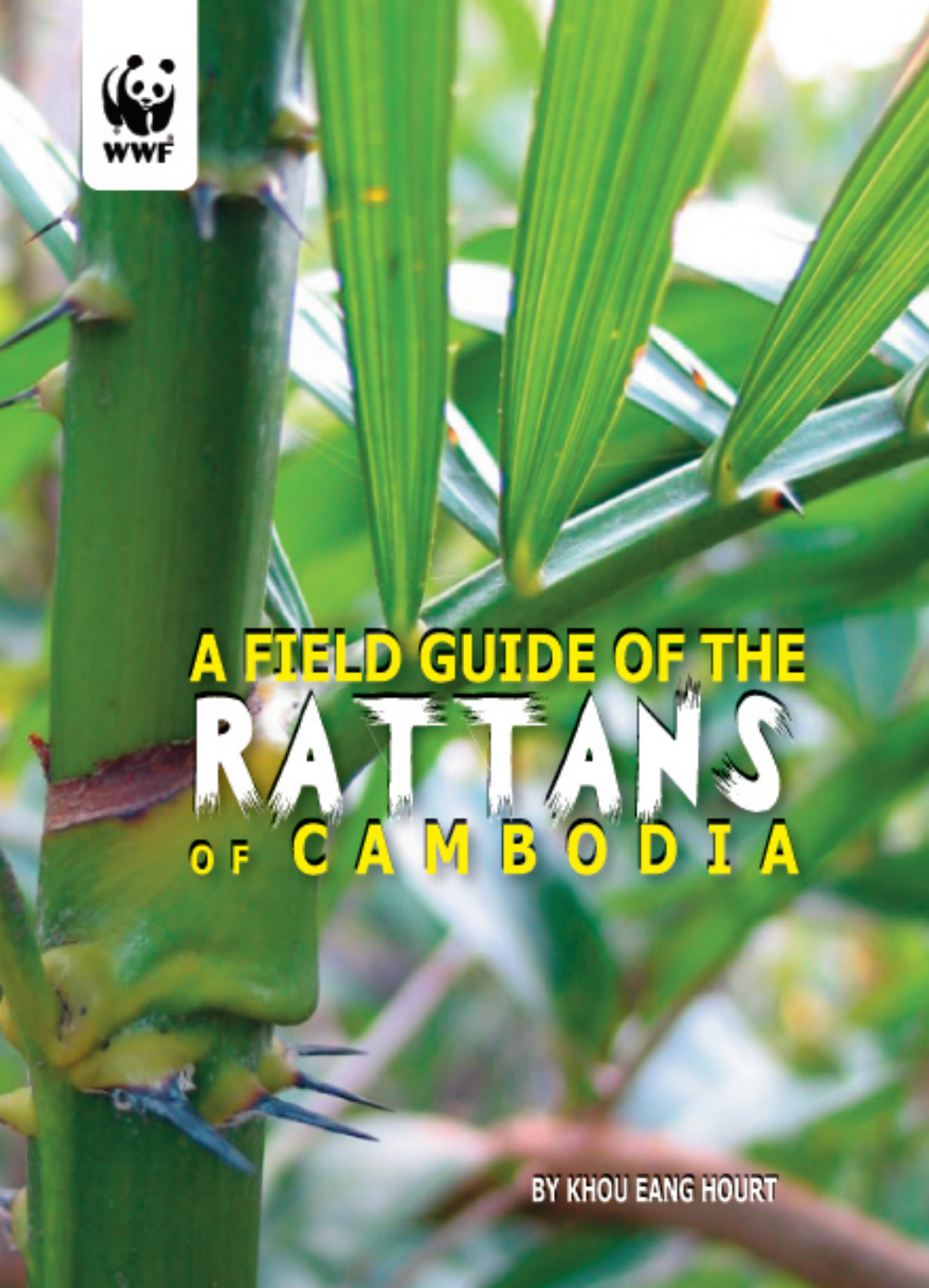
WWF
A FIELD GUIDE OF THE
RATTANS
OF CAMBODIA
BY KHOU EANG HOURT

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BY KHOU EANG HOURT

Version 1

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FOREWORD

Rattan counts as one of the most important non-timber forest products that contribute to livelihoods as source of incomes and food and also to national economy with handicraft and furniture industry. In Cambodia, 18 species have been recorded so far and most of them are daily used by local communities and supplying the rattan industry.

Meanwhile, with rattan resources decreasing due to over-harvesting and loss of forest ecosystem there is an urgent need to stop this trend and find ways to conserve this biodiversity that play an important economic role for the country.

This manual is one step towards sustainable rattan management as it allows to show/display the diversity of rattan and its contribution. This is the first rattan taxonomic study carried out in Cambodia and should serve as a milestone. I would like to express my sincere thanks to Mr Khou Eang Hourt, senior botanist working with WWF, who spend the last 2 years working on this manual. I also would like to thanks to Dr Tom Evans, Technical Advisor, Natural Resources Management and Dr Andrew Henderson Curator, Institute of Systematic Botany, The New York Botanical Garden, for their technical guidance and support to Mr Hourt.

Finally, I would like to encourage all readers of this manual to actively contribute to its improvement and definement, and to share with others who can make use of the information it contains

Mr Teak Seng

Country Director

Acknowledgment

Technical Contributions

This document was written by Mr Khou Eang Hourt, working with Ministry of Environment, with additional support and technical inputs from Dr Tom Evans, Technical Advisor, Natural Resources Management and Dr Andrew Henderson Curator, Institute of Systematic Botany, The New York Botanical Garden,

This manual is mainly based on the materials deposited at WWF Cambodia, together with records found in the literature and provides knowledge of genera and species diversity that occurs in Cambodia. The number of Cambodian rattan species is small compare to the total number of recorded species (18 species in 6 genera out of the 600 species in 13 genera identified worldwide) therefore the species outlined in this manual cannot cover all characteristics of genera. In this context, the description of each genus is partly copied from 'A Manual of the Rattans of the Malay Peninsular' (*Dransfield*, J., 1979). Furthermore, many materials lack inflorescences and fruits. Hence some information on flowers and fruits is copied from the Rattans of Lao PDR, Flore Général de L'indo-chine and The Rattans of Sabah (*Dransfield*, J., 1984). Descriptive of the vegetative parts like leaf sheath, climbing organ and leaves are used from the book "Rattans of Lao PDR, (*Evans*, T. et al., 2002). Most of these species are also present in Lao PDR, Vietnam and Thailand, but only few of them occur in the Malaysian region.

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1- Introduction

We all know what rattan looks like as a manufactured product (chairs, tables, shelves), but very few people know what it looks like in the forest, or how many species exist in Cambodia?
To fill this knowledge gap, WWF's Greater Mekong Program through its 'Sustainable Rattan Harvesting and Production' project has produced Cambodia's first Field Guide to Rattan.

The purpose of this field guide is to illustrate the diversity of rattan species in Cambodia and to assist in their identification. Rattan species are widely used for handicrafts, furniture and food. However a taxonomic study of the Cambodian species has never been carried out in a comprehensive manner. Lack of botanical knowledge has been a key constraint in the development of the rattan industry, especially the selection of the right species for processing and trading.
To overcome this difficulty, this field guide documents rattan species diversity, their habitats, ecologies and also provides additional information on rattan use, growth and trade.

2- How to use this book

This book contains three main sections. Since the morphology of rattan is different from other plant families, its terminology is also different so the first section of this book provides general rattan information, whilst the second details overall rattan characteristics. The final section contains detailed accounts for each of the 18 species currently found in Cambodia. Those who intend to gain knowledge of a rattan and are not familiar with it should take a look at its morphology first, and then step to the identification key to genera and species to see how they are different or closely related on the basis of a particular or a common character. After the key identification, full descriptions which contain two main parts - a taxonomic description and field notes - are provided. The full taxonomic description provides the information of detailed characters of individual species, and the field note provides special characters which differentiate closely related species.

The taxonomic descriptions provide detailed information on rattan characteristics including habit, size, shape, color, texture and spine arrangement. The field notes provide only a few key characteristics which assist to quickly identify rattan species in the field and differentiate closely related species. Color pictures of each species further serve to assist with rapid identification.

3- Rattan in Cambodia

Cambodian rattan researches to date have documented 18 species across the country. Two more species which are not described in this field guide are *Calamus acanthophyllus* which has been recorded in Preah Vihear province, and an erect stem species which has been come across on the peak of Phnom Khmoach and Phnom Samkos of Phnom Samkos Wildlife Sanctuary and Phnom Thom of Phnom Aural Wildlife Sanctuary. The species diversity is expected to be over 20 species if on-going research is carried out and taxonomical study is carefully done.

Rattan is regarded as a non-timber forest product with considerable potential to contribute to rural livelihood development in Cambodia and to the national economy through in-country processing. Despite the importance of rattan as a local community Non Timber Forest Products, it has not

been sustainably harvested and its prevalence has declined throughout the country.
According to a national survey carried out by WWF (Vuthy, Hourt, 2006) the main threats to rattan are over-harvesting and deforestation due to forest land conversion and frequent forest/habitat fires.

The degradation of rattan resources affects both the livelihoods of forest dwellers and biodiversity in Cambodia. Currently, rattan harvesting and collection are not adequately regulated, and replanting is not generally practiced. This makes even harder the task of ensuring that there is a steady supply of rattan (whether raw canes, processed or finished products) for community livelihoods, marketing and trade. Rattan processing and product development skills and techniques are currently not well developed, thereby limiting marketing options for rural communities dependent on forest resources for their livelihoods.

Furthermore, due to a lack of policy support and low market price for raw canes in Cambodia, most are sold to neighboring countries rather than locally, or for wider export. Rattan processed and finished products (e.g., crafts and furniture, etc.) are made domestically and mainly sold to local buyers. These processed and finished products are generally not of export quality.

4- Use

Rattans have been used for centuries by local communities for food, construction materials, traditional medicine, and furniture. Rattan shoots of many species of *Calamus* and *Daemonorops jenkinsiana* are edible and are preferred food by forest dwellers. They are usually bitter and slightly sweet. The forest dwellers of Kampong Thom Province also collect larvae that are found in the shoots of *D. jenkinsiana* for sale for the price of 8000 riel (US 2$) per larva. Leaves of *D. jenkinsiana* and *C. rudentum* are used for thatching by certain forest dwellers. Roots of some species like *C. salicifolius* are used for traditional medicine. Rattan canes are used for various products ranging from household items to furniture. Usually small cane rattans are used as rope to tie material and for crafting and weaving many types of baskets. Medium and large cane rattans like *Daemonorops jenkinsiana*, *Korthalsia laciniosa* and *C. rudentum* are used for frames of furniture like chairs, sofas, beds and wardrobes.

5- Rattan ecology and habitat

Rattans mostly grow in forest, where they climb up other plants to reach the sunlight using specially adapted organs covered in recurved hooks. Seedlings grow well in forest canopy gaps where sunlight can penetrate to the ground. Rattans grow slowly when they are still in the seedling stage, but mature plants grow faster.

Different species grow well under different sun, light and soil conditions and therefore certain species have adapted to different forest types. For example, *Calamus siamensis* and *Calamus rudentum* usually grow along stream banks or in other areas that flood briefly, whilst *Calamus godefroyi* grows in flooded forests that may be under water for several months. As well as growing in evergreen forests, *Calamus viminalis* is the only climbing species commonly found in mixed

deciduous and deciduous dipterocarp forests. The stemless Calamus acanthophyllus is also found in deciduous dipterocarp forest (not described in this field guide), and these are the only two species that appear to be tolerant of regular forest fires. Calamus salicifolius is the only Cambodian rattan typical of non-forest - it is common in natural grasslands, rice field bunds, roadsides and lowland scrub.

The fruits are covered by scales and seeds have fleshy layers (sarcotesta). The sarcotesta of certain species is sweet and sour which is attractive to frugivorous birds, mammals and humans. The seeds would be hard to germinate naturally if their sarcotesta were not removed. In this context, animals may play an important role in removing sarcotesta when ingesting or sucking the seeds and distributing them through their dung.

6- Rattan characters

The parts of a rattan can be divided into two groups. The vegetative parts include the roots, stems, sheaths, leaves, climbing organs and spines. They are very useful to identify rattan at the genus level, and can also be used to identify some to species level. The reproductive parts (inflorescence, flowers and fruits) are often required for species identification.

