Palms

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The International Palm Society

Founder: Dent Smith

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Close-up of the sheaths of the newly described *Dypsis pustulata*, showing its pustules. See article by Dransfield and Rakotoarinivo, p. 161. Photo by J. Dransfield.

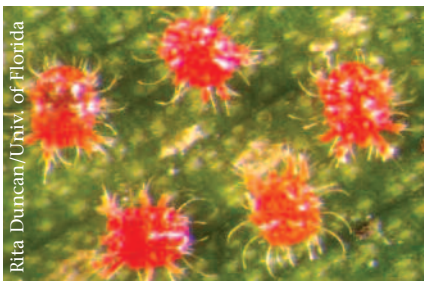
BACK COVER

Palms, including *Copernicia fallaensis*, viewed from the "skywalk" at Nong Nooch Tropical Garden, site of the 2012 IPS Biennial. Photo by S. Zona.

PALM NEWS


Nong Nooch staff

For his dedication to palms and his service to the IPS in hosting the 1998 and 2012 Biennials, **Mr. Kampon Tansacha was awarded an honorary lifetime membership in the IPS**. The founder and creative force behind Nong Nooch Tropical Garden and Resort, in Pattaya, Thailand, Kampon has assembled one of the finest palm collections in the world. The superb collection, both on display and behind the scenes, is particularly strong in species from SE Asia, New Guinea and Madagascar. Kampon has also promoted a hybridization program with genera such as *Dypsis* and *Veitchia* to create garden-worthy interspecific hybrids that thrive in landscape settings in Thailand. Palms are featured throughout the landscaping at Nong Nooch, lushly interplanted with cycads and other tropical plants, and can be viewed from the ground or from the elevated walkways that snake through most of the garden. The thrill of being among the crowns of palms and having bird's-eye views of their leaves, flowers and fruits is without compare (see Back Cover).


Rita Duncan/Univ. of Florida

A special number of the journal Experimental and Applied Aracology (vol. 57, nos. 3–4. Aug. 2012) features **13 articles devoted to the biology and control of the red palm mite**, *Raoiella indica*, the scourge of palm and banana growers in the Neotropics and, recently, southern Florida. The issue includes articles on the host range of the mite, the spatial distribution of an infestation on coconut palms, the dynamics of the red palm mite and its predators, a review of natural enemies and chemical control.

In a recent study of the phenology and pollination biology of a rattan (Flowering phenology and mimicry of the rattan *Calamus castaneus* (Arecaceae) in southern Thailand. Botany 90: 856–865. 2012.), Doyle McKey found that **this rattan species has a striking system of mimicry, quite different from those in other dioecious plants**. In this insect-pollinated, dioecious rattan, nectar and pollen rewards, together with visual and olfactory cues, attract insects to male flowers. Pistillate flowers offer no reward. However, each pistillate flower is accompanied by a sterile staminate flower that appears to contribute to insect attraction by offering visual and olfactory cues similar to fertile males but fewer rewards (nectar but no pollen). *Calamus castaneus* thus ensures pollination success by gender differences in flower function and by floral mimicry

We note with sadness **the passing of Ed S. Moore** (1943–2012) of San Diego, California. Ed was one of the original founding members of Dent Smith's Palm Society and the first to organize a chapter in California. Ed was born in Brunswick, Maryland, and graduated from Strayer College in Washington, D.C., where he held positions with major accounting firms. Ed moved west, first to Las Vegas, Nevada, and in 1992, to San Diego, where his passion for palms took root. He will be greatly missed by all his many friends in the IPS and Southern California Palm Society.

The Palms of Tsitongambarika, Southeast Madagascar

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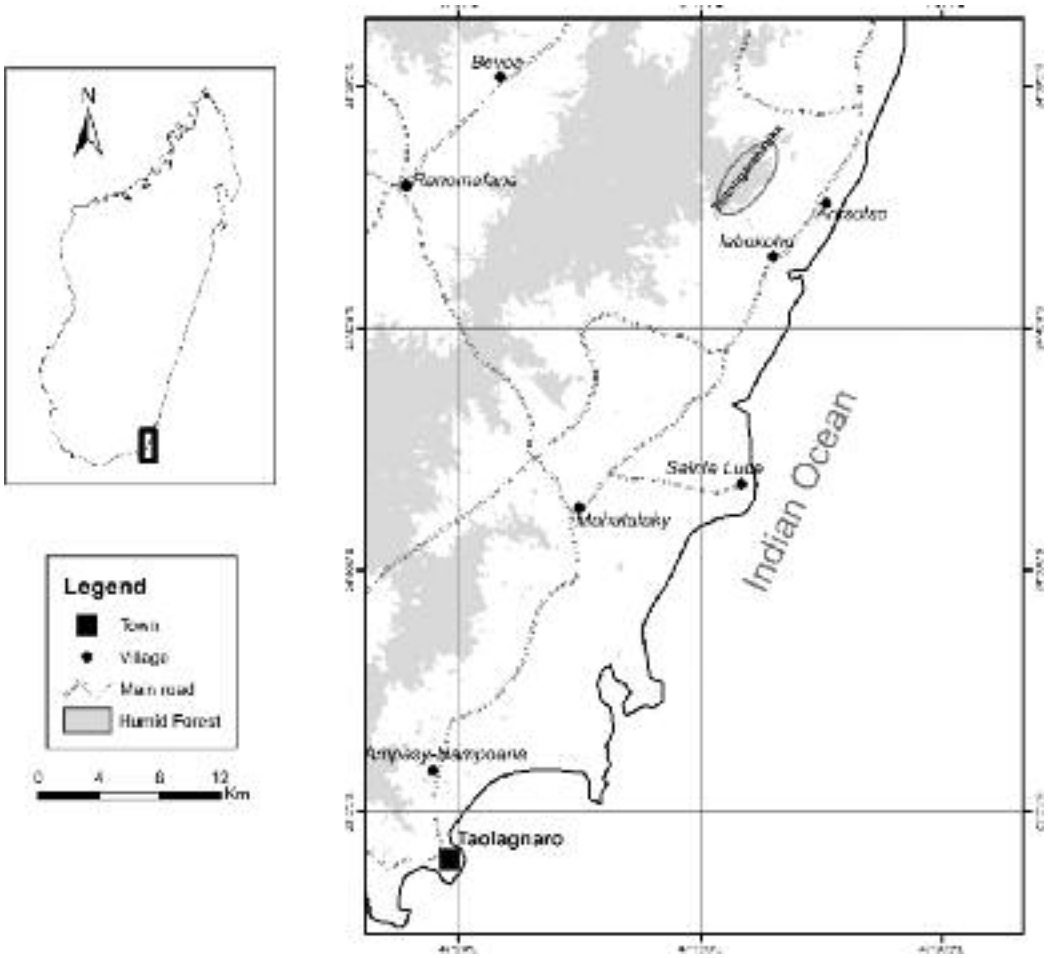
Tsitongambarika is a forested area in the extreme southeast of Madagascar, lying just to the north of Taolagnaro (Fort Dauphin) (Fig. 1). Although it harbors substantial areas of good forest cover and is moderately easy to access, botanical exploration of the area has only recently begun.

Much recent botanical activity in southeast Madagascar has concentrated on the highly threatened littoral forests at Sainte Luce and elsewhere on the coastal plain north of Taolagnaro, the site of the QMM ilmenite mining concession. QMM (QIT Madagascar Minerals) is managed by Rio Tinto Iron and Titanium to exploit the mineral sands that occur in the flat coastal lowlands at the foot of the mountain ranges in this part of southern Madagascar. The deposit of high grade ilmenite (titanium dioxide) is considered to be the largest undeveloped deposit of the mineral in the world. QMM runs a very active biodiversity program, aimed at minimizing the impact of mining on the fragile vegetation. Even before the start of mining, the whole area was under immense human pressure, particularly from burning during the dry season, to make farms for growing rice. The presence of QMM and the associated botanical activity has undoubtedly added immensely to our knowledge of plant diversity there and has the potential to do much for the long-term conservation of these fragile ecosystems.

Beyond the coastal lowlands lie spectacular hills, the southern end of the eastern mountain system that runs along almost the entire length of the eastern coast of Madagascar. On the road north from Taolagnaro towards Sainte Luce these rugged coastal hills are clearly visible, some of them covered with good looking forest and with the much higher range of the Chaine Anosyenne rising up behind. It is this area of coastal hills, separated from the main mountains of the Chaine Anosyenne that has been referred to as Tsitongambarika (BirdLife International 2011). Tsitongambarika forms the water catchment of streams and rivers that are of crucial importance for irrigated rice cultivation in the coastal plain. In the southern part one of these rivers carries the only known population of



1. Map showing the southeast corner of Madagascar and the position of Tsitongambarika.

the extraordinary aquatic palm *Ravenea musicalis*. Towards the northern end of Tsitongambarika several of the river catchments provide habitat for another aquatic palm, *Dypsis aquatilis*. Recent botanical collecting within the Tsitongambarika area by biodiversity staff of QMM in collaboration with staff of Missouri Botanical Garden, has turned up an astonishing number of novelties, perhaps as many as 70 new plants (BirdLife International 2011) including a new genus of Asteraceae (P. Lowry, pers. comm.). Little was known about the palm flora of the area and no palm collections seemed to have been made on these coastal hills, so for some time the area has been high on a list of priority areas for palm surveying.

In fact it was to be a couple of years before we could both find the opportunity to visit Tsitongambarika together. Encouraged by Pete Lowry (Missouri Botanical Garden) we made contact with Johny Rabenatoandro, Faly Randriatafika and David Rabehevitra at QMM in Taolagnaro and made firm arrangements for a visit in September 2010. Our party comprised MJR, JD, Soejatmi Dransfield (searching for bamboos) together with Ramisy Edmond and Mara Bergé, local naturalists who have collaborated with most of the botanical surveys of this area, and whose knowledge was most impressive. Throughout our visit to Tsitongambarika, we received superb logistical help from QMM.

On 21 September 2010 we left the capital Antananarivo by air and arrived in Taolagnaro (Fort Dauphin), delighted to be back in this scenically spectacular part of Madagascar. On the following day we drove north to Mandena to the headquarters of QMM to have meetings with QMM environment staff and then back in the town of Taolagnaro where we bought provisions for the trip.

On 23 September we drove north, picking up Ramisy Edmond, and then heading for the

2 (top). Ivohibe stands proud above the anthropogenic grassland. 3 (bottom). Our camp near the edge of the forest.

List of Palms Observed

Beccariophoenix madagascariensis
Dypsis aquatilis
Dypsis brevicaulis
Dypsis culminis
Dypsis elegans
Dypsis eriostachys
Dypsis fibrosa
Dypsis lilacina nov. sp.
Dypsis mananjarensis
Dypsis nauseosa
Dypsis nodifera
Dypsis prestoniana
Dypsis psammophila
Dypsis pustulata nov. sp.
Dypsis saintelucei
Dypsis subacaulis nov. sp.
Orania longisquama
Ravenea declivium nov. sp.
Ravenea hypoleuca
Ravenea sambiranensis

village of Antsotso, the nearest village to the isolated mountain of Ivohibe, Tsitongambarika, reaching the village shortly after noon. The journey requires three ferry crossings. In Antsotso we negotiated with the village headman, Soja Armstrong, for entrance to the forest (this requiring payment to CoBa, Communauté de Base, an association of village members empowered to implement development plans for natural resources), for a guide (Armstrong himself) and Mara Bergé, who would act as cook and guide and for five porters. In fact, the daily tasks of the guide and cook seemed to be interchangeable and for most of the time we were accompanied by Mara Bergé and Ramisy. At 2 p.m. in the full afternoon sun we started the trek across anthropogenic grasslands towards the massif of Ivohibe.

Ivohibe rises to 677 m out of the coastal lowlands as an isolated peak (Fig. 2) (incidentally, this is not the only mountain called Ivohibe in Madagascar). Good, relatively undisturbed forest clothes the upper slopes forming a forest cover about 27,000 ha in extent (BirdLIfe International 2011). The mountain looked extremely tempting as we walked through the hot dry grasslands. Nearing the base of Ivohibe, we began to see remnants of Malagasy vegetation along streams, such as clumps of *Ravenala* and species of *Pandanus* and abundant *Nepenthes madagascariensis*. *Dypsis aquatilis* appeared and our spirits rose.

We reached our camp site at 3.30. We camped on a cleared ridge-top about 30 m from an excellent rocky stream with waterfalls, the last reliable water on that side of the mountain (Fig. 3).

For the next two days we made day long excursions into the forest, each involving a steep trek up to the forest margin. Once into the forest, we began to find exceptionally interesting palms and we realized that Ivohibe is a site of major palm significance.

Finally on 26 September we broke camp and walked out through the grasslands to the road where we were picked up by the driver from QMM and driven back to Taolagnaro.

Ivohibe is composed of a substantial block of igneous rock. In places the relief is very high and the underlying rock exposed as cliff faces or bluffs. The southwestern ridge-top which we visited is generally narrow and carries a relatively low crown forest that physiognomically resembles montane forest despite its low elevation of about 400 m. Where the

4. Open forest rich in *Dracaena* spp, *Pandanus* spp and palms, on thin soil overlying rock.

5 (left). *Beccariophoenix madagascariensis* on Ivohibe has very slender inflorescences. 6 (right). Mara Bergé holds inflorescences of *Beccariophoenix madagascariensis*; note how few rachillae there are.

underlying rock is exposed or near the surface, the forest tends to be rather open, with abundant palms, pandans and *Dracaena* (Fig. 4). There is an abundance of moss belonging to Leucobryaceae. At the time of our visit (towards the end of the dry season) there were no running streams above about 250 m but there is plenty of evidence of seasonal water courses within the forest, particularly in areas where the bedrock is exposed.

