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The International Palm Society

Founder: Dent Smith

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FRONT COVER

Licuala ramsayi var. *ramsayi* photographed by Michele Falzone at Cape Tribullation, Queensland, Australia. More of Mr. Falzone's photographs can be seen on his website, www.michelefalzone.net.

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A cascade of ripening fruits of *Arenga pinnata*. Photo by S. Zona.

NEWS FROM THE WORLD OF PALMS

We are very pleased to note that on 3 January 2005, the Harold L. Lyon Arboretum reopened to the public. The arboretum was closed by University of Hawaii shortly after the IPS Biennial visited the arboretum last summer (see News From the World of Palms 48: 160). In closing the facility, UH officials cited safety and liability concerns. While the arboretum was closed, slippery trails were posted, dangerous trees were trimmed and unsafe buildings were vacated. An audit by the state of Hawaii released last December found that the Arboretum was operating without adequate financial support and strategic guidance from UH. The long-term prospects of this magnificent collection of tropical plants – including hundreds of fabulous palms – depend on developing a strategic plan and obtaining $3 million from the Hawaiian legislature to fund necessary infrastructure improvements.

Three new palm books have come across our desks recently, all of which will be reviewed in forthcoming issues of PALMS. From IPS member David Leaser of California we received *Palm Trees: A Story in Photographs*. This breathtaking, large-format book, sumptuously illustrated from cover to cover, will be appreciated by every palm lover.

A grant from the IPS Endowment Fund supported the publication of *Flora de Palmeras de Bolivia* by Mónica Moraes Ramírez. The book is a botanical account, in Spanish, of the palm flora of Bolivia and is the first such book of its kind for that country. Dr. Moraes has spent many years researching and preparing this flora, which enumerates 83 taxa of indigenous palms.

From Brazil, a country rich in beautiful palms, comes *Palmeiras Brasileiras e Exóticas Cultivadas* by Harri Lorenzi and colleagues. This book, in Portuguese, covers both native and cultivated exotics. The species treatments include habit photographs, photos of the fruits and distribution maps. It is a welcome addition to the bookshelf, especially since so few illustrated accounts of Brazilian palms are available.

The Asociación Venezuelana de Palmas, better known as AVEPALMAS, has launched a new website, www.avepalmas.org, which will surely be of interest to palm enthusiasts in Latin America. AVEPALMAS is South America's only palm society and is affiliated with the IPS. The site, in Spanish, has much to offer, including pages devoted to endangered Venezuelan palms, palm nurseries and seed suppliers and palms in art, poetry and music.

The IPS, originally the Palm Society, grew out of Dent Smith's idea in 1955 that palms were a neglected group of economically and horticulturally important plants. Less than a year later, in 1956, the first newsletter of the Society was distributed, and then in 1957, the Society was formally incorporated. As we reflect on the 50th anniversary of Dent Smith's visionary idea, we can be pleased with the international appeal of palms and the reach of the IPS. Now, in 2005, the Society is a vibrant, multinational organization devoted, as ever, to the world of palms.

THE EDITORS

On the Identities of Thai Sugar Palms

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1. *Arenga pinnata* in Thailand.

Recent fieldwork in Thailand focusing on economic botany of sugar palms, which is here used as a collective term for the arborescent species of *Arenga*, (Fig.1) has revealed a number of useful fruit and seed morphological characters that we hope will help clarify species limits.

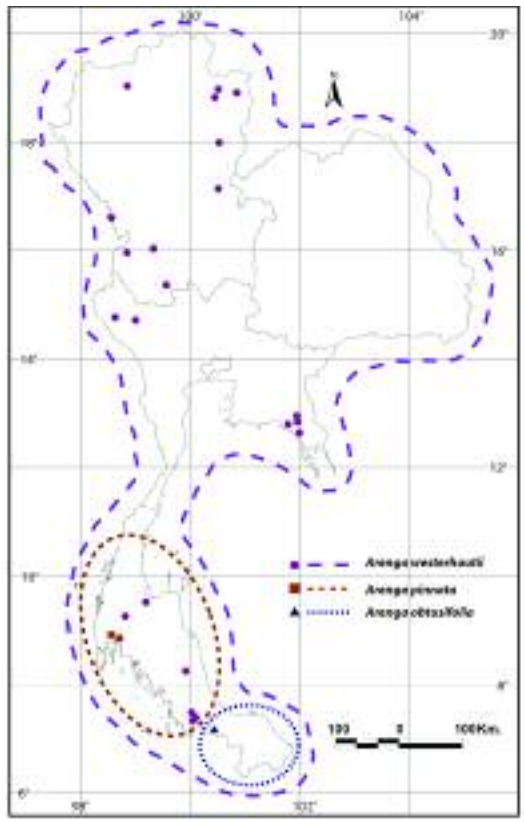
The genus *Arenga* is distributed in South China, the Ryukyu Islands and Taiwan in the north to Christmas Island in the south and from India in the west to Queensland, Australia in the east. The greatest diversity is found in Sumatra, Peninsular Malaysia and Borneo (Dransfield & Mogea 1984, Uhl & Dransfield 1987). In his recent revision the genus, Mogea (1999) described 22 species, two subspecies and four varieties. Five species are distributed in Thailand (Hodel 1998, Dransfield et al. subm.) of which three are arborescent, viz. *A. obtusifolia*, *A. pinnata* and *A. westerhoutii* (Fig. 2). The identity of the latter two species, which are both solitary, is often confused in Thailand. *Arenga pinnata* and *A. westerhoutii* are separated based on their leaf morphological characters in the identification keys. *Arenga pinnata* is separated from *A. westerhoutii* by having clustered pinnae that arise from the rachis in several planes (Dransfield & Mogea 1984, Hodel 1998). The problem is that this character shows age dependent variation and is not well represented on herbarium sheets.

Recently, we have initiated a study of the economic botany of sugar palms in Thailand. The name 'Sugar Palm' is used here in the broad sense for all the arborescent members of the genus *Arenga*. Several authors have stressed the economic importance of sugar palms in Thailand (Hoare et al. 1998, Jintana et al. 2001, Subansenee et al. 1999, Juiprik & Kijtewachakul 2001). The uncertainties relating to species delimitation, however, must be overcome to enable precise mapping of distributional ranges and to provide a scientific basis for resource management. Based on observations made on a large number of natural, semi-cultivated and cultivated populations we have extracted a number of characters that we believe are particularly useful for identification of Sugar Palms in Thailand.

Distinctive characters for arborescent species of *Arenga* in Thailand

An overview of the vegetative and reproductive characters of the three arborescent species of *Arenga* in Thailand is given in Table 1. In the following we describe the differences in more detail.

Habit and leaf morphology. *Arenga pinnata* (Fig. 1) and *A. westerhoutii* (Fig. 3) are both single-stemmed palms. They are similar in stem diameter and both have persistent leaf sheaths for a long distance below the crown. *Arenga obtusifolia* (Fig. 4) is distinguished by being multi-stemmed. The loosely clustered stems are slender and tall (Zakaria et al. 1999, 2000). The leaf sheaths only persist for a short distance underneath the crown.



2. Distribution of Thai sugar palms.

All three species of *Arenga* have 12–30 leaves that are gathered in a rather loose crown. Leaf dimensions depend on the age of the palm, e.g., the length varies from 6 to 15 m. The leaves are imparipinnate with opposite to subopposite pinnae (leaflets). The individual pinnae are ensiform (sword-shaped) with more or less revolute to undulate margins. They are dark lustrous green above and mealy below. The distal margins are jaggedly toothed. The bases are unequally auriculate.

In *A. pinnata* the pinnae are often arranged irregularly along the leaf rachis in several planes, a character that becomes more distinct with age. (vouchers: *Barfod et al. 41546* and *Pongsattayapipat et al. 24*). The mealy undersides of the pinnae often have a ferruginous tinge. The leaflets of *A. westerhoutii* are regularly arranged and arising from the leaf rachis in one, rarely several planes. The mealy covering of the undersides is silvery to rusty brown (voucher: *Barfod et al. 41104* and

Table 1 Vegetative and reproductive characteristics of the three arborescent *Arenga* species.

	Arenga obtusifolia	*Arenga westerhoutii*	*Arenga pinnata*
Vegetative			
Leaflets	leaflets in several planes, evenly distributed	leaflets in one plane, evenly distributed	leaflets in several planes, unevenly distributed
Leaf sheath fibres	not present in older leaves	persistent in older leaves	not present in older leaves
Phenology	pleonanthic, acropetal	hapaxanthic, basipetal	hapaxanthic, basipetal
Male inflorescences			
Length	0.8–1.0 m	1.2–1.5 m	1.8–2.5 m
Male flowers			
Stamen connective	yellow, narrow	yellow, wide	yellow with brown stripe, wide
Filament	short	longer	short
Female inflorescence			
Density of flowers on the rachillae	compact (in contact)	loose (separated, not touching)	compact (in contact)
Fruits			
Shape	longer than wide	equal in length and width	wider than long
Color at maturity	yellowish green	dark green	greenish yellow to orange
Color of perianth	black	calyx black, corolla green	calyx black, corolla yellowish green
Carpel keels	absent	present	absent
Locules	separated by mesocarp	not separated by mesocarp	not separated by mesocarp
Mesocarp thickness	moderate	thick	moderate
Stigma remnant	narrow, with 3 slits	wide, with 6 slits	narrow, with 3 slits
Seed			
Shape	elongate, with rounded keel	elongate, with sharp keel	rounded
Funicular scar	conspicuous, light colored	inconspicuous, dark	inconspicuous, dark
Distribution	peninsula	widely distributed	semi-cultivated in the south
Ecology			
Habitat	limestone and steep slopes	limestone and steep slopes	semi-cultivated
Altitudinal range	0–200	0–900 (1200)	0–200

3 (left). *Arenga westerhoutii* in habitat. 4 (right). *Arenga obtusifolia*, in its natural habitat.

Pongsattayapipat et al. 26). In *A. obtusifolia* the leaflets are usually regularly arranged as well; however, they arise from the leaf rachis in several planes. The leaflets are silver-grey below. The auricles at the leaf base are not quite as unequal as is the case with the former two species (voucher: *Barfod et al. 141643* and *Pongsattayapipat et al. 25*).

Phenology. Both *A. pinnata* and *A. westerhoutii* (Fig. 5 & 6) are hapaxanthic with a basipetal flowering sequence of the inflorescences in which emergence proceeds opposite to the order of formation. All the functional flowers of the first-produced inflorescences are female, whereas the last-produced inflorescences near the base contain only male flowers. *Arenga obtusifolia* (Fig. 7) differs by being pleonanthic and having a acropetal flowering sequence in which emergence follows the order of formation of the inflorescences. Dransfield and Mogea (1984) did not observe any trees where both sexes were represented, and they suggested that this species may functionally be dioecious. On female individuals, even the oldest inflorescences are entirely composed of female flowers, and male trees never bear infructescences.

Inflorescence. All three species of arborescent *Arenga* in Thailand are monoecious with flowers grouped in sympodial clusters of three, the so-called triads. The clusters are composed of one female flower flanked by two male flowers. The morphological differences between male and female flowers are

5. *Arenga pinnata* with inflorescence in staminate anthesis.

pronounced. All the flowers of one sex are usually suppressed during the development of the inflorescence so that it becomes functionally unisexual. In *A. pinnata* and *A. westerhoutii* a bisexual inflorescence is sometimes produced in between the female and male phases of flowering.

Flowers. The three imbricate sepals of the male flowers are about one fourth the length of the corolla. The corolla is smooth and fleshy. In *A. pinnata* it is red-brown to red-purple, in *A. westerhoutii* yellowish-red and in *A. obtusifolia* purplish (Fig. 8).

In all three species compared there are numerous stamens in the male flowers. The elongate anthers are borne on a short filaments. The connective of *A. pinnata* stamens is distinctly different from those of the other two species of Thai sugar palms by being reddish brown.

Fruits. The fruits of the three species of Thai Sugar Palms are similar in size. They are more or less angled and two- or three-seeded. The mesocarp is fleshy and full of irritant needle shaped crystals (raphides) released from ideoblasts. Fruit shape, fruit colour and seed morphology differ between the species and offer excellent distinctive characters.

The mature fruits of *A. pinnata* (Fig. 9 and Back Cover) are obovoid to sub-globose, smooth, about 3 cm long and 4 cm wide, with a depression on the upper surface. They are green to yellowish green ripening to yellowish brown or red. On the distal part of the fruits three lines radiate more or less distinctly from the stigmatic remains and along the middle of the carpels.

Fruits of *A. westerhoutii* (Figs. 10, 12) are rounded, obovoid to oblong-turbinate, approximately 4 cm both in length and in width. They are light bluish green when immature ripening to bluish green or dark green. The apex is rounded to slightly depressed. Three characteristic keels are often visible radiating from the stigmatic remains and along the middle of the carpels.

Arenga obtusifolia (Figs. 11, 13) has oblong-turbinate to ellipsoid fruits about 4.5 cm long

6 (left). *Arenga westerhoutii* with infructescence and staminate inflorescences past anthesis. 7 (right). *Arenga obtusifolia* with infructescences.

