



PRINCIPES

Journal of The International Palm Society

October 1990

Vol. 34, No. 4

THE INTERNATIONAL PALM SOCIETY, INC.

THE INTERNATIONAL PALM SOCIETY

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Manuscripts for PRINCIPES, including legends for figures and photographs, must be typed double-spaced on one side of 8½ × 11 bond paper and addressed to Dr. Natalie W. Uhl for receipt not later than 90 days before date of publication. Authors of two pages or more of print are entitled to six copies of the issue in which their article appears. Additional copies of reprints can be furnished only at cost and by advance arrangement.

THIS PUBLICATION IS PRINTED ON ACID-FREE PAPER.

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Cover Picture

Washingtonia filifera is well established in Palm Canyon in the Kofa Mountains of Arizona. See pp. 177-180.

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JOURNAL OF THE
INTERNATIONAL PALM SOCIETY

(ISSN 0032-8480)

An illustrated quarterly devoted to information about palms and published in January, April, July and October by The International Palm Society, Inc.

Annual membership dues of \$20.00 in USA and \$25.00 to other countries include a subscription to the journal. Dues outside USA include airlift delivery. Single copies \$6.00 each or \$24.00 per volume. The business office is located at **P.O. Box 1897, Lawrence, Kansas 66044-8897**. Changes of address, undeliverable copies, orders for subscriptions, and membership dues are to be sent to the business office.

Second class postage paid at Lawrence, Kansas

Principes, 34(4), 1990, p. 159

Editorial

This issue represents a landmark in the history of *Principes* and in a sense of the International Palm Society. For the first time we have so many papers on hand that we are publishing 60 pages; past issues have never exceeded 52 pages and many have only 44 or 36. How well the editors remember the early years of the journal when our first editor, Dr. H. E. Moore, Jr., would be hunting desperately among his folders and hurriedly revising and many times writing new copy to try to fill an issue. Hal was a fast and very rhythmic typist; the sound of his keys penetrated all floors of Mann Library. Were he living now, he certainly would approve The Society's greater international scope, and be excited about the many articles on different aspects of palms that its much increased membership generates.

This last issue of 1990 contains a diverse group of papers. Don Hodel continues to describe new species in preparation for his coming *Chamaedorea* book. Subgenus *Stephanostachys*, considered in this issue, contains many attractive and widely grown species and Don has found two new additions to the group. For our second paper, Victor Miller of the Arizona Chapter has written an intriguing account of the native palm of Arizona and how it may have been discovered and named.

Information on pollination of palms is useful in several ways but because of the many insects that live on and around palms, it is very difficult to determine which are doing what. Some presumably are the pollinators, others feeding, living in or on the palm, or breeding. 752 insects have been reported associated in some way with the coconut. Jens Olesen and Henrik Balslev describe pollination in *Geonoma macrostachys*. They discovered that the female flowers have no rewards for the pollinators but appear to attract the insects by a form of mimicry. The study is outstanding for its completeness and as a first report of mimicry in palms. We need such careful studies for many genera.

Cliff Nauman discusses a possible hybrid between *Coccothrinax* and *Thrinax* which occurs on No Name and Big Pine Keys in Florida. The hybrid with long drooping leaf segments is an attractive plant. Unlike several known hybrids in palms, it does not produce fertile flowers.

Those traveling in the Amazon encounter a large array of palm genera, including many that lack flowers or fruit or are juvenile and hard to recognize. Francis Kahn has spent ten years working on Amazonian palms and developing ways to recognize them from vegetative characters. His key should assist many of us.

You'll find information on the state of the IPS and some of its plans for the future in Chapter News and Events and in the report on the 1990 Biennial.

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 34(4), 1990, pp. 160-176

New Species and Notes on Related Taxa in *Chamaedorea* Subgenus *Stephanostachys*

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Recent studies in support of a work on the genus *Chamaedorea* in cultivation that will be published by the International Palm Society in 1991 have resulted in diagnostic information about subgenus *Stephanostachys*. This subgenus is set well apart and easily distinguished, at least when fertile, from other subgroups of *Chamaedorea* by a combination of characters, the most obvious being the staminate flowers densely crowded and contiguous in bud (Fig. 1). In addition, the petals of staminate flowers are spreading or erect and free apically. Petals of both sexes are distinct and thickened and those of pistillate flowers are persistent in fruit. Inflorescences are usually solitary although in a few species they are multiple at a node. Fruits are mainly black, less commonly red or orange. Some species of subgenus *Stephanostachys* have pinnae which are heavily nerved, the nerves being prominent and keeled and drying a distinct yellow.

Subgenus *Stephanostachys* includes about 10, or perhaps more, species widely or locally distributed on both the Atlantic and Pacific slopes from México to Colombia. They occur in moist or wet forests from sea level to 1,500 meters elevation. Some are well adapted to growing on limestone outcroppings and, in some instances, are more common on that substrate than on adjacent, more fertile soils.

With the exception of *C. casperiana*, all the named species of subgenus *Stephanostachys* are cultivated to some extent. A few are common and occur in gardens

and collections wherever palms can be grown while others are quite rare. Because of their unusual, distinctive inflorescences, they always attract attention when in flower or fruit and are favorites of palm growers everywhere. In addition to the showy staminate inflorescences with their densely packed, contiguous flowers, several species of subgenus *Stephanostachys* have pistillate inflorescences of a similar nature. Pistillate flowers are densely crowded or contiguous on a thickened spicate, furcate, or few-branched axis. These species are outstanding in the infructescence, appearing somewhat similar to an ear of corn with the fruits densely packed and often angled by mutual pressure.

Recent work has resulted in much new information about subgenus *Stephanostachys* including the circumscription of two new species. This information is made available largely because we have been fortunate in establishing in the greenhouse in Los Angeles wild-collected plants of several key taxa from known localities. We have been able to collect and observe flowers of both sexes easily and hand-pollinate them to produce fruits. Some of this information, especially as it pertains to flowers, is presented here for the first time, even for previously named species.

Here I provide a key to and citations for the species of subgenus *Stephanostachys*, but full descriptions are given only of the two new species and those for which I have new data. Complete descriptions of all named species in subgenus

Stephanostachys will be included in the forthcoming treatment of *Chamaedorea* in cultivation.

Chamaedorea subgenus **Stephanostachys** Klotzsch, Otto & Dietr. Allg. Gartenzeit. 20: 363, 1852.

Chamaedorea sect. *Stachyophorbe* Liebm. ex Mart., Hist. Nat. Palm. 3: 309, 1849.
Stachyophorbe (Liebm. ex Mart.)

Liebm. ex Klotzsch, Otto & Dietr. Allg. Gartenzeit. 20: 363, 1852; name only in Liebm., 1846. *Spathoscaphe* Oerst., Vidensk. Meddel. Kjoeb. 1858: 29, 1859. *Stephanostachys* (Klotzsch) Klotzsch ex Oerst., Vidensk. Meddel. Kjoeb. 1858: 26, 1859. *Dasystachys* Oerst., Vidensk. Meddel. Kjoeb. 1858: 25, 1859. *Chamaedorea* sect. *Stephanostachys* Burret, Notizbl. Bot. Gart. Berlin 11: 760, 1933.

Key to the Species of Subgenus *Stephanostachys*

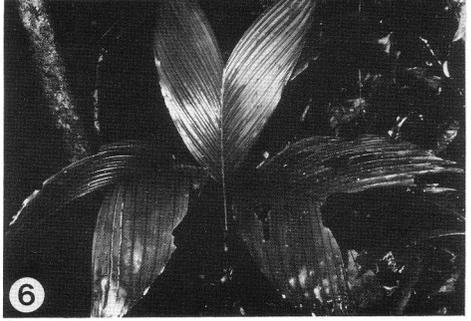
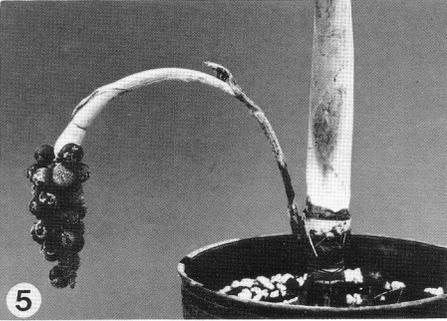
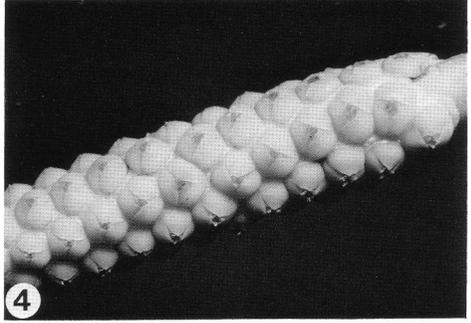
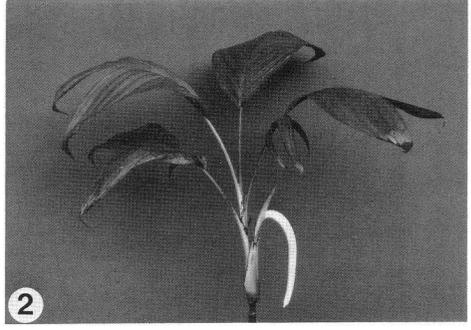
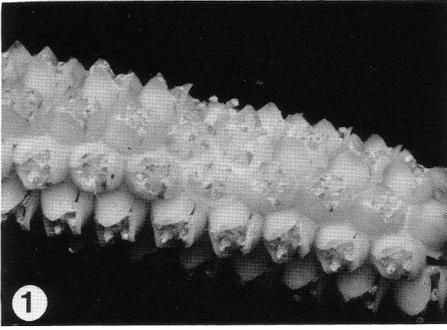
This key is adapted and modified from one developed by the late Harold E. Moore, Jr.

1. Pistillate flowers densely crowded, contiguous, on a thick spicate, furcate, or few-branched axis, calyx prominent; staminate calyx well developed in bud. 2
1. Pistillate flowers borne at distinct intervals or crowded in a definite spiral or vertical arrangement; calyx a low membranous ring; staminate calyx not prominent. 7
2. Pistillate inflorescence spicate or furcate. 3
2. Pistillate inflorescence with about 8 rachillae. *C. casperiana*
3. Staminate inflorescence spicate or furcate. 4
3. Staminate inflorescence with 8-10 rachillae. *C. arenbergiana*
4. Staminate and pistillate flowers green; staminate inflorescences multiple at a node. *C. deckeriana*
4. Staminate flowers yellow or white; pistillate flowers yellow; staminate inflorescences solitary at a node. 5
5. Staminate flowers yellow, sepals joined in a cupule half as high as the petals, stamens not as high as the petals. *C. allenii*
5. Staminate flowers white, sepals free nearly to the base, stamens equalling or exserted beyond the petals. 6
6. Staminate flowers with the anthers exserted above the petals; pinnae 9-11 on each side of the rachis. *C. crucensis*
6. Staminate flowers with the anthers not protruding beyond the petals; pinnae 1-6 on each side of the rachis with the terminal pair as broad or broader than the others combined. *C. zamorae*
7. Staminate and pistillate inflorescences spicate, stamens exserted beyond the petals or nearly so; fruit red-orange. *C. oreophila*
7. Staminate inflorescences branched, pistillate inflorescences branched or spicate, stamens mostly included; fruits black. 8
8. Stems short, creeping, branching in a dichotomous manner; pinnae decurrent at the base. *C. cataractarum*
8. Stems erect, not creeping or branching in a dichotomous manner; pinnae not decurrent. 9
9. Inflorescences usually 2-several at a node, more rarely, especially the pistillate, solitary; pistillate rachillae few, short, erect; pistillate flowers closely placed; margin of the leaf sheath whitish with green nerves. *C. alternans*
9. Inflorescences solitary at the nodes, pistillate with several long and spreading rachillae; pistillate flowers more widely spaced at distinct intervals; margin of the leaf sheath green. *C. tepejilote*

Chamaedorea allenii L. H. Bailey, Gentes Herb. 6: 241, fig. 126, 1943.
Type: Panama, *P. H. Allen* 1909 (holotype, MO).

Stem solitary, erect or decumbent, to 2 m tall or more but sometimes flowering

when acaulescent or nearly so, 1.5-2 cm diam., green, smooth, conspicuously ringed, internodes 3-10 cm long. Leaves 4-6, spreading, pinnate but sometimes flowering when leaves simple and bifid or variably pinnate (Fig. 2); sheath 25 cm long, white-margined apically, light green inside



1. Portion of staminate inflorescence of *Chamaedorea allenii*, D. R. Hodel 769A, showing the densely packed flowers characteristic of all members of subgenus *Stephanostachys*. 2. A staminate plant of *Chamaedorea allenii*, D. R. Hodel 769A, cultivated in Los Angeles, California that was collected originally from the type locality near El Valle, Panama. Note staminate inflorescence and that some leaves are simple and bifid and others pinnate. 3. *Chamaedorea allenii*, D. R. Hodel 769B, showing spicate pistillate inflorescences. 4. Pistillate inflorescence of *Chamaedorea allenii* showing densely packed flowers. 5. Inflorescence of *Chamaedorea allenii* with fruits densely packed at the terminal end. 6. A simple-leaved form of *Chamaedorea allenii* at the type locality near El Valle, Panama.

of this and dark green beyond, splitting opposite the petiole and there long-open, very faintly longitudinally striate-nerved; petiole slender, 25–35 cm long, 5–7 mm thick, lightly grooved and green adaxially, rounded and with a light green band abax-

ially; rachis 30–45 cm long or more, green and obtusely angled adaxially, rounded and with a light green band abaxially extending onto the sheath; blade 60–70 cm long, firm textured, glossy; pinnae alternate or subopposite, 7–9 per side, equally spaced,

25–30 × 3–6 cm, narrowly lanceolate, slightly sigmoid or falcate, acute-acuminate to caudate and drooping at the tip, somewhat narrowed at the base, 8–10 nerved, these light-colored and pronounced abaxially, end pair confluent and wider, if the blade simple and bifid then to 50 × 30 cm, rachis to 30 cm long, lobes to 25 cm long, 50 prominent nerves on each side of the rachis.

