REVISION OF CALAMUS AND DAEMONOROPS (ARECACEAE) IN SULAWESI

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SCHOOL OF POSTGRADUATE STUDY
BOGOR AGRICULTURAL UNIVERSITY
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2011
STATEMENT OF RESEARCH ORIGINALITY AND INFORMATION SOURCE

I, Himmah Rustiami, certify that this dissertation entitled: Revision of *Calamus* and *Daemonorops* (*Arecaceae*) in Sulawesi is my original work and has not been submitted in a previous application for higher degree.

Bogor, January, 2011

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ABSTRACT

HIMMAH RUSTIAMI. Revision of Calamus and Daemonorops (Arecaceae) in Sulawesi, supervised by SRI S. TJITROSOEDIRDJO, JOHANIS P. MOGEA, JOHN DRANSFIELD and MIEN A. RIFAI

There are three genera of rattan occur in Sulawesi, Calamus, Daemonorops and Korthalsia -which only have one single widespread species Korthalsia celebica. The rattan genus Calamus and Daemonorops are treated in this study as a common rattan genera occur in Sulawesi. Those two genera comprises of 28 and 7 species respectively. Six species are newly recognized: C. perpendiculus, C. rosetus, C. lorelinduensis, C. ahlidurii, D. mogeana and D. takanensis. A revised taxonomy is presented for the rattan genus Calamus of Sulawesi. The study is based on the recent collections from Sulawesi together with examination of existing herbarium specimens from Sulawesi. On the basis of morphological comparisons there are twenty eight species of Calamus occurred in this region. All those species belong to several groups of Beccari’s and most of the species belong to group XV where leaves cirrate or not, leaflets elongate, leaf sheath eflagellate, primary bracts tubular - tattering in age, rachilla pedicellate, involucrophorum sessile, endosperm homogenous or ruminate. Calamus pedicellatus has been assigned as synonymy of C. inops mainly because of better understanding of the range variation in specimens. Three names of uncertain application are discussed. C. zollingeri, giant rattan of East Indonesia which mostly used and exported as furniture, has very wide distribution all over Sulawesi. Based on phenetic analysis of morphological characters of seven species indicates that there are two main groups of Daemonorops in Sulawesi with an overall coefficient similarity ranges from 0.51–0.81. This value means the two groups have similarity about 51%–81%. D. takanensis and D. lamprolepis placed in one clade where these two species have coefficient similarity value 0.58. This group is characterized by the present or absent of the ocrea. Whereas group B divided into two subgroups, B1 and B2, with coefficient similarity value 0.59. This subgroup is characerized by their leaf sheath armature, absent or present of indumentum, fruit shape and type of endosperm. D. macroptera and D. mogeana are clustered in one clade and have morphological similarity around 81%. Both species possess some similarities on their leaf sheath armature. They are however different in their inflorescence and endosperm. Within seven species of Daemonorops occur in Sulawesi D. takanensis and D. mogeana confirmed as new species. Identification key, species description, distribution, conservation status and uses of Calamus and Daemonorops were discussed in this study.

Keywords: Revision, Calamus, Daemonorops, morphology, distribution, conservation status, uses, Sulawesi.
ABSTRAK

HIMMAH RUSTIAMI. Revision of Calamus and Daemonorops (Arecaceae) in Sulawesi, dibawah bimbingan SRI S. TJITROSOEDIRDJO, JOHANIS P. MOGEA, JOHN DRAŃSFIELD dan MIEN A. RIFAI


Kata kunci: Revisi, Calamus, Daemonorops, morfologi, distribusi jenis, status konservasi, pemanfaatan, Sulawesi.
SUMMARY

HIMMAH RUSTIAMI. Revision of *Calamus* and *Daemonorops* (*Arecaceae*) in Sulawesi, supervised by SRI S. TJITROSOEDIRDJO, JOHANIS P. MOGEA, JOHN DRANSFIELD and MIEN A. RIFAI

The rattans of Sulawesi presented by three different genera *Calamus*, *Daemonorops* and *Korthalsia*. *Calamus* and *Daemonorops* belong to subtribe *Calaminae* whereas *Korthalsia* belongs to subtribe *Korthalsiinae*. In Sulawesi *Calamus* is the biggest rattan genus with the number of species more than 23. This genus is very common tropical genus with the centre of diversity is in South East Asia. In Sulawesi *Daemonorops* consist of 7 species, whereas *Korthalsia* has one species only that is *K. celebica*, endemic species to Sulawesi. Recently the biodiversity of Sulawesi has been under severe threats caused by increasing large scale deforestation projects. Many commercial rattans has been illegally harvested and used as raw material for rattans industry. This alarming fact has ecological impact to the rattans of Sulawesi in the form of imminent massive of biodiversity lost. This situation is very true especially for the rattans because almost all species are climbers and they need trees to support their existence. With the intention to minimize the threat to the existence of the rattans of Sulawesi, basic study on the rattans taxonomy is needed as well as accurate documentation. Definite species delimitation is essential to be studied as the diversity continuously under threats and decreased.

The Sulawesi rattans is poorly studied, although some of the more widespread species are taxonomically well known such as *Calamus inops* complex or locally known as ‘Rotan Tohiti’. A herbarium specimen study as well as recent field collection made in Sulawesi difficult to identify using existing taxonomic sources. This was partly due to inadequate knowledge of the Sulawesi rattan flora or perhaps the early taxonomic account had often been written with inadequately if any specimens or many of the new specimens were infertile.

The aim of this study is to revise rattans in Sulawesi includes *Calamus* and *Daemonorops*, to discover new species and new record of rattans in Sulawesi and to identify rattans distribution in Sulawesi. This study can be used as basic information of the rattans diversity in Sulawesi. Moreover, this floristic study can be used in purpose of rattans identification which supported rattans conservation.

As a result of the revision study of *Calamus*, there were twenty eight species of *Calamus* occurred in Sulawesi. Four species recorded as new, *Calamus perpendiculus*, *Calamus rosetus*, *Calamus lorelinduensis* and *C. ahlidurii*. One new species, *Calamus ahlidurii* Fernando, is published here based on the determination note of Fernando on the herbarium specimen.

In the case of *Daemonorops*, all seven species recognized are endemic to the island. The genus *Daemonorops* itself is not well collected and poorly represented further east. Until recently, five species of *Daemonorops* were recorded for Sulawesi. A further two species have been recognized and described as a result of recent fieldwork so there are 7 species in total. Based on phenetic analysis of morphological characters of seven species indicates that there are two main groups of *Daemonorops* in Sulawesi with an overall coefficient similarity ranges from 0.51–0.81. This value means the two groups have similarity about
51%–81%. D. takanensis and D. lamprolepis placed in one clade where these two species have coefficient similarity value 0.58. This group is characterized by the present or absent of the ocrea. Whereas group B divided into two subgroups, B1 and B2, with coefficient similarity value 0.59. This subgroup is characterized by their leaf sheath armature, absent or present of indumentum, fruit shape and type of endosperm. D. macroptera and D. mogeana are clustered in one clade and have morphological similarity around 81%. Both species possess some similarities on their leaf sheath armature. They are however different in their inflorescence and endosperm. Within seven species of Daemonorops occur in Sulawesi D. takanensis and D. mogeana confirmed as new species.

Of all thirty six species of rattans in Sulawesi, thirty one species are endemic to the region and five species are having more wide distribution. From thirty one endemic species; 8 species have relatively wide distribution (C. inops, C. koordersianus, C. leptostachys, C. macrosphaerion, C. minahassae, C. scleracanthus, C. zollingeri, K. celebica – where C. minahassae, C. zollingeri and K. celebica can be found all over Sulawesi) and the rest of the species have limited distribution or restricted to the certain area in Sulawesi. Another reason why such species has narrow distribution related to vicariance event where the splitting or division of taxon through the development of a natural biogeographical barrier. Five species of Calamus reported have wider distribution across Sulawesi (i.e. C. mindorensis, C. ornatus var. ornatus, C. subinermis, C. symphysipus and C. robinsonianus). C. ornatus var. ornatus has wide areas of distribution and are also widely cultivated compared to other species of Calamus from Sulawesi. This species has bimodal distribution because it can be found in West and East of Wallace line. Another species which has bimodal distribution is C. subinermis because this species occurred in North of Borneo and North Sulawesi. C. symphysipus can be found in all over Sulawesi and up to the Phillipine. C. mindorensis is new record in Sulawesi because it was found only in Philippines but based on new herbarium specimens this species also found in Central and South East of Sulawesi. Whereas C. robinsonianus was first reported only occurred in Mollucas but recent study showed that this species also occurred in South East of Sulawesi.

Most of commercial rattans in Sulawesi have restricted areas of distribution however – despite of illegal harvesting, the environmental pressure around their natural habitat are very high. Eventhough the conservation status of those species could not be addressed because only few herbarium data available so far, but at least from this study suggested that all those species has potential threats and more populations and distribution data are required to assess the conservation status of those species.

In general the cane of commercial rattans from Sulawesi used for the furniture industry. Their cane ideal for binding purposes and their smooth cane surface highly suitable for weaving, matting and fine basket-ware after splitting. It has been widely known that some of commercial rattans from Sulawesi have good cane value for export and local use. For local use, local people has an astonishing variety or carrying baskets, hats, sleeping mats, tobacco pouches and other woven items made from a variety of species. C. zollingeri, giant rattan of East Indonesia which mostly used and exported as furniture, has very wide distribution all over Sulawesi.
Other part of rattan such as its fruit also reported has potential value. Local people in Kulawi, Central Sulawesi used to eat fruit of *Calamus ornatus* var. *ornatus* which has very sour taste. The fruit-flesh of most species of rattan is edible and be used as tamarind substitution. Usually it is sour and bitter, but in other species may be sweet and good to eat. Young shoot of *Daemonorops mogleana*, *C. zollingeri* and *D. robusta* are edible and have sweet taste. Local people in Kulawi also used this young shoot for vegetable substitution because it has asparagus taste-like.

**Keywords:** *Calamus, Daemonorops*, revision, morphology, distribution, conservation status, uses, Sulawesi.
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REVISION OF CALAMUS AND DAEMONOROPS (ARECACEAE) IN SULAWESI

HIMMAH RUSTIAMI

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Bogor, January 2011

Himmah Rustiami
CURRICULUM VITAE

Himmah Rustiami was born on 05 June 1971, in Malang, East Java, as the eight daughter from ten children from father H. M. Suyuti Cholil, SH and the late Hj. Rosida Arief Tirtohusodo. She graduated from Brawijaya University in 1995. She has been working as researcher at Indonesian Institute of Sciences since 1996. In 1997 she was admitted to Master Degree program and studied plant and fungal taxonomy in School of Plant Sciences, University of Reading, England sponsored by World Bank through GEF project.

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GENERAL INTRODUCTION

Background

The rattans (derived from the Malay word *rotan*) are spiny climbing palm belongs to sub family *Calamoideae*. They are all included in the tribe *Calameae*. The *Calamoideae* is the second largest palm subfamily, in terms of numbers of species, containing around 650 species in 22 genera distributed throughout the wet tropical regions of the world (Baker *et al.* 1999). This subfamily is particularly diverse in Western Malesia and neighbouring parts of Southeast Asia. *Calamoid* palms are well defined as they possess a suite of morphological characters that are unique in the family (Dransfield *et al.* 2008). Member of this sub family can be easily recognized by having overlapping scales covering the fruit. This fruit scale is arranged regularly in the vertical line such as in *Salacca* fruit (Dransfield *et al.* 2008).

Mostly species of *Calamus* are used for a great variety of purposes. Rattans strength and their great flexibility are ideal for binding purposes. People living near the forest may have uses almost all the species encountered and only few species enter world trade in rattan’s furniture industry (Dransfield 1992c). Other uses are ranging from thatch to medicine. The red resin of *Daemonorops draco* and its allied species reported as natural colouring, medicine and other domestic uses (Rustiami *et al.* 2004).

The information of Sulawesi rattans is very limited. The rattans of Sulawesi presented by three different genera *Calamus*, *Daemonorops* and *Korthalsia*. *Calamus* and *Daemonorops* belong to subtrbe *Calaminae* whereas *Korthalsia* belongs to subtrbe *Korthalsiinae*. In Sulawesi *Calamus* is the biggest rattan genus with the number of species more than 23 (Mogea 2002). This genus is very common tropical genus with the centre of diversity is in South East Asia. Many species of *Calamus* has been known as a good furniture material. The differences between *Calamus* and *Daemonorops* is *Calamus* has tubular bract in the inflorescence not easily fall off whereas in *Daemonorops* has cymbo-like bract that easily fall off. *Korthalsia* differs with other two genera because it has rhomboid leaflets dentate in its apex. In Sulawesi *Daemonorops* consist of 7
species, whereas *Korthalsia* has one species only that is *K. celebica*, endemic species to Sulawesi. Considering large area of study to be covered, the possibility to find new species and new record is tremendous. An example of this is *Calamus suaveolens* newly described seven years ago (Baker & Dransfield 2004). This information support hypothesis the possibility of other new species can be appeared.

Recently the biodiversity of Sulawesi has been under severe threats caused by increasing large scale deforestation projects, land-clearings, re-settlements, coffee and cacao plantation, paddy fields and other kinds of threats (Holmes 2000). Besides that, many commercial rattans has been illegally harvested and used as raw material for rattans industry. This alarming fact has ecological impact to the rattans of Sulawesi in the form of imminent massive of biodiversity lost. This situation is very true especially for the rattans because almost all species are climbers and they need trees to support their existence.

With the intention to minimize the thread to the existence of the rattans of Sulawesi, basic study on the rattans taxonomy is needed as well as accurate documentation. Definite species delimitation is essential to be studied as the diversity continuously under threats and decreased.

**Objectives of the study**

The aim of this study is to revise rattans in Sulawesi includes *Calamus* and *Daemonorops*, to discover new species and new record of rattans in Sulawesi and to identify rattans distribution in Sulawesi. This revision study consists of two main courses: (1) Revision of *Calamus* in Sulawesi, (2) Revision of *Daemonorops* in Sulawesi. The main courses would be accomodating in the next following chapters.

This study can be used as basic information of the rattans diversity in Sulawesi. Moreover, this floristic study can be used in purpose of rattans identification which supported rattans conservation.
REVISION OF THE GENUS CALAMUS (ARECACEAE) FROM SULAWESI

Introduction

Whether the objective is for protection, better harvesting or cultivation, a functioning taxonomic base is essential to the process of managing Sulawesi rattans. However, a herbarium specimens study as well as recent field collection made in Sulawesi difficult to identify using existing taxonomic sources. This was partly due to inadequate knowledge of the Sulawesi rattan flora or perhaps the early taxonomic account had often been written inadequately if any specimens or many of the new specimens were infertile.

Revision study of the rattans of Sulawesi since 2006 began. The aim was to develop an improved taxonomic system and simultaneously gather information on aspects such as habitat, uses and vernacular name. As a result of the revision study there were twenty eight species of *Calamus* occur in Sulawesi. Four species recorded as new, *Calamus perpendiculus*, *Calamus rosetus* and *Calamus lorelinduensis*. One new species with nomen nudum, *Calamus ahlidurii* Fernando, is published here based on the determination note of Fernando on the herbarium specimen. Many other taxonomic changes were also required and so there was a clear need for updated, unified account of the Sulawesi rattan flora especially for the genus *Calamus* presented here.

The *Calamus* of Sulawesi as a whole is poorly known, although some of the more widespread species are taxonomically well known such as *Calamus inops* and its allied species. The magnificent monographic work of Beccari (1911; 1913; 1914) has been used for any study on *Calamus* of Sulawesi. More recent work on the rattans of Sulawesi especially smaller group within *Calamus* also received more global treatments (Kramadibrata 1992a).

The genus *Calamus* was described by Linnaeus in his Species Plantarum published in 1825, based on a single species which he named *Calamus rotang* Linnaeus. *Calamus* is Latin name for a reed. This name reflects the long climbing stem (Dransfield 1984). *Calamus* with about 374 species is the largest rattan genus. It belongs to the subtribe *Calaminae*, tribe *Calameae* of the palm
subfamily Calamoideae. It has very wide distribution, occurring in the humid tropics of Africa, India, Burma and South China through the Malay Archipelago to Queensland and Fiji. The richest diversity and greatest number of species is in the Sunda Shelf especially Borneo (Dransfield et al. 2008).

Previously the taxonomic account for Calamus of Malesia region including Sulawesi was based on monographic work of Beccari (1911; 1913; 1914). Beccari divided Calamus into sixteen groups based on the present or absent cirrus and flagella, armature of the leaf sheath and the structure of inflorescence. Furtado recognized seventeen species of Calamus where eight species reported as new species (1935). In 1956, Furtado divided Calamus into six sections based mainly on the present or absent of cirrus and flagellum, leaf sheath armature, rachilla and involucrophores. Kramadibrata treated small group within Calamus that is Calamus inops and its relatives (1992a) and recognised four species of this group. Additionally, Kramadibrata also studied Calamus section Macropodus sensu Furtado (1992b) and proposed two new groups – group XVII and XVIII (C. inops group). In 1992, Dransfield & Baker described one new species from Sulawesi, Calamus suaveolens. Floristic study of palms in Rawa Aopa National Park carried out by Sabilu (1999) and he reported eight species of Calamus occurred in this area (i.e. C. inops, C. koordersianus, C. leiocaulis, C. leptostachys, C. ornatus, C.ortostachyus, C. symphysipus and C. zollingerii). More recently a preliminary study on the palm flora of the Lore Lindu National Park in Central Sulawesi conducted by Mogea (2002) and he found four species of Calamus (i.e. C. inops, C. ornatus, C. symphysipus and C. zollingerii).

**Materials and Methods**

Field work had been done in several areas of Sulawesi to collect herbarium material. Herbarium specimen preparation followed standard procedure of Dransfield (1986). Data or information recorded from the field include location; general habitat; altitude; association with other plant; vernacular name; uses; habit (solitary/clustered); stem (height, diameter with/without leaf sheath, internode length, colour); leaves (length, leaflets arrangement, number of leaflets, length and width of leaflets); inflorescence (length, number of rachilla, colour); flower
(colour, scented/not scented); fruit and seed (length and width, colour). Field work data combined with herbarium data of each taxon to get comprehensive data set for morphological data comparation. Morphological comparative study had been done in several herbaria: Herbarium Bogoriense (BO) in Bogor, Herbarium Kewense (K) in Kew, United Kingdom and Herbarium Leiden (L) in Leiden, Netherland. Around 1500 herbarium specimens were studied based on their morphological similarity following de Vogel (1987) and Rifai (1976) using comparative morphology data as main source, especially in developing species concept (Davis & Heywood 1963; Dransfield 1999).

Results and Discussions

Morphology

Habit

All species of Sulawesi rattans are climbing plants; some species climb high into the forest canopy while others climb rather weakly or scramble in the forest undergrowth. Some rattans are solitary-stemmed (such as in *Calamus symphysipus*), while others clustered (such as in *C. minahassae*).

Stems

Most *Calamus* in Sulawesi have multiple, long, woody, flexible, unbranched stems arising from a single rootstock. In some species the stem form a short erect trunk. The rattan stems range from a few millimeters to over 6 cm in diameter (Figure 1).

![Stem of C. scleracanthus](image1) has up to 8 mm in diameter (A) compare with stem of *C. ahlidurii* has 6 cm in diameter (B).
Leaves

Each section of stem (or internode) ends in a ring (or node) bearing a large compound leaf. The leaf bases are though tubes which overlap, referred to as the leaf sheath, and conceal the upper part of stem (Evans et al. 2002). At its upper end, the sheath narrows into the petiole that continues into the rachis or leaflet-bearing portion of the leaf. The petiole of some *Calamus* in Sulawesi is sometimes very short or absent, in the field the absence of petiole is a useful character for distinguishing species. The rachis of some *Calamus* in Sulawesi is extended beyond the terminal leaflets into a barbed whip (cirrus) which acts as a climbing organ (Dransfield 1992b).

Rattan’s leaf sheath armature is the most striking feature. In almost all species the sheath bears spines. The spine arrangement is extraordinarily diverse and has diagnostic importance character (Figure 2). Within Sulawesi, it is possible to identify almost all 28 different species based on the mature leaf sheath. In a few species the leaf sheaths lack of spines such as in some forms of *Calamus ornatus*, but this species is not totally spineless because the leaf rachis, cirrus and flagellum are still heavily armed. Between the spines may be found a wide range of hairs, scales or indumentum and/or wax (Dransfield 1992b).

At the tip of the sheath (leaf sheath mouth) where the sheath narrows into the petiole or leaf rachis there is a prolongation of the main part of the sheath and known as an ocrea (Dransfield 1992a). All *Calamus* in Sulawesi have papery, short ocrea. *Calamus rosetus* has a pair of distinctive spine at the border of leaf sheath mouth and petiole which also diagnostic character to differentiate it with other species (Figure 2).
Figure 2  Leaf sheath of *Calamus perpendiculus* shows vestigial flagellum (A); Leaf sheath of *Calamus rosetus* shows distinct pair of spines on the leaf sheath mouth (B).

The leaf rachis is part of the leaf axis which bears the leaflets and sometimes bears reflexed grapnel-like spines on the lower surface and these contribute to the climbing process by locking on to support (Dransfield 1992b). The rattans leaf is basically feather-like rather than palmate or fan-like (Figure 3). The commonest arrangement of the leaflets in *Calamus* of Sulawesi is arranged regularly, that is evenly spaced along the rachis. Only few species has irregular leaflets which grouped and fanned within the group such as in *Calamus rosetus* which has beautiful paired leaflets.