Notes on the Palm Species Observed

Beccariophoenix madagascariensis (Figs. 5, 6)

On Ivohibe, *Beccariophoenix madagascarienis* was seen only on ridge-tops or growing on thin soil overlying rock outcrops. We saw perhaps 20 mature individuals and many seedlings and rosette palms. One individual had been cut, perhaps about 12 months before our visit, with evidence of removal of the cabbage for food. *Beccariophoenix madagascariensis* on Ivohibe is more slender than elsewhere in Madagascar and the inflorescences, in particular, are remarkably slender, with long peduncles and few (about 8) rachillae. Seedlings are indistinguishable from seedlings at nearby Sainte Luce and further north at Vondrozo near Farafangana and at Mantadia near Andasibe.

Dypsis aquatilis (Fig. 7)

This aquatic palm grows as solitary rosettes in the beds of slowly flowing sandy streams in the flat lowlands at the foot of Ivohibe. Isolated individuals became apparent as we walked in from the main road through the anthropogenic grasslands. Nearer the foot of Ivohibe the palm was more abundant and we saw probably about 75 individuals. It grows together with rheophytic pandans and *Ravenala*. Several individuals were in flower. We did not see this species growing in closed forest – all populations occur in areas that are denuded of native vegetation, apart from the presence of *Ravenala* and other rheophytic plants that, presumably, survive the grassland fires by virtue of growing in streambeds.

Dypsis brevicaulis

Only one individual was seen growing beside the path in rather open forest on sandy soil at approximately 300 m elevation. There were several dead inflorescences. Although there must surely be more individuals on Ivohibe, *D. brevicaulis* appears to be a rare palm on Ivohibe.

Dypsis culminis (Fig. 8)

This is one of the commonest palms on steep slopes and ridge-tops on Ivohibe. It was described as recently as August 2010 from

7. *Dypsis aquatilis* grows in streambeds with rheophytic *Pandanus* sp.

Vondrozo (Rakotoarinivo & Dransfield 2010), where it was regarded as being critically endangered and thus the record for Ivohibe not only represents a major extension in range but also provides a much improved conservation prognosis for the palm. It is a clustering species with stems to 4 m tall and entire bifid leaves. The inflorescence is sparsely branched with moderately robust rachillae. In some places, the undergrowth of the ridge-top forest is dominated by this species.

Dypsis elegans (Fig. 9)

This is an exquisitely beautiful palm with solitary slender stems and interruptedly pinnate leaves with dark green leaflets. Inflorescences are highly branched. We estimate that we saw about 25 mature individuals of this palm and numerous seedlings. Elsewhere it is known only from the Manombo Reserve, Farafangana, where it is regarded as critically endangered (Dransfield & Beentje 1995). Its discovery in Ivohibe is thus of considerable conservation significance.

Dypsis eriostachys

Confusingly similar to *D. culminis*, this species is generally smaller, has solitary stems, more finely branched inflorescences and hairy rachillae. Elsewhere it is known from a few localities from Vatovavy to Midongy. In Ivohibe, it is widespread on hill slopes and ridge-tops, often growing intermingled with *D. culminis*.

Dypsis fibrosa

Surprisingly we saw only one colony of this widespread and usually abundant palm. Unaccountably rare on Ivohibe, the colony comprised two clumps of dichotomously branching aerial stems. Inflorescences were rather smaller than usual.

Dypsis lilacina (Figs. 10, 23)

This species appears like a miniature extremely slender form of *D. pustulata* with which it grows. It lacks the sheath warts and the inflorescences are much more slender, have lilac-colored rachillae with slender lilac-colored staminate flowers with six stamens with elongate anthers. We have been unable to match this with any known species and thus describe it here as new.

Dypsis mananjarensis

This widespread southern tree palm is common in Ivohibe but we saw only juvenile

8 (upper left). *Dypsis culminis*, an abundant clustering palm of the undergrowth. 9 (upper right). *Dypsis elegans*, previously only known from Manombo, much further to the north. 10 (bottom). *Dypsis lilacina*, showing lilac-colored inflorescence, long petioles and abundant indumentum.

individuals, distinctive in their plumose leaves with "mealy bug" scales on the petioles and leaf sheaths. Mature tree palms glimpsed through binoculars on an otherwise bare rocky outcrop towards the summit of Ivohibe may belong to this species or *D. prestoniana*.

Dypsis nauseosa

We saw a few mature individuals and seedlings of this tree palm, distinctive in its epetiolate leaves and very regularly arranged leaflets. Elsewhere it has been recorded as far south as Manombo.

Dypsis nodifera

This species, one of the most widespread of all palms in Madagascar, is moderately abundant in Ivohibe. The specimen we collected has rather narrow flat leaflets lacking the characteristic swollen leaf bases found in typical populations.

Dypsis prestoniana

As with *Dypsis mananjarensis* this species was seen only as juvenile rosettes growing in anthropogenic grasslands. As mentioned above, tall palms seen through binoculars on a rock face near the summit of Ivohibe may belong to this species.

Dypsis psammophila (Fig. 11)

This species was abundant in rather open forest developed on thin soils on rock faces and outcrops and on ridge-tops. In some individuals there was substantial aerial branching forming entanglements in the forest, reminiscent of *D. serpentina* and its relatives.

Dypsis pustulata (Figs. 12–14, 23, Front Cover)

This and *D. lilacina* grow together, intermingled in the undergrowth of ridge-top forest together with *Dypsis saintelucei* and *D. culminis*. It is a solitary or clustering palm with stems to 5 m tall, ca. 3 cm diameter. The leaves are rarely more than 8 in the crown, are strongly arcuate and have few distant, sigmoid, grouped dark green leaflets. The most remarkable feature of the palm is the leaf sheath, which is covered, towards the sheath mouth, with irregular warty excrescences. At first we thought that this feature might be pathological but every single individual of the species displayed it. In cross section the warts appear to be composed of files of cells; the wart surface is somewhat corky. We know of no other Madagascar or, indeed, any palm that

11. Branching stems of *Dypsis psammophila*.

12 (left). *Dypsis pustulata,* showing the few, somewhat sigmoid grouped leaflets. 13 (right). *Dypsis pustulata,* crown and inflorescence

displays such warts. The inflorescences are interfoliar, and have few robust long rachillae. Staminate flowers are globular, creamy yellow, relatively large and have six stamens with more or less sagittate anthers. It is described as new below.

Dypsis saintelucei (Fig. 15)

This iconic palm is astonishingly abundant in the forests of Ivohibe, being particularly conspicuous on ridge-tops and in small crown forest developed on thin soils overlying rock outcrops. We estimate that we saw over 500 mature individuals and countless seedlings. It varies substantially in size, depending on the aspect. It is small (to 5 m tall or less) with very close internodes on exposed ridge-tops, while in more sheltered sites it can reach 8 m tall.

Dypsis subacaulis (Figs. 16, 24)

This is a very short-stemmed or almost acaulescent solitary palm with leaves not exceeding 40 cm long, with few narrow linear leaflets and spicate or furcate inflorescences. Inflorescence structure and leaves are somewhat reminiscent of *D. procumbens*. It was moderately abundant in a valley bottom near the forest margin. We have been unable to match it with any known species, so describe it as new below

Orania longisquama

We observed two individuals of *Orania longisquama* growing beside the stream in the lowlands near our encampment. Both were rosette juvenile palms, immediately identifiable by the spiral leaves and praemorse leaflet tips. Previously, Manombo was the most southerly locality for this species.

Ravenea declivium (Figs. 17–19, 25)

This astonishing palm represents perhaps our most exciting find on Ivohibe. It is an acaulescent ("stemless") solitary palm restricted to rock outcrops, tending to grow on the lip of cliffs and on outcrops beside dry stream courses. It has a very short stem, decumbent at the base, ca. 35 cm diameter and covered with old leaf bases. There are about 8 leaves to 2 m long in the crown; petioles are glaucous, and the leaflets are few in number, distant, curved, very dark green and hooded, and unusually broad; they have an almost succulent texture. Male inflorescences are solitary or multiple in the leaf axils and females are solitary. We found material in old inflorescence and in bud. In all we estimate that we saw about 50 mature palms and rather few juveniles and seedlings. This is undoubtedly undescribed and a most unusual species in the genus.

14 (top). *Dypsis pustulata*, close up of flowers. 15 (lower left). *Dypsis saintelucei* showing the long pendulous basalmost leaflets. 16 (lower right). *Dypsis subacaulis*, an untidy palm of the forest undergrowth.

Ravenea hypoleuca (Fig. 20)

This species was described as recently as August 2010 (Rakotoarinivo & Dransfield 2010) from Vondrozo where we assessed its conservation status as Critically Endangered. In Ivohibe we found a well-structured population of about 25 mature individuals, numerous rosette palms and seedlings. The species is instantly recognizable by its strongly discolorous leaflets (dark green above and gleaming white beneath). We saw old male and old female inflorescences. The presence of this rarity in such a healthy population in Ivohibe emphasizes the importance of this locality for palms.

Ravenea sambiranensis (Fig. 21)

We found several individuals of this very widespread species. It is distinctive in its arcuate leaves and multiple male inflorescences.

Description of New Species

Dypsis lilacina *J. Dransf. & Rakotoarin.*, **sp. nov.** Slender clustering palm with few leaves in the crown, the lanceolate leaflets few in number and rather distant, arranged in groups of 2 or 3; inflorescences with few lilac-colored branches, with lilac-colored flowers, the stamen filaments inflexed and anthers medifixed. Type: MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM538* (holotype K, isotypes MO, TAN) (Fig. 22)

Clustering palm with 2–3 stems, up to 2 m tall. Stems 1.5–1.9 cm diam., internodes dark green with abundant caducous dark reddish brown scales; internodes greenish brown, 2.1–4.7 cm; leaf scars paler, 2–5 mm wide. Leaves ca. 8 in crown, to 80 cm long, held ± erect and rather lax; crownshaft not well defined, 25–35 cm long, 15–22 mm wide; sheaths tending to split partially long before

17 (above). *Ravenea declivium* showing glaucous leaves with relatively few, broad leathery leaflets.18 (below). *Ravenea declivium*, decumbent stem; one inflorescence bud emerges between living leaf bases.

19 (left). *Ravenea declivium*, leaf rachis and emerging leaflets covered with wax and punctiform scales. 20 (right). *Ravenea hypoleuca* has few stiff leaves.

abscission, to 16 cm long, 3.5 cm wide when opened out, 2 short membranous auricles at the base of the petiole, the whole sheath covered abaxially with caducous dark brown scales and drying striate; petiole 27–35 cm long, 4 mm wide near the base, tapering slightly distally, ± triangular in section, bearing sparse caducous red-brown indumentum; rachis 35–50 cm long; leaflets narrow lanceolate, long acuminate, 9–12 on each side of the rachis, arranged in distant groups of 2 or 3; basal leaflets 18–20 × 0.5–1.5 cm, mid leaf leaflets 15–23 × 0.8–1.3 cm, apical leaflets 10–12 × 0.5–1.5 cm; leaflet surfaces glabrous. Inflorescence interfoliar, 30–55 cm long, branched to 2 or 3 orders; prophyll persistent, to 30 cm long, 6 mm wide, 2-keeled; peduncular bract caducous, not seen, inserted up to 20 cm above the prophyll; peduncle to 20 cm long, 3.5–4.5 mm diam.; first order branches 15–16 in all, the basal 2–4 branched to the third order, next few to the second order, the remainder unbranched; rachillae rather distant, slender, lilac, 1.5–6.5 cm long, 1 mm diam., bearing rather distant flower groups. Staminate flower at anthesis lilac, in bud pointed, ca. 2.1 × 1.1 mm; sepals rounded, ca. 7 mm diam., the margins entire and with irregular keels; petals striate, 1.7 × 1.1 mm, broad triangular; stamens 6; filaments 2 × 0.2 mm, inflexed in distal 0.4 mm; anthers medifixed 1.2 × 0.4 mm; pistillode narrow ovoid, ca. 0.4 mm high. Pistillate flower known only from very immature globular buds, 0.5 mm diam. Fruit not seen.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34′ 0.5″ S, 47° 11′ 56″ E, alt. 418 m, 25 September 2010, *M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM538* (holotype K, isotypes MO, TAN).

Conservation status CR (B2ab(ii,iii,v);D). Known only from the ridge top of Ivohibe forest where the area of occupancy is less than 1 km square and where fewer than 20 clumps are recorded. The forest is quite well preserved at the moment but any disturbance in the future may affect the quality of the habitat and thus the population size.

Dypsis pustulata *J. Dransf. & Rakotoarin.*, **sp. nov.** Single-stemmed or clustering palm, distinctive in the presence of irregular pustules on the leaf sheaths, the sigmoid leaflets few in number and grouped, the inflorescence branched to 2 orders with staminate flowers at anthesis globose, with whitish petals and sagittate anthers. Type: MADAGASCAR.

21. Ramisy Edmond stands besides *Ravenea sambiranensis*.

Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7791* (holotypus K, isotypi MO, TAN) (Fig. 23).

