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Systematics and biogeography of the rattan *Calamus javensis* complex (Arecaceae, Calamoideae) in Malesia

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Chapter 5

Revision of the rattan *Calamus javensis* Blume Complex (Arecaceae, Calamoideae) in Malesia with notes on all recognisable taxa and forms

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Abstract -- The problem of polymorphism in the *Calamus javensis* complex has been examined by various techniques in several publications. A wide range of morphological variation was identified during these studies. Characters showing high variation were leaf sheath and ocrea morphology, number and arrangement of leaflets, length, and arrangement of the rachillas. All names used in the complex are regarded as synonyms of *C. javensis* except *C. tenompokensis*, which is retained as a distinct species. One variety is here recognized, *C. javensis* var. *polyphyllus* (including *C. acuminatus*). Using morphological characters, we recognized 11 informal (often not monophyletic) forms within *C. javensis* var. *javensis*. Here we present identification keys, descriptions and notes of all recognisable forms, varieties and species included in the *Calamus javensis* complex.

5.1. Introduction

As a large genus, *Calamus* has long been of interest in the world of palm taxonomy. Recently, Henderson (2000) has revised the entire genus, which resulted in 411 phylogenetic species; of these, 38 are recognized as new and eight species as ochlopecies. *Calamus javensis* has been identified as an ochlopecies with 11 species names subsumed in it, namely *C. acuminatus* Becc., *C. amplexans* Becc., *C. amplijugus* J.Dransf., *C. congestiflorus* J.Dransf., *C. corrugatus* Becc., *C. elopurensis* J.Dransf., *C. filiformis* Becc., *C. hypertrichosus* Becc., *C. impar*

Becc., *C. javensis* Blume, and *C. kemamanensis* Furtado. Henderson (2020) treated morphotypes as recognized but not named.

Calamus javensis Blume is a polymorphic species that forms one of the most difficult complex species in Southeast Asian palms (Dransfield, 1999; Henderson, 2020). The species has a wide distribution, ranging from Southern Myanmar, Southern Thailand, and Peninsular Malaysia, throughout Sumatra, Java, and Borneo to Palawan and Luzon in the Philippines. *Calamus javensis* occurs in all major forest types except mangrove, from sea level to about 2000 m altitude and is found on a wide range of soils in tropical rainforest (Dransfield and Manokaran, 1993; Dransfield, 1999; Watanabe and Suzuki, 2007). Rattans prefer soils rich in organic carbon that are not subjected to severe dry conditions and water logging (Pantanello, 2005). However, we observed that some forms of *C. javensis* grew abundantly outside the dense forest in a soil mixed with very fine gravels in Bukit Hampuan and Telupid, Sabah.

All forms in the *C. javensis* complex are defined by the presence of a flagellum, papyraceous leaves, the terminal leaflet pair conspicuously connate, distant partial inflorescences, with rachillae generally diverging at 90 degrees with rather distinctive, closely set rachilla bracts, the whole inflorescence cherry-red at anthesis, and fruits with rather flat, white scales (Dransfield, 1992). Because of a high variation in width of stem, leaf sheath profile and spines, ocrea, leaflet number, shapes, and arrangement, inflorescence structure, and fruit shape and scales, a description is long and with few non-variable characters (see below).

The high variation resulted in the description of various forms as species or infraspecific taxa. A chronological history of names and taxa involved in the *Calamus javensis* complex was presented in Atria et al. (2017). The status of these names is variable and inconsistent as some forms are more obvious and without transitional forms than others. However, a taxonomic revision of the *C. javensis* complex was never completed. Interpretations of species boundaries based on morphological characters alone frequently generated misleading results when only a limited number of samples were used, because discontinuity in a character can disappear once the sampling intensity is increased (Dransfield, 1999).

A series of studies revealed the polymorphic problem in the *C. javensis* species complex. The two most distinctive taxa in Sabah related to *C. javensis* were separated at the specific level, *C. tenompokensis* Furtado and *C. amplijugus*

J. Dransf. The other taxa in this complex appear to intergrade (Dransfield, 1997). But, based on recent work with multivariate (Atria et al., 2017) and molecular analysis (Atria et al., 2020), *C. amplijugus* is part of the *C. javensis* group/clade and not distinctive. Both studies showed that in the complex only two groups of specimens can be distinguished, one is the robust short-stemmed rattan *C. tenompokensis* and the other is the large group of *C. javensis*, which consists of all the other forms and taxa formerly described in the complex. The markers used (*matK* and 5SnrDNA) gave little resolution in the phylogeny reconstruction (Atria et al., 2020), but a few groups in the *C. javensis* complex are phylogenetically and morphologically supported to some degree. More sequences of other markers or complete genomes should be added before a clear picture of the complex can be given.

The multivariate analysis (Atria et al., 2017) also showed *C. acuminatus* Becc. as more or less distinct. Phylogenetically (Atria et al., 2020), this form is less apparent, but the narrow distribution and ecological preferences support the idea to recognise *C. acuminatus* as a distinct entity at the varietal level. Morphologically it cannot be separated from *C. javensis* Blume var. *polyphyllus* (Becc.) Becc. with which it is synonymized here. Notes about *C. acuminatus* will be presented under the description of the latter variety.

Calamus javensis seemingly adapts morphologically very well to local circumstances. This probably also means that local, recognizable forms may arise independently in parallel as several forms have disjunct distributions and/or are present in different clades (Atria et al., 2020). Recognition of the forms in informal groups, as we will do here, likely indicates that the specimens in these groups live under comparable conditions.

The polymorphism may also occur as a result of hybridization. In the Areaceae, hybridization is common in date palm species, *Phoenix* spp. (Coryphoideae) (Pintaud et al., 2010; Gros-Balthazard, 2013; Flowers et al., 2019). The possibility of hybridization may occur in *Calamus javensis* but in our series of studies we did not focus on this nor did the material or results give rise to suspect this. There is no report on hybridization in rattan species so far.

The aim of this paper is to describe the various taxa and informal groups that are morphologically recognisable.

5.2. Materials and Methods

In this study we use the groups described by Atria et al. (2017, 2021) and the recent revision of *Calamus* by Henderson (2020) and the revision of the Aceraceae for Thailand by Barfod and Dransfield (2013). Morphological examinations were conducted on fresh material collected during fieldwork in Brunei, Java, and Sabah, and on herbarium specimens made available by several herbaria: Herbarium Bogoriense (BO), Herbarium Firenze (FI), Royal Botanic Gardens Kew (K), Naturalis Biodiversity Center (L, U), the Sandakan Herbarium (SAN), and the Sarawak Herbarium (SAR) (see Thiers, continuously updated, for herbarium abbreviations).

5.3. Results

Key to the species and varieties in the *Calamus javensis* complex

- 1a. Leaf sheath abundantly covered with horizontal, hairy, black-tipped spines, 1–5 cm long. Flagellum absent or short (rarely longer than 1 m). Petiole and rachis somewhat angular. Leaflets 8 or 9 pairs, opposite, narrowly to broadly elliptic. Inflorescences to c. 1 m long, but some only c. 25 cm long. Staminate calyx tubular, lobes swollen. Pistillate rachillae bracts with a broadly cupuliform limb **2. *C. tenompokensis***
- b. Leaf sheath (smooth to) mostly sparsely (to densely) armed with various spines, spines mostly glabrous (some with hairs along the margin), straight and patent, reflexed upward or downward or mixed in orientation, stout, clawed to solid pointed, mostly with a black tip, 2–7(–15) cm long. Flagellum to c. 150 cm long. Petiole and rachis rounded. Leaflets 2–12 pairs, usually opposite to subopposite (to alternate), mostly lanceolate to ovate, very rarely broad-ovate. Inflorescences up to 1.5 m long. Staminate calyx basally tubular, lobes not swollen. Pistillate rachilla with tightly sheathing bracts **2 (1. *C. javensis*)**
- 2a. Leaflets in 1–6 pairs, rarely to 12 pairs, grouped or more rarely subregular, usually opposite to subopposite, some alternate, mostly lanceolate to ovate, very rarely broadly ovate. Inflorescences up to 1.5 m long, staminate and pistillate ones almost similar. Fruits oblong to some ellipsoid to globose, up

to 10 by 8 mm; pericarp covered with 15–19 vertical rows of scales, yellow to light brown scales with reddish-brown lines, apex mucronate

1a. *C. javensis* var. *javensis*

- b. Leaflets in 9–12 pairs, regularly arranged or sub-equidistant, subopposite to alternate, lanceolate to narrowly elliptic, some elliptic. Staminate inflorescences c. 50 cm long; pistillate ones to c. 140 cm long. Fruits broadly ovoid to globose, 4–6 by 3–4 mm; pericarp covered with 8 vertical rows of scales, yellowish with red tinged acuminate apex

1b. *C. javensis* var. *polyphyllus*

1. *Calamus javensis* Blume

Calamus javensis Blume (1847, p. 62)

Based on the same type: *Palmijuncus javensis* (Blume) Kuntze (1891, p. 733).

Type: Indonesia. Java, *C.L. Blume s.n.* (lectotype: L-0699971!, selected by Henderson (2020, p. 217); isolectotype: P-02147162! [photo image]).

Taxonomic synonyms: *Calamus javensis* var. *firmus* Blume (1847, p. 62). **Type:** not indicated by Henderson (2020, p. 217).

- *Calamus javensis* var. *tetrastichus* Blume (1847, p. 62), basionym of *Calamus tetrastichus* (Blume) Blume (1847, p. 62, tab. 153), based on the same type as *Palmijuncus tetrastichus* (Blume) Kuntze (1891, p. 733). **Type:** Blume, 1847, t. 153 (lectotype, designated by Henderson (2020, 217)).
- *Calamus borneensis* Miq. (1850, p. 4). Based on the same type as *Palmijuncus borneensis* (Miq.) Kuntze (1891, p. 733). **Type:** not indicated.
- *Calamus amplexans* Becc. (1884, p. 78), based on the same type as *Palmijuncus amplexans* (Becc.) Kuntze (1891, p. 733). **Type:** Malaysia. Sarawak, *O. Beccari s.n.* (lectotype: FI- 013529 selected by Henderson (2020, p. 217)).
- *Calamus javensis* var. *peninsularis* Becc. (1892, p. 442). **Type:** Malaysia. Perak, *King's collector 1996* (female) (lectotype: K-000207740!, designated here). Henderson (2020) indicated *Scortechini 236b* (FI) as lectotype, but this collection is not mentioned by Beccari (1892) and cannot serve as lectotype.
- *Calamus javensis* var. *peninsularis* subvar. *intermedius* Becc. (1892, p. 443), basionym for *Calamus javensis* var. *intermedius* (Becc.) Becc. (1902, p. 201). **Type:** Malaysia. Perak, *B. Scortechini 236b* (lectotype: FI-018943*),

- indirectly selected by Henderson (2020, p. 217)). Henderson (2020) regarded the specimen in FI as holotype, but Beccari (1892) did not indicate a holotype, which makes all duplicates syntypes, therefore we consider Henderson's choice as a lectotypification.
- *Calamus javensis* var. *peninsularis* subvar. *penangiana* Becc. (1892, p. 443). *Calamus penicillatus* var. *penangiana* (Becc.) Ridl. (1907, p. 192). Based on the same type of *Calamus javensis* var. *penangiana* (Becc.) Ridl. (1925, p. 51). **Type:** Malaysia. Pulau Penang: Mount Elvira, *C. Curtis s.n.* (lectotype: SING-0186878 (photo image), selected by Henderson (2020, p. 217)).
 - *Calamus javensis* var. *peninsularis* subvar. *purpurascens* Becc. (1892, p. 443). **Type:** Malaysia. Perak, *King's collector 7932* (lectotype CAL, *n.v.*; isoelectotypes: BM, *n.v.*, FI-018947*(photo image), K-000207739!, selected by Henderson (2020, p. 217).
 - *Calamus javensis* var. *peninsularis* subvar. *tenuissimus* Becc. (1892, p. 443). Basionym of *Calamus javensis* var. *tenuissimus* (Becc.) Becc. (1902, p. 201). **Type:** Malaysia. Perak: summit of Gunong Tambang Batok, *Scortechini 648b* (lectotype FI-018949*(photo image), indirectly selected by Henderson (2020, p. 217)). Henderson (2020) regarded the specimen in FI as holotype, but Beccari (1892) did not indicate a holotype, which makes all duplicates syntypes, therefore we consider Henderson's choice as a lectotypification.
 - *Calamus filiformis* Becc. (1902, p. 609). **Type:** Malaysia. Sarawak: Mount Mattang, prop. Kutcing [Kuching], *O. Beccari PB 1909* (holotype: FI-008448).
 - *Calamus corrugatus* Beccari (1902, p. 201). **Type:** Malaysia: Sarawak, *O. Beccari PB 1910* (holotype: FI-008446).
 - *Calamus penicillatus* var. *purpurascens* Ridl. (1907, p. 192). Basionym of *Calamus javensis* var. *purpurascens* (Ridl.) Ridl. (1925, p. 49). **Type:** Malaysia. Perak: Gunong Batu Putih, *L. Wray 981* (lectotype: CAL, *n.v.*, selected by Henderson 2020, p. 217).
 - *Calamus penicillatus* var. *inermis* Ridl. (1907, p. 192). Basionym of *Calamus javensis* var. *inermis* (Ridl.) Ridl. (1925, p. 51). **Type:** Malaysia. Negeri Sembilan: Gunong Angsi, *H.N. Ridley s.n.* (lectotype: SING-0056674, selected by Furtado (1956, p. 176).
 - *Calamus javensis* var. *javensis* subvar. *exilis* Becc. (1908, p. 178). **Type:** Indonesia. Java, *C.G.C. Reinwardt s.n.*, (holotype: M-0199069*[photo image]).

