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PALM NEWS

An excellent overview of palm horticulture has been published in Horticulture Reviews, vol. 42. Entitled "Ornamental Palms: Biology and Horticulture" by T. Broschat, M. Elliot and D. Hodel, the work covers general aspects of palm biology, propagation, nursery production and landscape and interiorscape management practices. The 120-page article is available as a free download: http://media.johnwiley.com.au/product_data/excerpt/94/11189167/1118916794-19.pdf.

In a recent paper in PLOS One (DOI: 10.1371/journal.pone.0089295), Andrew Cline and colleagues teased apart a **remarkable five-way relationship that underscores the complexity of palm ecology**. They documented the feeding relationships among a sap-feeding scale insect (*Comstockiella sabalis*), a sap beetle (*Brachypeplus glaber*), filamentous fungi, and a yeast, all of which live out their lives on *Sabal palmetto* in the southeastern USA. The beetle lives under the bracts of the inflorescence and feeds on filamentous fungi that grow as epiphytes on the inflorescence, as well as on the shed exoskeletons of the scale insects, which also live and feed among the inflorescence bracts. Finally, the yeast appears to live as an endosymbiont of the beetle and is believed to secrete powerful anti-fungal compounds that protect the beetle from fungal infection. These amazing findings for this one palm species highlight how little we know about palm-animal-fungal interactions in the wild.


S. Zona

The BBC has recently produced a radio series describing the work of the Royal Botanic Gardens Kew. Entitled "**Plants: From Roots to Riches**" and introduced by the Director of Science, Dr. Kathy Willis, the program was aired on BBC Radio 4 as daily, 15-minute installments over 25 days. One episode, "Dynamic Rainforest," was devoted to palms and features our own Dr. John Dransfield telling the story of the discovery of *Tahina*. The episode also includes an interview with Kew's Head of Palms, Dr. William J. Baker, who explains how DNA sequencing has revolutionized our understanding of palm evolution and the time scale on which palms diversified. The full series is available as free downloads at http://www.bbc.co.uk/programmes/b04dm6v3.

In biology class, we all learned that genes are passed from parent to offspring (intergenerational or vertical transfer). Now, M. El Baidouri et al. (Genome Research 24: 831–838. 2014.) published their survey of **horizontal (interspecific) transfer of transposable elements** (so-called "jumping genes") in a large number of plant species, species that are not necessarily closely related. Of interest to us: evidence of a transposable element shared by the date palm, *Phoenix dactylifera*, and the grape vine, *Vitis vinifera*. The authors could not determine the direction or mechanism of the transfer, but pathogens (fungi, bacteria, viruses) and/or insects are likely culprits. Furthermore, the effect of the transposable element on its host genome is not known. This sort of genetic mixing has exciting implications for our understanding of possible causes for sudden bursts of evolutionary change in palms and other plants.


Meg Stewart

The Palms of Taiwan

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Unlike several other large islands with rich assemblages of palms such as Madagascar, New Caledonia and Cuba, the palm flora of Taiwan is conspicuous by its paucity of genera and species. Just five genera and seven species occur there, with only three genera and five species on the main island. Two other genera and two species, *Livistona chinensis* and *Pinanga tashiroi*, occur on the smaller offshore islands of Guishan and Lanyu respectively. Two additional species, *Areca catechu* and *Cocos nucifera*, are cultivated, sometimes commonly so, and have naturalized in many areas, especially in the southeast. Despite their paucity, Taiwan's indigenous palms are interesting, and two, *Arenga engleri* and *Livistona chinensis*, are hardy, durable, dependable and widely cultivated ornamentals.

Straddling the Tropic of Cancer and about 180 km off the southeastern coast of mainland China, Taiwan is about 330 km long and 120 km wide in a nearly north-south configuration, comprises 35,883 km^2 and encompasses several small islands or island groups, including Guishan (Turtle Island) and Lanyu (Orchid Island), which figure significantly in this discussion. Taiwan has several tall (to 3952 m), rugged mountain ranges stretching along

two-thirds of the eastern side of the main island. These slope to flat or gently rolling plains in the western third where most of Taiwan's 24 million people live.

Taiwan's climate is primarily subtropical in the north to tropical in the south, with some seasonal variation in temperatures and precipitation. Island-wide hot, humid, wet weather occurs from June through September, a period typically punctuated with often numerous typhoons (hurricanes). The northern part of the island has rain mostly evenly distributed year round while the southern part is rainy in the summer and somewhat dry in the winter. The average annual temperature is about 22°C in the north and 24°C in the south. Average winter temperatures are about 15°C in the north and 19°C in the south. The wettest areas are along the eastern slopes of the mountains (up to 6700 mm annually), while the driest areas are along the western plains (less than 1000 mm annually) (TCWB 2014).

Because of its location, topography and climate, Taiwan encompasses a wide variety of vegetation types, from wet to dry, tropical lowland to subalpine cold-temperate, including coniferous, broad-leaved evergreen, monsoon, thickets, grasslands, swamps and bogs, bamboo and mangrove communities. Indeed, the vegetation types of Taiwan are a microcosm of those found in the world (Song & Xu 2003).

Taiwan's seven indigenous and two naturalized species of palms encompass three subfamilies of the palm family: Calamoideae (*Calamus*); Coryphoideae (*Arenga, Livistona*, and *Phoenix*); and Arecoideae (*Areca*, *Cocos*, and *Pinanga*). For the most part, affinities of the palm flora are with mainland China although the two indigenous palms on tiny Lanyu Island (*Calamus siphonospathus* and *Pinanga tashiroi*) extend to or are more closely allied with species from the Philippines to the southeast. While the family occurs island wide, it is most diverse and more common in the wetter areas of the mountainous eastern two-thirds of the main island. Of the indigenous palms only *Phoenix loureiroi* occurs in the drier western one-third of the main island.

1. *Areca catechu* is commonly cultivated in Taiwan and frequently naturalizes, as here on Lanyu Island (D.R. Hodel).

Key to Species of Taiwan's Indigenous and Naturalized Palms

1a. Leaves palmate . . . . . *Livistona chinensis*

1b. Leaves pinnate 2

2a. Pinnae induplicate (trough formed by pinna fold facing adaxially or upwards) . . . 3

3a. Proximal pinnae reduced to spines, pinnae apices pointed, abaxial pinnae surfaces green . . . . . *Phoenix loureiroi*

3b. Proximal pinnae not reduced to spines, pinnae apices jaggedly toothed, abaxial pinnae surfaces silvery gray . . . . . *Arenga engleri*

2b. Pinnae reduplicate (trough formed by pinna fold facing abaxially or downwards) . 4

4a. Climbing palms armed with needle-like spines; fruits scaly 5

5a. Leaves with flagellum (clawed, whip-like climbing organ derived from the inflorescence) but lacking cirrus (clawed, whip-like leaf extension) . . . . . *Calamus beccarii*

5b. Leaves with cirrus but lacking flagellum 6

6a. Habit solitary; leaf sheath spines ± uniform, arranged in partial combs . . . . . *Calamus siphonospathus* var. *sublaevis*

6b. Habit clustered; leaf sheath spines variable, solitary . . . . . *Calamus formosanus*

4b. Erect palms; unarmed; fruits not scaly . . 7

7a. Leaf bases not forming a crownshaft; fruits typically 25 cm diam. or more . . *Cocos nucifera*

7b. Leaf bases forming a crownshaft; fruits typically 6 cm in diam. or less 8

8a. Major nerves on abaxial pinna surface with brownish scales . . . . . *Pinanga tashiroi*

8b. Major nerves on abaxial pinna surface lacking brownish scales . . . . . *Areca catechu*

Descriptions are from Pei et al. (2014), Henderson (2005, 2006, 2009), Hodel (1998) and supplemented with our observations on living plants in the field. Readers can also consult Phil Markey's on-line accounts of Taiwanese palms for additional information (Markey 2014a).

Areca catechu L. – betel nut palm, *bin lang*.

Moderate, solitary, tree palm to 20 m tall (Fig. 1). Stem to 15 cm diam., smooth, green, conspicuously ringed, aging gray to brown. Leaves 10–12, pinnate, ascending to spreading, eventually drooping, typically recurved and forming a compact canopy in high light, ± straight and forming an expansive canopy in low light, ± stiff; leaf bases 80–100 cm long, tubular, forming a well-developed, dark green, sometimes swollen crownshaft; petiole short, to 5 cm long; rachis 1.5–2 m long; pinnae 20–30 per side, 30–60 × 3–7 cm, close-set, regularly arranged, often ascending from rachis in high light; apical ones with truncate, coarsely toothed tips. Inflorescences 3–5, infrafoliar, to 60 cm long; peduncle short, to 3 cm long; rachis 25–40 cm long with several main branches; rachillae numerous, 20–25 cm long, slender, flexuous, erect and stiff in flower, drooping in fruit. Fruit 7–8 × 5–6 cm, ovoid, green, becoming orange.

Distribution and Ecology: The betel nut palm is cultivated from the tropical eastern coast of Africa and India to China, Southeast Asia, Taiwan, Micronesia, Malesia, New Guinea, Solomon Islands and Vanuatu, from sea level up to about 1000 m elevation. It frequently escapes cultivation or is intentionally planted in moist to wet, disturbed or even primary forest around homes and villages, where it readily naturalizes (Fig. 1).

Notes: Primarily cultivated for the hard seed, called betel or betel nut, it contains a mild narcotic that produces a pleasant, soothing feeling. Betel nut palms are extensively planted in central and southern Taiwan, and vast plantations containing 1000s of trees are a common sight. Taiwan is home to a thriving betel nut industry, both for domestic use as well as export. Small shops or stands selling betel nut, typically with flashing red lights, are a common sight along roads and in villages and towns throughout Taiwan.

Areca catechu is difficult to distinguish from *Pinanga tashiroi* on Lanyu Island, especially with juvenile and sterile adult plants, where the former has naturalized and the ranges of the two overlap. However, they can be distinguished in any instance because *A. catechu* has glabrous major nerves on the abaxial pinnae surface while *P. tashiroi* has nerves with brownish, scale-like hairs (see Fig. 34).

For a complete list of synonyms consult the World Checklist of Selected Plant Families (*http://apps.kew.org/wcsp/synonomy.do?name_id=14517*).

2. Robert M. Hodel provides scale for *Arenga engleri*, one of the most common and widespread palms of Taiwan. It typically forms large attractive clumps in the shady forest understory, as here at Pingtung (D.R. Hodel).

3. This narrow-leaved form of *Arenga engleri* is at Pingtung (D.R. Hodel).

Arenga engleri Becc. – Formosan sugar palm, *shan zong*.

Arenga tremula var. *engleri* (Becc.) Hatus.

Didymosperma engleri (Becc.) Warb.

Medium, moderately to densely clustered, shrubby, hapaxanthic, often gregarious, understory palm, forming clumps to 6 m tall and wide (Figs. 2 & 3). Stems several, erect to leaning, to 4 m tall, 15 cm diam., typically densely covered with persistent, fibrous leaf

4 (left). Pinnae margins of *Arenga engleri* are most often prominently lobed. 5 (right) Sometimes pinnae margins of *A. engleri* are unlobed (both by D.R. Hodel).