As in all palms, the stem of a rattan grows by extending from the tip. Leaves are produced one by one, also at the stem tip, and each has a tubular base or sheath, which encloses the soft young stem. Older leaves fall off to reveal the mature stem. Each sheath leaves a circular scar or node, with smooth internodes between. The inflorescence is a complex, woody branching structure which can be several metres long in some species. Although the inflorescences are borne at the nodes, they are joined to the outer surface of the leaf sheaths directly above that node.

Rattans are highly variable, depending on growth conditions such as light, soil and damage, so great care needs to be taken when comparing species. Also, the leaves and sheaths produced on a short (juvenile) stem can be remarkably different from those on a longer (mature) stem.

Clustering habit

Solitary habit

6.1 Habit

Most rattan species in Cambodia have a ***clustered habit*** - a single rootstock with many stems of different ages. These species can grow new stems after harvesting. If the rootstock can produce only one stem the species is said to have a ***solitary habit***. The individual dies when its cane is cut, making such species highly susceptible to over-harvesting if there is a large market demand for them.

6.2 Stem/Cane

When the stem of a rattan is cut and stripped of its sheaths it is called a ***cane***. In Cambodia most species are ***climbing*** whilst one, *Calamus acanthophyllus* is ***non-climbing***. Rattan stems do not branch above ground level except in the genus Korthalsia which branches extensively when it reaches the canopy. The soft young tissue at the top of the stem is called the ***rattan shoot*** or ca***bbage***.

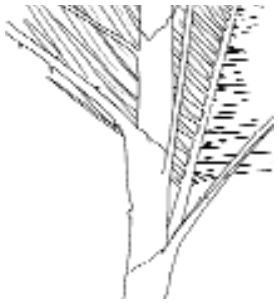
Stems that are covered by sheaths are grey or yellow, have higher water density, and when dry they wrinkle and are sensitive to fungus. Older sections of stem without sheaths are green and woodier with less water density and are more durable. All rattans have circular rings (i.e., nodes) on their stem where the leaves were attached.

Climbing stem | Branching habit | Stemless

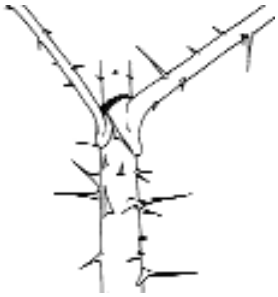
6.3 Leave sheath

There are three important features on the leaf sheath, the ***spine***, ***knee*** and ***ocrea***.

Spines on the sheath protect the plant. The number and arrangement of spines varies both between species and between individual stems of the same species. Most species have numerous spines scattered irregularly across the whole sheath. *Calamus lateralis* often has few or no spines on a given sheath. Spines of *Myrialepis paradoxa*, and *Plectocomia elongata* are arranged in neat rows. Different species of Calamus have subtly different patterns of spine arrangement often pointing in different directions. Many species have a ***crescent spine base*** and flat spine, whereas others have a ***conical spine base*** and needle-like spines.



Spineless



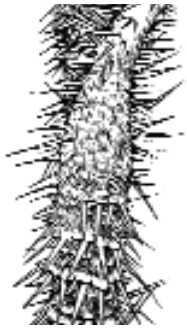
Crescent spine base

Conical Spine base

Spines of many species are light green to yellow-green, but spines of a few species like *C. godefroyi* and *C. salicifolius* are black. Spines of *C. rudentum* are grey or straw-coloured.

Neath row spines

Different pointing direction spines



Downward pointing spines

Upward pointing spines

The **knee** is found on the leaf sheath of *Calamus spp*. and *Daemonorops jenkinsiana* except on juvenile stems. It appears as a conspicuous or inconspicuous nose-like structure just below the base of the petiole. Knees of Cambodian rattan have two distinct forms - knot-shaped and keel-shaped. *Korthalsia*, *Myrialepis*, *Plectocomia* and *Plectocomiopsis* always lack knees.

No knee

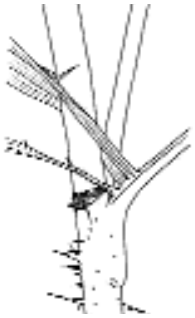
Nose like knee

Keel shaped knee

The ocrea is an extension of the leaf sheath above the point of exertion of the petiole. It is a significant character for rattan identification. *Korthalsia* species has thorny, net-like ocreas, whereas other species have thin, unarmed sheet like ocreas, which can be short or long. The ocrea of certain species becomes tattered. It quickly disintegrates, and so is only seen on freshly emerged sheaths. Ocreas of a few species such as *C. salicifolius* and *C. rudentum* bear hairs or bristle.

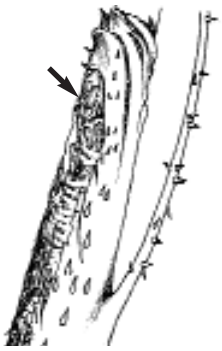
Tiny ocrea

Short appendix ocrea



Ocrea with bristle

Long ocrea



Net like ocrea

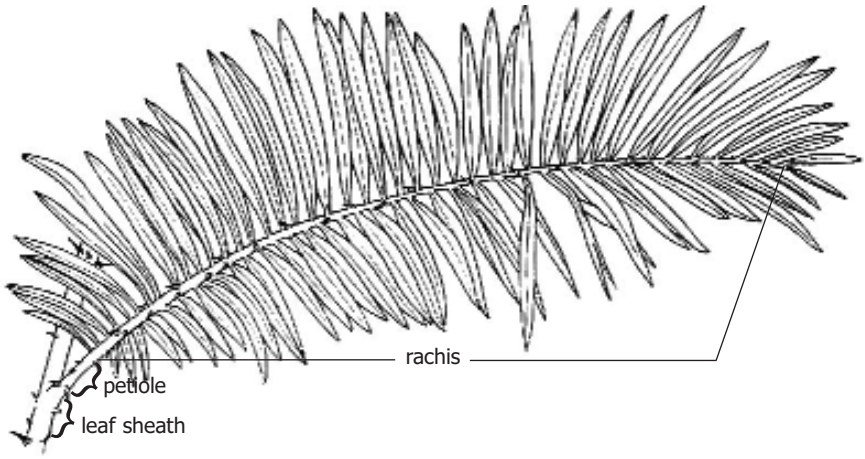
6.4 Leave and leaflet

Leaves of rattan are compound like a coconut leaf, with many leaflets along each side of the main axis. Leaves are divided into four or five sections: s**heath, petiole, rachis leaflet and (sometimes) cirrus**.

The petiole is the axis from the sheath mouth to the first leaflet. It is variable in length within or between different species. The petiole is usually long when the plant is still young, and then becomes shorter when the plant reaches maturity. Some species like *C. godefroyi*. and *Plectocomia pierreana* have very short to sessile petioles. Spines on the back of the petiole are either present or absent within the same species, but *C. erinaceus* lacks spines on the petiole. The rachis is the

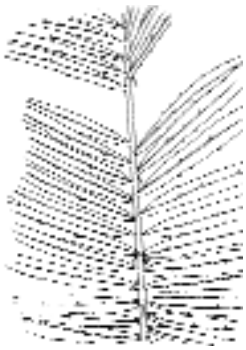
section of the axis where leaflets are attached. Leaflets are arranged in characteristic ways in each species so it is another key character for identification. The common leaflet arrangements among Cambodian species are **regular** (pinnate), **interrupted pinnate, grouped**, and **irregular**. Some species show more than one arrangement. For instance, *C. siamensis* has either regular or interrupted pinnate leaflets, and *Myrialepis paradoxa* has either grouped or regular leaflets.

Leaflets can be **diamond-shaped, linear**, or a range of shapes from **lanceolate** to **oblanceolate**. Diamond shaped leaflets are typical of Korthalsia (which has finely toothed leaflet margins) and *Calamus bousigonii* (which has smooth margins) Leaflet margin and surfaces usually have hair-like bristles, but the species belonging to *Plectocomia* and *Korthalsia* lack bristles on the margins.

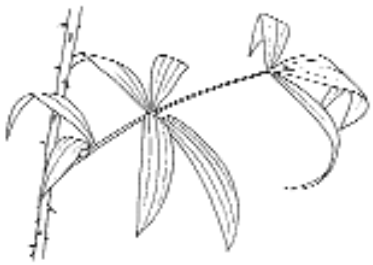


Leave with different sections

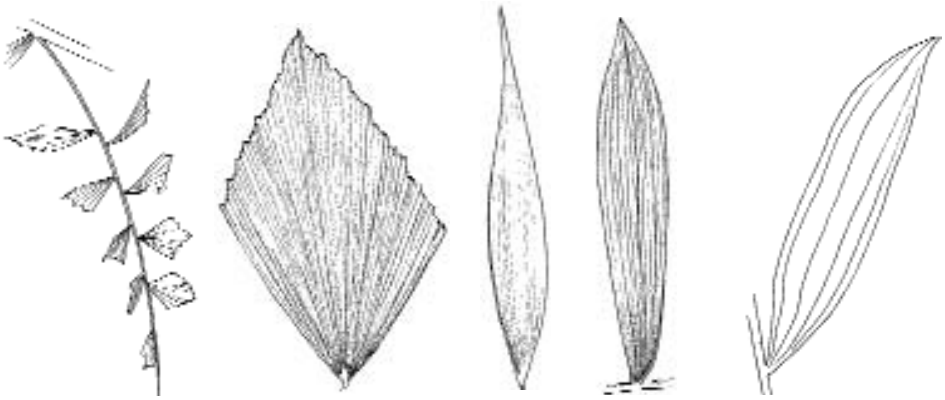
Pinnate or regular



Interrupted pinnate



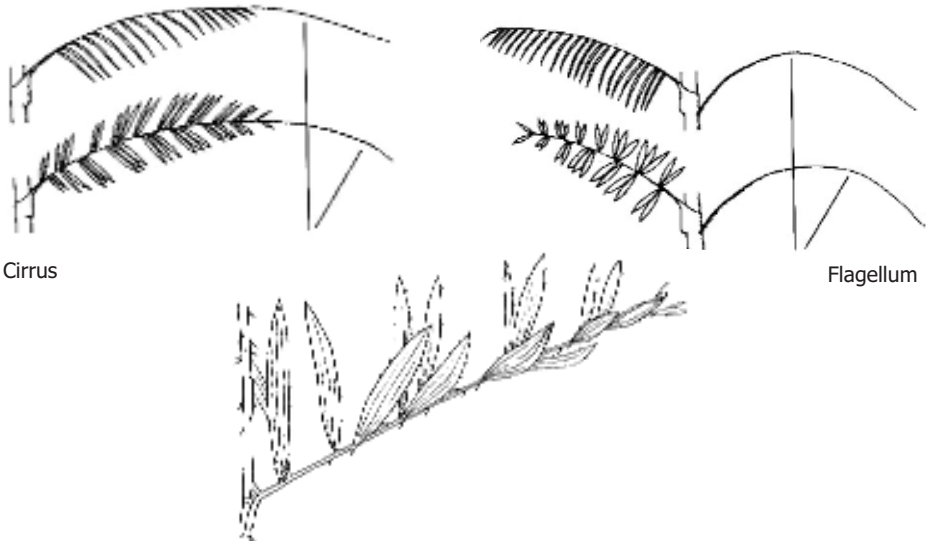
Strongly grouped



Irregular | Diamond shaped | Lanceolate with bristle | Oblanceolate | Oblong

6.5 Climbing organs

There are two types of climbing organ - **flagellum** and **cirrus**. The plural of flagellum is flagella, and the plural of cirrus is cirri. A flagellum is a sterile inflorescence that arises from the leaf sheath, whereas a cirrus extends from the leaf apex.. Flagella are found in many *Calamus spp*., whereas cirri are found in other genera and in a few species of *Calamus*. They function to cling to nearby trees to support the upward growth. *Calamus salicifolius* has neither flagellum nor cirrus, but sometimes there is an appendix, not cirrus, extending a few centimeters from the leaf apex.



Cirrus

Flagellum

Absence of cirrus and flagellum

6.6 Inflorescence

Rattan species follow one of two flowering strategies: **pleonanthic** or **hapaxanthic**. In Cambodia, Calamus and *Daemonorops* are pleonanthic whilst *Korthalsia*, *Myrialepis*, *Plectocomia* and *Plectocomiopsis* are hapaxanthic. The stem of a pleonanthic species flowers many times in its life. It produces a series of leaves with inflorescences attached during each flowering season and then continues to grow as normal between seasons. By contrast, the stem of a hapaxanthic species grows for many years and then flowers once and dies. During this flowering period the sheaths and leaves produced are small and differ from those on the rest of the stem. As most hapaxanthic species grow in clumps and stems flower at different times, this does not result in the death of the whole individual.

