

# Palms

Journal of the International Palm Society

Vol. 55(3) Sep. 2011



# THE INTERNATIONAL PALM SOCIETY, INC.

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### FRONT COVER

*Phoenix roebelenii* on the Mekong River, near Guanlei. See article by K. Boyer, p. 137. Photo by K. Boyer.

## Palms (formerly PRINCIPES)

Journal of The International Palm Society

An illustrated, peer-reviewed quarterly devoted to information about palms and published in March, June, September and December by The International Palm Society, 810 East 10th St., P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

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Annual membership dues are US\$45.00 for Individuals (or US\$120 for three years) and include a subscription to the Journal. Donor memberships are US\$500 per year. Individual Lifetime memberships are available for a one-time fee of US\$1000. Benefactor memberships require a one-time payment of US\$2500. Subscription price is US\$45.00 per year for libraries and institutions. Dues include mailing of the Journal by airlift service to addresses outside the USA. Dues may be paid on-line at [www.palms.org](http://www.palms.org).

**Change of Address:** Send change of address, phone number or e-mail to The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA, or by e-mail to info@palms.org.

**Claims for Missing Issues:** Claims for issues not received in the USA should be made within three months of the mailing date; claims for issues outside the USA should be made within six months of the mailing date.

Periodical postage paid at Lawrence, KS, USA.

Postmaster: Send address changes to The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA.

PALMS (ISSN 1523-4495)

Mailed at Lawrence, Kansas 14 Sept. 2011  
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The full text of PALMS is available on EBSCO Publishing's database.

**This publication is printed on acid-free paper.**

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**BACK COVER**

*Saribus woodfordii* is found in coastal forests on limestone or lateritic soils in Milne Bay Province, Papua New Guinea and the Solomon Islands. Photo: John Dowe. See article by C. Bacon and W. Baker p. 109.

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Young *Saribus papuanus* in heath forest at 500 m near Mt. Jaya, Papua, Indonesia. See article p. 109 by C. Bacon and W. Baker. Photo: A. McRobb, RBG Kew.

# PALM NEWS

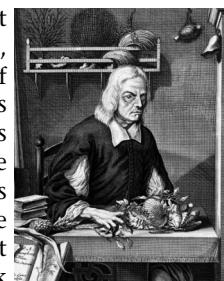
Two intensive studies of palm phylogeny appeared recently. One examined the **relationships among genera of the Arecoide palms and the other** examined the relationships within the Bactridinae. Both studies were based in sequence data from multiple genes. The former study, by W.L. Baker and colleagues, is the most thoroughly sampled molecular phylogeny of Arecoide palms yet undertaken. It appeared on-line in the journal Annals of Botany (doi:10.1093/aob/mcr020). The second study, by W. Eiserhardt et al., examined the relationships among genera of the Bactridinae. One of their surprising findings was the close relationship between *Acrocomia* and *Desmoncus*, a relationship that had not previously been discovered. They also found that current subgeneric classifications within *Astrocaryum* and *Bactris* were untenable. This paper appeared in the journal Taxon (60: 485–498. 2011.). Fortunately, neither of these studies will necessitate changes to the *Genera Palmarum 2* classification.



Last year, we reported on the rediscovery in Singapore of *Pinanga simplicifrons*, a palm long thought to be extinct [Palm News 54(4)]. Now we have news of more joy from that tiny, heavily populated island. Two separate reports document the addition of two palms to the flora of Singapore, one thought to have been extirpated and the other new to the island. Adrian Loo documented the rediscovery of *Salacca affinis* in the same Nee Soon Swamp Forest where the *Pinanga simplicifrons* was found (Nature in Singapore 4: 123–126. 2011.). The new palm for Singapore is *Plectocomiopsis geminiflora*, as documented by Tan et al. (Nature in Singapore 4: 1–4. 2011.). It was found in a tiny fragment of primary forest, within sight of a hiking trail. These two exciting additions to Singapore's flora bring the number of native palms present on the island to 55 species.

As a companion volume to the new *Anatomy of Palms* (see review in this issue, p. 130), Oxford University Press is rereleasing P.B. Tomlinson's *The Structural Biology of Palms*. Originally published as a hardcover book in 1990, this book synthesized all that was known on the anatomy and morphology of palms. The new release will be sold as a print-on-demand book. Print-on-demand technology will allow the book to be produced and sold at a substantially lower price than a comparable book produced in a traditional print run. Details are available on the Oxford University Press website, [www.us.oup.com](http://www.us.oup.com).

Georg Eberhard Rumphius (1627–1702) was a German-born botanist employed by the Dutch East India Company in Amboin, Moluccas, Indonesia. His great Herbarium Amboinense – a six volume masterpiece of natural history writing – was published posthumously in 1741. Rumphius provide some of the very first and most vivid descriptions of familiar palms such as the coconut, sugar palm and *lontar*, along with rattans. The Herbarium Amboinense has been difficult to access, not only because it is rare, but also because it was written in Latin and rather archaic Dutch. The late Monty Beekman completed the translation of the entire work just before he died. Yale University Press has just published the whole work and two symposia – one in Miami at the Kampong earlier this year and one at the Linnean Society in London in May – celebrated Beekman's achievement and the life of Rumphius.



# *Saribus* Resurrected

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AND

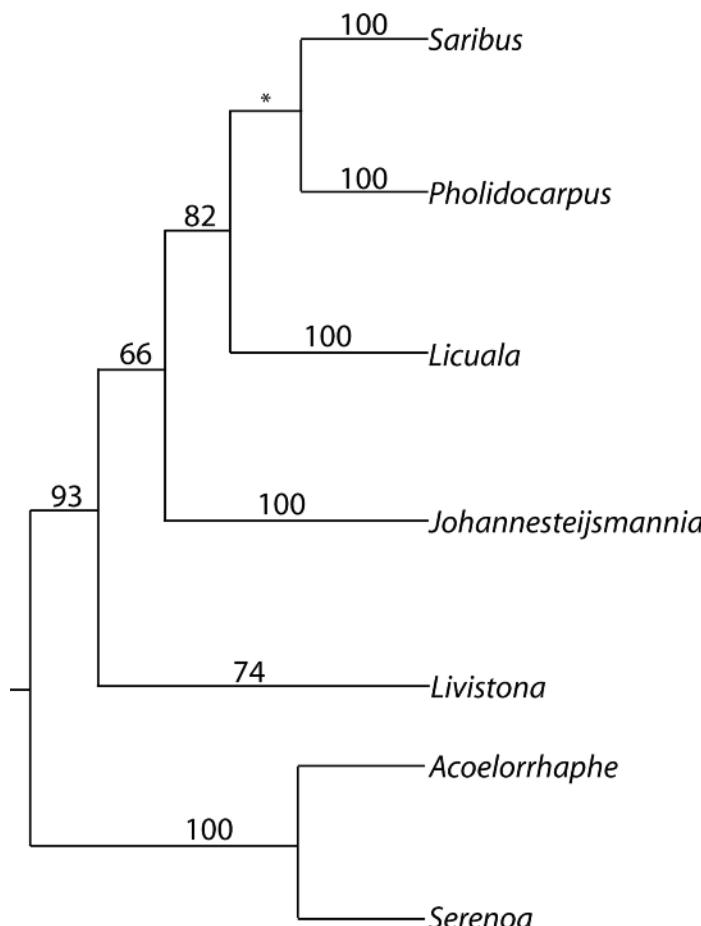
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Recent analysis of molecular data uncovered the startling fact that *Livistona*, as currently recognized, is not a natural, coherent genus and that eight of its species, including the widely cultivated *Livistona rotundifolia*, along with the rare *Pritchardiopsis jeanneneyi* constitute a distinct genus, for which the earliest name is *Saribus*.

The palm tribe Trachycarpeae contains some of the most widely cultivated fan palms, such as *Livistona chinensis*, *Pritchardia pacifica*, *Trachycarpus fortunei* and *Washingtonia filifera*. The group is among the most widespread of all palm tribes and its species are conspicuous components of many different vegetation types, from deserts and pinelands to tropical rainforests.

Despite more than a decade of DNA-based phylogenetic research aimed at revealing evolutionary relationships of palms (e.g. Asmussen et al. 2006, Baker et al. 2009), the Trachycarpeae remains one of the most significant areas of phylogenetic ambiguity within the family due to poor resolution among genera and low support for relationships. To address this problem, a focused tribal-level analysis using DNA evidence has been conducted recently, based on dense sampling across 113 species and six different regions of the genome (Bacon et al., in review). This new phylogenetic framework has provided the best estimate of relationships among the genera of Trachycarpeae available to date and has yielded some surprising taxonomic and biogeographic insights.

Our primary goal was to test the delimitation of the genera of Trachycarpeae by determining whether or not they constitute natural evolutionary units containing all descendants of a common ancestor (monophyletic groups). Our molecular data indicated that the majority of genera were indeed monophyletic. *Livistona*, however, was not found to be monophyletic, but was divided among two different groups that were not each other's closest relative (Fig. 1). One group comprised three *Livistona* species (*L. merrillii*, *L. rotundifolia* and *L. woodfordii*) and two samples of the monotypic *Pritchardiopsis jeanneneyi*. The second group included 19 *Livistona* species from eastern Asia, south-east Asia, Australia and Africa. The grouping of the three *Livistona* species and *Pritchardiopsis* was highly supported and was more closely related to *Pholidocarpus*, *Licuala* and *Johannesteijsmannia* than to the remaining species of *Livistona*. Thus, to render all Trachycarpeae genera monophyletic, this group requires recognition at the genus level. A generic name, *Saribus* (Blume 1838) typified on *Saribus rotundifolius* (Lam.) Blume (syn. *Livistona rotundifolia* (Lam.) Mart.), is already available for this group. It takes priority over



1. Phylogeny of relationships between *Saribus* and the remaining genera of subtribe Livistoninae (tribe Trachycarpeae) based on Bacon et al. (in review). Numbers on branches are parsimony support values for each node on the tree. The asterisk indicates support less than 50%. *Saribus* is well-supported (100%) and separate from *Livistona*.

the other generic name in the group, *Pritchardiopsis* (Beccari 1910), which must be placed as a synonym of *Saribus* because of its later publication date.

*Saribus* includes a Philippines endemic species (*S. merrillii*), a group of Papuasian species (*S. brevifolius*, *S. chocolatinus*, *S. papuanus*, *S. rotundifolius*, *S. surru*, *S. tothur* and *S. woodfordii*), an outlier species in New Caledonia (*S. jeanneneyi*) and one species widespread in Malesia (*S. rotundifolius*) (Fig. 2). The removal of *Saribus* reveals a new disjunction in the distribution of true *Livistona* between Australia and southern New Guinea (*L. alfredii*, *L. australis*, *L. benthamii*, *L. concinna*, *L. decora*, *L. drudei*, *L. eastonii*, *L. fulva*, *L. humilis*, *L. inermis*, *L. lanuginosa*, *L. lorophylla*, *L. mariae*, *L. muelleri*, *L. nasmophila*, *L. nitida*, *L. rigida* and *L. victoriae*) and tropical Asia west of Wallace's Line (*L.*

*boninensis*, *L. chinensis*, *L. endauensis*, *L. exigua*, *L. halongensis*, *L. jenkinsiana*, *L. saribus*, *L. speciosa* and *L. tahanensis*), in addition to the known disjunction in Arabia and the Horn of Africa (*L. carinensis*).

The occurrence of *Livistona carinensis* in Djibouti, northern Somalia, and southern Yemen, so distant from remaining species of the genus, has fascinated many palm biologists. First recognized as a species of *Hyphaene*, it was placed by Burret in the monotypic genus *Wissmannia* in 1943. However, on grounds of close morphological and anatomical similarities, Dransfield and Uhl (1983) reduced *W. carinensis* into synonymy with *Livistona* (see also Tomlinson 1961a, Monod 1955). The placement of *L. carinensis* within *Livistona sensu stricto* is strongly supported by our DNA data. Our

biogeographical results are consistent with Dransfield and Uhl's (1983) hypothesis that the distribution of *Livistona* was once much more widespread during the time of the northern boreotropical forests (Miocene; about 5–24 million years ago) and that, due to geological and climate changes, *L. carinensis* became isolated in the African-Arabian region in a relict forest fragment. In our phylogenetic analysis, *L. carinensis* is resolved on a long branch as sister to all the remaining *Livistona* species, which suggests that there have been high levels of extinction within this lineage. Nevertheless, there is no current phylogenetic justification for recognizing *Wissmannia*, and given its high morphological similarity to *Livistona*, it is most appropriate to retain it within the revised circumscription of this genus.