Solitary or clustered palm, to 6 m tall, occasionally with aerial branching. Stem 21–25 mm diam.; internodes 20–30 mm long, dull brown; leaf scars ca. 3 mm wide. Leaves ca. 9 in the crown, held ± erect in a rather lax crown; crownshaft well developed, 20–30 cm long, ca. 2.1–3.1 cm diam., mid green; leaf sheath 13–17 cm long, 5.4–6.7 cm wide when opened out, mid green, covered with scattered caducous dark brown scales and with 6–13 or more irregular rounded pustules near the base of the petiole, these green when first emerged, becoming corky and grey with age, pustules up to 1.2 cm wide and standing ca. 5 mm proud of sheath; leaf to 1.25 m long; petiole ca. 35 cm long, 8 × 5 mm wide, tapering to 5 × 3 mm at the insertion of the basalmost leaflets, adaxially flattened, bearing scattered caducous dark brown scales; rachis up to 90 cm long, scaly as the petiole; leaflets ca. 14 on each side of the rachis, arranged singly or in groups of 2 or 3, slightly fanned within the groups, dark green, cucullate; basal leaflets 26–30 × 1.3–1.5 cm; mid leaf leaflets 25–32 × 2.8–3.6 cm; apical leaflets 6–9 × 1.2–1.5 cm; all leaflets ending in drip tips to 4 cm long; leaflet surfaces glabrous apart from bands of caducous dark brown scales along margins. Inflorescences interfoliar, branched to 2 orders; peduncle ca. 30–35 cm long, flattened at the base, ca. 9 mm wide, distally rounded in cross section, ca. 4 mm diam., densely covered with dark brown indumentum; prophyll adnate to peduncle in basal 6–7 mm, free part 2-keeled, tightly sheathing, 15–20 × 1.2 cm, covered with caducous dark brown scales; peduncular bract borne 9 cm above prophyll insertion, similar to prophyll but lacking keels; rachis up to 30 cm long, 4–5 mm diam. at base with dense dark brown indumentum; first order branches 11–13, the basal 5 or 6 branched to 2nd order; rachillae ca. 20–22, 9–20 cm long, 1.5–2.5 mm diam., dull green, covered with dense caducous brown scales; triads ca. 4 mm apart. Staminate flowers somewhat globular at anthesis, ± bullet-shaped in bud, ca. 5 mm long, 5 mm wide; sepals rounded, ca. 1.5 × 1.5 mm, irregularly emarginate, strongly keeled, glabrous; petals 4 × 3 mm, broadly triangular, rather fleshy, white; stamens 6, 3.1 mm long, filaments 1.6 × 1 mm, anthers ± sagittate, 2.1 × 1.5 mm; pistillode pyramidal, ca. 1 mm high. Immature pistillate flower obovoid, ca. 3.5 × 2 mm; sepals ca. 3 × 2 mm; petals ca. 2 × 1.5 mm; staminodes 3, irregular, tooth-like, at one side of the gynoecium; gynoecium ovoid to pyramidal, ca. 1.5 × 1 mm. Fruit unknown.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34′ 3.3″ S, 47° 11′ 56.4″ E, alt. 391 m, 25 September 2010, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7791* (holotype K, isotypes MO, TAN).

This unusual species forms colonies in low-crown forest on ridge tops. It occurs together with the previous species, *D. lilacina*, the two species very similar in form. *Dypsis saintelucei* and *Beccariophoenix madagascariensis* are also prominent features of the palm flora of these ridge tops. *Dypsis pustulata* is unlike any other species in the genus because of the consistent presence of the corky pustules on the leaf sheaths of every single individual observed. Pustules were sectioned in the field to investigate whether they are galls, but there was no sign of any animal within the swellings. Developing sheaths within the crownshaft already show the presence of pustules. The nature and function of these pustules is as yet unknown, but developmental material has been collected for further study.

22. *Dypsis lilacina*. **A**. habit; **B**. crown with sheaths, one leaf and inflorescence; **C**. detail of rachilla and flower groups; **D**. whole flower; **E**. stamen. Scale bar: A = 40 cm; B = 6 cm; C = 1.5 cm; D = 2 mm; E = 1.6 mm. A–E all from *M. Rakotoarinivo & J. Dransfield RM538*. Drawn by Lucy T. Smith.

Apart from the presence of the curious pustules (Front Cover), *D. pustulata* differs from *D. lilacina* in its more robust habit, the green rather than lilac rachillae, the white rather than lilac petals of the staminate flowers and the stamens with straight filaments and sagittate anthers rather than inflexed filaments and medifixed anthers.

23. *Dypsis pustulata*. **A**. habit; **B**. crown with sheaths and inflorescence; **C**. detail of pustules on leaf sheaths; **D**. leaf base; **E**. mid section of leaf; **F**. leaf apex; **G**. detail of rachilla; **H**. whole staminate flower; **I**. staminate flower, one petal removed; **J**. two views of stamen. Scale bar: A = 30 cm; B = 8 cm; C = 2.5 cm; D, E, F = 8 cm; G = 1 cm; H, I = 4mm; J = 2 mm. A–J all from *J. Dransfield & M. Rakotoarinivo JD7791*. Drawn by Lucy T. Smith.

Conservation status CR (B2ab(ii,iii,v);D). Known only from the ridge top of Ivohibe forest where the area of occupancy is less than 1 km square and where fewer than 20 clumps are recorded. The forest is quite well preserved at the moment but any disturbance in the future may affect the quality of the habitat and thus the population size.

Dypsis subacaulis *J. Dransf. & Rakotoarin.*, **nov. sp.** Solitary or clustered undergrowth palm, somewhat reminiscent of *D. procumbens* but with very short erect stems, often appearing acaulescent, the inflorescences spicate or bifurcate and with narrow papery leaflets. Type: MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM531* (holotype K, isotypes MO, TAN) (Fig. 24).

Solitary or clustering undergrowth palm, about 1 m tall, the whole palm appearing ± acaulescent. Stem erect, very short, ca. 12 mm diam., internodes 9–10 mm long, the surface covered with dark brown caducous indumentum, much of the stem obscured by marcescent leaf bases and leaf litter. Leaves about 12 in crown, marcescent, 60–75 cm long; sheaths ± open throughout much of their length, not forming a crownshaft, to 9 cm long, ca. 2.5 cm wide when opened out, 2 papery triangular marcescent auricles to 7 mm long present one each on either side at the base of the petiole, sheath surface densely covered with dark red-brown indumentum; petiole 11–13 cm long, ca. 3.5 × 3 mm wide near the base, tapering distally, shallowly channelled near the base, bearing abundant caducous dark brown indumentum; rachis 50–62 cm long; leaflets 12 or 13 on each side of the rachis, ± regularly arranged, rather distant, long acuminate; basal leaflets 17–19 × 0.8–1.1 cm; mid leaf leaflets 23–28 x 1.1–1.4 cm; apical leaflets 10–12 × 0.7–0.8 cm, leaflet surface glabrous. Inflorescence interfoliar, spicate or with two rachillae only; prophyll remaining hidden by the leaf sheaths, to 8 × 0.7 cm, papery, strongly 2-keeled, tightly sheathing; peduncular bract inserted ca. 3 cm above the base, persistent, to 12 × 0.3 cm, it and the prophyll with scattered caducous scales; peduncle 25 × 0.11 cm, bearing scattered caducous red-brown scales; rachilla or flower-bearing portion of the spike 14–15 cm long, 1.5–2.2 mm diam., bearing crowded triads. Staminate flowers already fallen. Pistillate flowers to 1.7 × 0.7 mm, ovoid; sepals rounded, ca. 6 mm diam., striate; petals imbricate, 1.2 × 1.0 mm, striate with very short triangular tips; staminodes minute, 3, dentiform; gynoecium ovoid, 1.4 × 0.6 mm. Fruit not known.

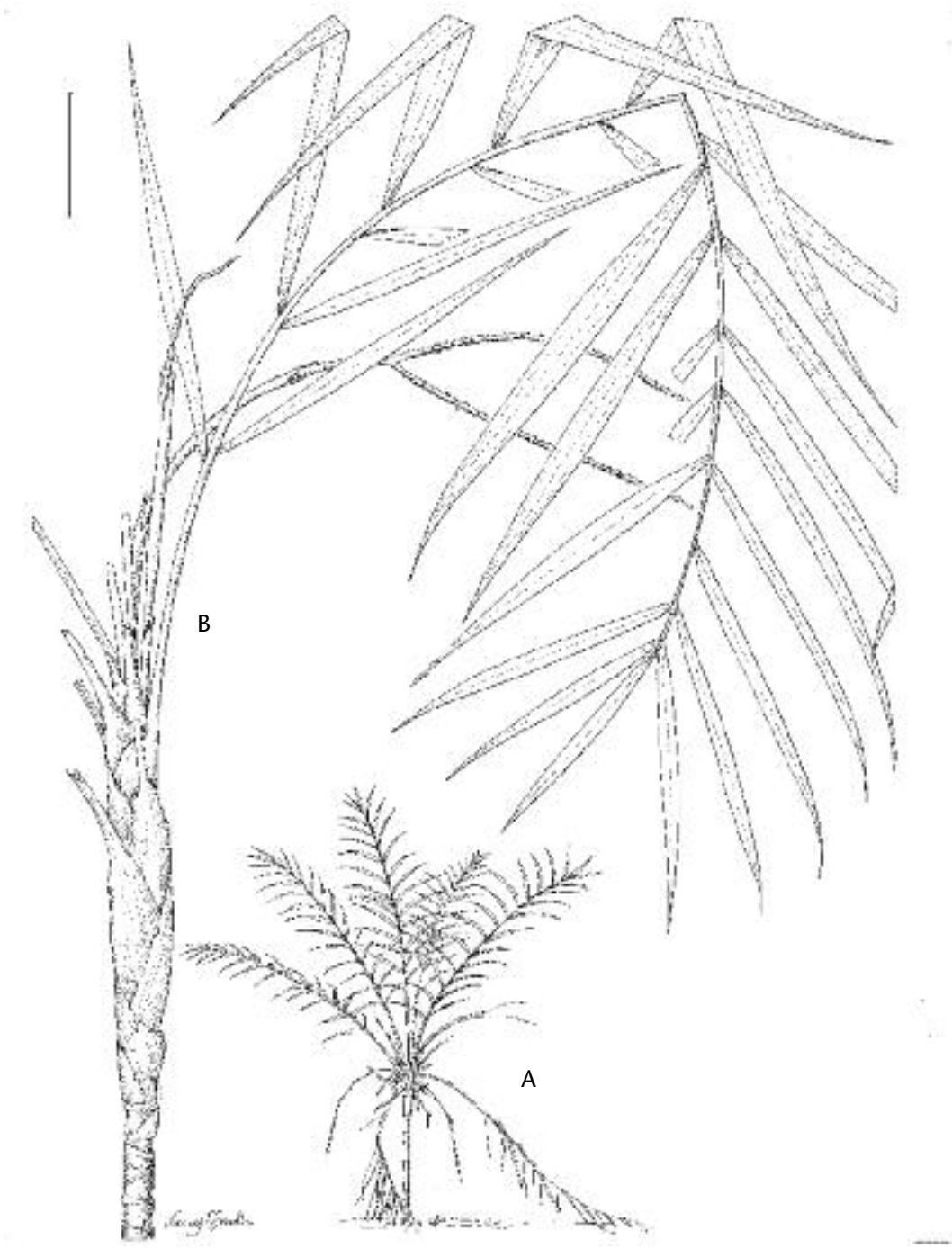
MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34′ 0.8″ S, 47° 12′ 14″ E, alt. 182 m, 24 September 2010, *M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM531* (holotype K, isotypes MO, TAN).

This palm does not match with any known species of *Dypsis*; it seems related to highly polymorphic *D. procumbens* but the habit and thin papery leaflets are distinctive. Unfortunately we only found material with old inflorescences.

Conservation status CR (B2ab(ii,iii,v);D). Endemic to the Tsitongambarika forest where fewer than 10 mature trees were recorded in area of occupancy estimated to be less than 2 km square. Unless protected in the future, disturbance in this forest will probably cause decline of the population size of this species.

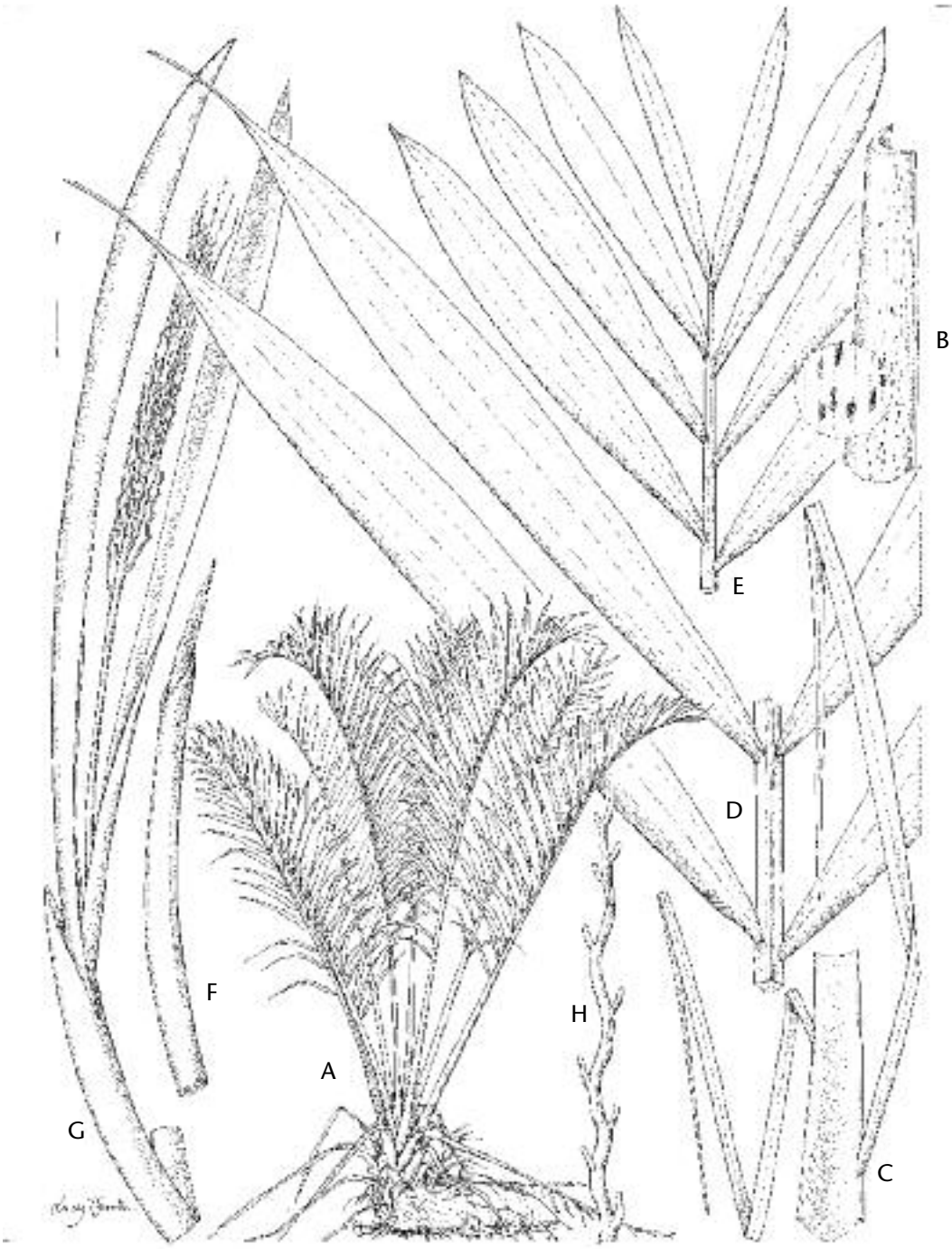
Ravenea declivium *J. Dransf. & Rakotoarin.*, **sp. nov.** Differing from all other species in the genus by the combination of acaulescent habit with decumbent stem and the leaves with few, strongly coriaceous very broad glaucous leaflets. Type: MADAGASCAR: Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7786* (holotype K, isotypes MO, TAN) (Fig. 25).