6. Fruits of *Arenga engleri* on Lanyu Island are about full size but still not reddish purple and ripe (D.R. Hodel).

bases. Leaves 6–8 per stem, pinnate, ascending to spreading; leaf bases deeply split opposite petiole, margins fibrous-netted, fibers extending more than half way to petiole of next upper leaf; petiole to 1.8 m long; rachis to 3 m long; pinnae up to ca. 40 per side with a triangular terminal pinna, to 70 × 2–4 cm, linear, regularly arranged, mostly flat in one plane except proximally, glossy dark green adaxially, silvery gray abaxially, briefly lobed mid-pinna or sometimes unlobed (Figs. 4 & 5), tips jaggedly toothed. Inflorescences several per stem, initiating distally and progressing proximally on stem, stem eventually dying, solitary at a node, to 60 cm long; rachillae 15, spreading, to 30 cm long. Fruit 1.5–2 cm diam., globose, orange to purplish or purplish red (Fig. 6).

Distribution and Ecology: *Arenga engleri* is widespread and now considered endemic in Taiwan, occurring nearly throughout the island from sea level up to about 1000 m elevation. Appearing to be a forest palm, it looks more luxuriant, graceful and natural in shaded situations. Although it is frequently encountered in exposed places, such as windswept coastal grasslands, rocky areas and disturbed forest, the plants in these harsher habitats never have the beauty and grandeur of their more protected, shaded counterparts.

Conservation Status: Because it is abundant and widespread, *Arenga engleri* is not considered threatened.

Notes: The range of *Arenga engleri* once extended into the Ryukyu Islands of southern Japan. However, Henderson (2006) concluded that the Japanese plants were a distinct species, and he named them *A. ryukyuensis*. He stated that *A. ryukyuensis* differed in its pinnae with prominent ribs adaxially and lacking mid-pinna lobes. Nevertheless, an examination of plants growing in Taiwan and the Ryukyu Islands showed variability in pinna lobing and adaxial ribbing, suggesting only one, highly variable species. *Arenga engleri* is hapaxanthic but not monocarpic because, while individual stems die after flowering, the plant lives on through the production of new stems from the base.

A handsome, relatively cold-tolerant (to -5°C) ornamental, widely cultivated around the world in suitable climates, *Arenga engleri* does best with a little shade during the hotter times of the day. Judiciously remove dead or unwanted stems to manage clump height, width, and density. Beware of the attractive fruits; while unusually colorful and eye-catching, they contain a highly irritating juice that cause severe, burning itch if it contacts tender skin.

7 (upper left). *Calamus beccarii* in Pingtung is a clustered rattan. 8 (upper right). Leaf sheaths are densely armed with short whorls of spreading, needlelike, black spines interspersed with shorter spines. 9 (bottom). The inflorescence of *Calamus beccarii* is up to 3 m long. (all by D.R. Hodel).

Calamus beccarii A.J. Hend. – *tu teng*.

Moderate, clustered, high-climbing, rattan palm to 50 m long (Fig. 7). Stems to 4 cm diam. with leaf bases, to 2 cm diam. without; internodes to 30 cm. Leaves pinnate, spreading; leaf base tubular, light green but densely covered with dark brown tomentum that ages to tan and then weathers away, densely armed with short whorls of spreading, needlelike, black spines to 2.5 cm long and interspersed with shorter spines to 5 mm long (Fig. 8), ocrea 1–2 cm high and densely spiny; knee poorly developed, flagella to 3 m long; petiole to 30 cm long; rachis to 1 m long; pinnae up to ca. 60 per side, to 40 × 1.5 cm, linear, regularly arranged and flat in 1 plane, closely set, veins minutely bristly; cirri lacking. Staminate and pistillate inflorescences somewhat similar, flagelliform, to 3 m long, branched to 2 orders (Fig. 9); partial inflorescences up to 6, these to 50 cm apart,; staminate partial inflorescences to 15 cm long (Fig. 10), rachillae up to 8, to 10 cm long, flexuous; pistillate partial inflorescences up to 45 cm long (Fig. 11), rachillae up to 12, to 8 cm long. Fruit to 2 × 1.2 cm, globose-ellipsoid, brown, scales fringed.

10 (top). Staminate plants of *Calamus beccarii* have relatively short partial inflorescences with congested flowers. 11(bottom). Pistillate partial inflorescences of *Calamus beccarii* are longer, with more remotely placed flowers than their staminate counterparts (both by D.R. Hodel).

12. Juveniles of *Calamus beccarii* are especially attractive (D.R. Hodel).

Distribution and Ecology: Endemic to the main island, *Calamus beccarii* is uncommon at several locations in Kaohsiung and Pingtung counties in southern Taiwan, where it occurs in lowland moist to wet forest up to about 500 m elevation.

Conservation Status: Because *Calamus beccarii* is known from relatively few, scattered locations and is frequently cut to extract the edible apical meristem ("heart"), it is likely threatened and perhaps should be considered vulnerable. Fortunately, this species is of clustered habit so cutting the stems to remove the edible meristem does not kill the plant but might help to maintain it in a perpetually immature or juvenile state, thus reducing its chances to reproduce sexually and enhance or spread populations through seed dispersal.

Notes: Although long recognized as one of the three rattan species in Taiwan but confused with *Calamus formosanus*, *C. beccarii* was without a name until Henderson (2005) formally described it. Juvenile, non-climbing plants are especially leafy and attractive (Fig. 12).

Calamus typically has pistillate inflorescences branched to two orders and staminate branched to three; thus, *C. beccarii* is unusual in that staminate inflorescences apparently are branched only to two orders rather than three.

Calamus formosanus Becc. – *huang teng, sheng teng*.

Calamus orientalis C. E. Chang

Calamus quinquesetinervius Burret.

Moderate, clustered, high-climbing, rattan palm to 40 m long (Fig. 13). Stems to 5 cm diam. with leaf bases, to 2.5 cm diam. without; internodes to 25 cm. Leaves pinnate, spreading; leaf base tubular, light green to yellowish brown, sparsely covered with tan tomentum that ages to gray and then weathers away, densely armed with solitary, spreading to ascending, narrowly triangular, greenish-based, brownish spines to 2.5 cm long (Fig. 14), ocrea to 1 cm high; knee conspicuous; flagella absent; petiole nearly lacking to 10 cm long; rachis to 2.5 m long; pinnae up to ca. 30 per side, to 45 × 5 cm, lanceolate to broadly lanceolate, more or less regularly arranged, sometimes irregularly arranged (nearly always irregularly arranged in juvenile, non-climbing individuals (Figs. 15 & 16), tips drooping, distantly spaced, veins bristly; cirri to 2 m long. Staminate and pistillate inflorescences dissimilar, flagelliform, staminate to 1 m long, branched to 3 orders, pistillate to 1.5 m long, branched to 2 orders; staminate partial inflorescences up to 8, to 20 cm long, to 10 cm apart, rachillae up to 12, to 3 cm long, flexuous; pistillate partial inflorescences up to

13 (upper left). *Calamus formosanus*, fairly common and widespread in Taiwan, is a moderate, clustered, rattan, as here in Pingtung. 14 (upper right). Leaf bases are densely armed with solitary, spreading to ascending, narrowly triangular spines. 15 (bottom). Leaves frequently have irregularly arranged pinnae. (all by D.R. Hodel).

16 (top). Juvenile, non-climbing plants of *Calamus formosanus* nearly always have irregularly arranged pinnae. 17 (bottom). Rachillae of pistillate inflorescences are up to 10 cm long. Inset: Fruits of *Calamus formosanus* are ellipsoid and ripen white (all by D.R. Hodel).

14, to 6 cm apart, rachillae up to 12, to 10 cm long (Fig. 17). Fruit to 2.2 × 1 cm, ellipsoid, yellowish brown to whitish (Fig. 17).

Distribution and Ecology: Endemic to the main island, *Calamus formosanus* is common and widespread, occurring in lowland moist to wet forest up to about 1000 m elevation.

Conservation Status: Because *Calamus formosanus* is common and widespread, it is not considered threatened although, like *C.*

18 (clockwise from upper left). On Lanyu Island *Calamus siphonospathus* var. *sublaevis* is a solitary, high-climbing rattan. 19. Once devoid of leaf bases, stems are about 2.5 cm in diameter. 20. Its leaf bases are densely armed with short combs or partial whorls of spreading, needle-like spines. 21. Leaves have up to 75 pairs of narrow, close-set, regularly arranged pinnae. 22. Fruits are globose-ellipsoid and ripen white. 23. Pistillate inflorescences are about 2 m long, branched to 3 orders. (all by D.R. Hodel).

beccarii, stems are sometimes cut to remove the edible meristem.

Notes: *Calamus formosanus,* still widely known as *C. quinquesetinervius*, is somewhat variable across its wide range. Juvenile, non-climbing specimens have clustered, irregularly arranged pinnae, a condition that remains sometimes even after the plants have started to climb (Fig. 16). This variability has resulted in the two synonyms and is responsible for the confusion that "hid" *C. beccarii* until recently.

Calamus siphonospathus Mart. var. **sublaevis** Becc. – *lanyu sheng teng, guan bao sheng teng*.

Large, robust, solitary, high-climbing, rattan palm to 40 m long (Fig. 18). Stem to 10 cm diam. with leaf bases, to 2.5 cm diam. without; internodes to 25 cm. (Fig. 19). Leaves pinnate, spreading; leaf base tubular, green to yellowish brown, densely covered with whitish tomentum that ages to gray and then weathers away, densely armed with short combs or partial whorls of spreading, needle-like, greenish-based, brownish spines to 2 cm long (Fig. 20); ocrea 1 cm high, membranous; knee conspicuous to obscure; flagella lacking; petiole to 25 cm long; rachis to 2.5 m long; pinnae up to ca. 75 per side, to 35 × 2.5 cm, linear, regularly arranged (Fig. 21), slightly elevated off rachis, closely spaced, veins bristly; cirri to 2.5 m long. Staminate and pistillate inflorescences probably dissimilar, not flagelliform; staminate not seen but reported (Beccari 1908) to be to 1 m long with several partial inflorescences (Fig. 23), rachillae to 1.5 cm long, flexuous; pistillate to 2 m long, branched to 3 orders, curved, fairly stout, partial inflorescences up to 10, to 15 cm apart, to 20 cm long, each branch with up to 6 rachillae to 8 cm long. Fruit to 0.6 × 0.4 cm, globose-ellipsoid, yellowish brown to whitish (Fig. 22).

Distribution and Ecology: *Calamus siphonospathus* is more widespread in the Philippines and extends into Taiwan only on Lanyu Island, where it occurs in moist to wet forest up to 500 m elevation. It also occurs in Indonesia in North Sulawesi.

Conservation Status: Because *Calamus siphonospathus* var. *sublaevis* is localized on the small island of Lanyu, it should be considered locally vulnerable, although in the Philippines it is not threatened.