**Climbing organs**

There are two types of organs related with climbing in *Calamus*. They look superficially similar but they differ completely in their morphological origin, the cirrus and the flagellum. The former form is an extension of the leaf rachis beyond terminal leaflets whereas the latter is a sterile inflorescence borne on the leaf sheath near the knee (Figure 3). Both of climbing organs bear groups of short, grapnel-like spines (Dransfield 1992b). *Calamus* found in Sulawesi is mostly climbing using their cirrus instead of using their flagellum. The result of this study shows that *Calamus perpendiculus* is the only species which has vestigial flagellum to 20 cm long and bears slightly 5 peduncular bracts.
Inflorescence

The pistillate inflorescence bears dyads (pairs of flowers), consisting of female flower and sterile male flower along each side of the rachilla in the axils of the rachilla bracts, whereas staminate inflorescence bear male flowers only (Figure 3). In the axil of each bract on the female rachilla there are two bracteoles – the involucre and involucrophore as can be seen in Figure 4 (Dransfield 1984).
**Infructescence**

*Calamus* fruits as the other rattans fruits are covered in vertical rows of reflexed scales and there is often a beak at the top of the fruit, tipped by the remains of the stigmas and the remains of the sepals and petals are found at the base of the fruit (Dransfield 1992b). Inside the fruit there is usually single seed, but some species in Sulawesi also have two seeds such as in *Calamus* *didymocarpus* and *C. koordersianus*.

![Figure 5 Fruits and seeds of *Calamus rosetus* showing involucre and involucrophore in the left side (A); Fruit and seed of *Calamus scleracanthus* (B).](image)

**Groups within Calamus spp.**

Groups of *Calamus* spp. in Sulawesi according to Beccari’s as in Table 1 consist of: Group V (*Calamus pseudomollis* Becc., *Calamus plicatus* Blume); Group XII (*Calamus kandariensis* Becc. ex Heyne, *Calamus minahassae* Becc. ex Heyne, *Calamus paucijugus* Becc. ex Heyne, *Calamus symphysipus* Mart., *Calamus leioaulis* Becc. ex. Heyne); Group XIII (*Calamus ornatus* Blume); Group XIV (*Calamus zollingerii* Becc., *Calamus ahlidurii* Fernando ex Rustiami, *Calamus lorelinduensis* J.P. Moea & Rustiami); Group XV (*Calamus didymocarpus* Warb. ex Becc., *Calamus kjelbergii* Furtado, *Calamus leptostachys* Becc. ex Heyne, *Calamus macrosphaerion* Becc., *Calamus mindorensis* Becc., *Calamus pachystachys* Warb. ex Becc., *Calamus subinermis* H. Wendl. ex Becc., *Calamus rosetus* Rustiami, *Calamus scleracanthus* Becc. ex Heyne, *Calamus siphonospathus* var. *dransfieldii* Baja Lapis; Group XVII (*Calamus perpendicularus* Rustiami); Group XVIII (*Calamus inops* Becc. ex Heyne, *Calamus orthostachyus*
Beccari recognized 16 groups of *Calamus* based mainly on the present or absent of the cirrus, present or absent of flagella in the leaf sheath and/or in the inflorescence, shape of primary bract, rachillae sessile or pedicellate, involucrophore sessile or pedicellate and endospermae homogenous or ruminate. Kramadibrata and Dransfield (1992) added two groups – Groups XVII for species which has vestigial flagellum and Group XVIII for *Calamus inops* groups. In Sulawesi, Group XVII only presented by *Calamus perpendiculus*, the rest of the species occur in Borneo. Furtado had proposed sections within *Calamus* but it seems that his sections did not work very well because most of his section can be referred to Beccari’s group. In total based on the recent study 18 groups has been known for grouping within *Calamus* and 7 groups occurs in Sulawesi.

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>LEAVES</th>
<th>LEAFSHEATH</th>
<th>INFLORESCENCE</th>
<th>PRIMARY BRACTS</th>
<th>RACHILLAE</th>
<th>INVOLUCROPHORES</th>
<th>ENDOSPERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecirrate</td>
<td>Flagellate, eflagellate</td>
<td>Flagellate or eflagellate</td>
<td>Elongate, tubular, closely sheathing, sometimes split longitudinally in the upper part, never entirely open or laminar</td>
<td>Sessile</td>
<td>Sessile</td>
<td>Homogenous</td>
<td></td>
</tr>
<tr>
<td>Subecirrate</td>
<td>Flagellate</td>
<td>Flagellate</td>
<td>Elongate, tubular, very narrow</td>
<td>Sessile</td>
<td>Sessile</td>
<td>Homogenous</td>
<td></td>
</tr>
<tr>
<td>Cirrate</td>
<td>Flagellate</td>
<td>Eflagellate</td>
<td>Elongate, tubular, closely sheathing</td>
<td>Sessile</td>
<td>Eflagellate</td>
<td>Homogenous or ruminate</td>
<td></td>
</tr>
<tr>
<td>Subcirrate</td>
<td>Flagellate or slightly flagellate, shorter than the leaves</td>
<td>Eflagellate</td>
<td>Elongate, tubular, closely sheathing</td>
<td>Sessile</td>
<td>Sessile</td>
<td>Homogenous or ruminate</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Eflagellate</td>
<td>Eflagellate</td>
<td>Elongate, loosely tubular</td>
<td>Sessile</td>
<td>Sessile</td>
<td>Ruminante</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Eflagellate</td>
<td>Eflagellate</td>
<td>Short, tubular, persistent</td>
<td>Sessile</td>
<td>Sessile</td>
<td>Homogenous</td>
<td></td>
</tr>
</tbody>
</table>

Taxonomic Treatment

*Calamus*


Solitary or clustering, stemless to high climbing or erect pleonanthic dioecious rattans; sheaths usually heavily armed with spines, the spines frequently highly organised. Flagellum (sterile inflorescence) often present, borne on the leaf sheath, sometimes absent and replaced by a cirrus at the end of the leaf, very rarely both present or bot absent; knee often present; ocrea sometimes well developed, usually inconspicuous. Male and female inflorescence superficially similar, often ending in a long flagellum, sometimes with gradual succession of branches, often with discrete distant branches (partial inflorescences); bracts always tubular at the base, rarely with broad limbs splitting down one side, but if so, the the base always tubular and unsplit, bracts variously armed; partial inflorescences usually much longer than the subtending bract, very rarely shorter, involucres and involucrophore inconspicuous. Male flower with cup-shaped calyx, usually with 3 well defined lobes; corolla split almost to the base into 3 petals; stamens 6, very shortly epipetalous; pistilode minute. Female flower borne together with a sterile male flower as a pair. Sterile male flower like the fertile male, but with empty anthers. Female flower usually larger than the male, with calyx shallowly 3-lobed; corolla with 3 petals; staminodes 6, joined basally to form a ring; ovary tipped with 3 stigmas and covered with reflexed scales. Seed usually one only, very variable in shape, covered in a thin to thick sarcotesta; endosperm homogenous or ruminate; embryo basal or lateral. Seedling leaf bifid or pinnate.

**Distribution.** With about 374 species, *Calamus* is the largest palm genus. It has very wide distribution, found in equatorial Africa, India, Himalayan foothills to south China, throughout Southeast Asia to the western Pacific Islands and Australia (*Dransfield* *et al.* 2008).

**Habitat.** This genus can be found from sea level to over 3000 m asl. Most of the species are adapted to primary and secondary tropical rain forest.
**Uses.** Boiled shoots of some *Calamus* can be eaten and to some extent the taste likes asparagus. Cane of several Calamus are collected commercially for weaving, binding and household daily needs such as rope and basketries.

### Key to species of *Calamus* in Sulawesi

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vestigial flagellum present</td>
<td><em>C. perpendiculus</em></td>
</tr>
<tr>
<td>2</td>
<td>Vestigial flagellum absent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Leaves ecirrate</td>
<td><em>C. pseudomollis</em></td>
</tr>
<tr>
<td>2</td>
<td>b. Leaves subecirrate or cirrate</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>a. Leaves subcirrate</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>b. Leaves cirrate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>a. Alternate diminutive leaflets on its summit of leaf rachis present</td>
<td><em>C. ornatus</em></td>
</tr>
<tr>
<td>5</td>
<td>b. Alternate diminutive leaflets on its summit of leaf rachis absent</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>a. Leaflets lanceolate, leaf sheath flagellate</td>
<td><em>C. symphysipus</em></td>
</tr>
<tr>
<td>7</td>
<td>b. Leaflets broadly linear, leaf sheath eflagellate</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>a. Petiole up to 1 cm, basal leaflets swept back across the stem</td>
<td><em>C. minahassae</em></td>
</tr>
<tr>
<td>9</td>
<td>b. Petiole more than 1 cm, basal leaflets not swept back across the stem</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>a. Leaf sheath and leaf rachis covered with smooth cotton-like easily detached indumentum</td>
<td><em>C. kandariensis</em></td>
</tr>
<tr>
<td>11</td>
<td>b. Leaf sheath and leaf rachis glabrous</td>
<td><em>C. plicatus</em></td>
</tr>
<tr>
<td>12</td>
<td>a. Primary bracts tubular, tattering in age; rachilla pedicellate</td>
<td><em>C. ahlidurii</em></td>
</tr>
<tr>
<td></td>
<td>b. Primary bracts elongate and tubular; rachilla sessile</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>a. Leaf sheath dark green, very densely covered in reflexed almost collars spines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Leaf sheath not green, not covered with reflexed almost collar spines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. The spines on the leaf sheath in two form, flat triangle, the larger is 10 x 14 mm, the smaller is 2 x 3 mm</td>
<td><em>C. lorelinduensis</em></td>
</tr>
<tr>
<td></td>
<td>b. The spines on the leaf sheath only in one form but very much larger up to 55 mm, 8 – 12 adjacent spines at their base united to form collar</td>
<td><em>C. zollingeri</em></td>
</tr>
<tr>
<td></td>
<td>a. Primary spatha very closely sheathing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Primary spatha loosely sheathing and often more or less inflate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Cirrus very robust and strongly clawed, petiole almost sessile</td>
<td><em>C. mindorensis</em></td>
</tr>
</tbody>
</table>
b. Cirrus fine and fairly clawed, petiole present .................................................. 13

13 a. Fruiting perianth not pedicelliform or subpedicelliform .................................. 14
b. Fruiting perianth distinctly pedicelliform ......................................................... 15

14 a. Leaflets has spine along the margins of their apical portion .......... C. kjebergii
b. Leaflets not so ................................................................. C. leptostachys

15 a. One female flower at each bract accompanied by a neuter flower ............... 16
b. Two female flower at each bract ................................................................. 17

16 a. Involucrophorum sessile ................................................. C. macrosphaerion
b. Involucrophorum pedicellate ................................................................. C. subinermis

17 a. Fruit conically beaked ................................................................. C. pachystachys
b. Fruit cylindric (not subconic) beak ...................................................... C. didymocarpus

18 a. Leaf sheath armed with scattered spines, grouped in 3s or 5s, but never forming comb-like structures ................................................. C. robinsonianus
b. Leaf sheath armed with spines of one or two types, spirally arranged in comb-like structures ......................................................... 19

19 a. Fruit contains of two seeds ................................................................. C. koordersianus
b. Fruit contains of one seed ................................................................. 20

20 a. Major bracts on primary axis of inflorescence heavily armed .. C. suaveolens
b. Major bracts on primary axis of inflorescence rarely armed .................. 21

21 a. Leaf sheath covered with scattered, solitary spines ....................... 22
b. Leaf sheath covered with densely series of spines .......................... 24

22 a. Leaf sheath spines 1 mm only. Leaflets subregularly arranged.. C. paucijugus
b. Leaf sheath spines more than 1 mm. Leaflets regularly arranged .......... 23

23 a. Leaf sheath surface shiny yellow, horizontal ridges present ...... C. boniensis
b. Leaf sheath surface green, horizontal ridges absent .................. C. leiocaulis

24 a. Leaflets arranged in group or fanned within the groups ............... C. rosetus
b. Leaflets arranged regularly ................................................................. 25

25 a. Involucrophore of pistillate inflorescence pedicellate ................. 26
b. Involucrophore of pistillate inflorescence sessile ......................... 27

26 a. Spines of two types, the spirals alternating between big spines (10-15 x 2 mm) and small spines (4 x 1 mm), petiole from 18-30 cm long .... C. inops
b. Spines of single type (10-20 x 3 mm), petiole 4-10 cm long .. C. ortostachyus
27. a. Clustering rattan; stem with sheath to 15 mm in diameter, covered with dull whitish indumentum; knee unarmed …………………. *C. scleracanthus*

b. Solitary rattan; stem with sheath 15 – 40 mm in diameter, indumentum absent; knee armed ……….. *C. siphonospathus* var. *dransfieldii*

**Species Description of *Calamus* in Sulawesi**

1. *Calamus pseudomollis* Beccari


   Clustering rattan. Leaf sheath unknown. Knee present unconspicuously. Ocrea present, short papery. Flagellum absent. Leaves ecirrate, regularly pinnate; petiole elongate about 1 cm long, broad at its base, upper surface armed with unequal, straight, scattered, needle like spines, lower surface smooth except few solitary claws along the centre, petiole margin armed with spreading acicular spines, longer than those on the upper surface; rachis unarmed, underneath with a single line of solitary claws; leaflets numerous, regularly arranged, equidistant, thinly papyraceous, green on both surfaces, lanceolate or narrow and long, narrowing from below the middle to an acute base and above; gradually long acuminate to a bristly tip; in the uppermost leaflets the point is less acuminate and more bristly; mid lamina 35 – 38 cm long and 18 – 20 mm wide; transverse veinlets present. Staminate inflorescence unknown. Pistillate inflorescence elongate and flagellate at its upper end with several partial inflorescence; prophyll cylindrical, elongate, very closely sheathing to 8 mm in diam. and gradually produced an elongate triangular point which is densely bristly on its back or armed with small prickles; upper bract also cylindrical and armed with small prickles but the apex not hispid; partial inflorescences 40 – 45 cm long, rising above the mouth of their respective bracts; secondary bracts tubular, elongate; glabrous and unarmed; each partial inflorescence consists of spikelet with 25 – 30 flowers on each side and reduce to 8 – 10 flowers at the uppermost; involucrophore copular, bidentate and two keeled; involucres deeply copular.
Fruiting perianth not pedicelliform, 4 mm long; calyx split down to the base into 3 ovate, acute lobes; corolla little longer than calyx. Fruit ovoid-elliptical, 11 x 7 mm, scaled arranged in 18 longitudinal series, dirty straw colour. Seed irregular, slightly longer than broad, slightly flattened; endosperm homogenous.

**Distribution.** North Sulawesi.

**Habitat and ecology.** This species can be found at about 50 m above sea level in the primary lowland forest.

**Vernacular name.** Pondos Taisi, Pondos Aret Raindang, Pondos Wasal (Minahasa language).

**Specimen examined.** North Sulawesi: Minahasa, near Kayuwatu 50 m asl., Koorders 18395ß, fruiting (BO, L); Koorders 18413ß, fruiting (BO, L)

**Notes.** This species closely related to *Calamus mollis* of the Philippines. This species could be representative form in Sulawesi. It has very regular leaflets armed with very long bristles on the main nerves adaxially, and mid nerve only on abaxial surface. Leaflets margin has distinct ciliate. This species characterized by having ecirrate leaves and inflorescence elongate and flagellate.

2. *Calamus plicatus* Blume

*Calamus plicatus* Blume, Rumphia 3: 67 (1847). Type: Sulawesi, Forsten 115. (holotype L!).

Slender rattan. Stem with sheath to 15 mm in diam., stem without sheath up to 10 mm in diam. Knee and ocrea not known. Leaf sheath armed with small straight pale spines. Leaves to 60 cm long including petiole; petiole very short, 3.5 cm long, along the middle of petiole armed with relatively strong claws; leaflets 12 on each side, inequidistant, in pairs; mid lamina 13 – 15 cm long and 15 – 18 mm wide, narrowly oblanceolate, spoon shaped at their apex and suddenly into a linear acuminate tip, bristly at the tip, narrowed to the base, green and glabrous on both surfaces, deeply plicate with around seven equal slender costae; transverse veinlets present, rather distinct; leaf margins smooth or armed with small spinules. Other part unknown.

**Distribution.** Sulawesi (it is not known where exactly the location of this species formerly found).
**Habitat and ecology.** There is no evidence or information on the habitat and the ecology of this species.

**Vernacular name.** Not recorded.

**Specimen examined.** Celebes: Forsten 115, 116, L 8738.

**Notes.** No herbarium specimen kept in BO or K as *C. plicatus* and only one leaf of herbarium specimens kept in Leiden Herbarium as type specimen. The type specimen has cirrate leaves, leaflets arranged slightly irregular or in group, with very distinct leaflets tip prolonged into acuminate tip. Type locality mentioned Celebes only. Legitimate by Korthals followed by Beccari in December 1902.

**3. Calamus symphysipus** Martius


Solitary, slender rattan climbing to 6 m long. Stem stilt rooted at base. Stem with sheath to 2 cm in diam., stem without sheath to 1 cm in diam. Internodes to 30 cm long. Leaf sheath dark green armed with very elegance whorls of yellowish green spines, covered with slightly grey dull indumentums. Leaf sheath mouth not armed, papery. Knee absent. Ocrea present, conspicuously, papery brown, elongate forming slightly tubular form, 1 – 2 cm at base, to 6 cm long. Flagellum present, to 3 m long, relatively slender, armed with 1 – 5 short hooked spines, arranged in 1 – 12 mm apart. Leaves to 1.5 m long including petiole; petiole to 8 cm long, armed with scattered, solitary slightly hooked spines, 4 – 10 mm long, adaxially, abaxially and along the edges; petiole and rachis covered with reddish brown indumentums; leaflets grouped in pairs below, more regular above, 17 on each side of the rachis, spatulate somewhat cucullate, subocharceous on the under surfaces; mid lamina up to 40 cm long and 5.5 cm wide. Staminate inflorescence unknown. Pistillate inflorescence ascending, shorter than the leaves, about 50 cm long, with up to 12 partial inflorescences 3 – 5 cm apart, decreasing in size distally, covered densely with brown reddish indumentums; phylloll semi tubular, 5 – 7 x 1 cm, elliptic in section, 2-keeled
with one keel longer than the other, covered with brown reddish indumentums, not armed, becoming less densely to glabrous; peduncle very short, to 0.6 cm long; partial inflorescence to 28 cm long, bearing up to 21 tubular bracts 10 – 15 x 3 – 4 mm, not armed, the proximal up to 20th bract bearing rachillae to 8.5 cm long, each rachilla bearing distichously arranged bracts to 2 mm long, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, the first prophyllar bracteole (invulcrophorum) pedicellate.

Young fruit 8 x 5 mm, covered with 7 rows of alternating scales; seed 10 x 6 mm, surface reticulate, endosperm homogenous.

**Distribution.** North Sulawesi, Central Sulawesi and South Sulawesi.

**Habitat and ecology.** Steep slope, river valley

**Vernacular name.** Rue Embel, Pondos Embel (Tonsea language), Wumulo, Omulo, Umbol (Gorontalo language), Rotan Ambol, Rotan Ombol (Donggala language), Pangi, Umbul (Wolo/Kolaka language), Limbul (Kulawi language), Rotan Laru (Kendari language).

**Specimen examined.**

**North Sulawesi:** Bolaang Mongondow, Pindool, Lolak, 17 October 1973, 40 m asl., J. Dransfield & J.P. Mogea: JD 3769, flowering (BO), JD 3774, fruiting (BO, K, L), JD 3775, sterile (BO, L, K); Toraut, Dumoga Bone National Park, 4 March 1984, 200 m asl., J.P. Mogea: JPM 5042, sterile (BO, L); Toraut, Dumoga Bone National Park, 2400 m asl., July 1998, Jonathan S. Walker & Alexis J. Cahill: DB 321, sterile (K); Kosinggolan, Kp Urwan road to Matayangan, 29 February 1984, 200 m asl., J.P. Mogea: JPM 4971, young fruit (BO, K, L); Boalemo, Ambodu, Menado, 20 July 1930, 400 m asl., A Uno 6, sterile (BO); Near Paku Ure, Koorders 18403ß, sterile (BO, L), Koorders 18412ß, fruiting (BO), Koorders 18411ß, mature fruiting (BO, L), Minahasa, Menado, 50 m asl., 26 February 1895, Koorders 18409ß, fruiting (L), Koorders 18412ß, fruiting (L), Mas SuHarman 51, sterile (BO); T. Ch. J. Bisjh 117, sterile (BO); Noerkas 485, sterile (BO); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, Lynn Clayton 4, sterile (K).

**Central Sulawesi:**

Donggala, 11 May 1975, W. Meijer 10085, sterile (BO, L); Sungei Sadaun, 2500 – 3600 feet, between 1974 – 1976, G.G. Musser: M7, sterile (K); Kuala Navusu, on adjacent Gunung Benteng, 1500 feet, August – November 1975, G.G. Musser: R3, sterile (K); Kulawi, Saluburi, 450 m asl., February 1986, Anggana & Yunus Dali 057, fruiting (K); Batui River, inland between Batui – Saseba, 15 October 1989, 70 – 100 m asl., M. Coode 5936, sterile with stilt-rooted (K).

**South Sulawesi:**

SW Peninsula, NE of Makassar, 4 July 1976, W. Meijer 10808, sterile (BO, L); Toli-toli, Heyne 2509, sterile (BO), Heyne 2506, sterile (BO), Heyne 2582, sterile (BO), Heyne 2520, sterile (BO); Masamba, Desa Percara, Kampung Balaseba, 200 m asl., 30 December 1983, Stephen Siebert: R 8, sterile (K); R3, sterile (K).

**South East Sulawesi:**

Boni, Heyne 13, sterile (BO); Wadjo, Heyne 2609, flowering & fruiting
(BO), *Heyne 2605*, male flower (BO); Kendari, Kolaka, Wolo, 350 m asl., 11 August 1985, *Anggana & Yusuf Dali 032*, sterile (K).

**Notes.** This species has stilt rooted stem and elegant whorls of leaf sheath spines, the inflorescence is arcuate and the fruit borne on long pedicel.

