>
Borasseae		Hyphaeninae	<i>Hyphaene</i>	
			Lataniinae	<i>Borassodendron</i>
		<i>Borassus</i>		
Arecoideae	Oranieae		<i>Orania</i>	
		Cocoseae	Attaleinae	<i>Cocos</i>
	Areceae			Arecinae
		<i>Nenga</i>		
		<i>Pinanga</i>		
		Carpoxylinae	<i>Satakentia</i>	
			<i>Oncospermatinae</i>	<i>Oncosperma</i>
	Unplaced Areceae	<i>Bentinckia</i>		
		<i>Clinostigma</i>		
		<i>Cyrtostachys</i>		
		<i>Iguanura</i>		
		<i>Loxococcus</i>		
		<i>Rhopaloblacte</i>		

Myanmar and Vietnam, because the palms of Thailand have been so well illustrated by Hodel (1998) and Vatcharakorn (2005).

Classification of Southern Asian Palms

The most recent classification of the palm family is that of Dransfield et al. (2005). I give the position of Southern Asian genera within that classification in Table 1.

Morphology of Palms

In this section I discuss the morphology of palms, and define all the terms that are used in the descriptions. While I have tried to keep the level of jargon to a minimum, some technical terms are unavoidable. Many important identification features are illustrated. The following discussion refers only to Southern Asian palms.

Stems of individual palms are described as clustered (i.e., an individual plant with several stems forming a clump) or solitary (an individual plant with only one stem). Most palms have free-standing stems—a few have short, subterranean stems and many have slender, climbing stems. Maximum heights and diameters of stems are given.

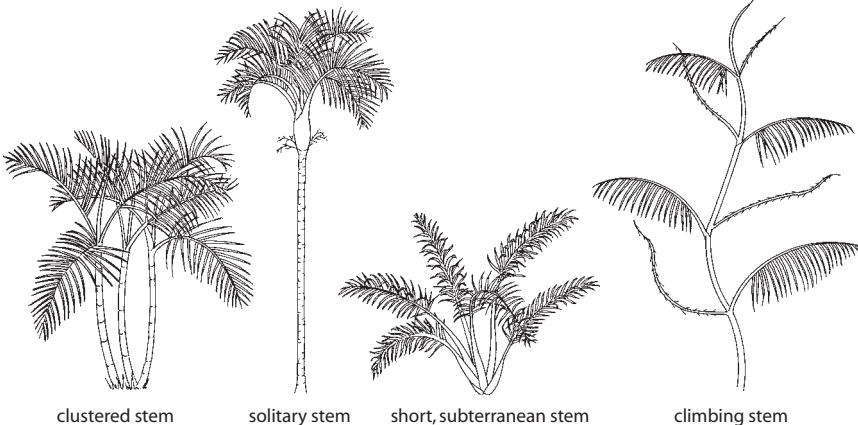
Leaves of palms are usually spirally arranged around the stem, rarely in one or a few planes.

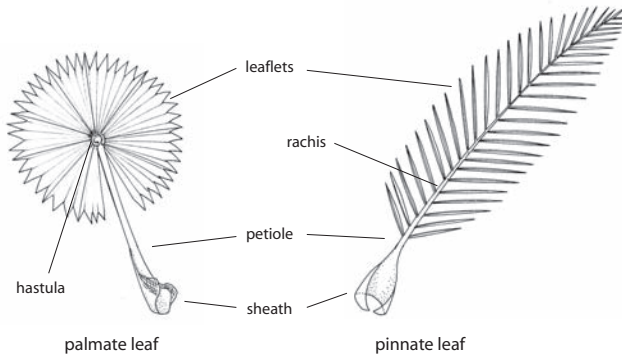
They are immediately divided into two types, palmate (or fan-shaped) and pinnate (or feather-shaped).