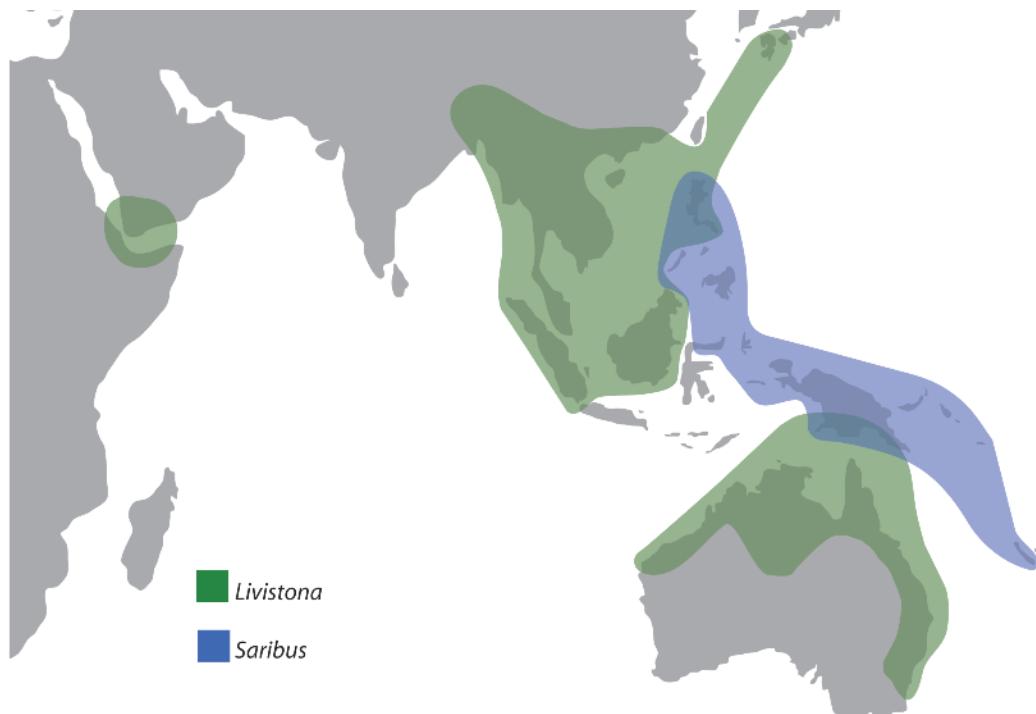
*Saribus* is readily distinguished from *Livistona* in the field, in cultivation and in the herbarium. The morphological characters that enable identification of *Saribus* include trifurcate inflorescences, consisting of three main axes (sometimes two) that join at their base within a single prophyll (Fig. 3), whereas *Livistona* produces inflorescences comprising a single main axis only (Dowe 2009). *Saribus* has orange, orange-brown, or red mature fruit color (Fig. 4), whereas the fruits of *Livistona* are

green, blue, purple, brown or black (Dowe 2009, Dransfield et al. 2008). It should be noted that this group had already been highlighted by Dowe (2009) as a distinctive element within *Livistona* in its former sense. Because of these clear, consistent characters, we have been able to place several species in *Saribus* that we were not able to sample for our phylogenetic research.

From an anatomical perspective, *Saribus* and the rest of the *Livistoninae* excluding *Livistona* have intercostal cells of the adaxial epidermis that are differentiated into long and short cells within the same cell file. *Livistona* has adaxial epidermal cells uniformly of the long cell type, like all genera of *Trachycarpeae* outside of *Livistoninae* (Tomlinson 1961b, Tomlinson et al. 2010). A similar character distribution occurs for the presence of fibers that are associated with surface layers and also depart from the sheath of transverse veins of the lamina ramifying in the mesophyll (Tomlinson 1961b, Tomlinson et al., 2011). These character states, though not unique to *Saribus*, further distinguish *Saribus* from *Livistona*.

The reduction of the monotypic *Pritchardopsis* into synonymy as *Saribus jeanneneyi* is a notable outcome of this research, given the rarity and conservation significance of this species, which persists as one adult and a few

## 2. The global distribution of *Livistona* and *Saribus*.



juveniles in the far south of New Caledonia. This taxonomic change is strongly supported by both the molecular and morphological data described above. *Saribus jeanneneyi* deviates slightly in some respects from other members of the genus. Its fruit are reported to be purplish (Hodel & Pintaud 1998), although a near-ripe fruit figured in this reference is in fact yellow-orange. The fruit are also large (ca. 4 cm diam.; Hodel & Pintaud 1998) with seeds surrounded by a keeled, woody endocarp (Dransfield et al. 2008). However, fruits of similar or larger size are found in some species of *Saribus* (*S. surru*, *S. tothur*) and at least one other has an equally woody, thickened endocarp (*S. papuanus*; Fig. 5). The loss of charismatic genera through nomenclatural change can be controversial, but it in no way reduces the conservation importance of this critically endangered New Caledonian endemic. In fact, by knowing its evolutionary relationships more clearly, we may be better placed to understand its biology and to make appropriate, informed conservation decisions as a result.

#### Taxonomic treatment of *Saribus*

***Saribus*** Blume, Rumphia 2: 48. 1838.  
Lectotype: *S. rotundifolius* (Lam.) Blume  
(*Corypha rotundifolia* Lam.)

*Pritchardiopsis* Becc., Webbia 3: 131. 1910.  
**synon. nov.** Type: *P. jeanneneyi* Becc.

Distribution: Philippines, Borneo (Banggi Island only), Sulawesi, Moluccas, New Guinea, Solomon Islands, New Caledonia.

***Saribus brevifolius*** (Dowe & Moga) C.D. Bacon & W.J. Baker, comb. nov. *Livistona brevifolia* Dowe & Moga, Palms 48: 201. 2004. Type: Indonesia, Papua, Raja Ampat Islands, West Waigeo, Kawe Is., Nov. 2002, Moga et al. 8171 (holotype BO; isotypes K, L, MAN, NY).

Distribution: New Guinea (Raja Ampat Islands only).

***Saribus chocolatinus*** (Dowe) C.D. Bacon & W.J. Baker, comb. nov. *Livistona chocolatina* Dowe, Palms 48: 199. 2004. Type: Papua New Guinea, Central Province, Kuriva Mission

3. Herbarium specimen of *Saribus chocolatinus* showing trifurcate inflorescence, with three main inflorescence axes arising within a single prophyll. Photo: C.D. Bacon.





4. *Saribus merrillii* in cultivation, showing bright red fruit. Photo: C.E. Lewis.

area, 4 km north of Haritano Highway along forestry road, Mar. 2000, Barfod et al. 466 (holotype AAU; isotypes BRI, CANB, K, LAE). (Fig. 3)

Distribution: New Guinea.

***Saribus jeanneneyi*** (Becc.) C.D. Bacon & W.J. Baker, comb. nov. *Pritchardiopsis jeanneneyi* Becc., Webbia 3: 132. 1910. Type: New Caledonia, Prony District, Jeanneney s.n. (K).

Distribution: New Caledonia.

***Saribus merrillii*** (Becc.) C.D. Bacon & W.J. Baker, comb. nov. *Livistona merrillii* Becc. in J.R. Perkins and al., Fragm. Fl. Philipp. 1: 45. 1904. Type: Philippines, Luzon, Tayabas Province, Guinayangan, Jan. 1903, Merrill 2071 (holotype FI). (Fig. 4)

*Corypha minor* Blanco non Jacq., Fl. Filip.: 229. 1837.

*Livistona whitfordii* Becc., Webbia 1: 341. 1905.

*Livistona blancoi* Merr., Sp. Blancoan.: 84. 1918.

Distribution: Philippines.

***Saribus papuanus*** (Becc.) Kuntze, Revis. Gen. Pl. 2: 736. 1891. *Livistona papuana* Becc., Malesia 1: 84. 1877. Type: Indonesia, Papua, Miosnom Island, Apr 1875, *Beccari s.n.* (holotype FI). (Fig. 5)

Distribution: New Guinea.

5. *Saribus papuanus* in heath forest at 500 m near Mt. Jaya, Papua, Indonesia. Photo: W.J. Baker, RBG Kew.



***Saribus rotundifolius*** (Lam.) Blume, Rumphia 2: 49. 1838. *Corypha rotundifolia* Lam., Encycl. 2: 131. 1786. *Licuala rotundifolia* (Lam.) Blume in J.J. Roemer and J.A. Schultes, Syst. Veg. 7: 1305. 1830. *Livistona rotundifolia* (Lam.) Mart., Hist. Nat. Palm. 3: 241. 1838. Type: Illustration in Rumphius, Herb. Amboin. 1 (1741) t. 8 (lectotype).

*Livistona altissima* Zoll., Tijdschr. Ned.-Indië 14: 150. 1857.

*Livistona microcarpa* Becc., Philipp. J. Sci., C 2: 231. 1907. *Livistona rotundifolia* var. *microcarpa* (Becc.) Becc., Philipp. J. Sci. 14: 341. 1919.

*Livistona mindorensis* Becc., Philipp. J. Sci., C 4: 615. 1909. *Livistona rotundifolia* var. *mindorensis* (Becc.) Becc., Philipp. J. Sci. 14: 341. 1919.

*Livistona robinsoniana* Becc., Philipp. J. Sci., C 6: 230. 1919.

*Livistona rotundifolia* var. *luzonensis* Becc., Philipp. J. Sci. 14: 340. 1919.

Distribution: Philippines, Borneo (Banggi Island only), Sulawesi, Moluccas, New Guinea (Raja Ampat Islands only)

***Saribus surru*** (Dowe & Barfod) C.D. Bacon & W.J. Baker, comb. nov. *Livistona surru* Dowe and Barfod, Austrobaileya 6: 169. 2001. Type: Papua New Guinea, West Sepik Province, Miwaute, Nov. 1996, Barfod et al. 390 (holotyp, AAU; isotypes BRI, K, LAE).

Distribution: New Guinea.

***Saribus tothur*** (Dowe & Barfod) C.D. Bacon & W.J. Baker, comb. nov. *Livistona tothur* Dowe & Barfod, Austrobaileya 6: 171. 2001. Type: Papua New Guinea, West Sepik Province, Oenake Mts, on road to Niau Kono from Vanimo, Nov 1996, Damborg & Barfod 418 (holotype AAU; isotype BRI, K, LAE).

Distribution: New Guinea.

***Saribus woodfordii*** (Ridl.) C.D. Bacon & W.J. Baker, comb. nov. *Livistona woodfordii* Ridl., Gard. Chron. ser. 3, 23: 177. 1898. Type: Solomon Islands, San Cristobal Island, 1898 (1897?), Micholitz s.n. (lectotype BM; isolectotypes FI, K, SING).

*Livistona beccariana* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 326. 1941.

Distribution: New Guinea, Solomon Islands.

## Note

Full taxonomic accounts of all species of *Saribus* can be found in Dowe's (2009) monograph of *Livistona* under the names previously accepted in that genus, with the exception of *S. jeanneneyi*, which was treated most recently by Hodel and Pintaud (1998).

## Excluded names

*Saribus chinensis* (Jacq.) Blume, Rumphia 2: 49. 1838. = ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.

*Saribus cochinchinensis* (Lour.) Blume, Rumphia 2: 49. 1838. = ***Livistona saribus*** (Lour.) Merr. ex A. Chev.

*Saribus hasseltii* Hassk., Flora 25 (Beibl. 2): 16. 1842. = ***Livistona saribus*** (Lour.) Merr. ex A. Chev.

*Saribus hoogendorpii* (Hort. ex Teijsm. & Binn. ex Miq.) Kuntze, Revis. Gen. Pl. 2: 736. 1891. = ***Livistona saribus*** (Lour.) Merr. ex A. Chev.

*Saribus humilis* (R. Br.) Kuntze, Revis. Gen. Pl. 2: 736. 1891. = ***Livistona humilis*** R. Br.

*Saribus inermis* (R. Br.) Kuntze, Revis. Gen. Pl. 2: 736. 1891. = ***Livistona inermis*** R. Br.

*Saribus jenkinsii* (Griff.) Kuntze, Revis. Gen. Pl. 2: 736. 1891. = ***Livistona jenkinsiana*** Griff.

*Saribus kingianus* (Becc.) Kuntze, Revis. Gen. Pl. 2: 736. 1891 = ***Pholidocarpus kingianus*** (Becc.) Ridl.

*Saribus mariae* (F.Muell.) Kuntze, Revis. Gen. Pl. 2: 736. 1891 = ***Livistona mariae*** F. Muell.

*Saribus oliviformis* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 176. 1842 = ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.

*Saribus speciosus* (Kurz) Kuntze, Revis. Gen. Pl. 2: 736. 1891. = ***Livistona jenkinsiana*** Griff.

*Saribus subglobosus* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 177. 1842. = ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.

## Acknowledgments

We thank John Dowe, John Dransfield, Jay Horn, Mark Simmons and Scott Zona for suggestions and information that greatly improved this paper. Fairchild Tropical Botanic Garden, Lyon Arboretum and John Dowe provided samples for DNA analysis. This work was supported by the National Tropical Botanic Garden (McBryde Graduate Fellowship), the Montgomery Botanical Center (Research

Associateship), the International Palm Society and the Bentham-Moxon Trust at the Royal Botanic Gardens, Kew to C.D.B.

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# Palm Ash: A Humble Product of Many Uses

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**Incineration of any or all parts of a palm tree produces a fine ash that has subsistence and commercial utility. The ash plays a role in religion, is a salt substitute, serves as a soil amendment, has certain industrial applications and is used in traditional medicine.**

Plant ash is the powdery residue that remains after plants are burned; chemically the ash is alkaline ( $\text{pH} > 10$ ) and composed primarily of calcium carbonate and, secondarily, most often, of potassium chloride (interestingly, *alkaline* derives from the Arabic word meaning *plant ashes*). Tree ash is the ancient source of the corrosive alkaline substance lye, used in food curing and in powerful cleaners. The chemical process of wood incineration brings about a reduction to 1% of mass. In its natural state, plant ash can be applied as an amendment to acidic soils and as a substitute for limestone fertilizer. Palm tree ash, or palm ash, as used in this paper, refers to the burning of leaves (leaflets to petiole bases), inflorescences, infructescences, fruits (any or all parts), stems and roots of a palm.

Palm ash is occasionally utilized as a substitute condiment when common mineral or sea salts (sodium chloride) are unavailable. When employed in this manner, the ash may be called *palm salt*, *plant salt* or *vegetable salt*. The latter term is ambiguous and often confused with culinary vegetable salt, or herbal salt, a ground mixture of common salt and some combination of herbs, spices or vegetables. The first term given is preferable and is used in this paper.

Tree ash as a salt source has been the subject of at least two field research studies which have included palms, one in Papua (Ohtsuka

et al. 1987) and the other in Paraguay (Schmeda-Hirschman 1994). Palm salt was a minor subject in a lengthy study of the pre-Hispanic Maya salt industry and trade (Andrews 1983). The comprehensive world history of salt by Kurlansky (2002) mentioned Maya palm salt.

Palm ash is reportedly a desirable component in artisanal soap making, as well as possessing several present and potential industrial uses. Traditional medicinal use of both palm ash and salt is recorded.