4. *Calamus kandariensis* Beccari


Slender, climbing rattan. Stem with sheath 8 – 10 mm in diam., without sheath to 5 mm in diam. Leaf sheath covered with smooth cotton-like easily detached indumentum, armed with a few short straight horizontal spines. Knee absent. Ocrea very short, indistinct. Flagellum absent. Leaves to 100 cm long including petiole and cirrus, petiole short, 5 – 6 cm long, flat above, convex beneath, armed with very few solitary claw; rachis smooth, under surface armed with solitary claw, covered with cotton-like easily detached indumentum; leaflets very few, 4 – 6 pairs on each side of the rachis, regularly arranged, narrowly lanceolate or oblanceolate, acuminate at the tip, papyraceous, uniform brown colour on both surfaces; mid lamina 20 – 22 cm long and 2 – 2.5 cm wide; leaflets margins smooth; transverse veinlets present conspicuously. Staminate inflorescence pendulous, 60 cm long, straight at the base and nodding at the summit, with up to 4 partial inflorescence; prophyll elongate-tubular, covered with greyish, rusty scurf, papyraceous, slightly closely sheathing; involucre sessile, subtended by its own spatha. Pistillate inflorescence and infructescence unknown.

**Distribution.** So far only known from the type locality South East of Sulawesi, near Kandari.

**Habitat and ecology.** There is no information regarding its habitat and ecology.

**Vernacular name.** Not recorded.

**Specimen examined.** *South East Sulawesi*: July 1874, Beccari sn.
Notes. There is not enough information of this species because the specimen has never been collected since it was collected by Beccari in July, 1874. The leaflets of this species have the costae very inconspicuous and like the margins it does not have any bristles, hairs or spinules.

5. *Calamus minahassae* Warb. ex Beccari


Slender clustering rattan, climbing to 15 m. Stem with sheath to 20 mm in diam., stem without sheath to 13 mm in diam.; internodes to about 20 cm long. Leaf sheath covered with white reddish indumentums, armed with solitary to series of spines, scattered, up to 7 mm long and 1 mm wide, some are slightly swollen at the base. Leaf sheath mouth not armed. Knee present, conspicuously, not armed. Ocrea present, short. Flagellum absent. Leaves cirrate to 2.5 m long including cirrus and petiole; cirrus to 60 cm long, armed with 1 – 2 hooked spines, arranged in 2 – 8 mm apart; petiole very short (-11 cm) or absent; rachis covered with white reddish indumentums, armed with scattered, solitary (sometimes 2 hooked grapnels) arranged 1 – 10 mm apart, leaflets about 7 on each side of the rachis, arranged irregularly; leaflets armed with bristles 1 – 2 mm long along all main nerves on the under part of abaxial surface and along the edges of the leaf; leaflets tip not prolonged into needle like projection; transverse veinlets prominent; mid lamina 24 – 26 cm long and 5.6 – 6.6 cm wide. Staminate inflorescence unknown. Pistillate inflorescence ascending, shorter than the leaves, to 60 – 120 cm long, with up to 6 partial inflorescences 8 – 15 cm apart, decreasing in size distally, covered with scattered white yellowish indumentums; prophyll semi tubular, 16 – 23 x 1 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with brown indumentums, armed with scattered spines, becoming less densely to glabrous; peduncle short, to 4 cm long; partial inflorescence to 26 cm long, bearing up to 20 tubular bracts 9 – 11 x 3 – 4 mm, not armed, the proximal up to 11th bract bearing rachillae to 9 cm long, each rachilla bearing distichously arranged bracts to 3 mm long, each bract subtending
a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2.5 x 1.25 mm; calyx 3-lobed, basal tube to 1.5 x 0.75 mm; corolla with 3 petals each 3 x 0.75 mm; staminodes present; ovary 2.5 mm diam., ellipsoid, tipped with 3 twisted stigmas. Fruit elliptic, 9 - 15 x 7 - 11 mm, covered with 8 rows of alternating scales, each scale with a slightly midgroove; seed 10 x 7 mm.

**Distribution.** This species can be found from North Sulawesi to South of Sulawesi.

**Habitat and ecology.** Ridgetop, primary forest on volcanic soil, ultrabasic region.

**Vernacular name.** Dato (Luwuk and Tolaki language), Lauro Koampu, Anduru (Koronsi, Topadu language), Moli (Horontalo language), Hue Rintuk (Minahasa language), Lauro Wasu (Tobelo, Topadu language), Uwe Karuku (Besoa language), Pondos Alus (Menado language), Tusasa or Pondos Tunas (Menado language), Rotan Data (Mamuju language), Rotan Ruru & Rotan Putih (Kulawi language), Rattan Kapinei (Kaili language).

**Specimen examined.**

**North Sulawesi:** Menado, Boalemo, Ambudu, 400 m asl., 29 July 1930, A. Uno 8, sterile material; Minahasa, Pinili, Tatelu, slopes of G. Klabat, 400 m asl., 1 November 1973, J. Dransfield & J.P. Moea: JD 3896, fruiting material (BO); Suaka Alam Batu Angus, 7 October 1973, 600 m asl., J. Dransfield & J.P. Moea: JD 3741, fruiting material (BO, L); Menado, Tolombulan, 12 April 1895, 900 m asl., Koorders 18414ß, fruiting material (BO, L), 29 April 1895, 25m asl., Koorders 18405ß, male flower; Talaud, leg. ign. Noerka 888, sterile (BO). **Central Sulawesi:** Sopu Valley, c. 80 km SSE of Palu, 1000 m asl., 5 May 1979, E.F. de Vogel 5212, young fruit (BO, K, L), E.F. de Vogel 5210, sterile (K, L), E.F. de Vogel 5209, sterile (BO, K); Kulawi, Desa Moa, G. Parawatu, Lore Lindu National Park, 24 October 1997, 800 m asl., S. Siebert 26, sterile (K); Mataue, Kulawi, Lore Lindu National Park, 25 May 1981, 650 m asl., Ramadhanil & S. Siebert 389, fruiting (L, K); Bukit Parawatu, Moa, Kulawi, Donggala, Lore Lindu National Park, 24 June 2001, 900 m asl., Ramadhanil & S. Siebert 500, sterile (K); East of Tongoa, 1 March 1981, 650 m asl., J. Th. Johannsson, H. Nybom & S. Riebe 110, fruiting (K). Sungei Sadaunta, around 1974 – 1976, G.G. Musser: M 11, sterile (K); M. Mope, Kulawi, February 1986, 400 m asl., Anggana & Yunus Dali 059, sterile (K). **South Sulawesi:** Malili, Kawata, 20 August 1934, 300 m asl., A Hoornstra 14, fruiting material (BO); 21 March 1934, H.N. Reppie 40, female flower (BO); Mamuju, Kaluku, Desan Roa, Desa Pantai Kaluak, near S. Kara-kara Besar, 9 February 1993, Padmi Kramadibrama: PK 32, sterile (BO); Matano lake, NE of Malili, 16 July 1976, W. Meijer 11207, sterile (BO); Malili, 21 March 1934, H.N. Reppie 40 (BO). **South East Sulawesi:** Wadjo, leg. ign. Heyne 2619, sterile (BO); Boni, Heyne 4, sterile (BO).
Notes. Most of the species has basal leaflets swept back. Based on personal observation this species has good cane because the cane can easily to bend. I think this is good for making basket and rope.

6. *Calamus paucijugus* Beccari ex Heyne


Slender rattan, climbing over 4 m long. Stem with sheath up to 10 mm in diam., stem without sheath up to 7 mm in diam. Leaf sheath covered with scattered, solitary, bulbous based spines, very short, 1 mm only. Knee conspicuous, unarmed. Ocrea present, papery, small, up to 2 mm. Flagellum absent. Leaves 150 cm long including petiole 15 cm long, cirrus 1 m long, armed with slender, slightly hooked claw spines; leaflets subregularly arranged up to 7 leaflets on each rachis; mid lamina 25 cm long and 1 cm wide, elongate, lanceolate; transverse veinlets present, inconspicuously, unarmed. Staminate and pistillate inflorescence unknown. Infructescence pendulous to 70 cm long, first bract tubular, tightly sheathing, armed with solitary slightly hooked spine, short; consists of 7 rachilla, involucre pendulous, involucrophore pendulous. Fruit dull brown, ellipsoid, 10 x 5 mm long, conically beaked, covered with 7 – 8 scales in vertical rows. Seed ellipsoid, elongate, 8 x 3 mm, surface reticulate, endosperm homogenous.

Distribution. North Sulawesi and South East Sulawesi

Habitat and ecology. Ridgetop primary forest, alt. 250 m

Vernacular name. Dolodus (Gorontalo language)

7. *Calamus ornatus* var. *ornatus* Blume

*Calamus ornatus* var. *ornatus* Blume, in J. J. Roemer & J. A. Schultes, Syst. Veg. 7: 1326 (1830). Type: Indonesia, Sulawesi, *leg. ign. sn.* (holotype FI; pictures in K!).

Clustering robust rattan, climbing up to 30 m long. Stem with sheath to 5 cm in diam., without sheath to 3 cm in diam. Internodes to 20 cm long. Leaf sheath dull green, when young covered with white to buff dense indumentums, armed with short triangular, slightly reflexed, yellowish above, brownish on dorsal side spines. Leaf sheath mouth not armed. Knee present, very well developed, unarmed. Ocrea present, very short. Flagellum present, up to 3 m long, armed with 1 – 5 hooked black tipped, spines (half whorled claws), arranged in 0.3 – 3 cm apart. Leaves to 3 m long including petiole; petiole 40 – 70 cm long, circular in transverse section, flattened adaxially, convex abaxially, around 10 mm wide, 8 mm thick near the base, armed with solitary, short, scattered spines abaxially and along the edges; leaf rachis strongly clawed distally and furnished with alternate diminutive leaflets on its summit; leaflets numerous, mid lamina 50 – 8 cm long and 5 – 9 cm wide, rather remotely alternate, regularly arranged, papyraceous, very large, elongate-lanceolate, acuminate at the apex, sparsely bristly on 1 – 3 or all the 5 costae on the upper surface; transverse veinlets present, not conspicuous, but numerous; leaflets margins bristly. Staminate inflorescence very large with very long and robust flagellum and many branched partial inflorescence; primary bract very long, tubular, closely sheathing, armed with seriate prickles; secondary bract short, tubular, rather loosely sheathing in their upper part, smooth and densely ciliate at the mouth; each rachilla 5 – 8 cm long, bearing 13 – 17 distichous flowers; involucre sessile, acutely bidentate on the side next to the rachis; male flowers oblong-ovoid, the calyx striately veined, divided into 3 broad triangular acute lobes; the corolla one-third longer than the calyx. Pistillate inflorescence almost similar to staminate inflorescence but very large, elongate, flagelliform, up to 1.5 – 2 m long, not including robust strongly clawed flagellum about as long or longer; primary bract elongate, tubular, closely sheathing, slightly prolonged at one side into a short and broad point, rarely armed with short triangular, flat, seriate spines, up to 60 cm long, consisting 15 – 16
rachilla; secondary bract tubular, short, 10 – 15 mm long; rachilla very robust, 10 – 18 cm long with 10 – 20 flowers on each side; involucrophore and involucre sessile; female flowers bifarious, about 5 mm long. Fruit large, ellipsoid, 3 – 3.5 cm long; covered with 8 rows of alternating scales, each scale with rather short obtuse point and toothed margin; seed with irregular uneven surface; 1 – 2 cm long; endosperm homogenous.

**Distribution.** South Sulawesi, South East Sulawesi, Central Sulawesi up to the North Sulawesi

**Habitat and ecology.** Generally this species can be found in secondary and much disturbed primary forest on the land slope, stream side lowland forest, alluvial soil. This species also found in flat slightly swampy ultrabasic soil in stunted forest or lowland rainforest, growing on steep hillside well above the river, sandy soil.

**Vernacular name.** Londowulu (Tobela language), Rotan Rumpang (Tinombala language), Lenkuji (Besoa language), Lengkudi (Moa language), Pondos Mupentu, Pondos Embel, Pondos Taisi, Pondos Tondejan (Menado language), Rotan Buku Tinggi (Gorontalo dialect), Rotan Buku Dalam (Kolomodale language), Rotan Lambang (Kulawi language), Rotan dolalai (Lore Kalimata language), Lampalai (Lore Lindu language).

**Specimen examined.**

**North Sulawesi:** Bolaang Mongondow, Pindool Lolak, 19 October 1973, 50 m asl., J. Dransfield & J.P. Mogea: JD 3811, dead male inflorescence (BO, L); Toraut, Dumoga Bone National Park, 200 m asl., 31 April 1984, J.P. Mogea: JPM 5041, sterile (BO, K, L); 1895, Koorders 18404β, fruiting (BO), 2 March 1895, Koorders 18394β, fruiting (BO), Koorders 18390β, sterile (BO), Koorders 18402β, sterile (BO), Koorders 18408β, fruiting (BO); Kolomodale, Tawi, 3 March 1989, Lynn Clayton 18, sterile (K); Gorontalo, near Marisa, Iloheleuma, 8 January 1989, Lynn Clayton 8, sterile (K); Toraut, Dumoga Bone National Park, 220 m asl., 26 March 1985, E.F. de Vogel & Vermeulen 6784, female inflorescence (K).

**Central Sulawesi:** Tinomamba, G. Toli-toli, 400 m asl., 9 March 1985, Ramlanto & Zaenal Fanani 726, fruiting (BO); Sopu Valley, 1000 m asl., 2 May 1979, E.F. de Vogel 5172, female inflorescence (BO, L), 26 April 1979, E.F. de Vogel 5054, dead female inflorescence (BO, L, K); Kulawi, Moa, Agathis forest on slope of G Malemo, 22 October 1977, 100 m asl., J.P. Mogea: JPM 1411, young fruit (BO, K, L); Sungei Tolewonu, 30 km south of Kuala Navusu, in the mountain, 1974 – 1976, G.G. Musser: T4, fruiting (K); Kulawi, Mt. Saluburi, February 1986, 400 m asl., Anggana & Yunus Dali 054, sterile (K); Mt Nokilalaki, Lore Kalimata Reserve, 1000 m asl., 24 April 1975, W. Meijer 9543, sterile (BO, L); Mt Nokilalaki, SE of Lake Lindu to Sadaunta, 1000
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– 1500 m asl., 4 May 1975, W. Meijer 10013, mature fruiting (L, BO).

South Sulawesi: Malili, Kawata, 4 May 1933, 25 m asl., A. Hoornstra 5, sterile (BO);
Kabupaten Luwu, between Pantai Pao & Palopo, 14 February 1993, Padmi
Kramadibrata: PK 033, male inflorescence (BO). South East Sulawesi: Kendari,
Umalaha, Ahuma, 13 October 1978, 150 asl., S. Prawiroatmodjo & Maskuri
1144, fruiting (BO, K).

Uses. Mogein his field note said that the cane has a very low price on the
market. Ripe fruit of this species is red, edible and very sour.

Notes. The leaf sheath of Calamus ornatus near knee somewhat blackish and has
woody ocrea. This is very variable species ranging from Java, Borneo, Sumatera,
The Malayan Peninsula and the Philippines (Beccari 1913).

8. Calamus zollingeri Beccari

(1908). Type: Indonesia, cultivated plant in Bogor Botanic Garden, Zollinger
3433 (holotype Bruxelles Herb.; pictures in K!).

Solitary robust rattan, climbing up to the 50 m long. Stem with sheath up
to 10 cm in diam., stem without sheath up to 8 cm in diam. Leaf sheath woody,
strongly armed with very stout, unequal, brown tip, short seriate spines, 5 – 6 cm
long. Knee and ocrea present. Flagellum absent. Leaves 4 – 5 m long including
cirrus and petiole; petiole 3 – 3.5 cm, broad, deeply channelled above, round
beneath and armed with straight, strong spines; rachis rounded beneath, armed
along the middle with solitary claws and scattered prickles; leaflets numerous,
regularly arranged, 3 – 4 cm apart, papyraceous; mid lamina 50 – 70 cm long and
3 – 3.5 cm wide, gradually acuminate at the tip, plicate at the base, green on both
surface, middle vein of under surface armed with long bristles, 2 – 2.5 cm long;
leaf margin smooth, but bristly near the tip; cirrus robust, armed with almost
whorls of strong black claws. Staminate inflorescence large and many branched
and consist of many rachilla; each rachilla panicled, compact, divided into many
secondary branches and consist of several simple spikelets; primary bract not
seen; secondary bracts tubular, 2 – 4 cm long, closely sheathing, papyraceous,
unarmed, prolonged in one side into a triangular acute point, consist of several
rachillae, each rachillae consist of 6 – 7 spike; involucre cupular, apparently form
by two bracts, more or less united at their base; male flowers oblong, 4 mm long,
the calyx entirely split into 3, rather obtuse parts; corolla twice as long as the calyx, divided in the middle into 3 ovate-united at the base. Pistillate inflorescence around 1 – 1.5 m long, not flagelliferous at its summit, consist of partial inflorescences, between 30 – 50 cm long, terminated by short tail-like appendix and bearing 8 – 14 rachilla on each side; primary bract short, 10 – 20 cm long, tubular slightly enlarged above, closely sheathing, covered with scattered spines and prolonged into a triangular acuminate point; secondary bract as in the staminate flower, splitting in the fruiting stage; rachilla ascending first then spreading, the lowermost 8 – 10 cm long with 15 – 20 distichous flowers on each side; involucrophore narrowed to the base and distinctly pedicellate; involucre cupular; female flowers conical-ovoid, 4 mm long; the calyx with 3 small triangular acute point; the corolla almost the same size as the calyx, divided down into 3 lanceolate lobes; neuter flowers long, permanent, smaller and thinner than the female. Inflorescence ascending. Fruit still immature, small, globose, 9 x 6 mm long, including brown acute apical; covered with 18 longitudinal series of scales; endosperm homogenous.

Distribution. North Sulawesi, South Sulawesi and South East Sulawesi.

Habitat and ecology. Open lowland forest on volcanic soil, apparently very dry.

Vernacular name. Pondos Batang (Minahasa language), Pondos Sasiagan (Menado language), Lauro Wulemea (Tobela language), Wata Ape, Nango Wata (Tobela language), Rotan Batang (Kulawi language), Rotan Bata, Rattan Pece, Rattan Uvu Momi (based on GG Musser expedition), Rotan Merah (Kolaka language).

Specimen examined. North Sulawesi: Bolaang Mongondow, Tapak Kulintang, Dumoga Bone National Park, 220 m asl., 8 March 1984, J.P. Mogea: JPM 5077, fruiting (BO, K, L); Toraut, Dumoga Bone National Park, 200 m asl., 4 March 1984, J.P. Mogea: JPM 5040, sterile (BO, K); Minahasa, Suaka Alam Batu Angus, Bitung, 75 m asl., 6 October 1973, J. Dransfield & J.P. Mogea: JD 3728, fruiting, (BO), JD 3726, male flower (BO); Toraut, Dumoga Bone National Park, 2400 m asl., July 1998, Jonathan S. Walker & Alexis J. Cahill: DB 319, sterile (K); Menado, Paku Ura, 400 m asl., 18 April 1895, Koorders 18401B, female flower (BO); Kolomadale, Towi, 4 March 1989, Lynn Clayton 21, sterile (K); Toraut, Dumoga Bone National Park, 250 m asl., 16 September 1984, T.C. Whitmore & K. Sidiyasa: TCW 3408, died female inflorescence (K); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, Lynn Clayton 1, sterile (K). Central Sulawesi: Kuala Navusu, Sungei Tolewono, 400 – 1500 feet, between 1974-
1976, G.G. Musser: T7, sterile (K); Kuala Navusu, on adjacent Gunung Benteng, 1500 feet, August to November 1975, G.G. Musser: R4, sterile (K); Gulf Tomini between Parigi and Poso, 1500 feet, August – November 1975, G.G. Musser: R8, sterile (K); Kulawi, Moa, G. Parawat u, Lore Lindu National Park, 950 m asl., 24 October 1997, S. Siebert 25, sterile (K); 1100 m asl., 24 October 1997, S. Siebert 27, sterile (K), 1110 m asl., 24 June 2001, S. Siebert 502, female flower (K). South Sulawesi: Malili, Kawata, 25 m asl., 22 May 1933, A. Hoornstra 12, female flower (BO); 25 m asl., 25 April 1934, A.G. Waturandang 41, fruiting (BO), 4 January 1935, A.G. Waturandang 42, sterile (BO); Mamuju, Kaluku, Sundoang, 100 m asl., 3 February 1993, Padmi Kramadibrata: PK 21B, sterile (BO); Masamba, Pencahara, Saloeseba, 30 December 1983, S. Siebert: R6, sterile (K). South East Sulawesi: Boni, Heyne 2577, sterile (BO), Heyne 2576, sterile (BO), Heyne 2570, sterile (BO), Heyne 2564, sterile (BO); Bili-bili, Rahmat 83, fruiting (BO); Kendari, Kolaka, Wolo, G Mekonga, 300 m asl., 12 August 1985, Anggana & Yunus Dali 035, sterile (K).

Notes. This is giant rattan of East Indonesia, which mostly used and exported as furniture.

