PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for April

Cover Picture

Large-trunked Sabal sp. with rancher and IPS member, Mike Rayburn, in Brazoria County, Texas. Photo by Carol Lockett.

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Principes, 35(2), 1991, p. 63

Editorial

April 1991 is a select 60-page issue with seven articles on very different facets of palms and a large number of features.

The color covers and the first article highlight recent discoveries about palms in Brazoria County, Texas. Landon Lockett provides an intriguing account of the early sightings of *Sabal mexicana* and new information about a trunked palm which may be a hybrid between *S. mexicana* and *S. minor*. He also has found an unusual new locality in rather dry hill country for *S. minor*.

Our second article describes six more new species of *Chamaedorea* that Don Hodel has discovered in Costa Rica, Panama, and Nicaragua. The *Chamaedorea* book is progressing very well. For information and a request for help with its color pages, see page 72.

Dennis Johnson gives us an introduction to the mpapindi palm, *Chrysalidocarpus pembanus*, an attractive tree with arching plumose leaves, smooth, green, ringed trunks, and crimson fruits. Seed of the mpapindi has been distributed by The Seed Bank. The palm has been little used but promises to be a fine ornamental, perhaps as versatile as the frequently grown and lovely *C. lutescens*.

The ecological interactions of many palms are complex and little understood. We are pleased to have a report by Ken Oyama and R. Dirzo on some studies of *Chamaedorea tepejilote* and the beetle that feeds on its leaves in preference to those of other plants.

Two other articles describe experiences encountered in palm hunting. Ed Brown discusses the thrills and hazards of finding *Jubaeopsis caffra* in its wild habitat and Dick Endt the excitement of seeing the many palms of Ecuador.

Our last article by Richard Illingworth reports the success of a hybrid coconut seed garden in Costa Rica. The new hybrids will the produced for the first time in Central America and look very promising because of their vigor and probable resistance to Lethal Yellowing.

Editor Harold E. Moore, Jr., during the first 20 years of *Principes*, took special care to have most of the important literature on palms reported in the journal. Through the 1980's this feature was somewhat neglected because of lack of space and preparation time. We now introduce it as an annual feature of the 1990's with Drs. Andrew Henderson and Anders Barfod as editors. Other features emphasize a new European Palm Society, interesting palm briefs on *Jubaea* nuts, bonzai palms, an *Acrocomia* naturalized in Florida—and more! All should note the call for nominations of directors (p. 119).

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 35(2), 1991, pp. 64–71

Native Texas Palms North of the Lower Rio Grande Valley: Recent Discoveries

LANDON LOCKETT
3210 Stevenson Avenue, Austin, TX 78703

For decades the generally accepted view has been that Texas has no native tree-sized palms north of the lower Rio Grande Valley. *Sabal mexicana* (syn. *S. texana*), a tall palm found in Mexico and Central America, was believed to reach the northern limit of its native range along the lower Rio Grande, at the southernmost tip of the state. *Sabal minor*, the normally trunkless dwarf palmetto of East and South Central Texas, was assumed to be the only native palm found north of there. There were, however, two populations of tree-sized palms far north of the lower Rio Grande that had never been satisfactorily explained. For many years residents of Victoria, in South Central Texas, had cultivated *S. mexicana*, although no one seemed to know the origin of the population. Since 1941, when Houston botanist Robert A. Vines discovered them, botanists had wondered about some other palms, taller by far than any *S. minor*, hidden in a thick forest in Brazoria County, south of Houston.

Orator F. Cook (1913) examined the Victoria palms, which he suspected to have been brought from Mexico, and declared them to be a new species, *Inodes exul*. But at this time, before the assumption that Texas' native tall palms were confined to the lower Rio Grande Valley had become fixed, Cook (1908, 1913) also believed that *S. mexicana*, which he called *Inodes texana*, had once been found far north of the Rio Grande. In 1908 (p. 5, n. a) he had noted that "Tall palmettos were seen in Jackson County as late as 1876 by Mr. J. D. Mitchell, of Victoria." Jackson County is east of Victoria, and 200 miles north of the lower Rio Grande.

After discovering the Brazoria County palms Vines sent specimens to Miriam Bomhard, who (1943) identifed them as *Sabal louisiana*, a small, trunked palm known from Louisiana and Southeast Texas. But shortly thereafter Liberty Hyde Bailey (1944) classified *S. louisiana* as simply a caulescent form of *S. minor*. That Bailey was aware of the Brazoria County palms is evident from his description of *S. minor*, in which he notes (1944, p. 387) that the species has a "short erect part" that "sometimes emerges into a trunk 2–3 or reported to 6 m. tall." Six meters is the trunk height Vines (1960) had reported for the tallest Brazoria County palm. Since we know of no *S. minor* even approaching this height, the reference apparently was to Vines' measurement. Neither Bomhard nor Bailey ever visited the Brazoria County site, but on the basis of Bailey's work Texas botanists (except those, such as Vines, who still insisted they were *S. louisiana*) came to consider the Brazoria County palms to be trunked *S. minor*. Thus Correll and Johnston (1970, pp. 340–341) write: "According to Bailey, the conspicuously caulescent plants, such as those found in Brazoria County, represent the optimum emergence of the species. Other than size, there seems to be no botanical difference between the dwarf acaulescent plants and

those that develop a prominent trunk. The arborescent plants have been given the name *S. louisiana.*" Consistent with this determination, in 1979 the Texas Forest Service measured the tallest Brazoria County palm at 27 feet, with a 16-foot crown spread and a 43-inch trunk circumference, and pronounced it the national champion *Sabal minor.* The palm is so listed in the big-tree registries of both the Texas Forest Service (1989, p. 8) and The American Forestry Association (1988, p. 16).

As will be shown, it was a mistake to lump the Brazoria palms in with caulescent *S. minor.* The botanical differences between them and *S. minor,* whether caulescent or acaulescent, are many. But there the matter rested, and might still rest, had not the the owner of the 43-acre tract on which most of the Brazoria County palms stand offered his land for sale. In March 1989, when I learned of this development, I contacted the Texas Nature Conservancy and the Texas Parks and Wildlife Department, urging acquisition of the tract. Since neither organization showed much interest, I set out to determine exactly what the Brazoria palms were. Could palms so large really be *Sabal minor*? If so, why had these particular trees become the giants of their species, towering over all others? I called Natalie Uhl of the Liberty Hyde Bailey Hortorium at Cornell. Uhl referred me to Dennis Johnson, of the International Union for the Conservation of Nature, who in turn referred me to palm taxonomist Robert W. Read, then retiring from the Smithsonian Institution. Read's immediate reaction to specimens and photographs was that, in view of their size and morphology, these palms could hardly be *S. minor.* But he refused to come to any conclusion without visiting the site, which he insisted on doing only in the fall, when the fruit would be ripe.

Suspecting, however, that the Brazoria palms might be an aberrant population of *S. mexicana,* Read began to look for evidence that *S. mexicana* was native to the Texas Central Coast. He soon found Cook's 1908 article, with its footnote reference to tall palmettos in Jackson County, as well as notes from Cook's files (now lodged at the Smithsonian) expressing Cook's belief as to the original range of *S. mexicana.* Hearing of our work, IPS member Dennis O'Connor, of Victoria, sent me a copy of Cook's 1913 article, in which Cook reiterated his belief regarding the former range of *S. mexicana,* and described "*Inodes exul.*" Cook's "type individual of the new species" was a palm on the lawn of Dennis O'Connor's aunt, Mrs. Martin O'Connor. The palm, now over 40 feet tall, still stands. *Inodes exul,* however, was later shown by Davis (1942) to be *S. texana,* which Moore (1971) reduced to synonymy of *S. mexicana.*

Armed with this information, I started looking for historic references to tall palms north of the lower Rio Grande—and a living population. Within weeks I found both.

In 1685 La Salle established the first European colony in Texas, near Lavaca Bay on the Central Coast. In a careful and impressively accurate account appearing in Margry (1876–86, vol. 3, p. 212) La Salle's historian Henri Joutel describes the local flora and fauna. The account includes a two-sentence description of "trees" with leaves similar to those of the *lataniers* (fan palms), and bearing an edible fruit. My search for a living population aroused the interest of a reporter who interviewed me for an article in the Victoria Advocate. The day after the article appeared four fishermen called to tell of palms, up to 20 feet tall, along Garcitas Creek, the border between Victoria and Jackson Counties. According to Kathleen Gilmore (1984) archeological evidence proves that La Salle's colony, which was annihilated by Indians in 1688, was located on Garcitas Creek. Further evidence provided by Brownson Malsch (1988, and pers. comm.) indicates that during the last century the

1. *Sabal mexicana* on Garcitas Creek, Jackson County, Texas.

original Central Coast population of *S. mexicana* was almost entirely removed to meet a demand for pilings for wharves, and by transplant to Victoria. The Garcitas Creek population thus appears to be a younger generation, seeded by a few survivors. (A detailed account of this discovery, and a description of the population, appear in Lockett and Read 1990. Also see Fig. 1.)

What was the extent of the native range of *S. mexicana*? A deposition by survivors of the La Salle colony (in Weddle, 1987, pp. 228, 249) indicates that it probably extended northeastward from Garcitas Creek at least to the Lavaca River, and southwestward at least to the Guadalupe River. But there is also some interesting evidence from San Antonio, 120 miles northwest of Garcitas Creek. In 1716 Fray Isidro Felix de Espinosa, a priest accompanying a Spanish expedition led by Don Domingo Ramón, reported seeing "*palmitos legítimos*" at San Antonio Springs, source of the San Antonio River, in what is today the city of San Antonio. (Espinosa's diary is on microfilm at the Latin American Collection of the University of Texas Library, Austin.) According to Ignacio Piña Lujan (1972, p. 85), *palmito* is the common name for *S. mexicana* in the Huasteca region of northeastern Mexico. Espinosa was born in Querétaro, capital of the Mexican state of Querétaro, which apparently has no *S. mexicana*, but borders on the Huasteca region.

Although one could argue that Espinosa saw *S. minor*, my own inspection of the remnants of forest in Brackenridge Park and on the Incarnate Word College campus, adjacent to what is left of San Antonio Springs and the present headwaters of the San Antonio River, revealed no *S. minor*, but many young *S. mexicana*, and one 30-foot specimen almost hidden in the trees. Since *S. mexicana* is commonly cultivated in the area there appears to be no way of knowing, without intensive historical research, whether the wild specimens are the progeny of imported transplants, or are descendants of a native population, which itself may have been relocated for

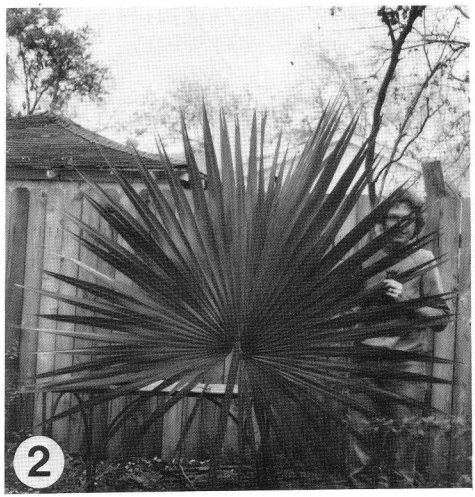
landscaping. What we do know is that *S. mexicana* thrives in the area, while *S. minor* is lacking.

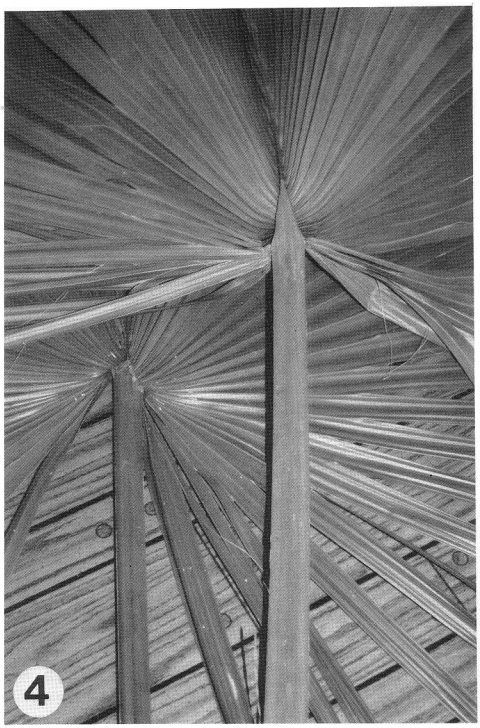
With it now established that *S. mexicana* is native to the Central Coast, in November 1989 Read visited the Brazoria County palm site, 60 miles up the coast from Garcitas Creek. After careful study of the palms there he believes, however, that they are not *S. mexicana*, but hybrids of *S. mexicana* and *S. minor*.

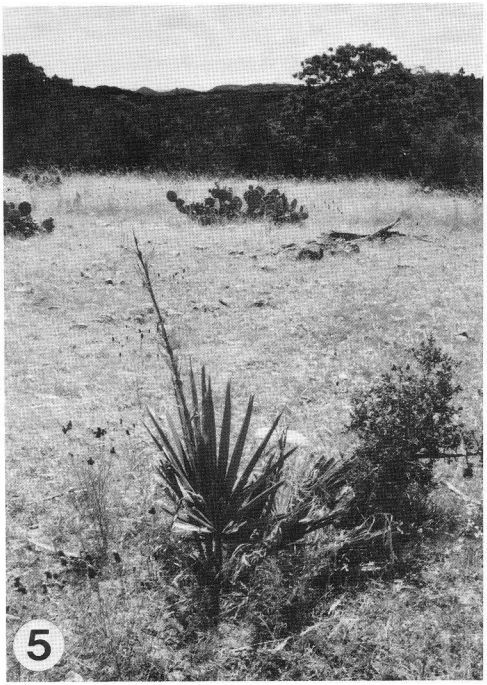
According to palm-hybrid specialist Michael J. Balick (1988, p. 29), "Sometimes, in a population comprising several related species (or even genera) of palms, variation that is beyond what is usually expected can be found. When the variation reveals a series of characters intermediate in nature between other members of the population, then hybridization can be suspected." Because Read's examination of the morphology of the palms at the Brazoria site revealed more specimen-to-specimen variation than he would expect in a single (nonhybrid) species at a single site, and because this variation is intermediate between *S. minor* and *S. mexicana*, he concluded they were probably hybrids of these two species. As such they would be, according to Balick (pers. comm.), the first known hybrids of *Sabal* species, and the only known naturally occurring palm hybrids in the United States. (Nauman 1990, reports the recent discovery of apparent intergeneric hybrids in Florida, but, unlike the Brazoria palms, these are sterile.) In his recent monograph of the genus Scott Zona (1990, p. 619) puts *S. minor* in a class apart from all other *Sabal* species. Likewise Bailey (1994, p. 383) considered *S. minor* to be the sole representative of a subgenus, "*Eusabal*" (correctly *Sabal*), which was distinct from *Inodes*, the subgenus to which he assigned all other *Sabal* palms. Thus the Brazoria palms would be hybrids of two very different species—one a temperate-zone, flat-leaved dwarf and the other a tall palm, with highly costapalmate leaves, found mainly in Mexico. This raises the interesting question of why the only hybrids of the genus would be between two species that, apparently, are not closely related.

Although the hybrid nature of the Brazoria palms is yet to be proven, the morphological and phytogeographic evidence is strong. Two large leaves from separate palms at the site exemplify the variation characteristic of hybrids. The leaf in Figure 2, whose blade measures 225 cm wide by 141 cm long, and has 65 segments, is relatively flat, with an asymmetric hastula measuring 6 cm on the long side, and a 63-cm costa. In contrast, the leaf in Figure 3 is highly costapalmate. Although the blade size (211 cm wide by 142 cm long, with 68 segments) is similar to that of the first leaf, it has a 13-cm, symmetric hastula and an 86-cm costa. (See Fig. 4 for hastula contrast.)

The variation shown by the Brazoria palms is intermediate between the morphological characteristics of *S. minor* and *S. mexicana*. Zona (1990) gives hastula lengths for *S. minor* (p. 644) and *S. mexicana* (p. 639) as 0.8–4.7 cm and 9.5–15.5 cm, respectively. Read found hastulas of the Brazoria palms to be 4.5–13 cm long. Both Bailey (1944, p. 383) and Bomhard (1935, p. 44) give 40 cm as the maximum costa length for *S. minor* (*S. louisiana*, in the case of Bomhard). Read found Brazoria costas to be 39–86 cm long, or about ½ blade length, while indicating that for *S. mexicana* the costa exceeds ½ blade length. The Brazoria costa in Figure 2 is less than ½ blade length, while that of Figure 3 exceeds ½ blade length. Bailey (1944, p. 387) indicates 16–40 segments per leaf for *S. minor*, while Zona (1990, p. 644) gives 15–65. Read found 46–68 for Brazoria leaves, and Zona (1990, p. 639) gives 80–115 for *S. mexicana*. And we now know, from the discovery of the Garcitas Creek *S. mexicana* population, that the ranges of *S. minor* and *S. mexicana* overlap in the Central Coast, since the range of *S. minor*







2. Relatively flat Brazoria hybrid leaf. 3. Highly costapalmate Brazoria hybrid leaf. 4. Hastulas of leaves in Figures 2 and 3. 5. *Sabal minor* in Texas Hill Country.

extends well to the southwest of Garcitas Creek. Since the Brazoria palms would be hybrids of Texas' two native species of palm, and are endemic to Texas, in a paper Read and I are preparing we propose calling them *Sabal xtexensis*.

The Brazoria County site consists of approximately 30 trunked palms, plus an uncounted number of young (trunkless) specimens, scattered through a heavily forested area of about 60 acres. Although *S. minor* abounds at the site, forming the understory of the forest, as far as we know the nearest wild *S. mexicana* is on Garcitas Creek, 60 miles southwest of the hybrid site. The hybrids are apparently beginning to slowly disperse beyond the main concentration. We found one two miles away.