The purpose of this study is to document the various past, present and potential future uses of palm ash. Information is drawn from a variety of published sources but only when the reference contains enough detail so that the palm species exploited can be determined to a reasonable level of confidence is it included. This standard has reduced the number of examples cited, but I feel confident that the breadth of usage is accurately portrayed.

## Ritual Use

To discuss the ritual use of palm ash it is first necessary to describe the religious role of palm leaves. The date palm (*Phoenix dactylifera*) and its fruits and leaves are mentioned multiple times in the holy books of the Jewish, Christian and Islamic religions. In several instances, the leaves are not specifically stated

to be from the date palm, but this can be inferred. The leaves, their incineration and their ashes have ritual roles in Jewish and Christian ceremonies. The date palm and its useful products are revered in Islamic writings, but apparently the palm has no specific role in Islamic religious rituals (Cath. Ency. 1996–2010; CJME 2007–2009; Jewish Ency. 2002).

The Jewish Feast of Tabernacles (Sukkot) takes place in September or October and is in part a harvest festival. A shelter traditionally is built outdoors and the roof thatched with palm leaves, originally from the date palm; this shelter is also called a *sukkot*. It symbolizes the temporary structures Jews occupied in the desert. Four plant species (*Arba Minim*) play a part in Sukkot rituals. The *lulab* is made up of three species: a shoot of a partially-opened date palm leaf, three twigs of myrtle and two willow branches all tied together at the base with three rings of palm leaf strips. The fourth species is the etrog (*esrog*) or citron (*Citrus medica*). These four plants are waved and shaken in the synagogue or temple at a time of prayer recitations and are utilized over the seven days of Sukkot. After Sukkot, the etrog is eaten. The *lulab* may be discarded or preferably allowed to dry and kept for about six months until the day before Passover and used as kindling for the burning of existing supplies of leavened bread (*Biur Chametz*); this is done because only unleavened bread can be eaten during Passover. In this instance, it is the bread that is being incinerated; the *lulab* provides part of the fuel and is, desirably, part of another religious observance (Abramowitz pers. comm.). Thus, in this case, the *lulab* is ritually reduced to ashes. Lulabs and etrogs are available in the United States on the internet from religious suppliers.

In the Christian faith, palm leaves and palm ash each have major ritual significance. Catholics observe Palm Sunday by carrying fresh palm leaves (traditionally from the date palm) in processions to celebrate the entry of Christ into Jerusalem. The palm leaves are blessed prior to the processions. In some instances the leaves are tied into a cross; in Elche, Spain the procession includes blanched elaborately-woven date palm leaves. After the procession is over, palm leaves preferably are returned to the church, stored and dried. Later, they are burned to produce ash accompanied by the recitation of prayers to bless the ashes. On the following Ash Wednesday, the fine black ashes are mixed with holy oil or water to make a paste and imposed in a cross on the

foreheads of the faithful to mark the beginning of Lent. The practice represents an interesting form of sacred recycling.

The burning of leaves from Palm Sunday observances by individual churches in many denominations has given way to the purchase of ashes for Ash Wednesday. For example, palm ashes can be purchased from commercial religious on-line suppliers. The palm ash sold commercially is obtained, in the United States, from either leaves or stems. A large supplier in Central Florida makes ash from palm wood. An ounce of ash is said to be sufficient to mark the foreheads of 250 people (Seattle Times 2007). The Central Florida ash producer is likely exploiting *Sabal palmetto*, a common palm species of that area. Figure 1 shows samples of palm ash I made from the leaves of the parlor palm (*Chamaedorea elegans*) and of commercial palm ash.

The practices described here are most strongly adhered to in the Catholic faith, but the Anglicans and other Christian denominations likewise observe Palm Sunday and Ash Wednesday although the practices differ among denominations.

The shared ritual significance of palm leaves in the Jewish and Christian religions is striking; the act of praying and carrying a *lulab* in ceremonies of the older religion and a palm leaf in the more recent, have led to speculation that the traditional Christian Palm Sunday may have been derived from, or at least influenced by, the Jewish Feast of Tabernacles. However, there is not the same suggestion of religious synchronism in the case of palm ash.

#### Condimental Use

Salt is the universal condiment, and every human society either provides for its own salt needs or engages in commerce to obtain it. Lacking a source of sodium chloride salt, the alternative of the potassium chloride in plant salt can serve as a substitute. Palm salt use appears to be pantropical but rare because if mineral or sea salts are available, they are utilized. Other reports can be found in the literature but without details as to the palm species involved. Confusion exists in other accounts owing to imprecise palm identification. Leaves are most commonly employed to make palm ash/salt, but other palm parts are used as well. Andrews (1983) provided the most detailed account of the Maya making salt from the *escoba* palm (*Cryosophila sp.*) and the *botán* palm (*Sabal yapa*). He commented that

the geographical range of palm-salt making occurred in a region lacking mineral salt. Preparing palm salt is a laborious process because the quantity of ash from burning leaves is less than 1% of the original mass and the ashes are grimy. In Latin America, palm ash salt is also reportedly derived from the grugru palm *Acrocomia aculeata* (Steward 1946); *inaja* (*Attalea maripa*) and *xila* (*Itaya amicorum*) (Henderson 1995); *caranday* (*Copernicia alba*) (Schmeda-Hirschman 1994); carnauba (*Copernicia prunifera*) (Pinheiro & Balick 1984); and *jará* (*Leopoldinia major*) (Wallace 1853).

Palm salt is less frequently documented in Africa. In West Africa the petiole and stem of the doum palm (*Hyphaene thebaica*) are burned for salt (Burkill et al. 1997); in the case of the raffia palm (*Raphia hookeri*) seeds are incinerated (Edem et al. 1984). In this region, according to Burkill et al. (1997), coconut leaf ash is a salt substitute.

In the Asia-Pacific region, palm salt use appears to be uncommon. Reliable references describe palm salt from the sago palm (*Metroxylon* sp.) in Papua New Guinea (Townsend et al. 1973). Burned coconut leaves are a salt source in Papua (Ohtsuka et al. 1987). In the Malay Peninsula, *nipa* palm (*Nypa fruticans*) roots and leaves are burned for salt (Burkill 1966); sago palms (*Metroxylon* spp.) in Vanuatu are

exploited for ash/salt from the leaves and petiole of the plants (Dupuyoo 2007).

Little research has been done on the chemical/nutritional properties of palm ash. Townsend et al. (1973) analyzed ash from the base of the leaf midrib of sago palm (*Metroxylon* sp.), used as a salt substitute in Papua, and found that it contained: (mg/g) Na 5.9, Ca 117, K 263, Mg 34.4. In a study of tree ash as a salt source in Paraguay, Schmeda-Hirschman (1994) sampled ash from the *carandilla* palm (*Trithrinax schizophylla*), with the following results: (g %) Na 0.39, Ca 0.14, K 2.71, Mg 0.09, P 0.12; (ppm) Fe 82, Cu 4, Mn 4, Zn 9. Potassium is high in both analyses. Palm salt users may gain some benefit from trace elements it contains.

I sampled both types of palm ash in Figure 1, and to me they tasted unpleasantly like ashes and nothing like sodium salt.

#### Industrial and Fertilizer Use

African oil palm (*Elaeis guineensis*) is the most industrialized palm in the world, with extensive areas under plantation cultivation, especially in Southeast Asia. Palm oil factories take in the entire ripe fruit bunches; the fruits are removed and the fruits processed to express edible industrial mesocarp and seed oil. The empty bunches and unusable residues from

1. Palm ash. Left: from leaves of parlor palm (*Chamaedorea elegans*). Foreground and right: commercial ash, probably from the stem of *Sabal palmetto*.



oil extraction are used as fuel. Palm oil fuel ash (POFA), also referred to as oil palm ash (OPA), typically is disposed of in landfills. In recent years studies have been undertaken to utilize the considerable quantities of ash the industry generates. POFA has been found to be a suitable replacement for up to 20% of Portland cement in concrete (Sata et al. 2004). Darus et al. (2009) found that OPA has suitable absorption capacity to remove dye from aqueous solutions.

OPA has also shown to be an effective absorbent in flue gas desulfurization (Mohamed et al. 2005). By itself, palm bunch ash is as an effective fertilizer for mature oil palms on peat soils (Othman et al. 2005) and as a substitute for NPK fertilizer in maize growth (Awodun et al. 2007). Palm bunch ash is a commercial product exported from Indonesia.

Incineration of coconut husks produces ash containing 25–35% potash (Grimwood 1975), and it has been demonstrated experimentally that the ash is an excellent fertilizer for young coconuts (Bonneau et al. 2010). Coconut shell ash can also be applied as fertilizer, although it contains less potash than husk ash (Woodrooff 1979).

Burkill (1966) stated that palmyra palm (*Borassus flabellifer*) leaves are burned to make potash-rich ash for fertilizer in Southeast Asia. The same holds true for the *brejáuba* palm (*Astrocaryum aculeatissimum*) in Brazil (Pinheiro & Balick 1987).

Palm ash is the scouring agent in some recipes for African black soap, which also typically contains African palm oil. Most ingredient lists for this soap do not name the palm source of the ash. In the case of the Dudu-Osum brand, palm bunch ash is a stated ingredient, which identifies the source as the African oil palm. This soap name comes from the Yoruba designation for the product; according to advertisements and other information, West Africa appears to be the major commercial source.

#### Miscellaneous Other Uses

Salt (mineral, sea or plant) figures almost universally in folk remedies, alone or as a key ingredient in medicaments. Traditional medicine in the Malay Peninsula includes a mixture of coconut shell ash, pepper, garlic and vinegar, given to women after childbirth; the ash and vinegar alone are also rubbed on

the body as a general remedy to treat swelling (Burkill 1966). Miah et al. (2003) stated that *nipa* palm leaf ash is employed as a toothache remedy in Bangladesh. According to ancient Islamic writings, palm leaf ash, presumed to be from date palm, can be applied to stop a bleeding wound (Sahih Bukhari 2007). Ash from the burned fruit of the Amazonian *jará* palm (*Leopoldinia major*) is employed as an antidote applied directly to a curare-poison arrow wound (Plotkin & Balick 1984).

The Pume Indians of Venezuela use ash from burning the leaves of either the *manaca* palm (*Euterpe precatoria*) or petioles of the *moriche* palm (*Mauritia flexuosa*), mixing the ash with resin from the timber tree (*Sympomia globulifera*) to make a waterproofing sealant (Gragson 1992). In Peru, the Bora Indians mix the ash from burning the stem of the *temiche* palm (*Manicaria saccifera*) with tobacco to take it as a stimulant (Grández Rios & Henderson 1993).

#### Conclusion

Palm ash is a by-product most often discarded as useless. However, palm ash possesses qualities that give it several practical applications in industry and agriculture. Dietary and medicinal utilization of palm ash/salt is unpromising because sodium chloride or potassium chloride can be obtained from mineral sources or sea salt. Ritual use of palm leaves and their ashes represents an ancient tradition that largely persists as an aspect of contemporary religion.

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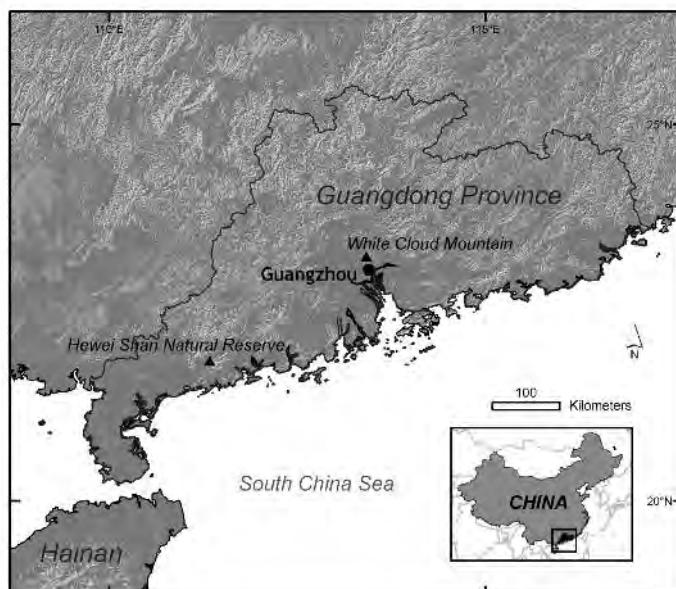
# *Arenga longicarpa*, a Poorly Known Species from South China

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1. Map of Guangdong Province showing the two localities (triangles) visited to find *Arenga longicarpa*.



In this paper, the authors describe the hunt for a little known species of *Arenga*, *A. longicarpa*, restricted to South China.

In February 2010 Marc Jeanson visited China as part of his continuing revision of the caryotoid palms (*Arenga*, *Caryota* and *Wallichia*). China has an interesting palm flora comprising ca. 73 native species, out of which 27 are endemic, including the seldom-seen

and poorly known *Arenga longicarpa*. Chinese palms are mainly distributed in the southern provinces of Hainan (26 native species on the island) and Yunnan. Native palms are also present in Guangxi, Guangdong, Jiangxi and Fujian (Pei et al. 1991) but are rather scarce in



2. *Caryota maxima*, a common palm in Guangdong province.

these provinces (Henderson 2009). Some of them, however, are particularly noteworthy, such as *Guizhouia* in Guangxi (Dransfield et al. 1985).

The first stop on Jeanson's itinerary was Guangdong Province (Fig. 1), to visit the type locality of a large *Caryota* (Fig. 2) described as *Caryota ochlandra* by Hance in 1879. Govaerts and Dransfield (2005) considered this name to be a synonym of *Caryota maxima* Blume ex.

Mart. This palm is very common in the area of Dinghu Shan and is, without a doubt, conspecific with *Caryota maxima*.

