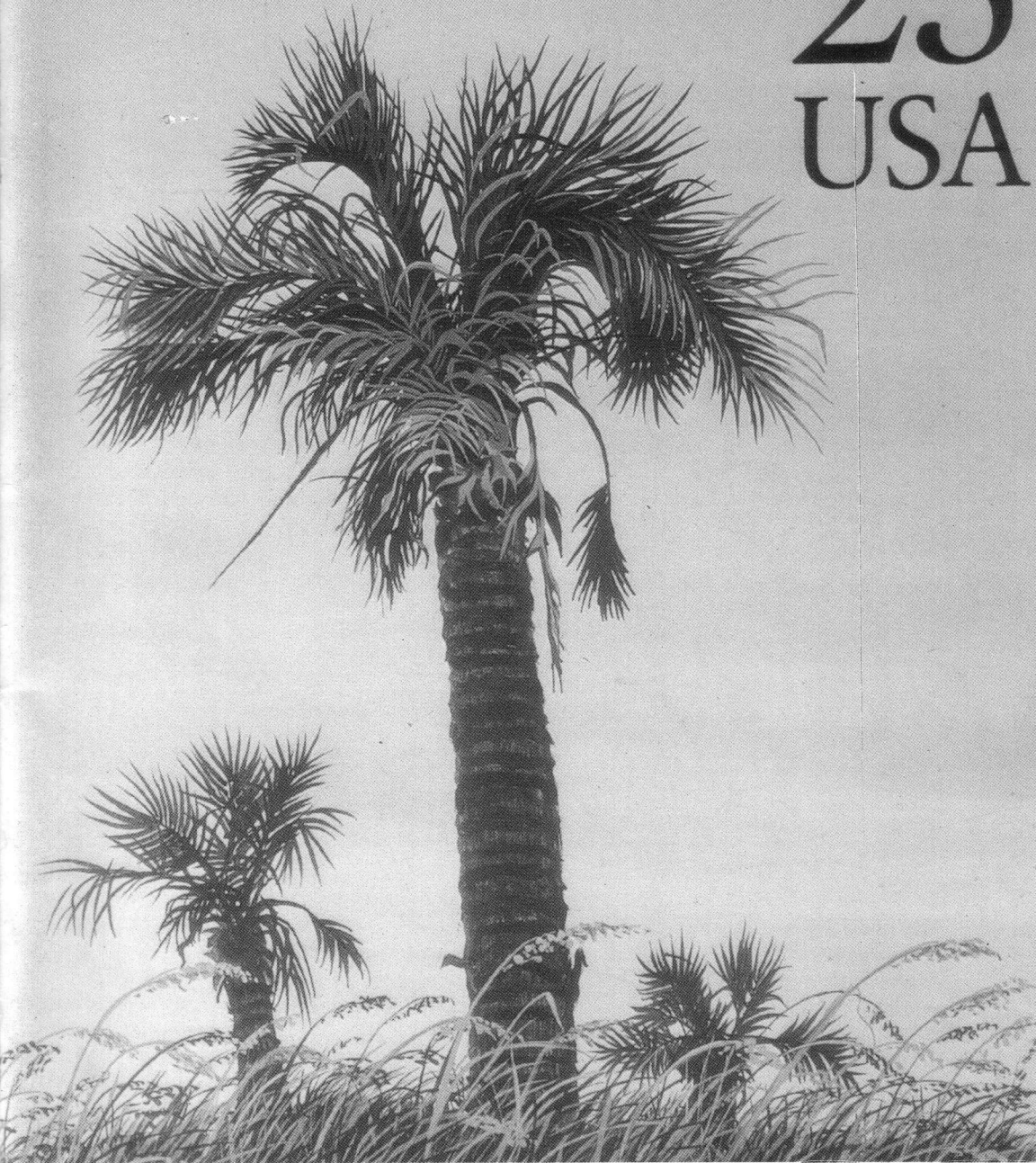


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PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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Cover Picture

The palmetto palm (*Sabal palmetto*), South Carolina's state tree, is the focal point of an attractive seashore scene on this 25-cent postage stamp commemorating the state's ratification of the U.S. Constitution on May 23, 1788. © United States Postal Service 1988. Reproduced with permission of USPS. See pp. 175-177.

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A New *Pritchardia* from Kaua'i, Hawai'i

ROBERT W. READ

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While preparing a manuscript on the palms for the "Manual of The Flowering Plants of Hawai'i," under the auspices of the Bernice P. Bishop Museum in Honolulu, I was told of the great confusion that persisted among the taxa of *Pritchardia* along the Pole Line Trail (Power Line Trail) leading over the Makaleha Mountains from Hanalei to Lihue on the island of Kaua'i. Derral Herbst told me of Earl Bishop's report on the confusion among the three species described from the area. Bishop reported that the tallest plants were *P. hardyi*, the shortest plants with the extremely long inflorescences were *P. weissichiana* and that *P. viscosa* could not be found. In addition, he said he thought there was an undescribed species. In a letter from Don Hodel I was informed that "*P. hardyi* . . . approach(ed) 30 meters in height . . . much more than the 6-8 meters reported for *P. viscosa*." Hodel also said, "The way to distinguish *P. hardyi* from *P. weissichiana* which grows with it is by height. The former is constantly taller, averaging 25 m in height. In addition, the abaxial leaf surface is not densely tomentose, at least not like *P. weissichiana*." Hodel (1980: 73) referred to an undescribed species discovered by Robert Hobdy, past Forestry Officer on Kaua'i, who felt it was different and that further study was needed. Among the specimens at Pacific Tropical Botanical Gardens and The Bishop Museum I have not found any that do not fit accepted species. However, following my recent explorations on Kaua'i with great assistance from Tim Flynn of the Pacific Tropical Botanical Garden, I now believe I have unravelled the mysteries of the Pole Line Trail and can state with confidence that there is indeed an

undescribed species which I am naming for the wettest spot on earth, Mt. Wai'ale'ale.

Pritchardia waialealeana R. W. Read,
sp. nov.

Complexui *P. remota* affinis. Palma robustissima 10-20 m alta, caudice 30-50 cm diam., laevi et griseo; corona magna, foliis ca. 40; lamina ceraceo-glaucua vel pallide viridis, abaxilater lepidiis dispersis cinerascentibus obsita; costa prope laminae basem glabra vel glabrescens; inflorescentia petiolum aequans vel brevior; rachillae glabrae; fructus parvus; semen ovoideum, 12-13 mm longum, 17-18 latum. Typus: HAWAII, Kaua'i, R. W. Read et al., 87-211 (Holotypus US; isotypi BISH, HLA, LHB, PTBG).

Very large palms up to about 20 m or more high; trunk very robust 30-50 cm or more in diameter, smooth and gray. Crown rather large with more than 40 leaves; sheath ca. 40-60 cm long, soon becoming matted fibrous; petiole excluding the sheath ca. 60 cm long, ca. 5.5 cm wide at the sheath insertion, ca. 4 cm wide at the hastula, at first thinly velutinous adaxially, lightly lepidote abaxially, but densely so along the margins; blade costapalmate ca. 80-100 cm wide, waxy-glaucous to pale green; rachis ca. 20-30 cm long; palman ca. 75 cm deep, with a fragile thread-like filament extending in the sinus between each segment; abaxial costae at the base of the blade densely but fugaceously tan-lepidote, continuous onto the petiole, soon glabrous; adaxial costae densely and fugaceously gray-lepidote; hastula triangular, ca. 5 cm wide, 3.5 cm long, at first velutinous basally, glabrous



1. *Pritchardia waialealeana* (type plant). Close up of the crown showing the naked petioles and short inflorescences, and large number of leaves.

apically and marginally; segments ca. 70–75 in number, ca. 120 cm long (from rachis), ca. 4–5.5 cm wide at widest point, bifid into very slender to filamentous apices ca. 8–12 cm long.

Inflorescence ca. 110–120 cm long, equal or shorter than the petiole, usually divided near the base within the first peduncular bract into two main branching systems; prophyll 2-keeled, glabrescent; peduncular bracts tubular, very lightly (inconspicuously) lepidote, mostly glabrate, perforated obliquely; panicle rather large, glabrous in every part, spreadingly divided into several primary branches, lowermost panicle branches bearing spirally, at different heights, as many as 10–12 floriferous branchlets, the lowest of which, at times, divide again, or are forked; upper branches simple; rachis ca. 20–30 cm long rachillae 8–12 cm long, glabrous, subulate apically, with sessile flowers uncrowded,

spirally arranged, 2–8 mm apart, each of which subtended by a very small 2–5 mm long subulate bracteole; (mature flowers not available). Fruit small, (subpyriform when mature?), frequently with two carpels developed; seed ovoid, 12–13 mm long by 17–18 mm broad.

Specimens Examined: Kaua'i; on Kualapa ridge near district boundary, along the Power Line Trail, February 1987, R. W. Read, E. M. Read, S. Wiser, T. W. Flynn & D. K. Harder 87-211 (Holotype US; isotypes BISH, HLA, LHB, PTBG); North of Kualapa ridge in Hanalei District, along the Power Line Trail, 4 December 1987, R. W. Read, E. M. Read, T. W. Flynn and K. Wood 87-261 (US; FTG); Pole Line Trail, Hanalei side, "scattered through dying Ohia forest," 1,480', 31 May 1972, L. E. Bishop & D. Herbst 1279 (HAW).

Distribution: Endemic on Kaua'i. Viewed



2. *Pritchardia waialealeana*, photographed against a backdrop of Mt. Wai'ale'ale, showing the symmetrical crown with numerous leaves. Photographed along the Power Line Trail near its divide over a spur of the Makaleha mountains.

from the Power Line Trail out of Lihue at about 450–800 m elevation, this species is easily recognized because of its massive size, and can be seen as tall robust palms with symmetrically globose crowns growing along the slopes and ridges running from the Makaleha Mountains to the ridges below the summit called Wai'ale'ale on Kaua'i. This species is named for Mt. Wai'ale'ale, purported to be the wettest spot on earth. Subsequent observations by helicopter have confirmed the extensive population and distribution.

There has clearly been considerable confusion in the past regarding the palms seen along the Power Line Trail which runs from Lihue to Hanalei. Sometimes known as the Pole Line Trail, it is no doubt a regular avenue for collectors and has been cited at various points as localities for several species of palms. The earliest were

Pritchardia hardyi and *P. viscosa* described by J. F. Rock (in Beccari and Rock 1921). The latter species was described from a collection "one mile north of Summit Camp and two miles east of Pole Line Trail, elevation 2,000 feet, in Kalihiwai Valley, windward side of the island." *Pritchardia hardyi* on the other hand was collected "on the Lihue side along the Pole Line Trail near Summit Camp, 1900 feet elevation." Later a third species was described from the same region of Kaua'i, *Pritchardia weissichiana* also described by J. F. Rock (1962), but forty-one years later, from "beyond the ridge which terminates the Pole Line Trail, overlooking Lihue, altitude 2,500 feet". All three species were described as having leaves with their "lower surface densely tomentose with appressed light golden yellow, much fringed (confluent gray) lepidia



3. From the top to the bottom of the pile, a complete inflorescence, the abaxial and adaxial leaf surfaces, and hastular regions of the type specimen of *Pritchardia waialealeana*, photographed in the type locality.

in the young and old leaves"; and petioles covered ("beneath, in the lower half" or "on both margins" at least) with a "deep rufous tomentum" and the rachillae "covered with a rufous to salmon-colored tomentum," or "coarsely yellowish white villose," none of which is characteristic of this new taxon.

All three previously described species from the Pole Line Trail were compared by their author with other species using fruit size and shape, an unreliable character at best except for extremes. *Pritchardia viscosa* was otherwise distinguished by its "decidedly viscous inflorescence, calyx, and corolla." However, it also differs from *Pritchardia hardyi* and *P. weissichiana* in its very short inflorescence. *Pritchardia hardyi* Rock, said to be "one of the tallest species," is "distinguished . . . in the long drooping spadix." *Pritchardia weissichiana*

according to Rock "resembles *P. hardyi* in fruit only"; and "is at once distinguished from other Hawaiian *Pritchardias* by the long spadix," etc. Discounting calyx measurements, fruit size and shape, and length of inflorescence, all of which vary considerably or cannot be used satisfactorily in this case, I must consider these last two a single taxon.

The Pole Line Trail and the region of Mt. Wai'ale'ale and Mt. Kahili are the only verified localities so far in the Hawaiian Islands where two or more distinct species of *Pritchardia* are found growing sympatrically.

Five species of *Pritchardia* are now recognized on the island of Kaua'i, the oldest of the principal islands. They can be distinguished by the following key:

1. Leaves densely and completely tomentose-lepidote, silvery-white to subaureous beneath 2
1. Leaves green or glaucous, glabrous or glabrescent, definitely not tomentose beneath 4
2. Inflorescence greatly exceeding the petiole, usually greatly exceeding the entire leaf; rachillae scarcely velutinous, hairs not obscuring the base of the flowers at anthesis; Makaleha Mts., Power Line Trail *P. hardyi*
2. Inflorescence equaling or shorter than the petiole 3
3. Rachillae densely velutinous, the hairs nearly obscuring the base of the flowers at anthesis; flower buds not sticky; Kokee State Park and Alakai Swamp *P. minor*
3. Rachillae glabrous; flower buds very sticky; Power Line Trail towards Hanalei ... *P. viscosa*
4. Plants of small stature; trunk ca. 18-20 cm in diam.; leaf blades rather flat, not wavy or undulate; lower costae, at the base of the blade, and the petiole densely tan woolly; crown with fewer than 25 leaves; valleys of Na Pali coast *P. napaliensis*
4. Plants of massive stature; trunk ca. 30+ cm in diam.; leaf blades strongly folded, undulate; lower costae, at the base of the blade, and petiole very early glabrescent or lightly lepidote; crown with more than 40 leaves; slopes of Mt. Waialeale to Power Line trail *P. waialealeana*

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Botanical Garden, especially Derral Herbst and Tim Flynn respectively, Paul Weissich of the Foster Botanical Garden for information regarding his namesake, Susan Wisner (my research technician) for climbing the new palm, and my wife Betsy, for their tremendous contributions to studies on this new species. World Wildlife Fund US and the Smithsonian Institution Research Opportunities Fund provided financial support for fieldwork in Hawai'i, and the Seed Bank of the International Palm Society helped with funding to collect seed. Last but not least my sincere thanks

to Dr. William Dress, Professor Emeritus, L. H. Bailey Hortorium for the Latin diagnosis; and to Dr. John Dransfield for critically reading the manuscript.

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Collecting *Pritchardias* in Hawai'i

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After considerable preparation and a couple of false starts the Smithsonian/World Wildlife Fund-US expedition to study species of *Pritchardia* in their natural habitats finally got off the ground on Friday, the 13th of February 1987. The primary purpose of the trip was to identify correctly certain species that might be in immediate danger of extinction or threatened in one way or another. It is well known that the taxonomy of *Pritchardia* was a morass in need of considerable study and revision. It was toward this end that I visited the Hawaiian Islands in order to gather data for taxonomic studies, determine population size, stability, regeneration, distribution and natural threats to survival. While making the observations we were afforded excellent opportunities to collect mature seed which would have otherwise fallen and been destroyed by rats, pigs, or goats. The wider the distribution of such seed through agencies such as the International Palm Society, the greater the chance for species survival in the hands of botanical gardens and individual expert palm collectors and growers. Betsy, my wife and field assistant, and I visited O'ahu, Kaua'i, Hawai'i, and Maui. Susan Wisner, my research technician, met us first on O'ahu, and again a week later on Kaua'i

where we hiked the Power Line Trail to collect *P. hardyi* and determined *P. waialealeana* (Figs. 2,3) to be an undescribed species. Susan then returned to O'ahu to collect in the Wai'anae Range with Steve Perlman and John Obata, while Betsy and I met up with Don Hodel on the Big Island. We were greeted on Hawai'i by Palm Society members Bob Egge, Suzette Williams and Dan Lutkenhouse, all of whom assisted in many ways to make our trip successful.