Leaves of palmate-leaved palms are divided into several parts. The basal, sheathing part of the leaf is known as the sheath, and this is often very fibrous. At the apex of the sheath, above the point of insertion of the petiole, there is often a short extension known as the ocrea. The sheath is continuous with the petiole. Thorns occur along the margins of the petioles of many palmate-leaved palms. At the apex of the petiole there is usually a flap of material, where it joins the blade, known as the hastula. Some species of palmate-leaved palm have a short central axis, or rachis, and the leaf is then termed costapalmate.

The blades of palmate-leaved palms are usually divided into leaflets, and only two genera have undivided leaves—*Johannesteijsmannia* and a few species of *Licuala*. The blade may be divided part way or almost to the base. The number of leaflets per blade is given in the descriptions.

Leaflets of all palms are folded, and this folding takes place in two different ways. Most palmate-leaved palms have gutter-shaped folding (V-shaped in cross section, known as induplicate). A very few palmate palms have roof-shaped folding, and this is a useful character for identification. Roof-shaped folding (Λ-shaped in cross section, known as



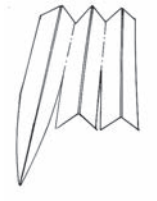


reduplicate) is common in pinnate-leaved palms.

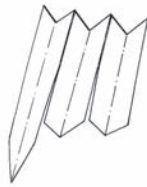
The structure of pinnate-leaved palms is essentially similar to that of palmate-leaved palms, with some modifications. Leaf sheaths

is borne on the leaf sheath, and is actually a modified inflorescence.

The number of leaflets along one side of the rachis is given. Leaflets are arranged in various ways, and the kind of arrangement is a useful



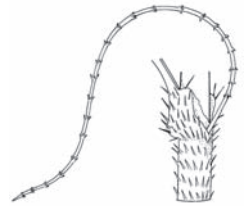
reduplicate folding



induplicate folding



cirrus



flagellum

are always present, but in some species the sheaths are closed and form a structure known as the crownshaft. Ocreas are present in some pinnate palms, especially the rattans, where their form is useful in identification. A feature of the sheath found only in rattans (although not all) is the knee, a swollen projection of the sheath directly below the petiole. Petioles are usually well developed, but the hastula is absent or poorly developed in pinnate-leaved palms. The main axis of the leaf blade of pinnate-leaved palms is the rachis, and the rachis bears the leaflets.

In climbing palms, the rattans, the rachis may be extended into a long, whiplike organ known as the cirrus (plural, cirri). A second organ associated with the climbing habit of rattans is the flagellum (plural, flagella). This

character in identification. Most commonly, leaflets are regularly arranged along the rachis and spread in the same plane. Less commonly, leaflets are irregularly arranged, and leaflets spread in the same or different planes. Occasionally, pinnate leaves do not split, and an undivided leaf results. However, the venation is still pinnate.

The apices of the leaflets are usually pointed, but in a few palms they are jagged or lobed. In a few genera, only the apical few leaflets have lobed apices. Some palms have leaflets that are silvery or gray on the lower surfaces, and this is always a useful identification character. Leaves of many Southern Asian palms are spiny, espe-



leaflets regularly arranged, spreading in one plane



leaflets regularly arranged, spreading in several planes



leaflets irregularly arranged, spreading in several planes



undivided leaf, with pinnate venation

cially the rattans. Arrangement of spines, especially on the leaf sheaths, can also be a useful character in identification.

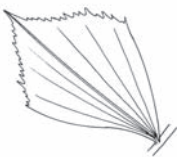
One genus, *Caryota*, has bipinnate leaves, that is, the leaflets themselves are split again into secondary leaflets. Any palm with such leaves must be a *Caryota*.

There are two life-history strategies in palms. The most common strategy, known as iteroparity (also known as pleoanthy), is where an individual stem reproduces (i.e., produces inflorescences) over a relatively long period. The second, less-common strategy is where an individual stem reproduces over a relatively short period, and this is followed by death of the stem. This is known as semelparity (or hapax-anthy). In several semelparous palms, especially *Corypha*, all inflorescences are produced

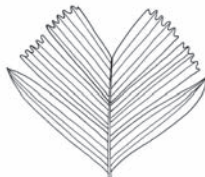
together above the leaves, and appear like one enormous inflorescence. However, like all other palms, these structures consist of several, separate inflorescences.

