REINWARDTIA

A JOURNAL ON TAXONOMIC BOTANY, PLANT SOCIOLOGY AND ECOLOGY

ISSN 0034 – 365 X | E-ISSN 2337 – 8824 | Accredited 792/AU3/P2MI-LIPI/04/2016

2017 16 (2)

REINWARDTIA

A JOURNAL ON TAXONOMIC BOTANY, PLANT SOCIOLOGY AND ECOLOGY

Vol. 16 (2): 49 – 110, December 19, 2017

Correspondence on editorial matters and subscriptions for Reinwardtia should be addressed to:
HERBARIUM BOGORIENSE, BOTANY DIVISION,
RESEARCH CENTER FOR BIOLOGY– INDONESIAN INSTITUTE OF SCIENCES
CIBINONG SCIENCE CENTER, JLN. RAYA JAKARTA – BOGOR KM 46,
CIBINONG 16911, P.O. Box 25 CIBINONG
INDONESIA
PHONE (+62) 21 8765066; Fax (+62) 21 8765062
E-MAIL: reinwardtia@mail.lipi.go.id
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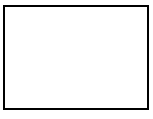

Cover images: Plant and flower of *Appendicula cordata* Wibowo & Juswara. Photos by A. R. U. Wibowo.

The Editors would like to thank all reviewers of volume 16(2):

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REINWARDTIA
Vol 16, No 2, pp: 49−63

A SYNOPSIS OF *CALAMUS* (ARECACEAE) IN SULAWESI

Received May 26, 2017; accepted October 5, 2017

HIMMAH RUSTIAMI
Herbarium Bogoriense, Botany Division, Research Center for Biology – LIPI , Cibinong Science Center, Jln. Raya Jakarta Bogor Km. 46, Cibinong, 16911, Bogor, Indonesia. Email: himmah@hotmail.com

ANDREW HENDERSON
Institute of Systematic Botany, New York Botanical Garden, 2900 Southern Blvd, Bronx, NY 10458, USA. Email: ahenderson@nybg.org

ABSTRACT
RUSTIAMI, H. & HENDERSON, A. 2017. A synopsis of *Calamus* (Arecaceae) in Sulawesi. *Reinwardtia* 16 (2): 49–63. — A synopsis of the rattan genus *Calamus* in the Indonesian island of Sulawesi is given. Twenty-three species are recognized, including two new species that are described and illustrated: *Calamus posoanus* and *C. sandsii*. Nomenclature, including designation of 17 lectotypes, is given for each species, as well as notes on distribution, habitat, vernacular names, specimens examined, uses, and systematics.

Key words: distribution, morphology, palmae, rattans, uses.

ABSTRAK
RUSTIAMI, H. & HENDERSON, A. 2017. Sinopsis *Calamus* (Arecaceae) di Sulawesi. *Reinwardtia* 16 (2): 49–63. — Sinopsis rotan marga *Calamus* di Sulawesi, Indonesia disajikan. Terdapat 23 jenis termasuk dua jenis baru yang dipertelakan dan disajikan fotonya yaitu *Calamus posoanus* dan *C. sandsii*. Tatanama termasuk penunjukan 17 lektotipe untuk tiap jenis termasuk catatan persebaran, habitat, nama daerah, spesimen yang diamati, manfaat dan sistematikanya disajikan.

Kata kunci: manfaat, morfologi, palem, persebaran, rotan.

INTRODUCTION

Calamus is currently the largest genus of palms. Govaerts and Dransfield (2005) recognized 374 species, and more have been added since, making a total of about 400. The genus is classified in the subtribe Calaminae, tribe Calameae, subfamily Calamoideae (Dransfield *et al*., 2008). It is widespread across the Old World tropics, from West Africa to Fiji, but most diverse in the Asian tropics, particularly in lowland and montane rainforests of the Indo-Burma, Sundaland, Wallacea, and Sahul regions. Systematic knowledge of *Calamus* is uneven. The only monograph of the entire genus was published over a century ago (Beccari, 1902; 1907; 1908; 1913; 1914), but this is now out-of-date. More recent works have consisted of manuals and field guides to various regions (*e.g.* Dransfield, 1979; 1982; 1984; 1992; 1997; Evans *et al.*, 2001; Dransfield & Patel, 2005; Sunderland, 2007; Henderson, 2009; Baja-Lapis, 2010; Renuka & Sreekumar, 2012; Peters & Henderson, 2014). There is no modern treatment of the entire genus, although the second author is currently working on a revision. We note that of all the manuals and field guides cited above, none covers Indonesia (except for Kalimantan in Dransfield & Patel, 2005), and there is a great need for such guides for Indonesia. Of all the areas where *Calamus* occurs, the Indonesian island of Sulawesi is the most poorly known.

Systematic knowledge of *Calamus* in Sulawesi had an inauspicious beginning. Blume (1847) described *Calamus plicatus* from a specimen said to have been collected by Forsten from the Celebes (an earlier name for Sulawesi). There are two sheets extant at L, both sterile, and they have conflicting labels. The evidence suggests that they were both collected by Korthals in southern Borneo during his visit there in 1836 (Henderson, 2015). *Calamus plicatus* thus becomes an earlier and overlooked name for specimens commonly determined as *C. laevigatus*, occurring in Peninsular Thailand, Peninsular Malaysia, Sumatra, Borneo, and the Philippines.

The great Italian botanist Odoardo Beccari (1843 -1920) visited Sulawesi in 1873 and 1874 as part of his Asian travels. He collected in several places in northern and southern Sulawesi, including Gorontalo, Makassar, and Kendari. Curiously he described only one of his Sulawesi collections as a new species, *Calamus kandariensis*. On his return to Florence, Beccari began to work on a monograph of *Calamus*, and produced a magnificent series of large folio publications on the genus (Beccari, 1908; 1913; 1914), that remain, to this day, the foundation of our knowledge of the genus.

At some point shortly before 1920 Beccari received a large number of herbarium specimens from Karl Heyne (1877-1947), a Dutch botanist who worked at Buitenzorg Garden (now Bogor) in

Java from 1906 until 1926. In return, Beccari sent Heyne names for these species, including nine new species (all but one from Sulawesi). These were not formally described by Beccari, who died soon after receiving the specimens, but were described by Heyne in the second edition of his classic work *De nuttige planten van Nederlandsch-Indië* (*The Useful Plants of the Dutch East Indies*) (Heyne, 1922).

Heyne himself did not carry out much field work, and it is not clear how he obtained the specimens he sent to Beccari. Either he received them from other collectors, or made them from plants cultivated in the Buitenzorg Garden. The latter seems more likely given the condition of the specimens (*i.e.* apparently not preserved in alcohol). It is also not clear how the rattan canes he described in 1922 were associated with the herbarium specimens he sent to Florence. None of the specimens in Florence has any naked cane, and all consist of leaf and reproductive parts only. Whatever their origin, Heyne's descriptions of his new rattan species are not based on these specimens but on the actual canes themselves. The descriptions are thus minimally informative from a systematic point of view. All collections of Heyne were deposited at Herbarium of Forest Research Institute in Bogor (BB) but most of them are damaged when moving to a new building and they only kept the collection labels. Fortunately all Heyne collections are deposited as well at Herbarium Bogoriense (BO).

There has been some recent work on Sulawesi *Calamus*. Kramadibrata and Dransfield (1992) treated a small group of four species within *Calamus, C. inops* and its relatives. Baker & Dransfield (2004) described a new species from Sulawesi, *Calamus suaveolens.* There have also been various ecological or floristic studies published. Sabilu (1999) reported eight species of *Calamus* occurred in Rawa Aopa National Park. A study of the palm flora in two plots in Lore Lindu National Park in Central Sulawesi conducted by Mogea (2002) reported 20 species of *Calamus*, 16 of which were unidentifiable. In a more detailed study, Stiegel *et al*. (2011) found 33 species of *Calamus* in Lore Lindu National Park, 24 of which they were unable to identify. In another National Park in south-eastern Sulawesi, Powling (2009) recorded 19 species of *Calamus*, two of which he was unable to identify.

The figures from Lore Lindu National Park, in particular, emphasis how poorly known *Calamus* is in Sulawesi. Recently, Rustiami initiated studies of *Calamus* in Sulawesi and carried out field work in the island (Rustiami, 2011). We now present a synopsis of the genus in Sulawesi as a basis for further studies. Given the importance of *Calamus* as a non-timber forest product in Sulawesi (Siebert, 2012), the poor state of its systematic knowledge, and continuing deforestation from land-clearings, resettlements, coffee and cacao plantation, paddy fields and other kinds of threats (Holmes, 2000), it is timely to present a synopsis of our current knowledge of the genus in the island.