8. Staminate flowers of *Arenga*. Top: *A. pinnata*. Middle: *A. westerhoutii* . Bottom: *A. obtusifolia*.

and 3 cm wide. The apex is rounded and adorned with three lines that radiate along the middle of the carpels. The fruits are light green when mature to yellowish green at maturity.

Seeds. The seeds of all three species of arborescent arengas are black (Fig. 14). In *A. pinnata* the seed is round to shortly elliptic in outline. The outer face is convex whereas the

inner face is bifacial with a blunt keel. The seeds of *A. westerhoutii* are elongate to elliptic, convex-bifacial with a sharp keel to subtrigonous. The seeds of *A. obtusifolia* are similar to the latter in size and shape, however the keel is not quite as sharp. The best distinguishing feature is the white scar from the funiculus (ovule stalk) at the base.

Notes on distribution

Arenga pinnata is widespread throughout South East Asia as a cultivated or semi-domesticated tree (Dransfield & Mogea 1984). According to Hodel (1998) it is rare in Thailand and always seen around human habitation. The other two species of Sugar Palms occurring in Thailand, *A. westerhoutii* and *A. obtusifolia,* are widespread in evergreen and semi-evergreen forests in Peninsular Malaysia and Thailand (Zakaria et al. 1999 & 2000) where they occur from sea-level to 900 m elevation.

Our fieldwork conducted throughout Thailand has revealed that the traditional view on the distribution species of Sugar Palms in Thailand is not correct. It is true that *A. pinnata* is cultivated or semi-domesticated, but its distribution in Thailand is restricted to the coastal plain and limestone foothills of the Peninsula in the provinces of Suratthani, Phangnga and Krabi. It occurs from sea level to approximately 200 m elevation. On rare occasions, trees are observed in forests, but these are probably either planted or escaped from cultivation. *Arenga westerhoutii* is common in moist or wet forest throughout Thailand from sea level to 900 m elevation. In Peninsular Thailand, *A. westerhoutii* is locally abundant on steep slopes often associated with limestone formations. *Arenga obtusifolia* is rare in the hill dipterocarp forest in the extreme south of Thailand. It has been observed only in the Khao Namkhang National Park, Province of Songkhla, where it occurs scattered on the slopes.

Uses

Arenga pinnata is an economically important resource that is exploited for multiple purposes. The most important use is tapping of sap from the inflorescence for sugar, wine or vinegar and extraction of starch from the stem for sago. Minor local uses include young

9 (left). Infructescence of *Arenga pinnata*. 10 (right). Infructescence of *Arenga westerhoutii.*

11. Infructescence of *Arenga obtusifolia*.

endosperms and cabbage for human consumption, leaves for thatch, leaf sheath fibers for blowgun darts and brooms (Miller 1964). Mogea et al. (1991) claimed that *A. pinnata* is the most important sugar palm of the humid tropic and one of the most versatile multipurpose tree species in culture.

Very little information is available on the utilization of *A. westerhoutii* in Southeast Asia mainly because its identity has been confounded with that of *A. pinnata*. To our knowledge the economic botany of *A. westerhoutii* has never before been studied in Thailand, however we find it quite likely that several minor research projects have been conducted on populations misidentified as *A. pinnata*.

According to Burkill (1966), the pith of *A. obtusifolia* is sweetish and is prepared in various ways for curries by the Malays. Ethnic groups dwelling in the rainforest near the border with Malaysia consider the cabbage a delicacy.

Recent economic botanical studies of *Arenga pinnata* and *A. westerhoutii* in Thailand, have revealed that the young endosperms are the main product of *A. westerhoutii* in northern Thailand as well as in adjacent Laos and Myanmar (Pongsattayapipat & Barfod in prep.) The endosperms, which are collected in the gelatinous stage, are consumed throughout Thailand as a dessert or for ice cream topping. *Arenga pinnata* is used both for sugar extraction and edible young endosperms. To our knowledge there is no record on utilization of *A. obtusifolia* in Thailand. Species of *Arenga* are gaining in popularity all over SE Asia as ornamentals (Miller 1964, Burkill 1966).

Conclusion

A confused taxonomy has been an impediment for science-based management of Sugar Palm resources in Thailand. Recent fieldwork has revealed a number of diagnostic characters particularly relating to fruit and seed morphology that facilitates correct identification of the three species of Sugar Palms that occur in Thailand, viz. *Arenga pinnata*, *A. obtusifolia* and *A. westerhoutii*. A well established taxonomy makes it possible to produce precise maps of distribution ranges, which are important for future resource management and conservation efforts.

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12 (top). Fruits and cross-section of *Arenga westerhoutii.*

13 (bottom). Fruits of *Arenga obtusifolia.*

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14. Comparison of dissected fruits. Row 1. *A. obtusifolia*. Row 2. *A. westerhoutii*. Row 3. *A. pinnata*. Column 1. Distal view. Column 2. Basal view. Column 3. Cross section. Column 4. Longitudinal section. Column 5. Seed.

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The Enigmatic Australian Fan-Palm *Licuala ramsayi*

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1. The beautiful foliage of *Licuala ramsayi* var. *ramsayi* at Licuala State Forest, Mission Beach, Queensland. Photo by J.L. Dowe.

Based on herbarium and literature studies, an attempt is made to untangle the confusing taxonomic history of the Australian fan-palm *Licuala ramsayi* (Fig. 1). Recent field work conducted in Queensland has revealed considerable morphological variation in this species and has led to the description of a new variety from Cape York Peninsula.

Licuala ramsayi (F. Muell.) Domin was first described in 1874 as *Livistona ramsayi* by Ferdinand von Mueller in volume 8 of his monumental work *Fragmenta Phytographiae Australiae*. The new species was based on a collection made by Edward Pearson Ramsay from "Rockingham's Bay," which was a broad location name for the area around the coastal township of Cardwell and the mountainous Cardwell Ranges hinterland. Ramsay was a self-taught naturalist with a special interest in ornithology. In 1876, he was appointed the first Australian-born curator of the Australian Museum. In the original publication of *L. ramsayi* there is no indication of when Ramsay had made the collection at Rockingham Bay.

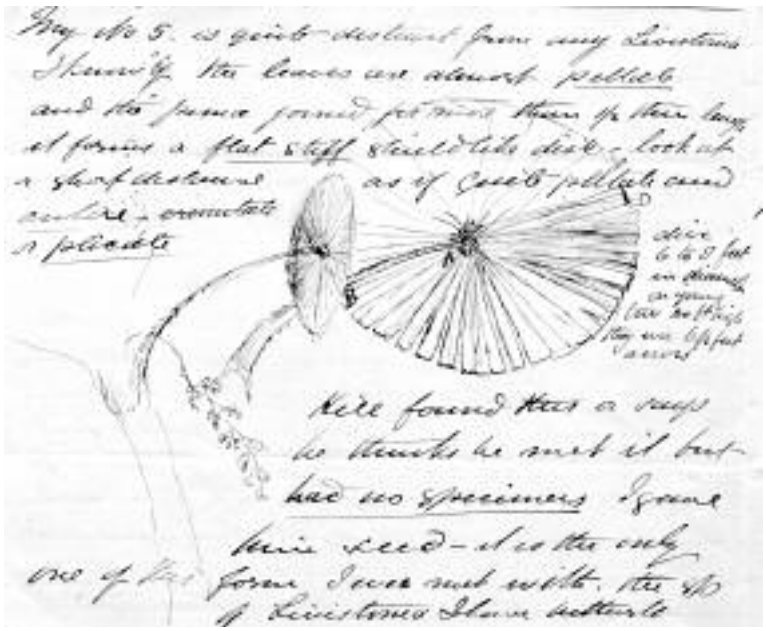
The correspondence between Mueller and Ramsay that is kept in the archives of the Royal Botanic Garden in Melbourne gives us some insight into what might have happened. In a letter to Mueller, dated June 26, 1874, Ramsay provided a description and sketch of the leaves of a palm that he had never seen before (Fig. 2). It is not clear from the non-technical and somewhat contradictory description whether it is a *Licuala* or indeed a *Livistona* leaf to which he was referring. Ramsay admitted, "I am not well enough acquainted with botanical terms to explain fully what I mean but perhaps my sketch may show some of what I wish to point out." The sketch clearly represents a leaf of *Licuala ramsayi*. Ramsay also indicated in the letter that he had yet to dispatch the specimens, so it appears that the letter was received independently of the specimens.

Mueller acknowledged Ramsay's letter soon after on 5 July, 1874 and related his frustration:

> I labour under especial disadvantage for working on palms this moment, because I lent my whole normal collection to Mr. H. Wendland, who works exclusively on palms; but although this took place several years ago, I have up to date not a single line from him on the subject of their elucidation, nor has he returned the original specimens, placing me thus at great inconvenience for further comparisons.

We have been able to locate two Ramsay specimens of *Licuala ramsayi* from Rockingham's Bay. One is kept in National Herbarium of Victoria (MEL) but is dated 1878, which is four years after the publication of the name and at *prima facie* cannot be the holotype. The other, which is most probably a duplicate of the same collection, is kept at the Herbarium, Royal Botanic Gardens, Kew (K).

Mueller's protologue of *Livistona ramsayi* draws much of its descriptive content from Ramsay's letter (Mueller 1864), and it may be that Mueller described the species in the absence of a specimen. It is known that Ramsay spent from October 1873 to April 1874 in the Rockingham Bay area (Longmore 1991), but there is no record of Ramsay having visited that area in 1878. The Ramsay specimen in MEL, although dated 1878 in Mueller's



2. Excerpt from Ramsay's letter to Mueller dated June 26, 1874, describing and illustrating the leaf of *Licuala ramsayi* seen and collected by him at Rockingham Bay. Reproduced with permission from the State Botanical Collection, National Herbarium of Victoria.

3. *Licuala ramsayi* var. *ramsayi* in rainforest at Dalrymple Gap, Cardwell Range, Queensland. Photo by J.L. Dowe, 2004.

handwriting, is most probably the one collected by Ramsay in 1874. Mueller probably received it in 1878 due to circumstances of which we are not aware. Despite this apparent anomaly, we designate the Ramsay specimen in MEL as the holotype for *Livistona ramsayi*, and that in K as an isotype.

In 1875, Hermann Wendland and Oscar Drude described *Licuala muelleri* based on a January 1866 collection from "Dalrymplis Cape" that

was forwarded to Wendland in Germany from Mueller in Melbourne (Wendland & Drude 1875). The locality name was an incorrect transcription of Dalrymple Gap from the specimen label. Dalrymple Gap is a rain-forested low elevation "pass" through the otherwise steep and rugged Cardwell Range (Fig. 3) and is located about 15 km south of the coastal town of Cardwell, which is situated on the shore of Rockingham Bay. The Gap was discovered and explored by George Elphinstone Dalrymple (Dalrymple 1865) and was first used as a trade route with cattle-raising properties on the western side of the ranges and beyond in 1864. However, an easier trade route was opened a few years later, and the track passing through the Gap was all but abandoned to trade by the mid 1870s.

Wendland and Drude did not provide the name of the collector of the specimen from Dalrymple Gap, but it is known to be John Dallachy, who was active in that area during that time (Dalrymple 1865, Blake 1955), and the collection was subsequently attributed to him. Wendland and Drude appeared to be unaware of Mueller's publication of *Livistona ramsayi* at the time of their work on Australian palms (Wendland & Drude 1875) and described the same species for a second time. Wendland (1878) in due course became aware of Mueller's earlier species and interpreted Mueller's *Livistona ramsayi* to be a synonym of *Livistona inermis* R. Br., which was itself a misinterpretation of what was ultimately to be described as *Livistona decipiens* Becc. (= *Livistona decora* (W. Bull) Dowe). Drude (1893), on the other hand, interpreted *L. ramsayi* to be a synonym of *Livistona rotundifolia* (Lam.) Mart. in his diagnostic key to Australian species. One can appreciate that there was still some confusion as to the identity of these otherwise newly described and not fully understood species.

Bentham (1878), in *Flora Australiensis*, took up Wendland and Drude's *Licuala muelleri* over Mueller's *Livistona ramsayi*, which he placed as a synonym. This action was nomenclaturally incorrect as the correct procedure should have been to maintain the original specific epithet whilst transferring it to *Licuala*, as the specific name "*ramsayi*" antedated and thereby had precedence over "*muelleri*." Bentham added:

> Although the flowers are unknown it is probable that Wendland and Drude are correct in transferring this palm from *Livistona* to *Licuala*, but its precise affinities must remain for the present undetermined.

4. *Licuala ramsayi* var. *ramsayi*. Part of flowering rachilla. Note the grouped flowers, and the flowers in different stages of flowering. The opened cream colored flowers in the middle are in the male phase whereas as the brownish flower at the bottom is in the female phase. Cultivated in Mt. Coot-tha Botanic Garden, Brisbane. Photo by A.S. Barfod, 1999.