Throughout the tropics the cutting of forest, and degradation of the environment by man is usually the greatest danger to many species. This is not necessarily the present major threat to species of *Pritchardia* in Hawai'i. On the island of O'ahu the two widely distinct species, *P. martii* and *P. kaalae* are found mostly on fog shrouded, nearly inaccessible ridges, gulches and stream margins. There appears to be adequate protection from felling of the surrounding forest since the former is commonly in protected watershed areas of the Ko'olau Range and the latter is restricted to nearly inaccessible ledges in highly undesirable reaches of the Wai'anae Range. From what I could see on the Ohikilolo Ridge where the vegetation was low and sparse, the area is highly xeric. John Obata, who knows the region very well,

→

1. Bob Read with a plant of *Pritchardia minor* in Koke'e State Park, on cliffs overlooking the Kalalau Valley of Kaua'i.
2. *Pritchardia waialealeana*, a new species formerly confused with *P. hardyi*, along the Power Line Trail overlooking Mt. Waialeale, on Kaua'i, purported to be the wettest spot on earth.
3. Susan Wisner, using climbing irons and a nylon rope, successfully collects a specimen of *Pritchardia waialealeana*, on Kaua'i.
4. Bob Read preparing to collect an inflorescence from *Pritchardia beccariana* along the Kulani Prison Road out of Hilo on the Big Island of Hawai'i.



said that it was normally hot and dry, in spite of the fact that it rained and was windy with a chill factor of about 40° F or less the day we attempted (but failed) to reach a small population on a protected ridge at about 610 m (2,000 ft) elevation. Any threat to *P. kaalae* seems to be from the activities of numerous feral goats which have reduced great areas to stubble. The goats would no doubt eat the fruit and young plants, or even seedlings, should they make it that far. Only a few plants of this species persist in each of the few known localities. Susan collected seeds from a cultivated plant for distribution by the International Palm Society.

On the other hand *P. martii* is widely distributed throughout the length and slopes of the Ko'olau Range. It is fairly common in some localities and fruits abundantly. It is also commonly seen in botanical gardens under various aliases (such as *P. gaudichaudii*, *P. rockiana*, *P. kahanae*, *P. martioides*, *P. kahukuensis*, *P. kamapuanua* and *P. macdanielsii*). Susan collected a good assortment of fruit from several plants in the Ko'olau Range near the junction of Poamoho and the Summit Trail. Susan also reported that in some of the localities at lower elevations, where there were reported to be numerous plants, she found only a few remaining, which were infested with scale insects. She believed the scale was contributing to their demise.

Whether the mongoose has any controlling influence over rats, is a moot point since I am told mongooses are diurnal and rats tend to be nocturnal (but unreliably so). Little damage from rats was noted on O'ahu except in botanical gardens where measures must be taken to prevent loss of mature seed. However, on Kaua'i where there are apparently no mongooses, the rats are having a field day. We found one isolated plant of *P. minor* (*P. eriophora*) (Fig. 1) in the Koke'e State Park where the rats not only apparently prevent regeneration by eating the seed and seedlings, but they have resorted to chewing up the

vegetative parts as well. On one 5 m tall plant half the leaves had been chewed off at the base of the hastula leaving only the petioles. In a nearby population of perhaps 10 individuals, no seedlings or young plants were seen and the ground was seriously disturbed by the rooting of wild pigs. It seems unlikely that any seedlings would survive such disturbance. Even if a seedling were to become established it would be only a matter of time before it was consumed by pigs or rats.

We visited populations of *Pritchardia napaliensis* on the Na Pali trail out of Haena, *P. hardyi* along the Power Line (Pole Line trail) where the forest is already heavily disturbed, and *P. minor* in the Koke'e State Park, but no juvenile plants or seedlings were seen. Only mature or senescent plants were observed, and sadly no mature fruits were collected. The species here seemed to be at the peak of flowering with only a few very immature fruits.

Practically all the species of *Pritchardia* on the Big Island of Hawai'i were in fruit with most of the fruit just approaching full maturity. We were very happy to find *P. schattaueri* dropping fruit everywhere on the ground, and were especially pleased to collect them before the numerous cattle or the more destructive wild pigs got to them. The entire area where the palms grow was formerly ohia (*Metrosideros*) forest that has been cleared for cattle ranching. No plants are known to exist in the remaining uncut ohia forest. The only known plants are so tall, exceeding 20 m height, that it would not have been possible to reach the crown without extreme measures. No younger plants have been found according to Mr. Schattauer, who led our party along with Don Hodel who described the species. Mr. Schattauer said that wild pigs are very numerous in the region, which was obvious from the disturbed ground around the plants. One recently germinated seedling was found and a small barrier of lava rock was erected. I doubt it will survive. Unless a permanent barrier



5. *Pritchardia beccariana* growing in the brush near Volcano National Park, above Hilo on the Big Island of Hawai'i.

6. Betsy Read and Jon Hermsdorf collecting fallen seed of *Pritchardia beccariana* above Hilo on the Big Island of Hawai'i.

is built to exclude cattle and pigs no seedlings will survive to replace the population. On the Kohala Ridge, where the fog shrouded, swamp-like plateau supports numerous plants of *P. lanigera* we obtained a quantity of mature fruit. Here too, the total absence of younger plants is probably the direct result of wild pigs. We noted obvious rooting disturbances throughout the area, as if some careless farmer harrowed the ground, barely missing the scattered shrubby vegetation and palms. A quick trip up to the type locality of *P. eriostachya* also resulted in getting good seed. This species is suspiciously like *P. lanigera*. Although we found only 3 mature individuals, a few very immature plants were also found on rock outcrops nearby. In between the rocks signs of wild pigs were quite evident. Rats were apparently not a real problem although only a few miles down the trail are vast fields of sugar cane, a favorite habitat for rats.

Nearer to Hilo, we visited a population of *P. beccariana* (Figs. 4–6) on a palm collector's property where again the only plants were exceptionally tall, with no immature plants. Two freshly germinated seedlings were found, one was provided a small barrier of sticks and the other was transplanted for better care. Only a few fallen fruits were found here. Nearby, along the old Kulani prison road numerous plants of shorter stature were observed, but none was in flower or fruit. Again no younger immature plants, or seedlings, were observed. In this area, only a narrow border along each side of the road remains uncut, while the areas beyond have been or are being cleared and planted with *Eucalyptus*. We witnessed massive clearing of one area for the purpose of chipping wood for fuel. I do not know how long the road borders, with their scattered palms, will survive and I wondered how extensive the population was. When we flew, via helicopter, along the slope of Mauna Kea out of Hilo, we observed quite a large population of *Pritchardia* throughout a totally

undisturbed region of Ohia forest. I presume they are *P. beccariana* but since they are on the slopes of Mauna Kea at about the same elevation as the type locality of *P. montis-kea* there is a remote possibility of their being that species. This needs further investigation.

Along the Kailua-Kona coast we visited several very small natural populations of *P. affinis* (Figs. 7,8). Only a few individuals remain at each locality on private property in areas under great pressure for development. The largest population, of questionably natural origins, is at the Puna black sand beach site. A number of individuals were obviously formerly planted along what was once the curve in the road. The road is now located further out along the edge of the beach dunes. Next door in a vacant lot there are about 10–20 mature, heavily fruiting individuals. Seed was collected from the trees along the curved drive. It appears that it is only a matter of time before development takes its toll, not only at the black sand beach area but the several other localities as well. Two very interesting populations of *P. affinis* were studied in the very dry zone near the hotels of Kailua-Kona. One population with several individuals, is along the shoreline road in the last remaining relatively undisturbed vacant lot of the area. There is now a sale sign on it. Directly across the street is a public bathing beach. It will be sad if one of the last remaining natural populations, dating from before the advent of the Hawaiians, is not joined to the park across the street and preserved for posterity. The next most interesting population of this species contains about 7 individuals, almost directly uphill, by about 244 m elevation. They too persist in the only remaining vacant lot in a local development. These trees, like the others at the coast, were obviously revered by the early Hawaiians. In the lower population the plants were, as is usual with palms in dry areas, growing near a source of underground seepage. Apparently the early Hawaiians built rock



7. *Pritchardia affinis* above Kailua-Kona on the Big Island of Hawai'i. Several of these trunks have foot notches. There are two or more dead trunks here and plants on the adjoining property have been cut down.
8. *Pritchardia affinis* with climbing notches cut by the ancient Hawaiians for collecting thatch or weaving materials. Notches may have also been used for lookouts.

walls about the water holes, enclosing the palms also. The palms had climbing notches cut in one side which were no doubt used for gathering thatch and perhaps fruit or immature leaves for weaving. At some point, long ago, the cutting of climbing notches was discontinued and the trees continued to grow, with the crown now well out of reach from the top notch. The palm population at the higher elevation was also no doubt in a seepage area, again accounting for the presence of palms in such a dry region. We visited a few scattered individuals in large open fields, but there was insufficient time to test my theory regarding the seepage area and palms. Although naturally occurring plants of *P. affinis* are few and far between, this species is widely cultivated along the Kailua-Kona coast, and may survive only in cultivation

as progress encroaches on the last remaining naturally occurring plants.

Another species, first observed in cultivation, but not yet seen by me in the wild is *P. hillebrandii* from Moloka'i. We collected seed from a cultivated plant above Kailua-Kona with stiff, leathery blue-gray-green glaucous leaves and black shiny fruit. Each fruit has a slight straight ridge down one or both sides which was not observed as clearly on fruit of other species. After careful consideration we decided this must be the species from Moloka'i. Lacking time myself, I asked Don Hodel to have a quick look around Moloka'i on his way back to Honolulu. He later reported that there are numerous plants of the blue-green glaucous form in cultivation on Moloka'i, but there are also numerous gradations to plain green. Quite a bit more work needs to be

done, especially a more thorough visit to Moloka'i.

Meanwhile, Betsy and I went over to Maui where we collected *P. glabrata*, the midget of the genus. Unfortunately after a rather strenuous climb up behind the Iao Needle we found only immature fruits. *Pritchardia glabrata* was found growing on very steep scree slopes where the wind was strong enough to blow you up the hill. If you have never been through a Hau (*Hibiscus tiliaceus*) forest don't try that one. Later at the Maui Zoological Park and Botanical Garden we obtained some ripe seed that were labeled *P. remota*. From having seen *P. remota* in cultivation at Lyon Arboretum and Foster Gardens I believe the identification was fairly accurate.

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The Palms of a Tropical Rain Forest in Veracruz, Mexico

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The Palmae is a medium-sized family in México with 21 genera and some 150 species (Aguilar 1986, Quero 1986). Of these, 15 genera and about 40 species can be found in the phytogeographically interesting Sierra de Los Tuxtlas area in the southern state of Veracruz where Caribbean, Central American, and Mexican mainland floristic elements meet. In this zone the Instituto de Biología of the National Autonomous University of México maintains a field station (Estación de Biología Tropical "Los Tuxtlas"), located between 95°04'/95°09'W and 18°34'/18°36'N, for research and study. The station contains large pockets of virgin tropical rain forest in its 700 hectares. The number of vascular plant species in this reserve is about 818 (Ibarra-Manríquez and Sinaca 1987), and of these 289 are trees and 223 herbs. As part of a comprehensive floristic project, initiated in 1982 (Ibarra-Manríquez 1985), this report presents descriptions of the palm species found in the preserve, a key to their identification, phenological data, and their common names and uses. The collections on which this study is based are located mainly in MEXU and the reference herbarium maintained in the station.

Ten species in six genera are encountered in the preserve. Most are represented by just one species except *Chamaedorea*, which has 5 species. They are all understory palms and hardly reach 10 m in height. One of the most striking characteristics of this forest is the abundance of the palms, especially *Astrocaryum mexi-*

canum, which has a density of 300-1,230 individuals per hectare (Piñero et al. 1977) and has also been the subject of diverse studies including demography and population genetics. These 10 species in the reserve are easy to spot and the following key is produced as an aid in their identification.

KEY TO THE PALMS OF BIOLOGICAL STATION "LOS TUXTLAS"

1. Palms climbing 2
1. Palms not climbing 3
2. Plants unarmed 4. *Chamaedorea elatior*
2. Plants armed 8. *Desmoncus ferox*
3. Palms armed 4
3. Palms unarmed 5
4. Plants single-stemmed; trunk with verticillate markedly flattened spines; leaf-blades greyish below 1. *Astrocaryum mexicanum*
4. Plants clustered; trunk with aciculiform scattered spines; leaf-blades greenish below 2. *Bactris trichophylla*
5. Leaves entire, bifid; flowers orange 5. *Chamaedorea ernesti-augusti*
5. Leaves pinnate; flowers green or yellowish-green 6
6. Pinnae with windows between the secondary veins, cuneate, outer margins coarsely dentate 10. *Reinhardtia gracilis* var. *gracilior*
6. Pinnae without windows, elliptic to obovoid-elliptic, outer margins slightly dentate 7
7. Trunk yellowish-brown; pinnae not damaged and orange when senescent; monoecious 9. *Geonoma oxycarpa*
7. Trunk green pale or dark; pinnae with longitudinal or circular ruptures throughout the lamina when senescent, never orange; dioecious 8
8. Pinnae symmetrical; leaves 1-1.5 m long; inflorescences (1-)4-8(-11) per plant; fruit ellipsoid; plants frequently multistemmed 7. *Chamaedorea tepejilote*

8. Pinnae strongly asymmetrical; leaves 0.5–1 m long; inflorescences 1–3 per plant; fruit spherical or falciform; plants single-stemmed 9
9. Pinnae dark green above, the middle 5.5–11.5 cm wide; inflorescence infrafoliar; fruits ovoid-ellipsoidal, frequently falciform, black 6. *Chamaedorea oblongata*
9. Pinnae pale green above, the middle 2.5–5 (–6) cm wide; inflorescence interfoliar; fruits spherical, orange to black at maturity 3. *Chamaedorea concolor*

1. ***Astrocaryum mexicanum*** Liebm. ex Mart., Hist. Nat. Palm. 3: 323. 1853.

Armed, monoecious treelets (1.5–)2.5–6(–8) m tall, 4–8 cm d.b.h., trunk clothed with numerous flattened, blackish spines 15–50 mm long, arranged in whorls. Leaves pinnate, 1.5–2 m long, rachis clothed with spines and sheath open; leaf segments 15–32 on each side, 40–60 cm × 2–3.5 cm, elliptic-lanceolate, greyish beneath. Inflorescence 15–25(–35) cm × 11–20(–28) cm, interfoliar, branched, with basal flowers pistillate and staminate flowers densely congested at the upper part of the rachillae; peduncular bract 20–45 × 11–35, boat-shaped, brown, spiny and persistent. Staminate calyx 3–4 mm long, woolly; corolla 4–5 mm long, yellowish-white, glabrous; stamens 6, 2–3 mm long; pistillode absent. Pistillate calyx and corolla 2–3 mm long, scarcely woolly, yellowish-white; staminodes absent; pistil 6–7.5 mm long. Fruits 4–6 × 4–6 cm, turbinate, brown, clothed with slender spines 1–3 mm long. Germination adjacent-ligular.