TAXONOMIC TREATMENT

CALAMUS

Calamus Linnaeus, Sp. Pl. 325 (1753); Beccari, Ann. Roy. Bot. Gard. Calcutta 11(1): 1–518 (1908); Furtado, Gard. Bull. Sing. 15: 32–265 (1956); Dransfield, Man. Ratt. Mal. Pen. 122 (1979) — Type: *Calamus rotang* Linnaeus.

Solitary or clustering, stemless to high climbing or erect 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 both absent; knee often present; ocrea sometimes well developed, usually inconspicuous. Male and female inflorescences superficially similar, often ending in a long flagellum, sometimes with gradual succession of branches, usually with discrete distant branches (partial inflorescences); bracts always tubular at the base, rarely with broad limbs splitting down one side, but if so, the base always tubular and unsplit, bracts variously armed; partial inflorescences usually much longer than the subtending bract, very rarely shorter, flowers subtended by small bracteoles. Male flower with cup-shaped calyx, usually with 3 well defined lobes; corolla split almost to the base into 3 petals; stamens 6 (rarely 12), very shortly epipetalous; pistillode minute. Female flowers borne together with a sterile male flower as a pair or flower comprising two female flowers and one male flower (in at least one species in Sulawesi). Sterile male flowers like the fertile males, but with empty anthers. Female flowers usually larger than the males, with shallowly 3-lobed calyx; 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, rarely 2-3 per fruit, very variable in shape, covered in a thin to thick sarcotesta; endosperm homogenous or ruminate; embryo basal or lateral. Seedling leaf bifid or pinnate.

1. CALAMUS BONIENSIS Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2: 365 (1922). Lectotype (designated here): Celebes, Boni, no date, *K. Heyne 2596* (lectotype FI!, isolectotype BO! BB!).

Distribution and habitat. Central and southern Sulawesi in undisturbed montane forest on shallow clayey soil, dominated by Fagaceae and Myrtaceae.

Vernacular name. Tomani (Bugis language).

Specimens examined. South East Sulawesi: Boni,

Key to the species of *Calamus* in Sulawesi

1	a.	Leaf rachis apices not extended into a cirrus; flagella well-developed ……...	2
	b.	Leaf rachis apices extended into an elongate cirrus; flagella absent, rarely vestigial …….	5
2	a.	Pinnae elliptic, usually without spinules on veins, brownish indumentose abaxially …….	*C. symphysipus*
	b.	Pinnae linear or lanceolate, with spinules on veins, not indumentose abaxially …….	3
3	a.	Pinnae 40-65 per side of rachis; fruits 2-3-seeded ……...	*C. koordersianus*
	b.	Pinnae 8-42 per side of rachis; fruits 1-seeded ……	4
4	a.	Middle pinnae 35.5-80.0 cm long, 3.6-9.0 cm wide; fruits 25.3-40.0 mm long ……..	*C. ornatus*
	b.	Middle pinnae 21.0-39.5 cm long, 1.0-2.6 cm wide; fruits 9.6-12.1 mm long ……	*C. usitatus*
5	a.	Inflorescences diverging from sheath near sheath apex; partial inflorescences with short rachis bracts, straight rachises, and straight, erect, elongate female and short male rachillae subtended by short rachillae bracts, these decreasing in length distally ……..	6
	b.	Inflorescences diverging from sheath well below sheath apex, rarely from near sheath apex; partial inflorescences not as above ……..	8
6	a.	Pinnae 11 per side of rachis, elliptic; middle pinnae 28.0-35.5 cm long, 2.5-3.6 cm wide; neuter flowers borne on a well-developed pedicel ……...	*C. pedicellatus*
	b.	Pinnae 22-45 per side of rachis, linear; middle pinnae 13.5-35.5 cm long, 0.8-1.7 cm wide; neuter flowers not borne on a pedicel ……..	**7**
7	a.	Seeds with an asymmetrically lobed apex, with smooth surfaces ……...	*C. orthostachyus*
	b.	Seeds with a symmetric apex, with grooved surfaces ……..	*C. inops*
8	a.	Pinnae linear or lanceolate, usually with spinules on veins …….	9
	b.	Pinnae elliptic, usually without spinules on veins ……...	10
9	a.	Male and female rachillae with a proximal, pedicellate section ……..	*C. zollingeri*
	b.	Male and female rachillae sessile …….	*C. siphonospathus*
10	a.	Inflorescences somewhat congested, not elongate nor flagellate, terminating in a short, flat structure diverging from the main inflorescence axis; rachis bracts slightly flattened, slightly expanded at the apex, relatively short, one side of the oblique apex extended into a longer limb……...	11
	b.	Inflorescences slender and elongate, usually without recurved spines, terminating in a long, tubular structure in line with the main inflorescence axis and covered with overlapping bracts; rachis bracts tubular but not closely sheathing the rachis, abruptly narrowed proximally, often brown tomentose ……..	18
11	a.	Female rachillae usually subtended by bracteoles with sparse, small, short, recurved spines, with at least some triads or tetrads of 2 female and 1-2 neuter flowers, the rachillae terminating in a modified, spine-like female dyad bracteole ……...	12
	b.	Female rachillae not or rarely subtended by bracteoles with sparse, small, short, recurved spines, with dyads of 1 female and 1 neuter flower, the rachillae not terminating in a spine-like bracteole ……...	13
12	a.	Cirri with irregularly arranged clusters of recurved spines; pinnae 8 per side of rachis, arranged in divergent pairs; middle pinnae 15.5-24.5 cm long, 1.3-1.9 cm wide ……..	*C. sandsii*
	b.	Cirri with more or less regularly arranged clusters of recurved spines; pinnae 23-28 per side of rachis, regularly arranged, rarely irregularly; middle pinnae 23.5-66.0 cm long, 1.6-5.2 cm wide ……..	*C. didymocarpus*
13	a.	Leaf sheath spines few, scattered, shortly recurved on a swollen base, sometimes swellings only, not leaving a distal impression in the sheath; inflorescences diverging from sheath near sheath apex ……...	*C. kjelbergii*
	b.	Leaf sheath spines not as above ……...	14
14	a.	Pinnae with numerous, spinules all over abaxial surface; embryos lateral in seed …….	*C. scleracanthus*
	b.	Pinnae without spinules abaxially; embryos at or near base of seed ……...	15
15	a.	Pinnae midvein and distal lateral vein usually raised and spinulose adaxially, the proximal lateral vein scarcely raised and usually not spinulose adaxially; seeds reniform; endosperm homogeneous or scarcely ruminate ……..	*C. moseleyanus*
	b.	Pinnae midvein and lateral veins equally raised; seeds not reniform; endosperm with numerous, deep, pit-like ruminations …….	16
16	a.	Leaf sheath spines narrowly triangular, horizontal, short, dense, black; pinnae with long spinules on the adaxial pinnae surface.…….	*C. macrosphaerion*
	b.	Leaf sheath spines not as above; pinnae without long spinules on the adaxial surface ……...	17

Key to the species of *Calamus* in Sulawesi (continued)

17	a.	Leaf sheath spines slender, triangular, concave at the base proximally, horizontally spreading, scattered, yellowish-brown ……..	*C. tolitoliensis*
	b.	Leaf sheath spines triangular, often downward pointing, swollen at the base distally, scattered to dense, brownish, often black-tipped, sometimes with shorter spines interspersed ……..	*C. leptostachys*
18	a.	Cirri with irregularly arranged clusters of spines; basal pinnae usually swept back across the sheath ……...	19
	b.	Cirri with more or less regularly arranged clusters of spines; basal pinnae not swept back across the sheath ……...	20
19	a.	Pinnae with numerous, spinules all over abaxial surface; middle pinnae 27.7-34.5 cm long, 5.9-9.0 cm wide ……	*C. suaveolens*
	b.	Pinnae without spinules on abaxial surface; middle pinnae 14.0-28.5 cm long, 2.0-6.7 cm wide ……..	21
20	a.	Leaf sheaths densely spiny ……...	*C. minahassae*
	b.	Leaf sheaths without or with few spines……...…	*C. leiocaulis*
21	a.	Rachis bracts with a dense fringe of narrow, light brown hairs at the apex…….	*C. boniensis*
	b.	Rachis bracts without a fringe of hairs at the apex ……..	22
22	a.	Leaf sheath spines elongate, needle-like, densely arranged, borne in horizontal rows ……...	*C. posoanus*
	b.	Leaf sheath spines slender, triangular, concave at the base proximally, horizontally spreading, scattered, or spines absent ……	*C. kandariensis*

no date, *K. Heyne 2596*, flowering material (FI, BO, BB); *K. Heyne 4*, sterile material (FI); Malili, *H. Reppie GG 17594*, flowering material (BO); G. Kolonodale, *Rachmad 658*, fruiting (BO). Central Sulawesi: Kulawi District, Moa, G. Malemo, 18 Oct 1977, *JP Mogea 1328*, (BO).