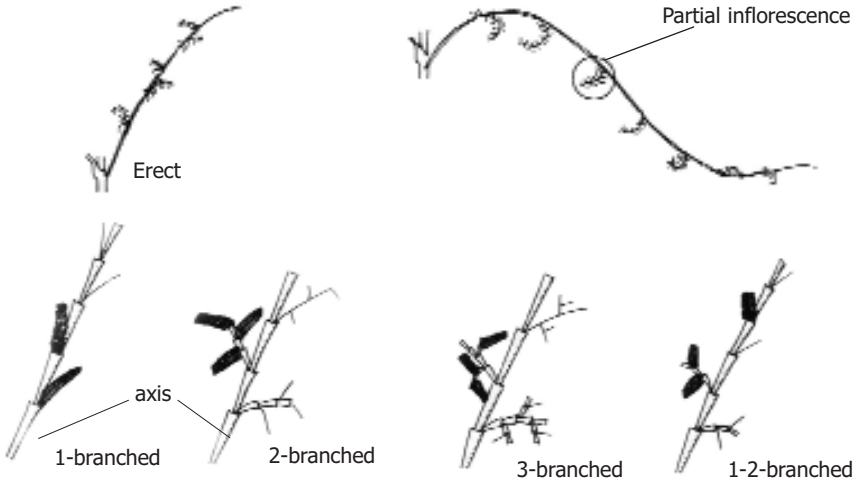
Pleonanthic flower

Hapaxanthic flower

The inflorescences usually have a complex but highly ordered branching structure. There is a main axis with a limited number (3-8) of large, first-order branches. These each produce a larger number of smaller second-order branches which may in turn produce smaller third-order or even fourth-order branches. Female inflorescences typically have first and second order branches (2-branched) while the male inflorescences may be 3-branched or 4-branched.

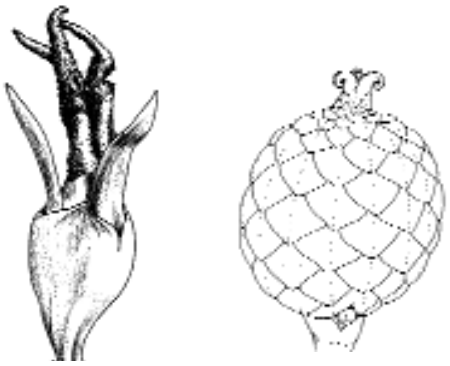
The primary axis of the inflorescence is termed **rachis**. One first order branch, together with all of its higher-order branches, is called a **partial inflorescence**. The flowers are only borne on the last-order branches, and these branches are termed a **rachillae** (singular: rachilla).

Branches at all levels are covered by tubular bracts. The bracts on the rachillae are called bracteoles. The structure of the bracts along the axis are especially important for identification since they have a range of forms including tight and entire, inflated and entire, slightly tattered, lacerate and extended into a flat limb (Evans et al., 2001). In most species they are relatively inconspicuous, but in *Daemonorops jenkinsiana* they are expanded to cover the entire inflorescence rather like a banana flower.



6.7 Flowers

Generally, rattans produce male and female flowers on different plants, and are so termed **dioecious plants**. However, *Korthalsia* species are **monocious** and bear hermaphrodite flowers (Dransfield, 1979). The flowers are usually quite inconspicuous with small white or dull coloured petals. They are composed of three calyx lobes, three corolla lobes, six stamens or staminodes, and a trilocular ovary or pistillodes. Calyx and corolla are fused or free by species. In *Calamus* and *Daemonorops* the female inflorescence has paired flowers with a fertile female flower and a sterile male flower, both of which are situated within a bracteole. An ovary has many overlapping scales and reflexed stigma (Dransfield, 1979).



Sterile male flower

Fertile female flower

6.8 Fruits

Rattan fruits have many shapes including globose, ovoid, ellipsoid or top-shaped (Evans et al., 2001). The outer part of the fruit consists of **perianth, scales** and **stigma**, and the inner part is composed of **sarcotesta** (flesh) and **seed**.

The perianth is a result of the permanently remaining calyx and corolla of flowers when developing to fruits. In some species the lobes are split to the base, forming an open star shapes, whilst in others the lobes remain partly fused, forming a tubular cup that lifts the fruit away from the rachilla.

Scales in most species are closely and neatly arranged in vertical rows, but in *Myrialepis* the scales are tiny and irregularly arranged (a little like shark skin). Scales of *Calamus* and *Daemonorops* are mostly hard, smooth and grooved along the mid-line, and fruit scales of *Plectocomiopsis spp*. bear bristle-like indumentum. The scale colors of young and mature fruits are often dark green with a brown margin, and gradually change to various colours when the fruit ripens. The scale colours of ripe fruits are variable from whitish yellow to light brown and ivory.

Smooth scales

Indumentum scales

Beak - The beak refers to the permanent stigma attached to the tip of the ovary. The rattan fruits remain the beak. The beak is not significant in identification, as other characters like fruit's scales or certain vegetative parts like spines are more distinctive. However, it could be used as a marginal character for the species identification. Certain species of the two genera sometimes can be confused if fruit is missing. The beaks of *Calamus* and *Daemonorops* are generally fused from the base and then split into three lobes. The fruit beak of *Plectocomiopsis* is very short and not split into lobes (Evans et al., 2001).

globose, short beak

ovoid, long beak

ellipsoid

top-shaped

The **sarcotesta** is a thin brownish fleshy layer surrounding the seed. It is sweet and sour, and often edible. A seed which is grooved or channeled on the surface is termed **ruminate** and when cut open reveals a patterned black and white interior. Seeds with more or less smooth surfaces and uniform white interiors are **non-ruminate** or homogeneous.

Sarcotesta

Ruminate

Non-ruminate

7- Specimen collection

The general rule of botanical collection is to collect the representative parts or organs of plants such as bark, twig, leaves and flowers and/or fruits, or also collect the whole plant if it is small, especially herbaceous plants. Usually one specimen can fit one folder of a newspaper. However, rattan specimens, as with many palm species, often require more than one section of the plant for a complete specimen. So, it is usually time consuming and needs patience to collect a good herbarium specimen.

7.1 Collection method

The characters of rattan change from immature to a mature plant so it is important to be careful in collecting them. Collect organs from mature, climbing parts of the stem with complete characters. It is best to avoid:

- Organs from immature sections of stem (as they do not develop climbing organs and knee)
- Old, worn organs because they may have lost key features
- The very tip of the stem, as it contains a high density of water which may cause the specimen to be affected by fungus, and change shape when it is dried.

The specimens of certain species like *C. salicifolius* and *C. tetradactylus* may fit only one paper folder, but the specimens of species with bigger canes cannot fit in one folder and need to be separated into two or three folders. The separated folders of one specimen should have the same number to avoid confusion when taken back from the field or deposited at a herbarium. If possible, it is best to attach a small hanging tag with the specimen number to each organ to prevent specimens getting mixed up.

The collection of complete rattan specimens has to encompass many representative characters which include as below.

1- **Vegetative parts**: cane, leaf sheath, leaf and climbing organs. The leaf sheath has a knee, ocrea, spine and sometimes a flagellum so we have to be careful not to separate them. Leaves of many species are long and large so we cannot collect the whole organ. In this case, we collect only a portion of the leaf base, middle section and apex. If the leaf ends with cirrus, we collect the leaf apex with cirrus. If the leaflet is large which does not fit to the folder, we cut the leaflets off one side (leaving the leaflet bases in place) and the other side is folded to fit the folder. Flagella of certain species like *C. rudentum* are up to 5-8 m long, which is hard to collect as a whole so taking only the base and the tip is enough.

2- **Reproductive parts:** Many rattan species have large and long inflorescence which could not be collected as a whole specimen. To collect such specimens, we take a portion at the base of the inflorescence including primary axis, bract and the whole partial inflorescence, and then collect the last partial inflorescence to see the range sizes.

It is valuable to take more than one set of organs so that the specimen can later be divided, with one set for your home institution and others for sending to herbaria elsewhere for identification.

7.2 Field record

Specimen notes are very important. They provide information that cannot be seen in the dry specimen. The information includes collectors' names, date, location including geographic coordinates, habitat, altitude and morphology. Morphologically, the field record of rattan specimens include the habit, length and diameter of the stems, the length of leaves and flagellum if it is too long which could not all be collected, number of leaflets per leaf, presence or absence of a cuticle on the leaflet or sheath, the size of the inflorescence, the number of partial inflorescences, and color of fresh specimen. Also note the range of variation in each organ, since this will not be obvious from the dry specimen either.

7.3 Maintenance and drying

As with other non rattan specimens, each sample is put in the newspaper folder, piled and packed with cardboard in between, then tied tightly with a string or rope. The pile of specimens is put in a big plastic bag and soaked with 90 or 70 percent alcohol to prevent fungus growth. A plastic bag is wrapped very close to the sample pile to prevent alcohol evaporation. When drying, each of the specimens is placed between two cardboard sheets. A set of specimens is tightly tied with a pair of ropes and put on a dryer. A cooker is set on a very low flame to get a low fire intensity to get good dry specimens. If the fire intensity is too high, the specimens will wrinkle.

8- Local names

Phdao is a common Khmer name for rattan, except for Lpeak, which is a rice field rattan species. In a combination with the last name, it becomes a specific local name. Some villagers use the last name as a short cut. i.e. Phdao Soam is sometimes called Soam. Communities living in different areas use different local names of the same species, which can lead to confusion. For example, *C. viminalis* is generally called Phdao Krek, but it is also called Phdao Kok, Phdao Lving, Tresh Sor or Phdao Kantel by local communities in different areas. Different species may also have the same local name. For instance, Phdao Dambang of the name of *C. rudentum* is also sometimes applied to *Plectocomia elongata* by local people in the south and southwest. *Calamus siamensis* and *Calamus godefroyi* are called by the same local name Phdao Toeuk. Not all forest dwellers know rattan very well which can lead to mistakes in the attribution of scientific names if based soley on local names without seeing the plant. It is therefore very important to see the rattan first hand to correctly identify the species.

Table1: Species list of Cambodian Rattan and a summary of abundance and distribution

No	Khmer name	Other local names	Botanical name	Habitat	Altitude	Geographical sites	Distribution and abundance
1	Phdao Chhveang	Kbang/Kantrong/Ta-uonh	*C. palustris*	Evergreen to semi-evergreen forest	< 100 to about 600 m	Hill slope/high ground	Moderate distribution across the country
2	Phdao Krek	Phdao Kok/Phdao Lving/ Traes Sor/Phdao Kantel	*C. viminalis*	Deciduous to semi-evergreen forest	< 100 to about 500 m	High ground, at termite hill and dry area.	Abundant everywhere
3	Lpeak		*C. salicifolius*	Bush along dike of paddy rice field.	About 100 m	Dike of paddy rice field and high ground at rice field.	Abundant in rice field
4	Phdao Arech		*C. bousigonii*	Evergeen to semi-evergreen forest	300 to 600 m	High ground/hill slop	Moderate at SBCA and BNP.
5	Phdao Dambang		*C. rudentum*	Semi-evergreen to riparian forest	< 100 to about 400 m	On bank of river, periodically flooded and moist soil areas.	Abundant on islands of Mekong River, Keo Seima, Kg Thom and Samkoh.
6	Saesoeng	Phdao Changreth/Phdao Lpeak/Hapeak	*C.tetradactylus*	Evergreen to semi-evergreen forest	< 100 to 300 m	High ground and periodically flooded area.	Partly abundant in Cambodia
7	Phdao Achmoan	Phdao Traes/Traes Achmoan	*C. guruba*	Evergreen to semi-evergreen forest	from -3 m below sea level to 400 m	Periodic or seasonal wetland area.	Abundant and home range is from Bokor
8	Phdao Toek		*C. siamensis*	Riparian forest	< 100 to 200 m	Along the seasonal flooded banks of stream and river	Abundant in the east of Cambodia
9	Phdao Toek		*C. godefroyi*	Flooded forest	< 100 m	On small island and reported around Tonle Sap River.	Around Tonle Sap and Mekong catchment
10	Unknown		*C. lateralis*	Semi-evergreen forest	200 to 300 m	Hill slope and high ground area.	Rare, only at Keo Seima
11	Phdao Aeng	Phdao Toek Prei	*C. erinaceus*	Sea tributary	10 to 40 m	Along estuaries.	Moderate abundance, Koh Kong
12	Phdao Toek Khmom		*Calamus sp .*	Evergreen forest	300 to 600 m	Along the bank of streams	Moderately abundant, Samkos and Samlot.

