



Seven New Species of *Areca* (Arecaceae)

CHARLIE D. HEATUBUN^{1,2}

¹Fakultas Kehutanan, Universitas Papua, Jl. Gunung Salju, Amban, Manokwari 98314, Papua Barat, Indonesia

²Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, United Kingdom. E-mail: charlie_deheatboen@yahoo.com

Abstract

Seven species of *Areca* (Arecaceae) are here described as new: *Areca bakeri*, *A. churchii*, *A. dransfieldii*, *A. gurita*, *A. mogeana*, *A. riparia* and *A. triginticollina*. Five of the species are endemic to Borneo, one to Sumatra and one to Cambodia. A discussion of morphological characters, such as habit, leaf structure, inflorescence architecture and floral structure is presented for the species and putative relatives. Distribution, ecology, habitat, uses and conservation status are also discussed.

Key words: Palmae, palms, South-East Asia, taxonomy

Introduction

The palm genus *Areca* Linnaeus (1753: 1189) is distributed from India and South China through Malesia to New Guinea and the Solomon Islands (Dransfield 1984, Dransfield *et al.* 2008), and contains approximately 50 species (Henderson 2009). Since the last revision of the entire genus by Furtado (1933), concepts of generic limits and relationships have been modified and tested phylogenetically (Dransfield 1984, Govaerts & Dransfield 2005, Loo *et al.* 2006, Dransfield *et al.* 2008, Baker *et al.* 2009, 2011), and a number of new species have been described (Heatubun 2008, Henderson *et al.* 2010). A full account of the genus is currently in preparation with the aim of critically assessing Furtado's treatment and the work that has followed it in the light of new materials and data now available.

As a result of recent field trips to Borneo and herbarium visits (K, L, SAR), the author discovered a seven new species, five of which are endemic to Borneo (*Areca bakeri*, *A. churchii*, *A. dransfieldii*, *A. gurita*, *A. mogeana*), whereas *A. triginticollina* and *A. riparia* are known only from Sumatra and Cambodia respectively. For the time being, these new taxa are not placed in an infrageneric classification because the subgenera and sections of Furtado (1933) are currently the subject of a molecular systematic study, which, it is anticipated, will result in the new species being placed within a revised generic classification.

Taxonomic Treatment

Areca bakeri Heatubun, *sp. nov.*

A ceteris speciebus Borneensibus habitu acaule-caespitoso, petiolis longis 100–105 cm, inflorescentia erecta rigida, floribus staminatis distichis, floribus foemineis singulariter dispositis distincta.

Type:—CULTIVATED. Borneo, Sarawak: Cultivated at the Semengoh Forest Arboretum, 22 April 1996, Baker *et al.* 716 (holotype K!, isotypes KEP, SING, SAR!).

Undergrowth palmlet densely clustering with ca. 20 stems in a clump to 1 m in height. Stem subterranean to very short (to 1 cm), ca. 2 cm diam.; internodes very close (0.5–1 cm long), not conspicuous, covered by marcescent leaf sheaths. Leaves 4–6 in crown, litter trapping, pinnate, 140–200 cm long (excluding petiole); sheath tubular, 20–31 cm long and 3–4 cm wide, smooth, not fibrous, yellowish green; crown shaft not well defined, up to 40 cm long and up to 4 cm diam.; petiole 100–105 cm long, channelled adaxially, rounded abaxially; rachis ascending but not arching, with adaxial longitudinal ridge, rounded abaxially; blade with slightly irregularly arranged leaflets, 7–8 leaflets on each side; basal leaflets ca. 52×6.4 –14 cm, with 7–9 folds, sigmoid, the middle leaflets 57 – 59×4.5 –10 cm, with 5–9 folds, slightly sigmoid and the terminal leaflets ca. 42×11 cm, with up to 11 folds, slightly sigmoid, tips pointed except for the terminal leaflets slightly oblique-lobed, papery, discolourous, darker adaxially than abaxially. Inflorescence infrafoliar, erect, bursting out among marcescent sheaths, 20–26 cm long and 4.5–12.5 cm wide, protandrous, branching to 1 order; prophyll elongated, up to 26 cm long, ca. 3 cm wide, two-keeled, leathery, cream, light green near the apex; peduncle 6–10 cm long, pale yellowish green; rachis yellowish green; rachis bracts caducous; rachillae 11–13, 8.5–14 cm long and 3.5–5.6 mm wide, very stiff, stout and straight, slightly swollen and flattened near the base, pale green, elongate. Floral clusters distichous on rachillae, only one complete triad including female flower occurring at the base of each rachilla. Staminate flowers small, sessile, triangular, ca. 6.2×3.1 mm, asymmetric; sepals 3, low; petals 3, triangular, small, striate; stamens 6, small, anthers shorter than the filaments; filaments slender, elongate; pistillode ca. 2.5×1.0 mm, pointed. Pistillate flowers larger than the staminate, triangular, borne on the enlarged basal portion of rachillae, only one flower on each rachillae, buds varying greatly in size depending on stage of development, ca. 17 mm long and 8 mm wide in late anthesis; sepals 3, strongly imbricate, ca. 7×7 mm, triangular, asymmetrical, striate; petals 3, imbricate, triangular, ca. 12.5×6.5 mm, striate; gynoecium ca. 10.5 mm long and 4 mm wide at the base; stigma ca. 8 mm long, pointed with 3 lobes, split 8 mm to the base; style ca. 1.5 mm long; staminodes ca. 6, irregularly dentiform, 0.5 – 1×0.25 – 0.5 mm. Fruits elongate, sickle-shaped, 6.0 – 6.5×1.3 – 1.45 cm (young fruits), beak 1.4–1.5 mm; epicarp smooth, shiny, dark green (young), mature fruits not known. Seed very young; endosperm sparsely ruminant. (Figures 1 & 2).

Distribution:—Only known from very limited collections from Miri (4th) Division of Sarawak in northern Borneo and from a plant cultivated in Semengoh Forest Arboretum near Kuching.

Habitat:—This species grows in primary mixed dipterocarp forest in river valleys at about 42 m above sea level.

Local names:—Not recorded.

Uses:—Traditional uses are not known. However, the palm has potential as an ornamental.

Conservation status:—Critically Endangered (CR B2ab). This palm meets the criteria for the threat category “Critically Endangered” (IUCN 2001) because it is known only from one locality at Ulu Anap, Tatau, Miri, Sarawak and its area of occupancy is estimated to be less than 10 km². In addition, rain forest is highly threatened in general in Sarawak, for example due to logging activities and oil palm plantation, and thus a decline in extent of occurrence, area of occupancy and quality of habitat is inferred. One clump of this palm has been successfully established and fruits in Semengoh Forest Arboretum as part of the *ex situ* conservation program run by Biodiversity Research Centre, Sarawak Forestry Corporation (previously known as Sarawak Forestry Institute).

Etymology:—This new *Areca* is named after Dr. William J. Baker, the Head of Palm Research at the Royal Botanic Gardens, Kew and the collector of the type specimen.

Additional specimens examined:—MALAYSIA. Borneo, Sarawak: Miri (4th) Division, Tatau, Ulu Anap, 22 June 1982, *Mokhtar & Othman S 44726* (K!, L!, KEP, SAN, SAR!). CULTIVATED. Borneo, Sarawak: Semengoh Forest Arboretum, 01° 24.059' N 110° 19.423' E, 31 March 2008, *Heatubun & Kuda 903* (K!, SAR!).



FIGURE 1. *Areca bakeri*. A. Apical portion of leaf. B. Middle portion of leaf. C. Basal portion of leaf and petiole attached to crown shaft. D. Inflorescence attached to stem just below the crown shaft and showing acaulescent habit. E, F. Staminate flower whole and in section. G. Pistillate flower. Scale bar: A, B = 8 cm; C, D = 3 cm; E, F = 2.2 mm; G = 7 mm. A–D from Baker *et al.* 716; E–G from Mokhtar & Othman S 44726. Drawn by Lucy T. Smith.

