



# RATTANS of MYANMAR

2018

*Andrew Henderson and Charles M. Peters  
with a contribution from U Aung Zaw Moe*



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## Foreword

I am delighted to have the opportunity to write a foreword for the pictorial guidebook entitled *Rattans of Myanmar*.

Myanmar lies at the convergence of different ecoregions, resulting in remarkable ecological diversity and species richness. Conservation, effective management, and sustainable use are primary objectives to preserve the biological resources of Myanmar. Scientific information is the core element in conserving and managing biodiversity effectively. In this regard, the Forest Department (FD) is promoting scientific cooperation and research on biodiversity with international and national organizations.

The *Rattans of Myanmar* is one of the fruitful results of scientific cooperation and research between the FD and two prominent international NGOs, the New York Botanical Garden (NYBG), which focuses on plant conservation, and the Wildlife Conservation Society (WCS), which focuses on wildlife conservation.

The *Rattans of Myanmar* is an extremely useful and important document about the taxonomy and ecology of one of the most important non-timber forest products in Myanmar. And this is a welcome contribution, because the more we know about the rattans of Myanmar, the greater the potential to conserve and manage these valuable forest resources. I do believe that this book will become a valuable resource for educational purposes, a good reference for botanists and conservationists, as well as a guide for social foresters who work for community development through the sustainable production of NTFPs, including rattan.

Last but not least, I offer my sincere gratitude to NYBG and the WCS Myanmar Program for their diligence and scientific rigor in producing the *Rattans of Myanmar*—and for their enduring efforts to understand and conserve Myanmar's incomparable biodiversity.

It is my hope that the FD, NYBG, and WCS can produce more publications from long and continuous scientific cooperation and research on the biodiversity of Myanmar.

A handwritten signature in blue ink, consisting of stylized, overlapping loops and a long, sweeping horizontal stroke extending to the right.

*Nyi Nyi Kyaw, Ph. D.*  
*Director General*  
*Forest Department*  
*Ministry of Natural Resources and Environmental Conservation*  
*The Republic of the Union of Myanmar*  
*Nay Pyi Taw, Myanmar*

## A Word from the WCS Myanmar Program

As the name implies, the work of the Wildlife Conservation Society has traditionally focused on the conservation of threatened and endangered fauna. Our involvement in the publication of *Rattans of Myanmar*, however, represents an important step forward into new territory and a broadening of context. Clearly, the flora and the fauna of a region are intimately connected and it is difficult to conserve one without conserving the other. We are thrilled by the potential conservation benefits of including plants in our work, and are enthusiastic about the possibilities for future collaborations between botanists and wildlife biologists.

The production of a guide to the rattans of Myanmar was largely the result of the hard work, dedication, and far-sighted vision of two organizations. At the local level, the Myanmar Forest Department provided the necessary permits to complete the fieldwork and assigned capable staff to assist with the data collection activities. Internationally, the New York Botanical Garden was one of the first research institutions to appreciate the botanical richness of Myanmar and facilitated repeated field visits to Myanmar for senior scientists. The WCS Myanmar Program would like to thank both of these fine organizations for their close collaboration over the years, and for producing what will undoubtedly become the standard for specimen-based field guides to plants in Myanmar.



Than Myint  
Country Program Director  
Wildlife Conservation Society (WCS)  
Myanmar Program  
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## Preface

*Rattans of Myanmar* is the result of a 14-year collaborative effort between the New York Botanical Garden, the Wildlife Conservation Society (WCS) Myanmar Program, and the Forest Department of the Myanmar Ministry of Natural Resources and Environmental Conservation (MONREC) to promote the conservation and sustainable use of one of the most valuable and widely used non-timber forest products in the world. This volume is a valuable contribution to palm systematics, community forestry, sustainable resource use, and to all of the stakeholders involved with rattan in Myanmar.

This book will help you identify rattans and will give you a greater understanding of how rattans grow and maintain themselves in the forest. It is our hope that the *Rattans of Myanmar* will provide an incentive for further botanical exploration, collection, and documentation of local rattans, and will eventually form the foundation of more sustainable systems for exploiting wild rattan populations. We thank you for your interest in the rattans of Myanmar and hope you find this book useful.



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## Acknowledgments

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All of our work in Myanmar has been done in close collaboration with the Wildlife Conservation Society (WCS) Myanmar Program. For their tireless logistic and administrative support, advice, and encouragement, we thank Than Myint (Country Program Director), Saw Htun (Deputy Country Program Director), Rob Tizard (Senior Technical Advisor), Hla Naing (Technical Coordinator, Northern Mountain Forest Complex), Kyaw Moe (Site Coordinator), Kyaw Thinn Latt (Landscape Coordinator, Southern Forest Complex), Myint Myint Oo (Technical Coordinator, Education and Outreach), Gumring Jong Kum (Site Coordinator), Kyaw Zay Ya (GIS and RS Technician), Naw May Lay Thant (National Landscape Coordinator), Annie Chit (Project Manager), and Soe Than (Logistics Officer). Josh Ginsburg (former Director, Asia and Pacific Programs), Alan Rabinowitz (former Executive Director, Science and Exploration), Saw Tun Khaing (former Country Program Director), and Colin Poole (Managing Director, Asia Regional Conservation Hub) provided invaluable assistance getting fieldwork started in Myanmar.

We have been extremely fortunate to work together with staff from the Nature and Wildlife Conservation Division (NWCD) and the Forest Department (FD) of the Ministry of Natural Resources and Environmental Conservation. Sincere thanks to Myint Maung (former Warden, Hukaung Valley Wildlife Sanctuary), Maung Win (former Warden, Htamanthi Wildlife Sanctuary, Khin Maung Hla (Warden, Htamanthi Wildlife Sanctuary), Myint Thein (Ranger, Htamanthi Wildlife Sanctuary), Kyaw Zin Aung

(Ranger, Htamanthi Wildlife Sanctuary), Win Hlaing (Range Officer, FD), Sein Moe (FD), Myo Naing Win (FD), Sein Aung Mein (Staff Officer, NWCD), Zaw Lin (Range Officer, Hukaung Valley Wildlife Sanctuary), Sai Aung Htwe (Forest Officer, Khamti District), and Kyaw Shwe (Forest Officer, Homalin District). Special thanks to Nyi Nyi Kyaw (Director-General, FD) for his support and enthusiasm for the rattan research.

We gratefully acknowledge the assistance of Saw Lwin, Tin Maung Ohn, and Kyaw Lwin during the initial rattan survey in the Hukaung Valley, and thank all of the local people who have cut and climbed and collected and shared their knowledge of local rattans with us. Josh Dee prepared all of the distribution maps and Isabel Villalba made the line drawings for the glossary.

Finally, we thank the curators of the following herbaria for making specimens available for study: Aarhus University; Arnold Arboretum, Harvard University; Bailey Hortorium, Cornell University; Museo di Storia Naturale dell'Università, Florence; Missouri Botanical Garden; Muséum National d'Histoire Naturelle, Paris; New York Botanical Garden; Royal Botanic Gardens, Kew; United States National Herbarium; V.L. Komarov Botanical Institute, St. Petersburg.



## Introduction

Rattans are spiny, climbing palms in the subfamily Calamoideae. There are over 550 different species of rattan belonging to 12 genera distributed throughout the Old World tropics (Dransfield et al., 2008). Rattan palms are used for a variety of subsistence purposes, e.g. cordage, basketry, food, medicine, and thatch, and the flexible stems, or *canes*, form the basis of a multi-billion dollar a year furniture industry. The great majority of this material is harvested from wild populations. It is estimated that several million people use, collect, and sell rattan or are involved in some way in the international rattan trade (Dransfield and Manokaran, 1994). Rattan, is, without question, one of the most important and widely used non-timber forest products in the world.

Of special interest in this regard is Myanmar. Unlike several neighboring countries where local rattans are relatively well-studied, e.g. Lao PDR (Evans, 2001; Evans et al., 2001), China (Pei et al., 1991; Yin and Zeng, 1997), Thailand (Hodel, 1998), and India (Renuka, 1992, 1995; Basu, 1992), the last systematic treatment of rattans in Myanmar was done over 140 years ago (Kurz, 1874). This lack of information is especially noteworthy given that Myanmar contains over 30% of all the remaining forests in mainland Southeast Asia.

We started our investigations on the rattans of Myanmar in 2004. Initial collecting work was conducted in the vicinity of Yangon and in Mon State, and in early 2005 we participated in a four-week rattan survey of the Hukaung Valley Wildlife Sanctuary (HVWS) in Kachin State which involved both specimen collection and forest inventory. We continued working in the HVWS until 2009, and although fieldwork was largely focused on developing community-based natural resource management activities in local villages, additional rattan specimens were collected and ten hectares of forest were inventoried for rattan and a variety of other plant resources. Subsequent resource surveys were conducted in Leshi Township of the Naga Self-Administered Zone, numerous rattan specimens were collected from the Taninthayi Region in the south, and our current work is focused on community forestry

and resource management (including rattan) within the buffer zone of the Htamanthi Wildlife Sanctuary in Sagaing Region. All of this research has been done in collaboration with the Wildlife Conservation Society (WCS) Myanmar Program under the auspices of the Myanmar Forest Department.

Based on the results of our fieldwork, the rattan resource in Myanmar exhibits four general characteristics. First, rattan cane is an extremely important subsistence fiber for many villagers, and it is actively collected, and occasionally cultivated, throughout its range. Second, the sale of rattan represents a valuable revenue stream for the government and an attractive business opportunity for local enterprises. Rattan collection also provides employment for large numbers of villagers and represents a reliable, albeit seasonal and somewhat limited, source of rural income. Third, the existing taxonomy of Myanmar rattans is outdated, and there are, without question, numerous new species and country records that remain to be collected and described. Finally, in spite of the subsistence importance and economic value of rattan, very little is known about the ecology, size structure, and growth of wild populations.

The goal of this book is to summarize the current state of knowledge about the systematics and ecology of Myanmar rattans. It has been written with the caveat that it is necessarily incomplete, i.e. a “work in progress,” but we hope that its publication will stimulate the plant collecting, inventory work, and yield studies needed to change this. Rattans are an important component of the forests and livelihoods and cultures of Myanmar. The more we know about these valuable plant resources, the greater the potential that they will be conserved and used wisely—rather than simply used up.

## **Method of Presentation**

There are three chapters and a Literature Cited section with references to supporting material. A brief description of the distribution, use, and processing of rattan in Myanmar is presented in Chapter I, including a discussion of existing domestic and export markets for rattan products. Chapter II, which represents the core of the volume, is a specimen-based field guide to the rattans of Myanmar. A dichotomous key is provided to allow the reader to identify each of the 32 different species currently known to occur in the region. Detailed descriptions, distribution maps, and diagnostic photos are provided for each species. Chapter III focuses on the ecology of local rattans, outlines the different life forms and reproductive dynamics exhibited by these plants, and presents data on the density, size-class distribution, and annual growth of selected species. Recommendations on the baseline data needed to formulate a sustainable program of rattan exploitation in Myanmar are also included.



# CHAPTER I

## The Rattan Resource in Myanmar

*Aung Zaw Moe*

Myanmar, with a total land area of 67.6 million hectares, is the second largest of the ASEAN countries. The country is situated between the latitudes 9°58' and 28°29' North and longitudes 92°10' and 101°10' East. The country is endowed with vast tracts of forest covering more than half of the total land area and is rich in natural forest resources.

The Forest Department is responsible for the management and conservation of the forest resources in Myanmar. Generally, there are three types of forest products : 1) wood or timber, 2) wood-based value added products, and 3) non-wood forest products (NWFP). NWFPs have been regarded as *minor forest products* until recently because the contribution of wood—especially teak and other hardwoods—to the national economy in Myanmar is greater than NWFPs. Nonetheless, NWFPs are of significant social and economic importance to the lives of rural people, who represent about 70% of the total population of 54 million.

### 1.1 Utilization of Rattan

Like bamboos, rattans are very valuable to the Myanmar villager. Rattans are used for various purposes because of their favorable physical properties. The stems have a smooth outer skin, they are durable and can grow to be very long, and they are easy to bend or weave; rattan stems are used either whole or split. Rattans are used as ropes for tying, especially for timber rafts, as cables for suspension bridges in the hills, increasingly for making furniture, and for walking sticks, basketwork, and for weaving ornamental items for home use.

Rattan species in the genus *Calamus* are the most commonly utilized in Myanmar. Some species of poor quality are only used locally to make household utensils, while higher quality, more widely distributed species are harvested in large quantities and

processed for making commercial products. Rattan harvested by collectors is traded in the form of raw canes in both domestic and international markets. The normal length of a merchantable rattan cane is about 13 feet.

## **1.2 Harvesting**

Canes are harvested by cutting the stem about three feet from the ground and then pulling the plant down from its position in the tree; the last six feet of the stem is also cut as this portion is of limited utility. The stem is then cut into 13 foot lengths and carried out of the forest. Freshly-cut rattan canes are heavy due to their high moisture content, and a collector can usually carry a bundle of only about five green canes on his shoulder. When the cane is dry, however, a collector can carry about 20 canes. Rattans are usually given a pre-treatment with kerosene before being transported to market or a processing center.

## **1.3 Rattan Resources and Distribution**

Rattans are widely distributed throughout Myanmar and are more abundant in moist forest types than in drier types. Dense populations of wild rattan are often found in lowland moist forests and sometimes in deciduous moist forests, especially in valleys and along river banks. The altitudinal range of rattan can extend up to 1000 m in hilly regions.

Among the eight major forest types in Myanmar, tropical evergreen forest, moist upper mixed deciduous forest, lower mixed deciduous forests, hill forests, and temperate evergreen forests are the major forest types within which rattan grows. Rattan is usually associated with closed, broad-leaved vegetation and rarely observed in other types of plant communities like mangrove swamps, bamboo thickets, or pine forests. The largest natural populations of rattan are currently found in the Taninthayi region, the Ayeyarwady region, the Rakhine region, the Bago Yoma region and the Upper Myanmar region (including Kachin State and upper Sagaing Division).

## **1.4 Policy and Legislation**

1. Bamboo and rattan are categorized under minor forest products.
2. As bamboo and rattan are abundant in the country, villagers are free to exploit these resources for domestic trade and use.
3. Internal trade of bamboo and rattan is essentially free with little tax payable to the government. State and division authorities control unreasonable cutting of bamboo and rattan.
4. Export of bamboo and rattan is controlled by the Forest Department; a sales tax, an export tax, and a customs duty are applied.

The Forest Law of 1992, in line with the forest policy objectives listed above, promotes environmental and biodiversity conservation and expands the extension of permanent forest estates (PFEs) and the protected areas system (PAS). Above all, the Forest Law provides opportunities for the promotion of private sector involvement in the timber trade and decentralizes the management responsibilities. It encourages community participation in the management of forest resources, particularly as a means to satisfy the basic needs of rural people. It demonstrates a shift from the concept of revenue generation and restriction to motivation and sharing management responsibilities with the people.

## **1.5 Rattan Production**

Annual production data for rattan in Myanmar from 2001-2008 are shown in Figure 1.1. As can be appreciated, there is a notable drop in the total amount of rattan collected after 2006. An average of 60.3 million rattan canes/year were collected during the interval from 1991 to 1996, while less than a third of this quantity was collected in subsequent years. The average annual collection of rattan from 2001 to 2008, in contrast, was only 19.7 million canes. The abrupt drop in production in 2008 to 11.6 million canes was



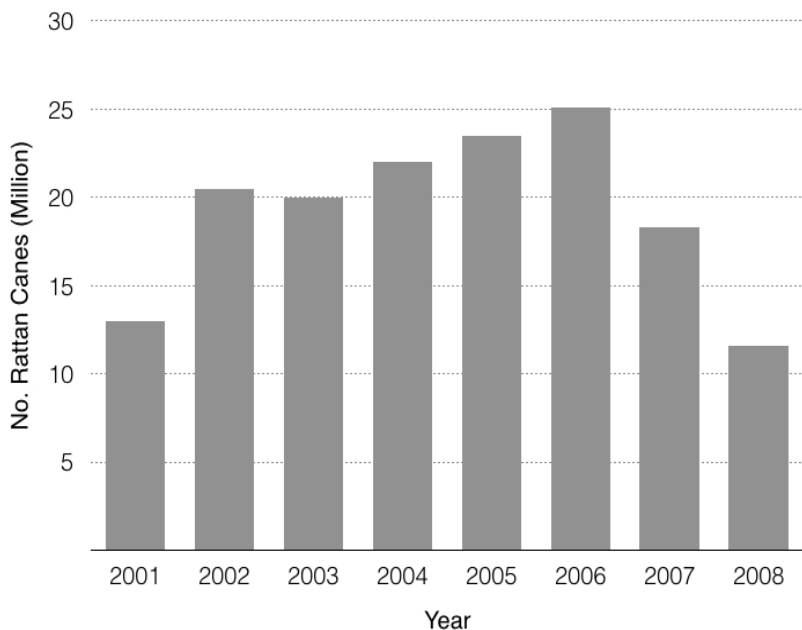


Figure 1.1 Annual production of rattan canes in Myanmar from 2001 to 2008. (Source: Planning & Statistics Division, Forest Department, 2009).

undoubtedly a reflection of the economic crisis that occurred throughout Asia during this year.

The first step toward developing a rattan industry in Myanmar was taken in 1970 when the Ministry of Forestry opened several rattan purchasing centers in Kachin State and Taninthayi Division and subsequently exported 15 tons of rattan canes to Singapore (Win Myint, 2004). The rattan trade continued to grow over the next two decades, and by the early 1990s Myanmar was exporting an average of 12,000 metric tons of rattan valued at over 3.6 million dollars (US) each year (INBAR, 2004). The great majority of this material, i.e. over 95%, is sold to China.

Raw rattan is harvested for commercial purposes almost exclusively from natural forests. Rattans have been planted only in demonstration plots and for research purposes, and there are, to date, no commercial rattan plantations in Myanmar.

Commercial rattan companies harvest rattan from natural forest areas during the collection period. A company normally appoints one representative (buyer) for each area. The buyer sets up a basecamp near the forest and purchases the raw rattan from local harvesters as they come out of the forest. The buyer usually pays the price in full to the harvesters on delivery of the cane, although in some cases the harvesters may receive a pre-payment percentage (50%) from the company's buyer, the remainder paid when the cane is delivered to the basecamp. The actual price for the rattan usually depends on the size of the cane. The price for a small-sized rattan, for example, is approximately 50–70 Kyats, while a large-sized rattan may sell for as much as 500–600 Kyats.

After collection, the raw rattan is transported to a landing, usually located by the side of a road near the camp. The rattan is then trimmed and tied into bundles of thirty canes. Once a sufficient quantity of rattan has been collected, the canes are transported out of the forest and sent to specified locations in the city for further processing and distribution.

According to interviews with rattan trade companies, commercial quantities of rattan have been collected from the Ye, Dawe, and Myeik regions of the Taninthayi Division; the Tanaing, Hukaung Valley, Htigyaik, Katha, and Myitkyina regions of Upper Myanmar (Kachin State and Sagaing Division); the Taungkok and Sittwed regions of Rakhine State; the Belin region of Mon State; the Shwekyin and Bago regions or Bago Division; and the Pathein, Latputta, Shawbya, and Thabaung regions of the Ayeyarwady Division.