13	Phdao Soam		*Daemonorops jenkinsiana*	Evergreen to semi-evergreen forest	< 100 to 600 m	River banks and wet areas.	Partly abundant in Cambodia
14	Preah Phdao	Phdao Krahorm	*Korthalsia laciniosa*	Evergreen to semi-evergreen forest	100 to 600 m	River banks, wet areas and hill slope.	Partly abundant in Cambodia
15	Phdao Reussey	Traes Chheu	*Myrialepis paradoxa*	Degraded forest to semi-evergreen forest	< 100 to 300 m	High ground area and hill slope.	Partly abundant in Cambodia
16	Phdao Reussey Yeak	Phdao Dambang	*Plectocomia elongata*	Evergreen forest	600 to 1000 m	Hill slope and hill ridge.	Moderately abundant, confine in the south and southwest.
17	Chang O	Traes Amboh, Phdao Reusey Msao	*P. pierreana*	Evergreen to semi-evergreen forest	< 100 to 800 m	Hill slope and high ground area.	Partly abundant, in Cambodia
18	Teang Oa	(Phdao) Thngae	*Plectocomiopsis geminiflora*	Semi-evergreen to Evergreen forest	< 100 to 400 m	Hill ground	Rare, found only at Keo Seima, Toap Cheang commune, Sre Ambel district.

9- Key identification to rattan genera

A1 Ocreas net-like; leaflets rhomboid with jagged margins, gray on the lower surface ....*Korthalsia*
A2 Ocreas tiny or long but not net-like; leaflets green or white on lower surface...B

B1 Inflorescence congested with the outermost bract enclosing the whole inflorescence; bracts swollen, not closely sheathing the inflorescence axis .....*Daemonorops*
B2 Outer bracts of inflorescences not boat-shaped, smooth or with short spines....C

C1 Sheaths with knees, rarely inconspicuous; inflorescence axillary .....*Calamus*
C2 Sheaths without knees; inflorescence terminal.....D

D1 Sheath spines not in rows.....*Plectocomiopsis*
D2 Sheath spines in rows.....E

E1 Leaflets with no cuticle; fruits without stigmas; with minute scales .....*Myrialepis*
E2 Leaflets with cuticle on lower surface, the margins without spines; fruits with long permanent stigma ..... *Plectocomia*

9.1 Calamus L.

Habit: solitary or clustering; stemless to high-climbing pleonanthic dioecious rattan.
Leaf sheath: green; sometimes with cuticle when young.
Sheath spine: sparsely to densely spiny; sometimes absent.
Knee: usually present; conspicuous or inconspicuous
Ocrea: always present; tiny to very long; sometimes with indumentum.
Climbing organ: many species with flagella; except for *C. palustris* with *cirri*; and *C. salicifolius* absent.

Leaf: short or long; leaflets regular; interrupt pinnate; irregular or grouped.
Inflorescence: male and female superficially similar; with distant branches (partial inflorescences); usually ending in a flagellate extension; bracts always tubular at the base; above half sometimes splitting in broad limp at one side. Male flowers with well-defined, lobed, small cup-shaped calyx; 3 petals, splitting to the base; 6 stamens, shortly epipetalous; pistil minute. Sterile male flower borne with female flower, with empty anther. Female flower larger than male flower; with shallowly 3-lobed calyx, 3 petals; 6 stamens, joined basally to form cup-like ring; ovary with 3 stigmas; covered with reflexed scale.
Fruit: variously shaped. Seed covered in thin or thick sarcotesta, ruminate or not.

There are approximately 370 species worldwide, ranging from tropical Africa, India, Southeast Asia and South China to the western Pacific. 14-15 species are recorded in Cambodia.

This genus is closely related to *Daemonorops sp*. in terms of vegetative parts. However, the inflorescence is usually long, with few to many partial inflorescences (and flagella are never found in *Daemonorops*) In addition, inflorescent bracts are always tubular and permanent, whereas in *Daemonorops* the bracts are boat-shaped and densely spiny.

Key to species of *Calamus* L.

A1 Habit solitary; sheath spines absent .....*C. lateralis*
A2 Habitat clumped; sheath spines present .....B

B1 Neither flagellum nor cirrus present .....*C. salicifolius*
B2 Either flagellum or cirrus present C

C1 Cirrus present .....D
C2 Flagellum present .....E

D1 Leaflets regular .....*C. erinaceus*
D2 Leaflets in groups .....*C. palustris*

E1 Leaflets in group .....F
E2 Leaflets regular or irregular .....G

F1 Leaflets less than 6 groups; apical pair of leaflets joined for about two thirdstheir length
.....*C. tetradactylus*
F2 Leaflets more than 6 groups; apical pair of leaflets not joined.....*C. viminalis*

G1 Leaflets rhomboid, more than 4 distinct veins; indumentum absent
on leave surface.....*C. bousigonii*
G2 Leaflets linear to nearly oblanceolate; veins less than 4; indumentum or
bristles absent on leaflet surface .....H

H1 Ocrea more than 3 cm long I
H2 Ocrea less than 1 cm long .....J

I1 Sheath spines pointing downward, straw coloured; knee indistinct .....*C. rudentum*
I2 Sheath spines pointing upward, light brown or green; knee distinct .....*C. guruba*

J1 Knee keel-shaped; spines less than 1 cm long, with swollen bases .....*Calamus sp.*
J2 Knee knot-shaped; sheath spines up to more than 7 cm long, with crescent-shaped bases
.....K

K1 Spines light green to brown; petiole more than 10 cm long; leaflets interrupted
pinnate or regular .....*C. siamensis*
K2 Sheath spines black; petiole sessile to about 5 cm long; leaflets always regular
.....*C. godefroyi*

1 **Calamus lateralis** Henderson, N. K. Ban & N. Q. Dung

Local name: Unknown
Synonym: None

Description

Habit: solitary; climbing rattan; up to 30 m long.
Leaf sheath: 1.8 to 5 cm diameter; green with black cuticle.
Sheath spine: absent to few.
Knee: conspicuous; keel-shaped.
Ocrea: tiny; grey; broken early.
Climbing organ: flagellum 150-250 cm long.
Leaf: 60-90 cm long; petiole 11-15 cm long rachis 55-70 cm long; petiole no channel; spine sparse on margin and back surface; apical pair of leaflets not joined. Leaflets regular; 40-42 on each side; leaflets of middle rachis 18-21 x 1.1-1.5 cm; base cuneate; margin ciliate; apex acuminate; mid vein prominent; side two distinct; surface above bristles.
Cane: 0.8-1.8 cm diameter; 12-18 cm long; durable; weakly flexible.

Field note: this species can be distinguished from other species by two prominent characters; solitary habit and spineless or very few spines on its sheath. "*Calamus lateralis* bears a close resemblance to *C. poilanei*, but differs in its fruits with ruminate (versus homogeneous) endosperm and lateral (versus basal) embryo".
Growth: there is no information available.
Location: this species seems to only inhabit Seima Biodiversity Conservation Area (SBCA) of Keo Seima district, Mondulkiri province, east Cambodia.
Habitat: semi-evergreen forest.
Altitude: 200-250 m.
Use: its cane is reported to be not very flexible and therefore not suitable for furniture, as it is easily broken when bent. Its shoot is not edible because of a strong bitter taste.
Trade: there used to be collected for sale to Vietnam prior to 2005, but it is now stopped because of the poor quality.

Calamus lateralis Henderson, N. K. Ban & N. Q. Dung

1. Observation site of *C. lateralis*;
2. Leave sheath with absence of spine;
3. Leave showing arrangement of leaflets.

2 Calamus salicifolius Becc.

Local name: Lpeak (rice field rattan)
Synonym: *C. salicifolius* var. *leiophyllus* Becc.

Description

Habit: clustering; non-climbing rattan; 2-6 m long.
Leaf sheath: 0.4-0.7 cm diameter; green with white cuticle when young; wearing off when older.
Sheath spine: sparsely spiny; the spines 0.4-0.6 cm long; base swollen; light green; above base to tip needle shaped; black.
Knee: yellowish green to light green; knot-shaped to ridge-shaped; spine absent.
Ocrea: 0.1-0.2 cm long; brown, bristly.
Climbing organ: neither flagellum nor cirrus present.
Leaf: 15-30 cm long: petiole 0.2-1 cm long; rachis 14.7-28.5 cm long; apex with short appendage up to 1.5 cm long. Leaflets in groups of 2-3, leaflet longer at leaf base to gradually smaller at apex; leaflet at middle rachis 5-11 x 0.7-1.5 cm; linear to lanceolate; base cuneate; margin serrate with sparse bristles; apex acuminate; surface above with distinct veins; sparsely bristly on middle vein; lower surface with white cuticle; bristles absent.
Cane: 0.25-0.4 cm diameter; 5-23 cm long; flexible and durable.
Inflorescence: 25-30 cm long including appendix; female 2- branched; primary bract tubular at base; open in short and small sheet at mouth; brown.
Fruit: ripen fruit 0.8-1.2 x 0.7-1 cm; sub-globose to oval; scale dark yellow with light brown margin; beak 0.1-0.2 cm long; seed not ruminate.

Field note: characteristic that distinguishes this species from other *Calamus spp.* is the absence of climbing organs.
Growth: 2 m per year.
Location: it is wide spread on central plains, especially around Tonle Sap Great Lake and in south eastern parts of the country.
Habitat: confined to rice fields and severely degraded bush land of lowland areas.
Altitude: less than 200m.
Use: it is used for handicrafts, such as baskets, matting and rope, bringing a good source of income for local communities. Its shoot is also collected and eaten as a vegetable.
Trade: a cane of 4-5 m costs 100-150 riel. Its cane is collected for domestic handicraft production only. No export record of this species exists.

Calamus salicifolius Becc.

1. Observation site of *C. salicifolius*;
2. Basket made of *C. salicifolius*;
3. Habit;
4. Leave showing arrangement of leaflets;
5. Knee and ocrea;
6. Fruits.

3 Calamus erinaceus (Becc.) J. ransf.

Local name: Phdao Aeng (Phdao Toek Prai)
Synonym: *Daemonorops erinacea* Becc.; *Calamus aquatilis* Ridley.

Description

Habit: clustering; climbing; 20-30 m high.
Leaf sheath: 1.4-3.5 cm diameter; pale orange-green.
Sheath spine: a mixture of short and long up to 4 cm long; spines at sheath mouth to 6 cm long; hard, in short and long rows; needle-shaped; pointing upward and downward; yellow-brown from base upward.
Knee: conspicuous, knot-shaped; spines and bristles in rows on knee; light brown.
Ocrea: 0.1-0.2 cm long; black; bristles absent.
Climbing organ: cirrus 1.2-1.8 m long.
Leaf: sheath 3 cm long, petiole 2.8 cm long; yellow; rachis 2 m long; petiole with no channel; surface above absent of spine; margin with long and short spines. Leave apex ended with cirrus. Leaflet regular; up to 70 cm on each side. Leaflet on middle rachis 30-35 x 1-1.5 cm; base cuneate; margin with sparse bristles; apex narrowly acuminate; mid vein prominent; side two distinct; surface above absent glabrous; lower surface brown sport and bristles.
Cane: 0.8-1.5 cm diameter; internode 10-25 cm long; not flexible; durable.
Inflorescence to 1.5 cm long, peduncle enclosed by bract; bract tubular, sparsely spiny, flatter in small sheet at mouth; female inflorescence 2 branched.
Fruit: fruit to 1 cm diameter; globose; parianth divided at base.

Field note: this species grows in association with *Daemonorops jenkinsiana*, and could be easily confused, as morphologically they share a number of common characters like regular leaflet, cirrus, knee and spines, but the reproductive part is completely different. So, care should be taken when identifying in the field. For the vegetative part, this species has light orange-green sheath, slender spines, swollen knee and the back surface of petiole lacks spines.
Growth: 1.25 m per year.
Location: found only along a sea estuary in Koh Kong province.
Habitat: on the bank of estuary where seasonally flooded.
Altitude: from sea level to 20 m.
Use: its canes are used for the production of furniture, in combination with other products such as wood. However, the flexibility of the cane is poor, and is not used mush by a handicraft maker.
Trade: its cane is 200 riel for 4-5 meters. It is reported that it had been exported to Thailand, but not anymore.

Calamus erinaceus (Becc.) J. ransf.

1. Observation site of *C. erinacea* Becc;
2.Bookshelves made of *C. erinacea* Becc;
3. Habit;
4. Knee;
5. Leave showing arrangement of leaflets;
6. Inflorescent.