Uses. Heyne (1922) reported that this rattan had a good cane for export and local use. The only other information on the species is the label notes of *J.P. Mogea 1328* that records the cane as having as good quality as that of *Calamus leiocaulis*.

Notes. *Calamus boniensis* is known from only a few specimens. It is distinguished from similar species (*C. kandariensis, C. leiocaulis, C. minahassae, C. perpendiculus, C. suaveolens*) by its rachis bracts with a dense fringe of narrow, light brown hairs at the apex.

2. CALAMUS DIDYMOCARPUS Warb. ex Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11 (1): 467 (1908). Lectotype (designated here): N. Celebes, at Bojong in the Province of Minahasa, *O. Warburg s.n.* (lectotype FI!) (the holotype at B was destroyed).

Calamus pachystachys Warb. ex Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11(1): 465 (1908). Lectotype (designated here): South East Sulawesi, Wawo Karaeng, on the high mountain in the southern part of the island, *O. Warburg s.n*. (lectotype FI!) (the holotype at B was destroyed).

Distribution and habitat. Throughout Sulawesi in lowland or montane primary forest on steep hill slopes, at 350-2,060 m elevation.

Vernacular name. Rotan humampu, Rotan Talangallai (Sadaunta dialect), Si Ombo, Owe Waatang, Owe Rongo, Pandas.

Specimens examined. North Sulawesi: Bojong in the Province of Minahasa, *O. Warburg s.n.* (lectotype FI!). Central Sulawesi: East mountain of Sadaunta, NW of G. Bonthain, 9 June 1921, 2,200 m, *H. Bunnemeijer 12010*, fruiting (BO); 20 June 1921, 2,060 m, *H. Bunnemeijer 12020*, fruiting (BO); mountain east of Sadaunta, April-May 1976, 3,400 feet, *G. Musser RS2*, fruiting material (K); same locality, 3,000 feet above mountain stream, April-May 1976, *G. Musser RS1*, fruiting material (K); Mountain Roroka Timbu, Lore Lindu National Park, 19 May 1979, *E. de Vogel 5466*, fruiting (L, BO, K). South Sulawesi. Malili, Kawata, 14 October 1933, *A. Waturandang bb 17974*, female inflorescence and infructescence (BO). South East Sulawesi: Wawo Karaeng, *O. Warburg s.n*. (FI).

Notes. *Calamus didymocarpus* differs from all other species in Sulawesi (except *C. sandsii*, see below) in its female rachillae with at least some triads or tetrads of 2 female and 1-2 neuter flowers. It occurs in scattered localities, with specimens from each locality slightly different from one another. It is not clear if this distribution is an artefact of uneven collecting. *Calamus pachystachys* is included here as a synonym; it does not appear to differ from *C. didymocarpus*.

3. CALAMUS INOPS Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2: 372 (1922). Type: Sulawesi, Toli-toli, *K. Heyne 2518* (holotype FI!, isotype BO!).

Distribution and habitat. Throughout Sulawesi in montane rainforest at 1,000-1,600 m elevation.

Vernacular name. Tungka, Tohiti (Tobela

language), Samole (Bugis language), Ruimaeto Bahata (Tobelo language).

Specimens examined. Central Sulawesi: Kulawi District, Moa, G. Malemo, 24 October 1977, *J. P. Mogea 1477*, male inflorescence (BO, K), *J. P. Mogea 1474* (BO), *J. P. Mogea 1475* (BO), *J. P. Mogea 1476* (BO). South Sulawesi: Malili, Kawata, 28 October 1910, *A. G. Waturandang 36*, male inflorescence (BO); Bone, *K. Heyne 8*, sterile (BO, FI).

Notes. Kramadibrata & Dransfield (1992) have provided a revision of this group of related species (*C. inops, C. orthostachyus, C. pedicellatus, C. robinsonianus*). *Calamus inops* is difficult to distinguish from the sympatric *C. orthostachyus*. Kramadibrata & Dransfield distinguished them by their leaf sheath spines and petioles; two types of spines and petioles 18–30 cm long in *C. inops versus* one type of spine and petioles 4–10 cm long in *C. orthostachyus*. We have not observed this difference in sheath spines, and for petioles we have overlapping ranges (15–30 cm long in *C. inops versus* 1.5–25 cm long in *C. orthostachyus*). The only character we have found to distinguish the two species is seed shape (with a symmetric apex with grooved surface in *C. inops versus* with an asymmetrically lobed apex and smooth surface in *C. orthostachyus*). However, this is based on few samples and more specimens are needed to resolve the problem. Both Powling (2009) and Rustiami (2011) considered that *Calamus robinsonianus* occurred in Sulawesi. We have not seen the specimen collected by Powling, but Rustiami cited *van Zijl de Jong s.n.*, collected at Kawata in South Sulawesi. However after thorough examination it does not look like *Calamus robinsonianus*.

4. CALAMUS KANDARIENSIS Beccari, Rec. Bot. Surv. India 2: 210 (1902). Lectotype (designated here): Indonesia. Penisola S. E. Lepo-Lepo, prope Kandari, July 1874, *Beccari s.n.* (lectotype FI!).

Calamus kandariensis var. *glabratus* Beccari, Rec. Bot. Surv. India 2: 210 (1902). Indonesia. Kandari, no date, *O. Beccari s.n.* (holotype FI!).

Calamus paucijugus Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2: 381 (1922). Lectotype (designated here): Indonesia. Sulawesi, Boni, no date, *K. Heyne 2598* (lectotype FI!, isolectotype BO!).

Distribution and habitat. Southwestern and southeastern Sulawesi in lowland, primary rain-forest on ridge tops at 300–800 m elevation.

Vernacular name. Dolodus (Gorontalo dialect).

Specimens examined. North Sulawesi: Dumoga Bone National Park, 16 September 1984, 250 m, *T. C. Whitmore & K. Sidiyasa 3402*, fruiting (BO). South East Sulawesi: Boni, *K. Heyne 2598*, fruiting (BO), *K. Heyne 6*, fruiting (BO); Wadjo, *K. Heyne 2588*, sterile (BO), *K. Heyne 2575*, sterile (BO); *V. Hulstyn 394*, sterile (BO). Penisola S. E. Lepo-Lepo, prope Kandari, July 1874, *Beccari s.n.* (FI); Kandari, no date, *O. Beccari s.n.* (FI).

Notes. *Calamus kandariensis* is known from only a few specimens, most of them sterile. It is distinguished from similar species (*C. boniensis, C. leiocaulis, C. minahassae, C. perpendiculus, C. suaveolens*) by its cirri with regularly arranged spines, rachis bracts without a fringe of hairs, and slender, triangular (or absent) leaf sheath spines. *Calamus kandariensis* var. *glabratus* and *C. paucijugus* are included here; we find no differences between them and *C. kandariensis*.

5. CALAMUS KJELBERGII Furtado, Gard. Bull. Straits Settlem. 8: 252 (1935). Lectotype (designated here): Sulawesi, Kawata, by the river Maliki, *G. Kjelberg 2367* (lectotype S!, isolectotype BO!) (the holotype at B was destroyed).

Distribution and habitat. South Sulawesi in lowland rainforest at 200 m elevation.

Vernacular name. Not recorded.

Uses. Ripe fruits are eaten by local people.

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

Notes. Furtado (1935) considered that this species belonged to group XV of Beccari (1913) and that it was 'very closely related' to the Philippine *Calamus arugda* Becc. This seems unlikely, and here we consider it related to a group of similar Sulawesi endemics (*C. leptostachys, C. macrosphaerion, C. scleracanthus, C. tolitoliensis*). It differs from these in its swollen-based leaf sheath spines and inflorescences diverging from sheath near the sheath apex. It is known from only one specimen.

6. CALAMUS KOORDERSIANUS Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11 (Suppl.): 65 (1913). Type: North Sulawesi, Minahasa, near Kajuwatu, 27 February 1895, *S. Koorders 184000β* (holotype BO!, isotypes FI!, L!).

Distribution and habitat. Throughout Sulawesi in lowland rainforest or disturbed forest at 50-100 m elevation.

Vernacular name. Lauro Kikira (Tobelo and Topadoe languages), Pondos Ajamen (Minahasa language).