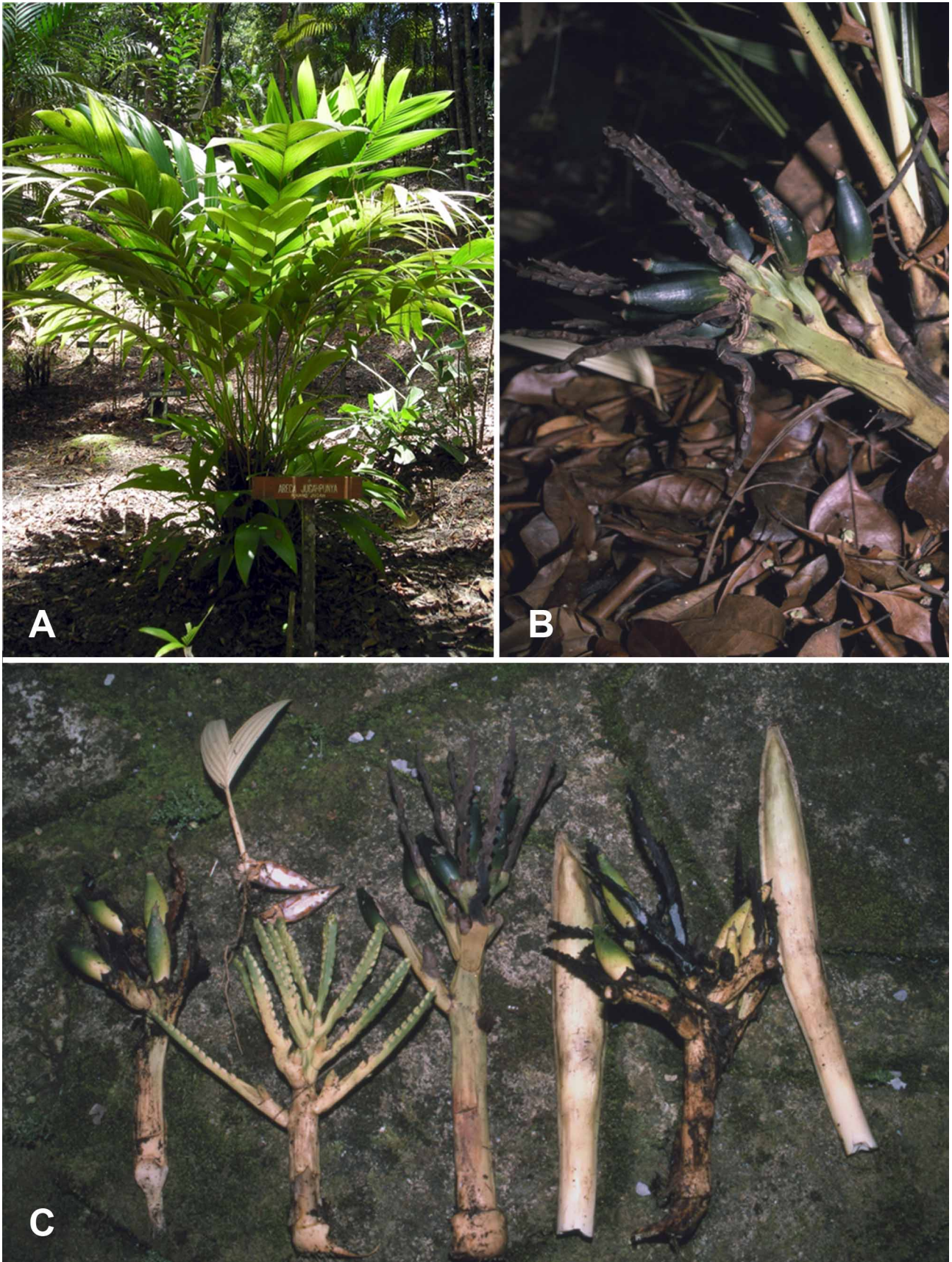


FIGURE 2. *Areca bakeri*. A. Acaulescent habit with densely suckering clump; the palm was mis-identified as *A. jugahpunya*, as shown on the label. B. Inflorescence bursting out from the marcescent leaf sheaths. C. Prophyll, inflorescence, infructescence and seedling. All photos were taken from the specimen cultivated at Semengoh Forest Arboretum near Kuching, Sarawak, Malaysia. Photos: A (Charlie D. Heatubun), B–C (John Dransfield).

Discussion:—*Areca bakeri* is similar to *A. jugahpunya* Dransfield (1984: 13) in its acaulescent, clustering habit and broad leaflets, but can immediately be distinguished by the densely clustering habit with ca. 20 stems in the clump, very long and slender petioles, leaflets more papery and the tips of terminal leaflets slightly obliquely lobed. The inflorescence of *A. bakeri* is more similar to *A. dransfieldii* than to *A. jugahpunya*, especially with its swollen-flattened rachillae and only one pistillate flower on each rachilla. However, *A. bakeri* is easily distinguished from *A. dransfieldii* by its acaulescent litter-trapping habit, leaves with very long petioles (100–105 cm) and broad leaflets, and infrafoliar inflorescences borne among marcescent leaf sheaths with somewhat long peduncles. In contrast, *A. dransfieldii* has conspicuous stems with aerial branching, leaves with long petioles (25–81 cm) and numerous finely-regular leaflets, and infrafoliar inflorescences with short peduncles.

***Areca churchii* Heatubun, sp. nov.**

Palma solitaria, caude gracillimo, inflorescentia fortiter effusa, floribus staminatis spiraliter dispositis, sepalis elongatis, staminibus 11–12, filamentis interdum tortilis et circinatis, floribus foemineis semper singulis in rachillis, 1–2 cm longioribus in rachillis basaliter dispositis, differt.

Type:—INDONESIA. Borneo, West Kalimantan Province: Serawai, Sungai Merah, 2 km to W of camp along Gaharu trail towards Sungai Labang, surrounding ridges and valleys, February 1995, *Church et al. 2083* (holotype K!, isotypes BO!, A).

Solitary, slender, undergrowth palmlet. Stem up to 2 m tall, ca. 2 cm diam.; internodes 1–2 cm long. Leaves ca. 8 leaves in crown, pinnate, 95–115 × 65–90 cm long; sheath tubular, not fibrous, up to 20 cm long, striate; crown shaft well defined, 30–40 cm long, 3 cm diam.; petiole up to 65 cm long, channelled adaxially, rounded abaxially, 5–6 mm wide and 6–7 mm thick; rachis with adaxial longitudinal ridge, rounded abaxially; blade with irregularly arranged leaflets, 5–7 leaflets on each side, 3–11 cm spacing between leaflets, leaflets with 2–7 folds, leaflets near petiole ca. 46.5 × 1.5 cm, slightly sigmoid and tip oblique-lobed, middle leaflets 47–51 × 5–5.5 cm, and terminal leaflets about 33 × 7 cm, tips bifid with lobes 0.5–2 cm depth, papery, dark adaxially and pale abaxially when dried. Inflorescence infrafoliar, erect, 20–25 × 14–24 cm at anthesis, protandrous, branching to 1 order; peduncle 2–2.2 cm long, prophyll not seen; rachis pale yellow at the base and peach-coloured towards the apex and light brown when dried; rachis bracts caducous; rachillae 13–17, 12–20 cm long, slender, spreading, covered by minute light brown to chocolate-brown indumentum, elongate, sinuous to slightly zigzag in appearance. Floral clusters spirally arranged on the rachillae, only one complete triad including a female flower occurring near the base of each rachilla. Staminate flowers relatively large, triangular, elongate, 8.5–10 × 2–2.5 mm, asymmetric, sessile; calyx cup-shaped, 1.5–2.3 mm wide and 2 mm high, 3-lobed, the lobes ca. 1.25 × 0.5 mm; petals 3, valvate, elliptic to slightly spatulate, ca. 7.7 mm long and 1.8 mm wide at anthesis, connate at the base, cream-coloured; pistillode lacking; stamens 11–12, 5–6.5 mm long, elongate, basifixed; anthers 2.5–3.5 mm long and 0.3 mm wide after anthesis, cream-coloured; filaments 2–3.5 mm long and 0.2 mm wide, dark brown, sometimes twisted and coiled, free near corolla and connate at the centre. Pistillate flowers larger than the staminate, triangular, 11.8–15 × 6.7–7.1 mm, only one flower on each rachilla, positioned 1–2 cm from the base of rachilla; sepals 3, imbricate, triangular, striate, 7–9 mm long and 6 mm wide at anthesis; petals 3, imbricate, triangular, striate, ca. 10 × 5 mm; gynoecium 13 × 4 mm at anthesis, tubular shaped; stigma trifid, 4 × 4 mm; style 9 mm long, 4 mm wide; staminodes lacking. Fruits very young, dull green and yellow at the base, mature fruits not seen. (Figure 3).

Distribution:—Only known from the type of locality in Sungai Merah, Serawai, West Kalimantan Province of Indonesia.

Habitat:—This species grows on hill slopes above the perennial stream of Sungai Labang in Dipterocarp forest in association with *Shorea*, *Dipterocarpus*, species of *Lauraceae* and *Sapotaceae*.

Local name and uses:—Not recorded.

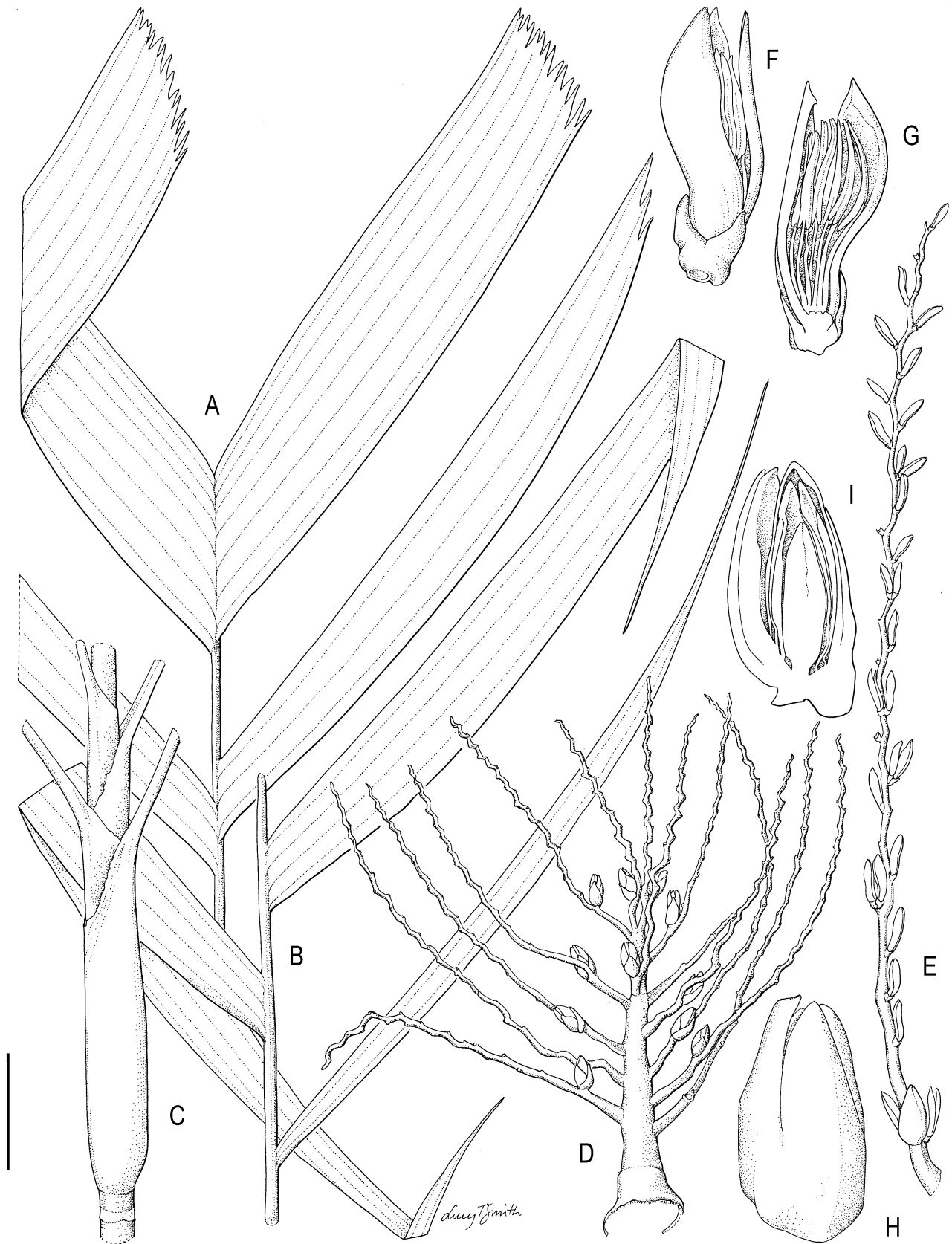


FIGURE 3. *Areca churchii*. A. Apical portion of leaf. B. Middle and basal portion of leaf. C. Petiole, leaf sheath and crown shaft. D. Inflorescence with pistillate flowers still attached. E. Detail portion of rachilla showing staminate and pistillate flowers in bud. F, G. Staminate flower whole and in section. H, I. Pistillate flower whole and in section. Scale bar: A–C = 6 cm; D = 4 cm; E = 2 cm; F, G = 3 mm; H, I = 5 mm. A–E, H from *Mogea* 3452; F–G from *Dransfield* JD 7531; I from *Heatubun* 901. Drawn by Lucy T. Smith.