The rattan collected commercially in Myanmar is sold either in a domestic or an export market. A few rattan products are traded at both levels.

## **1.6 Domestic Markets for Rattan Products**

There are three types of rattan products available in the domestic markets of Myanmar: 1) handicrafts, 2) furniture, and 3) household utensils. Handicrafts, for example, are baskets in different shapes and sizes, e.g. laundry baskets, litter baskets, and wine bottle baskets, trays in different shapes and sizes, tissue boxes, lamp

shades, file boxes, magazine racks, bowls, and handbags. Smaller rattan handicrafts, e.g. hair clips, decorative pins, are frequently sold as souvenirs. Common furniture items include rattan settees, tables, chairs, television stands, bookcases, and curtains; household items include kitchen utensils, food containers, and small cases.

## 1.7 Export Markets for Rattan Products

When Myanmar changed its economic system from a planned economy to a market-oriented economy, raw rattan and rattan products started to be exported to international markets. Since this time, Myanmar has become a major supplier of rattan cane to its neighbors. The Shweohgya Company and the Comet Rattan Trading Company are currently the two largest exporters of raw rattan in Myanmar. There are also over fifteen trading companies in Myanmar that export rattan products to the international market. Most of these companies are located in the Dagon Industry Zone and the Hlaing Thar Yar Industry Zone in Yangon Division and the Mandalay Industry Zone in Mandalay Division.

According to the Myanmar Customs Department, the export of rattan products is grouped into two categories: 1) rattan furniture and 2) rattan wares. Rattan handicrafts, baskets, handbags, lampshades, tabletops, jewelry boxes, flower vases, laundry baskets, and kitchen wares are all classified as “rattan wares”. The annual export value of these products from 2005 to 2008 is shown in Table 1.1.

Table 1.1 Export values (x1000 US\$) of rattan furniture and rattan wares in Myanmar from 2005 to 2008 (Source: Customs Department, 2009).

Product	2005	2006	2007	2008	Total	%
Rattan Furniture	39.0	103.3	46.9	6.4	195.6	2.7
Rattan Ware	533.6	2,271.1	2,812.9	1,492.3	7,109.9	97.3
TOTALS:	572.6	2,374.4	2,859.8	1,498.7	7,305.5	

As is shown in the table, the total export of rattan products during the period 2005–2008 was in excess of 7.3 million dollars(US). Rattan furniture represented only \$195,000 of this total, while the great majority (over 97 percent) of the revenue came from rattan ware. Clearly, rattan ware has had a greater acceptance in international markets than furniture. The fact that rattan furniture takes up more space in shipping containers and has higher shipping costs is at least partially responsible for this trend.

Based on Customs Department data, the average annual value of rattan exports during the period from 2001–2009 was 2.5 million dollars (US) per year. While local trading companies report that the overall export of rattan products decreased notably during the financial crisis, they also affirm that there is still a considerable international demand for rattan products from Myanmar. Rattan products made in Myanmar are exported to countries all over the world via Singapore. Europe is a major destination for these products.

In recent years, rattan trading companies in Myanmar have shifted their focus from exporting rattan products to expanding local markets. The high costs of shipping via Singapore is one of the major problems. Constraint in exporting rattan products and stiff competition from other countries like China, Vietnam, Thailand, and Indonesia are also great hurdles for rattan exporters.

## **1.8 Rattan Product and Marketing Chain**

There are two modes of production for rattan products. The first is the domestic industry system. In this production system the producers make their own products together with members of their family. The products are sold either in local markets or to brokers, intermediaries, or export companies.

The second mode of production is the company producer or company contractor system. Most of the producers and companies have their own workers and factories for making rattan products. Usually a group of workers is first organized at the village level where local weavers have experience working with rattan and are

skilled at making traditional products. The company gives the design, pattern, and size of the rattan item they want produced to the leader of the village group, who then coordinates the working group to make the products and complete the order on schedule. In this way, there is also a rural development component in this mode of production.

The rattan company normally uses a pre-payment system for procuring the products. Half of the labor costs and the raw material are provided upfront to the village groups, and the balance is paid when the work is finished and company collects the semi-finished products. These semi-finished rattan products are also occasionally purchased from brokers, producers, or traders.

After the company has collected and purchased the material, the semi-finished products are then sent to rattan factories for smoking, painting, polishing, and packing. Depending on current demand and prices, these products may be sold in either domestic or international markets. The general production chain for rattan furniture and handicrafts is shown graphically in Figure 1.2.

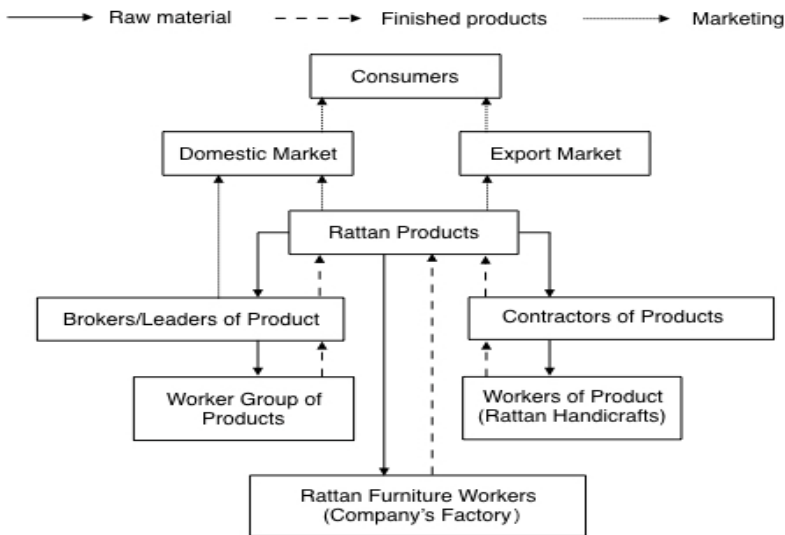


Figure 1.2. Schematic diagram of rattan product and marketing chain in Myanmar.

## **1.9 Current Status of Rattan Taxonomy**

Research on rattan taxonomy in Myanmar has been limited and sporadic. Pioneering research on the collection and identification of local rattans can be found in Lace (1912), Rodger (1921), Hundley (1957), Hundley (1962), and Hundley and U Chit Ko Ko (1986). More recently, Kress, *et al.* (2003) listed 5 genera and 36 species of rattan in Myanmar. The local names, however, are rather confusing as some of the same species are known under different local names in different localities. Additionally, the same names are used for different species in different localities. Perhaps, most importantly, however, this rattan checklist is not specimen-based, i.e. it is not based on an actual collection of rattan specimens, so there is no way to verify which species a name is referencing. Given the economic and subsistence importance of these forest resources, it is very important to clarify the taxonomy and local nomenclature of all the rattan species in Myanmar.

## **1.10 Conclusion**

The identification and systematic inventory of the rattan species are urgently needed for taxonomic study and documentation of the distribution of this forest resource in Myanmar. Current research activities on rattan are inadequate.

In Myanmar, rattan grows naturally in many regions and different forest types. But, rattan resources in natural forests are gradually decreasing due to over exploitation and high demand. So, in addition to concerted management of wild rattan populations, cultivation of commercial rattan species is also needed.

Overall, a multi-disciplinary development effort is needed in the rattan sector. Survey and exploration to identify, classify, and assess the potential of existing rattan resources are fundamental to this effort. Conservation of genetic material, propagation methods, and plantation establishment must also be promoted and facilitated through the development of research initiatives on these topics by the Forest Research Institute. Finally, guidance and encouragement from the government and Forest Department, financial support and sharing of technical know-how among neighboring countries, and

training support for young scientists interested in rattan research from agencies such as the International Network for Bamboo and Rattan (INBAR), the International Plant Genetic Resources Institute (IPGRI), the Forestry Research Support Program for Asia and the Pacific (FORSPA), and the International Tropical Timber Organization (ITTO) would be of great benefit to all of the rattan sectors in Myanmar.

### **1.11 Recommendations**

The taxonomic survey of rattan is essential to identify the species and understand the habitat requirements and geographic distribution of different taxa. This work would provide the basic information needed for further research on the cultivation and utilization of rattan. To achieve this objective, a thorough taxonomic inventory of rattan in Myanmar should be considered.

To develop the rattan sector in Myanmar, the following research activities should be supported:

1. Systematic survey and taxonomy study of local rattan species
2. Investigation of technologies for propagation and cultivation of rattan
3. Detailed evaluation of domestic rattan utilization
4. Improved utilization and marketing of rattan



## CHAPTER II

# A Field Guide to the Rattans of Myanmar

*Andrew Henderson*

This chapter contains a field guide to the rattans of Myanmar. The guide serves several purposes. It acts as the taxonomic foundation of all the other work reported in this book, it allows for the identification of any rattan from the country, and it contains information on the morphology, range, habitat, phenology, and uses of all the rattans. Perhaps most importantly, it contains the correct names for the species. This, the correct scientific name, is essential for communication on species, and if the rattan sector is to develop a common system of names is essential.

Local names are confusing, and great care must be taken in their use. Local people sometimes give different names to male and female plants, and local people from different places give different names to the same species. Conversely, several species can have the same local name. Local names from one country are completely unintelligible in other countries. Sometimes, a local name is given to a plant, and a different name to the cane. There is no standard list of accepted local names.

### 2.1 The Layout of This Guide

The guide begins with an illustrated glossary. Many of the features of rattans used in the key and descriptions are shown here. The glossary is followed by a key. This enables the user to find the correct scientific name of any rattan species in Myanmar. The key is structured by couplets. Each numbered couplet, starting with 1a. and 1b., gives the user two choices. For example, 1a. asks if the leaflets are rhomboidal with jagged apices. If the rattan under consideration has these types of leaflets, then it must be *Korthalsia laciniosa*. If not, the user goes to 1b.– leaflets linear, lanceolate, or ellipsoid with pointed apices – and is directed to couplet 2. The process is repeated until the final name is reached. Each couplet usually includes more than one morphological character.

Each species has a separate page. First, the Latin name is given, and this is followed by the abbreviated name of the botanist(s) who named the species for the first time. Nomenclature generally follows Henderson (2009). The Latin name is followed by the local names.

Next is a short description of the palm. These descriptions are designed to give the most important, easily visible characters of each species, starting with stems and proceeding with leaves, inflorescences, and finally fruits. The most important parts of the rattan—the first parts to look at when attempting to identify a plant—are bold-faced (**Stems, Leaf sheaths, ocreas, knees, flagella, rachis, cirri, Inflorescences, fruits**). Note that the stem diameters given include leaf sheaths; the rattan cane itself will have a narrower diameter. Also note that leaf sheath characteristics are best observed on youngest leaves as the coloring and hair patterns on older leaves may be obscured. Not all species of *Calamus* and *Daemonorops* have climbing stems. However, all species, climbing or non-climbing, are included in this guide.

The description is followed by notes on distribution and habitat. Distribution is given first for Myanmar, and then other countries in parentheses. Habitat is given as well as elevation range based on data taken from herbarium specimens.

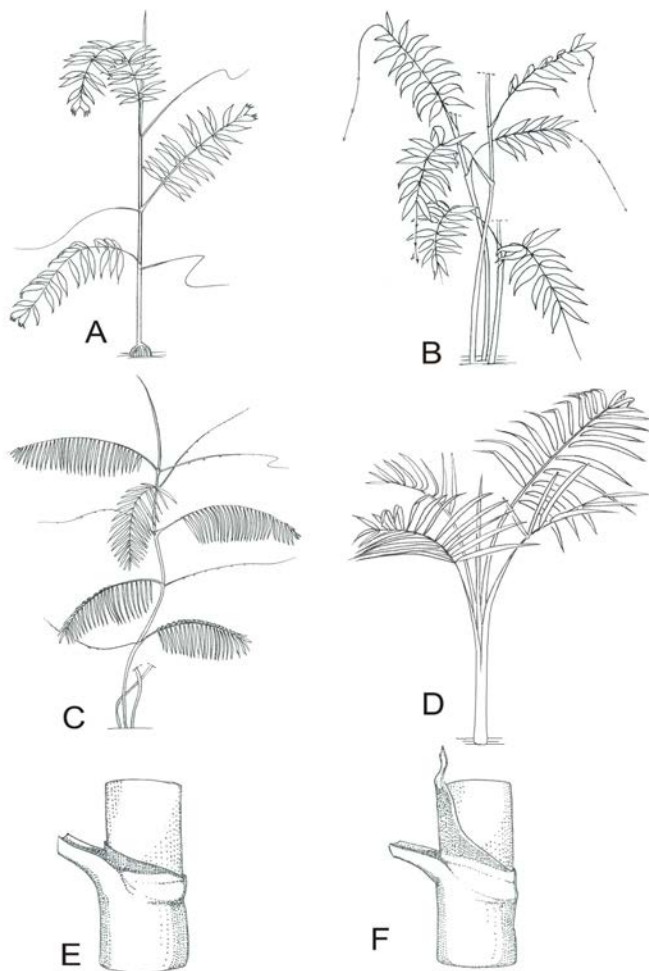
A short section on uses gives the most common uses of each species. As with many other palms, there are usually many uses for any particular species, but only the most important are given here.

Flowering and fruiting months are given. These are taken mostly from herbarium specimens, and so may give an incomplete account. Also note that the same species growing in different parts of the region may have different flowering and fruiting times.

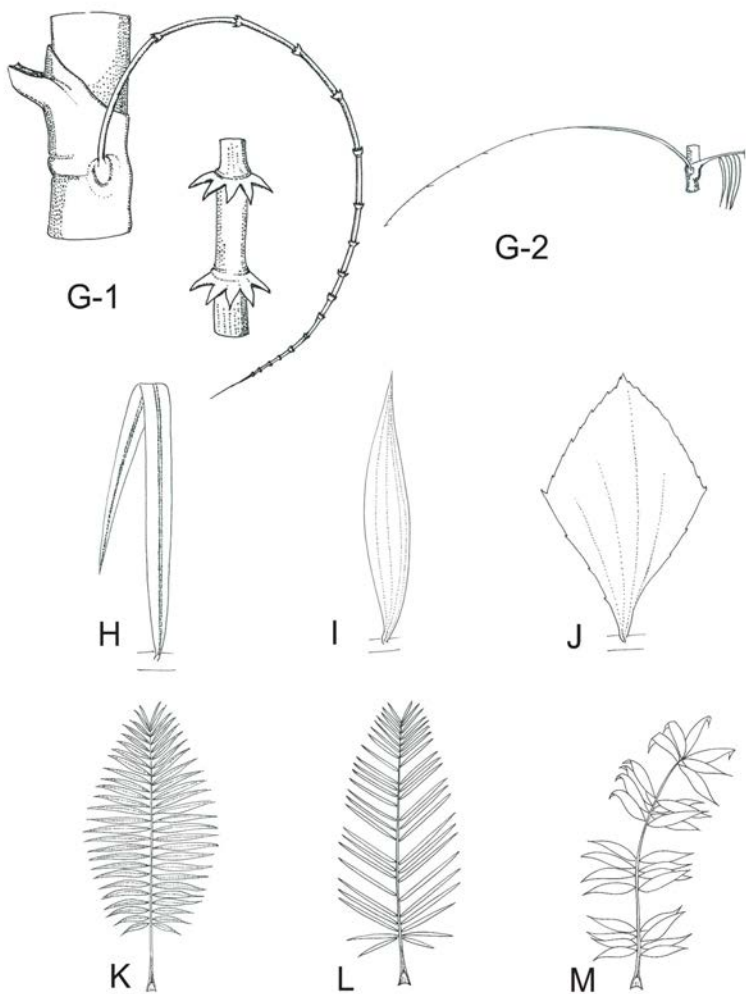
On the facing page to the description, illustrations are given. A range map for each species is based on herbarium specimens, and each dot on the map represents the locality of a herbarium specimen. Many species occur in a wider area than that indicated on the maps. For each species we have tried to illustrate the leaf sheath, the leaf, and either flowers or fruits.

Many areas in Myanmar are poorly known for rattans, and it is likely that new country records will be found. For example, *Calamus axillaris*, *C. pandanosmus*, *C. rhomboideus*, *C. siamensis* and *Plectocomia pierreana* occur in Peninsular Thailand and are likely to occur in southern Myanmar; and *Plectocomia himalayana* occurs in China and is likely to occur in northern Myanmar. Shan state is particularly poorly known and there are likely to be new records from China or Thailand.

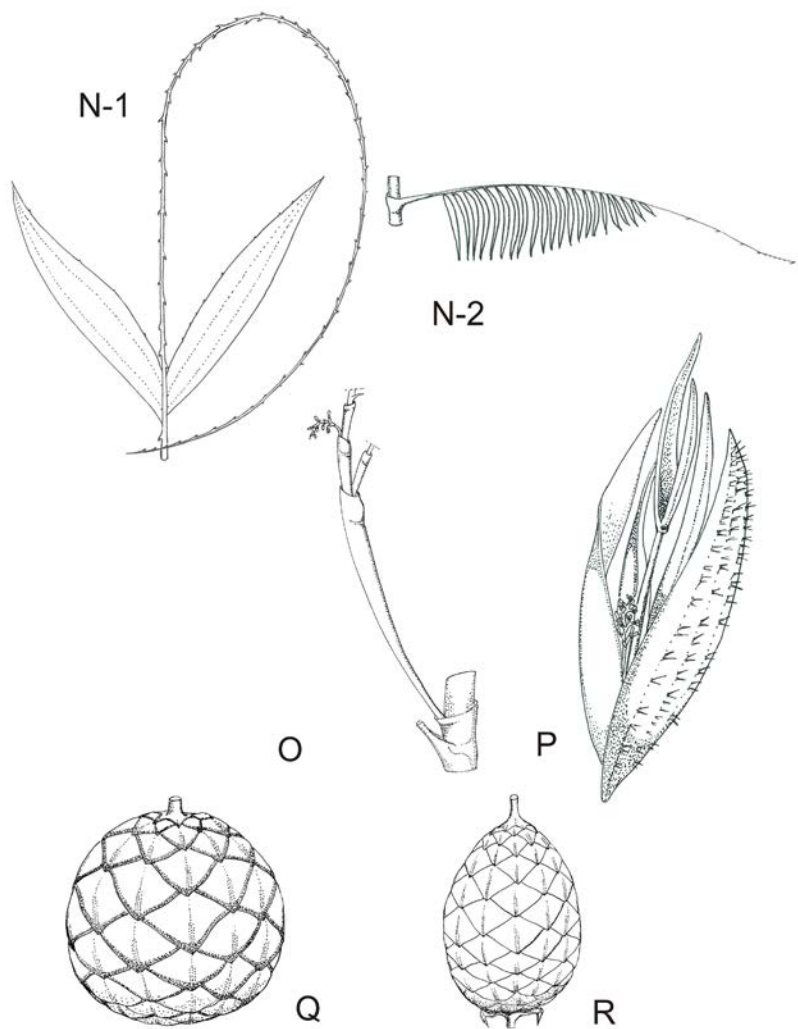
## 2.2 Illustrated Glossary



A. Solitary stem. B. Clustered stem. C. Climbing stem. D. Non-climbing stem. E. Scarcely developed ocrea. F. Well-developed ocrea.



G-1. Flagella. G-2. Flagella. H. Linear leaflet. I. Lanceolate leaflet. J. Rhomboid leaflet. K. Leaf with regularly arranged leaflets. L. Leaf with regularly arranged leaflets but with gaps. M. Leaf with clustered leaflets.