9. *Calamus didymocarpus* Warb. ex Beccari


Moderately robust, solitary rattan, climbing to 10 m. Stem with sheath to about 1.5 cm in diam., stem without sheath to about 1 cm in diam.; internodes to 22 cm long. Leaf sheath covered with grey indumentum densely, armed with moderately group of slightly swollen at base, triangular, irregularly arranged spines, 1 – 10 mm long and 1.2 mm wide. Leaf sheath mouth not armed. Knee present, conspicuously, up to 5 mm height, not armed. Ocrea present, papery, about 2 – 3 mm height and 10 mm wide. Flagellum absent. Leaves cirrate to 400 cm long including cirrus and petiole; cirrus to 2 m long armed with 4 – 6 hooked spines, arranged in 1 – 2 cm apart; petiole 24 cm long, slight circular in transverse section, flattened to slightly concave adaxially, slightly convex abaxially, 10 mm wide, 4 – 7 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spines widening at the base, decreasing in number towards the lamina; petiole and rachis covered with grey indumentums; rachis towards the cirrus armed with green, black tip, 1 – 5 hooked grapnels arrange to 2
cm apart; leaflets about 9 - 30 on each side of the rachis, very stiff and somewhat plicate, dark green, shiny, regularly arranged below, slightly arranged irregularly above; linear, armed with bristles 2 – 3 mm long along mid costae, on adaxial surface and along the margins; leaflets tips prolonged into black needle like bristles; transverse veinlets prominent; mid lamina leaflets 35 – 38 cm long and 1 cm wide. Staminate inflorescence ascending 25 – 65 cm long, with up to 5 or 7 partial inflorescence, 4 – 8 cm apart, decreasing in size distally, covered by black indumentums; prophyll tubular, 3 – 7 x 0.5 x 1 cm, elliptic in transverse section, 2-keeled with one keel longer at the base of the branches, covered by black indumentums, armed along the edges with a series of single spines to 3 mm long; other bracts similar but decreasing in size distally and become less densely armed and glabrous; peduncle 1.5 – 3 x 0.3 cm to the prophyll scar, covered by black indumentums; prophyll and other bracts subtending the partial inflorescence; partial inflorescence 13 – 30 cm long, bearing 6 – 12 tubular bracts 15 – 30 x 4 -5 mm, the proximal up to 10\textsuperscript{th} bract bearing second order branches 8 – 10 cm long, bearing up to 10 rachilla bearing very dense distichously arranged bracts to 1 – 1.5 mm long, each bract subtending a staminate flower. Staminate flower when young 2 – 4 x 1 – 1.5 mm, calyx 3-lobed, basal tube 1 – 1.5 mm long, lobes to 0.5 x 1 mm; corolla with three petals each 2-3 x 1 mm; stamens with free filament 0.5 – 1 mm long, anthers 1 – 1.5 mm long; pistillode reduced. Pistillate inflorescence ascending, longer than the leaves, to 3 m long, with up to 10 partial inflorescences 2.5 – 4 cm apart, decreasing in size distally, covered moderately with brown indumentums; prophyll semi tubular, 3 – 5 x 1 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with black indumentums, armed with scattered spines, becoming less densely to glabrous; peduncle to 13 cm long; partial inflorescence to 30 cm long, bearing up to 27 tubular bracts 10 – 15 x 3 – 4 mm, not armed, the proximal up to 17\textsuperscript{th} bract bearing rachillae to 9 cm long, each rachilla bearing distichously arranged bracts to 3 mm long, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2.5 x 1.25 mm; calyx 3-lobed, basal tube to 1.5 x 0.75 mm; corolla with 3 petals each 3 x 0.75 mm; staminodes present; ovary 2.5 mm diam., ellipsoid, tipped with 3
twisted stigmas. Young fruit 11 x 5 mm, covered with 12 rows of alternating scales, each scale with a midgroove; endosperm homogenous.

Distribution. North Sulawesi, Central Sulawesi, East Sulawesi

Habitat and ecology. Mountainous primary forest, steep hill slope, 800–1750 m asl.

Vernacular name. Rotan humampu, Si Ombo, Owe Waatang, Owe Rongo, Pandas.


Notes. Musser noted that this species are relatively similar with *Calamus inops*, but this rattan has green spines of its leaf sheath whereas the latter has more black tipped spines.

10. *Calamus kjelbergii* Furtado


Type: Sulawesi, Kawata, by the river Maliki, *Kejllberg* 2367 (holotype Berlin Herb.; ‘Kjellberg’ Sweden; isotype BO!).

Climbing rattan up to 5 m long. Stem with sheath 15 mm in diam. Leaf sheath armed with very short, in groups of 2’s, indistinct, oblique truncate spines. Knee not known. Ocrea present, very short. Flagellum absent. Leaves to 120 cm long including cirrus and petiole; petiole very rarely armed with short spines; leaf rachis robust divided into 3 – 4 part of leaflets, arranged irregularly, number of leaflets in total unknown; leaflets have spinules only along the margins of their apical portion; mid lamina 37.5 cm long and 5.5 cm wide; middle vein prominent, transverse veinlets present conspicuously. Staminate and pistillate inflorescence not known. Infructescence eflagellate, pedunculate up to 25 cm long; prophyll tubular, closely sheathing, up to 12 cm long, armed with short spines along the middle, oblique, truncate on its tip; secondary bract tubular, up to 8 cm long, funnel shaped, unarmed, glabrous, bottom part of the bract two edges, oblique, truncate on the tip; consist of 10 rachillae, sessile; each rachillae 2 – 3.5 cm long, consist
of 3 – 4 fruits; involucrophore sessile, apex cupule form; involucre saucer shaped; fruiting perianth flattened, 0.8 cm in diam., concave, calyx has same size as corolla. Fruit 17 x 11 mm, flattened, spherical, covered with 18 vertical rows of fruiting scales and channelled along the middle. Seed globose, 7 mm in diam. Endosperm ruminate.

**Distribution.** South Sulawesi.

**Habitat and ecology.** In the rain forest alt. c. 650 feet.

**Vernacular name.** Not recorded.

**Specimen examined.** South Sulawesi: Malili, Kawata, 20 September 1929, Dr. G. Kjelberg 2367 (BO), fruiting material.

**Notes.** This species belongs to group XV of Beccari and is very closely related to *Calamus arugda* Becc. from Philippine (Beccari 1913). Ripe fruits are eaten by local people.

11. *Calamus leptostachys* Beccari ex Heyne


Type: South East Sulawesi, Boni, Heyne 2594 (holotype FI; isotype BO!).

Small clustering rattan, climbing 60 cm long only. Stem with sheath up to 8 mm in diam., without sheath up to 5 mm in diam. Internodes to 16 cm long. Leaf sheath covered with solitary, pointing downward, scarcely, 2 – 12 mm x 2 – 3 mm, slightly bulbous based, green spines. Leaf sheath mouth armed with scattered, solitary, green spines. Knee present, conspicuously, not armed. Ocrea absent. Flagellum absent. Leaves cirrate to 2 m long including cirrus and petiole; cirrus to 100 cm long, armed with 1 – 3 hooked spines, arranged in 1 – 19 mm apart; petiole very short, only 1 cm long, slightly circular in transverse section, flattened adaxially, convex abaxially, 8 mm wide, to about 6 mm thick near the base, armed abaxially and along the edges with scattered solitary spines widening at the base, decreasing in number towards the lamina; petiole and rachis covered with slightly white indumentums, rachis at mid proton armed with blackish at tip, 1 – 3 hooked grapnels arranged 1 – 2.6 cm apart; leaflets about 45 on each side of the rachis, arranged regularly; leaflets armed with bristles 1 – 2 mm long along mid nerve; leaflets tip prolonged into needle like projection; transverse veinlets
prominent; mid lamina 30.5 cm long and 1.7 cm wide. Staminate inflorescence ascending, longer than the leaves, about 75 cm long, with up to 5 partial inflorescences 11 – 16 cm apart, decreasing in size distally, covered densely with reddish indumentums; prophyll semi tubular, 5 – 7 x 0.8 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with whitish indumentums, armed with scattered, slightly 1-5 hooked spines, becoming less densely to glabrous; peduncle very short, to 0.6 cm long; partial inflorescence to 50 cm long, bearing up to 13 tubular bracts 3 – 15 x 2 – 4 mm, not armed, the proximal up to 1.5 x 0.8 cm, bract bearing racillae to 3.4 cm long, each rachilla bearing distichously arranged bracts to 1 mm long, each bract subtending a staminate flower and two prophyllar bracteoles, involucrophorum pedicellate. Staminate flower to 2 x 1.2 mm; calyx 3-lobed, basal tube to 1 x 0.7 mm; corolla with 3 petals each 2 x 0.5 mm. Pistillate inflorescence unknown. Young fruit 10 x 6 mm, ellipsoid, tipped with 3 twisted stigmas, 0.1 mm, covered with 8 rows of alternating scales; seed 6 x 4 mm, surface reticulate, endosperm homogenous.

**Distribution.** North Sulawesi and Central Sulawesi.

**Habitat and ecology.** Primary montane forest

**Vernacular name.** Rotan Putih (Kaili language), Rotan Tohiti (Gorontalo language), Rotan Ronti (Toli-toli language)


**Notes.** S. Siebert 22 specimen apparently to be mix specimens between staminate inflorescence and infructescence. ‘Putih’ as vernacular name of this species refers to white fruit when it matures.
12. *Calamus macrosphaerion* Beccari


Clustering robust rattan, climbing up to 15 m long. Stem with sheath up to 3 cm in diam., without sheath to 6 cm in diam. Internodes to 20 cm long. Leaf sheaths covered in dense, prickled white latex, brown indumentums, armed with very dense, pointing downward and upward, greyish black, 2 – 23 mm x 1 – 2 mm, flattened – slightly bulbous at base, series of spines. Leaf sheath mouth armed with dense, solitary, greyish black spines. Knee present, conspicuously, armed as the rest of the sheath. Ocrea present, very short. Flagellum absent. Leaves cirrate to 5 m long including cirrus and petiole; cirrus to 200 cm long, armed with 7 hooked spines, arranged in 2 – 55 mm apart: petiole 50 cm long, circular in transverse section, convex adaxially and abaxially, 24 mm wide, to about 11 mm thick near the base, armed abaxially and along the edges with scattered solitary spines widening at the base, decreasing in number towards the lamina; petiole covered with slightly brown indumentums, rachis at mid portion armed with blackish at tip, 1 – 4 hooked grapnels arranged 1 – 3.5 cm apart; leaflets about 40 – 55 on each side of the rachis, arranged regularly; leaflets armed with bristles 1 – 15 mm long along mid nerve and leaf margin; leaflets tip prolonged into needle like projection; transverse veinlets slightly prominent; mid lamina leaflets 40 – 56 cm long and 2.2 – 2.4 cm wide. Staminate and pistillate inflorescence unknown. Infructescence very massive, ascending, shorter than the leaves, about 150 cm long, with up to 10 partial infructescence, axillary, arcuate, 2 – 3 cm apart, decreasing in size distally, covered with brown indumentums; prophyll semi tubular, 5 x 2.5 cm, elliptic in section, already fallen partly so it could not recognised its keel properly, covered with brown indumentums, not armed; partial inflorescence to 35 cm long, bearing up to 15 tubular bracts 15 – 20 x 3 – 6 mm, not armed, the proximal up to 15th bract bearing rachillae to 3.2 – 4 cm long, each rachilla bearing distichously arranged bracts to 2 mm long, Ripe fruit large 19 – 25 x 16 – 20 mm. ovoid, covered with 8 rows of alternating scales; seed 10 – 13 x 10 mm, surface reticulate, endosperm homogenous.
Distribution. This species occur in North, Central to South Sulawesi.

Habitat and ecology. Secondary forest, unstable volcanic soil, steep hillslope up to m1200 m asl.

Vernacular name. Tungka Tohiti (South East Sulawesi), Rotan Lelo (Central Sulawesi)


Notes. GG Musser collection no M16 collected from the summit of G. Nokilalaki.

It is noted in JD 3757 that fruit is exceedingly sour. This species is very distinct compare to other Calamus species from Sulawesi because it has very large round shape fruit and very deep ruminated seed surface. The original type specimen kept in the Berlin Herbarium and unfortunately it had been destroyed during world war two.

13. Calamus mindorensis Beccari


Solitary rattan climbing up to 22 m long. Stem with leafsheath 3 – 4 cm in diam, stem without sheath to 2 cm in diam. Internodes to 26 cm long. Leaf sheath mouth unarmred. Knee present, conspicuously, not armed. Ocrea present, papery, to 7 cm wide at base, to 5 cm long, covered with slightly brown indumentums. Flueellum absent. Leaf sheath whitish green, armed with black smooth, small, short, scattered, solitary spines. Leaves 3,9 m long, including cirrus and petiole; cirrus 60 – 125 cm long armed with 2 – 8 hooked spines, arranged in 0.2 – 35 cm apart; petiole to 35 cm long, slight circular in transverse section, flattened adaxially, convex abaxially, 21 mm wide, 8 mm thick near the base, armed
adaxially, slightly along abaxial surface and along the edges with scattered solitary spines widening at the base, decreasing in number towards the lamina; petiole and rachis covered with brown indumentums, rachis at mid-portion armed with black, rigid, 2 hooked grapnels abaxially, arranged 5 – 6 cm apart; leaflets about 25 – 35 on each side of the rachis, arranged regularly; leaflets armed with bristles 1 – 5 mm long adaxially, along mid nerve and leaf margins; transverse veinlets prominent slightly; mid lamina 30 cm long and 3.6 cm wide. Staminate and pistillate inflorescence unknown. Infructescence ascending to 90 cm long.

Young fruit 8 x 5 mm, covered with 7 rows of alternating scales; seed 10 x 6 mm, surface reticulate, endosperm homogenous.

**Distribution.** South East and Central Sulawesi.

**Habitat and ecology.** Sandy stone and alluvial soil in rain forest.

**Vernacular name.** Bopaloa, Powaloa (Kulawi language), Hoa (Mekonga language), Rotan hoa & Rotan Siumbo (Kolomodale language).

**Specimen examined.** Central Sulawesi: Sungei Tolewonu, Kuala Navusu, 400 – 1500 feet, during 1974 – 1976, G.G. Musser: T11, sterile (K); Mt. Mope, Kulawi, February 1986, 300 m asl., Anggana & Yusuf Dali 60, sterile (K). **South East Sulawesi:** G. Mekonga, Wolo, Kolaka, Kendari, 11 August 1985, 350 m asl., Anggana & Yunus Dali 031, sterile (K); Kolomodale, Towi, 4 March 1989, Lynn Clayton 20, sterile (K); Kuala Navusu on adjacent og Gunung Benteng, Tomini Gulf between Parigi and Poso, between August – November 1975, G.G. Musser: R2, fruiting (K).

**Notes.** It noted by Clayton (written in his labels) that this rattan is the expensive rattan, only growing on fertile alluvial soil. GG Musser reported (in his label) that this rattan seen mostly on slopes of hills and sometimes scattered along stream terraces. People from the mountains call this rattan ‘Powaloa’ but the lowland people call it ‘Tohiti tanange’. Beccari (1913) reported this rattan is closed to *C. moseleyanus* Becc. however differs in its larger dimensions, larger and more diffuse spadix with much longer spikelets and especially in the smaller fruit with more numerous and more appressed scales, which are arranged in 18 – 20 longitudinal series, while they are in 12 series only in *C. moseleyanus*. 
14. *Calamus pachystachys* Warb. ex Beccari


Robust clustering rattan. No information on the stem diameter and internode length. Leaf sheath dull green, covered with reddish indumentums, hardly armed. Leaf sheath mouth not armed. Knee present, very conspicuously, not armed. Ocrea present, very short. Flagellum absent. Leaves cirrate to 3 m long including cirrus and petiole; cirrus to 120 cm long armed with 4 hooked spines, arranged in 1.5 – 4.5 cm apart; petiole to 13.5 cm long, slight circular in transverse section, flattened abaxially, convex adaxially, 17 mm wide, 7 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spines widening at the base; petiole and rachis covered with white indumentums, rachis at mid-portion armed with black, rigid, 1 hooked grapnel arranged 1 – 4 cm apart; leaflets rather numerous on each side of the rachis, regularly arranged, papyraceous, glabrous, narrowly lanceolate, gradually acuminate into an obtuse and at the tip spinolus point; leaflets with bristles 1 – 5 mm long along mid nerve abaxially and leaf margins; transverse veinlets prominent. Staminate inflorescence not known. Pistillate inflorescence ascending, shorter than the leaves, about 60 cm long, with up to 10 partial inflorescences 3 – 5 cm apart, decreasing in size distally, covered densely with brown reddish indumentums; prophyll semi tubular, 5 – 7 x 1 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with brown reddish indumentums, not armed, becoming less densely to glabrous; peduncle very short, to 0.6 cm long; partial inflorescence to 40 cm long, bearing up to 21 tubular bracts 10 – 15 x 3 – 4 mm, not armed, the proximal up to 20th bract bearing rachillae to 8.5 cm long, each rachilla bearing distichously arranged bracts to 2 mm long, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2 x 0.8 mm; calyx 3-lobed, basal tube to 1 x 0.7 mm; corolla with 3 petals each 2 x 0.8 mm; staminodes present; flower in very early stage of fruit, ellipsoid, tipped
with 3 twisted stigmas, 0.1 mm. Young fruit 9 x 9 mm, covered with 9 rows of alternating scales; seed 5 x 5 mm, surface reticulate, endosperm homogenous.

**Distribution.** Central Sulawesi

**Habitat and ecology.** Primary forest above mountain stream around 3000 feet.

**Vernacular name.** Rotan Talangallai (Sadaunta dialect).

**Specimen examined.** Central Sulawesi: East mountain of Sadaunta, 3000 feet above mountain stream, April – May 1976, G.G. Musser: RS 1, fruiting material (K). NW of G. Bonthain, 9 June 1921, 2200 m asl., Bunnemeijer 12010, fruiting (BO); 20 June 1921, 2060 m asl., Bunnemeijer 12020, fruiting (BO).

**Notes.** It looks like huge rattan based on the specimen kept in K. This species close to *C. didymocarphus* but it differs in having smaller leaflet, more distinct lanceolate and its prophyll more robust, short and rigid and its fruit conically beaked. The original type specimen kept in the Berlin Herbarium and unfortunately it had been destroyed during world war two.

15. *Calamus subinermis* H. Wendl. ex Beccari


Solitary climbing rattan to 30 m, stem with sheath to 2.5 cm in diam., stem without sheath to 1.5 cm in diam. Internodes 23 cm long. Leaf sheath unarmed, smooth surface. Knee present very conspicuously, unarmed. Ocrea present, very short, up to 5 mm long, covered with glaucous grey indumentum. Flagellum absent. Leaves to 4 m long including petiole and cirrus; petiole to 13 cm long, circular in cross section, 1.5 cm wide and 5 mm thick close to the base, slightly armed with short spines along the margin; on the middle of rachis armed with 1 – 3 hooked spines arranged in 3 – 4 cm apart; covered with glaucous grey black indumentums; leaflets 25 on each of the rachis, dark green cucullate pendulous; leaves in region of inflorescences much smaller in size than above and below; cirrus to 125 cm long, armed with 1 – 5 hooked spines, arranged in 1 – 1.5 cm apart. Staminate inflorescence similar with pistillate inflorescence, ascending to 1 m, shorter than the leaves, with up to 5 partial inflorescence, branching into two orders; partial inflorescence more crowded than pistillate partial inflorescence;
rachillae to 40 mm long and 1.5 mm wide. Pistillate inflorescence ascending, shorter than the leaves, about 100 cm long, with up to 5 partial inflorescences, bearing rather distant flowers; partial inflorescence to 120 mm long and 3 mm wide, decreasing in size distally, covered with brown reddish indumentums; prophyll tubular, elliptic in section, covered with brown reddish indumentums, not armed, becoming less densely to glabrous; bearing up to 35 tubular bracts, not armed, each rachilla bearing distichously arranged bracts to 2 mm long, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2 x 1.2 mm; calyx 3-lobed, basal tube to 1 x 0.7 mm; corolla with 3 petals each 2 x 0.5 mm; flower in very early stage of fruit, ellipsoid, tipped with 3 twisted stigmas, 0.1 mm. Fruit rounded, 10 mm in diam., covered in 15 vertical rows of alternating pale greenish scales; seed 7 x 5 mm, deeply pitted, endosperm subruminate.

**Distribution. North Sulawesi**

**Habitat and ecology.** Dry coastal forest on volcanic rock, steep hillslope lowland forest.

**Vernacular name.** Not recorded.

**Specimen examined.** North Sulawesi: Minahasa, Suaka Alam Batu Angus, Bitung, 50 m asl., 5 October 1973, J. Dransfield & J.P. Moge JD 3721, female flower (BO, L, K); J Dransfield & JP Moga JD 3720, dead staminate flower (BO, L, K); 70 m asl., 18 October 1973, JD 3785, fruiting (BO, L); J Dransfield & JP Moga JD 3781, staminate flower (BO, L).

**Notes.** *C. subinermis* is a magnificent rattan native to Sabah and has great diameter of cane. This species has economic potential and requires urgent silviculture assessment. Present stocks are limited and their exploitation requires strict control (Dransfield 1984).

16. **Calamus inops** Beccari ex Heyne

*Calamus inops* Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2:372 (1922). Type: Sulawesi, *Heyne 2518* (holotype FI; isotype BO!). *Calamus pedicellatus* Becc. ex
Heyne, Nutt. Pl. Ned.-Ind.:381 (1922). Type: Sulawesi, Heyne 2601 (lectotype FI; isolecotype BO!).