- *Calamus javensis* var. *sublaevis* Becc. (1908, p. 184). **Type:** Malaysia. Sarawak: Kutcing [Kuching], Mt. Mattang, *O. Beccari PB 1694* (holotype: FI-013528).
- *Calamus javensis* var. *acicularis* Becc. (1908, p. 185). **Type:** Malaysia. Sarawak: Mt. Mattang [Matang], *R.W. Hullett 3471* (lectotype: FI-018945* (photo image), indirectly selected by Henderson (2020, p. 217); isolectotype: SING-0192571). Henderson (2020) regarded the specimen in FI as holotype, but Beccari (1908) did not indicate a holotype, which makes all duplicates syntypes, therefore we consider Henderson's choice as a lectotypification.
- *Calamus javensis* var. *tetrastichus* subvar. *mollispinus* Becc. (1913, p. 15). **Type:** Indonesia. Borneo: Sungei Mandai, *J.G.(H.) Hallier 2569* (holotype: BO-0036501; isotype: FI-018948* (photo image)).
- *Calamus hypertrichosus* Becc. (1913, p. 17). **Type:** Indonesia, Borneo: *J.E. Teijsmann HB 16330* ((holotype: BO-0039113!; isotype: iso FI-018946* (photo image)).
- *Calamus impar* Becc. (1913, p. 19). **Type:** Indonesia, Borneo: Sungei Kenepai, *J.G. (H.) Hallier 2033* (holotype: BO-0063384!; isotype: FI, *n.v.*)).
- *Calamus fissijugatus* Burret, (1943, p. 804). **Type:** Indonesia. North Sumatra: Sabang, *B. Krug 145* (holotype: B, destroyed).
- *Calamus kemamanensis* Furtado (1956, p. 170). **Type:** Malaysia. Terengganu: Kemaman, Sungai Nipa, *E.J.H. Corner SFN 30535* (holotype: SING-0056675; isotypes: BH, *n.v.*, K-000207734!).
- *Calamus javensis* var. *laevis* Furtado (1956, p. 177). **Type:** Malaysia. Johore: Sedinak 8, *H.N. Ridley 13518* (holotype: SING-0056830; isotype: BM, *n.v.*).
- *Calamus congestiflorus* J.Dransf. (1982, p. 785). **Type:** Malaysia. Sabah: Nabawan District, mile 46, Nabawan, *J. Dransfield et al. 5635* (holotype: K-000113076!; isotypes: KEP, *n.v.*, L!, SAN, *n.v.*, SAR, *n.v.*).
- *Calamus amplijugus* J.Dransf. (1982, p. 787). **Type:** Malaysia. Sabah: Sandakan District, Lungamis Experimental Plots, *J. Dransfield 5775* (holotype: K-K000112913!; isotypes: L, *n.v.*, SAN, *n.v.*, SAR, *n.v.*).
- *Calamus elopurensis* J.Dransf. (1982, p. 787). **Type:** Malaysia. Sabah: Sandakan, Elopura, Sepilok Forest Reserved, *B. Kadir A 2651* (holotype: K-000113249!; isotypes: KEP, *n.v.*, SAN, *n.v.*, SING, *n.v.*).
- *Calamus equestris* auct. non Willd.: Blume (1830, p. 1330).

(Shrub to) liana, small, clustering, dioecious; stem with leaf sheaths 5–20(–35) mm in diameter, without sheaths to about 8(–10) mm in diameter; internodes to 30 cm long. *Sheaths* light green to dark brown when dry; smooth to distinctly striate; (smooth to) mostly sparsely (to densely) armed with various spines, spines straight and patent, pointing upward or downward or mixed in orientation, flattened triangular, stout, clawed to solid pointed, mostly with a black tip, 2–7(–15) cm long, base almost always swollen, apex usually with a black tip; knee present, sometimes conspicuous; ocrea reddish, quite conspicuous, quickly tattering, rarely persistent. *Flagellum* up to 150 cm long, with groups of 2- or 3-clawed spines. *Leaves* alternate, ecirrate, 35–40(–60) cm long, petiole usually very short, only 2–5 cm long, but occasionally longer, with abundant dark hairs in young plants; rachis sparsely armed with small, curved or clawed spines, sometimes in groups of 2 or 3, rarely smooth, sometimes with some indumentum. *Leaflets* 2–6(–12) on each side of the rachis, grouped or more rarely subregular, usually opposite to subopposite (to alternate), mostly lanceolate to ovate, very rarely broad-ovate, the largest ones up to 29 by 4 cm, with 3 conspicuous parallel main veins; apex acuminate, mostly with spinules, latter sometimes also along the margin; lowermost pair always swept back across the stem, in some forms clasping the stem; median leaflet pairs usually smaller than the other two above, but sometimes the longest pair; adult leaves always with a terminal flabellum formed by 2 apical leaflets joined for $\frac{1}{4}$ – $\frac{3}{4}$ of their length, the latter do not always form the largest leaflets; the pair of leaflets below the flabellum (penultimate) usually very close (0–1 cm distant) to the flabellum, rarely far apart (more than 3 cm), opposite to subopposite, rarely regularly arranged, mostly not grouped. *Inflorescences* up to 1.5 m long, pendulous, staminate and pistillate ones almost similar, staminate ones finer/more slender than pistillate ones, each with 4–8 partial inflorescences, rachillae 4–8 cm long in staminate inflorescences and up to 12 cm long in pistillate inflorescences. *Prophyll* tubular at base, tightly enclosing the rachis, some loosely enclosing with a long distal opening, smooth to more spiny with sparse, small, black tipped spines, curved or tending to be so in the end; peduncular bracts with tubular base, enclosing the rachis but free at the end, with sparse, small, curved spines; rachis bracts enclosing the rachis tightly, some loose and keeled, mostly smooth or prickly with sparse, small, curved spines, rarely densely so. *Staminate rachillae* with bracts, explanate, 1.5–2 mm by c. 1 mm; 1 striated tubular pro-

phyllar bracteole subtending one staminate flower within the axil of the rachilla bract. *Pistillate rachillae* bigger than staminate one, with tightly sheathing rachilla bracts; prophyllar bracteoles tubular with two opposite acute tips, striate, subtending a dyad of a pistillate and a sterile staminate flower, each flower with only c. 1 mm interval on each side and thus appearing crowded. *Staminate flowers*: calyx basally tubular, deeply divided into 3 lobes (lobes not swollen), valvate, free on the top with acute tip; lobes elliptic, c. 1.5 by 1 mm; corolla usually quite far exceeding the calyx, petals oblong, 3–3.5 by 8–10 mm; stamens six, filaments narrow, tapering to the top, 1.5–2 mm long, tip hooked, anthers c. 1.5 mm long, dorsifixed, hanging freely, versatile, opening laterose with longitudinal slit. *Pistillate flowers*: calyx tubular, basally connate, shallowly divided into 3 valvate lobes, latter broadly elliptic, 1–1.8(–2) by 1.3–1.5(–1.8) mm; corolla rarely or slightly exceeding the calyx, petals ovate to elliptic, 2–2.5 by 0.8–1.5 mm, apex acute to acuminate; staminodes 6, epipetalous, the filaments united into a membranous, toothed-ring with empty anthers attached on top; pistil about 2–2.5 mm long, style short, together with stigma only 1–1.5 mm long, with 3 reflexed fleshy stigmas. *Fruits* one-seeded, oblong to somewhat ellipsoid to globose, up to 12–15 by c. 8 mm, mucronate, pericarp covered with 8–15(–19) scales, c. 3 by 1–1.5 mm, yellow to brown, with reddish brown margins. *Seeds* rounded, somewhat angular, 8–11 by 7–10 mm, endosperm homogenous.

Distribution

Southern Myanmar, Peninsular Thailand, Peninsular Malaysia, Singapore, Sumatra, western Java, Borneo, and the Philippines (Palawan & central Luzon).

Habitat & ecology

Calamus javensis ranges from the lowlands to up to 2000(–2600) m altitude and occurs on a wide variety of soils. Flowering: whole year through, but mainly April to August; fruiting: June to November.

Vernacular names

Thailand: Rote batu, Wai ukan, Wai tek (S part). Malay Peninsula: rotan lilin (throughout the peninsula); coonk stook (Perak). Sumatra: Rotan opot (Bengkulu). Java: Howe cacing (Western Java). Borneo: Sabah: Lempinit ular-ular; Kalimantan: Rotan lilin. Philippines: Arorog, Arurug (Palawan).

Uses

People make baskets and musical instruments from the cane, and they use it as binding material, for traps and carrying baskets. The length and strength of the cane itself is excellent and good in quality second to *C. caesius* Blume. The raw cabbage is eaten to cure coughs (Dransfield J. and Manokaran, 1993; Watanabe et al., 2006; Barfod and Dransfield, 2013).

Notes

The type of *Calamus javensis* Blume (1847) was collected on the Halimun-Salak mountain in West Java. However, already at this location, individuals showed variation in leaf blades and leaf sheaths, linked by intermediates. *Calamus javensis* populations found in northern Borneo show most variation, perhaps dependent on the various ecological niches, not only in the leaf sheath spines, leaflets number and arrangement, but also the ocrea, inflorescence rachillae, and some exhibit an erect habit; but individuals with intermediate characters can also be found. The previous studies on morphometry and phylogeny of *C. javensis* (Madulid 1981, Atria et al. 2017, Atria et al. 2020, Henderson 2020) showed that almost all variation (*C. tenompokensis* excepted) is part of one big cluster of specimens, *C. javensis*. The complex species of *C. javensis* have also been discussed in a work of Syam et al. (2016). Their treatment of *C. javensis* differed from our (Atria, 2017), as they regarded all names as part of the *C. flabellatus* Furtado complex (including not only *C. javensis*, but also *C. acuminatus*, *C. amplijugus*, *C. congestiflorus*, *C. corrugatus*, *C. hypertrichosus*, and *C. ruvidus*). The name is incorrect as *C. javensis* is the oldest name. *Calamus javensis* is a polymorphic taxon and consists of several small groups of specimens that show recognizable characters next to the more amorphous mass of most specimens. These recognizable groups are here described as informal taxa (group). As most specimens group under Form *Javensis*, this group will not be keyed out, due to too much overlap; therefore, all specimens that cannot be assigned to any of the Forms are part of Form *Javensis*. Specimens examined for Form *Javensis* are listed in Table 5-1.