N-1. Cirrus. N-2. Cirrus. O. Tubular inflorescence bract. P. Inflorescence with boat-shaped bracts splitting their entire length and remaining attached and enclosed by the prophyll. Q. Globose fruit. R. Ovoid fruit.

## 2.3 Key to the Rattans of Myanmar

1a. Leaflets rhomboidal, with jagged apices, silvery-gray on the lower surfaces; climbing stems branching above ground level; Taninthayi . . . . . ***Korthalsia laciniosa***

1b. Leaflets linear, lanceolate, or ellipsoid, rarely silvery-gray on the lower surfaces; climbing stems not branching above ground level . . . . . 2

2a. Knees on leaf sheaths absent; inflorescences borne simultaneously at apex of stem, their production ending life of stem; climbers . . . . . 3

2b. Knees on leaf sheaths usually present (absent in non-climbers); inflorescences borne sequentially along the stem, their production not ending life of stem; climbers or non-climbers . . . . . 6

3a. Leaflets silvery-gray on the lower surfaces; inflorescence branches covered with prominent, overlapping bracts, these obscuring the flowers . . . . . 4

3b. Leaflets usually green on the lower surfaces; inflorescence branches without prominent, overlapping bracts, the flowers visible . . . . . 5

4a. Leaf sheaths densely reddish-brown hairy; Kachin, Sagaing . . . . . ***Plectocomia assamica***

4b. Leaf sheaths gray tomentose; Kayin, Mon, Taninthayi . . . . . ***Plectocomia elongata***

5a. Spines in complete rows around the leaf sheaths; ocreas absent; fruits covered with minute scales; upper surfaces of leaflets without bristles on the veins; Taninthayi . . . . . ***Myrialepis paradoxa***

5b. Leaf sheath spines scattered, sometimes absent; ocreas present; fruits covered with normal-sized scales; upper surfaces of leaflets with conspicuous, yellow bristles on the veins; Taninthayi, Mon . . . . . ***Plectocomiopsis geminiflora***

6a. Inflorescences not flagellate, usually shorter than the leaves, with boat-shaped bracts splitting their entire length and then remaining attached and enclosed by the prophyll, without



grapnel-like spines; cirri present . . . . . 7

6b. Inflorescences flagellate or non-flagellate, usually longer than the leaves, with sheathing, tubular bracts not or only briefly splitting (rarely tattering) and remaining attached, not enclosed by the prophyll, usually with grapnel-like spines; cirri present or absent . . . . . 8

7a. Leaflets 75–100 per side of rachis, to 2.5 cm wide; Ayeyarwady, Bago, Rakhine, Taninthayi, Yangon . . . . . ***Daemonorops jenkinsiana***

7b. Leaflets 25–45 per side of rachis, 2.5–3.4 cm wide; Taninthayi . . . . . ***Daemonorops kurziana***

8a. Stems non-climbing, free-standing; knees, flagella, and cirri usually absent; inflorescence bracts without clawed spines . . . . . 9

8b. Stems climbing; knees, flagella, and/or cirri usually present; inflorescence bracts with clawed spines . . . . . 11

9a. Leaflets irregularly arranged in groups of 2–8; stems usually short and subterranean or creeping; Taninthayi . . . . . ***Calamus concinnus***

9b. Leaflets regularly arranged; stems vertical and erect . . . . . 10

10a. Petioles with groups or whorls of long, yellow or brown spines; leaflets green on the lower surfaces; Kachin, Sagaing, Shan . . . . . ***Calamus erectus***

10b. Petioles without groups or whorls of long yellow spines; leaflets grayish-white on the lower surfaces; Ayeyarwady, Bago, Yangon . . . . . ***Calamus arborescens***

11a. Flagella absent; cirri present . . . . . 12

11b. Flagella present; cirri absent . . . . . 14

12a. Leaflets lanceolate, yellowish at the base; Taninthayi . . . . . ***Calamus helferianus***

12b. Leaflets elliptic, not yellowish at the base . . . . . 15

13a. Stems clustered; sheath spines reddish-brown; leaflets usually arranged in distant clusters; fruits not borne on short stalks, to 1.2 cm long, with a pronounced tip, the scales not grooved; Bago,

Taninthayi . . . . . *Calamus latifolius*

13b. Stems solitary or clustered; sheath spines yellowish or reddish-brown; leaflets regularly or irregularly arranged; fruits born on short stalks, to 2.4 cm long, without a pronounced tip, the scales grooved; Kachin, Sagaing . . . . . *Calamus inermis*

14a. Leaflets 4–21 (rarely to 29) per side of rachis, usually irregularly arranged, the apical ones usually inserted close together in a fan shape, the apical pair free or often joined at their bases . . . . . 15

14b. Leaflets 27–75 per side of rachis, usually regularly arranged, the apical ones not inserted close together in a fan shape, nor the apical pair joined at their bases . . . . . 23

15a. Stems to 5 cm diameter, solitary; leaf sheath spines with sinuous margins, densely hairy initially; leaflets broadly lanceolate; Kachin, Kayin . . . . . *Calamus acanthospathus*

15b. Stems usually less than 2 cm diameter, usually clustered; leaf sheath spines not with sinuous margins and not densely hairy initially; leaflets linear or lanceolate; widespread . . . . . 16

16a. Leaflets gray on the lower surfaces . . . . . 17

16b. Leaflets green on the lower surfaces . . . . . 18

17a. Leaf sheath spines slender, triangular, concave at the base proximally, horizontally spreading or downward pointing, dense, yellowish-brown; flagella vestigial; Bago, Kayin, Mon, Taninthayi . . . . . *Calamus platyspathus*

17b. Leaf sheath spines short, triangular, concave at the base proximally, pointing upwards, often lying almost flat against the sheath, yellowish-brown to dark brown, with the lateral margins oblique, extending downwards, sometimes into a low ridge; flagella well-developed; Taninthayi, Kayin . . . . . *Calamus myrianthus*

18a. Petioles very short or absent, the basal leaflets swept back across the sheath; Mon, Taninthayi . . . . . *Calamus javensis*

18b. Petioles well-developed, the basal leaflets not swept back across the sheath . . . . . 19

19a. Leaflets curled over at the tips; leaf sheaths mottled with dark and whitish-brown hairs; Kachin, Sagaing . . . . . ***Calamus gracilis***

19b. Leaflets not curled over at the tips; leaf sheaths not mottled . . . . . 20

20a. Leaf sheath spines often downward-pointing; leaflets regularly but distantly arranged; Taninthayi . . . . . ***Calamus luridus***

20b. Leaf sheath spines horizontally-spreading; leaflets irregularly arranged, sometimes in distant groups; Kachin, Sagaing . . . . . 21

21a. Leaflets 10–20 per side of rachis; leaf sheath spines of two kinds, one flattened, brown, the other needle-like, black, both kinds to 4 cm long; Kachin, Sagaing . . . . . ***Calamus floribundus***

21b. Leaflets 3–10 per side of rachis; leaf sheath spines of one kind only, flattened, to 1 cm long . . . . . 22

22a. Rachises to 0.6 m; apical pair of leaflets briefly joined at the base; inflorescence bracts without bristles at the apices; Kachin, Sagaing . . . . . ***Calamus kingianus***

22b. Rachises to 0.3 m long; apical pair of leaflets joined at the base; inflorescence bracts with apical margins densely covered with bristles; Kachin, Sagaing . . . . . ***Calamus bukaungensis***

23a. Leaf sheath spines densely arranged, of two kinds, one large, flat, straight, triangular, usually lighter colored at the base; the other shorter, black, both kinds usually borne on short to long, horizontal to oblique, raised ridges . . . . . 24

23b. Leaf sheath spines not densely arranged and not of two kinds, not borne on ridges . . . . . 26

24a. Leaflets clustered, spreading in different planes; Ayeyarwady, Bago, Kayin, Mon, Rakhine, Taninthayi, Yangon . . . . . ***Calamus longisetus***

24b. Leaflets regularly arranged . . . . . 25

25a. Leaf sheaths with yellowish-brown spines; Taninthayi . . . . . ***Calamus rudentum***

25b. Leaf sheaths with black or gray spines; Kachin, Sagaing, Shan . . . . . *Calamus flagellum*

26a. Leaflets distinctly clustered and spreading different planes; Ayeyarady, Bago, Kachin, Kayin, Mon, Shan, Taninthayi, Yangon . . . . . *Calamus viminalis*

26b. Leaflets regularly arranged, rarely regularly arranged but with gaps . . . . . 27

27a. Stems solitary; Taninthayi . . . . . *Calamus peregrinus*

27b. Stems clustered . . . . . 28

28a. Leaf sheaths with upward-pointing spines; ocreas conspicuous, tattering and soon falling; inflorescence bracts not sheathing, splitting open and becoming flat, brown; Ayeyarwady, Bago, Kachin, Sagaing, Taninthay, Yangon . . . . . *Calamus guruba*

28b. Leaf sheath spines not upward-pointing; ocreas not prominent; inflorescence bracts not split open and flat, nor brown . . . . . 29

29a. Leaf sheath spines needle-like and erect at sheath apices; Sagaing, Kachin . . . . . *Calamus leptospadix*

29b. Leaf sheath spines not needle-like at sheath apices . . . . . 30

30a. Leaf sheath spines to 1 cm long; leaf sheaths mottled with dark and whitish-brown hairs; fruits to 2.5 cm long, stalked; Mon, Taninthayi . . . . . *Calamus melanacanthus*

30b. Leaf sheath spines to 4.5 cm long or more; leaf sheaths not mottled; fruits to 1.5 cm long, not stalked . . . . . 31

31a. Leaf sheath spines with oblique crescent-shaped bases; leaf sheaths often with ridges; Kachin, Rakhine, Sagaing, Taninthayi . . . . . *Calamus tenuis*

31b. Leaf sheath spines not with oblique, crescent-shaped bases; leaf sheaths without ridges; Kachin, Mon, Shan . . . . . *Calamus henryanus*

## 2.4 Species Descriptions

### ***Calamus acanthospathus*** Griff.

**Local names.** Not recorded.

**Description.** **Stems** solitary, climbing, to 21 m long and 5 cm diameter. **Leaf sheaths** green or pinkish-brown, with sparsely to densely arranged, sometimes in short rows, brown, flattened, to 1 cm long spines, these with sinuous, densely hairy margins initially; **ocreas** short, densely bristly; **knees** present; **flagella** present, to 5.6 m long; petioles short or absent; **rachises** 0.4–1.0 m long with 7–12, broadly lanceolate leaflets per side, these regularly arranged, sometimes irregularly, especially near base of leaves, minutely bristly on the margins; **cirri** absent. **Inflorescences** to 3 m long, flagellate; bracts tubular; flowering branches short and strongly recurved; **fruits** ovoid to ellipsoid, to 2.5 cm long and 1.5 cm diameter, yellowish-brown.

**Distribution and habitat.** Kachin and Kayin in lowland or montane rain forest at 600–2,333 m elevation (also in Bhutan, southwestern China, northeastern India, Laos, Nepal, Thailand, and Vietnam)

**Flowering and fruiting.** Flowers January.

**Uses.** Provides a cane used in basket making and furniture making.



## ***Calamus arborescens*** Griff.

**Local names.** *Danon, danote, danoug.*

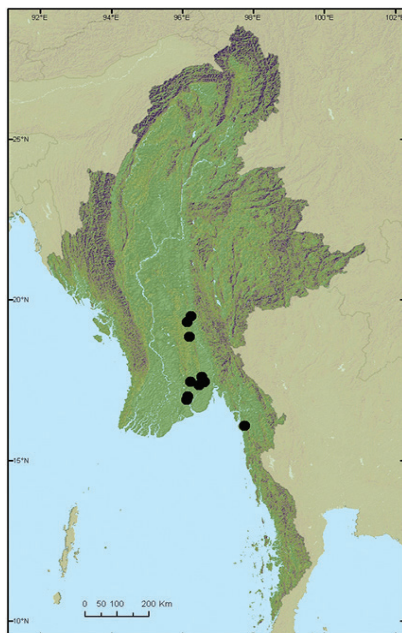
**Description.** **Stems** clustered, non-climbing, free-standing, to 5 m long and 6.5 cm diameter. **Leaf sheaths** open, gray-green, with rows of black, flattened to 4 cm long spines; **ocreas** present; **knees** absent; **flagella** absent; petioles 25–200 cm long, with black spines; **rachises** to 2.8 m long with 36–55 lanceolate leaflets per side, these regularly arranged, grayish-white on the lower surface; **cirri** absent. **Inflorescences** to 2.3 m long, not flagellate; bracts tubular, split, tattering at the apices; **fruits** ovoid to ellipsoid, to 2.2 cm long and 1.5 cm diameter, yellowish or reddish-brown.

**Distribution and habitat.** Ayeyarwady, Bago, and Yangon in lowland rain forest, now mostly in disturbed areas near villages but still common in the Pegu Yoma especially in wet places, below 400 m elevation (also in adjacent Thailand).

**Flowering and fruiting.** Fruits December, January.

**Uses.** The leaves are used for thatching.







## ***Calamus concinnus*** Mart.

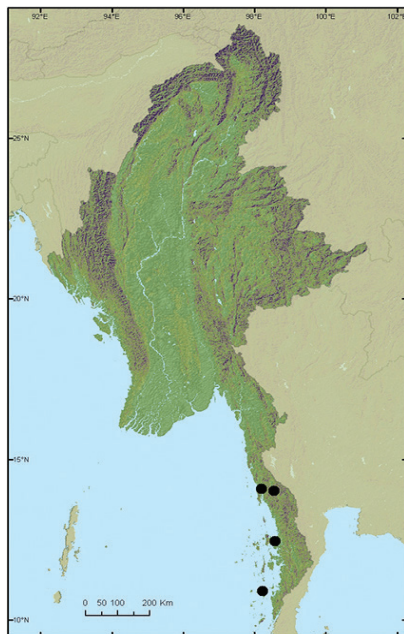
**Local names.** Not recorded.

**Description.** **Stems** clustered, non-climbing, short and subterranean or creeping, to 5 m long and 8 cm diameter. **Leaf sheaths** open, green with scattered, yellowish, triangular, to 4 cm long spines; **ocreas** present, elongate, to 75 cm long, tattering; **knees** absent; **flagella** absent; petioles 45–170 cm long; **rachises** 2.1–3.8 m long with 30–65, lanceolate leaflets per side, these irregularly arranged in groups of 2–7; **cirri** absent. **Inflorescences** 1.2–1.4 m long, not flagellate; bracts tubular, tattering at apices; **fruits** globose, 0.8–1.0 cm diameter, yellowish.

**Distribution and habitat.** Taninthayi in lowland rain forest, often near the sea or rivers, at 10–250 m elevation (also in Peninsula Malaysia and Thailand).

**Flowering and fruiting.** Flowers April, August, November; fruits January, February, May, September.

**Uses.** Not recorded.



## ***Calamus erectus*** Roxb.

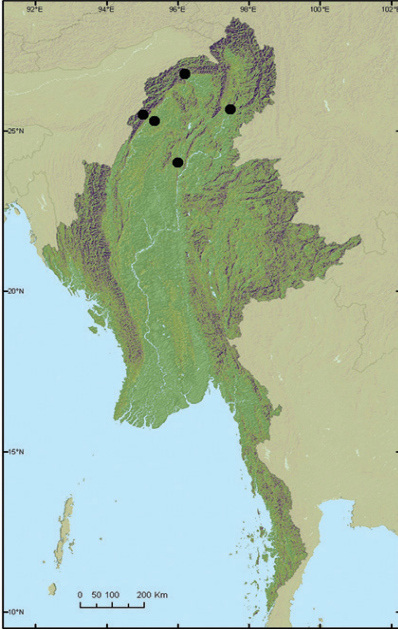
**Local names.** *Mauk chee kyein, soo-patle, thaing kyaing.*

**Description.** **Stems** clustered, non-climbing, free-standing or sometimes leaning, to 6 m long and 5 cm diameter. **Leaf sheaths** dark green with dark brown hairs, with short rows of flattened, to 3.5 cm long spines; **ocreas** present, with short rows of spines, split into two, soon falling; **knees** absent; **flagella** absent; petioles 100–190 cm long, with groups or whorls of long, yellow or brown spines; **rachises** 1.9–4.5 m long with 30–40, lanceolate leaflets per side, these regularly arranged, bristly along the margins; **cirri** absent. **Inflorescences** to 2 m long, not flagellate; bracts tubular, tattering at the apices; **fruits** ellipsoid, to 5 cm long and 2.5 cm diameter, greenish or brownish.

**Distribution and habitat.** Kachin, Sagaing, Shan on steep slopes in lowland or montane rain forest at 300–1,300 m elevation (also in Bangladesh, Bhutan, China, northeastern India, Laos, Nepal, and Thailand).

**Flowering and fruiting.** Flowers January, March; fruits January, April.

**Uses.** Provides a used in furniture making.





## ***Calamus flagellum*** Griff.

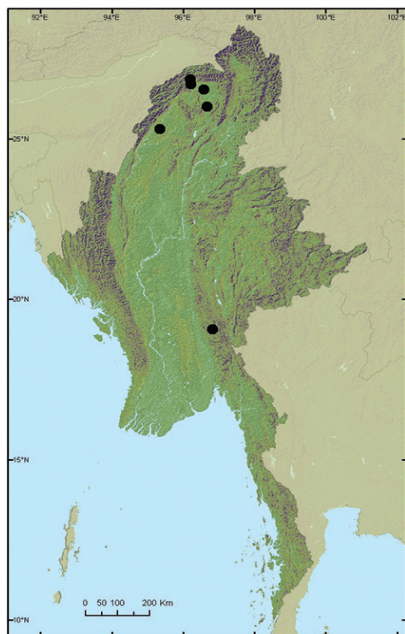
**Local names.** *Mauk chee kyein*.

**Description.** **Stems** clustered, forming thickets or climbing, to 30 m long and 2–4 cm diameter. **Leaf sheaths** with black or gray hairs, with densely arranged spines of two kinds, one large, flat, straight, triangular, black or gray to 5.5 cm long, sometimes to 10 cm at sheath apices, the other shorter, black, both kinds usually born on short to long, horizontal to oblique, raised ridges; **ocreas** to 10 cm long, fibrous, early tattering and falling; **knees** present, inconspicuous; **flagella** present, to 7 m long; petioles 12–70 cm long; **rachises** 1.2–3 m long with 14–36, linear-lanceolate leaflets per side, these regularly arranged, conspicuously bristly along the margins; **cirri** absent. **Inflorescences** to 5.3 m long, flagellate; bracts tubular, tattering at the apices; **fruits** ovoid to ellipsoid, 2.8–3.4 cm long and 1.8–2.3 cm diameter, yellowish or brownish, with grooved scales.

**Distribution and habitat.** Kachin, Kayin, Sagaing, and Shan in lowland or montane rain forest at 100–1,500 m elevation (also in Bangladesh, Bhutan, China, Laos, Nepal, northeastern India, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers January; fruits January, November.