Inflorescences interfoliar, erect, but often infrafoliar and horizontal in fruit, solitary, spicate or less often furcate. Staminate inflorescence with the peduncle 15–25 cm long, 5–8 mm wide at the base and there ± flattened, rounded and 5 mm diam. at the apex, pale or white, ascending or horizontal; bracts 4, light green at anthesis, tightly sheathing basally, ± inflated apically, thin-leathery, acute-acuminate, bifid, the uppermost exceeding the peduncle, prophyll 2 cm long, 2nd bract 7 cm long, 3rd 12 cm long, 4th 15 cm long; rachis or flower-bearing portion pendulous, flaccid, 10–20 × 1 cm. Pistillate inflorescence to 30 cm long, erect or horizontal (Fig. 3); peduncle 20 cm long, 8 mm wide at the base and there ± flattened, 6–8 mm diam. at the apex and there rounded, light green in flower, orange in mature fruit; bracts 4, similar to those of the staminate only becoming tattered and brown and ± fallen away in fruit, upper one about equalling the peduncle; rachis or flower-bearing portion to 10 × 1 cm, straight at anthesis, stiffish and curved, swollen and red-orange in fruit.

Staminate flowers contiguous in bud, densely spiralled in 8 rows (Fig. 1), 3.5 × 2.5 mm, bright yellow; calyx prominent, sepals united in a sheathing hyaline tube 2 mm high, whitish; corolla with the petals distinct, 3 × 2 mm, thickened, thicker distally, slightly grooved on the inside; stamens with the filaments thick, 1.5 × 0.5 mm, anthers in a close ring around the pistillode and about half the height of the petals, very small, 1 × 0.5 mm, latrorse; pistillode extending just above the anthers,

2 × 0.5 mm, swollen basally. Pistillate flowers (Fig. 4) spirally and densely arranged in 8 rows, contiguous in bud, immersed in shallow pits but so densely packed as to appear to be completely immersed in the rachis, bright yellow, 2.5 × 3.5 mm; calyx shallowly undulate, sepals forming a tight hyaline sheath around the base of the flower, 1.5 mm high; corolla with the petals distinct, broadly imbricate, hooded, 2.5 × 2.5 mm, margins rounded, apically acute; staminodes lacking; pistil 3-lobed, triangular, conical, 2 × 2 mm, fleshy, stigmas spreading or erect, prominent, sessile. Fruits black, densely packed (Fig. 5), globose but angled from mutual pressure, 7–10 mm diam., exocarp rough; seeds brown, globose but slightly angular, 5–7 mm diam.

Distribution: PANAMA. Coclé. Darién. Dense, wet forest on the Pacific slope, 500–1,000 m elevation. Endemic but, perhaps, also in Colombia.

Specimens Examined: PANAMA. Coclé: El Valle, *P. H. Allen* 1909 (holotype, MO); *J. Duke & B. Lallathin* 14970 (MO); *A. Gentry* 3633 (MO); *S. Mori & J. Kallunki* 2967 (MO); *D. R. & M. A. Hodel* 742 (BH, PMA). Darién: El Real, *J. Duke* 5042, 5078 (MO, BH); Río Tuquesa, *S. Mori* 6988 (MO). CULTIVATED. United States. California: Los Angeles, in greenhouse, *D. R. Hodel* 769A, 769B (BH), originally collected at the type locality, El Valle, Panama.

Chamaedorea allenii is an attractive, single-stemmed palm with a striking, bright yellow, spicate or furcate staminate inflorescence. Discovered by Paul Allen near El Valle, Coclé Province in Panama and described and named by Bailey (1943), it occurs predominantly in mountain forests at middle elevations on the Pacific slope usually at or near the Continental Divide. Bailey described *C. allenii* from a pistillate collection only; fruits and staminate flowers were not seen. We were successful in establishing plants in the greenhouse in Los Angeles from the type locality. These have

flowered and, fortunately, we have plants of both sexes and have successfully hand-pollinated them and set fruits.

Chamaedorea allenii seems to exhibit two vegetative phases. The first consists of simple, deeply bifid leaves (Fig. 6). Later, plants develop leaves that are pinnate. Flowering and fruiting is most closely associated with the pinnate-leaved phase. However, the two phases cannot be considered strictly juvenile and adult since flowering and fruiting have been observed on some plants with simple and bifid leaves.

Simple-leaved forms of *C. allenii* are similar vegetatively and in fruit to *C. deckeriana*. This latter species is found mainly on the Atlantic slopes from low to middle elevations. Their ranges do not seem to overlap greatly. *C. deckeriana* is clearly distinct in the leaf sheaths, green rather than yellow-margined, the green rather than yellow staminate flowers, the multiple rather than solitary staminate inflorescences at the nodes, and the fruit maturing smooth and red-orange rather than rough and black.

Galeano and Bernal (1987) report *C. deckeriana* from northwestern Colombia, but the accompanying description seems to refer to *C. allenii*. Chazdon (1989) reports *C. allenii* from Braulio Carrillo National Park on the Atlantic slope of Costa Rica but this is probably an unnamed, yet related, taxon.

Chamaedorea alternans H. A. Wendl.,
Regel Gartenfl. 29: 104, 1880. Type:
Cult., *Wendland s. n.* (GOET).

Nunnezharia alternans (H. A. Wendl.)
O. Kuntze, Rev. Gen. Plant. 2: 730,
1891.

Chamaedorea alternans is a handsome plant with large leaves and broad, dark green pinnae. It was first discovered in Chiapas, México, and introduced to European gardens in 1875 by J. Linden, the famous horticulturist of Ghent, Belgium

(Guillaumin, 1923). Wendland named the species from cultivated material growing at Herrenhausen near Hannover, Germany that he had obtained from Linden. An interesting feature of this species is the manner in which the inflorescences occur at the nodes, usually in multiples but occasionally alternating to solitary on the same individual, hence the specific epithet. *C. alternans* is endemic to México, occurring in wet forests in the states of Chiapas and Veracruz.

Chamaedorea arenbergiana H. A.
Wendl., Index Palm. 66, 1854. Type:
Cult., *Wendland s. n.* (GOET).

Spathoscapha arenbergiana (H. A.
Wendl.) Oerst., Vidensk. Meddel.
Kjoeb., 1858: 30, 1859.

Nunnezharia arenbergiana (H. A.
Wendl.) O. Kuntze, Rev. Gen. Plant. 2:
730, 1891.

Chamaedorea densiflora Hort.

Wendland (1854) described and named *C. arenbergiana* from plants cultivated in the gardens of the Duke d'Arenberg-Niepen in Belgium. It was discovered by Oersted, apparently in Guatemala, who introduced it to European gardens prior to 1850. Wendland was unsure of its provenance, but tentatively listed its origin as Guatemala. According to Guillaumin (1923), it was cultivated at the Musée de Paris in France as early as 1862 under the name *C. densiflora*.

Chamaedorea arenbergiana occurs in moist and wet forest from México through Guatemala, Honduras, El Salvador and, perhaps, Nicaragua. Some of the collections identified as *C. arenbergiana* which have extended its range to Costa Rica, Panama, and Colombia are probably *C. allenii*, *C. crucensis*, or closely related, yet unnamed, taxa.

Chamaedorea arenbergiana is very close to *C. casperiana* from which it differs mainly in its larger leaves and pinnae and

pistillate spadices being generally simple or furcate (Wendland 1854; Standley and Steyermark 1958). Also, photographs of the type specimens of *C. casperiana* (Dahlgren, pl. 99, 1959) show the staminate inflorescence to have an elongated rachis, more like that of *C. tepejilote*. Further study may prove *C. arenbergiana* to be conspecific with *C. casperiana*; if so, the latter name would have priority.

Chamaedorea casperiana Klotzsch in Otto & Dietr. Allg. Gartenzeit. 20: 363, 1852. Type: Cult., *Klotzsch s. n.* (HAN, destroyed).

Stephanostachys casperiana (Klotzsch) Oerst., Vidensk. Meddel. Kjoeb. 1858: 27, 1859.

Nunnezharia casperiana (Klotzsch) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

The only species of subgenus *Stephanostachys* apparently not presently in cultivation, *Chamaedorea casperiana* was named by Frederick Klotzsch (1852) from plants cultivated at the botanic gardens in Schonhausen near Berlin. These plants were grown from seeds collected by Warszewicz in Guatemala and sent to Europe in 1849. Its provenance is uncertain, however, since Guatemala then was a term rather loosely applied to areas from the present-day nation to as far south as Costa Rica. Standley and Steyermark (1958) noted that it has not appeared in recent collections from Guatemala. However, material from Costa Rica, *Moore 6689* and *6690* (BH) from near Moravia and Tuis, may be referable to *C. casperiana*, although it differs slightly from the description of the type in the fewer pinnae and yellow-green staminate flowers.

Material of *C. casperiana* distributed as such by Wendland and pictured by Dahlgren (1959, pl. 99) appears very similar to *C. tepejilote*. However, Standley and Steyermark (1958), citing Dahlgren's plate, note that the staminate calyx is con-

spicuously cupular in bud. This distinguishes it easily from *C. tepejilote* which has a low, annular calyx.

Chamaedorea cataractarum Mart., Hist. Nat. Palm. 3: 309, 1849. Type: México, *Liebmann 10808* (C).

Stachyophorbe cataractarum (Mart.) Liebm. ex Klotzsch, Allg. Gartenzeit. 20: 363, 1852; name only in Liebmann, 1846.

Chamaedorea martiana H. A. Wendl., Otto & Dietr. Allg. Gartenzeit. 21: 137, 1853. Type: Cult., *Wendland s. n.* (GOET).

Stephanostachys martiana (H. A. Wendl.) Oerst., Vidensk. Meddel. Kjoeb. 1858: 29, 1859.

Nunnezharia cataractarum (Mart.) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

Nunnezharia martiana (H. A. Wendl.) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

Vadia jotalana O. F. Cook, Nat. Hort. Mag. 26: 12, figs. 1-3, 5-8, 1947, name of no botanical standing.

Vadia atrovirens O. F. Cook, Nat. Hort. Mag. 26: 26, 1947, name of no botanical standing; not *C. atrovirens* Mart.

Fairly common in cultivation, *C. cataractarum* was introduced to Europe in the 1840s, probably by Frederick Liebmann who collected it during his travels in México along streams and cataracts near Joco-tepec in Oaxaca. Later, Martius (1849) formally described and named the species. A few years after Martius named *C. cataractarum*, Wendland (1853) described and named *C. martiana* from material introduced by Linden to European gardens from Chiapas, México. Wendland (1854) reported *C. martiana* growing in several gardens in Europe while Guillaumin (1923) stated that it had been growing at the Musée de Paris since 1850 from Linden's introduction.

I have examined Liebmann's type of *C. cataractarum* from Copenhagen (*Lieb-*

mann 10808) and seen photographs of Wendland's type of *C. martiana* from Göttingen. I see no significant differences and hold them to be the same.

In horticulture, *C. cataractarum* has been confused with *C. atrovirens*. In 19th-century Europe, this latter name was erroneously applied to material of *C. cataractarum* and, in many instances, this is still the case today in Florida, California, Hawaii, and Australia. On the other hand, some material grown as *C. cataractarum* is actually *C. oreophila*.

Chamaedorea cataractarum is unusual in its habitat and habit. One of the few rheophytes in the palm family, it inhabits the banks of rivers and streams of the Atlantic slope of México in the states of Oaxaca, Tabasco, and Chiapas, often occurring in the water and being wholly or partially submerged during heavy rains and floods. It was originally found near waterfalls and cataracts, hence the specific epithet. In Chiapas, I observed large clumps several meters across growing along the banks of streams or small rivers. These clumps, like giant bull rushes, tended to capture and trap debris during times of high water. The debris line on the clumps of the palms was an indication of how high the water rose.

Chamaedorea cataractarum is also unusual in its habit of dichotomous branching. With age, plants tend to creep along the ground with their horizontal stems branching in a dichotomous manner. Fisher (1974) provides a thorough and well illustrated account of this stem form. This dichotomous branching habit results in thick clumps with a sturdy network of thick, horizontal stems which grow along the ground, anchoring the clump securely. Along with flexible leaves and leaflets that tend to bend and sway with an opposing force, the creeping and securely anchored stem enables *C. cataractarum* to grow and survive in and along streams where it is occasionally inundated by swiftly moving water.