Specimens examined. South Sulawesi: Malili, Kawata, 27 December 1933, 25 m, *H. Reppie 39*, dead female flowers (BO); Kolaka, *K. Heyne 2565*, sterile (BO, BB); Boni, *K. Heyne 2603* (BO), sterile, *K. Heyne 11*, sterile (BO); Wadjo, *K. Heyne 2613*, sterile (BO); Kampung Malili, 01 June 1933, *A. Harnsteia 11*, female flower (BO); *leg. ign. P. Kramadibrata s.n.*, 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, August-November 1975, 1,500 feet, *G. Musser R7*, fruiting (K). North Sulawesi: Bolaang Mongondow, Pindool, Lolak, 18 October 1973, *J. Dransfield 3784*, fruiting material (BO, L); 19 October 1973, *J. Dransfield 3815*, (BO), fruiting material; Minahasa, Suaka Alam Batu Angus, Bitung, 6 October 1973, 100 m alt., *J. Dransfield 3731*, fruiting material (BO); 50 m alt., *J. Dransfield 3727*, male flower (BO, L); Kolomodale, Towi, (in stunted forest on level, ultra-basic soil), 3 March 1989, *L. Clayton 14*, sterile (K).

Uses. It provides a good cane for rope and basket making because it easily bends. The label of *L. Clayton 14* notes that this rattan is medium to low priced.

Notes. This species can be easily distinguished from the other *Calamus* of Sulawesi because it is the only species that has fruits with two to three seeds.

7. CALAMUS LEIOCAULIS Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2: 375 (1922). Lectotype (designated here): Sulawesi, Boni, no date, *K. Heyne 2597* (lectotype FI!).

Distribution and habitat. Southwestern and southeastern Sulawesi in lowland rainforest at 800 m elevation.

Vernacular name. Jermasin (Mekongga language).

Specimen examined. South East Sulawesi: Kendari, Kolaka, Wolo, G. Mekongga, 10 August 1985, 15 m, *Anggana & Yunus Dali 25*, sterile (K, BB). Boni, *K. Heyne 2511*, juvenile form (BO), *K. Heyne 5*, sterile (BO), *K. Heyne 2597* (FI).

Uses. As *Calamus boniensis*, this species is said to have a good quality cane.

Notes. *Calamus leiocaulis* is known from only a few specimens and remains poorly understood. It differs from *C. minahassae* in its leaf sheaths with few or no spines.

8. CALAMUS LEPTOSTACHYS Beccari ex Heyne, Nutt. Pl. Ned. Ind. 2:375 (1922). Lectotype (designated here): Celebes, Boni, no date, *K. Heyne 2593* (lectotype FI!, isolectotype BO!).

Distribution and habitat. Throughout Sulawesi in lowland or montane rainforest at 40-1,500 m elevation.

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

Specimens examined. North Sulawesi: Bolaang Mongondow, Pindool Lolak, 18 October 1973, 100 m alt., *J. Dransfield & J. P. Mogea 3786*, fruiting (BO, K), 40 m, *J. Dransfield & J. P. Mogea 3780*, male flower (BO, L, K); Toraut, Dumoga Bone National Park, 4 March 1984, 200 m, *J. P. Mogea 5036*, sterile (BO, K); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, *L. Clayton 7*, sterile (K); Boalemo, Imbodoe, 20 July 1930, 400 m, *A. Uno 7*, fruiting (BO). Central Sulawesi: G. Gindopo, Basidondo, 4 March 1985, *Ramlanto & Z. Fanani 604*, male flower (BO, L). East Sulawesi: Kolaka, *K. Heyne 2571*, sterile (BO). South East Sulawesi: Wadjo, *K. Heyne 2580*, sterile (BO).

Vernacular name. 'Putih' is the vernacular name of this species and refers to the fruit that is white at maturity.

Notes. *Calamus leptostachys* differs from similar species (*C. kjelbergii, C. macrosphaerion, C. scleracanthus, C. tolitoliensis*) in its leaf sheath spine arrangement.

9. CALAMUS MACROSPHAERION Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11 (1): 448 (1908). Lectotype (designated here): Indonesia, North Sulawesi, Minahassa, Tomohon, *Sarasin s.n.* (lectotype FI!) (the holotype at B was destroyed).

Distribution and habitat. Northeast and central Sulawesi in secondary forest, montane rainforest on steep slopes at 1,000-1,380 m elevation.

.

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

Specimens examined. North Sulawesi: Minahasa, Langoan, G. Soputan, 11 October 1973, *J. Dransfield & J. P. Mogea 3757*, fruiting (BO, K, L); Mountain Mahawu, Tomohon, 1,200 m, 21 June 1956, *L. Forman 184*, sterile (K). Central Sulawesi: Kulawi District, G. Malemo, 20 October 1977, *J. P. Mogea 1347*, fruiting (BO, L); Bukit Parawatu, Moa, Kulawi, Donggala, Lore Lindu National Park, 24 June 2001, *Ramadhanil & S. Siebert 503*, sterile (BO, K); Mountain east of Sadaunta, April - May 1976, *G. Musser R54*, fruiting (K); *G. Musser M16*, fruiting (K); Sopu Valley, Palu, 27 April 1979, 1000 m, *E. de Vogel 5070*, dead female

inflorescence (BO, K, L). South Sulawesi: Malili, Toli-toli, Kawata, 5 April 1933, *J. van Zijll de Jong bb 17422*, fruiting (BO); G. Wowonseru, 28 June 1979, *D. Darnaedi 2074*, fruiting (BO, K, L).

Uses. The label of *J. Dransfield & J. P. Mogea 3757* notes that the fruit has an exceedingly sour taste.

Notes. This species is distinct from other, similar *Calamus* species from Sulawesi (*C. kjelbergii, C. leptostachys, C. scleracanthus, C. tolitoliensis*) by its large round fruits and deeply ruminate seeds.

10. CALAMUS MINAHASSAE Warb. ex Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11 (1): 356 (1908). Lectotype (designated here): Indonesia, North Sulawesi, Minahassa, Bojong, *Warburg s. n.* (lectotype FI!, isolectotype SING!) (the holotype at B was destroyed).

Distribution and habitat. Throughout Sulawesi in lowland or montane rainforest on ridge tops at 270-1,434 m elevation.

Vernacular name. Dato (Luwuk and Tolaki language), Lauro Koampu, Anduru (Koronsi, Topadu language), Moli (Gorontalo 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).

Specimens examined. North Sulawesi: Menado, Boalemo, Ambudu, 400 m, 20 July 1930, *A. Uno 8*, sterile material (BO); Minahasa, Pinili, Tatelu, slopes of G. Klabat, 400 m, 1 November 1973, *J. Dransfield & J. P. Mogea 3896*, fruiting material (BO); Suaka Alam Batu Angus, 7 October 1973, 600 m, *J. Dransfield & J. P. Mogea 3741*, fruiting material (BO, L); Menado, Tolombulan, 12 April 1895, 900 m, *S. Koorders 18414ß*, fruiting material (BO, L), 29 April 1895, 25 m, *S. Koorders 18405ß*, male flowers (BO); Talaud, *leg. ign. Noerkas 488*, sterile (BO). Central Sulawesi: Sopu Valley, *ca.* 80 km SSE of Palu, 1,000 m, 5 May 1979, *E. de Vogel 5212*, young fruit (BO, K, L), *E. de Vogel 5210*, sterile (K, L), *E. de Vogel 5209*, sterile (BO, K); Kulawi, Desa Moa, G. Parawatu, Lore Lindu National Park, 24 October 1997, 800 m, *S. Siebert 26*, sterile (K); Mataue, Kulawi, Lore Lindu National Park, 25 May 1981, 680 m, *Ramadhanil & S. Siebert 389*, fruiting (L, K); Bukit Parawatu, Moa, Kulawi, Donggala, Lore Lindu National Park, 24 June 2001, 900 m, *Ramadhanil & S. Siebert 500*, sterile (K); East of Tongoa, 1 March 1981, 650 m, *J. Johansson, H. Nybom & S. Riebe 110*, fruiting (K); Sungei Sadaunta, around 1974-1976, *G. Musser M 11*, sterile (K); M. Mope, Kulawi, February 1986, 400 m, *Anggana & Yunus Dali 059*, sterile (K, BB). South Sulawesi: Malili, Kawata, 20 August 1934, 300 m, *A. Hoornstra 14*, fruiting material (BO); 21 March 1934, *H. Reppie 40*, female flower (BO); Mamuju, Kaluku, Dusun Roa, Desa Pantai Kaluak, near S. Kara-kara Besar, 9 February 1993, *P. Kramadibrata 32*, sterile (BO); Matano lake, NE of Malili, 16 July 1976, *W. Meijer 11207*, sterile (BO). South East Sulawesi: Wadjo, *leg. ign., K. Heyne 2619*, sterile (BO); Boni, *K. Heyne 4*, sterile (BO).

