

Palms

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The International Palm Society

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CONTENTS

- 161** *Chamaedorea Palms 20 Years After*
D.R. HODEL
-
- 176** *New Species of Calamus from Cambodia*
A. HENDERSON & E.H. KHOU
-
- 181** *Floral Structure in the Neotropical Tribes Leopoldinieae and Manicarieae (Arecaceae: Arecoideae)*
V. VILLÍMOVÁ & F.W. STAUFFER
-
- 194** *2014 IPS Biennial: South Florida*
S. ZONA
-
- 199** *Dypsis leucomalla, a New Species Described from Cultivation in Hawai'i*
J. DRANSFIELD & J. MARCUS
-



FRONT COVER

A rare palm from mountain rainforest on the Pacific slope of Costa Rica, *Chamaedorea incrustata* is distinctive in its blue-green, strongly cupped, boat-shaped pinnae. See article by D.R. Hodel, p. 123. Photo by D.R. Hodel.

BACK COVER

An unusual perspective on the palms of Fairchild Tropical Botanic Garden: from the bucket of a cherry picker. Photo by S. Zona.

Features

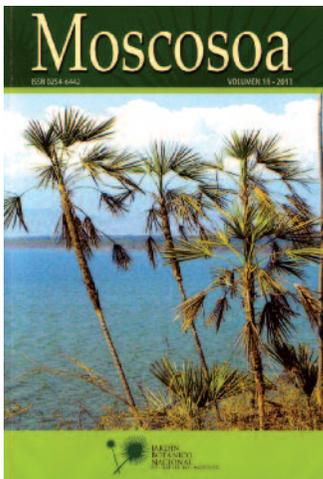
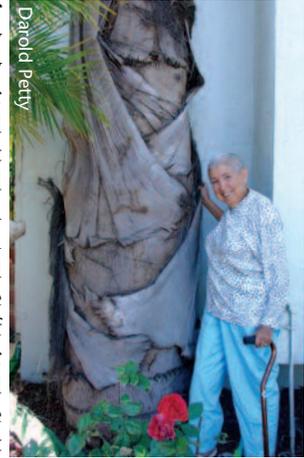
Palm News	160
Advertisement	194
Index to vol. 57	204



Seeds of *Dypsis leucomalla*, a new species described from a plant cultivated at Floribunda Nursery in Hawai'i. See article by J. Dransfield and J. Marcus, p. 199.

PALM NEWS

We are saddened to note the passing of **Inge Hoffmann (November 29, 1930–August 5, 2013)**. She was born in Nuremberg, Germany on 29 November 1930. Her friends and IPS members affectionately knew her as the “Seed Lady.” She traveled widely, sourcing seed for the IPS Seed Bank. She also had a strong interest in cacti and succulents and designed and constructed the cactus and succulent garden at the Dunsmuir House in San Leandro, California. She and her husband, Hans, led the committee to construct the Palmetum at the Lakeside Garden center in Oakland, California. Her own garden, in San Leandro, hosted student groups, college classes and many flower and garden clubs. She had 80 mature palm trees, some over 20 m tall, and over 600 kinds of cactus and 800 varieties of succulent plants. She passed away peacefully with friends – her devoted caregiver, Rose Alba Gonzales, and travelling companion and soulmate, Larry Shore – at her side. She is remembered in all the palms grown from the seeds she supplied to the IPS Seed Bank that now grace gardens all over the world.



A new species of *Coccothrinax* was described in the latest issue of *Moscosea* (18: 9–13. 2013), the journal of the Jardín Botánico Nacional Dr. Rafael M. Moscoso, Santo Domingo, Dominican Republic. The species, named *Coccothrinax jimenezii* by M. Mejía and R. G. García, honors Francisco Jiménez Rodríguez, the director of the Botany Department of JBN. It grows in dry forest over limestone, on the margins of Lake Enriquillo, in the Sierra de Neiba, Independencia Province, near Haiti. It also occurs on the Haitian side of the border. It is said to resemble *C. gracilis* but differs in several ways, including stiffer leaf segments that are whitish on the underside, unarmed leaf sheaths, and yellowish white fruits. In growth habit and habitat, it resembles *C. boschiana* and *C. ekmanii* but differs markedly from those species in morphology. With the description of this newest species, the island of Hispaniola now boasts ten species of *Coccothrinax*, six of which are endemic.

News has been received from Xavier Metz in Madagascar that the **sale of seeds of *Tahina spectabilis* earlier this year from the flowering in 2012 has raised a significant amount of money** with the great help of Toby Spanner from RarePalmSeeds.com. The funds will be used by the local community partly to formalize a protected area for the palm.

Four new species of *Calamus* from Vietnam were recently described in the on-line journal *Phytotaxa* by A. Henderson and N.Q. Dung. The publication is open-access and may be downloaded at www.mapress.com/phytotaxa/content/2013/f/pt00135p026.pdf. Also published on-line, in *Phytokeys*, is L. Noblick’s illustrated account of **the anatomy of *Syagrus* leaflets**. It, too, is freely accessible at www.pensoft.net/journals/phytokeys/article/5436/leaflet-anatomy-verifies-relationships-within-syagrus-arecaceae-and-aids-in-identification.

***Chamaedorea* Palms 20 Years After**

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1 *Chamaedorea plumosa* occurs on rocky limestone slopes in deciduous thorn forest at middle elevations in the great interior valley of Chiapas, Mexico, as here outside of Tuxtla Gutierrez; photo taken at the height of the rainy season.



It is hard to believe but over 20 years have passed since the International Palm Society published *Chamaedorea Palms* (Hodel 1992a), my monograph of this popular and widely cultivated genus. Since then new species have been identified, named and described, most in the pages of *Principes* and *Palms*; nomenclatural changes have reduced some species to synonymy while resurrecting at least one from a similar fate. New information has come to light that further enriches our understanding of this remarkable group of palms. Here I provide a summary of these developments in the past 20 years, emphasizing and/or illustrating those not previously discussed in this journal or where appropriate images were lacking.

New Species

Nineteen new species have been named and described since *Chamaedorea Palms (CP)* was published in 1992 although one, *Chamaedorea coralliformis*, has since been placed in synonymy with *C. crucensis*. Table 1 summarizes these 18 new, accepted species. Several of these new species now figure prominently in horticulture and are in gardens and collections around the world. John Ingwersen of Jungle Jack's Palms in Oceanside, California has championed two of these, *C. plumosa* and *C. benziei*, and they are now available in the worldwide trade. I described both these Mexican species and two others in *Principes* (Hodel 1992b), and because I had not seen them in the wild, I based them on cultivated plants in southern California. However, I saw both in the wild on trips to México in 1993 and 2000, enabling me to provide additional information about their habitat.

Chamaedorea plumosa, which is like a dwarf, slender version of the queen palm (*Syagrus romanzoffiana*) and which Jungle Jack's Palms

markets under the trademarked name Baby Queen in allusion to this similarity, occurs on rocky slopes and among large, table-like slabs of limestone rocks in deciduous thorn forest at middle elevations in the great interior valley of Chiapas, México (Figs. 1 & 2). This seasonally dry forest, which receives little or no rain for a great part of the year and is mostly leafless during this time, is home to many cacti and other succulent plants. Similar in appearance to *C. glaucifolia*, *C. plumosa* differs in its larger, more robust habit, adaxial (upper) surface of the petioles with a prominent groove or channel, lack of glaucous covering on petioles and rachises, pinnae arising from the rachis in a more pronounced plumose fashion and staminate (male) flowers with the petal tips free and spreading. Surprisingly, the two species grow not too far apart at one location outside Tuxtla Gutiérrez, the capital of Chiapas. *Chamaedorea glaucifolia* occurs at higher elevations in moist cloud forest overlooking the spectacular Sumidero Canyon while *C. plumosa* is found about 10 kilometers away but at lower elevations. While the latter also occurs much farther to the southeast in

Table 1. List of new, accepted species of *Chamaedorea* since publication of *CP* in 1992.

Species	Origin	Reference
<i>C. anemophila</i>	Panama	Hodel 1995
<i>C. benziei</i>	Mexico	Hodel 1992b
<i>C. binderi</i>	Costa Rica	Hodel 1996
<i>C. christinae</i>	Colombia	Hodel 1997
<i>C. frondosa</i>	Honduras	Hodel et al. 1995b
<i>C. hodelii</i>	Costa Rica	Grayum 1998
<i>C. ibarrae</i>	Mexico	Hodel 1992b
<i>C. incrustata</i>	Costa Rica	Hodel et al. 1997
<i>C. keelerorum</i>	Guatemala, Mexico	Hodel 1992b
<i>C. moliniana</i>	Honduras	Hodel et al. 1995b
<i>C. piscifolia</i>	Costa Rica	Hodel et al. 1997
<i>C. plumosa</i>	Mexico	Hodel 1992b
<i>C. ponderosa</i>	Panama	Hodel 1997
<i>C. recurvata</i>	Panama	Hodel 1995
<i>C. ricardoii</i>	Colombia	Bernal et al. 2004
<i>C. rosibeliae</i>	Costa Rica	Hodel et al. 1997
<i>C. rossteniorum</i>	Costa Rica	Hodel et al. 1997
<i>C. subjectifolia</i>	Panama	Hodel 1995



2 (left). Juan José provides scale for *Chamaedorea plumosa* among large, table-like slabs of limestone rocks in deciduous thorn forest southeast of San Cristobal de las Casas in Chiapas, Mexico (Hodel 1158). 3 (right). *Chamaedorea benziei* occurs in high-elevation but surprisingly somewhat dry cloud forest in southwestern Chiapas on the border with Oaxaca, Mexico (Hodel 1168).

Chiapas beyond San Cristóbal de las Casas, it is remarkable that two species of such similar and distinctive habit but otherwise not closely related can occur so close to each other.

Chamaedorea benziei occurs in high-elevation but surprisingly somewhat dry cloud forest in southwestern Chiapas, on the border with Oaxaca, México (Fig. 3). Then palm-seed dealer Inge Hoffmann of San Leandro, California, Juan José Castillo of the Universidad de San Carlos in Guatemala and I observed it there in early 1993. Similar to *C. carchensis* from adjacent Guatemala, *C. benziei* has ascending to arching, thick, dark green leaves and ascending, long-stalked inflorescences. When young it is somewhat reminiscent in foliage and habit of the sentry or kentia palm (*Howea forsteriana*) and is suggested as a substitute for this species as a potted subject for decorative use (Fig. 4).

In the same article (Hodel 1992b) I described the elusive and perplexing *Chamaedorea ibarrae*, basing it on herbarium specimens only, which provided no information about its

habit. I searched for it twice but without success in high-elevation, moist cloud forest in the mountains surrounding San Cristóbal de las Casas where it reportedly grew. Finally in 2000 I found it cultivated in a residential garden in San Cristóbal de las Casas and can now provide photographs of this striking species. A handsome plant with no visible, above-ground trunk, it has dark, velvety, nearly iridescent green leaves in a compact rosette arising directly from the ground (Fig. 5). In habit *C. ibarrae* is similar to the well-known *C. radicalis*, but the flowers and the leaf texture and color of the two species are clearly distinct. Other than the one plant cultivated in San Cristóbal de las Casas, I have seen no other plants of *C. ibarrae*, which is unfortunate because it is an attractive species and one worthy of gracing our gardens and collections.

Chamaedorea frondosa, another species named in *Principes* (Hodel et al. 1995b), deserves greater attention for its numerous good qualities. Found in wet, high-elevation cloud forests in Honduras, this exceptionally handsome species has performed superbly in



4. *Chamaedorea benziei* is somewhat reminiscent when young in foliage and habit of the sentry or kentia palm (*Howea forsteriana*) and is suggested as a substitute for this species as a potted subject for decorative use (cultivated, Lotusland, Santa Barbara, CA).

the *Chamaedorea* Research Collection in Los Angeles, flowering and fruiting readily for many years (Fig. 6). I have shared seeds and plants with collectors, growers and gardens in California, Florida, Hawaii, Europe and Australia. This remarkable species holds up to 20 thick, corrugated, simple and bifid, sometimes slightly mottled but rich, dark green to nearly gray green leaves. Complementing these handsome leaves are the inflorescences that hold the conspicuous if not showy bright yellow flowers and later the black fruits on orange-red spikes outside the leafy canopy (Figs. 7 & 8). Vigorous and easy to grow in Los Angeles, it sustained no damage in the January 2007 cold spell, when temperatures dipped slightly below freezing and severely damaged or killed nearby *C. ernesti-augusti*.

Chamaedorea piscifolia is the most remarkable of the new species and one of the most distinctive species of *Chamaedorea*, ranking with *C. tenerrima* and *C. tuerckheimii* for unusual leaves. Gerardo Herrera and Alfredo Cascante of the Costa Rican National Museum and I described this species, which is remarkable on several counts but might now be extinct, and three other *Chamaedorea* in the *Palm Journal* after late 1996 field work in Costa Rica (Hodel et al. 1997). *Chamaedorea piscifolia*, which we found in wet, incredibly rich and

5. The elusive and perplexing *Chamaedorea ibarrae*, a strikingly handsome plant with no visible, above-ground trunk, has dark, velvety, nearly iridescent green leaves in a compact rosette arising directly from the ground (cultivated, San Cristobal de las Casas, Chiapas, Mexico).





6. *Chamaedorea frondosa*, an exceptionally handsome species, has performed superbly in the *Chamaedorea* Research Collection, flowering and fruiting readily for many years (Hodel 1274 bis).

diverse mountain rain forest on the Pacific slope of Costa Rica, has small, corrugated leaf blades similar to those of the potato-chip palm (*C. tuerckheimii*) except they have distinctive, drawn out, bifid tips lending a fish shape to the blade to which the specific epithet alludes (Fig. 9). The spicate or few-branched inflorescences are borne at such a distance (60–90 cm) from the leaves on slender, bare, creeping, prostrate, often buried stems that they are difficult to associate with any given plant (Fig. 10). Indeed, in such cases they arise directly from the bare ground or leaf litter in an isolated manner and are frequently overlooked or escape attention as palm inflorescences until one traces back the stem to the plant. Unfortunately, I heard that the forest where this palm grows was largely destroyed, so the continued survival of this species is doubtful.

Two of the three other species named in the 1997 *Palm Journal* article are worthy of elaboration. One, *Chamaedorea rossteniorum*, which honors long-time International Palm Society members Kurt Rossten and his late wife Lois of Huntington Beach, California, is a striking species from Costa Rica and Panama. A handsome ornamental, *C. rossteniorum* has a rosette of dark green, ascending to spreading, thick, somewhat leathery, often large, simple

and bifid leaves, and unusually long inflorescences that hold yellow flowers and attractive black fruits on red-orange rachillae well clear of the foliage (Fig. 11). In *CP*, I actually included it with *C. stricta* from México and Guatemala, a species of similar habit, leaves and inflorescences but different staminate (male) flowers. Unfortunately, at the time, staminate flowers of the Costa Rican and Panamanian material, crucial for differentiating many species of *Chamaedorea*, were unavailable. However, in early 1996 I suspected that the Costa Rican and Panamanian plants were different when a plant from Panama in the *Chamaedorea* Research Collection produced staminate flowers that in their connate (joined) petal tips were amply distinct from those of *C. stricta* with its free and spreading petal tips. This suspicion was confirmed in late 1996 when Gerardo, Alfredo and I made good collections of staminate flowers from plants on the Pacific and Atlantic slopes (Fig. 12) of Costa Rica that clearly showed them to be distinct from *C. stricta*.