Bentham correctly attributed the collection from Dalrymple Gap, now kept in Melbourne (MEL), to Dallachy.

Beccari (1886), Salomon (1887), Mueller (1889) and Bailey (1889, 1890, 1902, 1909) also took up the name *Licuala muelleri*, apparently unaware of the nomenclatural inconsistency. However, the first critical examination of the taxonomy of *Licuala ramsayi* was provided by Domin (1915), a Czech botanist who visited Queensland during 1909–10. Domin collected extensively and subsequently provided a treatment of the Palmae in which he introduced both taxonomic changes and the descriptions of new species. Domin applied the transfer of *Livistona ramsayi* to *Licuala ramsayi* and placed *Licuala muelleri* as a synonym. Despite this clarification, the name

L. muelleri persisted and was used by Moore (1963) and Rodd (1971) as the supposedly correct name for the Australian taxon. Since 1978, the name *L. ramsayi* has been consistently used in a broad range of ecological and taxonomic works (Covacevich & Covacevich 1978, Tucker 1980, Johnson 1981, Hnatiuk 1990, Chapman 1991, Gorman 1996) and is the currently accepted name (Henderson 2002).

The recognition that there was some taxonomically effective variation within *Licuala ramsayi* first came when Tucker (1988) described what he termed "*Licuala* sp. aff. *ramsayi*" from Cape York Peninsula. Tucker was a well-traveled plantsman noted for his work with the Pandanaceae and his landscape design masterpiece, The Townsville Palmetum, a botanical garden devoted to palms (Dowe 1992a). Tucker noted that there were significant and constant morphological features that separated populations on Cape York Peninsula from those in northeastern Queensland, including, "…not so stocky and has wider internodes...petioles on the adults are unarmed...often fertile throughout the year…and…foliage which tends to be less rigid...."

Tucker did not provide a new name for the population on Cape York Peninsula, although he noted that "very possibly it is a Papua New Guinean species, known or unknown, or it may be a variety of *L. ramsayi*" (Tucker 1988, p. 17).

More recently, the authors have undertaken field work throughout Cape York Peninsula and northeastern Queensland and have also recognized that there were notable differences between northern and southern populations. This work therefore provides the description of a new variety of *Licuala ramsayi* that is named to commemorate the life and work of Robert Tucker.

Licuala ramsayi (F. Muell.) Domin, Biblioth. Bot. 85: 500. 1915.

Livistona ramsayi F. Muell., Fragm. 8: 221. 1874. Type: AUSTRALIA, Queensland, Rockingham Bay, post-dated 1878 in Mueller's handwriting, *E.P. Ramsay s.n.* (holotype MEL [503531]; isotype K).

Licuala muelleri H. Wendl. & Drude, Linnaea 39: 223. 1875. *Pericycla muelleri* Drude, in Salomon, Die Palmen 138. 1887. *nomen*. Type: AUSTRALIA, Queensland, Dalrymple Gap, Jan. 1866, *J. Dallachy s.n.* (holotype MEL [67694-67696]).

Solitary or rarely clustered palm tree. Stem up to 10 m tall, 7–10 cm in DBH. Crown with 9–12 erect to semi-drooping, often untidy looking, marcescent leaves and persistent leaf sheaths; leaf sheath up to 100 cm long in older leaves, tubular basally and disintegrating distally into a light to dark brown fibrous mesh, with ligule opposite to the petiole, up to 50 cm long, light brown, the ligule eventually splitting longitudinally; petiole variable in length up to 2 m long in fully developed leaves, distal portion 1.2–1.8 cm in diam., glabrous or with ramentose indumentum increasingly dense along the lateral sides, greenish beige basally to green distally, abaxial side from slightly ridged or furrowed basally to flat below the blade, lower 1/4 to 1/3 armed with up to 5 mm long, mixed long and short, straight to recurved spines to almost spineless; lamina broadly elliptic to almost circular, with scattered ramenta near central portion otherwise glabrous, adaxial side darker green than abaxial side, chartaceous, maximum diam. 1.2–1.8 m in diam., divided in 17–23 segments, transverse veinlets obscure; hastula slightly eccentric, pointed; the distal 1–3 segments inserted on a rather thick and conspicuous extension of costa, mid segment 7–23 costate, 60–80 cm long, 20–40 cm wide, apex truncate, lateral segments 2–5 costate, 50–75 cm long, 8–18 cm wide, apex truncate, basal segments 2–5 costate, 50–65 cm long, 5–10 cm wide, apex obliquely truncate; indentations mixed long and short, those leading to the adaxial folds 1–5 cm long, those leading to the abaxial folds about 0.5 cm long. Inflorescences usually several on one palm, 2.0–3.5 m long, arcuate, branched to second order; prophyll 20–30 cm long, green at the base to brown and chartaceous distally, length of peduncle plus first subtending bract 50–70 cm, rachis with 8–10 nodes, subtending bracts tubular, up to 30 cm long, decreasing in size towards the apex, glabrous or with scattered ramenta, first order branches to 25–55 cm long, decreasing in length towards the apex, the proximal ones bearing 15–50, glabrous to sparsely pubescent, 15–30 cm long rachillae. Flowers solitary, in pairs or in groups of 3 or 4, subsessile to shortly pedicellate, protandrous, subtending bract deltoid to strap-shaped, up to 1 mm long, early deciduous; anthesis progressing throughout the rachillae in no apparent pattern, flowers within one group rarely at anthesis simultaneously; floral

buds rounded to elliptic, or bullet-shaped, before opening 3.5–4.5 mm long; calyx 2.5–3.5 mm long, urn-shaped to cupulate, divided 1/2 to 1/3 of its length in three rounded to obtuse lobes, glabrous, cream with brown edges, receptacle and calyx fused for 0.3–0.5 mm; corolla cream-colored, 3.3–3.5 mm long, glabrous, turning brown to black after anthesis; androecium 2.0–2.3 mm long, fused to corolla for 1.5–1.7 mm, staminal ring cream-colored at anthesis, truncate, filaments subulate, about 0.2 mm long, anthers 0.3–0.6 mm long, rounded to elliptic; ovary ca. 1 mm long, glabrous, turbinate, rounded to truncate apically, style 1.2–1.3 mm long, filiform. Fruit ovoid, 1–1.5 cm long, 0.8–1 cm diam., orange to red at maturity. Seed globose, 0.6–0.9 cm diam.; raphe prominent.

Note: The name *Licuala australasica* Hort. ex H. Wendl. appeared in Kerchove, Les palmiers 67, 249 (1878) and *Licuala australasica* Benth., in Salomon, Die Palmen 138 (1887). No description of the palm was provided and thus the name is a *nomen nudum*, of no taxonomic standing, even though it most likely refers to *Licuala ramsayi*.

Key to varieties of *Licuala ramsayi*

Leaf sheath disintegrates into a fibrous mesh that eventually detaches from the leaf; petiole conspicuously armed with spines; flowers in groups of 2–4 but solitary at the tips of the rachillae . . . . . 1. var. ***ramsayi***

Leaf sheath remains attached to the leaf; petiole unarmed or armed with only a few, small spines at the base; flowers mostly solitary . . . . . 2. var. ***tuckeri***

1. **Licuala ramsayi** (F. Muell.) Domin var. **ramsayi** (Figs. 1, 3 & 4)

Solitary or rarely clustered palm; stem with persistent fibrous mesh from disintegrated leaf sheath eventually detached from the leaf and often sliding down the stem; petiole conspicuously armed with spines; flowers in groups of 2–4 to solitary at the tip of the flower-bearing branches; floral buds rounded to elliptic before anthesis; calyx rounded to obtuse basally; anthers 0.5–0.6 mm long, corolla apex turning brown or rarely black after anthesis.

DISTRIBUTION AND ECOLOGY: Distributed in northeastern Queensland in the "Wet Tropics" area, from about Cooktown, south to Mt. Spec National Park and Hinchinbrook Island, with population centers in the Cape Tribulation-Daintree River area, Russell and Johnstone River systems and Mission Beach, primarily in high rainfall lowland habitats but in some very high rainfall areas can be found at altitudes of up to 600 m. Occurs as a sub-canopy element in rainforest, swamp forest, mangroves, littoral forest and in diverse riparian and riverine habitats, on various soil types. Flowering is irregular, but most often Nov.–Jan, and fruiting Jan.–Mar.

SPECIMENS EXAMINED. AUSTRALIA. Queensland. Bloomfield, 15°50′S, 145°20′E, May 1899, *W.E. Roth 156* (BRI); 11 km S of Helensvale on road to Bloomfield R., 26 Jul. 1965, *A.N. Rodd 235* (NSW); Bloomfield R., Dec. 1885, *E. Bauer 2* (MEL); 15 miles NE of Daintree, 16°05′S, 145°28′E, 15 Nov. 1967, *D.E. Boyland 391A* (BRI); Bailey's Creek area, 25 miles E of sawmill, 7.5 miles ENE of Dai, 16°13′S, 145°25′E, alt. 15 m, 2 Oct. 1962, *L.S. Smith 11519* (BRI, L); Cape Tribulation, Pilgrim Sands, 21 Nov. 1991, *W. Cooper & W. Cooper 22* (QRS); Cooper Creek, N of Daintree River, Jan. 1972, *P. Hind 114* (NSW); Daintree River, 18 Dec. 1929, *S.F. Kajewski 1503* (BRI); Daintree River, S bank of estuary, 16°16′S, 145°23′E, *J. Wrigley & Telford 1076* (CANB); Mt Carter, 15 Sep. 1974, *B. Hyland 7525* (QRS); Puffdelooney Ridge, 4 Jul. 1972, *A.K. Irvine 273* (QRS); Cairns, edge of Campbell Creek, 19 Sep. 1946, *H. Flecker 3831* (QRS); Kuranda State Forest, between Cairns and Atherton, 16°40′S, 145°30′E, alt. 360 m, 12 Feb. 1964, *H.E. Moore et al. 9235* (BRI, BH); 3 miles N of Kuranda, 16°47′S, 145°38′E, alt. 400 m, 29 Jun. 1972, *J. Wrigley & Telford 1795* (CANB); Whitfield Range, W of Cairns, 16°57′S, 145°43′E, 15 Jun. 1972, *J. Wrigley & Telford 1196* (CANB); Cairns, Buddabadoo Track near Pine Creek, 25 Aug. 1946, *H. Flecker 10409* (QRS); Trinity Bay, undated, *Karsten s.n.* (MEL); Wyvuri Holding, 23 Aug. 1972, *A.K. Irvine 326* (NSW, QRS); Wyvuri Holding near State Forest 1185, 24 Jul. 1972, *A.K. Irvine 292* (QRS); Innisfail, 17°30′S, 146°00′E, 7 Dec. 1941, *C.T. White 11760* (BRI); Tully-Mission Beach Rd, 31 May 1967, *Olsen 360* (NSW); Licuala State Forest, 1 km along track off Tully-Mission Beach Rd, 16 Feb. 1996, *J.L. Dowe 289* (BRI, FTG); 17°53′S, 146°05′E, 25 Sep. 1999, *J.L. Dowe & Barfod* 600 (BRI, AAU); Tam O'Shanter State Forest, 7 km SW of Mission Beach, 17°55′S, 146°04′E, 27 Apr. 1991, *I.R. Telford & Rudd 11229* (CANB); Dalrymple Gap, headwater of Dalrymple Creek, S18°23′11″, E146°04′20″, 320 m alt., 12 Sep. 2004, *J.L. Dowe 741 with C.J. Dowe* (AAU, JCT); Rockingham Bay, 1878?, *E.P Ramsay s.n.*

5. *Licuala ramsayi* var. *tuckeri*. Habit. Near Captain Billy Landing. Photo by A.S. Barfod, 1999.

(K, MEL); near Dalrymple Creek, ca. 5 km SW from Dalrymple Gap carpark, 18°24'S, 146°04'E, alt. 500 m, 31 Jul 1976, *A.S. Thorsborne 273* (BRI); Bullocky Toms Creek, Mt. Spec National Park S of Ingham, 18°57'S, 146°14'E, alt. 150 m, 19 Feb. 1992, *A.R. Bean 4014* (BRI).

2. **Licuala ramsayi** var. **tuckeri** Barfod & Dowe, **var. nov.** (Figs. 5 & 6)

Varietas haec ab *Licuala ramsayi* var. *ramsayi* differt macula fibrosa crassa ab vagina folii fatiscenti destita, petiolo spinis paucis prope basin armato et floribus plerumque solitariis. Type: Australia. Queensland. Cape York Peninsula, Lockerbie Scrub, south of Pajinka Wilderness Lodge, 10°45'S, 142°33'E, 29 Sept. 1999, *J.L. Dowe 602* & *A.S. Barfod* (Holotype BRI; isotype AAU).

Solitary palm; leaf sheath remains attached to the leaf; petiole unarmed or with few, small spines at the base; flowers mostly solitary; floral buds bullet shaped at anthesis; calyx sclereified and truncate basally; floral buds bullet shaped before anthesis; anthers 0.3–0.4 mm long, persistent and conspicuous long after anthesis in between corolla lobes; corolla apex turning black after anthesis.