Robust palm with decumbent short stem to 40 cm diam., generally appearing acaulescent. Stem clothed in persistent shaggy leaf base remains. Leaves ca. 17 in crown appearing to be quadrifarious or quinquefarious, strongly curved, marcescent, litter trapping, to 3 m long; petiole to 1.25 m long, to ca. 5 cm wide at the base, c.1.5 cm thick at the midline, decreasing to ca. 1.5 × 1.5 cm at the insertion of the basal leaflets, leaf sheath open, green, young leaf bases glaucous, abaxially with scattered brown elongate peltate scales, 2–6 × 0.8–1.1 mm, and a thin covering of amorphous gray indumentum, petiole deeply channeled throughout, the margins razor sharp; rachis to 1.75 m long, arcuate, tapering gradually throughout its length, deeply channeled proximally, ± triangular in cross-section distally, bearing abundant elongate dark brown peltate scales as the petiole; leaflets to 18 on each side of the rachis, broad, leathery, bluish-green, cucullate and with long drip tips, basal leaflets 60–70 × 1.5–2 cm, mid-leaf leaflets 60–65 × 6–7 cm, apical leaflets 17–28 × 2–4 cm, drip tips terete to 75 × 2 mm, adaxial leaflet surface glabrous, smooth and slightly glossy when fresh, abaxial surface with scattered minute brown punctiform scales and with scattered dark brown peltate scales as the rachis along the margins exposed in bud.



24. *Dypsis subaculis*. **A**. habit; **B**. crown with sheaths, one leaf and inflorescence. Scale bar: A = 20 cm: B = 6 cm. A–B all from *M. Rakotoarinivo & J. Dransfield RM531*. Drawn by Lucy T. Smith.

Staminate inflorescences multiple, up to 3 in the leaf axil, already dead, to 80 cm long, mostly hidden among the leaf bases; prophyll ca. 11 × 3 cm, incompletely sheathing, thin, papery, with a triangular 2-keeled tip, striate, abaxially with abundant caducous brown scales and hairs, adaxially glabrous; peduncular bracts 3, first 17–27 × 2 cm, second 30 × 1–1.5 cm, third 42 × 8 cm; peduncle 40–60 cm long, ca. 8 mm diam.; rachis 15–30 cm long, branched to 1 order only; rachillae numerous, 8–16 cm long, ca. 1.5 mm diam., with rather distant flower scars, up to 35 in all, surface glabrous. Flowers borne on short pegs to 1.5 ×



25. *Ravenea declivium*. **A.** habit; **B**. petiole with detail of indumentum; **C.** tip of petiole with basal-most leaflets; **D**. mid-section of leaf; **E**. leaf tip; **F**. inflorescence bud; **G**. staminate inflorescence; **H**. detail of dead pistillate rachilla. Scale bar: A = 60 cm; B = 8 cm (detail = 3 mm); C, D, E, F, G = 8 cm; H = 7 mm. A–G from *J. Dransfield & M. Rakotoarinivo JD7786*, H from *J. Dransfield & M. Rakotoarinivo JD7787*. Drawn by Lucy T. Smith.

0.3 mm; staminate flowers available only as minute scarcely differentiated buds. Pistillate inflorescence solitary at the node, branched to 1 order, 58–70 cm long; prophyll not seen; peduncle 40–48 cm long, ca. 5–6 mm diam., rounded in cross section; peduncular bracts 3,

the first 27 × 2 cm, the second 32 × 1.5 cm, the third to at least 30 × 1.5 cm; rachis ca. 12 cm long; rachillae numerous 6–8 × 1–2 mm; flower scars ca. 50 per rachilla, flowers borne on short protuberances ca. 0.7 mm high. Pistillate flowers and fruit not seen.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34′ 43″ S, 47° 12′ 12.1″ E, alt. 286 m, 24 September 2010, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7786* (holotype K, isotypes MO, TAN); *JD7787* (K, TAN).

This distinctive species occurs perched on the lips of rock faces and along seasonal watercourses in rather open, low crown forest on hill slopes at an elevation of about 250–350 m above sea level. Soils are shallow and have a well-developed humus layer overlying a thin sandy layer.

Conservation status CR (B2ab(ii,iii,v);D). Known only from a single site in the summit area of Ivohibe forest where the area of occupancy is less than 1 km square and where only three mature individuals have been seen. The forest where this species has been recorded is not officially protected and may be subjected to human pressure that could affect the quality of the habitat and probably the loss of mature individuals.

The Significance of Ivohibe from a Palm Conservation Viewpoint

With 20 species recorded in the area, the mountain of Ivohibe, Tsitongambarika, is among the richest sites for palms in the southern part of Madagascar where similar species abundance has only been located in Vondrozo, in the mountains of Andohahela and from littoral forest at Manombo, Farafangana. The palm flora of Ivohibe is characterized mainly by rare and threatened species. Only four species (*Dypsis fibrosa*, *D. mananjarensis*, *D. nodifera* and *Orania longisquama*) are not threatened according to the latest conservation status of Madagascan palms using IUCN Redlist criteria (Rakotoarinivo & Dransfield 2012). One of the aims of QMM in surveying the biodiversity of Tsitongambarika is to discover whether species endemic to the littoral forest in Taolagnaro region might also occur in hills bordering the coastal zone, which could thus act as alternative conservation sites after the ilmenite exploitation. In our field work we have shown that two species previously thought to be restricted to the littoral forest (*Dypsis brevicaulis* and *D. saintelucei*) also inhabit the lowland humid forest on Ivohibe. Moreover, many species have been recorded for the first time in Taolagnaro area and for several species (e.g. *Dypsis elegans*, *D. eriostachys*, *D. nauseosa* and *Orania longi-squama*), the new records in Tsitongambarika represent major southwards extensions of range. Populations of these species are declining or becoming locally extinct elsewhere. Conserving these rare palms appears to be urgent as Ivohibe constitutes one of their last safe habitats.

The Need for Further Fieldwork

In the short time we spent at Ivohibe, it was not possible to explore the entire mountain and there must surely be further palms that we did not record. Elsewhere in the area known as Tsitongambarika we have no palm records at all. The view from Ivohibe in the clear weather we experienced was magnificent. Over to the west and southwest lie the mountains of the Chaine Anosyenne. There appears to be substantial intact forest on the steep slopes, even at lower elevations. Clearly it would be well worth exploring these areas for palms.

Acknowledgments

We are very grateful to the staff of QMM and drivers for logistic support. Lucy T. Smith prepared the analytical plates.

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Pauleen Sullivan

May 27, 1921 – August 8, 2012

Remembrances from Leland Lai, John Dransfield and Ralph Velez.

Leland Lai: *Chamaedorea elegans* was my first palm, given to me by a very elegant woman, Pauleen Sullivan. Her love for palms took her far beyond physical limitations faced by most polio victims to the jungles of Ecuador, Venezuela, Tonga, Australia, Indonesia, down rivers in Thailand and the Amazon basin, yes, all using a wheel chair. In a way, you could say she was driven by her passion for palms and along the way, gave a lot of others a ride to "can do." What better way to remember this Queen of Palms than a tribute of her involvement and commitment to the International Palm Society.

John Dransfield: Pauleen Sullivan had true grit and determination. My first contact with her was in 1975. Newly returned from four years in Indonesia, I had been appointed a palm taxonomist at the Royal Botanic Gardens Kew. Pauleen wrote to me to ask about the possibility of seeing interesting palms in Northern Sumatra, as she and her husband Joe were planning a trip to Indonesia. I enthused about interesting localities where I had seen unusual palms, little knowing that Pauleen was a polio victim and using a wheel chair. It was, in fact, not until much later that I learned that she had serious mobility problems. Notwithstanding this, Pauleen and Joe did indeed visit Sumatra. They found the going tough, but they did see some of the palms I had mentioned. They went on from Sumatra to Jakarta, in Java, where they were met by our old friend Eric Taylor, at the time an IPS member. Joe had a fatal heart attack in Jakarta, and Eric helped Pauleen with the traumatic business of repatriating Joe's body.

1. Pauleen Sullivan palm hunting on Mount Lewis, assisted by Tony Irvine and Randy Moore, while Maria Boggs, Natalie Uhl, Teddie Buhler and John Dransfield look on. Photo S. Dransfield.

The spirit and determination that had taken her to the jungles of Sumatra were often in evidence at IPS Biennials. One of the most memorable occasions was during the 1988 Queensland Biennial on a day's outing to the wet forests of Mount Lewis. Although the forest was visible from the road and exquisitely beautiful, several of the undergrowth palms were only visible if one penetrated the forest edge. Nothing daunted, Pauleen persuaded two or three stalwarts to carry her in her chair through the roadside scrub (Fig. 1) so she could see the as yet undescribed *Linospadix apetiolata* that is such a feature of the forest on Mount Lewis.

Natalie Uhl, my wife Jatmi and I stayed with Pauleen in 1983 when we were in California for an interim meeting of the IPS Board of Directors, at which we started the major drive to raise funds for the publication of the first edition of *Genera Palmarum*. Pauleen was the IPS Bookstore. She ran this with total commitment. The prospect of the IPS publishing GP enthused her, and she spearheaded the fund raising and pre-publication sale that was, eventually, to provide sufficient funds for the Society to co-publish the book.

In Ventura Pauleen lived in a single-story house, superbly set up for wheel chair access and including a pool for hydro-therapy. The house was decorated in jungle style. Surrounding the pool was a collection of palms that in the 1980s would have been considered great rarities. I particularly remember a wonderful plant of *Licuala peltata* var. *sumawongii*, with its entire fronds overhanging the pool. Outside in the narrow strip in front of her house was a sensational *Trithrinax campestris* and other treasures.

Pauleen's contribution to the IPS in the 1970s, 1980s and early 1990s was immense. Her commitment to singlehandedly running the Bookstore was complete, and the role she played in fund-raising for the publication of *Genera Palmarum* and Don Hodel's *Chamaedorea Palms* has a lasting legacy in the form of the Revolving Publications Fund. She was a most remarkable lady.

Ralph Velez: Pauleen was the "Palm Queen" (Fig. 2). I must have met her back in the late 1960s or early 1970s. At that time, it was primarily Joe, her husband, who had been fixated with palms. Earlier on, Joe and Pauleen operated a nursery in Ventura. They sold the nursery and purchased various apartment

2. Pauleen, the "Amazon Queen," in 1973.

complexes. Naturally, they landscaped all of them with palms. It was at one of these complexes that I helped Pauleen plant a *Jubaeopsis caffra*.

In her pool room she had a number of palms planted around the perimeter of the pool. That was the first and only time I saw *Pelagodoxa henryana*, native to the Marquesas. It is an incredible palm, and until that time I had never seen anything like it in California. She did a number of "firsts" like this, introducing many of us to palms unknown or rarely seen within the commercial nursery world.

Pauleen also had a great sense of humor. In 1996, a Palm Society of Southern California local chapter meeting was held at Leland Lai's Jardin Topagonia. There was always an auction at the end of the day. Pauleen was always full of surprises and brought a very special palm (as we all thought) from Madagascar. It had a bright orange crownshaft and everyone thought it would fetch a high bid for the Society. This plant was in a two gallon pot and, perhaps two feet high. As the bidding approached $200, Pauleen finally stopped the bidding and revealed that she had pulled a joke on everyone and that the specimen was actually a *Chamaedorea klotzschiana* of which she had painted the crownshaft an alluring orange.

Leland Lai: When she could no longer travel to far destinations, she embarked on her last commitment with the help of many friends, but mostly with her son Terry and Don Tollefson. She purchased 11 acres in Kapoho and planted over 3000 palms of more than 400 species on rock hard lava. Most of these were "surface" planted where the area around the plant was mounded with volcanic cinder. These grew so well that by the 2004 IPS Biennial in Hawaii, she had full grown specimens. She died 8 August 2012 at the age of 91 after a near lifetime devoted to the interest she loved. If there is a Palm heaven, know that Pauleen is the Queen, and we shall all miss her.

Harvest of *Palmiche* (*Pholidostachys synanthera*) by Communities in the Peruvian Amazon

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Amazon settlers use *palmiche* leaves (*Pholidostachys synanthera*) as materials to thatch their houses (Mejia 1988, Balslev et al. 2008). Thatch made with *palmiche* leaves lasts 10–12 years; such thatch is three times more resistant than that made with other palm species used in the region. In this paper the utilization of the leaves and the economic importance for local settlers are discussed.

Pholidostachys synanthera (Mart.) H.E. Moore, is a single-stemmed, understory palm 1.8–5 m tall and 3–8 cm in diameter with 10–25 leaves with sigmoid pinnae (Henderson et al. 1995, Henderson 1995). This species is found in Colombia, Ecuador, Brazil and Peru (Amazonas, Cuzco, Junin, Huanuco, Pasco, Loreto, Puno, San Martin), from the lowlands up to an altitude of 1650 m above sea level (Henderson et al. 1995, Henderson 1995, Borchsenius et al. 1998, Galeano & Bernal 2010).