Notes: *Calamus siphonospathus* var. *sublaevis* is a big, impressive, conspicuous rattan palm on Lanyu, where it is found with *Pinanga tashiroi*. In the Philippines it is much more variable and several additional varieties have been recognized.

As mentioned above, *Calamus* typically has pistillate inflorescences branched to two orders and staminate branched to three; *C. siphonospathus* var. *sublaevis* is unusual in that pistillate infloresces are branched to three orders.

24. *Cocos nucifera* is cultivated and infrequently naturalizes in southern Taiwan (C.-F. Chen).

25. *Livistona chinensis* forms vast, gregarious stands on Guishan Island where its grayish leaves and bright yellow inflorescences are conspicuous against the green vegetation (C.-F. Chen).

Cocos nucifera L. – coconut palm.

Mostly large, solitary, tree palm to 25 m tall (Fig. 24). Stem to 40 cm diam., often curved or leaning, expanded at based with exposed roots. Leaves 25–40, pinnate, ascending to drooping in a graceful canopy; leaf bases deeply split, stout, woody, margins with dense fibers, not forming a crownshaft; petiole to 1.5 m long, stout, yellowish; rachis to 7 m long; pinnae up to 100 per side, to 100 × 10 cm, linear, regularly arranged, drooping, dark green with prominently elevated midrib. Inflorescences up to 12, interfoliar, spreading, to 1.5 m long; peduncle to 50 cm long, stout; rachillae up to 50, to 45 cm long, stiffly spreading. Fruit to 30 × 25 cm, ellipsoid-globose, 3-sided, greenish yellow.

Distribution and Ecology: *Cocos nucifera* has occasionally naturalized in southeastern Taiwan, mostly in Kaohsiung, Pingtung, and Taitung Counties at low elevations. It is widely cultivated and has naturalized in many tropical regions of the world, especially in coastal areas.

Notes: Although its exact date of introduction is unknown, *Cocos nucifera* has long been cultivated in southern Taiwan, especially Pingtung County, for more than 500 years, mostly for its fruit but also leaves, fiber, and wood (stem). Fruit production likely peaked in the late 20th century but has declined since then because of less expensive, South Asian imports. Its primary use now is as an ornamental landscape subject.

Livistona chinensis (Jacq.) R. Br. ex Mart. – Chinese fan palm, Chinese fountain palm, *pu kui*.

Moderate, solitary, tree palm to 15 m tall. Stem to 30 cm diam., typically initially covered with persistent leaf bases and petiole stubs, these weathering away and then surface rough from leaf scars; internodes to 5 cm. Leaves to 45, palmate, ascending to drooping; leaf bases short, becoming deeply split opposite the petiole, stout, distal margins armed like petiole; petiole to 1.8 m long, margins armed with recurved, green or black teeth; hastula to 3 cm long; blades nearly circular, to 1.8 m wide, green, regularly divided to about one-half into up to 90 segments, these split and pendulous at tips. Inflorescences to 1.5 m long, interfoliar, yellowish in flower. Fruit to 2.6 × 1.8 cm, globose to ellipsoid or pear-shaped, green to blue-green.

Distribution and Ecology: In Taiwan, *Livistona chinensis* is known only from Guishan Island, where it occurs gregariously on steep slopes in low, wind-battered forest below 400

26 (upper left). Co-authors Adam Hsu (left) and Chien-Fan Chen (right) provide scale for this tall *Phoenix loureiroi* just inland from the beach on Lanyu Island. Note the salt-wind-burned leaves. 27 (upper right). This *Phoenix loureiroi* grows in dry forest on the western side of Taiwan near Taichung. 28 (bottom). This *Phoenix loureiroi* grows on alluvial soil just above the Beinan River on the wetter western side of Taiwan near Taitung (all by D.R. Hodel).

29 (top). Pistillate inflorescences of *Phoenix loureiroi* elongate beyond the protective acanthophylls and are orange when carrying mature fruit. 30 (bottom). Dry, grassy, disturbed, frequently burned slopes on the western side of Taiwan near Taichung are home to these *Phoenix loureiroi* (both by D.R. Hodel).

m elevation (Fig. 25), although it is widely cultivated around the main island. It is more widespread in mainland China, where it is found in Guangdong and Hainan, and in Japan, where it occurs in the Ryukyu Islands and southern Kyushu, mostly in moist forest at low elevations, often near the sea coast. Markey (2014a) noted that it also occurs on the tiny island of Uotsurijima (Japanese) or Diaoyudao (Chinese), which is the largest

island of the Senkaku (Pinnacle) Islands, currently controlled by Japan but claimed also by China and Taiwan. On this island, Markey estimated the population of the palms at over 100,000 individuals, making it by far the largest population of this species in the world.

Conservation Status: Because *Livistona chinensis* is localized on the small island of Guishan, it should be considered locally vulnerable in Taiwan. Indeed, human activity has much affected and disturbed its range from China to southern Japan. Its discontinuous, isolated populations, with often localized distribution on small islands within this range, likely make it vulnerable but its conservation status has not yet been thoroughly assessed.

Notes: Likely tolerating temperatures to about to -5°C or lower (depending on its provenance) with little or no damage, *Livistona chinensis* is widely cultivated in Taiwan and worldwide wherever palms can be grown. A highly variable species across its range, the conspicuously pendulous segment tips, set on tiered leaves, give the canopy the impression of a fountain; hence, the other common name for this palm. The infructescences are especially attractive when heavily laden with ripe, blue-green or turquoise fruit.

Livistona chinensis was represented in Taiwan by var. *subglobosa* but now most authorities simply consider this variety to be a synonym of the species. Markey (2014b), who provided an otherwise interesting account, maintained, however with some doubt, var. *subglobosa* for the Taiwanese *L. chinensis*, stating that it is "a much more attractive form than the usual form of *Livistona chinensis* found in Southern China, and is also more cold-hardy." Furthermore, he stated that the seed of the mainland China form (var. *chinensis*) "produces a typically elongate, smaller seed (15–9 mm) than the Japan/Taiwan form which produces a larger, more globose seed (18–12 mm)." His claim, though, that "no wild populations [of *L. chinensis*] exist in Taiwan today" is untrue (unless he is referring to the island of Taiwan proper) because the population on Guishan Island is certainly indigenous and natural.

For a complete list of synonyms consult the World Checklist of Selected Plant Families (*http://apps.kew.org/wcsp/synonomy.do?name_id=114913*).

Phoenix loureiroi Kunth. – *haizao*, *ci kui*.

Small to moderate, mostly solitary, rarely clustered, tree palm to 5 m tall (Figs. 26–28 &

31. On the wetter, eastern side of Taiwan *Phoenix loureiroi* grows just in back of the beach near Gangxi in Pingtung (D.R. Hodel).




32 (upper left). Restricted to Lanyu Island, *Pinanga tashiroi* is a solitary, understory tree palm. 33 (upper right). *Pinanga tashiroi*. 34 (lower left). Pinnae of *Pinanga tashiroi* have the major nerves on the lower surface covered with brownish, scale-like hairs (left) while those of the similar *Areca catechu* are glabrous (right). 35 (lower right). Inflorescences of *Pinanga tashiroi* are drooping (all by D.R. Hodel).

31). Stems to 40 cm diam., typically covered with persistent, diamond-shaped leaf bases for many years, these eventually weathering away and then surface rough from leaf scars; internodes to 4 cm. Leaves pinnate, ascending to drooping; leaf bases short, deeply split, stout; petiole lacking or to 10 cm long; pseudopetiole to 30 cm long, armed with up to 15 acanthophylls per side; rachis to 2 m long; pinnae up to 130 per side, irregularly arranged and spreading in different planes, to 50 × 4 cm, linear, sharp- and stiff-pointed. Inflorescences interfoliar, staminate and pistillate dissimilar; staminate to 65 cm long, erect, rachillae up to 30, to 10 cm long; pistillate to 2 m long, orange, spreading (Fig. 29), rachillae up to 40, to 40 cm long. Fruit to 1.8 × 0.9 cm, ellipsoid, dark purple to black.

Distribution and Ecology: *Phoenix loureiroi* occurs throughout nearly all of Taiwan and inhabits a variety of sites, including grassy areas, sand dunes, steep slopes, mixed forests, *Pinus* forests, and open, disturbed, often dry forests and places subject to burning, up to 1700 m elevation (Fig. 30). It often occurs in harsh sites, such as steep rocky slopes and windswept coastal areas. It is the only palm found in the dry western one-third of Taiwan. It also occurs in mainland China, Southeast Asia and the Philippines, India, Bhutan, Nepal and Pakistan.

Conservation Status: Because *Phoenix loureiroi* is widespread in Taiwan and adaptable to a variety of sites, it is likely not threatened, although it has yet to be assessed officially.

Notes: *Phoenix loureiroi* is a highly variable species across its wide range resulting historically in numerous synonyms. For a complete list of synonyms consult the World Checklist of Selected Plant Families (*http://apps.kew.org/wcsp/synonomy.do?name_id=152690*). Two varieties are accepted: var. *loureiroi*, which occurs in Taiwan and has newly opened pinnae with brown filament along the margins and var. *pedunculata*, which is restricted to the Indian subcontinent and lacks the brown filament. *Phoenix loureiroi* is an overlooked or undeservedly rare palm horticulturally and, because of its ornamental nature, small size and tolerance of adverse, harsh conditions, deserves wider use in the landscape.

Pinanga tashiroi Hayata – *lanyu shan bin lang*.

Pseudopinanga tashiroi (Hayata) Burret

Moderate, solitary, understory tree palm to 5 m tall (Figs. 32 & 33). Stem smooth, green, conspicuously ringed, aging gray to brown, to 10 cm diam. Leaves 10–12, pinnate, ascending to spreading, eventually drooping; leaf bases to 1 m long, tubular, forming a well-developed, dark green, sometimes swollen crownshaft with reddish brown scale-like hairs; petiole to 60 cm long; rachis to 2 m long; pinnae to 50 per side, to 60 × 2.5 cm, linear, close-set, regularly arranged, primary nerves abaxially with brownish scale-like hairs (Fig. 34); apical ones with truncate, jaggedly toothed tips. Inflorescences 3–5, infrafoliar, to 50 cm long, pendulous, 1-branched (Fig. 35); peduncle short, to 8 cm long; rachis to 40 cm long; rachillae up to 30, to 25 cm long, slender, flexuous, stiff, drooping in flower and fruit. Fruit to 1.8 × 1.2 cm, ovoid to globose, red (Figs. 36 & 37).

Distribution and Ecology: *Pinanga tashiroi* is endemic to Lanyu Island, where it occurs in moist to wet forest up to 500 m elevation.

Conservation Status: Because *Pinanga tashiroi* is known only from a small island just several kilometers across and unusually small population numbers, it is considered Critically Endangered (IUCN 2014). It is cultivated in the Taichung Botanical Garden and Taipei Botanical Garden.

Notes: Seeds of *Pinanga tashiroi* are chewed as a substitute for betel nut (*Areca catechu*), with which it can be confused, especially when juvenile or non-flowering. Indeed, wild, naturalized plants of *A. catechu* are frequently sympatric with *P. tashiroi*, especially at the latter's lower elevational range. However, non-flowering plants can be distinguished by the primary nerves on the abaxial surface, which in *P. tashiroi* have brownish scales while in *A. catechu* are glabrous.