ETYMOLOGY: Named for horticulturist, botanical illustrator and taxonomist (Pandanaceae) Robert James Thomas Tucker

(1955–1992), landscape designer for Townsville Botanic Gardens, 1982–1992, and designer of The Palmetum, Townsville, a botanic garden devoted to palms. Tucker collected palms and *Pandanus* throughout Cape York Peninsula and was the author of *The Palms of Subequatorial Queensland* (Tucker 1988) and taxonomic works on the Australian Pandanaceae.

DISTRIBUTION AND ECOLOGY: Distributed in northern Queensland, from Moa Island in Torres Strait, throughout coastal or near-coastal Cape York Peninsula, to about north of Cooktown, with population centers in Lockerbie Scrub, Jardine R., Nesbit R., Wenlock R., Iron Range and Silver Plains area. Occurs as a sub-canopy element in rainforest, swamp forest, mangroves, and in diverse riparian and riverine habitats, on various soil types. Flowers and fruits throughout the year.

SPECIMENS EXAMINED: AUSTRALIA. Queensland. Torres Strait, Moa Island, Moa Peak, N end of island, 11 Feb. 1989, 374 m alt., *D.L.Jones 3592* (CANB); Cape York, 2.7 km SWW of Bamaga, 26 Oct. 1965, *L.S. Smith 12488* (BRI); Somerset, Cape York Peninsula, 10°40′S, 142°30′E, Dec. 1897, *F.L. Jardine s.n.* (BRI); Bamaga-Pajinka Rd., km 16, 10°47′S, 142°30′E, 29 Sep. 1999, *J.L. Dowe & Barfod 601* (AAU, BRI); Heathlands, Eliot Creek, 10 km N of Captain Billy Landing turnoff, 29 Aug. 1996, *J.L. Dowe 372* (BRI); Iron Range, 12°40′S, 143°10′E, alt. 40 m, 20 Jun. 1948, *L.J. Brass 19267* (A, BRI, CANB, L); Iron Range National Park, 12°44′S, 143°13′E, 2 Oct. 1999, *J.L. Dowe & Barfod 603* (AAU, BRI); Tozers Gap, upper W Claudie River or tributary, Kennedy Rd, 150 m alt., 20 Aug. 1973, *P. Hind 318* (NSW); 11 km from Rocky River crossing towards Chester River, 13°44′S, 143°29′E, 21 Jun. 1979, *G. Butler 280* (CANB); McIlwraith Ra., Headwaters of Massey Creek near old mining site, 13°50′S, 143°20′E, Oct. 1969, *L.J. Webb & J.G. Tracey 9178* (BRI); Silver Plains, N of Rocky Creek, 13°55′S, 143°20′E, alt. 80 m, 13 Sep. 1971, *A.K. Irvine 68* (BRI, QRS); N of Edward River Community, 14°55′S, 141°38′E, 6 Dec. 1979, *W.C. Clarke WCC1019* (BRI); swamp forest, E of runway, Cooktown, 15°33′S, 145°12′E, 3 Oct. 1999, *J.L. Dowe & Barfod 605* (AAU, BRI).

NOTES: *Licuala ramsayi* var. *tuckeri* has become common in cultivation and is reputedly more amenable to cultivation than *L. ramsayi* var. *ramsayi*. The new variety is also reported to flower and fruit throughout the year, unlike *L. ramsayi* var. *ramsayi* in which flowering and fruiting is sporadic and may not occur every year. Apart from Gorman (1996), who provided a demographic study of the population at Mission Beach, there has been no ecological research of the species. Gorman's study suggested that *L. ramsayi* [in the Mission Beach population] did not conform to a classic "reverse-J" population curve expected of palms and that regeneration patterns may be linked to cyclonic events and periodic major disturbance. Dowe (1992b) provided some preliminary observations on leaf morphology, structure and growth patterns. Research on aspects such as phenology, pollination and population dynamics has yet to be carried out on this species.

6. *Licuala ramsayi* var. *tuckeri*. Detail of flowering rachilla after anthesis. Note the solitary flowers, the black corolla lobes and white anthers. Pajinka, *Dowe & Barfod 602*. Photo by A.S. Barfod, 1999.

Acknowledgments

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National Herbarium of Victoria (MEL) who kindly organized a scanned version of Ramsay's June 1874 letter to von Mueller available to us (see Fig 2). Financial support for the fieldwork conducted in 1999 was provided by the Carlsberg Foundation (grant no. 980298/10-1150). Anders S. Barfod's sabbatical leave at the Queensland Herbarium, 1999–2000 was funded by the Danish Natural Science Research Council (grant no. 9600861).

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Diversity, Conservation and Local Knowledge of Rattans and Sugar Palm in Gunung Halimun National Park, Indonesia

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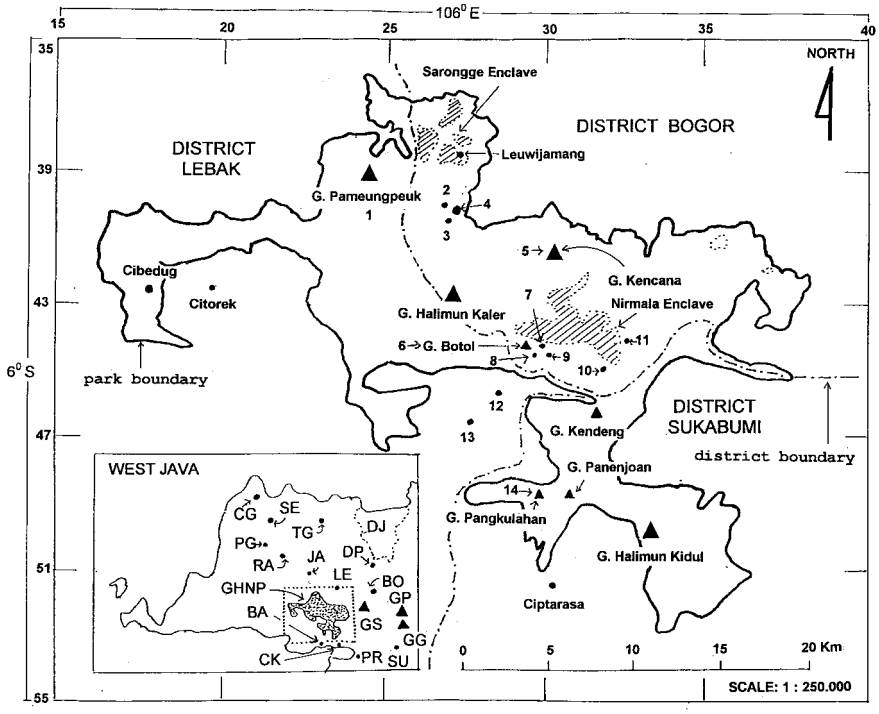
Gunung Halimun National Park represents one of the last significant areas of tropical rain forest in densely populated West Java, Indonesia. There is a diversity of rattans in the park and they, together with the sugar palm, *Arenga pinnata*, are intensively utilized by villagers living around and within the park boundary.

Gunung Halimun National Park (GHNP) in West Java, Indonesia was designated in 1992 and covers an area of 40,000 hectares. According to Simbolon et al. (1997) the park consists of hill forest at altitudes of 500–900 m above sea level (10%), submontane forest at altitudes of 901–1400 m (80%) and montane forest at altitudes of 1401–1900 m (10%). The vegetation map in Simbolon et al. (1998) showed that primary forest occupies about 67.29% of the park, and secondary forest occupies 28.45%. The remaining land is given over to agricultural development. The park thus includes a very significant area of primary vegetation in an otherwise heavily populated part of Java.



1. Map of study sites in Gunung Halimun National Park. Map of West Java (Inset): BA=Bayah, BO=Bogor, CG=Cilegon, CK=Cikotok, DJ=Jakarta, DP=Depok, GG=Gunung Gede, GHNP=Gunung Halimun National Park, GP=Gunung Pangrango, GS=Gunung Salak, JA=Jasinga, LE=Leuwiliang, PG=Pandeglang, PR=Pelabuhan Ratu, RA=Rangkasbitung, SE=Serang, SU=Surade, TG=Tanggerang. Fore names of sites No. 1–14 see NOTES in Table 2.

It is estimated that in and around GHNP there are approximately 160,000 people living within 46 villages and in 13 sub-districts (Biodiversity Conservation Project-JICA 1999). The people are predominantly Sundanese-speaking. Harada (2003, in press) pointed out that many people still live as subsistence farmers in a way of life that involves several land use patterns, such as gardens (*kebun*), mixed gardens (*kebun talun*), tree gardens (*talun*), paddy fields (*sawah*) and swidden cultivation (*huma*). Harada (in press) also showed that a system of communal ownership of lands and resources is widely practiced on land that is strictly private property, including these cultivation areas, facilitated by the distribution of land, lending and borrowing of land and collaborative labor systems. In addition, Harada (2003, 2004) showed that the people depended largely on forest resources for their daily needs such as food, construction materials, medicines, fuel woods and so forth; these products can be gathered not only in the gardens, but also in primary forest or old secondary forest (*leuweung kolot*), secondary forest (*reuma kolot*) and scrub (*reuma ngora*).

Table 1: Rattan species recorded from the study areas

Scientific name	Sundanese name
Calamus asperrimus	*hoe leuleus*
Calamus ciliaris	*hoe dage*
Calamus heteroideus	*hoe korod*
Calamus javensis	*hoe cacing*
Calamus javensis var.	*hoe omas*
Calamus melanoloma	*hoe lilin*
Calamus ornatus	*hoe seuti*
Calamus polystachys	*hoe gelang*
Calamus rhomboideus	*hoe dawuh*
Korthalsia junghuhnii	*hoe sampang*
Korthalsia laciniosa	*hoe ceker kidang*
Daemonorops oblonga	*hoe teretes*
Daemonorops rubra	*hoe pelah*
Daemonorops melanochaetes	*hoe seel*
Daemonorops hystrix	*hoe selang*
Plectocomia elongata	*bubuai*

Materials and Methods

One of the authors (JPM) observed the population density of rattans in and around the park in Cisarua village, Sukajaya sub-district, Bogor district (Fig. 1). After obtaining information from local people knowledgeable about the diversity of rattans in the area, three sites were selected for a species density study, i.e. primary and secondary forest at Cangkuang A at an altitude of 1000–1100 m, primary forest at Cangkuang B at an altitude of 1000–1150 m and primary forest at Cileungsi at an altitude of 900 m (Fig. 1). Rectangular plot transects 650 × 20 m, 400 × 20 m and 200 × 20 m, respectively, were made. To facilitate the study, each plot was divided into subplots 10 × 10 m. Every rattan in the subplot was counted, each clump was treated as one individual plant. Species density was also analyzed, using a modified Mueller-Dombois & Ellenberg method (1974). To analyze the rattan diversity of the whole park, data were inserted into a previously produced rattan relative density table for the park (Mogea 2002).

Three villages were selected for the ethnobotanical survey; Ciptarasa, Leuwijamang and Cibedug (Fig. 1). The survey showed that Ciptarasa, Leuwijamang and Cibedug have, respectively, 82, 59 and 65 households. Ciptarasa, Leuwijamang and Cibedug have respectively, 0.67, 0.29 and 0.23 ha of paddy fields per household and 0.25, 0.22 and 0.10 ha of dry lands including gardens, mixed gardens, tree gardens and swidden cultivation (Harada, in press). Two of us (KH and MR) spent two months from 1999 to 2000 studying the subsistence lives of the farmers by conducting extensive interviews and discussions with approximately twenty households from the each village. The informal interviews were conducted to find out how rattans were utilized and sugar palms tapped for their sap. Additionally, herbarium specimens of rattans used by people in the villages were collected for identification by JPM.

Results and Discussion

Rattan diversity, local names and utilization

In Java, 25 species of rattan have been recorded, belonging to *Calamus* (16 spp.), *Daemonorops* (3 spp.), *Ceratolobus* (2 spp.), *Korthalsia* (2 spp.) and *Plectocomia* (2 spp.) (Mogea 2002). In the study area, 16 species were recorded (Table 1), i.e. 16 in Leuwijamang, 15 in Cibedug and 12 in Ciptarasa.

However, in transects Cangkuang 1, Cangkuang 2 and Cileungsi there were 9, 6 and 12 species respectively. Compared with the rattans in Leuwijamang, the last two study areas lacked *C. melanoloma, C. javensis* var., *C. polystachys* and *K. laciniosa* (Tables 1 & 2).