Our next item on the agenda was the illusive *Arenga longicarpa*. This species was described in 1989 (Wei 1989) based on the study of only four specimens (including the type). The first collection of this palm was made by Otto Kuntze on White Cloud Mountain (Baiyun Shan) (Fig. 1) in 1875, and his specimen is in

the New York Botanical Garden herbarium but was not a basis for the original description. One specimen cited in the protologue (*South China Inst. Bot. Exped.* 383971) was collected in Taishan County in 1973 but was not seen in the herbarium of that institute, IBSC. The other two cited specimens and the type were collected in the same locality, Mt. Heweishan (Fig.1) (in the Heweishan Natural Reserve) in Dianbai County. Collections were made in 1980, 1984 and 1985. Because this species had not been collected since 1985, little information – and no DNA material – was available. Prior to the publication of his field guide of palms of southern Asia (Henderson 2009), Andrew Henderson visited the region but was unable to find this species.

During Jeanson's two week trip, two out of the three localities known from herbarium specimens were visited. After several days in the South China Botanical Garden checking the specimens in the herbarium, including the type specimen, Liu Qian, a student from Nanjing Agriculture University investigated Mt. Baiyun Shan (White Cloud Mountain). The mountain is located at approximately 17 kilometers north of Guangzhou city: it is now totally integrated in the huge suburban area surrounding Guangzhou. We tried as much as possible to investigate areas far from the touristic trails and roads filled with people

during the Chinese New Year holidays, emphasizing especially the streams banks, a habitat often preferred by *Arenga* species. We ended up lost and finally met a group of people asking us to leave immediately because we were in a forbidden area; we were unaware that we had entered a military zone. We followed their directions for the quickest way to get out, and after five hours of exploration on the mountain, decided that we would end our search in this locality. From what we had observed, most of the non-cultivated vegetation on Baiyun Shan is secondary, and *Arenga longicarpa* seems absent in this place (although we did not investigate the northern part of the park). Since the 1970s, Guangzhou was massively urbanized, and the forest of Baiyunshan was largely replanted, which could explain the absence of this species since Kuntze's collection.

After Baiyun Shan, we visited the locality where three collections were made in Dianbai county. The first day, after a six hour trip from Guangzhou, we followed our guide through the Heweishan Natural Reserve where he took us to *Caryota mitis* and *Caryota maxima*, two other representatives of tribe Caryoteae in this area. These two species were unfortunately the only species our guide could locate after having read the description. We were a bit desperate to find *Arenga longicarpa* after having seen the

### 3. Habitat of *Arenga longicarpa* in Heweishan Natural Reserve.





4. *Arenga longicarpa*. Top left: habit of a mature individual; top right: detail of the leaflets; bottom left: unripe fruits; bottom right: seedling.

desolate and highly modified landscapes of the southern part of Heweishan Natural Reserve. Again, our first instinct was to focus our time and attention on the banks of streams in the area (Fig. 3). A dam was built and created an artificial lake (Xiaoshui Brook). We decided to survey the downstream banks and quickly discovered, at about 295 m altitude, a small population of perhaps ten different clumps of

*Arenga longicarpa*, which allowed us to make herbarium collections and to update the description (Fig. 4).

The day after, we decided to go further north to see if the species could be found at higher elevations as indicated on the herbarium labels, one of which said the palm grew at 750 m. We followed a trail across a vast area that



5. Pristine forest above 700 m elevation in Heweishan Natural Forest.

was formerly a conifer plantation. The trees had been devastated by a disease and then by a fire a short time before our visit, which gave the entire area a lunar landscape aspect. At about 700 m altitude, the forest reappeared and looked pristine (Fig. 5). The contrast was striking between the zone we just walked through and the beauty of the landscape we now faced. We walked for hours along different mountain streams but unfortunately did not find any other population of *Arenga longicarpa*. More field work is necessary to determine whether this species is present at this altitude range, where *Calamus rhabdocladus* (Fig. 6) is common.

***Arenga longicarpa* C.F. Wei, Acta Bot. Austro Sin. 4: 7. 1989. TYPE: CHINA, Guangdong, Taishan, C.F. Wei 123250 (holotype: IBSC!).**

Shrub, 2–3 m high. Stems, when developed, clustered, to 50–60 cm high, 1–2 cm diam., to 7 cm with sheaths. Leaves 10–12, all along the stem, 2–2.5 m long, sheaths 20–25 cm long, disintegrating into brown/black fibers covering the stem; petiole rounded, 120–135 cm long, rachis 70–90 cm long, middle blade ca. 45 cm wide. Pinnae ca. 12 per side, mostly clustered in groups of 2 or 3 at the base and apex of rachis, elongated, linear obtriangular, 25–40 cm long, 4–5 cm wide at the widest (ca. the 2

thirds of the pinna length), dark shiny green adaxially, white silvery with very fainted brown stripes abaxially, margin entire, apex acuminate and jagged, 6–15 cm long, base wedge-shaped; terminal pinna flabellate, 18 cm long and 9.5 cm wide. Inflorescences erect, unisexual, the whole plant either dioecious or monoecious; female inflorescence ca. 75 cm (measured on few specimens), rachillae 3–8, 20–39 cm long; male inflorescence, 39–42(50) cm long, rachillae 6, light green when young, becoming pinkish, peduncle ca. 28 cm long (measured on few specimens), prophyll 9.5 cm long, 1.7 cm in diameter, peduncular bracts 6, the first and sixth peduncular bracts 17–18.5 cm long, second 22 cm, others to 26.5 cm long, prophyll and peduncular bracts covered with light to dark brown scales. Male flowers oblong, 8–9 mm long; sepals 3, to 3 mm long, imbricate, color unknown; petals 3, 12–15 mm long, to 0.45 cm wide, orange, stamens 6–20, anther linear, to 9–10 mm long, ca. 0.8 mm wide, filaments short, ca. 1 mm long. Female flowers unknown. Fruit oblong to conspicuously reniform, 1.5–18 cm long, 9–10 mm diam., from green to orange, red to purple red when mature, one seeded, sepals persisting, 4–5 mm long and 4–5 mm wide at the base, bright red, triangular. Seed oblong to slightly pyriform, 12–13 mm long, 6–7 mm wide; endosperm homogenous, white.



6. *Calamus rhabdoclados* Burret, a common palm in the understory of South China and Indochina.

**Specimens Examined.** CHINA: Guangdong Province: Dianbai County, Heweishan, 25 Jan. 1980, fl. and fr., C.F. Wei 123180 (IBSC!); Dianbai County, Heweishan, 10 Jun. 1984, fl. and fr., C.F. Wei 123215 (IBSC!); Dianbai County, Heweishan, 7 Jul. 1985, fl. and fr. C.F. Wei 123250 (Holotype, IBSC!); Dianbai County, Heweishan Natural Reserve, 295 m asl, 27 Feb. 2010, fr., Jeanson & Guo MJ85 (IBSC! NY! P! K!); Guangzhou, White Cloud Mountain, ca. 305 m asl, 6 Feb. 1875, fl., Kuntze s.n. (NY!).

The habit of this species appears much like that of *Arenga porphyrocarpa* (Blume ex. Mart.)

H.E. Moore from Indonesia (Java and Sumatra). Mogea (1999) suggested that the two names should be synonymized. Indeed, both species are densely clumped and stemless for most of their lifespan until the reproductive stage, when a short stem is developed. The first inflorescence is female, branched, and terminal; the following inflorescences develop in a basipetal sequence and are male and branched (Fig. 7). In *A. porphyrocarpa* the inflorescences are multiple whereas in *A. longicarpa*, inflorescences are always solitary. *Arenga longicarpa* can be easily identified by the shape of its pinnae (Fig. 4), which are

7. *Arenga longicarpa*. Top left: fruits at different stages of maturity; bottom left: detail of a fruit and seed; right: immature male inflorescence.





8. A clump of *Arenga longicarpa* in an open environment after deforestation of the gallery forest.

similar to those of some forms of *Arenga caudata* (Lour.) H.E. Moore, from which it is immediately distinguishable by its branched inflorescences (Fig. 7).

**Phenology.** Although the south of Guangdong Province has a very seasonal climate (Woo et al. 1997), this species was found flowering and fruiting all year long.

**Vernacular name.** Chang Guo Guang Lang (Pinyin 123180, Mandarin)

**Uses.** Unknown

**Distribution.** Endemic to the southern part of Guangdong province.

**Conservation.** The clumps that we observed growing in open areas in this population did not look very healthy. The signs of stress of these clumps were a general yellowing, the papery brown margins of the pinnae and the shorter size compared with those growing in a shaded position (Fig. 8). It seemed obvious that what we observed was the remnant of a population that used to be more widespread. It was confirmed from the guide, who told us that there were more individuals before the construction of the reservoir. The retention lake drowns part of the population, but several other causes can explain this unhealthy appearance. *Arenga longicarpa* is a reophyte of seasonal streams (Fig. 3). Guangdong Province,

like other provinces of South China, experiences many intense rainstorms associated with typhoons and tropical storms (Woo et al. 1997), yet the hydrographic system has been highly modified by the dam (Fellowes et al. 2002). In addition, the gallery forest was cleared, and exposure to the sun has deleterious effects on this species (see above), which seems to be at its ecological optimum on sandy soils on river banks in the shade of riparian forests.

The distribution of *Arenga longicarpa* has been reduced over the past century. From the data we were able to gather, *A. longicarpa* faces several anthropogenic threats in Guangdong Province including urbanization and deforestation. In the absence of more extended field data we recommend the IUCN status "endangered" for this species (IUCN 2004). If this species could be found at higher elevations (700–800 m) the conservation perspective would be much improved because the lowland forests of this area have been much more disturbed than the forest above ca. 700 m altitude (Fellowes et al. 2002). Unfortunately of the fruits collected during this expedition (Figs. 4 & 7) none contained ripe seeds. Seedlings (Fig. 4) and part of a clump were collected to try an *ex situ* conservation experiment in the South China Botanical Garden under the supervision of Ms. Guo

Lixiu. Ms. Guo is also still in contact with the guide of Heweishan Natural Reserve in order to obtain mature seeds and distribute it to as many botanical institutions as possible. The Heweishan Natural Reserve (City-level) was established in Dec., 2008, next to the Ehuangzhang Nature Reserve (Province-level). We hope that this protection will be enough to allow *in situ* conservation as well!

### Acknowledgments

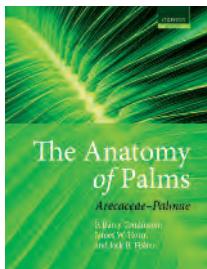
This trip was made possible thanks to the Annette Kade Fellowship and a PPF Barcoding grant from the Museum National d'Histoire Naturelle in Paris. Thanks to Andrew Henderson, Liu Qian from Nanjing Agriculture University, Mr. Li Zhishu from Heweishan Natural Reserve, Fangfang Weng, Qunkai Liu and Lawrence Kelly for their assistance and support.

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## PALM LITERATURE

THE ANATOMY OF  
PALMS ARECACEAE –  
PALMAE. P. B. Tomlinson,  
J. W. Horn & J. B. Fisher.  
Oxford University Press.  
2011. ISBN: 978-0-19-  
955892-6. Price \$225.00.  
Hardcover. Pp. 251.



A family-wide survey of the anatomy of palms is not a project for the faint of heart. The material needed for such a study is scattered across six continents and is sometimes difficult to identify. Palms are large, bulky and difficult to collect, and their tissues resist the dissection techniques developed for lesser plants. Prior to sectioning, the material must be soaked for days in hydrofluoric acid, washed and infused with alcohol and then infiltrated with resin, a lengthy and complicated process that can take weeks. In short, a study of palm anatomy requires comprehensive collections, a specialized laboratory and scientists with the time and commitment to see the project through.

Enter Barry Tomlinson, Jay Horn and Jack Fisher, who with support from Harvard University, National Tropical Botanical Garden, and the National Science Foundation, have tackled this Herculean task. This volume, in fact, is an updated version of Tomlinson's 1961 work, *Anatomy of the Monocotyledons. Vol. II: Palmae*. The new book completely supplants the old one with the clear advantage of 50 years of technological and intellectual progress. One of the most important advances is the phylogenetic underpinning of the new volume, following the classification in *Genera Palmarum 2*. Another important advance is the use of digital photography, which allowed the authors to capture color photomicrographs as they looked through their microscopes. Had they relied on old-fashioned color film, the cost of film and processing, not to mention the uncertainties of exposure and focus when shooting through a microscope, would have doomed the project from the start.

The book is into two main parts. Part one is an introduction to palm structure. The authors outline the heroic methods used to achieve the spectacular images of palm anatomy that grace the pages. They then explain the

anatomical diversity in leaves, stems and roots (the book does not cover floral or fruit anatomy), discussing the family as a whole and the various anatomical specializations found within it. The final chapter of part one examines the anatomical diversity within a phylogenetic context, showing where characters evolved in the family tree. Looking through these illustrations, one is struck by the parallelisms in unrelated lineages. For example, hat-shaped silica bodies have evolved at least six times within the family.

Part two examines the anatomical features of the five subfamilies, at the tribal, subtribal and generic level. The authors lamented that a species-by-species approach would have exceeded the time and funds allotted to the task, but the approach is satisfactory, as within most genera, sometimes even with subtribes, the species are anatomically similar. These pages are filled with the most colorful and striking anatomical images I have ever seen in an anatomical treatise. The color, the result of histological stains, is not introduced for aesthetic reasons: differential staining reveals important details in the anatomy, including the chemical composition of cell walls and cell contents. For example, the photomicrograph of a section through the leaf segment of *Coccothrinax ekmanii* reveals – in vivid blue – the massive fiber strands that give the leaf its rigidity. This part of the book also contains keys to genera or species based on anatomical characteristics, as well as additional cladograms

showing the distribution of certain characteristics across subfamily trees.