Named in the same 1997 *Palm Journal* article and not as striking as either *Chamaedorea piscifolia* or *C. rossteniorum* but, nonetheless, equally interesting, *C. incrustata* is unique in the genus by virtue of its conspicuously rough,



7 (left). Inflorescences of *Chamaedorea frondosa* hold the conspicuous if not showy bright yellow flowers above the handsome, leafy canopy (Hodel 1275 bis, cultivated, *Chamaedorea* Research Collection). 8 (right). Orange-red infructescences of *Chamaedorea frondosa* hold the black fruits outside the leafy canopy (Hodel 1274 bis, cultivated, *Chamaedorea* Research Collection).

crusty rachis and rachillae to which the specific epithet alludes. The crusty surface, reminiscent of some types of plate- and fan-shaped tropical corals, is the result of extraordinary encrustations arranged along the longitudinal ridges of the rachis and rachillae (Fig. 13). On their margins and apices they bear clusters of star-shaped, slender hairs, also diagnostic for this species. This rare plant from mountain rain forest on the Pacific slope of Costa Rica is also distinctive in its blue-green, strongly cupped, boat-like pinnae (Front Cover).

In 1998 Michael Grayum, friend, colleague and exceptional student of Costa Rican plants at the Missouri Botanical Garden in St. Louis, described five new species of palms from Costa Rica, including one that in *CP* (Plates 115 B–E) I had included and illustrated as *C. crucensis* (Grayum 1998). This new species, a member of subgenus *Stephanostachys*, has spicate inflorescences with densely packed, contiguous flowers and fruits, the latter appearing like kernels on an ear of corn. Grayum argued persuasively that this new species from the Atlantic slope of Costa Rica differed

substantially from *C. crucensis* from the Pacific slope, and he named it *C. hodelii* in my honor.

Nomenclatural Changes

In his work on the Costa Rican flora Grayum (1998, 2003) put several species of *Chamaedorea* into synonymy (Table 2). While I agree with most of these, I take exception to his inclusion of *C. tenella* with *C. geonomiformis* and *C. minima* and *C. sullivaniorum* with *C. pumila*. In the case of *C. tenella* and *C. geonomiformis*, they are at least horticulturally distinct, the former being distinctively smaller and with spicate (unbranched) inflorescences, while the latter is a much larger plant with inflorescences typically having up to five rachillae. There are no intermediate forms, and their ranges do not appear to overlap. *Chamaedorea geonomiformis* is restricted to lower elevations in Belize, Guatemala, Honduras and México while *C. tenella* occurs at middle elevations in México and low elevations in Costa Rica.

The case of *Chamaedorea minima*, *C. sullivaniorum* and *C. pumila* is somewhat more

Table 2. *Chamaedorea* synonymized by Grayum (1998, 2003) since publication of CP in 1992.

Previous Name	Accepted Name
<i>C. chazdoniae</i>	<i>C. dammeriana</i>
<i>C. coralliformis</i>	<i>C. crucensis</i>
<i>C. minima</i>	<i>C. pumila</i>
<i>C. pedunculata</i>	<i>C. macrospadix</i>
<i>C. quezalteca</i>	<i>C. costaricana</i>
<i>C. selvae</i>	<i>C. lucidifrons</i>
<i>C. sullivaniorum</i>	<i>C. pumila</i>
<i>C. tenella</i>	<i>C. geonomiformis</i>

troubling. While the three species do represent somewhat of a continuum but with three clearly demarcated entities, with *C. minima* (Fig. 14) the smallest and *C. sullivaniorum* (Fig. 15) the largest, both these latter species grow side by side in at least one location in wet mountain rain forest on the Pacific slope of Costa Rica (with *C. piscifolia*!) and there are no intermediate forms, suggesting that the two are distinct.

In the case of *Chamaedorea selvae* being put into *C. lucidifrons*, I had suggested this change as early as 1996 (Hodel & Binder 1996) and Grayum did it formally (2003). It has now appeared as a synonym in the on-line Kew World Checklist of Selected Plant Families (Govaerts et al. 2011). In our 1996 account, I copiously illustrated *C. lucidifrons*, which enhanced the description and one illustration of this species I had included in *CP*.

In another noteworthy case of synonymy, Ramón Zuñiga of the Escuela Agrícola Panamericana in Honduras, Juan José Castillo and I proposed (successfully as it turned out) that the name *Chamaedorea seifrizii*, a well-known, widely cultivated and commercially important species, should be conserved over *C. donnell-smithii*, an earlier name for an obscure, mostly unknown species (Hodel et al. 1995c). In *CP* I treated *C. donnell-smithii* as an imperfectly known species because the original specimen was a leaf fragment and the meager description told us little about this plant. In 1994 Ramón, Juan José and I visited the type locality of *C. donnell-smithii* in Honduras, and the only palm we encountered at the site was *C. seifrizii*. Comparing the leaf fragment of the original material of *C. donnell-smithii* to the

leaf of *C. seifrizii* showed that they were a good match, clearly suggesting that they were one and the same (Hodel et al. 1995a). Because the rules of botanical nomenclature state that older names generally have priority, the newer but well-known *C. seifrizii* should become a synonym of the older but poorly known *C. donnell-smithii*, a situation that would have created chaos and confusion in the commercial horticultural trade and in the botanical world concerning the appropriate name for this species. Fortunately, the rules make exceptions for special cases like ours where the older name is poorly known and little used while the newer name is well known and widely used. We argued successfully on these grounds that *C. seifrizii* should be conserved over *C. donnell-smithii*, effectively rejecting the older, latter name and making it a synonym of the newer *C. seifrizii*.

Sometimes, when new information comes to light, species that were once considered synonyms of other species can be taken out of synonymy and “resurrected.” This case is exactly what happened with *Chamaedorea schippii*, an unusual, multi-stemmed species with long-pinnate leaves and multi-nerved pinnae from limestone hills in Belize and

9. *Chamaedorea piscifolia* is one of the most distinctive species in the genus, ranking with *C. tenerima* and *C. tuerckheimii* (potato-chip palm) for unusual leaves (Hodel 1239, Pacific slope, Costa Rica).





10 (top). The spicate or few-branched inflorescences (center right) of *Chamaedorea piscifolia* are borne at a distance (60 to 90 cm) from the leaves on slender, bare, creeping, prostrate, often buried stems (Hodel 1239, Pacific slope, Costa Rica). 11 (bottom). *Chamaedorea rossteniorum* has simple, bifid leaves and long inflorescences (cultivated, Lyon Arboretum, Hodel 1541 bis, ex Atlantic slope, Costa Rica).

Guatemala. In *CP I* I treated *C. schippii* as a synonym of *C. graminifolia*, a poorly known species from Costa Rica that had not been collected or seen there in over 75 years and was

thought to be extinct. In 1994 I began to suspect that the two species were actually distinct after I saw cultivated material that I interpreted as *C. graminifolia* in the nursery of

Gerardo Herrera outside San José, Costa Rica and that he had collected on Cerro Nimaso in the remote, rugged, wet mountains of eastern Costa Rica (Fig. 16). This cultivated material was solitary stemmed and had numerous, straight, long, narrow, one-nerved, grass-like pinnae, both of which make it distinct from *C. schippii*. I returned to Los Angeles with a few small plants that Gerardo gave me and when they flowered in the *Chamaedorea* Research Collection the staminate flowers had free and spreading petal tips rather than the connate petal tips of *C. schippii*. Later Michael Grayum resurrected *C. schippii*, basing his decision on a review of the literature and an examination of the original material of both species, old, historic specimens and the living plants of *C. graminifolia* in Herrera's nursery.

Chamaedorea graminifolia differs from *C. schippii* in its solitary rather than multi-stemmed habit, one-nerved, bright green rather than multi-nerved, grayish or dull green pinnae, and staminate flowers with petal tips free rather than connate. All illustrations captioned as *C. graminifolia* in *CP* are actually *C. schippii*. The resurrection of *C. schippii* affects

the name of one of the parents I listed for *C.* × 'Irving Cantor' when I named this hybrid in *CP* (p. 226). I listed *C. graminifolia* as one of the parents (along with *C. pochutlensis*), but because the material used in this hybrid was from southern Mexico, Guatemala or Belize, *C. schippii* rather than *C. graminifolia* should be listed as one of the parents.

A discussion about nomenclatural changes in *Chamaedorea* would be incomplete without addressing the case of the suggested synonyms in the Henderson et al. (1995) treatment of American palms. While it is an excellent work, I feel that the authors were somewhat overzealous in their reduction of many *Chamaedorea* names to synonyms. While a few of these reductions have been verified, most have not. They seemingly ignored critical floral and other differences and suggested the lumping of species in several "species pairs" that were similar only in habit and perhaps slightly in leaf. For example, they noted that with the pairs *C. amabilis*–*C. sullivaniorum*, *C. palmeriana*–*C. pumila*, *C. pinnatifrons*–*C. oblongata*, *C. glaucifolia*–*C. plumosa*, *C. geonomiformis*–*C. rigida* and *C. graminifolia*–*C.*

12 (left). *Chamaedorea rossteniorum* occurs on the Atlantic slope of Costa Rica (Hodel 1541). 13 (right). *Chamaedorea incrustata* is unique in the genus by virtue of its conspicuously rough, crusty rachis and rachillae. (Hodel 1532, Pacific slope, Costa Rica).

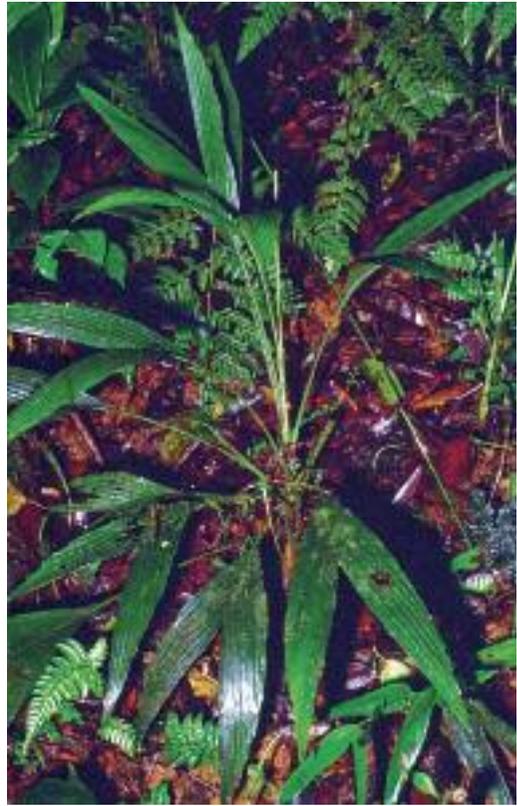


seifrizii, among many others, that the floral differences might simply be a variation in the degree of staminate petal spreading and that they are not really distinct species. They discounted or ignored other critical characters, like petal thickness and nervation, leaf blade thickness, texture and nervation and differences in stems and leaf attachment. I have intimate knowledge of all these species, having observed and photographed them in the wild, examined countless herbarium collections, and, in many cases, grown them into mature plants from seeds. I can say without a doubt that the species in these pairs and others are distinct species, and evolving DNA evidence has to a large extent supported my position (Cuenca & Asmussen-Lange 2005, Thomas et al. 2006).

Thomas et al. (2006) also showed, though, that the less species-rich subgenera are convincingly monophyletic and can be distinguished using morphological characters while, in contrast, the two largest subgenera, *Chamaedorea* and *Chamaedoropsis*, which I distinguished from each other primarily by the degree of connation in the staminate petals, are both resolved as highly polyphyletic, indicating that this character used to distinguish them is unreliable.

New Information

In December 1989 my late father and I were in moist oak-pine forest and cloud forest well up on the rugged, dirt road from the then sleepy, Pacific surfside hamlet of Puerto Escondido to the city of Oaxaca in Oaxaca, México. As was typically the case when my father accompanied me on plant exploration trips, he stayed in the auto parked along the road and contentedly read a book while I wandered off into the forest. Under oaks and pines and among large, smooth rocks on steep, decomposed granite slopes above the road, I found a rather nondescript, pinnate-leaved *Chamaedorea* that I initially thought was solitary stemmed, like *C. oblongata* or *C. pinnatifrons*. However, I quickly realized that it was multi-stemmed when I tried to gather one for a herbarium specimen and traced the base of the stem to a rhizome that extended to another plant nearly three meters away! I was unaware of any *Chamaedorea* with such widely spreading, rhizomatous stems. I was nearly breathless with excitement as I searched for flowers or fruits but found neither, so I had to be content with gathering a few pieces of rhizomes to try to establish this plant in the *Chamaedorea* Research Collection.



14. In wet, rich, mountain forest on the Pacific slope of Costa Rica, *Chamaedorea minima* (Hodel 1537) occurs with *C. sullivaniorum* (see Fig. 15) and there are no intermediate forms, suggesting that the two are distinct.

Based on its strongly rhizomatous habit, I named this species *Chamaedorea rhizomatosa* and included it in subgenus *Chamaedoropsis* in *CP* but only somewhat tentatively because staminate flowers were lacking. The pieces of rhizomes I had brought back to Los Angeles grew vigorously and plants flowered for the first time in December 1992 (Fig. 17). All the plants were staminate, even though I had selected pieces of rhizomes from different locations several meters distant. Much to my surprise and excitement, they were not the typical yellow flowers with spreading petal tips characteristic of subgenus *Chamaedoropsis*. Instead, they had bright orange, thick, fleshy petals hooded over the shorter stamens and pistillode, clearly placing this species in the distinctive and popular subgenus *Eleutheropetalum*, which includes *C. ernesti-augustii*, *C. metallica*, *C. sartorii* and *C. stolonifera*!

Chamaedorea rhizomatosa has pinnate leaves similar to those of *C. sartorii* and the rhizomatous habit of *C. stolonifera*, although

even more excessively so, making it a most intriguing species. An unusually vigorous grower, one small piece of rhizome in December 1989 grew into a plant with three

stems each about a meter tall that I planted out in 1994. By 2004 it had 12 stems to three meters tall, numerous smaller stems, and had spread to cover an area about three meters

15 (top). *Chamaedorea sullivaniorum* (Hodel 1535) occurring with *C. minima* (see Fig. 14). 16 (bottom). The elusive and poorly known but aptly named *Chamaedorea graminifolia* is solitary stemmed and has numerous, narrow, grass-like pinnae (cultivated, San Jose, Costa Rica).



long and six meters wide. Its rhizomes and method of spreading or colonizing are remarkable. From a vertical "mother" stem several rhizomes radiate underground to two meters or more away, each giving rise to a new vertical stem that will in turn form new rhizomes that again spread in all directions, repeating the process indefinitely. Perhaps this rhizomatous habit is an adaptation for survival among the large rocks and steep, shifting, decomposed granite substrate (Fig. 18).