Uses. Rustiami (2011) noted that this species had a good quality cane for making baskets and rope because it bent easily.

Notes. Most of the specimens have the basal pinnae swept back across the sheath.

11. CALAMUS MOSELEYANUS Beccari, Rec. Bot. Surv. India 2: 211 (1902). Type: Philippines. Malanipa Isl., January-February 1875, *H. Moseley s. n.* (holotype K!, isotype FI!).

Calamus subinermis H. Wendl. ex Beccari, Rec. Bot. Surv. India 2: 212 (1902). Type: Malaysia. Borneo, Sarawak, no date, *H. Low s.n.* (holotype K!).

Calamus mindorensis Beccari, Philipp. J. Sci. C 2: 235 (1907). Type: Philippines. Mindoro, Balete, Baco River, April 1905, *R. McGregor 309* (holotype K!, isotypes FI!, US!).

Distribution and habitat. Throughout Sulawesi in a variety of habitats, sandy stone and alluvial soils in rain forest, dry coastal forest on volcanic rock, or steep hill slopes mostly in lowland areas. The label of *G. Musser T11* reports that this rattan is seen mostly on slopes of hills and sometimes scattered along stream terraces.

Vernacular name. Bopaloa, Powaloa (Kulawi language), Hoa (Mekongga language), Rotan hoa & Rotan Siumbo (Kolomodale language). People from the mountains call this rattan 'Powaloa' but the low-land people call it 'Tohiti tanange'.

Specimens examined. North Sulawesi: Minahasa, Suaka Alam Batu Angus, Bitung, 50 m, 5 October 1973, *J. Dransfield & J. P. Mogea 3721*, female flower (BO, L, K); *J. Dransfield & J. P. Mogea 3720*, dead male flower (BO, L, K); 70 m, 18 October 1973, *J. Dransfield & J. P. Mogea 3785*, fruiting (BO, L); *J. Dransfield & J. P. Mogea 3781*, male flower (BO, L). Central Sulawesi: Sungei Tolewonu, Kuala Navusu, 400-1,500 feet, 1974-1976, *G. Musser T11*, sterile (K); Mt. Mope, Kulawi, February 1986, 300 m, *Anggana & Yusuf Dali 60*, sterile (K). South East Sulawesi: G. Mekongga, Wolo, Kolaka, Kendari, 11 August 1985, 350 m, *Anggana & Yunus Dali 031*, sterile

(K, BB); Kolomodale, Towi, 4 March 1989, *L. Clayton 20*, sterile (K); Kuala Navusu on adjacent to Gunung Benteng, Tomini Gulf between Parigi and Poso, between August-November 1975, *G. Musser R2*, fruiting (K).

Uses. The label of *Clayton 20* notes that this is an expensive rattan that only grows on fertile alluvial soil.

Notes. *Calamus moseleyanus* is widespread throughout the Philippines (including Palawan), northeastern Borneo (Sabah), and throughout Sulawesi. It has been identified as *Calamus subinermis* H. Wendl. ex Beccari from Sabah, and *Calamus mindorensis* Beccari from the Philippines, but these two names are here regarded as synonyms of *C. moseleyanus*. It is a variable species. Powling (2009) reported that specimens from southeastern Sulawesi, including Buton Island, had pinnae abaxially white indumentose and those from other areas did not.

12. CALAMUS ORNATUS Blume in J. Schultes & J. Schultes, Syst. Veg. 7: 1326 (1830). Lectotype (designated here): Indonesia. Java, without locality, no date, *C. Blume 187* (lectotype L!).

Calamus ornatus var. *celebicus* Beccari Ann. Roy. Bot. Gard. (Calcutta) 11 (Suppl.): 74 (1913). Lectotype (designated here): Indonesia. Celebes, Minahassa near Paku Ure, 10 April 1895, *S. Koorders 18404β* (lectotype BO *n. v.*, isolectotypes FI!, L!).

Distribution and habitat. Throughout Sulawesi in a variety of habitats including secondary and disturbed primary forest on slopes, stream side lowland forest on alluvial soils, flat slightly swampy areas on ultrabasic soils in stunted forest, and lowland rainforest growing on steep hillsides on sandy soils, usually at low elevations.

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).

Specimens examined. North Sulawesi: Bolaang Mongondow, Pindool Lolak, 19 October 1973, 50 m, *J. Dransfield & J. P. Mogea 3811*, dead male inflorescence (BO, L); Toraut, Dumoga Bone National Park, 200 m, 31 April 1984, *J. P. Mogea 5041*, sterile (BO, K, L); 1895, *S. Koorders 18404β*, fruiting (BO), 2 March 1895, *S. Koorders 18394β*, fruiting (BO), *S. Koorders 18390β*, sterile (BO), *S. Koorders 18402β*, sterile (BO), *S. Koorders 18408β*, fruiting (BO); Kolomodale, Towi, 3 March 1989, *L. Clayton 18*, sterile (K); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, *L. Clayton 8*, sterile (K); Toraut, Dumoga Bone National Park, 220 m, 26 March 1985, *E. de Vogel & Vermeulen 6784*, female inflorescence (K). Central Sulawesi: Tinombala, G. Toli-toli, 400 m, 9 March 1985, *Ramlanto & Zaenal Fanani 726*, fruiting (BO); Sopu Valley, 1,000 m, 2 May 1979, *E. F. de Vogel 5172*, female inflorescence (BO, L), 26 April 1979, *E. de Vogel 5054*, dead female inflorescence (BO, L, K); Kulawi, Moa, *Agathis* forest on slope of G Malemo, 22 October 1977, 100 m, *J. P. Mogea 1411*, young fruit (BO, K, L); Sungei Tolewonu, 30 km south of Kuala Navusu, in the mountain, 1974 - 1976, *G. Musser T4*, fruiting (K); Kulawi, Mt. Saluburi, February 1986, 400 m, *Anggana & Yunus Dali 054*, sterile (K, BB); Mt. Nokilalaki, Lore Kalimata Reserve, 1000 m, 24 April 1975, *W. Meijer 9543*, sterile (BO, L); Mt. Nokilalaki, SE of Lake Lindu to Sadaunta, 1,000-1,500 m, 4 May 1975, *W. Meijer 10013*, mature fruiting (L, BO). South Sulawesi: Malili, Kawata, 4 May 1933, 25 m, *A. Hoornstra 5*, sterile (BO); Kabupaten Luwu, between Pantai Pao & Palopo, 14 February 1993, *P. Kramadibrata 033*, male inflorescence (BO). South East Sulawesi: Kendari, Umalaha, Ahuma, 13 October 1978, 150 m, *S. Prawiroatmodjo & Maskuri 1144*, fruiting (BO, K).

Uses. The label of *J. P. Mogea 5041* noted that the cane had a very low price on the market. Ripe fruits of this species are red, edible, and very sour.

13. CALAMUS ORTHOSTACHYUS Furtado, Gard. Bull. Straits Settlem. 8: 244 (1935). Type: Sulawesi, B. Parema, 1,400 m, 27 October 1929, *G. Kjelberg 2649* (holotype S!, isotype BO!).

Distribution and habitat. Central and southeastern Sulawesi on hill slopes of primary forest at 1,067-2,000 m elevation.

Vernacular name. Pai (Kaili dialect).

Specimens examined. Central Sulawesi: Gunung Pada Esa, Lore Utara, Poso, 1471 m, 11 September 2005, *H. Rustiami 446*, fruiting material (BO, K); 1,525 m, *H. Rustiami 448*, fruiting material (BO, K); Mountain Parema, *G. Kjelberg 2649*, fruiting (S); Kulawi, Moa. G. Malemo, *J.P. Mogea 1329*, fruiting (BO, K, L), 18 October 1977, 2000 m, *J. P. Mogea 1330*, male flower (BO, K).

Uses. The label of *H. Rustiami 446* notes that this species is common on Gunung Pada Esa and has a medium quality cane that is used for tying, basket making, and making small handicrafts.

Notes. This species is similar to *C. inops*; see notes

under that species.

14. CALAMUS PEDICELLATUS Becc. ex Heyne, Nutt. Pl. Ned.-Ind.: 381 (1922). Lectotype (designated by Kramadibrata & Dransfield 1992): Indonesia. Sulawesi, Boni, no date, *K. Heyne 2601* (lectotype FI!, isolectotype BO!).