Many Southern Asian palms, including all the rattans, are dioecious. This means that individual plants of a species bear either male or female flowers.

The structures that bear flowers and fruits are referred to as inflorescences and infructescences, respectively. In a few species the inflorescences are borne below the crownshafts, but in most Southern Asian palms the inflorescences are borne among the leaves. Most palms have a single inflorescence at each node, but occasionally more than one can be produced, in some species of *Arenga*, for example.



leaflet with jagged margins



apical leaflets with lobed apices



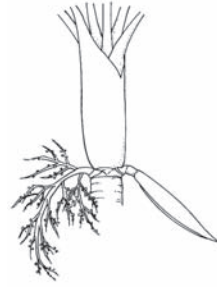
bipinnate leaf



inflorescences
produced together
above the leaves -
Corypha



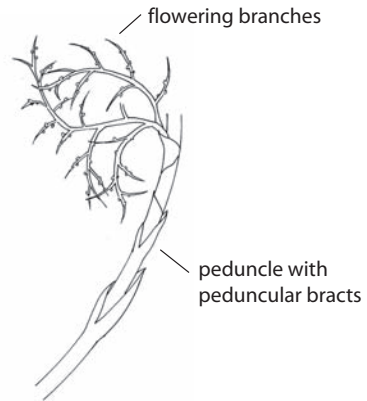
inflorescences
borne amongst
the leaves



inflorescences
borne below
the leaves

Inflorescences, like the leaves, consist of several parts. The basal axis, known as the peduncle, bears from one to many bracts. The very first bract is known as the prophyll, and the subsequent bracts on the peduncle as peduncular bracts. In many palms, particularly the calamoid palms, there are conspicuous bracts subtending all inflorescence branches. Most inflorescences are branched, and flowers are borne along the ultimate branches. Unbranched inflorescences are referred to as spicate. The arrangement of flowers along the branches is variable in palms, from solitary to paired, or commonly borne in threes of a central female and two lateral male flowers.

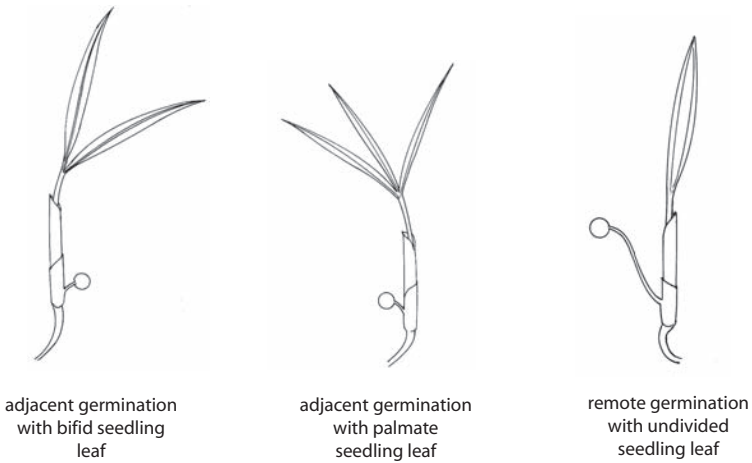
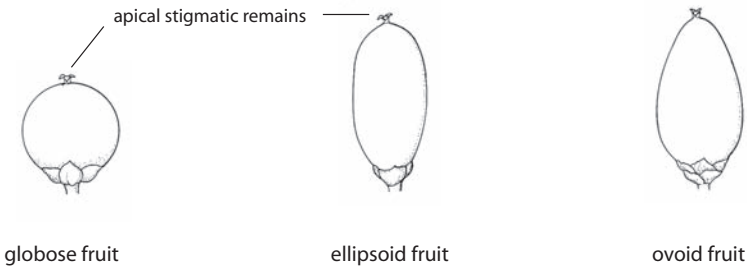
Fruits of palms come in a great variety of sizes, shapes, and colors. Size ranges from a few millimeters to almost 20 cm in diameter (e.g., in *Borassus*). Shape ranges from rounded (i.e., globose) to ellipsoid (i.e., football-shaped) to ovoid (i.e., egg-shaped), and there are various permutations of these shapes. In most palm fruits the remains of the stigmas (stigmatic remains) persist at the apices of the fruits, but in a few they are displaced to the base of the fruits. Almost all palm fruits are green as they mature, but ripen to a variety of colors, commonly black, yellow, or red.