Conservation status:—Critically Endangered (CR B2ab). This palm meets the criteria for the threat category “Critically Endangered” (IUCN 2001) because it is known only from one locality in Sungai Merah area in Serawai, Indonesian Province of West Kalimantan, Borneo and its area of occupancy is estimated to be less than 10 km². The area in which this palm grows faces major threats such as forest burning, land clearing for oil palm plantation and resettlement, logging and mining activities, and thus a decline in extent of occurrence, area of occupancy and quality of habitat is inferred.

Etymology:—The specific epithet of this species honours the collector of the type specimen, A. C. Church from Harvard University, USA.

Discussion:—*Areca churchii* is similar to a number of other miniature *Areca* species, namely *A. abdulrahmanii* Dransfield (1980: 33), *A. andersonii* Dransfield (1984: 6), *A. klingkangensis* Dransfield (1984: 13) and *A. mogeana* in its slender-solitary habit and pinnate leaves in general, although there are still some distinctions in leaf segmentation and texture. Primarily, they differ in the inflorescence and flower structure, including number of stamens. *Areca churchii* has an inflorescence with 13–17 long-slender sinuous rachillae, with sessile staminate flowers with 11–12 stamens. *A. abdulrahmanii* has an inflorescence with 3 divaricate-sinuous rachillae and stipitate staminate flowers with 16 stamens. *Areca andersonii* has an inflorescence with 3–4 very slender rachillae, and sessile staminate flowers with 6 stamens. *Areca klingkangensis* has an inflorescence with only 3 rachillae, and stipitate staminate flowers with 9 stamens. *A. mogeana* has an inflorescence with 5–8 slender rachillae, and sessile staminate flowers with 6 stamens.

The divaricate structure of the inflorescence and the sinuous to slightly zigzag rachillae of *A. churchii* are similar to those of *A. abdulrahmanii*, *A. arundinacea* Beccari (1877: 23), *A. furcata* Beccari (1877: 23), *A. minuta* Scheffer (1876: 146), *A. mogeana* and *A. ridleyana* Beccari in Furtado (1933: 236). However, in addition to the important characters of staminate flowers already mentioned above, this new species can be easily distinguished from these by the presence of only one pistillate flower on each rachilla, this positioned 1–2 cm from the base of the rachilla.

The fused, twisted and coiled filaments that are found in this species have never been reported in the genus *Areca* or even in the subtribe *Arecinae*. In the tribe *Areceae* these characters have only been spotted in the monotypic and endemic genus *Tectiphiala* from Mauritius and also perhaps in the genus *Calyptrocalyx* and *Chambeyronia* (Dransfield *et al.* 2008).

***Areca dransfieldii* Heatubun, sp. nov.**

Inflorescentiae structura A. tunku J.Dransf. & C.K.Lim affinis, sed caule caespitoso, inflorescentia cremaea vel viride, floribus staminatis uniseriatim vel distichis, staminibus antheris dorsifixis, floribus foemineis solitariis in rachillis bene distincta.

Type:—MALAYSIA. Borneo, Sarawak: Miri, Lambir National Park, Path from waterfall, 04° 12.209' N 114° 02.151' E, 1 April 2008, *Heatubun & Rebi 901* (holotype K!, isotype SAR!).

Small, slender, undergrowth palmet, clustering (rarely solitary) with aerial branching, sometimes decumbent, stilt roots up to 40 cm. Stem 2–3 m tall, 1–2.5 cm diam.; internodes 1–4 cm long, green near tip and greyish at the base, nodal scars conspicuous, whitish brown. Leaves 5–7 in crown, pinnate, 100–165 cm long (including petiole); sheath tubular, 15–25 cm long, smooth, pale green to mid green; crown shaft well defined, 30–40 cm long and up to 2–2.5 cm diam.; petiole 25–81 cm long, channelled adaxially, rounded abaxially; rachis ascending but not arching, with adaxial longitudinal ridge, rounded abaxially; blade with regularly arranged leaflets, 9–23 leaflets on each side; leaflets somewhat descending, 1–2 main veins running parallel from the base to the tip, leaflets near petiole small, ca. 30 × 0.9 cm, slightly sigmoid, the middle leaflets about 46 × 2.1 cm and the terminal 27–29 × 1.1–1.8 cm, linear, pointed tip except for the terminal slightly oblique-lobed, papery, green adaxially and pale green abaxially. Inflorescence infrafoliar, erect, 10–14 cm long at anthesis, protandrous, branching to 1 order; peduncle 1–2.5 cm long, cream when young and turning green when mature; prophyll green, ca. 13 × 2 cm, elongate-triangular with pointed tip; rachis cream to green; rachis bracts not persistent; rachillae 4–7 and 7–11 cm long, very stiff and stout but not straight, flattened, elongate.

Floral clusters distichous on rachillae, only one complete triad including female flower occurring at the base of each rachilla. Staminate flowers small, triangular, 3.5–6.3 × 1.8–2.2 mm, asymmetric, cream to pale green; sepals 3, low, about 1.5 × 1.5 mm; petals 3, triangular, 4.0–4.5 × 2.4–2.7 mm, striate; stamens 6, ca. 2.5 mm × 1.9 mm; anthers dorsifixed, 2.1–3.0 × 0.5–1.0 mm, cream-coloured, elongate, longer than the filaments; filaments 1.2–1.5 × 0.4 mm, dark brown; pistillode low, ca. 0.5 × 0.5 mm, rounded. Pistillate flowers larger than the staminate, triangular, borne on the enlarged basal portion of rachillae, buds varying greatly in size depending on stage of development, just before anthesis 15.4–18.2 mm long and 10–11 mm wide, pale green to green; sepals 3, strongly imbricate, ca. 11.8 × 8 mm, triangular, asymmetrical; petals 3, imbricate, triangular, 5.5–12.6 × 2.5–5.2 mm; staminodes 3–4, irregular dentiform, 0.8 mm high. Fruits elongate, sickle-shaped to ovoid, immature ca. 3.8 × 1 cm, apical stigmatic remains, perianth sometimes persistent; epicarp smooth, shiny, very thin, dark green when young; mesocarp fibrous, ca. 2.6 mm thick in immature fruit; endocarp very thin, adhering closely to seed. Seeds elongated with pointed tips, ca. 2.4 × 0.4 mm in immature fruits; endosperm ruminant; embryo basal. Eophyll bifid. (Figures 4 & 6A).

Distribution:—Central and Northern parts of Borneo (in Central Kalimantan of Indonesia, Sarawak and Brunei Darussalam).

Habitat:—This palm grows in primary forest in mixed Dipterocarp forest. Other palms that occupy the same habitat are *Areca insignis* var. *moorei* (J. Dransf.) Dransfield (1984: 13), *Licuala* sp., and *Pinanga* spp.

Local Name:—*Pinang Nyaring* and/or *Pinang Bandang* (local dialect in Central Kalimantan, Indonesia).

Uses:—Not recorded.

Conservation status:—Near Threatened (NT). The extent of occurrence of this species is a large triangle that includes part of Central Kalimantan (Indonesia), Lambir National Park (Sarawak, Malaysia) and Ladan Hills Forest Reserve in Lamunin, Tutong (Brunei Darussalam). However, it is known only from three wild localities, only two of which are protected. In Lambir, the species was observed to be rare. It is anticipated that this species will become increasingly threatened. Detailed population studies are needed to assess its conservation status more precisely.

Etymology:—The specific epithet to honour Dr. John Dransfield, former Head of Palm Research at the Royal Botanic Gardens, Kew, in recognition his great achievements in palm botany in general and to palm genus *Areca* in Borneo in particular.

Additional specimens examined:—BRUNEI DARUSSALAM. Tutong, Lamunin, Ladan Hills Forest Reserve, 20 May 1995, *Dransfield JD 7531* (K!, BRUN). INDONESIA. Borneo, Central Kalimantan Province: Upper Katingan River, ca. 60–80 km West of North West Tumbang Samba, Tumbang Merak, 20 November 1982, *Mogea & de Wilde 3452* (K!, L!, BO!).

Discussion:—*Areca dransfieldii* is similar to *A. tunku* Dransfield & Lim (1992: 81) in inflorescence structure, but it can be distinguished immediately by the clustering habit with aerial branching and sometimes decumbent stems. The inflorescence of *A. dransfieldii* is also cream when young, turning green when mature. The staminate flowers are mostly distichously arranged on the rachilla, with sepals free and stamens with dorsifixed anthers, and only one pistillate flower is borne on each rachilla. These features contrast with the purple inflorescence, uniseriate staminate flowers (spiral near the rachilla tip), and sepals united to form a cup-shaped calyx, sagittate anthers and more than one pistillate flower per rachilla in *A. tunku*. Moreover, this new palm is restricted to Borneo, whereas *A. tunku* is a species of Sumatra and the Malay Peninsula.