**Uses.** Not recorded.



## ***Calamus floribundus*** Griff.

**Local names.** *Maukye, ye-kyaing.*

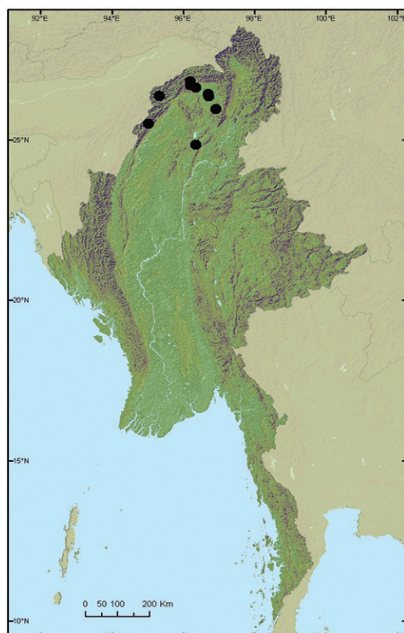
**Description.** **Stems** clustered, climbing, to 6 m long and 1–2.5 cm diameter. **Leaf sheaths** greenish-brown with brown hairs, with densely arranged spines of two kinds, one brown and flattened, the other black and needle-like, both to 4 cm long, interspersed with many short, black spines; **ocreas** present, short and densely bristly; **knees** present; **flagella** present; petioles 16–60 cm long; **rachises** 0.4–0.5 m long with 10–20, lanceolate leaflets per side, these irregularly arranged, the apical ones inserted close together in a fan shape, the apical pair free or joined at their bases; **cirri** absent. **Inflorescences** to 2.5 m long, flagellate; bracts tubular; **fruits** globose to ellipsoid, to 1.2 cm long and 1.0 cm diameter, yellowish.

**Distribution and habitat.** Kachin and Sagaing in lowland rain forest on river flood-plains or other flat areas, often in disturbed places, at 190–1,000 m elevation (also in Bangladesh and northeastern India).

**Flowering and fruiting.** Flowers January, February.

**Uses.** The canes are used for cordage and the fruits are eaten.







## ***Calamus gracilis*** Roxb.

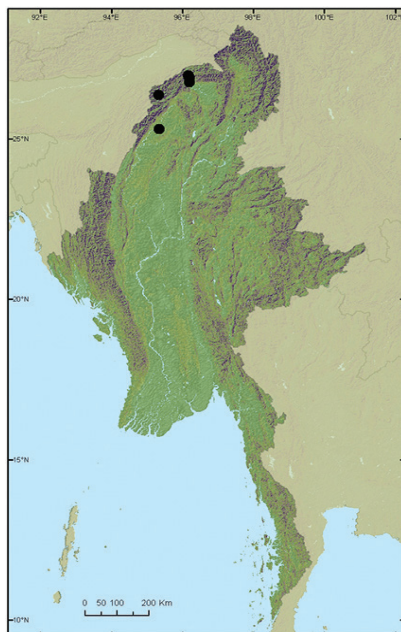
**Local names.** *Kyetu kyein*.

**Description.** **Stems** clustered, climbing, to 26 m long and 2 cm diameter. **Leaf sheaths** green, mottled with dark and whitish-brown hairs, without spines or with scattered, black-tipped, conical-based, to 0.5 cm long spines; **ocreas** small, not spiny; **knees** present; **flagella** present; petioles absent or to 20 cm long; **rachises** 0.2–0.6 m long with 10–29, linear or lanceolate leaflets per side, these regularly arranged but with wide gaps, shiny green, curled over at the tips, the apical ones inserted close together in a fan shape, the apical pair not joined at their bases, bristly on upper surface and lateral veins; **cirri** absent. **Inflorescences** to 0.7 m long, flagellate; bracts tubular; **fruits** ovoid to ellipsoid, 1.9–2.8 cm long and 1.2–1.8 cm diameter, yellowish or orange.

**Distribution and habitat.** Kachin, and Sagaing in lowland or montane rain forest at 290–1,300 m elevation (also in Bangladesh, China, northeastern India, Laos, and Vietnam).

**Flowering and fruiting.** Fruits January.

**Uses.** Not recorded.



## ***Calamus guruba*** Buch.-Ham.

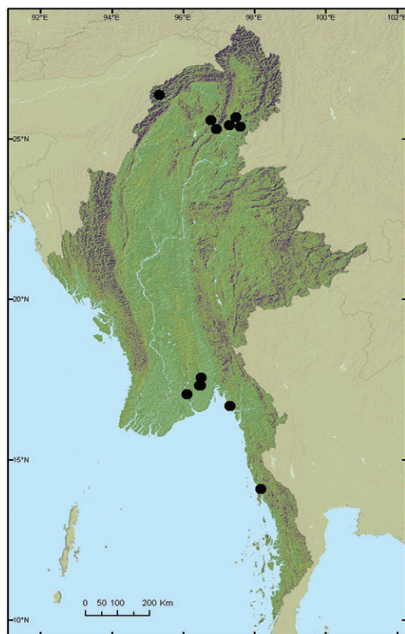
**Local names.** *Kyaing-ni, kyein-ni.*

**Description.** **Stems** clustered, climbing or forming thickets, to 20 m long and 3 cm diameter. **Leaf sheaths** dull green with rusty brown or light brown hairs, with scattered to densely arranged, brown, flattened, upward-pointing, to 3.5 cm long, sometimes to 10 cm at sheath apices, spines; **ocreas** present, conspicuous, tattering and soon falling; **knees** present; **flagella** present, to 3 m long; petioles 6–35 cm long; **rachises** to 1.3 m long with 30–52, linear-lanceolate leaflets per side, these regularly arranged, the apical ones smaller than the others; **cirri** absent. **Inflorescences** to 3 m long, flagellate, bracts not sheathing, split open and flat, brown; **fruits** globose, to 0.8 cm diameter, yellowish or brown.

**Distribution and habitat.** Ayeyarwady, Bago, Kachin, Sagaing, Taninthayi, and Yangon in lowland and montane rain forest, scrub forest, dry forest, and in disturbed places, especially roadsides, to 1,200 m elevation, rarely more (also in Bangladesh, Bhutan, Cambodia, China [Yunnan], eastern and northeastern India, Laos, Peninsular Malaysia, and Thailand).

**Flowering and fruiting.** Flowers January, February, October.

**Uses.** Provides a good quality cane used in basket making and furniture making.



## ***Calamus helferianus*** Kurz

**Local names.** *Kyein bya, kyein dan.*

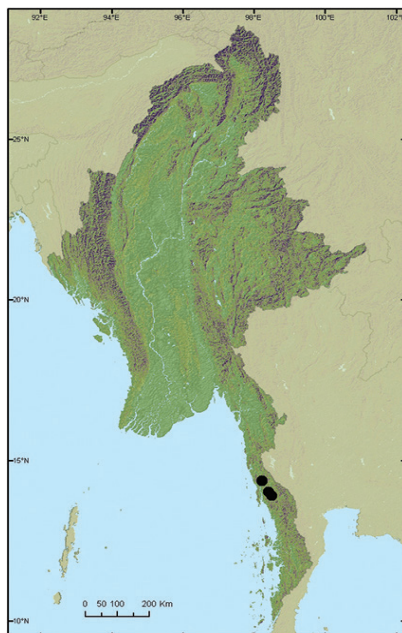
**Description.** **Stems** usually solitary, climbing, to 15 m long and 3 cm diameter. **Leaf sheaths** green with brown or pinkish hairs, with scattered, black or brown, flattened, to 5.0 cm long spines; **ocreas** present; **knees** present; **flagella** absent; petioles 4–50 cm long; **rachises** to 2.8 m long with 11–50, lanceolate leaflets per side, these borne in remote groups and spreading in slightly different planes, dark green with yellow bases; **cirri** present. **Inflorescences** to 2.2 m long, not flagellate; bracts tubular; **fruits** globose to ovoid, to 1.4 cm long and 1.0 cm diameter.

**Distribution and habitat.** Taninthayi in lowland or montane rain forest at 37–1,650 m elevation (also in Peninsular Thailand).

**Flowering and fruiting.** Flowers December.

**Uses.** The canes are used to make walking-sticks.





## ***Calamus henryanus*** Becc.

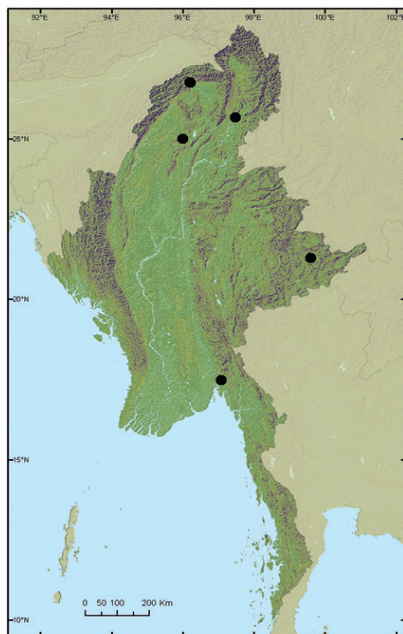
**Local names.** *Mauk chee kyein.*

**Description.** **Stems** clustered, climbing, to 20 m long and 1.8 cm diameter. **Leaf sheaths** green, mottled with reddish brown hairs, with scattered to densely arranged, yellowish, flattened, triangular, to 2.5 cm long, sometimes to 7 cm at sheath apices, long spines; **ocreas** very small, sometimes spiny; **knees** prominent; **flagella** present, to 4 m long; petioles 10–55 cm long; **rachises** to 1.3 m long with 29–45, linear leaflets per side, these regularly arranged, or often regularly arranged but with gaps, not bristly or bristly on upper surface veins; **cirri** absent. **Inflorescences** to 4.5 m long, flagellate; flowering branches very short, straight or recurved; bracts splitting and tattering at apices; **fruits** globose to ellipsoid, to 1.5 cm long and 1 cm diameter, yellowish-brown.

**Distribution and habitat.** Kachin, Mon, and Shan in lowland or montane rain forest, scrub forest, or secondary forest at 100–800 m elevation (also in China, Laos, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers January, April, November.

**Uses.** Provides a cane used in furniture making.





## ***Calamus hukaungensis*** Henderson

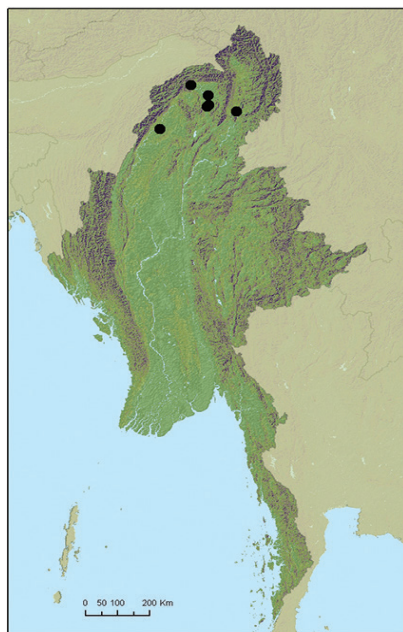
**Local names.** *Htin phu.*

**Description.** **Stems** clustered, climbing, to 4 m long and 1 cm diameter. **Leaf sheaths** greenish-brown with whitish hairs, with densely arranged, reddish-brown, flattened, horizontally spreading spines to 1 cm long; **ocrea** present, densely bristly; **knees** present; **flagella** present, to 1.5 m long; petioles 12–22 cm long; **rachises** to 0.3 m long with 4–6, lanceolate leaflets per side, these arranged in distinct groups, the apical pair joined at their bases; **cirri** absent. **Inflorescences** to 2 m long, flagellate; bracts loosely sheathing, the apical margins densely covered with bristles; **fruits** globose, to 1 cm diameter, yellowish-brown.

**Distribution and habitat.** Kachin and Sagaing in lowland forest at 190–285 m elevation.

**Flowering and fruiting.** Flowers February; fruits September.

**Uses.** The stems are used for weaving.



## ***Calamus inermis*** T. Anderson

**Local names.** *Kadin, ya-ma-lha kyaing, ya-ma-ta.*

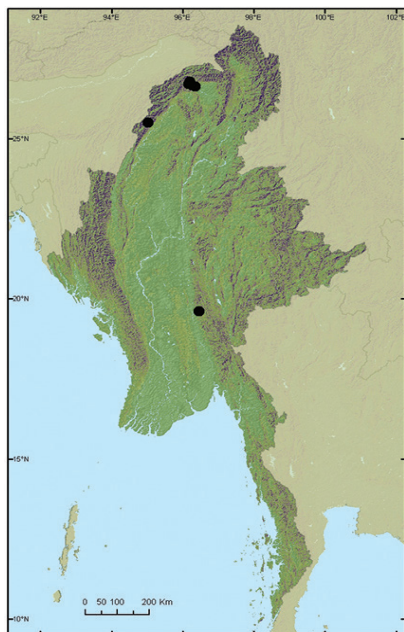
**Description.** **Stems** solitary or clustered, climbing, to 30 m long and 6 cm diameter. **Leaf sheaths** green with light brown hairs, with scattered to densely arranged, yellowish or reddish-brown, triangular, flattened, downward-pointing, to 3.5 cm long, rarely to 9 cm, spines, often interspersed among shorter spines, or sometimes spines absent; **ocreas** present; **knees** present, prominent; **flagella** absent; petioles 0–50 cm long; **rachises** to 4 m long with 36–40, lanceolate leaflets per side, these clustered or less often regularly arranged; **cirri** present. **Inflorescences** to 2 m long, not flagellate; bracts tubular; **fruits** globose to ovoid or ellipsoid, to 2.4 cm long and 2.5 cm diameter (rarely to 3.4 cm long), whitish to yellowish-brown, stalked, with grooved scales.

**Distribution and habitat.** Kachin, Kayin, and Sagaing in lowland or montane rain forest to 2,000 m elevation (also in Bangladesh, Bhutan, China [Yunnan], northeastern India, Laos, Nepal, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers and fruits January, February.

**Uses.** Provides a high quality cane used in furniture making and binding.

**Notes.** Formerly known as *Calamus nambariensis*; a very variable species, particularly in leaflet size and arrangement, and not easy, without fruits, to distinguish from *Calamus latifolius*.



## ***Calamus javensis*** Blume

**Local names.** *Kyein*.

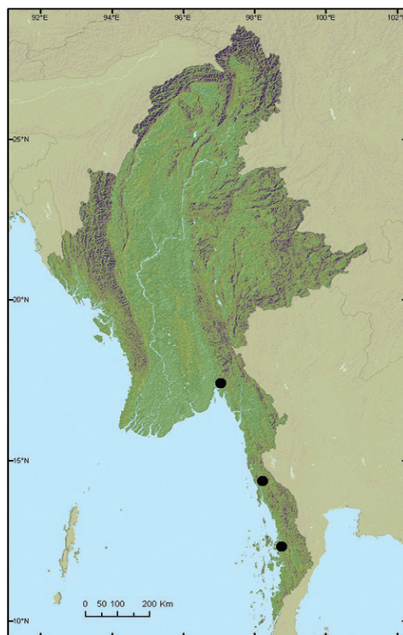
**Description.** **Stems** clustered, climbing, to 10 m long and 1.0 cm diameter. **Leaf sheaths** green, without spines or with scattered to densely arranged, brown, flattened or bulbous-based, to 0.5 cm long spines; **ocreas** present; **knees** present; **flagella** present, to 1.3 m long; petioles short or absent; **rachises** to 0.6 m long with 5–10, lanceolate to broadly lanceolate leaflets per side, these irregularly arranged, the basal pair often swept back across the sheaths, the apical pair joined for most of their length; **cirri** absent. **Inflorescences** to 1.5 m long, flagellate; bracts tubular, briefly split open and flat at the apex; **fruits** ellipsoid, to 1.5 cm long and 1.2 cm diameter, whitish.

**Distribution and habitat.** Mon and Taninthayi in lowland or montane rain forest to 1,200 m elevation (also in Borneo, Java, Peninsula Malaysia, Singapore, Sumatra, and Peninsula Thailand).

**Flowering and fruiting.** Flowers November.

**Uses.** Provides a thin cane for tying and basketry; the hearts are eaten.





## ***Calamus kingianus*** Becc.

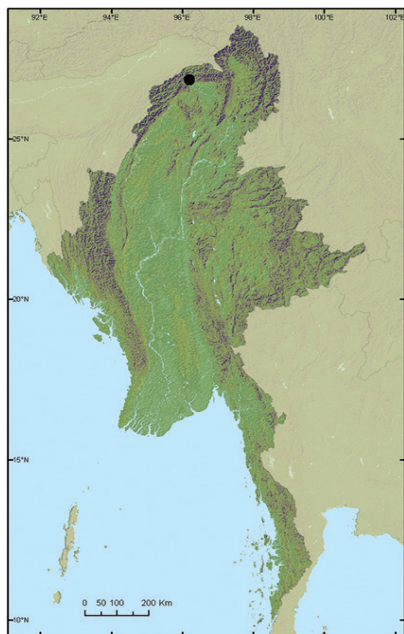
**Local names.** *Kyet Kyein*

**Description.** **Stems** clustered, climbing, to 5 m long and 1.2 cm diameter. **Leaf sheaths** green with brown hairs, with densely arranged, greenish, flattened, to 1.0 cm long spines, these sometimes in short rows; **ocreas** present; **knees** present; **flagella** not seen; petioles 9–43 cm long; **rachises** to 0.6 m long with 4–7, lanceolate leaflets per side, these in distinct clusters, the apical pair briefly joined at the bases; **cirri** absent. **Inflorescences** elongate, flagellate; bracts tubular; **fruits** globose, to 1.0 cm diameter, yellowish.

**Distribution and habitat.** Kachin and Sagaing in lowland rain forest to 500 m elevation (also in northeastern India).

**Flowering and fruiting.** Flowers January.

**Uses.** The fruits are eaten.





## ***Calamus latifolius*** Roxb.

**Local names.** *Kyeing phaung, la-me-kyein, ying kyein, ya-ma-lha kyaing, ya-ma-ta.*

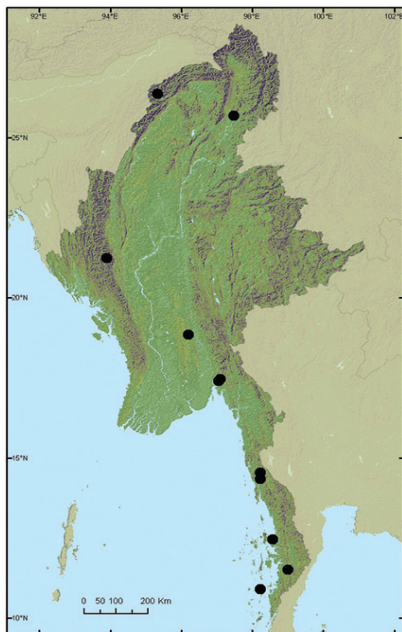
**Description.** **Stems** clustered, or sometimes solitary, climbing, to 30 m long and 5 cm diameter. **Leaf sheaths** green with whitish or brownish hairs, with scattered, or sometimes in partial rows, brownish, to 5 cm long spines, these often curving downwards; **ocreas** present; **knees** present, prominent; **flagella** absent; petioles short, flat and spiny on upper surfaces; **rachises** 1.7–2 m long with 12–25, broadly lanceolate leaflets per side, these regularly arranged, usually in distant, alternate clusters of 2–4 leaflets, sometimes regularly arranged; **cirri** present. **Inflorescences** to 1.7 m long, not flagellate, erect; bracts tubular; **fruits** ellipsoid to ovoid, to 1.2 cm long (rarely more) and 1 cm diameter, yellowish, with a pronounced tip and flattened perianth at the base, the scales not grooved.