inflorescence

The fruits of all calamoid palms are covered with overlapping scales. Most palm fruits have one seed, but it is not uncommon to have two- or three-seeded fruits. The endosperm of palms is termed either ruminant (i.e., with uneven indentations of the seed coat) or homogeneous (without such indentations). Both conditions are visible only when the seed is cut in half.

Germination in palms follows one of two patterns. In most species, the seedling develops



next to the seed, and this is known as adjacent germination. In other species, the seedling develops at some distance from the seed, and this is known as remote germination. The first seedling leaf is either undivided, bifid, or pal-

mate. Most palms with adjacent germination have bifid seedling leaves, and most palms with remote germination have undivided seedling leaves, but there are several exceptions to this.

Key to the Genera of Palms in Southern Asia

- 1a. Leaves palmate or costapalmate 2.
 1b. Leaves pinnate (or pinnately veined if undivided) or bipinnate 17.
- 2a. Leaf blades undivided; Thailand (Peninsular) 3.
 2b. Leaf blades divided into leaflets; all areas including Thailand (Peninsular) 4.
- 3a. Leaf blades diamond-shaped *Johannesteijsmannia*.
 3b. Leaf blades rounded *Licuala* (*L. peltata* var. *sumawongii*).
- 4a. Hastulas absent 5.
 4b. Hastulas present 6.
- 5a. Petioles deeply channeled; China (Hainan) and Vietnam (Northern) *Chuniophoenix*.
 5b. Petioles not deeply channeled; Afghanistan and Pakistan *Nannorrhops*.
- 6a. Leaf sheaths smooth, not fibrous, with a triangular cleft at the base 7.
 6b. Leaf sheaths fibrous, not split at the base 10.
- 7a. Stems branching dichotomously above ground; India (Gujarat, Maharashtra) *Hyphaene*.
 7b. Stems not branching; widespread 8.
- 8a. Petiole margins without thorns; blades divided almost to the base into numerous segments, and these again divided into leaflets; Thailand (Peninsular) *Borassodendron*.
 8b. Petiole margins with thorns; blades divided for about half their length into leaflets; widespread including Thailand (Peninsular) 9.
- 9a. Petiole margins with regularly arranged thorns; fruits to 7 cm diameter; inflorescences produced simultaneously above the leaves, their production ending the life of stem *Corypha*.
 9b. Petiole margins with irregularly arranged thorns; fruits to 20 cm diameter; inflorescences produced sequentially among the leaves, their production not ending the life of stem *Borassus*.
- 10a. Petiole margins with thorns 11.
 10b. Petiole margins without thorns 14.
- 11a. Leaflets split to their bases into multifold, wedge-shaped leaflets with lobed apices *Licuala*.
 11b. Leaflets not or seldom split to their bases, single or multifold, not wedge-shaped, with pointed or split apices 12.
- 12a. Petioles with 2 yellow stripes on the lower surfaces; fruits to 12 cm diameter; with warty surfaces; Thailand (Peninsular) *Pholidocarpus*.
 12b. Petioles without yellow stripes on the lower surfaces; fruits to 2.5 cm diameter; not warty; widespread including Thailand (Peninsular) 13.
- 13a. Adult leaves markedly costapalmate; petioles with stout thorns along the margins; fruits globose to ellipsoid, not grooved *Livistona*.
 13b. Adult leaves not costapalmate; petioles with small, blunt teeth along the margins; fruits kidney-shaped or oblong, grooved *Trachycarpus*.
- 14a. Leaflets green on the lower surface, the margins with scarcely visible thorns *Rhapis*.
 14b. Leaflets grayish or silvery white on the lower surface, the margins without thorns 15.
- 15a. Leaflets \wedge -shaped (reduplicate) in cross section; China (Guangxi, Guangdong) and Vietnam (Northern) *Guihaia*.
 15b. Leaflets V-shaped (induplicate) in cross section; Thailand (Peninsular) 16.
- 16a. Stems clustered, to 8 cm diameter *Maxburretia*.
 16b. Stems solitary, to 20 cm diameter *Kerriodoxa*.
- 17a. Leaflets at the base of the leaf modified into green, straight spines *Phoenix*.
 17b. Leaflets at the base of the leaf not modified into spines 18.