4 Calamus palustris Griff.

Local name: Phdao Chhveang (Kbang, Kantrang, Ta-uonh).
Synonym: *Calamus dumetorum* Ridl., *Calamus extensus* Roxb., *Calamus gregisectus* Burret, *Calamus humilis* Roxb., *Calamus kerrianus* Becc., *Calamus latifolius* Kurz, *Calamus latifolius* Roxb., *Calamus latifolius* var. *marmoratus* Becc., *Calamus loiensis* Hodel, *Calamus macracanthus* T. *Anderson*, *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

Description

Habit: clustering; climbing rattan to 25 m long.
Leaf sheath: 1-3 cm diameter; green.
Sheath spine: mix of short and long spines; moderately sparse spine; up to 3-5 cm long; flat from base to tip; base isolated or joint; light green to light brown; tip black.
Knee: conspicuous; knot-shaped; yellowish green; spine absent or present.
Ocrea: 0.6-1.2 cm long; extended on base of petiole; 1 cm long; spine or bristle absent; dark brown.
Climbing organ: cirrus 40-47 cm long.
Leaf: 60 to 110 cm long; excluding cirrus; petiole 8.7-18.3 cm long; surface above shallow channel; sparsely spine; rachis 52.2-85.2 cm long. Leaflet in groups of 2-5. leaflets of middle rachis 19-25 x 3.5-6 cm; base cuneate to obtuse; margin sparsely bristly; apex acuminate; vein 4-6; distinct; bristles absent on both surfaces.
Cane: 0.8-2 cm diameter; internode 10-25 cm long; durable and flexible.
Inflorescent: female 2-branched; male 3-branched; primary bract tubular; spiny.
Fruit: 0.9-1.1 x 0.5-0.7 cm; beak 0.2 cm long, oval; pariant widely divided at base

Field note: *C. palustris* can be identified based on a few characters, such as grouped leaflets, cirrus, and ocrea extension on above surface of petiole.
Growth: 1.8 m per year.
Location: this species is sparsely scattered throughout Cambodia.
Habitat: semi-evergreen forest, evergreen forest and sometimes riparian forest.
Altitude: about sea level to 500 m.
Use: its cane is classified as a small good quality rattan for handicraft and furniture. It is used to make bookshelves. It is also cored for waving chair and salon.
Trade: its canes are collected for either domestic use or international trade. A four to five meter cane costs between 180 and 350 riel.

Calamus palustris Griff.

1. Observation site of C. *palustris*;
2. Sofas made of C. *palustris*;
3: Habit.
4. Knee;
5. Leave showing arrangement of leaflets;
6. Fruits.

5 Calamus tetradactylus Hance

Local name: Sae Soeung (Phdao Changret, Phdao Lpeak, Hapeak)
Synonym: *Calamus bonianus* Becc., *Calamus cambojensis* Becc., *Calamus tetradactylus* var. *bonianus* (Becc.) Conrard, *Palmijuncus tetradactylus* (Hance) Kuntze

Description

Habit: clustering; climbing rattan; to 6 (-10) m long.
Leaf sheath: 0.4-1 cm diameter; dark or pale green; with white cuticle when young.
Sheath spines: spines very sparse to moderately dense; 0.7-2 cm long; up to 3 cm at sheath mouth; pointing all direction; base crescent; green to gradually brown at above half; tip black.
Knee: conspicuous; keel-shaped; green; spine absent.
Ocrea: up to 0.2 cm long; brown; bristle absent.
Flagellum: 30-75 cm long.
Leaf: 30-66 cm long; petiole 4-13 cm long; rachis 26-53 cm long; petiole with sparse spin; apex connate one-two thirds of total length. Leaflet (1)2-3(-5) groups of 2-4(-5). Leaflets of middle rachis 8-24 x 1.2-5 cm, lanceolate to oblanceolate; upper surface sparsely bristled, base cuneate, margin bristly; apex acute with hair-like appendage; veins 3, distinct.
Cane: 0.35-0.5 cm diameter; internode 10-15 cm long.
Inflorescence: 50-100 cm long including flagellate extension; bract strongly clasping with short spine and inflated in tiny sheet at bract mouth; 3 partial inflorescences; female inflorescence 2-branched.
Fruit: 0.5-0.6 x 0.5-0.6, globose; scales straw colored; margin brown; perianth divided at base; beak ca. 0.1 cm long. Seed not ruminate.

Field note: it is a small cane species and easy to recognize by its grouped leaflets and the apical pair of leaflets joined at their bases. It should be noted that some community called it Phdao Lpeak as its size is similar to *C. salicifolius* but they are different in habitat and certain characters, especially flagellum, spine, and leaf.
Growth: 2.5 to 3 m per year. *C. tetradactylus* grows well in open areas or gaps of semi-evergreen and evergreen forest. Its cane could be harvested 7 years after planting, and provides a yield f 1.2 tons per hectare (Plant Resources of South-East Asia 6, 1994).
Location: this species is widespread in lowland areas, throughout the country.
Habitat: disturbed mixed deciduous forest to evergreen forest.
Altitude: up to about 300 m.
Use: there are very few records on the use of this species. Some local communities reported that its cane is used for weaving baskets and ropes.
Trade: there is no record on the trade of this species in Cambodia, besides the collection for household use. However, neighboring countries like Lao PDR and Vietnam use this species extensively for crafts.

Calamus tetradactylus Hance

1. Observation site of *C. tetradactylus*;
2. Baskets made of *C. tetradactylus*;
3. Habit;
4. Knee;
5. Fruits.

6 Calamus viminalis Willd

Local name: Phdao Krek (Phdao Kok, Phdao Lving, Tresh Sor, Phdao Kantel)
Synonym: *Calamus extensus* Mart., *Calamus fasciculatus* Roxb., *Calamus litoralis* Blume, *Calamus pseudorotang* Mart., *Calamus viminalis* var. *fasciculatus* (Roxb.) Becc., C*alamus viminalis* var. *fasciculatus* subvar. *andamanicus* Becc., *Calamus viminalis* var. *fasciculatus* subvar. *bengalensis* Becc., *Calamus viminalis* var. *fasciculatus* subvar. *cochinchinensis* Becc., C*alamus 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.

Description

Habit: clustering; climbing rattan; up to 35 m long.
Leaf sheath: 0.5-2.7 cm diameter; green; young sheath with white cuticle and wearing off when mature.
Sheath spiness: sparsely to moderately dense spines; up to ca. 4 cm long; base crescent; flat; light orange-green; tip dark brown to black.
Knee: conspicuous; knot-shaped; green; spine absent or present.
Ocrea: up to 0.5 cm long; grey; spine absent.
Climbing organ: flagellum up to 300 cm long.
Leaf: 150-250 cm long; petiole 20-35 cm long; rachis 150-210 cm long; spine usually absent on upper and lower surfaces; sometime present; spine at margin to 3 cm long. Leaflet indistinct grouped of 20-30; each group with 2-7 leaflets; apex divided at base. Largest leaflets 11-35 x 0.7-1.5 cm; base cuneate; margin sparsely bristly; apex narrowly acuminate; mid vein prominent; both leaflet surfaces sparsely bristly.
Cane: 0.7-1.7 cm diametter; internode 10 to 30 cm long.
Inflorescence: 2-4 m long; 2-7 partial inflorescences; female inflorescence 2-branched; male
Inflorescence: 2-3-branched; primary bract clasping peduncle; tubular; spiny.
Fruit: 0.7-1 x 0.7-1 cm; globose; pariant split at base; beak 0.1 cm long; scale pale straw with dark grey margin.
Seed: not ruminate.

Field note: *C. viminalis* has a number of key characters like the presence of a knee, flagellum and grouped leaflets. This species has more groups of leaflet group than other species, and spine density on sheath is variable from sparse to dense. It can sometimes be confused with *C. siamensis* at first glance. However, the leaflets of *C. siamensis*, unlike *C. viminalis*, have a distinct interrupted pinnate arrangement.
Growth: 2.25 m per year.
Location: widespread across the country.
Habitat: this species prefers dry conditions. It is found in semi-evergreen forest, mixed deciduous forest and on termite hill of deciduous dipterocarp forest.
Altitude: 50-500 m.
Use: it is a good species for handicraft and furniture making. A range of products made from this species includes basket handles, baskets, and mattresses. It is also used for walls and floors of bookshelves, beds, chairs and sofas.
Trade: 220-350 riel for a cane of 4-5 m length. Its cane is extensively collected across the country for both domestic and international markets and thus this species is generally over-harvested.

Calamus viminalis Willd

1. Observation site of *C. viminalis*;
2. Rubbish bin made of *C. viminalis*;
3. Habit;
4. Knee;
5. Leave showing arrangement of leaflets;
6. Fruits.

7 Calamus bousigonii Becc.

Local name: Phdao Arech
Synonym: Unknown

Description

Habit: clustering; climbing rattan; 6 m (15) m long.
Leaf sheath 0.7-1.5 cm diameter; dark green.
Sheath spine: moderately dense spine; 0.5-2 cm long; base swollen; green; spine needle; brown; tip black.
Knee: conspicuous; keel-shaped; spines absent or sometimes few; yellowish green.
Ocrea: 0.1-0.3 cm long; extended on the petiole; spine or bristle absent; dark grey.
Climbing organ: flagellum 60-170 cm long.
Leaf: petiole 6-22 cm long; rachis 37-66 cm long; petiole no channel; sparse bristles and spine; leaf apex almost opposite; leaflet 6-8 on each side; leaflets of middle rachis 10-20 x 4-8 cm; rhomboid; base cuneate-oblique; margin densely bristly; apex long acuminate; veins 6-8; prominent; no bristles on either leaflet surfaces.
Cane: 0.8-1.1 cm diameter, internode 8-23 cm long, durable and flexible.

Field note: the particular characters of this species are diamond-shaped leaflets with dense bristles on the margin and swollen base of spine.
Growth: 1.5-2 m per year.
Location: found in two areas; the lowlands of Bokor National Park, southwestern Cambodia, and Keo Seima Biodiversity Conservation Area, eastern Cambodia.
Habitat: semi-evergreen to evergreen forest.
Altitude: 300-400 m.
Use: its cane is generally used as rope and weaving materials for household use.
Trade: there is no collection of this species for trade, but it is used for household purposes.

Calamus bousigonii Becc.

1. Observation site of *C. bousigonii*;
2. Knee;
3. Leave showing arrangement of leaflets;
4. Leaf shape.

8 Calamus rudentum Lour.

Local name: Phdao Dambang
Synonym: *Palmijuncus rudentum* (Lour.) Kuntze, *Rotang rudentum* (Lour.) Baill.

Description

Habit: clustering;climbing rattan;30-45 m long.
Leaf sheath: 2.5-6 cm diameter; light green.
Sheath spine: long spine arranged in long vertical rows with shorter spines in between each row; spines 5-7 cm long; base light yellow-brown; middle part flat; straw colour; tip black; downward pointing on sheath; upward pointing at sheath mouth.
Knee: inconspicuous; light green; covered with dense spines.
Ocrea: 5-10 cm long; dense bristles; grey; rotten early.
Climbing organ: flagellum 4-8 m long; moderately dense spines in rows at base of flagellum.
Leaf: petiole 20-63 cm long; rachis 160-380 cm long; petiole: above surface channeled, spine absent; back surface spiny; petiole margin with spines; upward pointing to 18 cm long; apical pair of leaflets joined for about half their length. Leaflets regular; 35-60 of each side. Leaflets of middle rachis 40-43 x 2.1-2.4 cm; base round; margin with bristles; apex apiculate; moderately dense bristles; mid vein prominent; bristles 2.5-3.5 cm long.
Cane: 1.8-3.5 cm diameter; internode 12-20 cm long and durable.
Inflorescence: 500-750 m long including flagellate extension; female 2-branched; male 3 branched; bract of primary branch tubular; moderately spiny; flatten in sheet at mouth.
Fruit: 1.40-1.70 x 0.7-1.1 cm; parianth divided at base; beak 0.2-0.3 cm long; dry scale yellow-orange; margin pale tan.