It is commonly called "*palmiche grande*" in Peru, *ubim* in Brazil and *chalar* in Colombia. The most frequent use of this plant in these countries is as a thatching material for houses, and occasionally the fruits and palm heart are also consumed (Mejia 1988, Balslev et al. 2008). In Colombia there are reports of this species being used traditionally as a medicinal plant (Borchsenius et al. 1998). In Loreto, in the Peruvian Amazon, it is widely distributed; nevertheless in rural communities it is rarely observed as thatch because there are other species more commonly used, such as *Lepidocaryum tenue* (*irapay*) and *Phytelepas macrocarpa* (*yarina*).

Methods

This study was conducted from April 2009 until March 2010 in the communities of Chingana (4°44'45''S; 73°37'9''W), Sapuena (4°41'37''S; 73°35'36''W), and Flor de Castaña (4°45'49''S; 73°35'22"W), located in the Province of Requena, Dept. Loreto. The main streams in which the community members extract their *palmiche grande* leaves are called the Breo, the Carahuite and the Chingana.

We conducted 25 semi-structured interviews in the three communities. After the first round of

1. Harvest of *Pholidostachys synanthera* leaves in Amazonian Peru.

interviews, we returned after 3 and 11 months to interview the same people as before, as well as a few new participants who were involved in the *palmiche* harvest. The number of persons interviewed is by no means a comprehensive sample of all people who use these palms in the communities, but they represent well the population who commonly harvest *palmiche*. The interviews are meant to complement field studies regarding uses of this resource. We conducted inventories of three natural populations of *palmiche grande*. Each population was divided into 25 m^2 quadrats and each stem was counted and measured. For two of these sites, we accompanied local people on subsequent days, to observe how the plants were harvested, packaged and transported to the community, and how the *criznejas* were manufactured. *Crizneja* is the palm leaf weaving technique used to thatch Amazonian houses.

Results and Discussion

Pholidostachys synanthera is found in upland forest, in well-drained sandy-clay to clayey-sand soils, with a pH of 3.9–4.6. It forms small patches (called *manchales*) with up to 110 individuals (X=89.33; sd=21.55), occurring together with other palm species, such as *Geonoma* sp.

For the initial harvest, 8–12 leaves are removed, leaving 3 or 4 young leaves on the plant. After this harvest, it takes 2 or 3 years, according to local harvesters, until a second harvest can occur; however, this second harvest is said to produce only 4–6 leaves. What often happens is that many people in the community, either because of improper harvest techniques or because they do not have the time to locate new populations, end up killing the plant during the first harvest, causing a depletion of this resource.

In the natural populations that we observed, we found plants as tall as 3.8 m in height and 5.7 cm in diameter, but the harvest of leaves was only undertaken with individuals less than 2 m in height; in larger individuals the petioles are too thick and they have lost some elasticity, causing the leaves to rip when they are tied together to weave the *criznejas*.

Leaf harvest is performed in the early morning; the harvester selects mature palm fronds (which are light green in color), and he uses a machete to cut the leaves off the plant, leaving

2. Preparing the loads of *Pholidostachys synanthera* leaves in Amazonian Peru.

ca. 50 cm of the petiole still attached to the plant (Fig. 1). Then the harvester proceeds to arrange the leaves together in a package and prepares them for transport.

The unit of measure for leaves transported from the place of harvest is locally called a *carga* (load) (Fig. 2). One load consists of about 500 leaves, which represents an average of 50 individual plants harvested from a natural population. In a palm patch (*manchal*), a person can complete the harvest of one load in 1.5 hours; the packing and preparation of the load can take an additional 3 to 3.5 hours. The transport of the load from the harvest location to the community can take another two hours, and this is achieved with small dugout canoes, propelled by paddles or, rarely, by small outboard engines.

The extraction of *palmiche grande* occurs during the months in which the levels of the Ucayali River (and its tributaries) reach their maximum height (February to April in most years), which facilitates access to the palm populations, as well as transport of leaves back to the communities. A second reason why this is a good time for palm leaf harvest is that in this high-water season, there is no agricultural work to be done due to the flooding.

To make thatching units, the palmiche leaves are woven by their petioles onto split stems of *Socratea exorrhiza* (*cashapona*). Each of these units is called a *crizneja*. One *crizneja* is 3 m long and 1.3 m in width, and contains 98–105 leaves, the variation relating to the size and maturity of the *palmiche grande* leaves (Fig. 3).

A man can weave up to 10 *criznejas* in one day, working from 5:00 a.m. until 6:00 p.m. In order to make a roof for a standard sized (54 m^2) house in these communities, one would need 75 *criznejas* which are placed 30–33 cm apart on the roof beams (Fig. 4). Roofs thatched with *criznejas* of *palmiche grande* can last 10–12 years, two or three times more resistant than *criznejas* made from *Lepidocaryum tenue* (*irapay*), which is considered one of the most long-lasting materials in the region. When all the materials are available, three people can roof a standard house in one day.

Economic Importance

Palmiche grande is harvested almost exclusively for thatching a family's own house (82% of people surveyed), and a much smaller

3 (top). Weaving *criznejas* of *Pholidostachys synanthera* leaves in the community of Chingana, Amazonian Peru. 4 (bottom). A typical house thatched with *Pholidostachys synanthera* leaves in the community of Flor de Castaña, Amazonian Peru. The palms in the background are *Mauritia flexuosa*.

proportion is sold to neighbors in the community either as loose leaves or in the form of *criznejas*. About 95% of the people who sell *criznejas* sell their leftover materials after putting a new thatch on their own house. Despite its high durability in comparison to the leaves of other common species in the region, the *palmiche grande* does not have a large market in the big Amazonian cities such as Iquitos. This is due to the large distances involved in transport from the place of harvest, in addition to the low prices offered by companies that would commercialize these products, making it unattractive as an economic activity for community members.

The Cost of one load of *palmiche grande* leaves in 2010 was US$3.77, which is equivalent to what is paid for a full day of agricultural work. The manufacture of each *crizneja* costs US$2.64–3.01. To make a standard-sized roof, one would need to buy US$84.52 worth of *criznejas*. This is calculated as US$61.13 in leaves (16.2 loads) and US$23.39 for the manufacture of the 75 *criznejas*.

Conclusions

Palmiche grande is a good example of a non-timber forest product that has great social and cultural importance in the communities of the Ucayali River. The species has a wide distribution in Amazonia, but its use in villages is not very common. Despite the fact that it is extracted for subsistence use for housing, we observed that harvest locations become increasingly further from each community, which is evidence of the overexploitation of the resource. It is thus necessary to initiate a program of environmental education for Amazonian communities in order to promote sustainable use, to restore this plant in degraded areas, and improve the methods commonly used to harvest the leaves.

Acknowledgments

The work performed by the Program of Amazonian Biodiversity Research is part of a larger study focused on understanding the ecology, evolution and use of Amazonian palms. We would like to thank our friends in the communities of Sapuena, Chingana, and Flor de Castaña for the information and help in the field and also the technician Wilson Gonzales who helped with the fieldwork. Also thank you to Paul Fine for help with English and reviewing the manuscript.

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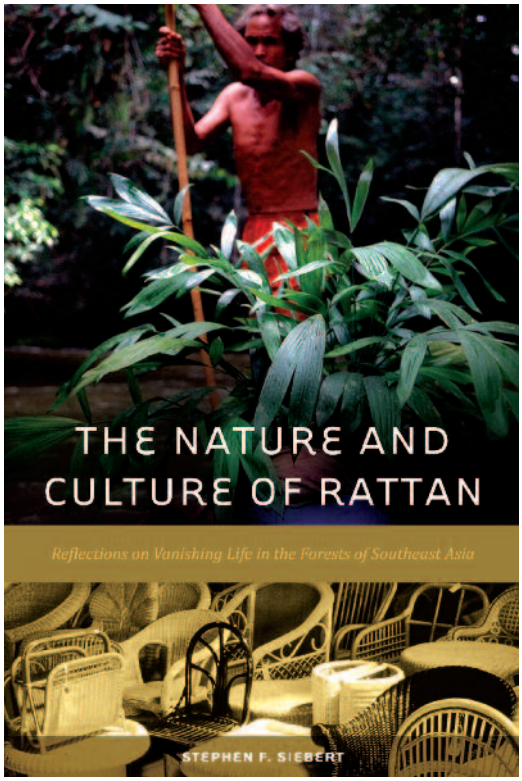
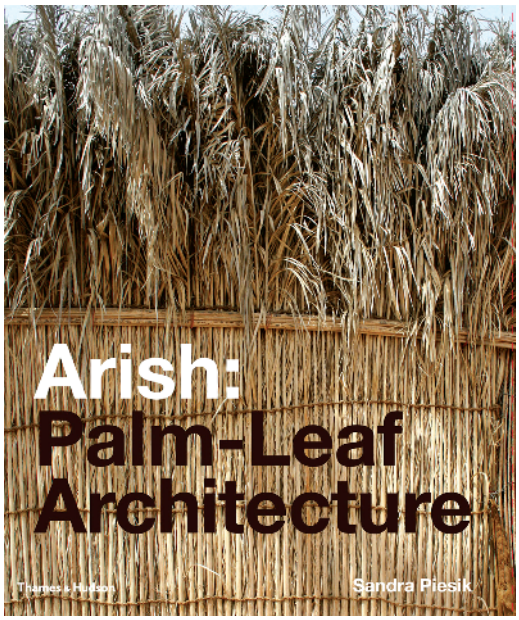
Palm Literature

THE NATURE AND CULTURE OF RATTAN: REFLECTIONS ON VANISHING LIFE IN THE FORESTS OF SOUTHEAST ASIA – Stephen F. Siebert. University of Hawai'i Press. 2012. ISBN 978-0-8248-3536-1. Price US$40.00. Hardcover. 145 pages, 26 illustratons.

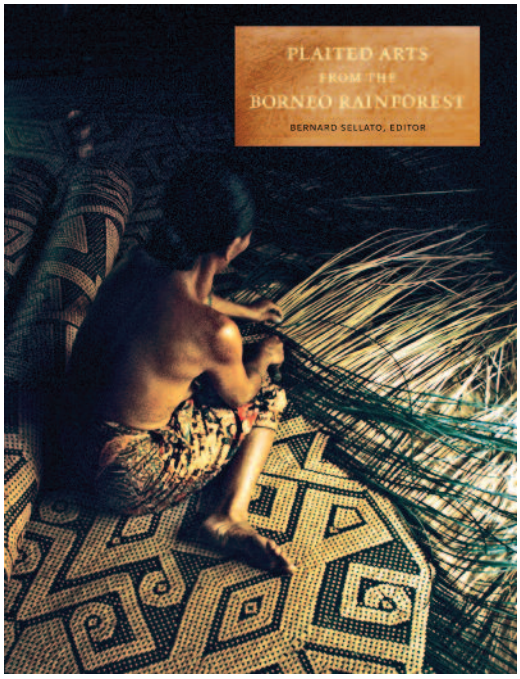


Stephen Siebert, who, along with his wife Jill Belsky, has unrivalled knowledge of the sociology of rattan harvesting communities in the southeast Asian region, has written a very personal book, describing how rattan impinges on society. His book provides a brief account of the natural history of rattans, historical and current uses of rattan, indigenous management systems for rattan, the trail of cane from the forest through to the finished furniture item, before providing a case study of a rattan harvesting village in Sulawesi. Sustainability and rattan cultivation are discussed. Finally Siebert muses on the links of rattan with religion and family planning and the future prospects for rattan. This is a very personal account of rattan; it reads well and is often thought provoking.

ARISH: PALM-LEAF ARCHITECTURE – Sandra Piesik. Thames & Hudson Publishers, London. 2012. ISBN 978-0-500-34280-0. Price: £28.00. Hardcover. 192 pages, 295 photographs.

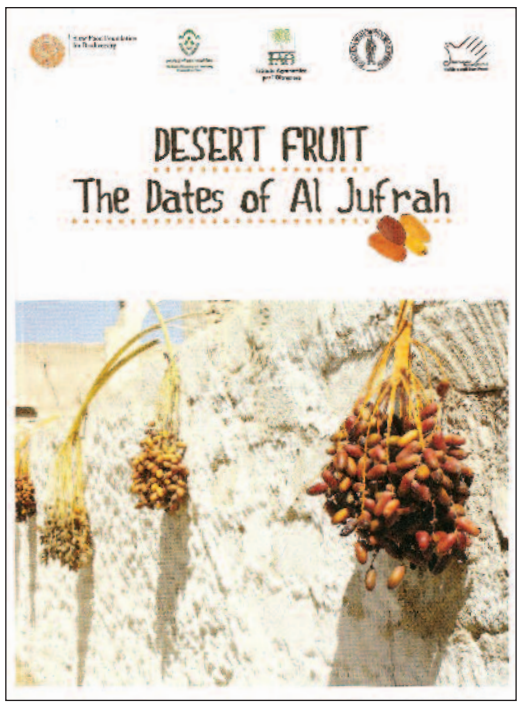


This lavishly illustrated book describes the traditional uses of the leaves of date palms in the construction of houses to provide shelter from the extreme climate of the Arabian Peninsula. Photographs of Dubai in 1950 reproduced in the book show a small fishing community of palm leaf houses, an extraordinary contrast to the present day metropolis of extravagant modern architecture. The book celebrates this unique indigenous building and craft tradition and makes some suggestions how this building material may still have a role to play in modern Arabia.



PLAITED ARTS FROM THE BORNEAN RAINFOREST – Bernard Sellato (ed.). The Lontar Foundation (Jakarta) and Nias Press (Copenhagen). 2012. ISBN 978-87-7694-074-4. Price US$70.00. Hardcover. 534 pages, 1200 illustrations.