Table 5-1. Specimens examined for *Calamus javensis* var *javensis*

Brunei, Mendaram: Atria MAT 108 (BRUN, L); Mendaram, Atria MAT 108 B (BRUN, L); Mendaram, Atria MAT 108 C (BRUN, L); Mendaram, Atria MAT 110 (BRUN, L); Kuala Belalong, Sg. Belalong riverside, Atria MAT 097 (BRUN, L); Sg. Belalong riverside, Atria MAT 100 B (BRUN, L); Sg. Belalong riverside, Atria MAT 100 C (BRUN, L); Temburong, North ridge of Bukit Retak, K.M. Wong WKM 745 (K); Bukit Belalong, south ridge, K.M. Wong WKM 1386 (K); Kuala Belalong, Canopy Trail, Atria MAT 103 A (BRUN, L); Sg. Belalong, Atria MAT 097 (BRUN, L); Kuala Belalong, Ashton trail, Atria MAT 092 (BRUN, L); Kuala Belalong, Ashton trail, Atria MAT 093 (BRUN, L); Kuala Belalong, Ashton trail, Atria MAT 095 (BRUN, L); Kuala Belalong, Ashton trail, M.J.E. Coode 7022 (K). Indonesia, Java: Lotzy s.n. (L); Batavia, Tjimanglit, Buitenzorg, Backhuizen vd brink 6273 (L); Buitenzorg, cultivated, Furtado SFN 30842 (L); West Java, Jasinga, Mt. Gede, Backer 9996 (L); West Java: Mt. Sanggabuana, Backer 23821 (L); West Java, Cibodas, forest fragmen in garden, Dransfield JD 1106 (L); West Java, Sukabumi, Jampang Tengah, Lengkong, Kosterman 23841 (L); West Java, Sukabumi, Jampang Tengah, Lengkong, Dransfield JD 1033 (L); West Java, Mt. Patuha, Junghun 43 (L); West Java, Sukabumi, Ciayunan, Dransfield JD 3086 (L); West Java, Junghun sn (L); West Java, Preanger, Cibodas, Sapiin W 2374 (L); Mt. Halimun NP, Atria MAT 001 (BO, L); Mt. Halimun NP, Atria MAT 002 (BO, L); Mt. Halimun NP, Atria MAT 004 (BO, L); Mt. Halimun NP, Atria MAT 005 (BO, L); Mt. Halimun NP, Atria MAT 007 (BO, L); Mt. Halimun NP, Atria MAT 008 (BO, L); Mt. Halimun NP, Atria MAT 010 (BO, L); Mt. Halimun NP, Atria MAT 011 (BO, L); Mt. Halimun NP, Atria MAT 013 (BO, L); Mt. Halimun NP, Atria MAT 018 (BO, L); Mt. Halimun NP, Atria MAT 021 (BO, L); Mt. Halimun NP, Atria MAT 022 (BO, L); Mt. Halimun NP, Atria MAT 024 (BO, L); South west Java, Ujung Kulon, Mt. Payung, Kostermans s.n. (L); Ujung Kulon, Cijaga watershed, Cijaga Besar Forest, 5 km SE Taman Jaya, Mc Donald & Afriastini 3443 (K); Kalimantan, East Kalimantan, Wanariset Samboja, Ambi & Arifin AA 453 (L); Tabang, Mt. Mendam, Gen Murata, Kunio Iwatsaki, Masahiro Kato, JP Moge B 2612 (L); Kutai, Mt. Mendam, Moge JPM 1620 (L); Balikpapan, Kenayan, Dransfield JD 4375 (L); Berau, Clemens MCS 140 (L); North west Tabang, Mt. Batukenye, J.P. Moge B, Kunio Iwatsuki, Gen Murata,

Masahiro Kato B 1590 (L); Mt. Batukenye, J.P. Mogeia JPM 1591 (L); Kutai, Bantian Besar, Dilang Putih, Van Valkenburg JVV 1320 (L); Wanariset Rintis Wartono Kadri area, Ambri & Arifin W 915 (L); Mt. Kongkat, Masahiro Kato & Harry Wiriadinata B 4943 (L); West Kalimantan, Betung Kerihun NP, Putussibau, Mendalam river bank, Sidiyasa et al. 1953 (L); South Kalimantan, Kab. Tanjung, Muara Uja, Near Mt. Sarempaka, EF de Vogel 1769 (L); Mt. Sarempaka, EF de Vogel 1701 (L); Kalimantan Selatan, J.P. Mogeia, Gen Murata, Masahiro Kato B 1692 (L); South Kalimantan, Banjarmasin, Batang Sengaleng, Mueller s.n. (L); South Kalimantan, Banjarmasin, Batang Sengaleng, Korthals s.n. (L); Borneo, Korthals no 9 (L). Central Kalimantan, Katingan, Bukit Raya, Mendawai area, J.P. Mogeia 3988 (L); Bukit Raya, Tumbang Tapi, Hary Wiriadinata HW 3299 (L); Sumatra, Dransfield JD 3355 (L); East Sumatra, Parbasiran Merbau, Rahmat Si Toroos No 331 (L); East coast Sumatera, Mt. Pangaribuan, Labuan Batu, Rahmat Si Toroos No 4350 (L); Karo, Carel Hamel & Rahmat Si Toroos No 765 (L); Silo Maradja, Asahan, Bartlett 8095 (L); North Sumatera, Sibolangit, Karo Plateu, Kabanjahe, Lorzing 8744 (L); Karo, Kabanjahe, Lorzing 13718 (L); Bohorok, Bkt lawang, Mt. Sinar Alas, Harry Wiriadinata & Mashuri 669 (L); Masihi Forest Reserves, Asahan east coast, BA Krukoff 4181 (L); West coast, Batoe Island, Haap 556 (L); Tanjung Pura, Ulu Besitang, Dransfield JD & D. Saerudin 1830 (L); Southwest Sumatra, Enggano Island, WJ Lutjeharms WJL 4253 (L); West Sumatera, Muro Kulampi, Gunung Putih, Dransfield & J.P. Mogeia JD JPM 3967 (L); Payakumbuh, Mt. Sago, Ladang lawas, W. Meijer No 4038 (L). Aceh Tenggara, Mt Kemiri, J.P. Mogeia 626 (L); Jambi, Sungai Penuh, Tapan km 19, Dransfield & J.P. Mogeia JD & JPM 4075 (L); Sungai Air Hitam, Berbak, peat swamp forest, Dransfield JD 2553 (L); Bengkulu, Kerinci Sebelat, Timothy J Forsyth TJF 29 (L); Bengkulu, Kerinci Sebelat, Kathrin Shreckenbergs KS 19 (L); Bengkulu, Kepahiang km 20, Dransfield JD 3595 (L); Bengkulu, Kepahiang, Pagar Gunung, Dransfield JD 3613 (L); South Sumatra, Palembang, Kebau, Pematang Ulu, Lambach 1328 (L); Palembang, Furtado 30829 (L). Malaysia: Sabah, Tawau, Elmer 21331 (L); Sandakan, Pulau Sapi, Bukit Marango, Dransfield JD 5737 (L); Sandakan, Lungmanis, GHS Wood San A 3990 (L); Sandakan, Fidilis Krispinus SAN 95821 (L); Sandakan, Moore (L); Sandakan, Kabili – Sepilok FR, Atria MAT 030 (SAN, L); Kinabalu, Dransfield JD 5672 (L); Crocker range, Nordin Abas SAN 85981 (L); Kinabalu, Ranau, Dransfield JD 5699 (L);

Kinabalu, Dransfield JD 5673 (L); Kinabalu, Dransfield JD 5672 (L); Kinabalu National Park, Pandanus Trail, Atria MAT 066 (SAN, L); Kinabalu National Park, Pandanus Trail, Atria MAT 067 (SAN, L); Kinabalu National Park, Pandanus Trail, Atria MAT 068 (SAN, L); Kinabalu National Park, Pandanus Trail, Atria MAT 069 (SAN, L); Kinabalu National Park, Pandanus Trail, Atria MAT 070 (SAN, L); Mesilau Nature Center, pathway in front of the HQ, Atria MAT 071 (SAN, L); Mesilau Nature Center, pathway in front of the HQ, Atria MAT 072 (SAN, L); Mesilau Nature Center, pathway in front of the HQ, Atria MAT 073 (SAN, L); Mesilau Nature Center, Nepenthes trail gate, Atria MAT 074 (SAN, L); Mesilau Nature Center, Nepenthes trail gate, Atria MAT 075 (SAN, L); Mesilau Nature Center, Nepenthes trail gate, Atria MAT 076 (SAN, L); Beaufort, Halojilat, Padas river, Cuadra A 3023 (L); Ranau, Sagindai, Dewol S et al. SAN 100151 (L). Keningau, Sepulut FR, Amin & Sigin SAN 69127 (L); Keningau, Crocker Range Nature Center, Atria MAT 078 (SAN, L). Telupid, Sapa Payau FR, Dransfield JD 5811 (L); Telupid, slope of Bukit Tangkunan, Dransfield JD 5783 (L); Mount Tawai, Vermeulen No 869 (L); Tawai FR, Atria MAT 045 (SAN, L); Tawai FR, Atria MAT 047 (SAN, L); Tawai FR, Atria MAT 048 (SAN, L); Tawai FR, Atria MAT 049 (SAN, L); Tawai FR, Atria MAT 050 (SAN, L). Lahad Datu, Pulau Sakar, Aban Sibot SAN 54826 (K); Dumpinit, Balajadia 3755 (K); Ranau, Poring, Bukit hampuan FR, Atria MAT 052 (SAN, L); Ranau, near Mamut Copper Mine, Atria MAT 063 (SAN, L); Ranau, near Mamut Copper Mine, Atria MAT 064 (SAN, L); Ranau, near Mamut Copper Mine, Atria MAT 065 (SAN, L). Sipitang, Mandulang-Maligan, Y.F. Lee & Dewol SAN 69853 (L). Sarawak: Sabal Tapang FR, Dransfield JD 4650 (L); Belaga, Ulu Belaga, Kuala Linau, Rumah Nyauing, Sg. Masoh, Dransfield JD 4706 (L). Kuching, Mt. Matang, Dransfield JD 4728 (L); Mt. Matang, Bernard Lee Meng Hock S 54137 (L); Mt. Matang, Ridley s.n. 2 (K); Lawas, Ulu Trusan, Bukit Tebunan, Bernard Lee S 52424 (L); Kelabit, Bukit Batu Lawi, Bario, Dyg. Awa & Bernard Lee S 50593 (L); Kapit, Balleh, Ulu mengiong, Sg. Entejum, Hj. Othman, Rantai & Jugah S 56410 (K). Malay Peninsula: Ipoh, Kledang Saiong FR, Dransfield JD & N. Manokaran JD 4485 (L); Kedah, Furtado SFN 33053 (L); Johor, NW Johore, Kepong, Mt. Ledang (Mt. Ophir), Whitmore FRI 12330 (L); Perak, Tapah, Kp. Sekam, Ave 218 (L); Tapah, Kp. Sekam, Ave 229 (L); Tapah, Kp. Sekam, Ave No 114 (L); Tapah, Kp. Sekam, Ave 4 (L); Perak, Tapah Hill, Dransfield JD 4519 (L); Northeast Tapah, Kp.

Sekam, Ave 145 (L); Northeast Tapah, Kp. Sekam, Ave 55 (L); Kp. Sekam, Ave 298 (L); Tapah, Kp. Sekam, Ave 216 (L); Tapah, Kp. Sekam, Ave No 218 (L). Pahang, Bentong-Raub boundary, Furtado SFN 33102 (L); Tasek Bera, Rosemarry Gianni A 668 (L). Terengganu, Kuala Trengganu, Ulu Nerus Forest Reserves, Dransfield JD 6506 (L). Singapore: Nee Soon swamp forest, Rajasegar & Adrian Loo 19 (K). Thailand: Nakhon Si Thammarat, T. Smitinand No 637 (L); Nakhon Si Thammarat, T. Smitinand No 841 (L); Pang Nga, Klong Saeng, C. Niyomdham 1254 (L); Pang Nga, Klong Saeng, non-hunting area, N. Niyomdhan 1253 (L); Pattani, Bachao district, AFG Kerr 7186 (L); Kao Kalakari, AFG Kerr 7785 (K); Province Ranong, Laemson NP, Ban Hin substation, A.S. Barford 45253 (K); Trang, Vongkaluang 210 (K); Ranawang (Ranong), AFG Kerr 11753 (L). The Philippines: Palawan, St. Paul's Bay NP, Dransfield, Madulid, Reynoso JD 6176 (L); Lion cave, Madulid F1008 (L).

1b. *Calamus javensis* Blume var. *polyphyllus* (Becc.) Becc.

***Calamus javensis* Blume var. *polyphyllus* (Becc.) Becc. (1902, 201)**

Calamus javensis Blume var. *polyphyllus* (Becc.) Becc. (1902, 201); 1908, 184). Basionym for *Calamus javensis* Blume var. *peninsularis* Becc. subvar. *polyphyllus* Becc. (1892, 443). **Type:** Malaysia, Perak, summit of Gunong Tambang Batak, *B. Scortechini 657b* (lectotype: FI-1018944* [photo image], indirectly indicated by Henderson 2020)). Henderson (2020) indicates that *Scortechini 657b* (FI) is the holotype, but Beccari (1892) mentions two collections that are syntypes, therefore we consider Henderson's choice as a lectotypification.

Calamus acuminatus (1913, 16). **Type:** Malaysia, British North Borneo (= Sabah), Tenom, 700 ft., *L.S. Gibbs 4349* (lecto FI-1014285* [photo image] (indirectly selected by Henderson 2020), iso BM *n.v.*)). Beccari (1913) did not indicate a holotype, therefore all duplicates are syntypes and Henderson's (2020) selection of the FI specimen as holotype is regarded here as a lectotypification.