Because all the rhizome pieces I collected in 1989 for the *Chamaedorea* Research Collection grew into staminate plants, I believe that they were all from an extensive, wide-spreading colony of a single plant. This colony was at least 10 meters wide. Unfortunately, pistillate flowers and fruits are unknown for *Chamaedorea rhizomatosa*, but because of its vigorous growth, I have been able to make divisions of the rhizomes and share the species with growers, collectors and gardens in southern California and Australia.

17. *Chamaedorea rhizomatosa* is a vigorous grower in the *Chamaedorea* Research Collection, producing 12 stems to three meters tall, numerous smaller stems, and spreading to cover an area about three meters long and six meters wide (Hodel 936 bis).



Another remarkable species of *Chamaedorea* that deserves attention because it has performed so well in the *Chamaedorea* Research Collection is a unique simple-leaved form of the typically pinnate-leaved, climbing and vining *C. elatior*. Of the several distinct forms of *C. elatior*, the most common and widespread one, which occurs on the Pacific slope of Chiapas, Mexico and Atlantic slopes of Guatemala, Honduras and México, has a solitary, moderately robust stem with strongly reflexed, hook-like pinnae. Although having pinnate leaves as an adult, this form has large, simple and bifid juvenile leaves. A second form of *C. elatior*, which occurs less frequently on the Atlantic slope in México and typically at higher elevations, is cespitose and has pinnate leaves with softer, more weakly reflexed terminal pinnae and slender stems that branch at the base and as much as a meter or more above the ground. A third form on the Pacific slope of Guatemala is solitary with robust, long stems and leaves, the latter of which are noteworthy for their length and great number of long, narrow, straight, grass-like pinnae. These last two forms have pinnate leaves during late juvenile stages, but I am unaware if they have simple leaves during early juvenile stages.

In early 1993, Inge Hoffmann, Juan José Castillo and I observed a fourth form of *Chamaedorea elatior* on jagged, razor-sharp limestone rocks at low elevation in Veracruz near the border with Oaxaca on the isthmus of Tehuantepec in México (Hodel & Castillo-Mont 1995). Ed Carlson and Loran Whitelock, plant aficionados in southern California who had encountered this unusual form with huge, simple and bifid leaves and apparently non-climbing stems in 1992, felt it was a new species of *Chamaedorea* and had tipped me off about its whereabouts. While I suspected it might be a form of *C. elatior*, Ed and Loran were adamant that it was not. Nonetheless, Inge, Juan José and I found this most unusual and striking *Chamaedorea* in wet, lowland forest where it was rather abundant and conspicuous on great, jumbled, limestone rocks (Fig. 19). The uneven, sometimes shifting, exceedingly sharp rocks, riddled with obscured sink holes and shafts, made exploring the site tedious and dangerous. This striking plant has a robust rosette of meter-long, simple and bifid leaves and reminds one in habit of some of the other, better known, neotropical simple-leaved palms like *Asterogyne martiana*, *Calyptrogyne ghiesbreghtiana* and *Geonoma* spp.



18 (top). The creeping, rhizomatous habit of *Chamaedorea rhizomatosa* might be an adaptation for survival in a rocky habitat (*Hodel 936 bis*, cultivated, *Chamaedorea* Research Collection). 19 (bottom). Juan José Castillo provides scale for this most unusual and striking, simple-leaved form of *Chamaedorea elatior* in wet, lowland forest in Oaxaca, Mexico (*Hodel 1169*).

We surveyed about 150 plants in the area and, while they were flowering and fruiting with their huge, simple leaves and showing no inclination to climb, we eventually discovered

a few, simple-leaved plants that had the newest leaf or two showing a pinnate blade with the reflexed, hook-like pinnae typical of *C. elatior*. A close examination of flowers and fruits



20. Marianne Hodel stands with a fruiting plant of the dramatic, simple-leaved form of *Chamaedorea elatior* that, after five years, is just beginning to hint at its climbing nature (Hodel 1170 bis, cultivated, *Chamaedorea* Research Collection).

showed that this plant with simple adult leaves was, indeed, *C. elatior*, albeit a highly unusual form.

Plants grown from seeds collected at the site and now in the *Chamaedorea* Research Collection flower and fruit with these huge, striking, simple leaves and have produced multiple generations over the last 20 years (Fig. 20). However, after about five years of producing these large, spectacular leaves and about one to two years after flowering and fruiting, they soon disappoint, producing increasingly elongated internodes and pinnate leaves with reflexed, hook-like pinnae, and the heavy, intractable plant begins to climb. Nonetheless, for a few years this most unusual but striking and handsome plant, which sustained no damage during the January 2007 freeze and has proven hardy and easy to grow outdoors in subtropical regions like southern California, would make an excellent substitute for the tropical, more tender species of *Asterogyne*, *Calyptogyne*, *Geonoma*, *Hydriastele* and *Iguanura*, which are much celebrated and sought after for their handsome simple leaves yet are difficult, if not impossible to grow in arid and/or subtropical climates.

Conclusion

Nearly all the newly developed information in *Chamaedorea* over the 20 years since *CP* was published has enlightened and enriched our understanding of this remarkable group of palms. Sadly, habitat destruction and zealous collecting have pushed several species to extinction or nearly so. I am often asked if there are new discoveries waiting to be made in *Chamaedorea*. I believe the answer is yes, and I look forward to the time when I can review the new collections that botanical institutions, like the Missouri Botanical Garden, have made over the last 20 years. Perhaps I shall be pleasantly surprised and rewarded with a species or two that is new to science.

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New Species of *Calamus* from Cambodia

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Two new species of *Calamus* from Cambodia are described and illustrated, and compared with similar species.

Calamus, the largest genus of palms, contains 374 species (Govaerts & Dransfield 2005), widely distributed throughout the Asian tropics with outliers in Africa and the Pacific. In the course of a revision of the genus (Henderson, in prep.), the following new species have been collected in Cambodia.

Calamus mellitus Henderson & Khou Eang Hourt, **sp. nov.**, differs from related species (*C. gracilis*, *C. melanacanthus* and *C. lateralis*) in its clustered habit and irregular seeds. Type. Cambodia. Battambang: Samlot district, Takoak commune, Phnom Rey village, 12.494°N, 102.754°E, ca. 200 m, 4 February 2013, A. Henderson, Khou Eang Hourt, Chey Koulang, Ou Ratanak, Tam Le Viet & Prak Ousopha 3839 (Holotype: RUPP; Isotypes: AAU, NY). (Fig. 1)

Stems clustered, climbing, 10–100 m long, 1.2–2.5 cm diameter with sheaths, with a mound of visible roots at the base. Leaf sheaths tubular, closed opposite the petioles, green with whitish and brownish tomentum giving a mottled appearance, with short, swollen-based, scattered spines to 0.5 cm long; knees present; ocreas scarcely developed, with two low, lateral ridges either side of sheath, absent from adaxial petiole surface; flagella present, well-developed; petioles 6.8–34.0 cm long;

rachises 45.7–90.5 cm long; pinnae 25–27 per side of rachis, regularly arranged, linear, the middle ones 21.5–41.5 cm long, 1.1–1.7 cm wide, the apical pair free almost to the base; cirri absent. Inflorescences arching, the partial inflorescences branched, the rachis bracts tubular, narrow, briefly splitting at the apices; staminate inflorescences not seen; pistillate inflorescences 200 cm long, narrow and elongate, with long flagellate apices; partial pistillate inflorescences an open raceme, with spreading rachillae to 8.2 cm long; fruiting perianths tubular; fruits ellipsoid, 21.2 mm long, 15.3 mm diameter, orange-brown, 1-seeded; seeds covered with a tanniniferous sarcotesta, seeds irregularly ellipsoid, the surfaces pitted; endosperm with numerous, deep, pit-like ruminations; embryos lateral in seed.

Local names and uses: *toek kamon*, *phdao toekkhmun*. The palm is locally known as the honey rattan because its cut stems smell of honey. It produces a good quality, flexible cane exported to both Thailand and Vietnam.

Distribution and habitat: Cambodia (Battambang, Pursat) in lowland or montane evergreen forest, at 200–927 m elevation.

Notes: In Khou (2009) this species was listed as *Calamus* sp. Specimens will not key in either



1. *Calamus mellitus*. A. habit. B. Leaf sheath showing insertion of flagella. C. Leaf. D. Fruit.

Henderson (2009) or Hodel (1998). In the course of a revision of *Calamus* (Henderson, in prep.), phylogenetic analysis of morphological

data comprising 90 characters taken from 2424 specimens representing 283 species of *Calamus*, two of *Ceratolobus*, six of *Daemonorops*, two of



2. *Calamus kampucheaensis*. A. base of stem with shoots. B. Leaves. C. Leaf sheath and ocreas. D. Spicate partial pistillate inflorescence.

Pogonotium, and one of *Retispatha*, with *Plectocomia* as outgroup, shows that *Calamus mellitus* is placed in a clade along with *C. gracilis*, *C. melanacanthus*, and *C. lateralis*. All four species have rather distinctive, mottled tomentum on the leaf sheaths and inflorescences, and seeds with lateral embryos. They also share a distinctive arrangement of knees and flagella. Knees are keeled from the base of the petiole downwards, and the flagella, inserted high on the sheath, has two lateral ridges running from the point of insertion to the sheath apex. *Calamus mellitus* differs from *C. lateralis* in its clustered stems and ruminant endosperm; from *C. gracilis* in its regularly arranged pinnae; and from *C. melanacanthus* in its irregularly shaped seeds with pitted surfaces (versus regularly shaped seeds with highly sculpted, irregular surfaces).

Additional specimens examined.

CAMBODIA. PURSAT: Veal Veng district, Khnang 1500, Yeay Mao area, on the road to Thmor Da, Anlung Reap commune, 12.210N, 102.902E, 927 m, 5 February 2013, A. Henderson, Khou Eang Hourt, Chey Koulang, Ou Ratanak, Tam Le Viet & Prak Ousopha 3840 (NY, RUPP); Veal Veng district, village 80, commune Anlung Reap, 12.241N, 102.923E, 350 m, 6 February 2013, A. Henderson, Khou Eang Hourt & Chey Koulang 3843 (NY, RUPP).

Calamus kampucheaensis Henderson & Khou Eang Hourt, **sp. nov.**, differs from other related species (*C. modestus*, *C. dianbaiensis*, *C. wuliangshanensis*, *C. rhabdocladus*, *C. yentuensis*, *C. albidus* and *C. macrorhynchus*) in its spicate partial inflorescences and production of bulbils on the inflorescences. Type: Cambodia. Pursat: Veal Veng district, Anlung Reap commune, Khnang 1500, Yeay Mao area, on the road to Thmor Da, 12.201°N, 102.904°E, 1200 m, 6 February 2013. A. Henderson, Khou Eang Hourt & Chey Koulang 3842 (Holotype: RUPP; Isotypes: AAU, NY). (Fig. 2)

Stems clustered, non-climbing, to 2 m long and 2.5 cm diameter without sheaths, green, with 6 cm long internodes, with new shoots forming on the stem at or near the base. Leaf sheaths open opposite the petioles, densely brown tomentose, with ridges with long, flat, brown spines, the longest ones to 6 cm long, interspersed with shorter spines; knees absent; ocreas well-developed, to 23 cm long, tubular but splitting as leaves develop, with erect spines at the apices; flagella absent; petioles 65–70 cm long, with groups or whorls of long spines as the sheath; rachises 35–42 cm long,



3. *Calamus kampucheaensis*, young plant forming at end of inflorescence.

with long, straight spines abaxially; pinnae 77–98 per side of rachis, regularly arranged (somewhat irregular in younger plants), linear, the middle ones 32 cm long, 1.4 cm wide, the apical pair free almost to the base; cirri absent. Inflorescences erect, to 1 m long, the partial inflorescences spicate, the bracts tattering; on some plants the inflorescences shorter, without any reproductive structures but the apex bulbous and forming a new plant; staminate inflorescences with 8 or more partial inflorescences; rachillae to 6 cm long, pedicellate; staminate flowers 7 mm long; sepals forming a 3-lobed corolla to 6 mm long; petals free, valvate; stamens 7, the filaments inflexed at the apices; pistillate inflorescences with 2 partial inflorescences; rachillae 9 cm long, pedicellate; pistillate flowers 8 mm long; sepals forming a 3-lobed corolla to 5 mm long; petals almost the same length as sepals. Fruits not known.

Local names and uses: *phdao banla dong penh*. No uses recorded.

Distribution and habitat: Cambodia (Pursat) in montane evergreen forest above 1200 m elevation. Local people report this species from several mountain tops in the Cardamom Mountains, e.g., Phnom Khmoach in Pursat province, Phnom Khnang Veal in Kampong

Speu province, and Khnang Lok in Koh Kong province.

Notes: In Khou (2009) this species was noted as being unknown. Specimens will not key in either Henderson (2009) or Hodel (1998). In same study of *Calamus* cited above (Henderson, in prep.), *Calamus kampucheaensis* is placed in a clade along with a group of Indochinese, mostly non-climbing species (*C. modestus*, *C. dianbaiensis*, *C. wuliangshanensis*, *C. rhabdocladus*, *C. yentuensis*, *C. albidus*, *C. macrorhynchus*). *Calamus temii*, although not included in this study, also appears to belong in this group. *Calamus kampucheaensis* differs from all of these in its spicate partial inflorescences and production of bulbils on some inflorescences.

Calamus kampucheaensis has a variety of means of reproducing, apart from sexual reproduction. Young plants form on the stem at or near the base (Fig. 2A). Similar young plants form, first as bulbils, at the apices of inflorescences (Fig. 3). The species also reproduces by older stems bending down and

rooting at or near the apices, where they touch the soil, in a similar manner to *C. dianbaiensis*.

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Floral Structure in the Neotropical Tribes Leopoldinieae and Manicarieae (Arecaceae: Arecoideae)

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Floral structure is studied in detail for the first time in the monogeneric neotropical tribes Leopoldinieae and Manicarieae (Arecaceae). In order to infer taxonomic relationships of these groups, morphological and anatomical data in members of the two tribes are compared with available studies in other tribes of the basal clades of the core arecoids, as defined by recent molecular phylogenies. Our results suggest an isolated position for *Manicaria* and highlight unexpected affinities between the tribe Leopoldinieae and representatives of the western Pacific Ocean tribe Pelagodoxeae.