This multi-author, large-format book with copious photographs records the amazing variety of plaited artefacts from Borneo, a very large proportion of which are made of rattan, either whole or split. This is a glorious celebration of how rattan, bamboo, *Donax*, sedge and other plants are used for the everyday necessities of the traditional peoples of Borneo. There are brief accounts of the sources of the material for plaiting (the botany of Bornean basketry), but the main bulk of the book concerns the ways in which the material is used, from mats to everyday carrying baskets, from intricate receptacles for storing the ingredients for betel chewing to ceremonial matting, baskets and hats. Artefacts are discussed region by region, ethnic group by ethnic group. Once can only marvel sadly at the use of plastic to substitute rattan where that has become scarce, the plastic baskets mimicking the intricate designs of the rattan work. A gorgeous, sumptuous book, anyone interested in Borneo, rattans or handicrafts will be beguiled by the astonishing diversity of handicrafts illustrated.



DESERT FRUIT: THE DATES OF AL JUFRAH – Marta Mancini (ed.). Istituto Agronomico per l'Oltremare, Firenze. 2010. No ISBN number. Price unknown. 65 pages and accompanying DVD.

This small, well-illustrated book provides an account of the dates and date groves of Al Jufrah in central Libya. It discusses date diversity and the astonishingly rich culture of the people whose lives depend on the date palm. Sponsored by The Slow Food Foundation for Biodiversity, the Italian Overseas Agronomic Institute and other agencies, the publication is a popular synopsis of continuing projects in Libya aimed at the promotion of the heritage of date cultivation. Inside the back cover is a DVD containing a pleasing film all about Libyan dates.

JOHN DRANSFIELD
Kew, UK

Notes on the Ethnobotany of Costa Rica's Palms

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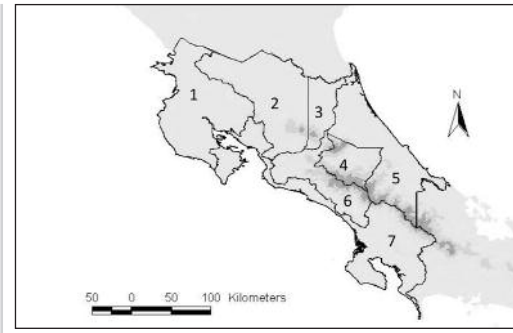
To support the implementation of policies that recognize human uses of wild plants, we documented palm ethnobotany within or bordering eight protected areas in Costa Rica. Through participant observation and semi-structured interviews with 37 participants from 18 communities, we documented the cultivation and harvest of 32 palm species from 21 genera. We also reported uses of five palms (*Cryosophila warscewiczii, Bactris gasipaes, Desmoncus costaricensis, Elaeis oleifera, Pholidostachys pulchra*) that, to our knowledge, were previously undescribed in the literature.

Twenty-nine genera and 109 species of palms are native to Costa Rica (Grayum 2003). The Costa Rican palm flora consists of a diversity of life-forms, ranging from understory shrubs and lianas (*Desmoncus* sp.) to canopy and subcanopy trees (Grayum 2003). This plant family is an important structural component of Costa Rican lowland forests. For example, at La Selva Biological Station, palms were found to represent 25.5% of stems over 10 cm in diameter (Lieberman et al. 1985). In Costa Rica, palms also persist at high elevations. Some

species are found near the highest mountain peaks in the country; for example, *Geonoma edulis* is found up to 2500 m above sea level (Grayum 2003). The ubiquity of palms in Costa Rica was demonstrated by Lieberman et al. (1996), who found that this group comprised 14.9% of all stems over 10 cm in diameter across an elevation gradient spanning four tropical life zones.

Given that palms are such an important part of Costa Rican flora, it is not surprising that their ethnobotanical use is widespread. The most well-known example is the edible heart-of-palm harvested from *Bactris gasipaes*. When Costa Rica began exporting *B. gasipaes* in 1978, it became the first country to export any cultivated palm species (Brazil opened the heart-of-palm market with the export from wild *Euterpe* spp. in the 1950s (Mora-Urpí 2002)). Although considerable attention has been given to this commercially important palm species, the harvest of other wild Costa Rican palms has been widely overlooked. Joyal (1994) presented a detailed description of the ethnobotanical uses of palms in one region (Sarapiquí) of Costa Rica, but a larger scale description of palm use is absent.

Many wild palm species are used in rural communities in Costa Rica (e.g., Sylvester & Avalos 2009, Sylvester 2009, Avalos 2007, Ocampo 1994). These wild species are often harvested from forests within protected areas, such as national parks. The Wildlife Conservation Law 7317 (Ley de Conservación de la Vida Silvestre 7317 1992) restricts wild palm harvest within protected areas, and as a result, many palm species are harvested illegally (e.g., Sylvester & Avalos 2009). Although palm harvesters and park managers have expressed interest in developing alternatives to illegal harvest, such as cultivation outside of protected areas, such alternatives are precluded by lack of basic information concerning which palm species are harvested and for what purposes (Sylvester 2009). Because of local interest in better understanding palm ethnobotany, we documented the use, harvest and cultivation of wild palm species. Our study was not comprehensive; rather we worked with key participants identified for their expertise in forest palm harvesting or cultivation within or bordering eight protected areas. By documenting which forest palm species are harvested within protected areas, our research will 1) support efforts to recognize people's traditional practices in forest management (IUCN 2012, MA 2005), and 2) identify key species for which alternatives to illegal harvest are needed.



1. Provinces of Costa Rica: 1. Guanacaste, 2. Alajuela, 3. Heredia, 4. Cartago, 5. Limón, 6. San José, 7. Puntarenas).

Methods

Our research was undertaken between April 2006 and April 2010. The information presented here was gathered from 37 participants residing in 18 communities. Eleven of these communities are located on the border of one of eight protected areas in Costa Rica (see Table 1 for an overview of locations). Because we were interested in describing the use of forest palms, rather than documenting the frequency of use, we chose a qualitative research design (Creswell 2009).

Participant Selection: We used purposive sampling to identify palm-harvesting participants. Purposive sample is a non-random sampling technique where participants are selected deliberately based on their expertise of the given research topic (Bernard 2010, Tongco 2007). We relied on the following criteria to identify participants that fit the objectives of our study: 1) people that engaged in forest palm harvesting or cultivation within or bordering protected areas and 2) people who were willing to participate in interviews and/or allow the authors to accompany them during palm harvesting.

We began the participant selection process by working with protected area managers and national park rangers from eight protected areas (Table 1). We worked with protected area staff that previously participated in projects related to palm cultivation and harvesting (e.g., Sylvester 2009, Sylvester & Avalos 2009, Avalos 2007). With the help of the protected area staff, we drafted a list of communities where palm harvesters resided (Table 1).

Table 1: Communities involved in palm harvesting within national parks or in their associated buffer zones. Where national parks are not mentioned, harvesting was reported on private land. Numbers of participants are given in parentheses.

Province	Communities	National Parks and Protected Areas
Guanacaste	Santa Cruz (2)	
Alajuela	Bajos del Toro Amarillo (3), Cariblanco (4), Cinchona (1), San Miguel (1),	Poás Volcano National Park
	Carrizal de Alajuela (1), San José de la Montaña (2) Atenas (1), Orotina (2)	
Heredia	Barva (2), San Rafael de Vara Blanca (2) and Vara Blanca (3)	Braulio Carrillo National Park
Cartago	Orosí (2)	Tapantí National Park
Limón	Las Colinas (3)	Barra del Colorado Wildlife Refuge and Tortuguero National Park
Puntarenas	Santa Elena (3)	Reserva Bosque Nuboso Santa Elena, and The Monteverde Cloud Forest Reserve
	Turrubares (2)	Carara National Park
	San Vito (1), Puerto Jiménez (2)	

Within the communities, we approached the local community-level development associations (viz., Asociación de Desarrollo Integral, ADI) and asked their members to provide us with names of people known to have experience in palm harvesting or cultivation. Additionally, some palm harvesters approached us directly and volunteered to participate in the study.

Once we drafted a list of potential participants, we contacted these individuals in face-to-face meetings and asked them to participate in our study. We also asked these individuals to direct us to other participants that fit our criteria (i.e., snowball-sampling; Bernard 2010). We approached a total of 37 potential participants, all of whom volunteered to participate in the study; the number of participants from each community is summarized in Table 1. Informed consent was solicited from each participant verbally or in writing. The informed consent process included a detailed explanation of the study objectives, methods, benefits and risks of participation, and how the results would be used. Because palm harvesting often occurs in protected areas where it is illegal, participation in our study was anonymous.

Data Collection Techniques: Our primary data collection method was face-to-face semi-structured interviews. When possible, interviews were triangulated with participant observation, i.e., the authors' participation in people's harvesting activities (Bernard 2010). Participant observation was possible in the following communities: Bajos del Toro Amarillo, Barva, Cariblanco, Cinchona, Las Colinas, San Miguel, San Rafael de Vara Blanca, Santa Cruz and Vara Blanca. Semi-structured interviews occurred primarily in the field. Specifically, we accompanied participants to places where they knew a given palm species occurred, or we asked participants to talk to us on their palm harvesting routes (i.e., transect walks; De Leon & Cohen 2005). When field interviews were not possible, participants

identified palms using photographic field guides (e.g., Thomas et al. 2007). Semi-structured interviews covered the following themes: nomenclature, use, harvesting technique and the extent of palm cultivation. Interview responses were hand-written. Interviews ranged from approximately 30 minutes to 60 minutes. The duration of participant observation was variable because it depended upon the time to reach palm species (e.g., home gardens versus remote montane habitats), as well as the techniques involved in harvesting. Upon return visits to the communities, we held workshops to check our results on palm species names and uses with participants.

In Las Colinas, we worked with and interviewed three members of an association involved in the harvest and cultivation of forest palms, viz., Asociación Mixta de Productores y Artesanos Las Estrellas del Carmen (AMPALEC). Because palm cultivation within this organization is a group activity, group interviews were used as a data collection method to explore members' collaborative palm cultivation efforts (Dunn 2005). Group interviews occurred in the field or at AMPALEC's plant laboratory in Las Colinas and did not exceed one hour. We triangulated these interviews with participant observation during individual members' harvesting activities either in patches of community-managed forest or in members' home gardens.

When possible, voucher specimens were collected and deposited in the Herbarium of the Universidad de Costa Rica (USJ). In some instances, participants did not permit collection of palms; in these cases pictures of palms were taken and deposited in the Herbarium USJ. We collected one voucher specimen and/or photograph per location of harvest or cultivation of each species.

Presentation of Results: We presented our results as an alphabetical list of palms. Palm vernacular names are presented in Spanish. A separate list was created for the palm species cultivated by members of AMPALEC in Las Colinas (Limón Province) in the buffer zone of Tortuguero National Park and Barra del Colorado National Wildlife Refuge. A separate list was created because many of the palm uses were found to be unique to this region. When applicable, we reported the national parks where harvesting occurred (Table 1). In national parks, harvesting may have occurred within the park or outside of the park boundaries but within its buffer zone; we do not distinguish between these two potentials in our study. Finally, we limited ourselves to describing the social and cultural uses of Costa Rican native palm species. For context, some natural history information was gleaned from Grayum (2003). The reader is encouraged to consult this and other works (e.g., Dransfield et al. 2008) for a detailed discussion of palm natural history and distribution.

Palm Ethnobotany

Acrocomia aculeata (Jacq.) Lodd. ex Mart. – *Coyol*

Acrocomia aculeata is a large solitary palm reported as harvested to make palm wine in Atenas and Santa Cruz. Participants reported that many small towns within the vicinity of Santa Cruz harvest this palm for wine-making. *Acrocomia aculeata* is harvested to extract the sap, which is locally referred to as coyol wine (*vino de coyol* in Spanish). The harvest of coyol wine was reported in March and April and was described as associated with lunar cycles. If a palm is not felled within three days before or after a full moon, participants reported the palm would not produce much sap. To extract the sap, a palm is felled and is left horizontal on the ground. A hole is cut out in the stem where the sap concentrates and accumulates. The sap is then placed into bottles and allowed to ferment naturally. In Santa Cruz, nothing was reported as added to the sap, whereas in Atenas participants reported to add a small amount of sugar to speed up the fermentation process. Depending upon the harvester, the wine may be chilled with ice and refrigerated before sale or consumption. The methods used to extract coyol wine in Costa Rica are similar to those observed around San Pedro Sula, Honduras (for a detailed description see Balick 1990).

In Santa Cruz, harvest of *A. aculeata* was reported on private lands and cultivation was not reported. Participants reported that cattle disperse the seeds of this palm. Palm fruits are reported as a source of cattle feed. The exocarp of the fruit may also be used as chicken feed.

The heart-of-palm of this species was harvested in Las Colinas. In this town, one participant suggested that the use of heart-of-palm from *A. aculeata* was undervalued. For example, palms must be felled when palm wine is extracted, but the heart-of-palms is left unused. The spines on *A. aculeata* were reported as one challenge to harvesting its heart-of-palm.

Attalea rostrata Oerst. – *Palma Real*

Attalea rostrata is a large solitary palm harvested in Las Colinas and Puerto Jiménez. In land patches around Las Colinas, *A. rostrata* was reported as uncommon. Leaves of *A. rostrata* are used for thatching houses and ranches in both towns. Roofs are constructed by overlapping the leaves with their mid-vein in the horizontal position. Layering leaves horizontally was reported to prevent rain from entering a dwelling. A roof made from *A. rostrata* leaves is reported to last between five and eleven years before replacement is needed. Smoking of the underside of the roofs, as a result of smoke emitted by wood ovens, was reported to preserve the leaves and enhance the duration of these palm roofs. Participants from Puerto Jiménez reported to have reduced the harvest of *A. rostrata* after it was prohibited (Ley de Conservación de la Vida Silvestre 7317, 1992); these participants did not know of any cultivation efforts to supplement wild harvest. Palm fruit and heart-of-palm were also reported as harvested in both towns. Palm fruits were reported as a source of pig feed because of their high fat content.

In Las Colinas, heart-of-palm from this species was reported for human consumption and was described as providing the largest quantity of heart-of-palm from all palms harvested for this purpose in Costa Rica.