Although we know the hybrids are reproducing, we do not know whether they are mainly backcrossing with *S. minor*, or crossing with each other. To the extent they are backcrossing the *S. minor* population will be enriched by a genetic infusion from a much larger and very different species. This will help *S. minor* have the genetic variability it needs to adapt to changing conditions. To the extent the hybrids are crossing with each other they could eventually stabilize into a new species, perhaps a tall palm for the middle Gulf Coast, a region which has no such native palm. Either way the site constitutes a natural genetic laboratory where researchers can study an ongoing evolutionary process, in its ecological context. For this reason both Read and Balick (pers. comm.) stress the importance of protecting the Brazoria palms in the forest where they stand. Balick (1988, p. 30) writes: "Since hybrid progeny can develop into distinct species over time, it must be recognizied that these are distinct taxa worthy of conservation efforts." And also: "In the case of palms, much greater emphasis needs to be put on field studies of naturally occurring as well as disturbed populations in the wild in order to fully recognize the importance of hybridization in this family."

This dense bottomland hardwood forest, with an understory of *S. minor*, seems to have protected the palms from human intrusion, since few people, even in Brazoria County, are aware of them. As a remnant of a continuous hardwood forest that, according to Del Weniger (1984, p. 33), once covered most of two counties, it deserves protection in its own right. None of what remains of this unique coastal forest is now in a preserve.

For decades botanists have puzzled over the rare trunked form of *S. minor*, with Bomhard (1943) noting that they appear to reach their greatest development in Louisiana and Texas. Testing *S. minor* from the Carolinas to East Texas, Paul Ramp (1989) found an east-west genetic cline. By studying leaf production in the crown and counting leaf scars down the trunk, Read estimates the tallest hybrid (27 feet) to be 150 years old. He does not, however, believe this palm is necessarily the original hybrid. Since the original hybridization could have preceded this palm by many years, with backcrossing with *S. minor* already in progress, perhaps seed dispersal up the coast, toward the Mississippi delta, and inland, could explain Texas' and Louisiana's scattered populations of trunked *S. minor*. Although the morphological differences between trunked *S. minor* and the putative hybrids are clear, if backcrossing with *S. minor* has been long in progress genetic influence from the hybrid source could still be the cause of the trunked forms.

In his monograph Zona (1990, p. 645) writes: "Throughout its range, [*S. minor*] is a palm of the rich soils of floodplains, levees, river banks, and swamps. . . ." But, in the Hill Country of Texas, a limestone region with an average annual rainfall of 30 inches, and frequent drouths, I have found a population of *S. minor* growing amid rocks and cactus on a ridge top 2,000 feet above sea level. (See Fig. 5.) Since *S. mexicana* is a palm of relatively drier environments (ses Zona, 1990, p. 640), Read

believes the apparent ability of Hill Country *S. minor* to grow in a xeric environment could also be due to the influence of hybridization.

Conservation Efforts

The 43-acre tract on which most of the Brazoria palms stand is for sale. The availability of the tract presents, Read and I believe, a unique conservation opportunity. The Brazoria palms not only would be the only known hybrids of *Sabal* species, but the only naturally occurring and reproducing palm hybrids in the United States. Only 50 miles south of Houston, and over 200 miles north of the lower Rio Grande, they are, as far as we know, the northernmost natural population of tall palms west of Florida (*Sabal palmetto*) and east of Arizona (*Washingtonia filifera*), and one of only two such natural populations north of the lower Rio Grande. Further, if the tract can be protected, prospects for successful conservation of the palms, and thus of the evolutionary event taking place, are excellent. They are healthy and reproducing, and slowly dispersing outward from the site. On the other hand, IPS member Mike Rayburn, a Brazoria County rancher, believes that if the tract is sold it will probably be cleared, since there would be no economic use for the land in its present densely wooded state. Most of the remaining palms, outside the 43-acre tract, stand on two adjoining tracts of 12 and 3 acres each. Ideally these tracts would eventually be added to the preserve.

A local conservation organization is now receiving donations toward purchase of the tract. Those wishing to help may send checks, payable to the "BNCAP Palm Fund," to the Brazosport Nature Center and Planetarium, P.O. Box 1464, Lake Jackson, TX 77566. Also please call or write the following persons, urging them to protect the Brazoria County palm site:

DAVID BRAUN, Director, Texas Nature Conservancy, P.O. Box 1440, San Antonio, TX 78295-1440. Tel. 512/224-8774.

JOHN C. SAWHILL, President, The Nature Conservancy, 1815 North Lynn Street, Arlington, VA 22209. Tel. 703/841-5300.

ANDREW SANSOM, Director, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, TX 78744. Tel. 512/389-4800.

Acknowledgments

Mike Rayburn and George Stevenson (author of *Palms of South Florida*) explored the Brazoria palm site, my wife Carol Lockett took most of the photographs for this article, and Frank Smith helped pay Robert Read's air fare to Texas. Ranchers John Bennett and Dave Marlow, and fisherman Lon Drushel, took us to the Garcitas Creek *Sabal mexicana* population. Gralic Less let us study palms on her land.

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Principes, 35(2), 1991, pp. 72–82

New Species of Chamaedorea from Central America

DONALD R. HODEL
University of California, 2615 S. Grand Ave., Suite 400, Los Angeles, CA 90007

Since the International Palm Society will publish my treatment of *Chamaedorea* in 1991, I propose several new species here for inclusion in that work. Four occur in Costa Rica, one is found in Nicaragua and two are in Panama.

Chamaedorea minima D. R. Hodel **sp. nov.** (Figs. 1,2).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter. *C. pumilae* H. A. Wendl. ex Dammer affinis sed laminis nervis 6–8 utrinsecus, non iridescentibus smaragdinis venetis maculosis differt. Typus: Cult., *D. R. & M. A. Hodel 622A* (holotypus, BH).

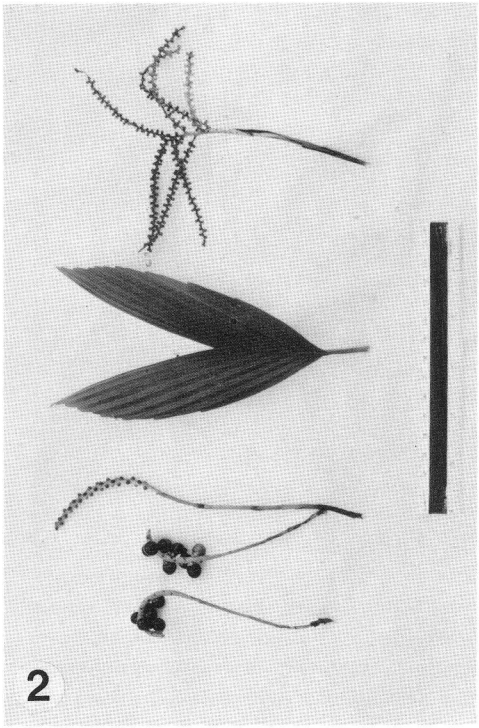
Stem solitary, erect or creeping, short, to 25 cm tall, 1–2 cm diam., densely and prominently ringed, internodes 2–3 mm long, often with adventitious roots. Leaves 7–10 (Fig. 1), spreading, simple and bifid, ± stiff; sheath short, 2.5 cm long, deeply split opposite petiole and clasping completely in circular manner only at base, green, minutely white-spotted; petiole 5–7 cm long, flat and green adaxially, rounded and green abaxially; rachis to 7 cm long, green and angled adaxially, rounded and pale green abaxially, minutely white-spotted; blades simple and deeply bifid to ca. ½ their length, 15 × 6 cm, 4–5 cm wide at tips, grayish dark forest green, lobes acute-acuminate, coarsely toothed along exterior margin, 6–8 prominent primary nerves on each side of rachis.

Inflorescences (Fig. 2) interfoliar, enclosed in upper rolled margins of sheath, erect-spreading; peduncles to 12 cm long, 3 mm wide at base and there ± flattened, 2–3 mm diam. at apex, green in flower, exposed and orange in fruit; bracts 6–8, tightly sheathing, acute-acuminate, bifid, papery, brownish in flower and fruit, longitudinally striate-nerved, prophyll 0.5 cm long, 2nd bract 1.5 cm long, 3rd 2 cm long, 4th 3 cm long, 5th 4 cm long, 6th 5 cm long, 7th 3 cm long. Staminate inflorescence with rachis 2 cm long, green in flower; rachillae 6, these to 7 cm long, 1–1.5 mm diam., spreading or slightly drooping, green in flower. Pistillate inflorescence spicate; rachis or flower-bearing portion to 7 cm long, 3 mm diam. and green in flower, swollen to 4–5 mm diam. and red-orange in fruit, curved.

Staminate flowers in moderately dense spirals, green and barrel-shaped in immature bud, 1.5 × 0.75 mm, calyx low, 3-lobed; petals valvate, free, spreading apically. Pistillate flowers in moderate spirals, green and subglobose in immature bud, 1 × 1 mm; calyx 3-lobed, sepals imbricate; petals tightly imbricate, apically acute, thickened, dark green. Fruits purple-black, ± globose, 8–10 mm diam.

Distribution: COSTA RICA. Dense, wet forest at middle elevations, exact locality unknown.

Specimens Examined: CULTIVATED. Costa Rica: Puntarenas, San Vito de Coto Brus, Jardín Botánico Robert y Catherine Wilson, *D. R. & M. A. Hodel 622A* (holotype, BH), *622B* (BH). United States: California, Huntington Beach, garden of Frank Ketchum, *D. R. Hodel 673* (BH).



1. Staminate plant of *Chamaedorea minima* cultivated at Jardín Botánico Robert y Catherine Wilson, San Vito, Costa Rica from which we collected the type specimen, *D. R. & M. A. Hodel 622A.* 2. Infructescences and pistillate inflorescence (bottom), leaf blade (center), and staminate inflorescence (top) of *Chamaedorea minima.*

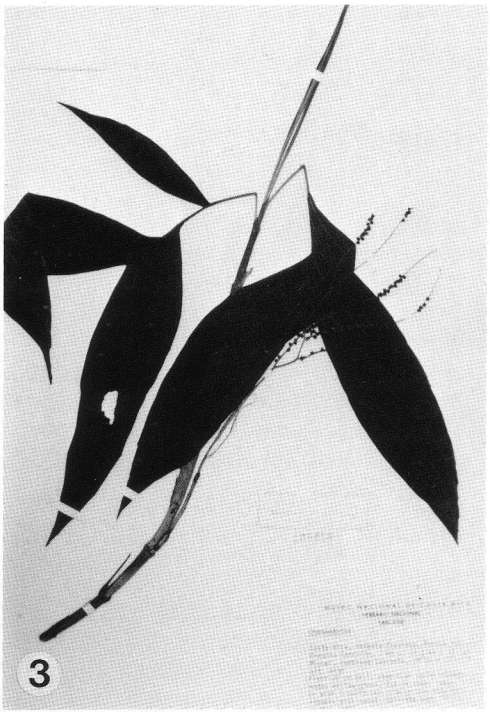
The specific epithet means smallest, in reference to the habit of this species, among the smallest in the genus.

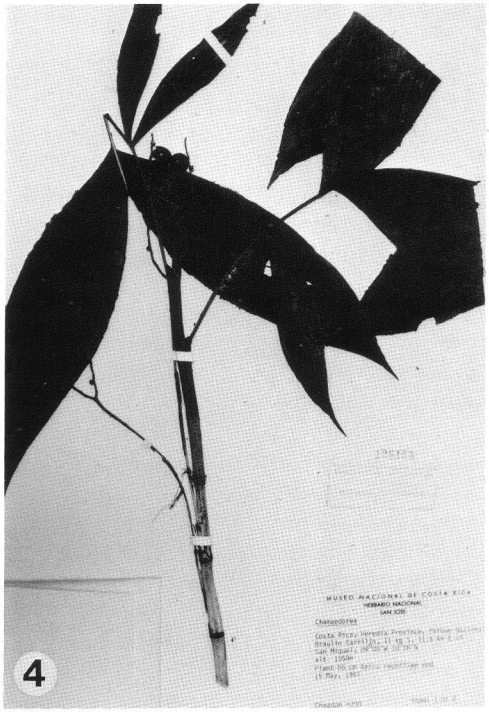
In the late 1960s, Robert Wilson began to plant this species at his garden at San Vito in southeastern Costa Rica. Local collectors brought the plants to him but gave no specific locality other than that they grew in the mountains not too distant from San Vito. Wilson established fruiting populations of this dwarf palm in his garden (illustrated Figs. 6,7 in *Principes* 25(2): 51–52, 1981) and frequently distributed seeds and plants to palm collectors and hobbyists, most of whom lived in the United States. Wilson called this palm dwarf pumila, in reference to its similarity to *C. pumila.*

Chamaedorea minima is indeed close to *C. pumila* but can be distinguished by its even more dwarf habit and smaller blades with no more than 8 prominent primary nerves on each side of the rachis. In addition, the blades lack the iridescent, slightly mottled bluish green color so characteristic of those of *C. pumila.* Through Wilson's efforts, *C. minima* is cultivated in Hawaii, California, Florida, and perhaps elsewhere.

Chamaedorea chazdonii D. R. Hodel **sp. nov.** (Figs. 3,4).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter. *C. correae* D. R. Hodel & N. W.





3. Type specimen of *Chamaedorea chazdonii, R. Chazdon 205,* showing leaf blades with large terminal lobes and small basal pinnae and staminate inflorescence. 4. Fruiting specimen of *Chamaedorea chazdonii, R. Chazdon 200.*

Uhl affinis sed laminis tenuibus, nervis paucioribus, petiolis viridibus, bracteis paucioribus, rachillis masculis 5–10 patentibus, floribus masculis remotis differt; *C. dammerianae* Burret affinis sed habitu minore, caulibus repentibus, foliis et nervis minoribus numerum, rachillis masculis patentibus, floribus remotis masculis ovoideis calycibus non prominentibus, staminibus aequantibus pistillodum, fructibus globosis differt. Typus: Costa Rica, *R. Chazdon 205* (holotypus, CR).

Stem solitary, procumbent and rooting along its length then briefly erect to 1 m tall, 7 mm diam., smooth, green, ringed, internodes to 4 cm long. Leaves 4–5, spreading, pinnate (Fig. 3) or less often simple and bifid; sheath to 7 cm long, tubular, tightly clasping, briefly obliquely open apically, green, finely longitudinally striate-nerved; petiole to 7 cm long, 2–2.5 mm diam., longitudinally striate, flattened adaxially, rounded abaxially; rachis to 7 cm long, angled adaxially, rounded abaxially, rachis and petiole green adaxially and with a pale band abaxially extending onto sheath; blade if pinnate to 30 × 20 cm with 2 pinnae on each side of rachis, apical pair largest, these to 18 × 5 cm, broadly lanceolate, contracted at base, acuminate, slightly sigmoid, exterior margin remotely and shallowly toothed, 5–6 prominent primary nerves above, 1 secondary between each pair of primaries, tertiaries numerous, faint, primaries and secondaries drying yellow especially below, basal pair of pinnae to 13 × 2.5 cm with 1–2 prominent primary nerves and 1–2 secondaries on each side of this; if blade simple and bifid then to 20 × 16 cm,

deeply bifid apically to ¾ its length, lobes broadly diverging, 18 × 5 cm, 5–7-nerved.

Inflorescences interfoliar, perhaps infrafoliar in fruit; peduncles erect, to 15 cm long, 2–3 mm wide at base, 1–1.5 mm diam. at apex, greenish in flower, orange in fruit; bracts 4–5, tightly sheathing, greenish, membranous, becoming brown and tattered at anthesis, finely longitudinally striated, prophyll 5 mm long, 2nd bract 1.5 cm, 3rd 4 cm, 4th 7 cm long. Staminate inflorescence with 5–10 rachillae, these to 11 cm long, slender, spreading, greenish at anthesis. Pistillate inflorescence furcate (Fig. 4) or with 3 rachillae to 8 cm long, erect, greenish in flower, orange in fruit.

Staminate flowers in loose spirals, 1–3 mm apart in bud, ± ovoid at anthesis, 2 × 2 mm, 1 mm wide at apex, cream-colored, superficial leaving elliptic scars 1–1.5 mm long; calyx low, 0.5 × 2 mm, membranous, 3-lobed, lobes broadly rounded; petals valvate, free to base, erect, deltoid, 2 × 2–2.5 mm, acute or slightly rounded; stamens short, filaments short or absent, anthers bilobed, lobes elliptic; pistillode columnar, 1.25–1.75 mm high, reddish and slightly lobed apically. Pistillate flowers in loose spirals, 2–3 mm apart, ovoid, 2 × 1.5 mm, superficial leaving rounded scars 1.25 mm long; calyx low, 0.5 × 1.5 mm, membranous, scarcely 3-lobed; petals imbricate basally, free apically, 1.75 × 2 mm, acute or rounded apically; staminodes present; pistil ovoid, 1.75–2 × 1.5 mm, greenish, stigma lobes darkened, flat, recurved. Fruits black, globose, 8–10 mm diam.

Distribution: COSTA RICA. Heredia. Limón. Dense, wet forest on the Atlantic slope, 700–1,100 m elevation.

Specimens Examined: COSTA RICA. Heredia: Braulio Carrillo National Park, *R. Chazdon 136* (BH), *160, 198, 200* (CR), *205* (holotype, CR); *M. H. Grayum 6733* (MO). Limón: Volcán Irazú, *R. Ocampo s. n.* (CR).

The epithet honors Robin Chazdon, collector of the type and a majority of the paratypes and who has added immensely to our knowledge of palms in Braulio Carrillo National Park.

Chamaedorea chazdonii is known from only a few collections from the Atlantic slope of Costa Rica in Braulio Carrillo National Park on Volcán Barva and outside the park on Volcán Irazú. It is most closely related to *C. correae* from Panama but this latter species can be distinguished by its gray-green, moderately thick leaves with more nerves on each side of the rachis, gray petioles, staminate inflorescence with 1–3 ascending and more densely flowered rachillae, more peduncular bracts, and yellowish staminate flowers. *C. chazdonii* may also be confused with *C. dammeriana* but this differs in its larger habit, erect stems, more numerous leaves with more nerves, pendulous staminate rachillae, densely placed and globose staminate flowers with a prominent calyx and stamens equalling the pistillode, and oval fruits distinctly narrowed at both ends.

Chazdon (1987) referred to *C. chazdonii* as *Chamaedorea* sp. "chiquita."