The genus *Leopoldinia*, dedicated to the archduchess of Austria, Josefa Carolina Leopoldina, was described in 1824 by the celebrated palm botanist Carl F. P. von Martius (1794–1868) (Figs. 1–6). It represents the single representative of the neotropical tribe Leopoldinieae (Martius 1824). The genus *Manicaria* was described in 1791 by the German botanist Joseph Gaertner (1732–1791) and corresponds with the single representative

of the tribe Manicarieae, as defined by Dransfield et al. (2008) (Figs. 7–12). These two remarkable monogeneric tribes belong to the large subfamily Arecoideae, known to be the largest and most diverse subfamily within palms (Dransfield et al. 2008). The tribes Manicarieae and Leopoldinieae represent two basal lineages of the core arecoid clade as defined by Baker and Couvreur (2012), here called “basal core arecoids,” including also

tribes Pelagodoxeae, Euterpeae and Geonomateae.

The number of species within *Leopoldinia* and *Manicaria* remains a subject of taxonomic debate. In the case of *Leopoldinia*, different numbers of species have been proposed since the description of the genus. Hence, Martius (1824) recognized two species, whereas Wallace (1853) increased the number to three, a taxonomic point of view that was supported by Henderson (1995). Bernal and Galeano (2010) recognized only two species and more recently, Henderson (2011) proposed that all species published so far for the genus (*L. piassaba* Wallace, *L. major* Wallace and *L. pulchra* Mart.) should be recognized as valid. A similar situation can be traced in *Manicaria*, a genus described by Gaertner (1791) based on only one species (*Manicaria saccifera* Gaertn.). Different taxonomic and floristic treatments on the genus have recognized three species (i.e. Wessels Boer 1988) or only one (i.e. Henderson 1995). More recently, Bernal and Galeano (2010) have recognized *M. martiana* Burret and *M. saccifera* Gaertn. as the only two accepted species for the genus.

Both genera are distributed in the neotropical region. *Manicaria* has a wide distribution, ranging from Central America, across Trinidad, the Orinoco Delta and the Guianas to the lower Amazon River (Dransfield et al. 2008). In contrast, *Leopoldinia* is an endemic palm genus of the Amazon basin, restricted to the Rio Negro and upper Orinoco region of Venezuela, Colombia and Brazil (Dransfield et al. 2008, Henderson 1995, Stauffer 2000). Representatives of both genera have been reported to be economically important for indigenous groups of the Amazon and Orinoco basins. At least two species of *Leopoldinia* (*L. piassaba*, *L. pulchra*) have been reported as economically important for their stems (Fig. 6), fibers, leaves and fruits (Putz 1979), whereas the leaves of *Manicaria* are used primarily for thatching (Dransfield et al. 2008) by ethnic groups such as the Warao Indians from the Orinoco delta region (Fig. 12).

The molecular phylogenetic relationships of Leopoldinieae and Manicarieae with the remaining tribes of Arecoideae are not yet completely understood. Both tribes are included in the "core" arecoid clade, but their precise position remains unclear (Dransfield et al. 2008). The Manicarieae was found to be sister to the Geonomateae in the RFLP tree of Uhl et al. (1995); this relationship was

suggested also by Asmussen et al. (2006) in the Plastid DNA tree and supported by the supertree of Baker et al. (2009). However, the *prk*-based phylogeny of Lewis and Doyle (2002) and the combined *prk* & *rpb2* tree of Baker et al. (2011) placed the Manicarieae as sister to a clade composed of the tribes Euterpeae, Leopoldinieae, Pelagodoxeae, Geonomateae and included the tribe Leopoldinieae in their plastid DNA tree for the first time in a molecular phylogeny of the palm family. In this analysis the tribe was resolved as sister to the Manicarieae. Later, the Leopoldinieae was resolved as sister to Euterpeae (Lewis & Doyle 2002, Loo et al. 2006) and as sister to the Areceae/Euterpeae, Geonomateae and Manicarieae clades in the plastid DNA tree of Hahn (2002). A sister relationship of Leopoldinieae with the Manicarieae/Geonomateae clade was indicated by Asmussen et al. (2006) and recovered by the study of Baker et al. (2009). In all these phylogenies the relationships of the tribe Leopoldinieae with other arecoid groups was always resolved with low bootstrap support. Norup et al. (2006) proposed a sister relationship, although with moderate bootstrap support, between Leopoldinieae and Pelagodoxeae, the latter endemic to the Marquesas Islands and the western half of the mainland New Guinea. The same relationship was recovered by Baker et al. (2011), with strong bootstrap support. This relationship is surprising because both tribes, Leopoldinieae and Pelagodoxeae, display highly disjunct and geographically isolated distribution patterns (Dransfield et al. 2008). The most recent molecular phylogenetic analysis of the palm family confirms previous studies in which Leopoldinieae is resolved as sister to a clade composed of the tribes Geonomateae and Manicarieae (Baker & Couvreur 2012). The Old World tribe Pelagodoxeae, composed of the genera *Pelagodoxa* and *Sommieria*, remains relatively close in the topology presented.

Morphology and anatomy of palm reproductive structures have been studied in detail in only 4% of the almost 2500 palm species (Stauffer et al. 2002). Floral structure, especially anatomy has never been studied in detail in *Leopoldinia* and *Manicaria*. Information on gross morphological characters has been provided for members in all tribes of the basal core arecoids (Dransfield et al. 2008), but the floral structure has been studied in detail in only three of them: Pelagodoxeae (Stauffer et al. 2004), Geonomateae (Stauffer & Endress

2003, Stauffer et al. 2003), and Euterpeae (Kuchmeister et al. 1997). As a contribution to the understanding of the reproductive structures in arecoid palms and in order to explore relationships of the two enigmatic monogeneric tribes Leopoldinieae and Manicarieae within the core arecoid clade, a thorough study of the floral structures of *Leopoldinia piassaba*, *Leopoldinia pulchra* and *Manicaria saccifera* has been conducted. The specific aims of the present study are (1) to contribute to a better understanding of the floral structure of the neotropical tribes Leopoldinieae and Manicarieae and (2) to explore the systematic relationships of Leopoldinieae and Manicarieae with other groups of the basal clade of the core arecoids using floral structural characters.

Materials and Methods

The morphological and anatomical study was based on flowers collected from wild populations and fixed in alcohol (Table 1). Inflorescences at several stages of development and young infructescences of *L. piassaba* and *L. pulchra* were collected by Dr. Lorena Guevara (Venezuelan Central University) and also obtained from the spirit collection of the L. H. Bailey Hortorium (Cornell University, Ithaca, USA). In both cases the material was originally

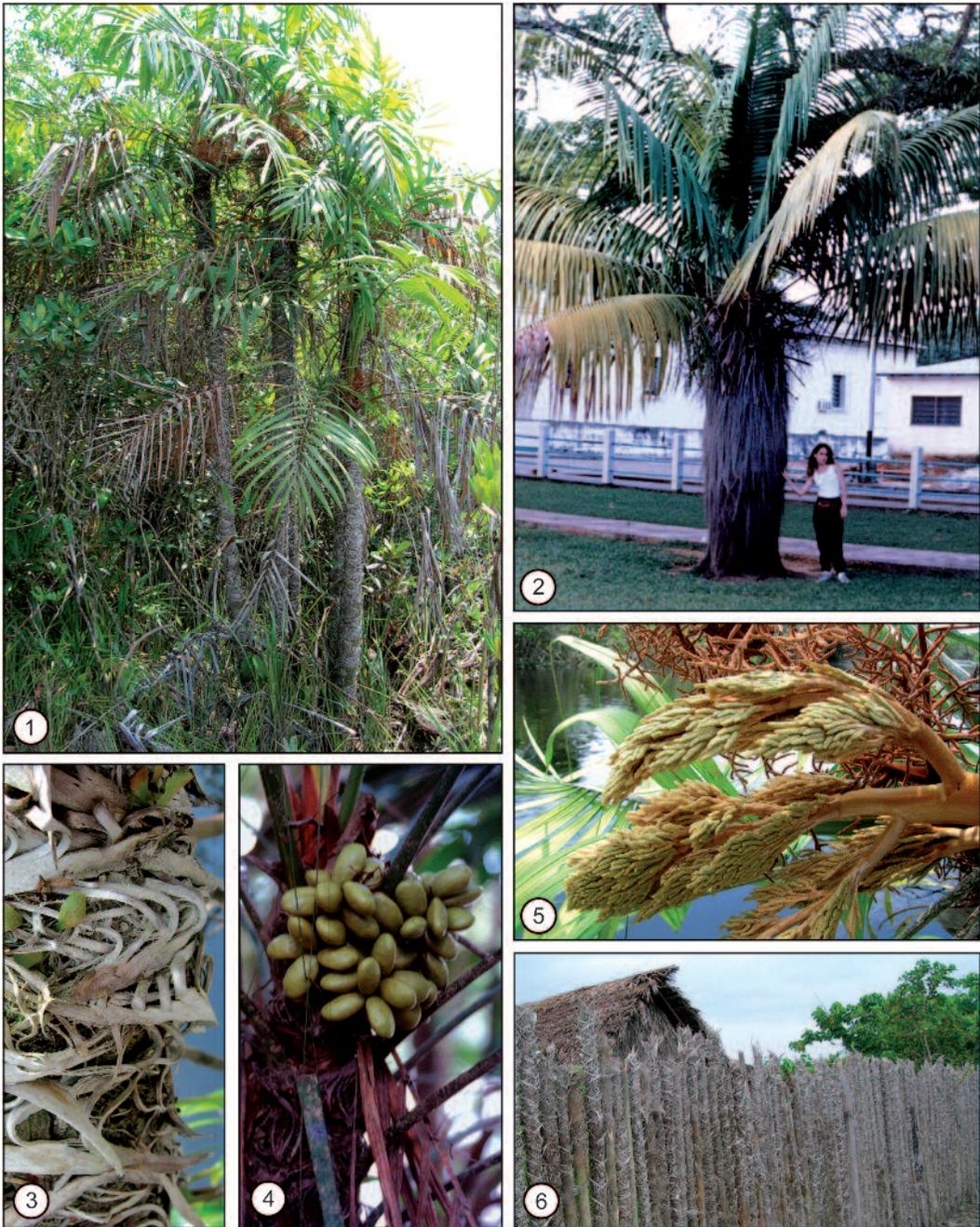
collected in the Venezuelan Amazon. Male and female flowers at bud stage of *M. saccifera* were collected by FWS in the Orinoco Delta (Venezuela).

For the anatomical investigations, small fragments of rachillae or individual flowers were evacuated, dehydrated and embedded in the resin Kulzer's Technovit 7100 (2-hydroxyethyl methacrylate [HEMA]). Further details of this techniques are given in Igersheim and Cichocki (1996). The material was serially cross sectioned and longitudinally sectioned at 7–10 µm using a rotary microtome (Leitz 1512), stained with ruthenium red and toluidine blue and mounted in Assistant-Histokitt mounting medium. Observations and photographs were made with a digital light microscope (NIKON Eclipse 80i) at the Laboratory of Cytology and Vegetal Histology (University of Geneva); the permanent slides were deposited at the Laboratory of Micro-Morphology of the Conservatory and Botanical Garden of Geneva.

For scanning electron microscopy (SEM), fragments of inflorescences, individual flowers and individual floral organs were dehydrated, critical-point dried and sputter-coated with gold. Micrographs were obtained using a Zeiss DSM 940A SEM (Orion 6.60 Imaging System)

Table 1. Plant material studied

Species	Collection	Reproductive status	Repository
<i>Leopoldinia piassaba</i>	Guanchez s.n. (19 Oct. 1990)	Fruits	L.H. Bailey
Wallace	Guanchez s.n. (22 Oct. 1990)	Fruits	Hortorium
	Guanchez s.n.	Pre-anthetic ♀ buds	
	Guanchez 5080	Late ♀ buds	
	Guanchez 5081	♀ buds	
<i>Leopoldinia pulchra</i>	Guanchez 4912	Early fruits	L.H. Bailey
Mart.	Guanchez 4911	Early fruits	Hortorium
	Guanchez s.n. (06 Oct. 1990)	♂ buds	
	Guanchez s.n.	Early ♂ and ♀ buds	
	Guevara 79a	♂ buds	Venezuelan
	Guevara 79b	Early ♂ and ♀ buds	Central Univ.
	Guevara 78	Early ♂ buds	
<i>Manicaria saccifera</i>	Stauffer (Feb. 2012)	Late ♀ and ♂ buds	Conservatory
Gaertn.			and Botanical Garden of Geneva



1. Habit of *Leopoldinia pulchra*. 2. Habit of *L. piassaba*. 3. Stem surface with leaf sheaths of *L. pulchra*. 4. Inflorescence of *L. pulchra*. 5. Inflorescence of *L. pulchra*. 6. Fences constructed with stems of *L. pulchra* by indigenous tribes of the Orinoco region. (photos: L. Guevara and F. Stauffer)

at the Natural History Museum of Geneva, Switzerland.

Results

Flower morphology and anatomy of *Leopoldinia*

The inflorescence is interfoliar and bears unisexual flowers sunken in shallow pits. The

female flowers are solitary or arranged in triads with two male flowers (Fig. 14) flanking one central female flower. Solitary female flowers are usually more robust than the ones borne in combination with male flowers. When not in floral triads, male flowers are either solitary or inserted in dyads; they are surrounded by a brown, dense tomentum (Fig. 13).

The male flowers are sessile, oblong, ovoid, 1 mm long or even smaller in diameter, in all cases smaller than the pistillate flowers. The calyx reaches one-third of the flower length and is composed of three distinct, imbricate, keeled and striate sepals, with toothed margins. The corolla is composed of three distinct, valvate, triangular-ovate petals, with entire margins. The petals are on the inner side marked by the impression of the anthers. The androecium is composed of six, latrorse, dorsifixed stamens (Figs. 15 & 16). Three stamens are antepetalous and three antesepalous. The ones in the antesepalous position are attached at a slightly lower level than the antepetalous. The filaments are short, broad and connate only at the very base; they have inflexed tips. The anthers are short and ovate in a cross-section (Fig. 17). The pistillode has a three-lobed barrel shape.

The female flowers are sessile, globose, 2.5–3 mm long and 2.5–3 mm in diameter at late bud stage. The calyx is composed of three distinct, imbricate, rounded and membranous sepals, with slightly toothed margins. The corolla is composed of three distinct, valvate, rounded petals, with entire margins. The sterile androecium is represented by six reduced staminodes, which are short, flat and truncate. The gynoecium is synascidiate, composed of three postgenitally united carpels, which at mid-height of the ovary become separated. No epithelium that could be associated with a septal nectary was identified in the carpel flanks. The gynoecium is trilocular and triovulate; however, only one ovule fully develops towards anthesis. The stage of development of the ovule characterizes the shape of the gynoecium, ranging from slightly pyramidal to rounded (Figs. 18, 19). The ovule is campylotropous, bitegmic, crassinucellate and hanging; it is laterally attached to the ventral side of the locule and fills the entire cavity (Fig. 20). Towards the micropyle the outer and inner integuments are 8 and 4 cell layers thick, respectively; the micropyle is straight and slightly expanded due to the large obturator. The three stigmatic branches are lined with unicellular papillae. The pollen tube transmitting tract (PTTT) separates downwards in three branches, corresponding to the three locules. It reaches the ovule by surrounding the funiculus.