**Distribution and habitat.** Bago, Chin, Kachin, Sagaing, and Taninthayi in lowland or montane rain forest, disturbed areas, and sometimes near villages, to 1,300 m elevation (also in Andaman Islands, [and possibly Nicobar Islands], Cambodia, Laos, Peninsular Malaysia, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers December.

**Uses.** Provides a good quality cane used in furniture making, and the palm hearts are eaten.

**Notes.** A very variable species, particularly in leaflet size and arrangement, and not easy, without fruits, to distinguish from *Calamus inermis*.



## ***Calamus leptospadix*** Griff.

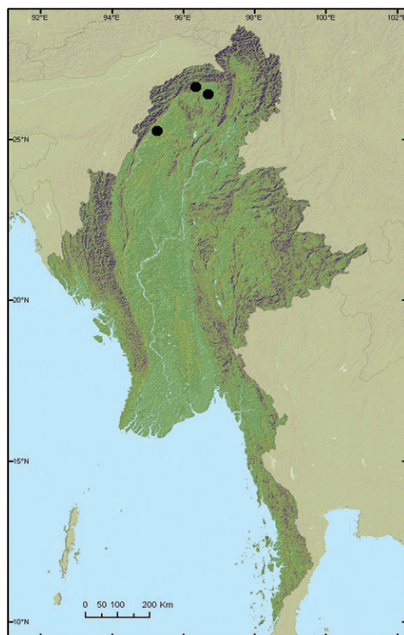
**Local names.** *Moke-soe-ma*.

**Description.** **Stems** clustered, climbing, to 25 m long and 2 cm diameter. **Leaf sheaths** green with grayish-brown hairs, with scattered to densely arranged, brownish, flattened, to 2.5 cm long, up to 5 cm at sheath apices, spines, those at sheath apices needle-like, yellowish; **ocreas** present, to 1.5 cm long, densely bristly, with long, needle-like spines; **knees** present; **flagella** present; petioles 20–38 cm long; **rachises** to 2 m long with 50–55 linear leaflets per side, these regularly arranged; **cirri** absent. **Inflorescences** to 4 m long, flagellate; bracts tubular, briefly open and spreading at the apices; flowering branches very short; **fruits** globose, to 1.5 cm diameter, white or yellowish.

**Distribution and habitat.** Kachin and Sagaing in lowland and montane rain forest, often along river margins, at 1,300 m elevation (also in Bangladesh, Bhutan, northeastern India, and Nepal).

**Flowering and fruiting.** Not recorded.

**Uses.** Provides a low-quality cane used in basketry and furniture making.



## ***Calamus longisetus*** Griff.

**Local names.** *Ka baung, la mei, thine kyein.*

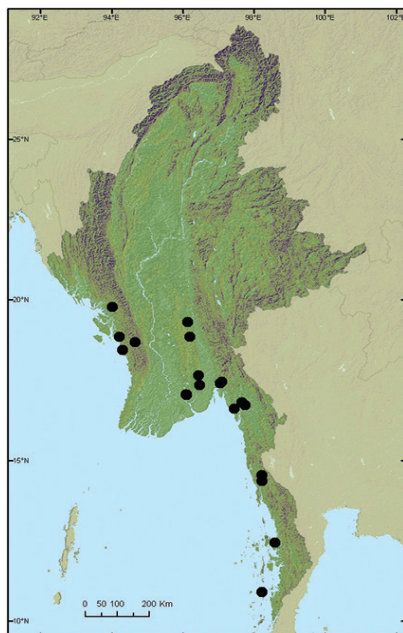
**Description.** **Stems** clustered, climbing, to 50 m long and 10 cm diameter. **Leaf sheaths** green with brownish hairs, with densely arranged spines of two kinds, one large, flat, straight, triangular, usually light-colored at the bases, to 6 cm long (sometimes to 10 cm at sheath apices), the other shorter, black, both kinds usually borne on short to long, horizontal to oblique, raised ridges; **ocreas** present, inconspicuous; **knees** present, inconspicuous; **flagella** present, to 13 m long; petioles 20–186 cm long; **rachises** 2.5–4.0 m long with 30–75, lanceolate leaflets per side, these irregularly arranged in clusters and spreading in different planes; **cirri** absent. **Inflorescences** to 10 m long, flagellate; bracts tubular, splitting and tattering at the apices; **fruits** ellipsoid, to 3.5 cm long and 2.0 cm diameter, the scales dark brown with paler brown, lacinated fringes.

**Distribution and habitat.** Ayeyarwady, Bago, Kayin, Mon, Rakhine, Taninthayi, and Yangon in lowland rain forest or more open places, persisting in disturbed areas, at low elevations (also in Andaman and Nicobar Islands, Bangladesh, Peninsula Malaysia, and Peninsular Thailand).

**Flowering and fruiting.** Flowers October–December.

**Uses.** Provides a low-quality cane used in furniture making. The leaves are used for thatching and the fruits are eaten.





## ***Calamus luridus*** Becc.

**Local names.** Not recorded.

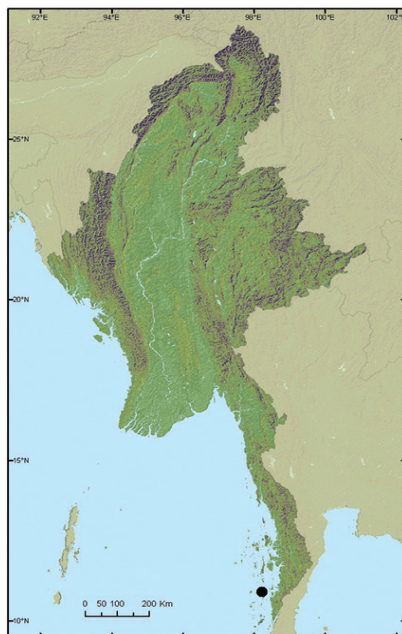
**Description.** **Stems** clustered, climbing, to 20 m long and 2.0 cm diameter. **Leaf sheaths** green with brown hairs, with scattered to densely arranged, green, flattened, often downward-pointing, to 1.0 cm long spines; **ocreas** present; **knees** present; **flagella** present, to 2.3 m long; petioles 3–30 cm long; **rachises** to 1.3 m long with 6–12, lanceolate leaflets per side, these regularly arranged and distantly spaced; **cirri** absent. **Inflorescences** to 2.0 m long, flagellate; bracts tubular; **fruits** ellipsoid, 1.0 cm long and 0.8 cm diameter, yellowish.

**Distribution and habitat.** Taninthayi in lowland or montane rain forest to 1,400 m elevation (also in Peninsula Malaysia, Singapore, and Peninsula Thailand).

**Flowering and fruiting.** Not recorded.

**Uses.** Provides a medium-quality cane used in furniture making.





## ***Calamus melanacanthus*** Mart.

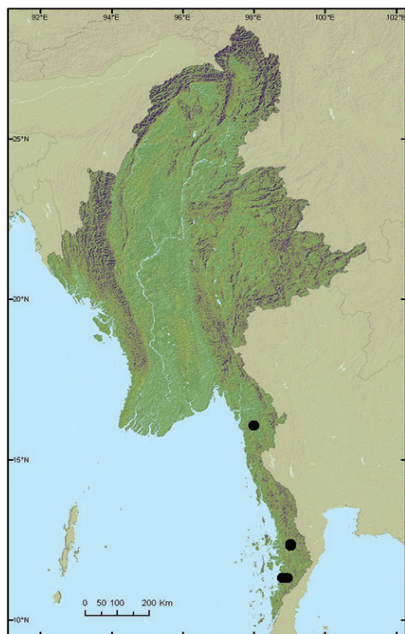
**Local names.** *Kyein dut, medan.*

**Description.** **Stems** clustered, climbing, to 25 m long and 2.5 cm diameter. **Leaf sheaths** green, mottled with dense, dark brown hairs and scattered, light brown hairs, with flattened, upward-pointing, to 1.0 cm long spines; **ocreas** present, very short; **knees** present; **flagella** present, to 4.0 m long; petioles 10–20 cm long; **rachises** to 1.0 m long with 34–38, linear-lanceolate leaflets per side, these regularly arranged; **cirri** absent. **Inflorescences** elongate, flagellate; bracts tubular; **fruits** ovoid-ellipsoid, to 2.5 cm long and 1.5 cm diameter, yellowish.

**Distribution and habitat.** Mon and Taninthayi in lowland rain forest at low elevations (also in Peninsula Thailand).

**Flowering and fruiting.** Not recorded.

**Uses.** Not recorded.



## ***Calamus myrianthus*** Becc.

**Local names.** *Tarazu chaung.*

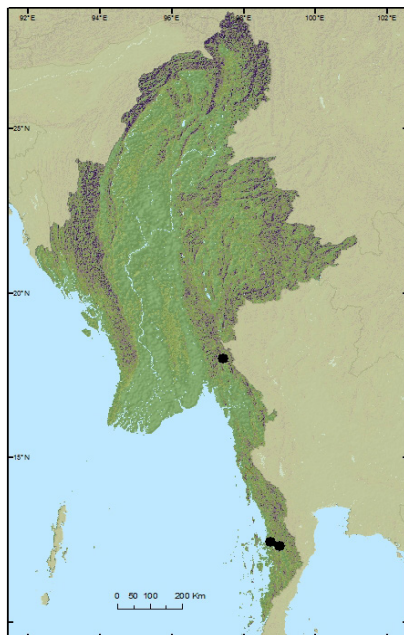
**Description.** **Stems** clustered, climbing, to 25 m long and 0.7–1.8 cm diameter. **Leaf sheaths** green with brown hairs, with densely arranged, brown, flattened, upward-pointing spines to 2 cm (–5 cm at sheath apices) long; **ocreas** present, fibrous and soon disintegrating; **knees** present; **flagella** present, to 1.5 m long; petioles 8.5–30 cm long; **rachises** 0.7–1.7 m long with 5–9, broadly lanceolate leaflets per side, these irregularly and distantly arranged, gray on the lower surfaces, the apical pair joined; **cirri** absent. **Inflorescences** to 3.5 m long, flagellate; bracts open, not sheathing; **fruits** globose, to 0.8 cm diameter, whitish.

**Distribution and habitat.** Kayin and Taninthayi in lowland forest at low elevations (also in Peninsula Thailand).

**Flowering and fruiting.** Flowers January, November; fruits March, May.

**Uses.** Not recorded.





## ***Calamus peregrinus*** Furtado

**Local names.** Not recorded.

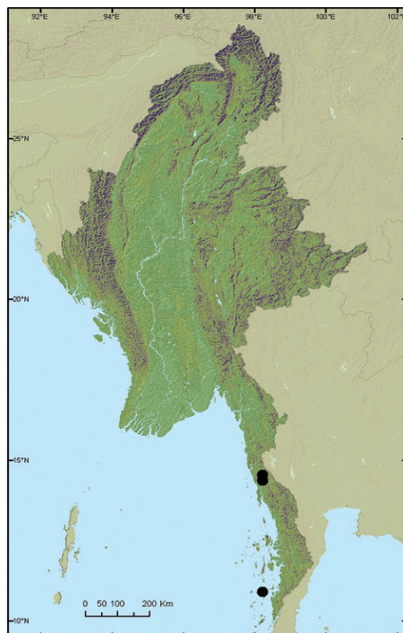
**Description.** **Stems** solitary, climbing, to 40 m long and 9.0 cm diameter. **Leaf sheaths** mottled green and yellow, with scattered or short rows of yellowish, black-tipped, flattened, triangular, to 4.0 cm long spines, these with hairy margins; **ocreas** present; **knees** present, swollen; **flagella** present, to 6.0 m long; petioles 52–150 cm long; **rachises** 0.9–3.5 m long with 45–60, linear-lanceolate leaflets per side, these regularly arranged; **cirri** absent. **Inflorescences** to 6 m long, flagellate, the 2–3 partial inflorescences borne close to the base of the inflorescence; bracts becoming tattered and splitting lengthwise; **fruits** globose to obovoid, to 2.0 cm long and 1.6 cm diameter, reddish-brown.

**Distribution and habitat.** Taninthayi in lowland rain forests at low elevations (also in Peninsula Malaysia and Peninsula Thailand).

**Flowering and fruiting.** Flowers November–December.

**Uses.** Not recorded.





## ***Calamus platyspathus*** Mart.

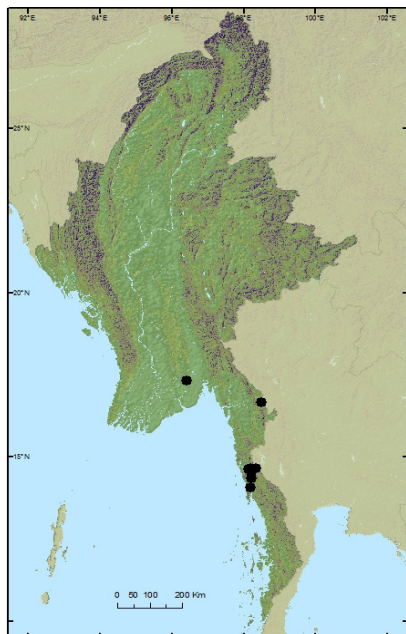
**Local names.** *Kyein boke*.

**Description.** **Stems** clustered or forming thickets, climbing, to 15 m long and 0.6–1.9 cm diameter. **Leaf sheaths** green with brown hairs, with densely arranged, yellowish-brown, slender, horizontally spreading spines to 2 cm long (–5 cm at sheath apices); **ocreas** present, fibrous and soon disintegrating; **knees** present; **flagella** present, poorly developed; petioles 3.7–12 cm long; **rachises** 0.3–0.4 m long with 4–9, broadly lanceolate leaflets per side, these regularly but distantly arranged, gray on the lower surfaces, the apical pair free; **cirri** absent. **Inflorescences** to 1 m long, flagellate; bracts open, not sheathing; **fruits** globose, to 0.8 cm diameter, whitish.

**Distribution and habitat.** Bago, Kayin, Mon, Taninthayi in lowland forest at low elevations (also in Peninsular Thailand).

**Flowering and fruiting.** Flowers January, November; fruits December

**Uses.** Not recorded. The common names means “bad cane” because it is of little use.



## ***Calamus rudentum*** Lour.

**Local names.** *Kyein ni*.

**Description.** **Stems** clustered, climbing, to 75 m long and 7 cm diameter. **Leaf sheaths** split open, not tubular, yellowish-green with brown hairs, with densely arranged spines of two kinds, one large, flat, straight, triangular, yellowish-brown, to 6 cm long, sometimes to 15 cm at sheath apices, ) cm long, the other shorter, both kinds usually borne on short to long, horizontal to oblique, raised ridges; **ocreas** present; **knees** inconspicuous or absent; **flagella** present, to 10 m long; petioles 12–82 cm long, the upper surfaces without spines and deeply grooved; **rachises** to 3 m long with 45–87, lanceolate leaflets per side, these regularly arranged; **cirri** absent. **Inflorescences** to 10 m long, flagellate; bracts tubular; **fruits** globose-ellipsoid, to 2 cm long and 1.5 cm diameter, yellowish.

**Distribution and habitat.** Taninthayi in lowland rain forest and disturbed areas, at 100–500 m elevation (also in Cambodia, Laos, Thailand, and Vietnam) .

**Flowering and fruiting.** Flowers December.

**Uses.** Provides a high quality cane used in furniture making.





## ***Calamus tenuis*** Roxb.

**Local names.** *Htan-ye-li-kyiang, kyien dui, thi kek, ye kyein.*

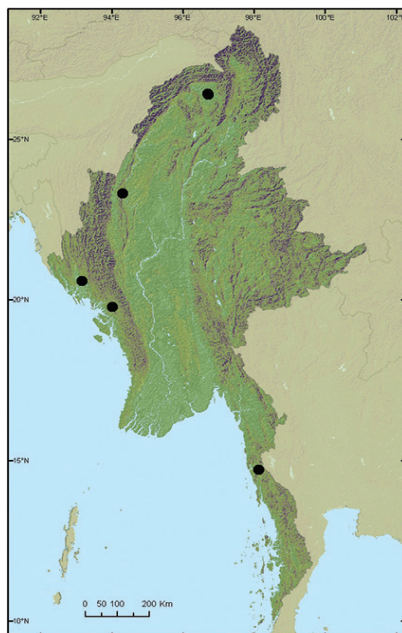
**Description.** **Stems** clustered, often forming thickets, climbing, to 20 m long and 2.5 cm diameter. **Leaf sheaths** green with brownish-white hairs, often with ridges, with scattered or rows of greenish-brown or black, flattened, to 2 cm long spines, with oblique, crescent-shaped bases and hairy margins; **ocreas** present, very small and papery; **knees** present; **flagella** present, to 2.5 m long; petioles 7–30 cm long; **rachises** 1–1.2 m long with 31–42, linear or linear-lanceolate leaflets per side, these regularly and closely arranged; **cirri** absent. **Inflorescences** to 2.5 m long, flagellate; bracts tubular; **fruits** globose to ellipsoid, to 1.6 cm long and 1.2 cm diameter, whitish or yellowish-brown.

**Distribution and habitat.** Kachin, Rakhine, Sagaing, and Taninthayi in lowland rain forest, swampy or flooded areas, or often cultivated or persisting near villages, to 300 m elevation (also in Bangladesh, Bhutan, northern and northeastern India, Indonesia [Java, Sumatra], central Laos, Nepal, Thailand, Vietnam, and probably Cambodia).

**Flowering and fruiting.** Fruits March.

**Uses.** Provides a medium quality cane used in basketry and weaving. The palm heart is eaten in some areas.





## ***Calamus viminalis*** Willd.

**Local names.** *Krane, kyaing-kha, taung kyein.*

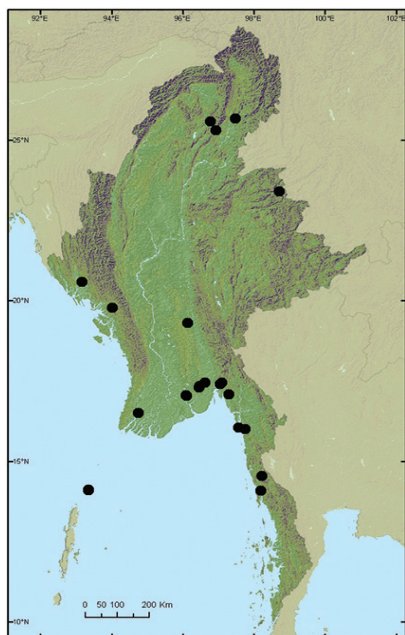
**Description.** **Stems** clustered, climbing or often forming thickets, to 35 m long and 4 cm diameter. **Leaf sheaths** green with dense covering of grayish or brownish hairs, with scattered, greenish or brownish, triangular, flattened, to 4.5 cm long spines; **ocreas** present; **knees** present; **flagella** present, to 5 m long; petioles 2–40 cm long; **rachises** to 1.3 m long with 32–55, lanceolate leaflets per side, these gray-green, distinctly clustered and spreading in different planes, the apical ones usually smaller than the others; **cirri** absent. **Inflorescences** to 3 m long, flagellate, bracts tubular; **fruits** globose, to 1 cm diameter, whitish or yellowish, sometimes borne in pairs.