Although Henderson (2009) and Pei et al. (2014) stated that *Pinanga tashiroi* can be solitary or clustered, we saw only solitary plants. Careful comparison of *P. tashiroi* with some of its Philippine counterparts might show it not to be distinct.

That *Pinanga tashiroi* grows well in the relatively cooler climate, especially in the winter, in Taipei in the northern part of Taiwan seems significant. It is likely one of the few cool-tolerant species of *Pinanga* and is worthy of trial in marginal palm-growing areas with subtropical or Mediterranean climates.

Acknowledgments

We thank Professor Sheng-Zehn Yang who assisted in this study and made available Wei-

36 (left). These fruits of *Pinanga tashiroi* are about full size but unripe (D.R. Hodel). 37 (right). Fruits of *Pinanga tashiroi* are red when mature (A.C. Hsu).

Yu Wang and Kuan-Wei Li to help us in the field.

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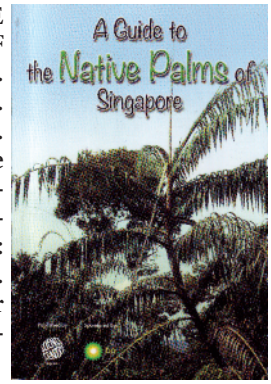
PALM LITERATURE

A GUIDE TO THE NATIVE PALMS OF SINGAPORE – A.H.B. Loo, A.W. Foong, W.J. Baker and H.T.W. Tan. Science Centre Singapore, Singapore. 2014. ISBN 978-981-07-8878-0. Price: Unknown. Softcover. 176 pages. Color illustrations throughout.



Among palm lovers, Singapore is perhaps best known for the spectacular horticultural achievements of the Singapore Botanic Gardens and Gardens by the Bay. Not so well known (even among Singaporeans) are the island's native palms, which still persist in pockets of native forest in stalwart defiance of rampant urbanization. A few species have lost the battle – a dozen are no longer found on the island – but 42 taxa remain. This splendid little guide provides a useful account of the extant palm species.

In this compact (only 10.5 × 15 cm) guide, Loo and coauthors begin with a brief but lucid introduction to the unique morphology of palms in general and some of the specialized terminology. The text paints a clear and colorful picture of palms, such as the description of Royal Palms (*Roystonea regia*) that "reach for the sky in a most uncompromising way." The introduction discusses economically important palms in the region. The authors give equal time to the economic boon and environmental devastation brought by African oil palms to Southeast Asia. The introduction goes on to describe the growth habits of palms, including rattans, the leaf diversity (pinnate, palmate, bipinnate), the crownshaft, climbing organs (cirrus, flagellum), flowers and fruits.

The bulk of the book is made up of the individual portraits of the extant species, starting with the non-rattans (both feather and fan palms) and ending with the rattans. Each species treatment begins with a full-page portrait, which may be followed by additional photos of interesting or diagnostic features. The accompanying text, organized in the same way for each species, includes Common Names, World Distribution, Local Distribution, Characteristics, Conservation Status and Notes of Interest. In addition, the authors include Horticultural Value, Propagation, Availability [in the nursery trade] and Drawbacks/Advantages. This additional horticultural information is not generally found in local guides of this sort and makes this book all the more useful.

I very much enjoyed reading the Notes of Interest for the species. Here, the authors included local uses of the palm, ecological observations, etymology or even (in the case of *Caryota mitis*) that it is the food host for the larvae of the Tufted Jungle King butterfly (*Thauria aliris*). Very often, the species is contrasted with similar or related species from the flora, highlighting key differences. In only one case (that of *Iguanura geonomiformis*) was the species compared to a species (*I. wallichiana*) that does not occur in the flora, although perhaps the latter species is familiar in Singaporean horticulture.

As is customary, the book includes a plea for the conservation of palms. The table on p. 54–56 lists all 42 extant taxa and their conservation assessments, along with the dozen species presumed extinct on the island. Shockingly, only one species (*Caryota mitis*) is considered common enough not to warrant some level of conservation concern. Some species, listed as Critically Endangered, are teetering on the edge and may disappear from the island without continued protection, but even then, climate change may trump legal protection or forest conservation efforts. On a happier note, the authors mention several cases of palms once thought to be extinct but recently rediscovered on the island. Perhaps additional exploration will bring to light a few more of the "extinct" palms.

This guide is an excellent introduction to Singapore's native palms and is enthusiastically recommended for anyone interested in the island's natural history. It is the latest in a long list of handy guides to the flora and fauna of the island published by Science Centre Singapore. Attendees of the 2016 IPS Biennial, which will include Singapore on the itinerary, will surely want to have this book in their carry-ons when they arrive on the island.

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Dypsis rosea

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1. *Dypsis rosea* growing at Floribunda Palms, Hawai'i, showing the striking pink crownshaft and grouped leaflets (Photo: JD).

The palm widely cultivated as *Neophloga* 'Pink crownshaft' is described as *Dypsis rosea*, based on material from cultivation but also known from the wild.

Dypsis rosea J. Dransf, D.R. Hodel & J. Marcus **new species.** Superficially similar to *Dypsis pinnatifrons* Mart., but differing in its much larger size, distinctive pink, newly emerged leaf sheaths, inflorescences branched to 4 rather than 3 orders and staminate flowers with 6 rather than 3 stamens, didymous rather than sagittate anthers and low conical rather than pyramidal pistillode. Type: Hawai'i, garden of J. and S. Marcus, *Hodel 2016* (Holotype K).

Single-stemmed palm to 4 m tall. Stem 8–10 cm diam., conspicuously ringed, internodes 3–5 cm long. Leaves 15–20 in the crown (Fig. 1), erect-spreading to drooping, pinnate, newly emerged leaf tinged pink, the sheaths forming a well-defined crownshaft; leaf sheath to 48 cm long, tubular, 8–13 cm diam., when opened out and flattened 30 cm wide proximally, 35 cm wide mid-sheath and abruptly narrowing to 5 cm wide at petiole, completely encircling or clasping in proximal 12 cm, obliquely open in distal up to 36 cm, when newly emerged bright pink (Fig. 2), abaxially green tinged with pink towards the margins, covered with a thin layer of whitish wax medially, elsewhere covered with scattered reddish brown to pink, ragged, irregularly shaped clusters of hairs to 0.3 mm diam. near petiole, becoming smaller and more widely spaced toward base, striate-nerved with a raised rounded ridge extending from petiole for ca. 12 cm, adaxially bright yellow; petiole 0–2 cm long, 3–5 cm wide, flattened and brownish adaxially, rounded and greenish abaxially, covered with hairs as the sheath; rachis to 2.25 m long, strongly recurved, 3–5 cm wide at base, gradually tapering to 4 mm diam. at apex, adaxially flattened and abaxially rounded in distal half, rounded at apex, green and sparsely covered with minute hairs as petiole and base; leaflets to 40 on each side of the rachis, arranged in ca. 9 groups of 2–6 leaflets each and conspicuously fanned in several planes to give a plumose appearance, groups ca. 20 cm apart proximally and ca. 10 cm apart distally, proximal leaflets nearly erect and the distal ones flat in the same plane as rachis, proximal leaflets to 25 × 4 cm, mid-rachis leaflets to 55 × 10 cm, most distal leaflets to 15 × 5 cm, slightly falcate, margins uneven and leaflets slightly cupped downwards, tips acuminate and drooping, base with swollen warty protuberance at point of attachment, up to 3 primary nerves prominent adaxially and slightly raised abaxially, secondary and tertiary nerves faint adaxially and slightly raised abaxially. Inflorescences interfoliar or infrafoliar, pendulous in flower and fruit, branched to 4 orders (Fig. 3); peduncle to 45 cm long, 6 cm wide and 1.5 cm thick at base, to 4.5 cm wide and 1.5 cm thick at apex, downward curved; prophyll to 55 cm long, 2–keeled, coriaceous, attached 10 cm distal to the peduncle base with lateral margins extending nearly to peduncle base, exceeding and concealing bases of three most proximal branches, in places densely covered with reddish brown tomentum, peduncular bract 1, attached 25 cm above peduncle base, not seen, leaving a short collar-like base 1–1.5 cm high; rachis 1.3 m long, straight to slightly curved, at base 5 cm wide and 1 cm diam., at apex 3–4 mm diam., with up to 30 1st-order branches, the most distal simple rachillae, the most proximal the largest and most highly branched, these attached at right angles to the rachis and with a rigid basal portion and downward-curved secondary rachis, to 70 cm long and with up to 20 2nd-order branches, these to 25 cm long and with up to 11 3rd-order branches, ± to 8 cm long; rachillae to 45 cm long, 1 mm diam. proximally, 0.6 mm

2. *Dypsis rosea*, detail of crown, Floribunda Palms, Hawai'i (Photo: DRH).

3. *Dypsis rosea* with a young inflorescence clearly branched to four orders, in the garden of Mr. and Mrs Piercy, Hilo, Hawai'i (Photo: JD).

diam. distally, slender, pendulous, glabrous. Staminate flowers in bud ca. 1.1 × 1.4 mm; sepals irregularly keeled, 0.8 × 1.0–1.2 mm, the outer 2 more strongly keeled and larger than the innermost; petals 1 × 1.1 mm, faintly striate; stamens 6, biseriate, the antisepalous stamens with filaments to 0.2 × 0.2 mm, the antipetalous with filaments to 0.5 × 0.2 mm,

4. *Dypsis rosea*, heavily laden with fruit, Floribunda Palms, Hawai'i (Photo: JM).

anthers didymous, 0.7 × 0.7 mm, dehiscence introrse; pistillode a low pyramidal protrusion, scarcely 0.1 mm high. Pistillate flower buds very immature, ca. 1 mm diam. Fruits (Fig. 4) 11–13 × 7–9 mm, ellipsoid. Seeds 8 × 5 mm, endosperm homogeneous.

This beautiful palm has long been recognized by growers as being a distinct species, widely called *Neophloga* 'Pink crownshaft.' Originally introduced to Australia by Rolf Kyburz, who cannot remember the precise locality where the seed originated, the palm is now

widespread and popular in cultivation. Unfortunately, it has taken rather a long time to assemble evidence for disentangling it from *D. pinnatifrons* with which it had been confused in *The Palms of Madagascar* (Dransfield & Beentje 1995). The source of the problem is the palm described initially by Jumelle and Perrier de la Bâthie (1913) as *Dypsis gracilis* var. *sambiranensis*, based on material collected by Perrier de la Bâthie from Lokobe, and later elevated to species rank as *Dypsis sambiranensis* (Jumelle 1933a). The basionym was also used in combinations with *Chrysalidocarpus* (*C. sambiranensis*) by Jumelle (1933b) and with *Adelodypsis* (*A. sambiranensis*) by Guérin (1950). We identified a palm from Marojejy illustrated in *The Palms of Madagascar* as being a robust form of *Dypsis pinnatifrons* and equated it with Jumelle and Perrier's *D. sambiranensis* that we included in synonymy with *D. pinnatifrons*. The strong similarity between *Neophloga* 'Pink crownshaft' and the robust Marojejy palm raised several questions. Were they the same species? Was this *D. pinnatifrons*? Was *D. sambiranensis*, after all, distinct from *D. pinnatifrons,* or were we dealing with yet another undescribed species?