In general the five dominant species in the park are still *C. heteroideus, P. elongata*, *C. javensis*, *D. melanochaetes* and *C. melanoloma* with average relative density 41.56%, 17.50%, 14.76%, 8.36%, and 7.515% respectively. Mogea (2002) indicated that the species distribution in the park is not homogenous. The analysis, however, excluded the presence of *C. javensis* var. *A*, *C. polystachys* and *K. laciniosa* as these species were not found in the plot transects. *Calamus ciliaris* and *C. asperrimus* can only be found in Gunung (G.) Pameungpeuk and G. Pangkulahan. *Calamus ornatus* is rather widespread up to G. Kencana and *C. rhomboideus* and *K. junghuhnii* were found in G. Pameungpeuk, Citalahap–Cikaniki and G. Pangkulahan. In addition,

2. Making a basket (*kaneron*).

Table 2. Relative density (as a percentage of all rattans plants in the plot) of rattan species in Gunung Halimun National Park

	LOCATION*														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	AVERG**
SPECIES															
C. heteroideus	40.2	39.6	24.6	11.4	44.4	00.0	70.1	60.0	42.9	52.4	61.5	69.2	18.9	47.3	41.56
P. elongata	02.4	34.4	08.9	13.4	17.8	06.6	11.2	27.0	42.9	19.6	23.1	09.2	24.3	04.9	17.50
C. javensis	32.7	14.0	42.5	25.0	03.6	00.0	01.7	06.0	07.1	19.6	15.4	06.6	18.9	14.2	14.76
D. melanochaetes	07.6	08.6	07.5	03.8	27.8	00.0	08.8	07.0	07.1	07.2	00.0	05.4	16.8	10.1	08.36
C. melanoloma	00.4	00.0	00.0	00.0	00.0	93.4	08.2	00.0	00.0	00.0	00.0	00.0	00.0	00.2	07.51
D. hystrix	02.8	00.6	16.1	07.7	00.0	00.0	00.0	00.0	00.0	00.0	00.0	03.5	20.1	00.0	03.58
C. ciliaris	04.6	00.6	00.0	11.7	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	18.2	02.46
D. oblonga	03.7	01.3	00.0	12.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	03.8	00.0	02.3	01.65
D. rubra	01.1	00.0	00.0	03.4	06.4	00.0	00.0	00.0	00.0	00.0	00.0	03.3	00.0	01.7	01.16
C. ornatus	00.2	00.0	00.0	07.4	00.8	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.6	00.64
K. junghuhnii	01.7	00.6	00.4	03.4	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.3	00.46
C. asperrimus	01.9	00.0	00.0	00.8	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.1	00.20
C. rhomboideus	00.7	00.3	00.0	00.0	00.0	00.0	00.0	00.0	00.0	01.2	00.0	00.0	00.0	00.1	00.16
SN***	13	9	6	11	6	2	5	4	4	4	3	7	5	12	

*Locations: 01 = G. Pameungpeuk, 02 = Cangkuang A, 03 = Cangkuang B, 04 = Cileungsi, 05 = G. Kencana, 06 = G. Botol, 07 = Cikudapaeh – Citalahap, 08 = Pasir Baut, 09 = Cikopo – Ciangsana, 10 = Citalahap – Cikaniki, 11 = Cikaniki, 12 = Cisungsang, 13 = Cikidang, 14 = G. Pangkulahan.

**AVERG = average relative density. For study site locality see Fig. 1.

**SN = number of species in the site.

Table 3. List of rattans and their uses.

1. *hoe leuleus* (*Calamus asperrimus*) – cabbage edible; split cane used as binding material for rice pot containers (*asepan*), weaving bamboo containers (*boboko*), bamboo stem containers (*lodong)*, baskets (*kaneron*); entire cane used for binding hut floors made of bamboo culms (*tiang lantaian*)

2. *hoe dage* (*C. ciliaris*) – entire cane used for making mattress beaters (*penggebuk kasur*); split cane used as binding material for *asepan* and *boboko*.

3. *hoe korod* (*C. heteroideus*) –entire cane used for binding material for *tiang lantaian*, rope for binding fire wood and rope for tethering water buffalo.

4a. *hoe cacing* (*C. javensis*) – split cane used as binding materials for *asepan* and *boboko*.

4b. *hoe omas* (a variety of *Calamus javensis*) – entire cane used for binding materials for building; split cane used for weaving *boboko*.

5. *hoe lilin* (*C. melanoloma*) – entire cane used for binding material for *tiang lantaian*, *boboko*, kaneron, sickles or field knives for cutting shrubs and grass (*arit*), axe handles (*kampak*) and special knife for slicing peduncle during tapping of sugar palm (*baliung* or *balium*).

6. *hoe seuti* (*C. ornatus*) – cabbage edible, also used as anti dandruff shampoo; leaflets used for wrapping palm sugar; the entire cane used for making a special chair for use during a boy's circumcision ceremony (*sunat*).

7. *hoe gelang* (*C. polystachys*) – entire cane used for binding materials for building and binding fire wood, also for walking sticks; split cane used for making *kaneron*, *boboko*.

8. *hoe dawuh* (*C. rhomboideus*) – entire cane used for binding materials in building; split cane used for weaving *kaneron* and *boboko*.

9. *hoe selang* (*Daemonorops hystrix*) – cabbage edible and used medicinally during menstruation; entire cane is used for binding building poles, rope for tying firewood; split cane used for weaving *kaneron,* broom handles and fences.

10. *hoe seel* (*D. melanochaetes*) – cabbage and ripe fruit edible, leaves used for thatching huts; split cane used for weaving *kaneron* and *saringan*.

11. *hoe teretes* (*D. oblonga*) – cabbage edible; entire cane used for binding building poles; leaf used for thatching huts.

12. *hoe pelah* (*D. rubra*) – used in same way as *C. asperrimus*; split cane used also as string to tie a bamboo container (*lodong*)

13. *hoe sampang* (*Korthalsia junghuhniana*) – cabbage edible; entire cane used for binding material in building and for tying firewood bundles; split cane used for binding hut floors, axe handles, weaving garbage containers and broom handles.

14. *hoe ceker kidang* (*K. laciniosa*) – entire cane used as rope in building, tethering water buffalo and tying fences.

15. *bubuai* (*Plectocomia elongata*) – use unknown.

other species were more widespread such as *P. elongata, C. heteroideus, C. javensis* and *D. melanochaetes*. Gunung Pameungpeuk has 13 species of rattans. On the other hand, G. Botol has only two, namely *P. elongata* and *C. melanoloma*. Endemic Javanese species in the GHNP are *D. rubra, C. asperrimus* and *C. melanoloma* (Mogea 2002).

We found that identification of rattans based on local names was unreliable because one botanical name may represent more than one local name and vice versa. For example, in Java 49 local names have been recorded for 25 species of rattans. *Calamus ornatus* is variously referred to as *penjalin retung*, *rotan latun* and *seuti,* and other species may have numerous

3. bag (*kaneron*)
(Photo by J. Dransfield)

names. The Sundanese vernacular name *hoe lilin* may be applied to *C. asperrimus* and *C. melanoloma,* and *seel* may be used for *C. horrens* and *D. melanochaetes*. However, a few local names were consistently used such as *bubuai* for *P. elongata*, *hoe dawuh* for *C. rhomboideus* and *rotan tunggal* for *C. occidentalis* (Mogea 2002).

In Leuwijamang, Cibedug, and Ciptarasa, six of the 16 species were found to be particularly useful for local people, viz: *Calamus melanoloma, C. ornatus*, *Daemonorops melanochaetes*, *D. rubra*, *D. hystrix* and *Korthalsia junghuhnii*. The cabbage (*umbut*) of *D. melanochaetes, D. rubra, C. ornatus* and *K. junghuhnii* is edible raw or cooked. The cabbage of *D. hystrix* was heated or roasted over an open fire and then ground, using a small stone, and was eaten as a remedy for dysmenorrhoea. The liquid within young shoots of *C. ornatus* was used as an anti-dandruff shampoo. The cane of these six species was used for binding up woven bamboo walls and roofing leaves of traditional houses. In addition, the split cane of these species was used as binding material for many household items such as hand bags (*kaneron*) (Figs. 2 & 3), the conical container of woven bamboo used for cooking steamed rice (*aspan*) and baskets used as containers for steamed rice (*boboko*); portions of whole stems were used as handles for brooms (*sapu*), riddles (*saringan*), axes (*kampak*) and the special knife used for slicing the inflorescence stalk during the tapping of sugar palm (*balium* or *baliung*). Leaflets of *C. ornatus* were used for wrapping blocks of palm sugar. The canes of *D. hystrix* and *D. melanochetes* possess a glossy siliceous surface that gives the split cane a smooth outer surface, good quality and greater durability as compared with other species. People insisted that the canes possess *kulumut* (known in Sumatra, Kalimantan and Sulawesi as *ronti*), a glossy and durable surface layer. The cane of *D. hystrix* 12 mm in diameter may provide six

4. *Arenga pinnata*: beating the male inflorescence stalk.

splits 2 mm wide, 1 mm thick. The cane of *D. melanochaetes* 16 mm in diameter may provide eight splits. To facilitate the weaving process the split cane is usually cut in 1 to 2 m lengths. A *kaneron* 30 × 25 × 10 cm may need about 20 m of cane, and one skilled person can make one *kaneron* in two or three days (Fig. 2). A high quality *kaneron* has a glossy white smooth surface (Fig. 3). These are sold to visitors in the park at a price of 20,000–25,000 rupiahs each (about US$2.50–3.00). Further cane uses are listed in Table 3.

That *D. melanochaetes* and *D. hystrix* are regarded in GHNP as best quality split rattans for weaving is new to our knowledge. Canes from this genus were formerly thought to produce lower quality material for weaving. The sources of best quality weaving material are *C. caesius, C. trachycoleus* and *C. optimus* from West Malesia (excluding Java) (Dransfield & Manokaran 1993).

Arenga in Java

Of the three species of *Arenga* found in Java, only *A. pinnata* (*aren* or sugar palm) has been recorded in GHNP; it is a multipurpose plant, found from the lowlands up to an altitude of 1000 m in primary or secondary forest. The distribution of *aren* outside Java is very great, occurring from Indochina through to New Guinea. Due to its importance as a multipurpose plant it can be regarded as being semi-domesticated (Mogea 1999).

Use of the sugar palm

In GHNP, people utilize the sugary sap tapped from the peduncle of the male inflorescence. The sap is later boiled down to produce blocks of sugar sold in local markets. Additionally, the fruits are used as a source of young endosperms known as *caruluk* or *kolang kaling*, used for a dessert called *kolak*. To prepare it, *caruluk* are cooked with sugar, pandan leaf (*Pandanus amaryllifolius*), salt and coconut milk. Alternatively, the young endosperms are cooked in syrup and then used in desserts called *manisan*. The cabbage or *umbut* is eaten as a cooked vegetable. *Injuk* or *ijuk*, the long black fibers of the leaf sheath that occur in interwoven masses about 50 × 40 cm, are used as material for thatching the roofs of traditional houses and for making brooms (*sapu*). A roof thatched with *ijuk* can last for ten years, while a roof made from sago leaves

5 (left) A farmer, carrying lodongs, goes to harvest sugar palm sap. 6 (right) Sugar palm sap is being poured into a wok for boiling.

(*Metroxylon sagu*) lasts just four years, one made from *daun tepus* leaves (*Alpinia* sp.) three years and from *patat* leaves (*Phrynium pubinerve*) for only two years.

The outer part of the stem of the sugar palm is used for making *pangaduk* – a kind of wooden pole used for stirring the evaporating syrup in the preparation of the blocks of sugar. The roots may be boiled and mixed with 39 small pieces of bark and leaves of other plants, the resulting liquid being drunk as a tonic. The roots are also used as an eye treatment by women after childbirth by crushing and mixing with water. The sap from young leaves is used to treat sore eyes.

Extraction of sugar palm sap

Sugar palm is solitary and has a basipetal hapaxanthic habit. Each stem produces inflorescences and then dies; the oldest inflorescence arises from the very top of the stem and then successively younger inflorescences are produced following a sequence from the top to the base of the stem. About four to seven inflorescences at the top of the stem are female and after these female inflorescences subsequent inflorescences are male. Only the male inflorescences are tapped. In the mature stage, the stalk is about 50–80 cm long, 5–10 cm in diameter and covered by many bracts.

The tapping process starts when the inflorescence is one half to one year old. The stalk is cleaned and its bracts removed, the upper part of the stalk about 10 cm long is beaten gently once a week for one or two months (Fig. 4). This stimulates the stalk to produce sugar sap. The duration of beating depends on the maturity of the inflorescence, the more mature, the longer the duration. After beating, the upper part of the stalk near the first rachis bract is cut off and the cut stalks are left for three days, after which they are ready to be tapped. The sap is collected in a *lodong*, a portion of a big hollow bamboo stem about 90 cm long and 15 cm diameter (Fig. 5).