Chamaedorea matae D. R. Hodel **sp. nov.** (Figs. 5–7).

Subgeneris *Chamaedoreae* Mart. ex H. A. Wendl. floribus masculis petalis connatis apicaliter corollis aperturis lateralibus. *C. warscewiczii* H. A. Wendl. affinis sed foliis pinnis paucioribus (8), rachillis femineis pendulis differt. Typus: Costa Rica, *G. Mata 497* (holotypus, CR) (Fig. 5).

Stem solitary, erect, to 3 m tall, 1.5–2 cm diam., green, smooth, ringed, internodes 5–12 cm long. Leaves 4–7, spreading, pinnate; sheath to 20 cm long, tubular, tightly clasping, obliquely open apically, longitudinally striated; petiole to 15–25 cm long, green and grooved adaxially, rounded and pale abaxially; rachis 50–70 cm long, green and angled adaxially, rounded with a yellowish band abaxially

5. Type specimen of *Chamaedorea matae*, *G. Mata 497*.

extending onto sheath; pinnae 4–5 on each side of rachis, broadly lanceolate, basal ones to 30 × 9 cm, acuminate, strongly sigmoid, thick, leathery, 5–6 prominent primary nerves, these drying yellow and prominent below, end pair of pinnae conspicuously wider, to 15 cm wide, 10–12-nerved (Figs. 5,7).

Inflorescences interfoliar, erect to nodding or arching; peduncles to 50 cm long, 7–10 mm diam., greenish in flower and red-orange in fruit where exposed; bracts 5, ± loosely sheathing, brownish in flower and fruit, bifid, acuminate, fibrous, becoming tattered, prophyll to 6 cm long, 2nd and 3rd bracts to 15 cm, 4th to 23 cm, 5th to 26 cm; rachises 3–8 cm long, green in flower, red-orange in fruit. Staminate inflorescence with up to 15 rachillae, these to 25 cm long, pendulous, green in flower. Pistillate inflorescence with 7–10 rachillae, these to 15–20 cm long, green and pendulous in flower, red-orange and pendulous in fruit (Fig. 7).

Staminate flowers in moderately dense spirals 1–2 mm apart, ± ovoid to barrel-shaped, 3 × 2.5 mm, leaving superficial elliptic scars 2.5–3 mm long; calyx low, 2.5 × 0.75 mm, scarcely 3-lobed; petals 3.5 × 2.5–3 mm, acute, connate at tips and corolla opening by lateral slits, corolla and calyx strongly nerved when dry; stamens shorter than pistillode, anthers 1.5 mm high; pistillode columnar, 2.5–2.75 mm high. Pistillate flowers leaving ± rounded superficial scars 2 mm long; petals broadly rounded in fruit, imbricate, 2 × 3 mm, dark-centered, brown-margined; calyx 0.75 mm high, scarcely 3-lobed. Fruits black, ± oval, 7–8 × 5–6 mm; perianth strongly nerved in fruit.

Distribution: COSTA RICA. Puntarenas. PANAMA. Herrera. Dense, moist forest on the Pacific slope, to 400 m elevation.

Specimens Examined: COSTA RICA. Puntarenas: Osa Peninsula, Marenco Biological Station, *D. R. & R. J. Hodel 715* (BH, CR); Corcovado National Park, *A. Gentry 48472* (MO); *R. Liesner 2841* (MO, CR), *3259* (CR); *O. Tellez et al. 4197* (CR); Rincón de Osa, *G. Mata 497* (holotype, CR); *W. Burger & J. Gentry 8905* (MO, F); *P. Raven 21516* (F); *J. & K. Utley 1189* (F); Carara Reserve, *M. Grayum & P. Sleeper 5946* (MO); hills north of Palmar Norte, *T. Croat 35184* (MO); *G. deNevers et al. 7750* (CR); Esquinas Forest Reserve between Palmar Sur and Golfito, *H. E. Moore 6539* (BH). PANAMA. Herrera: Cerro Alto Higo, *B. Hammel 4225* (MO).

The name honors Guillermo Mata, collector of the type. *Chamaedorea matae* is close to *C. warscewiczii* with which it shares the broadly sigmoid, prominently nerved, leathery pinnae and barrel-shaped staminate flowers with petals connate apically and the corolla opening by lateral slits. However, this latter species has dou-

6. *Chamaedorea matae, D. R. & M. A. Hodel 715*, at Marenco Biological Station on the Osa Peninsula, Costa Rica. 7. Leaf and infructescence of *Chamaedorea matae, D. R. & R. J. Hodel 715*, showing broad terminal pinnae and pendulous fruiting rachillae.

ble the number of pinnae and spreading, rather than pendulous, pistillate rachillae.

Chamaedorea serpens D. R. Hodel **sp. nov.** (Figs. 8,9).

Subgeneris *Chamaedoreae* Mart. ex H. A. Wendl. floribus masculis petalis connatis apicaliter corollis aperturis lateralibus. *C. pinnatifrondi* (Jacq.) Oerst., *C. warscewiczii* H. A. Wendl. et *C. murriensi* Galeano affinis sed habitu minori, repenti et repullulanti ramificanti differt. Typus: *D. R. & M. A. Hodel 745* (holotypus, BH; isotypus, PMA).

Stems cespitose, procumbent and sprawling and twisting along ground and through adjacent vegetation to 3–4 m long then shortly erect to 1.5 m tall (Figs. 8,9), 5–10 mm diam., rooting and sprouting at nodes, smooth, green, prominently ringed, internodes 5–10 cm long. Leaves 4–5, erect-spreading, glossy green, pinnate or rarely simple and bifid; sheath to 20 cm long, tubular, tightly clasping, obliquely open apically, green, longitudinally striated; petiole to 20 cm long, green and flat above, pale and rounded below; rachis to 25 cm long, green and angled above, rounded and with a pale yellow or light green band extending onto sheath; pinnae 2–5 on each side of rachis, all but apical pair lanceolate, 12–18 × 2.5–4 cm, sigmoid, acuminate, narrowed at base, 4–5 prominent primary nerves above, 1 secondary between each pair of primaries, tertiaries numerous, faint, apical pair of pinnae (or if bifid) 27–30 × 8–12 cm, slightly sigmoid, acuminate, 9–12 prominent nerves above, these 1–2 cm apart.

8. A clump of *C. serpens*, *D. R. Hodel & M. A. Hodel 745*, grows on the near vertical side of a ravine, El Valle, Panama. 9. Portion of a clump of *C. serpens* showing rooting and sprouting stems.

Staminate inflorescences infrafoliar or interfoliar; peduncle to 15 cm long, 5 mm wide at base and there flattened, 1.8–2 mm diam. at apex and there ± rounded, pale to green at anthesis; bracts 4–5, long-lanceolate, obliquely open apically, finely longitudinally striate-nerved, papery, greenish to brown at anthesis, lower ones acute, upper ones acute-acuminate, prophyll 2 cm long, 2nd bract 6 cm long, 3rd 9 cm long, 4th 10 cm long and exceeding peduncle, 5th 4 cm long and sometimes concealed by the larger 4th; rachis to 3 cm long, greenish in flower; rachillae 6–10, to 10 cm long, slightly drooping.

Staminate flowers in ± dense spirals, 1–2 mm apart, only slightly immersed in superficial elliptic depressions 3 × 1.5 mm, ± globose, 2–2.5 × 1.8–2.5 mm, greenish yellow at anthesis, drying brownish; calyx 0.8–1 × 1.8–2 mm, deeply 3-lobed nearly to base, lobes rounded to acute, only lightly nerved; petals valvate, connate apically and there adnate to pistillode and the corolla opening by basal and lateral apertures, petals 2.5 × 2 mm, acute, ± thin, lightly longitudinally striate-nerved; stamens 1.25–2 mm long, anthers sessile or nearly so, 2 mm long, longitudinally bilobed; pistillode columnar, 2–2.5 mm tall, very slender, slightly flared apically. Pistillate flowers and fruits not seen.

Distribution: PANAMA. Panama. Coclé. Dense, wet forest and cloud forest at or near the Continental Divide, 800–1,000 m elevation.

Specimens Examined: PANAMA. Panama: Cerro Campana, letter and photograph from H. F. Loomis to H. E. Moore, *G. Fairchild & H. Loomis s. n.* (BH). Coclé: El Valle de Antón, *D. R. & M. A. Hodel 745* (holotype, BH; isotype, PMA).

The epithet is from a Latin word meaning creeping and rooting, in reference to the stems of this species. *C. serpens* is one of the most unusual members of the genus with its sprawling, procumbent, slender stems rooting and sprouting at the nodes along their length. The stems appear to grow upright until about a meter tall at which point they tend to fall over. In this manner, they form a rather loose colony of tangled stems several meters across and a meter high. The only other member of the genus approaching it in the branching habit of the stems is a form of *C. elatior* from Veracruz and Oaxaca, Mexico, that is easily distinguished by its long, vining, climbing stems and leaves with 10 or more, often deflexed, pinnae on each side of the rachis.

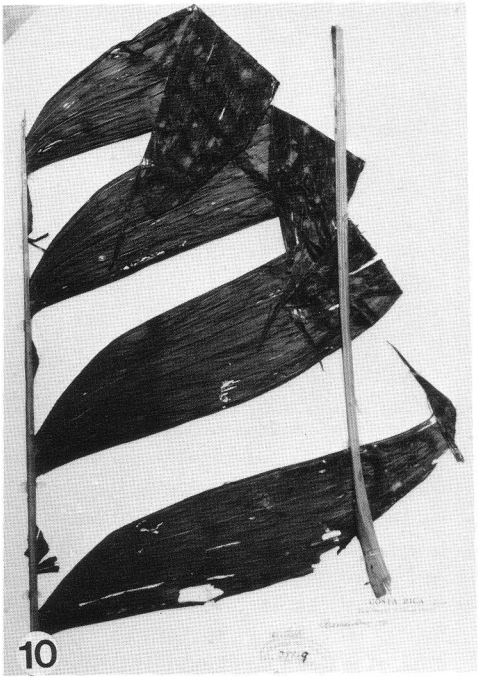
Florally, *C. serpens* is close to *C. pinnatifrons* from northern South America and related species including *C. warscewiczii* and *C. murriensis*. However, *C. serpens* is amply distinct in its creeping stems rooting and sprouting at the nodes and generally much smaller overall habit.

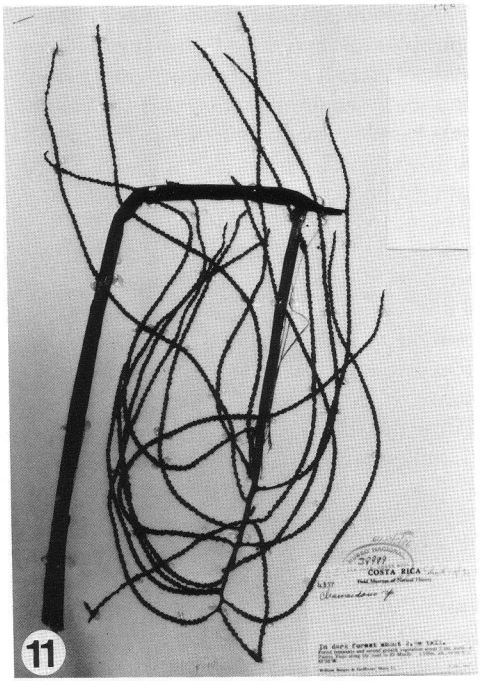
Chamaedorea serpens occurs in wet forest and cloud forest at about 1,000 meters elevation in western central Panama. It is not a common plant. We found it on the sides of steep ravines near El Valle where it occurs in dense forest often shrouded in clouds. This is an area rich in chamaedoreas; nearby grow *C. allenii*, *C. amabilis*, *C. correae*, *C. costaricana*, *C. pinnatifrons*, *C. sullivaniorum*, *C. tepejilote*, *C. warscewiczii*, and *C. woodsoniana*.

Chamaedorea selvae D. R. Hodel **sp. nov.** (Figs. 10–12).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter. *C. tepejiloti* Liebm. ex Mart., *C. deneversianae* Grayum & Hodel et *C. murriensi* Galeano habitu affinis sed subgeneri diverso pertinens subgenere differt. *C. vistae* Hodel & Uhl, *C. carchensi* Standl. & Steyerm. et *C. woodsonianae* L. H. Bailey affinis sed pinnis paucioribus (3–8 utrinque versus 20 vel plus) latioribus differt. Typus: Costa Rica, *W. Burger & G. Mata 4337* (holotypus, CR; isotypus, F).

Stem solitary, (rarely cespitose? *Ste-*





10, 11. Portion of leaf (10) and staminate inflorescence (11) of *W. Burger & G. Mata 4337*, holotype of *C. selvae*.

vens 24461), erect, to 2 m tall, 2 cm diam. Leaves 4–5, spreading, pinnate; sheath green with no pale stripe extending onto rachis abaxially; petiole to 35 cm long, robust; rachis to 66 cm long; pinnae 3–8 on each side of rachis (Fig. 10), to 45 × 9 cm, broadly lanceolate, sigmoid, falcately acuminate, thin-papery, 6–10 primary nerves prominent and elevated adaxially, 1 secondary between each of 2 primaries, tertiaries numerous, faint, primaries paler abaxially, end pair of pinnae sometimes very large, then each lobe to 50 × 30 cm on a rachis 40 cm long with 30 primary nerves on each side, outer margin remotely toothed toward apex.

Inflorescences infrafoliar, attached well below the leaves; peduncles erect, ± robust, to 75 cm long, 7–8 mm diam.; bracts 5–6, tubular, tightly sheathing, acuminate, fibrous, longitudinally striate-nerved, prophyll to 3 cm long, 2nd bract to 10 cm, 3rd to 25 cm, 4th to 40 cm, 5th to 35 cm, 6th to 30 cm. Staminate inflorescence with rachis to 10 cm long, straight; up to 17 rachillae (Fig. 11), these to 30 cm long, slender, pendulous. Pistillate inflorescence with rachis to 7 cm long, ± straight; up to 11 rachillae (Fig. 12), these to 20 cm long, drooping in flower, pendulous and orange in fruit.

Staminate flowers in superficial and elliptic depressions 1.25 mm long, not strongly nerved abaxially when dry, in bud arranged in moderately dense spirals but not contiguous, 0.5–1 mm apart, ± dome-shaped, 1 × 1.25–1.5 mm; calyx coroniform, 1.5 mm across, ± thick, deeply 3-lobed, lobes rounded, 0.5 × 1.5 mm, sepals connate and/or imbricate basally; petals valvate, spreading, 1 × 1.5 mm, acute, stamens with anthers 0.65 mm high, tightly appressed around pistillode, pistillode columnar, 0.75 mm high, apically

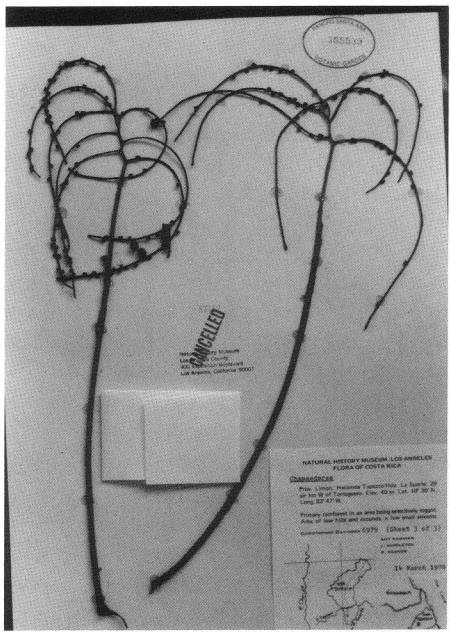
lobed. Pistillate flowers in moderately dense spirals 1–2 mm apart, leaving shallow elliptic scars 1.5 mm long, ± globose, 2 × 2 mm, sepals of fruiting perianth imbricate basally, broadly rounded, 0.75 × 1.75 mm; petals of fruiting perianth imbricate basally, 1.75 × 2.5 mm, acute, petals and sepals lightly nerved adaxially; pistil ovoid, 1.25 mm high, stigma lobes pointed, erect, darkened. Fruits green when immature, oblong, 7 × 5 mm, maturing black.

Distribution: COSTA RICA. Limón. Heredia. San José. NICARAGUA. Río San Juan. Hillsides in wet, lowland forest on the Atlantic slope mostly below 200 m but occasionally to 700 m elevation.

Specimens Examined: COSTA RICA. Limón: 29 air kms west of Tortugera at Hacienda Tapezco and Hacienda La Suerte, *C. Davidson et al. 6979* (RSA); 8 kms north of Linda Vista, *R. Liesner et al. 15449* (CR); Cerro Coronel, east of Laguna Danto, *W. Stevens & O. Montiel 24461* (CR). Heredia: 5 kms north of Puerto Viejo, *W. Burger & G. Mata 4337* (holotype, CR; isotype, F); Puerto Viejo, La Selva, *M. Grayum 9625, 9627* (CR), *H. E. Moore & G. Hartshorn 10122* (BH), *N. Hammer & S. Gonzales 112* (FTG). San José: Braulio Carrillo National Park, Sendero Chacón, *N. Zamora & P. Sanchez 446* (CR); Estación Carrillo, *I. Chacón & G. Herrera 1625* (CR). NICARAGUA. Río San Juan: between San Juan del Norte (Greytown) and Delta de San Juan along Río San Juan, *G. Bunting & L. Licht 873* (F).

The specific epithet is derived from the Spanish *selva* meaning jungle (lowland tropical rain forest). A majority of the collections comes from such a habitat below 200 m elevation; four of the collections are from La Selva, the O.T.S. station near Puerto Viejo. Only the two collections from Braulio Carrillo National Park are from above 200 m elevation.

Leaves of *C. selvae* are very similar to those of *C. tepejilote*, especially in the nervation. However, the short peduncles,



12. Pistillate inflorescence of *C. selvae, C. Davidson et al. 6979.*

contiguous staminate flowers, and prominent yellow stripe on the abaxial surface of the rachis and petiole distinguish this latter species. *C. deneversiana* is also somewhat similar vegetatively but differs in the flexuous rachises of the inflorescences, fewer and shorter rachillae, and apically connate staminate petals.