Bactris gasipaes Kunth – *Pejibaje*

Bactris gasipaes is a clonal palm that is cultivated in plantations for the sale and export of its heart-of-palm and palm fruits for both national and international markets (e.g., Mora-Urpí 2002). A pre-Columbian Chibcha civilization from South America may have introduced *Bactris gasipaes* to Costa Rica (Stone 1951 in Mora-Urpí et al. 1997). It was suggested this could have occurred 1700 to 2300 years ago (Corrales-Ulloa & Mora-Urpí 1990).

In our study, we found *Bactris gasipaes* was cultivated in rural agroforestry systems for both the heart-of-palm and palm fruits from all participants. Heart-of-palm was reported to be eaten raw or cooked and prepared in diverse recipes, including "*picadillo*" (chopped heart-of-palm mixed with spices, and possibly other vegetables or eggs) and casseroles, such as rice with heart-of-palm. In Las Colinas, the immature inflorescences of *B. gasipaes* were harvested for consumption; these inflorescences were roasted or prepared in *picadillo*. Also in Las Colinas, *B. gasipaes* palm stems were reported to be polished and used for making lamps and small pieces of furniture.

Chamaedorea tepejilote Liebm. – *La Disciplina, Pacaya*

Plants from the genus *Chamaedorea* are understory palms commonly found in lowland and montane forests throughout the country. Heart-of-palm was reported as harvested from *Chamaedorea tepejilote* in Cariblanco, Cinchona, San Miguel, Santa Elena and Vara Blanca. It is likely that other *Chamaedorea* species are harvested because one of its vernacular names "*pacaya*" refers to many species (Grayum 2003). Participants reported that *pacaya* heart-of-palm is consumed raw; for example, participants from Santa Elena, Cariblanco and San Miguel mentioned that *pacaya* was common source of food during lengthy hunting or other field expeditions.

The male inflorescence of *C. tepejilote* was also reported for consumption from forest and from cultivated palms in Las Colinas, Orotina and Turrubares (Fig. 2). *Chamaedorea tepejilote* inflorescences can be roasted or prepared with ingredients such as eggs or vegetables (Fig. 2). Cultivation of *Chamaedorea* species for personal inflorescence consumption was found in home gardens.

Chamaedorea tepejilote was also found in home gardens as ornamental plants in towns within the Limón, Heredia and Alajuela provinces. Although not reported by participants in our study, in the literature young *Chamaedorea* leaves are reported as livestock feed (González 2012).

Cryosophila sp. – *Palma de Escoba, Súrtuba, Guágara*

Two species of *Cryosophila* were reported as useful in our study: *Cryosophila guagara* P.H. Allen and *Cryosophila warscewiczii* H. Wendl. (Fig. 3). *Cryosophila warscewiczii* and *C. guagara* are understory palms that are found in the Caribbean and Pacific regions of Costa Rica respectively (Grayum 2003). These species were harvested for heart-of-palm and inflorescence consumption in Las Colinas (*C. warscewiczii*), Orotina and Turrubares (*C. guagara*). *Cryosophila* heart-of-palm harvest occurred during Holy Week celebrations (corresponding to Easter) within Tortuguero and Carara national parks. Eating the inflorescence of *C. warscewiczii* was reported to increase one's energy levels. Cultivation of *C. warscewiczii*

2. Immature inflorescences of *Chamaedorea tepejilote* (A) are harvested for consumption (B, here cooked with chayote squash).

was reported in Las Colinas with the intention of selling this species in local markets. Participants also reported using *C. warscewiczii* as material to make brooms (Fig. 3).

Elaeis oleifera Kunth – *Corozo, Palmiche*

Elaeis oleifera is a solitary understory palm harvested for its heart-of-palm in Las Colinas; participants reported this heart-of-palm as bitter. Palm fruits of this species were also valued in Las Colinas for their high oil content (similar to the fruits of the introduced African oil palm, *E. guineensis*). Because *E. oleifera* is a native species, one participant suggested that harvest of the oil from this plant would be a more ecologically sustainable practice than the current use of the introduced African oil palm cultivated in Costa Rica for the same purpose.

Euterpe precatoria Mart. – *Palmito Mantequilla*

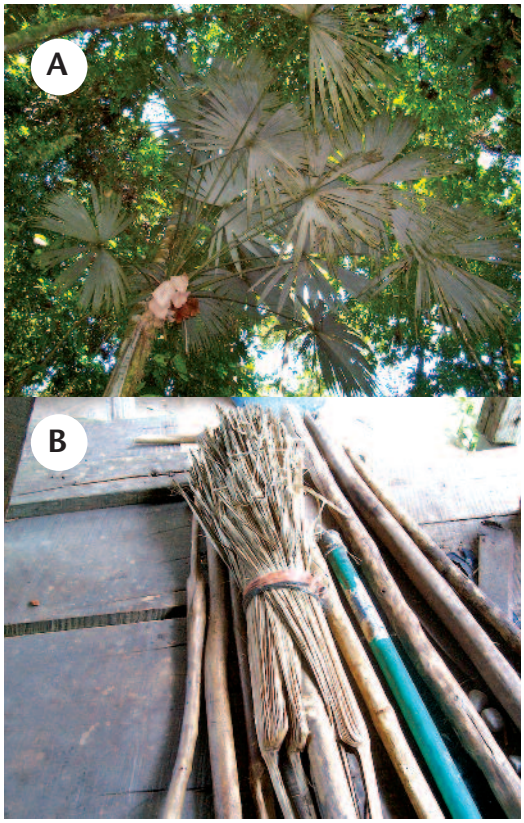
Euterpe precatoria is a solitary sub-canopy palm found in the Costa Rica lowlands and mid-elevations. Heart-of-palm from this species was harvested by participants from Cariblanco, Las Colinas and San Miguel. Its illegal harvest is particularly pronounced in Braulio Carrillo National Park (Avalos 2007). The vernacular name of this palm name signifies 'butter,' which describes the flavour of this heart-of-palm. This butter flavour was reported to make this heart-of-palm species more favourable than the *Bactris gasipaes* heart-of-palm. The heart-of-palm of this species may be eaten cooked or raw. Small-scale cultivation for local consumption of this palm was observed on private land in Las Colinas and Cariblanco in the buffer zones of the Tortuguero and Poás Volcano National Parks.

Geonoma congesta Wendl. ex Spruce – *Suita*

Geonoma congesta is a clonal palm, and its leaves are selectively harvested from a cluster of palm ramets. Participants from Las Colinas reported that *G. congesta* leaves are harvested to thatch roofs. After leaves are harvested, they are hung to dry. To construct roofs, leaves are tied to wooden rods and overlapped to produces roof panels (Fig. 4). The reported duration of roofs was variable (i.e., 2–4 years).

Geonoma edulis H. Wendl. ex Spruce – *Súrtuba*

Geonoma edulis is a solitary understory palm found in montane cloud forests of the Central and Talamanca Mountain Ranges (Figs. 5 & 6). *Geonoma edulis* harvest was reported only within protected areas, including the Braulio Carrillo, Poás Volcano and Tapantí National Parks and the La Amistad International Park. Participants reported harvesting this species from towns bordering protected areas (e.g., Bajos del Toro Amarillo, Barva, Cariblanco, Carrizal de Alajuela, Cinchona, Orosí, San José de la Montaña, San Miguel, San Rafael de Vara Blanca, Santa Elena, San Vito and Varablanca), and other participants reported travelling to protected areas to harvest these palms (e.g.,



3. *Cryosophila warscewiczii* in the forest (A) and a broom made from four leaves of *Cryosophila warscewiczii* (B).

from Carrizal de Alajuela, San José de la Montaña or San Vito). From towns bordering protected areas, walking distances of 4 or 5 hours were reported as common to reach the montane habitats where this species is found.

The heart-of-palm of *G. edulis* was reported to have high nutritional value; for example, participants believed it to be high in iron because it grows in the fertile soils of montane forests. The nutritional value of this palm was reported to make it a good substitute to meat consumption when religious holidays prohibit eating meat (e.g., Holy Week). Participants reported that in the past *G. edulis* was primarily harvested during Holy Week (*Semana Santa*). Although consumption still peaks during Holy Week, a study in 2007 found that *G. edulis* was harvested year round (Sylvester & Avalos 2009). Cultivation of *G. edulis* was not reported. Participants reported that *G. edulis* requires cloud forests (located within protected areas) to germinate and grow. Because *G. edulis* was reported to require cloud forests to grow, people reported a hesitancy to plant palms in areas outside of protected forests.

Grayum (2003) described the epithet of this species – meaning edible – as deceiving because the flavor of this heart-of-palm is uniquely bitter. Surprisingly, participants reported that this flavor drives some of the appeal of consuming this palm. Participants also reported medicinal properties associated with this species. For example, it is consumed to help treat rheumatism, fatigue, digestion and muscular pain (Sylvester & Avalos 2009). Diverse cooking styles were reported, but the species is traditionally roasted in a wood oven.

Iriartea deltoidea Ruiz & Pav. – *Palmilera, Chonta Negra, Palmito Dulce*

Iriartea deltoidea is a solitary canopy palm. It was reported as harvested for its heart-of-palm, which has a sweet flavor; the stem was also reported as used as a construction material for walls, floors and pipes (Bajos del Toro Amarillo, Cariblanco, Cinchona, Las Colinas, San Miguel, San Rafael de Vara Blanca, San Vito, Santa Elena, Turrubares and Vara Blanca). In Las Colinas, the seeds were used for artisanal crafts, such as making curtains.

In Cariblanco, harvest of *I. deltoidea* was reported to be a practice of the past in the

4. *Geonoma congesta* (A); leaves used for thatching roofs (B).

5. *Geonoma edulis* in montane cloud forests of Poás Volcano National Park.

Alajuela and Heredia provinces. One participant reported this species as historically abundant such that it could even be found in one's backyard. Participants reported that abundance has drastically decreased and that harvesting has also declined or is no longer practiced.

Prestoea acuminata (Willd.) H.E. Moore – *Palmito, Palmito Dulce, Palmito Morado*

Prestoea acuminata is a subcanopy clonal palm harvested by participants from multiple towns (Bajos del Toro Amarillo, Barva, Cariblanco, Carrizal de Alajuela, Cinchona, Orosí, San Rafael de Vara Blanca, Santa Elena, San Vito and Vara Blanca). Similar to *Geonoma edulis*, *P. acuminata* heart-of-palm is harvested in cloud forests of the Central and Talamanca Mountain Ranges (Figs. 5 & 6). Heart-of-palm harvest was reported within the following protected areas: Braulio Carrillo and Poás Volcano National Parks and La Amistad International Park. In Cariblanco, harvesters were observed to selectively remove stems (ca. 8 cm in diameter) from a cluster of palm ramets. In communities bordering the Poás Volcano National Park (Table 1), this heart-of-palm was prepared in picadillo or roasted in wood oven. The flavour of this heart-of-palm was reported as sweet, unlike the bitter *G. edulis* that co-occurs with *P. acuminata* in montane cloud forests. In Cariblanco, this palm was reported to sell for the highest price in national, informal markets. No cultivation of this species was reported.

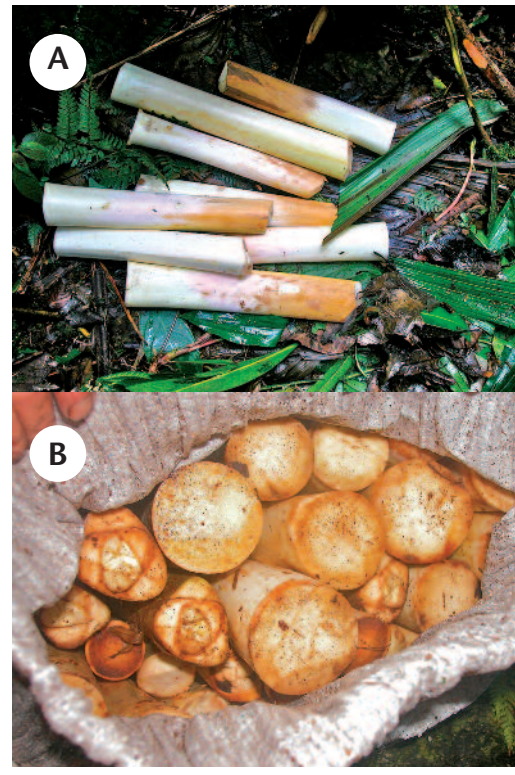
Socratea exorrhiza (Mart.) H. Wendl. – *Maquenque, Chonta, Chonta Dura, Palmito Amargo*

Socratea exorrhiza is a solitary canopy palm. Participants from Cariblanco, Las Colinas and San Miguel reported that this species was harvested in the past for its bitter heart-of-palm; none of these participants reported current consumption of this species. These same communities reported the use of *S. exorrhiza* stems to construct floors and walls of houses; to do so, the stem is split lengthwise into four planks. Similar to *Iriartea deltoidea*, the *S. exorrhiza* stems were reported as highly valued because of their strength and durability. In Las Colinas, participants reported the use of *S. exorrhiza* seeds to make curtains.

Palms Cultivated and Harvested by AMPALEC

In the town of Las Colinas in the Pococí Canton of the Limón Province, members of

6. Heart of palm from *Geonoma edulis* (A) and both *Geonoma edulis* and *Prestoea acuminata* (B). This wild heart of palm is sold fresh directly after harvesting.



AMPALEC reported the following palm species as cultivated and used for ornamental and artisan purposes, as well as occasionally for human consumption. Other palms used by participants from Las Colinas are also reported in the list above.

Asterogyne martiana (H. Wendl.) H. Wendl. ex Hemsl. and *Calyptrogyne ghiesbreghtiana* (Linden & H. Wendl.) H.Wendl – *Suita*

Asterogyne martiana and *Calyptrogyne ghiesbreghtiana* are small understory palm species. The seeds of both species are sold internationally for ornamental use. Participants reported that seeds from *Asterogyne martiana* were in highest demand. Leaves from both of these species were reported as popular to be used to thatch roofs in the Pococí region.