Clustering rattan. *Stem* to 10 m long, c. 8 mm in diameter with leaf sheath, c. 5 mm in diameter without leaf sheath. *Leaf sheath* striate, mostly smooth or

almost smooth or with few small, clawed spines, or pointing, swollen-based spines, 3–5 mm long. *Ocrea* tubular, persistent, 20–30(–40) mm long. *Knee* conspicuous. *Flagellum* c. 1 m long. *Leaves* ecirrate, 35–40(–58) cm long; petiole very short, less than 2 (sometimes to 16) cm long; rachis with small, clawed, some black-tipped, swollen-based spines. *Leaflets* 9–12 pairs, regularly arranged or subequidistant, subopposite to alternate, lanceolate to narrowly elliptic, some elliptic, 9–15(–24) by 1.5–4 cm, conspicuously 3-nerved, several black-tipped spines along the nerves, transverse veinlets conspicuous, margin with small, soft spines, apex acuminate (to cuspidate), abaxial surface with red soft spines along main vein; uppermost pair joined for 1/3–1/2, forming a flabellum, c. 8(–13–19) by 1–3.5 cm; penultimate pair very close; basal pair smallest, spreading or swept back, 8–10 by 1–1.5 cm. *Staminate inflorescences* c. 50 cm long; prophyll tubular, closely sheathing, up to 27 cm long, prickly or with small, clawed spines; peduncular bracts tubular, sparsely armed with small black, clawed spines; rachis bracts tubular, smooth, 11–16 cm long, closely sheathing, with short longitudinal opening and asymmetrically extended into narrowly elliptic limb, c. 3 mm long, with several small, brown, swollen-based, downward pointing, c. 1 mm long spines, subtending 2 partial inflorescences each with up to 10 rachillae; rachillae 4–8 cm long; rachilla bracts strongly striate, tubular, later slightly cupuliform, with small extended limb; rachilla bracts strongly striate, shortly tubular, later cupuliform or explanate with broadly ovate limb asymmetrically extended into acuminate tip; floral bracteole explanate, shortly tubular with 2 acute tips. *Staminate flowers* c. 2 mm long; inserted at an angle of 45° with the axis; calyx valvate, deeply divided into 3 lobes, lobes broadly elliptic, c. 1.5 by 1 mm, apex acuminate; petals 3, oblong, 1–2.5 by c. 0.5 mm; stamens 6, filaments triangular, flat, tapering, c. 1.5 mm long, anthers hastate, 1–1.5 mm long, versatile to the filament; pistillode with 3 reddish, linear stigmas, c. 1 mm long. *Pistillate inflorescences* to 140 cm long, main inflorescence axis inserted in a conspicuous, swollen-based prophyll; prophyll tubular, c. 19 cm long, closely sheathed, with few small, clawed spines; peduncular bract tubular, closely sheathed, c. 21 cm long, with short, broad limb, sparsely armed with small, clawed spines; rachis bract tubular, c. 17 cm long, with limb expanded to 4 cm long, armed with clawed spines, subtending 3 partial inflorescences; subsequent bracts first tubular, closely sheathing, 12–20 cm, moderately armed with small, brown, downward pointing spines, later with

expanded limb to 6 cm long; rachillae 4–8, 4–8.5 cm long; rachilla bracts striate, tubular, smooth or almost smooth, reddish, closely sheathing, later cupuliform, with one-sided extension into an acuminate tip, 10–20 mm long; rachilla bracts strongly striate, tubular, later cupuliform with extension on one side ending into an acuminate tip, subtending 2 floral bracteoles; cupuliform, subtending a fertile pistillate flower. *Pistillate flowers* seen young, c. 2 mm long; calyx valvate, with 3 ovate lobes, tip acuminate, c. 1.5 by 1 mm; petals three, small, ovate, c. 2 by 1.8 mm long; staminodes thin, connected at the base, filaments short, less than 0.5 mm long, anther empty, sagittate, dorsifixed, yellow, short, c. 0.5 mm long; stigmas 3, reddish, ovate, short, c. 0.5 mm long. *Fruits* broadly ovoid to globose, 4–6 by 3–4 mm, beak c. 1 mm long; scales narrowly elliptic to elliptic, in 8 vertical rows, yellowish with red tinged acuminate tip. *Seed* oblong, c. 30 by 22 mm, to globose, c. 50 by 48 mm; endosperm ruminant.

Distribution

Peninsular Malaysia, Sumatra, Borneo (Brunei, Sarawak, and Sabah).

Habitat & Ecology

Lowland mixed dipterocarp primary forest to rocky hill slopes and ridges, in Sabah often in secondary forests and roadside ‘belukar’ (weedy vegetation of small woody plants) (Dransfield, 1984), up to 1350 m altitude. Flowering: February, May to August, November, December; fruiting: January, February, April, September, November. Seemingly, this taxon can withstand areas affected by pollution as it was abundant in an open area in Mamut Copper Mine (Sabah) (Jopony and Tongkul, 2009; Van der Ent and Edraki, 2016).

Specimens examined

Brunei: Kuala Belalong, *Atria* MAT 103A (L); Temburong, Gunong Retak, *Johns* 6509 (L). Indonesia: Sumatra, Aceh, Gunung Leuser Nature Reserve, *de Wilde & de Wilde-Duyffes* 12847 (L). Malaysia: Kedah, Bukit Seblak-Weng, *Furtado* SFN 33068 (L); Sabah: Kabili-Sepilok, *Atria* MAT 025 (L); Kabili-Sepilok, *Atria* MAT 026 (L); Kabili-Sepilok, *Atria* MAT 027 (L); Kabili-Sepilok, *Atria* MAT 028 (L); Kabili-Sepilok, *Atria* MAT 029 (L); Kabili-Sepilok, *Atria* MAT 030 (L); Kabili-Sepilok, *Atria* MAT 031 (L); Kabili-Sepilok, *Atria* MAT 033 (L); Kabili-Sepilok, *Atria* MAT 034 (L); Kabili-Sepilok, *Atria* MAT 036 (L); Kabili-Sepilok, *Atria*

MAT 037 (L); Kabili-Sepilok, Atria MAT 038 (L); Kabili-Sepilok, Atria MAT 039 (L); Kabili-Sepilok, Atria MAT 056 (L); Kabili-Sepilok, Atria MAT 057 (L); Kabili-Sepilok, Atria MAT 058 (L); Kabili-Sepilok, Atria MAT 059 (L); Kabili-Sepilok, Atria MAT 060 (L); Kabili-Sepilok, Atria MAT 061 (L); Kabili-Sepilok, Atria MAT 062 (L); Ranau, Asin & Jarius SAN 121188 (L); Ranau, Amin & Jarius SAN 116575 (L); Keningau, *Krispinus* SAN 121886 (K, L); Keningau, Ag. Abas SAN 85869 (L); Ulu Tungud FR, Saw et al. SAN 146090 (K); Bukit Tenom, Moore & Meijer 9208 (L); Tambunan, Maikin & Joseph SAN 125852 (K). Keningau, along road Keningau-Kimanis, Vermeulen & Duistermaat 679 (L); Keningau, Kg. Bandukan, Clemens 5982 (K); Mt. Kinabalu, J. & M.S. Clemens 27320 (L); Pensiangan, SAN (*Jimpin*) 139385 (K); Pinangah Tongod, Dewol & Mansur SAN107646 (K, L); Sandakan: Dransfield JD 5584 (L); Kinabatangan, Sundaling SAN 97700 (L); Sarawak: Sematan, Gn. Pueh, Dransfield et al. JD 5992 (L).

Notes

This taxon always has many (9–12) narrow leaflets, regularly arranged, subopposite and with a smooth or almost smooth leaf sheath. The appearance of the leaf sheath and leaflet arrangement is variable, but the most frequent form bears 10 or 11 subequidistant linear leaflets. The inflorescences resemble those of form *javensis* in the var. *javensis*, but those are mostly smaller or finer. The size of the fruit varies. Beccari (1908) stated that *C. acuminatus* is indistinguishable from some *C. javensis* varieties. The first author observed that *C. acuminatus* is similar to Beccari's *C. javensis* var. *polyphyllus* (Beccari, 1908: pl. 40), but *C. acuminatus* has an almost smooth leaf sheath, smaller flowers and fruits and the bracts of the peduncle are more cupuliform. Beccari (1913) considered to treat this entity as a subspecies. However, several specimens with characters partly intermediate can still be recognized. *Mega* MAT 027 (Sabah) was identified as *C. javensis* var. *polyphyllus* as it exhibits the characters of var. *polyphyllus*, but the leaf sheath is almost smooth, like the leaf sheath of *C. acuminatus*. One sample, identified as *C. acuminatus* (Dransfield JD 5584), agrees with *C. acuminatus* in the almost smooth leaf sheath, numerous (9) leaflets and prickly peduncular bracts (in *C. javensis* var. *javensis* a robustly spiny leaf sheath, eight leaflets and spiny peduncular bracts), but the fruits are more ovoid, like *C. javensis* var. *javensis*, and

not spherical as typical *C. acuminatus* (Dransfield 1984). In the phylogenetic analysis (Atria et al., 2020) it groups in group B, not even closely related to the rest of the *C. acuminatus* specimens. Other intermediate specimens have leaflets varying between lanceolate and narrowly elliptic and leaf sheaths ranging from smooth to moderately spiny; the inflorescence can range from fine to the size of typical *C. javensis* var. *javensis*. *J & M.S. Clemens 27320* resembles typical *C. acuminatus*, but with a petiole to 17 cm long (absent in *C. acuminatus*). *Moore & Meijer 9208* has characters like *C. acuminatus*: a smooth leaf sheath, 11 subopposite leaflets, lowest pair swept back, no petiole, but the pistillate inflorescences resemble those of *C. javensis* var. *javensis*. In his description, Beccari (1908) mentioned that the female prophyll of *C. acuminatus* has a very conspicuous axillary callus at the insertion with the stem. However, this character is not typical for *C. acuminatus* as a typical *C. javensis* var. *javensis* specimen from Java (*Kostermans 136*) shows the callus too. As there are no constant differences between both taxa, *Calamus acuminatus* is synonymized with *C. javensis* var. *polyphyllus* and recognized at the variety level. This variety is polyphyletic in the phylogeny (Atria et al. 2020).

Key to Groups

(non-fitting specimens are Form *Javensis*)

1. Stem slender, c. 5–6 mm in diameter with leaf sheath, 2–3 mm in diameter without leaf sheath. Leaf sheath smooth, without spines 2
 —Stem slender to robust, 5–25 mm in diameter with leaf sheath, 2.5–10 mm in diameter without leaf sheath. Leaf sheath with spines 5
2. Leaflets only 1 pair (flabellate) or 2 pairs (upper most pair biggest and flabellate)..... 3
 — Leaflets in 3–9 pairs, uppermost pair flabellate, not the biggest 4
3. Leaflets only 1 pair (2 pairs when juvenile), flabellate, joined for 1/2 of their length, abaxial midrib with few clawed spines group *Kemamanensis*
 — Leaflets in 2 pairs, the uppermost pair largest, forming a flabellum, joined for 3/4 of their length, penultimate pair always sub opposite to alternate, abaxial midrib smooth group *Impar*
4. Leaf sheath with corrugated horizontal lines, mostly connecting and forming a circle. Flagellum thick, 20–30 cm long. Leaf 25–37 cm long, petiole 2–10 cm long, dark indumentum presents on the long petioles; rachis pilose, with

- abundant red hairs. Leaflets in 3–5(–9) pairs, opposite (some subopposite), glabrous; terminal pair joined for 1/4–3/4 of their length, not the biggest pair group *Corrugatus*
- Leaf sheath smooth. Flagellum very fine, c. 50 cm long. Leaf up to 40 cm long; petiole very short, less than 2 cm long, floccose; rachis floccose. Leaflets in 7 pairs, middle pair alternate, both margin and surface tomentose, hairs whitish yellow, swollen-based; terminal pair joined for 3/4 of their length, biggest of all pairs group *Hypertrichosus*
5. Leaflets in 2 or 3 pairs, terminal pair (flabellum) usually very big and the biggest pair 6
- Leaflets in 4–13 pairs, terminal pair (flabellum) may not the biggest pair8
6. Stem very short, to 1.5 m tall. Flagellum absent. Leaflets in 3 pairs, surfaces floccose with yellow hairs, terminal pair much bigger than the other pairs; abaxial main vein floccose, and with small spines till halfway the vein. Pistillate inflorescence c. 20 cm long, all bracts abundantly floccose..... group *Acaulis*
- Stem 2–10 m tall. Flagellum to 1 m long. Leaflets in 2 or 3 pairs, glabrous, terminal pair not always the biggest; abaxial main vein glabrous. Pistillate inflorescences c. 40 cm long, all bracts glabrous (unknown for group *Elopurensis*) 7
7. Stem to 10 m tall. Flagellum up to 1 m long. Ocrea with triangular limb, up to 6 cm long. Leaves 27–50 cm long, petiole 9–15 cm long; Leaflets in 2 or 3 pairs, if 2 pairs then all leaflets in rosette; if in 3 pairs, then penultimate usually opposite; narrowly elliptic to broadly elliptic. Staminate inflorescences more than 1 m long; prophyll c. 28 cm long, closely sheathing, smooth group *Elopurensis*
- Stem 2–3 m tall. Flagellum c. 60 cm long. Ocrea apically truncate, short. Leaves c. 32 cm long, petiole 4–5 cm long. Leaflets in 2 pairs, penultimate pair always subopposite to alternate, narrowly elliptic. Staminate inflorescences very fine or slender, c. 56 cm long; prophyll c. 8 cm long, closely sheathing, but later with extended limb, sparsely armed with small, clawed spines group *Impar*
8. Petiole very short or absent. Leaflets in 6 pairs, narrowly obovate to elliptic.