Perhaps *C. vistae, C. carchensis,* and *C. woodsoniana,* all from higher altitudes, are most closely related to *C. selvae.* However, these three are amply distinct in their narrower and more numerous pinnae (20 or more on each side of the rachis versus 3–8 for *C. selvae*). In addition, *C. vistae* and *C. carchensis* have many more staminate rachillae (80–100 and 40 respectively versus 17 for *C. selvae*).

The only species of subgenus *Chamaedoropsis* that occurs in the same range as *C. selvae* is the highly variable *C. dammeriana.* However, the interfoliar inflorescences, few-branched staminate inflorescences, usually spicate or furcate

pistillate inflorescences, and much smaller habit (about half the size of *C. selvae*) distinguish this latter species.

Chamaedorea selvae is rare over its range and should probably be considered endangered due to destruction of lowland forest in Limón, Heredia, and Alajuela provinces of Costa Rica and adjacent portions of Nicaragua. In fact, several of the collections are from forest remnants, indicating that suitable habitats for its growth are noncontiguous and isolated. *C. selvae* does exist in protected areas; it is well documented at La Selva as *Chamaedorea sp. nov. fide* Moore (Chazdon 1985, 1987; Moore and Chazdon 1985).

Acknowedgments

I thank John Dransfield and Natalie Uhl for reviewing and offering helpful suggestions on the manuscript.

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Principes, 33(3), 1989, pp. 00–00

Palmy Extracts

compiled by Bill Gunther

"Palms are excellent, graceful, and durable decorators from regions where their strong roots can reach the water. Remember, then, never to let palms dry out at the roots, and when watering, soak them thoroughly. Brown tips may be caused both by drying out in warm surroundings, as well as by an overly wet condition at their roots, especially when cold."

by Alfred Byrd Graf, in EXOTICA 3, 1968.

"We can have, right in New York, during our summer, a temperature and humidity every bit as tropical as Jakarta, Java, or Belem, Brazil—excepting only for the absence of the daily tropical rains. Only because the unmerciful cold season following forbids it, are we without the visual evidence in the landscape of the real tropics, the graceful palm tree."

by Alfred Byrd Graf, in EXOTICA 3, 1968.

"Rio de Janeiro is enchanting and tropical, spreading between conical mountains of the Serra de Carioca and Guanabara Bay, a maze of beautiful vistas and picturesque valleys. Slender palms testify to a warm and humid climate, and none is more imposing than the Royal palm, Roystonea regia."

by Alfred Byrd Graf, in EXOTICA 3, 1968.

"On the island of New Georgia in the Solomons group, during World War II, the Japanese used a 'fairy palace supported by a hundred columns' to conceal an aerodrome which they were making. The trunks (of the palms) were cut, but the crowns remained, supported by cross cables. One day there was a coconut plantation and the next revealed to American aviators an air-strip in use."

E. J. H. Corner, THE NATURAL HISTORY OF PALMS, 1966.

Principes, 35(2), 1991, pp. 83–85

The Mpapindi Palm (Chrysalidocarpus pembanus) of Pemba Island, Tanzania

DENNIS V. JOHNSON
605 Ray Drive, Silver Spring, MD 20910

The mpapindi palm is one of about twenty species of the genus *Chrysalidocarpus*. Geographic distribution of the genus is limited to the Indian Ocean and includes Madagascar, the Comoro Islands and Pemba Island. Two species are known only in cultivation: *C. glaucescens* and *C. cabadae*. The ecology of *Chrysalidocarpus* spp. is quite varied. They occur from sea level to elevations of 2,000 m in littoral forests, lowlands and montane forests, including rocky and mossy surfaces. The so-called "areca" palm (*C. lutescens*) occurs wild in Madagascar on sand dunes and along streams. It is one of the most widely and easily cultivated ornamental palms. The natural history of the genus is poorly known and is in need of taxonomic study (Uhl and Dransfield 1987).

Williams (1949) included the mpapindi palm in his book on useful and ornamental plants in Zanzibar and Pemba, but did not provide a name for the species. *Chrysalidocarpus pembanus* was formally described by Moore (1962*a*, *b*), using herbarium materials. Later, Moore (1965) visited Pemba and was able to collect flowers and immature fruits. There is general agreement that the palm is endemic to Pemba Island, specifically to the Ngezi Forest Reserve in the northwestern portion of the island. Williams (1949) mentions the mpapindi palm being in cultivation in Zanzibar. I have been unable to find any record of it having been brought into cultivation elsewhere in botanic gardens, although it is in a private garden on the southern coast of Kenya (J. Dransfield, pers. comm.)

Moore (1962*a*) provided a complete botanical description of the palm. In it he stated that the species is a clustering palm up to 18 m in height, with a green trunk and bright red fruits.

During a trip to Tanzania in January 1990, I visited both Zanzibar and Pemba Island and gathered information on the current conservation status of the mpapindi palm.

Zanzibar

As reported by Williams (1949), the mpapindi palm is cultivated in and around Zanzibar Town. The largest stand is in a small garden beside the House of Wonders on the waterfront. There are 95 palms in that garden, representing various age classes; the largest palm is about 10 m tall. It was noticed that not all of the trunks were producing basal suckers. In more recent years, mpapindi palms have been planted along the driveway (Fig. 1) and on the grounds of the Bwawani Hotel, as well as beside the parking lot at Zanzibar airport. In all three locations, the palms looked healthy, growth appeared to be vigorous and some specimens were fruiting heavily. It appears that the mpapindi is as suitable an ornamental palm for other parts of the tropics as *Chrysalidocarpus lutescens*.

Pemba

Pemba Island has undergone significant deforestation due to the establishment of clove plantations beginning in the 1830s,

1. The mpapindi palm (*Chrysalidocarpus pembanus*) under cultivation at the Bwawani Hotel, Zanzibar Town, Tanzania. 2. A cluster of native mpapindi palms (*Chrysalidocarpus pembanus*) in the western coastal strip of Ngezi Forest Reserve, Pemba Island, Tanzania.

as well as other forms of agriculture. The sole remnant of the original forest is the Ngezi Forest Reserve, in the northwestern part of the island. It covers 1,456 ha. As Rodgers et al. (1986) and Beentje (1990) report, the forest is still largely intact, but with some areas replanted with exotics and native species. Selective logging of valuable timber species has taken place within the reserve.

Personal observations of the status of *Chrysalidocarpus pembanus* were made along the east-west road through the Ngezi Forest. The palm is fairly common in the understory of the moist evergreen forest which is characterized by sandy soils. Populations are reproducing and palms of various sizes and ages were seen. Rodgers et al. (1986) state that the palm has "healthy and extensive populations with abundant regeneration." Beentje (1990) found the mpapindi palm occurring in 32 of the 84 plots into which the forest has been divided, and estimated that the entire forest contains about 3,000 individuals. I did not see any fruiting palms in the moist evergreen forest, but it was early in the season. Mpapindi palms occur in the reserve with and without basal suckers. The growth habit is apparently variable.

The westernmost portion of the Ngezi Forest Reserve is a dry semi-evergreen forest atop poorly developed, rocky, coral soils. The habitat is much more open than the moist evergreen forest. In this area, the mpapindi palm is emergent and forms a part of the canopy (Fig. 2). Several palms were found to be in fruit. Again, the same pattern of solitary palms and those with basal suckers was noted.

Conservation Status

Currently, *Chrysalidocarpus pembanus* is classified as an Endangered species. Beentje (1990) describes it as being vulnerable. Based on my observations of the *in situ* status of this palm, I concur with Beentje and recommend that it be changed formally to Vulnerable. Native populations have been seriously reduced because of forest clearing and there remains the threat of further degradation of the Ngezi Forest; therefore, the ultimate security of the palm is not guaranteed. Of primary concern to its *in situ* survival is a proposal to use the western coastal strip of the Ngezi Forest for development of a sport fishing and beach resort. Such a facility and the added transportation infrastructure it would require would not only reduce the already small area of the reserve, but would likewise threaten the nearby moister evergreen core of the forest where the mpapindi palm occurs in greatest numbers.

Fortunately, the mpapindi palm is not under much pressure from local people for useful products. Beentje (pers. comm.) observed one instance of mpapindi palm trunks being used as goal posts (two uprights and a horizontal bar) at the Bandarikuu football field southeast of Ngezi Forest. The leaves appear not to be harvested, and the fruits are not eaten by humans. Beentje encountered a stand of fruiting trees where monkeys were eating the fruits.

Fresh mpapindi seed were collected from cultivated palms in Zanzibar and native palms in the western coastal strip of the Ngezi Forest. About 375 seeds were carried back to the United States. A dozen I kept for myself to germinate, and turned the remainder over to the Palm Society Seed Bank for distribution. If these seed are successfully germinated, *Chrysalidocarpus pembanus* will have been brought into cultivation outside East Africa, greatly improving its *ex situ* conservation status. I believe the mpapindi palm has strong potential as a new ornamental, given its arching pinnate leaves, smooth green trunk and crimson fruits.

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Ecological Aspects of the Interaction between Chamaedorea tepejilote, a Dioecious Palm and Calyptocephala marginipennis, a Herbivorous Beetle, in a Mexican Rain Forest

K. OYAMA* AND R. DIRZO

Centro de Ecología, UNAM, Apartado Postal 70-275, México, 04510, D.F.

ABSTRACT

Chamaedorea tepejilote Liebm. ex Mart., an abundant dioecious palm in the lowland rain forest of Los Tuxtlas (Southeast Mexico), typically bears evidence of leaf damage by *Calyptocephala marginipennis* Bohem. (Chrysomelidae). The beetles markedly prefer this palm in comparison to other plants on this site, including other sympatric species in the same genus. Additionally, beetles showed some marginal preference for the foliage of female plants under experimental and field conditions. Sex-related phytochemical attributes of the palm, such as secondary compounds and nutritional characteristics of the foliage, did not differ markedly between sexes and did not seem to be the proximal causes of the inter-sexual differences in herbivory. Thus, the hypothesis that differences in resource allocation to defense and nutritional quality, resulting from sex-related differential allocation to reproduction, is not supported by this study. This investigation suggests that plant–herbivore interactions in palms may be as complex as those of other flowering plants.

Studies on the interactions between herbivores and plants in tropical communities have been increasing markedly in recent years (Coley 1983, Dirzo 1984, Janzen and Waterman 1984, Marquis 1984, among others). Also, much empirical evidence has been obtained which can be used for the development of theories of plant–herbivore interactions (see Crawley 1983, Rosenthal and Janzen 1979, Strong et al. 1984). In this expanding field, some workers have made studies regarding intraspecific differences in herbivory in the context of polymorphic plant systems in temperate zones (e.g., Jones 1966, Cates 1975, Dirzo and Harper 1982*a*). Dioecy constitutes one of the most common polymorphic systems, particularly in some Neotropical communities (Croat 1979, Bawa and Opler 1975, Bawa 1980, Flores and Schemske 1984, Bawa et al. 1985). Suggestion in the literature of sex-based differences in herbivory include male inflorescences suffering higher levels of predation than female inflorescences (Fryxell and Lukefahr 1967, Bawa and Opler 1978) and cases in which herbivores preferentially feed either on leaves of female (Danell et al. 1985, Lovett Doust and Lovett Doust 1985) or male (Agren 1987) plants. However, folivory is extremely poorly known for dioecious tropical plants, particularly palms.

In the lowland rain forest of Los Tuxtlas, Southeast Mexico, *Chamaedorea tepejilote*, a dioecious understory palm, normally bears extremely variable levels of leaf damage and we explored the possibility that this variation might explained, to some degree at least, by inter-sexual differences. The plants on this site are normally eaten by *Calyptocephala marginipennis*, a chrysomelid beetle which appears to be largely monophagous. We measured the selectivity of this insect for the leaves of each sex in the field and laboratory. Also, we attempted to correlate the effect of

* Present address: Department of Botany, Faculty of Science, Kyoto University, Kyoto, 606, Japan.

herbivory with differences in contents of secondary compounds and nutritional characteristics of the sexes.

Materials and Methods

Study Species. The palm genus *Chamaedorea* includes approximately one hundred species distributed through Neotropical forests from Brazil and Bolivia to Guatemala and the Central part of Mexico (Standley and Steyermark 1958, Uhl and Dransfield 1987). All the species in the genus are dioecious (H. Quero, pers. comm.). In Los Tuxtlas, Mexico, *C. tepejilote* is a common palm that forms dense patches in the forest understory where slight natural disturbances have occurred. The tallest individuals reach up to 5.0 m in height. Plants of both sexes bear from 3 to 5 leaves. The plants flower from October through December. Both sexes have yellow green flowers; male flowers tend to be slightly smaller (1.5 to 2.5 mm) than females (2.5 to 3.5 mm). Single female plants can bear from 5 to 400 fruits (Oyama 1984). Mortality of adult plants is due mostly to branches or other debris falling from the canopy. Tree falls frequently break apical meristems and kill the palms (Oyama 1987, 1990).

Eight species of *Calyptocephala* have been reported in Neotropical forests from Mexico to Brazil, paralleling the geographic distribution of the *Chamaedorea* species. The beetles are small (ca. 6 mm long) with pale brown elitrae and a dark line at the margin. This insect feeds on leaves of *C. tepejilote* making specific longitudinal ruptures along the leaf veins, which are easily recognized in the field.

Study Site. This study was conducted in a 600 m^2 permanent plot in a lowland rain forest in the Gulf of Mexico (95°14′–95°09′W, 18°34′–18°36′N), in the biological reserve Estación de Biología Tropical Los Tuxtlas at 150–650 m altitude.

Methods. We recorded herbivory on the leaves of male and female plants in the field using two methods: a) an instantaneous measurement based on broad categories of damage, and b) estimates of leaf area loss during a 3-month period. For the first method, leaf damage was scored on an A to D scale (A $\leq$ 25%; B $>$ 25 $\leq$ 50%; C $>$ 50 $\leq$ 75%; D $>$ 75%) in all the leaves of 48 male and 45 female plants. The leaves of each plant were separated into four age categories (I–IV). Contingency analyses (after a heterogeneity test for the leaves of different age) were carried out to assess the distribution of categories of damage of the leaves of both sexes. b) For the second method, leaf damage was also scored with a grid of 893 points on a transparent plastic sheet (10 cm $\times$ 5 cm). This grid was placed on the adaxial surface of the pinnae in a way that we could count the number of visible points coinciding with ruptures of the lamina (as a product of herbivore damage). We took care to check all types of damage and differentiated them from the specific damage produced by *C. marginipennis*; this was, by far, the most abundant type of damage (see Oyama 1984). We then calculated an index of leaf area removed as the quotient of the number of points registered (ruptured) to the total number of points of the grid (i.e., 893). Following this second method, we recorded the cumulative damage on the leaves by marking a permanent area of observation (of equal size to the grid) on the last two (youngest) leaves produced by the plant. We recorded the damage monthly for three consecutive months. For this analysis, we chose randomly 15 individuals of each sex in three categories of height (0 to 2.0 m; 2.0 to 3.5 m; $>$ 3.5 m). Two-way analyses of variance were done in function of sex and height (age) of the plants, after arcsin transformation of the data.

In a second line of investigation, intact pinnae of male and female plants of the same size and age were bagged together and exposed to 6 beetles previously starved

Table 1. Contingency analysis for the number of leaves of different age of male (M) and female (F) plants of Chamaedorea tepejilote *in each category of damage.* Values in parentheses below each pair of values are the absolute deviations from those expected if beetles damaged leaves regardless of sex; the sign of the deviation is shown in parentheses after each value. Chi-square analyses are shown for leaf age, the pooled data of leaves and the heterogeneity among them.

Leaf age	Sex	Category of beetle damage A	B	C	D	Total	χ^2	df	P
I	M	905	7	6	6	924	6.96	3	n.s.
	F	1,045	15	1	6	1,067			
II	M	827	46	13	11	897	1.29	3	n.s.
	F	929	60	11	14	1,014			
III	M	711 (+)	72 (−)	22 (+)	19 (−)	824	26.88	3	<0.001
	F	690 (−)	147 (+)	21 (−)	34 (+)	892			
		(38)	(33)	(1)	(6)				
IV	M	470 (+)	122 (−)	40 (−)	28 (−)	660	36.76	3	<0.001
	F	314 (−)	153 (+)	43 (+)	56 (+)	566			
		(48)	(26)	(5)	(17)				
Total							71.89	12	
Pooled	M	2,913 (−)	247 (−)	81 (+)	64 (−)	3,305	31.07	3	<0.001
	F	2,978 (+)	375 (+)	76 (−)	110 (+)	3,700			
		(65)	(128)	(5)	(46)				
Heterogeneity							40.82	12	<0.001

for 24 hours. The experiments were carried out in a laboratory arranged for this purpose. We recorded the leaf area consumed for each type (sex) of plant 12 and 24 hours after. Each experiment consisted of six replicates. Statistical analyses (t-tests) were done to compare the mean leaf area eaten of male and female plants. All the statistical analyses were done following Zar (1974).

A third line of study consisted of a phytochemical screening of secondary compounds (alkaloids, tannins, flavonoids, saponins and cyanogenic compounds) and nutritional characteristics (protein, fiber, sugar, minerals and fat contents) as possible factors affecting the intensity of herbivory. Young and mature leaves of each sex were collected, dried and analyzed in the laboratory (see Dominguez (1979) for a description of techniques for analyses of secondary compounds, and Flores (1977) for a description of techniques for assessing nutritional characteristics).