The plant illustrated on page 338 of *The Palms of Madagascar* has a different appearance from typical *D. pinnatifrons*. Not only is it more robust but the leaf sheaths are strikingly pink-tinged when freshly exposed, and the inflorescence is branched to four orders, features shared with *Neophloga* 'Pink crownshaft.' We have no doubt now that the Marojejy palm illustrated in *The Palms of Madagascar* is the same as 'Pink crownshaft.'

All growers argued that 'Pink crownshaft' was distinct from *D. pinnatifrons*. Material is rarely complete, and our original determinations were made without having access to staminate flowers. In marked contrast to *D. pinnatifrons*, which has 3 stamens with sagittate anthers and a conical pistillode, 'Pink crownshaft' has 6 stamens with didymous anthers and a low pyramidal pistillode and is thus very different. What can we say about *D. sambiranensis*? The type specimen of this taxon (*Perrier 18742* – P) has an inflorescence branched to three orders (as in *D. pinnatifrons*), but there is little else that can be used to differentiate it. We thus maintain *D. sambiranensis* as a synonym of *D. pinnatifrons* and describe 'Pink crownshaft' as a new species, *Dypsis rosea*. We have been able to match some specimens from the wild with *D. rosea,* and it seems to be a plant of ever-wet forest in the north of the island. Unfortunately, specimens often lack the staminate flowers that would allow certain determinations, so some material may remain tentatively identified as *D. rosea* based on the inflorescence branching.

Acknowledgments

We thank Rolf Kyburz for comments on the origin of the new palm.

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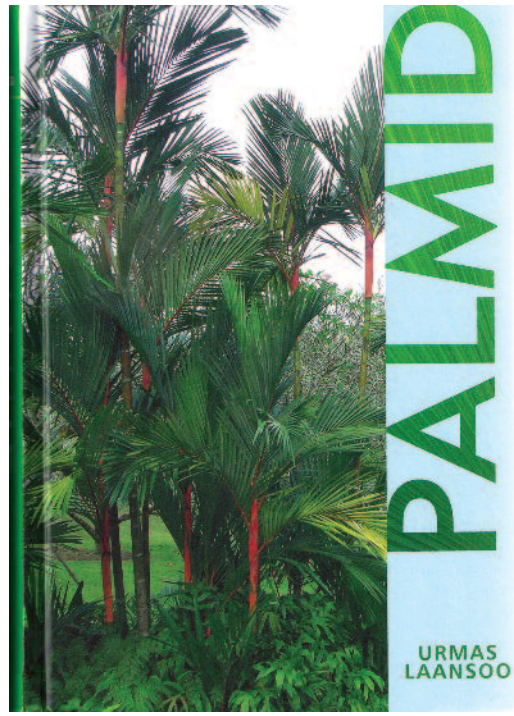
PALM LITERATURE

PALMID – U. Laansoo, Kirjastus Varrak, Tallinn, Estonia. 2014. Pp 352, numerous photographs. Price €27.70, presumably available from the publisher.

This is a beautifully produced book, elegantly designed and filled with photographs and is the first book devoted to palms in Estonian. I have relied on the description of the book I received by email from the author with whom I have corresponded for several years, as Estonian is beyond my linguistic capabilities! Clearly there is a great deal of information about palms in the book. Unlike most palm books that describe palms genus by genus in alphabetical order, this book deals with palms differently. There are chapters on palm regions, most species rich genera, changes in palm systematics, palms as symbols, palms as national trees, record breaking palms, the significance of palms in the world, plants that are called palms but are not, how to grow palms at home, winter hardy palms, the most popular palms of the world, holy palms, the most unusual palms, red palms, the smallest and tallest palms, the most important palms, monotypic genera, the rarest palms and those that are extinct in the wild and palm species described in the 21st Century. It provides a guide to where to go to see palms and lists palm societies and clubs and important books about palms. A glossary of palm terms is provided and palm names in Estonian are provided with their Latin equivalents. This lovely book should open up the world of palms to fellow Estonians. The author is to be congratulated on a fine publication.



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Saribus jeanneneyi at the Botanical Garden of Nancy

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1. A tall specimen of *Saribus jeanneneyi* now pushing toward the conservatory roof.

At the end of spring 2011, in Conservatoire et Jardins Botaniques de Nancy (CJBN), in northeast France, the extremely rare palm tree *Saribus jeanneneyi*, endemic to New Caledonia, flowered for the first time.

The CJBN is a scientific and cultural institute, co-managed by the Communauté Urbaine du Grand Nancy (local authority) and the Université de Lorraine. The CJBN includes the Montet Botanical Garden at Villers-lès-Nancy (in the suburbs of Nancy) and the Alpine Garden of Haut-Chitelet in the Vosges Mountains (located about 100 km from Nancy). More than 12,000 plant species are in cultivation in the park and greenhouses of Montet, with notably a collection of rare palms from the Mascarenes and other islands of the Indian Ocean, as well as New Caledonia.

As such, the CJBN grows *Saribus jeanneneyi*, previously known as *Pritchardiopsis jeanneneyi* (Bacon & Baker 2011), one of the world's rarest palms. Discovered in 1890, it was already rare at that time, and its intensive harvest for palm hearts decreased its population so much that it was thought to be completely extinct by the beginning of 20th Century (Beccari 1910, 1920). Fortunately, the palm was re-discovered in 1980 in the south of New Caledonia (Moore & Uhl 1984, Hodel & Pintaud 1998, Pintaud 2000, Baker & Pintaud 2008). Nevertheless, the species was in grave danger, because only one adult specimen had survived! An *in situ* conservation plan was immediately organized; the location was kept secret, and the zone closely watched. Although the plantlets were well protected, the majority of young specimens, which grew near the mother plant were stolen by unscrupulous enthusiasts.

3. Both the rachillae and flowers of *Saribus jeanneneyi* are deep red in color. Photo by P.-F. Valck.

At the same period, an *ex situ* conservation plan was considered; seeds were sent

2. The inflorescence of *Saribus jeanneneyi*.

4 (upper left). Young, developing fruits of *Saribus jeaneneyi*. 5 (upper right). A single, ripe fruit, rich orange-brown in color. 6 (lower left). A fruit cut open to show the thick mescarp and single, large endocoarp. 7 (lower right). The ridged endocarp containing a single seed. Photos by P.-F. Valck.

worldwide in the aim to grow this species, and with, ideally, the aim of its reintroduction. With the support of the New Caledonian branch of ORSTOM (Office de la Recherche Scientifique et Technique Outre-Mer – Office for Scientific and Technical Research in French Overseas Departments And Territories, now replaced by IRD [Institut de Recherche pour le Dévelop-pement – Institute for Research and Development]), a few seeds were sent to the CJBN in 1982. The seedlings were grown for a few years in clay pots in the tropical greenhouses, then, with the opportunity provided by the construction of a new greenhouse in 1987, one of the palm trees was planted in the ground in 1989. It settled little by little, with moderate growth during several years. It finally reached a state of vigorous development by 2005. This small plant that was 2 m in height at that time now exceeds 5 m (Fig. 1)! This surge of strength eventually resulted in blooming at the end of May 2011.

During anthesis artificial pollination was made; each day, flowers were pollinated amongst themselves with a small brush. After a few weeks, a majority of non-fertilized flowers fell, and small fruits began to form. Unfortunately, the intense heat of the early summer quickly killed all these young fruits. Luckily, in May of the following year, a second flowering with seven vigorous inflorescences occurred (Figs. 2 & 3).

To avoid excessive heat and ensure shade, shading was put above the inflorescences. The same care was given to these new flowers, with more success, however; the summer of 2012 was more favorable to fruit development and only a few young fruit failed to ripen. About 60 drupes ripened slowly, and the first mature fruit fell in the middle of July 2012 (Figs. 4–7). In total, 54 fruits were collected from 26 July to 11 October 2012.

All fruits were sown immediately, and different treatments were tried for the fruit – with or without pericarp, with or without soaking, antifungal chemicals, rasping, in many different substrates, etc. Finally, these methods did not make any difference. The first root was observed on 26 September 2012 from a seed sown on 26 July 2012. Leaves began to emerge from the ground in the middle of December 2013 (Fig. 8).

About 30 seeds were shared with eminent institutions and relevant growers, five stored in herbaria and the remainder were kept at Nancy's greenhouses to ensure the long term future of this species in our collections. In May

8. Young seedlings of *Saribus jeaneneyi* grown from seeds harvested from CJBN's plant. Photo by P.-F. Valck.

2014, about two years after the flowering that provided the fruits, 19 healthy young palm trees are in cultivation in the CJBN. News from other seeds sent out is also really optimistic. For such a rare species, the mortality rate is surprisingly low.

At the time when these lines are written, a new flowering has begun; five beautiful inflorescences have started to grow. The young flowers have already been pollinated by hand.

However, the bad news is that this tree has reached 5.5 m and the greenhouse where it grows is only about 6 m at this point. If we would like to keep this plant at the CJBN, we have three choices: move the plant in the greenhouse to a place where the roof is higher, build a new greenhouse for the palm tree, or increase the height of the current greenhouse. An alternative possibility could be to move the plant into another garden, but can this adult tree survive travelling? A last choice that would be the worst: if nothing is done, *Saribus jeanneneyi* will have to be chopped down when it becomes too high. This would be the cheapest choice, but needless to say nobody wants this! However, the problem is the lack of funding.

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Solfia Transferred to *Balaka*

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***Solfia*, a monotypic genus from Samoa, is synonymized with *Balaka*, based on molecular evidence. When transferred to *Balaka*, *Solfia samoensis* requires a new name for which we propose *Balaka insularis*.**

Recent research in the subtribe Ptychospermatinae has brought us incrementally closer to understanding the evolutionary history of this important, species-rich branch of the palm family tree. One long-standing problem in the group has been the disposition of *Solfia samoensis*, a seldom-seen species from Samoa. It was originally described by Rechinger in 1907, but soon thereafter was transferred to *Drymophloeus* by Martelli, based on the work of Beccari (Martelli 1935). The work of the first author (Zona 1999), analyzing morphological characters, suggested that the species be returned to its own genus. That decision was based on the fact that it lacked many of the characters of *Drymophloeus*, including wedge-shaped leaflets and a persistent peduncular bract.

The advent of molecular work shed new light on the phylogenetic position of *Solfia*. Initial studies (Norup et al. 2006; Baker et al. 2009) paired it, for the first time, with *Balaka*, a genus of seven species in Fiji and two in Samoa, but these studies had only one species of *Balaka* to compare with the one species of *Solfia*. More recent studies with two species of *Balaka* (Baker et al. 2011, Zona et al. 2011) continued to show *Solfia* to be most closely related to two *Balaka* species. In terms of the taxonomy, *Solfia* could continue to stand as a genus sister to all *Balaka* species, the position taken in *Genera Palmarum* ed. 2. (Dransfield et al. 2008).