Flowering March–June; fruiting September–December; nevertheless, there are individuals reproductive in forest gaps throughout the year (Fig. 1A).

Representative Specimens: *Ibarra 159, 475, 792, 1448, 2074.*

Astrocaryum mexicanum, commonly known as “chocho,” is immediately recognized by its treelike habit, flattened spines that cloth the trunk, leaf segments greyish beneath, and spiny fruits. The palm is definitely the species with most numbers of individuals per hectare. Demographic

studies and their use in understanding community dynamics have been discussed by Piñero et al. (1986). The plants are protogynous and the time of anthesis is early morning (A. Búrquez, pers. comm.). The fallen fruits are actively removed by mice. As yet, it is not known whether most removed fruits are eaten or secondarily dispersed (R. Dirzo, pers. comm.). Squirrels (*Sciurus deppei* and *S. aureogaster*) take fruits directly from the plant and disperse some of them; several seeds may germinate and establish on trunks or branches visited by them. Moles (*Orthogeomys hispidus*) eat the roots, frequently felling the plants. *A. mexicanum* plays a useful role in the local economy; the young inflorescence and endosperm are eaten; the leaves form excellent material for thatching; and the trunks are used for handles or tools. The species ranges from México (Veracruz, Tabasco, Oaxaca, and Chiapas) to Guatemala.

2. ***Bactris trichophylla*** Burret, Repert. Spec. Nov. Regni Veg. 32: 113. 1933.

Armed, monoecious palm, 2–4 m tall, 1.5–4 cm d.b.h.; plants cespitose, forming clumps of (1–)3–10 stems per individual, numerous acicular, blackish spines, 3–60 mm long scattered on stems. Leaves pinnate, 1–2 m long; rachis clothed with spines and sheath open; leaf segments (5–)12–18(–25) on each side, 20–35 × 2–5 cm, elliptic-lanceolate. Inflorescence 10–15 cm long, 7–12 cm wide, infrafoliar, branched, with staminate flowers scattered among the pistillate; peduncular bract 12–25 × 6–13 cm, boat-shaped, brown or blackish-brown, spiny and persistent. Staminate calyx 0.8–1 × 2.5–3 mm, yellowish; corolla 2.5–3.5 × 2.5–3.5 mm., yellowish; stamens 6, 1.8–2.5 mm long; pistillode absent. Pistillate calyx 0.8–1 × 0.8–1 mm, yellowish; corolla 4.5–5 × 2.8–3.2 mm, yellowish, perianth strongly obovoid; staminodes present; pistil 5–6 mm long. Fruits 10–20 × 12–21 mm, sub-spherical, red. Germination adjacent ligular.



1. A) *Astrocaryum mexicanum*; B) *Bactris trichophylla*; C) *Chamaedorea concolor*.

Flowering March–June; fruiting (August–) September–January(–February) (Fig. 1B).

Representative Specimens: Ibarra 170, 228, 867, 1967, 2433, 3088, S. Sinaca C. 1222.

Bactris trichophylla, commonly known as “chischi,” is recognized by its clumping habit and acicular spines that clothe the trunk. The plants are protogynous and the time of anthesis is in the evening (A. Búr-

quez, pers. comm.). The floral cycle is completed in about 24 hrs. The fruits are severely damaged by insects. The species ranges from Mexico (Veracruz, Tabasco, Quintana Roo) to Guatemala.

3. **Chamaedorea concolor** Mart., Hist. Nat. Palm. 3: 160. 1838.

Unarmed, dioecious palm 1.5–2(–3) m tall; 1–4 cm d.b.h.; trunk green, ringed with leaf scars. Leaves pinnate, 0.5–0.7 m long, sheath tubular; leaf segments 4–7 on each side, (11–)18–27 × (2–)5–9 cm wide, elliptic, strongly sigmoid. Inflorescence 30–40 cm long, interfoliar, branched; bracts 2(–3), 2.5–9 × 0.4–0.6 cm, tubular, brown, persistent. Staminate calyx 0.6–1.2 × 1.8–2.2 mm, pale green; corolla 2.7–3.2 × 1.5–2.1 mm, cup-shaped, green, greenish-yellow at the base; stamens 6, 1.8–2 mm long, pistillode 2–2.2 mm long. Pistillate calyx 0.5–0.8 × 1.5–1.7 mm, green; corolla 1.3–1.5 mm × 1.8–2 mm, yellowish-green; staminodes absent; pistil 0.9–1.2 mm long. Fruits 6–7 mm × 6–7 mm, spherical, orange to black. Germination adjacent ligular.

Flowering May–July (–August); fruiting November–February (Fig. 1C).

Representative Specimens: *Ibarra* 237, 344, 448, 992, 1774, 1790, 2103, 2485.

Chamaedorea concolor is recognized by its typical circular ruptures (rarely longitudinal) in the lamina (present almost as in *C. oblongata*), interfoliar inflorescence, and spherical fruits. The palm is shade-tolerant. The pollination is probably by wind. The fruits are dispersed by birds (D. Van Dorp, pers. comm.). The leaves of this plant are used in ornaments. Its distribution ranges from México (Hidalgo, Puebla, Veracruz, Tabasco, Oaxaca, and Chiapas) to Guatemala and Honduras.

4. **Chamaedorea elatior** Mart., Linnaea 5: 205. 1830.

Unarmed, dioecious climbing palm, 0.8–2.5 cm d.b.h.; trunk green, rarely with

ringed leaf scars. Leaves pinnate 0.7–1.5 (–2) m long, sheath open tubular; leaf segments 9–19 on each side, 13–35 × 1.5–6 cm, elliptic. Inflorescence 20–30 cm long, interfoliar, branched; bracts 3–5, 6–13 × 0.6–1 cm, tubular, brown, persistent. Staminate calyx 0.5–0.8 × 2–2.2 mm, pale green; corolla 2.8–3 × 1.8–2 mm, white, cup-shaped; stamens 6, 2.2–2.6 mm long; pistillode 2–2.2 mm long. Pistillate calyx 1–1.2 × 2.2–2.8 mm, green; corolla 2.6–2.8 × 3–3.2 mm, white; staminodes absent; pistil 2–2.2 mm long. Fruit 9–11 × 11–13 mm, spherical, black. Germination adjacent ligular.

Flowering April–June; fruiting December–January (Fig. 2B).

Representative Specimens: *Ibarra* 922, 1176, 2876, *S. Sinaca* C. 642, 643, 716, 1212, 1213.

Chamaedorea elatior, commonly known as “Junco blanco,” is immediately recognized by its unarmed climbing habit. The pollination is probably by wind and the fruits are dispersed by birds. Its leaves are used in the construction of traps for shrimps and rarely for ornament. The species ranges from Mexico (Veracruz, Oaxaca, and Chiapas) to Guatemala and Honduras.

5. **Chamaedorea ernesti-augusti**

H. A. Wendl. in Otto & Dietr., Allg. Gartenzeitung 20: 73. 1852.

Unarmed, dioecious palm, 1.5–2 m tall, 1–1.5 cm d.b.h., trunk green, ringed with leaf scars. Leaves simple, 0.5–1.2 m long, sheath open, lamina 40–60(–90) × 20–35 cm, cuneate-obovate, deeply cleft at the apex. Staminate inflorescence 20–30 cm long, branched, interfoliar; pistillate inflorescence 70–110 cm long, unbranched, interfoliar; bracts 5–7, 11–50 × 0.4–0.6 cm, tubular. Staminate calyx 0.8–1.2 × 1.5–2 mm, green; corolla 2.5–2.8 × 2–2.7 mm, orange; stamens 6, 1.3–1.5 mm long; pistillode 1.2–1.5 mm long. Pistillate perianth similar to those of staminate flowers; staminodes 6, 1.5–2 mm long; pistil 1.8–2 mm long. Fruit 12–14 × (6–)8–10 mm, subspherical or



2. A) *Chamaedorea ernesti-augusti*; B) *C. elatior*; C) *C. oblongata*.

ellipsoidal, black. Germination adjacent ligular.

Flowering January–March(–April); fruiting February–September(–December) (Fig. 2A).

Representative Specimens: *Ibarra* 273, 430, 1177, 1390, 1391, 2073, 2263, 2264, *S. Sinaca* C. 597.

Chamaedorea ernesti-augusti, locally known as “cola de pescado,” is immedi-

ately recognized by its simple leaves, orange flowers, and unbranched pistillate inflorescence. The plants are shade-tolerant and the seeds are dispersed by birds. There is little differentiation between the sexes in nitrogen, phosphorus, potassium, and total non-structural carbohydrates, among leaves and stems. The ratio of vegetative to reproductive biomass is 3.5 for males but only 1.2 for females on a per module basis (Bullock 1984). The species ranges from México (Veracruz, Tabasco, and Chiapas) to Honduras.

6. ***Chamaedorea oblongata*** Mart.,
Hist. Nat. Palm. 31: 160. 1838.

Unarmed, dioecious palm, 1–3 m tall, 1–2 cm d.b.h.; trunk green, ringed with leaf scars. Leaves pinnate, 0.6–1 m long, sheath tubular, sometimes slightly open; leaf segments 5–9 on each side, 12–29 × 2–8 cm (–13 cm at the leaf apex), rhombic-lanceolate, strongly sigmoid. Inflorescences 1–3 per plant, 30–50 cm long, infrafoliar, branched; bracts 4–6, 3–27 × 0.6–0.8 cm, tubular, green, persistent. Staminate calyx 3–3.2 × 0.5–1 mm, green; corolla 3.8–4 × 2.2–2.5 mm, greenish; stamens 6, 1.8–2 mm long; pistillode 2–2.2 mm long. Pistillate calyx 0.8–1 × 2.5–2.8 mm, green, cup-shaped; corolla 2.3–2.6 × 1.8–2.2 mm, greenish; staminodes absent; pistil 1.8–2.2 mm long. Fruits 12–15 mm × 6–8 mm, turbinate to ellipsoidal, reniform, black. Germination adjacent ligular.

Flowering April–June; fruiting November–January (–March) (Fig. 2C).

Representative Specimens: *Ibarra* 343, 1790, 2149, 2444, *S. Sinaca* C. 234, 877, 1214, 1215.

Chamaedorea oblongata is recognized by the circular ruptures in the lamina (as in *C. concolor*), inflorescence infrafoliar, and reniform fruit. The palm is shade-tolerant. Pollination is probably effected by wind. The fruits are dispersed by birds (D. Van Dorp, pers. comm.). Leaves are

used in ornaments. The species range from México (Puebla, Veracruz, Oaxaca, and Chiapas) to Nicaragua.

7. ***Chamaedorea tepejilote*** Liebm. in
Mart., Hist. Nat. Palm. 3: 308. 1849.

Unarmed, dioecious palm, 2–4.5(–6) m tall, 2–4(–6) cm d.b.h., frequently forming clumps, 1–3(–8) stems per plant; trunk green, ringed with prominent leaf scars. Leaves pinnate, 1–1.5 m long, sheath open; leaf segments 10–20 on each side, (10–)30–50(–70) × 2–7(–9) cm, elliptic. Inflorescence 1–3(–6) at each node, 2–8(–11) per plant, 15–50 cm long, 12–20 cm wide, infrafoliar, branched; staminate bracts 14–20 × 2–4 cm, boat-shaped, green, deciduous, pistillate bracts 4–5, 2–15 cm × 0.6–1.5 cm, tubular, yellowish-brown, deciduous. Staminate calyx 0.4–0.6 × 1–1.5 mm, green; corolla 2–3 × 2–3 mm, yellowish; stamens 6, 1.8–2 mm long; pistillode 1.5–1.8 mm long. Pistillate calyx 0.3–0.4 × 2.8–3.2 mm, yellowish; staminodes absent; pistil 2–2.2 mm long. Fruits 10–15 × 6–8 mm, ellipsoidal, black. Germination adjacent-ligular.

Flowering September–January and March–July; fruiting July–January (Fig. 3A).

Representative specimens: *Ibarra* 361, 362, 1014, 1434, 2023, 2027, 2104, 3078, 3079.

Chamaedorea tepejilote, commonly known as “tepejilote,” is recognized by the typical longitudinal ruptures along the veins of the leaves, frequently multistemmed habit, and 2–8(–11) inflorescences per plant. It is a common palm forming dense patches in the forest in places where slight disturbance has occurred. In some particular areas, its local density can be even higher than that of *Astrocaryum mexicanum* (Oyama 1984). The spatial pattern of distribution is aggregated and association between sexes is independent; the sex ratio is around 1:1 (Oyama 1984). The longitudinal ruptures are produced by the adults of the beetle, *Calyptocephala mar-*



3. A) *Chamaedorea tepejilote*; B) *Desmoncus ferox*; C) *Geonoma oxycarpa*; D) *Reinhardtia gracilis* var. *gracilior*.

ginipennis (Chrysomelidae). The size and number of flowers per inflorescence in the males is smaller than in the females and it has been suggested that pollination is by wind (L. Eguiarte, pers. comm.). The fruits are dispersed by birds (D. Van Dorp, pers. comm.). The young inflorescences are eaten and the leaves are much valued as ornaments. The species ranges from México (Jalisco, Veracruz, Tabasco, Oaxaca, and Chiapas) to Panama.

8. **Desmoncus ferox** Bartlett, Journ. Wash. Acad. Sci. 25: 87. 1935.

Armed, monoecious, climbing plants, 1.5–2.5 cm d.b.h., sheaths clothed with numerous scattered acicular, blackish spines, 1–4 cm long. Leaves pinnate 0.25–2(–2.5) m long, sheath tubular, rachis spiny; leaf segments 6–12 on each side, (7–)10–35 × 2–7 cm, elliptic or obovoid-elliptic, with spines 2–5 mm long on upper surface and along midvein. Inflorescence 30–40 cm long, with staminate flowers scattered among the pistillate, branched; peduncular bract 35–60 cm long, boat-shaped, brown, spiny, persistent. Staminate calyx 0.8–1.5 × 2.5–3 mm, yellowish; corolla 5.5–9 × 2–3.5 mm, yellowish, falcate; stamens 8–11, 1.5–2 mm long, subsessile; pistillode absent. Pistillate calyx 0.8–1.5 × 2.8–3.2 mm, yellowish; corolla 2–2.2 × 3–3.5 mm, yellowish; staminodes absent; pistil 2–2.3 mm long, spherical. Fruits 11–12 × 10–11 mm, subspherical to ellipsoidal, black.

Flowering May–June (Fig. 3B).

Representative Specimens: *Ibarra* 2535. *S. Sinaca* C. 1227, 1230.

Desmoncus ferox is commonly known as “junco negro.” This species is easily recognized by its climbing habit, trunk with spines, and naked leaf tips, armed with reflexed spines. The species forms clumps, with numerous stems that are a constant obstacle to anyone walking through the forest. The plant is much favored locally since its leaves are used in trap construction. The flowers are predated by insects;

in the flowers males eat the corolla and stamens and the females oviposite, killing the pistil. The species occurs from México (Veracruz and Tabasco) to Guatemala.

9. **Geonoma oxycarpa** Mart., Palmet. Orb. 30. 1843.

Unarmed, monoecious palm, (1–)4–5 (–7) m tall, 4–7 cm d.b.h., trunk yellowish-brown, ringed with leaf scars. Leaves pinnate, (0.5–)1.5–2.5 m long, sheath open; leaf segments (3–)8–13 on each side, 35–60 × 2–7.5 cm (–15 cm at the leaf apex) elliptic-lanceolate. Inflorescence 45–80 cm long, interfoliar, with staminate flowers scattered among the pistillate, branched; bracts 2, 25–35 cm long, boat-shaped, green. Staminate calyx 2–2.5 × 0.8–1 mm; corolla 2.5–3.5 × 1 mm wide, greenish; stamens 6, 2–4 mm long; pistillode 1.5 mm long. Pistillate perianth similar to those in staminate flowers; staminodes absent; pistil 2–2.5 mm long. Fruit 5–6.5 × 3.5–4.5 mm wide, ellipsoidal to spherical, black. Germination adjacent-ligular.