Results

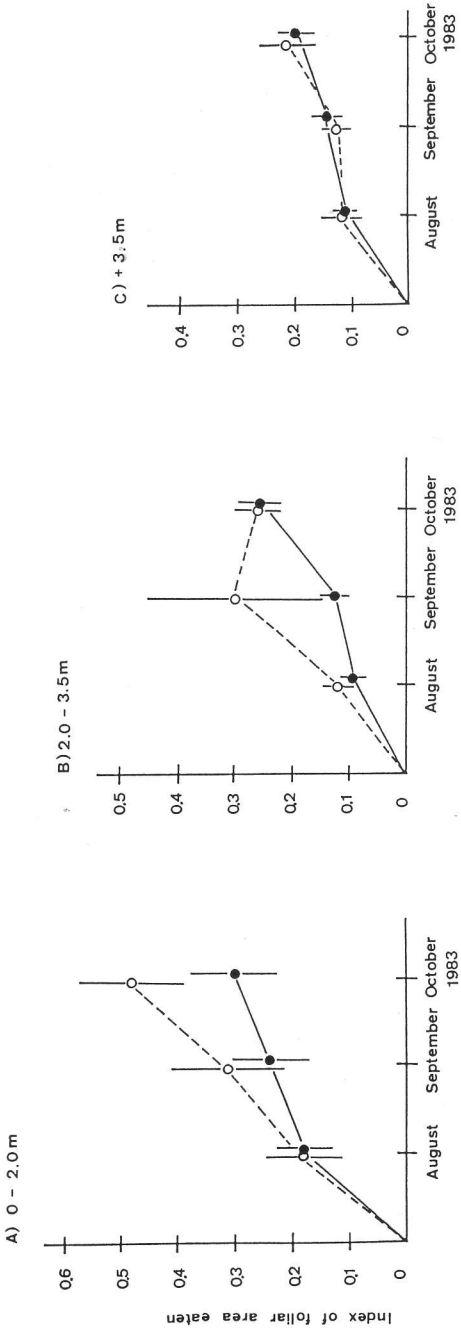
In the survey of leaf damage scored on a visual scale, the heterogeneity test between leaves of different age was significant ($\chi^2 = 40.82$; $P < 0.001$) and the results of each leaf age were examined independently (Table 1). The heterogeneity appears to be due to the fact that leaves in categories I and II did not show sex-related differences while categories III and IV were the only cases where sexes differ in the levels of damage. Moreover, the leaves of the youngest category were mostly undamaged (905/924 for female and 1,045/1,067 for male plants) and damage gradually increases with leaf age. Thus, sex-related differences could only be detected when damage was high in general. For leaves of age categories III and IV, clearly females were over-represented in the heaviest category of damage (D) and in category B, while males were under-represented in these categories. Males, in

contrast, were over-represented in the lightest category of damage (A) and females under-represented (Table 1).

The time-course of damage for male and female plants of the three categories of size (Fig. 1) showed that leaves with herbivory were high in the young (smallest) plants and decreased with plant age. An intersexual difference was only apparent in the smallest plants after 3 months. The statistical analysis revealed that the effect of plant sex was not significant ($F = 1.41$; $P > 0.05$) while plant size significantly affected the level of damage ($F = 5.01$; $P < 0.05$). The interaction size × sex was also not statistically significant ($F = 0.82$; $P > 0.05$).

The feeding trials carried out under controlled conditions showed a significant preference for female tissue when recordings were made 12 hours after ($t = 3.017$; $P < 0.01$, Table 2). However, the intensity of the preference decreased when the beetles were maintained within the bagged plants for 24 hours ($t = 2.367$; $P > 0.05$), suggesting that the proximal factors determining the relative acceptability reduce their influence with time. There was not any preference for male plants.

The chemical screening of secondary metabolites showed the presence of flavonoids and tannins in the young and mature leaves of plants of all three size categories of both sexes (Table 3a). Alkaloids, saponins and cyanogenic compounds were not detected in any plant size of either sex. The nutritional analysis showed some qualitative differences in fiber, fat, minerals and sugar contents between sexes.



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1. Time-course of the cumulative leaf damage between male (●) and female (○) plants of *Chamaedorea tepejilote*, by *Calyptocephala marginipennis*. Values are means of ± 1 S.D. the index of leaf damage. A to C represent individuals of different height. (The index, when multiplied by 100, gives an estimate of the percent leaf area damaged per plant; details about the index, see text.)

2. Leaf of *Chamaedorea tepejilote* showing heavy damage by the beetle *Calyptocephala marginipennis.*

The values of the first three were slightly greater in the leaves of male plants and the latter was greater in female plants (Table 3b). Unfortunately, these chemical data are not amenable to statistical analyses, but the differences appear to be only marginal.

Table 2. Comparison of feeding preferences of Calyptocephala marginipennis *for the leaves of male (M) and female (F) plants of* Chamaedorea tepejilote. n represents the number of assays and the values are means ± 1 S.D.

	Leaf area removed (mm 2)	
Sex	After 12 h (n = 24)	After 24 h (n = 24)
M	4.08 ± 2.58	6.27 ± 3.73
F	7.03 ± 3.30	9.40 ± 5.24
t	3.02	2.37
P	<0.05	n.s.

Discussion

The recognizable damage of *C. marginipennis* on the foliage of *C. tepejilote* in the field is an indication of the preference of the herbivore for this particular plant. Moreover, preliminary laboratory studies (Oyama 1984) strongly suggest that of the five sympatric species of *Chamaedorea* in Los Tuxtlas, *C. tepejilote* is, by far, the most acceptable food for *C. marginipennis.* On the other hand, these observations and laboratory results are not only indicative of the marked degree of preference on the part of the herbivore, but also suggest a tendency for exclusivity of this herbivore damage being experienced by the plant. The mature leaves of *C. tepejilote* accumulate the beetles' damage for several months and when combined with the fall of branches or other debris from the canopy constitute a major cause

Table 3. Chemical attributes of leaves of male (M) and female (F) plants of Chamaedorea tepejilote

a. Secondary compounds*

Sex	Leaf age	Alkaloids	Saponins	Tannins	Flavonoids	Cyanogenic capacity
M	Young	−	−	+	++	−
	Mature	−	−	+	++	−
F	Young	−	−	+	++	−
	Mature	−	−	+	++	−

b. Nutritional components (%)

Sex	Proteins	Fats	Fibers	Carbohydrates	Minerals	Total
M	20.56	3.77	31.11	32.42	12.14	100
F	20.55	3.53	27.41	37.70	10.81	100

* − = absent; + = present; ++ a more intense response.

of leaf death (Oyama 1987). Experiments of artificial defoliation showed detrimental effects on the growth and reproduction behavior of this plant (Oyama 1987, Oyama and Mendoza, 1990).

Another issue of this paper relates to the suggestive results for a marginal female tissue preference. Though in the laboratory there was consistently an initial preference for female tissue and in no case was male tissue preferably taken, the field data are not as conclusive although a similar tendency was observed for leaves of intermediate to old age. The elucidation of the role of other components of the natural history of the system (such as the role of beetles' own predators and parasitoids) is still obscure, but the results of this study (particularly those of the laboratory) warrant further study in more detail and of longer duration.

The screening of chemical components did not reveal any significant differences between sexes in the secondary metabolites and nutritional characteristics and thus did not give any hint as to what could be the proximate cause behind the marginal differential damage suffered by female plants.

A testable explanation for the differential herbivory can be proposed on the basis of differences in resource allocation between male and female plants, in a similar way to that some authors have suggested for other polymorphic systems (Cates 1975; Dirzo and Harper 1982*a*, *b*). In these studies, there is an indication that one of the morphs, the one preferred by herbivores, displays also a greater competitive ability, growth potential, or reproduction, presumably as a result of lower investment of resources in defenses; the "defended" morph, instead, has fewer resources allocated to reproduction, growth or competitive ability. In *C. tepejilote*, female plants produce a substantially more costly reproductive structure (Oyama 1987, Oyama and Dirzo 1988): large, heavy inflorescences which then become heavy infructescences that remain attached to the plant for one year; male plants, in contrast, produce long, thin and ephemeral inflorescences which represent a much lower proportion of the biomass of the plant. These differences are, in principle, compatible with an interpretation on the grounds of differential resource allocation, which might lead to greater susceptibility to herbivory by female plants.

The documented studies of folivory on dioecious plants show contrasting results.

Lovett Doust and Lovett Doust (1985) found that female plants of *Rumex acetosella* suffer heavier damage than male plants and they hypothesized that female plants, with a lower leaf area, are in some way more capable of withstanding environmental buffeting than male plants. In contrast, Agren (1987) found that male leaves of *Rubus chamaemorus* were more damaged that female leaves. Different physiological responses of each sex in dioecious species have been documented (Crawford and Balfour 1983, Fox and Harrison 1981, Zimmerman and Lechowicz 1982) but they appear to be due to local conditions rather than a general pattern (Willson 1983).

The present paper provides some basic aspects of the natural history of the interaction between *C. tepejilote* and *C. marginipennis*; it exposes the complexity of the system and suggests that some species (populations) of palms may be engaged in as complex and exciting interactions with herbivores as those commonly reported for other flowering plants.

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Principes, 35(2), 1991, p. 94

FUNDING FOR THE CHAMAEDOREA BOOK

Dear Palm Enthusiasts,

You are probably aware that Don Hodel is in the throes of writing a book about *Chamaedorea* that the International Palm Society will publish late in 1991. Actually, the manuscript is completed and a team of reviewers have looked it over. The book will be the first treatment of *Chamaedorea* (one of the most popular and important groups of palms) in nearly 50 years and the first one ever that is illustrated. All 125 species will be described, and there will be chapters on culture, history of the genus, distribution and ecology, conservation, and introductory information. The book is written in a style and language and presented in a format that makes the information in it readily availably to all regardless of their level of interest or expertise. The book will be named, *Chamaedorea Palms: The Species and their Cultivation.*

Don has taken over 3,000 photos of chamaedoreas in the wild in the jungles of Central America and Mexico and also in cultivation in Florida, California, Hawaii and Germany. We are committed to having the book all in color, no black and white illustrations. Right now, there are about $27,000 budgeted for 300 color photos. We feel that it would be an injustice to this group of palms, to the botanists and horticulturists who study them, the collectors and hobbyists who grow them, and Don's extensive and exhaustive field work if only 300 color photos were included in the book. There are easily enough quality photos to do an additional 200, bringing the total in the book to 500, still an average of less than five photos per species. This is the bare minimum, and still is probably inadequate in itself.

For this reason, we are soliciting your assistance to help the Palm Society raise an additional $18,000 to cover the cost of an additional 200 color photos. Every dollar raised above and beyond the budgeted $27,000 will mean additional color at virtually no increase in cost of the book. As you know, all donations to the International Palm Society are tax deductible.

Revenues from sales of the book will go back into the Society's Revolving Publications Fund for future books about palms; Don will receive no money personally from sales of the book, nor has he received any money for writing the book. If you feel you would like to contribute to this worthwhile project, please send donations to The International Palm Society's Revolving Publications Fund, 3616 Mound Ave., Ventura, CA 93003, USA.

PAULEEN SULLIVAN

Principes, 35(2), 1991, pp. 95–98

Ecuador—A Paradise of Palms

DICK ENDT
108 Parker Road, Oratia Ak 7, New Zealand

It would be a major endeavor to describe the many and varied species of palms growing in Ecuador. One of the smaller countries of South America, Ecuador probably has one of the most diverse palm floras in the world. The equator passes through the middle of the country, while the massive Andes divide the country into the coastal plains on one side and the extensive Amazon basin on the other. The peaks of the Andes reach up to a height of 20,000 feet (6,310 m). The climate, therefore, ranges from the hot humid tropics to the eternal ice and snow of the mountain peaks. Palms grow most luxuriantly in the tropical lowlands where most species are to be found, yet on the slopes of the Andes different palms appear, according to the elevation at which they grow. Temperature is largely determined by altitude. The largest proportion of the human population lives in the intermontane valleys of the Andes, which range in altitude from 2,200 to 3,000 m.

My work for the Ecuadorean government as technical advisor to the subtropical fruit industry in the highlands was a unique experience where I had an opportunity to visit many nearly inaccessible places, by horseback and in four wheel drive vehicles. What made it especially interesting in my case was that the climate of the highlands is very similar to the mild maritime climate of northern New Zealand where I have a fruit orchard and my palm collection. Many of the fruit-crops we grow in New Zealand had their origin in South America, such as the tamarillo (*Cyphomandra betacea*), passion fruit (*Passiflora* spp.), babaco (*Carica pentagona*) and the Cherimoya (*Annona cherimolia*). My conclusions were that many of the palms growing in areas where these subtropical fruit trees grow will also grow in New Zealand. For some time I have been active in importing seeds of palms from South America. This is difficult as communications are erratic. In the last ten years I have visited South America on a number of occasions, the last and perhaps the most successful during June, July and August of 1988. My interest was centered on those species of palms suited to the mild subtropical climate of New Zealand. To find these, the high altitude areas in Ecuador were my happy hunting grounds.

Very little botanical information is available in Ecuador. My knowledge of South American palms is limited to a few well described species. I did not realize so many undescribed palms are still being discovered. I will attempt to make generalized descriptions of the palms I saw. I would like to thank Rodrigo Bernal, botanist at the National University of Colombia, Bogota for his assistance in the identification of some of the palms from photos I sent to him.

The palm most closely associated with the people of Ecuador is undoubtedly the "Cococumbe," or "Cumbe" for short. To the palm world it is known as *Parajubaea cocoides* (Fig. 1). The palm is most common in the cities of the highlands, growing to an altitude of more than 3,000 m. It can be seen in parks and along avenues. In country areas the Cococumbe are usually planted near large farm estates. A slender trunked pinnate-leaved palm, very graceful in form, and growing to a height

of ten meters, it bears an uncanny resemblance to the tropical coconut. The crown when open, allows screened lighting to shine through which benefits plantings underneath. The seeds are large, in husk about the size of a small peach. Each infructescence may carry as many as a hundred seeds, and each palm carries many infructescences. One will rarely find any seeds on the ground. The hard shell 3 cm in length contains a coconut-like kernel much enjoyed by the local people. Not satisfied with picking up the seeds, people often bring down the nuts by using rocks attached to strings to pull down the whole infructescence. The shell is contained in a fibrous husk, difficult to remove. The Ecuadoreans have solved this problem by feeding the seeds, husk and all to the many guinea pigs kept by the people. The husks are the favored food of the guinea pig; and in turn, the guinea pig is the favored food of the people. The seeds I collected were cleaned overnight by these useful rodents.

The "Cococumbe" is by no means common in the wild in Ecuador. I did not see any in the forests. The seeds take a long time to germinate, and small seedlings rot easily in the ground. It is perhaps unfortunate that more recently *Phoenix canariensis* has replaced the "Cococumbe" in street plantings. I was told that many of the tall "Cococumbes" planted in Quito were moved there as large trees.

Planted for the same purpose as the "Cococumbe" is the Chilean Wine Palm, *Jubaea chilensis*. Although not common, these palms may occasionally be seen in parks, particularly in the city of Ambato.

The Andean Wax Palm, *Ceroxylon* spp., Palma de cera

The term wax palm is used for all species of *Ceroxylon*. There are many species, all instantly recognized by their prominently ringed trunks. The pinnate leaves are variable. Some species have erect pinnae while others have drooping or unevenly spaced pinnae, giving a plumose appearance. The lower leaflet surface is usually silvery or rusty-brown in color. Nearly all *Ceroxylon* spp. are large in size, some reputed to reach a height of 60 meters. Colombia has recognized its native palm, *Ceroxylon quindiuense*, as the national tree. Although not common, this palm is being propagated at the University nurseries for planting in the streets and parks of Bogota. Some fine specimens of *Ceroxylon quindiuense* can be seen in the old parks and monasteries around town.

In Quito, Ecuador, *Ceroxylon ventricosum* is the most common species planted. When compared with *C. quindiuense*, the obvious difference is the uneven distribution of the pinnae on *C. ventricosum* as opposed to a regular, even spacing of pinnae in *C. quindiuense*.

Ceroxylon palms are quite common on both the western and eastern slopes of the Andes, ranging from 1,500 m to over 3,000 m. In most cases the palms are easy to spot since they have been spared where the native vegetation has been cleared for farming.

Perhaps the most interesting area for observing Ceroxylons and other native palms is in Loja province in the very south of Ecuador. Here a recently formed road winds through a mountainous area largely covered with unexplored forest. We stopped at a place we referred to as the Inca Trail where a track that was used prior to the completion of the new road still exists. The altitude at this spot is around 2,500 m and the area is often shrouded in mist and rain. Along the new road one cannot say that palms are plentiful with

→

1. *Parajubaea cocoides*, typical specimen; note open crown. This palm does not tolerate strong winds. 2. *Ceroxylon* sp., Nanegalito (1,600 m), Western Andes. 3. *Ceroxylon vogelianum*, Southern Ecuador (2,500 m), Inca Trail. 4. Detail of foliage of *C. vogelianum*.


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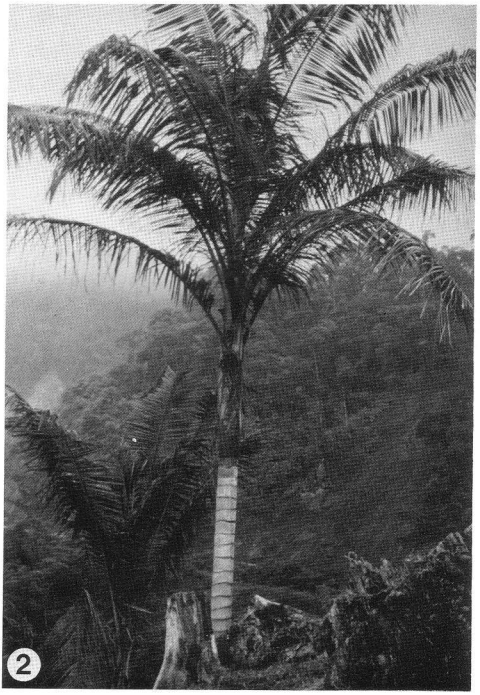
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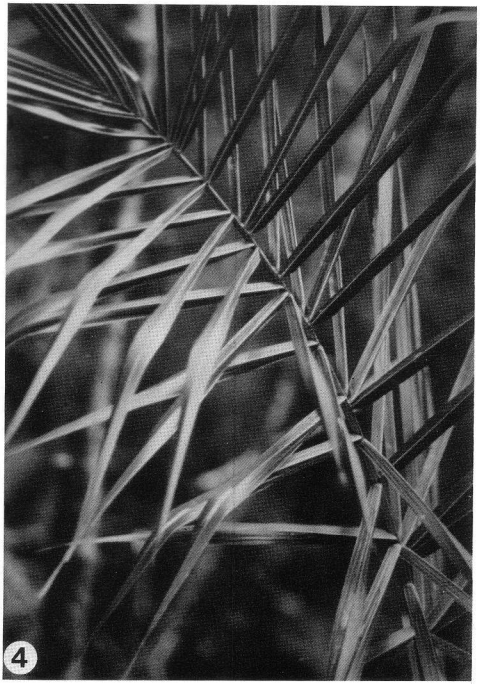
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the exception of the area around the Inca Trail. On the flanks of the exposed ridge I observed three different species of *Ceroxylon* growing side by side. One, a rather slender trunked palm with plumose leaves, was identified as *C. vogelianum* (Figs. 3,4). Another *Ceroxylon* had a very upright crown, almost like a feather duster palm such as *Rhopalostylis sapida*, and regularly-spaced pinnae, arranged in an upright V. The lower surface of the leaflets was brown. A third species of equally large size had leaflets that were pendulous. Identification of the last two species could not be ascertained but a revision of the genus by Gloria Galeano of Bogotá is underway.