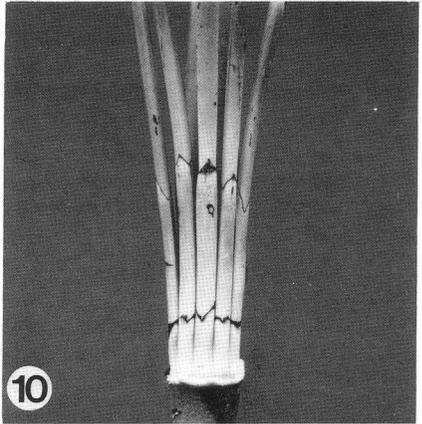
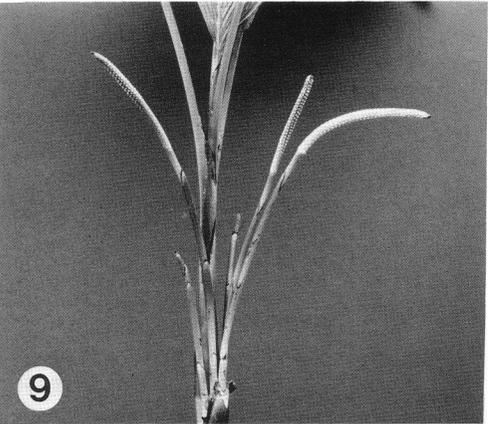
***Chamaedorea crucensis* D. R. Hodel
sp. nov.** (Fig. 7).

C. allenii affinis sed floribus masculinis albidis, antheris exsertis differt; *C. zamorae* affinis sed antheris exsertis, fructibus nigris, segmentis 9–11 utrinsecus differt. Typus: Costa Rica, D. R. & M. A. Hodel 706A (holotypus, BH; isotypus, CR).

Stem solitary, erect or rarely decumbent, 1–2 m tall, 1.8–2 cm diam., green, smooth, ringed, basally with prominent brown stilt roots to 10–15 cm high, internodes 4–8 cm long. Leaves 5, erect-spreading, pinnate; sheath to 30 cm long, obliquely open at the apex and split opposite the petiole, green but distinctly pale or yellow-margined, longitudinally striate-nerved; petiole to 50 cm long, slightly grooved adaxially toward the base, rounded and pale-banded abaxially; rachis to 80 cm long, green and angled adaxially, rounded and pale abaxially; pinnae 9–11 on each side of the rachis, shining green, subopposite, regularly arranged, lanceolate, to 35 × 6.5 cm, sigmoid, falcately long-acuminate, slightly drooping at the tip, slightly contracted at the base, 9 prominent and equidistant primary nerves adaxially, the apical pinnae slightly wider.

Inflorescences interfoliar but often infrafoliar in fruit, erect, long-pedunculate, spicate or sometimes the staminate furcate; peduncles to 30 cm long, pale at anthesis, orange in fruit; bracts 5–6, green, deciduous; staminate with the rachis or flower-bearing portion to 10–15 cm long, pendulous; pistillate with the rachis or flower-bearing portion to 10 cm long, straight and stiff at anthesis, curved, swollen and red-orange in fruit.

Flowers densely packed, contiguous in bud. Staminate flowers white; calyx prominent, sepals 3 × 1 mm, joined in a very low rim with narrow lobes to 2 mm long, lobes ± double along the truncate upper margins; corolla with the petals distinct, valvate, opening distally, 3.5 × 2.25 mm; stamens with the filaments 4 × 0.75 mm,



7. *Chamaedorea crucensis*, D. R. & M. A. Hodel 806A, the individual from which the type specimen was collected, grows in rain forest near San Vito, Costa Rica. Note the staminate inflorescence below the hand. 8. *Chamaedorea deckeriana*, D. R. & M. A. Hodel 718, grows in dense, wet rain forest along the Río Sarapiquí near San Miguel, Costa Rica. Note the simple, bifid leaves and infrutescence with densely packed fruits. 9–10. The spicate, staminate inflorescences of *C. deckeriana* are multiple at a node. Figure 10 shows the basal portions of the inflorescences with the leaf base removed from that node. Both photographs are of a plant cultivated in Los Angeles, D. R. Hodel 797, grown from seeds originally collected near the Río Sucío, Costa Rica.

curved distally, anthers 1×0.5 mm, borne at the tips of the filaments and exerted above the petals at anthesis, forming a stellate pattern on the surface of the flower; pistillode columnar, 2.5×0.5 mm, at a

lower level than the anthers. Pistillate flowers irregular, $2.5\text{--}3.5 \times 2.5$ mm, yellowish; calyx prominent, sepals forming a complete ringlike sheath around each flower, 1.5 mm high, no definite sepal tips

but very low notches between some sepals; corolla with the petals not open, imbricate, hooded, flat distally; staminodes lacking; pistil nearly globose, 2 mm diam. Fruits densely packed, angled by mutual pressure, 8–10 mm long, green when immature changing to red or orange near maturity and then black when completely ripe; seeds ellipsoid, 5–7 mm long.

Distribution: COSTA RICA. Puntarenas: dense, wet forest on the Pacific slope, 1,000 m elevation. Probably endemic.

Specimens Examined: COSTA RICA. Puntarenas: San Vito de Coto Brus, in forest remnants adjacent to Jardin Botanico Robert y Catherine Wilson, 1,000 m elev., *D. R. & M. A. Hodel 706A* (holotype, BH; isotype, CR); *706B* (BH, CR); *H. E. Moore, Jr. 9430, 9991* (BH); *H. E. Moore, Jr. & M. V. Parthasarathy 9444* (BH). CULTIVATED. United States. California: Huntington Beach, in the garden of Frank Ketchum, received as seedlings grown by R. Wilson from seeds collected at the type locality, *D. R. Hodel 776* (BH).

The epithet is taken from the type locality near the Jardin Botanico Robert y Catherine Wilson (JBRCW), formerly well known to botanists and horticulturists as Las Cruces Tropical Botanical Garden. *C. crucensis* occurs in forest remnants adjacent to JBRCW near San Vito, Puntarenas in southeastern Costa Rica (Fig. 7). Wilson established the species in his garden and over the years distributed seeds and seedlings to palm collectors and hobbyists.

Chamaedorea crucensis is similar to *C. allenii* but can be distinguished by the white staminate flowers with the stamens (anthers) protruding beyond the corolla at anthesis. It can be distinguished from *C. zamorae* in the anthers protruding beyond the corolla at anthesis, black fruit, and 9–11 pinnae on each side of the rachis with the end pair not as broad as the others combined.

Apparently not widely distributed, *C. crucensis* has been collected with certainty

only at or near the type locality. It is unfortunate that numerous, similar collections from the Pacific slope of Costa Rica are pistillate specimens since staminate material is better for diagnosing this species and related taxa. Future collections of staminate material may result in a broadening of the range of *C. crucensis*.

Chamaedorea deckeriana (Klotzsch) Hemsl. in Godman & Salvin, Biol. Centr. Amer., Bot. 3: 404, 1885.

Stachyophorbe deckeriana Klotzsch, Otto. & Dietr. Allg. Gartenzeit. 20: 364, 1852. Type: Cult., *Klotzsch s. n.* (HAN, destroyed).

Dasystachys deckeriana (Klotzsch) Oerst., Vidensk. Meddel. Kjoeb. 1858: 25, 1859.

Nunnezharia deckeriana (Klotzsch) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

Stem solitary, 0.3–2 m tall, erect but sometimes procumbent for a short distance, green, smooth, conspicuously ringed, internodes 2–5 cm long. Leaves 4–5, simple and bifid (Fig. 8), 90–125 cm long; sheath 15–25 cm long with an oblique and \pm elongated opening, only about the lower $\frac{2}{3}$ tightly clasping the stem in a circular manner; petiole 15–25 cm long, green and flattened adaxially with the lower margins of the leaf faintly visible as they extend on either side to the sheath, rounded and pale abaxially; rachis 20–35 cm long, angled adaxially, rounded and pale abaxially; blade thin, 50–70 \times 25–35 cm, obovate in outline, cuneate at the base, deeply incised at the apex, lobes broadly lanceolate, 25–35 \times 15–20 cm, outer margins coarsely serrate, primary nerves 20 on each side of the rachis.

Inflorescences interfoliar, emerging from behind the leaf bases although sometimes infrafoliar in fruit, spicate, erect although pendulous when heavily laden with fruits. Staminate inflorescences 4–10 per node (Figs. 9, 10), the middle one developing and opening first; peduncle 20–25 \times 0.5–1

cm, rounded, green in flower; bracts 4-5, green when young becoming brownish with age, longitudinally striate-nerved, \pm loosely sheathing, becoming progressively larger distally, slightly inflated, the terminal one equalling or exceeding the peduncle, acute-acuminate, bifid, slightly flattened, prophyll 3 cm long, 2nd bract 8 cm long, 3rd 15 cm long, 4th 15-20 cm long; rachis or flower-bearing portion 10 cm long. Pistillate inflorescence solitary at the nodes (Fig. 13); peduncle to 30 cm long, erect and then arching downward in fruit, greenish in flower, flattened and orange in fruit, 1 cm wide at the base, 1-1.5 cm wide at the apex; bracts 5, green in flower, fibrous and tattered in fruit, longitudinally striate-nerved, acute-acuminate, bifid, prophyll 3 cm long, 2nd bract 8-10 cm long, 3rd, the longest, to 18 cm long, bifid, 4th 13 cm long, uppermost very short and \pm rudimentary; rachis or flower-bearing portion to 15 cm long, green and erect in flower, \pm flattened, 1 cm wide, 5 mm diam., swollen and orange in fruit, hanging downward, 2 cm diam.

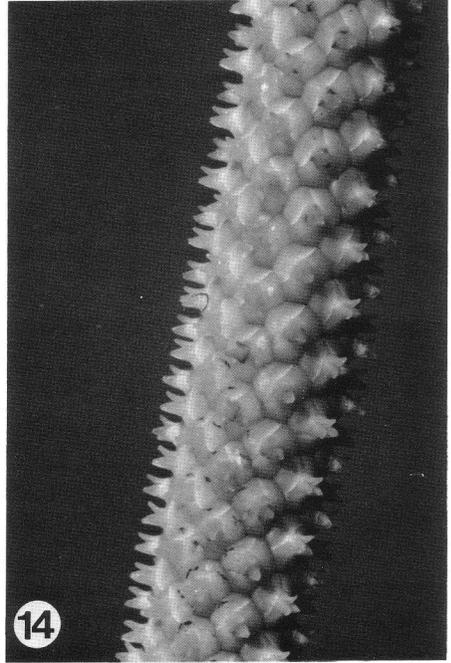
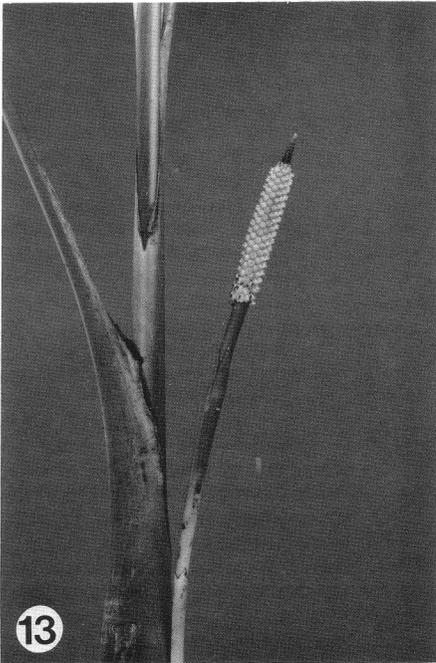
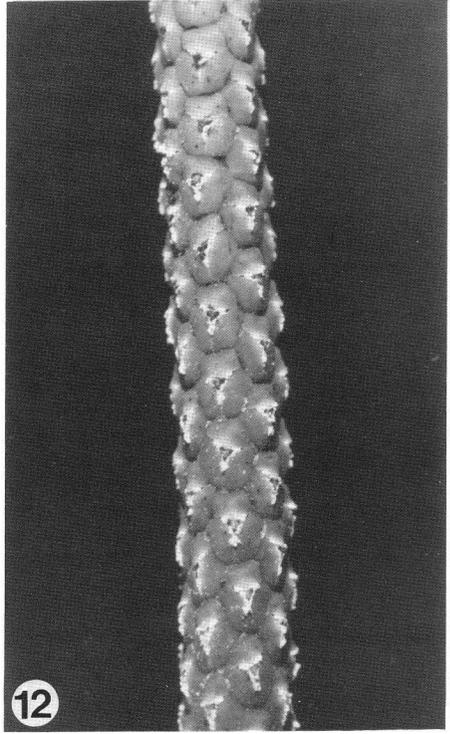
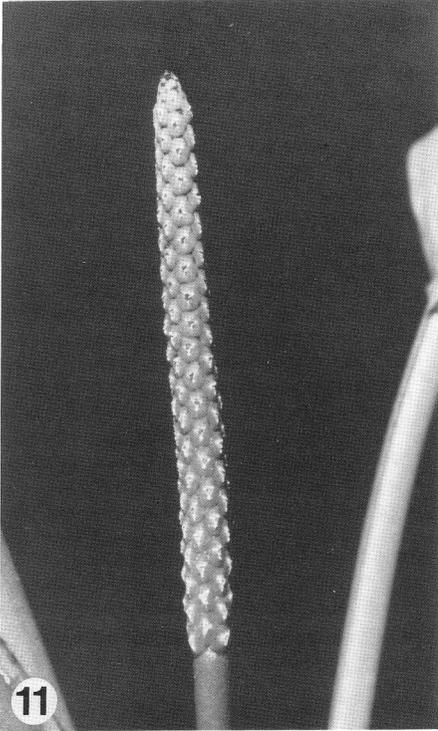
Staminate flowers immersed in the axis and borne in 6-10 very densely appressed rows (Figs. 11, 12), contiguous, green, 1.5-2 \times 2.5-3 mm, emitting a distinct spicyanise odor at anthesis; calyx prominent, sepals joined basally to form a very shallow thin ringlike cupule with 3 erect apically rounded lobes 1 \times 0.5-0.75 mm, membranous; corolla with the petals irregularly 6-angled apparently from mutual pressure of close packing, distinct, valvate, thick-fleshy, green, varying in width from 1-2 mm, usually 2 wider and 1 narrower per flower, erect for 1.5 mm then abruptly inflexed and tapering to flat pointed tips, the tips of adjacent petals closely appressed in bud, opening as slits through which the anthers are exerted at anthesis; stamens with the filaments flattened, short, 1 \times 0.75 mm, fleshy, tapering abruptly at the tip, anthers very short, 0.75 \times 0.3 mm, latrorse, dorsifixed, \pm versatile at anthesis, exerted from between petal slits on the