The swollen, flattened rachillae in the inflorescence structure suggest that *A. dransfieldii* has close relationships with *A. bakeri* and *A. tunku*. Dransfield & Lim (1992) mentioned that *A. tunku* is related to *A. ahmadii* Dransfield (1984: 4) and *A. jugahpunya* because of its swollen rachillae and purplish inflorescence, but in fact the rachillae of these two acaulescent species are long and cylindrical rather than truly flattened. The differences between *A. bakeri* and *A. dransfieldii* have already discussed (see notes under *A. bakeri*).

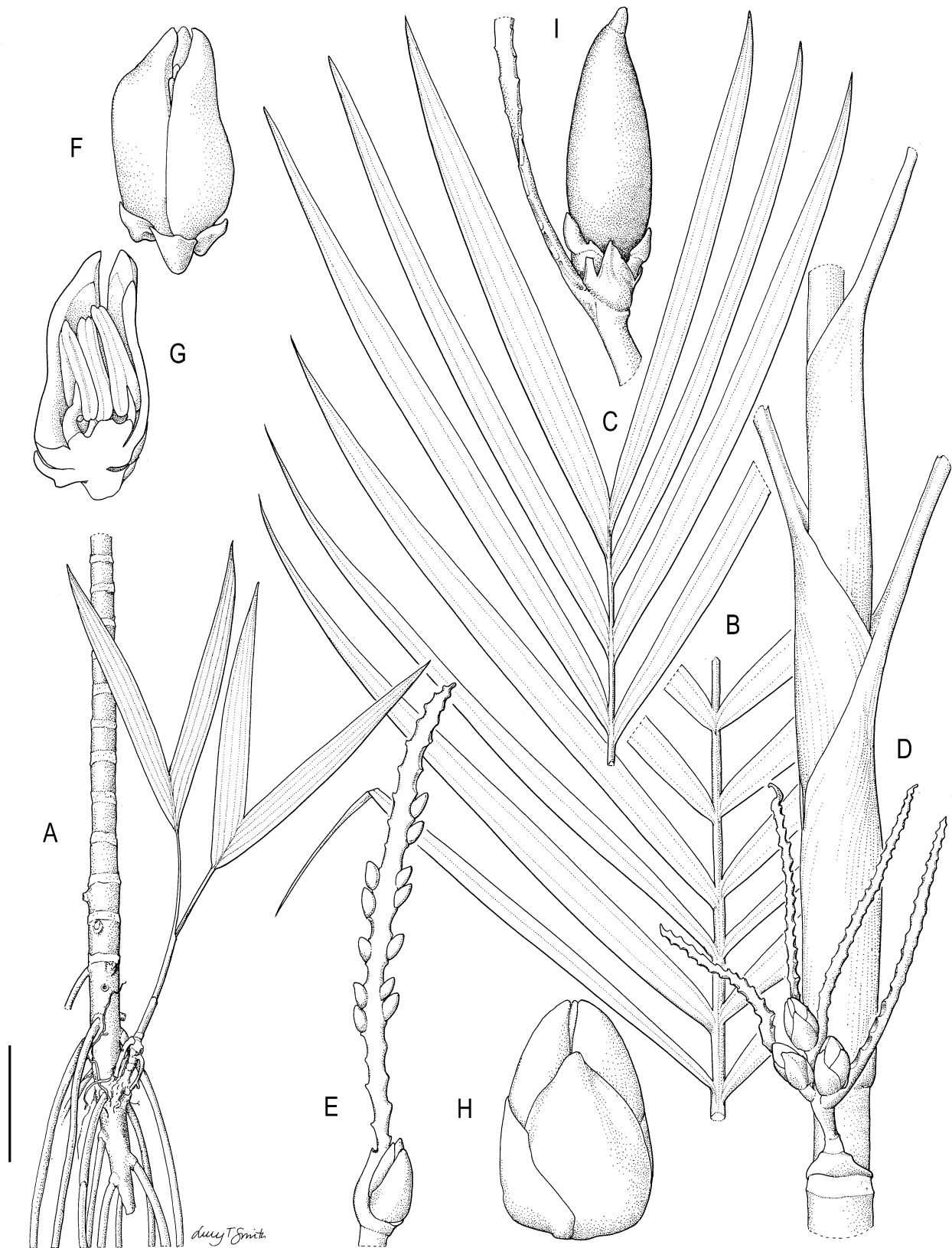


FIGURE 4. *Areca dransfieldii*. A. Stem, stilt roots and clustering habit. B. Middle portion of leaf. C. Apical portion of leaf. D. Inflorescence attached to stem just below the crown shaft. E. Detail portion of rachilla showing staminate and pistillate flowers in bud. F, G. Staminate flower whole and in section. H. Pistillate flower. I. Fruit still attached to rachilla. Scale bar: A–C = 6 cm; D = 3 cm; E = 1.5 cm; F, G = 2.5 mm; H = 7 mm; I = 2 cm. A–E, H from *Mogea* 3452; F–G from *Dransfield* JD 7531; I from *Heatubun* 901. Drawn by Lucy T. Smith.

***Areca gurita* Heatubun, sp. nov.**

Palma elegantissima Borneensis caespitosa, A. minutae Scheff. habitu similis, inflorescentia octopiformi, rhachillis recurvatis, floribus secundis ab inum usque ad apicem et spiraliter ad apicem, floribus staminatis alternatis, antheris connectivo lineare distincta.

Type:—CULTIVATED. Borneo, Sarawak: Semengoh Forest Arboretum, Palm Collection, 01° 24.061' N 110° 19.443' E, 31 March 2008, *Heatubun & Kuda 896* (holotype K!, isotype SAR!).

Clustering with many suckers, small, undergrowth palmet. Stem to 1.5 m high, 1 cm in diam.; internodes 3 cm long, smooth and green near the crown, light brown to whitish near the base. Leaves ca. 11 in crown, pinnate, ca. 32 cm long (including petiole); sheath tubular, ca. 20 cm long and 1–2 cm wide, light brown to brown, and light brown when dried; crown shaft well-defined, up to 30 cm long and 1–2 cm diam.; petiole ca. 3 cm long, channelled adaxially, rounded abaxially; rachis very slender with adaxial longitudinal ridge, rounded abaxially; blade with irregularly arranged leaflets, 2–4 leaflets on each side, spacing between leaflets 1.5–3 cm; leaflets from narrow to broad, leaflets near petiole ca. 15 × 3 cm, slightly sigmoid, tip oblique acuminate, the middle leaflets about ca. 12 × 2 cm, linear with 1 vein, the terminal leaflets broad, flabellate, ca. 15 × 6 cm, margin toothed, papery, concolorous. Inflorescence infrafoliar, erect, small and compact, to 10 cm long and to 10 cm wide, protandrous, always branching to 1 order; peduncle short to 3 cm, covered in thick brown indumentum; prophyll persistent; rachis also covered in rusty brown indumentum; rachillae 3–8 (including main axis), divaricate, to 10 cm long and ca. 5 mm wide near base, recurved. Floral clusters uniseriate, but spiral at the tip of rachillae, 1–3 complete triads including female flowers occurring near the base of rachilla and more (5–15 flower clusters) on terminal rachilla. Staminate flowers small, triangular to rounded, 2–2.5 × 1.5–1.80 mm, asymmetric, white to cream; calyx fused, triangular cup-shaped, ca. 1.5 × 1 mm before anthesis, 3-lobed, light brown to brown; petals 3, fused near base, obovate, 2–2.2 × 1.2–1.5 mm at anthesis, white to cream-coloured; stamens 6, 1.5–1.7 mm × 0.5 mm, basifixed; anthers ca. 1.2 × 0.5 mm, cream-coloured, sagittate, longer than filaments; filaments ca. 0.5 × 0.2 mm, dark brown, connective linear; pistillode absent. Pistillate flowers larger than the staminate, triangular, ca. 5.5 mm long and 3.5 mm wide before anthesis, greenish; sepals 3, strongly imbricate, 4–4.5 × 4 mm before anthesis, somewhat triangular, asymmetrical; petals 3, imbricate, triangular, ca. 4.5 × 4 mm before anthesis; lacking staminodes; gynoecium ca. 4 mm (including stigma). Fruits (young) white with green at the tip, obovoid with beak, ca. 2 cm long and 1 cm wide (young fruit still in development), apical stigmatic remains, mature fruits not seen. (Figures 5 & 6B–D).

Distribution:—This species is known from several collections in Bintulu Division and Miri Division of Sarawak.

Habitat:—Heath forest to montane forest from an elevation 80–750 m above sea level.

Local Name and uses:—Not recorded.

Conservation status:—Endangered (EN B2ab). This species is known from only four localities in the wild, at least one of which may have been destroyed. Only one locality falls within a protected area (Lavang forest). *Areca gurita* is cultivated in Semengoh Forest Arboretum near Kuching where the palm grows well and sets fruit. However, further population study is needed to assess the conservation status of this palm, considering the trend of deforestation rates in the region.

Etymology:—The specific epithet is *gurita*, the Malay word for octopus, which reflects the curious appearance of the inflorescence of this species.

Additional specimens examined:—MALAYSIA. Borneo, Sarawak: Bintulu Division, Bukit Kana, Ulu sg. Sanggan, Tatau, 25 March 1995, *Yii & Jugah S. 71688* (K!, KEP, SAR!); Lumut Range, 22 September 1992, *Mohtar & Yii S. 65877* (SAR!); Sabal, Logging road, Sabal sisi, 18 February 1995, *Runi et al. S. 71203* (K!, KEP, L!, SAR!); Miri Division, Lavang Forest Protected Area, 24 April 1994, *Yii et al. S. 67563* (KEP, SAR!).