So who is this book for? This book is aimed squarely at an academic audience and will be much appreciated by plant anatomists seeking to understand palm anatomy or compare palms with other plants at the anatomical level. But the value of this compendium goes well beyond its appeal to plant anatomists. Students of palm ecology will see new ways in which ecological specialization is underpinned by anatomical specialization. This book will be invaluable to paleobotanist working with fossil of palms or palm-like plants. It will be valuable to entomologists and pathologists working with the pests and diseases of palms. It will be useful to anthropologists and museum curators, wishing to identify palm materials used in the construction of artifacts. It may even inspire materials engineers to create composites that mimic the strength found in palm wood. One can never predict how scientific advancements such as this will seep into other fields and spur new discoveries.

Tomlinson, Horn and Fisher are to be congratulated on producing such an authoritative, detailed study of the anatomical diversity of palms. It will be the standard reference on palm leaf and stem anatomy for many years to come. Now, who will write the companion volume on palm flower and fruit anatomy?

Scott Zona  
Florida International University

By special arrangement with the IPS, Oxford University Press is offering a 20% discount to IPS members ordering the book directly from the OUP website. When ordering from the US on-line catalog, <http://www.us.oup.com/us/>, type the promotion code 30015 in the box in the upper right of the screen where it says "Enter Sales Promo Code" and then press "Go!" The book will appear at the discounted price. The procedure is a bit different for members ordering from the UK site, <http://www.ukcatalogue.oup.com/>. Once the book is selected and added to the shopping basket, type AAFLY5 into the promotional code box. Press "update" to apply the discount. The discount will apply to all biology titles purchased from the UK site.

# The World of Palms – Rediscovering Diversity

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AND

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An exhibition at the Botanic Garden and Botanical Museum Berlin-Dahlem in collaboration with the Royal Botanic Gardens, Kew, will run from 20 May 2011 through 26 February 2012. It provides a full introduction to palms.

Apart from palm enthusiasts, most people have no eye for the amazing richness and diversity of the palm family. For them, palms are mere symbols and iconic plants of the modern paradise, representing travel and leisure in tropical surroundings. Marketing experts, travel agencies, producers of soft drinks and other goods have long ago discovered how to use this persuading image most profitably. The iconic power of palms is so forceful that it may often detain people from paying attention and looking more closely at the diversity of palms.

The Botanical Museum Berlin-Dahlem encourages its visitors to look behind this image and (re)discover the diversity of the Principes, i.e. "sovereigns" of the plant kingdom, as this plant family was previously known. As one of the very few public museums in the world dedicated to plant taxonomy and plant diversity, we decided not to focus on a specific palm genus and its use, but to offer instead an overview of the entire "world of palms" with its approximately 2,400 species among 183 genera. Palms have been systematically collected, described, classified, investigated and displayed in conservatories and museum collections for more than two centuries. Although more than 150 years have passed since Carl Friedrich Philipp von Martius published the first attempt to classify the family of palms on a global scale in his *Historia Naturalis Palmarum* (1823–1853), working with

palms still yields remarkable results and new species continue to be discovered every year. On the other hand, the use of palms by humans dates back to ancient times. Human colonization of the islands in the Pacific would not have been possible without them. Today, palm products are indispensable for our daily lives.

With only about 250 square meters of special exhibition space to fill, the biggest challenge for the Berlin exhibition team was to pick out the most relevant points in this huge and multifaceted topic. The advice of Bill Baker, head of palm research at the Royal Botanic Gardens Kew and his colleagues, was invaluable for this undertaking. On the one hand, we had to offer our visitors a comprehensible survey of the family with a limited number of stories, images and objects, while on the other hand, the stories we selected and the objects we focused on had to be reasonably attractive and emotionally appealing. Due to a close cooperation with RBG Kew we were able to include in our exhibition valuable specimens from the Palm Herbarium and rare artifacts from the Economic Botany collection at Kew.

The exhibit is divided into five chapters, each of which is marked by a specific sign: diversity, life histories, diversity of use, desire and palm islands. Apart from bilingual exhibition plates



1. View of the World of Palms exhibition at the Botanical Museum Berlin-Dahlem.

in German and English, the visitor's path is lined with numerous objects in showcases as well as hands-on interactive installations.

**Diversity:** A polo stick made of rattan catches the eye upon entering (Fig. 1). This deviation from the common tree form casually opens an eye for the diversity of stems and architecture. In contrast, the display of a sun hat made of *Hyphaene thebaica* fibers at first glimpse seems to comply with the popular belief that palms are mostly found in desert oases. However, the neighboring biogeography map explains that palms reach their highest levels of diversity in evergreen rain forests. A DNA-based "tree of life" together with genuine palm fossils from the Berlin Natural History Museum offer insights into the basic features of palm evolution, and interested visitors can obtain more in-depth information on specific palm species leafing through the website [www.palmweb.org](http://www.palmweb.org).

Some of the most striking features in palms are the numerous records they hold, one of the most spectacular being the largest leaf in the plant kingdom. In order to show its huge dimensions of over 25 meters, we display a

model of the Botanical Museum Berlin-Dahlem together with a stylized in-scale leaf of *Raphia regalis*.

As leaves are the main distinguishing character of palms, they also feature at the very center of the exhibition. A rotary disc and selected specimens from the famous Berlin Palm Herbarium illustrate the distribution of major leaf forms and splitting types across the subfamilies of palms and encourage visitors to deal with this, what P.B Tomlinson called the "most complex determinate organ built by plants."

**Life histories:** In this chapter, visitors learn more about the reproductive strategies of palms, notably the hapaxanthic life history. Multiple wet and dry specimens, on display in a large cabinet showcase, illustrate the striking diversity of form and shape in fruits and flowers. Due to its sheer size, one of the most prominent objects had to remain on display in the entrance hall of the Botanical Museum. With an age over 300 years, the trunk of a female *Chamaerops humilis* was one of the chief figures in the famous *experimentum berolinense* conducted by Johann Gottlieb



2. "Shop" filled with 101 contemporary commercial products, Botanical Museum Berlin-Dahlem.

Gleditsch in 1749 in order to prove for the first time experimentally and convincingly, that plants reproduce sexually.

**Diversity of use:** Apart from their underground organs, virtually all parts of palms are used in one way or another. An array

of selected specimens and objects, including wax, resin, paper, oils and sugars as well as adornments and basketry convey that both the diversity of useful palms and the uses themselves can be very surprising (Figs. 2 & 3). The three economically most important palms *Elaeis guineensis*, *Cocos nucifera* and *Phoenix dactylifera* receive special attention in the exhibit. Archaeological objects from Berlin collections together with a 3-D reconstruction of the famous Oasis garden of Jericho at the time of King Herod the Great stress the importance of the date palm since antiquity. Nowadays, the continuing boom of oil palm monoculture causing massive destruction of tropical forests constitutes the downside of our society's continuously mounting consumption of palm oil. Visitors can browse our "shop" filled with 101 contemporary industrial products (Fig. 2) and see for themselves, that palm products, and especially oil and fat, are indispensable not only for the food industry but also for the manufacture of fuels, detergents and cosmetics. Children aged 5 years and above can learn even more about palm products in a special "shopping game."

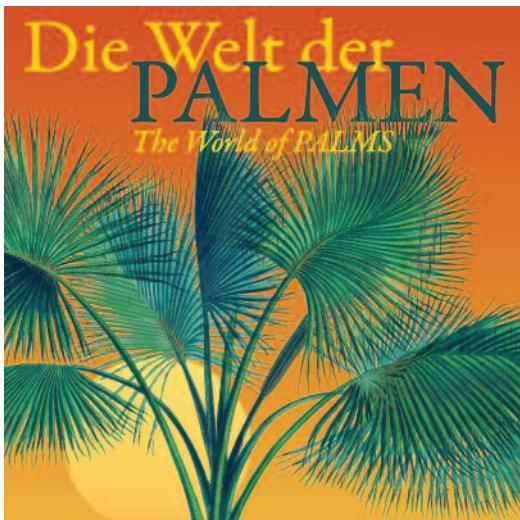
**Desire:** The introduction of palms in Europe has been fueled decisively by our yearning for

the tropics. European knowledge about palm diversity was at first slow to develop. In 1753 Linnaeus was familiar with only eight different palm species. However, the spectrum of well-known palm species broadened dramatically due to the colonial expansions of Great Britain, France, Spain and the Netherlands. In 1821 the first fully glazed greenhouses specially designed for the needs of tall palm trees were constructed simultaneously in Hackney near London and in the Royal Botanic Garden in Schöneberg near Berlin. There is hardly another plant family as connected to the development of modern greenhouses. Iron-and-glass construction reached a technical and aesthetic highpoint in 1848 with the completion of the palm house at the Royal Botanic Gardens, Kew. The great glass palaces that were built in the second half of the nineteenth century in European capitals such as the Berlin "Flora" already used an evergreen tropical backdrop for commercial purposes, not unlike contemporary indoor amusement parks.

**Palm islands:** Islands with, in many cases endemic, palm populations do not only activate common stereotypes, but indeed offer perfect settings for palm research, as we present

3. Another view of the World of Palms exhibition at the Botanical Museum Berlin-Dahlem.





4. The World of Palms exhibition book.

in four examples. The survival of the extremely endangered *Lodoicea maldivica* with its spectacular seeds, fruits and inflorescences is a main issue on the Seychelles archipelago. Collecting and comprehending the out-

standing palm diversity in Cuba is a research focus of our institution. Studies on Lord Howe Island have shown that investigating speciation in *Howea* can help understanding processes of sympatric speciation that are of interest beyond the palm family. The extinction of *Paschalococos disperta* on Easter Island caused by man stresses the importance of palms in island ecosystems.

The exhibition offers just a first glimpse of the "World of palms", aiming to inspire an even closer look at this almost inexhaustible field. It will be on display in Berlin until the end of February 2012: the panels and selected items will then be available for loan. A bilingual catalogue (Fig. 4) edited by H. W. Lack & W. J. Baker, *Die Welt der Palmen/The World of Palms*, Berlin 2011 (ISBN 978-3-921800-69-0) is available for sale ([m.sonntag@bgbm.org](mailto:m.sonntag@bgbm.org)). Further information on the loan of the exhibition can be obtained by contacting Kathrin Grotz at the Botanical Museum Berlin-Dahlem (+49 +30 838 50165; [k.grotz@bgbm.org](mailto:k.grotz@bgbm.org)).

# ***Phoenix roebelenii* on the Mekong and Ou Rivers**

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1. *Phoenix roebelenii* on the Mekong near the port of Guanlei



This paper provides observations on the distribution and habitat of *Phoenix roebelenii* on two rivers in Indochina.

In 1994 Sasha Barrow wrote a very informative paper for *Principes* (now, of course, *Palms*), "In Search of *Phoenix roebelenii*: The Xishuangbanna Palm." The paper detailed the history of *P. roebelenii* O'Brien, information on its habitat, its conservation status and the single stemmed form usual in cultivation and commonly known as the Pygmy Date Palm.

The paper introduced us to the clustering form of *P. roebelenii*.

In 2009 and 2010 we travelled on the Mekong River a distance of 700 km from Ganlanba, 34 km south of Jinghong, in Xishuangbanna, China, to Louangphrabang (Luang Prabang) in central, northern Lao PDR (Laos).



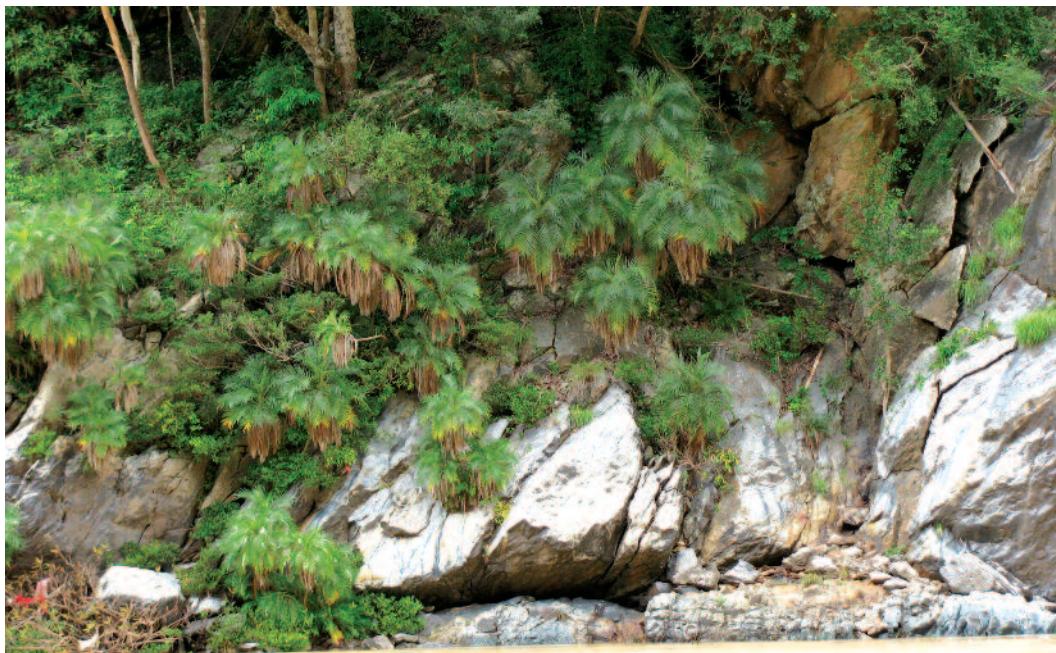
2. *Phoenix roebelenii* on the Mekong near the port of Guanlei.

### The Mekong River

The Mekong River is 4350 km long. In China, the Mekong River is called the Lancang River. Towards the most southern part of China the river forms the border with Myanmar (Burma).

Further downstream the Chinese port of Guanlei is the river border check point between Laos and China. The Mekong then flows between Myanmar and Laos until it reaches The Golden Triangle, where Thailand

3. *Phoenix roebelenii* on the Mekong near the port of Guanlei.



begins. The Mekong flows between Thailand and Laos for nearly 100 km until it has Laos on both sides.