The juxtaposition of *Balaka*, with its black, angular, beaked endocarps (square or pentagonal in cross-section) with *Solfia* (straw-colored endocarps, circular in cross-section) was unexpected. Hodel (2010) claimed that the Samoan *Balaka* species have obscurely or slightly angled endocarps with no beaks, but specimens examined by the first author of the Samoan *Balaka samoensis* (*Zona et al. 717*) and *B. tahitensis* (*McClatchey 1191*), both in the herbarium of Fairchild Tropical Botanic Garden (Fig. 1), have strongly angled endocarps with tapered beaks, similar in morphology to endocarps found in Fijian taxa.

The taxonomy fell apart with the work of Alapetite et al. (2014), which included five species of *Balaka*, along with *Solfia samoensis*. In their work, based on eight gene sequences, *Solfia* was unambiguously placed on the strongly supported branch of the tree that comprises *Balaka*. It resolved as sister to *B. tahitensis*, which despite its name, is native to Samoa. The remaining species of *Balaka* formed another very strongly supported branch. There are two solutions that would

1. Left to right, rachillae, fruit and seed of *Balaka tahitensis* (*McClatchey 1191*); fruits and seeds of *Solfia samoensis* (*Tipama'a 2*); fruits, seed and seed cross-section of *Balaka samoensis* (*Zona et al. 717*). Scale is mm.

make the taxonomy reflect the evolutionary history suggested by Alapetite et al. (2014). The first solution is to transfer the Samoan *Balaka* into *Solfia*. This option has molecular support but would make *Solfia* a disharmonious genus in which dark, angular endocarps are present in two (former *Balaka*) species and terete, straw-colored endocarps are found in the type species. The second option, the one followed here, is to sink *Solfia* into *Balaka*, thereby creating one monophyletic genus, *Balaka*, in which only one species is a morphological outlier.

When included in *Balaka*, *Solfia samoensis* requires a new epithet. The one chosen here is a nod to its home in Samoa and to its isolated morphology within the genus.

Balaka insularis Zona & W.J. Baker, **nom. nov**.

based on *Solfia samoensis* Rech., Repert. Spec. Nov. Regni Veg. 4: 233. 1907 (non *Balaka samoensis* Becc., Webbia 4: 267. 1914). Type: Samoa, Savai'i, August 1905, *K. Rechinger 79* (FI!).

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Tuberous Roots in *Ravenea xerophila*

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1. Greg Ksenzakovic holding sections of the tuberous root of *Ravenea xerophila*.

Tuberous, water-storing roots in *Ravenea xerophila* are described and illustrated. They are the first such roots ever recorded for a palm. Tuberous roots are probably an adaptation to the xeric habitat in which this palm grows in southern Madagascar.

It is a sobering thought that when we look at a palm, we are seeing only a fraction of it. The above-ground parts are plainly obvious, but the underground parts, namely the roots, are subterranean "dark matter" – we know they must be there, but we rarely see them. Roots comprise ca. 30–50% of a palm's total biomass (Goodman et al. 2013), and yet they remain poorly known. On the few occasions botanists have critically examined palm roots, they have found variation in anatomy that has taxonomic value at the generic (Seubert 1996a & b, 1997, 1998a & b) and species (Martel 2012) levels, diversity in structure and function (Tomlinson 1990, Jourdan & Rey 1997) and adaptations to anaerobic environments (De Granville 1974). Botanists have even discovered that, at the microscopic level, the cellulose orientation in the cell walls of palm roots is unique, unlike that of any other flowering plant (Kerstens & Verbelen 2002).

Even in the light of these remarkable findings, palm roots are too often ignored and assumed to be of little interest. So it was when we met Greg Ksenzakovic in the garden of Mike Harris of Cooper City, Florida. Greg casually mentioned his observation of thickened roots in *Ravenea xerophila*, a seldom-cultivated species restricted to a small area of dry and spiny forest in southern Madagascar (Dransfield & Beentje 1995). We were immediately intrigued, as no such roots had ever been noted for this or any other species of palm. Greg grabbed a shovel and satisfied our curiosity by excavating around a young *R. xerophila* and producing the section of the root seen in Fig. 1. The root was sliced by the shovel during excavation, but the general shape and size of the thickened region can be clearly seen.

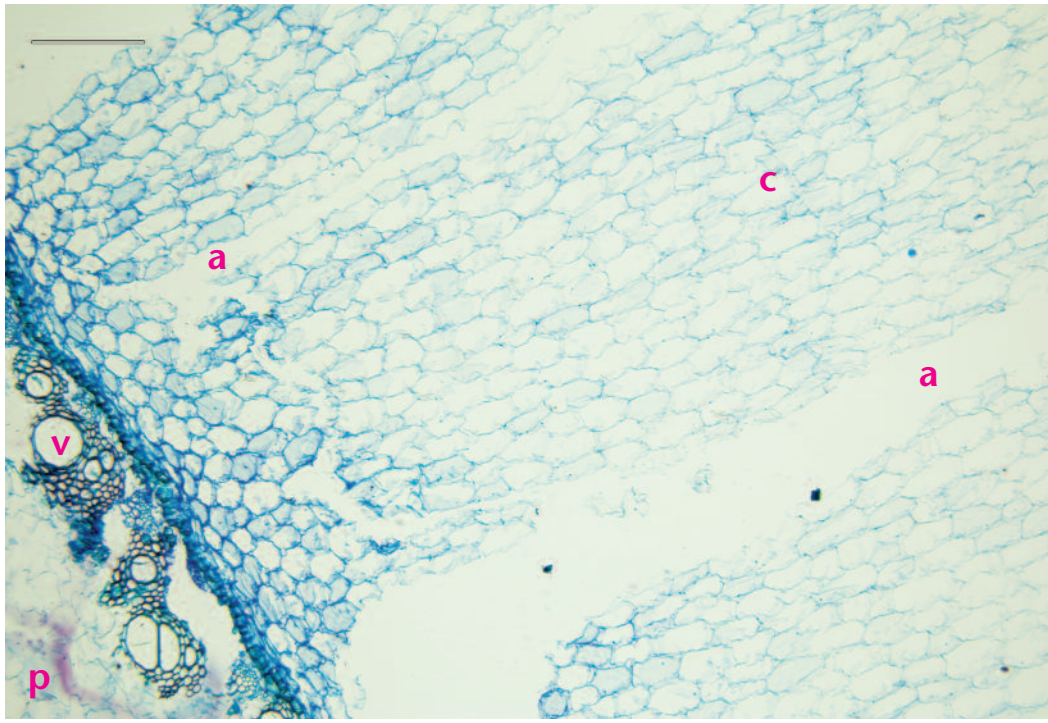
The root bearing the tuberous portion was growing laterally in soil at about 30–40 cm depth. Greg noted that tubers can occur up to 2 m away from the palm. The enlarged area that makes up the tuberous portion occurs within the length of the non-thickened root and is tapered at both ends. In the specimen we examined, the largest diameter of the thickened region is 3.5 cm, compared with 0.5 cm in the non-thickened root (Fig. 2). We estimate the length (from the two pieces) at ca. 30 cm. Fine roots, 0.1 cm in diameter, emerge from both the thickened region and the non-thickened root. The enlarged region shows no signs, externally or internally, of damage, so we conclude that it is not a pathogenic condition.

Anatomical investigation revealed that both the thick and thin roots are generally

2. Cross-sections of the tuberous root (right) and the non-thickened root (left) to which it was attached. Air-canals are visible as radial splits in the cortex. Scale divisions are millimeters.

differentiated into a surface layer, cortex and stele (terminology of Tomlinson et al. 2011). In both kinds of roots, the surface layer forms a tough cylinder (0.2 mm thick) of thick-walled, tanniniferous cells, making sectioning the root very difficult. In the tuberous root (Fig. 3), the cortex, comprising thin-walled parenchyma, is much larger than in the thin roots (ca. 10 mm vs. 0.5 mm thick). The cells of the cortex are radially elongated, ca. 162.2 µm long and 66.4 µm diameter and function in water storage. A few scattered raphide-containing cells were observed but no fibers or secretory canals. No starch granules were visible. Radial air-canals (lacunae) are present (Tomlinson 1990). The stele (vascular cylinder) of the tuberous root is also larger than that of the small roots (11.6 mm vs. 2.5 mm in diameter). The xylem and phloem, along with thin-walled fibers, form a thin cylinder (0.2–0.3 mm thick) around the thin-walled parenchyma of the pith, which lacks any distinguishing anatomical features.

As its epithet suggests, *Ravenea xerophila* grows in dry (xeric) habitats. Its stiff, waxy leaves are probably evolutionary adaptations to the dry, sunny conditions in which it grows. It really should come as no surprise that water-conserving adaptations extend to the root system as well. Water storage systems are clearly beneficial to species that are regularly subjected to drought stress. Such systems can be seen in succulent plants of all kinds. A dispersed storage system, scattered under-



3. Photomicrograph of a section though the tuberous root of *Ravenea xerophila* showing the cortex (c) with air-canal (a), vascular cylinder (v) and pith (p). Scale bar = 0.2 mm. Photo by Jack Wahl.

ground among the larger roots, would have obvious benefits in both redundancy and secrecy. Large, visible, water-storing stems or leaves might be more susceptible to attack by thirsty predators than the numerous, hidden storage roots of *R. xerophila*. The water-storing capacity of these roots is considerable. In a simple cylinder, volume increases with the square of the radius, so a 1-cm length of the non-swollen root has a volume of less than 0.2 cm^3 whereas the 1-cm length of the tuberous portion has a volume of more than 9.6 cm^3 – a 48-fold increase!

It is not known whether the morphology of these tuberous roots was affected by cultivation, under which the plants received irrigation during droughts. The fact that this palm produced tuberous roots even under irrigation, when water-storing structures are not "needed," suggests that the structures are under strong genetic control. Our observations were made on a single, cultivated individual. Clearly it would be highly desirable to examine the roots of wild *R. xerophila* growing in its natural habitat, as well as palms cultivated elsewhere, and compare them with the roots from the Harris garden.

The tuberous roots reported here drive home two important points. Firstly, we still know very little about palm roots. They represent a largely unknown area for palm research, and we cannot help but wonder what other interesting features of palm roots await discovery. Secondly, the observations of palm growers, who live and work with palms on a daily basis, are of tremendous value. The science of botany is advanced incrementally, and everyone can contribute useful data.

Acknowledgments

We are grateful to Greg Ksenzakovic for sharing his knowledge with us and allowing us to write about it. We thank Mike Harris for inviting us into his garden and allowing us to extract a sample from his *Ravenea xerophila*. Thanks also go to Brett Jestrow and Jack Wahl of Fairchild Tropical Botanic Garden for their help with sample preparation and photomicroscopy. This contribution 282 to the FIU Tropical Biology Program.