**Distribution and habitat.** Ayeyarwady, Bago, Kachin, Mon, Shan, Taninthayi, and Yangon in lowland rain forest or deciduous forest, persisting in cleared areas and often present near villages, sometimes planted, to 600 m elevation (also in Andaman Islands, Bangladesh, China [Yunnan], India, Indonesia [Bali, Java], Laos, Peninsular Malaysia, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers October; fruits December, January.

**Uses.** Provides a widely-used cane for basketry and furniture making, and the palm heart and fruits are eaten.

**Notes.** A very common and widespread species.



## ***Daemonorops jenkinsiana*** (Griff.) Mart.

**Local names.** *Kyein-yea taung*.

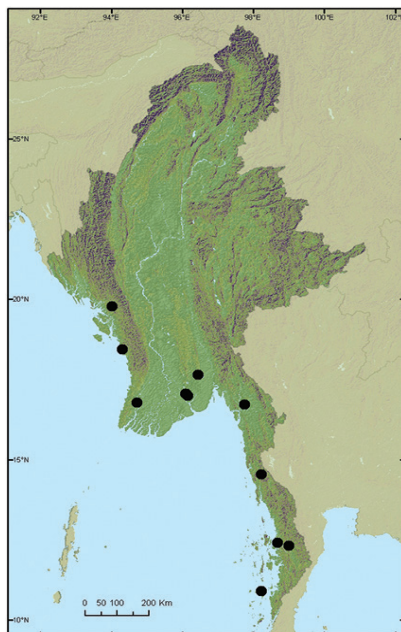
**Description.** **Stems** clustered, climbing or often forming thickets, to 15 m long and 5 cm diameter. **Leaf sheaths** yellowish-green, with gray, brown, or reddish-black hairs, with scattered or rows of black, flattened, triangular, to 4 cm long spines, interspersed amongst smaller, needle-like spines; **ocreas** obscure; **knees** present, conspicuous; **flagella** absent; petioles 30–40 cm long; **rachises** to 2.3 m long with 75–100, linear leaflets per side, these regularly and closely arranged, minutely spiny on the margins and sometimes with long, yellow bristles on upper surfaces on the veins; **cirri** present. **Inflorescences** to 0.8 m long, erect; bracts persistent, swollen, splitting lengthwise to reveal the flowering branches, eventually falling as fruits develop; **fruits** globose to ellipsoid, to 2 cm long and 2 cm diameter, yellowish-brown or orange-brown.

**Distribution and habitat.** Ayeyarwady, Bago, Rakhine, Taninthayi, and Yangon in lowland rain forest, often persisting in disturbed areas, at 20–1,200 m elevation (also in Bangladesh, Bhutan, Cambodia, China, northeastern India, Laos, Nepal, Thailand, and Vietnam).

**Flowering and fruiting.** Flowers March.

**Uses.** Provides a cane used in furniture making.





## ***Daemonorops kurziana*** Hook f. ex Becc.

**Local names.** *Kyein-kalah, kyein paung.*

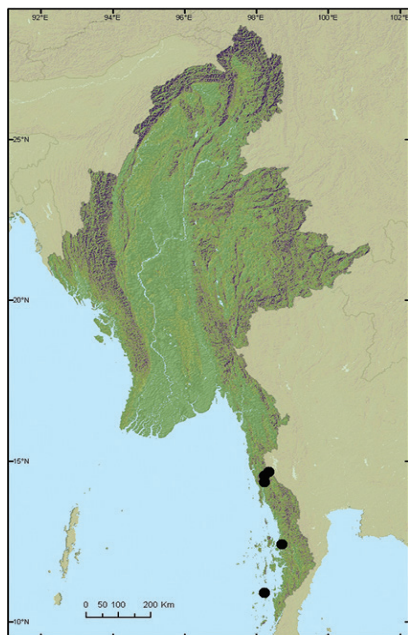
**Description.** **Stems** clustered, climbing, to 25 m long and 6 cm diameter. **Leaf sheaths** yellowish-green without hairs, with partial whorls of black, triangular, to 4 cm long (to 6 cm at sheath apex) spines; **ocreas** obscure; **knees** present; **flagella** absent; petioles 40–112 cm long; **rachises** 2.0–3.2 m long with 25–45, lanceolate leaflets per side, these regularly arranged; **cirri** present. **Inflorescences** to 0.6 m long, erect; bracts persistent, swollen, splitting lengthwise to reveal the flowering branches; **fruits** globose, to 2 cm diameter, brown.

**Distribution and habitat.** Taninthayi in lowland rain forest at low elevations (also in Andaman Islands and probably Thailand).

**Flowering and fruiting.** Flowers and fruits November, December.

**Uses.** Provides a cane used in furniture making.





## ***Korthalsia laciniosa*** (Griff.) Mart.

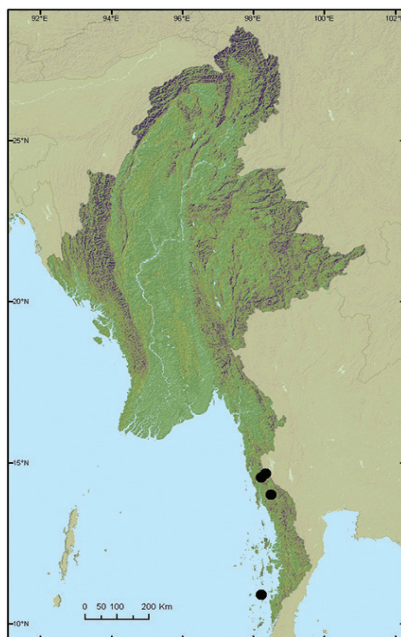
**Local names.** Not recorded.

**Description.** **Stems** clustered (and also branching above ground level), climbing, to 75 m long and 7 cm diameter. **Leaf sheaths** green with brown hairs, with scattered, black, triangular, to 1.9 cm long spines; **ocreas** to 20 cm long, sheathing, becoming loose and net-like in older leaves; **knees** absent; **flagella** absent; petioles 10–65 cm long; **rachises** to 2 m long with 7–11, rhomboidal leaflets per side, these regularly arranged, with jagged apices, silvery-gray on the lower surfaces; **cirri** present. **Inflorescences** to 0.8 m long; **fruits** globose to ellipsoid, to 2 cm long and 1.5 cm diameter, brown.

**Distribution and habitat.** Taninthayi in lowland rain forest or dry forest at 224–1,000 m elevation (also in Andaman and Nicobar Islands, Cambodia, Laos, Vietnam, Thailand, Java, Peninsular Malaysia, the Philippines, Singapore, and Sumatra).

**Flowering and fruiting.** Not recorded.

**Uses.** Provides a cane used in furniture making and basketry.



## ***Myrialepis paradoxa*** (Kurz) J. Dransf.

**Local names.** *Yamatha khyeing*

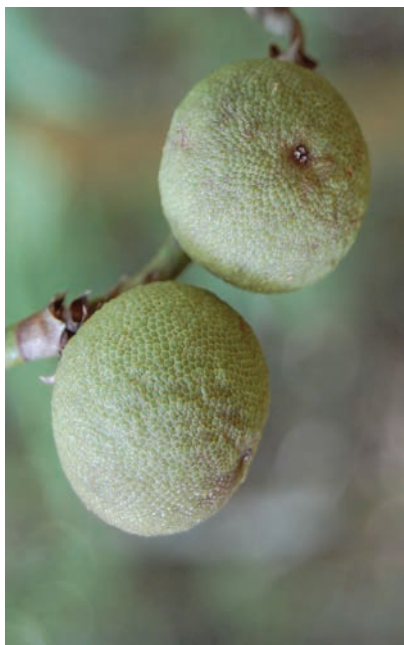
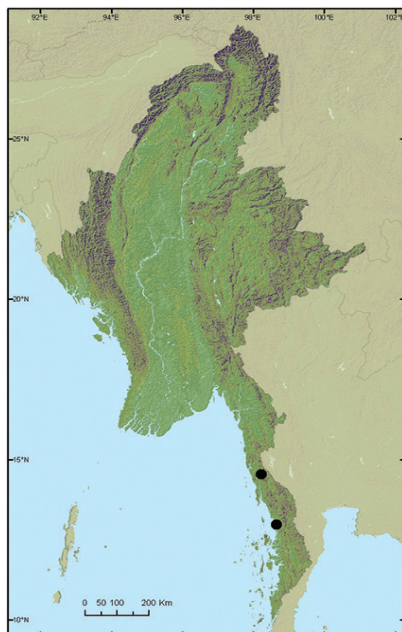
**Description.** **Stems** clustered, climbing, to 25 m long and 3.5 cm diameter. **Leaf sheaths** green with reddish-brown hairs, with short or long, oblique rows of needle-like, yellowish-brown, to 5 cm long spines; **ocreas** absent; **knees** absent; **flagella** absent; petioles to 20 cm long; **rachises** to 2.1 m long with 15-26, lanceolate leaflets per side, these irregularly arranged in clusters and spreading in different planes, sometimes with small spines on the margins; **cirri** present. **Inflorescences** to 0.75 m long; **fruits** depressed globose, to 2.5 cm long and 3 cm diameter, greenish; fruit scales minute.

**Distribution and habitat.** Taninthayi in lowland rain forest, usually at forest margins or in disturbed places at 150–224 m elevation (also in Cambodia, Laos, Thailand, Peninsular Malaysia, Singapore, Sumatra).

**Flowering and fruiting.** Not recorded.

**Uses.** Provides a low quality cane sometimes used in basketry and furniture making.





## ***Plectocomia assamica*** Griff.

**Local names.** *Sin kyein*.

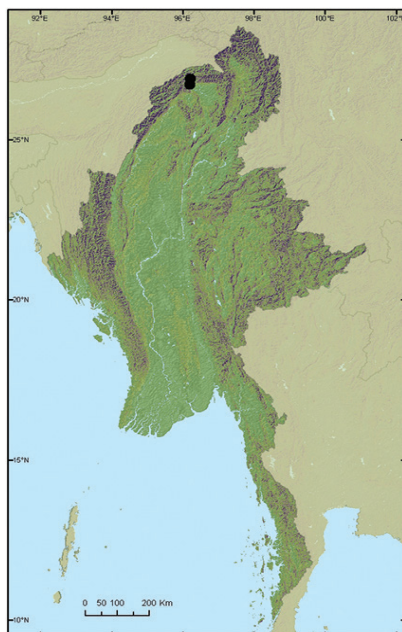
**Description.** **Stems** solitary, climbing, to 15 m and 15 cm diameter. **Leaf sheaths** grayish-green with dense reddish-brown hairs, with scattered or short rows of yellowish-brown, stout, to 6 cm long spines; **ocreas** absent; **knees** absent; **flagella** absent; petioles to 20 cm long; **rachises** to 5 m long with 18–44, lanceolate leaflets per side, these regularly arranged and spreading in the same plane, silvery-gray on the lower surfaces, with prominent sub-marginal veins and non-spiny margins; **cirri** present. **Inflorescences** to 1 m long; flowering branch bracts to 5 cm long, felty on outer surfaces; **fruits** globose, to 2.5 cm diameter; fruit scales reddish-brown with woolly, lacerate, erect apices.

**Distribution and habitat.** Kachin and Sagaing in lowland rain forest on steep slopes at 220–850 m elevation (also in northeastern India).

**Flowering and fruiting.** Fruits January.

**Uses.** The stems are sometimes used in furniture making.





## ***Plectocomia elongata*** Mart. & Blume

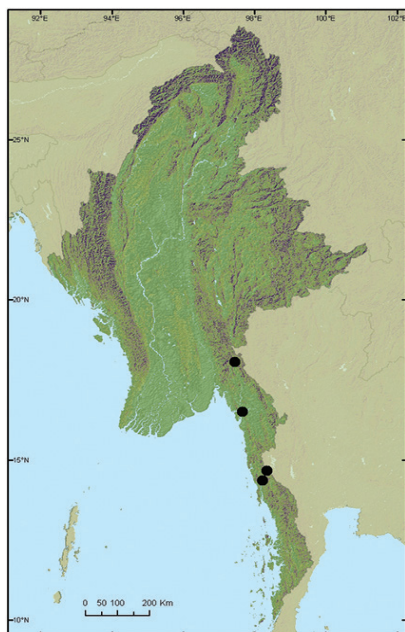
**Local names.** *Gigg, gahit, kyein-ban.*

**Description.** **Stems** solitary or with basal shoots, climbing, to 50 m long and 15 cm diameter. **Leaf sheaths** green with gray hairs, with short rows of brown, needle-like, to 4 cm long spines borne in rows below the petioles and along sheath margins; **ocreas** absent; **knees** absent; **flagella** absent; petioles 20–50 cm long; **rachises** to 6 m long with 20–70, lanceolate leaflets per side, these clustered and spreading in different planes, grayish on the lower surfaces, with prominent sub-marginal veins and non-spiny margins; **cirri** present. **Inflorescences** to 1 m long; flowering branch bracts to 7 cm long, with few felt-like hairs on outer surfaces; **fruits** globose, to 3 cm diameter; fruit scales reddish-brown with woolly, lacerate, erect apices.

**Distribution and habitat.** Kayin, Mon, and Taninthayi in lowland or montane rain forest or seasonal forest, often in disturbed places at 300–1,488 m elevation (also in Borneo, Java, Peninsula Malaysia, the Philippines, Singapore, Sumatra, Thailand, and Vietnam).

**Flowering and fruiting.** Not recorded.

**Uses.** The canes are rarely used.



***Plectocomiopsis geminiflora*** (Griff.)  
Becc.

**Local names.** *Kyein ni*.

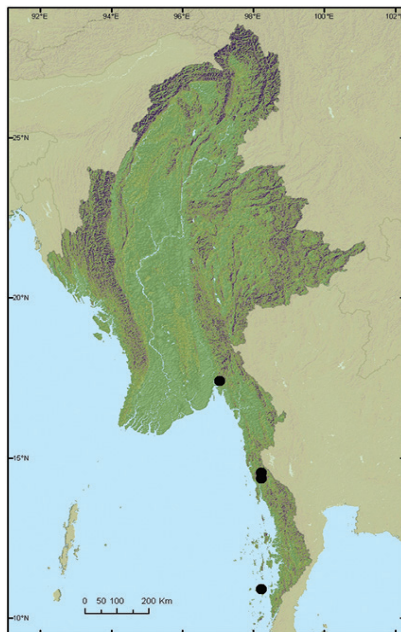
**Description.** **Stems** clustered, climbing and forming thickets, to 30 m long and 2.5 cm diameter. **Leaf sheaths** green or grayish, with scattered, yellow, needle-like, to 2 cm long (longer at sheath apices) spines; **ocreas** present, short, becoming tattered; **knees** absent; **flagella** absent; petioles short or absent (longer on younger plants); **rachises** 1.3–1.9 m long with 12–21, lanceolate leaflets per side, these regularly arranged, pendulous, with conspicuous, yellow bristles on the upper surfaces; **cirri** present. **Inflorescences** to 0.4 m long; **fruits** depressed-globose, to 3 cm long and 3.5 cm diameter, yellowish-green.

**Distribution and habitat.** Taninthayi and Mon in lowland rain forest, usually in disturbed places or forest margins, at 20–158 m elevation (also in Cambodia, Laos, Thailand, Borneo, Peninsula Malaysai, Sumatra, and Vietnam).

**Flowering and fruiting.** Fruits December.

**Uses.** Produces a poor quality cane that is seldom used.





## 2.5 Synonyms

Synonyms are listed under each species name (**bold face**). These are superfluous names that have sometimes been applied to the species under which they are listed. This list includes all synonyms for each species even if they were described from other countries.

### ***Calamus acanthospathus* Griff.**

*Calamus feanus* Becc., *Calamus feanus* var. *medogensis* S. J. Pei & S. Y. Chen, *Calamus montanus* T. Anderson, *Calamus yunnanensis* Govaerts, *Calamus yunnanensis* var. *densiflorus* S. J. Pei & S. Y. Chen, *Calamus yunnanensis* var. *intermedius* S. J. Pei & S. Y. Chen, *Palmijuncus acanthospathus* (Griff.) Kuntze, *Palmijuncus montanus* (T. Anderson) Kuntze

### ***Calamus arborescens* Griff.**

*Calamus hostilis* Wall., *Palmijuncus arborescens* (Griff.) Kuntze

### ***Calamus concinnus* Mart.**

*Palmijuncus concinnus* (Mart.) Kuntze, *Plectocomiopsis ferox* Ridl.