Flowering (September–)November–January; fruiting February–March(–July) (Fig. 3C).

Representative Specimens: *Ibarra* 997, 1247, 2021, 2144, 3137.

Geonoma oxycarpa is commonly known as “chocho blanco” and is recognized by its unarmed solitary trunk; its yellowish-brown leaf segments are coriaceous and orange when senescent (almost as in *Astrocaryum mexicanum*). The plants are confined to primary forest and in the preserve this is one of the rarer species. The fruits are dispersed by birds. The trunk is used for handles of tools. Its distribution is from México (Veracruz, Oaxaca, and Chiapas) to Nicaragua.

10. **Reinhardtia gracilis** (H. A. Wendl.) Burret, var. **gracilior** (Burret) H. E. Moore. Principes 1(4). 1957. *Malortia gracilis* H. A. Wendl. in Otto & Dietr., Allg. Gartenzeitung 21: 26, 146. 1853.

Unarmed, monoecious palm, 0.5–1.5 tall, 0.5–2 cm d.b.h., trunk brown. Leaves pinnate, rarely simple, 20–35(–50) cm long, sheath open, brown; leaf segments (1–)2(–3) on each side, 7–14 × 1.5–3.5 cm wide, cuneate with holes (windows) at the base between the folds. Inflorescence 30–40 cm long, interfoliar, with staminate flowers scattered among pistillate, branched; bracts 2, 55–75 cm long, tubular, brown, persistent. Staminate calyx 0.5–1.5 × 0.5–1.5 mm, green; corolla 3–3.5 × 0.8–1 mm, yellowish-white; stamens 10, 2.7–3 mm long; pistillode absent. Pistillate perianth similar to those in staminate flowers; staminodes 9–10, 1.8–2 mm long; pistil 1.8–2.3 mm long. Fruits 8–15 × 7–10 mm wide, ellipsoidal, black. Germination adjacent-ligular.

Flowering (May–)July–September; fruiting June–September (Fig. 3D).

Representative Specimens: *Ibarra 229, 1975, 3077, Ramamoorthy 3705.*

Reinhardtia gracilis var. *gracilior*, commonly known as “coquillo” is recognized by its small size, leaf segments cuneate with holes at the base and outer margins coarsely dentate. The spatial pattern of distribution is clumped; vegetative reproduction (clonal) in this plant is very common. The species is shade-tolerant and fruits are dispersed by birds (V. Souza, pers. comm.). The young fruits (seeds) are eaten by people. Its distribution ranges from México (Veracruz, Tabasco, Oaxaca, and Chiapas) to Honduras.

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Chromosome Counts on Nigerian Species of the Genus *Raphia*

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Chromosome counts carried out from root tips of six Nigerian species of *Raphia* Beauv. viz. *R. hookeri*, *R. vinifera*, *R. africana*, *R. sudanica*, *R. mambillensis*, and *R. regalis* show that each has 28 somatic chromosomes. The distinctive karyotype of each species supports their earlier separation that was originally based on external morphological characters.

Raphia palms are of great economic and cultural importance among the peoples of West Africa. In Nigeria alone, the consumption of *Raphia* palm wine, an alcoholic beverage made from the sugar-containing sap of the palms, far outstrips the consumption of beer and imported spirits put together (Opute 1978). The trunks of *Raphia* palms are used as building materials, and fiber, edible oil, wax and dyes are obtained from their fruits. Very few West African plants are put to better use than the species of *Raphia* (Russel 1965).

In spite of these many uses, very little cytological work has been undertaken in this economically important genus to facilitate breeding for its improvement. Out of the 20 known species of *Raphia* (Otedoh

1982), chromosome complements have been reported for only two species, *R. farinifera* (as *R. ruffia*, $2n = 32$ (Sato 1946) and *R. taedigera*, $2n = 28$ (Read 1966). In Nigeria, *Raphia* is represented in the wild by six species, namely *R. hookeri* Mann & Wendl., *R. vinifera* Beauv., *R. africana* Otedoh, *R. sudanica* Chev., *R. mambillensis* Otedoh, and *R. regalis* Becc. A summary of the characteristics used in their identification is given in Table 1.

Chromosome counts and karyotyping may help in the classification of *Raphia* and can also be very useful for its improvement through breeding.

Materials and Methods

Ripe fruits were collected from mature bunches on trees from different parts of Nigeria as follows:

Seeds were germinated essentially using Otedoh's (1977) method. Root tips of seedlings were collected between 8:00 A.M. and 9:00 A.M. and pretreated with 0.002 M 8-hydroxyquinoline at 12-16°C for four hours. Fixation was with Carnoy's fluid I (3 parts absolute alcohol : 1 part of glacial

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Species	Number	Locality
<i>R. hookeri</i>	N 243	Eyboneka, Bendel State
<i>R. vinifera</i>	N 40	Warri, Bendel State
<i>R. africana</i>	N 312	Oban, Cross River State
<i>R. sudanica</i>	N 309	Lokoja, Benue State
<i>R. regalis</i>	N 223	Oban, Cross River State
<i>R. mambillensis</i>	N 316	Gembu, Gongola State

Table 1. Summary of identification characteristics for six Nigerian species of *Raphia*.

Species	Trunk Height Habit	Maximum Leaf Size	Nature of Fibers	Disposition of Inflores- cence	Fruit Shape	Number of Verti- cal Rows of Scales on Fruit
<i>R. hookeri</i>	10 m, occasion- ally branching from base	12 m	Black and coiled	Pendulous	Top-shaped	12
<i>R. vinifera</i>	5 m, suckers pro- fusely	14 m	Brownish- black and straight	Pendulous	Cylindrical- ellipsoid	9
<i>R. africana</i>	10 m, always branching from base	17 m	Black and straight	Pendulous	Turbinate	10-12
<i>R. sudanica</i>	6 m, suckers pro- fusely	6 m	None	Pendulous		10
<i>R. mambila- lensis</i>	Subterranean or prostrate, suck- ers freely	7 m	None	Pendulous	Oval	9
<i>R. regalis</i>	1 m, under- ground	16-20 m	Brownish black, broad and straight	Erect	Spindle shaped	9

acetic acid) for at least 18 hours. Fixed tips were hydrolysed in 1.5 N HCl at 60° C for 23 minutes.

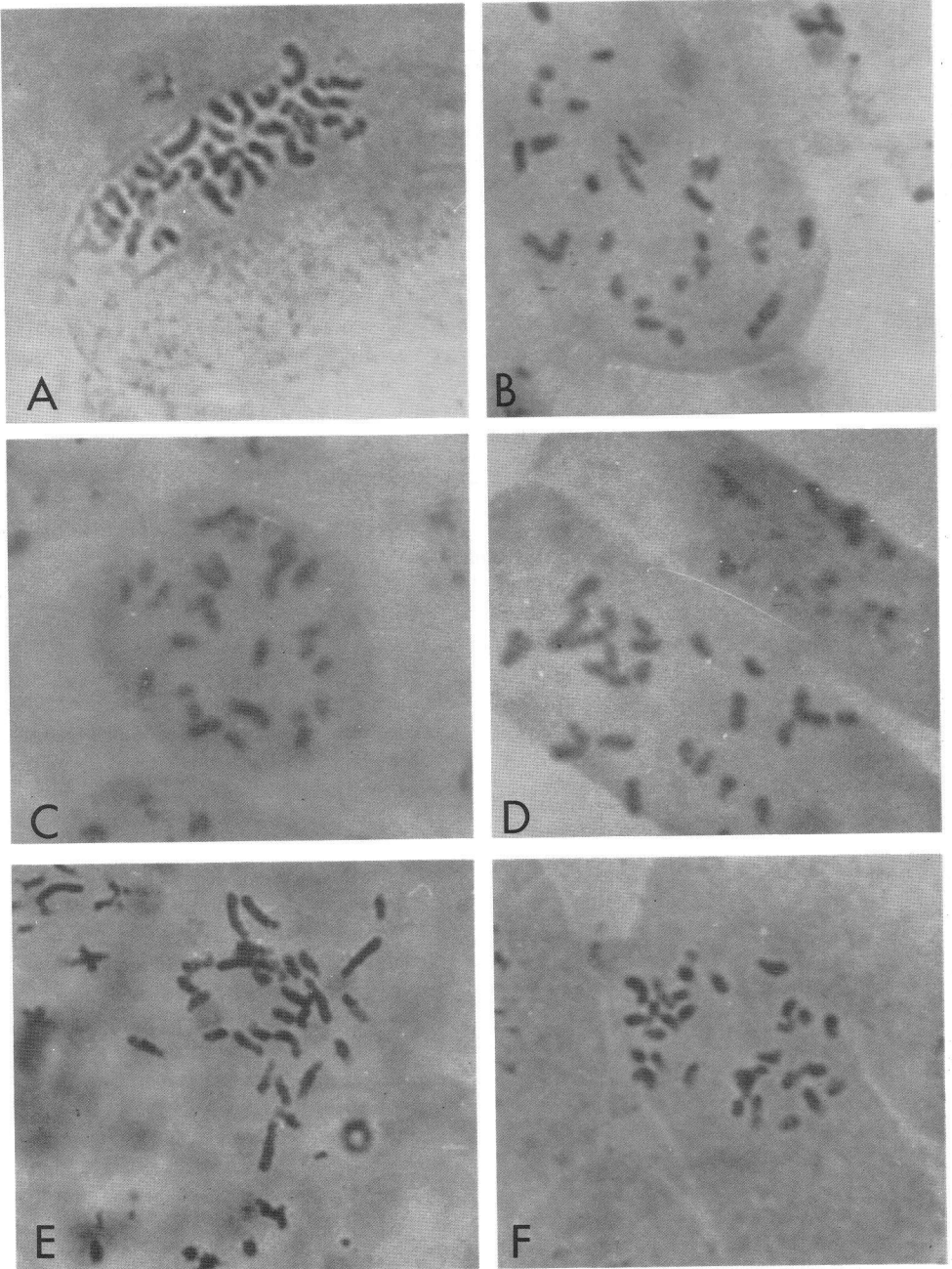
Giemsa staining (Sharma and Natarajan 1973, Verma and Rees 1974, Vosa 1976) for G-bands was modified as follows: after hydrolysis, the root cap was carefully removed with a pair of forceps, then thoroughly washed in distilled water, and the milk-colored meristematic zone excised and squashed in 45% acetic acid. Good quality preparations had their coverslips and slides separated through the Quick-Freeze Method (Conger and Fairchild 1953) and were allowed to air-dry overnight. Separated and dried coverslips and slides were incubated at 60° C in 2 × SSC (0.3N NaCl + 0.03N trisodium citrate) solution for 45 minutes. They were then washed in distilled water and stained for seven minutes in Giemsa diluted 200 times with Sorenson's buffer (pH 6.8). Both were again rinsed in distilled water, cleared in xylene and mounted in Canada balsam. Observations were made with a Leitz Ortholux

II microscope and photographs were taken at a magnification of 1,000. Chromosome counts were taken from each good metaphase plate obtained.

Approximate karyotype analysis was carried out because of the small sizes of the chromosomes. For this, measurements were made of lengths of chromosomes using an ocular micrometer. For each species measurements were taken from ten different metaphase cells from preparations made from different seedlings. However, in *R. regalis* only five good preparations could be obtained. All measurements are expressed in microns (). The position of kinetochores (constrictions) was noted in each chromosome. Homologues were identified using this, and the lengths recorded.

Results

Normal somatic cells of each of the six species investigated were found to have 28 chromosomes (Plate 1A, B, C, D, E, F). Chromosomes having median, submedian and subterminal constrictions were found



1. Metaphase in root tips of A. *R. hookeri*, B. *R. vinifera*, C. *R. africana*, D. *R. sudanica*, E. *R. mambillensis*, and F. *R. regalis*, (all $\times 2,500$).

Table 2. Classes of chromosomes found in the genomes of six species of *Raphia*.

Species	Meta-centrics	Sub-meta-centrics	Acro-centrics
<i>R. hookeri</i>	8	3	3
<i>R. vinifera</i>	8	2	4
<i>R. africana</i>	6	4	4
<i>R. sudanica</i>	7	5	2
<i>R. mambillensis</i>	6	1	7
<i>R. regalis</i>	6	2	6

in each species. The number of the three classes found in the genomes of each species was different and is summarized in Table 2. Generally, average lengths of chromosomes in the six species varied from 1.00–5.00. For comparative purposes chromosomes above 3.00 were regarded as long, 2–3 medium, and below 2 short. Table 3 presents the summary of the approximate relative lengths of homologues of the different species of *Raphia* studied.

Discussion

Sharma and Sarkar (1956) observed that there is apparent homogeneity in chromosome number in different species of the same genus in the tribe, Calameae, of the Palmae. *Raphia* belongs to this tribe and the observation of 28 chromosomes in each of the six species investigated tends to support this assertion.

Although marked differences in the lengths of chromosomes are found in each species, one common feature among all the six species is that all of the chromosomes classified as short have median constrictions, while medium and long chromosomes include metacentrics, submetacentrics and acrocentrics.

Based on the lengths of chromosomes and the position of constrictions on these chromosomes, each of the six species of *Raphia* investigated has its own distinct karyotype. This supports their previous separation into species that was based on differences in vegetative morphology.

Table 3. Approximate relative lengths of chromosomes in the genomes of six species.

Species	Long	Medium	Small
<i>R. hookeri</i>	7	4	3
<i>R. vinifera</i>	8	3	3
<i>R. africana</i>	5	6	3
<i>R. sudanica</i>	1	10	3
<i>R. mambillensis</i>	3	10	1
<i>R. regalis</i>	5	8	1

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Seed and Fruit Development of *Phoenix dactylifera* as Influenced by Type of Pollination and Some Growth Substances

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ABSTRACT

Experiments on date palm pollination were run in Baghdad, Iraq. When fresh pollen (hand pollination) was replaced by pollen extract, heat killed pollen, no pollen, 2,4,5-T,2-NOA, kinetin, or no treatment (wind pollination), a drastic reduction in fruit set was obtained. Fruit set in untreated inflorescences left open to wind pollination was 33 percent of that in hand pollinated spadices. About 96 percent of fruits produced by hand pollination were full seeded, ripe, and of good quality. A comparable percentage of fruits produced by air pollination were also ripe and full seeded; such fruits, however, were shrivelled and of inferior quality, although they were about 25 percent larger than the good quality fruits. In all other treatments where no viable pollen was applied, 60-85 percent of the remaining fruits reached *khalal* stage size but never ripened and all such fruits were seedless.

From experience gained through the ages, there is common agreement among date growers that hand pollination of the female flowers produces fruits of superior quality compared with those produced by natural wind pollination.

A tendency has been also observed indicating that fruits might be developed without pollination, but no insight into the details of these observations is available. A few attempts, however, have been made to test the effects of certain growth substances and other chemicals on fruit development, but the results have not been encouraging (Nixon 1959, Sharples and Hilgeman 1950, Ketchie 1967).

In the investigation reported here, the aim was directed at finding out the effects

of non-pollination on the fruit set, development, ripening, and parthenocarpy as compared with the effects of hand pollination and natural pollination. The effects of certain other treatments, including some growth substances, were also studied.