In the same area grew a multitude of other palms, perhaps the most interesting being a medium sized pinnate palm with a bright red crownshaft. According to Rodrigo Bernal, this is *Geonoma undata*. Several other geonomas that were smaller in stature were seen. In among the dense vegetation several *Chamaedorea* were present, one of them a palm more than 10 m high. A species of *Prestoea*, a tall, very fine-leaved palm with a smooth green-ringed trunk grew near a stream. Other palms had spiny trunks and were identified as *Aiphanes* sp.

ERRATA

Ken Foster has pointed out a mistake in the name of a garden. Hilo's Tropical Botanical Garden as mentioned in the Biennial account (Principes 34(4): 211) should have been Hawaii Tropical Botanical Garden. HTBG now has over 100 species of palms in the ground and nearly that many more waiting in containers.

Principes, 35(2), 1991, pp. 99–101

The Quest for Jubaeopsis caffra, the Pondoland Palm

ED BROWN
10712 Lippizan Drive, Jacksonville, FL 32203

In all respects, Africa does not have a diversity of palms in contrast to cycads. Only five species of palms are found in South Africa; these are *Phoenix reclinata, Rhapia australis, Hyphaene coriacea* (syn. *H. natalensis*), *Borassus aethiopum*, and *Jubaeopsis caffra.*

Of these, I have long been interested in *Jubaeopsis caffra*, the Pondoland palm, mostly because of its rarity and purported cold-hardiness. *Jubaeopsis caffra* is singular for its rarity as it is found in a very restricted area and nowhere else in the entire world. My interest is romantic (i.e., the quest for the unobtainable) as this palm is very rare in collections. Two groves exist in the wild, a handful occur in South Africa collections, two or three in U.S. collections, and a single specimen tree is cultivated at Port Elizabeth, R.S.A.

As a reaction to this interest, I sought to visit South Africa to photograph this tree, collect seeds, and eventually propagate the plant in the U.S. as a hedge against extinction in the wild. I had been in active correspondence with Philippe Cremer of the S.A. Palm Society learning as much as I could before embarking on the trip. He had explained that it would be quite a trip to get to the localities involving two days in the Transkei, camping, fording rivers, and climbing a cliff to get to the locality.

The palm is found in the Mkambati Reserve which is located deep within the Transkei, one of the tribal homelands, and the palm is concentrated on the north banks of two rivers (the Msikaba and the Mtentu) emptying into the Indian Ocean. I landed in Durban on August 21 and there waiting was Philippe Cremer. Within five minutes, I had collected my luggage and was on the road heading south to the reserve. The trip south was quite impressive as we drove through mile after mile of luxuriant stands of 40 foot *Strelitzia nicolai* and *Phoenix reclinata* periodically punctuated by the heavily fruit laden *Hyphaene natalensis* and the occasional *Raphia* palm.

Once in the Transkei, we drove six hours of the worst roads that I had ever experienced. As it was the dry season, huge clouds of dust billowed up as we proceeded on through the back roads lined with rondavels and littered with abandoned stolen cars and the ubiquitous donkey carts.

We arrived right at dusk and were warmly greeted by Neville Elaff, the Ranger of the reserve. That evening we enjoyed a "bride" or South African barbeque that consisted of bloodeborst (a local sausage), steak, and cheese and talked of the numerous theories concerning *Jubaeopsis caffra*, its phylogeny, and why it is confined to the north banks of these rivers. Philippe Cremer is a veritable encyclopedia of knowledge on this palm and other species. In listening to him one feels his convictions and appreciates the passionate interest that he shares in these magnificent plants.

The next day saw us up and out early. A fisherman had kindly offered us a ride across the river. This we gladly accepted as I was very reluctant to swim across the swiftly flowing river with full camera gear. However, half way across things were not

1. Close-up of a *Jubaeopsis* crown. Note infructescence with fruit in center above.

so well as the boat's engine quit, the boat listed sharply and lost its passengers. Fortunately, all were survivors as the water turned out to be only waist deep. I looked up and there a mile away on the cliffs, I took my first view of *Jubaeopsis caffra*. We walked up the beach to cliffs and on to the grove.

The Pondoland palm grows in a luxuriant forest amidst *Strelitzia nicolai*, *Phoenix reclinata*, *Asplenium* ferns and an occasional *Stangeria eriopus*. To get to the trees, one however must do some rock climbing. Once over the cliffs and into the grove, I feasted my senses on the profusion of these palms. *J. caffra* (Fig. 1) superficially resembles a hybrid between a coconut and pindo palm. It is tall and graceful as a coconut and the fronds are a lovely iridescent green, yet the trunk is knobbed like a pindo palm. The palms within the grove showed frequent double and triple forking which is rare elsewhere in the palms. The grove is very dry and one could see evidence of frequent brush fires.

We covered the grove in anticipation of locating seeds; however none were to be found. The seeds resemble miniature coconuts and the Transkei herder boys will collect them and break them open for the sweet juice and meat. As I walked through the trails, I saw untold generations of this palm dashed upon the rocks. Tragically, one of the world's rarest palms is being destroyed for a handful of sweets. After an intense search for the rest of the morning we were only able to locate a paltry 10 ripe seeds.

During the afternoon, we visited the second locality and scoured the grove for any seeds or ripe fruit. Our success was similar and about all I could locate was the odd seed that had rolled from the grasps of the hungry herder boys into the thatch. As the sun was quickly waning, we concluded the search as it would be next to impossible to find our way out of the very

dense forest in darkness. In climbing up the cliff, I noticed one lone seedling that had been spared the ravages of human predation and stood as the sole progenitor for the next generation.

The next morning after breakfast, we visited the lone *Jubaeopsis* tree behind the reserves' offices and to our excitement, it was replete with ripe fruit. At last success! We proceeded to reap the harvest of this very rare palm and within 10 minutes had collected 180 seeds. With that rare booty, we broke camp and started on the long trip through the Transkei and back to Durban.

Principes, 35(2), 1991, pp. 101

PALM LITERATURE

BALICK, MICHAEL J. AND COLLABORATORS. *Jessenia* and *Oenocarpus*: Neotropical Oil Palms Worthy of Domestication. 191 pp. Plant Production and Protection Paper 88, Food and Agriculture Organization of the United Nations, Rome. 1988.

The author of this study has been engaged for a decade in field and laboratory research on the closely related genera and species in the *Oenocarpus–Jessenia* complex. This book is a synthesis of his and other earlier published work on the subject, along with new findings.

Chapters 1 and 2 deal with subsistence and economic utilization. A case study, by G. Blaak, of small-scale oil extraction in Colombia makes up chapter 3. These initial chapters are the longest and together provide a fine state-of-the-art assessment of the 9 species within the complex. The following 7 chapters are shorter and address particular aspects of the palms, with a focus on providing essential background information on the subjects of botanical classification, distribution and ecology, germination and growth, natural hybridization (a key research question), reproductive biology, mycorrhizal enhancement (by T.V. St. John) and agroforestry. Breeding prospects for domestication are discussed in chapter 11 and are judged to be promising because of the considerable species diversity present in the complex and their ability to cross and produce hybrids. Chapter 12 suggests lines of research to expand utilization and promote actual domestication of a new oil palm species. A bibliography of uses, and a set of guidelines for the proper collection of palms for systematic study, are provided as appendixes. High quality illustrations are found throughout the book.

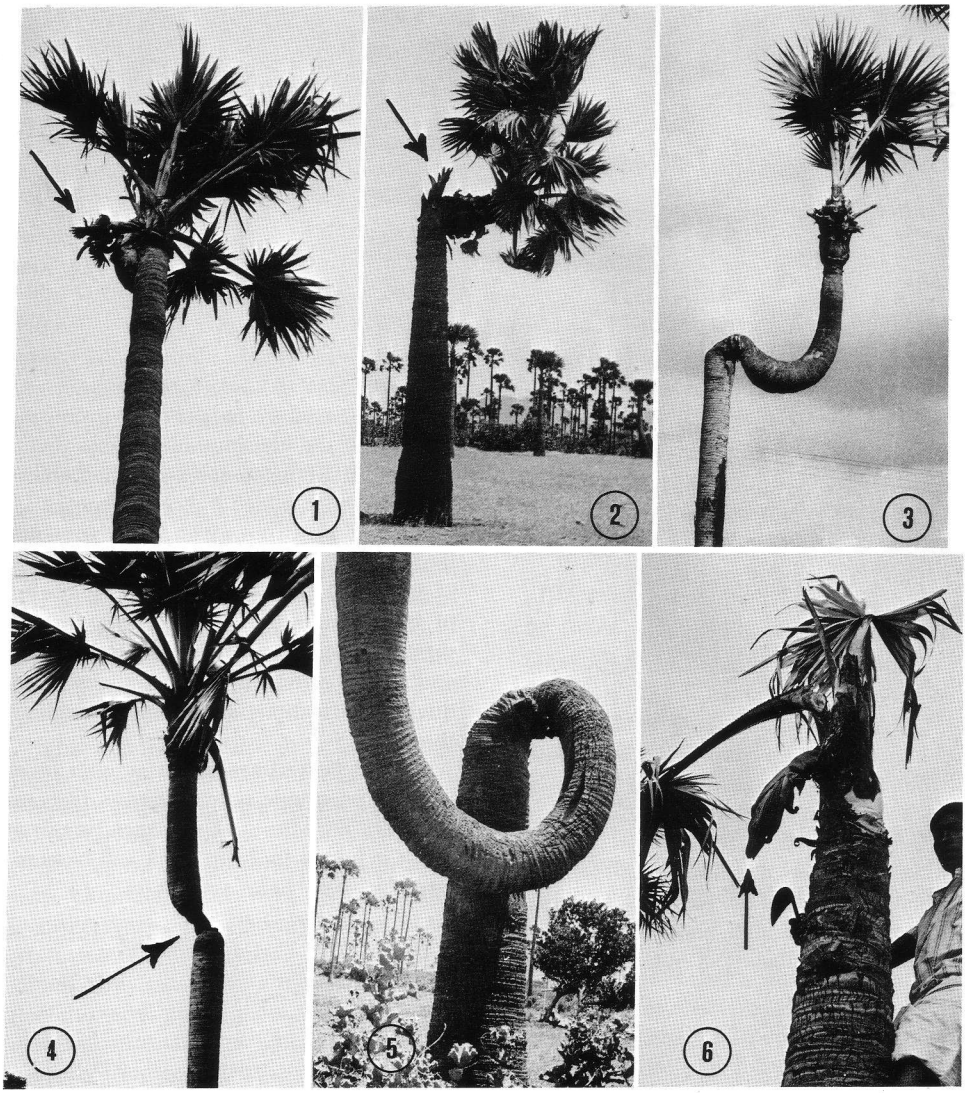
A vital part of realizing the palm family's full economic potential rests in comprehensive studies such as Balick has given us. It is hoped that this book will be emulated by other palm specialists.

DENNIS JOHNSON

Principes, 35(2), 1991, pp. 102–103

PALM PORTRAIT

In South India, it is not unusual to encounter palmyra (*Borassus flabellifer*) palms that branch or are deformed in some way. The photographs in the Figs. 1–8



1. Laterally projecting new crown with leaves (arrow). Leaves of the original crown are gradually drying. 2. Plant after resuming growth upwards. Note remnants of the leaves in the original crown (arrow). 3. Plant with hunchback-like stem. 4. Stem with a constriction (arrow). 5. A twisted stem. 6. Original crown with dried-up leaves and laterally protruded new crown (arrow).

7. Dried-up leaves of original crown of the plant shown in Figure 6 dissected out to show the projecting new crown. 8. Same plant at a later stage. Note leaves of the new crown appearing like juvenile leaves of coconut.

show unusual "hunchback" stems growing in Tamil Nadu. Such "hunchback" stems are the result of the stem apex growing out of the side of the crown after damage to the apex caused by the rhinoceros beetle (*Oryctes rhinoceros*) and palm weevil (*Rhyncophorus ferrugineus*). These beetles can kill palms, but where only part of the apex is eaten by larvae, the apex may recover and grow out sideways to produce the bizarre shapes illustrated. Such damage has been recorded in other palms but the palmyras illustrated are some of the most bizarre examples of recovery after beetle attack.

S. VEERASAMY

Principes, 35(2), 1991, pp. 104–106

Hybrid Coconut Seed Garden in Costa Rica

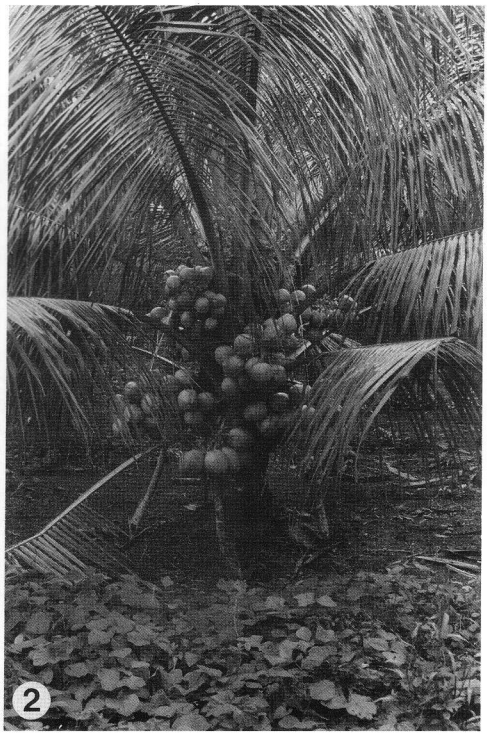
RICHARD ILLINGWORTH
SACRAC S.A., Apartado 299, Centro Colón, 1007 San José, Costa Rica

A timely venture signals the development of an important new agricultural industry in Latin America. From July 1990 SACRAC Limited will be in the unique position of exporting high grade hybrid coconut seed from its seed garden in Costa Rica.

SACRAC's original hybrid will be Malayan Dwarf (Figs. 1,2) crossed with Rennell Tall; other tall parents may be used later in response to research findings or client demand. Hybrids have been extensively proved in the Far East and Africa over twenty-five years by coconut industry leaders, Unilever and I.R.H.O. (Institut de Recherches pour les Huiles et Oléagineux). The Malayan Dwarf × Rennell Tall hybrid is one of the best all-round performers, with copra yields double traditional varieties. The Rennell Tall originated in the Solomon Islands and is more precocious, disease-tolerant and yields more copra than most other talls. The Malayan Dwarf comes into bearing early, produces prolific numbers of coconuts and has the highest proven resistance to Lethal Yellowing Disease of any coconut. The latter destroyed millions of palms in Jamaica and Florida, and is at work in the Yucatan peninsula of Mexico. Hybrid coconuts tend towards the disease resistance of the more resistant parent, unite the best characteristics of tall and dwarf, and have been standard for years in massive planting and re-planting schemes in the Philippines, Indonesia and Jamaica. Hybrids are also used in Brazil, India, Ivory Coast, Malaysia, Papua New Guinea, Thailand, Solomon Islands, Sri Lanka and U.S.

SACRAC's rationale for pioneering production of improved coconut planting materials for Latin America and the Caribbean is geared to the expansion of coconut planting which is under way in the region; superior hybrid seed is not now available. The region has almost twenty per cent of the world's people, but only seven per cent of its coconut population. Practically all the world's coconut oil exports in the last seven years came from six Far East producing countries, eighty per cent from the Philippines alone, chiefly to U.S. and western Europe.

Latin America, from Mexico to Bolivia, has suitable growing conditions for coconuts, and all these countries are net importers of vegetable oils, only with the exception of Brazil, for whom oil exports provide some welcome relief in the balance of payments. They also have high rates of population growth, under-employment, under-utilization of land, premium domestic prices for oils and a shortage of foreign exchange. That governments and industry are aware of these pressures has been shown by coconut seed orders emanating from a number of countries including Brazil, Colombia, Mexico and Venezuela. That the high cost of planting large areas with coconut can be sustained is facilitated by acceptance of its future role by international lenders such as World Bank and its suitability for cultivation by smallholders, as a mono-crop or underplanted with other crops such as cocoa. That the coconut will continue to provide a profitable crop in growing countries is predicated upon its wide range of products, its non-substitutable character in some industrial uses, and, in the event of surplus, the proximity of



1. Dwarf palm and leguminous cover (Kudzu). 2. Productive yellow dwarf palm.

the world's largest import market, the United States. The U.S. imports about 450,000 tons of coconut oil annually, of which two thirds is for industrial consumption. Thus recent substantially unproved and protectionist health scares against tropical oils in the U.S. should not greatly affect world use patterns. Practically all the U.S. supply comes from the Philippines, which is threatened by climatic disasters, political uncertainty, and the advanced age and deteriorating condition of millions of its coconut palms. Latin America enjoys the advantage of freight time and cost over the Philippines.

SACRAC chose Costa Rica for its pivotal location and internationally acclaimed reputation for peace, democracy and stability, and the Atlantic Zone for its ideal conditions for growing coconuts. The seeds for the Malayan Dwarf mother palms were certified by the Jamaica Coconut Industry Board in 1985, six thousand trees were field planted in 1986 and ninety per cent had flowered in 1988. Selected Rennell Tall pollen is imported from Indonesia and Papua New Guinea. Not only has the highest genetic purity of materials been assured, but impeccable standards have been maintained at every stage of the seed garden operation, with rigorous selection criteria (Figs. 3,4, p. 106).