Field note: *C. rudentum* can be differentiated from other species by a number of significant characters in particular, dense spines on the sheath and straw-color spines with black tip. The knee is indistinct and covered with dense spines. It is notable that this species has long with spiny ocrea hardly visible as it disintegrates and disappears early. Flagellum is up to 8 m long, and its base is 0.4-0.8 cm diameter and densely covered with spines.
Growth: 1 meter per year.
Location: it is widespread in the east and southeast of the country.
Habitat: Semi-evergreen forest and riparian forest surrounded by deciduous dipterocarp forest.
Altitude: 50-300 m.
Use: its cane is used for making frames and supports for kinds of furniture including bookshelves, beds, chairs etc. It is a large diameter, good quality rattan for furniture that is in high demand and therefore over-harvested.
Trade: a 4-5 m cane is around 4000 riel in Phnom Penh, but its local price varies from 500 to 3300 riel. It is the most expensive species of all rattans. Exports to Vietnam and Hong Kong have been reported but volumes are unknown.

Calamus rudentum Lour.

1. Observation site of *C. rudentum*;
2. Folding partition made of *C. rudentum;*
3. Habit;
4. Knee;
5. Fruits.

9 **Calamus** sp.

Local name: Phdao Toeuk Khmom
Synonym: N/A

Description

Habit: clustering; climbing rattan; 15 (-70) m long.
Leaf sheath: 1.5 cm diameter; green with black cuticle.
Sheath spine: sparse spine; 0.1-0.2 cm long; base cone-shaped, green; spine dark brown.
Knee: conspicuous; keel-shaped; green; spine in sparse row on rib.
Ocrea: 0.2-0.4 cm long; grey; spine absent.
Climbing organ: flagellum 1.5-3 m long.
Leave: petiole 15 cm long; not channeled; rachis 75-84 cm long; apex divided at base. Leaflets regularly arranged 3-4 cm apart, leaflet of middle rachis 35-36.5 x 1.5-1.7 cm; base broadly cuneate; margin sparsely bristled; apex narrowly acuminate; veins three; prominent, sparsely bristled.
Cane: 1-2.3 cm diameter; internode 12-30 cm long; durable and flexible.
Inflorescence: unknown
Fruit: unknown
Seed: unknown

Field note: this species is morphologically similar to *C. siamensis* in terms of habit, leaflet arrangement and climbing organ, but remarkably different at swollen base and with short spines and less distinct knee. In addition, it has stilt roots, which emerge from the ground.
Growth: it takes approximately 7-9 years from a seedling to mature plant.
Location: this species seems confined to the Southwest, ranging from Phnom Samkos Wildlife Sanctuary to Samlot Multiple Use Area.
Habitat: evergreen forest, prefers to grow along the edge of streams which are periodically flooded after rain.
Altitude: 300-500 m.
Use: due to its durability and flexibility, the cane is preferably used to make the base in furniture like bookshelves, beds and chairs.
Trade: it is extensively collected for commercial trade to Thailand and therefore over-harvested. A cane of 4-5 m long was worth 700 riel in Battambang province and 900-1100 riel in Kravanh district, Pursat province.

Calamus sp.

1. Observation site of *C. Phdao Toeuk Khmom*;
2. Bookshelves made of *C. Phdao Toeuk Khmom*;
3. Habit;
4. Leave showing arrangement of leaflets;
5. Knee.

10 Calamus guruba Buch.

Local name: Phdao Achmoan (Phdao Tresh, Tresh Anchmoan)
Synonym: *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

Description

Habit: clustering; climbing rattan; 8 - 10 m long.
Leaf sheath: 2-3 cm diameter; dark green.
Sheath spines: dense and a mixture of short and long spines; upward pointing; up to ca. 2.5 cm long and up to 7 cm long at sheath mouth; flat from base to tip; light brownish green at base; tip dark brown or black.
Knee: conspicuous; knot-shaped; densely short spines; light yellow-green.
Ocrea: about 10 cm; papery; absence of bristles; twist; fall off at old sheath.
Climbing organ: flagellum 3-4 m long.
Leaf: 131 cm long: petiole 18 cm long, rachis 113 cm long; petiole with channel; covered by dense and disorder short spines; long spines in a row on the back and margin; leaf apex widely divided from the base. Leaflet regular; more or less opposite; 1.3-3 cm distance. Largest leaflets 30-40 x 2.5 cm; linear; base cuneate; margin with bristles; apex narrowly acuminate; mid vein prominent; 4 side veins distinct; both leaflet surfaces bristly.
Cane: 0.5-2 cm diameter; internode 5-20 cm long; core soft; not flexible.
Inflorescence: 240 cm long plus flagellum; 3-5 partial inflorescences; male inflorescence 3 branched; zigzag; female inflorescence 2 branched; primary bracts tubular at base; then spread in sheet at mouth. Bract up to about 40 cm long; brown; middle vein and margin bristly.
Fruit: 0.6-0.8 x 0.6-0.8 cm, globose, scale of mature fruit dark green, yellow when dry, with brown margin, calyx 6, beak 0.1-0.2 cm long.
Seed: not ruminate.

Field note: this species can be easily distinguished from other *Calamus spp*. by its upward pointing sheath spines; regular and usually close distant leaflet; knee present and distinct; young and mature leave sheath with long ocrea; and inflorescence with long bract. It can be confused with *Daemonorop sp*. but has a flagellum and not a cirrus, and sheath spine color. A plant that is collected in Kampong Thom province has a number of different characters like keel-shaped knee, slender stem and different plain-pointed spines. Further taxonomic study of this specimen should be carefully conducted to precisely confirm about the species.
Growth: 1-1.5 m per year.
Location: the home range of this species is from Bokor National Park, in the southwest through the Cardamom mountain ranges to the Samlot area in the western region of the country.
Habitat: open area to evergreen forest. This species inhabits a high rainfall region on high acidic soil.
Altitude: from sea level to about 300 m.
Use: the cane's core is soft, so the cane can not be used for furniture. However, its cane is split into four pieces for weaving and tying material.
Trade: no accurate figure of trade has been reported so far. This species is collected for domestic use but not for export because of the poor quality. Its cane is split into four pieces and sold for 100 riel per piece.

Calamus guruba Buch.

1. Observation site of *C. guruba*;
2. Chairs made of *C. guruba*;
3. Habit;
4. Knee;
5. Leave showing arrangement of leaflets;
7. Fruits.

11 Calamus siamensis Becc.

Local name: Phdao Toeuk
Synonym: *C. siamensis* Becc. var. *malaianus* Furtado

Description

Habit: clustering rattan; climbing; up to 20 m long.
Leaf sheath: 0.7-2 cm diameter; green with grayish white or some times brown cuticle when young; wearing off when older.
Sheath spine: moderately dense to sparse spines; to 4; rarely to 7 cm long; base crescent; green; spine flat from base upward; upper part yellow-green to brown; tip dark brown or black.
Knee: conspicuous; knot-shaped; dark green; indumentum absent
Ocrea: 0.7-1.4 cm long; soon rotten and fall off; resulted in short ocrea; dark grey; indumentum absent.
Climbing organ: flagella 100-175 cm long.
Leaf: 70-95 cm long: petiole 9-17 cm long; rachis 71-79 cm long; petiole with sparse long spines; apex divided at base of leaflet. Leaflets regular or interrupted pinnate, 35-45 on each side; 12-17 x 1-1.7 cm; linear; surface above dark green with bristles; base cuneate; margin sparsely bristly; apex narrowly acuminate to apiculate; mid vein prominent; bristles on both surface.
Cane: 0.5-1.3 cm diameter; internodes 12-25 cm long; durable; not flexible.
Inflorescence: 150-300 cm plus flagellate extension; (1)3-5 partial inflorescences; primary bracts tubular; clasping rachis. Female inflorescence 2-branched; secondary branches 8-30 cm long; zigzag; secondary bract sparsely armed. Male rachillae 3-branched; third branches ? 1 cm long; crowded with flowers.
Fruit: 0.7-0.9 x 0.8-10 cm; sub-globose; calyx connate at base scales whitish; parianth 6; slightly connate at base; beak short.
Seed: not ruminate.

Field notes: this species closely resembles *C. viminalis*, which has similar habit, sheath spines, knee, flagellum and small ocrea. The main difference is the arrangement of leaflets, which are all in one plane and regular or interrupted pinnate. As with many species the spines are variable from few to moderately dense on the sheath. This species could also be confused with *C. guruba* which has a similar leaflet arrangement but different ocrea, spine pattern and inflorescence. It could also be confused to *C. godefroyi*, but *C. godefroyi* has a very short petiole, blacker sheath spines and usually a small spine on the top surface near the base of each leaflet.
Growth: there is no growth information of this species but local communities reported that it takes about 7-9 years from seedling to maturity at which time the stems can be harvested.
Location: this species is largely found in the east, central and northeast of the country.
Habitat: in forest or scrub, on the banks of streams or rivers with periodic or seasonal flooding. The local name of this species is based on its habitat, i.e., close to the water.
Altitude: about sea level to 200 m.
Use: its canes are used by local communities for making the base or walls of furniture. It is not the most preferred species for factory use due to low quality in terms of durability and flexibility.
Trade: 150 to 300 riel for a cane of 4-5 m long. Cane collection for export to Vietnam was reported by collectors at Snuol district, Kratie province. However, this species is not commonly used in the country because its cane is lower quality than *C. viminalis* and *C. palustris*, which are similar in size.

Calamus siamensis Becc.

1. Observation site of *C. siamensis*;
2. Bookshelves made of *C. siamensis*;
3. Knee, ocrea and spine arrangement;
4. Leave showing arrangement of leaflets;
5. Fruits.

12 Calamus godefroyi Becc.

Local name: Phdao Toeuk
Synonym: N/A

Description

Habit: clustering; climbing rattan; 5 m long.
Leaf sheath: 1.5-4 cm diameter; moderately green.
Sheath spine: sparsely and individually scattered or rarely connate at base; up to 2 cm long; base enlarged; crescent; light orange-green; above base upward black.
Knee: conspicuous; knot-shaped; orange-green; spine absent.
Ocrea: up to 0.6 cm long, brown; indumentum absent.
Climbing organ: flagellum 150-250 cm long.
Leaf: 50-80 cm long: petiole sessile to 4 cm long; shallow fissure; rachis 50-80 cm long; apex connate to rachis 0.5-0.8 cm long; then divided. Leaflet regular; 26-35 on each side. Leaflet of middle rachis 22-30 x 1.5-2 cm; linear-elliptic; base cuneate margin bristly; apex acuminate; mid vein on upper surface prominent; bristle on both surfaces.
Cane: 1-1.3 cm diameter; internode 10-15 cm long; not durable and flexible.
Inflorescence: 1-1.5 m long plus flagellum; partial inflorescences small; starting deep inside primary bract; primary bract tubular.
Fruit: 1.2 x 1.6 cm; subspherical; periant tubular at base; then divided.
Seed: Unknown.

Field note: this species is vernacularly called the same as *C. siamensis*, due to its water-confined habitat. Its samples are collected on the small and seasonal flooded rattan island (Koh Phdao) of Mekong River in Samboo district, Kratie province. This species mainly inhabits flood plain of Tonle Sap Great Lake. It can be differentiated from *C. siamensis* by its black spines and mainly sessile petiole.
Growth: about 1.2-1.6 m a year.
Location: it is found on a seasonally flooded island in Samboo district, Kratie province. The Flore of Indo-chine (Humbert H., 1937) reported that this species was found in Siem Reap province and some parts of the Mekong River.
Habitat: flooded forest or marshy areas.
Altitude: about sea level to ca.100 m.
Use: it is used mainly by local communities for basketry and matting for local use.
Trade: 150 - 250 riel for 4-5 meter long cane. This species is at present extensively collected for basket waving at Krabei Real commune, Siem Reap province.

Calamus godefroyi Becc.

1. Observation site of **C**. *godefroyi*;
2. Basket made of *C. godefroyi*;
3. Habit;
4. Knee, ocrea and spine arrangement;
5. Leave showing arrangement of leaflets.

13 9.2 Daemonorops Bl.

Habit: solitary or clustering stemless to high climbing paraxanthic or pleonanthic dioecious rattans.
Sheath spine: usually densely spiny; frequently grouped in rows.
Knee: present or absent (Knee present for Cambodian species).
Ocrea: tiny; dark brown.
Climbing organ: cirrus present; absent for stemless species (not in Cambodia).
Leaf: leaflet regular.

Inflorescence: male and female inflorescences superficially similar. The genus with two basic types of inflorescent bracts - one with bract enclosing the whole inflorescence; then splitting to expose flowers; and another one (not represented in Cambodian species) with bracts borne on somewhat elongated inflorescence; then splitting and usually quickly falling at flowering; male flower with 3 lobed; small cup-shaped calyx; 3 petals; almost splitting to the base; stamens 6; slightly borne on petal; pistil minute. Sterile male flower borne on female flower; with empty anthers; and soon falling. Female flower usually larger than male flower; 3-lobed; truncate calyx; 3 petals; 6 stamens; joined at base to form ring.