distal flat top of the flower; pistillode columnar, fleshy, 3-lobed, the rounded tip exposed in the center of the flower at anthesis. Pistillate flowers densely packed in 10-12 rows of up to 30 flowers per row (Fig. 14), contiguous, slightly immersed in the rachis, 3 \times 3 mm, greenish changing to greenish-yellow, angled by close packing as those of the staminate; calyx with the sepals connate in a cupule 1 mm high; corolla with the petals distinct, imbricate, subreniform, 2 \times 2.5 mm, tips inflexed to 1 mm, the distal margins rounded to truncate; pistil ovoid, 3 \times 2.5 mm, \pm 3-sided, stigmas separate, exerted well beyond the corolla, 1 mm long, open, erect and only very slightly if at all reflexed, light yellow; ovules 3, laterally attached.

Fruits green when immature becoming red-orange when soft ripe (Fig. 15) and finally aging blackish, contiguous, densely packed, flattened and/or angled by mutual pressure, \pm obovoid-globose and stalked in appearance, 1-1.5 \times 0.5-1 cm, exocarp smooth, mesocarp fleshy, endocarp thin; seeds obovoid, 10 \times 7 mm, endosperm homogeneous; embryo lateral; abortive carpels basal; perianth persistent, sepals 1 mm long, petals 2 mm long.

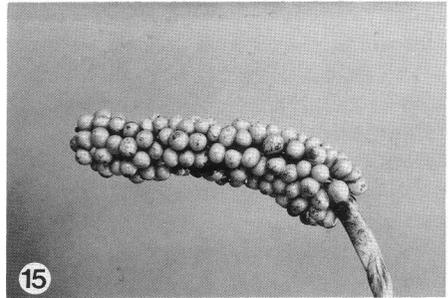
Distribution: COSTA RICA. Alajuela. Cartago. Limón. PANAMA. Bocas del Toro (Fig. 16). Colón. Panama. Dense, wet forest on the Atlantic slope, 0-900 m elevation.

Specimens Examined: COSTA RICA. Cartago: Moravia, *H. E. Moore Jr.* 6688 (BH); Pavones, *H. E. Moore Jr.* 6741 (BH). Alajuela: San Miguel, Río Sarapiquí, *D. R. & M. A. Hodel* 717 (BH, CR), 718 (BH); Río Peje, *G. de Nevers & B. Hammel* 7811 (MO); *G. de Nevers* 7809 (MO); San Ramón, *G. de Nevers et al.* 7804 (MO). Limón: Quebrada El Molinete, *M. Grayum & B. Jacobs* 3537 (MO). PANAMA. Colon: Río Guanache, *T. Croat* 26178 (MO); *S. Mori & J. Kallunki* 3017 (MO); *S. Knapp* 1420 (MO); Santa Rita Ridge, *G. de Nevers* 6877 (MO). Panama: headwaters of the Río Chagres, Río Esperanza,



and Río Piedras, *G. de Nevers* 4062 (MO). Bocas del Toro: Chiriquí Grande, *D. R. & R. J. Hodel* 660 (live plant taken to Los Angeles, California). CULTIVATED. Costa Rica: San Vito de Coto Brus, Jardín Botánico Robert y Catherine Wilson, *D. R. Hodel* 618A, 618B (BH), originally collected near Moravia, Cartago, Costa Rica. United States. California: Los Angeles, in greenhouse, *D. R. Hodel* 780, 797 (BH), grown from seeds originally collected by J. Folsom along the Río Sucío, Costa Rica. Germany. Hannover: Herrenhausen, plant grown by H. Wendland, probably from Warscewicz's original introduction (photo in Dahlgren, pl. 178, 1959).

With large, simple and bifid leaves and spicate inflorescences heavily laden with densely packed, bright red-orange fruits, *Chamaedorea deckeriana* is a spectacular plant. It was reportedly found in Guatemala by Warscewicz who sent seeds of it to Europe in 1849. Klotzsch described and named it from cultivated plants grown from these seeds. It is doubtful if its origin is Guatemala, though, since it has never been recollected there (Standley and Steyermark 1958) and has apparently never been recorded north of Costa Rica. In the 19th Century, the term Guatemala was rather loosely applied to the area from that present-day state south to Costa Rica. Furthermore, Hermann Wendland found it in the valley of the Río Sarapiquí in Costa Rica (Dammer 1904) where it still occurs today. Although a type has not been located, Klotzsch's original description (1852), especially as it pertains to the green flowers, is adequate for diagnostic purposes. Other than Klotzsch's description, the only other clue to its habit is Dahlgren's photo (pl. 178, 1959) of a specimen grown



15. Inflorescence of *Chamaedorea deckeriana* heavily laden with densely packed, mature fruits, *D. R. Hodel* 780. 16. *Chamaedorea deckeriana*, *D. R. Hodel* 660, in dense, wet rain forest near Chiriquí Grande, Bocas del Toro, Panama.

at Herrenhausen by Wendland probably from Warscewicz's original introduction.

We have successfully established plants of *C. deckeriana* in the greenhouse in Los Angeles. These were grown from seeds collected along the Río Sucío on the Atlantic slope of Costa Rica and agree well with Klotzsch's description and photographs of Wendland's cultivated material. Fortunately, we have plants of both sexes and have successfully hand-pollinated them and set fruits. At anthesis, flowers of both sexes emit a fragrance best described as spicy-anise. Filling the entire greenhouse with its distinctive odor, it conjures up images of a deep, dark, primeval rain forest, just

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11-12. Staminate inflorescence of *Chamaedorea deckeriana* showing densely packed flowers. 13. The spicate, pistillate inflorescences of *Chamaedorea deckeriana* is solitary at a node, *D. R. Hodel* 780. Cultivated but grown from seeds originally collected along the Río Sucío, Costa Rica. 14. Portion of pistillate inflorescence of *Chamaedorea deckeriana* with crowded flowers.

the sort of habitat in which one finds *C. deckeriana*.

Chamaedorea oreophila Mart., Hist. Nat. Palm 3: 309, 1849. Type: México, *Liebmann 10810* (C).

Stachyophorbe montana Liebm. ex Oerst., Vidensk. Meddel. Kjoeb. 1858: 10, 1859; name only in Liebmann, 1846; not *C. montana* Mart.

Nunnezharia oreophila (Mart.) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

Chamaedorea monostachys Burret, Notizbl. Bot. Gart. Berlin 11: 761, 1933. Type: México, *Seler 5183* (B, destroyed).

Stachyophorbe oreophila (Mart.) O. F. Cook, Nat. Hort. Mag. 22: 146, 1943.

Stachyophorbe filipes O. F. Cook, Nat. Hort. Mag. 22: 145, fig. 15, 1943, name of no botanical standing.

Chamaedorea oreophila was described and named by Martius from material collected by Liebmann in the 1840s in Oaxaca, México. Liebmann (1846) had suggested the name *Stachyophorbe montana* for the material he had collected. However, Martius (1849) felt that *Stachyophorbe* was simply the same as *Chamaedorea* and, accordingly, used this latter name. Martius was precluded from using the epithet *montana* since in the same paper he had already used it for another Liebmann collection from Oaxaca, México. Martius did, though, respect Liebmann's intent for the epithet *montana* since he replaced it with *oreophila*, derived from a Greek word meaning mountain-loving. Oersted (1859) continued to maintain *Stachyophorbe* separate from *Chamaedorea*.

Later, Burret (1933) named *Chamaedorea monostachys*, based on collections in Veracruz, México by Seler and Galeotti. Burret admitted that he was not confident of the differences between it and *C. oreophila*, especially since he had not seen

staminate material of the latter. The two species have been separated mainly on slight differences in the shape of leaflets and the number of staminate inflorescences per node, both variable characters. I have examined Liebman's type of *C. oreophila* from Copenhagen (*Liebman 10810*). Unfortunately, Burret's type of *C. monostachys* was destroyed during the Second World War but, based on his description and analysis, I can find no important differences. Some material of *C. oreophila* in cultivation is erroneously referred to as *Chamaedorea cataractarum* or, more infrequently, *C. atrovirens*.

Chamaedorea tepejilote Liebm. ex Mart., Hist. Nat. Palm. 3: 308, 1849; name only in Liebman, 1846. Type: México, *Liebmann s. n.* (C).

Stephanostachys tepejilote (Liebm. ex Mart.) Oerst., Vidensk. Meddel. Kjoeb. 1858: 28, 1859.

Stephanostachys wendlandiana Oerst., Vidensk. Meddel. Kjoeb. 1858: 28, 1859. Type: Cult., *Wendland s. n.* (C).

Chamaedorea wendlandiana (Oerst.) Hemsl. in Godman & Salvin, Biol. Cent. Amer. Bot. 3: 407, 1885.

Nunnezharia tepejilote (Liebm.) O. Kuntze, Rev. Gen. Plant. 2: 731, 1891.

Nunnezharia wendlandiana (Oerst.) O. Kuntze, Rev. Gen. Plant. 2: 730, 1891.

Chamaedorea exorrhiza H. A. Wendl. ex Guillaum., Bull. Mus. Hist. Nat. Paris 28: 542, 1922. Type: Cult., *Wendland s. n.* (P).

Chamaedorea anomospadix Burret, Notizbl. Bot. Gart. Berlin 11: 763, 1933. Type: Guatemala, *Tuerckheim 4042* (B, destroyed).

Chamaedorea sphaerocarpa Burret, Notizbl. Bot. Gart. Berlin 11: 762, 1933. Type: Nicaragua, *Preuss 1365* (B, destroyed).

Chamaedorea columbica Burret, Notizbl.

Bot. Gart. Berlin 12: 42, 1934. Type: Colombia, *Dryander 13* (B, destroyed). *Edanthe veraepacis* O. F. Cook & C. B. Doyle, Nat. Hort. Mag. 18: 174, figs. 1-9, 1939, name of no botanical standing.

Discovered by Liebmann at Matlaluca, Veracruz, México and described and named by Martius (1849), *Chamaedorea tepejilote* is widely cultivated today, appearing in gardens and collections in California, Hawaii, Florida, Australia, Europe, and elsewhere. In Europe, it has been cultivated since prior to the middle of the 19th Century where it was introduced by several collectors including Liebmann, Linden, and Oersted.

Chamaedorea tepejilote is an extremely variable species throughout its very wide range. The most widely distributed species of *Chamaedorea*, it occurs in moist or wet forests on a variety of substrates from México to northern Colombia. Separate taxa have been proposed based principally on size, number of parts, and nervature of pinnae. According to Standley and Steyermark (1958), it is difficult to find constant distinguishing features and, essentially, differences are of size, not of character. They placed *Chamaedorea wendlandiana* and *C. anomospadix* in synonymy with *C. tepejilote*. I have examined Liebmann's type of *C. tepejilote* from Copenhagen and the type of *C. exorrhiza* from Paris. I can see no outstanding differences and thus hold these to be the same. Unfortunately, the types of Burret's *C. sphaerocarpa* and *C. columbica* were destroyed at Berlin. However, from Burret's descriptions and discussions, these do not appear to be significantly different from *C. tepejilote*.