Materials and Methods

Based on uniformity, 14 female date palms (*Phoenix dactylifera* L.), variety Zehdi, were assigned at random from an orchard located within the vicinity of Baghdad. The prophylls of two inflorescences of each were manually opened and treated as outlined below, a third one was kept under natural conditions (wind pollination) for comparison. All the remaining inflorescences and those produced thereafter were removed to minimize the nutritional competition. Two trees were exposed to each of the following treatments:

1. *Fresh pollen* which was collected from *Simaismi* (male) variety.
2. *Heat killed pollen* which was obtained by placing the fresh pollen at 70° C (in drying oven) for 24 hours.
3. *Pollen extract* which was obtained by soaking 8.75 g of fresh pollen in 400 cm³ of distilled water. The mixture was stirred for a few hours until a homogeneous suspension was obtained which was then filtered; the filtrate was made up to 500 cm³.
4. *No pollen* whereby the inflorescences

Table 1. Average number of fruits per inflorescence of two stages of development as affected by the various treatments, together with the average number of seedless fruits per inflorescence at the kimri stage.

Treatment	Number and Percentage of Fruits per Inflorescence				
	End of May "Fruit Set"	Early July, kimri Stage*		Seedless Fruits	
		Number	% Drop	Number	%
Fresh pollen	1,883	1,502	20	0	0
Heat killed pollen	270	157	42	86	55
Pollen extract	182	120	34	84	70
No pollen	243	152	37	99	65
2-NOA	129	96	25	77	80
2,4,5-T	329	55	83	—	—
Kinetin	86	53	38	40	75
Untreated (not covered)**	622	444	29	0	0

* *kimri*, the first (green) stage of development in dates.

** This represents the average of 7 inflorescences.

of one tree were sprayed with distilled water whereas those of the other were left dry.

5. *β-Naphthoxyacetic acid* (2-NOA), applied at 50 ppm.
6. *2,4,5-Trichlorophenoxyacetic acid* (2,4,5-T), applied at 50 ppm.
7. *Kinetin*, applied at 50 ppm.

In the case of solid treatment media, i.e., fresh and heat-killed pollen, 2 g per inflorescence were dusted, whereas a 100 cm³ per inflorescence was sprayed in the case of solutions which contained two drops of Tween 80 per 500 cm³. The inflorescences were immediately covered with polythene and cloth bags. The former was removed 20 days after the treatment and the latter was kept for an additional 15 days. At this time, the treated inflorescences would no longer be receptive.

The number of fruits per treatment was counted at the end of May and early July of the same season. In addition, observations on dimensions, maturity, physical appearance, and seed content of the fruits were recorded at the end of the experiment in early October. Fruit volume was determined by water displacement and by the dimensions of the fruits, and a relative volume was estimated. The dry weight of

the fruits was determined as proposed by AOAC (1980). Because of the limited number of trees that were available for experimentation and because of the narrow differences between the samples under each treatment, no statistical analysis was undertaken.

Results and Discussion

Fruit Set. Early observations (May–July) on fruit development as affected by the various treatments are presented in Table 1.

The data clearly indicate that hand pollination (as it is usually practiced by the date grower) is an important factor for inducing fruit set in date palms. When no pollen, heat-killed pollen, or pollen extract was applied on receptive flowers instead of fresh pollen, a drastic reduction in fruit set was obtained. Similar results were also obtained when the fresh pollen was replaced by 2,4,5-T, 2-NOA or Kinetin. The extent of the reduction as compared with the number of fruits when fresh pollen was applied varied among the various treatments, i.e., from 82 percent in the case of 2,4,5-T to about 95 percent in the case of Kinetin. This reduction clearly indicates that none of the treatments used can sub-

stitute for hand-pollination and that pollination or subsequent fertilization or both has most likely stimulated the greater percentage of fruit set in the hand pollinated flowers.

The limited fruit set obtained by all the other treatments (5–18 percent of the hand pollination) may well be attributed to: a) parthenocarpy, b) accidental pollination or c) both, as appears to be the case.

The magnitude of fruit set in the inflorescences left uncovered to natural pollination is about 33% of that exhibited by hand pollination and covered inflorescences; a fact emphasizing again the efficiency of hand pollination in fruit formation. Natural pollination by wind on the other hand, does not insure pollination of all female flowers in a given inflorescence at the same time or at the time they are fully receptive. Wind borne pollen, furthermore, reaches the stigmas in a diluted form and at times when the individual pollen grains might have lost their viability. A somewhat similar reasoning is developed in the so-called pollen population phenomenon reported by Verkerk (1957) in tomato and by Akamine and Girolami (1959) in passion fruit where it was found that heavy pollination resulted in an increase in fruit set. This explanation, which is based on the quantitative aspect of auxin synthesis, cannot rule out the possibility that perhaps some factor, other than auxin, also induced by pollination, is involved in fruit set. It has been found, for example, that gibberellins can cause fruit set in a number of species (Presser and Jackson 1959, Crane et al. 1960, Weaver and McCune 1958).

Kimri Stage and June Drop. The second fruit count was made in July 7–10, at the so-called *kimri* stage, where usually a considerable natural fruit drop takes place, and the results are shown in Table 1. It appears that the percentage of June drop was the lowest when the flowers were hand pollinated and covered, and the 20 percent loss is about what is expected in date cultivation. This is also close to the

29 percent loss which occurred in the flowers left open to natural pollination. If the effects of the various treatments are considered, June drop in all these cases was higher than that which occurred in the case of hand-pollinated flowers, indicating again the efficiency and the advantage of hand pollination.

Another conspicuous aspect of the results at this stage is the effect of 2,4,5-T in causing the greatest June loss, i.e., 83 percent. It must be mentioned also that the 17 percent of the fruits retained under these treatments after the first fruit count in later May, actually never grew to *khalal* stage later. Thus the 50 ppm of 2,4,5-T used in this work seems to be very damaging. A similar trend is also apparent in the case of kinetin.

A test for seed development at this stage showed that the fruits produced by the hand pollinated (covered) inflorescences, were all fully seeded, and that all the fruits produced by the naturally pollinated inflorescences left uncovered, were also fully seeded (Table 1). In all the other treatments, where the inflorescences were covered, 55–80 percent of the fruits were seedless.

Maturation and Seedlessness. The final harvesting was done in early October where a little less in the total number of fruits was observed in all cases. The fruits were segregated into unripe *khalals* and mature *tamars*. The few damaged fruits found in many treatments were discarded. At least one sample of ten fruits from each group of all the treatments was picked up randomly and tested for seedlessness. Although seedlessness was often complete, yet in some fruits a small thread-like rudimentary seed was developed, but such fruits were considered seedless for practical purposes. The results, which are summarized in Table 2, are discussed for convenience, under the following aspects:

1. *Effect of kind of pollination on fruit morphology and quality.* It is seen that

Table 2. Average number of fruits per inflorescence, as khalal (unripe) and mature (ripe) fruits, together with the percent seedless fruits in the khalal groups of the untreated inflorescences.

Treatment	Number of Fruits per Inflorescence		
	Mature Seeded (<i>tamar</i> Stage)*	<i>Khalal</i> (Unripe) Stage**	Seedless % of <i>khalal</i>
Fresh pollen	1,267	54	0
Heat killed pollen	57	90	100
Pollen extract	20	90	100
No pollen	33	105	95
2-NOA	12	70	80
2,4,5-T	—	—	—
Kinetin	20	25	100
Untreated (not covered)	429	9	95

* *tamar*, the fourth, fully mature, stage of development in dates.

** *khalal*, the second, variety characteristic colored stage of development in dates.

about 96 percent of the fruits produced by the hand pollinated flowers were fully seeded, mature, and good quality. A comparable percentage of fruits, 98, on the inflorescences exposed to natural pollination, were also mature and fully seeded. Such fruits, however, were rather shrivelled and of inferior quality. These fruits showed similar dry weight but, on the average, they were about 25 percent larger than the good quality fruits produced by hand pollination (Table 3). This fact has been known through the ages of date cultivation, where hand pollination became essential for the development of good quality dates.

2. *Fruit ripening.* Considering all the treatments where no viable pollen was applied and where all the non-pollinated flowers were covered, it was found that 60–85 percent of the fruits reached the

full size *khalal* stage, marking the end of the growth period (Table 2). Such fruits, however, never ripened and practically all were seedless. The remaining 15–40 percent of the fruits were full seeded, ripe dates, but again of the shrivelled inferior quality described earlier. This observation establishes clear-cut evidence for the dependence of fruit ripening on the presence of full growing seeds. It seems, therefore, that fertilization and subsequent seed development stimulated the production of some growth factor, other than auxin, which is responsible for fruit ripening.

3. *Parthenocarpy.* As mentioned earlier, most of the unripe *khalals* were seedless fruits, developed by the non-pollinated covered flowers. Whether the various treatments had any effect on parthenocarpy, is a question that cannot be answered by the results of the present work. This is

Table 3. Average length (*L*), width (*W*), volume and dry weight of fruit produced by hand pollinated and naturally pollinated flowers.

Type of Pollination	Fruit Volume			Dry Weight (Pericarp) % of Fresh Weight
	L × W cm	Volume by Displacement, cm ³	Relative Volume	
Hand pollination	3.3 × 2.3	7.9	75	86.94
Natural pollination	4.2 × 2.3	10.7	100	86.67

because parthenocarpy was induced to the same extent even when nothing was added to the flowers or when only heat-killed pollen was added. It appears, therefore, that natural parthenocarpy is a tendency in date fruit development when no pollination takes place. And since the total number of fruits developed under the various treatments was so small compared with that developed from flowers that were hand-pollinated, it is possible that the small percentage of mature and seedless fruits developed under the various treatments resulted from accidental pollination.

4. *Rudimentary seeds.* An observation of considerable interest, as mentioned earlier, is that some of the unripe *khalals* had a small and elongated structure, reminiscent of a rudimentary seed. This fragile and dried-up structure represents an early stage of ovule development, where the already present auxin in the ovary, which was responsible for the observed parthenocarpy, stimulated the early parallel growth of both ovary and ovule. A similar correlated growth in the early stages of development of the ovary and ovules also occurs in parthenocarpic banana fruits (Audus 1965).

Conclusions

Hand pollination is an important factor in fruit set and production of good quality fruits in the date palm. When fresh pollen was replaced by pollen extract, heat-killed pollen, no pollen, 2,4,5-T, 2-NOA or kinetin, a drastic reduction in fruit set occurred. The magnitude of fruit set in the inflorescences left open to natural pollination was about 33 percent of that in hand-pollinated and covered inflorescences. About 96 percent of fruits produced by the hand-pollinated inflorescences were fully seeded, ripe, and of good quality. A comparable percentage of fruits on the inflorescences

exposed to natural wind pollination were also ripe and fully seeded. Such fruits, however, were rather shrivelled and of inferior quality, although they were on the average, about 25 percent larger than the good quality fruits. If all the treatments where no viable pollen was applied and where all the inflorescences were covered for five weeks after treatment are considered, it was found that 60–85 percent of the fruits reached the full size *khalal* stage but never ripened and all such fruits were seedless. This clearly establishes the dependence of fruit ripening on the presence of fully growing seeds. It also appears that natural parthenocarpy is a tendency in date fruit development when no pollination takes place.

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The Mottled-leaved Species of *Pinanga* in the Philippines

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Of the more than 20 species of *Pinanga*, thus far recorded for the Philippines (Beccari 1919, Merrill 1922), three endemic species, viz. *P. maculata*, *P. copelandii* and *P. curranii*, are known to exhibit mottling in their leaves; a fourth species, *P. bicolorana*, is described here for the first time. Several other species of *Pinanga* from Malay Peninsula, Sumatra and Borneo are also known to display mottling in their leaves (Dransfield 1974). The mottling of the leaves makes the species doubly attractive as palms for cultivation. It is usually more prominent and conspicuous in seedlings or juvenile plants, although in some species adult, fruiting plants may continue to show variegation.

The four Philippine species of *Pinanga* with mottled leaves may be keyed out as follows:

1. Leaflets \pm straight, not or only shallowly incised at the apex, densely pubescent-scaly underneath; calyx of fruiting perianth with free imbricate lobes 1. *P. curranii*
 1. Leaflets \pm cuneiform-sigmoidal, conspicuously and deeply incised at the apex, ashy-grey puberulous underneath; calyx of fruiting perianth with valvate lobes joined at their bases 2
 2. Inflorescence with flowers or fruits arranged spirally along the rachillae 2. *P. maculata*
 2. Inflorescence with flowers or fruits arranged distichously along the rachillae 3
 3. Fruit obovoid to subturbinate, shortly beaked, epicarp drying finely striate; rachillae in inflorescence often more than 8 3. *P. copelandii*
 3. Fruit oblong-ellipsoidal, prominently beaked, epicarp drying smooth and crustaceous; rachillae in inflorescence rarely more than 8 4. *P. bicolorana*
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- Iguanura* sp., Vidal exsicc. No. 1945, Vidal, Rev. Pl. Vasc. Filip. 279 (1886); Ceron, Cat. Pl. Herb. Rec. Per. Sup. Com. Fl. For. 174 (1892).
- Pinanga maculata* sensu Becc. non Portea ex. Lem. in Perkins, Fragm. Fl. Philipp. 1: 48 (1904), in Webbia 1: 325 (1905) (in part), in Philipp. J. Sci. (Bot.) 14: 317 (1919); Merrill, Enum. Philipp. Fl. Plts. 1: 166 (1922).

Clustering, rarely solitary, moderate to large palm to 8 m tall. Stem ca. 5-10 cm diam., internodes ca. 4-10 cm long. Crownshaft elongate, cylindrical, slightly swollen, to 90 cm long. Leaves to 7 in crown; leafsheath ca. 40-80 cm long, dark green, covered with fugaceous brown tomentose scaly indumentum; leaf without sheath 1.5-2 m long; petiole ca. 18 \times 1.2 cm, channelled above, convex below, covered with indumentum as the leafsheath; rachis angular, \pm bifacial above, indumentum as the leafsheath and petiole. Leaflets to 26 on each side of the rachis, unequal, inequidistant, to 4 cm apart, dark green above and with sharply edged costae, greyish-green or paler underneath and densely covered with pubescent, tomen-

tose-scaly indumentum; basal leaflets 3-4 costate, ca. 46-62 × 3.5-4.3 cm, ± straight or only slightly sigmoidal, the apex long-acuminate, subfalcate; middle leaflets 2-3 (4) costate, ca. 64-100 × 4-5 cm, ± straight, long-acuminate at apex; sub-terminal and terminal leaflets incised at apex to as many lobes as there are costae, the lobes to 2 cm long and further incised at their tips to 5 mm deep, resulting secondary lobes obtuse or rounded and convergent, becoming hook-shaped; terminal leaflet pair to 10-costate, ca. 25 × 7 cm, joined to 17 cm at the base along the rachis. Inflorescence infrafoliar, pendulous; prophyll elliptic-ensiform, 2-keeled, 26 × 6 cm, drying rusty brown, caducous; peduncle 2.5-6 × 1.0-1.5 cm, flattened, glabrous; inflorescence axis to 10 cm long, tapering distally; rachillae 13-20, deflexed, not strictly distichous, borne 0.5-1.5 cm apart, each 18-27 cm long, flattened, to 4 mm wide, 2-2.5 mm thick when dry, glabrous, the subtending bract narrowly semi-annular, apiculate in the middle, to 2 mm; triads borne distichously along the rachilla. Staminate flower triangular, trigonous, asymmetrical, 6 × 4.5 mm; sepals 3, unequal, fused at the very base, dorsally keeled, flexuous, long-acuminate, 3 × 1 mm; petals 3, unequal, valvate, ± ovate-lanceolate, 6 × 4.5 mm; stamens to 25; anthers basifixed, 3 × 0.5 mm; filaments very short or sessile. Pistillate flower depressed-globose, 1.5 × 1.5 mm, sepals ± as long as the petals; sepals 3, free, unequal, imbricate, ± rounded at tips, 1.0 × 1.5 mm; petals ± narrower than sepals, slightly dorsally keeled, ciliolate along the margins; ovary shortly oblong to rounded, 1 × 1 mm, tipped with an irregularly lobed stigma. Fruiting perianth depressed-cupular, to 3 mm high, 6 mm across, with a flat base and slightly broadened mouth; the sepals and petals subequal, the sepals with free, imbricate lobes, subtending bract broadly ovate to 1.5 mm long. Fruit distichous, 5-10 mm apart, ripening deep red, ovoid to oblong-ellipsoidal, ca. 1.5 ×

1.0 cm, apiculate at apex; epicarp drying sparsely and finely striate; mesocarp not loosely fibrous; seed ovoid to oblong, 1.0-1.2 × 0.8-0.9 cm, apiculate at tip, obtuse to rounded at base; endosperm ruminant; embryo sub-basal.