The base of the female flower is characterized by a six cell layers thick transition zone of square or rhomboid cells that may be interpreted as an abscission zone. Tanniferous

idioblasts were observed in the mesophyll of the gynoecium, especially from the base up to the mid-height of the ovary. Tanniferous idioblasts were also observed in the pistillode of the male flowers. Raphide idioblasts were not seen in the tissues studied.

Flower morphology and anatomy of *Manicaria*

The inflorescence is interfoliar and bears unisexual flowers sunken in pits. The staminate flowers are solitary and spirally arranged on the entire rachillae, whereas only few pistillate flowers concentrate at the base of the rachilla.

The male flowers are oblong, asymmetrical, 5 mm long and 4 mm wide. The calyx is composed of three slightly imbricate, distinct sepals, which are membranous, irregular in size and shape, slightly keeled, with fibrous variously notched margins. The corolla is composed of three, very thick valvate petals (Fig. 25), one remarkably smaller than the others. The petals are distinct and adnate to the base of the filaments of the peripheral stamens. The androecium is polyandrous (Figs. 21, 22, 24), with ca. 20–25 introrsely dehiscent, dorsifixed stamens; the length of the filaments and the anthers, including the shape of the latter, vary according to the position of the stamen in the androecium. Two filaments connate up to the level of the anthers were observed in some flowers; pistillode lacking.

The pistillate flowers are oblong, ovoid, 9 mm long and 6 mm in diameter, slightly compressed and asymmetrical. The calyx is composed of three imbricate sepals, which are distinct, membranous and irregular in size and shape, with fibrous margins. The corolla is composed of three very thick petals, two notably larger than the remaining one. The petals are valvate with an obtuse apex and congenitally fused up to 4–5 mm, with entire margins. Staminodes 9, small, thin, basally adnate to the ovary, upwards free; each staminode is served by one central vascular bundle; six staminodes are antepetalous and oblong in cross-section, whereas three are antesepalous and triangular in cross-section (Fig. 28). The gynoecium is obovoid, composed of three congenitally united carpels; all of them are equally developed at late bud stage, giving to the gynoecium a triangular shape in cross-section (Fig. 29). The ovary region is ovoid, topped with a pyramidal stigma with three clearly differentiated branches; the style is short. The PTTT is common at the stigmatic-



7. Habit of *Manicaria saccifera*. 8. Leaves; 9. Inflorescence. 10. Detail of a cross-sectioned fruit. 11. Portion of inflorescence with male flowers at late bud. 12. Thatching constructed by the Warao Indians in the Orinoco Delta. (photos: L. Guevara and F. Stauffer)

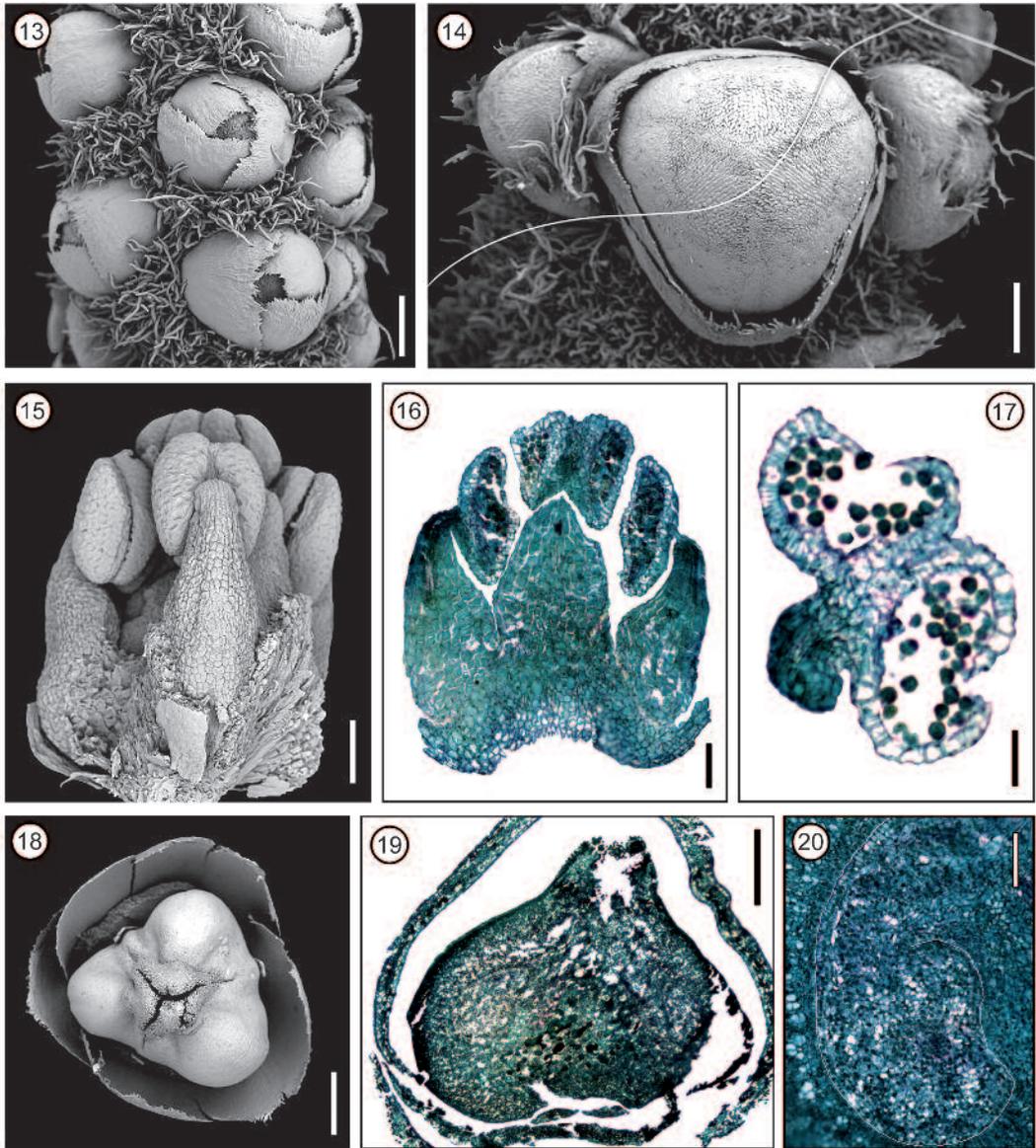
style region and separates downwards in three branches, one directing each locule. It reaches the ovule by surrounding the funiculus. The gynoecium is trilobulate and triovulate. The ovule is anatropous, bitegmic and crassinucellate (Fig. 23). It is attached to the ventral side and in the upper half of the locule and fills the entire cavity.

The whole gynoecium is highly vascularized, especially in the peripheral zones corresponding with the thick ovary walls (Fig. 27). Each carpel is served by one dorsal vascular bundle, 10–12 lateral procambial strands and four ventral vascular bundles. Vascular bundles were also clearly observed in

the region of the chalaza (Fig. 26). Tannins idioblasts concentrate at the base of the gynoecium but were also observed throughout the gynoecium, around the three ovules. These tanniferous idioblasts were not observed in the ovary walls. The lack of tannins in the ovary walls enables to distinguish two types of mesophylls in the cross-section of the gynoecium (Fig. 27). Raphide idioblasts were not seen in the tissues studied.

Discussion

This paper represents a contribution to the knowledge of the floral structure in the tribes Manicarieae and Leopoldinieae. The floral structure of *Leopoldinia* and *Manicaria* had

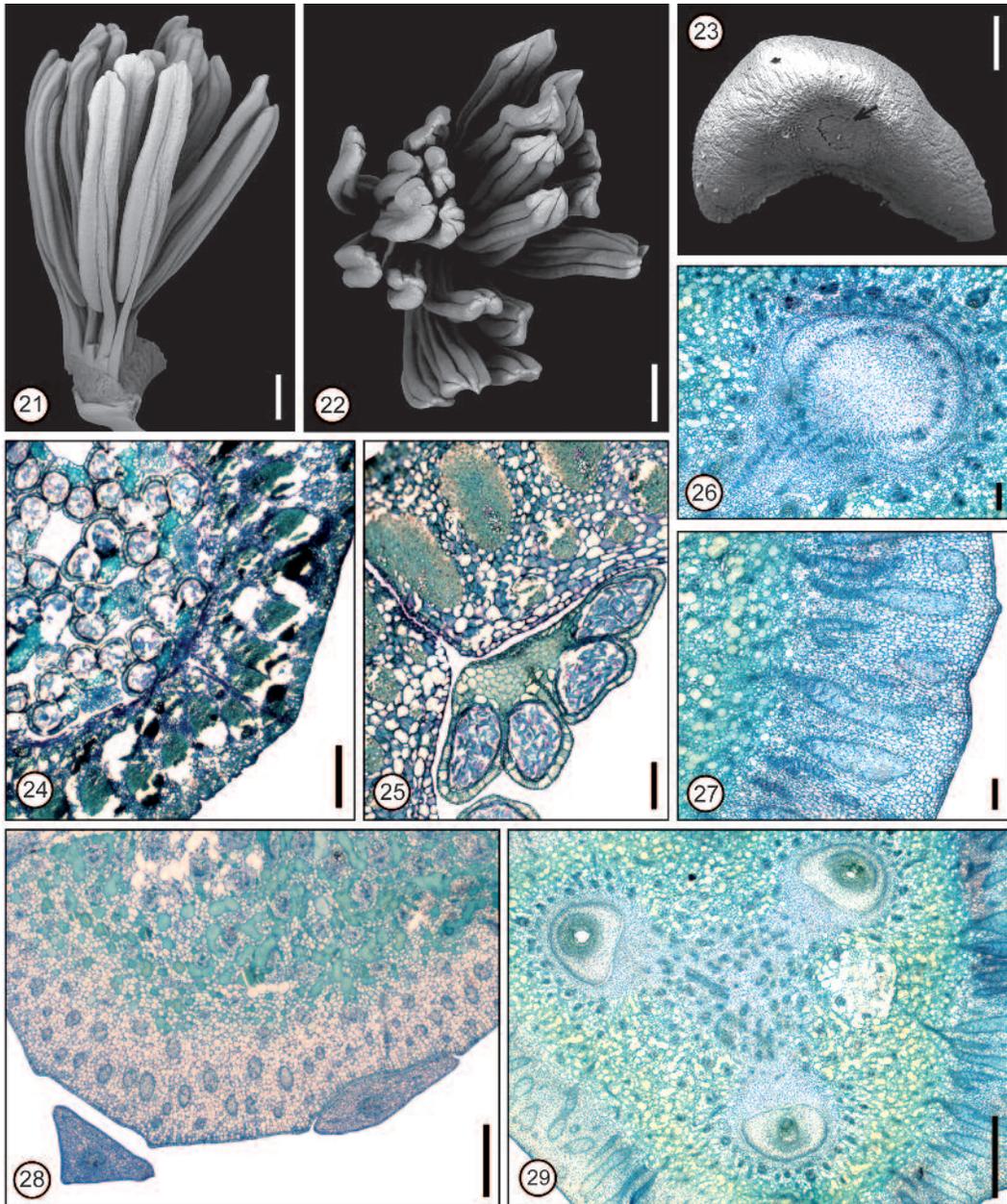


13–20. Morphology and anatomy of the flowers in *Leopoldinia*. 13. Portion of rachilla showing developing male floral buds, note dense hairs covering the rachilla, scale bar = 250 μm ; 14. Portion of rachilla showing a triad composed of one central female flower and two male flowers at bud stage, scale bar = 250 μm ; 15. Side view of a male flower at late bud stage, perianth removed, scale bar = 125 μm ; 16. Longitudinal section of a male flower at late bud stage, perianth removed, scale bar = 100 μm ; 17. Cross-section of an anther, note the well differentiated endothecium, scale bar = 50 μm ; 18. Upper view of female flower at late bud stage, petals removed, scale bar = 500 μm ; 19. Longitudinal section of a female flower at early bud stage, scale bar = 500 μm ; 20. Longitudinal section of an ovule, note micropylar region facing the ventral side of the locule, scale bar = 100 μm .

never previously been studied in detail, in spite of the large economic importance of these palms for indigenous populations in the neotropics and the fact that both taxa display unclear phylogenetic relationships among the taxa of the core arecoid clade.

Leopoldinia and *Manicaria* are characterized by floral triads, at least at the base of the rachillae,

composed of one central female flower and two lateral male flowers sunken in pits. This type of floral arrangement unequivocally supports the inclusion of these two tribes within the subfamily Arecoideae. The two genera display an important number of shared floral characters, namely oblong staminate flowers, with three distinct and imbricate



21–29. Morphology and anatomy of the flowers in *Manicaria*. 21. Side view of a polyandrous male flower, perianth removed, scale bar = 500 μm ; 22. Upper view of a polyandrous male flower, perianth removed, scale bar = 500 μm ; 23. Detail of an ovule, arrow pointing to the micropyle region, scale bar = 100 μm ; 24. Cross-section of a male flower showing anthers, scale bar = 250 μm ; 25. Cross-section of an anther with a detail on the mesophyll of the petal, scale bar = 100 μm ; 26. Cross-section of an ovule showing vascular bundles emerging from the funiculus, scale bar = 100 μm ; 27. Cross-section of the ovary, at the left side mesophyll with tanniferous cells, at the right side thick ovary wall with large vascular bundles, scale bar = 100 μm ; 28. Cross-section of the basal part of the ovary showing two staminodes with different shapes, triangular in antesepalous position and oblong in antepetalous position, scale bar = 250 μm ; 29. Cross-section of the ovary showing three equally developed ovules, scale bar = 500 μm .

sepals with variously notched or toothed margins and three valvate petals. The pistillate flowers are characterized by three distinct and imbricate sepals and three valvate petals; the

gynoecium presents distinct staminodes and a syncarpous, trilobulate, triovulate ovary topped by three stigmatic branches. Contrary to what has been observed in other arecoid groups

(Rudall et al. 2003, Stauffer et al. 2003, Stauffer et al. 2004) septal nectaries were not detected in either of the two genera, suggesting that other possible types of reward attract potential pollinators (e.g. pollen). On the other hand, raphide-containing idioblasts, suggested to be a reward for bee-pollinators (D'Arcy et al. 1996) or as defense devices (Sakai et al. 1972), were not evident in any organs of the flowers. The presence of tanniferous idioblasts throughout the gynoecium in both genera suggests that these inclusions may be regarded as a defense mechanism against herbivores. Interestingly, the absence of the septal nectaries and raphide-containing idioblasts in *Leopoldinia* and *Manicaria* appears to be unique, compared with representatives of other basal core arecoids (Table 2).