***Chamaedorea zamorae* D. R. Hodel sp. nov.** (Figs. 17-21).

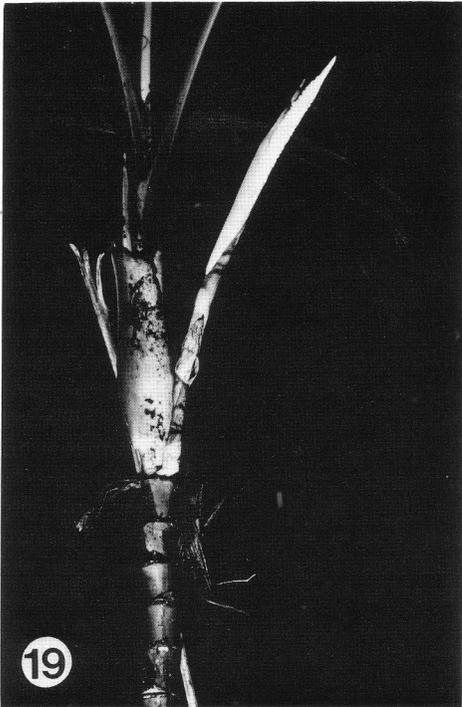
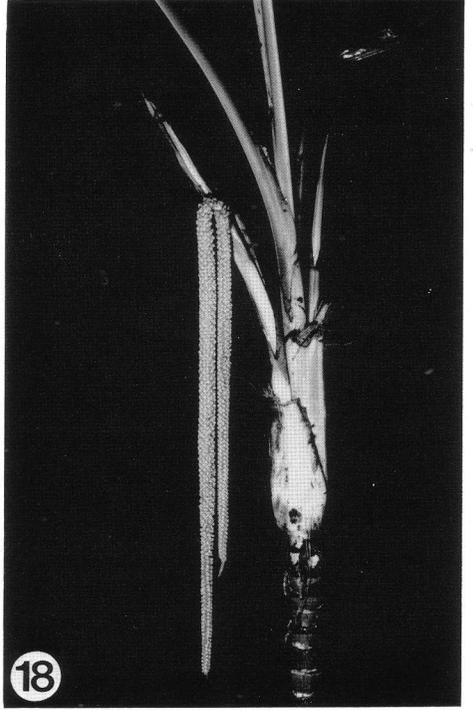
C. crucense et *C. allenii* affinis sed fructibus rubris, segmentis 1-6 utrinsecus,

apicalibus quam ceteris segmentis combinatus latioribus differt; a *C. crucense* antheris non exsertis differt; a *C. allenii* floribus masculinis albidis differt. Typus: Cult., D. R. Hodel & H. Bornhorst 830 (holotype, BH).

Stem solitary, erect, 2-3 m tall although flowering when acaulescent or nearly so, 2-2.5 cm diam., green, ringed, internodes 3-8 cm long (Fig. 17). Leaves 3-5, erect-spreading, pinnate or simple and bifid, shining green; sheath 15-20 cm long, obliquely open at the apex and there light green or nearly white and lightly striate-nerved; petiole 10-50 cm long, green and grooved adaxially, rounded abaxially with a pale band extending from the rachis onto the sheath; the rachis 40-60 cm long, green and angled adaxially, rounded and pale-banded abaxially; pinnae 3-6 on each side of the rachis, opposite or subopposite, all except the apical pair long-lanceolate, 20-30 × 2-3 cm, weakly sigmoid, falcately long-acuminate and drooping slightly at the tips, slightly contracted at the base, a midrib and 4-5 prominent nerves on each side of this adaxially, the apical pair of pinnae very broad, as broad or broader than the others combined, 12-18 cm wide and with more nerves, exterior margin coarsely toothed toward the apex.

Inflorescences interfoliar but often infrafoliar in fruit, erect; peduncles 15-30 cm long, erect or sometimes curved when laden with fruits, pale or greenish in flower, red-orange in fruit; bracts 5-6, green, thin-papery, turning brown in fruit, the uppermost opening long-oblique at the apex and exceeding the peduncle; staminate inflorescence furcate (Fig. 18) with a very short rachis 1-2 cm long or perhaps spicate, rachillae (or rachis if spicate) pendulous, 20-30 cm long, 1 cm wide with flowers at anthesis; Pistillate inflorescence spicate (Fig. 19); rachis or flower-bearing portion 10-15 cm long, stiff and erect in bud and in flower, becoming downward-pointing and curved in fruit.

Staminate flowers densely packed and



contiguous in 8 rows, brownish-white; calyx prominent, sepals joined shortly at the base, \pm rectangular, 2×1.5 mm, the tips broad, nearly truncate, rounded, thickened below across the tip, about one-half the height of the petals; corolla with the petals valvate, 4×2 mm, \pm fleshy, thickened along the margins; stamens with filaments 2.5 mm long, longer than the pistillode, terete, anthers 1×0.5 mm, medifixed and \pm versatile, at least at right angles to the filament, just inside the open petals and not protruding; pistillode columnar, 1.5×0.5 mm, the tips slightly expanded and with 3 rounded lobes, one-half as high as the stamens. Pistillate flowers densely packed and contiguous in irregular rows, 3.5×2.5 – 3.5 mm, yellow at anthesis; calyx prominent, sepals joined in a hyaline cupule, 2 mm high, the tips widely truncate, 2×0.5 mm, thicker than the cupule; corolla with the petals distinct, broadly imbricate, hooded with a short tip in the center of the "hood," 3×2.5 mm; staminodes lacking; pistil subglobose, 2.5×2.25 mm, stigmas closed but \pm triangular. Fruits green, maturing red and perhaps aging black, densely packed (Fig. 21), contiguous, angled by mutual pressure, conical-globose, 10 – 15×10 – 12 mm.

Distribution: COSTA RICA. Guanacaste. Alajuela. Dense, wet forest on the Atlantic slope, 800 m elevation or, perhaps, higher. Probably endemic.

Specimens Examined: COSTA RICA. Alajuela: near San Miguel along the Río Sarapiquí, *D. R. & M. A. Hodel 719* (BH, CR) (Fig. 20). CULTIVATED. United States. Hawaii: Honolulu, Wahiawa Botanic Garden of the Honolulu Botanic Gardens, *HBG 66.915*, grown from seeds collected in 1966 near Laguna de Arenal, Guana-



21. Infructescence of *Chamaedorea zamorae* showing densely packed fruits.

caste, Costa Rica, *D. R. Hodel & H. Bornhorst 830* (holotype, BH); *D. R. Hodel & H. Bornhorst 830B* (BH).

The epithet honors Costa Rican botanist Nelson Zamora, collector of exemplary specimens of many kinds of plants from his country.

The type of *C. zamorae* is from cultivated plants grown at Wahiawa Botanic Garden of the Honolulu Botanic Gardens in Hawaii. They were grown from seeds collected in 1966 by Harold Koopowitz near Laguna de Arenal in Costa Rica. By 1974 and up until at least 1978, they were fruiting with simple, bifid leaves and were nearly acaulescent. In 1987, they were flowering and fruiting, had erect stems about 2 m tall, and, for the most part, had leaves with 3–5 narrow basal pinnae on each side of the rachis and a pair of very broadly lobed apical pinnae.

Chamaedorea zamorae is similar to *C. crucensis* and *C. allenii*. In fruit, it may be difficult to distinguish between *C. deckeriana* and simple-leaved forms of *C. zamorae* and *C. allenii*. Some differences between these four species are summarized in the table below.

←

17. The type specimen of *Chamaedorea zamorae*, *D. R. Hodel & H. Bornhorst 830*, was taken from the plant on the right cultivated in Hawaii. 18. Furcate staminate inflorescence of *Chamaedorea zamorae*. 19. Spicate pistillate inflorescence of *Chamaedorea zamorae*. 20. *Chamaedorea zamorae*, *D. R. & M. A. Hodel 719*, in dense, wet forest along the Río Sarapiquí near San Miguel, Costa Rica.

	<i>Chamaedorea zamorae</i>	<i>Chamaedorea allenii</i>	<i>Chamaedorea crucensis</i>	<i>Chamaedorea deckeriana</i>
pinnae/side	1-6; rarely simple, bifid	7-9; rarely simple, bifid	9-11	simple, bifid
sheath margin	whitish	whitish	whitish	green
inflor.	solitary	solitary	solitary	multiple
flowers	white	yellow	white	green
fruit	red > black	black	red > black	red > black

Acknowledgments

I am grateful to several individuals and institutions in assisting me with this study. Natalie W. Uhl assisted in developing floral descriptions of several of the taxa included in this paper. Richard W. Palmer, Pauleen Sullivan, Bill Gunther, and the International Palm Society and its Seed Bank encouraged and supported my work in *Chamaedorea*. Michael H. Grayum and Gregory de Nevers offered valuable suggestions and ideas. Paul Weissich and Heidi Bornhorst of Honolulu Botanic Gardens in Hawaii facilitated my work at that institution. In Costa Rica, the Organization for Tropical Studies and Luis Diego Gomez at JBRCW at San Vito helped make my work there pleasant and rewarding. Frank Ketchum of Huntington Beach, California permitted me to collect material in his garden. The keepers of the herbaria at Copenhagen, Missouri Botanical Garden, and Paris lent material. All deserve my sincere thanks.

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Arizona's Own Palm: *Washingtonia filifera*

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The "California" fan palm is Arizona's most spectacular native landscape plant. The Saguaro cactus is more unusual, but palms give an atmosphere to a street unmatched by any other plant. This palm is also known as the Desert palm, California Washington palm, California palm and Petticoat palm.

Fallacies are more abundant than facts in regard to this palm, *Washingtonia filifera* H. A. Wendl. There are four principal fallacies held. The first is that there are no native palms in Arizona. The second is that there is only one native locality, that in the Kofa Mountains. A third is that these differ from their brethren in California in being self-pruning. Lastly, that their scientific name was given to plants grown from seed collected in California, not Arizona.

The first fallacy was disproven in 1923, but many citizens are not yet aware of this. On December 5, 1923, the Morning Sun paper of Yuma headlined: "Find New Species Palm Yuma County" and "Botanist from Washington Establishes Existence of Genuine Palms at Quartzsite" (Anon. 1923). These were discovered on October 24 of that year after reports of their existence had been current for some time. Mr. O. F. Cook, a USDA botanist, proposed naming them *Washingtonia arizonica* because he felt they differed from the trees west of the Colorado River. This has not been accepted by the systematic botanists who decide such things.

These palms are still thriving in what is now called Palm Canyon. This is 18 miles south of Quartzsite on U.S. Route 95, then some eight miles east over a graded but

rocky road to the entrance of the canyon into the Kofa Mountains. After a walk upward and inward through the deep canyon, palms may be seen growing on the floor of very steep sided canyons, with very occasional ones perched hundreds of feet up on the sides where precarious footholds exist. Yuccas may easily be mistaken for palms at a distance.

The second fallacy was not disproven until 1976. In that year, Brown et al. (1976) published their discovery of native palms in a different locality. This is along Castle Creek in Yavapai County, over one hundred miles from Palm Canyon. Here, three separate groupings are found. Each of these is supplied water by springs or seeps. These palms are reseeding and maintaining themselves.

The third fallacy has to do with the reported self-pruning habit of the trees in Palm Canyon. This is described in "Arizona Flora" (Kearney et al. 1973), our most reputable reference, as: "The self pruning habit of these palms as they grow in Arizona may warrant recognition as a variety, but apparently there are no other differences from the California phase of the species."

Even the United States Government, which generally errs only in its economic predictions, agrees that these are self-pruning palms. It states this in a leaflet distributed at the Kofa National Wildlife Refuge, in which Palm Canyon lies. Specifically this states: "The west end of the Kofa Mountains is well known as the location of Palm Canyon, where native palms grow in a spectacular canyon setting. These palms differ from the California desert spe-



1. Palms with dead fronds at Castle Creek.

cies in that the dead fronds are dropped to leave the trunks naked, whereas those in California retain the dead fronds which entirely conceal the trunk" (Anon. 1982).

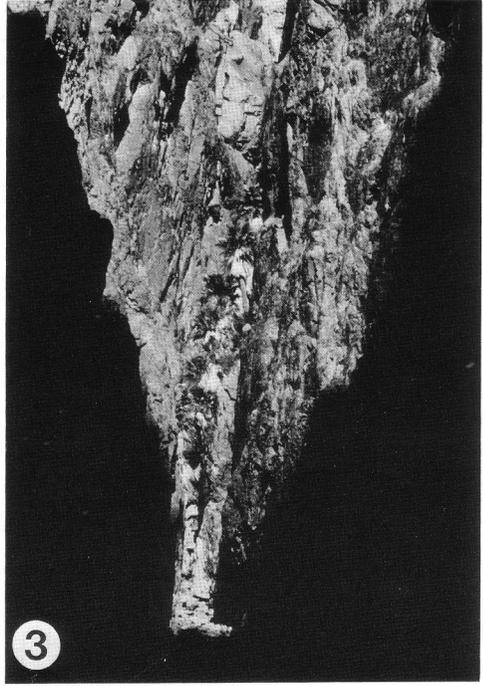
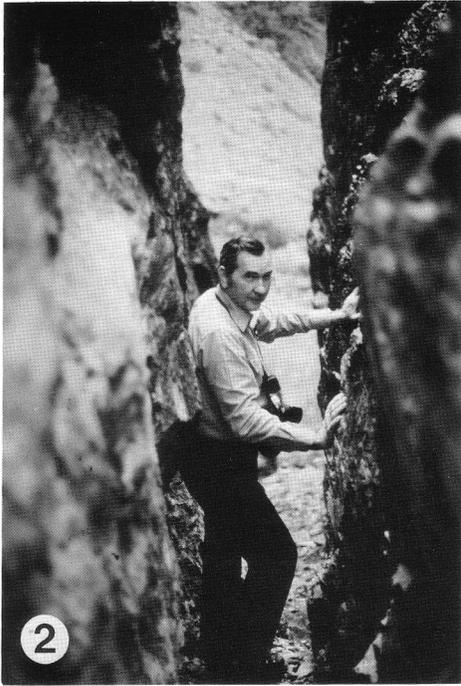
It is rather disconcerting to read this, then to hike into the canyon and find trees with their skirts completely to the ground. It is true that many have short skirts. They have been burned in past years. Where they haven't burned, however, the dead fronds hang on as petticoats just as they do on all of our cultivated California fan palms which aren't trimmed or burned.