Distribution and Habitat: Philippines: Palawan, Dumarán and Busuanga Islands; in forests, ca. 10-500 m alt. Endemic.

Vernacular Name: "Bunga-bunga."

Specimens Examined: PALAWAN: Puerto Princesa, *Curran F.B. 3515* (Holotype FI), Bagumbayan, *Fernando 637* (K, LBC), *Hernaez 3647* (CAHP), Iwahig River, *Merrill 712* (FI), Tagkaurim, *Madulid 1018* (K), St. Paul's Bay, Kabayugan, *Madulid & Dransfield 1038* (K).—DUMARAN IS: *Vidal 1945* (K).—BUSUANGA IS: *Ramos B.S. 41240* (K).

2. ***Pinanga maculata*** *Porte ex Lem.* in *Illus. Hort.* 10: pl. 361 (1863); *Drude* in *Bot. Zeit.* 40: 637 (1877); *H.A. Wendl.* in *Kerch. Les Palms.* 253 (1878); *Becc.*, *Malesia* 3: 145 (1886), in *Webbia* 1:325 (1905) (in part); *Furtado* in *Feddes Rep.* 35: 281 (1934) (in part and excl. syn. *P. copelandii* *Becc.*); *Martelli*, in *Nuov. Giorn. Bot. Ital.* (n.s.) 42: 69 (1935); *Moore* in *Principes* 7: 158 (1963). Type: pl. 361 in *Lem.*, l.c.

Ptychosperma maculatum (*Porte ex Lem.*) *Seem.* in *Gard. Chron.* 697 (1870).

Iguanura sp., *Vidal exsicc.* No. 1954, *Vidal Rev. Pl. Vasc. Filip.* 279 (1886); *Ceron*, *Cat. Pl. Herb. Rec. Pers. Sup. Com. Fl. For.* 174 (1892).

Pseudopinanga maculata (*Porte ex Lem.*) *Burret* in *Notizbl. Bot. Gard. Mus. Berlin-Dahlem* 13: 194 (1936) (in part, excl. *P. copelandii* *Becc.* and all specimens cited); *Salvosa*, *Lexicon Philipp. Trees* 120 (1963).

Pinanga barnesii *Becc.* in *Webbia* 1: 320 (1905), in *Philipp. J. Sci. (Bot.)* 3: 340 (1908), 6: 229 (1911), 14: 320 (1919), in *Leaf. Philipp. Bot.* 8: 3002 (1919);

Merrill, Enum. Philipp. Fl. Plts. 1: 164 (1922); Martelli in Nuov. Gior. Bot. Ital. (n.s.) 42: 66 (1935); Jones, Palms Austral. 223 (1984). Type: Luzon, Bataan Prov., Lamao River, *Barnes F.B. 122* (Holotype FI; Isotype K). **synon. nov.** *Pseudopinanga barnesii* (Becc.) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 193 (1936); Salvosa, Lexicon Philipp. Trees 120 (1963).

Pinanga barnesii Becc. var. *macrocarpa* Becc. in Philipp. J. Sci. (Bot.) 2: 227 (1907). Type: Mindoro, Balete, Baco River, *McGregor 275* (Holotype FI; Isotype K).

Solitary, moderate palm to 5 m tall. Stem ca. 3–5 cm diam., internodes to 3 cm long. Crownshaft elongate, slightly swollen, to 50 cm long. Leaves to 7 in crown; leafsheath ca. 40 cm long, purplish-brown to light orange, covered with brown scaly indumentum; leaf without sheath ca. 1.5–2 m long; petiole ca. 3–17 cm long, slightly channelled above, convex below, covered with brown scaly indumentum as leafsheath; rachis angular, \pm bifacial above, obtusely rounded below, covered with brown scaly indumentum as leafsheath and petiole. Leaflets to 15 on each side of the rachis, unequal, inequidistant, ca. 5–12 cm apart, the apex incised to as many lobes as there are costae, dull dark green above and mottled with large, irregular blotches of lighter shade, ashy-grey puberulous underneath; the costae above distinctly and sharply elevated, those beneath covered with contiguous ramenta; basal leaflets 2-costate, ca. 16–27 \times 1–1.5 cm, sigmoidal, long-acuminate at tips; middle leaflets usually 4–7 costate, ca. 28–54 \times 7–12 cm, \pm sigmoidal, cuneiform, narrowed towards the base, apical lobes falcate-acuminate, pendulous, ca. 6–19 cm long, generally $\frac{1}{5}$ to $\frac{1}{4}$ of leaflet length, rarely more; terminal leaflet pair to 13-costate, ca. 15 \times 3.5 cm, the pair joined to 19 cm at the base along the rachis, apical lobes to 4.5 cm long, falcate-

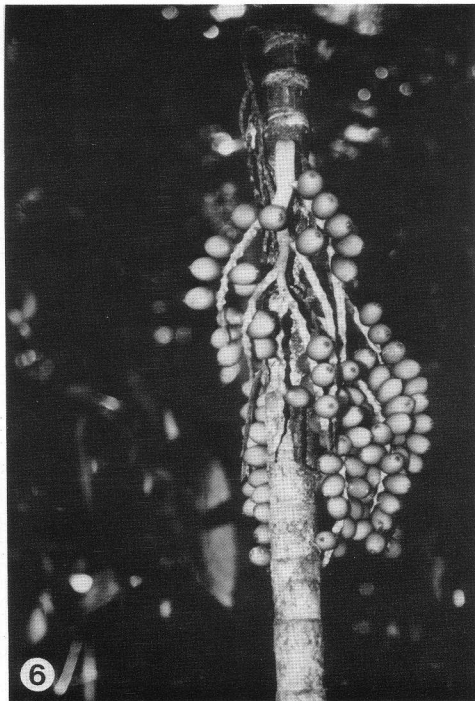
acuminate. Inflorescence infrafoliar, pendulous; prophyll not known; peduncle ca. 2–6 \times 0.7–1.5 cm, flattened, 5–7 mm thick, reddish to orange when fresh; rachilla usually 4–5, rarely more, borne ca. 2–3 cm apart, each ca. 18–35 cm long, angular, \pm twisted, sinuous, 4–6 mm thick, reddish to orange when fresh, the subtending bract a narrow, semi-annular collar; triads borne spirally in 3 series along the rachilla. Staminate and pistillate flowers not known. Infructescence pendulous. Fruiting perianth depressed-cupular with a broadened mouth, to 3 mm high, 8 mm across; the sepals and petals subequal, glabrous, dirty reddish-brown; sepals 3, valvate, joined at their bases; petals 3, free, imbricate, slightly broader than the sepals; subtending bract a low, explanate, semi-annular collar, almost inconspicuous. Fruits spirally arranged in 3 series, densely clustered, ripening red then purplish-black, ovoid-ellipsoidal to ellipsoidal, ca. 2.1–2.8 \times 1.2–1.6 cm, the apex shortly beaked; epicarp drying wrinkled with shallow depressions; mesocarp fibrous; seed globose-ovoid to ovoid, ca. 1.2–1.3 \times 0.9–1.2 cm, rounded at tip, slightly obliquely truncate at base; endosperm ruminant; embryo basal.

Distribution and Habitat: Philippines: Luzon, Polillo and Mindoro; in humid forests, ca. 300–800 m alt. Endemic. Merrill (1922) also reports this species (as *P. barnesii*) from Catanduanes, Panay, Siargao and Mindanao in primary forests to 1,600 m alt. (Fig. 1).

Vernacular Names: “Abiki” (Tagalog), “Gahiddan qan bittulung” (Ifugao), “Tig-bisa” (Dumagat) (see also Merrill 1922: 164 for other local names).

Specimens Examined: LUZON: Cagayan Prov., *Ramos B.S. 13858* (K); Ifugao Prov., Damag, *Fernando 355* (K, LBC), Botwag, *Conklin & Buwaya 2525* (K); Benguet Prov., Baguio, *Elmer 8850* (K); La Union Prov., Mt. Tonglon, *Loher 7067* (K); Zambales Prov., Pinagtubo, *Loher 7068* (K); Aurora Prov., Sierra





1. *Pinanga maculata*, habit, Sierra Madre Mts., Aurora Prov., Luzon, April 1985. 2. *Pinanga copelandii*, in the forest near Malayal, Zamboanga del Norte Prov., Mindanao, July 1986. 3. *Pinanga copelandii*, in the forest around Lake Bulusan, Sorsogon Prov., Luzon, July 1985. 4. *Pinanga copelandii*, infructescences with fruits at various stages of maturity, same plant as in Fig. 3. 5. *Pinanga bicolorana*, type plant showing habit, Bicol National Park, Camarines Norte Prov. Luzon, May 1985. 6. *Pinanga bicolorana*, infructescences with nearly mature fruits, same plant as in Fig. 5.

Madre Mts., *Fernando* 471 (K, LBC), *Fernando* 565 (LBC), *Jacobs* 7759 (K); Quezon Prov., Nakar, Sablang, *Fernando* 520 (LBC), Mt. Banahaw, *Dransfield et al.* 5476 (K, LBC), Dolores, *Vidal* 1954 (K), Lucban, *Elmer* 7924 (BM, K), Real, *Fernando* 551 (LBC), *Hernaes* 3566, 3568 (CAHP), Infanta, *Loher* 1357 (in part) (K); Tayabas, *Elmer* 9297 (BM), Atimonan, Quezon National Park, *Hernaes* 3590 (CAHP), *Natividad* 001 (LBC); Laguna Prov., *Mabesa F.B.* 26782 (K); Bataan Prov., Lamao, *Barnes F.B.* 122 (Type of *Pinanga barnesii* Becc.; Holotype FI); Rizal Prov., Mt. Tokduanbanoy, *Ramos & Edaño B.S.* 48600 (in part) (K), Montalban, *Loher* "7067" (K), Tanay, Morong, *Loher* 1395 (in part) (K).—POLILLO: *McGregor* 10466 (K), *Rob-*

inson B.S. 6937 (BM, K).—MINDORO: Pinamalayan, *Ramos B.S.* 40970 (K), Baco River, *McGregor* 275 (Type of *Pinanga barnesii* Becc. var. *macrocarpa* Becc.; Holotype FI; Isotype K).

The identity of *P. maculata* remained obscure for many years since publication, as it was typified only by a description and illustrated based on a sterile, juvenile plant which was then cultivated in a nursery in Belgium. The source of the plant was said to be the Horticultural Society then existing in Moscow, but the specimen was originally collected in the Philippines by Marius Porte in humid forest between 1,200–1,500 ft (ca. 365–457 m) above sea level (*Lemaire* 1863*b*).

In 1934, *Furtado* considered the problem of the identity of *P. maculata* and

concluded that Porte's species was conspecific with *P. copelandii* Becc. In his paper, Furtado (1934) writes . . . "*P. copelandii* is a palm widely distributed in the Philippines being found up to a height of 1220 m. In view of this it appears that the plant *P. copelandii* Becc. should be known as *P. maculata* Porte ex Lem." However, Furtado had overlooked another species closely related to *P. copelandii* and which until now was known as *P. barnesii* differing from the former only in its inflorescence and fruit structure.

P. barnesii occurs in the Babuyan Islands, Luzon (numerous localities), Polillo, Catanduanes, Mindoro, Panay, Siargao and Mindanao (Beccari 1919, Merrill 1922). *P. copelandii*, on the other hand, is known only from Basilan, Mindanao, Negros, Bohol, Leyte and from two localities in the southeastern peninsular region of Luzon (Beccari 1919, Merrill 1922). Another closely related species, *P. bicolorana* (described below), is found, so far, only in two adjacent localities in southeastern Luzon. *P. barnesii* is, thus, the more widely distributed species compared with *P. copelandii*. It is, indeed, very common in Luzon and is the only species of the four with mottled leaves that occurs in the provinces close to Manila, i.e. Laguna, Rizal, Bataan, Quezon and Pampanga. I have not seen *P. copelandii* or collections of it from elsewhere in Luzon other than in the above-mentioned localities.

M. Porte, a French explorer, is known to have collected from ca. 1858–1865 near Singapore and in the Philippines (Lemaire 1863*a*, Backer 1936, van Steenis-Kruseman 1950). Although it is not mentioned in the original publication (Lemaire, 1863*b*) specifically where in the Philippines Porte collected his specimen of *P. maculata*, it is, however, almost certain that he made his collections in Luzon near Manila from where he is also known to have discovered the orchid *Phalaenopsis schilleriana* Reichb.f. (Lemaire 1863*a*). Apparently in those times Manila was gen-

erally regarded as synonymous with Luzon (see Lemaire 1863*a*, 1866) and the nearby provinces around it were obviously the most easily accessible areas for plant collection. Moreover, there is no mention of Porte having collected in Mindanao or Palawan or elsewhere in Luzon.

What Porte collected in the Philippines as *P. maculata* therefore, was almost certainly from Luzon and was the same plant which was later to be named as *P. barnesii*. *P. maculata* is the earlier and thus correct name.

Following Moore (1973) and Dransfield (1980), I do not consider *Pseudopinanga* created by Burret (1936) as a distinct genus.

The plant illustrated by Wright (1905) as *P. maculata* based on a specimen from the Malay Peninsula and cultivated at Kew was identified by Ridley (1907) as *P. disticha* (Roxb.) Blume ex H.A. Wendl. under which he actually, although incorrectly, reduced *P. maculata* as a synonym. Wright's (1905) plant, however, is certainly not the true *P. maculata* from the Philippines.

The collection by Merrill (No. 712) from Palawan (a juvenile plant with mottled leaves) cited by Beccari (1904, 1905, 1919) and Merrill (1922) as *P. maculata* is, in fact, a specimen of *P. curranii* as has already been hinted by Furtado (1934). True *P. maculata* has, so far, not been recorded from Palawan.

3. ***Pinanga copelandii*** Becc. in Webbia 1: 320 (1905), in Philipp. J. Sci. (Bot.) 14: 320 (1919), in Leaflet Philipp. Bot. 8: 3002 (1919); Merrill, Enum. Philipp. Fl. Plts. 1: 165 (1922); Martelli in Nuov. Gior. Bot. Ital. (n.s.) 42: 67 (1935). Type: Mindanao, Davao Prov., Todaya, Mt. Apo, *Copeland* 1283 (Holotype FI).

Pinanga maculata sensu Furtado non Porte ex Lem. in Feddes Rep. 35: 281 (1934) (in part); Jones, Palms Austral. 226 (1984).