### ***Calamus erectus* Roxb.**

*Calamus collinus* Griff., *Calamus erectus* var. *birmanicus* Becc., *Calamus erectus* var. *collinus* (Griff.) Becc., *Calamus erectus* var. *macrocarpus* (Griff.) Becc., *Calamus erectus* var. *schizospathus* (Griff.) Becc., *Calamus macrocarpus* Griff., *Calamus schizospathus* Griff., *Palmijuncus collinus* (Griff.) Kuntze, *Palmijuncus erectus* (Roxb.) Kuntze, *Palmijuncus macrocarpus* (Griff.) Kuntze, *Palmijuncus schizospathus* (Griff.) Kuntze

### ***Calamus flagellum* Griff.**

*Calamus flagellum* var. *karinensis* Becc., *Calamus jenkinsianus*



Griff., *Calamus karinensis* (Becc.) S. J. Pei & S. Y. Chen, *Calamus polygamus* Roxb., *Palmijuncus flagellum* (Griff.) Kuntze, *Palmijuncus jenkinsianus* (Griff.) Kuntze, *Palmijuncus polygamus* (Roxb.) Kuntze

***Calamus floribundus* Griff.**

*Calamus mishmeensis* Griff., *Palmijuncus floribundus* (Griff.) Kuntze, *Palmijuncus mishmeensis* (Griff.) Kuntze

***Calamus gracilis* Roxb.**

*Palmijuncus gracilis* (Roxb.) Kuntze

***Calamus guruba* Buch.-Ham.**

*Calamus guruba* var. *ellipsoideus* S. Y. Chen & K. L. Wang, *Calamus mastersianus* Griff., *Calamus multirameus* Ridl., *Calamus nitidus* Mart., *Daemonorops guruba* (Buch.-Ham.) Mart., *Daemonorops guruba* var. *hamiltonianus* Mart., *Daemonorops guruba* var. *mastersianus* (Griff.) Mart., *Palmijuncus guruba* (Buch.-Ham.) Kuntze, *Palmijuncus nitidus* (Mart.) Kuntze

***Calamus helferianus* Kurz**

*Calamus aggregatus* Burret

***Calamus henryanus* Becc.**

*Calamus balansaeanus* Becc., *Calamus balansaeanus* var. *castanolepis* (C. F. Wei) S. J. Pei & S. Y. Chen, *Calamus henryanus* var. *castanolepis* C. F. Wei

***Calamus inermis* T. Anderson**

*Calamus doriaei* Becc., *Calamus giganteus* var. *robustus* S. J. Pei & S. Y. Chen, *Calamus inermis* var. *menghaiensis* S. Y. Chen, S. J. Pei & K. L. Wang, *Calamus khasianus* Becc., *Calamus multinervis* var. *menglaensis* S. Y. Chen, S. J. Pei

& K. L. Wang, *Calamus nambariensis* Becc., *Calamus nambariensis* var. *alpinus* S. J. Pei & S. Y. Chen, *Calamus nambariensis* var. *furfuraceus* S. J. Pei & S. Y. Chen, *Calamus nambariensis* var. *menglongensis* S. J. Pei & S. Y. Chen, *Calamus nambariensis* var. *xishuangbannaensis* S. J. Pei & S. Y. Chen, *Calamus nambariensis* var. *yingjiangensis* S. J. Pei & S. Y. Chen, *Calamus obovoideus* S. J. Pei & S. Y. Chen, *Calamus palustris* var. *longistachys* S. J. Pei & S. Y. Chen, *Calamus platyacanthoides* Merr., *Calamus platyacanthus* Warb., *Calamus platyacanthus* var. *longicarpus* S. Y. Chen & K. L. Wang, *Calamus platyacanthus* var. *mediostachys* S. J. Pei & S. Y. Chen, *Calamus polydesmus* Becc., *Calamus wailong* S. J. Pei & S. Y. Chen, *Palmijuncus inermis* (T. Anderson) Kuntze

### ***Calamus javensis* Blume**

*Calamus amplexans* Becc., *Calamus borneensis* Miq., *Calamus equestris* Blume, *Calamus filiformis* Becc., *Calamus javensis* var. *acicularis* Becc., *Calamus javensis* var. *intermedius* Becc., *Calamus javensis* var. *peninsularis* Becc., *Calamus javensis* var. *polyphyllus* Becc., *Calamus javensis* var. *sublaevis* Becc., *Calamus javensis* var. *tenuissimus* Becc., *Calamus javensis* var. *tetrastichus* Becc., *Calamus javensis* var. *peninsularis* subvar. *pinangianus* Becc., *Calamus javensis* var. *peninsularis* subvar. *purpurascens* Becc., *Calamus javensis* var. *tetrastichus* subvar. *mollispinus* Becc., *Calamus javensis* subvar. *exilis* Becc., *Calamus javensis* subvar. *intermedius* Becc., *Calamus javensis* subvar. *penangianus* Becc., *Calamus javensis* subvar. *polyphyllus* Becc., *Calamus javensis* subvar. *purpurascens* Becc., *Calamus kemamanensis* Furtado, *Calamus tetrastichus* Blume, *Palmijuncus amplexans* (Becc.) Kuntze, *Palmijuncus borneensis* (Miq.) Kuntze, *Palmijuncus javensis* (Blume)

Kuntze, *Palmijuncus penicellatus* (Roxb.) Kuntze, *Palmijuncus tetrastichus* (Blume) Kuntze

***Calamus kingianus* Becc.**

*Calamus spicatus* Henderson

***Calamus latifolius* Roxb.**

*Calamus dumetorum* Ridl., *Calamus extensus* Roxb., *Calamus gregisectus* Burret, *Calamus humilis* Roxb., *Calamus kerrianus* Becc., *Calamus latifolius* Kurz, *Calamus latifolius* var. *marmoratus* Becc., *Calamus loiensis* Hodel, *Calamus macracanthus* T. Anderson, *Calamus palustris* Griff., *Calamus palustris* var. *amplissimus* Becc., *Calamus palustris* var. *cochinchinensis* Becc., *Calamus palustris* var. *malaccensis* Becc., *Calamus quinquenervius* Roxb., *Palmijuncus extensus* (Roxb.) Kuntze, *Palmijuncus humilis* (Roxb.) Kuntze, *Palmijuncus latifolius* (Roxb.) Kuntze, *Palmijuncus macracanthus* (T. Anderson) Kuntze, *Palmijuncus palustris* (Griff.) Kuntze, *Palmijuncus quinquenervius* (Roxb.) Kuntze

***Calamus leptospadix* Griff.**

*Palmijuncus leptospadix* (Griff.) Kuntze

***Calamus longisetus* Griff.**

*Calamus tigrinus* Kurz, *Palmijuncus longisetus* (Griff.) Kuntze, *Palmijuncus trigrinus* (Kurz) Kuntze

***Calamus luridus* Becc.**

*Calamus belumutensis* Furtado, *Calamus distans* Ridl., *Calamus laxiflorus* Becc.

***Calamus melanacanthus* Mart.**

*Palmijuncus melanacanthus* (Mart.) Kuntze

***Calamus myrianthus* Becc.**

*Calamus leucotes* Becc.

***Calamus platyspathus* Mart.**

*Calamus hypoleucus* (Kurz) Kurz, *Calamus myrianthus* Becc., *Daemonorops hypoleuca* Kurz, *Daemonorops platyspatha* (Mart.) Mart., *Palmijuncus hypoleucus* (Kurz) Kuntze, *Palmijuncus platyspathus* (Mart.) Kuntze

***Calamus rudentum* Lour.**

*Palmijuncus rudentum* (Lour.) Kuntze, *Rotang rudentum* (Lour.) Baill.

***Calamus tenuis* Roxb.**

*Calamus amarus* Lour., *Calamus royleanus* Griff., *Calamus heliotropium* Buch.-Ham., *Calamus horrens* Blume, *Calamus stoloniferus* Teijsm. & Binn., *Palmijuncus amarus* (Lour.) Kuntze, *Palmijuncus heliotropium* (Buch.-Ham.) Kuntze, *Palmijuncus horrens* (Blume) Kuntze, *Palmijuncus royleanus* (Griff.) Kuntze, *Palmijuncus tenuis* (Roxb.) Kuntze, *Rotang royleanus* (Griff.) Baill.

***Calamus viminalis* Willd.**

*Calamus extensus* Mart., *Calamus fasciculatus* Roxb., *Calamus litoralis* Blume, *Calamus pseudorotang* Mart., *Calamus viminalis* var. *fasciculatus* (Roxb.) Becc., *Calamus viminalis* var. *fasciculatus* subvar. *andamanicus* Becc., *Calamus viminalis* var. *fasciculatus* subvar. *bengalensis* Becc., *Calamus viminalis* var. *fasciculatus* subvar. *cochinchinensis* Becc., *Calamus viminalis* var. *fasciculatus* subvar. *pinangianus* Becc., *Palmijuncus fasciculatus* (Roxb.) Kuntze, *Palmijuncus litoralis* (Blume) Kuntze, *Palmijuncus pseudorotang* (Mart.) Kuntze, *Palmijuncus viminalis* (Willd.) Kuntze, *Rotang viminalis*

(Willd.) Baill.

***Daemonorops jenkinsiana* (Griff.) Mart.**

*Calamus jenkinsianus* Griff., *Calamus margaritae* Hance, *Calamus nutantiflorus* Griff., *Daemonorops jenkinsiana* var. *tenasserimica* Becc., *Daemonorops margaritae* (Hance) Becc., *Daemonorops margaritae* var. *palawanica* Becc., *Daemonorops nutantiflora* (Griff.) Mart., *Daemonorops pierreana* Becc., *Daemonorops schmidtiana* Becc., *Palmijuncus jenkinsianus* (Griff.) Kuntze, *Palmijuncus margaritae* (Hance) Kuntze, *Palmijuncus nutantiflorus* (Griff.) Kuntze

***Korthalsia laciniosa* (Griff.) Mart.**

*Calamosagus harinifolius* Griff., *Calamosagus laciniosus* Griff., *Calamosagus wallichiiifolius* Griff., *Korthalsia andamanensis* Becc., *Korthalsia grandis* Ridl., *Korthalsia scaphigera* Kurz, *Korthalsia teysmannii* Miq., *Korthalsia wallichiiifolia* (Griff.) H. Wendl.

***Myrialepis paradoxa* (Kurz) J. Dransf.**

*Bejaudia cambodiensis* Gagnep., *Calamus paradoxus* Kurz, *Myrialepis floribunda* (Becc.) Gagnep., *Myrialepis scortechinii* Becc., *Palmijuncus paradoxus* (Kurz) Kuntze, *Plectocomiopsis annulata* Ridl., *Plectocomiopsis floribunda* Becc., *Plectocomiopsis paradoxa* (Kurz) Becc., *Plectocomiopsis scortechinii* (Becc.) Ridl.

***Plectocomia assamica* Griff.**

*Plectocomia bractealis* Becc., *Plectocomia khasyana* Griff.

***Plectocomia elongata* Mart. & Blume**

*Calamus maximus* Reinw., *Plectocomia crinita* Gentil, *Plectocomia elongata* var. *bangkana* Becc., *Plectocomia griffithii* Becc., *Plectocomia hystrix* Linden, *Plectocomia ichythospinus*



auct., *Plectocomia macrostachya* Kurz, *Plectocomia sumatrana* Miq., *Rotang maximus* Baill.

***Plectocomiopsis geminiflora* (Griff.) Becc.**

*Calamus geminiflorus* Griff., *Calamus turbinatus* Ridl.,  
*Plectocomia geminiflora* (Griff.) H. Wendl., *Plectocomiopsis*  
*geminiflora* var. *billitonensis* Becc., *Plectocomiopsis geminiflora*  
var. *borneensis* Becc.

## **CHAPTER III**

### **Ecological Factors Relevant to the Conservation and Management of Myanmar Rattans**

*Charles Peters*

Every rattan species exhibits a specific set of ecological characteristics that facilitates its growth, reproduction, and continued survival in the forest. Different species do different things. Some species grow fast, form high-density populations, are widely distributed, and maintain a continual level of seedlings establishment from year to year. Other species occur as slow growing scattered individuals on a restricted range of sites. The rattans in the first group will have a greater ability to withstand the rigors of commercial harvesting and will also be considerably easier to manage. Uncontrolled, intensive harvesting of the rattans in the second group can rapidly lead to resource depletion.

It is important to understand the ecological mechanisms that different rattan species have evolved to insure survival from seedling in the understory to fruiting adult. Building on the taxonomic information presented in Chapter II, therefore, a selective overview of rattan ecology is offered here. What are the different life forms and reproductive strategies exhibited by rattan and what effect do these parameters have on the management potential of a species? How abundant are different rattan species? Do these populations appear to be regenerating themselves and are there different patterns to the periodicity of seedling recruitment? How fast do the local rattan species grow? What are the main factors that influence the annual growth rate of wild rattan?

Very little information is available about the regeneration and growth of wild rattan populations in Myanmar. This chapter summarizes what we have learned about the ecology of local rattans, and highlights the importance of this type of information in designing systems for the conservation and sustainable management of this important forest resource.

### 3.1 Life Form

Rattan stems exhibit a variety of different forms. Many species creep along the forest floor until they encounter a host tree to climb, while others are non-climbing (e.g. *Calamus arborescens*, *C. concinnus*, and *C. erectus*). Some species produce a solitary stem (e.g. *C. acanthospathus*, *C. helferianus*, and *Plectocomia assamica*), others form clusters containing numerous stems (e.g. *C. floribundus*, *C. hukaungensis*, *Daemonorops kurziana*, and *Myrialepis paradoxa*), and several form dense, impenetrable thickets (e.g. *C. flagellum*, *C. viminalis*, and *D. jenkinsiana*). A few species have individuals with both solitary and clustered stems (e.g. *C. inermis* and *C. latifolius*). Of the 32 species of rattan described in Chapter II, 29 species are climbers, 3 species are non-climbers, 27 species have clustered stems, and 7 species have a solitary stem. Three of the solitary species, i.e. *C. helferianus*, *C. inermis*, and *C. latifolius*, produce high-quality rattan cane and are heavily exploited.

The inherent problem with the harvest of solitary rattans is that these species have only a single apical meristem or growing point at the tip of the stem. Cutting the stem to harvest the cane kills the plant. Rattan species with clustered stems, on the other hand, can produce new shoots after harvesting from accessory vegetative buds located at the base of the stem (Dransfield, 1978). Rattan species with clustered stems can be harvested repeatedly; those with solitary stems can be harvested only once.

### 3.2 Reproductive Dynamics

The great majority of the rattans in Myanmar, i.e. all species of *Calamus* and *Daemonorops*, produce flowers and fruits every year based on growing conditions and the health of the plant. In species of *Korthalsia*, *Myrialepis*, *Plectocomia*, and *Plectocomiopsis*, however, the production of flowers is followed by the death of the stem, i.e. these species are semelparous (Henderson, 2002). In species with solitary stems, e.g. some individuals of *Plectocomia elongata* and *P. assamica*, the entire plant dies after flowering. In clustering species, the individual continues to produce new basal shoots and only the flowering stem dies. With the exception of *Korthalsia*, which produces bisexual flowers, all the rattans in Myanmar are dioecious, i.e. with separate male and female plants (Henderson,

2009).

Rattans rely on a variety of different insect vectors to pollinate their flowers. Although few studies have been conducted and the exact pollinators of most species are not known, wasps, flies, and small beetles appear to be common pollinators for *Calamus* and *Daemonorops*, and bees and weevils have been reported as pollinators for *Plectocomia* (Dransfield, 1979).

A final parameter of importance, of which we know very little, concerns the age of first reproduction. After germination, how long does it take a wild rattan stem to grow up into the canopy and garner sufficient resources to flower and fruit? The length of this period depends on many factors, including climate, light levels, soil moisture, and species. It is estimated to take less than a decade for a small cane rattan growing under adequate light conditions to flower, while larger, clustering species may take several decades to reproduce (Henderson, 2002; Siebert, 2012).

The management importance of flowering and fruiting is straightforward. If no seeds are produced, there will be no new rattan seedlings. Without new recruits, there will be no smaller canes to replace the larger adult canes that are harvested. This is how rattan stocks get depleted. Delaying the harvest of solitary canes until after reproduction can greatly increase the input of rattan seeds and potentially enhance levels of seedling establishment in the forest. Maximizing rattan growth through management would not only increase yields, it would also reduce the pre-reproductive phase of young canes and enhance seed production.

### **3.3 Population Density**

A clear indication of the reproductive success of a species is the density and abundance of the populations it forms. Yet, in spite of the importance of this parameter, detailed surveys of wild rattan populations are virtually non-existent in Myanmar. As part of our research over the past ten years, we have conducted quantitative rattan inventories in several forest areas of northern Myanmar. Some of the forests were located inside a protected area (Hukaung Valley), others were part of the buffer zone of a protected area (Sagaing Region), and a few were on lands outside of

the jurisdiction of the Forest Department (Naga Self-Administered Zone); varying degrees of rattan exploitation were occurring in each of the forests. Not all of the species included in this book were sampled in our transects, and the inventories represent only a very small portion of the extensive and varied rattan habitats that are found in Myanmar. That said, our inventory data illustrate several important characteristics about the density of wild rattan populations, and hopefully they will stimulate additional surveys in other parts of the country.

Density data for eleven species of wild rattan are presented in Table 3.1. Perhaps the most notable feature of the table is the large variability in the density of different rattan species. The populations of some species may contain less than a hundred canes/hectare, while other species may form dense aggregations of almost thirty thousand canes/hectare. Even within a single species, the number of individuals recorded on one site or in one transect can be drastically different from that recorded in another. The interaction of several factors, including site, growth form, and harvest intensity, seems to be largely responsible for this heterogeneity.

The highest densities are exhibited by *C. flagellum* and *C. guruba*, both clustering rattans that are known to form dense thickets. Other clustering rattans like *C. hukaungensis*, *C. henryanus*, and *C. gracilis*, in contrast, display maximum densities that are a fraction of this. While some of this variability is undoubtedly due to site conditions and differential reproductive success, the low mean density calculated for *C. gracilis*, a desirable commercial species, is clearly the result of harvesting pressure. The only species with smaller population sizes, *C. erectus*, is a clustering, non-climbing rattan of limited commercial importance. The fact that only a few individuals were recorded in both of the transects containing *C. erectus* suggests that ecological factors are largely responsible for the sparse populations of this species.

Other species that occur at comparably low densities, e.g. *C. latifolius* and *P. assamica*, offer additional examples of the effect of harvesting, growth form, and site conditions on wild rattan populations. *Calamus latifolius* is widely distributed throughout Myanmar, produces both clustered and solitary stems, and appears able to adapt to a variety of different habitats; it was



Table 3.1. Mean and maximum density per hectare of selected rattan species in Myanmar. N represents the number of 2,000 m<sup>2</sup> belt transects that were inventoried to obtain the density estimate.

Species	Mean Density (stems/ha)	Max. Density (stems/ha)	N	Location
<i>Calamus acanthospathus</i>	975	975	1	Hukaung Valley
<i>Calamus erectus</i>	62	100	2	Hukaung Valley
<i>Calamus flagellum</i>	5,685	29,125	8	Hukaung Valley
<i>Calamus floribundus</i>	3,995	4,025	2	Hukaung Valley; Naga Self-Administered Zone
<i>Calamus gracilis</i>	82	1,750	58	Hukaung Valley; Sagaing Region
<i>Calamus guruba</i>	3,580	22,310	4	Sagaing Region
<i>Calamus henryanus</i>	1,035	1,825	3	Hukaung Valley
<i>Calamus hukaungensis</i>	1,255	1,255	1	Hukaung Valley
<i>Calamus inermis</i>	2,135	6,800	10	Hukaung Valley; Naga Self-Administered Zone
<i>Calamus latifolius</i>	242	345	103	Hukaung Valley; Kachin State; Sagaing Region
<i>Plectocomia assamica</i>	390	455	2	Hukaung Valley

the most commonly encountered rattan species in our transects. The species, however, also produces a good quality cane which is heavily exploited. We inventoried over one hundred transects that contained *C. latifolius* in different regions of Myanmar, but none of the samples had more than 200-300 individuals/hectare of this species. *Plectocomia assamica*, on the other hand, was recorded in similarly low densities, yet this large-cane rattan is rarely harvested. In this case, population size seems to be constrained more by the growth form and life-history characteristics of the species, i.e. *P. assamica* is dioecious, semelparous, has a relatively restricted distribution (see p. 90), and produces a solitary stem.

It is important to note that the density estimates shown in Table 3.1 represent the *total* density of all rattan plants, i.e. seedlings, saplings, pre-commercial individuals, and harvestable canes. As a

result, these estimates do not represent of the number of harvestable rattan canes that is growing in the forest. In most habitats, wild rattan populations are composed predominately of seedlings, saplings, and canes of pre-commercial size, i.e.  $\leq 4.0$  meters tall. This pattern is shown below in Table 3.2 which contains transect data for seven selected species grouped into seedlings, pre-commercial canes, and commercial (harvestable) canes. As can be appreciated, the seedling class contains the majority of the individuals recorded for each species, and there are consistently more pre-commercial canes than commercial ones. Each species seems to be regenerating itself in the forest, but there is much variability in the number of adult canes recorded.

Table 3.2. Density per hectare of seedlings, pre-commercial canes ( $\leq 4.0$  meters tall) and commercial canes ( $\geq 4.0$  meters tall) of seven rattan species recorded in inventory transects in northern Myanmar. Data for *C. latifolius* and *C. gracilis* from Sagaing Region, *C. floribundus* data from Naga Self-Administered Zone, and data for *C. inermis*, *C. flagellum*, *C. henryanus*, and *C. hukaungensis* from Hukaung Valley.