- Pistillate rachillae short, congested, to only 2.5–5 cm long..form *Congestiflorus*
 — Petiole usually longer, to 28 cm long, if absent or very short then leaflets in
 8–13 pairs. Leaflets 4–13 pairs, narrowly elliptic to broadly elliptic. Pistillate
 rachillae long (more than 5 cm) or not congested (unknown for form *Rubro-
 ochreatus* and form *Setosus*) 9
9. Leaflets abaxially with several setae along the veins, one black long setae
 on the main vein, c. 9 mm long group *Setosus*
 — Leaflets abaxially smooth 10
10. Flagellum and cirrus absent group *Rubro-ochreatus*
 — Flagellum present and cirrus absent or present 11
11. Ochrea absent or poorly developed, glabrous. Pistillate inflorescence long,
 up to 1.8 m long; prophyll to 25 cm long, later extended into an ovate limb,
 c. 4 cm long group *Amplijugus* — Ochrea
 conspicuous, hirsute with stiff hairs or spines, partly torn apart. Pistillate
 inflorescence short, only 16–18 cm long; prophyll to c. 17 cm long, truncate,
 without limb group *Brevipaniculatus*

Informal groups in var. *javensis*

The synonyms pertaining to a group are only mentioned, the full nomenclature is provided under the species.

Group *Acaulis*

Representative specimen: Malaysia. North Borneo: Sarawak, Gunung Murud National Park, 15 September 1982, *Yii Puan Ching S 44664* (K),

Non-climbing rattan. *Stem* very short, to 1.5 m tall; with leaf sheath c. 15 mm in diameter, without leaf sheath c. 10 mm in diameter. *Leaf sheath* abundantly floccose, moderately armed with flat, pointing, horizontal or upward pointing spines, to 15 mm long. *Ochrea* absent. *Knee* absent. *Flagellum* absent. *Leaves* ecirrate, c. 80 cm long; petiole long, c. 35 cm long, abundantly floccose, proximally armed with several flat, pointing spines of up to 5 cm long, then with several small spines; rachis floccose, glabrous or with few horizontal, pointing black-tipped spines, 5–9 mm long. *Leaflets* in 3 pairs, elliptic to broadly elliptic, tip acuminate, hairy, surfaces and margin tomentose with bulbous-based yellow

hairs; conspicuously 3-nerved, transverse veins obvious; terminal pair very big, forming a flabellum, bifid, joined for 2/3, c. 33 by 4 cm, main vein floccose on abaxial part, and with small horizontal, swollen-based spines, only to halfway the vein, c. 1 mm long; penultimate pair close to flabellum, c. 29 by 5.5 cm; basal pair spread, c. 25 by 5 cm, c. 15 cm below penultimate pair. *Staminate inflorescences* and *flowers* unknown. *Pistillate inflorescences* short, c. 20 cm long; all bracts abundantly floccose; prophyll tubular, glabrous, closely sheathing, extended into an elliptic limb of c. 1.5 cm long; peduncular bracts tubular, glabrous or with few short spines, closely sheathing, later with an extended, split limb, c. 2 cm long; rachis bracts tubular, smooth, closely sheathing, later with an auriculiform limb to 6 mm long; rachillae 4–6 cm long; rachilla bracts very shortly tubular, later infundibuliform, with an ovate extension at one side, tip acuminate, c. 2 by 1 mm.; prophyllar bracteoles striate, short tubular, explanate, subtending 2 flowers. *Pistillate flowers* c. 4.5 mm long; calyx valvate, deeply divided into 3 elliptic lobes, lobes c. 2 by 1.5 mm, apex acuminate; petals 3, ovate, c. 4.5 by 1 mm; staminodes 6, thin, filaments triangle, 3 filaments attached to the petals, c. 3.5 mm long, 3 others alternate to the petals, c. 2.5 mm long, connected at the base or half of their length, reddish; anther empty, sagittate, dorsifixed, yellow, c. 1.5 mm long; stigmas 3, curled. *Fruits* seen in young stage only, elliptic, c. 7 by 4 mm, beak to 1.8 mm long, scales c. 1.5 by 1 mm, in 10 vertical rows, light brown, with red line margin and tip. *Seed* unknown.

Distribution

Borneo (Sabah & Sarawak).

Habitat & Ecology

Mixed dipterocarp hill forest and lower montane forest; altitude up to 1300 m.

Specimen examined

Malaysia: Sabah, Sipitang, *Diwol & John et al. SAN 144483* (K, L).

Notes

‘Group *Acaulis*’ was called ‘Form 3’ in Atria et al. (2017). Unfortunately, the specimens did not yield usable DNA sequences and are absent in the phylogeny (Atria et al., 2020).

This entity differs from other specimens in the *C. javensis* complex, because it is stemless, has a peculiar arrangement of the floccose leaflets, and stigmas with a curled tip. Tomentose leaflets are also present in 'group *Hypertrichosus*', but the latter is climbing, has 7 leaflet pairs (3 pairs in this form) with a leaflet arrangement as in typical *C. javensis*.

The two specimens are both pistillate. *SAN 144483* has leaflets without hairs, but there are remnants of hairs.

Group Amplijugus

Based on *Calamus amplijugus* J. Dransf., see nomenclature under species.

Clustering rattan. *Stem* robust, up to 15 m high; 1.5–2.5 cm in diameter with leaf sheath, to 1 cm in diameter without leaf sheath. *Leaf sheath* moderate to densely armed with flat horizontal spines, up to 2.5 cm long. *Ocrea* absent or poorly developed, glabrous. *Knee* conspicuous. *Flagellum* c. 1.5 m long, armed with small, downward pointing, black spines, solitary, not in groups. *Leaves* ecirrate, up to 65 cm long; petiole absent or very short; rachis moderately armed with small but stout, swollen based spines, c. 3 mm long. *Leaflets* in 8–13 pairs, elliptic to broadly elliptic, conspicuously 3-nerved, transverse veins not so obvious, tip acuminate, regularly arranged, opposite to subopposite, abaxially smooth; the terminal pair forming a flabellum, joined for 2/3, 16–25 by 4.5–6 cm, median leaflets usually bigger than other pairs, 17–26 by 5–8 cm, the last 2 pairs amplexicaul, smaller, c. 8 by 2.5 cm. *Staminate inflorescences* and *staminate flowers* unknown. *Pistillate inflorescences* robust, up to 1.8 m long; prophyll tubular to 25 cm long, closely sheathing, later extended into an ovate limb of c. 4 cm, lower part with small clawed spines, upper part glabrous; peduncular bract tubular, closely sheathing, c. 60 cm long, sparsely armed with small clawed spines, upper part with longitudinal opening of 2.5–10 cm long; rachis bracts tubular, armed with small, clawed, black-tipped spines, upper part asymmetrically extended into an acute tip, c. 4 cm long; rachilla very long, up to 25 cm; rachilla bracts first tubular then cupuliform, extended on one side into an acuminate tip, striate, c. 2–3 mm long; floral bracteoles short-cupuliform, extended into 2 acute tips, striate. *Pistillate flowers*: pedicel short, 3–4 mm long; calyx valvate, shallowly divided into 3 broadly ovate lobes of c. 2 by 1.5 mm; petals 3, ovate, c. 2.5 by 1

mm; staminodes thin, 6, filaments valvate, connected at the base, narrowly elliptic lobes; anthers empty; stigmas 3, curled. *Fruit* globose, 5–6 x 5–6 mm, or oblong, c. 5 by 3.5 mm, with beak to 1.5 mm long; scales narrow, c. 3 by 1 mm, tip acute to acuminate, yellow, red or dark red lines along the margin and on the tip. *Seeds* broad elliptic to globose, c. 4–5 by 3 mm; endosperm ruminant.

Distribution

Borneo (Brunei and Sabah, in latter especially abundant in Tawai Forest Reserve in Telupid district).

Habitat & Ecology

In disturbed and primary mixed dipterocarp forest, areas with high relief, on ultrabasic soil and sediments; altitude up to 300 m. Flowering: January and May; fruiting: June to July.

Specimens examined

Brunei: Belait, Teraja FR, *Atria* MAT 109 (L); Teraja FR, *Atria* MAT 109C (L); Labi Mendaram, *Dransfield* JD 6548 (K). Malaysia: Sabah, Telupid, Tawai FR, *Atria* MAT 043 (L); Tawai FR, *Atria* MAT 044 (L); Tawai FR, *Atria* MAT 045 (L); Tawai FR, *Atria* MAT 046 (L); Tawai FR, *Atria* MAT 048 (L); Tawai FR, *Atria* MAT 049 (L); Tawai FR, *Atria* MAT 050 (L); Dengiranuk, *Lugas* 1600 (K); Sandakan, Bukit Silam, *Perumal & Diwol* S. SAN 134344 (K); Kabili-Sepilok, *Puasa* 6712 (K); Kampung Takutan, *Tadong* 320 (K).

Notes

This group can easily be recognized by its many (8–13 pairs) of shiny, broadly elliptic leaflets; a long pistillate rachilla; and narrow fruit scales.

Group *Brevipaniculatus*

Representative specimen: North Borneo, Sabah, Mt. Kinabalu, Mesilau Cave, *Chew & Corner* RSNB 4835 (L).

Clustering rattan. *Stem* to 10 m tall; c. 8 mm in diameter with leaf sheath, up to 6 mm in diameter without leaf sheath. *Leaf sheath* robust with a triangular, flat, hairy margin, covered with spines, the latter swollen-based, mostly pointing but several bent upward, the longest up to 3 cm long. *Ocrea* conspicuous, partly torn apart,

hirsute (covered with long stiff hairs) or spines. *Knee* conspicuous. *Flagellum* 35–60(–100) cm long. *Leaves* ecirrate, c. 56 cm long; petiole c. 5 cm long, armed with a few triangular, c. 11 mm long spines; rachis floccose, sparsely armed with horizontal, flattened spines, 8–10 mm long or clawed spines. *Leaflets* in 4–6 pairs, narrowly elliptic, conspicuously 3-nerved, transverse veins conspicuous, margin with soft spines, apex acuminate with ciliate tip, abaxially smooth; upper most pair forming a flabellum, joined for 1/2, c. 21 by 2.5 cm; penultimate pair largest, c. 25 by 3.5 cm, very close to the flabellum; the lowest pair when 4 pairs of leaflets not swept back across stem or spreading, c. 19 by 3.5 cm, when 6 pairs of leaflets then lowest pair swept back. *Staminate inflorescences* quite long, c. 25 cm long, in young inflorescences all bracts reddish; prophyll tubular, first with few small, clawed spines, later smooth, c. 12.5 cm long, with a narrowly elliptic limb to 4.5 cm long; peduncular bract tubular, closely sheathing, c. 35 cm long, armed with several clawed, swollen-based spines, later with extended elliptic limb to 5 mm long, subtending 5–7 partial inflorescences; rachis bracts tubular, closely sheathing, c. 6 cm long, later with c. 5 cm long limb, armed with dull brownish yellow, downward pointing, swollen-based spines, up to 2 mm long; rachilla to 8 cm long; prophyll bracts smooth, tubular, up to 3 cm long, first closely sheathing then loose, opening longitudinally with acuminate tip; rachilla bracts strongly striate, cupuliform, one side extended into acuminate tip; prophyllar bracteole strongly striate, cupuliform with 2 acute tips, subtending staminate flower. *Staminate flowers* young, inserted at c. 45°, c. 4 mm diameter; calyx valvate, shallowly divided into 2 elliptic lobes of c. 3 by 1.5 mm; petals three, narrowly elliptic, c. 3 by 1 mm; stamens 6, filaments ensiform, brown, c. 2 mm long, anther sagittate, dorsi-versatile, yellow, c. 2 mm long; pistillode with 3 linear, reddish stigmas, c. 1.3 mm long. *Pistillate inflorescences* short, 16–18 cm long; prophyll tubular, c. 17 cm long, closely sheathing, truncate, armed with several small, clawed spines, gradually glabrous distally; peduncular bract c. 22 cm long; rachis bract c. 21 cm long, with an extended limb of 2–3 cm long, narrowly elliptic, apex acute, subtending 2 partial inflorescences, each with 4 or 5 rachillae, all bracts sparsely armed with small, clawed spines; subsequent rachis bracts tubular, closely sheathing, 10–18 cm long, later with c. 2.5 cm long narrowly elliptic limb, armed with small, brown, stout, clawed, swollen-based spines; rachillae up to 9 cm long, in one specimen twisted (*Chew et al. 168*); prophyll bracts smooth, tubular,