Pseudopinanga maculata (Porte ex Lem.)
Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 194 (1936) (in part).

Solitary, moderate to large palm to 7 m tall. Stem ca. 10 cm diam., internodes to 12 cm long. Crownshaft elongate, cylindrical, swollen, to 1 m long. Leaves to 6 in crown; leafsheath to 65 cm long, dull green, covered with brown, scaly indumentum; leaf without sheath to 3 m long; petiole ca. 30–64 × 1.5–2.0 cm, ± rounded, shallowly channelled above, covered with brown, scaly indumentum; rachis angular, bifacial above, ± flattened to rounded below, glabrous to slightly brown-scaly. Leaflets to 13 on each side of the rachis, unequal, inequidistant, 3–9 cm apart, the apex incised to as many lobes as there are costae, dull dark green above and sometimes slightly mottled, pale and ashy-puberulous glaucous underneath, often drying brittle and delicate, the costae above elevated and flattened to 3 mm wide and rather sharply-edged, the costae below covered with brown, scaly indumentum; basal leaflets 2–3 costate, ca. 30 × 2.5 cm, ± sigmoidal, long acuminate at tips; middle leaflets 1–8 costate, ca. 41–80 × 7–14 cm, ± sigmoidal, cuneiform, narrowed towards the base, the apical lobes ca. 4.5–23 cm long, generally to ¼ of leaflet length, rarely more, falcate-acuminate, pendulous, sometimes further incised at their tips to 1.5 cm deep; terminal leaflet pair to 13-costate, ca. 22 × 18 cm, joined to 17 cm at their base along the rachis, apical lobes 3–4 cm long, falcate-acuminate, sometimes further incised at their tips to 1 cm deep. Inflorescence infrafoliar, pendulous; prophyll not known; peduncle ca. 5 × 1.5 cm, flattened, to 7 mm thick, glabrous green, becoming yellow to orange when fresh; the main axis to 15 cm long or more, ± appearing zigzag when dry; rachillae 9–14, rarely less, ± reflexed or slightly bent backwards near point of attachment, distichous, ± in the same plane, borne ca. 3 cm apart, each

ca. 9–31 cm long, flattened, to 5 mm wide, 3 mm thick when dry, light green, becoming orange when fresh, glabrous, drying light brown and distinctly striate, the subtending bract semi-annular, apiculate, to 3 mm in the middle; triads borne strictly distichously along the rachilla. Staminate and pistillate flowers not known. Inflorescence pendulous. Fruiting perianth cupular, to 3 mm high, 7 mm across, with a broadened mouth; the sepals and petals ± equal, glabrous, finely striate dorsally, drying orangish-brown; the sepals valvate, joined at their bases; the petals free, imbricate; the subtending bract a low, semi-annular collar. Fruits distichous, to 7 mm apart, ripening red then purplish-black, obovoid to subtruncate, narrowed towards the base, ca. 2.0–2.5 × 1.0–1.3 cm, the apex shortly beaked; epicarp drying finely striate, rather thin; mesocarp loosely fibrous; seed shortly oblong to spherical, ca. 1.0–1.2 × 0.8–1.0 cm, rounded or sometimes shortly apiculate at tip, obliquely shallowly concave-truncate at base; endosperm deeply ruminant; embryo basal.

Distribution and Habitat: Philippines: Luzon (Camarines and Sorsogon provs.), Bohol, Leyte, Mindanao, and Basilan; in humid forests ca. 100–1,250 m alt. Endemic. Merrill (1922) also reports this species from Negros Is. (Figs. 2–4).

Vernacular Names: “Timbagnalan” (Bagobo), “Bagtoan” (Manobo).

Specimens Examined: LUZON: Camarines Prov., *Ramos Phil. Plts. 1594* (BM, FI); Sorsogon Prov., Irosin, Mt. Bulusan, *Elmer 15497* (BM, K), Bulusan Lake, *Fernando 542* (K, LBC), *Hernaes 3630* (CAHP).—BOHOL: *Ramos B.S. 42874* (BM).—LEYTE: Baybay, Mt. Pangasugan, *Reyes 1102* (CAHP).—MINDANAO: Agusan Prov., Butuan, *Weber 1134* (K), *Fenix B.S. 15918* (BM), Agusan River, *Merrill 7281* (BM), Cabadbaran, Mt. Urdaneta, *Elmer 13875* (BM, K), Trento, *Fernando 413* (K, LBC); Davao Prov., Todaya, Mt. Apo, *Copeland 1283* (Holotype FI), *Elmer 10467* (BM, K);

Zamboanga del Norte Prov., Malayal, *Fernando* 585 (K, LBC); Zamboanga del Sur Prov., Malangas, *Ramos & Edaño B.S.* 36880 (BM, K), localities unknown, *Brown B.S.* 38366 (in part) (K), *Hernaez* 3666 (CAHP).—BASILAN: Maligui, *Fernando* 615 (LBC).

4. ***Pinanga bicolorana*** E. Fern., *sp. nov.*
P. copelandii Becc. affinis, a qua imprimis fructu oblongo-ellipsoideo, epicarpio siccitate laeve et crustaceo, inflorescentiae rachillis 5–8 differt. Typus: Philippines, Luzon, Camarines Norte Prov., Bicol National Park, *Fernando* 498 (Holotypus K; Isotypus LBC) (Figs. 5–7).

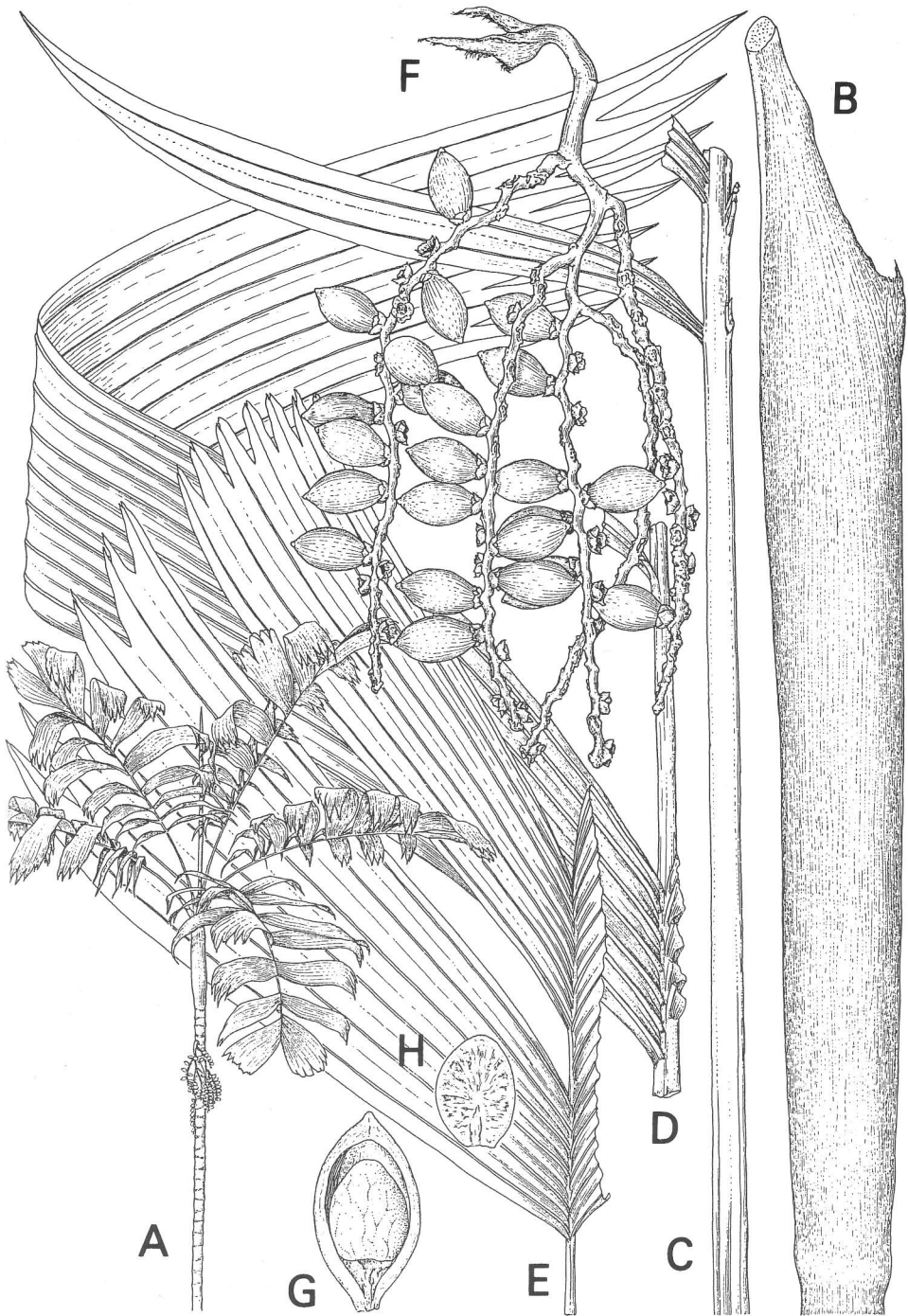
Solitary, moderate, unarmed, pleoanthic, monoecious palm to 3 m tall. Stem ca. 4 cm diam., internodes to 6 cm long. Crownshaft elongate, cylindrical, slightly swollen, to 60 cm long. Leaves 5–6 in crown; leafsheath ca. 42 cm long, dull light green, covered with dense, brown, scaly indumentum; leaf without sheath 75–100 cm long; petiole ca. 25 × 1.3 cm, channelled above, convex below; covered with indumentum as the leafsheath; rachis angular, bifacial above, obtusely rounded below, covered with indumentum as the leafsheath and petiole. Leaflets to 10 on each side of the rachis, unequal, inequidistant, to 6 cm apart, the apex incised to as many lobes as there are costae, dull dark green above and slightly mottled with blotches of lighter shade, ashy puberulous-glaucous underneath, the costae above sharply edged, those beneath covered with brown scaly indumentum; basal leaflets generally uncostate, ca. 17 × 1 cm, ± sigmoidal, long-acuminate; middle leaflets 1–6 costate, ca. 40 × 8 cm, ± sigmoidal, cuneiform, narrowed towards the base, apical lobes acuminate-falcate, pendulous, to ca. 7.0–8.5 cm long, generally about 1/2 of leaflet length; terminal leaflet pair to 14-costate, ca. 18.5 × 12.5 cm, the pair joined to 14 cm at the base along the rachis, apical lobes falcate-acuminate, to

3.5 cm long. Inflorescence infrafoliar, pendulous; prophyll not known; peduncle ca. 5 × 0.8 cm, flattened, ca. 3–4 mm thick, glabrous, light green becoming orange when fresh; main axis to 8 cm long, tapering distally, ± zigzag when dry; rachillae 5–8, very rarely more, deflexed, distichous, ± in the same plane, borne 3–4 cm apart, each ca. 9–14 cm long, flattened, to 4 mm wide, 3 mm thick when dry, light green becoming orange when fresh, the subtending bract a narrow low collar; triads borne strictly distichously along the rachilla. Staminate and pistillate flowers not known. Infructescence pendulous. Fruiting perianth depressed-cupular, 3 mm high, 7 mm across, with a broadened mouth; the petals and sepals subequal, glabrous, drying dark brown; sepals valvate, joined at their bases; petals free, imbricate, broader than the sepals; subtending bract as a low explanate, semi-annular collar, almost inconspicuous. Fruits distichous, to 8 mm apart, ripening red then purplish-black, oblong-ellipsoidal, ca. 2.2 × 1.4 cm, prominently beaked or mammilate, with a collar to 2 mm high and 3 mm wide near the base surrounding the apical stigmatic remains; epicarp drying smooth, sometimes with shallow depressions, rather thick and crustaceous; mesocarp loosely fibrous; seed broadly ovoid, ca. 9.5 × 9.0 mm, rounded at tip, shallowly concave-truncate at base; endosperm ruminant, embryo basal.

Distribution and Habitat: Philippines: Luzon (Camarines Norte and Sur provs.); in dipterocarp forest ca. 100–200 m alt. Endemic.

Specimens Examined: LUZON: Camarines Norte Prov., Bicol National Park, *Fernando* 464 (LBC), *Fernando* 498 (Holotype K; Isotype LBC), *Fernando* 562 (BH, K, LBC), *Hernaez* 3585, 3587 (CAHP), *Pancho & Hernaez* 3453 (CAHP), *Reyes & Pancho* 1059 (CAHP); Camarines Sur Prov., Lupe, *Pancho* 2489 (CAHP).

This species is closely related to *P. copelandii* in the distichously arranged fruits along the rachilla but is easily distinguished



7. *Pinanga bicolorana* E. Fern. A, habit, $\times \frac{1}{20}$; B, leafsheath, $\times \frac{1}{2}$; C, basal portion of leaf with petiole and first leaflets, $\times \frac{1}{2}$; D, mid-portion of leaf, $\times \frac{1}{2}$; E, apical portion of leaf, $\times \frac{1}{2}$; F, infructescence, $\times \frac{1}{2}$; G, vertical section of fruit, $\times 1$; H, vertical section of seed, $\times 1$. All from *Fernando* 498. Drawn by E. A. Lapitan.

by its prominently beaked, oblong-ellipsoid fruits with the epicarp drying smooth and rather crustaceous. The inflorescence bears rarely more than 8 deflexed rachillae.

P. bicolorana together with *P. maculata* and *P. copelandii* belong to a distinct group within *Pinanga* in bearing united sepals in their pistillate flowers. Within that group they form an unusual subgroup in having broad, pluricostulate leaflets which are ashy-grey on the undersurface and with deeply incised tips.

All the four species of *Pinanga* discussed above are excellent ornamental palms, especially at the juvenile stage (e.g., as pot plants) when the mottling of the leaves is most prominent. In *P. maculata*, *P. copelandii* and *P. bicolorana* the first seedling leaves are generally much larger and with broader spots than in *P. curranii*. It is, however, in *P. maculata* where the variegation is most striking and in most cases continues until fruiting stage.

Seeds of *P. maculata* and *P. copelandii* may have been distributed through the Palm Society Seed Bank, but names provided should be treated with caution. Precise identification of the plants is only possible when they start to flower and bear fruits.

Acknowledgments

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Sabal palmetto Gets Stamp of Approval

JACK COOK

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On Monday, May 23, 1988, The South Carolina General Assembly met in Charleston's historic old Exchange building. This special joint session of both legislative chambers was convened to commemorate the state's ratification of the U.S. Constitution exactly two hundred years earlier, May 23, 1788. By this action, South Carolina became the eighth of the original thirteen states to take such a move and by this act, formally entered the union. Perhaps more noteworthy to members of The Palm Society, were the events taking place on the same day a hundred odd miles upstate in Columbia, the State Capital. There, long lines had formed on this warm May morning at the city's main, downtown post office awaiting the 7:00 A.M. opening.

Philatelists, souvenir seekers and history buffs from many parts of the country joined Columbians and other interested South Carolinians to be among the first to purchase the new South Carolina Statehood Stamp (see Cover Photo). Later in the day, this stamp was formally dedicated in ceremonies at the State Capitol building by Eastern Regional Postmaster General, Johnny Thomas, and Governor Carroll Campbell.

Designed by artist, Bob Timberlake, the stamp depicts a palmetto, the state tree, on a sand dune with sea oats bent by ocean breezes in the foreground and tops of two other palmettos in the background. The state's name and date of statehood appear at the bottom. Thousands of the stamps were sold during that first day of issue in Columbia, and the following day 160 million went on sale in all parts of the country.