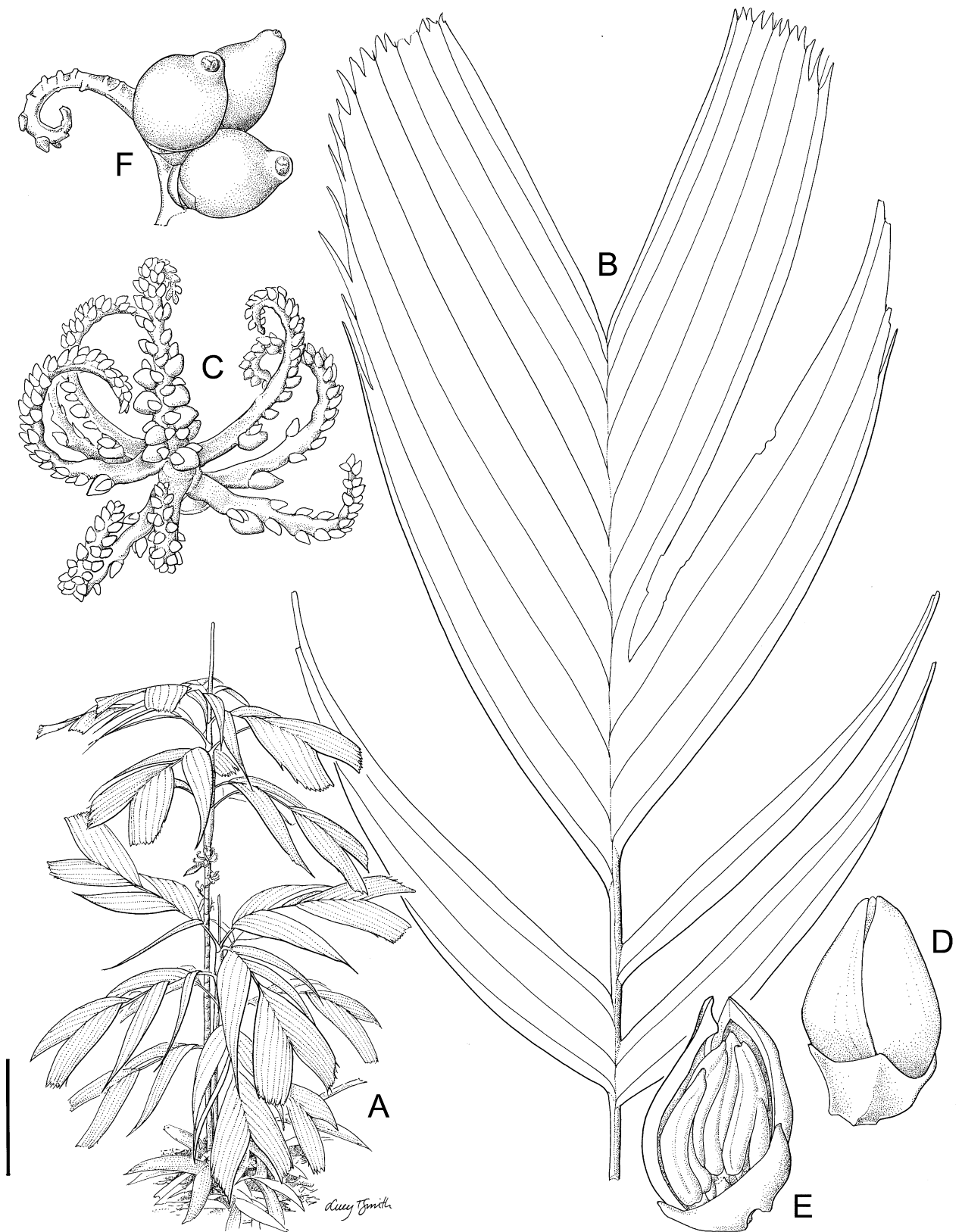


FIGURE 5. *Areca gurita*. A. Habit. B. Leaf. C. Inflorescence showing staminate and pistillate flowers in bud and their arrangement on rachillae. D, E. Staminate flower whole and in section. F. Fruit still attached to rachilla. Scale bar: A = 31.5 cm; B = 3 cm; C = 3.6 cm; D, E = 1.2 mm; F = 1.3 cm. All from *Heatubun* 896. Drawn by Lucy T. Smith.

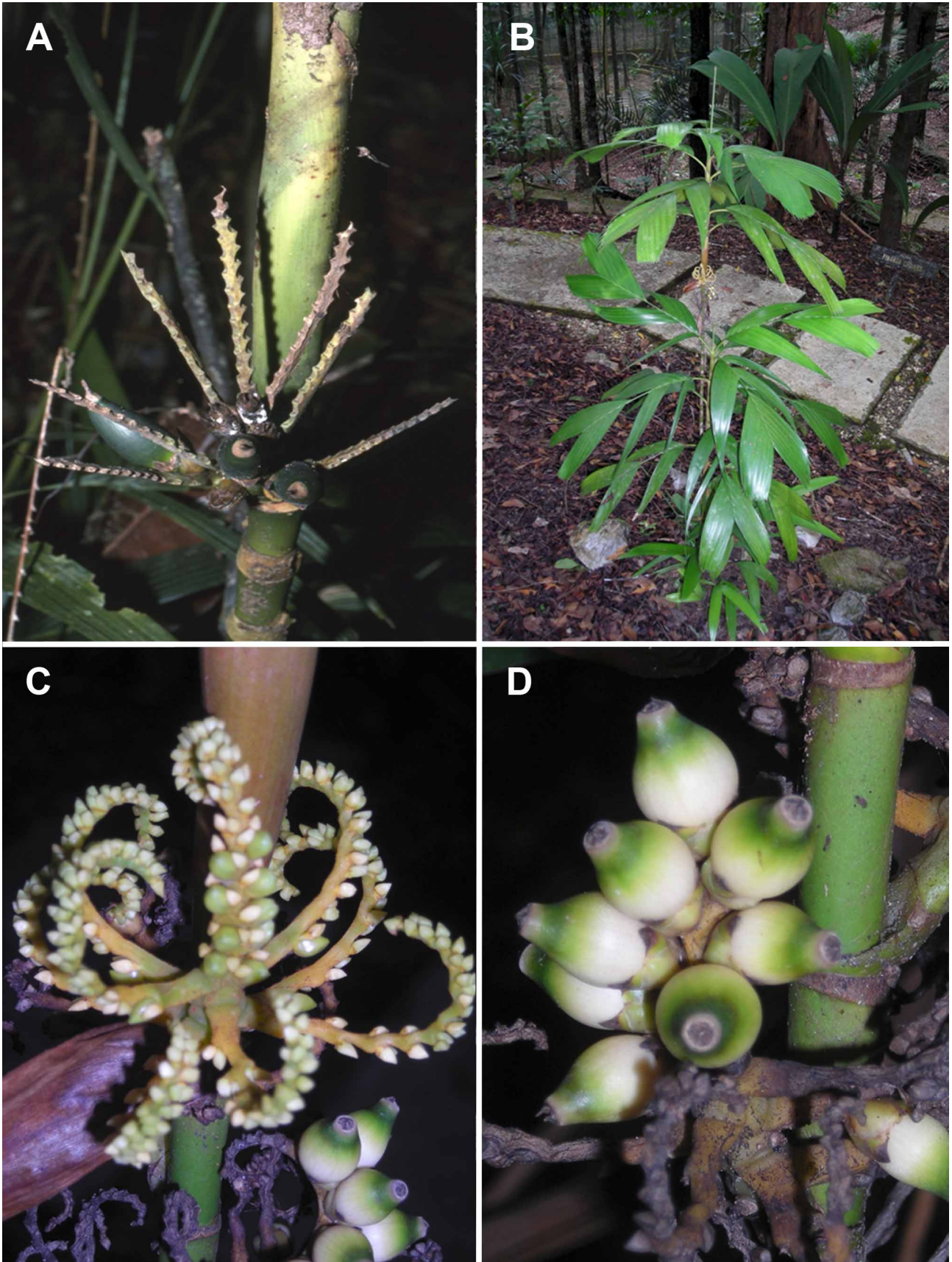


FIGURE 6. A. Inflorescence of *Areca dransfieldii* in Lambir National Park showing the stiff, straight rachillae with young fruits. B. Habit of *Areca gurita* with very few clustering stems and shoots, the palm cultivated at Semengoh Forest Arboretum near Kuching, Sarawak. C. Inflorescence of *Areca gurita* with the octopus tentacle-like rachillae. D. Young fruits of *Areca gurita*. Photos: A (John Dransfield), B–D (Charlie D. Heatubun).

Discussion:—*Areca gurita* is similar to *A. minuta* in habit, leaves and general appearance. However, they can easily be differentiated by inflorescence structure and flower arrangement. The rachillae of *A. gurita* are recurved and resemble octopus tentacles, and the flowers are mostly uniseriate. The rachillae are numerous (3–8 including terminal rachilla) and the anther connective is also linear, rather than the rachillae being few (usually with only 3 rachillae), the flowers arranged spirally on the rachillae and the furcate connective in *A. minuta*.

The flower arrangement in *A. gurita* appears to be a modification from spiral to uniseriate; spirally arranged flowers still persist at the tip of rachillae. The rachillae are expanded on one side and display all flowers in the one direction.

***Areca mogeana* Heatubun, sp. nov.**

Arecae abdulrahmanii J.Dransf. habitu et inflorescentia structura similis, sed staminibus 6, floribus foemineis plus quam uno (–10) semper in rachis sitis ab imum usque ad apicem, differt.

Type:—INDONESIA. Borneo, Kalimantan Barat Province: Kabupaten Hulu Kapuas, Bentuang Karimun National Park, *Mogea* ITTO/BA 0605 (holotype SAR!).