closely sheathing, with several small, stout, black-tipped, swollen-based spines; rachilla bracts tubular, later with one side extending into an acuminate tip of c. 2 mm long; floral bracteoles 2, strongly striate. *Pistillate flowers* c. 3 mm long, rather distantly arranged, c. 8 mm apart; calyx shallowly divided into 3 lobes, latter broad-elliptic, c. 2 by 1.5 mm, apex obtuse-acuminate; petals 3, slightly longer than calyx, elliptic, c. 2.5 mm long, apex acute; staminodes 6, united into a ring at the base of the ovary, each with a free, empty anther; stigmas 3, reddish, fleshy; some pistillate flowers longer, up to 8 mm long; calyx like other flowers, but base swollen; petals oblong, c. 6 by 1.5 mm, apex acuminate; staminodes like in smaller flowers, anther hastate, c. 0.5 mm high; stigmas 3, c. 1 mm long, dark spotted, fleshy. *Fruit* ellipsoid, c. 15 by 10 mm, yellowish brown, beak to 2 mm long, scales c. 2 by 1 mm, in 10 vertical rows.

Distribution

Sumatra and Borneo (Sabah).

Habitat & Ecology

In mossy montane heath forest, altitude 1300–1800 m. Fruiting specimens collected in February, April and July.

Specimens examined

Indonesia: West Sumatra, Payakumbuh, Gunung Sago, *Mejia 2019* (K); Central Sumatra, Kerinci, *Aumeeruddy YA 308* (K). Malaysia, Sabah: Mt. Kinabalu, Mesilau Cave, *Chew & Corner RSNB 4835* (L); Mt. Kinabalu, Mesilau river, *Chew & Corner RSNB 7025* (K); Mt. Kinabalu (eastern shoulder), *Chew et al. 168* (K); Ulu Meligan, *Diwol et al. SAN 144475* (K).

Notes

This form was called ‘Form 4’ in Atria et al (2017, 2020). This group is easily recognized by its peculiar rough ocrea texture, which is typically covered either with white setae or hirsute hairs or spines. Typical *C. javensis* almost always has a tubular, smooth, reddish, and glabrous ocrea. Other characters that distinguish this form from typical *C. javensis* are the length of the pistillate inflorescences; which are shorter, up to only 18 cm and which have a twisted rachilla (especially specimen *Chew et al. 168*) and the flowers are rather far apart; while typical *C. javensis*

usually has a longer pistillate inflorescences, up to 1.5 m long, with a straight rachilla and closely arranged flowers. *Chew & Corner RSNB 4835*, selected as representative specimen, has only 4 pairs of leaflets, but other specimens resemble the arrangement of *C. javensis* with 5 or 6 pairs of leaflets. The label of *Chew & Corner RSNB 4835* states that the flowers are purple instead of the typical red of *C. javensis*.

This form differs from ‘group *elopurensis*’, which also has 4 pairs of leaflets, in the staminate inflorescence: the rachilla is longer in ‘group *elopurensis*’ (up to 14 cm versus c. 9 cm), the bracts are much longer in ‘group *elopurensis*’ (up to 16 cm vs c. 3 cm).

A short rachilla in the *C. javensis* complex is also shown by ‘group *congestiflorus*’, but the latter has a short rachilla bearing very congested flowers. The leaflets in ‘group *congestiflorus*’ are obovate to elliptic and not narrowly elliptic as in ‘group *brevipaniculatus*’. Beccari (1908, plate 41) described *C. javensis* var. *acicularis* (belonging to typical *C. javensis*) based on a slender specimen (SING 0192571*, collected by R.H. Hullet in 1890) which also has a short pistillate inflorescence with short rachillae, but the features of the leaf sheath, ocrea and leaflets are different from ‘group *brevipaniculatus*’. In the *acicularis* group of *C. javensis* the leaf sheath is armed with scattered short horizontal spines, ocrea tubular and glabrous, leaflets in two pairs and there is a pair of acicular spines (3–3.5 cm long) inserted between petiole and leaf sheath.

‘Group *brevipaniculatus*’ is apparently confined to higher altitudes between 1300–1800 m and ‘*acicularis* form of Form *javensis*’ was found in lowland of c. 240 m a.s.l.

Group *Congestiflorus*

Based on *Calamus congestiflorus* J.Dransf., see nomenclature under species.

Clustering rattan. *Stem* to 33 m high; c. 6 mm diameter with sheath, c. 4 mm diameter without sheath. *Leaf sheath* slightly striate, with scattered, small, flat, bulbous spines, facing downward. *Ocrea* obvious, first tubular later torn apart, up to 8 mm long. *Knee* conspicuous. *Flagellum* 28–60 cm long. *Leaves* ecirrate, 24–46 cm long; petiole very short or absent; rachis floccose, with several small, black tipped, clawed spines. *Leaflets* in 6 pairs, narrowly obovate to elliptic, acuminate,

tip with soft spines, 3 main nerves and transverse veinlets conspicuous, margin glabrous; uppermost pair joined for c. 1/3, 12–17 by 2–3.5 cm; penultimate pair opposite, c. 1 cm below the terminal one, c. 15 by 3.5 cm; median pair subopposite to alternate, c. 7 cm below the penultimate one, c. 15 by 3 cm; lowest pair swept back across stem, 7–10 by 1.5–2.5 cm. *Staminate inflorescence* and *flowers* not known. *Pistillate inflorescences* short, 27–40 cm long; prophyll tubular, mainly on the proximal part of 10–28 cm long, closely sheathing, with several small, clawed, black tipped spines, limb c. 5 cm long; peduncular bract tubular, closely sheathing, c. 14 cm long, armed with scattered small black-tipped spines, subtending 2 partial inflorescences; bracts much longer or the same length as the partial inflorescence; rachis bracts tubular, closely sheathing, 10–15 cm long, distally armed with a few very small, black, clawed spines, either with a prickly lanceolate limb, up to 13 by 0.5 cm or an oblong limb of c. 3.5 by 1.5 cm; prophyll bracts tubular, closely sheathing, floccose, c. 1.5 mm long or less, some with several short black spines, with c. 4 mm extension limb enclosing the rachilla; rachillae short, congested, 2.5–5 cm long; rachilla bracts very short, only c. 1 mm long, with conspicuous acuminate tip limb; floral bracteoles strongly striate, explanate. *Pistillate flowers* very close together (crowded); calyx valvate, deeply divided into 3 broad elliptic lobes, tip acuminate, sepals c. 2 by 1 mm; petals 3, elliptic, c. 3 by 1.5 mm. staminodes thin, valvate, with 6 small elliptic lobes, c. 0.5 mm long; stigmas 3, curled. *Fruit* in young stage, small, c. 4 mm long; with c. 8 diamond-shaped scales, of c. 2 by 2 mm, yellow, margin white; beak c. 1.5 mm. *Seed* broadly ellipsoid, c. 7 by 5 mm to globose and up to 10 by 8 mm; endosperm ruminant.

Distribution

West Java, Borneo (Sabah and East Kalimantan).

Habitat & Ecology

Flowering: February; fruiting: February, March and November.

Specimens examined

Indonesia: East Kalimantan, Maruwai, *Kessler et al. PK 2688* (L); West Java: Ujung Kulon Reserves, Mt. Pajung, *Kostermans et al. 136* (L). Malaysia, Sabah: Telupid, Sapi Nangoh FR, *Atria MAT 042* (SAN, L); Keningau, Crocker Range Nature Center, *Atria MAT 079* (SAN, L); Crocker Range Nature Center, *Atria*

MAT 080 (SAN, L); Nabawan, *Dransfield JD 5635* (K); Pandewan, Mesopo river, *SAN (Krispinus) 114061* (L); Sandakan, Tawau, *SAN (Sundaling) 105576* (K).

Notes

This group, only represented by a single entry in the phylogeny (Atria et al. 2020), has a disjunct distribution and probably represents parallel, locally developed forms.

The form is easily recognized by its crowded and congested flowers due to the very short rachillae. A few specimens consigned to this group are somewhat intermediate with more typical *javensis*. *SAN 105576* from Tawau (Sabah) has the closest resemblance with the type of *C. congestiflorus*, but it slightly differs in the smaller rachis limb that is oblong instead of lanceolate as in more typical ‘group *congestiflorus*’. *SAN 114061* (Pandewan, Sabah) has a similar rachis limb as in typical ‘group *congestiflorus*’, but the prophyll is longer (c. 40 cm long) versus c. 15 cm in ‘group *congestiflorus*’; and the shape of the leaflets and their arrangement is closer to typical *Calamus javensis* than to ‘group *congestiflorus*’. Included is a specimen from West Java (*Kostermans et al. 136*), because it also has a subtending oblong bract, a short pistillate inflorescence and a congested rachilla of c. 4.5 cm long (versus up to 11 cm in typical *C. javensis*), but that is still longer than the rachilla in the Borneo specimens (only c. 2–2.5 cm).

Group *Corrugatus*

Based on *Calamus corrugatus* Becc., see nomenclature under species.

Slender stem, c. 6 mm in diameter with leaf sheath, c. 2 mm in diameter without leaf sheath. *Leaf sheath* striate, glabrous (without spines), with corrugated horizontal lines, mostly connecting and forming a circle. *Ocrea* conspicuous, tubular, c. 2 cm long, floccose. *Knee* prominent. *Flagellum* 20–30 cm long. *Leaves* ecirrate, about 25–37 cm long; petiole 2–10 cm long, with few, small, clawed spines, dark indumentum present on the long petioles; rachis pilose, with abundant reddish hairs, sparsely armed with small, swollen-based, black-tipped, clawed spines, some in groups of 3. *Flagellum* thick, 20–30 cm long. *Leaflets* in 3–5(–9) pairs, opposite, some subopposite, narrowly elliptic, apex acuminate to caudate, glabrous; terminal pair forming a flabellum, joined for 1/4–3/4, not the biggest

pair, 9–13 by 2–3 cm; penultimate pair 2–4 cm below flabellum, 11–15 by 2–3.5 cm; 2 lower pairs swept back across stem, 7–11 by 2–2.5 cm and the lowest pair 5–7.5 by 0.5–2 cm. *Pistillate flowers* small, c. 3 mm high; calyx valvate, shallowly divided into 3 elliptic lobes, c. 1.5 by 0.8 mm; petals 3, narrowly elliptic, c. 3 by 1 mm; staminodes thin, 6, c. 2.5 mm long, filaments valvate, triangular, anther empty, sagittate, c. 1 mm long; pistil c. 3 mm long, with 3 stigmas, not curved.

Distribution

Borneo (Sarawak, Central Kalimantan).

Habitat & Ecology

In primary mixed, dipterocarp forest, secondary forest and heath forest, on (steep) slopes, soil with clay or sandstone, at low altitudes up to 900 m. Flowering: March.

Specimens examined

Indonesia: Central Kalimantan, Bukit Raya, 24 Nov 1982, *Mogea 3615* (L). Malaysia, Sarawak: Mt. Mattang, 8 Apr 1981, *Dransfield JD 5868* (L); Sabal Tapang, 19 May 1981, *Dransfield JD 6080* (L); Semongoh FR, 9 Jul 1976, *Dransfield JD 4930* (L). Lubuk Antu, 5 Jun 1993, *Dransfield JD 1428* (K); Ulu Temalad, Hose mountain, 27 Mar 1964, *S (Ashton) 19775* (K).