The *Sabal palmetto*, often referred also as "The Cabbage Palm," has long held a revered place in the hearts of South Carolinian's as well as a prominent place in its history and its pageantry. Nicknamed proudly as The Palmetto State, South Carolina has the *Sabal palmetto* on both its state flag and state seal. It also appeared on the state's 1976 license plate as one feature of the observance of the nation's Bicentennial. South Carolina's love affair with this palm began long ago. On June 28, 1776, the palmetto played a significant role in the first American military victory against the British. Coming, providentially, just a few days before the Declaration of Independence was signed in Philadelphia, the victory was an important morale builder to South Carolina as well as the 12 other American colonies as they prepared their long struggle against Britain. The Battle (Ripley 1983, Stokely 1985) took place in Charleston harbor where a small band of South Carolina militiamen under Colonel William Moultrie had constructed a small, crude fortification of sand and palmetto logs on Sullivan's Island across from Charleston, then the largest city in the colonies, south of Philadelphia.

The palmetto is native all along the immediate South Carolina coast, and thousands of these sturdy palms were cut on Sullivan's and other nearby sea islands to erect the fort that South Carolina military leaders planned as a key to the defense of its colonial capital against a large British naval and land force. In a fierce daylong battle of almost continual bombardment, the small force of South Carolina militia,

under the 46 year old Moultrie, acquitted themselves astoundingly well. Despite being short of cannon and low on gun powder most of the torrid June day, they kept their cool and concentrated their aim and ended the day by soundly defeating the large, well equipped attacking British Naval force. By nightfall, the British had had enough, and Admiral Sir Peter Parker ordered the remnants of his battered fleet out to the open sea to lick their wounds. The extent of the momentous and almost unbelievable victory accomplished by Moultrie and his men can be grasped by the casualty report. The British suffered some 200 dead and wounded, while the Americans counted only 12 dead and 25 wounded. However, five of the wounded died later. Parker, the British admiral, was among the casualties. He was wounded in both the thigh and knee and suffered the additional humiliation of literally having his britches shot off and his backside laid bare by a colonial broadside. Meanwhile, as could be expected, Moultrie and his gallant men of the 2nd South Carolina regiment were accorded instant hero status by the jubilant South Carolinians. Along with their cool under fire and pin-point accuracy of their marksmanship, two other factors aided them in pulling off their astonishing feat. Three of the British warships, while attempting a flanking action against the Americans, grounded on sandbars in treacherous Charleston harbor putting them effectively, for the Americans, out of commission. The second favorable factor for Moultrie and his men turned out to be the strength and elasticity of the little fort's palmetto logs. Not generally used in military or nonmilitary construction in that time, the palmetto logs held in place and surprisingly, the enemy's cannoballs buried into the soft, spongy wood without throwing off a shower of splinters as most other woods used in fortifications of that day had been found to do. According to

military historians, these splinter showers were a major source of casualties during artillery bombardment of wooded structures of that period. Honors rapidly piled up for the victorious American commander. The little fort originally named "Sullivan" was renamed "Moultrie" and Moultrie, himself, was hastily promoted to General.

The previous year, 1775, the South Carolina Revolutionary Council on Safety had asked Moultrie to design a flag to be used by South Carolina troupes. The Colonel chose a deep blue to match the color of their uniforms for the background. In the upper right hand corner, he placed a small white crescent to represent the silver crescent his militiamen wore on their caps. Now, he added a large white palmetto to the center of the flag, and there it remains.

Strangely, this revered palm was not officially designated as the "state tree" until by legislative proclamation in 1939. In 1953, Florida also made it its official state tree. The only other state to so honor a Palm is Hawaii. Its state tree is the Coconut Palm, *Cocos nucifera*.

In his memoirs, General Moultrie paid one more grand tribute to the *Sabal palmetto*. The British managed to refloat two of their man of wars grounded in Charleston harbor. The third could not be recovered, however, and was set afire to prevent capture by Moultrie's men. An exultant Moultrie described the resulting inferno as "a grand pillar of smoke, which soon expanded itself at the top, and in appearance, formed the figure of a Palmetto Tree."

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PALM BRIEF

Palms on U.S. Postage Stamps

The handsome cover picture depicting *Sabal palmetto* in a field of sea oats was designed by Bob Timberlake of Lexington, North Carolina. One of the current Statehood Constitution Series, this 25-cent commemorative is the first to be issued with the new first-class postage rate. I was so impressed with this beautiful palm postage stamp that I was motivated to find out which other U.S. postage stamps have portrayed palms, and to try to identify them.

According to my perusal of the Guide to U.S. Stamps (USPS 1987) the cover picture represents the fifth time that the palmetto palm has been on a U.S. stamp. What appears to be a *Sabal palmetto* is included in the design of a 1924 5-cent stamp issued to mark the Huguenot Walloon Tercentenary. Pictured on the stamp is the Huguenot Monument located in Jacksonville, Florida. In 1930, a 2-cent stamp issued to mark the 250th anniversary of the founding of Charleston, South Carolina, shows part of what can be assumed to be a palmetto palm. A third is a 6-cent 1970 stamp commemorating the 300th anniversary of the founding of the Carolina Colony by the English. The state flag with the palmetto palm is part of its quite stylized design. Finally, a 1976 Bicentennial series of 13-cent stamps featuring state flags included South Carolina. The state flag is composed of a white palmetto palm and a quarter moon on a blue background.

Two other species of palms have been depicted on U.S. postage stamps. The coconut can be found on five different stamps. In 1913, a 1-cent stamp was issued to mark the 400th anniversary of Balboa's "discovery" of the Pacific Ocean upon crossing the isthmus of Panama. Coconut

palms are part of the backdrop framing the explorer's portrait. A 1937 series honoring U.S. territories includes individual 3-cent stamps portraying La Fortaleza, San Juan, Puerto Rico, and Charlotte Amalie, capital of the Virgin Islands. Coconuts and possibly other palms decorate the Puerto Rican fort scene; a clear representation of coconuts appears in the later stamp. Hawaii has been honored with two air mail stamps containing coconuts. An 80-cent stamp in 1952 shows Diamond Head in Honolulu with the trunks and lower leaves of coconuts in the foreground. In 1972, an 11-cent stamp honored the City of Refuge National Park in Hawaii. A single coconut appears in the background. The California fan palm (*Washingtonia filifera*) is the other palm. It appears in a 9-cent 1956 stamp picturing The Alamo in San Antonio, Texas.

The subject of palms on postage stamps has received modest attention thus far. Illustrations accompanying letters from Kiner (1957) and Kanagawa (1974), and an article by Weber (1960), provide fine examples of the variety of palm stamps around the world. A letter written by Delfeld (1975), on behalf of the American Topical (Stamp) Association, made a plea to *Principes* readers for help in the identification of palms on stamps; I have no information what response was generated. Let this note serve as an opportunity to invite a philatelic palmophile to give this interesting subject the attention it deserves.

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DENNIS V. JOHNSON

EDWARD M. McGEHEE 1921-1988

Edward M. McGehee, President of The International Palm Society during 1987-1988 and President-Elect for the next two years, 1989-1990, died suddenly on October 16th. His enthusiasm, compassion, and legal expertise will be sorely missed. Tributes to Ed are to be published in January *Principes*. Friends may send remembrances to one of his special interests, The IPS Endowment Fund, c/o Ross I. Wagner, 4943 Queen Victoria Rd., Woodland Hills, CA 91364.

OFFICERS FOR IPS DURING 1989-1990

Jules Gervais, elected Vice President during the recent Biennial Meeting in Australia, will take over as President of The International Palm Society. A new Vice President will be elected by the Board. Other officers, board members, and personnel are listed on the masthead.

NOTICE

New in 1989—Color covers for *Principes*.

PALM RESEARCH

For the next year I will be working on the species of *Allagoptera*. I will be grateful for any information on this genus such as field notes, new collections, common names, distribution, uses, etc. MONICA MORAES, Botanisk Institut, Aarhus Universitet, Nordlandsvej 68, DK-8240 Risskov, Danmark.

Brahea edulis in the Wild

BILL GUNTHER AND PAUL MAHALIK

740 Crest Road, Del Mar, CA 92014, and P.O. Box 547, Solana Beach, CA 92075

On March 27, 1988, 32 passengers and a ship's crew of eight departed from San Diego for the Mexican island, Isla Guadalupe, on the chartered sport-fishing vessel "Pacific Queen." This is believed to be the first time since 1981 that the Mexican government has permitted visitors on the island, which is a military reservation, and which is the only place on earth where the palm *Brahea edulis* grows as a native.

Isla Guadalupe is Mexico's western-most possession; it is home for perhaps 100 Mexican military personnel, abalone fishermen, and goat hunters. Located about 250 miles southwest of San Diego and about 160 miles west of Baja California, latitude 29°N, it is about 25 miles long and 7 miles wide; it is a volcanic island, estimated to be seven million years of age, which has never been attached to the North American mainland. From a deep gorge in the Pacific Ocean, it rises steeply, in places almost vertically, to a height above sea level of about 1,430 m.

How the ancestor of *Brahea edulis* ever reached Isla Guadalupe is a riddle which bothers every person who has studied this palm. The genus *Brahea* is common on the Mexican mainland and in Baja California, but the viable seeds of *Brahea* do not float, and the prevailing currents of the Pacific Ocean would take any mature *Brahea* palm which during a storm was washed into the sea, southward—rather than westward toward Isla Guadalupe. No known bird or animal or fish would have any capability or reason for carrying a *Brahea* seed from Baja California to Isla Guadalupe. The palm was on Isla Gua-

dalupe thousands of years before any human being arrived in Baja California who might have carried it there. Nonetheless, somehow, sometime in history, a *Brahea* seed reached Isla Guadalupe. It sprouted on the inhospitable shore where it landed, and somehow managed thereafter to get its strong-hold on a steep savannah between 2 and 3 thousand feet (1,000 m) above the cliffs in the more hospitable conditions which prevail on the fog-drenched northwestern slope of the Island. There the palm prospered, and evolved into a very distinct species, *Brahea edulis*. Unaccountably, during its evolution, it developed seeds much larger than any of its mainland forebears; these seeds are covered by a layer of sweet pulp (almost in the fashion of a date), from which was derived its specific name "edulis," which means edible. But why did it develop edible sweet pulp over its seed when no known mammal ever existed on Isla Guadalupe (before around 1830) to eat that sweet pulp? And why, with no mammal existing in Isla Guadalupe which might eat the palm, did it retain sharp spines on the petioles of its young leaves?

The answers to these questions are an enigma; these questions are one reason why *Brahea edulis* is so interesting to taxonomists. Edward Palmer was the first botanist to visit Guadalupe in 1875. He identified 117 species of vascular plants, 20 of which are endemic, that is, not existing anywhere else in the world. The moister northern end of the island supports Monterey pines and cypress trees (many over 20 m tall) in large numbers at its highest



1. This photo, taken during a break in the usual fog, vividly shows the current status (April 1988) of the palm *Brahea edulis* on Isla Guadalupe, Mexico—its only native habitat. In the foreground are a few old palms with trunks badly mangled by goats. The scattered dark spots on the savannah below also are old palms, equally chewed up. All young palms and all palm seeds which drop are eaten by the goats; other plants are eaten too. About 1,100 old dying palms are the survivors of what once—before goats—was a large and healthy palm forest.

elevations in contrast to several species of lichens at its southern end which only receives about 2 cm of rain per year.

To the scientists, as well as the International Palm Society members, the trip was a great success. The seas enroute and during return were pleasantly calm, and the weather during our trip was unusually and exceptionally good. In contrast to the usually fogged-over condition, sunshine prevailed, as is evident by the photos which illustrate this article.

In 1830 on Isla Guadalupe an event occurred which has changed significantly the vegetation of the island. What happened was that an unidentified clipper ship, probably Spanish, dropped off some domestic goats, probably to provide a fresh supply of meat for future stops there. In

the absence of natural enemies, these goats multiplied to the maximum ability of the island to provide forage for them. While they devastated the island's flora, one of their main forage items is the large meaty seeds of *Brahea edulis*. After the goats arrived, every last *Brahea* seed which dropped in an accessible spot was eaten and every last seed which dropped inaccessibly between rocks and there sprouted was eaten as a young seedling by the goats. Thus it is that the youngest *Brahea edulis* alive on Isla Guadalupe now is perhaps 150 years old. Since the average lifespan of a *B. edulis* is estimated to be around 180 years, the very existence of this palm on Isla Guadalupe—its one and only native habitat—is limited to perhaps thirty more years. The palms also inhabited a deep

canyon, Barracks Canyon, on the north-east side of the island. This small grove has been destroyed by the inhabitants of the islands in recent years for food and shelter material.

If the goat population on Isla Guadalupe were exterminated during the next thirty years, *Brahea edulis* would survive there by reseeding itself. Or if a goat-proof fence were built and maintained around a cluster of the palms, young palm seedlings could sprout therein and perpetuate the species in its only native habitat. But who would

donate the money to build and maintain such a fence? (God forbid that goats might get trapped inside an unkept fence!) And what organization would have sufficient lobbying strength to convince the Mexican government that palms, which provide nothing but beauty, are more important than goats, which provide meat to eat?

So let us prepare for the time, during the span of our lives, when the very beautiful palm *Brahea edulis* becomes extinct in its only native habitat.

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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
A MANUAL OF THE RATTANS OF THE MALAY PENINSULA (J. Dransfield, 1979, 270 pp.)	25.00
COCONUT PALM FROND WEAVING (Wm. H. Goodloe, 1972, 132 pp.)	3.95
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.)	6.00
EXOTICA (4) (A. Graf, pictorial encyclopedia, 2 vols., including 250 plant families, 16,600 illust., 405 in color, 2590 pp.)	187.00
FLORA OF PANAMA (Palms) (R. E. Woodson, Jr., R. W. Schery, 1943, 122 pp.)	17.00
FLORA OF PERU (Palms) (J. F. MacBride, 1960, 97 pp.)	8.00
FLORIDA PALMS , Handbook of (B. McGeachy, 1955, 62 pp.)	1.95
FLORIDA TREES AND PALMS (L. and B. Maxwell, 30 palm species, 120 pp.)	6.00
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INDEX TO PRINCIPES (Vols. 1-20, 1956-1976, H. E. Moore, Jr., 68 pp.)	3.00
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PALMAS PARA INTERIORES, PARQUES Y AVENIDAS (in Spanish, A. Braun, 1983, 83 pp., 39 pp. color)	8.95
PALEM INDONESIA (in Indonesian) (Sas-traprdja, Moge, Sangat, Afriastini, 1978. 52 illustrations, 120 pp. For English translation add \$2.00)	5.50
PALMS (A. Blombery & T. Rodd, 1982, 192 pp., 212 colored photographs)	30.00
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PALM SAGO (K. Ruddle, D. Johnson, P. K. Townsend, J. D. Rees, 1978, 190 pp.)	10.00	RARE PALMS IN ARGENTINA (reprint from <i>Principes</i> , E. J. Pingitore, 1982, 9 pp., 5 beautiful drawings)	2.75
PALMS OF SUBEQUATORIAL QUEENSLAND (Robert Tucker, 1988, 91 pp.)	20.00	PALMS—ANCESTRY AND RELATIONS (B. Ciesla, 1979, a chart)	6.00
REVISIONS OF THE PALM GENUS SYAGRUS MART. AND OTHER SELECTED GENERA IN THE COCOS ALLIANCE (S. Glassman, 1987, 222 pp.)	19.95	PALMS FOR TEXAS LANDSCAPES (R. Dewers & T. Keeter, 1972, 3 pp.)	1.25
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