7. Palm sugar has a sticky, deep brown consistency, ready to be printed in the hemisphere wooden mold.

Harvesting is done twice a day, in the morning and in the evening. When the *lodong* is exchanged, the top 1–2 cm of the peduncle is usually cut off to facilitate sap flow. The duration of harvest can be up to one month, depending on the size of the palm or peduncle. The larger the tree is, the longer it can be tapped and the greater the sap harvest. In most cases, the process of harvesting the sugar sap in GHNP is the same as reported by Miller (1964), who observed in great detail the process of utilization of sugar palm trees near Bogor in West Java and compared it with other places in North Sumatra and the Philippines. In our study site, the fresh sap was collected in *lodongs*. Six individual trees produced 15 *lodongs* of fresh sap. The sweet fresh sap was put in a big aluminum pan called *gantang* (Fig. 6). To avoid rapid fermentation, the fresh sap in the *gantang* is always boiled for four to six hours. If the fire goes out during this period, the fresh sap becomes sour due to rapid fermentation. Half way through the boiling process the liquid becomes pale brown and is called *wedang*. Further on into the process the sap begins to solidify, and the color changes to darker brown called *gula ngora*, which means young sugar palm sap (Fig. 7). In the center of *gantang* above the liquid, is a small aluminum tube called *bubung*. The *bubung* prevents unnecessary foam from being produced. After three to six hours, depending on the volume of the sap, it can be formed into a hemisphere, 10 × 4 cm tall with a wooden form (*dempok monyong*, Fig. 8). The *dempok monyong* is cleaned with water before the sugar is pressed into it. After the sugar cools and solidifies, two pieces of palm sugar are removed from the wooden mould, pressed together by their flat surfaces and wrapped with *hoe seuti* leaves (*C. ornatus*) (Fig. 9). This kind of sugar is called *gula kojor*. It is sold at a price of 1000 rupiahs. The other shape is cylindrical, each piece about 4 × 3 cm, and formed in a bamboo culm. Five of these cylindrical pieces of palm sugar are wrapped together and sold at a price of 1000 rupiahs. This type of palm sugar is known as *gula hulu*.

Conservation and management implementation

Rattans and sugar palm are shown to be indispensable for income generation as well as for daily consumption by local people. However, traditional plant management practices are not well developed, and the dependency on forest within GHNP as a source of plant material is still high. This situation has

8 (left). The sticky brown sugar is removed into a *dempok monyong* or hemispherical wooden mold. 9 (right). The blocks of sugar are in the process of being wrapped up in the leaflets of *Calamus ornatus*.

the potential to damage natural resources in the near future, if no intensive management of plants by local residents is implemented. In addition, even if the forest law forbids local people to collect resources within GHNP, they are forced to enter into the area to meet their daily needs.

According to local government sources, the village of Cisungsang during 1960 to 1980 was a center of rattan weaving home industries. At that time, about a hundred tons of *Calamus javensis* were sold to Cirebon. This city is well known as the center of rattan handicraft industries on the north coast at the very east of West Java. Currently, Biodiversity Conservation Project, conducted by JICA (Japan International Cooperation Agency) Indonesian Ministry of Forestry and LIPI, has a participatory program to plant five important local species of rattans for weaving materials; these species are *Daemonorops melanochaetes*, *Daemonorops hystrix*, *Calamus ornatus*, *Calamus javensis* and *Calamus rhomboideus*. Planting will take place in collaboration with local people of Cisungsang, in an area located adjacent to the park, in Cibeber sub-district, Lebak in Banten district. In this project, ripe fruits were searched for in the park by the park staff. Suitable nurseries and some 100 hectares of land including trees for the rattans to climb were ready to be used. In addition to this project, studies on embryo culture and vegetative propagation of rattans will be conduct by LIPI in the near future. A study of elasticity and durability of local rattans for weaving material has the possibility of diversifying the resource. As for the sugar palm, approximately 2,000 seedlings were planted recently in village lands as an intensive agroforestry project. A nursery for the sugar palm will also soon be established and more sugar palm will be planted in the near future. Participatory plant management can contribute to the local peoples' demands and also to the mitigation of negative human impacts on the ecosystem of GHNP.

Conclusions

The number of species of rattans in the park is 15, including two species and one variety recorded for the first time in this study; these are *Calamus polystachys*, *Korthalsia laciniosa* and *Calamus javensis* var. *A*. The intensive role of local rattans in the area for weaving materials is very impressive, particularly the use of *Daemonorops melanochaetes* and *D. hystrix* that are unusual in the genus. Local people can easily access these species within the park. The sugar palm was also shown to be quite important in the everyday lives of local

people. Therefore, the people in the study area really need assistance to develop the products sustainably, so that the forest ecosystems are not destroyed. The intensive cultivation effort of local rattan species and the sugar palm trees by LIPI with local people can be one strategy to realize the coexistence of local people with GHNP.

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Rapid Excision of *Pritchardia* Embryos

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In order to study specific types of dormancy mechanisms and desiccation tolerance in *Pritchardia* species a large amount of embryos is required. This article presents a technique for the rapid excision of embryos from seeds of *Pritchardia*.

Pritchardia is a genus of tropical Pacific distribution. Species can be found in Fiji, Tonga, Taomotus and Hawaii (Uhl & Dransfield 1987; Wagner et al. 1999). Of the 19 species endemic to the Hawaiian Islands nine are listed as endangered species (USFWS 2003). Most of the remaining unlisted species are considered threatened or of conservation concern.

Current Research on *Pritchardia* spp.

Current research on *Pritchardia* focuses on two areas: 1) understanding mechanisms that control germination and 2) desiccation tolerance of seed and embryos. This type of work represents some of the first steps towards successful *ex situ* conservation. However, numerous embryos must be regularly excised from fruits of various developmental stages for this research. It is important to harvest and treat embryos as quickly as possible in order to avoid unwanted drying or hydration.

Hodel (1977) mentions excising embryos with a scalpel, but does not provide details of the method. Trying to excise embryos from mature seed (i.e. those with hard endosperm) with a scalpel or knife is difficult and very time consuming. My early attempts to excise embryos in a timely manner proved to be unsuccessful. Therefore a rapid method of embryo excision needed to be developed. Here I describe a method to excise embryos from *Pritchardia* seed.

Using the Right Tools Makes the Job Easier

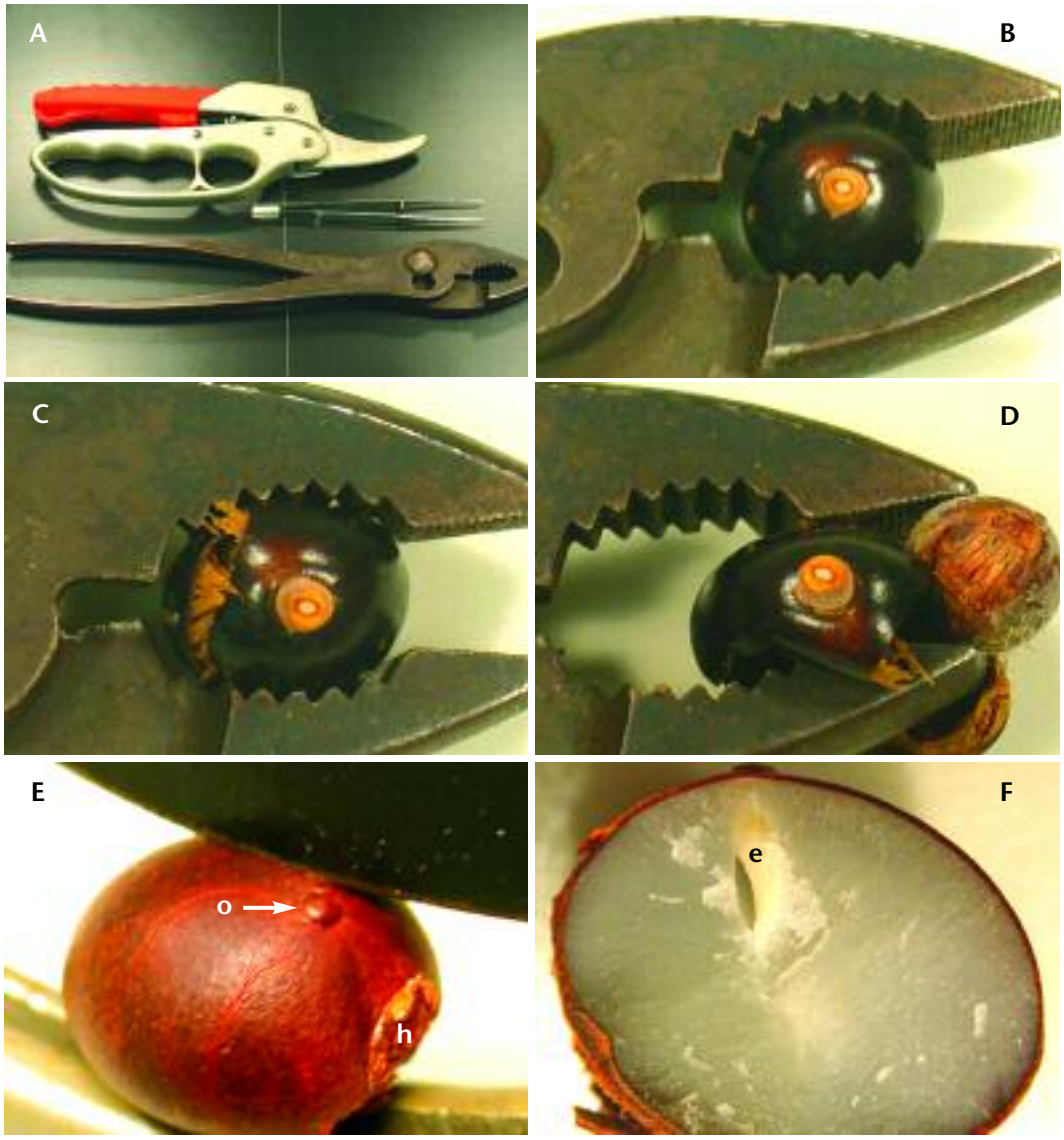
Three tools are needed for this technique: a pair of long-handled pliers, anvil-type horticultural pruners with a curved impact jaw and ratcheting action, and forceps (Fig. 1a). Long handled pliers are used to crack the hard endocarp and expel seeds from the pericarp. The anvil pruners are used to remove bulk amounts of seed tissue. The pericarp of immature fruits can be removed with the anvil pruners as well. Embryos are then retrieved with forceps.

Excising Embryos from Mature Fruits of *Pritchardia* spp.

The following procedure has been successfully used on *Pritchardia hillebrandii*, *P. kaalae* and *P. remota*. Adaptations may have to be made for smaller or larger seeded species.

Step 1 – Cracking the endocarp and expelling seed

Place fruit in jaws of long-handled pliers. Ensure that the pedicel is parallel to plane of the jaws of the pliers (Fig. 1b). Squeeze pliers until endocarp makes cracking sound. Seed may be visible through crack in endocarp at this point (Fig. 1c). Place fruit in tapered portion of jaws of the pliers with cracked portion facing out. Apply pressure once again. Seed should now be expelled from pericarp (Fig. 1d). You should not have to apply the same amount of pressure to expel seed that was used to crack the endocarp.



1. **A.** Tools required for *Pritchardia* embryo excision. **B.** Placement of fruit in pliers with pedicel perpendicular to plane of pressure. **C.** After pressure has been applied a crack should form in the pericarp. **D.** After cracking the endocarp, fruits are moved into the tapered jaws. Pressure is applied once again to expel seed. **E.** Proper placement of seed on curved impact jaw of pruners. Note alignment of blade next to operculum = o. The large hilar scar = h is visible near the operculum. **F.** Hemisphere of seed containing embryo = e.

If initial pressure did not crack the endocarp enough to see the seed, continue applying pressure until endocarp cracks and the seed is partially exposed. You may have to turn the fruit in the pliers then apply pressure a few times. Likewise, it may take more than one attempt to expel the seed from within the pericarp.

Step 2 – Removing bulk seed tissue and revealing the embryo

Place seed on impact jaw of anvil pruners. Seed can be held in place with thumb and index finger. Always ensure that fingers are away from cutting blade. Make sure that the operculum, or germination lid, is facing you. The embryo will be directly under the operculum. Align cutting blade as close to operculum as possible (Fig. 1e). Make sure that the cutting blade does not cut through the operculum or embryo damage will occur. Squeeze handle and allow ratcheting action to hold seed in place. Remove fingers. Continue cutting until seed is split in half (Fig. 1f). Discard portion without operculum unless needed.

2. **A.** Placement of seed, with endosperm facing curved jaw, for first cut to fully expose embryo. The cutting blade should not be allowed to pass into the operculum = o. **B.** Rotation of seed 180° on impact jaw to complete full exposure of embryo. Note that blade tip does not extend more than half way into the seed below the embryo. **C.** Seed wedge formed to fully expose embryo = e. **D.** Excising embryo with forceps.

Place exposed endosperm on impact jaw with operculum facing you. Align cutting blade so that it is centered on the operculum (Fig. 2a). Gently, begin cutting into seed coat, stopping short of the operculum. The seed should begin splitting after squeezing pruner handles 1 or 2 times. As the seed splits a crack will extend to the operculum. Remember, do not cut into operculum or embryo damage will occur.

Remove seed from blade and rotate 180° on anvil jaw. The operculum should now be facing away from you. Insert tip of cutting blade into newly created crack below the embryo zone and continue cutting remaining endosperm in half (Fig. 2b). Do not insert blade tip more than half way into diameter of seed or embryo damage will occur. You should now have a wedge shaped piece of seed with the embryo in plain view (Fig 2c).