(continued)

Key to the Genera of Palms in Southern Asia (continued)

- 18a. Stems, leaves, and inflorescences spiny 19.
- 18b. Stems, leaves, and inflorescences not spiny 30.
- 19a. Leaf sheaths forming a crownshaft; inflorescences borne below the crownshaft; fruits smooth, not covered with overlapping scales *Oncosperma*.
- 19b. Leaf sheaths not forming a crownshaft; inflorescences borne among the leaves; fruits covered with overlapping scales 20.
- 20a. Stems thin and flexible, climbing, with either flagella or cirri 21.
- 20b. Stems stiff and erect, sometimes short and subterranean, not climbing, without flagella or cirri 27.
- 21a. Leaflets narrowly to broadly rhomboidal, with jagged apices, usually silvery on the lower surfaces; climbing stems branching above ground *Korthalsia*.
- 21b. Leaflets not rhomboidal, usually with pointed apices, green on the lower surfaces, rarely silvery; climbing stems branching only at ground level, rarely above ground 22.
- 22a. Knees on leaf sheaths absent; inflorescences borne simultaneously at apex of stem, their production ending life of stem; female flowers solitary 23.
- 22b. Knees on leaf sheaths usually present; inflorescences borne sequentially along the stem, their production not ending life of stem; female flowers paired 25.
- 23a. Leaflets usually silvery gray, rarely green on the lower surfaces, without scales; inflorescence branches covered with prominent, overlapping bracts, these obscuring the flowers *Plectocomia*.
- 23b. Leaflets green on the lower surfaces, with small, brown scales; inflorescence branches without prominent, overlapping bracts, the flowers visible 24.
- 24a. Leaf sheath spines scattered, sometimes absent; ocreas present; leaflets with conspicuous, yellow spines on the upper surfaces; fruits covered with normal-sized scales *Plectocomiopsis*.
- 24b. Leaf sheath spines arranged in rows; ocreas absent; leaflets without conspicuous, yellow spines on the upper surfaces; fruits covered with minute scales *Myrialepis*.
- 25a. Inflorescences covered with only 1 bract, this covering the flowers and splitting as the fruits develop; Thailand (Peninsular) *Ceratolobus*.
- 25b. Inflorescences covered with several bracts, these not covering the flowers; widespread including Thailand (Peninsular) 26.
- 26a. Cirri always present; inflorescences not flagellate, usually shorter than the leaves, with boat-shaped bracts splitting their entire length and then either falling off or remaining attached and enclosed by the prophyll, without grapnel-like spines *Daemonorops*.
- 26b. Cirri present or absent; inflorescences flagellate or nonflagellate, usually longer than the leaves, with sheathing, tubular bracts not or only briefly splitting and remaining attached, not enclosed by the prophyll, usually with grapnel-like spines *Calamus*.
- 27a. Inflorescences arising from the center of the leaves, stout and erect with no apparent branches, to 3 m long; stems often with dense stilt roots at the base *Eugeissona*.
- 27b. Inflorescences borne among the leaves, not stout and erect, branched, to 2 m long; stems without stilt roots at the base 28.
- 28a. Stems subterranean or erect; ocreas present, often conspicuous *Calamus*.
- 28b. Stems always short and subterranean, or creeping; ocreas absent 29.
- 29a. Fruits not spiny; leaflets at apex of leaf split, not forming a broad, compound apical leaflet *Eleiodoxa*.
- 29b. Fruits spiny; leaflets at apex of leaf usually forming a broad, compound apical leaflet, sometimes the apical leaflets split *Salacca*.
- 30a. Leaf sheaths closed and forming a crownshaft; inflorescences borne below the crownshaft 31.
- 30b. Leaf sheaths open, not forming a crownshaft; inflorescences borne among the leaves 40.