Solitary, small palm. Stem to 2 m tall, 5–8 mm diam.; internodes 2–2.5 cm long. Leaves 5–7 in crown, pinnate, to 50 cm long (including petiole); sheath tubular, ca. 10 cm long and 1.2–2 cm wide, striate, dark green to tinged red, tomentose, and brown to dark brown when dried, covered by punctiform scales, sparse or very dense near the petiole; crown shaft well defined, up to 17 cm long and 1 cm diam.; petiole 4–10 cm long, channelled adaxially, rounded abaxially, covered with thick brown indumentum; rachis very slender with adaxial longitudinal ridge, rounded abaxially; blade with irregularly arranged leaflets, 5–6 leaflets on each side, spacing between leaflets 3–6 cm; leaflets from narrow to slightly broad, leaflets near petiole 21–26 × 1–1.2 cm, linear, tip oblique acuminate, the middle leaflets about 23–25 × 0.5–2.2 cm, linear with 1–3 veins, the terminal leaflets broad, sometimes less broad than middle leaflets or sometimes flabellate, 13–16 × 1–15 cm, somewhat lanceolate with small cleft, papery, discolourous when dried, slightly pale adaxially and dark abaxially, with sparse brown ramenta along the mid-ribs in abaxial surface. Inflorescence infrafoliar, erect, small and slender, 10–12 cm long and 4.5–6 cm wide, protandrous, always branching to 1 order; peduncle 2–5 mm long, covered by thick brown indumentum; prophyll not seen; rachis also covered by brown indumentum; rachis bracts persistent, low, triangular; rachillae 5–8 (including main axis), divaricate, 7–10 cm long and ca. 2 mm wide near base, elongate, very slender, sinuous. Floral clusters spirally arranged on the rachillae, only one complete triad including female flower occurring at the base of each rachilla, except for terminal rachilla with 1–10 complete triads distributed to the half of the terminal rachilla length. Staminate flowers small, triangular, sickle-shaped when young to elongate at anthesis, 3.5–4.8 × 1.2–2 mm, asymmetric, cream to pale brown, sessile; calyx fused, triangular cup-shaped, ca. 1.2 × 2 × 0.8 mm at anthesis, 3-lobed; petals 3, fused near base, obovate, 2.5–3.5 × 1.2–1.75 mm at anthesis, striate; stamens 6, 2–2.5 mm × 0.5 mm, basifixed; anthers ca. 5.3 × 0.6 mm, cream-coloured, elongate, sagittate, shorter than the filaments; filaments ca. 0.5 mm long, dark brown, connective furcate; pistillode absent. Pistillate flowers larger than the staminate, triangular, ca. 4.5 × 2.5 mm (young stage); sepals 3, strongly imbricate, ca. 4 × 2.5 mm (young stage), triangular, asymmetrical; petals 3, imbricate, triangular, ca. 4 × 2.6 mm (young stage); staminodes absent. Young fruits light orange at the base becoming red and darker red at the tip, elongate, sickle-shaped, ca. 1.5 cm long and 0.3 cm wide, apical stigmatic remains, mature fruits not seen. (Figure 5).

Distribution:—This species is known only from Bentuang Karimun National Park in Kabupaten Hulu Kapuas, Kalimantan Barat Province, Indonesian Borneo.

Habitat:—This palm was recorded growing in submontane forest at an elevation 1100 m above sea level.

Local name and uses:—Not recorded.



FIGURE 7. *Areca mogeana*. A. Stem, leaf and inflorescence. B. Inflorescence showing staminate and pistillate flowers in bud and their arrangement on rachillae. C, D. Staminate flower whole and in section. Scale bar: A = 4 cm; B = 2 cm; C, D = 1.5 mm. A, C, D from *Mogea* ITTO/BA 0595; B from *Mogea* ITTO/BA 0605. Drawn by Lucy T. Smith.

Conservation status:—Vulnerable (VU D2). *Areca mogeana* occurs in submontane areas in Bentuang Karimun National Park in the Indonesian province of West Kalimantan. The protected forest area extends across the border to Lanjak Entimau Wildlife Sanctuary in Sarawak, Malaysia. However, with only four records from two localities, we infer that the populations are highly restricted and potentially vulnerable to stochastic events or human activities. However, further population study is still needed to assess the conservation status of this palm more precisely.

Etymology:—The specific epithet honours the collector of the type specimen Professor Johanis P. Mogeana, palm botanist from Herbarium Bogoriense —LIPI (Indonesian Institute of Science) in recognition of his contribution to our understanding of the palm flora of Indonesia.

Additional specimens examined:—INDONESIA. Borneo, Kalimantan Barat Province: Kabupaten Hulu Kapuas, Bentuang Karimun National Park, trail to Bukit Condong, 17 September 1997, *Chai et al. ITTO/BA 0368* (SAR!); *Mogeana ITTO/BA 0585* (BO, SAR!); *Mogeana ITTO/BA 0595* (BO, SAR!).

Discussion:—*Areca mogeana* is similar to *A. abdulrahmanii* and *A. churchii* in its solitary habit, dissected-leaf blade with several leaflets and its inflorescence structure with elongated-sinuuous rachillae. The first differs from the last two in the arrangement of floral clusters especially complete triads and the staminate flowers, including number of stamens. In *A. mogeana*, only one complete triad including female flower occurring at the base of each rachilla, although the terminal rachilla may bear up to 10 complete triads, distributed to half the length of the rachilla. The staminate flowers are sessile, spirally arranged and contain six stamens. In contrast, *A. abdulrahmanii* has complete triads including female flowers along the lower third of all rachilla and bears conspicuously stipitate staminate flowers with 16 stamens. *Areca churchii* has only one complete triad on all rachillae and sessile staminate flowers with 11-12 stamens.

***Areca riparia* Heatubun, sp. nov.**

A ceteris speciebus Cambodianis distinctissima; palma rheophytica, A. triandrae Roxb. ex Buch.-Ham. similis, foliolis angustissimis semper simplicem plicatis, inflorescentiis in 2 ordines ramosis, floribus femineis semper singulis in rachilla differt.

Type:—CAMBODIA. Koh Kong Province: Tatai Chveng waterfall, 11° 35' N 103° 06' E, 27 September 2008, *Evans 174* (holotype K!).

Clustering, small and slender palm, snaking, rarely vertical. Stem to 2.5 m tall, 1–1.5 cm diam.; internodes 2.5–3 cm long, green near the crown, shiny, brown near the base, nodal scars conspicuous, white to whitish brown. Leaves about 7 in the crown, pinnate, to 80 cm long (including petiole); sheath tubular, ca. 19 × 4 cm long, smooth, greenish cream, speckled with reddish scurf-like ramenta; crown shaft well defined, 28–30 cm long and 1–2 cm diam.; petiole short, 12–13 cm long, 5 × 5 mm at the base, channelled adaxially, rounded abaxially; rachis somewhat arching, very slender with adaxial longitudinal ridge, rounded abaxially, covered by rusty brown indumenta; blade with regularly arranged leaflets, about 25 leaflets on each side; leaflets somewhat arching, single fold, linear, 20–30 cm long, acuminate, with pointed tips, papery, green adaxially and light green abaxially, slightly discoloured when dried; continuous white woolly ramenta present along the mid-ribs on abaxial surface. Inflorescence infrafoliar, erect, small and slender, 13–15 cm long and 6–8 cm wide, protandrous, branching to 1 order and sometimes the basalmost rachilla branches to 2 order; peduncle 1–1.5 cm long; prophyll ca. 14 × 4.5 cm, lanceolate, 2-keeled, papery, cream coloured, entirely enclosing the inflorescence, then splitting longitudinally and falling before staminate flower anthesis; rachis cream to greenish; rachillae ca. 16, divaricate, elongate, yellowish. Floral clusters uniseriate, only one complete triad including female flower occurring at the base of each rachilla, rarely several triads. Staminate flowers small, triangular, ca. 2 × 0.75 mm (young stage), asymmetric, cream to pale brown; calyx low, triangular cup-shaped, ca. 0.75 mm wide and 0.5 mm high (at young stage), 3-lobed; petals 3, strongly keeled, valvate, ca. 1.5 × 0.75 mm (at young stage); stamens 3, about 1 mm long (at young stage), basifixed; anthers ca. 0.8 mm long (at young stage), white to cream-coloured, longer than the filaments; filaments ca. 0.2 mm (at young stage), orange to brown; pistillode lacking. Pistillate flowers larger than the staminate, triangular, ca. 6.2 mm long

and 4 mm wide (at young stage); sepals 3, strongly imbricate, ca. 4 × 3 mm (at young stage), triangular; petals 3, imbricate, triangular, ca. 5 × 3 mm at anthesis; gynoecium about 3 mm (at young stage), lacking staminodes. Fruits 2–2.8 × 1–1.5 × 1–1.5 cm, elongate, fusiform, apical stigmatic remains, epicarp smooth, mesocarp fleshy, endocarp fibrous, bright crimson when ripe. Seeds ca. 1.6 × 1.2 cm, obovoid, endosperm ruminant, embryo basal. (Figures 8 & 9).

Distribution:—This palm is only known from one collection made by Dr. Tom Evans in Tatai Chveng waterfall in Koh Kong Province, Cambodia.

Habitat:—This species grows as a rheophyte in a wet, vegetated rocky river bank at elevation less than 20 m above sea level, downstream of the falls and outside the splash zone, but below the peak flood level.

Local Name and uses:—Not recorded.

Conservation Status:—Data Deficient. Further population studies are needed to assess the conservation status of this palm, although the collector had stated that this palm is common on the river system near the type locality.

Etymology:—The specific epithet reflects the habitat where this species grows.