After leaving Ganlanba, we saw *Phoenix roebelenii* well represented on rocky sections of the river banks by small groups of palms with clustering stems to 1.5 m tall. Significant roads were being bulldozed on both banks and large amounts of soil were being forced over into the river covering many of the palms.

Further down the river towards the port of Guanlei, the river banks had not been disturbed, and *P. roebelenii* was prolific (Figs. 1–3). Colonies of the palm with clustering stems 30–50 mm in diameter up to 5 m tall were growing on the rocky banks and on small cliffs and islands protruding from the river. If conditions were suitable for them, they grew from the high level of the river to 15 m up the banks. When the river is high, palms on rocks in the river and those close to the edge are completely submerged for some time.

After passing Guanlei the Mekong was often narrow, deep and very swift. *Phoenix roebelenii* continued to grow in large numbers in every available location, which made the scenery spectacular. This remote part of the river was controlled; shipping had been restricted for many years to prevent opium entering China from The Golden Triangle. It had also been closed to foreign tourists for many years.

Approximately 80 km downstream from the port of Gaunlei the palm population became less dense and individuals were smaller in stature with slender clustering stems (Fig. 4). After Xieng Kok (a Laos check point), there were numerous small plants of *P. roebelenii* for only a short distance, then there were no more.

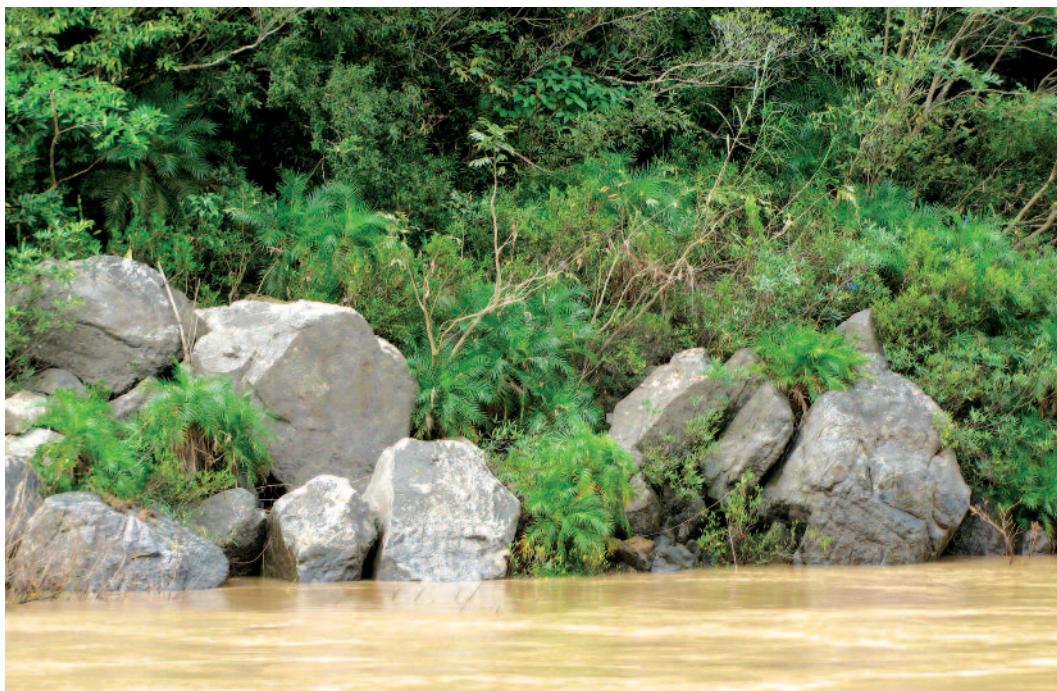
After leaving this section of the river we reached The Golden Triangle and the border between Myanmar and Thailand. Many kilometers later after we had passed Thailand and were well into Laos we saw a handful of small *P. roebelenii* occurring on a remote part of the river.

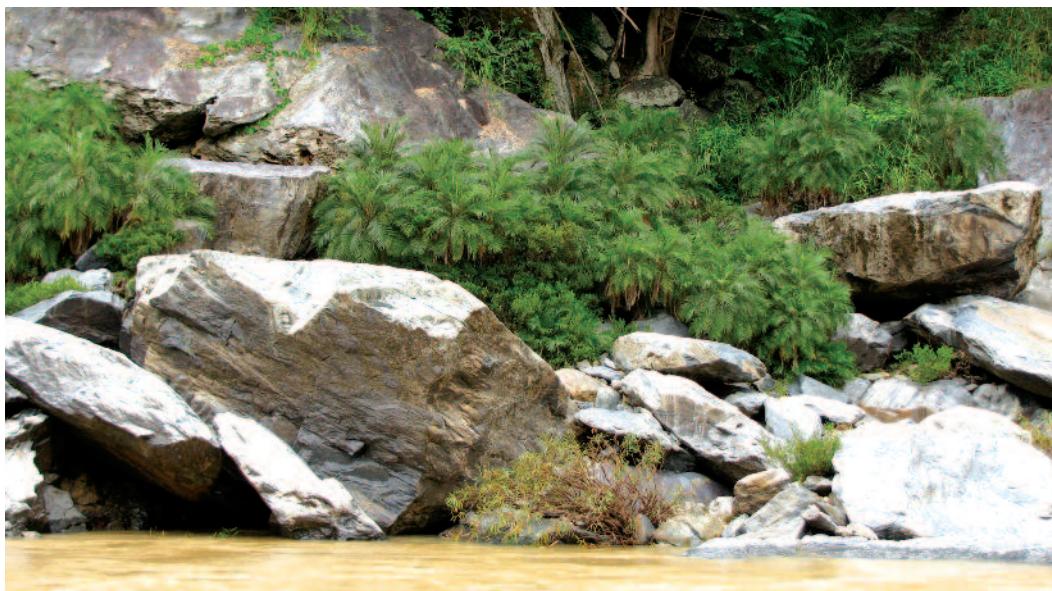
### The Ou River

The Ou River (Nam Ou in Lao) is 380 km long. It begins in China and enters the eastern side of Laos near Vietnam. It flows south and southwest through gorges and mountain valleys before joining the Mekong at Ban Pak Ou, 24 km north of Luang Prabang.

We joined the river at Hat Sa north of Phongsali in Laos and traveled to Luang Prabang. *Phoenix roebelenii* grows wild in scattered populations for a distance of 100 km on many sections of the river between Hat Sa and 20 km before Muang Ngoi (Fig. 5). It is likely that the palm also occurs north of Hat Sa towards the Chinese border.

4. *Phoenix roebelenii* on the Mekong near Xieng Kok, Laos.





5. *Phoenix roebelenii* on the Ou River, Laos.

Near Muang Khua, about 70 km down river from Hat Sa, *P. roebelenii* had stems that were thicker than the palms on the Mekong; they were approximately 100 mm in diameter. There were individual palms with straight stems 2–4 m tall. We could not go ashore, and from the river we were unable to ascertain if the palms had single stems or had clustering stems. The tall individual palms may have had small stems clustering from their bases, or there may have been numerous seedlings regenerating beneath palms with single stems.

#### Discussion

On the Mekong undisturbed populations of clustering *P. roebelenii* occur between Ganlanba, China, and Xieng Kok, Laos, for a distance of approximately 150 km. On either side of this range populations have been disturbed, and palms have been removed in large numbers. Now only a few areas of small palms remain. *Phoenix roebelenii* no longer grows wild in Thailand, and it does not grow for 100 km either side of Thailand's borders. These palms have been removed from the river banks and taken to Thailand for sale. Restrictions on shipping and travel from The Golden Triangle through the remote region between Laos and Myanmar towards the Chinese border may have saved some of the palms from poachers. There is still a section of the Mekong that is relatively natural along which *P. roebelenii* still flourishes.

On the Ou River *P. roebelenii* grows on most of the rocky banks and rocky outcrops of the

river. One could expect to see a larger number of tall or mature palms than are there. Palms may have been removed and taken to Vietnam or Thailand for sale but they have not been used in Laos. It is very rare to see *P. roebelenii* in cultivation in any town or city in Laos.

Sasha Barrow discussed the saturation of Thai markets with *P. roebelenii* collected from the wild, the difficulty of traders collecting tall plants without going further afield and the large quantities of seeds that were collected and being grown for future use. Growing plants from seed may have also had a positive effect on the conservation of this palm. Seventeen years after Sasha Barrow's paper there is little evidence that *P. roebelenii* is still being removed from the Mekong or Ou Rivers. Pressure may be off the palm in Thailand and other countries in Indochina, but pressure may be resumed if *P. roebelenii* becomes a desirable landscape palm in China.

Several dams are being constructed on the Lancang River in China and proposed on the Mekong in northern Laos. It is anticipated they will lower the level of the river. If this occurs the habitat of *P. roebelenii* may be modified, and the palm may be subjected to a new threat.

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# Hybrids in the Genus *Syagrus*

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1. *Syagrus × montgomeryana* holds many, dark green, ascending to arching leaves. Ingwersen nursery, Lampang, Thailand.

Several natural hybrids occur in *Syagrus*, a large, diverse and wide-ranging genus of pinnate-leaved, cocosoid palms from South America and the Caribbean, attesting to the relative ease of hybridization between some of its species. This relative ease of hybridization, along with the highly ornamental nature and cold tolerance of some of its species from southern Brazil, has attracted several collectors and growers who, through hybridization, wish to expand the landscape potential of this useful genus. Because at least one of these artificial hybrids has entered the trade and is being widely promoted, I name and describe it here as a new hybrid species while I discuss other natural and artificial hybrids in the genus.

At least five natural interspecific hybrids occur in *Syagrus* where the ranges of species overlap (Lorenzi et al. 2010) and at least two intrageneric hybrids (one artificial and the other natural but occurring spontaneously in cultivation) are documented (Hodel 2005, Lorenzi et al. 2010) for *Syagrus* and related genera, and collectors and growers, including Jack Ingwersen in Thailand and Dick Douglas and Patrick Schafer in northern California, are continuing to make more. In general the hybrids are variable and the artificial hybrids frequently tend to resemble the seed (pistillate) parent more than the pollen (staminate) parent, a situation that is less likely to occur in natural hybrids where there are multiple opportunities for the hybrid to occur with either of the parents serving as the seed or pollen provider.

### A New Artificial Hybrid

Ingwersen, who is doing most of the interspecific hybridization in *Syagrus*, has focused his attention on a superb hybrid between *S. schizophylla* and *S. romanzoffiana*, which he has been distributing to the trade for several years under the registered trademark name Coconut Queen® and for which I here provide a formal hybrid species name.

***Syagrus × montgomeryana*** Noblick ex Hodel sp. hyb. nov. (*S. schizophylla* × *S. romanzoffiana*).

Palma inter *Syagrum schizophyllum* et *S. romanzoffianam* quasi intermedia et hybridatione harum specierum orta, magnitudine habitus inter parentes media, ad illud habitu maiore, trunco maiore, pinnis pluribus, petiolis et rachidibus foliorum et bracteis pedunculorum longioribus, rachillis brevioribus differt; ad hoc habitu minore, trunco minore, pinnis paucioribus, petiolis et bracteis pedunculorum longioribus, rachillis pluribus et longioribus differt. Typus: CULTIVATED. USA. California, San Diego County, Vista, nursery of John Ingwersen. D. R. Hodel 2030 (holotypus BH, isotypus HNT). Figs. 1–7.

Solitary, moderate, tree palm, to 12 m tall (Figs. 1 & 2). Trunk 25 cm diam., ringed, internodes 5 cm. Leaves 40–60, ascending, eventually spreading, 3–4 m long, distal 60–90 cm drooping; base 40 cm long, persistent and becoming woody, deeply split opposite petiole, margins with coarse, hair-like fibers to 10 cm long (Fig. 3); petiole to 1.1 m long, 5–10 cm wide at base and there convex abaxially and

very slightly channeled adaxially, 2.5–4 cm wide at apex and there convex abaxially and ± flat adaxially, green but with whitish or grayish, scurfy, mealy, ± deciduous tomentum abaxially, margins with tan, coarse fibers to 10 cm long and finer hair-like fibers to 60 cm long in proximal 75 cm, these progressively reduced to small teeth or scurfy, wing-like fibers in distal 25 cm; rachis 2.5–3 m long, convex with tomentum abaxially as in petiole, ± flat adaxially near the base progressively becoming an angled, sharp costa distally; pinnae 100–120 per side, irregularly arranged, clustered and fanned in 1 or 2 planes in proximal one-half to two-thirds of blade, regularly arranged and in 1 plane in distal one-third to one-half of blade, proximal pinnae to 65 × 0.8 cm, proximal mid-blade pinnae largest, these to 85 × 3.2–4 cm, most distal pinnae 45 × 0.5 cm, long-lanceolate, straight, thin-leathery, dark green, tips split for 8–10 cm, midrib prominent and elevated adaxially, with 5–7 conspicuous secondary nerves on either side, these conspicuous abaxially, midrib with whitish or grayish, medifixed ramenta to 8 mm long scattered in proximal one-half to nearly the entire pinna length abaxially.

2. *Syagrus × montgomeryana* makes a handsome ornamental. Ingwersen nursery, Lampang, Thailand.





3 (left). Petiole margins of *Syagrus × montgomeryana* have coarse, hair-like fibers to 10 cm long (Hodel 2030, holotype). Ingwersen Nursery, Vista, California. 4. (right). Inflorescences of *Syagrus × montgomeryana* are ascending to arching in flower. Ingwersen nursery, Lampang, Thailand.