This burning, incidentally, was practiced on native palms in California. S. B. Parish (1907) describes this as: "The dead leaves are usually kept cut away from cultivated trees, while it is almost impossible to find mature indigenous palms from which the leaves have not been repeatedly burned. So to burn them was the immemorial custom of the desert Indians, and it has been erroneously alleged that in this they were

influenced by a superstitious motive—the making of an offering by fire to the spirits of the dead. In fact, their purpose was purely utilitarian, namely, to facilitate the gathering of the fruit, and, as they believed, to increase the fruitfulness of the trees."

The groves on Castle Creek also hold their dead leaves without dropping them. Brown et al. (1976) described how, on these: "The 'shag' of dead leaves was recently burned on most of the trees by the land owner to dispel yellow jackets." A visit to these in December of 1982 revealed another long skirt of dead fronds hanging on the trees.

The fourth and last fallacy has to do with the origin of the plants which were officially named *Washingtonia filifera*. It is normally assumed that these came from California. A thesis advanced here is that the plants were named by a German botanist (Wendland 1879) from plants growing in a nursery in Belgium. The seeds



2. The author in the entrance slit to Palm Canyon. 3. A row of palms straggle up an arroyo at Palm Canyon.

from which these were grown were collected in Arizona (Drude 1876), and the approximate latitude and longitude of the collection site were published by an Italian (Fenzi 1876). This must have been the grove of palms on Castle Creek.

Proof of this is a bit fragmentary and speculative. S. B. Parish (1907), previously referred to, wrote the first definitive work on the genus *Washingtonia* in America. He summarized a great deal of literature. Drude (1876) describes how the palm seed was collected by B. Roehl "in Nord-Mexico, bei Arizona, am Rio Colorado." We thus have the seeds coming from Arizona.

The Italian E. O. Fenzi (1876) described the location of the seed source as: "Arizona (Stati Uniti), dove cresce spontanea sulle rive del Colorado, a circa 115° de longitude ouest del meridian de Parigi, e circa de 35° latitudine nord."

Checking that longitude will reveal that

the location is in California. Since this was before the Washington Meridian Conference of 1884 which established the Greenwich Meridian as the standard, we have measured from the Capital of France, Paris. Subtracting that distance east of Greenwich, we have 112°40' west of Greenwich.

Parish, a California botanist, states that this longitude: "would locate the parent trees in the neighborhood of Prescott, Arizona, a region rather of pines than of palms. Definite as are these statements, it is impossible that Roehl could have seen a *Washingtonia* growing spontaneously or collected its seed. The seeds which he carried to Europe he could have received from another, probably in San Francisco." He adds that Roehl was in Denver, and: "made a trip, of a fortnight's duration, into northern New Mexico."

We find now that, unknown to Parish, there was a grove of palms only 38 miles from Prescott. A Wickenburg stage line

went up Castle Creek just where these palms are located. Wickenburg was the transportation hub of central Arizona.

Col. Hodges (1877) described his travels to Arizona during the early 1870's. His veracity was attested to by A. P. K. Safford, Governor of the Territory, and 40 other officials. He wrote: "The California and Arizona Stage Line is the other great stage line of Arizona. The line now connects with the Southern Pacific Railroad at Indian Wells, runs thence to Ehrenburg on the Colorado River, thence to Wickenburg, from whence the main line runs to Prescott and the intermediate stations, and a branch line to Phoenix and Florence." "A weekly stage line runs from Prescott via the Chiquita Colorado and Camp Wingate to Santa Fe in New Mexico."

We find, then, that stages were passing our Castle Creek palms. At least at one time this was the Wickenburg, Vulture and Phoenix Line. Trees would have had ripe fruits in September, the time when Roezl was in New Mexico, very possibly in Santa Fe. A traveller going to Santa Fe might well have taken some attractive purple fruits along.

Transportation, then, existed at that time to move the fruits from an area which now seems extremely isolated. Even if Roezl didn't enter Arizona, he could have obtained the fruits and seeds.

The approximate latitude and longitude are interesting. They were an approximation as indicated by the "circa" description. Yet, the Castle Creek groves are at 112°22'10" longitude, just 17 miles from the estimated 112°40' we calculated from Paris. The latitude is a bit high, being nearer Perkinsville than Prescott.

When a palm grove exists where one was described geographically, and when a stage line passed it by in 1872, and when the seeds reportedly came from Arizona, should not we claim the *Washingtonia filifera* for Arizona? Had Parish known of

the native grove then, which we only learned of in 1976, he would have gracefully conceded the honor.

We owe a debt to him for his thoroughness. We also owe one as Americans to Hermann Von Wendland (1879). He decided the genera *Brahea* and *Pritchardia* in which various workers put this palm were incorrect. As he wrote himself: "Ich schlage für diese bisher als *Brahea* oder *Pritchardia filifera* bezeichnete Pflanze den Gattungsnamen *Washingtonia*, als Erinnerung an den grossen Amerikaner. Vor. Herrenhausen, 15. Dec. 1878." Loosely translated, he struck the previous names and designated the name *Washingtonia* in memory of the great American.

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Note: Reprinted from *Desert Plants* 5(3), 1983.

Flower Biology and Pollinators of the Amazonian Monoecious Palm, *Geonoma macrostachys*: A Case of Bakerian Mimicry

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ABSTRACT

The protandrous understory palm, *Geonoma macrostachys* Mart., has staminate and pistillate phases of at least 4 and 3 days duration, respectively. The staminate flower offers pollen and possibly euglossine active compounds to visitors, while the pistillate probably does not present food rewards. The pistillate flower resembles the staminate in size, color, and scent; it has a staminodial tube, and is pollinated by imitation of the staminate and/or by provision of sites for mating and egg-laying. The inflorescence is visited by 22 species of insects and arachnids during its staminate phase and 10 species during the pistillate phase. Visiting insects include drosophilids, bees, syrphids, and beetles. Trigonids and drosophilids are probably the most important pollinators.

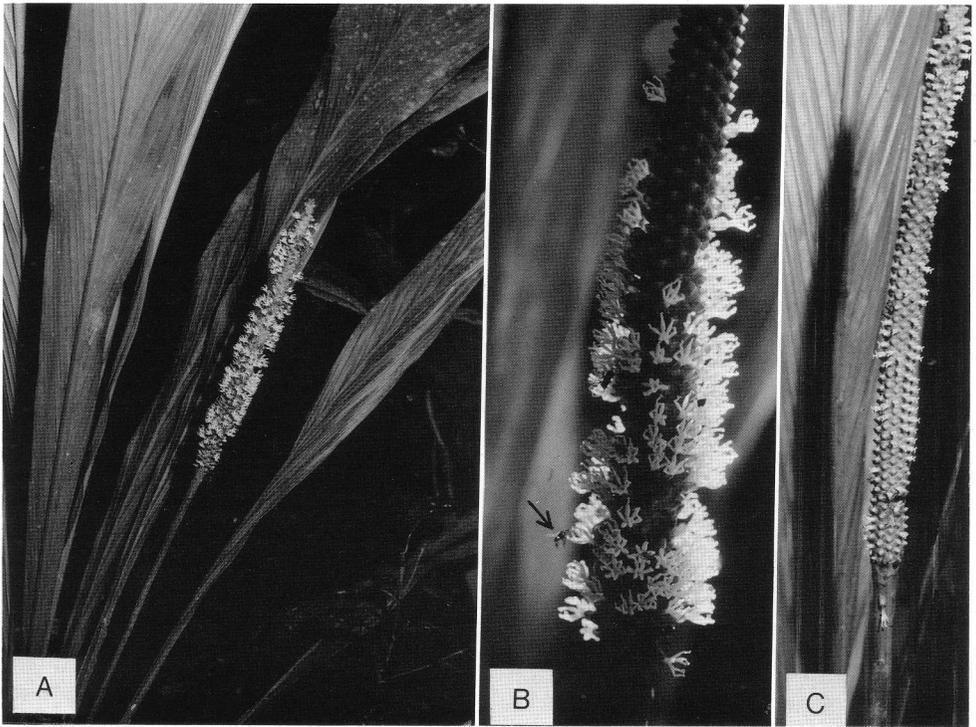
In his review of palm pollination Henderson (1986) concludes that the palm family possesses a great diversity of pollination modes. Beetles, bees, and flies are the main groups of pollinators.

This paper reports on flower biology and diversity of inflorescence visitors of *Geonoma macrostachys* Mart., a common understory palm in Amazonian Ecuador. It is acaulescent with undivided leaves and has an erect spicate inflorescence. Like other geonomoid palms it is monoecious and protandrous (Wessels Boer 1968, Uhl and Dransfield 1987).

Study Area and Population

This study was conducted in tropical lowland rainforest on the non-flooded *terra*

firme 3 km S to Añangu, Río Napo, Yasuní National Park, Ecuador (00°32'S, 76°26'W) at 300 m a.s.l., April 13-28, 1986. The population of *Geonoma macrostachys* studied was delimited in part by stands of *Heliconia* (Heliconiaceae), and partly by relatively large *Geonoma*-free areas. The area occupied by the population was estimated to be 2.5 hectares. The ground vegetation is poor in species and consists mainly of *G. macrostachys*. Its density was estimated as 200 individuals per hectare. Only five individuals inside the study area flowered during the study period. They were all kept under observation. Fluorescent pigments (RADGLO®, Hercules Kemiska AB, Box 300, 401 24 Göteborg, Sweden) were used as pollen mimics to study pollen flow (Stockhouse 1976). In the study area 62 infructescences of *G. macrostachys* were found. Of these 50 were collected and fruit set estimated. We censused abundance and visitation of flower visitors. Specimens of the insect species visiting the inflorescences were preserved in ethanol. Voucher specimens of plants are deposited at Herbarium AAU and Herbarium QCA. Insect specimens are deposited at The Natural History Museum, Aarhus, Denmark, and The Entomological Division, QCAZ, Pontificia Universidad Católica del Ecuador, Quito.



1. Inflorescence of *Geonoma macrostachys*. A-B, inflorescence in staminate phase (arrow in B: small trigonid bee, compare Fig. 5:11); and C, inflorescence in pistillate phase.

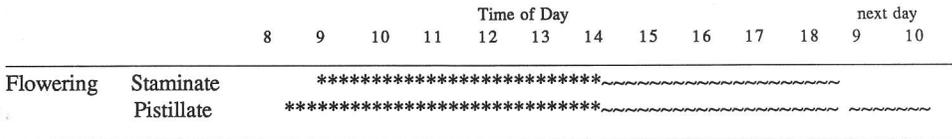
Floral Biology

Geonoma macrostachys is monoecious and protandrous. As in other geonomid palms its flowers are grouped in triads consisting of two staminate and one pistillate, sunken in pits on the spike. Corolla, androecium, and gynoecium are white.

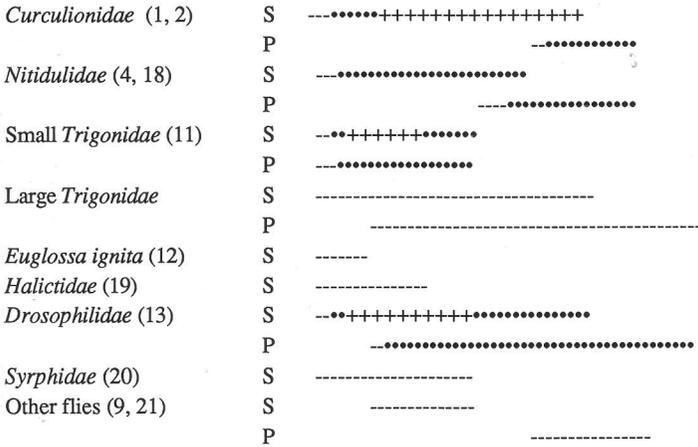
Staminate flowering lasts four days or more per inflorescence, with daily pulses of up to 200 flowers per inflorescence (Fig. 1A,B). The newly opened flowers are usually restricted to a part of the spike. For example on April 15, most flowers were found on the upper third of one of the inflorescences, on April 16 most were found on the middle part, and on April 17 most were found on the lower part. All staminate flowers in the studied population opened within one half hour between 0900 and 1000 hours (Fig. 2). Withering occurs

about 1400 hours or at least before the next morning when a new pulse of staminate flowers opens. If the weather is dry at the time of withering, the staminate flowers turn brown and fall off. When raining some of the flowers turn brown and fall off while the rest remain on the inflorescence as a wet mass of decaying material. Immediately after the opening of the three petals the six inflexed stamens deflex partly (Fig. 3A-D). A small vestigial gynoecoid structure (pistillode) is found on the inner side of the wall of the androecial tube (Fig. 3G). Pollen grains vary in shape (Fig. 3E). Their length averages $39.6 \pm 2.5 \mu\text{m}$ ($N = 200$, from 5 different flowers, range 32-46 μm , Fig. 4). Neither the staminate nor the pistillate flower seem to produce any nectar.