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ANNOUNCEMENT

World Palm Symposium 2015
Cocora Valley, Quindío, Colombia, June 22–26, 2015
http://palms2015.au.dk/

The World Palm Symposium 2015 will be held in the Cocora Valley, Colombia, home of the famous Quindío wax palm (*Ceroxylon quindiuense*), the world's tallest palm. For the first time, this event will take place in a tropical country, in fact, one of the world's most palm-rich countries.

The Symposium will be developed in collaboration between the National University of Colombia, the University of Aarhus, the Quindío Botanical Garden and the IRD and CIRAD institutes in France. There will be two field trips: a one-day visit to the huge stands of *Ceroxylon quindiuense*, where hundreds of thousands palms are to be found, and two trips to the Serranía del Baudó, in the Panama-Colombia border, home of the recently discovered *Sabinaria magnifica*. For further information, please contact Yisela Figueroa (yfigueroac@unal.edu.co).

Three New Palm Genera from Indonesia

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This paper is an illustrated introduction to three recently-described palm genera from Indonesia.

The past few years have seen a surge in the recognition of new palm genera. Some, like *Tahina* from Madagascar and *Sabinaria* from Colombia, were the results of new exploration yielding palms never before seen by botanists. Others, such as *Dransfieldia*, *Lanonia*, *Leucothrinax* and *Saribus*, were hiding in plain sight, masquerading as other genera, their new identities first revealed by DNA sequencing. The three recently-described Indonesian genera (Heatubun et al. 2014a) came to light as a result of both new exploration *and* molecular analyses. All three genera are monotypic and belong to the subtribe Ptychospermatinae, which includes important ornamental genera such as *Ptychosperma*, *Veitchia* and *Wodyetia*.

Two of the three genera were discovered in the course of work toward a comprehensive account of the palms of New Guinea (PoNG). The PoNG project, led from Kew but involving collaborators from many institutions, has instigated field work in New Guinea, focusing on areas not previously visited by botanists and has brought about the discovery and description of dozens of new species. Nevertheless, the discovery of two new palm genera in the offshore islands at the western end of New Guinea, and another new genus in nearby Halmahera (Fig. 1), in the span of just a few years was surprising and unprecedented.

The first herbarium specimens of the new genera, named *Jailoloa*, *Manjekia* and *Wallaceodoxa*, were collected in 2011, 1998 and 2006 respectively. All were easily assigned to subtribe Ptychospermatinae on the basis of their jagged (praemorse) leaflets and bullet-

shaped male flower buds with numerous stamens, but none of them conformed strictly to any accepted genus. It was not until French PhD student Elodie Alapetite completed an in-depth molecular analysis of the subtribe that persuasive evidence was obtained for the need for three new genera (Alapetite et al. 2014). In this work DNA sequence data from eight different gene markers were painstakingly assembled to produce a tree of relationships (phylogeny) among the members of Ptychospermatinae. The phylogeny provided much support for most well-known genera but highlighted the isolation of the three new genera plus *Adonidia* on two distinct branches, *Jailoloa* and *Manjekia* on one branch and *Adonidia* and *Wallaceodoxa* on the other. These taxa are not closely related to other Ptychospermatinae and are also morphologically distinct. Here we provide a summary of each new genus with photographic illustration of key features.

Jailoloa

Jailoloa is based upon *J. halmaherensis* (Fig. 2), a palm discovered by one of us (CH) on the island of Halmahera, in the North Moluccas (Fig. 1). It was discovered during the course of an environmental impact survey of a nickel mining area and was first described as a species of *Ptychosperma*, *P. halmaherense* (Heatubun 2011), based on its resemblance to that genus. The new generic name is taken from Jailolo (sometimes spelled Gilolo), the former indigenous name for Halmahera.

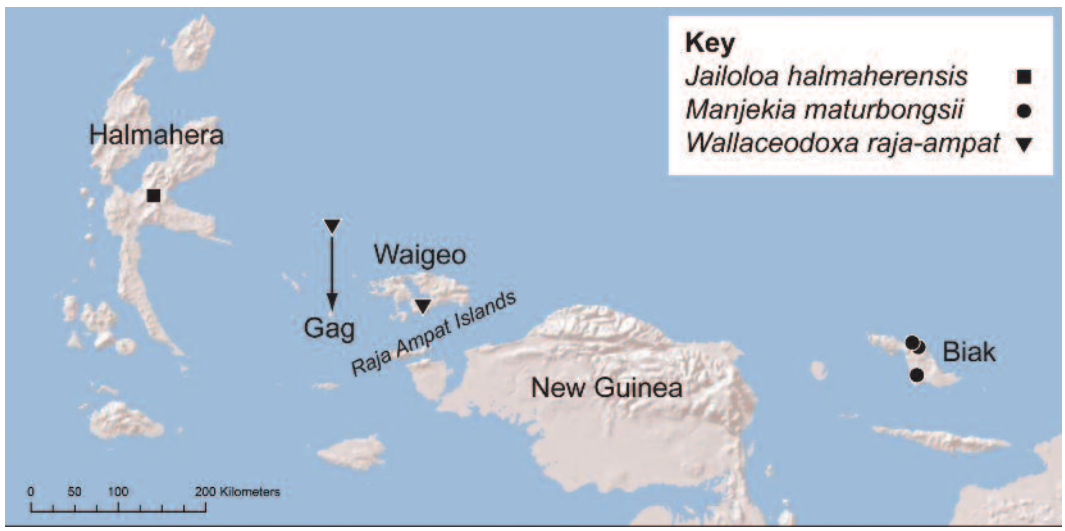
Jailoloa halmaherensis is unusual in the subtribe in that it is endemic to ultramafic soils, which are rich in heavy metals, including iron, magnesium and nickel. The metals in the soil are also found in the underlying rock, which is why many areas of ultramafic soil have been disturbed or even destroyed by mining. The plant life on ultramafic soils is often rich in endemic species, as the soil tends to be toxic to more common, generalist species. The only other ultramafic specialist in the Ptychospermatinae is believed to be *Veitchia lepidota* of the Solomon Islands.

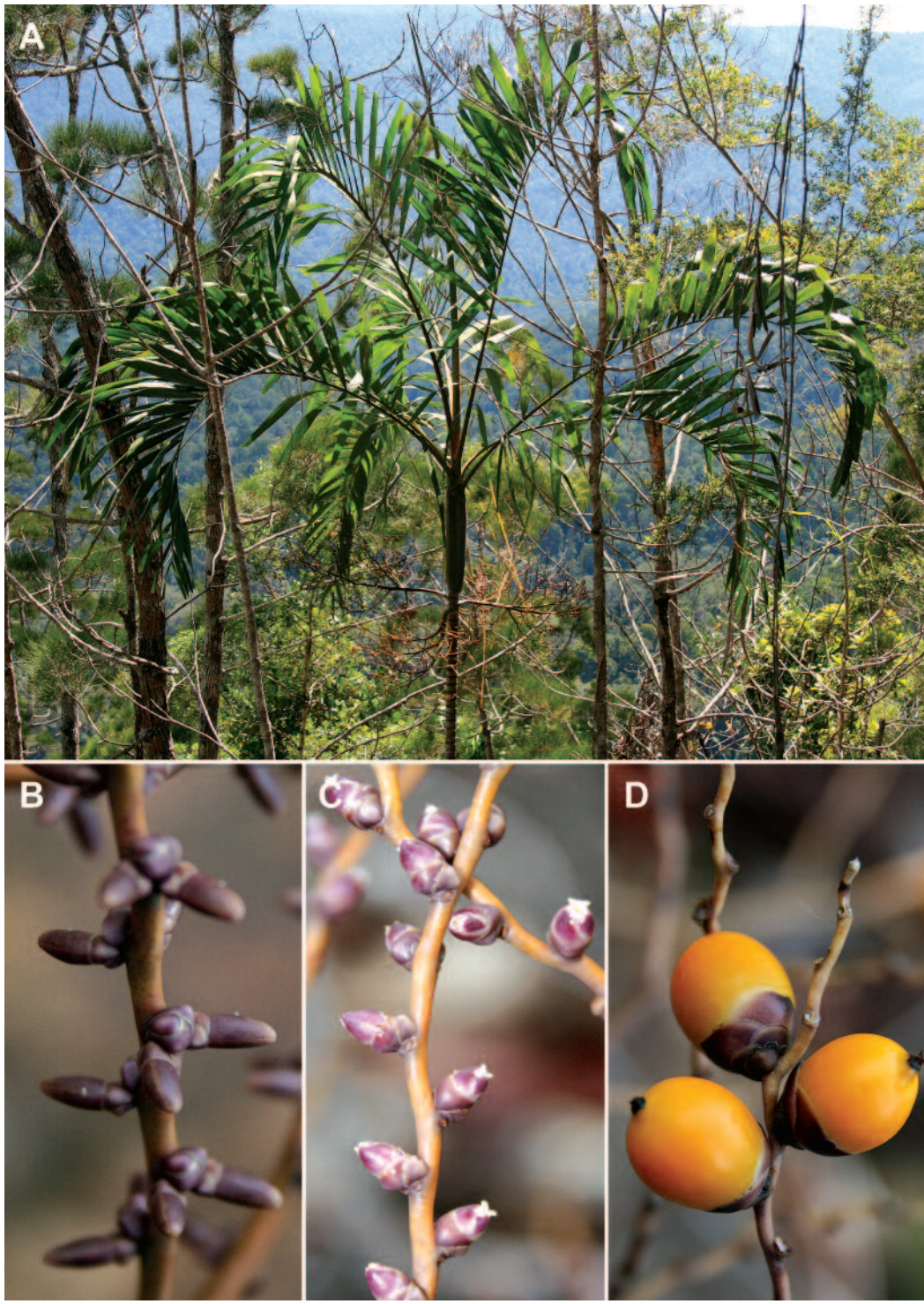
Jailoloa is a small, elegant palm with gracefully arching leaves and ascending, leathery leaflets. It has a single stem and a prominent crownshaft. The most distinctive features of the palm are the inflorescence axes and flowers, which are purple in color. The fruits are orange-yellow. The endocarp is terete (not ridged) and thin, with a mixture of thick and thin, straw-colored fibers, and the endosperm is ruminate. *Ptychosperma*, the most similar genus, typically has ridged endocarps and seeds and does not display ascending leaflets or the same combination of inflorescence and fruits colors.