Moderately robust, solitary rattan, climbing to 10 m. Stem with sheath to about 2.5 cm in diam., stem without sheath to about 2 cm in diam.; internodes 12 – 15 cm long. Leaf sheath covered with black indumentum densely, armed with series of spines arranged spirally, comb like, up to 15 mm long and 1.2 mm wide, some are swollen at the base. Leaf sheath mouth armed or slightly armed with small spine as the rest of leaf sheath. Knee present, conspicuously, not armed. Ocrea present but sometimes inconspicuous. Flagellum absent. Leaves cirrate to 3 m long including cirrus and petiole; cirrus to 1 m long armed with 5 – 8 hooked spines, arranged in 1 – 2.5 cm apart; petiole 18 – 30 cm long, slight circular in transverse section, flattened adaxially, convex abaxially, 7 – 13 mm wide, 4 – 7 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spines widening at the base, decreasing in number towards the lamina; petiole and rachis covered with black indumentums, rachis at mid-portion armed with black, rigid, 1 – 4 hooked grapnels arranged 3 – 8 cm apart; leaflets about 25 – 48 on each side of the rachis, arranged regularly; leaflets armed with bristles 2 – 5 mm long along all main nerves or sometimes only occur in the mid nerve; leaflets tip prolonged into into needle like projection; transverse veinlets prominent; mid lamina 20 – 35 cm long and 0.9 – 1 cm wide. Staminate inflorescence ascending 25 – 65 cm long, with up to 5 or 7 partial inflorescence, 4 – 8 cm apart, decreasing in size distally, covered by black indumentums; prophyll tubular, 3 – 7 x 0.5 x 1 cm, elliptic in transverse section, 2-keeled with one keel longer at the base of the branches, covered by black indumentums, armed along the edges with a series of single spines to 3 mm long; other bracts similar but decreasing in size distally and become less densely armed and glabrous; peduncle 1.5 – 3 x 0.3 cm to the prophyll scar, covered by black indumentums; prophyll and other bracts subtending the partial inflorescence; partial inflorescence 13 – 30 cm long, bearing 6 – 12 tubular bracts 15 – 30 x 4 -5 mm, the proximal up to the 10th bract bearing second order branches 8 – 10 cm long, each bract subtending a staminate flower. Staminate flower when young 2 – 4 x 1 – 1.5 mm, calyx 3-lobed, basal tube 1 – 1.5 mm long, lobes to 0.5 x 1 mm; corolla with three petals.
each 2-3 x 1 mm; stamens with free filament 0.5 – 1 mm long, anthers 1 – 1.5 mm long. Pistillate inflorescence ascending, shorter than the leaves, to 45 – 60 cm long, with up to 8 partial inflorescences 4 – 6 cm apart, decreasing in size distally, covered densely with black indumentums; prophyll semi tubular, 5 – 7 x 1 cm, elliptic in section, covered with black indumentums, armed with scattered spines, becoming less densely to glabrous; peduncle very short, to 2 cm long; partial inflorescence to 30 cm long, bearing up to 20 tubular bracts 10 – 15 x 3 – 4 mm, not armed, the proximal up to 17th bract bearing rachillae to 9 cm long, each rachilla bearing distichously arranged bracts to 3 mm long, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2.5 x 1.25 mm; calyx 3-lobed, basal tube to 1.5 x 0.75 mm; corolla with 3 petals each 3 x 0.75 mm; staminodes present; ovary 2.5 mm diam., ellipsoid, tipped with 3 twisted stigmas. Young fruit 11 x 5 mm, covered with 12 rows of alternating scales, each scale with a midgroove; endosperm homogenous.

**Distribution.** Endemic to Sulawesi (Central Sulawesi, South Sulawesi and South East Sulawesi).

**Habitat and ecology.** 200 m asl. – 1200 m asl.

**Vernacular name.** Tungka, Tohiti (Tobela language), Samole (Bugis language), Ruimaeto Bahata (Tobelo language).

**Specimen examined.** Central Sulawesi: Kulawi District, Moa, G. Malemo, 24 October 1977, J.P. Moge: JPM 1477, male inflorescence (BO, K), JPM 1474 (BO), JPM 1475 (BO), JPM 1476 (BO). South Sulawesi: Malili, Kawata, 28 October 1910, A.G. Waturandang 36, male inflorescence (BO). North shore of Lake Matano, Bonemaitu, East of Nuha, 04 July 1979, E.F. de Vogel 6088, female inflorescence (BO, L); Bone, Heyne 8, sterile (FI), Heyne 2594, female flower (FI, BO), Heyne 2601, female flower (lectotype FI; isolectotype BO); Malili, Kawata, 22 April 1933, 25 m asl., A.G. Waturandang 4, female inflorescence. South East Sulawesi: Kolaka, Heyne 2568, sterile (BO, FI); Heyne 8, sterile (BO).

**Notes.** Kramadibrata (1991) treated *C. pedicellatus* and *Calamus inops* as different species based on their leaflets size but after thorough observation the leaflets size of those species are significantly similar so I decided to treat them as one single species under name *Calamus inops* and placed *Calamus pedicellatus* as its synonym.
17. Calamus koordersianus Beccari


Moderate solitary rattan, climbing to 10 m long. Stem with sheath up to 4 cm in diam., without sheath to 3 cm in diam. Internodes to 25 cm long. Leaf sheath when old, grass green covered with rusty-furfuraceous removable indumentum, when young covered with red brown indumentum, armed with unequal, scattered, straight, slightly deflexed, short, 10 – 20 mm long, black spines. Leaf sheath mouth not armed. Knee present, conspicuously slightly armed with short solitary spines. Ocrea present, very rusty color and variation of spines are great. Flagellum to 5 m long, rusty at the base, armed with 3 – 5 hooked spines, arranged in 3 – 20 mm apart. Leaf ecirrate to 1.5 m long, petiole to 35 cm long, slight circular in transverse section, flattened adaxially, convex abaxially, 15 mm wide, to about 8 mm thick near the base, armed abaxially and along the edges with scattered 1 – 4 hooked spines widening at the base, decreasing in number towards the lamina arranged 4 – 20 mm apart; petiole and rachis covered with brown indumentums abaxially; leaflets about 45 on each side of the rachis, arranged regularly; leaflets armed with bristles 1 – 9 mm long along main nerves and leaf margins; leaflets tip prolonged into needle like projection; transverse veinlets prominent; mid lamina leaflets 48 cm long and 2 cm wide. Staminate inflorescence unknown. Pistillate inflorescence arcuate, longer than the leaves, up to 3 m long, with 7 arcuate partial inflorescence. Infructescence ascending to 3 m long, with 5 partial infructescence. Young fruit dark green, brown when dried, spherical with a short and broad conical beak, 9 x 6 mm, covered with up to 9 rows of alternating scales; seed 2 – 3, flattened, irregular and angular, endosperm homogenous.

**Distribution.** North, Central and East Sulawesi

**Habitat and ecology.** Much disturbed primary forest

**Vernacular name.** Lauro Kikira (Tobelo and Topadoe languages), Pondos Ajamen (Minahasa language)
Specimen examined. South Sulawesi: Malili, Kawata, 27 December 1933, 25 m asl., H.N. Reppie 39, dead female flowers (BO); Kolaka, Heyne 2565, sterile; Boni, Heyne 2603, sterile, Heyne 11, sterile; Wadjo, Heyne 2613, sterile; Kampung Malili, 01 June 1933, A. Harnsteia 11, female flower (BO); leg. ign. Padmi Kramadibrata sn, sterile (K). Central Sulawesi: P. Gimpa, Rachmat 688, young fruiting material (BO); Kuala Navusu, on adjacent G. Benteng, Gulf of Tomini between Parigi and Poso, 1500 feet asl., August – November 1975, G.G. Musser: R7, fruiting (K). North Sulawesi: Bolaang Mongondow, Pindool, Lolak, 18 October 1973, J. Dransfield: JD 3784, fruiting material (BO, L); 19 October 1973, JD 3815, fruiting material; Minahasa, Suaka Alam Batu Angus, Bitung, 6 October 1973, 100 m alt., J. Dransfield: JD 3731, fruiting material (BO); 50 m alt., JD 3727, male flower (BO, L); Kolomodale, Towi, (in stunted forest on level, ultrabasic soil), 3 March 1989, Lynn Clayton 14, sterile (K).

Uses. It has good small cane for rope and making basket because its cane easily to bend.

Notes. This species can be easily distinguished from the other Calamus of Sulawesi because it is the only Calamus of Sulawesi which has two to three seeds. One single collection made by P Kramadibrata cultivated in Kew Gardens where seeds are obtained from South Sulawesi. One single specimen collected by Lynn Clayton noted that this rattan to 3.75 m, leaf to 4.3 m, not yet climbing, flagellum present, sheaths light brown, stem diameter 17 mm, medium to low priced.

18. Calamus orthostachyus Furtado


Type: Sulawesi, Kjelberg 2649 (holotype Berlin Herb.; pictures in K!).

Moderately robust, solitary rattan, climbing to 40 m. Stem with sheath to 4 cm in diam., stem without sheath to 3 cm in diam. Internodes to about 15 cm long. Leaf sheath covered with black indumentum densely, armed with series of spines arranged spirally, comb like, up to 15 mm long and 1.2 mm wide, some are swollen at the base. Leaf sheath mouth not armed. Knee present, conspicuously, about 1 cm height, armed as the rest of the sheath. Ocrea present slightly, 3 x 10 mm. Leaves cirrate to 3 m long including cirrus and petiole; cirrus to 150 cm long armed with 1–6 hooked spines, arranged in 0.8 – 2 cm apart; petiole 10 – 25 cm long, slight circular in transverse section, flattened adaxially, convex abaxially, 17 mm wide, 7 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spines widening at the base, decreasing in number.
towards the lamina; petiole and rachis covered with brown reddish indumentums, rachis at mid-portion armed with black, rigid, 1 – 4 hooked grapnels arranged 1.5 – 4 cm apart; leaflets about 27 – 41 on each side of the rachis, arranged regularly; leaflets armed with bristles 1 – 5 mm long along mid nerve and leaf margins; leaflets tip prolonged into needle like projection; transverse veinlets prominent slightly; mid lamina 30 – 38 cm long and 1.2 – 1.6 cm wide. Staminate inflorescence not known. Pistillate inflorescence ascending, shorter than the leaves, about 40 cm long, with up to 10 partial inflorescences 3 – 5 cm apart, decreasing in size distally, covered densely with brown reddish indumentums; prophyll semi tubular, 5 – 7 x 1 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with brown reddish indumentums, not armed, becoming less densely to glabrous; peduncle very short, to 0.6 cm long; partial inflorescence to 28 cm long, the proximal up to 20th bract bearing rachillae to 8.5 cm long, each rachilla bearing distichously arranged bracts, each bract subtending a dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, involucrophorum pedicellate. Sterile staminate flower to 2 x 1.2 mm; calyx 3-lobed; corolla with 3 petals each 2 x 0.5 mm; staminodes present; flower in very early stage of fruit, ellipsoid, tipped with 3 twisted stigmas, 0.1 mm. Young fruit 8 x 5 mm, covered with 7 rows of alternating scales; seed 10 x 6 mm, surface reticulate, endosperm homogenous.

**Distribution.** Central Sulawesi.

**Habitat and ecology.** Hill slope of primary forest.

**Vernacular name.** Pai (Kaili dialect)

**Specimen examined.** Central Sulawesi: Gunung Pada Esa, Lore Utara, Poso, 1471 m asl., 11 September 2005, Himmah Rustiami: *HR 446*, fruiting material (BO, K); 1525 m asl., *HR 448*, fruiting material (BO, K); Mountain Parema, Kjelberg 2649, fruiting (holotype S); Kulawi, Moa. G. Malemo, J.P. Mogea: *JPM 1329*, fruiting (BO, K), 18 October 1977, 2000 m asl., *JPM 1330*, male flower (BO, K).

**Notes.** This is hardly known species which only collected several times since it was described first time by Furtado. It is noted this common species in Gunung Pada Esa has medium cane quality. Cane of this species collected for etnobotany purposes and kept in the BO. Its cane can be used for tying, making basket and small handicrafts.
19. *Calamus robinsonianus* Beccari


Slender, solitary, climbing rattan. Stem without sheaths to 1.5 cm diam., stem with sheath to about 2 cm in diam.; internodes to 15 cm long. Leaf sheath covered in scattered indumentum and armed with narrowly triangular spines to 1 cm long, irregularly arranged or arranged in 3s to 5s; leaf sheath mouth armed as the rest of the sheath. Knee present, glabrous. Ocrea present, tightly sheathing to 2 mm wide. Flagellum absent. Leaf cirrate to 150 cm long including petiole and cirrus; cirrus to 60 cm long, armed with 4 – 5 hooked like spines, arranged in 1.5 – 2 cm apart; petiole 5 – 12 cm long, semi circular in transverse section, flattened to slightly concave on adaxial side, 9 mm wide and 4 mm thick near the base, armed with spines along the edges; rachis in mid portion triangular in cross section, upper surface armed with 1 – 2 hooked like spines arranged 2 – 3 cm apart; leaflets 33 – 37 on each side of the rachis, regularly arranged, linear lanceolate, acuminate, armed with bristles to 5 mm long along the midrib of both surfaces, rarely along the mid costae and with very tiny spines along the margins, leaflets tip prolonged into needle like projections; transverse veinlets present conspicuously; mid lamina 23 – 27 cm long and 1 – 1.5 cm wide. Staminate inflorescence not complete with prophyll or primary bract semi tubular, elliptic in transverse section, unarmed, covered with black indumentum; each bract subtending rachilla up to 12 cm long; each rachilla consist of up to 8 rachillae which consist of 6 bracts, each bract consist of a cylindrical flower and a bracteole. Pistillate inflorescence ascending and similar to staminate inflorescence, 25 – 30 cm long, with up to 6 or 7 rachilla; prophyll semi tubular, elliptic in transverse section; rachilla to 12 cm long consist of 12 rachillae, each rachillae bearing distichously arranged bracts with each bract subtending a dyad of a sterile male flower and a fertile female flower; involucrophore pedicellate; involucre sessile; female flower with calyx 3-lobed; corolla of 3 petals. Immature fruit globose, 9 x 5 mm, beaked, covered with 11 – 12 scales in vertical rows, light brown; endosperm homogenous.
Distribution. South Sulawesi, Ambon and Seram.

Specimen examined. Moluccas: Amboina, June 1913, Robinson CB 1613. South Sulawesi: Kawata, 7 August 1933, Van Zijl de Jong sn., pistillate inflorescence, already fall off (BO, L).

Notes. This species is new record to Sulawesi where can be found in South Sulawesi based on single specimen collected by Van Zijl de Jong in 1933.

20. *Calamus boniensis* Beccari ex Heyne


Type: Sulawesi, *Heyne* sn. (holotype FI; pictures in K!).

Solitary/clustering rattan? Climbing up to 35 m high. Stem with leafsheath 5 - 8 mm in diameter, without leafsheath up to 5 mm in diameter, internodes 15 – 20 cm. Leaf sheath covered with very dense, horse tail like, mostly bulbous at base, in group of 2 – 5 spines. Leaf sheath surface shiny yellow, horizontal ridge present. Knee not armed, present obviously. Ocrea very short. Flagellum absent. Leafsheath mouth armed as the rest of the sheath. Leaves to 120 cm long, including cirrus and petiole. Leaflets 4 on each side of the cirrus; mid lamina 30 cm long and 1 cm wide. Staminate inflorescence, pistillate inflorescence and infructescence not known.

Distribution. So far reported from Bone (Heyne, 1922), East Sulawesi and Central Sulawesi.

Habitat and ecology. Undisturbed montane forest, dominated by Fagaceae and Myrtaceae mountain ridge, shallow clayey soil.

Vernacular name. Tomani (Bugis language).

Specimen examined. Central Sulawesi: Kualwi district, Moa village, slope of G. Malemo, 18 October 1977, J.P. Moge: *JPM* 1328, sterile (BO, K); Mt. Roroka Timbu, west slope, c. 80 km SSE of Palu, 20 May 1979, *E.F. de Vogel* 5482, sterile (BO, K).

Notes. Reported by Heyne (1922) this rattan has good cane value for export and local use. There is not enough information on this species. The only information on the species so far provided by Heyne in 1922 and notes on the sterile specimen collected by JPM and deVogel. It is said to have good quality of cane as *Calamus laiocalus*. 
21. *Calamus leiocaulis* Beccari ex Heyne


Type: Sulawesi, *Heyne sn.* (holotype FI; isotype BO!).

Moderate clustering rattan, climbing up to 42 m long. Stem with sheath about 6 – 10 mm in diam., without sheath about 4 mm in diam. Internodes to 3.5 mm long. Leaf sheath armed with solitary, very rare, triangular, 4 – 7 mm x 2 – 4 mm, widened at base, yellow to green spines. Leafsheath mouth not armed. Knee present, conspicuously, not armed. Ocrea present, very short. Flagellum absent. Leaves cirrate, to 95 cm long including cirrus and petiole; cirrus to 53 cm long, armed with 1 – 3 hooked spines, arranged in 4 – 11 mm apart; petiole to 11 cm long, circular in transverse section, flattened adaxially, convex abaxially, 6 mm wide, to about 6 mm thick near the base, armed abaxially and along the edges with solitary, very rare spines widening at the base, decreasing in number towards the lamina; petiole and rachis surfaces very smooth, rachis at mid portion armed with blackish at tip, 1 (–3) hooked grapnels arranged 0.8 – 2.6 cm apart; leaflets arranged regularly; leaflets armed with bristles 1 – 2 mm long along mid nerve; leaflets tip prolonged into needle like projection; transverse veinlets prominent; mid lamina 26 – 29.5 cm long and 3.4 cm wide. Staminate and pistillate inflorescence unknown.

**Distribution.** South East Sulawesi.

**Habitat and ecology.** Primary forest

**Vernacular name.** Jermasin (Mekonga language)

**Specimen examined.** South East Sulawesi: Kendari, Kolaka, Wolo, G. Mekonga, 10 August 1985, 15 m asl., *Anggana & Yunus Dali 025*, sterile (K).

**Notes.** As *Calamus boniensis*, this species is said to have good quality on its cane. The information only gathered from Heyne (1922) where most of species named as Beccari then published by Heyne kept in FI as type specimen. The type specimen of this species also presumably preserved in FI.
22. Calamus scleracanthus Beccari ex Heyne


Moderate clustering rattan, climbing to 20 m long. Stem with sheath to 15 mm in diam., stem without sheath to 8 mm in diam. Internodes to 25 cm long. Leaf sheath mouth not armed – slightly armed with solitary spines. Knee present, well developed, not armed. Ocrea present. Flagellum absent. Leaf sheath armed with solitary, bulbous based, triangular, slightly hooked blackish tip, sometimes in pairs and comb like arranged spines, 5 – 12 x 2 – 4 mm, covered with dull whitish red scarcely indumentums. Leaves to 4 m long including cirrus and petiole; cirrus to 2 m long, armed with 1 – 4 hooked spines, arranged in 3 – 14 mm apart; petiole short, only to 14 cm long, slight circular in transverse section, flattened abaxially, convex adaxially, 10 mm wide, 5 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spines widening at the base gradually become less toward the rachis; petiole and rachis covered with whitish grey indumentums, rachis at mid-portion armed with black, rigid, 1 – 4 hooked grapnel arranged 1 – 4 cm apart; leaflets about 19 – 50 on each side of the rachis, arranged in groups of 2 – 15 leaflets; leaflets armed with bristles 1 – 5 mm along mid nerve abaxially and leaf margins; transverse veinlets prominent; mid lamina 38 – 40 cm long and 1.8 – 2.2 cm wide. Staminate inflorescence ascending to 50 cm long, shorter than the leaves with up to 5 partial inflorescences 11 – 16 cm apart, decreasing in size distally, covered densely with reddish indumentums; prophyll semi tubular, 5 – 7 x 0.8 cm, elliptic in section, covered with whitish indumentums, armed with scattered, slightly 1- 5 hooked spines, becoming less densely to glabrous; peduncle very short, to 0.6 cm long; partial inflorescence to 50 cm long, bearing up to 13 tubular bracts 3 – 15 x 2 – 4 mm, not armed, the proximal up to 17th bract bearing rachillae to 3.4 cm long, each bract subtending a staminate flower and two prophyllar bracteoles, involucrophorum pedicellate. Staminate flower to 2 x 1.2 mm; calyx 3-lobed.; corolla with 3 petals each 2 x 0.5 mm. Pistillate inflorescence ascending, about 120 cm long, with up to 14 partial inflorescences 3 – 15 cm apart, decreasing in size distally, covered densely with white greenish indumentums; prophyll tubular, 5 – 7 x 8 mm, elliptic in section,
covered with white greenish indumentums, slightly armed, becoming less densely
to glabrous; peduncle very short, to 6 cm long; partial inflorescence to 20 cm
long, not armed; each rachilla bearing distichously arranged bracts to 2 mm long,
each bract subtending a dyad of sterile staminate and a fertile pistillate flower and
two phyllar bracteoles, involucrophorum pedicellate. Young fruit 8 x 5 mm,
covered with 7 rows of alternating scales; seed 10 x 6 mm, surface reticulate,
endosperm homogenous.

Distribution. Central Sulawesi.

Habitat and ecology. Disturbed primary forest

Vernacular name. Rotan Puti, Rotan Kalaka, Gelaka (Donggala language)

Nokilalaki, 850 m asl., 18 November 2000, J.P. Mogea & Andi Tanra Tellu: JPM 7441, sterile (BO, K, L); J.P. Mogea & Andi Tanra Tellu: JPM 7440, dead male
inflorescence (BO, K, L); Kuala Navusu, Sungei Tolewono, 400 – 1500 feet,
between 1974 – 1976, G.G. Musser: T2, fruiting (K); Sungei Sadaunta, 4000 feet,
between 1974 – 1976, G.G. Musser: M2, sterile (K); Kulawi, Mt Petulu, 700 m
asl., February 1986, Anggana & Yunus Dali 061, fruiting (K); 900 m asl.,
February 1986, Anggana & Yunus Dali 063, sterile; Kulawi, Moa, Bukit
Parawatu, 950 m asl., 24 June 2001, Ramadhanil & S Siebert 501, male flower
(BO, K, L). North Sulawesi: Bolaang Mongondow, Pindool Lolak, 100 m asl.,
18 October 1973, 100 m asl., J. Dransfield & J.P. Mogea: JD 3786, male flower (BO, L), JD 3780, as JD 3786 but female (BO, L). South East Sulawesi: around Opa swamp,
west side hills, 20 -250 m asl., S. Prawiroatmojo & S. Soewoko 1925, fruiting
material (BO, L).

Notes. This species is common on upper slopes and tops of ridges, upper part of
lowland evergreen forest and higher into lower part of lower montane chestnut
forest, common around 3000 – 4000 feet, clumping rattan with large rosettes and
several stem coming out of the rosettes base (GG Musser T2 & M2). It seems that
this species has good quality of cane, because it can be bent easily (personal
observation).

23. *Calamus siphonospathus* Mart. var. *dransfieldii* Baja-Lapis

Batu Angus, Bitung, 500 m asl., 7 October 1973, J. Dransfield & J.P. Mogea: *JD 3738*, fruiting (holotype: K!; isotype BO!, L!).