The pistillate phase starts the day after the last staminate flowering pulse. The pis-



Visitor Group
(numbers, compare fig. 5)



-----	<	5	individuals at a time per inflorescence	*	=	main flowering period
.....	5	-- 25	" " "	~	=	extended flowering on
+++++	>	25	" " "			very rainy days

2. The diurnal pattern of visitation of the different insect groups to inflorescences of *Geonoma macrostachys* in relation to flowering. Numbers in parentheses refer to illustrations in Fig. 5. S: staminate inflorescence visitors; P: pistillate inflorescence visitors.

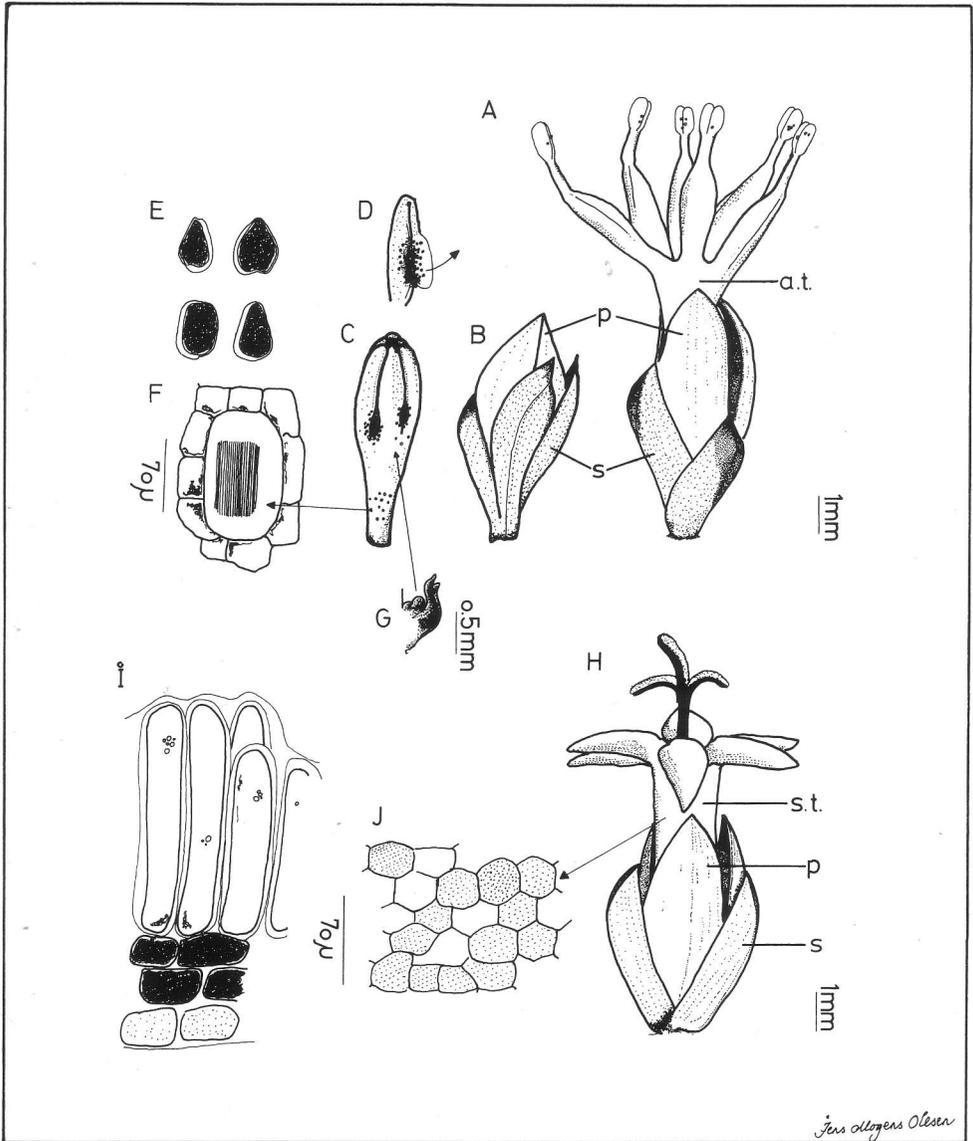
tillate phase lasts at least 3 days. The number of new flowers per inflorescence per day and the tendency to present flowers concentrated on restricted parts of the inflorescence are less than during the staminate phase (Fig. 1C). The pistillate flowers open about one half hour earlier than the staminate (Fig. 2), and remain open until the next morning, and sometimes old and new pistillate flowers are found intermingled. Within the petals a staminodial tube is conspicuous (Fig. 3H). The stigma is covered by a thick layer of adhesive cells (Fig. 3I). Staminate flowers produce a strong sweet scent, which is emitted from the bud as early as one hour before anthesis. The pistillate has a weaker scent. Both flower types contain abundant idioblasts

and tannin tissue in the androecial and staminodial tubes (Fig. 3F,J).

During the study period staminate and pistillate inflorescences were never found closer to each other than about 100 m. Fluorescent pigments were used many times on staminate flowers, but were never refound on pistillate ones. Fruit set was, however, high on almost all infructescences with about 0.55 fruits/pistillate flower (N = 50).

Insect Visitors

Several groups of insects visit the inflorescences especially during the morning hours (Fig. 2). The inflorescence is visited much more frequently during its staminate phase than during the pistillate phase (Fig.



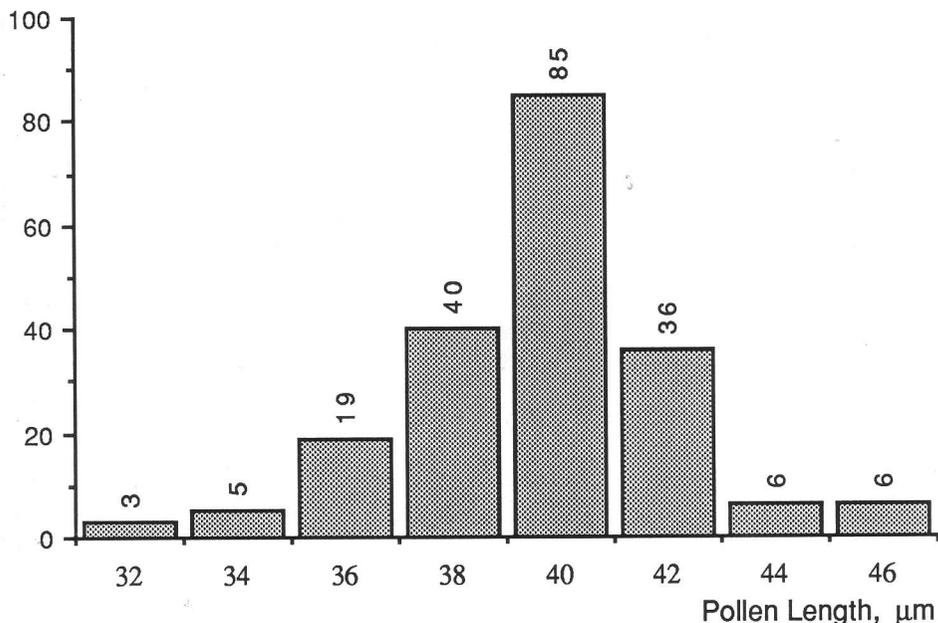
3. Flowers of *Geonoma macrostachys*. A: staminate flower (p: petals, s: sepals, a.t.: androecial tube), B: bud, C: immature androecium, D: young stamen, E: pollen grains of varying shape, F: idioblast, G: gynoeoid structure, H: pistillate flower (s.t.: staminodial tube), I: stigmatic tissue (cross section), J: tannin cells in the parenchymatous tissue of the staminodial tube (stained with FeCl_3).

2). The number of visitor species caught, while they were foraging on the staminate and pistillate inflorescence was 22 and 10, respectively (Table 1, Fig. 5). Which

species visited which phase is given in Table 1.

Visitors Included: Two species of weevils (Curculionidae, *Phyllotrox*): One has

Number of Counts (N=200)

Distribution of Pollen Length in *Geonoma macrostachys*4. Size distribution of pollen grains of *Geonoma macrostachys*.

a light brown body with a dark patch in the middle of each elytron (Fig. 5:1). The other one has a light brown body with black elytra and thorax (Fig. 5:2).

At least four different species of leaf beetles (Chrysomelidae): They were foraging on the staminate inflorescence. Two belong to Acticinae: a light brown one (Fig. 5:3), and one with light brown body, dark elytra and very thick hind legs (Fig. 5:17). One species is a green tortoise beetle (Cassidinae) (Fig. 5:15). The fourth species with a black-light brown elytra belongs to Galerucinae (Fig. 5:16).

Two Nitidulidae spp. (Fig. 5:4, 18).

Two rove-beetles (Staphylinidae): The larger one is completely black (Fig. 5:5), while the smaller one has a light-colored hind body with a broad dark stripe (Fig. 5:6).

Two ant species (Formicidae): They patrolled up and down the spike, a small black one with big eyes (Fig. 5:7), and a big brown one with small eyes (Fig. 5:8).

Two stingless bee species (Trigonidae) 7 mm and 2.5 mm long: The small one with light-colored abdomen and dark thorax and head (Fig. 1B,5:11). The larger one was completely black. The small species was observed collecting pollen and had white corbicular pollen loads. They walked around on the inflorescence. The larger bee species was observed several times, flying around the inflorescence, but it was never seen landing.

A green orchid bee species *Euglossa ignita* (Apidae): It foraged from the not fully opened staminate flowers. Only male bees were observed (Fig. 5:12).

Two individuals of a green iridescent

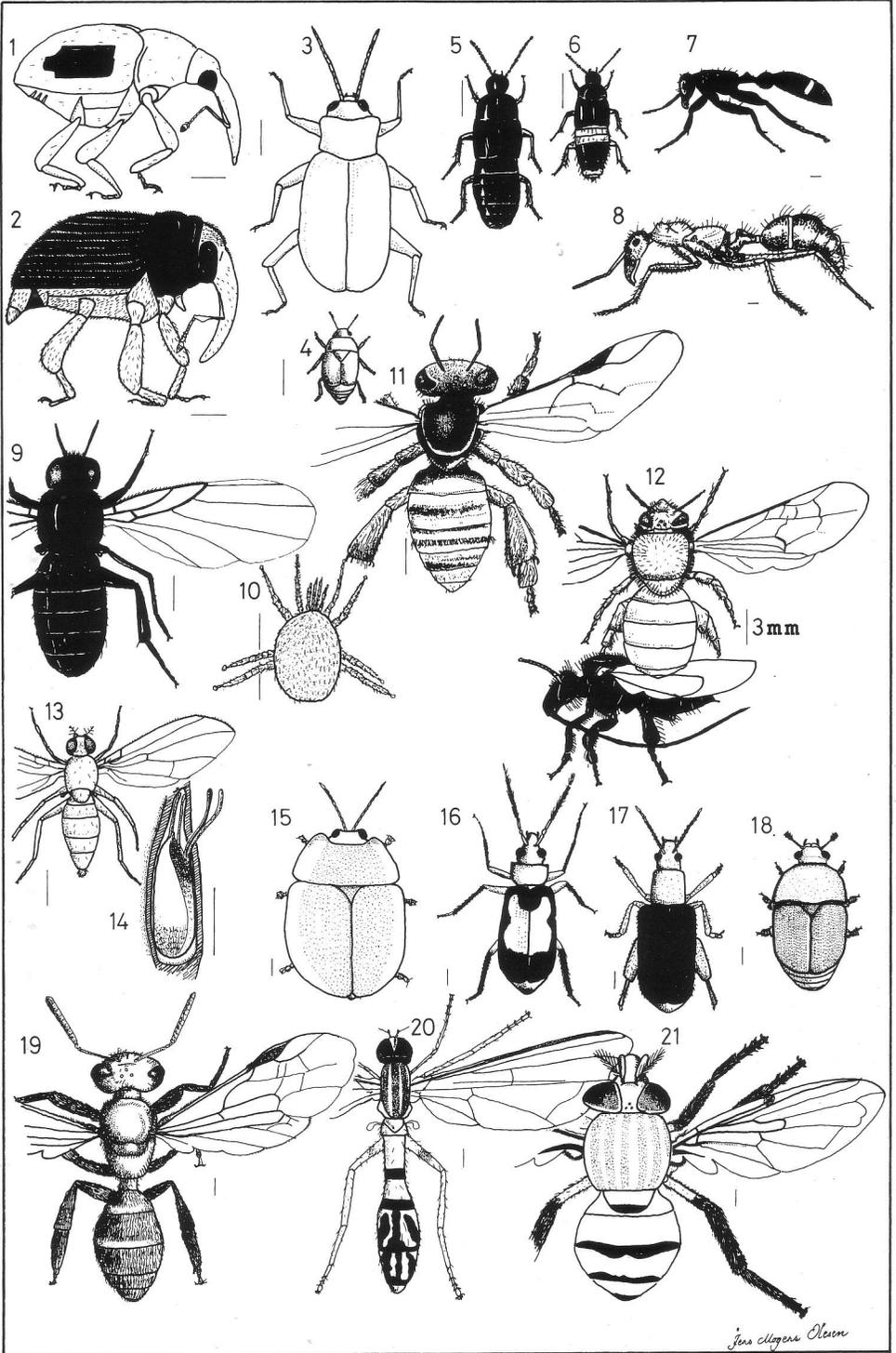


Table 1. Visitors to staminate and pistillate phases of the inflorescence of *Geonoma macrostachys*.