In spite of several shared characters, the flowers of *Leopoldinia* differ from *Manicaria* in several important aspects concerning the floral structure. Male flowers of *Leopoldinia* are characterized by the typical monocotyledon trimery, represented by six latrorse, basally connate stamens with broad filaments, and a three-lobed syncarpous pistillode. In the case of *Manicaria*, the male flowers have 20–25 thin, elongated and introrse stamens, and the pistillode is completely lacking. The stamen filaments are rarely connate up to the anthers and the filaments of the peripheral stamens are basally connate to the petals. The female flowers of the two genera differ mostly in the shapes of the gynoecium and perianth parts. *Leopoldinia* is characterized by a pyramidal to rounded gynoecium, rounded petals and sepals. *Manicaria* has on the contrary an obovoid gynoecium with oblong or irregular and asymmetrical sepals and petals.

Although both genera have syncarpous, trilocular and triovulate gynoecia, the gynoecium of *Manicaria* presents three equally developed ovaries at late bud stage, whereas the gynoecium of *Leopoldinia* shows what may be described as late pseudomonometry, in which the fertile ovary and the two sterile ovaries are almost equal in size and shape (Stauffer & Endress 2003). The ovules are campylotropous and hanging in *Leopoldinia*, whereas they are anatropous and laterally attached in *Manicaria*. In the case of *Leopoldinia*, the globose gynoecium is topped by three free stigmatic branches with unicellular papillae, whereas in *Manicaria*, the obovoid gynoecium is topped by a rather smooth pyramidal stigmatic region with connate stigmatic branches. Numerous

stamens in *Manicaria* is characteristic of the male flowers, and female flowers display an increased number of staminodes. *Leopoldinia* has consistently six stamens in the male flowers and six staminodes in the female flowers.

Our study explored the possible taxonomic relationships among representatives of the five tribes of the basal core arecoids, based on comparison with data presented in similar studies of floral structure (Table 2). Indeed, representatives of all five tribes share only a few common characters, namely distinct imbricate sepals, valvate petals, inflexed stamens at bud stage in the male flowers and imbricate sepals and three differentiated stigmatic branches in the female flowers. Morphological and anatomical characters associated with the floral structure of *Leopoldinia* show surprising affinities with flowers of the palm genus *Pelagodoxa* (Table 2), endemic to the Marquesas Islands, and supports the relationships proposed by the molecular studies of Norup et al. (2006) and Baker et al. (2011). *Leopoldinia* and *Pelagodoxa* present oblong male flowers, distinct and imbricate sepals, triangular-ovate valvate petals, six dorsifixed stamens and a syncarpous pistillode. Female flowers of these two genera have distinct and imbricate sepals, distinct petals and more or less rounded, pseudomonomerous, trilobulate, triovulate gynoecia, topped by three stigmas covered with unicellular papillae.

Leopoldinia resembles *Euterpe* only with respect to perianth characters. These two genera have similar distinct, rounded, variously tattered or notched, imbricate sepals, distinct, valvate petals, six wide stamens inflexed at bud stage and three-lobed pistillode in male flowers. Female flowers of *Leopoldinia* and *Euterpe* have similar, distinct, imbricate sepals and distinct petals. Flowers of *Leopoldinia* share with *Geonoma* the presence of distinct and imbricate sepals, valvate petals and three-lobed pistillode in male flowers and imbricate sepals, valvate petals, pseudomonomerous trilobulate gynoecium with papillate stigmatic branches and six staminodes in the female flowers.

Manicarieae does not show evident affinities with any other representative of the basal core arecoids. The surprisingly isolated position of this palm, already suggested by the molecular study of Baker et al. (2011), may be supported by the male flower with many stamens but lacking a pistillode and a clearly trimerous

Table 2. Main floral characters in representatives of the basal core arecoids.

(1) Stauffer et al. 2004; (2) Stauffer et al. 2002, Stauffer & Endress 2003, Dransfield et al. 2008, Wessels Boer 1968; (3) Kuchmeister et al. 1997, Dransfield et al. 2008.

Character	<i>Leopoldinia</i>	<i>Manicaria</i>	<i>Pelagodoxa</i> ¹	<i>Geonoma</i> ²	<i>Euterpe</i> ³
<i>Staminate flower</i>					
<i>Sepals - connation</i>	distinct	distinct	distinct	distinct	distinct
- <i>shape</i>	rounded	irregular	ovate	deltoid-elongate	rounded
- <i>margins</i>	toothed	notched	entire	entire	tattered
- <i>aestivation</i>	imbricate	imbricate	imbricate	imbricate	imbricate
<i>Petals - connation</i>	distinct	distinct	basal	fused up to 2/3 of length	distinct
- <i>shape</i>	triangular-ovate	irregular, triangular-ovate	triangular-ovate	ovate	asymmetrical
- <i>aestivation</i>	valvate	valvate	valvate	valvate	valvate
<i>Stamens - number</i>	6	20–25	6	(3–) 6	6
<i>Filaments - adnation</i>	free	basally with petals	with pistillode	with inner side of petals	free
- <i>connation</i>	at the very base	rarely connate	free	free	free - <i>shape</i>
triangular	thin, elongate	triangular	narrow, flat	basally wider	broad,
<i>Anthers - shape</i>	dorsifixed, oval	dorsifixed, elongate	dorsifixed, oval	divaricate	medifixed, elongate
- <i>position at bud stage</i>	inflexed	straight to inflexed	inflexed	inflexed	inflexed
- <i>dehiscence</i>	latrorse	introrse	introrse	introrse	latrorse
<i>Pistillode - presence</i>	present	absent	present	present	present
- <i>shape</i>	barrel shaped, 3-lobed	(-)	barrel shaped, 3-lobed	round, 3-lobed	columnar, 3-lobed

gynoecium in the female flower. The presence of a completely enveloping prophyll and peduncular bract (even at fruiting stage) may be added as a unique character for *Manicaria* among the basal core arecoid tribes. Male flowers of *Manicaria* and *Pelagodoxa* have an oblong shape, distinct and imbricate sepals, distinct petals and dorsifixed introrse stamens. The female flowers of these two taxa share distinct, imbricate sepals, a trilobulate, triovulate gynoecium with anatropous ovules. *Manicaria* shares with *Euterpe* the same group of characters that is shared with *Leopoldinia*, namely distinct, imbricate sepals with variously notched margins, distinct, valvate and asymmetrical petals in male flowers, and distinct, imbricate sepals and an ovoid gynoecium in the female flowers. The male flowers of *Manicaria* and *Geonoma* share distinct sepals, valvate petals and introrse stamens, whereas the female flowers of both genera have imbricate sepals, valvate, basally united petals and trilobulate gynoecium with an anatropous ovule. Finally, flowers in representatives of Geonomateae and Euterpeae show some affinities with Manicarieae and Leopoldinieae, but further studies may be necessary to infer more defined relationships between these groups.

Acknowledgments

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2014 IPS Biennial: South Florida

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1. The needle palm in Highlands Hammock State Park.

Plans are well underway for an exciting and palm-filled 2014 IPS Biennial in South Florida, USA. The event will showcase palms in private and public gardens, as well as palms in the wild.

The last Biennial in South Florida was in 1992, just weeks after Hurricane Andrew, one of the most devastating and destructive hurricanes ever to hit the region. Palm collections, such as Fairchild Tropical Botanic Garden, nurseries

and palm habitats were devastated. Now, some 22 years later, the recovery is nothing short of astonishing. The palms are back and look better than ever, so pack your bags and prepare to see some amazing palms!

The Biennial will begin in Miami on Saturday, May 24, 2014. This is a public holiday weekend in the USA (Memorial Day), so the airport is likely to be busier than normal. Attendees are advised to reserve their flights early. Banks and many other businesses will be closed. Miami in late May is usually sunny and warm but not oppressively humid and hot, so the Biennial participants should expect fine weather. The hurricane season does not officially begin until June, so there is little chance of history repeating.

Members of the IPS Board of Directors will meet during the first day. Any IPS members wishing to observe the meeting may attend (contact IPS President Leland Lai for meeting details). Biennial attendees will meet in the evening for the kick-off banquet at the host hotel and an after-dinner presentation by Dr. Patrick Griffith, the director of the Montgomery Botanical Center. An early bedtime is in order, as the following day will be a long one.

Day Two (Sunday, May 25) will see the attendees on buses traveling to palms in habitat at Highlands Hammock State Park. This park, about 3 hours by bus, from Miami has the southern-most populations of *Rhapidophyllum*

hystrix (Fig. 1) and *Sabal minor*, as well as some of the most beautiful specimens of *Sabal palmetto* to be seen anywhere in the state. After visiting the park, attendees will visit Archbold Biological Station, a working scientific research station in the sand pine scrub habitat of Florida. This unique habitat is home to the endemic *Sabal etonia*, a palm seldom seen by visitors to Florida, as well as many other plants and animals specially adapted to the deep, infertile sand and periodic fires. The day will end with a barbecue at Searle Brothers Nursery, a well-known palm nursery in Broward County.

Day Three (Monday, May 26) features tours of two iconic palm collections in Miami. Participants will spend the morning at Pinecrest Gardens, the former site of the venerable Parrot Jungle. The performing parrots are gone, but the palm collections, originally begun by one of the IPS founders, Nat De Leon, and continued in recent years by Craig Morell, are mature and beautiful. The lush plantings, water features and serpentine pathways are cool and shady, so visitors will enjoy exploring for palms. Be sure to see the *Pholidocarpus macrocarpus*, grown from seed sent to Nat De Leon by Hal Moore in 1966.

2. A small portion of the palm collection at Fairchild Tropical Botanic Garden.





3. A collection of squat *Hyophorbe* and slender *Gaussia* species at Fairchild Tropical Botanic Garden.



4. *Acoelorrhaphe wrightii* in Everglades National Park. Photo by Ray Hernandez.

A few minutes away is Fairchild Tropical Botanic Garden, where participants will spend the rest of the day. Lunch will be provided in the Garden, and visitors will be able to explore at their leisure one of the epicenters of palm horticulture. The Garden, founded in 1938, is a mecca for palm enthusiasts, but like any garden, it is always changing and always growing. Even if you have visited FTBG before, you are sure to see something new, unexpected or photogenic. If you have not visited FTBG before, prepare yourself for a mind-blowing experience. There are exceptional palms and gorgeous vistas throughout the Garden (Figs. 2 & 3). IPS participants will stay after hours to enjoy cocktails as the sun sets, followed by an elegant banquet and an illustrated presentation by FTBG Director, Dr. Carl E. Lewis.

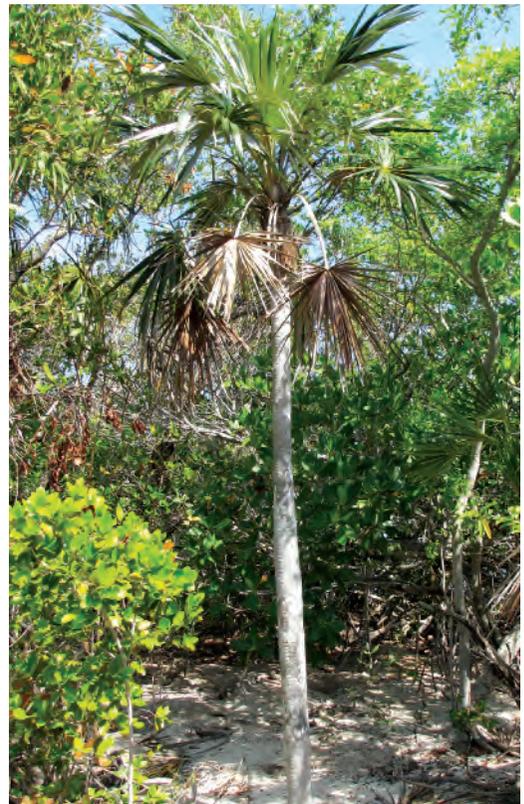
Day Four (Tuesday, May 27) will see the IPS group checking out of our Miami hotel and beginning a bus tour to Key West. The first destination will be Everglades National Park, with stops in Mahogany Hammock and Royal Palm Hammock to see *Acoelorrhaphe wrightii* (Fig. 4) and *Roystonea regia*. These palms are familiar in cultivation, but to see them growing in the wild is an unforgettable experience. The

buses will continue south making two more stops. The first set of busses will stop at Bahia Honda State Park to see a population of unusually tall *Coccothrinax argentata* (Fig. 5). If you have seen *C. argentata* on the mainland, where it is no more than chest-high, the towering specimens in Bahia Honda will be a revelation. The other set of buses will visit Villa Paradiso, the private garden of local palm aficionado Franco D'Ascanio, in the middle Keys. Not ordinarily open to tours, this garden features an exceptional collection of palms doing very nicely next to the salt water. On the return trip, on Thursday, the buses will switch, so every bus will visit every destination. All of the buses will arrive in Key West just in time for dinner.

Day Five (Wednesday, May 28) is a free day, in which IPS attendees can relax at the hotel, sight-see around the island or take part in any number of other activities (fishing, snorkeling, shopping, museums, etc.). Optional tours can be arranged at the hotel, or visitors can set out on their own.

On Day Six (Thursday, May 29), the IPS group will board the buses for the return trip north,

5. *Coccothrinax argentata* in Bahia Honda State Park. Photo by Ray Hernandez.





6. Some of Montgomery Botanical Center's palm collection. Photo courtesy Montgomery Botanical Center.

stopping at the sites from Tuesday, as well as two additional private gardens where palms and other tropical plants are used throughout the landscape. These professionally designed gardens, like the previous one, are not normally open to visitors, so Biennial attendees will have a rare glimpse of two stunning private gardens. Punta Roquena is a 4.5-hectare (11-acre) estate originally developed by Bernie C. Papy, a legendary Keys politician. It has gone through several transformations since but maintains a large palm collection on a point of land jutting out into the Atlantic. Bait Shack is a 2-hectare (5-acre) garden owned by an avid fisherman that, while much younger than Punta Roquena, contains many unusual and mature palm species. Once back in Miami, the group will meet for dinner at a local restaurant, followed by a presentation on the palms of Cuba by the globe-trotting, island-hopping Paul Craft.

Day Seven (Friday, May 30) is the last full day of Biennial activities. The day will begin by a tour of a private botanical garden just minutes away from the hotel. The garden's creator and owner, Dr. Jeff Block, is a palm enthusiast (and

bromeliad enthusiast and begonia enthusiast...), who has created a remarkable garden in suburban Miami. He attributes much of his success to the use of deionized water. The proof, it would seem, is in the lush, vigorous growth of palms and other tender tropicals.

The next stop on the itinerary is Montgomery Botanical Center (Fig. 6), where attendees will enjoy a picnic lunch on the lawn with scenic views of the garden. MBC staff will be on hand to give guided tours of this large botanical garden's exceptional collection of palms, cycads and tropical conifers. The mature specimens of *Hemithrinax ekmaniana* and *Nypa fruticans* should be on everyone's must-see list! After a full day of palm-viewing, attendees will return to the hotel for the farewell banquet.