Manjekia

Manjekia is based on *M. maturbongsii* (Fig. 3), which is endemic to Biak, a small island in Cenderawasih Bay, on the north coast of Indonesian New Guinea (Fig. 1). Rumor of this species, mistakenly thought to be a species of *Drymophloeus*, circulated in the early 1990s. It was not until fieldwork by WJB and CH in 2009 that sufficiently informative material became available for study in the herbarium and laboratory. Recently, the species was

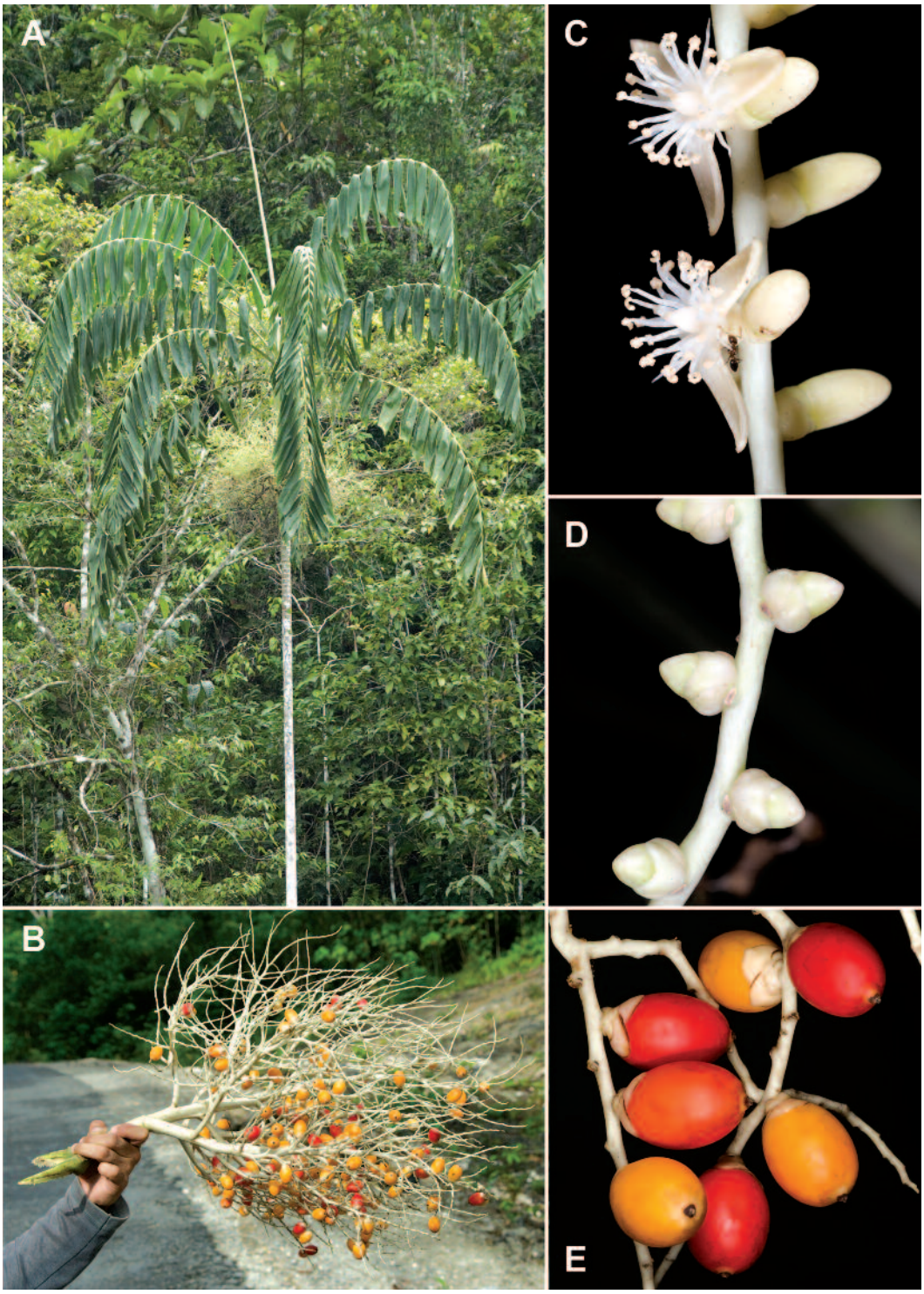
1. The distribution of the new genera, *Jailoloa*, *Manjekia* and *Wallaceodoxa,* in eastern Indonesia.





2. *Jailoloa halmaherensis*. **A**. In habitat in Halmahera. **B**. Staminate flowers. **C**. Pistillate flowers. **D**. Fruits.

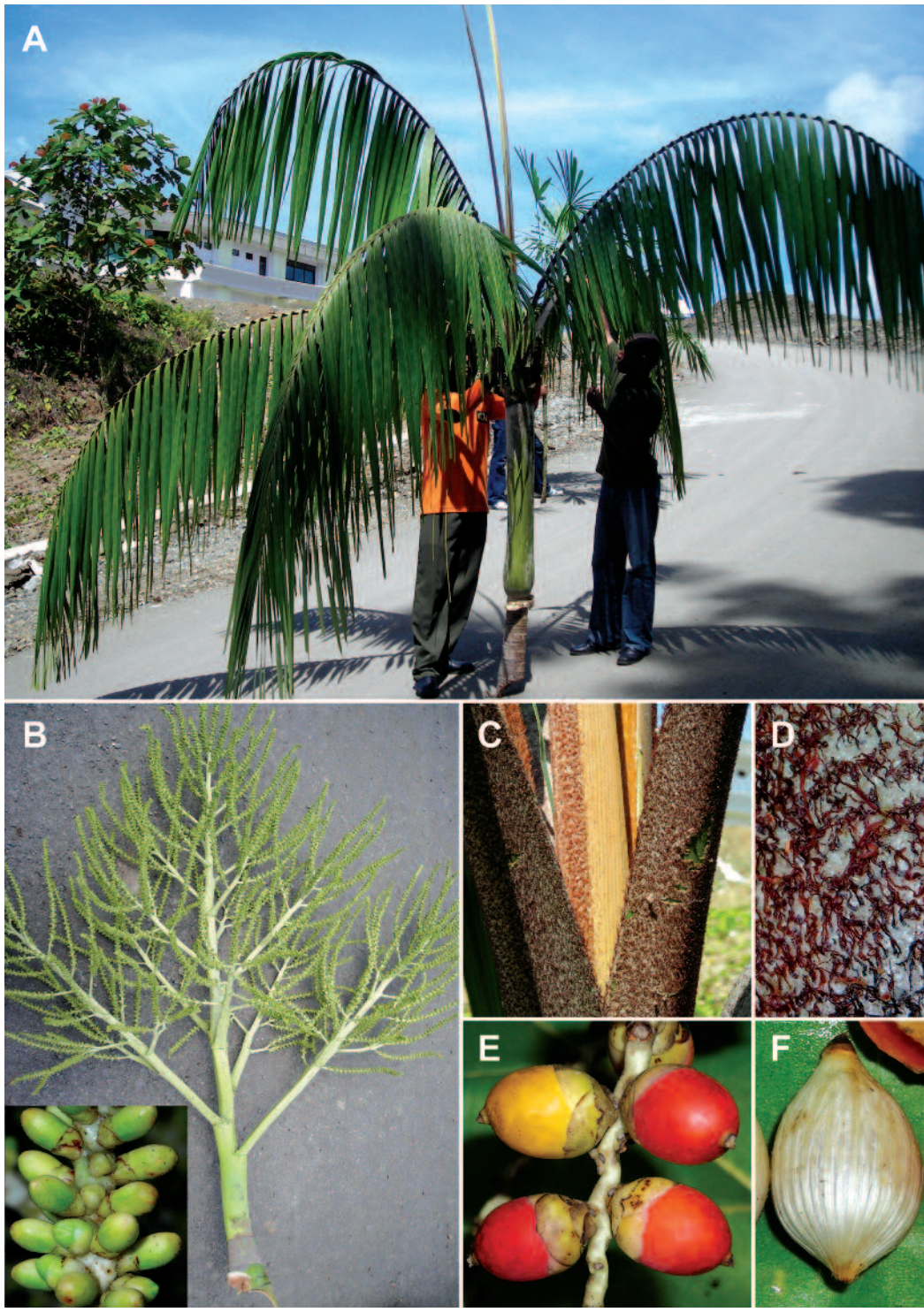
placed, somewhat uncomfortably, in *Adonidia* when it was described (Baker & Heatubun 2012) based on earlier molecular evidence (Zona et al. 2011). Although the inflorescence, fruits and seeds resembled the familiar *Adonidia merrillii*, the foliage of the new palm was startlingly different: long arching leaves with broad, pendulous leaflets. The new molecular data provided strong evidence that the species is not close to *A. merrillii*, and in fact, is most



3. *Manjekia maturbongsii*. **A**. In habitat. **B**. Infructescence. **C**. Staminate flowers. **D**. Pistillate flowers. **E**. Fruits.

closely related to *Jailoloa halmaherensis*. However, having few morphological features in common with *Jailoloa*, it required its own genus. The name *Manjekia* is based on *Manjek*, the local name in Biak dialect for this palm.

Manjekia maturbongsii is a medium-sized palm that can emerge above the surrounding vegetation, ultimately growing to 15 m tall. The stem is solitary, and bears a conspicuous crownshaft and a crown of ten or so leaves.



4. *Wallaceodoxa raja-ampat*. A. Crown. B. Inflorescence. Inset: densely-arranged flower buds. C. Petiole bases, showing hairs. D. Close-up of the white and brown hairs. E. Fruits. F. Endocarp.

The leaves are extraordinarily beautiful, gracefully arching and bearing broad, pendulous leaflets that are strongly truncate and jagged at the tips. The white rachillae bear fruits that ripen from green through orange to red. The endocarp is thin and terete, with both thick and thin, straw-colored fibers. The seed is terete; the endosperm is ruminate.

Manjekia maturbongsii is, at the moment, the only one of the three new genera that is in cultivation. It was brought into cultivation long before it had an official name and was seen during the IPS Biennial in 2012, in Nong Nooch Tropical Botanical Garden, in Thailand.

Wallaceodoxa

Wallaceodoxa raja-ampat (Fig. 4) has never been recognized previously within any other genus. This species was discovered by CH during an IPS-funded PoNG survey of the Raja Ampat Islands (Heatubun et al. 2014b), a small archipelago off the Bird's Head Peninsula of western New Guinea (Fig. 1). It grows on limestone in Gag and Waigeo Islands. The genus name, meaning "Wallace's Glory," honors Alfred Russel Wallace, intrepid explorer of the South-East Asian archipelago (including Waigeo), co-discoverer with Darwin of the mechanism of evolution by natural selection and (most importantly for palm enthusiasts) author of the first ever field guide to palms (Wallace 1853).

Wallaceodoxa raja-ampat is a robust, solitary palm. It has a conspicuous, green crownshaft and a sparse crown of arching leaves bearing long, narrow, pendulous leaflets. The apex of the crownshaft, the petiole and the base of the rachis are thickly covered with white, wooly hairs interspersed with dark, twisted hairs. The inflorescence is white, and the flowers are densely packed on the rachillae. The fruits ripen from green through yellow-orange to red. The endocarp is terete and covered with thin and thick, straw-colored fibers. The seed is terete, and the endosperm is ruminate.

What next?

With the comprehensive synthesis of palm knowledge provided just six years ago in the second edition of *Genera Palmarum* (Dransfield et al. 2008), one might have been forgiven for thinking that palm taxonomy was now stabilizing, but these new genera and others like them suggest that this is far from the case. Both the rain forest and the laboratory are frontiers for biodiversity exploration. These discoveries show that, despite decades of study, palms continue to awe and surprise us with spectacular novelties. New discoveries tend also to be threatened with extinction, and these new genera are no exception. The exploration of the world's palm diversity has never been more urgent and worthwhile.

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