Notes

This group has two unique characters, the corrugated ring-like lines on the sheaths and the complete absence of the spines. However, the arrangement of the leaflets is similar to that of typical *C. javensis*. The corrugate lines are not completely circular in some specimens. A specimen from Central Kalimantan (*Mogea 3615*) has the typical *Calamus javensis* feature of an incomplete corrugate leaf sheath. In the phylogeny (Atria et al. 2020) the three included specimens are para-polyphyletic in not supported clades.

Group Elopurensis

Based on *C. elopurensis* J. Dransf., see nomenclature under species.

Clustering rattan. *Stem* to 10 m tall, c. 5–8(–10) mm in diameter with leaf sheath, up to 2.5–5 mm in diameter without leaf sheath. *Leaf sheath* smooth or striated, moderately armed with small clawed-spines, or spines short triangular bulbous, or

tubular and pointing horizontally, to 5 mm long. *Ocrea* conspicuous, tubular with triangular limb, reddish, up to 6 cm long. *Knee* conspicuous. *Flagellum* to 1 m long. *Leaves* ecirrate, about 27–50 cm long; petiole floccose, sometimes abundantly hairy, c. 9–15 cm long, with short, clawed, swollen based spines, some in groups or with triangular flat spines, c. 3 cm long; rachis abundantly floccose, very short in specimens with only two pairs of leaflets and c. 13 cm long in specimens with three pairs, armed with a few small, stout, clawed, bulbous-based spines. *Leaflets* in 2 or 3 pairs, narrowly elliptic to broadly elliptic, glabrous (also abaxial main veins), conspicuously 3-nerved, transverse veins obvious, margin smooth, apex acuminate with ciliate tip; when in 2 pairs, then penultimate pair forming a rosette with the terminal one, upper most pair forming a big flabellum, joined for 3/4, c. 20–35 by 3–6 cm; penultimate pair c. 13–33 by 3–8 cm, very close to the flabellum; if in 3 pairs, then the flabellum 25–36 by 3–6 cm, penultimate pair usually opposite, narrowly elliptic to broadly elliptic, c. 33 by 6.5 cm, basal pair 8–24 by 2.5–6 cm. *Staminate inflorescences* long, more than 1 m; prophyll tubular, closely sheathing, smooth, c. 28 cm long; peduncular bract tubular, closely sheathing, c. 30 cm long, armed with several clawed, black, bulbous-based spines; rachis bract tubular, c. 20 cm long, with an extended limb of c. 9 cm long, armed with small black, clawed, bulbous based spines, subtending six partial inflorescences; subsequent rachis bracts floccose, tubular, closely sheathing, 13–15 cm long, older ones with a 3–5 cm long limb, armed with dark, downward, swollen based spines, up to 2 mm long; rachilla 8–12 cm long; rachilla bracts strongly striate, infundibuliform, with a 1-sided extension into an acuminate tip; floral bracteole strongly striate, cupuliform with 2 acute tips, subtending staminate flower. *Staminate flowers*, *Pistillate inflorescences* and *flowers* and *fruits unknown*.

Distribution

North Borneo (Sabah).

Habitat & Ecology

Disturbed mixed, lowland dipterocarp forest, recorded from swampy hollows, altitude 50–200 m. Flowering: October.

Specimens examined

Malaysia, Sabah: Kinabatangan, *Andersen & Rasit bin Abdullah 224* (K);

Sandakan, Segaliud Lokan mile 42, Virgin Jungle Reserves, *Dransfield JD 5774* (K); Danum valley, *Dransfield 6265* (L); Ranau, *Sani Sambuling 130* (K).

Notes

This group can easily be distinguished by the rosette of large leaflets and the peculiar rachis bracts with a long-extended limb to 9 cm. It should not be confused with ‘group *Impar*’, which also has few leaflets, but with a much narrower stem (c. 5 mm vs. to 10 mm), and a different staminate rachilla (up to 12 cm in ‘group *Elopurensis*’ vs c. 5 cm in ‘group *Impar*’).

Group *Hypertrichosus*

Based on *C. hypertrichosus* Becc., see nomenclature under species.

Stem slender, c. 6 mm in diameter with leaf sheath. *Leaf sheath* smooth, striate, glabrous. *Ocrea* tubular, conspicuous, truncate. *Flagellum* very fine, c. 50 cm long. *Leaves* up to 40 cm long; petiole very short, less than 2 cm long, floccose (densely covered with dark woolly tufts of hairs); rachis floccose. *Leaflets* in 7 pairs, narrowly elliptic, apex acuminate, both margins and surfaces tomentose with swollen-based, whitish yellow hairs, conspicuously 3-nerved, transverse veinlets not obvious; terminal pair forming a flabellum, joined for 3/4, c. 16 by 3 cm, bigger than all other pairs; penultimate pair c. 2 cm below the flabellum, subopposite to alternate; middle pairs alternate, 11–14 by 2–3.5 cm; 2 lowest pairs swept back across stem, 5–7.5 by 1–3 cm. *Inflorescences, flowers and fruits* unknown.

Distribution

Endemic in Borneo (Sarawak).

Habitat & Ecology

Hill slope in lowland mixed dipterocarp, altitude: c. 25 m.

Specimen examined

Malaysia, Sarawak, Semongoh FR, near Kuching, *Dransfield JD 4637* (K!, L!).

Notes

Beccari (1913) described *C. hypertrichosus* based on a sterile specimen from

Borneo; the type has leaflets in four pairs and a very long petiole (c. 30 cm long). Seemingly the type was a young plant, while the specimen examined is fully grown with leaves with seven pairs of leaflets in an arrangement that resembles typical *C. javensis*. The specimen studied only differs from typical *Calamus javensis* in having the leaflets covered with whitish yellow hairs.

This group was not represented in the phylogenetic analysis (Atria et al., 2020) as the DNA extraction failed.

Group Impar

Based on *C. impar* Becc., see nomenclature under species.

Stem 2–3 m high; c. 5 mm in diameter with leaf sheath, c. 3 mm in diameter without leaf sheath. *Leaf sheath* striate, some floccose, unarmed or sparsely armed with small, black-tipped, swollen-based spines. *Ocrea* conspicuous, closely sheathing, truncate, short. *Flagellum* c. 60 cm long. *Leaves* c. 32 cm long; petiole floccose, 4–5 cm long; smooth or with spines. *Leaflets* in 2 pairs, narrowly elliptic, glabrous (including abaxial vein), the uppermost pair largest, forming a flabellum, joined for c. 3/4, 23–26 by 2–3 cm; penultimate pair always subopposite to alternate, one leaflet 0.5–4 cm below the flabellum, c. 17 by 1.5–2.5 cm. *Staminate inflorescences* very fine or slender, c. 56 cm long; prophyll tubular c. 8 cm long, closely sheathing, later with extended limb, sparsely armed with small, clawed spines; rachis bracts subtending inflorescences 2, 10–12.5 cm long, tubular, distally with an extended limb of 1–1.5 cm long and longitudinally opening, armed with solitary, clawed, black-tipped spines; subtending 3 partial inflorescences; subsequent rachis bracts tubular, closely sheathing, up to 11 cm long, extended limb up to 7 mm long, almost smooth or with few small clawed spines; rachillae c. 5 cm long; rachilla bracts striate, infundibuliform, c. 1 mm long, shorter in mature inflorescences, slightly extended on one side into a conspicuous acuminate tip, bent in some specimens, subtending one prophyllar bracteole, strongly striate, short-cupuliform, with two acute tips. *Staminate flowers* small, attached at 90° to the axis; 4–5 mm long; calyx valvate, tubular, deeply divided into 3 lobes, lobes elliptic, c. 1 by 0.8 mm, apex acute to acuminate; petals slightly longer than calyx, oblong-elliptic, c. 3 by 1 mm, apex acute; stamens 6, dorsi-versatile, filament triangular, tapering, c. 1.5 mm long, anther sagittate, yellow, c. 1.5 mm long; pistillode with 3 red, slightly

falcate stigmas, c. 1.5 mm long. *Pistillate inflorescences* slender, c. 40 cm long; prophyll tubular, c. 17 cm long, smooth, with an extended lanceolate limb of c. 10 mm long; peduncular bracts tubular, closely sheathing, c. 23 cm long, with few small clawed spines on swollen bases; rachis bracts tubular, closely sheathing, c. 20 cm long, with a small limb of c. 8 mm long, subtending 2 rachillae; each rachilla 7–8 cm long, subsequent bracts tubular, more than 9 cm long, with a few brown, downward pointing, swollen-based spines; prophyll bracts tubular, closely sheathing, 2–3 cm long, smooth or with one or two small bulbous-based spines; prophyllar bracteoles striate, first tubular then cupuliform, reddish, 2–3 mm long. *Pistillate flower* unknown. *Fruits* broadly elliptic, c. 8 by 6 mm, with yellow scales, latter in 10 rows, margin, and beak reddish, beak to 7 mm long.

Distribution

Peninsular Thailand, Malay Peninsula (Perak), Borneo (Sabah, East Kalimantan).

Habitat & Ecology

In primary forest, often on steep hills or ridges, locally on ultrabasic soil with loose stones and boulders and thick layer of litter, or on bare rock in full sun; altitude c. 900 m. Flowering: February, April.

Specimens examined

Indonesia: East Kalimantan, Berau, *Watanabe NMW 41* (K); West Java, G. Kendeng, *Dransfield JD 1434* (L). Malaysia, Sabah: Ranau, Mt. Kinabalu, *de Vogel 8695* (L); Kinabalu, *Lugas 14* (K); Ranau, *Meijer SAN 21064* (K, L); Kampung Poring, *Sambuling 115* (K); Kampung Poring, *Sambuling 130* (K); Ranau, *SAN (Amin et al.) 114102* (L); Kinabalu, *Lugas 1626* (K); Perak: Kp. Tapah, *Ave 136* (L). Thailand: Klong Seang, Pangnga, *Niyomdham 1253* (L).

Notes

The description of Beccari (1913) is broadened by adding more variability. Beccari (1913) described *C. impar* as a taxon with a deeply bilobed flabellum, but also observed were specimens with the flabellate pair joined for 2/3rd. The type has the penultimate pair of leaflets alternate, one leaflet growing directly below the flabellum and the other leaflet 4–5 cm further below. In a specimen from Sabah (*SAN 21064*), two forms of penultimate arrangement can be observed, one alternate with one leaflet closely attached to the flabellum and the other rather

distant, but also opposite penultimate pairs in other leaves.

From typical *C. javensis* it differs in the number of leaflets and the arrangement. The penultimate pair in *C. javensis* is almost always opposite and close to the flabellum. Among other forms within the *C. javensis* complex, this taxon resembles ‘group *elopurensis*’ as both have a few pairs of leaflets (two pairs in ‘form *impar*’ and up to three pairs in ‘form *elopurensis*’). The ocrea of ‘group *impar*’ is said to be cylindrical and truncate, however, one specimen from Ranau, Sabah (*Sambuling 130*), has the typical ‘group *impar*’s conspicuous ocrea, closely sheathing, truncate, and short, but the leaflet arrangement resembles ‘group *elopurensis*’. Another specimen from Ranau, Sabah (*SAN 114102*), has two pairs of leaflets, one pair flabellate and the penultimate pair alternate but the upper leaflet not very close to the terminal pair, and it has an ocrea that resembles ‘group *elopurensis*’. However, the size of the leaflets in ‘group *impar*’ is smaller than in ‘group *elopurensis*’ (up to 20 cm versus up to 35 cm long, respectively), moreover, in ‘group *elopurensis*’, the staminate inflorescence, has a conspicuous peduncle bract with a long limb up to 10 cm long, while in ‘group *impar*’ the peduncle bract is tubular, c. 13 cm long, closely sheathing, and with an extended limb to 2.5 cm long. These differences clearly segregate both forms.

Group *Kemamanensis*

Based on *C. kemamanensis* Furtado, see nomenclature under species.

Slender clustering rattan. *Stem* c. 4 m long; c. 6 mm in diameter with leaf sheath, c. 3 mm in diameter without leaf sheath. *Leaf sheath* striate, glabrous. *Ocrea* obvious, tubular, to 1 cm long. *Knee* conspicuous. *Flagellum* c. 75 cm long, with small, clawed spines. *Leaves* ecirrate, 27–35 cm long; petiole floccose, 5–7 cm long, longer in juvenile plant, armed with clawed spines. *Leaflets* narrowly elliptic, in adult plant only 1 pair, flabellate, joined for $\frac{1}{2}$, 26–29 by 4.5–5 cm, apex acute, with setae, conspicuously 3-nerved, transverse veins obvious, abaxial midrib with few clawed spines. *Staminate and Pistillate inflorescence, Flowers and Fruits* unknown.