Not to be missed, the South Florida Biennial promises to be a memorable event, a chance to see some of the finest palm collections in the area, in the company of IPS members from all over the world. Bring your camera. Bring your sunglasses. We shall supply great palms, fascinating presentations, delicious food and outstanding camaraderie.

Dypsis leucomalla, a New Species Described from Cultivation in Hawai'i

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1. The specimen from which the type of *Dypsis leucomalla* was obtained, with Suchin Marcus, Floribunda Palms, Hawai'i.



A spectacular new species of *Dypsis* is described from cultivation in Hawai'i.

This beautiful new species (Fig. 1) from the eastern escarpment forests of central Madagascar has been grown for some time by JM at Floribunda Palms in Hawai'i under the name of *Dypsis* "white petiole." JM acquired seed of it in 1994 from Curt Butterfield of Aroids and Palms, Port Douglas, Queensland, Australia, the seed having been collected in

Madagascar by Mark Overend. The seed was duly sowed in Hawaii, but because growth was very slow, JM returned to Queensland and brought back two batches of seedlings in 1995 and 1996. Seedlings were sold to other collectors in Hawai'i and in California. It is thought that most if not all the plants in California subsequently died. Those on the

Marcus property flourished on the lava soils and have now started to flower and fruit for the first time.

Independently Gunter Gottlieb, a commercial seed exporter in Toamasina, Madagascar, sent photographs of a mystery palm to Toby Spanner, and once circulated, JM was able to match these with his *Dypsis* "white petiole." The Gottlieb palm is said to have been collected in forest "200 km west of Toamasina." This seems improbable as 200 km would mean that the locality would lie well out of the eastern escarpment rain forests and in open plateau, which is contradicted by the photograph in Figures 2 and 3.

Wherever its origins are, the palm has flourished at Floribunda Palms and has reached maturity, flowering and setting seed for the first time. It has been widely admired by growers visiting the nursery. The leaf sheaths in particular are astonishing, with their thick felt of white wool, and the texture of the emerging inflorescence bracts is almost like Styrofoam (Fig. 5). In adult palms it seems that the thick white indumentum becomes less pronounced and more reddish. Although there are some similarities with the poorly known *D.*

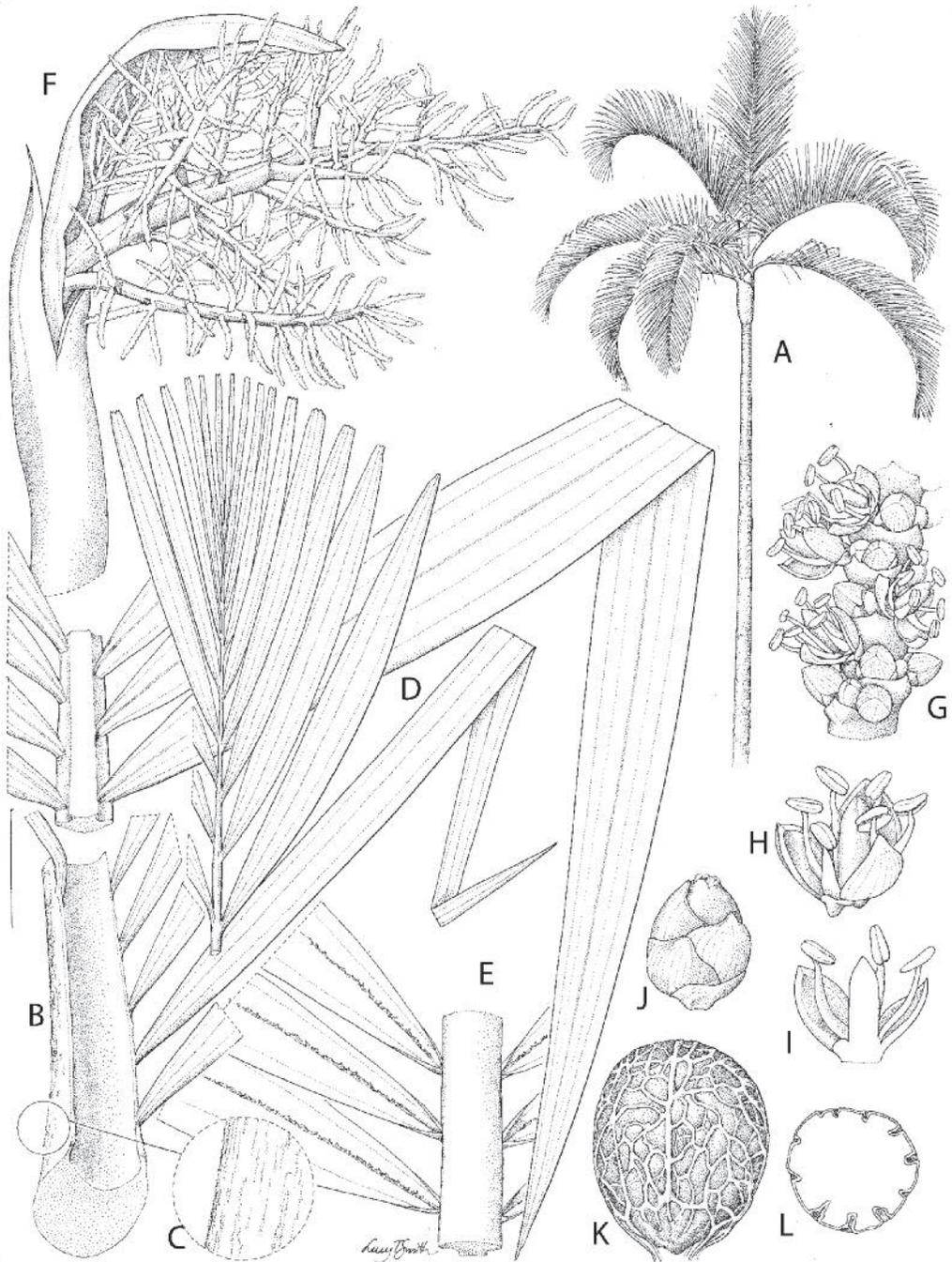
ovobontsira, it has nevertheless defied determination, and we now consider that it is undescribed.

***Dypsis leucomalla* J.Dransf. & J. Marcus sp. nov.** Robust single-stemmed tree palm, with crownshaft and leaves with regularly arranged leaflets; sheaths covered with thick, white and brown woolly indumentum, leaflets abaxially with conspicuous red brown lacinate ramenta; endosperm shallowly ruminant. Differs from *D. ovobontsira* in the thick predominantly white indumentum of the sheaths (as opposed to thinner rust-coloured indumentum) and the abundant ramenta on the abaxial leaflet surface (absent in *D. ovobontsira*). Type: Hawai'i, Hilo, Floribunda Palms, Marcus 2 (K). Fig. 4.

Single stemmed robust tree palm; stem to at least 5 m tall, ca. 35 cm diam. Leaves 6–10 in crown, arcuate, to 472 cm long; sheaths somewhat swollen, forming an irregular crownshaft in juvenile palms, more regular and symmetrical in adults, to 74 cm long, ca. 32 cm in diam., sheath abaxially covered with a very dense layer of soft woolly white tomentum in exposed areas, brownish where hidden by preceding leaf sheath, and

2 (left). A mature tree, probably identifiable as *Dypsis leucomalla*, eastern escarpment of Madagascar (Photo: G. Gottlieb). 3 (right). Wild plant of *Dypsis leucomalla* with an inflorescence (Photo: G. Gottlieb).





4. *Dypsis leucomalla*. A. Habit; B. Basal leaflets; C. Detail of woolly surface of petiole; D. Mid and apical leaflets; E. Undersurface of leaflets showing ramenta; F. Inflorescence; G. Triads; H. Staminate flower; I. Staminate flower in vertical section; J. Pistillate flower bud; K. Seed covered by endocarp fibers; L. Seed in cross section. Scale bar: A = 3 m; B, D, E = 8 cm; C = 4 cm; F = ; G = 1 cm; H, I, J, K, L = 7 mm; J = 5 mm. A from a photo by Gunther Gottlieb; B–L from Marcus 2. Drawn by Lucy T. Smith.

interspersed with scattered red brown lacinate scales, adaxially glabrous, dull brown, the apex of the sheath with two triangular auricles to 14 cm long, the margins dark brown and

tattering and with abundant brown scales; petiole very short or to 75 cm long, ca. 10 cm wide, deeply channelled, densely covered with soft white woolly indumentum (Fig. 5); rachis



5. *Dypsis leucomalla*: Petiole bases and peduncular bract showing thick white indumentum.

to 378 cm long, arcuate, bearing 85–91 leaflets on each side; leaflets regularly arranged and held more or less in the same plane, mid leaf

6. *Dypsis leucomalla*: Inflorescence.



leaflets 108 cm long, 8.5 cm wide, all leaflets with a dense covering of red-brown ramenta along the midrib on the abaxial surface and thin white wax on both surfaces; transverse veinlets obscure. Inflorescence (Fig. 6) interfoliar, branched to 2–3 orders to 110 cm long; prophyll beaked, 2-keeled, ca. 85–106 cm long, 12–25 cm wide, densely covered with soft woolly white indumentum; peduncular bract 55 cm long, 25 cm wide, covered with indumentum as the prophyll. Peduncle ca. 30 cm long, ca. 5 × 4 cm in cross section; rachillae crowded, numerous, pale green, glabrous, 15–17 cm long, 6–7.5 mm diam.; triads rather densely arranged, ca. 6 per 1 cm length of rachilla; rachilla bracts conspicuous, thick, triangular, to 4 mm long, 5 mm wide, acute or acuminate, glabrous, forming shallow pits. Staminate flower in bud ca. 4.5 mm long, mid green, expanded flowers 7 mm wide, paler green within (Fig. 7); sepals to 2.5 mm long, connate in the basal 0.5 mm, lobes 1.5 mm wide at the point of connation, somewhat irregular and gibbous at the base due to close packing, margins thin, emarginate or irregularly ciliate; petals 4.5 long, 3 mm wide, longitudinally striate, joined at the very base; stamens 6, filaments 4 × 1 mm, inflexed with a very slender tip, anthers versatile, medifixed, 2.5 × 0.7 mm, pistillode conspicuous, white, ellipsoid. Pistillate flower globular to ellipsoid, ca. 5 × 4 mm; sepals imbricate, striate, 3.3–4 ×



7. *Dypsis leucomalla*: Staminate flowers at anthesis.

2.5–3.5 mm, the margins ciliate; petals similar to sepals, imbricate, striate, 3.5–4.5 × 4 mm, with minute triangular valvate tips, the margins ciliate; staminodes 6, minute, tooth-like, borne at one side of the base of the gynoecium; gynoecium ellipsoid, 5 × 3.5 mm, stigmatic area with three grooves. Fruit spherical, pale green when ripe, 25 mm diam., the epicarp shiny; mesocarp ca. 5 mm thick, mesocarp fibres forming a net-like covering of the seed. Seed more or less spherical, 13–15 × 12–13 mm, seed surface shallowly channelled; endosperm shallowly, rather sparsely ruminant; embryo subbasal.

CULTIVATED: Hawaii, garden of Jeff Marcus, Floribunda Palms, *Marcus 2* (holotype K).

MADAGASCAR: Toamasina, said to be 200 km west of Toamasina, photographs communicated by T. Spanner from G. Gottlieb (K).

ETYMOLOGY. Greek – *leucomalla* = white wool, in reference to the thick indumentum on bracts and petioles.

NOTES: In some ways *D. leucomalla* resembles *D. ovobontsira*. This latter species is still known only from a single herbarium specimen – the type collection from Mananara Avaratra. The identity of living specimens purporting to be *D. ovobontsira* has yet to be confirmed and in our opinion seems unlikely. *Dypsis ovobontsira* shares with *D. leucomalla* the regularly arranged leaflets, the densely tomentose sheaths and petioles, inflorescence branched to 3 orders and the shallowly and rather regularly ruminant endosperm. However, the indumentum on the sheaths of *D. leucomalla* is very much thicker, is predominantly gray-white, rather than rust-coloured, and the leaflets have conspicuous densely arranged ramenta that are lacking in *D. ovobontsira*. *Dypsis ovobontsira* is also a rather less robust palm than *D. leucomalla*.

Acknowledgments

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Index to Volume 57

- 2014 IPS Biennial: South Florida 195
 A new species of *Korthalsia* (Palmae) from Laos and Vietnam 150
Acoelorrhaphe wrightii 197
Acrocomia 56
Acrocomia aculeata 56, 96
 Adaptations of an understory *Geonoma* 109
Ammandra 33
 An anatomical character to support the cohesive unit of *Butia* species 30
 Anderson, E.: Twin remembrances of Ed Moore (1917–2012) 145
Aphandra natalia 33
Archontophoenix 116
Archontophoenix cunninghamiana 64
Areca catechu 9, 14, 21
Arenga engleri 68
Asterogyne 174
Asterogyne martiana 172
Balaka 10
 Barfod, A.S. & J. Dransfield: Flora of Thailand vo. 11, pt. 3. Arecaceae (Palmae), reviewed 108
Beccariophoenix madagascariensis 135–138, 142
 Bhat, K.G.: Palms of Karnataka, reviewed 108
 Broschat, T.K. & E.F. Gilman: Effects of fertilization and pruning on canopy leaf number and potassium deficiency symptom severity in *Sabal palmetto* 84
 Broschat, T.K.: review of: The Biology and Management of Landscape Palms 36
Butia 30–33
Butia archeri 31
Butia campicola 33
Butia capitata 31
Butia catarinensis 31
Butia eriospatha 31
Butia exospadix 31
Butia lallemantii 31
Butia leptospatha 33
Butia marmorii 31, 32
Butia matogrossensis 31, 32
Butia microspadix 31
Butia odorata 31, 97
Butia paraguayensis 31, 33
Butia purpurescens 31
Butia yatay 31, 32
 × *Butiagrus nabonnandii* 97
Calamus 160, 176, 177, 180
Calamus albidus 179, 180
Calamus dianbaiensis 179, 180
Calamus gracilis 176, 179
Calamus heteroideus 111
Calamus javensis 111
Calamus kampucheaensis 178–180
Calamus lateralis 176, 179
Calamus macrorhynchus 179, 180
Calamus melanacanthus 176, 179
Calamus mellitus 176, 177
Calamus modestus 179, 180
Calamus reinwardtii 111
Calamus rhabdocladus 179, 180
Calamus temii 180
Calamus wuliangshanensis 179, 180
Calamus yentuensis 179, 180
Calyptrogyne 174
Calyptrogyne ghiesbreghtiana 172
Carpentaria acuminata 97
Caryota mitis 97
Ceratolobus 177
Chamaedorea 111, 164–166, 169, 170, 172, 174
Chamaedorea amabilis 169
Chamaedorea anemophila 162
Chamaedorea benziei 162, 163, 164
Chamaedorea binderi 162
Chamaedorea charchensis 163
Chamaedorea christinae 162
Chamaedorea costaricana 167
Chamaedorea crucensis 162, 166, 167
Chamaedorea dammeriana 167
Chamaedorea elatior 172–174
Chamaedorea ernesti-augusti 111, 170
Chamaedorea frondosa 162, 163, 165, 166
Chamaedorea geonomiformis 166, 167, 169
Chamaedorea glaucifolia 162, 169
Chamaedorea graminifolia 168, 169, 171
Chamaedorea hodelii 162, 166
Chamaedorea ibarrae 162, 163, 164
Chamaedorea incurstata 159, 162, 165, 169
Chamaedorea keelerorum 162
Chamaedorea lucidifrons 167
Chamaedorea macrospadix 167
Chamaedorea metallica 111, 170
Chamaedorea minima 166, 167
Chamaedorea moliniana 162
Chamaedorea oblongata 169, 170
Chamaedorea palmeriana 169
Chamaedorea pinnatifrons 169, 170
Chamaedorea piscifolia 162, 164, 165, 167, 168
Chamaedorea plumosa 161–163, 169
Chamaedorea pochutlensis 169
Chamaedorea ponderosa 162
Chamaedorea pumila 166, 167, 169
Chamaedorea radicalis 163
Chamaedorea recurvata 162
Chamaedorea rhizomatosa 170, 172, 173
Chamaedorea ricardoii 162
Chamaedorea rigida 169
Chamaedorea rosibeliae 162
Chamaedorea rosteniorum 162, 165, 168, 169
Chamaedorea sartorii 170
Chamaedorea schippii 167–169
Chamaedorea seifrizii 167, 170