Discussion:—*Areca riparia* is the third species of *Areca* that has been reported from Cambodia and the fifth for Indo-China (Govaerts & Dransfield 2005, Henderson 2009, Henderson *et al.* 2010). This palm differs from other *Areca* species in the region by its growth-form being truly rheophytic (van Steenis 1981, Dransfield *et al.* 2008) in the flood zone of fast-flowing rocky rivers. This species has three stamens, similar to *A. songthanensis* Henderson *et al.* (2010: 34), *A. triandra* Roxb. in Buchanan-Hamilton (1826: 310) and *A. montana* Ridley (1907: 136)—this last species was synonymized by Andrew Henderson in his recent monograph of palms of Southern Asia (Henderson 2009), a taxonomic decision questioned here. However, *A. riparia* can easily be distinguished from *A. songthanensis*, *A. montana* and *A. triandra* by having narrow and flexible single-folded leaflets adapted to flowing flood water. Additional morphological characters found in *A. songthanensis* and *A. montana*, such as solitary habit and pistillate flowers borne only on distal rachillae, further distinguish this new species, which is clustering and bears pistillate flowers on all rachillae. Differences from *A. triandra* are in dimension and inflorescence structure in general. *Areca riparia* is a small and slender palm with a stem diameter to 1.5 cm and stem height to 2.5 m, inflorescences branched to two orders, rachillae relatively few with only one pistillate flower on each rachilla. In contrast, *A. triandra* is typically medium-sized with a stem diameter to 7 cm or more and stem height to 6 m, inflorescences branched to three orders, numerous rachillae and 3 to 5 (sometimes up to 10) pistillate flowers on each rachilla. Also the inflorescence of *A. triandra* also has a powerful lemon scent as emphasized by Lim & Whitmore (2001), which has not been recorded for *A. riparia*.

A rheophytic form of *A. triandra* has been reported recently from Vietnam (Henderson 2009, Henderson *et al.* 2010). One herbarium specimen collected by Andrew Henderson and his colleagues (Henderson *et al.* 3623) from a lowland area of Vietnam has been studied at Kew and is clearly not the same taxon as *A. riparia*. In this specimen, the typical features of *A. triandra* can be observed, such as the relatively broad leaflets with multiple folds (at least two-folded with prominent nerves in the leaflet, in contrast to the single-folded, smooth leaflets without prominent nerves in *A. riparia*), the relatively large inflorescence (about 2.5 times longer and wider than *A. riparia*) that is branched to three orders, as opposed to two orders in *A. riparia*.

Areca riparia is the second rheophytic species in the genus, the other species is *A. rheophytica* Dransfield (1984: 18) from Borneo. Besides being rheophytes, these two species are different from each other in many ways.

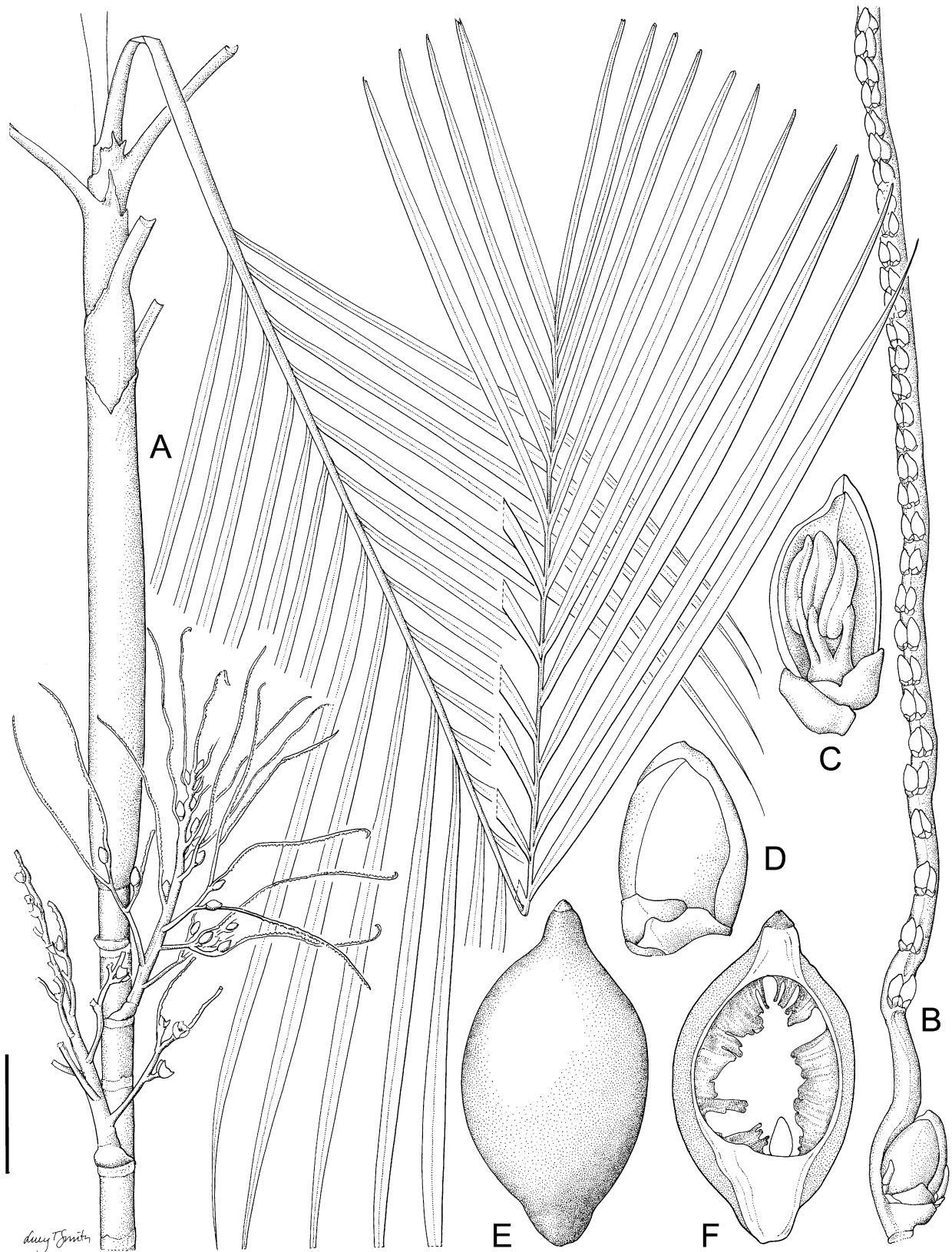


FIGURE 8. *Areca riparia*. A. Stem, leaf and inflorescence. B. Detail of rachilla showing staminate and pistillate flowers in bud. C. Staminate flower in section. D. Pistillate flower. E, F. Fruit whole and in section. Scale bar: A = 4 cm; B = 7 mm; C = 1 mm; D = 3 mm; E, F = 1 cm. All from *Evans 174*. Drawn by Lucy T. Smith.

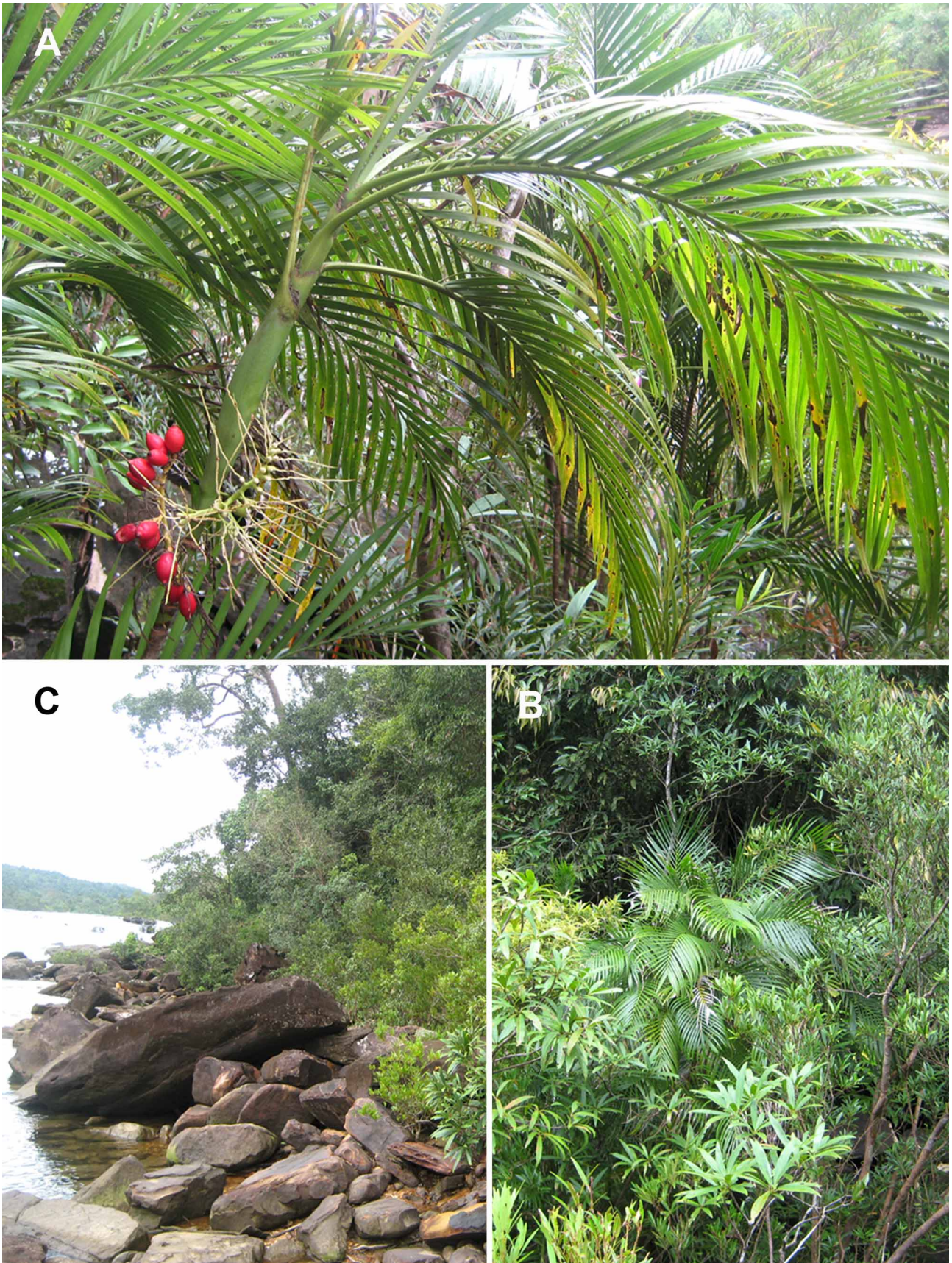


FIGURE 9. *Areca riparia* in its natural habitat in Cambodia. A. Close up view of the crown with leaves and leaf sheath, inflorescence and the ripe red fruits. B. *Areca riparia* surrounded by other riverside vegetation. C. The flowing rocky river bank is the habitat of *Areca riparia*. All photo by Tom D. Evans.