Species	Seedlings	Pre-commercial Canes ( $\leq 4.0$ meters tall)	Commercial Canes ( $\geq 4.0$ meters tall)
<i>C. inermis</i>	850	300	10
<i>C. gracilis</i>	532	94	30
<i>C. latifolius</i>	1064	275	87
<i>C. floribundus</i>	1162	228	124
<i>C. hukaungensis</i>	4500	1600	175
<i>C. henryanus</i>	975	675	263
<i>C. flagellum</i>	930	820	425

This variability is largely the result of harvesting pressure. For example, *C. inermis*, *C. gracilis*, and *C. latifolius*, are all commercial rattans that are intensively exploited, and these species, not surprisingly, also exhibit the lowest densities of harvestable canes. The fact that each of the populations contains a considerable number of seedlings and individuals of pre-commercial size suggests that the number of larger adult canes will ultimately replenish itself over time. Relaxing the harvesting pressure on these commercial

species for a few years, and allowing the adult plants to reproduce and establish a new crop of seedlings, would increase the overall size of their populations and greatly expand the available stock of harvestable rattan cane.

When collectors say that the rattan stocks within a particular area have been depleted, what they really mean is that there is no longer a good supply of rattan canes longer than 4.0 meters. There may, however, still be an abundance of seedlings and pre-commercial canes growing in the forest. These canes are not immediately harvestable, but they represented the regenerative potential, or *future harvest*, of the local rattan resource. With time, the seedlings will turn into pre-commercial canes, and the pre-commercial canes will eventually grow to commercial size.

This concept is shown graphically in Figure 3.1 using population data for *C. latifolius* collected in a systematic inventory of a 100 hectare tract of forest in the Hukaung Valley. Density contours were created by extrapolating the rattan counts from 500 sample plots (25 plots/transect x 20 parallel transects) using the Spatial Analyst extension in ArcGIS. The density of harvestable *C. latifolius* canes (upper map) is quite low and scattered in the forest. There are few clumps containing densities of 5 to 10 canes/hectare, but extensive areas of the forest contain no merchantable cane at all. From a commercial perspective, rattan stocks are relatively depleted. If we look at the entire rattan population (lower map), we are presented with a different story. There are *C. latifolius* individuals growing throughout most of the forest, and, in some habitats, at densities of up to 150 canes/hectare. It's just that most of these individuals are not large enough to harvest—yet.

The current situation with many of the commercial rattan species in Myanmar appears to reflect this pattern. Local stocks may be greatly reduced through over-harvesting, but, in a large number of cases, there is still an abundance of seedlings and pre-commercial canes that, if left alone, will produce the rattan resources needed for future harvests. Reliable information on the population density of wild rattan species, especially for commercial species and from quantitative inventories that include seedlings and pre-commercial size classes, are desperately needed to provide the foundation for developing more sustainable systems for exploiting local rattan resources.

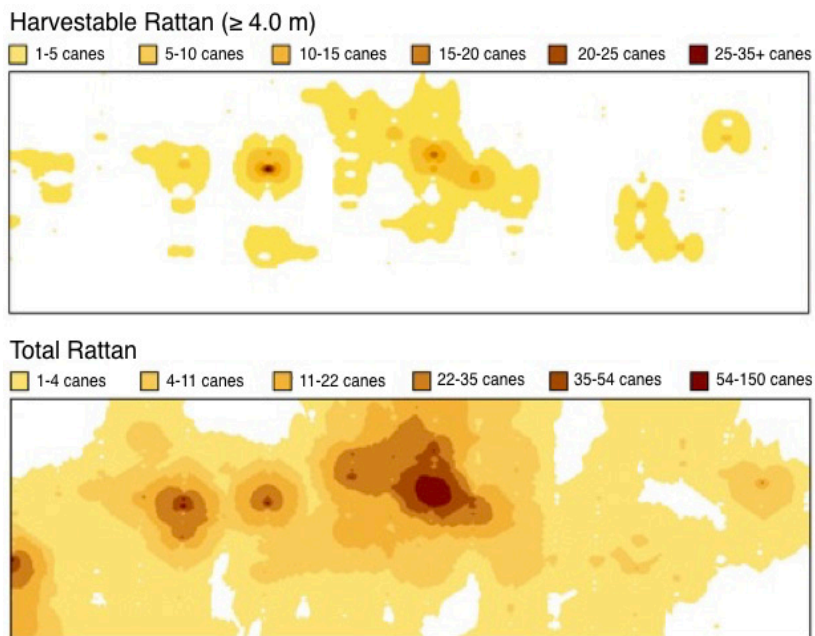


Figure 3.1. Spatial distribution of *Calamus latifolius* individuals throughout a 100 hectare tract of forest in the Hukaung Valley, Kachin State. Data collected from twenty, 500 m long transects; density contours created using ArcGIS.

### 3.4 Size-Class Distribution

An even more detailed assessment of the structure and dynamics of a rattan population can be obtained by grouping the density data from a forest inventory into size classes. Plotting the results in a histogram, which produces a characterization, or “snapshot,” of the population in one moment of time, can provide a wealth of information about the ecological behavior of a rattan species over time. Such an analysis, for example, can reveal whether a species is regenerating or not, whether seedling establishment occurs periodically or continually, and the degree to which a rattan species depends on disturbance or canopy openings for seedling establishment. Long used by foresters to investigate the regeneration characteristics of timber trees, size-class histograms have also recently become an important analytical tool in the study of rattan (e.g. Siebert, 2004; Binh, 2009).

In spite of the variety of different reproductive and growth strategies used by rattans, their populations reflect only a limited number of different size-class distributions. Three of the most common distributions exhibited by rattan populations are shown in Figure 3.2. The data were collected from wild rattan populations in Sagaing Region (*C. inermis* and *C. floribundus*) and Kachin State (*P. assamica*); histograms depict the proportion of the number of individuals found in each size class. After the initial seedling class that contains small, stemless individuals, the size classes reflect stem height in meters, e.g. class 2 contains rattans from 1.1 to 2.0 meters tall.

The type I size-class distribution, illustrated by *Calamus inermis* in Figure 3.2, displays a greater number of small individuals than large, commercial canes, and there is a consistent reduction in the number of stems from one class to the next. This type of population

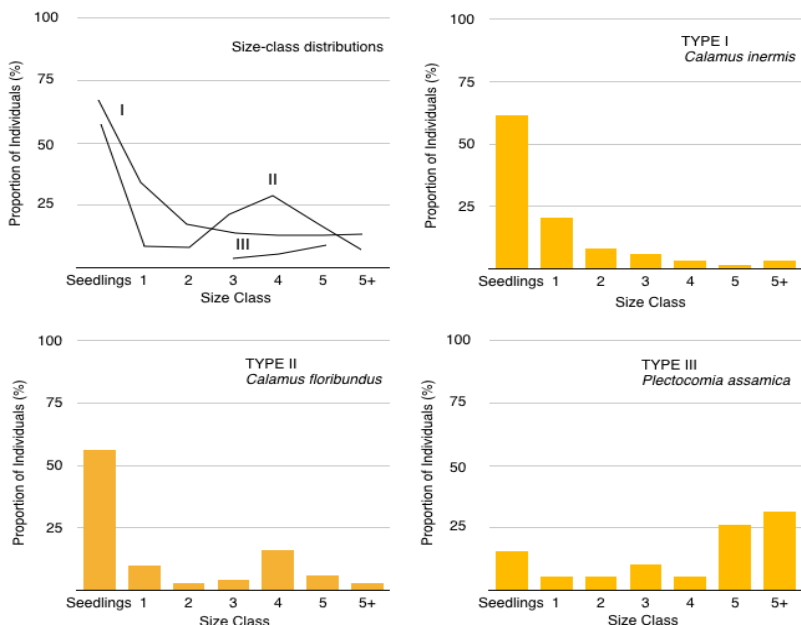


Figure 3.2. Generalized size-class distributions exhibited by wild rattan populations with specific examples from *C. inermis* (Homalin Township, Sagaing Region), *C. floribundus* (Leshi Township, Sagaing Region), and *P. assamica* (Tanai Township, Kachin State).



structure is characteristic of rattan species that maintain a more or less constant rate of recruitment from year to year. There is a high probability that the harvest of commercial canes will be eventually replaced by the growth of individuals from the smaller size classes.

A type II distribution, such as that displayed by *Calamus floribundus*, is characteristic of rattan species that show discontinuous or periodic seedling recruitment. The actual level of seedling establishment may be sufficient to maintain the population, but its infrequency causes notable discontinuities, i.e. gaps and peaks, in the size distribution. It is unclear what might have caused this pattern in the *C. floribundus* population sampled, but the regeneration event that produced the peak in numbers in size class 4 did not occur in several of the subsequent years. Given the availability of a significant proportion (e.g. 60-70%) of individuals in the smaller size-classes, however, this population should also be able to eventually replenish the stock of adult canes following harvesting.

The final size distribution, type III, reflects a species, in this case *P. assamica*, whose regeneration is severely limited for some reason. Population density is low (Table 3.1), seedling numbers are greatly reduced, and there are very few individuals in the intermediate size classes. Unless conditions change to increase the level of recruitment, e.g. increased seed production by adult canes or higher rates of seedling survival, this species could gradually disappear from the forest. The selective removal of adult canes through harvesting would greatly accelerate this process. Rattan populations that display a type III distribution are notoriously unable to replenish stocks of commercial canes after harvesting due to the lack of advance regeneration. . These populations will require a concerted management effort if they are to be exploited on a sustained-yield basis.

The size-class distribution of a rattan population is extremely sensitive to environmental conditions. A type I distribution can easily change into a type II if existing levels of seedling recruitment are diminished or mortality rates, i.e. harvesting levels, go up. Further constraints on regeneration may drive the populations to a type III size-class distribution. It is, perhaps, most useful to view these three distributions as a single sequence through which a rattan population passes as it is being over-exploited. The analysis of size-

class distributions is a simple and reliable method to monitor the dynamics and vigor of a rattan population, and the occurrence of a type III curve for a commercial species is a strong signal that the rate of harvest needs to be adjusted — or harvesting suspended completely until the population starts to regenerate again.

### 3.5 Growth

While the population density or number of harvestable rattan canes is clearly the parameter of greatest interest to a rattan collector, the annual growth rate of different species may actually be a more important number in terms of management. Growth rates determine the length of the pre-reproductive period, and growth rates determine the amount of time required to produce a merchantable cane, and growth rates are what ultimately define a sustainable harvest of rattan from the forest. The faster a rattan grows, the more harvestable cane it will produce. Unfortunately, reliable estimates of the annual extension growth of different species of wild rattan, even the most important commercial species, are virtually non-existent in Myanmar.

We have recently initiated growth studies of two species of rattan (*C. gracilis* and *C. latifolius*) in Sagaing Region, but the plants have been growing for less than a year and there are, as a result, no results to report. From 2006 to 2010, however, we conducted extensive field studies on the growth of wild rattan populations in Cambodia, Laos, and Vietnam (Peters, *et al.*, 2013; Peters and Henderson, 2014), and several of the species included in our studies also grow in Myanmar. Although it is doubtful that these species grow at the same rate in Myanmar as they do in the Lower Mekong Region<sup>1</sup>, the data from this research can be used to illustrate some basic principles about the annual extension growth of rattan cane, and to provide a general idea of the range of growth responses exhibited by different species.

Selected results from these growth studies are shown in Table 3.3 for six rattan species, all of which also grow in Myanmar. The annual

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<sup>1</sup>It is strongly recommended that these growth estimates not be used for management purposes in Myanmar. A better course of action is to initiate long-term growth studies of the commercial rattan species in this country.

Table 3.3. Average rates of annual extension growth (meters/yr) for six species of rattan growing wild in the Lower Mekong Region. Data for *D. jenkinsiana*, *C. inermis*, and *C. gracilis* collected in Vietnam; growth estimates for *C. latifolius*, *C. viminalis*, and *M. paradoxa* based on data collected in Cambodia. All six rattan species also grow in Myanmar.

Species	All Canes		Commercial Canes	
	N	Growth (meters/year)	N	Growth (meters/year)
<i>Daemonorops jenkinsiana</i>	1,385	1.13±0.07	439	1.47±0.08
<i>Calamus inermis</i>	284	0.45±0.05	87	0.68±0.06
<i>Calamus gracilis</i>	239	1.11±0.07	84	1.43±0.07
<i>Calamus latifolius</i>	122	0.79±0.05	14	1.41±0.15
<i>Calamus viminalis</i>	173	1.39±0.65	73	1.84±0.08
<i>Myrialepis paradoxa</i>	60	1.29±0.14	20	2.29±0.29

growth estimates for each species are shown as a mean value ± standard error<sup>2</sup> for all canes combined and then for commercial canes (≥4.0 meters tall) alone; N is the number of sample plants included in the growth estimate for each group.

As can be appreciated in the table, there are distinct differences in the annual growth rates of different species, *Myrialepis paradoxa* exhibiting a rate of stem growth that is over three times faster than that presented by *C. inermis*. Additionally, the annual growth rates of commercial-size canes alone are significantly faster than the average growth rates calculated using all of the size classes—for every species shown.

Growth estimates for different species are faster when only commercial-size canes are included in the calculation because plant size is a strong determinant of growth. Taller rattan plants are exposed to more light (both higher intensity and longer duration) than smaller plants, they have larger leaf areas, experience less competition, and are less susceptible to damage because of their

<sup>2</sup>A measure of the variability of an estimate of the mean, the standard error is calculated as the standard deviation of the observations divided by the square root of the sample size.

connection to a host tree. The climbing habit of rattan plants enables them to move out of the forest understory with only minimal investment in stem tissue, and the higher they move into the canopy, the faster they grow.

The effect of plant size on growth is shown in Figure 3.3. Size-specific growth data were collected from wild populations of *C. viminalis* and *C. gracilis* in Cambodia and Vietnam, respectively. The number above each histogram indicates the number of sample plants measured; the dotted horizontal lines represent the average growth rates for commercial (upper line) and all (lower line) canes.

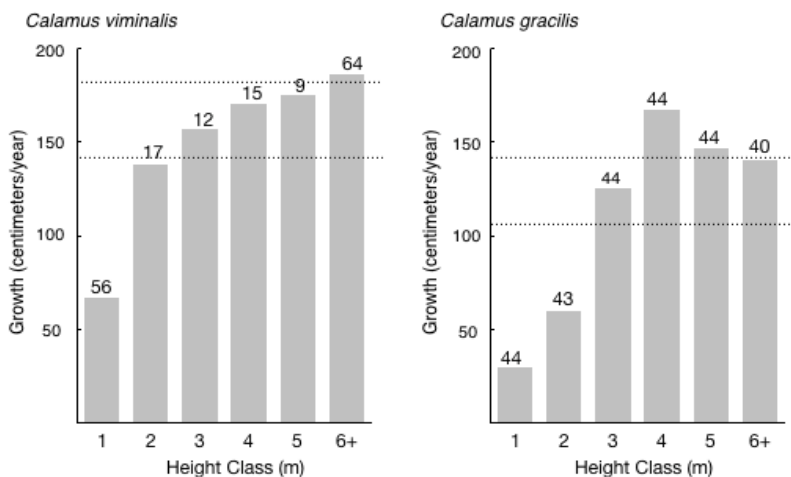


Figure 3.3. Average annual size-specific growth (centimeters/yr) for *C. viminalis* and *C. gracilis*. Sample sizes shown above the bars in each histogram; mean growth of commercial (upper) and all (lower) canes are indicated as dotted, horizontal lines.

Several points of importance should be noted in this figure. First, each of the species exhibits increased growth with increasing size. This growth increase is quite pronounced for both *C. viminalis* and *C. gracilis*, merchantable canes growing four to five times faster than canes that are only 1.0 meters tall. Second, the form of the growth response exhibited by each species as plants increase in size is distinct. For *C. viminalis*, there is a drastic increase in growth rate from the 1.0 to 2.0 meter height class, with a progressive,

linear increase in extension growth across all of the larger size classes. In contrast, *C. gracilis* exhibits the most pronounced growth response as it moves out of the 2.0 meter height class, its growth rate peaks in the 4.0 meter height class, and then starts to decline in subsequent classes. Finally, although *C. viminalis* appears to grow faster than *C. gracilis*, the annual growth rate of the commercial canes of both species is about 40 cm/yr faster than the mean growth rate calculated for each species using all cane sizes, i.e. the distance between the two dotted, horizontal lines in each histogram is surprisingly similar.

It is tempting to use the faster growth rates of larger plants to estimate the time required to produce a merchantable cane or to calculate the annual allowable harvest of rattan from a forest<sup>3</sup>. The biological reality, however, is that large canes spend several years growing up through the smaller size classes before they reach the canopy. The time spent in the shade of the forest understory must necessarily be taken into account. The average growth rate of a rattan includes periods of both fast and slow growth, and to be truly useful, the growth estimates that guide the conservation and management of these resources should also include both life stages.

### 3.6 Data Needs

Although this book is a good place to start understanding the taxonomy, ecology, and use of rattans in Myanmar, there is still very much that we do not know about wild populations of these valuable forest resources. Until systematic collections are made in all of the regions in which rattan grows, the total diversity of rattan species found in Myanmar will remain a mystery. In the absence of detailed inventories of wild rattan populations, critical questions about the size of commercial rattan stocks, the relationship between environment and the distribution and abundance of different rattan species, and the conservation status of rattan throughout the country cannot be addressed. And, as long

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<sup>3</sup>For example, if a given rattan species grows 1.0 meter/year and a merchantable cane is assumed to  $\geq 4.0$  meters tall, it would take an average of four years for a cane to reach commercial size. Similarly, assuming that it takes 4.0 years to produce a merchantable rattan cane, less than 25% of the commercial stock of this species should be harvested from the forest each year.

as there are few quantitative data about the growth and yield of wild rattan populations, defining sustainable harvest levels will be virtually impossible. To be able to manage a wild rattan population sustainably, we need to know the exact taxonomic identity of the species, the abundance of commercial and pre-commercial canes, and the rate at which new cane is produced every year.

The following recommendations are offered to help realize the objective of a truly sustainable program of rattan exploitation in Myanmar:

1. Collecting herbarium specimens of rattan is a bit more tedious and prickly than for broadleaf trees, but a concerted effort to collect wild rattans would be greatly beneficial. Regions from which few collections are available, e.g. Shan State, should be given priority. Replicate specimens of single taxa should be collected from each habitat, and photographic documentation is also useful. Detailed instructions for collecting, preparing, and annotating palm specimens is provided in Dransfield (1986).
2. More quantitative inventories of wild rattan populations are sorely needed. A systematic sample composed of parallel, 10 meter wide transects provides a high level of precision with a minimal investment of time. Data collected using this methodology also allows comparison with the results from previous rattan inventories conducted in Myanmar. Several different rattan species can be recorded in a single transect. Rattan canes encountered in each transect should be identified to species (and collected, if needed), counted and assigned to a 1.0 meter height class. A simple, step by step explanation of the mechanics of conducting a rattan inventory is offered in Peters and Henderson (2014).
3. Virtually nothing is known about the growth of wild rattan canes in Myanmar. This is a problem, because these data are what ultimately determine how much rattan can be harvested from the forest on a sustainable basis. Growth studies of rattan are relatively simple to conduct— a group of sample plants of varying size are marked and a year later the plants are re-visited and measured, and a series



of growth studies of commercial rattan species conducted in different forest types and environment would provide a large amount of data in a relatively short period of time. Based on research conducted by Peters et. al (2013) in Laos and Cambodia, a reasonable estimate of the annual growth of wild rattan can be obtained by marking 50–60 sample plants, over half of which are of pre-commercial size. Sampling protocols for quantifying the growth and yield of wild rattan are provided in Peters and Henderson (2014).

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# Rattans of Myanmar

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