- 31a. Leaflets with pointed apices 32.
- 31b. Leaflets, at least the apical ones, with lobed or jagged apices 36.
- 32a. Crownshafts red or orange *Cyrtostachys*.
- 32b. Crownshafts green or grayish green 33.
- 33a. Bonin and Ryukyu islands 34.
- 33b. Nicobar Islands and southern India 35.
- 34a. Flowering branches hairy; inflorescence bracts 3 (prophyll and 2 peduncular bracts);
Ryukyu Islands *Satakentia*.
- 34b. Flowering branches smooth; inflorescence bracts 2 (prophyll and 1 peduncular bract);
Bonin Islands *Clinostigma*.
- 35a. Basal 2 branches of the inflorescences strongly recurved; fruits orange to red, with
apical stigmatic remains; Nicobar Islands *Rhopaloblaste*.
- 35b. Basal 2 branches of the inflorescences not recurved; fruits brown or black, with
basal stigmatic remains; southwestern India and Nicobar Islands *Bentinckia*.
- 36a. Inflorescences with 2 bracts (or bract scars); all or most leaflets with lobed or jagged
margins 37.
- 36b. Inflorescences with only 1 bract (or bract scar); only apical leaflets with lobed margins 38.
- 37a. Stems solitary, to 12 m tall and 12 cm diameter; Sri Lanka *Loxococcus*.
- 37b. Stems usually clustered, sometimes solitary, to 4 m tall and 3.5 cm diameter; Myanmar and
Thailand (Peninsular) *Iguanura*.
- 38a. Apical few nodes of stems covered with reddish brown or gray scales; apical part of flowering
branches not shriveling, male and female flowers borne all along the flowering branches *Pinanga*.
- 38b. Apical few nodes of stems green, without scales; apical part of flowering branches with male
flowers only, shriveling after flowers are shed 39.
- 39a. Female flowers much larger than males, borne only at bases of flowering branches; most of the
flowering branches shriveling after flowers are shed; apical pair of leaflets conspicuously lobed *Areca*.
- 39b. Female flowers the same size or smaller than the males, borne along about three-quarters of
the flowering branches; apical pair of leaflets obscurely lobed *Nenga*.
- 40a. Leaves bipinnate *Caryota*.
- 40b. Leaves pinnate 41.
- 41a. Leaflets with lobed or jagged apices 42.
- 41b. Leaflets with pointed apices 46.
- 42a. Leaflets green on the lower surfaces 43.
- 42b. Leaflets silvery gray on the lower surfaces 44.
- 43a. Inflorescences with 2 bracts (or bract scars); all or most leaflets with jagged margins *Iguanura*.
- 43b. Inflorescences with only 1 bract (or bract scar); only apical leaflets with lobed margins *Pinanga*.
- 44a. Stems to 20 m tall and 25 cm diameter, clean, not covered in persistent leaf bases *Orania*.
- 44b. Stems usually smaller, covered with persistent leaf bases 45.
- 45a. Leaflets strongly asymmetrical, scarcely to deeply lobed along the margins; sepals of male
flowers joined at their bases into a cupule *Wallichia*.
- 45b. Leaflets more or less symmetrical, notched but usually not lobed along the margins; sepals
of male flowers free to the bases and overlapping *Arenga*.
- 46a. Stem creeping, seldom visible; leaves erect *Nypa*.
- 46b. Stem erect; leaves spreading *Cocos*.