Inflorescences 4–7, interfoliar, to 2.25 m long, ascending to arching in flower, pendulous in fruit, 1-branched (Fig. 4); peduncle 90–120 cm long, 2.5 cm wide and 1.2 cm thick at apex, gradually widening toward base, densely covered with tan tomentum; peduncular bract to 2 m long, thick-leathery, golden coppery and finely striate to nearly smooth adaxially, greenish with deciduous, mealy, white to tan tomentum and prominently, densely, and deeply grooved abaxially; rachis to 75 cm long, 2.5 cm wide at base and flattened, tapering to 1 cm wide at apex; rachillae ca. 90, to 65 cm long, to 1 cm diam. at base, 0.75 mm diam. at apex, cream to yellow-green in flower, ± lax, forward pointing, conspicuously flexuous. Stamine flowers in distal one-half to two-fifths of rachillae, seated in shallow clefts 1 mm long, 1 mm wide, 1 mm deep and 2–4 mm distant, the proximal lip of cleft a prominent, collar-like bracteole 0.75 mm high; triads, consisting of a center, later-opening pistillate flower flanked on each of two sides by earlier-opening staminate flowers, in proximal one-half to three-fifths of rachillae, triads in prominent clefts 8 mm long, 6 mm wide, 2.5 mm deep and subtended by 2

imbricate, collar-like bracteoles 0.75–1 mm high; staminate flowers 8 × 13 mm, fragrant, yellow-orange (Fig. 5); calyx 2 × 3.5 mm, cupular, sepals connate and cream-colored in proximal 1 mm, distal lobes free, brown, rounded triangular, light yellow to nearly transparent, barely exceeding base of petals; petals 9 × 3 mm, long-ovate, yellowish orange, valvate, free nearly to base, acute, very faintly nerved; stamens 6, 4–5 mm long, shorter than petals, style 3 mm long, light yellow, anthers 4 mm long, dorsifixated below middle; pistillode short, 1 mm tall, columnar, barely trifid apically, yellowish; pistillate flowers 9 × 7 mm, ovoid, greenish yellow (Fig. 6); calyx 7 × 7 mm, cupular, sepals imbricate nearly to apex and there broadly rounded, acute, light green, margins thin, nearly transparent; petals 7 × 7, cup-like, imbricate nearly to apex and light green except for mucronate, erect, free, yellowish tip and clear, thin, nearly transparent margins, staminodes connate in a clear, collar-like ring 2.5 mm high; pistil 8.5 × 5 mm, ovoid, style lacking, stigma trifid, tips conspicuous, 2 mm long, free, recurved. Fruit 3.5 × 2.8 cm, irregularly oblong-ovoid, maturing yellow-orange (Fig. 7).



5 (top). Staminate flowers of *Syagrus × montgomeryana* are fragrant and yellow-orange (Hodel 2030, holotype). Ingwersen Nursery, Vista, California.



6 (middle). Pistillate flowers of *Syagrus × montgomeryana* are greenish yellow (Hodel 2030, holotype). Ingwersen Nursery, Vista, California.



7 (bottom). Fruits of *Syagrus × montgomeryana* are irregularly oblong-ovoid and mature yellow-orange (Hodel 2030, holotype). Ingwersen Nursery, Vista, California.

Noblick (1992) suggested the specific epithet to honor the late Robert H. Montgomery and the Montgomery Botanical Center in Florida. The original plant to which Noblick referred was in Fairchild Tropical Botanical Garden in Florida, was likely an unintentional hybrid, and perished in Hurricane Andrew (Noblick, per. comm.). Although not the first to make it, Jack Ingwersen has championed this hybrid and has been making the cross for nearly 10 years at his nursery near Lampang, Thailand, using *Syagrus schizophylla* as the seed parent and *S. romanzoffiana* as the pollen parent. He ships the seeds produced in Thailand to California, where his son John germinates and

grows them on for the trade in their nursery, Jungle Jack's Palms, in Vista, under the registered trademark name Coconut Queen®. In extolling the virtues of *Syagrus × montgomeryana* Coconut Queen® the Ingwersens state that the hybrid has the gracefulness and elegance of a kentia palm (*Howea forsteriana*) and the hardiness of a queen palm. Indeed, they report that visitors to their California nursery sometimes at first sight mistake it for an extraordinarily vigorous kentia palm (*Howea forsteriana*).

The Ingwersens report that the handsome *Syagrus × montgomeryana* Coconut Queen® has

several horticultural features that make it a superb choice and better alternative to the ubiquitous queen palm (*S. romanzoffiana*) in subtropical and Mediterranean-climate landscapes. With a much fuller canopy, it holds two to three times as many leaves (40–60 vs. 15–20) as a queen palm, and the leaves are consistently darker green, possibly indicating a lower nitrogen requirement than queen palms, which have a high nitrogen requirement and frequently have yellow leaves in the California landscape. A lower nitrogen requirement could encourage less applied fertilizers, reducing the potential for harmful nutrient leaching into streams, ponds, lakes and other bodies of water.

Because it is a hybrid, *Syagrus × montgomeryana* Coconut Queen® is largely sterile and has consistently less fruit set than a queen palm (ca. 90% less), significantly reducing landscape fruit litter. For this reason, it has been employed extensively in at least one theme park near San Diego, California. Although a relatively fast grower in tropical Thailand, where it has reached nearly five meters overall height with a trunk 60 cm tall after five years from seed, it is somewhat slower than a queen palm in California. This slower growth rate is another appealing horticultural feature that would likely reduce leaf and inflorescence litter entering the municipal green waste stream and result in a plant better and longer suited to diminishing urban landscape space.

Although largely undocumented, the Ingwersens note that *Syagrus × montgomeryana* Coconut Queen® might be more heat tolerant and might require less water than queen palms. Heat intolerance is one of the limiting factors to successful culture of queen palms in hot, inland, desert areas of California. As water becomes an even more precious, expensive and ever-diminishing resource in many urban areas, plants that require less water yet still perform optimally and provide desired landscape functions and amenities will be more highly valued.

#### Other Artificial Hybrids

For many years Jack Ingwersen has been making hybrids in *Syagrus* at his nursery in Thailand in an attempt to develop plants of superior horticultural and landscape merit. Other than *S. romanzoffiana*, the species he has used in his hybridization efforts originated from seeds that he or others collected in Brazil and Bolivia and grew on to mature size in Thailand. Here I list, describe and illustrate

some of his hybrids. I list these hybrids without names and place the seed parent first followed by the pollen parent.

#### *Syagrus coronata* × *S. picrophylla*.

Solitary, moderate to robust tree palm to 15 m tall (Fig. 8). Trunk 25–35 cm diam., flared or slightly enlarged at base, ringed, internodes 5 cm. Leaves 12, ascending, arching, 3.5–4 m long, distal 60–90 cm drooping; base to 60 cm long, green with deciduous, whitish, mealy tomentum, persistent and becoming woody, base bulbous and swollen to 25 cm long, abruptly tapering to 25–30 cm long and 5 cm wide “neck,” lacking medial costa abaxially but there convex, deeply split opposite petiole, margins with coarse, tan to brown, ragged fibers to 15 cm long, fibers near base much longer and encircling trunk; petiole to 1 m long, 5 cm wide at base, 3.5 cm wide at apex, green, convex abaxially and with deciduous whitish mealy tomentum, ± flat adaxially, margins in proximal 30 cm with coarse ragged fibers; rachis 2.5 m long, convex abaxially, flattened adaxially at base but becoming sharply angled at mid-blade; ca. 120 pinnae per

8. *Syagrus coronata* × *S. picrophylla* is a moderate to robust palm. Ingwersen nursery, Lampang, Thailand.





9 (left). Pinnae of *Syagrus coronata* × *S. picrophylla* are irregularly arranged in groups and fanned in several planes to give a plumose effect. Ingwersen nursery, Lampang, Thailand. 10 (right). Inflorescences of *Syagrus coronata* × *S. picrophylla* are ascending to spreading. Ingwersen nursery, Lampang, Thailand.

side, ± irregularly arranged in groups of 3–5 and fanned in several planes to give plumose effect (Fig. 9), to  $80 \times 3.5$  cm, long-lanceolate, straight, stiff, leathery, dark green adaxially, grayish abaxially with glaucous bloom, midrib prominent and elevated adaxially, with 4–6 secondary nerves on either side, midrib abaxially covered densely with ± contiguous, tan, mealy ramenta to 7 mm long in proximal one-half, these becoming scattered at mid-pinnna. Inflorescences several, interfoliar to mostly infrabfoliar in flower, 80–125 cm long, ascending to spreading, 1-branched (Fig. 10); peduncle ca. one-half to two-thirds of total inflorescence, most of it concealed by persistent sheath of subtending leaf, panicle one-third to one-half of total inflorescence; peduncular bract to 1.5 m long, thick-leathery, becoming woody, green with deciduous, whitish tomentum and densely, deeply, and prominently grooved abaxially; rachis 1.5–2 cm diam. at base, green, becoming flexuous, tapering to 8 mm diam. at apex; rachillae numerous, to 30 cm long, to 8 mm diam. at base, tapering to 1.5 mm diam. at apex, glabrous. Staminate flowers in distal one-half of rachilla, 13–15 × 13–15 mm; pistillate

flowers in proximal one-half of rachilla, 10 × 8 mm.

This hybrid is unusually variable, and some forms have a tendency for petioles to break, detracting somewhat from its otherwise ornamental nature. It has reached about five meters overall height with one meter of trunk after five years from seed in tropical Thailand.

#### ***Syagrus picrophylla* × *S. romanzoffiana*.**

Solitary, large tree palm to 20 m tall (Fig. 11). Trunk 25 cm diam., abruptly flared at base, ringed, internodes 15 cm. Leaves 12–15, ascending-spreading, arching, 5.5–6 m long; base to 1 m long, green, densely covered with whitish, mealy tomentum, prominent medial costa extending on to petiole, deeply split opposite petiole, margins with coarse, ragged fibers; petiole to 1 m long, 4–5 cm wide at base, 3 cm wide at apex, green, convex abaxially and with deciduous whitish mealy tomentum, ± flat adaxially, margins with coarse, ragged fibers mostly in proximal 75 cm but sometimes for entire length, sometimes fibers in distal 25 cm degraded or reduced to ± scurfy, wing-like margins; rachis 3.5–4 m



11. *Syagrus picrophylla* × *S. romanzoffiana* can become a large palm. Ingwersen nursery, Lampang, Thailand.

long, convex abaxially, flattened adaxially at base but becoming sharply angled at mid-blade; ca. 160 pinnae per side, ± irregularly arranged in groups of 2–4(–7) and fanned in several planes to give plumose effect, to 95 × 4.5 cm, long-lanceolate, straight, distal 15–20 cm drooping, leathery, glossy dark green

adaxially, paler abaxially and moderately dotted with minute, irregularly shaped to ± round, tan scales, midrib prominent and elevated adaxially, with 5–7 conspicuous secondary nerves on either side, transverse veinlets conspicuous, midrib abaxially covered densely with ± contiguous, tan, ramenta to 5



12. *Syagrus romanzoffiana* × *S. yungasensis* is a slender palm. Ingwersen nursery, Lampang, Thailand.

mm long in proximal three-fourths, these becoming scattered in distal one-fourth. Inflorescences 3 or 4, interfoliar in flower and fruit, to 2.5 m long, ascending to spreading in flower, pendulous in fruit, 1-branched; peduncle 1–1.25 m long, 2.5 × 1.5 cm at apex, green with deciduous, mealy, white tomentum; peduncular bract to 2.5 m long, thick-leathery, becoming woody, green with deciduous, whitish tomentum and densely, deeply, and finely grooved abaxially; rachis 1–1.25 m long; rachillae numerous, to 90 cm long, 1.5 cm wide at base. Stamine flowers in distal two-thirds of rachilla; pistillate flowers in proximal one-third of rachilla.

A relatively fast grower in tropical Thailand, this hybrid has reached about six meters overall height with three meters of trunk after five years from seed.

#### *Syagrus romanzoffiana* × *S. yungasensis*.

Solitary, slender, tree palm to 15 m tall (Fig. 12). Trunk 20 cm diam., flared at base, ringed, internodes 20 cm. Leaves ca. 20, spreading, 3–3.25 m long, distal 90 cm pendulous; base 45–60 cm long, medial costa prominently raised, persistent and becoming woody, covered with white mealy tomentum, deeply

split opposite petiole, margins with coarse fibers to 40 cm long with the distal 25–30 cm falling away leaving 10 cm base; petiole 40 cm long, 5 cm wide at base, 2–2.5 cm wide at apex, green, slightly convex to ± flattened abaxially with whitish tomentum throughout, flat adaxially, margins with a few slender hair-like fibers to 10 cm long in proximal 10 cm; rachis 2 m long, slightly convex abaxially, prominently raised and sharp costa adaxially; 115 pinnae per side, arranged in groups of 3–4 and fanned in several planes to give plumose effect, to 65 × 1.8 cm, long-lanceolate, straight, thick-papery, green, drooping, midrib prominent adaxially, with 4 prominent secondary nerves on either side, only secondary nerves conspicuous abaxially, midrib with scattered whitish ramentae to 4 mm long. Inflorescences several, interfoliar or rarely infrafoliar, to ca. 1.25 m long, ascending to spreading in flower, drooping in fruit, 1-branched (Fig. 13); peduncle 45 cm long, typically nearly completely concealed by subtending leaf base, 2.5 × 1.5 cm at apex, densely covered with tan mealy tomentum; peduncular bract to 1.25 m long, finely striate adaxially and prominently, densely, and deeply grooved with whitish mealy tomentum

13. Inflorescences of *Syagrus romanzoffiana* × *S. yungasensis* are ascending to spreading in flower. Ingwersen nursery, Lampang, Thailand.



abaxially; rachillae numerous, 45–50 cm long, 1.5 cm wide at base and ±flattened, tapering to 0.5 mm diam. at apex, flexuose, golden yellow in flower. Staminate flowers in distal three-fourths of rachilla, 10 × 15 mm, white, a few staminate flowers mixed with pistillate flowers in transition zone; pistillate flowers in proximal one-eight to one-fourth of rachilla, 10 × 7 mm, white.