- Chamaedorea serpens* 111
Chamaedorea stolonifera 111, 170
Chamaedorea stricta 165
Chamaedorea subjectifolia 162
Chamaedorea sullivaniorum 166, 167, 169, 171
Chamaedorea tenella 166
Chamaedorea tenerrima 164
Chamaedorea tuerckheimii 164, 165
Chelyocarpus 33
Clinostigma carolinense 7, 15–17, 19
Clinostigma ponapense 5, 7, 12–14, 19
Coccothrinax 115–120
Coccothrinax argentata 117, 119, 197
Coccothrinax barbadensis 117
Coccothrinax ekmanii 160
Coccothrinax gracilis 160
Coccothrinax jimenezii 160
Coccothrinax readii 96
Coccothrinax scoparia 117
Coccothrinax spissa 117, 121
Cocos nucifera 7, 84, 93–98, 135
Cocos weddelliana H. Wendl. 1871, reviewed 108
 Couvreur, T.L.P., A. Faye & B. Sonké: Palms of southern Cameroon 123
Daemonorops 177
Dictyospermum album 108
 Downer, A.J. & D.R. Hodel: Suitability of ground palm trunk tissues as a medium for growing potted plants 67
 Downer, A.J., as co-author 63, 72, 79
 Downer, A.J., D.R. Hodel, D.M. Mathews & D.R. Pittenger: Effect of fertilizer nitrogen source on susceptibility of five species of field-grown palms to *Fusarium oxysporum* f. sp. *canariensis* 89
 Downer, A.J., M. Mochizuki, D.R. Hodel & D.R. Pittenger: Effect of leaf tie-up and pre-plant storage on growth and transpiration of transplanted Mexican fan palms 58
 Dransfield, J. & J. Marcus: *Dypsis leucomalla*, a new species described from cultivation in Hawai'i 199
 Dransfield, J.: review of: *Cocos weddelliana* H. Wendl. 1871 108
 Dransfield, J.: review of: Palms of Karnataka 108
Drymophloeus 10
Dypsis 199
Dypsis ambositrae 101, 102
Dypsis baronii 101
Dypsis brevicaulis 135, 137, 138, 140, 142
Dypsis decaryi 142
Dypsis decipiens 55, 101, 102
Dypsis fibrosa 135, 137, 140
Dypsis leucomalla 159, 199–202
Dypsis leucomalla, a new species described from cultivation in Hawai'i 199
Dypsis lutescens 135
Dypsis madagascariensis 108
Dypsis mananjarensis 134, 135, 138
Dypsis nodifera 135, 137–140, 142
Dypsis ovobontsira 200, 202
Dypsis prestoniana 135, 137–139, 142
Dypsis psammophila 135, 139, 140, 142
Dypsis saintelucei 135, 137, 139, 142, 143
Dypsis scottiana 107, 135, 137, 139–143
 Edelman, S. & J. Richards: Shedding light on the *Pseudophoenix* decline 24
 Effect of leaf removal and tie-up on date palms transplanted in extremely hot, arid conditions 72
 Effect of leaf tie-up and pre-plant storage on growth and transpiration of transplanted Mexican fan palms 58
 Effect of sand backfill on transplanted king, queen and windmill palms 63
Elaeis guineensis 56, 81
 Elliott, M.L., as co-author 93
 Ellis, E.R., as co-author 133
Eremospatha 128, 130
Eremospatha barendii 129–131
Eremospatha haullevilleana 126, 128
Eremospatha laurentii 127
Eremospatha wendlandiana 125, 127
Euterpe 190–192
 Faye, A., as co-author 123
 Flora of Thailand vo. 11, pt. 3. Arecaceae (Palmae), reviewed 108
 Floral structure in the neotropical tribes Leopoldinieae and Manicarieae (Arecaceae: Arecoideae) 181
 Funnell, S., as co-author 133
Geonoma 172, 174, 190–192
Geonoma brevispatha 112
Geonoma congesta 112
Geonoma pinnatifrons var. *martinicensis* 109
 Gilman, E.F., as co-author 84
 Griffith, M.P., E. Witcher, L. Noblick & C. Husby: Palm stem shape correlates with hurricane tolerance, in a manner consistent with natural selection 115
 Gros-Balthazard, M., as co-author 37
 Harrison, N.A., as co-author 93
Hemithrinax ekmaniana 198
 Henderson, A. & E.A. Khou: New species of *Calamus* from Cambodia 176
 Henderson, A. & Q.D. Nguyen: A new species of *Korthalsia* (Palmae) from Laos and Vietnam 150
Heterospathe elata 7, 22, 23, 108
 Hodel, D.R.: *Chamaedorea* palms 20 years after 161
 Hodel, D.R.: Island hopping for palms in Micronesia 5
 Hodel, D.R.: Loulu: The Hawaiian palm, reviewed 113

- Hodel, D.R.: Recent advances in palm horticulture 57
- Hodel, D.R.: The Biology and Management of Landscape Palms, reviewed 36
- Hodel, D.R., as co-author 58, 67, 89
- Hodel, D.R., A.J. Downer, M. Mochizuki & D.R. Pittenger: Effect of sand backfill on transplanted king, queen and windmill palms 63
- Hodel, D.R., A.J. Downer & D.R. Pittenger: Effect of leaf removal and tie-up on water loss and estimated crop coefficients for juvenile, trunkless, containerized queen palms 79
- Hodel, D.R., D.R. Pittenger, A.J. Downer & M. Mochizuki: Effect of leaf removal and tie-up on date palms transplanted in extremely hot, arid conditions 72
- Hoffman, I., obituary 160
- Hogg, F., S. Funnell, M. Shrum, E.R. Ellis and L.H. Tsimijaly: The useful palms of Sainte Luce: Implications for local resource availability and conservation 133
- Howea fosteriana* 163
- Husby, C., as co-author 115
- Hydriastele* 174
- Hydriastele palauensis* 3, 18, 19, 20, 23
- Hyospathe* 111
- Iguanura* 174
- Ivorra, S., as co-author 37
- James, A.: Adaptations of an understory *Geonoma* 109
- Jubaea* 32, 33
- Jubaea chilensis* 31, 33
- Jubaeopsis caffra* 32
- Khou, E.A., as co-author 1176
- Knecht, J.U.: review of: Loulu: The Hawaiian palm 113
- Korthalsia* 150, 152–154
- Korthalsia bejaudii* 150, 151
- Korthalsia celebica* 153
- Korthalsia concolor* 153
- Korthalsia debilis* 153
- Korthalsia lacinoso* 150–153
- Korthalsia minor* 151–153
- Korthalsia paucijuga* 153
- Korthalsia rigida* 153
- Korthalsia rogersii* 153
- Korthalsia tenuissima* 153
- Kyburz, R.: Twin remembrances of Ed Moore (1917–2012) 145
- Laccosperma korupense* 125
- Laccosperma robustum* 107, 124, 125
- Laccosperma secundiflorum* 125
- Lai, L.: The bequest of Richard Douglas 122
- Leopoldinia* 181, 182, 184, 186, 187, 189–192
- Leopoldinia major* 182
- Leopoldinia piassaba* 182, 183
- Leopoldinia pulchra* 182–184
- Licuala* ‘Mapu’ 4
- Licuala* 4
- Licuala cordata* var. *ashtonii* 4
- Licuala mattanensis* var. *paucisecta* 4
- Lodoicea maldivica* 4
- Loulu: The Hawaiian palm, reviewed 113
- Manicaria* 181, 182, 184–192
- Manicaria martiana* 182
- Manicaria saccifera* 182, 183, 186
- Marcus, J., as co-author 199
- Martel, C., L. Noblick & F.W. Stauffer: An anatomical character to support the cohesive unit of *Butia* species 30
- Mathews, D.M., as co-author 89
- Mauritia flexuosa* 56
- Metroxylon amicarum* 3, 6, 7, 8, 14, 15
- Mier, P.: *Cocos weddelliana* H. Wendl. 1871, reviewed 108
- Mochizuki, M., as co-author 58, 63, 72
- New species of *Calamus* from Cambodia 176
- Newton, C., M. Gros-Balthazard, S. Ivorra, L. Paradis, J.-C. Pintaud & J.-F. Terral: *Phoenix dactylifera* and *P. sylvestris* in northwestern India: A glimpse of their complex relationships 37
- Nguyen, Q.D., as co-author 150
- Noblick, L., as co-author 30, 115
- Noblick, L.: *Syagrus stenopetala*, a good species 147
- Ntushelo, K., N.A. Harrison & M.L. Elliott: Palm phytoplasmas in the Caribbean Basin 93
- Nypa fruticans* 7–9, 198
- Oncocalamus* 128
- Oncocalamus mannii* 124–126
- Palm conservation in Itremo, Madagascar 101
- Palm phytoplasmas in the Caribbean Basin 93
- Palm stem shape correlates with hurricane tolerance, in a manner consistent with natural selection 115
- Palms of Karnataka, reviewed 108
- Palms of southern Cameroon 123
- Paradis, L., as co-author 37
- Pelagodoxa* 182, 189–192
- Phoenix* 37, 45, 49, 89, 91, 94, 95, 97
- Phoenix canariensis* 68–70, 72, 79, 84, 89, 91, 92, 96–98
- Phoenix dactylifera* 37, 39, 41–43, 45, 48, 55, 72, 75, 80, 90–92, 96, 97
- Phoenix dactylifera* and *P. sylvestris* in northwestern India: A glimpse of their complex relationships 37
- Phoenix reclinata* 90–92, 97
- Phoenix roebelenii* 62, 72, 80, 85, 91, 92, 97
- Phoenix sylvestris* 37, 38, 41–49, 96, 97
- Phoenix theophrasti* 37
- Pinanga insignis* 3, 7, 23

- Pinanga rivularis* 111
 Pintaud, J.-C., as co-author 37
 Pittenger, D.R., as co-author 58, 63, 72, 79, 89
Pholidocarpus macrocarpus 196
Podococcus 125, 130
Podococcus acaulis 125
Podococcus barteri 125
Pogonotium 179
Ponapea 5
Ponapea hosinoi 5, 7, 11–13, 15
Ponapea ledermanniana 5, 7–10, 12–15
Ponapea palauensis 7, 18, 20
Pritchardia 113, 114
Pritchardia gordonii 114
Pritchardia hillebrandii 114
Pritchardia kaalae 113, 114
Pritchardia lowreyana 114
Pritchardia martii 114
Pritchardia pacifica 114
Pritchardia thurstonii 114
Pseudophoenix 24–28, 117,
Pseudophoenix ekmanii 24, 25, 27, 29
Pseudophoenix lediniana 24, 25, 27, 29
Pseudophoenix sargentii 24, 25, 27–29, 97
Pseudophoenix vinifera 24, 25, 27, 29
Ptychosperma 5, 10
 Rajaovelona, L.R., as co-author 101
 Rakotoarinivo, M. & L.R. Rajaovelona: Palm
 conservation in Itremo, Madagascar 101
Raphia 125, 128, 130
Raphia farinifera 135
Raphia hookeri 128, 129
Raphia regalis 130
Ravenea sambiranensis 135, 140, 142
 Recent advances in palm horticulture 57
Retispatha 179
Rhapidophyllum hystrix 196
Rhopaloblaste augusta 108
 Richard (Dick) Douglas (1938–2013) IPS
 President 1983–1984 146
 Richards, J., as co-author 24
Roystonea 97
Roystonea regia 197
Sabal 95
Sabal etonia 196
Sabal mexicana 96, 97
Sabal palmetto 72, 80, 85–88, 96, 97, 196
 Shrum, M., as co-author 133
Solfia 10
Sommieria 182
 Sonké, B., as co-author 123
 Stauffer, F.W., as co-author 30, 181
 Suitability of ground palm trunk tissues as a
 medium for growing potted plants 67
Syagrus 32, 33, 115–122, 147, 148, 160
Syagrus amara 117, 118, 120, 121
Syagrus botryophora 117, 119–121
Syagrus coronata 31, 117, 120
Syagrus × costae 117
Syagrus kellyana 31, 117, 120
Syagrus oleracea 117
Syagrus orinocensis 117, 147–149
Syagrus romanzoffiana 41, 64, 68–70, 72, 79,
 83, 96, 117, 162
Syagrus sancona 117
Syagrus stenopetala 147–149
Syagrus stenopetala, a good species 147
Syagrus vermicularis 117
Syagrus weddelliana 108
Tahina spectabilis 56, 160
 Terral, J.-F., as co-author 37
 The Biology and Management of Landscape
 Palms, reviewed 36
 The useful palms of Sainte Luce: Implications
 for local resource availability and con-
 servation 133
Thrinax radiata 96, 97
Trachycarpus fortunei 64
 Tsimijaly, L.H., as co-author 133
 Turcotte, M.: Richard (Dick) Douglas (1938–
 2013) IPS President 1983–1984 146
 Twin remembrances of Ed Moore (1917–2012)
 145
Veitchia 10
 Villímová, V. & F.W. Stauffer: Floral structure
 in the neotropical tribes Leopoldinieae and
 Manicarieae (Arecaceae: Arecoideae) 181
Washingtonia filifera 68–70, 90–92
Washingtonia robusta 58–62, 68–70, 72, 79, 96
 Witcher, E., as co-author 115
Wodyetia 10
 Zona, S.: 2014 IPS Biennial: South Florida 194
 Zona, S.: review of: Flora of Thailand vo. 11,
 pt. 3. Arecaceae (Palmae) 108