***Areca triginticollina* Heatubun, sp. nov.**

Species nova Sumatrana A. tunku habitu et A. jugahpunya inflorescentiae structura similis, sed floribus staminatis spiraliter dispositis, differt.

Type:—INDONESIA. Sumatra, Riau Province: Indragiri Hulu Regency, Seberida District, Bukit Tiga Puluh National Park, 10 km North of Jambi border, 5 May 1991, *Gundersen et al. 15* (holotype K!, isotype BO).

Solitary, understory tree palm. Stem 2–5 m tall, 3–4 cm diam.; internodes 3–6 cm long. Leaves 11–12 in crown, pinnate, 95–110 cm long (including petiole); sheath tubular, 20–25 cm long and 6–10 cm wide, smooth, yellowish-green to grey brown, covered in punctiform brown indumenta, sparse or very frequent near the petiole; crown shaft well defined, up to 50 cm long and 15 cm diam., sometimes swollen; petiole very short or lacking, channelled adaxially, rounded abaxially; rachis with adaxial longitudinal ridge, rounded abaxially; blade with irregularly arranged leaflets, 6–12 leaflets on each side, spacing between leaflets 6–7 cm; leaflets variable from narrow to broad, leaflets near petiole shorter than others, ca. 32 × 5 cm, slightly sigmoid, the middle leaflets about 47–55 × 4.5–8 cm, with up to 4 folds, the terminal leaflets broad, 22–33 × 7.5–14 cm, linear, tips pointed except for the terminal leaflets with notched tips, papery, slightly dark adaxially and pale abaxially. Inflorescence infrafoliar, erect, 15–22 cm long and 5–6 cm wide, protandrous, branching to 1 order (sometimes 2 at basalmost rachilla); peduncle 2–5 cm long, cream to warm yellow; prophyll 14–24 × 2.5–7 cm, borne about 1/2 way up the peduncle, lanceolate, 2-keeled, boat shaped, papery, cream to light brown, entirely enclosing the inflorescence, then splitting longitudinally and disintegrating into numerous fibres, still persistent after staminate anthesis; rachis cream-coloured; rachis bracts not persistent; rachillae ca. 13, 10–13 (–15) cm long, very stiff, flattened, wide or swollen near base, zigzag, slightly congested. Floral clusters distichous on the rachillae, complete triads including female flowers occurring from the base to half the length of each rachilla, 3–6 complete triads per rachilla. Staminate flowers small, triangular, sickle-shaped when young to elongate at anthesis, 6.9–9.3 × 2.5–4 mm, asymmetric, cream to pale brown; calyx fused, cup-shaped, ca. 2.3 × 2.5 mm at anthesis, 3-lobed, the lobes triangular about 1.6 × 1 mm; petals 3, fused near base, lanceolate, 5.1–6.7 × 1.3–2 mm at anthesis, striate; stamens 6, ca. 6.7 mm × 0.6 mm, elongated, basifixed; anthers ca. 5.3 × 0.6 mm, creamy, elongated, sagittate, shorter than filaments; filaments ca. 6.7 × 0.3 mm, joined to anther from base to tip, dark brown; pistillode absent. Pistillate flowers larger than the staminate, triangular, buds varying greatly in size depending on stage of development, 10–13 mm long and 5–6 mm wide at anthesis; calyx with 3 sepals; sepals free, strongly imbricate, ca. 7.2 × 6.4 mm at anthesis, triangular, asymmetrical; petals 3, imbricate, triangular, ca. 13 × 5 mm at anthesis; staminodes lacking. Fruits (young) green, elongate, apical stigmatic remains, mature fruits not seen. (Figure 10).

Distribution:—This species is only known very few collections from Bukit Tiga Puluh National Park in Riau Province in South Western of Sumatra, Indonesia.

Habitat:—Recorded growing on a ridge crest on primary forest at 120–250 m above sea level.

Local Name and uses:—Not recorded.

Conservation status:—Endangered (EN B1ab, B2ab). *Areca triginticollina* occurs in a restricted area within Bukit Tiga Puluh National Park, Riau, Sumatra. This protected area is small and adjacent to forest production areas. Thus, despite its protected status, the habitat of this lowland palm area is at risk.

Etymology:—The specific epithet refers to the type locality of this new palm in Taman Nasional Bukit Tiga Puluh in Riau, Sumatra, Indonesia. *Triginticollina* in latin mean thirty hills or bukit tiga puluh in Indonesian.

Additional specimens examined:—INDONESIA. Sumatra, Riau Province: Indragiri Hulu Regency, Seberida District, Bukit Tiga Puluh National Park, 5 km West of Kelesa, 15 May 1991, *Gundersen et al. 32* (K!, BO); Talang Langkat village, 9 August 1991, *Witono et al. 146* (K!, BO!); 10 August 1991, *Witono et al. 150* (K!, BO!).

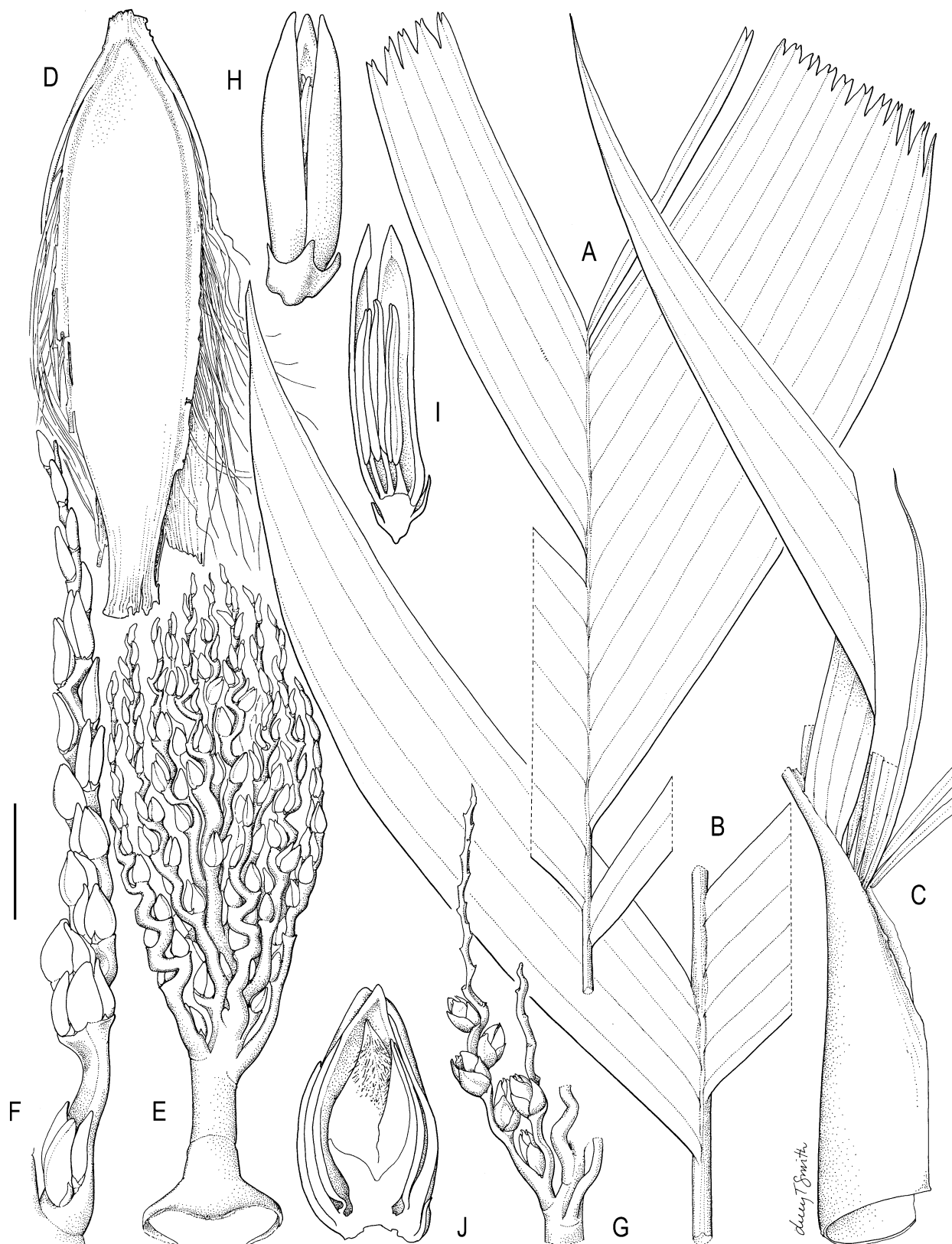


FIGURE 10. *Areca triginticollina*. A. Apical portion of leaf. B. Middle and basal portion of leaf. C. Basal portion of leaf and leaf sheath showing absence of petiole. D. Prophyll with disintegrating fibrous mass. E. Inflorescence. F. Details of rachilla showing staminate and pistillate flowers in bud and their arrangements. G. Pistillate flowers at anthesis on rachillae. H, I. Staminate flower whole and in section. J. Pistillate flower in section. Scale bar: A–C = 6 cm; D, E = 3 cm; F = 1.5 cm; G = 2.5 cm; H–J = 4 mm. A–F, H–J from Witono *et al.* 150; G from Gundersen *et al.* 15. Drawn by Lucy T. Smith.

Discussion:—*Areca triginticollina* is similar to *A. tunku* in many respects, including the litter-trapping crown and the inflorescence sometimes bursting out from the persistent prophyll. However, they can be distinguished by inflorescence structure. *Areca triginticollina* has swollen-flattened rachillae, which are folded in a zigzag fashion, this corresponding to the position of the pistillate flowers; also the triads are distributed along half of the length of the rachilla. *Areca tunku* has erect, stiff and rigid rachillae and triads with female borne at the base of the rachillae only. Although the inflorescence structure is slightly similar to *A. jugahpunya*, the species are totally different in habit.

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