Distribution and habitat. Southern Sulawesi in lowland rainforest at 25-400 m elevation.

Specimens examined. North shore of Lake Matano, Bonemaitu, East of Nuha, 4 July 1979, *E. de Vogel 6088*, female inflorescence (BO, L); Bone, *K. Heyne 2594*, female flower (FI, BO); *K. Heyne 2601*, female flower (BO); Malili, Kawata, 22 April 1933, 25 m, *A. G. Waturandang 4*, female inflorescence (BO). South East Sulawesi: Kolaka, *K. Heyne 2568*, sterile (BO, FI).

Notes. *Calamus pedicellatus* differs from the related *C. inops, C. orthostachyus,* and *C. robinsonianus* by its broader, longer, elliptic pinnae and well-developed neuter flower pedicels.

15. **Calamus posoanus** Rustiami *spec. nov.* — Type: Central Sulawesi, Poso, Lore Utara, Gn. Pada Esa, 11 September 2010, 1,525 m, *Himmah Rustiami, Dewi, M. Amir, Hamzah & Ato 447*, fruiting material (holotype K!, isotype BO!). Fig.1.

Diagnosis. This species can be easily recognized because it is the only species in Sulawesi with vestigial flagellum up to 20 cm long.

Moderately robust, solitary rattan, climbing to 20 m long with sheath to 4 cm in diam., without sheaths to 2 cm in diam.; internodes to about 15 cm long. Leaf sheath armed with needle-like, red to brown spines united at the base, densely arranged, borne in horizontal rows, covered with dense brown indumentum. Leaf sheath mouth armed with similar spines. Knee present, slightly conspicuous, armed as the leaf sheaths. Ocrea present, very conspicuous, forming a tube, 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 covered with 5 tubular bracts. *Leaves* cirrate to 350 cm long including cirrus and petiole; cirrus to 150 cm long armed with 2-4 hooked spines, arranged 5–26 mm apart; petiole to 40 cm long, slightly convex adaxially, convex abaxially, 10 mm wide, 4 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 brown indumentums; rachis armed with scattered solitary hooked grapnel spines arranged 0.6–2.5 cm apart; pinnae about 10 on each side of the rachis, regularly arranged, 1.8–3.6 cm apart; pinnae armed with small brittle spinules along leaf margin; leaflet tips ending with red, stiff bristles; transverse veinlets prominent; basal pinnae 42–45 × 4–6 cm, mid lamina pinnae 35–40 × 3.5–4.8 cm, apical pinnae 18 –20 × 2–2.5 cm. Male and female inflorescences unknown. *Infructescence* ascending, shorter than the leaves, about 120 cm long, with up to 7 partial inflorescences 18–20 cm apart, decreasing in size distally, covered densely with red brown indumentum; prophyll semi-tubular, 18 × 1.8 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with red brown indumentum, not armed; peduncle 15 cm long; partial infructescence to 12 cm long, bearing up to 12 tubular bracts to 2 × 0.5 cm, not armed, covered with red brown indumentum, the 1st up to 12th bract subtending rachillae to 10 cm long, each rachilla bearing distichously arranged bracts to 4 mm long, each bract subtending a scar of dyad of sterile male and a fertile female flower and two prophyllar bracteoles, the first prophyllar bracteole (involucrophore) pedicellate to 2 mm long. Very young fruit to 10 × 8 mm, covered with scales; seed to 5 × 2 mm, seed surface reticulate.

Distribution and habitat. Known only from the type locality in Central Sulawesi on hill slopes in primary forest at 1,525 m elevation.

Vernacular name. Lauro Tali (Kaili Language).

Specimen examined. Central Sulawesi: Poso, Lore Utara, Gn. Pada Esa, 11 September 2010, 1,525 m, *H. Rustiami, Dewi, M. Amir, Hamzah & Ato 447*, fruiting material (BO, K).

Notes. This is the only cirrate species which has a vestigial flagellum to 20 cm long and covered with 5 peduncular bracts. The epithet refers to the original type specimen location.

16. **Calamus sandsii** Rustiami *spec. nov*. — Type: South Sulawesi, Enrekang district, G. Latimojong, 4 November 1969, *M. Sands 367*, fruiting (holotype K!). Fig. 2.

Diagnosis. This species has small habit, only up to 2 m long and the leaflets aggregated.

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 lightly covered with greenish grey indumentum, armed with small spines, scattered, up to 9 mm long and 1 mm wide, some slightly swollen at the base adaxially. Leaf sheath mouth armed with smooth brown bristles, 1–3 mm long, with a pair of distinctive spines at the border of leaf sheath mouth and petiole. Knee present, conspicuous, about 4 mm in height, not armed. Ocrea present, very short. Flagellum absent. *Leaves* cirrate to 1 m long including cirrus and petiole;

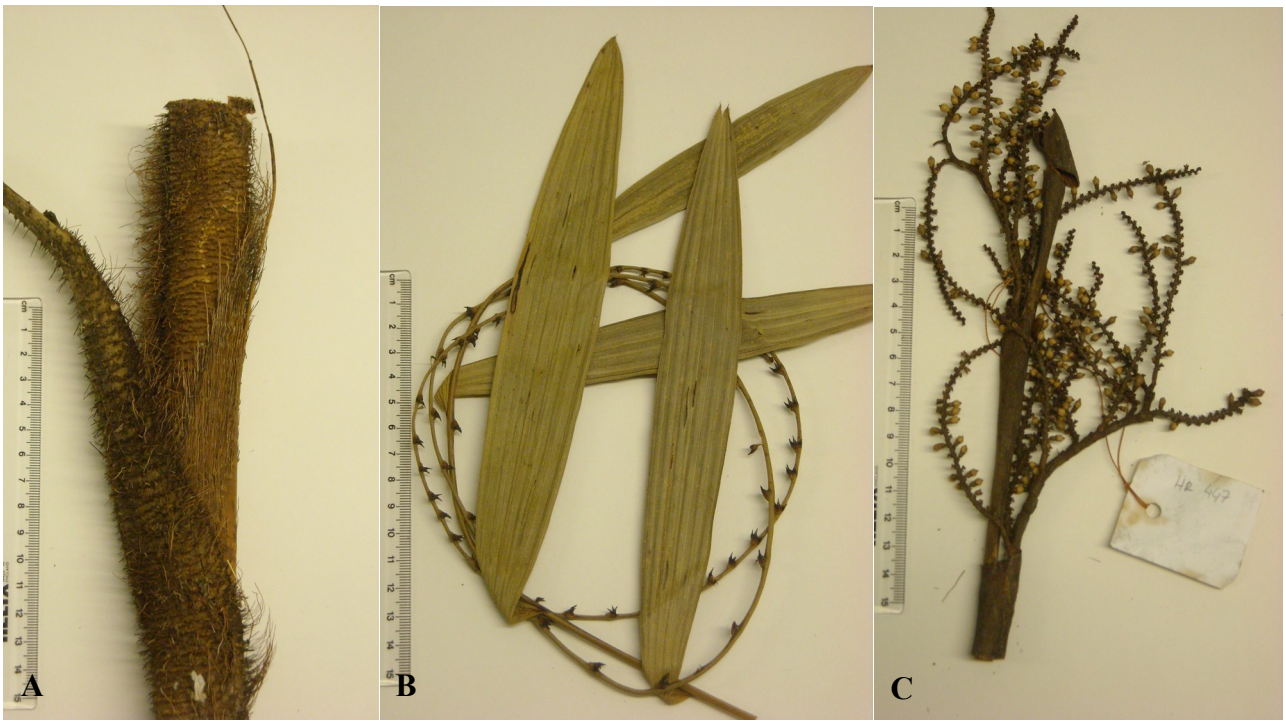

Fig. 1. *Calamus posoanus* Rustiami *spec. nov*. A. Portion of stem with leaf sheath armature; B. Portion of cirrus; C. Portion of infrustescence. From *Rustiami 447 et al.* (BO, K).

cirrus to 50 cm long armed with 1-3 hooked spines, arranged 1–11 mm apart; petiole to 12 cm long, flattened adaxially, convex abaxially, 4 mm wide, 3 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 greenish grey indumentum, rachis armed with yellow, stiff, 1-3 hooked grapnels arranged 1.1–2.9 cm apart; pinnae about 6-8 on each side of the rachis, arranged in pairs, 5–13 cm apart; pinnae armed with very small bristles 1 mm long along leaf margins, covered with very tiny pale green scales adaxially and abaxially; pinna tip prolonged into a needle-like projection; transverse veinlets prominent; basal pinnae 17–19 × 1.5–1.8 cm, mid lamina pinnae 20–25 × 1.6–2 cm, apical pinnae 17.5–18.7 × 1.4–1.8 cm. Male and female 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, densely covered with pale green indumentum; prophyll semi-tubular, 12.7 × 0.4 cm, elliptic in section, 2-keeled with one keel longer than the other, covered with pale green indumentum, armed with short, solitary, slightly hooked spines; 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 × 0.4 cm, not armed, covered with whitish indumentum, 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 with at least some triads or tetrads of 2 female and 1 -2 sterile male flowers and two prophyllar bracteoles, the first prophyllar bracteole (involucrophorum) pedicellate. Fruits to 15 × 5 mm, covered with 8 vertical rows of scales; seed 8 × 5 mm, seed surface reticulate, endosperm homogenous.