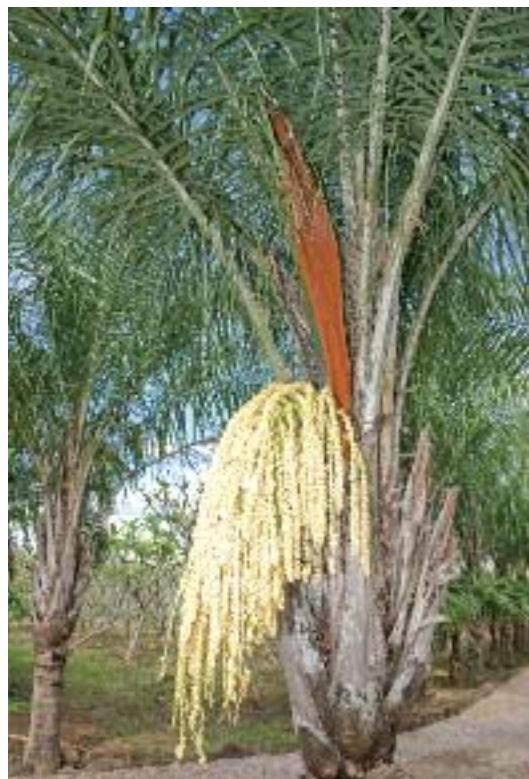
A relatively fast grower in tropical Thailand, this hybrid has reached about six meters overall height with three meters of trunk after five years from seed.

***Syagrus schizophylla* × *S. × montgomeryana*.**

Juvenile plant, no trunk. Leaves 10, ascending, ± stiff, to 3 m long (Fig. 14); sheath 45 cm long, margins with ragged tan coarse fibers,

14. Leaves of *Syagrus schizophylla* × *S. × montgomeryana* are ascending, stiff, and with pinnae mostly in one plane. Ingwersen nursery, Lampang, Thailand.





15 (left). *Syagrus × camposportoana* can become a robust palm. Ingwersen nursery, Lampang, Thailand. 16 (right). Inflorescences of *Syagrus × camposportoana* are about two meters long. Ingwersen nursery, Lampang, Thailand.

those near base completely encircling stem, those distally becoming progressively shorter; petiole 60 cm long, 4–5 cm widen at base, 2.5 cm wide at apex, covered with deciduous, mealy, whitish tomentum but becoming ± glabrous, convex abaxially, concave adaxially proximally and ± flattened to slightly channeled distally, margins with ragged tan fibers in proximal 45 cm, these reduced to papery or scurfy wing in distal 15 cm; rachis 1.75–2 m long, green, convex abaxially, flattened adaxially but proximally becoming sharp, raised costa from mid-blade to apex; ca. 95 pinnae per side, arranged in groups of 3 or 4 proximally and in ± the same plane to ± regularly arranged distally, ascending from rachis to give V-shaped blade, ± flat in distal 30 cm, to 55 × 2.5 cm, long-lanceolate, straight, stiff, dark glossy green, midrib prominent and raised adaxially with 5 secondary nerves on either side, moderately white- or tan-punctate adaxially, secondary nerves conspicuous abaxially, midrib with brown ramenta to 4 mm long scattered along proximal 35 cm.

This complex hybrid, currently known only from a small juvenile plant, is the result of

back crossing *S. × montgomeryana* with one of its parents, *S. schizophylla*. It is decidedly more like *S. schizophylla* in appearance, especially to the pinnae arranged mostly in one plane.

#### Natural Hybrids

These natural hybrids, most with *Syagrus coronata* as one of the parents, occur in Brazil and the descriptions are mostly taken from Lorenzi et al. (2010), who also provided nice illustrations. They are more or less intermediate between the parents and frequently share characters of each. In parentheses following the species names I list each parent alphabetically because both species serve as the seed and pollen parent.

***Syagrus × camposportoana*** (Bondar) Glassman, Fieldiana (Bot.) 31: 392. 1968. (*S. coronata* × *S. romanzoffiana*).

Solitary, robust tree palm, to 10 m tall (Fig. 15). Trunk 30 cm diam., flared or slightly enlarged at base, ringed, internodes 3–10 cm. Leaves 12–30, arranged in 5 distinct, vertically spiraling rows, mostly ascending, few spreading, to 6.5 m long, distal 75 cm drooping; base to 1 m long, bulbous and



17 (left). This *Syagrus × costae*, collected at the type locality in Brazil, is a medium-sized palm. Montgomery Botanic Center (941218), Miami, Florida. 18 (right). Fruits of *Syagrus × costae* are greenish brown. Montgomery Botanic Center (941218), Miami, Florida.

swollen proximally, to 30 cm long, tapering to 70 cm long “neck” with prominent medial costa, margins with coarse fibers to 15 cm long, green with dense, mealy white tomentum; petiole 1–1.7 m long, 5 cm wide at base, 3 cm wide at apex, convex abaxially, flattened adaxially, green with mealy, white tomentum, margins with ragged, coarse fibers to 15 cm long, reducing to small teeth 2 cm long at apex; rachis to 2.5–3.8 m long, convex abaxially, flattened adaxially at base but becoming sharply angled at mid-blade; ca. 130 pinnae per side, ± irregularly arranged in groups of 2–6 and fanned in several planes to give plumose effect, to 105 × 3.5 cm, long-lanceolate, straight, distal 30–35 cm drooping, leathery, green adaxially, paler abaxially, elevated midrib adaxially, with 4 or 5 secondary nerves on either side, secondary nerves conspicuous abaxially, no ramentae. Inflorescences several, interfoliar in flower, to 2 m long, ascending to pendulous, 1-branched (Fig. 16); peduncle to 1 m long, 4.5 × 3 cm at apex, densely covered with mealy, white tomentum; peduncular bract 2–3 m long, thick-leathery, becoming woody, green with deciduous, whitish tomentum and densely,

deeply, and prominently grooved abaxially; rachis 1–1.8 m long, tapering to 1–1.5 cm diam. at apex, yellow-green; rachillae numerous, 7–80 cm long, to 1.5 cm wide and flattened at base, tapering to 1–2 mm diam. at apex, glabrous, yellow-green, drooping, slightly flexuose. Staminate flowers in distal two-fifths of rachilla, 11 × 11 mm, white; pistillate flowers in proximal three-fifths of rachilla, 8 × 7 mm. Fruit 3–3.2 × 3 cm, ovoid, orange.

The description is supplemented from cultivated material in Thailand. This natural hybrid occurs in Bahia, Brazil, where the ranges of *Syagrus coronata* and *S. romanzoffiana* overlap. Its leaves arranged in five, distinct, vertically spiraling rows and trunk leaf scars are similar to those of *S. coronata*, and it has the appearance of a very robust form of this species. Leaves, peduncular bracts and fruits are larger than those of *S. coronata*, while seeds are not as deeply ruminate as those of *S. romanzoffiana*. In Thailand, Ingwersen made this hybrid using *S. coronata* as the seed parent and *S. romanzoffiana* as the pollen parent, and offspring have reached about 6 m height with 3 m of trunk after seven years from seed.



19. *Syagrus × tostana* is a slender palm. Ingwersen nursery, Lampang, Thailand.

***Syagrus × costae*** Glassman, Fieldiana (Bot.) 32: 244. 1970. (*S. cearensis* × *S. coronata*).

Solitary, moderate, tree palm to 10 m tall (Fig. 17). Trunk 12–22 cm diam. Leaves 10–18, arranged in vertical lines or spiraling rows, mostly ascending to spreading, 2–3 m long; base 23 cm long; petiole 50–60 cm long, margins initially with cloth-like fibers that weather into variable, flexible or rigid, flat, individual fibers; rachis 2–2.3 m long; ca. 124 pinnae per side, ± irregularly arranged in groups of 2–4 and in 1 plane, 75–80 × 3–4 cm, linear, lightly glaucous. Inflorescences several, interfoliar, ascending to spreading, branched; peduncular bract woody, densely, deeply, and prominently grooved abaxially, expanded part 70–80 × 20 cm; rachis 66–73 cm long; rachillae 43–53, 34–53 cm long. Fruit 2.8–3.2 × 2.6–2.8 cm, oblong, greenish brown (Fig. 18).

This natural, fertile hybrid occurs in Pernambuco and possibly Alagoas, Brazil where the ranges of *Syagrus cearensis* and *S. coronata* overlap. Petiole fibers are similar in size to those of *S. coronata* but are softer and leaf arrangement is variable, either in distinct rows or not. Glassman erroneously reported this hybrid between *S. coronata* and *S. oleracea*, but Lorenzi et al. (2010) showed that it was *S. cearensis*, rather than *S. oleracea*, that was one of the parents.

Plants from cultivated origin and labeled as this hybrid are in Fairchild Tropical Botanic Garden in Miami, Florida but appear different from plants collected at the hybrid's type locality in Brazil and labeled as such at the Montgomery Botanical Center in Miami. The differences may simply be due to hybrid variability or may represent mislabeled or misidentified plants.

***Syagrus × matafome*** (Bondar) A.D. Hawkes, Arq. Bot. Estado Sao Paulo, n. s., f. m. 2: 178. 1952. (*S. coronata* × *S. vagans*).

Solitary, moderate, slender, tree palm to 12 m tall. Trunk 15–25 cm diam., markedly ringed. Leaves 15–30, arranged spirally but not in distinct rows, mostly ascending; base 15 cm long; petiole 90–150 cm long, proximal margins with long, stiff fibers; rachis 0.5–2 m long; pinnae 60–90 per side, irregularly arranged in groups of 2–5 but in 1 plane, 20–50 × 2.5–4.5 cm, linear, glaucous. Inflorescences several, interfoliar, sometimes infrabfoliar in fruit, ascending to spreading, branched; peduncle 60–90 cm long; peduncular bract woody, densely, deeply, and prominently

grooved abaxially, grayish, 75–120 cm long, expanded part 25–200 × 6–11 cm; rachis 43–95 cm long; rachillae 30–80, 10–55 cm long. Fruit 2.5–3 × 2.1–2.5 cm, ovoid, greenish.

This natural, fertile hybrid occurs in Bahia, Brazil where the ranges of *Syagrus coronata* and *S. vagans* overlap. It is more similar in habit to *S. coronata*, which can be distinguished by its leaves arranged in distinct rows with wide, flat, woody sheath fibers, while *S. × matafome* has leaves spirally arranged with much narrower sheath fibers.

***Syagrus × teixeiriana*** Glassman, Fieldiana (Bot.) 32: 27. 1968. (*S. oleracea* × *S. romanzoffiana*).

Solitary, moderate, slender, tree palm to 6 m tall. Trunk 15 cm diam. Leaves 10–12, arranged spirally but not in distinct rows, ascending to spreading; base 30 cm long; petiole 60–90 cm long, proximal margins with few, short, stiff fibers, grayish; rachis 2.1 m long; pinnae 150 per side, irregularly arranged in groups of 3–5 and fanned in several planes, 66 × 2.5 cm, linear, stiff, glaucous. Inflorescences several, interfoliar, sometimes infrabfoliar in fruit, ascending to arching, branched; peduncle 50–70 cm long; peduncular bract woody, densely, deeply, and prominently grooved abaxially, grayish, 100–120 cm long, expanded part 82 cm long; rachis 60 cm long; rachillae 38–86, 41–48 cm long. Fruit 3 × 2.1 cm, ovoid with a short beak, orange.

This natural, fertile hybrid occurs in Sao Paulo and Goias, Brazil where the ranges of *Syagrus oleracea* and *S. romanzoffiana* overlap. It has stiff pinnae like *S. oleracea* and fruit that, while intermediate in size between both parents, is ellipsoid or ovoid like that of *S. oleracea*. The orange fruit and irregular endocarp cavity are like those of *S. romanzoffiana*.

***Syagrus × tostana*** (Bondar) Glassman, Rhodora 65: 261. 1963. (*S. coronata* × *S. schizophylla*).

Solitary, moderate, slender, tree palm to 8 m tall (Fig. 19). Trunk 10–15 cm diam. Leaves 8–15, arranged spirally, mostly ascending to spreading; base margins armed with long, flat, curling or spine-like fibers; petiole 100–126 cm long, armed as base, grayish (Fig. 20); rachis 2.1–2.3 m long; pinnae numerous, ± irregularly arranged in groups of 2 and fanned in several planes proximally but in 1 plane distally, 70–80 × 3.5–4 cm, linear. Inflorescences several, interfoliar, ascending to spreading, branched; peduncle 70–80 cm long; peduncular bract



20 (left). Leaf base and petiole margins of *Syagrus × tostana* are armed with long, flat, curling fibers. Ingwersen nursery, Lampang, Thailand. 21 (right). Inflorescences of *Syagrus × tostana* are mostly ascending to spreading. Ingwersen nursery, Lampang, Thailand.

woody, densely, deeply, and prominently grooved abaxially, 120–140 cm long, expanded part 82–97 × 10 cm; rachis 50 cm long; rachillae 60 or more, 40–45 cm long (Fig. 21). Fruit 3–4 × 1.5–2 cm, ovoid, reddish.

This natural, fertile hybrid occurs in Bahia, Brazil where the ranges of *Syagrus coronata* and *S. schizophylla* overlap. While the trunk is intermediate in size between both parents, the leaves are green, like those of *S. schizophylla*, instead of grayish green, like those of *S. coronata*. Fruits are larger than those of either parent. Ingwersen made this hybrid in Thailand using *S. schizophylla* as the seed parent and *S. coronata* as the pollen parent.

#### Acknowledgments

Jack and John Ingwersen allowed me to visit their nurseries in Thailand and California and provided information about many of these

hybrids. Marilyn Griffiths at Fairchild Tropical Botanic Garden provided information about their *Syagrus* accessions. Larry Noblick of Montgomery Botanical Center reviewed the manuscript.

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