Astrocaryum alatum H.F. Loomis and *Astrocaryum standleyanum* L.H. Bailey

Astrocaryum alatum is a solitary understory species. *Astrocaryum standleyanum* is a solitary sub-canopy palm. Seeds from both of these species were reported to be polished and used locally in multiple artisan practices, including making handbags and window curtains.

Bactris sp.

Bactris is a genus comprised of a diverse group of spiny palms. The seeds of various *Bactris* species were reported as sold for ornamental plants. These species included *Bactris coloradonis* L.H. Bailey, *Bactris glandulosa* Oerst., *Bactris gracilior* Burret, *Bactris hondurensis* Standi., *Bactris longiseta* H. Wendl. ex Burret and *Bactris militaris* H.E. Moore. Participants described *B. glandulosa* as a popular plant for plant collectors. Many *Bactris* species have edible fruits (e.g., *B. coloradonis*), but participants did not consume them often.

Chamaedorea deckeriana (Klotzsch) Hemsl.

Seeds from *C. deckeriana* were documented as sold because this species is a popular ornamental. Members of AMPALEC reported this species to grow in the driest parts of the tropical wet forest (the most predominant life zone within the Tortuguero National Park; Holdridge et al. 1971). One participant reported that the immature inflorescences of this species are morphologically similar to the edible *Chamaedorea tepejilote* inflorescence; this participant expressed interest in determining whether *C. deckeriana* inflorescences were also edible.

Desmoncus costaricensis (Kuntze) Burret – *Matamba*

Desmoncus costaricensis is a climbing palm with large spines. The stem of this species was used for basket making. *Desmoncus costaricensis* was also reported to have potential to be cultivated as an ornamental plant because of its attractive, red fruits.

Manicaria saccifera Gaertn.

Manicaria saccifera is a clonal species found in swampy terrains. It was reported as a source of leaves for thatching roofs. It is also an ornamental plant whose seeds are exported for this purpose.

Pholidostachys pulchra H. Wendl. ex Burret – *Caña Lucía*

Pholidostachys pulchra is a solitary clustering understory palm. This species was harvested for its heart-of-palm and immature inflorescences, both of which were reported as bitter. Immature inflorescences are harvested before they open and are prepared similar to those of *Chamaedorea tepejilote* (see above). Participants described the heart-of-palm from this species to be small and its extraction uncommon.

Raphia taedigera (Mart.) Mart. – *Yolillo*

Raphia taedigera is a large palm reaching heights of up to 12 meters found in swampy terrain. *Raphia taedigera* was harvested for its heart-of-palm and its fruits, for human and livestock consumption respectively. The heart-of-palm was described as bitter. *Raphia taedigera* was reported as an ornamental plant with an attractive inflorescence. The seeds of this palm – along with those of other angiosperms and pieces of bamboo – were mentioned as used to make window curtains. Participants mentioned that this species is generally found within swampy areas within protected forests; however, one participant was successful cultivating this palm outside of swamps in drier patches of his home garden.

Reinhardtia gracilis (H. Wendl.) Drude ex Dammer and *Reinhardtia simplex* (H. Wendl.) Drude ex Dammer – *Ventanilla* (*R. gracilis*) and *Palma Enana* (*R. simplex*)

Reinhardtia species are small understory palms. Both *Reinhardtia* species were cultivated and their seeds exported for ornamental purposes. Monitoring of seed production by members of AMPALEC revealed that *R. gracilis* produces seeds once every four years.

Synechanthus warscewiczianus H. Wendl.

Synechanthus warscewiczianus is a solitary clustering understory palm. Participants mentioned it was generally found in old

growth forests. This palm was cultivated as an ornamental plant, and its seeds are exported for this purpose. The bright green, unripe fruits of *S. warscewiczianus* (which turn black when mature) were reported to make it an attractive ornamental plant and a source of seeds to make jewelry.

Welfia regia Mast. – *Corozo*

Welfia regia is a solitary canopy palm, and its seeds were exported for ornamental production. Participants also reported *W. regia* as a popular source of heart-of-palm for people living in the Pococí region. This species is often harvested illegally, and its harvest was reported as most common in Holy Week. From data collection during palm cultivation, participants revealed that *W. regia* grows slowly. Such slow growth makes it difficult to cultivate this palm for heart-of-palm production. For example, participants reported that in over 20 years they have not been successful in cultivating palms that reach sizes suitable to extract its heart-of-palm. Because of this observed slow growth, participants highlighted *W. regia* as a species for conservation concern in forests where it is illegally harvested.

One participant in Las Colinas revealed that *Welfia regia* leaves were harvested for thatching roofs, and its leaves produce the most resistant roofs (compared to leaves from *Asterogyne martiana* or *Attalea rostrata* also harvested for thatching). Thatching using *W. regia* leaves was reported as similar to the process described above for *A. rostrata*.

Discussion

Within and bordering protected areas, we found that palms provided multiple sources of food, medicine and construction material. The sale of palm products within organized international markets (seeds) and local informal markets (heart-of-palm) also provided sources of income for palm harvesters. In total, we documented the cultivation and harvest of 32 palm species from 21 genera. Of these species, only *Bactris gasipaes* is cultivated on large-scale palm plantations (Mora-Urpí 2002). This reflects the underdevelopment of the cultivation of forest-palm species as alternative food sources and as a potential income-generating activity for rural communities. We herein report the previously undocumented consumption of heart-of-palm from *Cryosophila warscewiczii* and *Elaeis oleifera*, the consumption of immature inflorescences from *Pholidostachys pulchra* and *Bactris gasipaes* and basket-making from *Desmoncus costaricensis*. Some examples of alternative food sources identified here and reported elsewhere in the literature for Latin America include heart-of-palm from *Acrocomia aculeata*, *Attalea rostrata, Euterpe precatoria*, *Iriartea deltoidea*, *Prestoea acuminata*, *Socratea exorrhiza* and *Welfia regia* (Bernal et al. 2011, Balslev et al. 2008, Brokamp et al. 2011, Van Looy et al. 2008, Haynes & McLaughlin 2000, Svenning & Balslev 1998, Joyal 1996), and immature palm inflorescences from *Chamaedorea tepejilote* (Castillo Mont et al. 1994).

Palms were harvested from both cultivated sources (e.g., community-managed forests, home gardens) and from forests within protected areas. Similar to findings compiled from a review of the management of palms in South America (Bernal et al. 2011), few participants reported the cultivation or organized management of forest palms. The exception was the cultivation of a suite of palms (26 species) on private lands for artisan, commercial and reforestation purposes in Las Colinas by members of AMPALEC. Within our study, AMPALEC was the only association reported to have created a community-based enterprise for the cultivation, sale and export of palm products. Although AMPALEC was focused on palm seed export, members of this association are working to sell other palm products (e.g., heart-of-palm from *C. warscewiczii*, N. Chavez *pers. obs.*).

We recorded the illegal harvest of heart-of-palm from nine different species. Elsewhere in Latin America, some of these species were reported as illegally harvested (e.g., *P. acuminata* in Colombia; Gamba-Trimiño et al. 2011) or harvested for sale in local and international markets (e.g., *E. precatoria* in Venezuela and Bolivia; Van Looy et al. 2008, Stoian 2004). To our knowledge, the cultivation potential or the available markets for these nine species has been overlooked, with one exception, i.e., a thriving local market for *G. edulis* heart-of-palm exists in the Costa Rican Central Valley (Sylvester & Avalos 2009).

Palm harvesters expressed the knowledge and expertise related to cultivating some of the palms reported as illegally harvested. For example, AMPALEC members were found to propagate and cultivate five of the nine illegally harvested species (e.g., *C. tepejilote, C. warscewiczii, E. precatoria*, *I. deltoidea* and *S. exhorrhiza*). Through cultivation and monitoring of palm growth, AMPALEC

members were also able to determine which palms would be more practical to cultivate and sell. For instance, *Welfia regia* is illegally harvested for its heart-of-palm, but participants reported this would not be a viable business for palm harvesters because they observed this species to grow slowly relative to other species. On the other hand, participants revealed that species such as *Chamaedorea tepejilote* or *Cryosophila warscewiczii* could be cultivated to reproductive stages relatively quickly; thus, the sale of these species could result in a viable business option.

Although it is mandatory for Costa Rican national parks to recognize people's traditional practices in forest management (e.g., Ley de Biodiversidad 7788), there are few policy directives on how to do so (Cajiao Jiménez 2002). We expect that our results may be useful when developing more informed forest management strategies that consider traditional palm use. Our study also documented palm species that have been successfully cultivated outside of protected areas. The sale of cultivated palms is one palm management option that may support the continuity of cultural practices while helping decrease the frequency of illegal harvest.

Acknowledgments

Numerous palm harvesters and protected area staff contributed to the information in this review. All participants consented to publishing this information for educational purposes. Although this document was produced with the support of many people, the authors alone are responsible for any oversights. C. Morales provided scientific identification of some of the palms. O. Vargas facilitated the use of palm images from La Flora Digital de La Selva. D. Steen and one anonymous reviewer provided valuable comments that improved this manuscript.

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Photo Feature

Pseudophoenix lediniana in the Wild

These photographs by William Cinea (Director of the Cayes Botanic Garden, Haiti) and Marcos Caraballo (graduate student at Pennsylvania State University) taken in August, 2012, confirm the presence of wild individuals of *Pseudophoenix lediniana* in southern Haiti, at the type locality. On-going environmental challenges, coupled with recent natural disasters, have put the native palms of Haiti under tremendous threat. There was some doubt whether *Pseudophoenix lediniana* still survived. Cinea and Caraballo's confirmation is a welcome update for a flora that seldom gets good news. The only known population of this species has approximately 50 individuals and very few juveniles, so its continued survival in the wild is still not assured. The Mohamed Bin Zayed Species Conservation Fund is supporting a project focusing on the conservation biology of this very rare species. *Ex situ* conservation collections will be established in the Jardín Botánico Nacional (Dominican Republic), Botanical Garden of the University of Puerto Rico, Cayes Botanic Garden (Haiti), the Montgomery Botanical Center, Fairchild Tropical Botanic Garden and the USDA Chapman Field Station (Florida).

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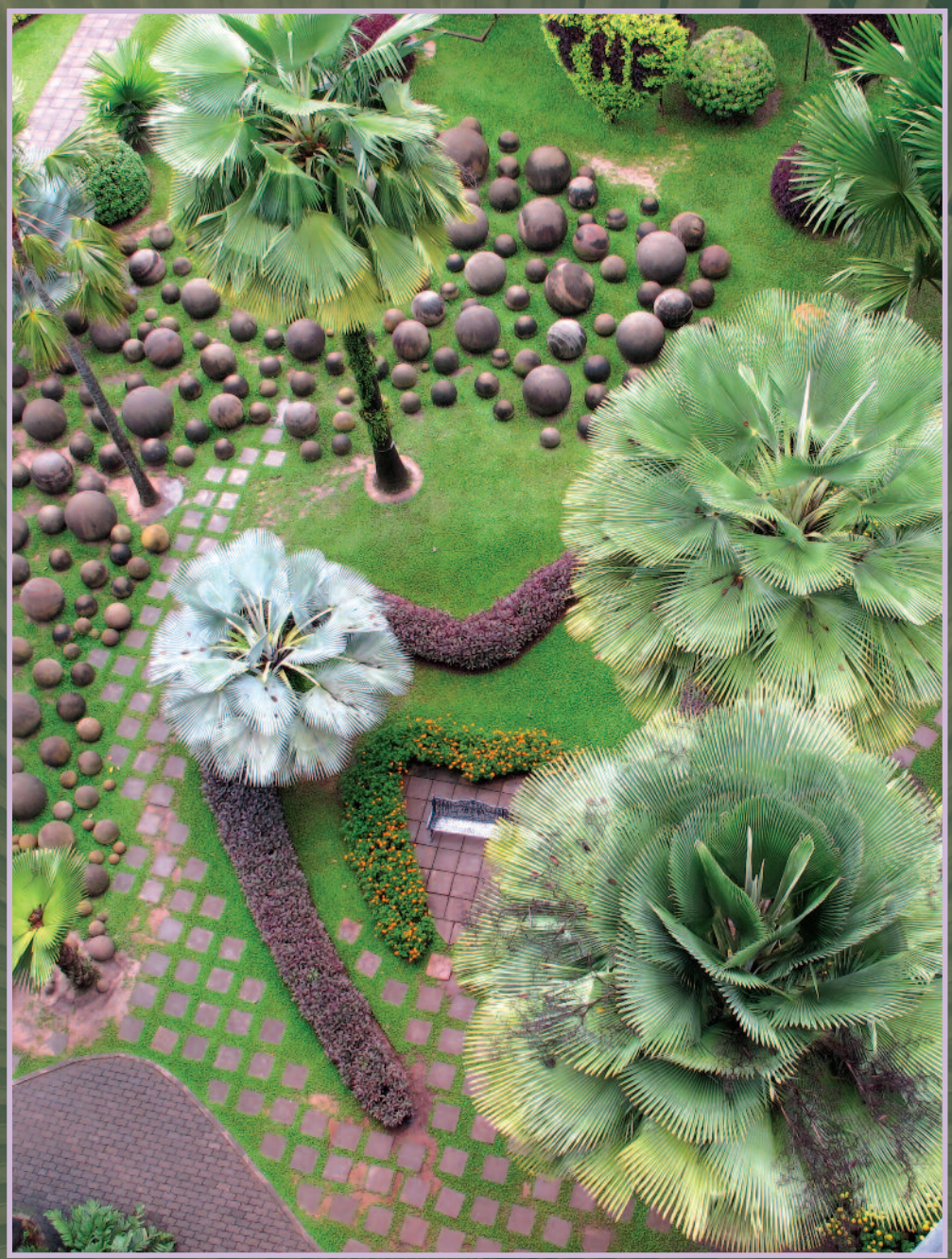
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