The operculum can be removed with forceps to better access the embryo. Gently, insert one tine of the forceps between embryo and endosperm. Lightly nudge embryo until it becomes dislodged from seed (Fig. 2d). Removing embryos from freshly shed seed is usually easier than removing from seed that have been allowed to dry for some time. Embryos will typically be much drier and less flexible in the latter situation. More care is needed when removing these embryos. If embryo moisture content is not a concern crack the endocarp and allow fruit to soak in water for 48–72 hours. This will allow imbibition to commence and facilitates removal of turgid embryos.

Sometimes it is difficult to locate the operculum on mature seed. However, do not give up to easily. The operculum will always be in close proximity to the hilar scar (e.g. point of seed to fruit attachment). The operculum typically resembles a small round blister (Fig. 1e). If the seed coat does not possess an operculum, then it will not possess an embryo.

Excising Embryos from Immature Fruits of *Pritchardia*

Embryo excision in young fruits is quick and easy. The key is to have fruits that are not so immature as to have extremely small embryos.

For example, at 90 days after anthesis (DAA) embryos of *P. remota* are usually too small to find. At 156 DAA embryos are large enough to see with the naked eye. At this stage of development when the fruit is still usually soft, embryo removal is easy.

Step 1 – Removing developing pericarp

Locate pedicel. Place young fruit in pruners and begin cutting fruit coat. Do not sink blade entirely into the seed. Some *Pritchardia* fruit possess a ridge that extends laterally from pedicel. Cut along this ridge to avoid embryo damage. Cut around the entire fruit circumference. It is easiest to begin and end at the pedicel. Once cutting is complete peel pericarp away with fingers. The young, developing seed should now be exposed. Locate the developing operculum. Usually it appears as a darker colored disk in the seed coat. The operculum will be near the hilum. Embryos should be visible under the developing operculum. Seed can also be pried loose from pericarp with fingers in order to facilitate location of embryo.

Step 2 – Recovering Embryos

Once the embryo has been located peel away the developing seed coat with forceps. Gently insert forceps around embryo and pull it out. Alternatively, inserting the forceps between the embryo and endosperm and gently pushing up can free embryos.

Conclusion

As with any technique where cutting is involved safety precautions should always be observed. Remember to keep your fingers clear of the cutting blade. I prefer to use pruners with ratcheting action because they supply sufficient pressure to keep seed in place while cutting, without a need to hold seed in place with your fingers. With sufficient practice embryos can be removed from mature fruits in about 60–90 seconds. Removing embryos from immature fruit is even faster. Embryos can be used for in vitro germination, morphological studies, and determination of moisture content and desiccation tolerance.

Acknowledgments

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Dypsis delicatula

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1. *Dypsis delicatula* forms neat clumps in the undergrowth at Betampona.

Another new palm from Madagascar has been discovered. This clustering dwarf palm, *Dypsis delicatula*, is one of the smallest species in the genus.

The subject of this paper is a wonderfully delicate new species of *Dypsis* (Fig. 1), hence the species epithet. Britt was aware of this palm being widespread in the forest under-story whilst working at Betampona from 1997–2002. Baker and Dransfield visited Betampona in 1999 and made a collection of it; however, at the time of their visit only dead inflorescences were available. Britt was able to collect it in 2000, but his collections remained in Madagascar until additional material was collected in 2003 and finally shipped to Kew. Britt also located this species in further forest fragments around the Betampona area. Thus it appears to have very restricted distribution in the remnants of low-altitude rain forest in the Betampona region, northwest of Toamasina.

Dypsis delicatula *Britt & J. Dransf.* **sp. nov.**, inter speciebus minimis inflorescentia ramosa rachillis tenuissimis brevibusque, floribus minutissimis remotisque staminibus oppositipetalis antheris rotundatis bene distincta; *D. viridi* similis sed habitu minore, foliis angustioribus, rachillis gracilioribus floribus minoribus sphericis recedit. Typus: Madagascar, Toamasina, Betampona, 14 Mar. 2003, *Britt et al. 2* (Holotypus K; isotypi AAU, P, MO, TAN).

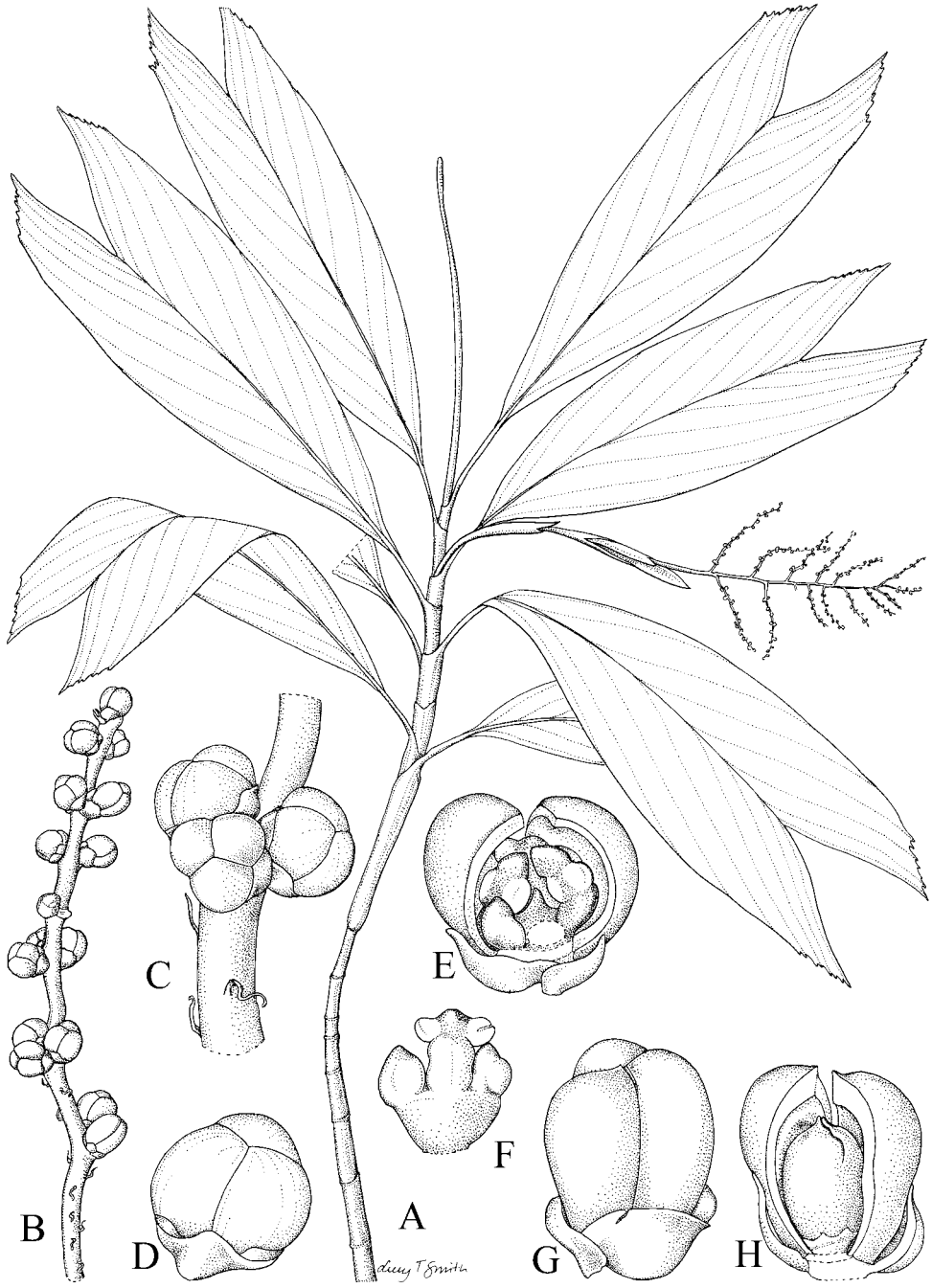
Slender, clustering palmlet of forest undergrowth. Pale to dark green stem 46–110 cm ca. 5–10 mm diam., internodes 12–52 mm long. Leaves 6–19 in crown, sheaths 1–3.6 cm long, petiole absent or up to 2.6 cm long, ca. 1mm diam., leaf blade entire bifid, 10–18 cm long, with 13–18 abaxial ribs diverging at an angle of about 30° from the rachis, blade divided to one fifth to one quarter, ca. 36–64 mm wide just below the sinus, apical segments shallowly toothed on outer surface with up to 11 teeth, rachis 7.6–14 cm long, lamina bearing sparse scattered minute gray scales abaxially. Inflorescences interfoliar, very slender, 1 or 2 per stem, never exceeding leaves, branching to 2 orders; peduncle 5.0–6.5 cm long; prophyll 2–5 mm long; peduncular bract 2.4–3.8 mm long; first order branches 14–21; second order branches 4, the proximal 2 branched to 2 orders; rachillae very slender, ca. 0.3 mm diam., bearing scattered dark brown scales; triads ca. 3 mm distant near the base of the floriferous portion of the rachilla, ca. 1–2 mm distant distally; rachilla bracts very slender, acuminate, ca. 0.5 × 0.2 mm. Staminate flowers globose ca. 0.7 mm diam.; sepals ca. 0.3 × 0.3 mm, imbricate, broadly triangular with rounded bases, irregularly keeled, emarginate, faintly striate; petals rounded, gibbous, very fleshy, 0.6 × 0.6 mm, glabrous; stamens 3, antepetalous, alternating with and connate with 3 antesepalous staminodes, free stamen filament ca. 0.2 mm high, ca. 0.2 mm wide, connective broad, anthers pendulous, didymous, ca. 0.15 × 0.10 mm, staminodes somewhat club-shaped, flattened, the connective wider at the tip, anthers lacking; pistillode conical, 3-lobed, ca. 0.2 mm wide, minutely trifid at the apex. Pistillate flower globose, ca. 0.7 × 0.7 mm; sepals ca. 0.3 × 0.3 mm, striate, irregularly emarginated and keeled; petals broad, rounded, ca. 0.6 × 0.6 mm, valvate but slightly imbricate at the base, very fleshy; staminodes not seen; ovary eccentrically spherical, ca. 0.4 × 0.4 mm, stigmas 3, ca. 0.1 mm high. Fruit unknown (Figs. 2–4).

SPECIMENS EXAMINED. Madagascar, Toamasina, RNI Betampona, Piste Principale 2200 m, 6 Nov. 2000, *Britt 22* (MO, K); Madagascar, Toamasina, RNI Betampona, Piste Principale 1700 m, 17°54′57″S/49°12′1.38″E, alt. 450 m, 14 Mar. 2003, *Britt et al. 2* (Holotypus K; isotypi AAU, P, MO, TAN); 17°55′54″S/49°12′12″E, alt. 350 m, 19 Nov. 1999, *Baker & Dransfield WJB1033* (K, MO, NY, P, TAN); growing specimens at RNI Betampona, Jan. 2002.

SPECIMENS SEEN. Sept. 2001: Antanamalaza Forêt Classé (17°50′S/49°11′E), Ambakaka forest (17°52′S/49°10′E).

HABITAT: Occurring in rain forest on ridge-tops, mid-slopes and in valley bottoms at elevations of 300–600 m above sea-level, locally abundant at Betampona.

NOTES: The palm we describe here and name as *Dypsis delicatula* has already been illustrated, as *D. hirtula*, in Beccari (1912–1914) and in Jumelle and Perrier de la Bâthie (1945). *Dypsis hirtula* was described and named by Martius, based on a collection (*Poivre s.n.*) in the Jussieu Herbarium in the Museum d'Histoire Naturelle in Paris. In Dransfield and Beentje (1995), *D. hirtula* was discussed at length and included in synonymy with *D. forficifolia* Noronha ex Mart. In 'Palme del Madagascar', Beccari (1912–1914) had interpreted *D. hirtula* differently, accepting it as a species distinct from *D. forficifolia*. He illustrated the species, not with a photograph of the type, but instead with a photograph of a collection made by Majastre in Tamatave, preserved in Hamburg herbarium. This



2. *Dypsis delicatula*. **A** habit ×2/3; **B** rachilla ×6; **C** Portion of rachilla with triad ×15; **D** Staminate flower ×24; **E** Staminate flower, one petal removed ×28; **F** Stamen flanked by two staminodes ×28; **G** Pistillate flower ×28; **H** Pistillate flower, one petal removed ×28. All from *Britt et al. 2*. Drawn by Lucy T. Smith.

Majastre collection, not traced by Dransfield and Beentje, bears a remarkable resemblance to the palm we describe here. Beccari also described and illustrated the staminate flowers, clearly showing the stamens to be opposite to the sepals; however, unusually, he does not indicate which collection provided the material for his analytical drawing. Dransfield and Beentje suggested that the Majastre collection was more likely to be *D. viridis* than

3. *Dypsis delicatula*: detail of crown.