Distribution and habitat. Known only from the type locality in South Sulawesi on steep, south-facing slopes of a valley in mixed Oak-*Podocarpus* montane forest at 1,650 m elevation.

Vernacular name. Uhe (Bugis language).

Specimen examined. South Sulawesi, Enrekang district, G. Latimojong, 4 November 1969, *M. Sands 367*, fruiting (K).

Notes. *Calamus sandsii* noted as dwarf rattan only up to 2 m long. It has beautiful paired pinnae and a pair of distinctive spines at the border of leaf sheath mouth and petiole. The epithet to commemorate Dr. Martin Sands, an honorary research associate at Herbarium Kewense who collected this species.

17. CALAMUS SCLERACANTHUS Beccari ex Heyne, Nutt. Pl. Ned.-Ind., ed. 2, 1: 387 (1922). Lectotype (designated here): Indonesia. Celebes, Toli-toli, no date, *K. Heyne 2519* (lectotype FI!, isolectotype BO! BB!).

Distribution and habitat. West-central Sulawesi in lowland or montane rainforest at 700-1,200 m elevation. The labels of *G. Musser T2* and *G.*

Fig. 2. *Calamus sandsii* Rustiami *spec. nov.* A. Portion of stem with leaf sheath armature, whole leaves and infructescence; B. Portion of rachilla, seeds & fruits; C. Leaf sheath armature. From *Sands 367* (K).

Musser M2 report that this species is common on upper slopes and tops of ridges, upper part of low-land evergreen forest, and higher into the lower part of lower montane chestnut forest.

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

Specimens examined. Central Sulawesi: Kulawi, Desa Moa, G. Parawatu, Lore Lindu National Park, 1,100 m, 24 October 1997, *S. Siebert 22*, fruiting material (K), 27 March 1999, 1,200 m, *S. Siebert 29*, fruiting (K); Donggala, Kamarora, foot of Gn. Nokilalaki, 850 m, 18 November 2000, *J. P. Mogea & Andi Tanra Tellu 7441*, sterile (BO, K, L); *J. P. Mogea & Andi Tanra Tellu 7440*, dead male inflorescence (BO, K, L); Kuala Navusu, Sungei Tolewonu, 400-1,500 feet, between 1974-1976, *G. Musser T2*, fruiting (K); Sungei Sadaunta, 4,000 feet, between 1974-1976, *G. Musser M2*, sterile (K); Kulawi, Mt. Petulu, 700 m, February 1986, *Anggana & Yunus Dali 061*, fruiting (K, BB); 900 m, February 1986, *Anggana & Yunus Dali 063*, sterile (K, BB); Kulawi, Moa, Bukit Parawatu, 950 m, 24 June 2001, *Ramadhanil & S. Siebert 501*, male flower (BO, K, L). North Sulawesi: Bolaang Mongondow, Pindool Lolak, 18 October 1973, 100 m, *J. Dransfield & J. P. Mogea 3786*, male flower (BO, L), *J. Dransfield & J. P. Mogea 3780*, female (BO, L). South East Sulawesi: around Opa swamp, west side hills, 20-250 m, *S. Prawiroatmojo & S. Soewoko 1925*, fruiting material (BO, L).

Notes. Rustiami (2011) noted that this species has a good quality of cane that was easily bent.

18. CALAMUS SIPHONOSPATHUS Mart. var. Dransfieldii in Baja-Lapis, Sylvatrop 12: 80 (1987 publ. 1989). Type: Indonesia, North Sulawesi, Minahasa, Suaka Alam Batu Angus, Bitung, 500 m, 7 October 1973, *J. Dransfield & J.P. Mogea 3738*, fruiting (holotype K!, isotypes BO!, L!).

Distribution and habitat. Northeast Sulawesi on steep hill slope primary forest on volcanic soils at 500 m elevation.

Vernacular name. Not recorded.

Specimen examined. North Sulawesi: Minahasa, Suaka Alam Batu Angus, Bitung, 500 m, 7 October 1973, *J. Dransfield & J. P. Mogea 3738*, fruiting (BO, K).

Notes. *Calamus siphonospathus* is widespread in the Philippines; var. *dransfieldii* represents the only record from Sulawesi. It is notable for its densely spiny leaf sheaths with flattened, laciniate spines.

19. CALAMUS SYMPHYSIPUS Martius ex Walpers, *Ann. Bot. Syst.* 487 (1852). Type: Indonesia, Sulawesi, in the strait of Buton, *J. Labillardière s. n.* (holotype FI!, isotype P!).

Distribution and habitat. North, Central, and South Sulawesi on steep slopes and river valleys at 10-550 m elevation.

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).

Specimens examined. North Sulawesi: Bolaang Mongondow, Pindool Lolak, 17 October 1973, 40 m, *J. Dransfield & J. P. Mogea 3769*, flowering (BO), *J. Dransfield & J. P. Mogea 3774*, fruiting (BO, K, L), *J. Dransfield & J. P. Mogea 3775*, sterile (BO, L, K); Toraut, Dumoga Bone National Park, 4 March 1984, 200 m, *J. P. Mogea 5042*, sterile (BO, L); Toraut, Dumoga Bone National Park, 2400 m, July 1998, *J. Walker & A. Cahill DB 321*, sterile (K); Kosinggolan, Kp Urwan road to Matayangan, 29 February 1984, 200 m, *J. P. Mogea 4971*, young fruit (BO, K, L); Boalemo, Ambodu, Menado, 20 July 1930, 400 m, *A Uno 6*, sterile (BO); Near Paku Ure, *S. Koorders 18403β*, sterile (BO, L), *S. Koorders 18412β*, fruiting (BO), *S. Koorders 18411β*, mature fruiting (BO, L); Minahasa, Menado, 50 m, 26 February 1895, *S. Koorders 18409ß*, fruiting (L), *S. Koorders 18412ß*, fruiting (L); *Mas Suharman 51*, sterile (BO); *T. Bisjh 117*, sterile (BO); *Noerkas 485*, sterile (BO); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, *L. Clayton 4*, sterile (K). Central Sulawesi: Donggala, 11 May 1975, *W. Meijer 10085*, sterile (BO, L); Sungei Sadaunta, 2,500-3,600 feet, between 1974-1976, *G. Musser M7*, sterile (K); Kuala Navusu, on adjacent Gunung Benteng, 1,500 feet, August-November 1975, *G. Musser R3*, sterile (K); Kulawi, Saluburi, 450 m, February 1986, *Anggana & Yunus Dali 057*, fruiting (K, BB); Batui River, inland between Batui–Saseba, 15 October 1989, 70-100 m, *M. Coode 5936*, sterile (K). South Sulawesi: SW Peninsula, NE of Makassar, 4 July 1976, *W. Meijer 10808*, sterile (BO, L); Toli-toli, *K. Heyne 2509*, sterile (BO, BB), *K. Heyne 2506*, sterile (BO, BB), *K. Heyne 2582*, sterile (BO, BB), *K. Heyne 2520*, sterile (BO, BB); Masamba, Desa Perchara, Kampung Balaseba, 200 m, 30 December 1983, *S. Siebert R 8*, sterile (K); *R3*, sterile (K). South East Sulawesi: Boni, *K. Heyne 13*, sterile (BO, BB); Wadjo, *K. Heyne 2609*, flowering & fruiting (BO, BB), *K. Heyne 2605*, male flower (BO, BB); Kendari, Kolaka, Wolo, 350 m, 11 August 1985, *Anggana & Yusuf Dali 032*, sterile (K); in the strait of Buton, *J. Labillardière s. n.* (FI, P).

Notes. This species has stilted rooted stems and elegant whorls of leaf sheath spines; the inflorescence is arcuate; and the fruits borne on long pedicels. Apart from Sulawesi, it also occurs in the Philippines (excluding Palawan) and the Moluccas (Mangoli, Sulabes).