Fruit: covered in reflexed scale; 3 stigmas. Seed with thin to thick; sweet or sour sarcotesta.

This genus is closely related to *Calamus*, but the inflorescent bracts distinguish the two genera from each other. The inflorescence bracts of *Daemonorops* are boat-shaped and open along the margins, whereas inflorescent bracts of *Calamus* usually sheath the rachis and are persistent.

There are around 115 species that are widespread from India and China, west to New Guinea. There is only one species, D. *jenkinsiana* that occurs in Cambodia.

14 Daemonorops jenkinsiana (Griff.) Mart)

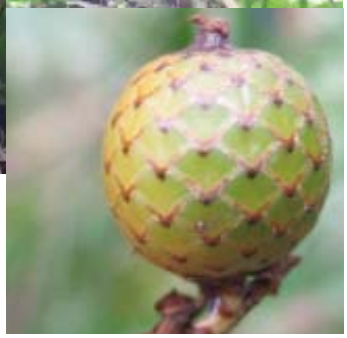
Local name: Phdao Soam (Phdao Em)
Synonym: *Calamus jenkinsianus* Griff., *Calamus margaritae* Hance, *Calamus nutantiflorus* Griff., *Daemonorops* jenkinsiana var. *tenasserimica* Becc., *Daemonorops margaritae* (Hance) Becc., *Daemonorops margaritae* var. *palawanica* Becc., *Daemonorops nutantiflora* (Griff.) Mart., *Daemonorops pierreana* Becc., *Daemonorops schmidtiana* Becc., *Palmijuncus jenkinsianus* (Griff.) Kuntze, *Palmijuncus margaritae* (Hance) Kuntze, P*almijuncus nutantiflorus* (Griff.) Kuntze

Description

Habit: clustering; 'climbing rattan', up to 30 m long.
Leaf sheath: 2-6 cm diameter; green.
Sheath spine: densely spiny; a mixture of short and long spines up to ca. 6 cm long; flat; light brown to black; base light green; soft.
Knee: conspicuous; knot-shaped; green to light brown-yellow; moderately sparse to dense spine.
Ocrea: 0.1-0.2 cm long; dark brown; bristles absent.
Climbing organ: cirrus 50-80 cm long
Leaf: 180-240 cm long: petiole 14-36 cm long; rachis 165-220 cm; upper surface absence of spine, with line rib on the middle, back surface and margin with sparse spine; longest spines at base of petiole 4-6 cm long; leaf apex ended with cirrus. Leaflets regular; 50-100 on each side of rachis. Leaflets of middle rachis 25-36 x 1-1.5 cm; linear; base broadly cunete; margin bristly; apex narrowly acuminate; mid vein prominent; both surfaces sparsely bristled along vein.
Cane: 1-1.7 cm diameter; internode 10-25 cm long; durable and flexible.
Inflorescence: concentrate near apical growth; enclosed by bract; 17-40 cm long; primary bract boat-shaped with moderately sparse spines on above surface; split off when fruits mature; female inflorescence 2-branched; male inflorescence 4-branched; branches zigzag; ovoid; parient fully open; beak short.
Fruit: 1-1.5 x 1-1.5 cm; globose to ovoid; scale light brown with dull brown margin; parianth split at base; beak 0.2-0.3 cm long.
Seed: ruminate.

Field note: the spiny boat-shaped inflorescence bracts are the special character of this species. There are also a number of characters like the presence of knee, cirrus, regular leaflet and light brown to black spine on leave sheath. In vegetative parts only, it is identical to *C. erinaceus*, but different sheath color and the presence of spines on the upper surface of the petiole distinguishes it.
Growth: 0.26 m per year.
Location: it is generally widespread across the country.
Habitat: it prefers moist areas of semi-evergreen forest, evergreen forest and riparian forest.
Altitude: about sea level to 500 m.
Use: its palm heart (shoot) is edible and eaten by local communities as vegetable. Larvae that live in the rattan shoot are also collected for food and sale. One larvae is 2000 to 4000 riel at local market or village, and up to around 8000 riel at urban market. Its cane is flexible and durable, and thus preferred for bending as a decoration of furniture production.
Trade: it is heavily collected for either domestic or international trade but its harvesting volume is not known. A raw cane of 4-5 m long is 300-500 riel, and the price is up to 1200 riel a cane of the same length after first stage processing.

Daemonorops jenkinsiana (Griff.) Mart)



1. Observation site of D. jenkinsiana;
2. Habit;
3. Knee;
4. Infructescence and fruits;
5. Leave showing arrangement of leaflets.

15 9.3 Korthalsia Bl.

Description

Habit: slender to robust clustering; high-climbing hermaphrodite rattans, frequently branching in the canopy.
Sheath spine: sparse to moderately dense.
Knee: absent.
Ocrea: fibrous; net-like, .
Climbing organ: cirrus present.
Leaf: petiole short; leaflets sparsely and regularly arranged; diamond-shaped; margin erose; surface with many veins; plicate; glabrous; often with grey cuticle on below surface.
Inflorescence: produced simultaneously in the axils of the uppermost; reduced leaves; the stem dying after fruiting. Inflorescences branch to produce pendulous catkin-like; flower bearing branches; each covered in a tight or loose spiral of bracts. Flowers bisexual; subtended by bracts with a dense mass of hairs; sepals 3; petals 3; much longer than sepals; short tubular at base; stamens 6 or rarely 7; borne on petals; ovary with sharp; pyramid-shaped stigma; and rows of scales.
Fruit: fruits with stigma, surrounded by the remains of the corolla; scale brownish arranged in neat vertical rows; sacotesta, fleshy, sweet.
Seed: ruminate or homogeneous.

There are approximately 26 species, all of which occur in Southeast Asia, ranging from Myanmar and Indo-china to New Guinea. Only one species has been recorded in Cambodia so far.

It is the easiest recognizable species of all taxa through many characters such as fibrous and net-like ocrea and the shape of leaflet. Its inflorescence is also distinct from other genera but rarely seen.

16 **Korthalsia laciniosa** Mart.

Local name: Preah Phdao (Phdao Krahorm)
Synonym: *Calamosagus harinifolius* Griff., *Calamosagus laciniosus* Griff., *Calamosagus wallichiifolius* Griff., *Korthalsia andamanensis* Becc., *Korthalsia grandis* Ridl., *Korthalsia scaphigera* Kurz, *Korthalsia teysmannii* Miq., *Korthalsia wallichiifolia* (Griff.) H. Wendl.

Description

Habit: clustering; climbing rattan; branching; up to ca. 80 m long.
Leaf sheath: 1.5-6 cm diameter; pale green in middle section.
Sheath spine: 0.7-1 cm long; sparsely scattered on sheath; swollen at base; cone-line shaped; hard; base dark brown; tip black.
Knee: absent.
Ocrea: 10 - >30 cm long, fibrous; net-like; grey, spine sparsely present.
Climbing organ: cirrus 35-130 cm long.
Leaf: 70-230 cm; petiole 7-32 cm long; rachis 60-210 cm long; petiole: side above shallow channel; back surface sparsely spiny; covering cuticle; apex ended with cirrus. Leaflet regular; 7-10 on each side. Leaflet on middle rachis: petiole 1-3 cm long; blade 16-40 x 9-21 cm; base cuneate; margin entire half below; erose half above; apex acute-acuminate; veins 5-16, prominent; blade surface plicate; indumentum absent; light to dark green on above surface; grey on lower surface.
Cane: 1.4-2.5 cm diameter; red; durable and poorly flexible. Usually categorized as a large diameter cane.
Inflorescence: bisexual; up to 75 cm long; erect.
Fruit: 2 x 2 cm; globose; scale brown when ripe; with wide pale margins.
Seed: ruminate.

Field note: this species can be recognized via its particular fibre ocrea, irregular leaflet arrangement, rhomboid-shaped and plicate leaflet and erose margin of leaflet. *K. laciniosa Mart.* is identical to *K. bejaudii* Gagnep, and thus hard to be distinguished. According to Rattan of Lao PDR, ocrea of *K. bejaudii* is as long as 4 cm long, which is far shorter than *K. laciniosa*. Recent rattan research across the country has found only plant with its ocrea more than 10 cm long upward, which is confirmed belonging to *K. laciniosa*. Only future molecular study may confirm if they are different or the same.
Growth: unknown
Location: it can be seen across the country.
Habitat: semi-evergreen forest to evergreen forest with high rainfall.
Altitude: from sea level to 500m.
Use: it is used for the frames of furniture.
Trade: it is extensively collected for trade and exportation. A 4-5 m cane is 450-1000 riel, and rarely up to 1800 riel.

Korthalsia laciniosa Mart.

1. Observation site of *C. laciniosa*;
2. Furniture made of *K.ladniosa*
3. Habit;
4. Absence of knee and net-like ocrea;
5. Leave showing arrangement of leaflets.

17 9.4 Myrialepis Becc.

Description

Habit: robust clustering high-climbing dioecious hapaxanthic rattans.
Sheath spine: sheath spine in long and curved row.
Knee: absent
Ocrea: tiny; inconspicuous.
Climbing organ: cirrus present.
Leaf: petiole present; leaflet grouped or regular; leaflet linear-elliptic.
Inflorescence: bract subtended branch. Male inflorescence small; calyx 3 lobed; small; 3 petals; 6 stamens; joined in a cup-shaped; attached to petal; pistil minute. Female inflorescence robust; calyx 3-lobed; large; petal 3-lobed; large; stamens 6 joined at base; anther sterile; ovary globose; stigma 3.
Fruit: globose; scale small; deflexed; stamen absent.
Seed: not ruminate.

One species in Laos, Cambodia, Vietnam, Thailand, Myanmar, Malaysia Peninsular and Sumatra.

This genus is similar to *Plectocomia* Becc., but has shorter sheath spines, bristles on the margin of leaflets are absent, and the fruit has stigma. It is also similar to *Plectocomiopsis* Becc. but the sheath spines are not in rows, although sometimes in groups of a few spines.

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

Local name: **Phdao Reussey (Tresh Chheu)**
Synonym: *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.

Description

Habit: clustering; climbing rattan; up to 30 m long.
Leaf sheath: ca. 2-6 cm diameter; green with light brown cuticle when young; wearing off when matures.
Sheath spine: base of spine connate together; arranged as comp or vertical line; short or long; upward or downward pointing; up to ca. 4 cm long; light green-yellow to green-brown, tip light brown.
Knee: absent.
Ocrea: 0.2-0.4 cm long, brown.
Cirrus: 50-150 cm long.
Leaf: 105-240 cm long: petiole 12-32 cm long; rachis 92-211 cm long; apex terminating in a cirrus; petiole broadly channeled; spines absent on upper surface; present on margin and lower surface. Leaflets grouped or sometimes slightly regular; 14-20. Leaflet of middle rachis 35-70 x 2-4.5 cm; base cuneate; margin brown stripe on one side; sparsely bristled; apex narrowly acuminate; mid vein prominent; hair absent on both surfaces; white dots on below surface.
Cane: 1.2-2.1 cm diameter; internode 12-27 cm long; core soft; poorly flexible.
Inflorescence: 0.6-2 m long; erect; primary bract entire; tightly sheathing; unarmed; female inflorescence 3-branched; rachillae less than 3 cm long; male inflorescence 3-branched.
Fruit: 2.5 x 2.5 cm; scales tiny; grey-green.
Seed: not ruminate.

Field note: the prominent character of this species is the spines (long or short) comparranged line and absence of beak on fruits. The other important characters are bristles on the margin and a smooth surface on both sides of the leaflet.
Growth: 0.7-1.2 m per year.
Location: this species can be found throughout Cambodia.
Habitat: its habitat range is broad from severely degraded forest to semi-evergreen forest.
Altitude: to ca. 300 m.
Use: the cane has a soft core and hard bark which can not be bent. It is used as a frame for lower quality furniture (mainly for local use).
Trade: in the southwestern part of Cambodia, it is collected for sale to local handicraft makers for the production of furniture. It is not suitable for export. A 4-5 m cane is 600-1000 riel, and rarely 300 riel or up to 1300 riel.

Myrialepis paradoxa (Kurz) J. Dransf.

1. Observation site of *C. paradoxa*;
2. Bookshelves made of *C. paradoxa*; 3. Habit;
4. Absence of knee, net-comb arranged spines, and tiny ocrea,
5. Leave showing arrangement of leaflets.

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9.5 Plectocomia Mart. ex Bl.