Solitary very robust rattan climbing to 20 m or more. Stem with sheath to 7 cm in diam., stem without sheath to 5 cm in diam. Internodes to 20 cm long. Leaf sheath armed with terrifically spiny with dense reflexed and upward pointing papery black spines, up to 7 cm long. Leaf sheath mouth armed with strikingly enormous spines, up to 5 cm long. Knee present obviously, armed as the rest of the sheath. Ocrea present. Flagellum absent. Leaves to 4 m long including cirrus and petiole: cirrus to 1.5 m long, very robust, armed with gigantic 1 – 6 hooked spines, arranged in 0.5 – 5 cm apart; petiole to 60 cm long, armed with densely black spines yellow at based; circular in transverse section, flattened abaxially, convex adaxially, 11 mm wide, 5 mm thick near the base; petiole and rachis covered with brown indumentums; rachis armed with grey, rigid, solitary to group of striking spines; leaflets about 90 pairs on each side of the rachis, somewhat drooping darkgreen, arranged regularly; leaflets armed with dense bristles 1 – 5 mm along mid nerve abaxially and leaf margins; transverse veinlets prominent; mid lamina 38 – 40 cm long and 1.8 – 2.2 cm wide. Staminate inflorescence and pistillate inflorescence unknown. Infructescence massive, arcuate, pendulous with spathes tattering at tips green when fresh, consist of 12 partial infructescence.

**Distribution.** North Sulawesi

**Habitat and ecology.** Steep hillslope primary forest on volcanic soil

**Vernacular name.** Not recorded


**24. Calamus suaveolens** W.J. Baker & J. Dransf

Robust, solitary rattan climbing to 10 m. Stem with sheaths 15 - 40 mm diam., without sheaths 11 - 20 mm diam.; internodes 30 - 40 cm. Leaf sheath dark green, with sparse to abundant, caducous indumentum of minute, irregular, brown and white scales, spines numerous, 2 - 25 x 0.5 - 5 mm, black, triangular, slightly deflexed, scattered evenly throughout sheath, spine bases slightly swollen adaxially, sheath mouth densely armed. Knee present conspicuously, moderately to densely armed spines and indumentum as on sheath. Ocrea present, indistinct, 14 - 23 mm, forming a hard, woody, persistent flange, divergent from stem, armed with bristle-like spines and spines as on sheath, base of ocrea extending along petiole to an acute angle. Flagellum absent. Leaf cirrate, c. 4.3 m long including cirrus and petiole; petiole 20 - 30 mm, 14 - 17 mm wide and 7 - 8 mm thick at base, flat adaxially, rounded abaxially, indumentum as on sheath, with numerous short triangular spines; rachis up to 3 m, with few, very small, triangular spines, with irregularly triangular spines; rachis, irregularly arranged in divergent pairs and solitarily, broadly lanceolate, cucullate, mid lamina 28 - 40 cm long and 6.5 - 9 cm wide; leaflet margins unarmed or with very few bristles 1 - 1.5 mm, increasing in density towards leaflet apex, transverse veinlets moderately inconspicuous; cirrus 1.2 - 2 m, cirrus grappel spines arranged irregularly. Staminate inflorescences up to 3.8 m long including c. 35 cm sterile tip, branched to 3 orders; prophyll 12 - 16.5 x 1 - 1.3 cm, strictly tubular, with 2 keels, prophyll mouth entire, with narrow, acute, triangular limb to one side, indumentum as on sheath, densely armed with spines 1 - 18 mm long, similar to spines on sheath; peduncular bracts absent, rachis bracts 19 - 26.5 x 0.7 - 1.5 cm, similar to prophyll, densely armed towards apex as prophyll; primary branches up to c. 12, to 28 cm long, 31 - 38 cm apart, strongly recurving, with up to c. 250 rachillae, bracts on primary and secondary branches funnel-shaped; rachillae sublinear, glabrous; rachilla bracts subdistichous, glabrous. Staminate flowers very sweetly scented; calyx tubular, with 3 lobes, glabrous. Pistillate inflorescence similar to staminate inflorescence, primary branches c. 25 cm long, with c. 26 rachillae, bracts on primary branch funnel-shaped; rachillae 25 - 70 x 2 mm, sublinear or irregular; rachilla subdistichous, glabrous. Pistillate flowers very sweetly scented, calyx tubular, with 3 lobes,
glabrous. Sterile staminate flowers not known. Fruit globose, c. 8 x 6 mm including beak 1.5 mm, with c. 20 longitudinal rows of shallowly channelled scales with entire, uneven margins. Seed 6 x 4 x 4 mm, globose, with a deep, narrow pit on one side, the surface covered with numerous deep pits and irregular channels; endosperm homogeneous.

Distribution. North and Central Sulawesi

Habitat and ecology. Hill forest and lower montane forest, on steep slopes, 780 – 1350 m.

Vernacular name. Not recorded.


Notes. This quite recent new species (published in 2002 by WJ Baker & J Dranfield) has been found in the disturbed lower montane forest. This species has heavily armed major bracts on the primary axis of the inflorescence and the relatively large, heavily armed, persistent ocrea.

25. *Calamus perpendiculus* Rustiami sp.nov.

Hic speciei novae vestigium flagellum praesentium 20 cm longis non nisi in Celebica. Type: Central Sulawesi: Poso, Lore Utara, Gn. Pada Esa, 11 September 2010, 1525 m asl., Himmah Rustiami, Dewi, M Amir, Hamzah & Ato: HR 447, fruiting material (holotype BO!; isotype K!).

Moderately robust, solitary rattan, climbing up to 20 m long. Stem with sheath to 4 cm in diam., stem without sheath to 2 cm in diam.; internodes to about 15 cm long. Leaf sheath armed with striking hair like, red to brown colour, united at the base spines, covered with densely brown indumentums. Leaf sheath mouth armed with straight forward hair like, red to brown spines. Knee present, slightly conspicuous, armed as the leaf sheath. Ocrea present, very conspicuous, a tube form, slightly broader proximally, 3 mm in diam., to 1 cm long, armed with smaller hair like red to brown spines. Vestigial flagellum present, 20 cm long
subtending 5 slightly tubular bracts. Leaves cirrate to 350 cm long including cirrus and petiole; cirrus to 150 cm long armed with 2 – 4 hooked spines, arranged in 5 – 26 mm apart; petiole to 40 cm long, slight circular in transverse section, slightly convex adaxially, convex abaxially, 10 mm wide, 4 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spine widening at the base; petiole and rachis covered with brown indumentums; rachis armed with scattered solitary hooked grapnel arranged 0.6 – 2.5 cm apart; leaflets about 10 on each side of the rachis, regularly arranged, 1.8 – 3.6 cm apart; leaflets armed with small brittle along leaf margin; leaflets tip ending with red, stiff bristles; transverse veinlets prominent; basal leaflets 42 – 45 x 4 – 6 cm, mid lamina leaflets 35 – 40 x 3.5 – 4.8 cm, apical leaflets 18 – 20 x 2 – 2.5 cm. Staminate and pistillate inflorescence unknown. Infructescence ascending, shorter than the leaves, about 120 cm long, with up to 7 partial inflorescence 18 x 20 cm apart, decreasing in size distally, covered densely with red brown indumentums; prophyll semi tubular, 18 x 1.8 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with red brown indumentums, not armed; peduncle 15 cm long; partial infructescence to 12 cm long, bearing up to 12 tubular bracts to 2 x 0.5 cm, not armed, covered with red brown indumentums, the 1st up to 12th bracts bearing rachillae to 10 cm long, each rachilla bearing distichously arranged bracts to 4 mm long, each bract subtending a scar of dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, the first prophyllar bracteole (involucrophorum) pedicellate to 2 mm long. Very young fruit to 10 x 8 mm, covered with 7 rows of alternating scales; seed to 5 x 2 mm, seed surface reticulate, endosperm homogenous.

**Distribution.** So far only known from the type locality in Central Sulawesi.

**Habitat and ecology.** Hillslopes of primary forest at 1525 m asl, in 1° 20’08.1” Lat, and 120°19’39.9” Long.

**Vernacular name.** Lauro Tali (Kaili Language).

**Specimen examined.** Central Sulawesi: Poso, Lore Utara, Gn. Pada Esa, 11 September 2010, 1525 m asl., Himmah Rustiami, Dewi, M Amir, Hamzah & Ato: HR 447, fruiting material (holotype BO; isotype K).
Notes. This is the only species which has vestigial flagellum to 20 cm long and bears slightly 5 peduncular bracts. The epithet name refer to the striking spines which covered the leaf sheath abundantly.

Figure 6 Calamus perpendiculus Rustiami. A. Portion of stem with leafsheath armature; B. Portion of infrustescence; C. Portion of cirrus; D. Mid portion of leaf. After H Rustiami 447 (BO, K).
26. *Calamus rosetus* Rustiami sp. nov.

*Calamus rosetus* marked parvulus habitus caulus 2 m altus erectus et binatus foliolus. Type: Enrekang district, G. Latimojong, 04 November 1969, *M. J. S. Sands 367*, fruiting (holotype K!)

Very slender, solitary rattan, climbing to 2 m only. Stem with sheath to 7 mm in diam., stem without sheath to 3 mm in diam.; internodes to about 17 cm long. Leaf sheath covered with greenish grey indumentum lightly, armed with small spines, scattered, up to 9 mm long and 1 mm wide, some are slightly swollen at the base adaxially. Leaf sheath mouth armed with smooth brown bristles, 1 – 3 mm long, a pair of distinctive spine at the border of leaf sheath mouth and petiole. Knee present, conspicuously, about 4 mm height, not armed. Ocrea present, very short. Flagellum absent. Leaves cirrate to 1 m long including cirrus and petiole; cirrus to 50 cm long armed with 1 – 3 hooked spines, arranged in 1 – 11 mm apart; petiole to 12 cm long, slight circular in transverse section, flattened adaxially, convex abaxially, 4 mm wide, 3 mm thick near the base, armed abaxially, adaxially and along the edges with scattered solitary spine widening at the base; petiole and rachis covered with greenish grey indumentums, rachis armed with yellow, stiff, 1 – 3 hooked grapnels arranged 1.1 – 2.9 cm apart; leaflets about 6 – 8 on each side of the rachis, arranged in group of 2’s (pair leaflets), 5 – 13 cm apart; leaflets armed with very small bristles 1 mm long along leaf margins, covered with very tiny pale green scale adaxillay and abaxially; leaflets tip prolonged into needle like projection; transverse veinlets prominent; basal leaflets 17 – 19 x 1.5 – 1.8 cm, mid lamina leaflets 20 – 25 x 1.6 – 2 cm, apical leaflets 17.5 – 18.7 x 1.4 – 1.8 cm. Staminate and pistillate inflorescence unknown. Infructescence ascending, shorter than the leaves, about 64 cm long, with up to 3 partial inflorescences 11.5 – 13.5 cm apart, decreasing in size distally, covered densely with pale green indumentums; prophyll semi tubular, 12.7 x 0.4 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with pale green indumentums, armed with short, solitary, slightly hooked spine; peduncle very short, to 0.2 cm (in total of 12.7 prophyll) long; partial infructescence to 5 cm long, bearing up to 2 tubular bracts 2 x 0.4 cm, not armed, covered with whitish indumentums, the proximal and second bract bearing
rachillae to 3 cm long, each rachilla bearing distichously arranged bracts to 2 mm long, each bract subtending a scar of dyad of sterile staminate and a fertile pistillate flower and two prophyllar bracteoles, the first prophyllar bracteole (involucrophorum) pedicellate. Fruit to 15 x 5 mm, covered with 8 rows of alternating scales; seed 8 x 5 mm, seed surface reticulate, endosperm homogenous.

**Distribution.** So far only known from the type locality in South Sulawesi

**Habitat and ecology.** Steep slopes of valley c 2.5 km south west of Bunte Tjejeng (0.5 km from base camp), 1650 m asl., mixed Oak – *Podocarpus* montane forest, in complete shade on steep south facing slope; deep loam.

**Vernacular name.** Uhe (Bugis language).

**Specimen examined.** Enrekang district, G. Latimojong, 04 November 1969, M.J. S. Sands 367, fruiting (K).

**Notes.** *Calamus rosetus* noted as dwarf rattan only up to 2 m long. It has beautiful paired leaflets and a pair of distinctive spine at the border of leaf sheath mouth and petiole. The epitet name refer to the leaflets arrangement in form of rosset like.
Figure 7 *Calamus rosetus* Rustiami sp. nov. A. Portion of stem with leafsheath armature, whole leaves and infructescence; B. Portion of rachilla; C. Seed and fruit. After M. J. S. Sands 367 (K).
27. *Calamus lorelinduensis* JP Mogea & Rustiami sp.nov.

*Calamus zolingeri* affinis sed vaginis foliorum spinas rariorus parvulus.

Type: Central Sulawesi, Lore Lindu National park, subdistrict Lore Selatan, Bariri, primary sub mountain forest, alt. 1400 m., 03 September 2006, *J.P. Mogea 8608*, male inflorescence (holotype BO!; isotypes BIOT!, CEB!).

Clustering rattan, climbing up to 10 m long. Stem without sheath 10 mm in diameter, with sheath 27 mm in diameter. Leaf sheath covered abundantly by two kind of flat triangle spines, the larger is 10 – 14 mm long, the smaller 2 -3 m long. The larger spines rare and scattered, often forming comb of a union of 3 or 4 spines; the smaller spines more abundantly distributed. The knee and the lower surface of the petiole unarmed. Knee 3 mm thick. Petiole flat, elongated 7 – 18 cm long, rachis up to 2 m long. In the upper and lower surface covered rapidly by small spines, the spines up to 2 mm long. Cirrus up to 1.8 m long, armed with 3 or 4 hooked grapnels; the hooked grapnel at its top acicular 3 mm long, at its base swollen 4 mm thick. At the very base of the cirrus, the hooked grapnels arranged 25 mm apart and gradually smaller in number becoming one hooked grapnel only and shorter in the arrangement up to 1 mm apart towards the top. Leaflets regular, rather pendulous, 22 – 28 on either side, the largest at the very base of the rachis, linear, 35 by 2.5 cm, the leaflets near the top of the rachis linear, 28 – 30 by 1.5 – 1.8 cm, along the margin with many tiny bristles; leaflets at the very top of the rachis linear, 25 by 1.5 cm. Male inflorescence flagelliform, slender up to 3 m long, at the base erect up to 50 cm long, then the rest pendulous, in second order branching pattern, prophyll absent; peduncular bract, tubular, on the upper surface flat, up to 35 cm long, at the base and along the margin covered by scarcely small spines. The peduncular bracts bears the following inflorescence bract and gradually shorter and smaller towards the top, 30 – 35 cm long. The inflorescence bears 6 primary branches. The primary rachis bracts bears the following primary first rachis bract and the secondary rachis bract. The primary rachis bract tubular up to 16 cm long, unarmed. The secondary rachis bract widely tubular 5 mm long, unarmed. The secondary rachis bract bears the rachillas. The first secondary bract bears 12 rachillas, the second secondary bract bears 11 rachillas. Rachilla slender, up to 12 cm long, consists of 10 pairs of male flowers, flower in bud. The primary
branch near the top of the inflorescence is the largest, up to 120 cm long, bearing
17 secondary branches. The primary rachis bract here only 3 cm long, towards the
top, the bract gradually smaller, up to 2.5 cm long. The number of the rachilla 9 –
12, rachilla slender, 12 cm long. Infructescence pendulous up to 1 m long, in
general similar to the male inflorescence, but in one order branching pattern.
Primary branches 3. Rachilla slender, 10 – 14 cm long, bears 4 – 8 fruits. Ripe
fruit ellipsoid, 12 mm long, 7 mm in diameter, covered by 10 vertical row pale
brown yellowish scales. Stigma remnant 3 mm long.

**Distribution.** So far only known from the type locality

**Habitat and ecology.** Primary sub mountain forest

**Vernacular name.** Uwe pait or Rotan humampu (Kulawi language). ‘Uwe’
means rattan plant, ‘pait’ means bitter. This local name refers to the cabbage of
the rattan though it is edible but bitter taste. ‘Humampu’ means plenty in this case
means the rattan is in clump in contrast with ‘Tohiti’ which means single (the
rattans grow solitary).

**Use.** The cabbage is said to be adible as a cooked vegetable. Though it is bitter it
is commonly eaten. The other sweet edible rattan cabbage in the area is from
Rotan batang (*Calamus zollingeri*) and Uwe momi or the commonly known as
Rotan noko (*Daemonorops macroptera*).

**Notes.** To some extent the species is closely related to Rotan batang, but the
former is very much smaller. The cane here is 10 mm in diameter, with sheath 27
in diameter, while in *C. zollingeri*, the cane is 30 – 40 mm in diameter with sheath
is 40 – 50 mm in diameter. The spines on the leaf sheath not so enormous
compare to the spines of *C. zollingeri*. The spines distribution and composition on
the leaf sheath close to *C. koordersianus*. The spines on the leaf sheath in *C.
lorelinduensis* are in two form, flat triangle, the larger is 10 by 14 mm, the smaller
is 2 by 3 mm; while in *C. zollingeri* only in one form but very much larger up to
25 mm, 8 – 12 adjacent spines at their base united to form collar. The leaflets in
*lorelinduensis* are perpendicular to the rachis while in *C. zollingeri* are
pendulous. Both *C. lorelinduensis* and *C. zollingeri* has cirrus, whereas *C.
koordersianus* has flagellum. The epithet name refers to the name of the National
Park.
**Specimen examined.** Central Sulawesi, Kulawi, Toro, Hawombo, sterile, 20 February 2005, J.P. Mogea: *JPM 8441* (BO, CEB); Lore Lindu National Park, Lore Selatan, Bariri, male inflorescence, 3 September 2006, J.P. Mogea: *JPM 8608* (BIOT, BO, CEB); *JPM 8613* (BIOT, BO, CEB).

Figure 8 *Calamus lorelinduensis* Rustiami. A. Portion of leaves with leaflets and the cirrus; B. Portion of stem with leafsheath armature, some of leaflets and staminate inflorescence; C. Portion of staminate inflorescence. After J. P. Mogea 8608 (BIOT, BO, CEB).
28. *Calamus ahlidurii* Fernando ex Rustiami sp. nov.

Gigantius spinus collariferum on vaginis foliorum. Type. Indonesia, North Sulawesi, Bolaang, G. Ambang, Kotamobagu, 26 October 1973, 1250 m asl., J Dransfield & JP Mogeja JD 3868, fruiting material (holotype K!; isotype BO!).

Apparently clustering extremely robust rattan, climbing to 30 m long. Stem without sheaths to 6 cm in diam., with sheaths to 12 cm in diam. Internodes to 30 cm long. Sheaths dark green, very densely covered in reflexed spines, in more or less collars, spines laminate, black at base, whitish at tip very fierce ocrea 2 eared. Leaves to 4.5 m long including petiole and cirrus; petiole 4.5 cm, yellowish above, slight circular in transverse section, flattened adaxially, convex abaxially, armed with groups of short up to 5 mm spines along the edges; leaflets 80 on each side, bristly, pendulous, regularly arranged. Staminate and pistillate flower unknown. Infructescence very long, to 3 m with circa 25 partial infructescence, eflagellate. Fruit very young.

**Distribution.** North Celebes, Bolaang Mongondow, G. Ambang, Kotamobagu

**Habitat and ecology.** Lower montane forest, gentle hillslope, volcanic rock at 1250 m.

**Vernacular name.** Not recorded.

**Specimen examined.** North Celebes, Bolaang Mongondow, G. Ambang, Kotamobagu, 26 October 1973, J. Dransfield 3868, fruiting material (BO, L, K, BH).

**Uses.** Not recorded

**Notes.** The epithet name of this species refers to very robust and abundant spines on the leaf sheath.
Figure 9. *Calamus ahlidurii* Fernando ex Rustiami. A & B. Portion of stem with leafsheath armature; C & D. Portion of infrustescence. After J Dransfield 3868 (BH, BO, K, L)
EXCLUDED AND UNCERTAIN NAME

*Calamus acidus* Becc. This name is doubtful name because there is insufficient information about this name. Actually Beccari wrote his description based on Rottang assam of Rumphius but some of his picture match with *Calamus barbatus* of Zippelius where Zippelius described it from New Guinea. Rumphius (1741) based his description on the specimen sent to him from Buton Sulawesi in 1692, he said that its fruit locally used as tamarind substitutes so he named this species as Rottang assam. However, we do not know where the specimen is or how to apply it because the only figure that we can refer is part of infructescence and a seed which it does not match with other description provided by Beccari.

*Calamus obscurus* Becc. ex. Heyne. Treated as doubtful name because there is insufficient information on this name.

*Calamus toli-toliensis* Becc. ex Heyne. So far there is no information of this species. There is lack of fertile specimen that we have here either in BO, Kew or Leiden, only small portion of leaflets kept either in BO or Leiden.

REVISION OF THE RATTAN GENUS *DAEMONOROPS* IN SULAWESI USING PHENETIC ANALYSIS APPROACH

**Introduction**

The palm flora of Sulawesi is distinctive and combines elements in common with Sunda, Sahul, and the Philippine. In the case of *Daemonorops*, all seven species recognized are endemic to the island and their affinities are not yet clear – whether with Sunda, Philippines or West of Malesia. The genus *Daemonorops* itself is not well collected and poorly represented further east. Until recently, five species of *Daemonorops* were recorded for Sulawesi. As a result of recent fieldwork a further two species have been recognized and described (Rustiami 2009b).