20. CALAMUS SUAVEOLENS W. Baker & J. Dransf., Kew Bulletin 59: 69 (2004). Type: North Sulawesi, Bolaang Mongondow, Kotamobagu, Gunung Ambang, October 1973, *J. Dransfield & J.P. Mogea 3858* (holotype K!; isotypes BH *n. v.*, BO!, L!).

Distribution and habitat. North and Central Sulawesi in hill forest and lower montane forest, on steep slopes, at 780-1,350 m.

Vernacular name. Not recorded.

Specimens examined. North Sulawesi: Bolaang Mongondow, Kotamobagu, G. Ambang, October 1973, *J. Dransfield & J. P. Mogea 3855* (BH, BO, K, L); *J. Dransfield & J. P. Mogea 3858* (BH, BO, K, L). Central Sulawesi; Mt Rorokatimbu, West Slope 80 km SSE of Palu, 11 May 1979, *E. de Vogel 5283* (L).

Notes. This species has heavily armed bracts on the primary axis of the inflorescence and a relatively large, heavily armed, persistent ocrea.

21. CALAMUS TOLITOLIENSIS Beccari ex Heyne, Nutt. Pl. Ned.-Ind., ed. 2, 1: 389 (1922). Lectotype (designated here): Indonesia. Celebes, Toli-toli, no date, *K. Heyne 2606* (lectotype FI!, isolectotype BO! BB!).

Distribution and habitat. Northwestern Sulawesi in rainforest, elevation not recorded.

Specimens examined. Central Sulawesi: Tolitoli, no date, *K. Heyne 2606* (FI, BO, BB).

Notes. *Calamus tolitoliensis* is known from only one specimen and its relationships are unclear. In some respects it resembles the Philippine *C. samian* and *C. vidalianus*.

22. CALAMUS USITATUS Blanco, Flora de Filipinas: 265 (1837). Neotype (designated by Dransfield 1982): Philippines. Luzon, Angat, Bulacan, December 1914, *E. Merrill Sp. Blancoanae No. 682* (neotype BM!, isoneotypes A!, CAL!, F!, GH!, MO!, NY!, P!, US!).

Calamus pseudomollis Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11 (Suppl.): 23 (1913). Lectotype (designated here): Indonesia, North East Sulawesi, Minahasa, near Kayuwatu at about 50 m, *S. Koorders 18395β* (holotype BO!, isotype L!).

Distribution and habitat. Northeastern Sulawesi at about 50 m elevation in primary, lowland forest.

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

Specimens examined. North Sulawesi: Minahasa, near Kayuwatu 50 m, *S. Koorders 18395β*, fruiting (BO, L); *S. Koorders 18413β*, fruiting (BO, L).

Notes. *Calamus usitatus* is widespread in the Philippines (including Palawan), and just reaches northeastern Borneo (Sabah), northeastern Sulawesi, and Buru. Specimens from Sulawesi, like those from Buru, have much longer spinules on the adaxial surfaces of the pinnae.

23. CALAMUS ZOLLINGERI Beccari, Ann. Roy. Bot. Gard. (Calcutta) 11(1): 104 (1908). Lectotype (designated here): In sylvis littoralibus Boni, ins. Celebes, November 1847, *H. Zollinger 3433* (lectotype G *n.v.*, G image!, isolectotypes FI!, P!).

Distribution and habitat. Throughout Sulawesi in lowland or montane rainforest at 10-1,434 m elevation.

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 G. Musser expedition), Rotan Merah (Kolaka language).

Specimens examined. North Sulawesi: Bolaang Mongondow, Tapak Kulintang, Dumoga Bone National Park, 220 m, 8 March 1984, *J. P. Mogea 5077*, fruiting (BO, K, L); Toraut, Dumoga Bone National Park, 200 m, 4 March 1984, *J. P. Mogea 5040*, sterile (BO, K); Minahasa, Suaka Alam Batu Angus, Bitung, 75 m, 6 October 1973, *J. Dransfield & J. P. Mogea 3728*, fruiting, (BO), *J. Dransfield & J. P. Mogea 3726*, male flower (BO); Toraut, Dumoga Bone National Park, 2400 m, July 1998, *J. Walker & A. Cahill DB 319*, sterile (K); Menado, Paku Ura, 400 m, 18 April 1895, *S. Koorders 18401β*, female flower (BO); Kolomodale, Towi, 4 March 1989, *L. Clayton 21*, sterile (K); Toraut, Dumoga Bone National Park, 250 m, 16 September 1984, *T. C. Whitmore & K. Sidiyasa 3408*, dead female inflorescence (K); Gorontalo, near Marisa, Illoheleuma, 8 January 1989, *L. Clayton 1*, sterile (K). Central Sulawesi: Kuala Navusu, Sungei Tolewonu, 400-1,500 feet, between 1974-1976, *G. Musser T7*, sterile (K); Kuala Navusu, on adjacent Gunung Benteng, 1,500 feet, August to November 1975, *G. Musser R4*, sterile (K); Gulf Tomini between Parigi and Poso, 1,500 feet, August–November 1975, *G. Musser R8*, sterile (K); Kulawi, Moa, G. Parawatu, Lore Lindu National Park, 950 m, 24 October 1997, *S. Siebert 25*, sterile (K), 1,100 m, 24 October 1997, *S. Siebert 24*, sterile (K), 900 m, 25 March 1999, *S. Siebert 27*, sterile (K), 1,110 m, 24 June 2001, *S. Siebert 502*, female flower (K). South Sulawesi: Malili, Kawata, 25 m, 22 May 1933, *A. Hoornstra 12*, female flower (BO); 25 m, 25 April 1934, *A. Waturandang 41*, fruiting (BO), 4 January 1935, *A. Waturandang 44*, sterile (BO); Mamuju, Kaluku, Sundoang, 100 m, 3 February 1993, *P. Kramadibrata 21B*, sterile (BO); Masamba, Pencahara, Saloseba, 30 December 1983, *S. Siebert R6*, sterile (K). South East Sulawesi: Boni, *K. Heyne 2577*, sterile (BO, BB), *K. Heyne 2576*, sterile (BO, BB), *K. Heyne 2600*, fruiting (BO, BB), *H. Zollinger 3433* (FI, P); Kolaka, *K. Heyne 2570*, sterile (BO, BB), *K. Heyne 2564*, sterile (BO, BB); Bili-bili, *Rahmat 83*, fruiting (BO); Kendari, Kolaka, Wolo, G. Mekongga, 300 m, 12 August 1985, *Anggana & Yunus Dali 035*, sterile (K, BB).

Uses. This is the giant rattan of eastern Indonesia, which is one of the most used and heavily collected rattans and exported for furniture making.

Notes. Siebert (2005) has noted that there are two forms of *Calamus zollingeri* in Central Sulawesi; a lower elevation form from below 1,000 m known as ‘batang’, and a higher elevation form from above 1,100 m known as ‘lelut’. Rattan

collectors considered that 'lelut' had shorter, thicker canes, spinier leaf sheaths, and vegetative rather than sexual reproduction. However, sterile specimens were indistinguishable. It is not known if these two forms represent different taxa. Rustiami (2011) recognized a new species, *Calamus ahlidurii* (based on Edwino Fernando notes on the specimen label), from 1,250 m elevation, and this may represent the upland form. However, Powling (2009) also noted two forms of *C. zollingeri* in Buton occurring sympatrically at low elevations; one with shorter internodes and more closely spaced pinnae ('batang') and one with longer internodes and more widely spaced pinnae ('mombi'). More study throughout Sulawesi is needed to solve this problem.

ACKNOWLEDGEMENTS

The first author expresses her deep gratitude to many individuals and institutions who helped with her work. Dr. Mien A. Rifai from AIPI and Dr. John Dransfield (K) for their advice, wise guidance, attention, patience and valuable discussion during this research study. This work has been possible by the financial support of LIPI, STORMA project through BMZ grant and Bentham Moxon Trust from Kew for herbarium study in Kew and Leiden. She is very much indebted to the staff of the Herbarium Kewense and Herbarium Leiden for helping in various ways, particularly Dr. William Baker, Dr. Lauren Gardiner and Gerard Tisjje for their help and important discussion during her stay in Kew and Leiden. Data gathering was carried out from four herbaria, Herbarium Bogoriense, Herbarium of Forest Research Insitute in Bogor (BB), Herbarium Kewense and the National Herbarium of Netherland. Second author is most grateful for the support rendered at the three institutions especially for having an opportunity to study *Arecaceae* specimen kept at BO, K, and L. He acknowledges the curator and staff of the Herbarium Bogoriense for their help and support on his two visits.

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