Distribution

Endemic in Peninsular Malaysia (Trengganu).

Habitat & Ecology

Hill dipterocarp forest, altitude: c. 350 m.

Specimens examined

Malaysia: Kuala Trengganu, Ulu Nerus Forest Reserves, *Dransfield et al. JD 6506* (K); Kemaman, Sungai Nipa, *SFN (Corner) 30535* (K).

Notes

This is the only form with one pair of leaflets in adult plants; Corner's specimen is a juvenile specimen with two pairs of leaflets in a rosette. It is not present in the phylogenetic analysis (Atria et al., 2020) due to a DNA isolation failure.

Group Rubro-ochreatus

Representative specimen: North Borneo: Sarawak, Mt. Mulu National Park, *Dransfield JD 5301* (L).

Clustering rattan. *Stem* up to 3 m tall; c. 15 mm in diameter with sheath, c. 8 mm in diameter without sheath. *Leaf sheath* striate, robustly armed with flat spines, pointing horizontally or upward, some reaching up to 15 mm long. *Ocrea* conspicuous, persistent, to 3.5(–10) cm long, covered with abundant red hairs, torn apart. *Knee* not conspicuous. *Flagellum* absent. *Cirrus* absent. *Leaves* to 60 cm long; petiole up to 25 cm long, with a few, flat, horizontally pointing spines, 6–8 mm long; rachis striate, floccose, with a few pointing, black-tipped spines with swollen base, up to 17 mm long. *Leaflets* in 10 or 11 pairs, very regularly arranged, more or less the same size except for the lowest pair, narrowly elliptic to elliptic, conspicuously 3-nerved, transverse veins distinct, margin smooth, apex acuminate, tip hairy, abaxially smooth; terminal pair joined for 1/2, c. 15 by 2.5 cm, lowest pair swept back across stem, c. 9 by 1.5 cm. *Staminate inflorescences* short, c. 20 cm long; bracts of inflorescence red floccose; prophyll smooth, tubular, closely sheathing, base swollen, c. 7 cm long, with a small elliptic limb; rachis bract tubular, closely sheathing, glabrous, c. 4 cm long, later with an elliptic, c. 3 mm long limb, bearing 2 partial inflorescences; rachilla 3–4 cm long; prophyll bracts tubular, smooth, with 2 or 3 short swollen spines in the first part then smooth, c. 2.5 cm long, with extended broadly ovate limb, c. 3 mm high, enclosing rachilla and the subsequent bracts; floral bracteole warty, striate, shortly

tubular, with one-sided extension into a small acuminate tip, the tip usually bent. *Staminate rachilla* borne on the 2nd branch of the inflorescence. *Staminate flowers* unknown. *Pistillate inflorescences, flowers, and fruits* unknown.

Distribution

Borneo (Sarawak: Mount Mulu).

Habitat & Ecology

Lower montane forest; altitude 1200–1500 m.

Specimen examined

North Borneo: Sarawak, Mt. Mulu National Park, *Dransfield JD 5353* (L).

Notes

This group was called ‘Form 1’ in Atria et al. (2017). Unfortunately, the two specimens did not provide useful DNA and are lacking in the phylogenetic analysis (Atria et al., 2020).

Typical for this taxon are the short staminate inflorescences, the tubular, warty rachilla bracts, the lack of a flagellum and a cirrus. This taxon is clearly different from typical *C. javensis* in the leaves and arrangement of leaflets, leaf sheath features, and all inflorescence bracts. *Calamus tenompokensis* resembles this taxon, but ‘group *rubro-ochreatus*’ differs in the smaller leaflets (c. 15 cm long, *C. tenompokensis* up to 35 cm long), the tubular and warty rachilla bracts (*C. tenompokensis*: explanate and smooth) and the staminate inflorescence borne on the 2nd branch (3rd branch in *C. tenompokensis*). The multivariate analysis by Atria et al (2017) showed that the two specimens of ‘group *rubro-ochreatus*’ are separated far apart, one near the typical *javensis* cluster and the other one is outside this cluster; this indicates that the resemblance that unites them is only in the key characters mentioned.

Group Setosus

Representative specimen: Philippines: Luzon, Pampanga, Mt. Arayat, *Madulid et al. 7172* (L).

Slender rattan. *Stem* c. 8 mm in diameter with leaf sheath, c. 5 mm without sheath. *Leaf sheath* striate, moderately armed with cylindrical, pointing and flat

spines, horizontal or some slightly directed upward. *Ocrea* not so obvious, torn apart, the remnant attached to the petiole. *Knee* conspicuous. *Flagellum* absent. *Leaves* ecirrate, c. 50 cm long; petiole smooth, c. 28 cm long, with horizontal stiff pointing spines of c. 8 mm long; rachis smooth, with several scattered horizontal stiff pointing, black-tipped spines, up to 20 mm long. *Leaflets* in 6 pairs, opposite, grouped, narrowly elliptic, conspicuously 3-nerved, transverse veins distinct, margin with short setae up to the apex, apex acuminate, abaxial parts with few setae along veins and one black long seta on the main vein, to 9 mm long; the terminal pair could not be examined thoroughly, penultimate pair very close to the terminal one, opposite; the 3rd pair c. 7 cm below the penultimate one, close to the 4th pair of 12–14 by 2–2.5 cm; the basal two pairs close to each other, c. 7 cm below the middle pairs; the 5th pair c. 12 by 1 cm, the basal or 6th pair, c. 12 by 2 cm. *Inflorescences, flowers, fruits* unknown.

Distribution

Philippines (Luzon: Pampanga).

Habitat & Ecology

In primary forest; altitude c. 500 m.

Notes

This group was formerly called ‘form 2’ in Atria et al. (2017, 2020).

Typical for this group are the long black setae on the abaxial side of the main veins of the leaf blades, and one long seta on each leaflet, a character not present in other forms within the *C. javensis* complex. The leaflets resemble the arrangement of typical *C. javensis*, but with quite long petioles and peculiar rachis spines. The ocrea of this group is not tubular as it is in typical *javensis*. In Atria et al. (2017) ‘group *setosus*’ was separated from the cluster of typical *javensis*, but as it is only represented by a single specimen with incomplete flower and fruit data, it cannot be described as taxon.

2. *Calamus tenompokensis* Furtado

***Calamus tenompokensis* Furtado (1935, p. 260)**

Calamus tenompokensis Furtado (1935, 260). **Type:** British North Borneo (= Sabah), Mt. Kinabalu, Tenompok, towards Lumu, 5,500 ft., *C. Furtado* (*M.S.*

Clemens 28408) (holotype: SING-0056713* [photo image] over 2 sheets; iso A n.v., BM n.v., BO n.v., G-00039991* [photo image], K-000521383!, NY n.v.).

Calamus nanus Burret, (1943) 818. **Type:** Malaysia, Borneo, Sabah, Mount Kinabalu, Gurulau Spur, *J. & M.S. Clemens 50397* (lectotype: BM-000517233* [photo image], designated by Henderson 2020, the holotype at B destroyed).

Clustering and moderate rattan. *Stem* erect, 2–4 m long; c. 3 cm in diameter with leaf sheath, c. 2 cm in diameter without sheath. *Internodes* short, less than 10 cm long. *Leaf sheath* abundantly covered with triangular, flat, horizontal, margin hairy, black-tipped spines, 1–5 cm long. *Ocrea* conspicuous, to 6 cm long, spiny. *Knee* poorly developed. *Flagellum* absent or short (rarely longer than 1 m). *Leaves* ecirrate, c. 1 m long; petiole angular, 22–37 cm long, with several flat, triangular spines, 1–5 cm long, short-clawed spines towards the distal part; rachis angular, floccose, with a few small, floccose, clawed spines. *Leaflets* in 8 or 9 pairs, regularly arranged, opposite, narrowly to broadly elliptic, conspicuously 3-nerved, transverse veins conspicuous, margin with small, black soft spines (setae), apex acuminate; terminal pair forming a flabellum, joined for 1/2–3/4, 18–23 by 2–6 cm; middle pairs 16–35 by 3–8 cm; lowest pair swept back across stem, 19–28 by 3–6 cm. *Staminate inflorescences* robust, up to 1 m long, but some short, only c. 25 cm long; prophyll short, c. 8 cm long, with longitudinal opening c. 5 cm long, indumentum present, with one or two short spines; peduncular bracts tubular, more than 16 cm long, extended on one side into an elliptic, acute point, c. 6 cm long, with small, black-tipped spines and swollen bases; rachis bracts smooth, tubular, closely sheathing, 15–30 cm long, including the upper part with long splitting limb to c. 5 cm long, subtending 3–5 partial inflorescences; rachillae 6–9, each rachilla 5–12 cm long; rachilla bracts short, (slightly) swollen, cupuliform, some explanate, with a one-sided extension into an acuminate tip, subtending one flower bract; floral bracteole not tubular. *Staminate flowers* alternate, 4–6 mm long; calyx valvate, divided into 3 lobes, tubular, base swollen, elliptic, c. 2 by 1 mm, apex acute; petals 3, oblong, 4–6 by 0.5–1 mm; stamens 6, dorsifixed, c. 5 mm long; filament ensiform, yellowish brown, c. 3.5 mm long; anther sagittate, light yellow, 2–3 mm long; pistillode with 3 reddish, apically slightly falcate, c. 1.5 mm long stigmas. *Pistillate inflorescences* to 80 cm long,

bearing 2 partial inflorescences; prophyll short, c. 7 cm long, smooth or almost smooth, with a longitudinal opening of c. 9 cm; peduncular bracts tubular, at first closely sheathing, later splitting longitudinally into 2 limbs, c. 12 cm long, armed with stout, black-tipped, downward pointed spines on very swollen bases, latter 3–4 mm long, some in groups of 3; secondary bracts tubular, c. 10 cm long, closely sheathing, later split longitudinally, c. 18 cm long, subtending the inflorescence, with sparse, black-tipped spines on swollen bases, with a tendency to become clawed; rachis bracts tubular, closely sheathing, floccose, 6–9 cm long, armed with downward pointing, yellowish spines, these on swollen bases, some in groups of 3, the upper part of the bract with long splitting limb to c. 10 cm long, subtending 2 partial inflorescences; with 5 or 6 rachillae, each rachilla 4–6 cm long; prophyll bracts smooth, 5–6 mm long, at first short-tubular later split into 2 or 3 broadly ovate limbs, 4–8 mm long; rachilla bracts smooth, short, tubular, only c. 1 mm long, cupuliform, with a broad limb enclosing the young flower, two-keeled with acuminate tip, c. 4 mm long, subtending 2 floral bracteoles. *Pistillate flowers* 5–11 mm long; calyx valvate, shallowly divided into 3 lobes, lobes elliptic to broadly elliptic, 2–4 by 1.5–1.8 mm, apex acute to acuminate; petals 3, elliptic, 2–5 by 0.5–3 mm; staminodes 6, thin, adnate to the base of the ovary, with a free, empty anther at the top; pistil with 3 stigmas, c. 1.5 mm long, reddish. *Fruit* unknown.

Distribution

Endemic to Borneo (Brunei, Sabah, Sarawak).

Habitat & Ecology

In swampy places and steep slopes in lower montane forest and on ridges, altitude: 1300–1700 m. Observations in the field showed that the rattan lives in a moist and open areas on hillsides. Flowering: January, August, September.

Specimen examined

Brunei: Temburong, north ridge of Bukit Retak, *Wong WKM 792* (K). Malaysia: Sabah: Tenompok FR, *Atria MAT 053* (L); Tenompok FR, *Atria MAT 054* (L), Tenompok FR, *Atria MAT 055* (L); Mt. Kinabalu, Ulu langanani, *Chew et al. RSNB 1653* (K, L); Mt. Kinabalu, *Chew & Corner RSNB 1892* (L); Mt. Kinabalu, Mesilau river, *Chew & Corner RSNB 4056* (K); Mt. Kinabalu, *Dransfield et al. JD 5707* (L); Mt. Kinabalu, Pinosok, *Dransfield et al. JD 5554* (K). Malaysia:

Sarawak: Lawas, *S (Lee) 52573* (L).

Notes

Calamus tenompokensis can easily be distinguished from other forms within the *C. javensis* complex by its vegetative parts: its angular petiole and rachis, a very different leaf sheath appearance, because of the massive and robust sheath, and the number and arrangement of the leaflets. *Calamus tenompokensis* has eight or nine pairs of large, elliptic leaflets, which are almost always regularly arranged. The staminate inflorescence resembles that of *C. javensis*, but the base of the calyx lobes is swollen. The pistillate inflorescences have rachilla bracts that are different in the broadly cupuliform limb (*Chew & Corner RSNB 1892*).