The genus *Daemonorops* was described by Blume (1830), based on a single species which he named *Daemonorops melanochaetes* Blume. *Daemonorops* with more than 120 species is the second largest rattan genus after *Calamus*. It belongs to the subtribe *Calaminae*, tribe *Calameae* of the palm subfamily *Calamoideae*. Beccari (1911) divided *Daemonorops* into two sections based on the structure of the inflorescence, i.e. section *Cymbospatha* and section *Piptospatha*. Basically the former have concave boat-shaped bracts which are at anthesis completely enclosed by the prophyll (the first bract) and splitting longitudinally to expose the flowers. In contrast, the bracts of the species in the latter section split to the base and only the lower part is enclosed by the prophyll. Beccari identified 84 species of *Daemonorops* and placed 32 species in former section and 52 species in latter section. According to Furtado (1953) the bracts of section *Piptospatha* usually fall at anthesis and occasionally only the prophyll remains.

*Daemonorops* originated from Greek language combining two words ‘demon’ (devil) and ‘rops’ (bush or shrubs). This name reflects the scary appearance of the plant with its very robust leaf sheaths densely armed, with long, blackish brown or cream-colored spines (Dransfield 1984). The geographical distribution of *Daemonorops* is much more restricted than that of *Calamus*. The centres of distribution are the same, from China and India to New Guinea. *Daemonorops* does not occur in Africa, the Himalaya, Peninsular India, Sri Lanka and Australia (Dransfield et al. 2008).

The most common species concept that continues to be used in describing palms is the morphological species concepts where discontinuities in morphological variation provide the means to separate species (Davis & Heywood 1963; Dransfield 1999). Morphological species concept defines species as the smallest groups that are consistently
and persistently distinct (Cronquist 1978; Stuessy 1990). The concept is regarded as the most frequently employed by revisionary workers or taxonomist (Stuessy 1990). Morphological species concept in this study does not indicate that the other concepts are inferior compare to it but this is mainly due to the practical nature of the concept. The purpose of this study is to have a better understanding on the morphology of the genus and to investigate morphological variation within *Daemonorops* in Sulawesi using phenetic analysis technique on morphological data taken from herbarium specimens.

**Materials and Methods**

Field work had been done in several areas of Sulawesi (Central Sulawesi, East Sulawesi and South East Sulawesi) to collect herbarium material. Herbarium specimen preparation followed standard procedure of Dransfield (1986). Data or information recorded from the field include location; general habitat; altitude; association with other plants; vernacular name; uses; habit (solitary/clustered); stem (height, diameter with/without leaf sheath, internode length, colour); leaves (length, leaflets arrangement, number of leaflets, length and width of leaflets); inflorescence (length, number of rachilla, colour); flower (colour, scented/not scented); fruit and seed (length and width, colour). Morphological comparative study had been done in several herbaria: Herbarium Bogoriense (BO) in Bogor, Herbarium Kewense (K) in Kew, United Kingdom and Herbarium Leiden (L) in Leiden, Netherland. A total of 300 herbarium specimens were studied based on their morphological similarity following de Vogel (1987) and Rifai (1976) using comparative morphology data as main source, especially in developing species concept (Davis & Heywood 1963; Dransfield 1999).

**Data analysis**

The species clustering was constructed based on morphological characters observed for each species. Morphological similarity within *Daemonorops* was analysed using NT-Sys program 2.02i (Rohlf 2002) and SAHN Clustering with Unweighted Pair Group Method using Average (UPGMA) implemented and presented in a phenogram.
Results and Discussions

Morphology

Stem

The stem of Daemonorops is covered by tightly sheathing densely spiny, leaf sheaths. The diameter of the stem with the leaf sheaths can vary from a few mm to over 10 cm.

Leaves

Leaves consist of a tubular sheathing base, the leaf sheath, which arises from the node on the stem: at its upper end, the sheath narrows into the petiole that continues into the rachis or leaflet-bearing portion of the leaf. Although a petiole is usually present, it is sometimes very short or absent.

Figure 10 Knee, petiole, part of petiole, leaflets and inflorescence of Daemonorops lamprolepis.

In many species, the rachis is extended beyond the terminal leaflets into a barbed whip (cirrus) which acts as a climbing organ (Dransfield & Manokaran 1994). Spine arrangement on the leaf sheath is remarkably diverse and frequently of diagnostic importance. Just below the petiole or leaf rachis, there is a marked swelling known as the knee (Figure 10). This character is also of some diagnostic importance, because some of the Daemonorops species do not have very obvious knees or the knee is only slightly developed. An example of detail specimen as drawn in Figure 11.
Inflorescence

Most rattans are dioecious (and all species of *Daemonorops*) where female and male flowers are born on different plants. The basic branching pattern of inflorescences of *Daemonorops* is similar. The main axis bears a basal bract or prophyll which may be short and tubular or large. Branches are born in the axils of subsequent bracts. The branches in turn bear bracts, the lowermost of which is usually empty, subsequent bracts subtending branching and so on. The ultimate flower bearing branches are term rachillae.

Figure 11 Parts of *Daemonorops takanensis*, A. Portion of leaf sheath; B. Mid portion of leaf, abaxial view; C. Basal portion of leaf; E. Portion of infructescence; F. Fruit; G. Seed; H. Seed in longitudinal section.
On each flower, there is a bracteole which immediately surrounding the flower known as involucre and involucrophore.

**Phenetic analysis**

Phenetic derived from the Greek *phaino*, to appear. Phenetic classification is based on overall similarity of taxa (Sneath & Sokal 1973). The phenetic of the taxa is developed with numerical procedures applied to the character states of the organism classified, so this method also known as numerical taxonomy (Sokal 1986).

Numerical taxonomy developed in the late 1950’s as computers that could rapidly process large numbers of characters became available (Marcus 1993). The objects being classified in numerical taxonomy require a little definition. In order not to prejudice the issues in advance by assuming that group actually exist the term operational taxonomic unit (OTU) is used for the objects under study (Pankhurst 1991).

In this study twenty seven characters were selected for phenetic analysis (Table 2). Within twenty seven characters most are qualitative characters. Few characters were absent in some species but they were still put into analysis if they are considered as diagnostic characters. A data matrix of characters was scored according to the species descriptions. All characters were coded as binary, when characters cannot be defined is marked as “0”.

Based on phenetic analysis of morphological characters of seven species indicates that there are two main groups of *Daemonorops* in Sulawesi with an overall coefficient similarity ranges from 0.51–0.81. This value means the two groups have similarity about 51%–81% (Figure 12). *D. takanensis* and *D. lamprolepis* placed in one clade where these two species have coefficient similarity value 0.58. This group is characterized by the present or absent of the ocrea. Whereas group B divided into two subgroups, B1 and B2, with coefficient similarity value 0.59. This subgroup is characterized by their leaf sheath armature, absent or present of indumentum, fruit shape and type of endosperm. From the phenogram we can see that *D. macroptera* and *D. mogeana* are clustered in one clade and have morphological similarity around 81%. Both species possess some similarities on their leaf sheath armature. They are, however, different in their inflorescence and endosperm. Those two species close to *D. robusta* with 67.4% similarity.
Table 2 Morphological characters selected for phenetic analysis of *Daemonorops* in Sulawesi and their characters states and codes

<table>
<thead>
<tr>
<th>No</th>
<th>Characters</th>
<th>States and codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Habit</td>
<td>solitary (0), clustered (1)</td>
</tr>
<tr>
<td>2</td>
<td>Diameter of stem</td>
<td>≤ 2 cm (0), &gt; 2 cm (1)</td>
</tr>
<tr>
<td>3</td>
<td>Leaf sheath indumentum</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>4</td>
<td>Leaf sheath surface scales</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>5</td>
<td>Leaf sheath armed with spines</td>
<td>solitary spines (0), in group of spines (1)</td>
</tr>
<tr>
<td>6</td>
<td>Leaf sheath spines</td>
<td>easily detached (0), strongly attached (1)</td>
</tr>
<tr>
<td>7</td>
<td>Leaf sheath spines</td>
<td>hair-like spines (0), triangular big spines (1)</td>
</tr>
<tr>
<td>8</td>
<td>Ocrea</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>9</td>
<td>Direction of leaf sheath spines</td>
<td>horizontal (0), pointing upward (1)</td>
</tr>
<tr>
<td>10</td>
<td>Knee armature</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>11</td>
<td>Leaf sheath mouth armature</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>12</td>
<td>Petiole indumentum</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>13</td>
<td>Long of petiole</td>
<td>&gt; 100 cm long (0), ≤ 100 cm long (1)</td>
</tr>
<tr>
<td>14</td>
<td>Leaflets arrangement</td>
<td>regular (0), subdistant (1), distant (2)</td>
</tr>
<tr>
<td>15</td>
<td>Transverse veinlets</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>16</td>
<td>Leaflets spines</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>17</td>
<td>Leaflets spines arrangement</td>
<td>along midrib of both surfaces (0), along midrib on lower surface (1)</td>
</tr>
<tr>
<td>18</td>
<td>Leaflets spines on the apex</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>19</td>
<td>Leaflets spines on the margin</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>20</td>
<td>The number of leaflets</td>
<td>&gt; 30 pairs (0), ≤ 30 pairs (1)</td>
</tr>
<tr>
<td>21</td>
<td>Inflorescence pendulous</td>
<td>&gt; 50 cm long (0), ≤ 50 cm long (1)</td>
</tr>
<tr>
<td>22</td>
<td>Corolla</td>
<td>same size as the calyx (0), longer than the calyx (1)</td>
</tr>
<tr>
<td>23</td>
<td>Fruit</td>
<td>spherical (0), ellipsoid (1), subglobose (1)</td>
</tr>
<tr>
<td>24</td>
<td>Fruit scales</td>
<td>&gt; 9 in vertical rows (0), ≤ 9 in vertical rows (1)</td>
</tr>
<tr>
<td>25</td>
<td>Fruit with short conical beaked</td>
<td>absent (0), present (1)</td>
</tr>
<tr>
<td>26</td>
<td>Seed surface</td>
<td>smooth (0), reticulate (1)</td>
</tr>
<tr>
<td>27</td>
<td>Endosperm</td>
<td>slightly ruminate (0), deeply ruminate (1)</td>
</tr>
</tbody>
</table>

*D. mogeana*, *D. macroptera* and *D. robusta* clustered in one group. This is because they have some similarities in their leaf sheath armature and leaflet arrangement. However they do differ in their general morphological characters. In other groups we can see that *D. riedeliana* and *D. sarasinorum* have similarity around 77.4 %. These two species can be clearly separated by their leaf sheath armature.

The phenogram shows that, within seven species of *Daemonorops* occur in Sulawesi *D. takanensis* and *D. mogeana* confirmed as new species. These two species recently collected from the slopes of Bukit Takane-kane and G. Malemo respectively. *Daemonorops takanensis* is distinct from other species by leaf sheath having rusty-brown colored indumentum, armed with numerous very brittle, thin laminar, short, solitary brown spines with small bulbous bases. Whereas *D. mogeana* compared to other species it has subglobose fruit and slightly ruminate endosperm.
Figure 12  Phenogram of *Daemonorops* spp. from Sulawesi.

**Taxonomic treatment**


Solitary or clustering rattans, acaulescent to high climbing hapaxanthic (then always very short stemmed) or pleonanthic, dioecious. Sheaths usually heavily armed with spines, the spines frequently highly organized. Flagellum absent. Knee frequently present. Leaves ecirrate in acaulescent species or longly cirrate. Leaflets variously arranged. Inflorescence male and female superficially similar, but within the genus of two basic types: one with all bracts enclosed within the outermost bract or prophyll, splitting along their length to expose the flowers (section *Cymbospatha*) or the other with bracts splitting along their entire length to leave no tubular portion and frequently falling (section *Piptospatha*). Bracts variously armed. In the section *Piptospatha* partial inflorescences is longer than the subtending bract; bracteoles and "involucres" inconspicuous. Male rachilla bearing male solitary flowers, male flowers with small cup shaped; calyx with three small lobes; corolla split to the base into 3 petals; stamen 6, slightly epipetalous; pistilode minute. Sterile male flower found with each female flower, the fertile male, but stamens with empty anthers. Female rachilla bearing many flowers in dyads consists of one female flower and one sterile male flower. Female flower has
calyx truncate or shallowly 3 lobed; corolla with 3 petals; gynoecium with 3 stigmas and with 3 loculi. Sterile flower is smaller or at least more slender than the female ones, with well formed calyx and corolla and 6 sterile stamens and an abortive ovary. Fruit variously shaped, tipped with stigmatic remains and covered with reflexed scales. Seed only one, covered by thin to thick sweet or sour sarcotesta. Endosperm deeply ruminate. Embryo basal.

**Distribution.** Based on Dransfield et al. (2008) geographical distribution genus *Daemonorops* is more restricted than the genus *Calamus*. The center of distribution of those are similar, from China, India to New Guinea, specifically Sumatra, Borneo and Malay Peninsula. *Daemonorops* does not occur in Africa, Himalaya, Peninsular India, Sri Lanka and Australia.

**Habitat.** Rather disturbed primary forest, on alluvial soil near rivers, terrain flat to gently sloping, ridge top, lowland forest, and steep hill slope primary forest on volcanic soils.

**Uses.** One species is recorded to have sweet, edible young shoot (Mogea 1991).

### Key to species of *Daemonorops* in Sulawesi

| 1 | a. Leaf sheath covered with rusty-brown coloured indumentum and armed with short, up to 10 mm long, easily detached spines ........................................... | *D. takanensis* |
|   | b. Leaf sheath without indumentum and armed with long, more than 15 mm long, strongly attached spines ............................................................... |   |
| 2 | a. Leaf sheath armed with brittle, unequal solitary spines ........................................... |   |
|   | b. Leaf sheath armed strongly with large, irregularly seriate spines ................................ |   |
| 3 | a. Ocrea present ........................................................................................ | *D. lamprolepis* |
|   | b. Ocrea absent .......................................................................................... |   |
| 4 | a. Leaf sheath armed with very densely long, solitary, hair-like spines *D. sarasinorum* |   |
|   | b. Leaf sheath armed with short, scattered, needle like spines .................... | *D. riedeliana* |
| 5 | a. Leaf sheath armed with oblique spines; fruit spherical ........................ | *D. robusta* |
|   | b. Leaf sheath armed with upright spines; fruit subglobose to ellipsoid ........ |   |
| 6 | a. Leaf sheath densely armed with solitary, furfuraceous spines; fruit ellipsoid, endosperm deeply ruminate ......................................................... | *D. macroptera* |
|   | b. Leaf sheath densely armed with groups of 3’s – 5’s, greyish spines; fruit subglobose, endosperm slightly ruminate ........................................ | *D. mogeana* |
Species Description of Daemonorops in Sulawesi

1. **Daemonorops lamprolepis** Beccari


Clustering rattan. Sheathed stem up to 2 cm in diam., stem without sheath up to 1 cm in diam. Leaf sheaths green, covered with jointed bases forming collar spines, scarcely, up to 3 cm long, sheath surface smooth with caducous reddish-blackish scaly indumentum, leaf sheath mouth armed as the rest of sheath; knee present, very conspicuous, armed as the rest of sheath; ocrea present, papery, small, to 5 mm high. Leaves to 3 m long including petiole 30 cm long, armed adaxially with short, erect, scattered spines to 2 mm long, abaxially armed with erect, very rare solitary spines, up to 1 mm long; rachis unarmed, or armed only slightly proximally; cirrus up to 80 cm long, armed with regularly arranged groups of grapnel-like spines, leaflets mostly arranged regularly, 30 on each side of the rachis, stiff, horizontal; leaflets lanceolate, papery, acuminate, up to 30 cm long, 2 cm wide, armed with scattered reddish, short bristles along the main nerve on lower surface, transverse veinlets conspicuous. Staminate inflorescence and male flowers not known. Pistillate inflorescences pendulous to 37 cm long, peduncle 10 – 15 cm long, armed distally with groups of spines; prophyl papery, erect, 25 cm long, 3 cm wide, ellipsoid oblong, armed with scattered spines, some spines are in groups of 2’s; partial inflorescences up to 4, each inflorescence bearing up to 8 partial inflorescence; rachilla covered with chocolate scurf; involucre pendulous, flat, just above the involucrophore, 5 mm long; involucrophore short, papery, 2 mm long. Female flowers 6 mm long, ovoid, acute; calyx very short; the corolla several times longer than the calyx, ventricose at the base. Young fruits ovoid to ellipsoidal, 15 x 10 mm, covered by 8 – 9 vertical rows of encrusted scale. Seed ovoid, 10 x 7 mm, boldly tubercled and coarsely pitted. Endosperm ruminate.

**Distribution.** Donggala, Central Sulawesi and Kendari, South East Sulawesi.

**Habitat and Ecology.** Disturbed primary forest

**Uses.** Not recorded.

**Vernacular name.** Rotan Mapis (Donggala language), Lasero Epe or Lita (Tobelo language).

**Specimens examined.** Central Sulawesi: Northern central part, on the coast of South West of Donggala, 11 May 1975, W. Meijer 10086, fruiting (BO). Mountain Sojo,
November 1913, Rachmat 705, fruiting (BO). **South Sulawesi**: Maliki, Desoe, 02 June 1933, H.N. Reppie 18, sterile (BO). Wado, Heyne 2581, Heyne 2587, sterile (BO); Heyne 2615, fruiting (BO); Boni, Heyne 2599, young fruit (BO); Heyne 2595, Heyne 2604, fruiting (BO); Heyne 12, dead female inflorescence (BO).

**Notes.** This is the only species of *Daemonorops* from Sulawesi which has an ocrea. This ocrea papery, small, to 5 mm high.

2. **Daemonorops takanensis** Rustiami


Slender, clustering rattan, climbing to 20 m. Sheathed stem 2 cm. in diam., without sheaths 1.5 cm in diam., internodes 20 – 30 cm long; leaf sheath dark green, covered with conspicuously rusty – brown indumentum and armed with numerous very brittle, thin laminar, unequal, up to 1 cm long or even shorter, solitary, scattered, easily to detached, brown spines, with small bulbous bases; leaf sheath mouth densely armed with similar spines; knee present and conspicuous, 10 mm long, 20 mm wide, moderately armed; ocrea absent. Leaves 3.5 m long including petiole and cirrus; petiole to 20 cm long, 10 mm wide and 8 mm thick at base, flat adaxially, rounded abaxially, with acute edges, covered slightly with rusty – brown indumentum, as on sheath, armed with numerous short triangular spines; rachis up to 1.8 m long, armed with very short, erect, slender, triangular claws, that become ternate near the apex and 5-nate and half whorled on the cirrus; cirrus to 150 cm long; leaflets numerous, 55 pairs on each side of rachis, regularly arranged, linear-lanceolate, acuminate, armed with bristles to 5 mm long along the midrib of both surfaces; transverse veinlets minute; basal leaflets 34 cm long and 8 mm broad, middle leaflets 35 cm long and 1 cm broad, apical leaflets to 20 cm long and 8 mm broad. Staminate and pistillate inflorescences not known. Infrafruitescence pendulous, up to 50 cm long, consisting of 4 partial infrafruitescence, 5 cm apart; peduncle 10 cm long; partial infrafruitescence to 8 cm long bearing to 10 partial infrafruitescence. Fruit ellipsoid with a short conical beaked, pale, covered with 15 vertical rows of scale, 15 mm long and 10 mm broad. Seed one, ellipsoid. Endosperm deeply ruminate.

**Distribution.** Known from the type locality only.
Habitat and ecology. Disturbed primary forest on hill slope

Uses. Not recorded.

Vernacular name. Rotan Api


Notes. This species can be recognized easily by its leaf sheath dark green, covered with conspicuously rusty-brown coloured indumentum and armed with numerous very brittle, thin laminar, unequal, up to 1 cm long or even shorter, solitary, scattered, easily to detached, brown spines, with small bulbous bases. So far this species is only known from the type locality, Bukit Takane-kane.

3. Daemonorops macroptera (Miq.) Beccari


Clustering robust rattan, up to 40 m tall. Leaf with sheaths up to 3 cm in diam., without sheaths to 2 cm in diam., covered with jointed robust spines, up to 5 cm long, leaf sheath mouth armed as the rest of the sheath; knee present conspicuously, armed as the rest of the sheath; ocrea absent. Leaves up to 6 m long including petiole to 40 cm, armed with grouped of robust spines, to 2 cm long on both surfaces; rachis armed with scattered, solitary spines up to 1 cm long, gradually on the top of margin; cirrus more than 2 m long, armed with regularly arranged groups of very robust grapnel-like spines, blackish at the tip; leaflets mostly arranged regularly, slightly irregular above, 70 on each side of the rachis, stiff, horizontal; leaflets lanceolate, papyry, acute, up to 55 cm long, 3 cm wide, armed with scattered, reddish, short bristles along the main nerve on lower surface, up to 1 cm long, short bristles along the leaflets margin; transverse veinlets very minute, and sharp. Staminate inflorescence pendulous up to 85 cm long including peduncle 25 – 30 cm long, peduncle straight and rigid, flattened, densely armed with flat, irregular, erect, spreading, 1 -2 cm long spines; the outer bract is narrowly lanceolate before flowering; after flowering it is coriaceous, gradually narrow to acuminate, covered with furfuraceous indumentum; rachilla about 40 cm long, with 5 small partial inflorescence. Male flower small. 4 – 5 mm long; calyx very small, deeply three dentate. Pistillate inflorescence
72

**Elongate, rather slender, pendulous up to 65 cm long, bearing 6 – 7 partial inflorescence; secondary spatha short, acute or acuminate, up to 8 cm long, covered with rusty indumentum. Female flower unknown. Inflorescence pendulous to 60 cm long, peduncle up to 15 cm long, armed distally with groups of robust spines; peduncular bracts leathery, erect 25 cm long, 3 cm wide, ellipsoid oblong, covered by rusty indumentum, armed with solitary spines up to 2 cm long, partial inflorescences 5 each, bearing up to 9 partial inflorescence; involucre pendulous, flat, just above the involucrophore, 5 mm long; involucrophore short, papery, 2 mm long. Fruits obovoid, 15 x 15 cm, covered by 7 vertical rows of encrusted scales. Seed ovoid, 10 x 10 mm, smooth surfaces.**

**Distribution.** North and Central Sulawesi.

**Habitat and Ecology.** Rather disturbed primary forest, on alluvial soil near river, terrain flat to gently sloping.

**Uses.** Not recorded.

**Vernacular name.** Rotan Batang, Angah.

**Specimens examined.** **North Sulawesi:** Manado, Miquel sn., fruiting (BO, L). **Central Sulawesi:** Sopu Valley, c 80 km SSE of Palu, 1000 m alt., 02 May 1979, E.F. de Vogel 5171, fruiting (BO); 22 May 1979, E.F. de Vogel 5508, fruiting (BO); 26 April 1979, 1000 m asl., E.F. de Vogel 5055, fruiting (BO, K); Mountain Rorokatimbu, 13 May 1979, E.F. de Vogel 5326, fruiting (BO, K); Mt. Petulu, Kulawi, 18 February 1986, 700 m asl., Anggana & Yusuf Dali 62, sterile (K); Sungei Tolewonu, 30 km South of Kuala Navusu, between 1974 – 1976, G.G. Musser: T10 (K). **South East Sulawesi:** Tongoa, 730 m asl., 04 March 1981, J. Th. Johansson, H Nybom, S Riebe 169 (K).