4. *Dypsis delicatula*: detail of inflorescence.

D. forficifolia (syn. *D. hirtula*). However, the identity of the Majastre collection has no bearing on the nomenclatural problem, as it is not the type of *D. hirtula*.

Jumelle and Perrier de la Bâthie (1945) accepted *D. hirtula* as a distinct species, probably basing their concept of the species on Beccari's illustration of the Majastre collection, and illustrated it with a habit drawing based on *Perrier 17466*, collected at Betampona; the taxon illustrated is clearly the taxon we describe here as new. They do not appear to have examined the holotype of *D. hirtula*, and we suspect, also, that they did not dissect the flowers of *Perrier 17466*.

The position of the stamens is crucial to identifying the species of *Dypsis* with three stamens. In the informal classification of Dransfield and Beentje (1995), taxa with stamens opposite the sepals belong to either

Group 12 (*Dypsis* sensu strictu), Group 13 (*Adelodypsis*) or Group 14 (group without a previously published name), while those taxa with stamens opposite the petals belong to Group 18 (*Trichodypsis*). The Betampona taxon has stamens opposite the petals and thus its affinities are with taxa such as *D. viridis*, *D. hildebrandtii*, *D. mocquerysiana* etc., while the type of *D. hirtula* (= *D. forficifolia*) has stamens opposite the sepals. Whatever the identity of the Majastre collection, the Betampona dwarf palm is clearly in need of being described and named.

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A New Cultivar of *Sabal palmetto*

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A distinctive, naturally occurring form of *Sabal palmetto* (Walt.) Lodd. ex J.A. & J.H. Schultes, which we name 'Lisa,' has entered the horticulture trade.

In the spring of 1998, the senior author came upon a group of three unusual palms growing in southwestern Florida. These palms were immediately distinguished from the common *Sabal palmetto* by their leaf form, which is less divided, less filiferous, and more rigid than is typical for the species. Upon seeing this unusual palm, the senior author was impressed enough to gather seeds and begin a propagation program. While ordinary *Sabal palmetto* has been ignored and even treated with derision by landscaping elitists, the remarkable appearance of this cultivar makes it worthy of propagation and placement in the landscape.

A single individual of this unusual form of *Sabal palmetto* was found growing over 161 km (100 miles) from the original site. This cultivated individual (Fig. 1), growing alongside the typical form of *S. palmetto*, has been the source of seeds for the nursery trade. Of the seedlings produced from this source, approximately 68% show the leaf characteristics of the mother plant. Careful culling ensures that the distinctive new form, which we name 'Lisa,' is available for cultivation.

Initially, the senior author, in consultation with a plant geneticist, believed this palm to be an autopolyploid, based solely on heavy texture and robustness of the leaves. We have been unable to test this hypothesis using young root tips and standard methods for obtaining mitotic cell preparations. The likelihood of this palm representing a polyploid is remote, as polyploidy is not known to occur in the genus. Indeed, polyploidy is very rare throughout the entire palm family.

Sabal palmetto 'Lisa' is just as vigorous as the typical form of the species and hardy to USDA Zone 7 (depending on the number of hours of cold). As with all *Sabal* palms, *Sabal palmetto* 'Lisa' has minimal recurring maintenance costs in parking lots, rights of way, median strips and other municipal settings. The recent spate of hurricanes in Florida has demonstrated the virtues of *Sabal* palms in wind storms. They are less likely to be uprooted in high winds than many other ornamental trees, and they came through the recent storms relatively unscathed. Strategic planting of *Sabal* palms adds a lush, tropical look to municipal settings while preserving street access after storms, thus enhancing public safety.

We believe this cultivar has great potential as an ornamental landscape plant for Florida and elsewhere along the Gulf Coast and Mid-Atlantic States, wherever *Sabal palmetto* can be grown.

Sabal palmetto 'Lisa'

Stocky, solitary palm to ca. 10 m tall; trunk ca. 40–50 cm DBH, brownish gray, with leafbases

1 (left). A mature specimen of *Sabal palmetto* 'Lisa' showing its distinctive leaf morphology. Leaves of the typical form of *S. palmetto* are visible behind and to the left. Note the more divided leaves with pendulous leaflet apices in the typical form compared to those of *S. palmetto* 'Lisa.' (Photo by R. Riefer) 2 (right). A seedling of *Sabal palmetto* 'Lisa' already showing distinctive leaf morphology. (Photo by R. Riefer)

persisting. Leaves ca. 15 in crown, blade evenly deep green, somewhat undulate, costapalmate but costa only weakly recurved, not filiferous; petioles 3 cm wide and 70 cm long; hastula 9–12 cm long, glabrous, acute, margins flat, entire; segments ca. 86 per leaf, in groups of 2–7, segment groups united for ca. 33% of their length, segments within groups united for 90–95% of their length, middle segment (on one side of leaf) 107 cm long and 3 cm wide (at base of free portion), transverse veins short and conspicuous, segment apices scarcely bifid, stiff, not pendulous. Inflorescence interfoliar, arching, shorter than leaves, branched to two orders, rachillae 11–14 cm long and 1.1–1.3 mm diam, with 6–8 flowers per cm. Flower ca. 4.2 mm long; calyx urceolate-cupulate, not costate when dry, 1.4–1.8 mm long, 1.4–1.6 mm wide, sinuses 0.3–0.5 mm deep; petals obovate-spatulate, alternating with the outermost whorl of stamens, ca. 3.4 mm long and ca. 1.6 mm wide; stamens six, in two whorls, exserted just beyond petals, filaments narrowly triangular to awl-shaped, ca. 3.6 mm long, basally adnate to the petals for ca. 0.7 mm, anthers ca. 1.1 mm long and 0.4 mm wide; gynoecium 2.6–2.7 mm long, ovary 0.6–0.8 mm × 0.8 mm in diameter. Fruit oblate-spheroidal, 6.8–8.1 mm long × 7.0–8.4 in diameter, brownish-black; seed 4.3–4.7 mm long × 5.2–5.7 mm in diameter, embryo equatorial.

A specimen of this palm, *Riefer s.n.*, is preserved in the herbarium of Fairchild Tropical Botanic Garden. The cultivar epithet honors Lisa Riefer, wife of the senior author.

Sabal palmetto 'Lisa' is distinctive by virtue of its leaves, which are less strongly costapalmate and less filiferous than the wild type, traits that are apparent even in seedlings (Fig 2). Moreover, leaf segments are in groups (similar to *Sabal yapa* Wright ex Becc.) the apices of which are not pendulous.

The advantage of seed-grown *Sabal* palms over those transplanted from the wild lies in the smaller size of seed-grown palms. Field-grown or wild individuals of *Sabal palmetto* with 1–3 m of overall height are difficult to transplant successfully. Most die soon after transplanting. While larger, mature specimens transplant with ease, their height in most landscapes gives them all the aesthetic appeal of utility poles. *Sabal palmetto* 'Lisa' adapts easily to container culture. Seedlings in 10-gallon containers readily produce up to 2 m of foliage and can be installed in landscapes with relative ease.

A Little Palm, a Lot of Palaver

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1. (left to right) leaf from *C. elegans*, *C. ernesti-augusti* and *C. oblongata*.

Xate (shah-tay) describes the _Chamaedorea_ species, _C. elegans_, _C. oblongata_ and _C. ernesti-augusti_ (Fig. 1), used in the floral industry. The palms' attractive leaves stay fresh for up to four months, making them ideal for use in decorations and flower arrangements. Sadly their desirability has led to over-harvesting in Mexico and Central America and jeopardizes the health of their populations in the wild.

Such a threat is not new to this group of palms. The smallness and characteristic beauty of *Chamaedorea* species have long led to their exploitation, mostly in the form of potted plants, but also for leaves and, to a small degree, for inflorescences, such as with *C. tepejilote*. Unregulated gathering of seeds, leaves and the palms themselves from the wild has led to dramatic decline in several *Chamaedorea* populations (Vovides & Garcia 1994). Even plantations of farmed palms, often touted as saving non-timber forest products from overharvest, can add to, rather than relieve, the problems when initial stocks of seeds or plants are collected from the wild in such abundance as to upset the plants' ability to repopulate naturally.

Chamaedorea species are in trouble, and they are also causing some trouble for Central American neighbors, Belize and Guatemala. Guatemala exports *xate* from the Petén region bordering Belize. The demand is great, and over-collection has depleted natural supplies of Petén's *xate* species (Oyama 1992). Relying on income from the plants the men who collect the leaves, called *xateros*, risk illegal incursions over the border into Belize where the supply is greater. The two countries already have a history of border tension, and reports of illegal entries and resulting arrests put a strain on emotions on both sides of the border.

An estimated 600–700 *xateros* make use of the Belizean forest, and *xateros* camps have been found as far as 40 km into Belize. They travel over several days camping out and hunting for food while they search for leaves. Because *xateros* are paid for quantity rather than quality, unsaleable leaves are cut from the

2. Belizean 'fishtail,' *Chamaedorea ernesti-augusti*.

palms to bulk up earnings. As supplies grow scarce in one area, the *xateros* move on to the next, increasing the amount of forest affected.

The *xate* harvest is carried on the backs of the *xateros* in bundles and taken to drop off points where horses pick up the accumulated loads. From the forest the leaves go to processing plants for sorting. Here the leaves are sorted into several grades, according to the price they will fetch on the market. Cutting unusable leaves plus wear and tear during transport means that as much as 60% of the *xate* collected winds up discarded. The sorted leaves are stored in refrigerated units until they are shipped to international floral wholesalers.

At present the demand is greatest for *C. ernesti-augusti*, locally called *fishtail* or *cola de pescado* (Fig. 2), and it is being cut at an alarming rate from Belize's forests. One area where *xateros* collect is in Belize's Chiquibul National Park, a forest reserve where the British Natural History Museum operates Las Cuevas Research Station. Dr. Nancy Garwood, Scientific Coordinator of the station, was concerned about the effects of the Guatemalan *xateros* in the reserve. Little is known about the long-term effects or recovery of *xate* species, and Dr. Garwood wanted to increase knowledge about the Belizean *xate* situation, find out how much *xate* was in the Chiquibul forest and determine if a sustainable *xate* industry could be established in Belize. She applied for and received funding from the UK Darwin Initiative to research these issues.

The Darwin-funded project involves two major parts. The Natural History Museum, working with the Government of Belize's Forestry Department, is studying wild *xate* populations and the effects of wild harvest in the Chiquibul reserve. Belize Botanic Gardens is promoting sustainable *xate* farming in Belize. The botanic garden is exploring the economic potential of the palms grown in conjunction with other agroforestry products. The goal is to provide cultivation and marketing support to farmers so that they get the best crop and receive fair prices for their leaves. As of June 2004, initial germination experiments are complete, and a demonstration plot of the three most economically viable species established (Fig. 3). Farmers and the general public can visit the demonstrations, view information on growing *xate* and register to attend workshops later this year.

3. *Chamaedorea elegans* seedlings at Belize Botanic Gardens.

Representatives from three communities close to the botanic garden, San Antonio, Cristo Rey and El Progresso, work together as ITZAMNA society. The members of ITZAMNA manage a farmer's co-operative and are guardians of the Don Elijio Panti National Park. The farmers are interested in implementing organic farming techniques and finding alternative crops to replace or supplement income from slash and burn and vegetable farming. They are also worried about the evidence of *xateros* in their national park. Already 30 farmers from the three communities are willing to participate in the Darwin project.

There are many environmental benefits to farming *xate*. The palms are native to Belize. They can be grown organically at relatively low costs. They require heavy shade so farmers can keep existing forest mostly intact rather than clearing land to plant, or they can plant into existing agroforestry crops such as cacao and black pepper. The diversity can create a more stable income than relying on a single crop.

With careful management, *xate* could become a profitable industry for Belize. It will need properly educated producers, an infrastructure and a careful study of what it will take to keep the industry going. Unfortunately recent press about the Guatemala-Belize *xate* situation has convinced some that planting acres of *xate* or cutting leaves from the forest will guarantee a prosperous future. Would-be entrepreneurs in Belize are jumping aboard the *xate* bandwagon with no indication that they have weighed the environmental or financial risks. Without strong government policy and enforcement, Belize could wind up in the same situation as Guatemala, where demand exceeds a degraded supply, or like Mexico where other palms have been overexploited to the point of extinction.

Many international organizations are willing to assist in solving problems of over-exploitation of the plants and people involved in *xate*. Groups such as Rainforest Alliance, Asociación Coordinadora Indígena Campesina de Agroforestería Comunitaria Centro-americana (ACICAFOC), Alianza para un Mundo Justo and Belize Community Service Alliance are also involved in projects focusing on the social, economic and environmental aspects of *xate*. The groups are looking at the problem from different angles such as linking conscientious buyers of leaves with sustainable sources, trying to ease border tension, job training to provide alternative income, community farming endeavors and sustainable farming projects. With their efforts and the Darwin project leading to heightened public awareness, buyers may begin demanding sustainable *xate* for their flower arrangements helping to change the fate of the plants and the people involved.

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