The seed will be sold initially for (U.S.) $2.00 each FOB Limón, Costa Rica, a modest price by industry standards for a comparable hybrid. SACRAC is willing to arrange supervision of the establishment of germination and polybag nursery facilities at destination.

For further information, contact the author. FAX 551348

3. General view of seed garden. 4. Yellow dwarf seedlings in nursery.

Principes, 35(2), 1991, pp. 107–108

PALM BRIEF

Coquito Nuts (Jubaea chilensis)

A trip to the produce section of a well-stocked grocery store can be an object lesson in ethnobotany. For this reason, I am always on the look out for new and interesting products. A recent trip to my local grocery store in Claremont brought a pleasant surprise: coquito nuts, the seeds of *Jubaea chilensis* (Molina) Baillon, are now being marketed here in southern California. *Jubaea chilensis*, the Chilean Wine Palm, is sometimes cultivated locally as an ornamental, but never before have I seen coquito nuts, imported from Chile, offered for sale. My curiosity and scientific interest cost me $3.99 for a six-ounce package.

Coquito nuts are small and round, the approximate size and shape of a large macadamia nut (about 2 cm in diam.). They in fact resemble coconuts on a Lilliputian scale (Fig. 1). The seed coat is thin and brown and eaten with the nut; a raphe 0.5–1 cm long is present. The "meat" (endosperm) is translucent white and 3–4 mm thick, and the seed cavity is empty (not water filled as in coconut). The nuts have the flavor and aroma of coconut. An informal and unscientific survey of my colleagues around the lunch table revealed that most found the nuts to be of excellent flavor albeit less sweet than coconut. Coquito nuts are drier and crunchier than coconut.

The nuts are distributed by Frieda's Finest Produce Specialities, Inc. (Los Angeles, CA), which supplied the following information about its product: Coquito nuts are harvested and shelled by hand from trees cultivated in central coastal Chile. The trees average 2 m in height and produce nuts from April through September. No pesti-

1. Seeds of *Jubaea chilensis* marketed in California as "coquito nuts."

cides are used on the trees. The nuts have a shelf life of two weeks, longer if refrigerated with high humidity. A 28.3 g (one oz.) serving contains the following: 180 Calories, 2.34 g protein, 5.01 g carbohydrates, 17 g fat, and 3.4 g fiber.

It is encouraging to see *Jubaea* being exploited in a nondestructive manner. Destructive exploitation, for wine and "honey" (syrup), has severely reduced the numbers of this magnificent palm in the wild. Chilean botanists already consider *Jubaea* to be endangered. Will its spectacular size and impressive beauty alone be enough to save *Jubaea* from extinction? Perhaps not, but maybe its economic potential as an export crop will tilt the balance in favor of *Jubaea chilensis*.

SCOTT ZONA
Department of Botany
220 Bartram Hall
University of Florida
Gainesville, FL 32611-2009

Principes, 35(2), 1991, pp. 108–109

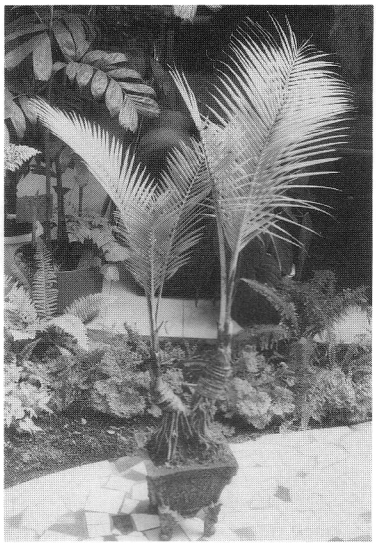
PALM BRIEF

Bonsai Chrysalidocarpus lutescens and Cocos nucifera

Centuries ago the Japanese developed the bonsai method of cultivating trees in small containers, by means of root and branch pruning, to produce miniature long-lived plants of great beauty. The bonsai technique apparently was more recently applied to *Rhapis* palms, giving us strikingly attractive small ornamental plants. The two major sources of information on growing these small rhapises (Okita and Hollenberg 1981, McKamey 1983) occasionally refer to them as bonsai, although the most common designations employed are "miniature" or "dwarf." Searching through the palm literature, I was able to find reference to other bonsai palms only in a note by Satake (1980).

In April 1988 I was at the Bogor Botanic Garden in Indonesia, to meet with Johanis Mogea concerning the World Wildlife Fund project on palm conservation and utilization. As part of local field visits, Johanis took me to a nearby plant nursery. Perched on a hillside above Bogor, Robbyanto Jayanata has created a plant lover's paradise of local and exotic species, with palms being very well represented. The palm collection was impressive, but Robby's personal bonsai *Chrysalidocarpus lutescens* and *Cocos nucifera* palms, were captivating. I photographed the palms (Figs. 1,2) and Johanis later sent me the following details he obtained from Robby about how these remarkable bonsai were grown.

1. Twenty-five-year old bonsai *Chrysalidocarpus lutescens* measuring 35 cm (13.8 in) in height.



2. Bonsai coconut palm with two stems. It is 14 years old and stands 90 cm (35.4 in) tall.

About 25 years ago, the *Chrysalidocarpus lutescens* was started by separating a group of 6 suckers from the clump of a normal plant. These suckers were planted in a small pot and it was placed within the orchid garden. There it received twice weekly applications of Hyponex, an orchid leaf fertilizer, at a concentration of 2.5 grams per liter. About once every two years, new suckers were pruned to maintain a desirable number. The clump has been repotted only three times, because of pot deterioration and to enhance its appearance for a local exhibition. For the past 10 years, no fertilizer has been applied.

The history of the 14-year-old bonsai coconut is somewhat different since it originated from a single polyembryonic seed of *Cocos nucifera* var. *eburnea*, which produced two suckers. The *eburnea* variety is a dwarf coconut growing to 3 m in height with a trunk diameter of about 25 cm. It begins to bear at three years of age and produces a rounded yellow fruit. This bonsai coconut has not been given any special treatment, and no fertilizer has been applied.

Both of these palms are such commonplace ornamentals in the tropics that one scarcely gives them more than a glance. Robby's skill and imagination has transformed them into beautiful and unusual new growth forms.

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Dennis V. Johnson
605 Ray Drive
Silver Spring, MD 20910

Principes, 35(2), 1991, pp. 110–111

PALM BRIEF

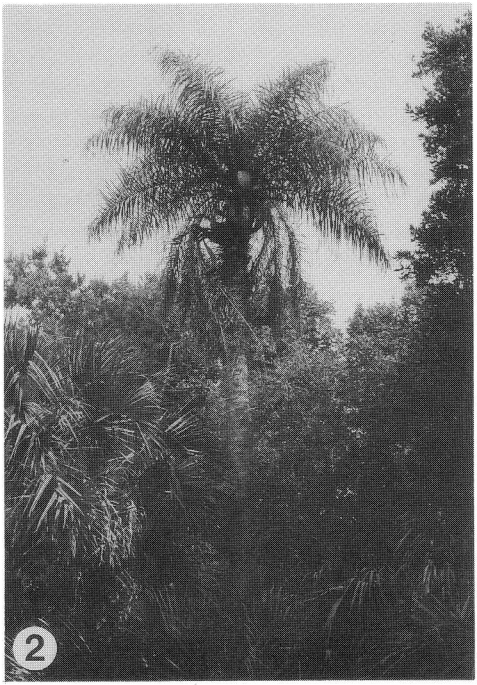
Acrocomia Naturalized in Central Florida

In a wooded area near Cocoa in east central Florida a small stand of *Acrocomia* palms is thriving and reproducing on its own. This community currently consists of eight mature trees, several juvenile plants, and numerous seedlings. They are probably *Acrocomia totai*, since even the young seedlings have not been damaged by sustained temperatures in the low 20° F.

At one time a house stood on the property, so presumably the original palm on the site was planted by man. The house has been gone for many years, but the *Acrocomia* palms seem to be very much at home. The original plant died several years ago after attaining a height of approximately fifty feet; the remaining trees represent two additional generations.

Although these *Acrocomia* palms are obviously well adapted to Florida's climate, they are rarely seen, and are usually not available in nurseries. The difficulty of propagating species of *Acrocomia*, along with their spiny nature probably explains their scarcity.

It is unfortunate that *Acrocomia* palms are not used more often in landscape plantings; they are rapid growers once they have germinated, they transplant easily,



1. In the foreground is the trunk of the original tree, which died several years ago. Recently the top portion of the dead trunk fell and damaged the crowns of the two younger trees to the left and behind it. 2. The finest specimen of the remaining trees stands alone a short distance from the others. *Sabal palmetto* is in the foreground.

3. A third generation of *Acrocomia* are found growing on the forest floor.

and are one of the most cold tolerant of pinnate leaved palms. The spines on the trunk add interest and an exotic atmosphere to the landscape, and are not a nuisance as long as the palms are planted well away from walkways and traffic areas.

BERNIE PETERSON
2410 Stanford Drive
Cocoa, FL 32926

Principes, 35(2), 1991, pp. 111–113

LETTERS

Dr. Natalie Uhl

The recent East Coast freeze left a trail of frozen palms and other subtropicals in Florida and along the Gulf Coast. For the third time in seven years, 100-year low temperature records were broken. In central Florida damage to *Washingtonia robusta*, though temporary, ranged from unscathed to 100% brown leaves. Temperatures in the high teens were recorded at Walt Disney World with a wind chill factor and temperatures below freezing for 24 hours that intensified the degree of injury. Many species of palms are used in the landscape and by midsummer a more reliable assessment of damage can be made.

One result of this freeze that is of particular interest, however, is the effect on the Queen Palm, *Syagrus romanzoffiana*. Of several hundred individuals of varying age and size, about 90% were burned brown, while the remainder varied from modest to negligible damage. Photographic records reveal completely green palms flanked by totally brown companions.

Age, shelter and cultural conditions have been considered and discounted. There may be genetic explanations, however. The late David Barry grew a small crop of Queen Palms from seed obtained from Uruguay. He considered that the species had a latitudinal range of 1,500 miles. If this is correct, those individuals farthest from the equator might be expected to tolerate lower temperatures than their sisters in Brazil, for example.

About twenty of Barry's palms found their way to Walt Disney World where, I am embarrassed to say, they were somehow lost in the shuffle of hundreds of Queen Palms. I would like to believe that the green palms to be found gracing the scene after the most recent devastating freeze are genetically different to the vast majority of the local representatives of the species.

Whatever the explanation, would it not be worth investigating the possible sources of this excellent ornamental. Florida and the Gulf Coast depend heavily on Queen Palms, but at this writing they look pretty unhappy and many have been killed. California appreciates the palm as well, and wherever it is cultivated, a hardier strain would be welcome. Because *Syagrus*

romanzoffiana is so well established, there is a tendency to take it for granted. We may have become too complacent and the horticultural disaster of a freeze like this one shocks us into reappraisal of a possibly missed opportunity to improve its usefullness.

Not too long ago, and again abetted by Dave Barry, a much hardier strain of *Caryota urens* was introduced to California where it is now finding its way into the local scene, heretofore considered off limits for Fishtails. Might not a similar search for cold tolerant *Syragrus* yield equally rewarding results?

MORGAN EVANS
Malibu, California

Dear Dr. Uhl,

Mr. Rolf Kyburz wrote for *Principes* Vol. 33(1): 40–42 on some aspects of my arboretum in Porto Ercole, Italy. The one that puzzled me most is the discovery in 1986 of a seedling of *Rhapidophyllum hystrix*. What is surprising about the discovery is that this palm was imported as the only subject of its species by the founder of the arboretum around 1880. It vegetated in good health until 1943 when a block buster bomb from a flying fortress fell in an adjoining pond, wiping out all form of vegetation including of course the *R. hystrix* (and killing all the goldfish). Some tall trees survived (*Washingtonia*) bearing deep scars. The aboretum was abandoned until I was able to start restoring it in 1985. The *R. hystrix* lay dormant

1. A clump of *Nannorrhops ritchiana* at the foot of a war-scarred Washingtonia filifera. 2. *Rhaphidophyllum hystrix* with long spines surrounding the base of the trunk.

for 43 years before it poked its first leaves over the soil. It is vegetating in good health and is a rarity in this country. The enclosed pictures (Fig. 2) show the long spines surrounding the trunk. The label is the original glazed china by Gen. Ricasoli. Other pictures (Fig. 1) show a lovely cluster of *Nannorrhops ritchiana* at the foot of a war-scarred *Washingtonia filifera* soaring over 70 ft. *Nannorrhops* is very rare here as is *Jubaea chilensis.*

C. T. CORSINI
"La Casa Bianca"
58018 Porto Ercole (Grosseto)
Italy

To the Editor
Re: Jul 89 issue, p. 151

Chuck Hubbuch raises the interesting question of Talipots flowering in the Caribbean. While I was in Trinidad from April 1954 to June 1955, one at the botanic garden there went through its entire reproductive cycle.

John V. Watkins reports in *Gardens of the Antilles* that *two* Talipots were in flower during his first visit to Hope Gardens in Jamaica, but doesn't give the year. From the evidence, it may be deduced that it was a summer between 1946 and 1951. Thus, the event would antedate the 1952 flowering at Atkins Garden in Cuba.

I hope these tidbits are of some interest to palm historians and botanists. The records of the Hope and Trinidad botanic gardens should yield more precise information.

JOHN E. SWISHER

P.S. While I was in Trinidad they also had four Double Coconut palms started from seed in 1926—not from the Seychelles, but from the Demerara Botanic Gardens in what is now Guyana. As I recall, there was a mature female specimen they had pollinated—successfully, it appeared.

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PALM RESEARCH, 1990

COMPILED BY ANDREW HENDERSON

New York Botanical Garden, Bronx, NY 10458

ANDERS S. BARFOD

Botanical Institute, Aarhus University, Nordlandsvej 68, DK-8240 Risskov, Denmark

The new decade seems an appropriate time to continue a feature of *Principes*, "Palm Research." Please bring to our attention any research on palms, current or planned, so we can include it.

A massive compendium of knowledge on the usefulness of palms. The main part of the work consists of abstracts of published papers on useful palms, and there is an elaborate cross-referencing system that allows easy access to the information.

Ecuadorean Palms for Agroforestry. By H. Borgtoft Pedersen and H. Balslev. AAU Report 23, Botanical Institute, Aarhus University, in collaboration with Pontificia Universidad Católica. ISBN 87-87600-30-7. 1990. 122 pp. 80 Dkr.

Books Published During 1990

The Structural Biology of Palms. By P. B. Tomlinson. Oxford University Press, Walton Street, Oxford OX2 6DP, England. ISBN 0-19-854572-X. 1990. 477 pp. $98.00

There is no doubt that this is the palm book of the year. A review will appear in *Principes.*

Useful Palms of the World: A Synoptic Bibliography. Compiled and Edited by M. Balick and H. Beck and collaborators. Columbia University Press, New York. 1990. 724 pp. $50.00

A review of palms in agroforestry, followed by a detailed discussion of five palms in Ecuador (*Astrocaryum jauari, Mauritia flexuosa, Jessenia bataua, Ammandra natalia, Euterpe chaunostachys*).

Palmeiras em Chamas. By P. May. EMAPA, FINEP, Ford Foundation, São Luís, Brazil. 328 pp. Price unknown.

A detailed history, in Portuguese, of the interaction of the babaçu palm (*Orbignya phalerata*) and local people and changing economics in northeastern Brazil. The title means "Palms in Flames."

The following two books, although published in 1989, are included here because of their outstanding interest to Palm Society members.

Sertum Palmarum Brasiliensium. By J. Barbosa Rodrigues. Tomos 1 & 2. Publicação do Jardin Botânico de Rio de Janeiro, Brazil. ISBN 85-208-0119-6. 1989. 254 pp, 174 color plates. Price unknown.

A very good quality reprint, in reduced format and in one volume, of this famous two volume, folio work which was originally published in 1903. It was previously available only in a few libraries. Taxonomists will want to own it, and non-taxonomic palm lovers will want to buy it for its color plates, originally painted by Barbosa Rodrigues.

Palms of the South-west Pacific. By J. L. Dowe. Palm and Cycad Societies of Australia, Queensland, Australia. ISBN 0-9587931-3-1. 198 pp. $29.95.

This is a wonderful book, full of color and black-and-white photographs, together with information on each of the 77 palms native to the region.

General Interest Articles Published in 1990

AL SHOWIMAN, S. S. 1990. Chemical composition of some date palm seeds (*Phoenix dactylifera*) in Saudi Arabia. Arab Gulf Journal of Scientific Research 8: 15–24.

BARFOD, A. S., H. B. PEDERSEN, AND B. BERGMAN. 1990. The vegetable ivory industry still exists and is doing fine in Ecuador. Economic Botany 44: 293–300.

CLANCY, K. AND M. J. SULLIVAN. 1990. Distribution of the needle palm, *Rhapidophyllum hystrix.* Castanea 55: 31–39.

DIETRICH, H. 1990. Palmen auf Kuba. Gartenpraxis 1: 50–53.

DRANSFIELD, J. 1990. Outstanding problems in Malesian palms. *In:* P. Baas et al. (eds.). The plant diversity of Malesia. Kluwer Academic Publishers, Dordrecht, pp. 17–25.

——— AND V. RANDRIANOSOLO. 1990. Plants in peril, 14. Kew Magazine 7: 90–95.

GRANVILLE, J.-J. DE. (1989) 1990. La distribucion de las palmas in Guyana Francesa. Acta Amazonica 19: 115–138.

KAHN, F. AND K. MEJIA. 1990. Palm communities in wetland forest ecosystems of Peruvian Amazonia. Forest Ecology and Management 33/44: 169–179.

LOCKETT, L. AND R. W. READ. 1990. Extension of native range of *Sabal mexicana* (Palmae) in Texas to include Central coast. Sida 14: 79–85.

NAUMAN, C. E. 1990. Electrophoretic analysis of palm hybrids: a research update. Fairchild Tropical Garden Bulletin 45(2): 31–34.