**Notes.** This rattan based on de Vogel field record has white gum producing from the cut of stem and immature fruit green. At low elevation this species found along river terraces (field note of T10).

4. **Daemonorops mogeana Rustiami**


Very large, robust, clustering rattan, climbing to 15 m. Sheathed stem 4 cm in diam.; stem without sheaths 2 cm in diam.; internodes 20 cm long; knee present conspicuously, armed as the rest of the sheath; ocrea absent. Leaf sheaths woody, creamy-yellow, densely armed with numerous broad spines, often with conspicuous bulbous bases, and arranged in groups of 3’s – 5’s, flat, greyish, irregularly seriate, 1 – 7 cm long, 5 mm wide, intermixed with smaller and ascending spines. Leaves very large up to 6 m
long including petiole and cirrus; petiole very robust, 1 m long, 2 cm wide and 1 cm thick at base, rounded adaxially and abaxially, densely armed with, seriate or irregularly, erect, triangular, 1 – 3 cm long and up to 1 cm wide spines; rachis up to 3 m long, with similar triangular spines; leaflets large, 30 pairs on each side of rachis, regularly arranged, linear-lanceolate, acuminate, armed with small bristles, 5 mm long along the mid nerve on both surfaces and the apex; transverse veinlets conspicuous; middle leaflets 40 cm long; 2 cm broad, papyraceous, green and concolorous; apical leaflets to 20 long, 15 cm broad; cirrus to 2 m long, armed with 4 – 5-hooked grapnels arranged 3 cm apart. Laminate and pistillate inflorescences not known. Infra-fruits ascending, to about 70 cm long, with 6 erect, very slender, cupressiform, partial infructescences, 5 cm apart; the main axis cylindrical, 20 cm long, armed with dense, glaucous, seriate spines, about 1 – 5 cm long, with bulbous bases, and covered with blackish brown indumentums; partial infructescence about 15 cm long bearing up to 10 unequal partial inflorescence. Fruit subglobose, covered with 14 vertical rows of glossy yellowish scale, 8 mm long and 4 mm broad. Seed one, globose. Endosperm slightly ruminate.

**Distribution.** Known from type locality only.

**Habitat and ecology.** This species is common in *Agathis* forest, beside streams on the slopes of G. Malemo, 1000 m alt.

**Distribution.** This species only known from the type locality.

**Uses.** Young shoot is edible and good.

**Vernacular name.** Uwi Manis (umbut manis)

**Specimen examined.** Central Sulawesi: Kab. Poso, District Kulawi, Dusun Moa, Mt. Malemo, 1000 m alt., 21 October 1977, JP Mogeja: JPM 1356, fruiting specimen (BO, K).

**Notes.** This species has been identified as *Daemonorops macroptera* by Maturbongs in 2001 (written in herbarium label) because it is similar to this species morphologically. However after thorough study and careful examination *D. mogeana* differs from *D. macroptera* by leaf-sheath armature where it has very robust spines, fruit subglobose and slightly ruminate endosperm, whereas the latter has gigantic, fragile, easily broken spines, and ellipsoidal fruit and deeply ruminate endosperm like common *Daemonorops* species from Sulawesi.
5. *Daemonorops robusta* Warb. ex Beccari


Solitary to clustering very robust, 5 – 7 m tall. Leaf with sheath 7 cm in diameter, without sheath 2 – 3 cm in diameter; internodes 15 – 35 cm long. Leaf sheaths pale yellow – green, covered with jointed bases, oblique, very large black thorns, up to 5 cm long, sheath surface with caducous glaucous black indumentum, leaf sheath mouth armed as the rest of sheath; knee present conspicuously, armed as the rest of sheath; ocrea absent. Leaves to 4 m long including petiole to 40 cm long, armed adaxially with densely erect long black spines to 5 cm long, abaxially armed with erect, obliques, groups of spines, up to 5 cm long; rachis armed with erect, solitary spines, up to 5 mm long; cirrus up to 150 cm long, armed with regularly arranged groups of grapnel-like spines, blackish at the tip; leaflets lanceolate, papery, acute, 60 cm long, 2 cm wide, armed with scattered reddish, short bristles along the main nerve on under surface, leaflets margin armed with short spinulae, reddish. Staminate inflorescence ascending to 50 cm long, peduncle up to 22 cm long, armed with group of 2 – 8 slightly bulbous based spines, 2 – 20 mm long, pointed tip, more robust adaxially than abaxially; peduncular bract woody, erect to 48 cm long, 4 cm wide, lanceolate at the tip, covered by rusty brown indumentum. Female inflorescence not known. Infrecvtescence pendulous, 50 – 100 cm long, peduncle 20 – 30 cm long, armed with forming rings spines; peduncular bracts leathery, erect, 30 cm long, 2 cm wide, ellipsoid oblong, covered by rusty indumentum, armed with scattered needle like, blackish spines; partial inflorescences 5 – 6 each, bearing up to 8 partial inflorescence; involucre pendulous, flat, just above the involucrophore, 5 mm long; involucrophore short, papery, 2 mm long. Fruits spherical, 15 x 10 cm, covered by 9 vertical rows of yellowish cream encrusted scales. Seed globular, 8 x 8 mm, seed surface reticulate, endosperm deeply ruminated.

**Distribution.** North Sulawesi: Bolaang Mongondow, Manado, Laelumbuan; Central Sulawesi: Toli-toli.

**Habitat and ecology.** Primary forest, land slope, lowland forest, deep valley, alluvial, flat near riverside, lowland rain forest on riverside.

**Uses.** Not recorded.

**Vernacular name.** Lauro Manu (Toli-toli), Pondas Valukan, Pondas Rasisagan, Pondas Kuluwi (Manado), Rotan Susu (Gorontalo language).
Specimens examined. North Sulawesi: Bolaang Mongondow, Tapak Kulintang, Dumoga Bone National Park, 220 m alt., 8 March 1984, J.P. Mogea: JPM 5076, young fruit (BO, K). Bolaang Mongondow, Pindol, Lolak, 50 m alt., 19 October 1973, J. Dransfield & J.P. Mogea: JD 3805, mature fruit (BO); JD 3800, male flower (BO, K). Manado, Pondok Pingsang, Karoewatoe, 50 m alt., 26 February 1895, Koorders 18410B, fruiting (BO, L); Laelumbulan by Paku Ure, 700 m alt., 9 March 1895, Koorders 18399B, fruiting (BO, L); Heyne 2510, sterile (BO); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, Lynn Clayton 3, fruiting (K). Central Sulawesi: Dako, Mountain Lakatan, Toli-toli, 750 m alt., 25 February 1985, Ramlanto & Z Fanani 530, fruiting (BO). Malili, Toli-toli, Kawata, 200 m alt., 13 April 1933, J. van Jijll de Jong 1, young fruit (BO); Inland from Batui and Seseba on Batui river, Sinsing, 16 October 1989, 70 – 100 m asl., M. J. Coode 5967, fruiting (K).

Notes. Its mature fruit has sour sarcotesta and young fruit is green. It seems that red when mature. Apparently related to *D. macroptera* but the fruit is spherical. Some specimens determined as *D. robusta* but their seed are different, especially the one from central Sulawesi, collected by MJ Coode 5967.

*Daemonorops riedeliana* (Miq.) Beccari


Slender, clustering rattan, up to 10 m tall. Leaf with sheaths up to 20 mm in diam., without sheaths to 6 mm in diam., internodes 8 – 10 cm long, covered with needle like, almost uniformly, pointing upward solitary or in groups of spines, enormous, up to 6 cm long, sheath surface smooth with corky creamy indumentum; leaf sheath mouth armed as the rest of the sheath; knee present conspicuously, armed as the rest of the sheath; ocrea absent. Leaves to 2 m long including petiole to 15 cm, armed very densely with 5 – 10 mm long spines all around, under side of rachis armed with terna clawes, upper side armed with slightly pickly; leaflets numerous, arranged rather distant, 38 – 57 pairs on each side of the rachis, arcuate somewhat spidery; leaflets lanceolate, papery, acuminate, 25 – 30 cm long, 1 cm wide, armed with scattered, reddish, bristly spinulos along the mid nerve of upper surface; young leaf covered in caducous white indumentum; transverse veinlets slender, on both surfaces; margins armed with ciliate spines, rather close. Staminate and pistillate inflorence not known. Fruits spherical, 13 x 13 mm, covered by 8 vertical rows of yellowish brown, dull encrusted scales. Seed irregularly oblong, 10 x 8 mm, reticulate surfaces.
**Distribution.** North and South Sulawesi

**Habitat and Ecology.** Disturbed primary forest and ridge top lowland forest, steep hillslope primary forest on volcanic soil, 500 m asl.

**Uses.** Not recorded

**Vernacular name.** Angah (this name also applied to *D. macroptera*).

**Specimens examined.**

**North Sulawesi:** Minahasa, Bitung, Batu Angus Nature Reserve, 500 m alt., 7 October 1973, J. Dransfield & J.P. Mogea: *JD 3737*, fruiting (BO); Bolaang Mongondow, Pindool Lolak, 150 m alt., 18 October 1973, *JD 3787*, male flower (BO, K); Manado, 2 March 1895, *Koorders 18389B*, fruiting (BO, L); *A.G. Waturandang 51*, sterile (BO).

**South Sulawesi:** Kabupaten Mamuju, Kec. Kaluku, Dusun Roa, Desa Dutas Kaluk, Bukit Banga, 300 m alt., 08 February 1993, Padmi Kramadibrata: *PK 030*, sterile (BO).

**Notes.** The seed of this species is terribly astringent but it has sweet taste.

7. *Daemonorops sarasinorum* Warb. ex Beccari


Robust, clustering rattan, climbing 15 – 30 m long. Stem with sheath 6 cm in diameter, without sheath to 4 cm in diameter. Internodes generally rather short, 20 cm long. Leaf sheath very densely covered in reflexed black spines, to 4 cm long, pinkish coloration when young; leaf sheath surface with buff scurfy sometimes variously grey indumentum, leaf sheath mouth armed as the rest of sheath; knee present, very conspicuous, armed as the rest of sheath; ocrea absent. Leaves 2.5 – 4 m long including petiole 40 cm or more somewhat reddish, armed adaxially with short, erect, scattered spines to 4 mm long, abaxially armed with erect, solitary spines, rarely up to 15 mm long; rachis unarmed or armed only slightly proximally; cirrus up to 2 m long, armed with regularly arranged groups of grapnel-like spines, blackish at the tip; leaflets mostly regularly arranged, densely crowded, 50 – 75 on each side of the rachis, stiff; leaflets lanceolate, papery, acuminate, 60 – 80 cm long, 2 cm wide, armed with scattered, reddish short bristles along the main nerve on both surfaces. Staminate inflorescence pendulous, up to 120 cm long, consist of 15 rachilla, each rachilla consist of 8 partial inflorescence. Male spadix up to 80 cm long, narrow and elongate, cupressiform with several, erect, compact or densely flowered appressed; spikelets covered with abundant furfuraceous indumentum; secondary spathes and involucra very small. Male flowers short, 4 mm
long, with anthers quite exserted from corolla and enclosed within spathes; calyx is very small, almost flat, corolla is longer than calyx. Pistillate inflorescences pendulous 60 cm long, peduncle 20 cm long, armed with densely groups of spines; peduncular bract leathery, elongate, 17 cm long, 3 cm wide, cupressiform, covered with rusty indumentum and innumerable long, narrow, scattered black spines, tubular before flowering; partial inflorescences 6 each, bearing up to 11 partial inflorescence; involucre pendulous, flat just above the involucrophore, 5 mm long; involucrophore short, papery, 2 mm long. Female flowers at the time of anthesis 4 mm long, exclusive of the stigmas which are exserted from the corolla and are about as long as the whole length of the female flowers is about 8 mm; calyx very short, copular, polished (not striate), superficially 3-toothed; corolla ventricose – urceolate, strongly seriately veined, coriaceous, having 3 broadly triangular, acute teeth.

**Distribution.** North Sulawesi: Manado, Bitung, Kota mobagu; Central Sulawesi: Palu, Mt. Rorokatimbu.

**Habitat and ecology.** Montane forest, hillslope or somewhat disturbed lower montane forest, terrain steep, shallow clayey soil.

**Uses.** Not recorded.

**Vernacular name.** Pondan Katunun (Manado)

**Specimens examined.** North Sulawesi: Manado, Minahasa 02 March 1895, Koorders 18391β, sterile (BO); 30 April 1895, Koorders 18407β, sterile (BO). Minahasa, Bitung, Batu Angus Nature Reserve, 800 m alt., 08 October 1973, J. Dransfield & J.P. Mogea: JD 3744, fruiting (BO). Bolaang Mongondow, G. Ambang, Kotamobagu, 1000 m alt., 26 October 1973, J. Dransfield: JD 3862, male flower (BO, K); JD 3861, fruiting (BO, K). Manado, Pondok Simpang, 50 m alt., 2 March 1895, Koorders 18388β, sterile (BO). Central Sulawesi: Mt Rorokatimbu, west slope c 80 km SSE of Palu, 1700 m alt., E.F. de Vogel 5484, female flower (BO, K); 13 May 1979, c. 1°16’S, 120°18’E, 1300 m alt., E.F. de Vogel 5335, sterile (BO, K); Mountain of Sadaunta, May 1976, G.G. Musser sn., (K).

**Notes.** This species has male flower unpleasantly ester scented.
DISTRIBUTION, CONSERVATION STATUS AND USES OF SULAWESI RATTANS

Distribution

Malesia is a floristic region that comprises political entities of Indonesia, Malaysia, Singapore, Brunei Darussalam, the Phillipines, Timor Leste and papua New Guinea. The area is extending to the southern part of Thailand. Based on recent study of palms distribution, Malesia regarded as the greatest palm diversity hotspot, there is considerable differentiation in species richness patterns throughout the region (Baker & Coufreur in press). Dransfield (1987) recognised three main types of distributions: 1) distributions to the west of Wallace’s line (West Malesia), 2) distributions to the east of Wallace’s Line (East Malesia) and 3) bimodal (“bicentric”) distributions. He emphasised the need to explain the limited Sulawesi palm flora and transitions across Wallacea in general (Dransfield 1981).

Of all thirty six species of rattans in Sulawesi, thirty one species are endemic to the region and five species are having more wide distribution as can be seen in the table 2. From thirty one endemic species; 8 species have relatively wide distribution (C. inops, C. koordersianus, C. leptostachys, C. macrosphaerion, C. minahassae, C. scleracanthus, C. zollingeri, K. celebica – where C. minahassae, C. zollingeri and K. celebica can be found all over Sulawesi) and the rest of the species have limited distribution or restricted to the certain area in Sulawesi. Several species so far are only known from type locality such as C. pseudomollis. This species found in Minahasa, near Kayuwatu at 50 m asl and closely related to C. mollis of the Phillipines. This species could be representative form in Sulawesi and has been separated by the formation of a natural barrier such as mountains and seas. C. perpendiculus is the only rattan in Sulawesi which has vestigial flagellum, so far can be found in hill slopes of primary forest at Sedoa mountainous area, Central Sulawesi. Certain species have restricted distribution because the species only recently described such as C. ahlidurii, C. lorelinduensis, C. suaveolens and D. takanensis and when more field work conducted their distribution could be wider. Several species had been reported occurred in certain areas of Sulawesi in the past such as C. kandariensis and C. kjelbergii. Both species found in Kendari (collected by Beccari in 1874) and Malili (collected by Kjelberg in 1929) respectively and there is no new evidence of herbarium
specimen could be referred to those species. Another reason why such species has narrow distribution related to vicariance event where the splitting or division of taxon through the development of a natural biogeographical barrier.

On the contrary, five species of *Calamus* reported have wider distribution across Sulawesi (i.e. *C. mindorensis*, *C. ornatus var. ornatus*, *C. subinermis*, *C. symphysipus* and *C. robinsonianus*). *C. ornatus var. ornatus* has wide areas of distribution and are also widely cultivated compared to other species of *Calamus* from Sulawesi. This species has bimodal distribution because it can be found in West and East of Wallace line. Another species which has bimodal distribution is *C. subinermis* because this species occurred in North of Borneo and North Sulawesi. *C. symphysipus* can be found in all over Sulawesi and up to the Phillipine. *C. mindorensis* is new record in Sulawesi because it was found only in Philippine but based on new herbarium specimens this species also found in Central and South East of Sulawesi. Whereas *C. robinsonianus* was first reported only occurred in Mollucas but recent study showed that this species also occurred in South East of Sulawesi.

**Conservation Status**

Certain species of *Calamus*, such as *C. kandariensis* and *C. k jelbergii* is likely to go extinct because so far there is no new evidence of herbarium specimens collected from type locality or other areas in Sulawesi. *C. ornatus var. ornatus* in this region meets criteria of Least Concern as well as *C. subinermis* (LC – IUCN 2001). Those two species have wide areas of distribution and the former species is widely cultivated in the Philippine as large diameter rattans for furniture industry (Mohamad *et al.* 1992). There are 11 species of *Calamus* and one species of *Daemonorops* – *D. robusta*, as commercial rattans in Sulawesi. All those species have not cultivated yet. Local people usually collected the rattans directly from the forest. These activities would threaten of the commercial rattans occurrence and increased levels of exploitation (Rustiiami 2009a). Most of commercial rattans in Sulawesi have restricted areas of distribution however – despite of illegal harvesting, the environmental pressure around their natural habitat are very high. Eventhough the conservation status of those species could not be addressed because only herbarium data available so far, but at least from this study suggested that all those species has potential threats and more populations and distribution data are required to assess the conservation status of those species.
Uses

In general the cane of commercial rattans from Sulawesi used for the furniture industry. Their cane ideal for binding purposes and their smooth cane surface highly suitable for weaving, matting and fine basket-ware after splitting (Heyne 1949; Dransfield 1992c; Siebert 1997; Rustiami 2009a). It has been widely known that some of commercial rattans from Sulawesi have good cane value for export and local use. For local use, local people has an astonishing variety or carrying baskets, hats, sleeping mats, tobacco pouches and other woven items made from a variety of species (Dransfield 1992c). *C. zollingeri*, giant rattan of East Indonesia which mostly used and exported as furniture, has very wide distribution all over Sulawesi.

Other part of rattan such as its fruit also reported has potential value. Local people in Kulawi, Central Sulawesi used to eat fruit of *Calamus ornatus* var. *ornatus* which has very sour taste. Dransfield (1992c) also reported that the fruit-flesh of most species of rattan is edible and be used as tamarind substitution. Usually it is sour and bitter, but in other species may be sweet and good to eat. Young shoot of *Daemonorops mogeana* (Rustiami 2009b), *C. zollingerii* and *D. robusta* are edible and have sweet taste. Local people in Kulawi also used this young shoot for vegetable substitution because it has asparagus taste-like (Siebert 1997).
CONCLUSIONS

On the basis of morphological species concept there are twenty eight species of Calamus occur in Sulawesi. All those species belong to several groups of Beccari’s and most of the species belongs to group XV where leaves cirrate, leaflets elongate, leaf sheath eflagellate, primary bracts tubular - tattering in age, rachilla pedicellate, involucrophorum sessile, endosperm homogenous or ruminate. Four of these twenty eight species have been discovered recently and recorded as new, *C. perpendiculus*, *C. rosetus*, and *C. lorelinuensis*. Another new species, *Calamus ahlidurii* Fernando, is published here based on the determination note of Fernando on the herbarium specimen. One new species reported as new record, *Calamus robinsonianus*. *Calamus pedicellatus* has been assigned as synonymy of *C. inops* mainly because of better understanding of the range variation in specimens. Three names of uncertain application are discussed.

Beccari recognized 16 groups of *Calamus* based mainly on the present or absent of the cirrus, present or absent of flagella in the leaf sheath and/or in the inflorescence, shape of primary bract, rachillae sessile or pedicellate, involucrophore sessile or pedicellate and endospermae homogenous or ruminate. Kramadibrata and Dransfield added two groups – Groups XVII for species which has vestigial flagellum and Group XVIII for *Calamus inops* groups. In Sulawesi, Group XVII only presented by *Calamus perpendiculus*, the rest of the species occur in Borneo. Furtado had proposed sections within *Calamus* but it seems that his sections did not work very well because most of his section can be referred to Beccari’s group. In total based on the recent study 18 groups has been known for grouping within *Calamus* and 6 groups occurs in Sulawesi.

The phentic study shows within seven species of Daemonorops occur in Sulawesi *D. takanensis* and *D. mogeana* confirmed as new species. These two species recently collected from the slopes of Bukit Takane-kane and G. Malemo respectively. *Daemonorops takanensis* is distinct from other species by leaf sheath having rusty-brown colored indumentum, armed with numerous very brittle, thin laminar, short, solitary brown spines with small bulbous bases. Whereas *D. mogeana* compared to other species has subglobose fruit and slightly ruminate endosperm.

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