Description

Habit: moderate to robust; solitary or clustering high-climbing dioecious hapaxanthic rattans. Sheath spine: short or long row; spines short to long.
Knee: absent.
Ocrea: tiny; inconspicuous.
Climbing organ: cirrus.
Leaf: petiole absent or present; irregularly grouped arrangement of leaflet; terminating with cirrus. Leaflet with cuticle on back surface; entire margin; indumentum absent on both surfaces of leaflet.
Inflorescence: male and female inflorescence superficially similar; produced simultaneously from the topmost nodes; bracts subtending and almost subtending branches; bearing flowers. Male flowers with short calyx; terminating in 3 teeth; 3 petals; almost free to the base; 6 stamens; attached to petal; pistil minute. Female flower with calyx; terminating in 3 lobes; 3 petals; free almost to the base; pistil with hair-like scaly ovary and 3 stigmas.
Fruits: with hair-like scales; 3 stigmas; reflexed scale; mesocarp quite thick.

It is similar to *Myrialepis* at first glance, especially in its comb-like spine arrangement on the sheath. However, *Plectocomia* lacks bristles on leaflet margins and surfaces, which are present in *Myrialepis*. Fruits of Plectocomia have long stigma, which is absent for *Myrialepis*. See the *Plectocomiopsis* section for the comparison of the two taxa.

There are approximately 16-18 species, distributed in the Himalayas, South China and Southeast Asia. There are only two species in Cambodia, both of which are probably new records for Cambodia.

Key to species of Plectocomia

A1 Leaf sheaths ≠ 4 cm diameter; sheath spines oblique ridges, to ca. 4 cm long; petioles ≠ 10 cm long, fruit scale spiny.....*Plectocomis elongata*

A2 Leaf sheaths £ 4 cm diameter;
sheath spines scattered, £ 2 cm long; petioles £ 10 cm long, fruit scale smooth .....*P. pierreana*

20 Plectocomia elongata Mart. & Blume

Local name: Phdao Reussey Yeak (also called Phdao Dambang in the south and southwest
Synonym: *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.

Description

Habit: clustering; climbing rattan; 30-40 m long.
Leaf sheath: 4-10 cm diameter; green.
Sheath spine: arranged in line; spine up to ca. 4 cm; or rarely to 4.5 cm long; base connate; light green; needle-like; light brown; tip dark brown.
Knee: absent.
Ocrea: tiny.
Climbing organ: cirrus 70-90 cm long.
Leaf: petiole 20-30 cm long; deep channel; rachis apex with cirrus. Leaflets in groups of 2-3 on each side; leaflets of middle rachis 44-55 x 3-4 cm; base cuneate; margin non-spiny; apex narrowly acuminate; mid vein prominent; indumentum absent on both leaflet surfaces; glossy green on above surface; white cuticle on underneath.
Cane: 3-5 cm diameter, internode 10-25 cm long, poorly durable and flexible.
Inflorescence: inflorescence bearing 2 branches. Primary branches 55-65 cm long; primary bract to 10 cm long; dark brown; subtended peduncle. Secondary bract arranged in opposite row; 4-6 x 4-6 cm; boat-shaped; subtended branches of 3-4 flowers; inflated in hard sheet when fruit in mature.
Fruit: fruits 2 x 2 cm; oval; scales not channel; dense bristles; brown; apex with 3 beaks of 1-1.5 cm long.

Field note: *P. elongatata* contains certain characters which make it easy to be differentiated from *P. pierreana*. These characters include bigger cane, longer sheath spines and bristly scales on the fruits. It is the largest cane species with hard skin and a soft core. In the south and southwest, this species is, (due to its big cane), called Phdao Dambang, which could be easily confused with *C. rudentum,* if the botanical name is given on the basis of only the local name without a field check.
Growth: its growth rate is not known.
Location: it inhabits evergreen hills or montane forest in Kampot, Kampong Speu, Koh Kong and Pursat provinces, which are located in the south west of the country.
Habitat: semi-evergreen to evergreen forest.
Altitude: 500-1100 m.
Use: its cane is rarely used except for frames of chairs, tables, beds etc., for local communities.
Trade: a 4-5 m cane is 1500 riel at Veal Renh rattan factory. It is collected mainly for local use and not for export.

Plectocomia elongata Mart. & Blume

1. Observation site of *C. elongata*;
2. Absence of knee and spines arrangement;
3. Infructescence and leaves showing arrangement of leaflets;
4. Fruits.

21 Plectocomia pierreana Becc.

Local name: Chang O (Tresh Amboh, Phdao Reussey Msao)
Synonym: *Plectocomia cambodiana* Gagnep.; *Plectocomia barthiana* Hodel.

Description

Habit: clustering; climbing rattan; to 30 m long.
Leaf sheath: 1.5-3.5 cm diameter; green with brown cuticle when the stem is immature.
Sheath spines: in short or sometimes long rows; up to 1-2 cm long; connate at base; light green-brown at base; dark orange or light brown; with black tip; pointing in all planes.
Knee: absent.
Ocrea: 0.2-0.3 cm long, dark grey; indumentum absent.
Climbing organ: cirrus 30-70 cm long.
Leaf: 55-121 cm long: petiole 4-9 cm long, channeled; spines absent on channeled side; sparsely present on under side; rachis 45-115 cm long; apex terminating in a cirrus. Leaflets not strongly grouped; in groups of 2-3 on each side; leaflets of mid rachis 13-30 x 3-4.5 cm; elliptic; base cuneate; margin entire; apex narrowly acuminate; veins distinct; surface above glossy green; under surface white cuticle; indumentum absent.
Cane: 0.8-2.9 cm diameter; internode 11-24 cm long; core soft; poorly durable and flexible.
Inflorescence: 0.5-1 m long; branch pendulous; up to 70 cm long; primary bract entire; slightly inflated; unarmed; secondary bract overlapping; expanded to covered rachillae; male and female 2-branched.
Fruit: 2 x 2 cm, globose; mature scale green with red margin.

Field note: this species can be easily recognized by a number of characters, such as small sheath, short spines and smooth scales of the fruit.
Location: scattered throughout forest areas of Cambodia.
Habitat: disturbed semi-evergreen forest to evergreen forest.
Altitude: about sea level to ca. 500 m.
Use: its cane is used for handicrafts and low quality furniture.
Trade: a 4-5 m cane is 150-220 riel. It is mainly collected for domestic use but not for export.

Plectocomia pierreana Becc.

1. Observation site of *C. pierreana*;
2. Habit;
3. Absence of knee, spines arrangement, and tiny ocrea;
4. Leave showing arrangement of leaflets;
5. Fruits.

22 9.6 Plectocomiopsis Becc.

Description

Habit: clustering; high-climbing rattans.
Sheath spines: sheath spines scatter; sometimes connate at base in very short row of few spines.
Knee: absent.
Ocrea: tattering sometimes well developed.
Climbing organ: cirrus
Leaf: leaflets regularly arranged in one plane, with bristly margins.
Inflorescences: produced simultaneously in the axes of uppermost leaves. Male and female superficially similar; primary axes branching to 1-2 orders; rachillae bearing tubular triangular-tipped bracts each subtending clusters of 2-7 flowers. Male flowers with tubular calyx; 3 triangular lobs; connate at base; stamens 6 jointed to the petals. Female flowers with tubular calyx; 3 very short obtuse lobs; corolla 3-lobbed; stamens 6; attached to stigma; 3 small; divergent stigma on ovary tip. Calyx enlarging, splitting irregularly and persisting to mature fruit.
Fruit: mature fruit with minute stigma; with many somewhat irregular; vertical rows of scale.
Seed: with thin sacostesta.

This genus is superficially similar to *Plectocomia*. However, this genus is able to be recognized by a number of characters, including the scattered spine arrangement on leaf sheath, bristly margin of the leaflets, absence of cuticle on lower surface of leaflet, and minute stigma on fruit.

There are 5 species in the world, confined to Southeast Asia (Cambodia, Laos, Thailand, Malaysian peninsular, Borneo and Sumatra). Cambodia has one species. It is not used much for handicraft and furniture because of its poor quality.

23 Plectocomiopsis geminiflora (Griff.) Becc.

Local name: Phdao Teang Oa, Phdao Thngae
Synonym: *Calamus geminiflorus* Griff., *Calamus turbinatus* Ridl., *Plectocomia geminiflora* (Griff.) H. Wendl., *Plectocomiopsis geminiflora* var. *billitonensis* Becc., *Plectocomiopsis geminiflo*ra var. *borneensis* Becc.

Description

Habit: clustering; climbing rattan; up to ca. 30 m long.
Leaf Sheath: 1.5-3 cm diameter; green.
Sheath spine: moderately sparse; individually scattered; 1-3 cm long; spine at sheath mouth up to 4 cm long; spines needle-shaped; thin, not hard; light greenish yellow.
Knee: absent.
Ocrea: 3-5 cm long; grey; dry and tattering.
Climbing organ: 70-120 cm long.
Leaf: 80-150 cm long, petiole 2-13 cm long; rachis 70-146 cm long; petiole not channel; spine absent on upper surface; spine in row on back surface; leaf apex ended with cirrus. Leaflet regular; 15-30 on each side. Leaflets on middle rachis 25-30 x 2-3.5 cm; linear-elliptic; base cuneate; margin bristly; apex acuminate; mid vein prominent; upper surface sparse bristles, below surface glabrous.
Cane: 1-1.5 cm diameter; internode 8-27 cm long; core soft; poorly durable and flexible.
Inflorescence: unknown.
Fruit: unknown.
Seed: unknown.

Field note: two main characters of this species, consisting of scattered spiny arrangement on the leaf sheath, and the presence of bristles on leaflet margins, easily distinguish it from *Plectocomia spp*. There are two samples collected from two different places - Sre Ambel district, Koh Kong province and Keo Seima district, Mondulkiri province.
Growth: 1.5-2 m per year.
Location: Keo Seima district, Mondulkiri province and Dang Peng commune, Sre Ambel district Mondulkiri province.
Habitat: mixed bamboo-semi-evergreen forest and evergreen forest.
Altitude: 100-250 m.
Use: it is not used for any kind of product, as its quality is poor and better quality cane from other species is available in the study area.
Trade: there is no local or international trade of this species.

Plectocomiopsis geminiflora (Griff.) B ecc.

1. Observation site of *C. geminiflora*;
2. Habit;
3. Absence of knee, disorder arranged spine, and tiny ocrea;
4. Leave showing arrangement of leaflets.

Glossary

Acuminate	: narrowing gradually to a point.
Anther	: part of the stamens that produce pollen.
Awn	: a bristle-like appendage, sometimes occurring at the leaflet apex.
Bract	: a much-reduced leaf, associated with inflorescences.
Calyx	: (pl. calyces) the outer perianth, composed of free or united sepals.
Cirrate	: bearing cirrus.
Cirrus	: an extension of the leaf rachis, armed with reflexed thorns.
Connate	: united with a similar part as stipules, bracts or stamens.
Corolla	: the inner perianth, composed of free or united petals.
Cuneate	: wedge-shaped.
Dioecious	: having male and female flowers on different plants of the same species.
Flagellum	: a sterile inflorescence modified as a climbing organ.
Hapaxanthic	: the terminal flowering of the stem in which the stem is terminated by the production of inflorescence.
Indumentum	: the covering of hairs or scales.
Inflorescence	: the arrangement of flowers on the floral axis; the flower cluster.
Knee	: a swelling of the leaf sheath just below the petiole.
Leaflet	: a leaf-like segment of a compound leaf.
Leaf sheath	: the lower part of leaf stalk which more or less encloses the stem.
Linear	: long and narrow with parallel sides.
Lobe	: any division of any organ, especially if the part is round.
Margin	: sides of leaf or petiole.
Obtuse	: blunt or round at the end.
Ocrea	: an extension of the leaf sheath beyond the insertion of the petiole.
Ovary	: the lower part of a carpel which contains the ovules.
Petals	: a single segment of the corolla.
Petiole	: a leaf stalk.
Pistil	: a single carpel in a free-carpel flower, or gyneocym in united-carpel flower.
Pleonanthic	: axial flowering in which the life of a stem in not ended.
Rachillae	: a secondary axis of all rattan inflorescence.
Rachis	: the axis of a compound leaf or inflorescence.
Sacostesta	: a fleshy seed coat.
Scale	: a thin, hard and shiny membrane, covering fruit.
Sheath	: see leaf sheath.
Solitary	: grow or born singly.
Stamen	: one of the male sex organs, usually consisting of anther, connective, and filament.
Stigma	: apex of the style, on which the pollen grains alight and germinate.

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