RUSSEL-SMITH, J. AND D. LUCAS. 1990. Notes on the natural distribution of *Ptychosperma bleeseri.* Palms & Cycads 26: 8–10.

Taxonomic Papers Published in 1990

BALINT, D. 1990. The genus *Areca* in Sarawak. Palms & Cycads 28: 2–9.

BARFOD, A. S. 1991. A monographic study of the subfamily Phytelephantoideae (Arecaceae). Opera Botanica 105: 1–73.

DRANSFIELD, J. 1990. Notes on rattans (Palmae: Calamoideae) occurring in Sarawak, Borneo. Kew Bulletin 45: 73–99.

FERNANDO, E. F. 1990. The genus *Heterospathe* in the Philippines. Kew Bulletin 45: 219–234.

GALEANO, G. AND R. BERNAL. 1990. La identidad de *Scheelea insignis* (Palmae). Caldasia 16: 10–13.

HENDERSON, A. 1990. Arecaceae. Part I. Introduction and the Iriarteinae. Flora Neotropica Monograph 53: 1–100.

HODEL, D. R. 1990. Three new species of *Chamaedorea* (Arecaceae) from Oaxaca, Mexico. Phytologia 68: 401–409.

———. 1990. *Chamaedorea castillo-montii* (Arecaceae), a new species from Guatemala. Phytologia 68: 401–409.

——— AND J. J. CASTILLO MONT. 1990. Two new species of *Chamaedorea* (Arecaceae) from Guatemala. Phytologia 68: 390–396.

KAHN, F. 1990. Las Palmeras del Arborétum Jenaro Herrera (Province de Requena, Departamento de Loreto, Perú). Candollea 45: 341–362.

MORAES, M. AND A. HENDERSON. 1990. The genus *Parajubaea* (Palmae). Brittonia 42: 92–99.

READ, R. AND D. HODEL. 1990. Arecaceae. Palm Family. *In:* W. L. Wagner, D. R. Herbst, and S. H. Sohmer. Manual of the flowering plants of Hawai'i. Volume 2. Bishop Museum Special Publication 83, pp. 1360–1375.

SAW, L. G. AND J. DRANSFIELD. 1990. A new species of *Licuala* from Peninsular Malaysia. Gard. Bull. Singapore 42: 71–73.

SILBERBAUER-GOTTSBERGER, I. 1990. Pollination and evolution in palms. Phyton 30(2): 213–233.

SPICHIGER, R. ET AL. 1990. Contribucion a la flora de la Amazonia Peruana. Los Arboles del Arboretum Jenero Herrera. Vol. 2: Linaceae a Palmae. Boissiera 44: 565 pp.

ZONA, S. 1990. A monograph of *Sabal* (Arecaceae: Coryphoideae). Aliso 12: 583–666.

Scientific Meetings in 1990

V Congreso Latinoamericano de Botánica, La Habana, Cuba. 24–29 June 1990. At least 16 papers on palms were presented at this meeting.

41st American Institute of Biological Sciences Annual Meeting, Richmond, Virginia. 5–9 August 1990. Four papers on palms presented.

XLI Congresso Nacional de Botânica, Fortaleza, Brazil. 21–27 January 1990. Five papers on palms presented.

Future Meetings of Interest

Palms in Tropical Rainforests. A meeting in September 1991 in Iquitos, Peru, being organized by Dr. Francis Kahn, ORSTOM, Lima, Peru.

BOOKSTORE

***A GUIDE TO THE MONOCOTYLEDONS OF PAPUA NEW GUINEA, PART 3, PALMAE** (R. J. Johns and A. J. M. Hay, Eds., 1984, 124 pp.) 8.00

COCONUT PALM FROND WEAVING (Wm. H. Goodloe, 1972, 132 pp.) 4.95

***COCONUT RESEARCH INSTITUTE, MANADO** (P. A. Davis, H. Sudasrip, and S. M. Darwis, 1985, 165 pp., 79 pp. color) 35.00

CULTIVATED PALMS OF VENEZUELA (A. Braun, 1970, 94 pp. and 95 photographs.) 7.95

EL CULTIVO DE LAS PALMAS EN EL TROPICO (in Spanish, A. Braun, 1988, 65 pp., some color and line drawings). 9.95

EXOTICA (4) (A. Graf, pictorial encyclopedia, 2 vols., including 250 plant families, 16,600 illust., 405 in color, 2590 pp.) 187.00

***FLORE DES MASCAREIGNES** (La Reunion, Maurice Rodrigues, 1984, 31 pp.) 5.00

FLORIDA PALMS, Handbook of (B. McGeachy, 1955, 62 pp.) 2.95

FLORIDA TREES AND PALMS (L. and B. Maxwell, 30 palm species, 120 pp.) 6.00

GENERA PALMARUM (N. W. Uhl and J. Dransfield, 610 pp.) 74.95

HARVEST OF THE PALM (J. J. Fox, 1977, 244 pp.) 24.00

INDEX TO PRINCIPES (Vols. 1–20, 1956–1976, H. E. Moore, Jr., 68 pp.) 4.00

MAJOR TRENDS OF EVOLUTION IN PALMS (H. E. Moore, Jr., N. W. Uhl, 1982, 69 pp.) 6.00

OIL PALMS AND OTHER OILSEEDS OF THE AMAZON (C. Pesce, 1941, translated and edited by D. Johnson, 1985, 199 pp.) 24.95

PALEM INDONESIA (in Indonesian) (Sastraprdja, Mogea, Sangat, Afriastini, 1978. 52 illustrations, 120 pp. For English translation add $2.00) 5.50

PALMAS DEL DEPARTMENTO DE ANTIOQUIA (Palms of Colombia, in Spanish; G. Galearno and R. Bernal, 1987, 207 pp.) 18.95

***PALMERAS DE BOLIVIA,** (in Spanish, H. Balslev and M. Moraes, 1989, 107 pp.) 12.95

PALMAS PARA INTERIORES, PARQUES Y AVENIDAS (in Spanish, A. Braun, 1983, 83 pp., 39 pp. color) 8.95

PALMAS AUTOCTONAS DE VENEZUELA Y DE LOS PAISES ADYACENTES (in Spanish, A. Braun, and F. D. Chitty, 1987, 138 pp., some color) 12.95

***PALMS OF THE WORLD** (Formerly **PALMS,** A. Blombery & T. Rodd, 1982, 192 pp., 212 color photographs) 34.95

PALMS IN AUSTRALIA (David Jones, 1984, 278 pp., over 200 color photographs) 30.00

PALMS IN COLOUR (David Jones, 1985, 93 pp.) 8.95

***PALMS OF THE LESSER ANTILLES** (R. W. Read, 1979, 48 pp.) 8.00

PALMS OF THE NORTHERN TERRITORY (AUSTRALIA) (A. White, 1988, 41 pp., 21 photographs, some color) 5.95

PALMS FOR THE HOME AND GARDEN (L. Stewart, 1981, 72 pp., some color) 19.95

PALMS OF MALAYA (T. C. Whitmore, 1973, 132 pp.) 31.00

PALM SAGO (K. Ruddle, D. Johnson, P. K. Townsend, J. D. Rees, 1978, 190 pp.) 10.00

***PALMS OF THE SOUTH-WEST PACIFIC** (J. L. Dowe, 1989, 198 pp., 33 pp. color) 29.95

PALMS OF SUBEQUATORIAL QUEENSLAND (Robert Tucker, 1988, 91 pp., 12 pp. color, many black and white photographs and maps) 20.00

SECRET OF THE ORIENT DWARF RHAPIS EXCELSA (L. McKamey, 1983, 51 pp.) 3.95

THE GENUS PTYCHOSPERMA LABILL. (F. B. Essig, 1978, 61 pp.) 6.50

THE INDIGENOUS PALMS OF NEW CALEDONIA (H. E. Moore, Jr., N. W. Uhl, 1984, 88 pp.) 12.00

***THE STRUCTURAL BIOLOGY OF PALMS** (P. B. Tomlinson, 1990, 477 pp.) 99.95

TROPICA (A. Graf, 7000 color photos, 1138 pp.) 125.00

***TROPICALS** (G. Courtright, 1988, 153 pp., Color Pictorial sourcebook & descriptions, 12 pp. of palms) 34.95

PALM PAPERS (Postage Included)

A NEW PRITCHARDIA FROM KAUA'I, HAWAI'I (Reprint from *Principes*, R. W. Read, 1988, 4 pp.) 2.00

FURTHER INFORMATION ON HARDY PALMS (J. Popenoe, 1973, 4 pp.) 2.00

NOTES ON PRITCHARDIA IN HAWAII (D. Hodel, 1980, 16 pp.) 2.50

RARE PALMS IN ARGENTINA (reprint from *Principes*, E. J. Pingitore, 1982, 9 pp., 5 beautiful drawings) 2.75

***PALMS FOR SOUTHERN CALIFORNIA** (Trish Reynoso, 1990, 11 pp.) 3.00

PALMS FOR TEXAS LANDSCAPES (R. Dewers & T. Keeter, 1972, 3 pp.) 1.25

PINANGA ISSUE OF PACSOA (#16, 1987, 17 pp.) 2.50

THE HARDIEST PALMS (J. Popenoe, 1973, 4 pp.) 2.00

***TROPICAL RAINFOREST** (A. Newman, 1990, 241 pp., World survey of endangered habitats, all color.) 45.00

* New arrival

The palm books listed above may be ordered at the prices indicated plus $2.00 extra per book to cover packaging and postage. (California residents please add 6.25% sales tax.) Foreign checks must be in U.S. dollars and payable on a USA bank. In some countries it is possible to send International Money Orders through the Post Office. Please include your International Palm Society membership number. Send check payable to The International Palm Society to Pauleen Sullivan, 3616 Mound Avenue, Ventura, CA 93003, U.S.A. ALL SALES FINAL.

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CHAPTER NEWS AND EVENTS

Mackay (PACSOA) Recent Group Activities

The Mackay Palm and Cycad Society (PACSOM) of PACSOA went on excursion to Rockhampton on November 3–4, 1990, with a full mini-bus of members participating. Saturday afternoon was spent at the Challinor and Boocock Gardens, each about eight years old. The group was impressed with the *Cyrtostachys renda* and other vigorous and handsome palms growing very well despite little rainfall and attendant local conditions, thanks to very capable gardeners! A long dinner was enjoyed in the evening. On Sunday morning, the group met Lou Randall and had a brisk and well led tour through the many plantings of the Botanical Gardens. The tour broke for generous helpings of scones with jam and cream and sandwiches at the behest of the Park Management, before finishing the last area and heading back to Mackay.

The Mackay (PACSOM) group held a party on November 25 with a gathering of 25 members and family for BBQ, late day shade, and talk of holiday plans. An elegant pen was given to Margaret Brown in appreciation of her secretarial duties since inception of the Mackay Society.

PACSOM held its general meeting on January 27, 1991, at Farleigh Plot in Mackay. Palm Society plantings at the Plot have now increased to 84 genera and 213 species at the last and by no means final count, with a nice plant of *Livistonia rigida* the latest contribution. The International Palm Society commends the Mackay Palm and Cycad Society for their continued efforts to increase appreciation and culture of palms in their area.

Recent News of Your Chapter??

If news of your Palm Society Chapter isn't finding its way to *Principes* every couple of issues, then perhaps your group isn't sending copies of their journals, newsletters and/or meetings notices to the Chapter Committee Chairman, Jim Cain. Jim provides this chapter summary information to *Principes* and largely uses the various items provided to him by the individual chapters as source materials. If it hasn't already been done, please include him on your Chapter mailing list, even for items of only local interest. If you have any questions or comments about implementation of this approved IPS policy, please send those as well.

Houston Texas Chapter Fall 1990 Activities

The Houston (Texas) Chapter of the IPS met on Saturday, September 15, 1990, at the home of Elizabeth and Jim Cain with Landon and Carol Lockett of Austin providing a detailed presentation on the native Texas Sabals, including the finding of *Sabal mexicana* growing on the central Texas coast. Also covered in detail were the tall *Sabal* palms growing in Brazoria County—thought to be hybrids of *Sabal mexicana* and *Sabal minor* by Bob Read—and other anomalous *Sabal* populations including upland populations of *Sabal minor* on ridges in west Texas, totally away from all water-indicating plants. A buffet dinner was provided, free seedlings distributed, and copies of the first Houston Chapter Newsletter issue presented. Subscriptions are invited (see information in Roster) for anyone interested.

The October meeting was held on Sunday, October 14, at the home of Horace Hobbs and Cynthia Ford Hobbs. A palm sale was held, where a collection of palms recently purchased by the Chapter were sold individually to attending members. Horace then presented a slide presentation on his recent trip to Australia, where he

had met with quite a few other Palm Society members in New South Wales and Queensland. A homemade Mexican Tamale, Rice, Beans, and Chili con Queso buffet dinner was served by Cynthia and Horace, with numerous desserts and snacks provided by several members.

On November 17, a tour was held of the palms at the Galveston Medical Complex and nearby areas, organized by Henry Homrighaus.

Activities of Sydney Branch, PACSOA

Dr. Ian Edwards gave a report and slide show of the IPS Post Biennial Trip to Malaysia at the September 18, 1990, meeting at the lunch room, National Herbarium, Royal Botanic Gardens in Sydney. Also held in September were the "Spring in the Gardens Festival" in Sydney from September 17 through 23 and the "Annual Spring Fair" at the Hunter Region Botanic Garden on September 15 and 16. The Palm Garden was officially opened at 3PM, September 15th. Congratulations to Don.

New Florida Palm Society Chapter Formed

We are pleased to announce the formation of a new Palm Society Chapter at West Palm Beach, Florida. This newly formed group plans to request full affiliation with the IPS. For those of you interested in more information, please contact Paul Craft, President, 16651 Rembrandt Road, Loxahatchee, FL 33470.

Florida First Coast Chapter Meetings

The October 1990 meeting of the Florida First Coast Chapter of the IPS was held at the FCCJ South Campus Palm Garden on Saturday, October 13, at 9AM. This was a work meeting to prepare the garden for the winter months. The development of the palm plantings undertaken by the chapter last year was evident.

Central Florida Palm Society Fall 1990 Activities

On October 20–21, 1990, the Central Florida Chapter of the IPS held a west coast meeting hosted by the Tampa and St. Petersburg area members. Saturday included trips to the Lowry Park Zoo, 30-year old Hudson Nursery, and an evening meeting at the Embassy Suite Hotel with Gill Whitten speaking on "Cultivation of Palms and Other Tropical Plants of Central Florida." Sunday started out with a visit to Mr. and Mrs. Tom Pavluvcik's home and garden, followed by a tour of the Gizella Kopsick Palm Arboretum in downtown St. Petersburg. More cities should have palm arboretums like the city of St. Pete! A palm sale and raffle rounded out the weekend and a good time was had by all.

The CFPS also was welcomed to an open house at Palmhead by Stacey Peacock on Sunday, November 18th, with an tour of the garden and a dutch picnic lunch on the grounds.

The Central Florida October 1990 Newsletter focused on "Beautiful *Butia*—A Collective Photo Essay" with numerous beautiful photos of this old friend. The next issue will feature *Phoenix rupicola.* For subscription information, see newsletter section in the IPS Roster.

Sunshine Coast (PACSOA) Group Activities

The Sunshine Coast's August 1990 meeting featured a presentation on Malaysian palms by Rob Kelly, who recently visited that country. At the September 1990 meeting, members brought in their favorite palms, which were then much admired and discussed. The evening highlight was a three-team "palm and cycad quiz" masterminded by Tino Andrighetto, who formulated the true/false questions. This was much enjoyed and a revenge match is planned for next year. A garden tour of the Broderick garden in Yandina was also held on September 16th, followed

by lunch at Lake McDonald, where a new Botanical Garden has recently been planted. The gardens are quite deceptive from the road and are much larger than you think. These gardens should be quite lovely in years to come. Stan Walkley was scheduled as October guest speaker (on cycads) and a potting up workshop/fun night was planned in November. December, of course, called for a Christmas Party, which was hosted by Mike Kvauka.

South Florida Fall 1990 Sale and Show

The South Florida Chapter of the IPS held their Fall Palm Show and Sale at Fairchild Gardens on November 3–4, 1990. Thanks to Stanley and Mary Kiem for playing major roles in setting up, organizing vendor areas, and maintaining the holding area. Don Evans was ever present, always making sure things came together and coordinating with FTG. Chuck Hubbuch has become just as active in the set up and organization at the garden and is always there to lend a hand. Thanks again to everyone who assists: the cashiers, the clippers, education booth personnel, show and sales personnel.

South Queensland Change of Meeting Venue

The South Queensland Group of PACSOA decided last summer to change the venue of their meetings, when possible, to Bread House, Gregory Tce, Spring Hill, just off the corner of Boundary Road.

Principes, 35(2), 1991, p. 119

Nominations and Elections

The By-Laws of the Society provide that:

ARTICLE VI—NOMINATIONS AND ELECTIONS Sec. 2—The Nominating Committee shall prepare the slate of Nominees for Directors. Members in good standing may propose candidates for nomination by writing to the Secretary of the Society. It must be accompanied by the written consent of the proposed candidate to serve if nominated by the committee and elected by the membership, and it must be seconded, in writing, by another member. Each proposed candidate and incumbent director must complete and return a questionaire provided by the Secretary. If the above conditions are met, the Secretary shall forward the candidate's name to the Nominating Committee for consideration by the committee as a nominee on the final ballot.

The Nominating Chairman will obtain from the Secretary a tally of membership according to regional distribution of members and use this as a guideline to obtaining and selecting representation worldwide. No one region shall have more than eight (8) directors (or a total of one less than our quorum) serving on the board at any one time.

Sec. 3—Voting for Directors by our membership shall be by mail only. Ballots shall be mailed in time for the results to be announced at the Biennial Meeting.

The Secretary is now accepting suggestions for Director nominees. Proposals and letters of consent must be received by July 31, 1991. Please forward to Lynn McKamey, P.O. Box 287, Gregory, TX 78359 USA.

Back Cover

Sabal minor growing in Hill Country, an unusual habitat for this species. Photo by Carol Lockett.