Visitor Taxon	Visitation	
	Staminate	Pistillate
Class Insecta, order Coleoptera:		
Fam. Curculionidae, tribus Derelomini, <i>Phyllotrox</i> sp. 1. (1)	X	x
Fam. Curculionidae, tribus Derelomini, <i>Phyllotrox</i> sp. 2. (2)	X	x
Fam. Chrysomelidae, subfam. Acticinae sp. 1. (3)	o	—
Fam. Chrysomelidae, subfam. Acticinae sp. 2. (17)	o	—
Fam. Chrysomelidae, subfam. Cassidinae sp. (15)	o	—
Fam. Chrysomelidae, subfam. Galerucinae sp. (16)	o	—
Fam. Nitidulidae sp. 1. (4)	x	x
Fam. Nitidulidae sp. 2. (18)	x	x
Fam. Staphylinidae sp. 1. (5)	o	—
Fam. Staphylinidae sp. 2. (6)	o	—
Order Hymenoptera:		
Fam. Formicidae sp. 1. (7)	o	—
Fam. Formicidae sp. 2. (8)	o	—
Fam. Trigonidae, tribus Meliponini sp. 1 (11)	X	x
Fam. Trigonidae, tribus Meliponini sp. 2	o	o
Fam. Apidae, tribus Euglossini, <i>Euglossa ignita</i> (12)	o	—
Fam. Halictidae sp. (19)	o	—
Order Diptera:		
Fam. Phoridae sp. (9)	o	o
Fam. Drosophilidae sp. 1 (13) and sp. 2	X	x
Fam. Syrphidae, <i>Ocyptamus</i> sp. (20)	o	—
Fam. Syrphidae, <i>Copestylum</i> sp. (21)	o	o
Class Arachnida, order Acarina sp. (10)	o	—

X > 25 individuals at a time per inflorescence.

x: Between 5 and 25 individuals at a time per inflorescence.

o < 5 individuals at a time per inflorescence.

Numbers in parentheses refer to illustrations in Figure 5.

colored bee species (Halictidae): They were observed collecting pollen (Fig. 5:19). Flower visiting times were between 1–2 seconds, and 1–3 anthers were manipulated during each visit. It visited 1–3 flowers, crawling from flower to flower, flew out from the inflorescence to a distance of 5 cm, spiralled around the inflorescence and then landed again.

A black fly species (Phoridae) (Fig. 5:9).

Two fruit fly species (Drosophilidae): They visited both staminate and pistillate phases of inflorescences in large numbers (Fig. 5:13). The size of adults varied considerably. Nearly all staminate flowers were infested with eggs, probably of drosophilid origin. The number of eggs per flower var-

←
5. Visitors to the inflorescence of *Geonoma macrostachys*: 1: Curculionidae, Derelomini, *Phyllotrox* sp. 1, 2: Curculionidae, Derelomini, *Phyllotrox* sp. 2, 3: Chrysomelidae, Acticinae sp. 1, 4: Nitidulidae sp. 1, 5: Staphylinidae sp. 1, 6: Staphylinidae sp. 2, 7: Formicidae sp. 1, 8: Formicidae sp. 2, 9: Phoridae sp., 10: Acarina sp., 11: Trigonidae, Meliponini sp., 12: Apidae, Euglossini, *Euglossa ignita*, 13: Drosophilidae sp. 1, 14: (Drosophilid?) egg with 4 respiratory tentacles inside the wall of the androecial tube, 15: Chrysomelidae, Cassidinae sp., 16: Chrysomelidae, Galerucinae sp., 17: Chrysomelidae, Acticinae sp. 2, 18: Nitidulidae sp. 2, 19: Halictidae sp., 20: Syrphidae sp., 21: Diptera sp. All bars are 0.5 mm long (except no. 12 which is 3 mm long).

ied between 0–6. The egg was found inside a cavity in the androecial tube wall (Fig. 5:14) often just below a hole made by one of the visiting insects. The egg has two pairs of respiratory tentacles at its end, pointing towards the distal part of the flower: one pair penetrates the outer wall surrounding the egg cavity, while the other pair is enclosed in the egg cavity. The egg also possesses a micropyle (*sensu dipterologica*) at its upper end.

Two hoverfly species (Syrphidae) (Fig. 5:20): One is 8–9 mm long, slender and orange-colored with dark stripes on mesonotum and brown stripes on abdomen (*Ocyptamus* spp., probably two species, Fig. 5:20). This species was observed eating pollen. Its gut load of pollen consisted of pure *Geonoma* pollen. It was often seen licking the lower parts of the filaments too. The species was often scared away by other visitors, such as the Trigonids. Several individuals of this species were observed. The other hoverfly, a 6.5 mm long and more broad fly species with orange-colored thorax and abdomen with dark stripes on abdomen, was observed a few times (*Copestylum* sp., Fig. 5:21). It was a rarer species and was observed to rest on the inflorescence a few times.

A light-colored mite species (Fig. 5:10).

Only the weevils, the stingless bees, and the fruit flies were common (Fig. 2).

All visitor groups arrived at the staminate inflorescence at the beginning of anthesis, while the visitation to the pistillate was delayed except for the small Trigonids until later in the morning (Fig. 2). This visitation pattern may be caused by the weaker scent and lack of food rewards of the female flowers. The insect activity ceased immediately when rain occurred. The Syrphidae visited the flowers only when a sun spot hit the inflorescence.

Discussion

The floral biology of *G. macrostachys* is in most respects similar to that of a species of *Geonoma* studied in the cloud

forest of Costa Rica (Henderson 1986). However, the pistillate phase in that species lasts only 24 hours, and only drosophilids were observed as flower visitors. The abundance of idioblasts and tannin cells may protect the ovary against herbivores (Uhl and Moore 1977).

The relative importance to pollination of the many different visitors to *G. macrostachys* is difficult to assess. Two major ecological groups are, however, recognized: One consists of the pollen-collecting insects: trigonids, drosophilids, halictids and syrphids. The other one consists of the fragrance-foraging euglossine males and the mating and egg-laying drosophilids and beetles.

Among the ten taxa visiting the pistillate phase of *Geonoma macrostachys*, only Trigonidae and Drosophilidae are suspected to have any quantitative importance for pollination. Their high abundances may explain the high fruit set found. Trigonidae and Drosophilidae have often been reported as pollen collecting visitors on palms (e.g., Beach 1984, Henderson 1986, Barfod et al. 1987). Fruit flies and euglossine males may be attracted by the same compounds, e.g., eugenol (Metcalf et al. 1975, Pearson and Dressler 1985). The larvae of flower-breeding fruit flies often develop within decaying flowers with their bacterial and perhaps yeast microflorae. The size of the adult drosophilids varied considerably. This may be explained by variation in afternoon flower moisture and in larval density per flower (Montague 1984).

The visiting Curculionidae and possibly Nitidulidae belong to taxa specific to palm inflorescences (Essig 1973, Beach 1984, Henderson 1986). Weevils and leaf beetles may use palms as mating- and egg-laying sites. Weevils are known as pollinators of several plants, e.g., *Zamia* (Norstog et al. 1986, Tang 1987), *Lophophytum* (Borchsenius and Olesen 1990), and some palms (Essig 1973).

Syrphidae have often been recorded as visitors and pollinators of palm flowers (e.g.,

Henderson 1985). The syrphids are without doubt too few in number to be of importance to the pollination of *G. macrostachys*. They are, however, known to be able to act as very selective pollen predators (Olesen and Warncke 1989).

The bee fauna at Añangu is briefly described in Olesen (1988, 1989) and Borchsenius and Olesen (1990). Male orchid bees are well known as pollinators of Orchidaceae and Araceae, where they are regarded as important long distance pollen agents (Williams and Dressler 1976, Montalvo and Ackerman 1986). Their importance as pollinators of palms is, however, unknown. *Euglossa ignita* is a very widespread species. In Central America the populations consist of bronzy individuals, but the Amazonian conspecifics are green. The species may be observed in "varzea" as well as "terra firme" forests (Pearson and Dressler 1985). It is unlikely that the males were collecting *Geonoma*-pollen. They are hypothesized to collect fragrances important in their sexual display.

Pollination is expected to be generated by intraspecific Batesian mimicry or Bakerian mimicry, i.e., the kind of mimicry that has the pistillate flower mimicking the staminate flower, which alone has the rewards (Baker 1976, Bawa 1980, Pasteur 1982). The staminodial tube in the pistillate flower resembles the androecial tube in the staminate flower. This kind of mimicry in pollination is quite common (Bawa 1977, van der Pijl 1978, Wiens 1978, Kay 1982, Little 1983, van der Werf 1983, Bell et al. 1984, Dafni 1984, Muenchow 1986, Ågren et al. 1986, Bierzychudek 1987, Dukas 1987); it has, however, never been reported in the palms. The pistillate phase is shorter with fewer open flowers than the staminate phase. Thus the mimic (the pistillate flower) is generally rarer than its model (the staminate flower).

Acknowledgments

Dr. Sergio Figueroa and Ingeniero Arturo Ponce of the Departamento de Par-

ques Nacionales y Vida Silvestre (MAG, Quito) helped with research permits and in other ways—for which we are most grateful. Director Tjitte de Vries and Dra. Laura Arcos Terán of the Departamento de Biología, PUCE, Quito were most helpful in providing working facilities in Quito. We thank R. L. Dressler, Univ. of Florida, O. Martin, B. Petersen, L. Lyneborg, Zoological Museum, Copenhagen, and E. Torp, Jelling, Denmark, for their determinations of the *Euglossa*, Coleoptera, Hymenoptera, Diptera, and Syrphidae. L. Lyneborg is thanked for his information about the drosophilid egg; R. L. Dressler for his information about perfume-collecting euglossines on palms, H. G. Baker for information about mimicry, and A. Henderson, New York Bot. Garden, for his field help and information on palm pollination. Field work was financed by a grant from the Danish Natural Science Research Council.

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Intergeneric Hybridization between *Coccothrinax* and *Thrinax* (Palmae: Coryphoideae)

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ABSTRACT

Unusual plants of what initially appeared to be a species of *Thrinax* were discovered in the Lower Florida Keys. The plants were observed to produce abundant inflorescences, but anthesis and fruit set did not occur. The sterility, apparent intermediateness in several leaf characters, and consistent co-occurrence with *Coccothrinax argentata* (Jacq.) Bailey and *Thrinax morrisii* H. A. Wendl. suggested a hybrid. Three criteria were evaluated to test the hypothesis of hybridity: morphological intermediateness, occurrence in the geographical zone of overlap of the putative parent species, and occurrence in ecologically intermediate habitats. Fifteen of the 22 characters examined exhibited intermediateness, three exhibited questionable intermediateness, and five exhibited apparent heterosis. Field studies indicated the putative hybrids to occur only with both parental species and only where the parents occur in immediate proximity to each other in ecologically intermediate habitats.

Unusual plants of what initially appeared to be *Thrinax morrisii* H. A. Wendl. were discovered by a local naturalist (Ann Williams) on No Name Key, Florida. The plants were subsequently found in several additional locations on neighboring Big Pine Key (Fig. 1). During several years of observation, none of these plants produced flowers, but abortive inflorescences were produced in abundance. This production of abortive inflorescences and an apparent intermediateness and co-occurrence with *Coccothrinax argentata* (Jacq.) Bailey (Fig. 2) and *T. morrisii* (Fig. 3) led to the

assertion that the plants represent an intergeneric hybrid between these two species.

Hybrids among vascular plants are sufficiently well known that several criteria can be used to establish a hybrid origin. Among these, the most important criterion is that the putative hybrid exhibits morphological intermediateness between its parents, usually in several characters. Seven additional criteria were listed by Gottlieb (1972). Since Gottlieb was concerned primarily with the confidence of detecting a hybrid origin for stable, presumably reproducing entities, and since these plants do not produce functional flowers, three of these criteria cannot be applied to the present study. These are the presence of partial F_1 fertility, the presence of unusual amounts of interpopulational variability in the hybrid, and occurrence in more recent geological formations than the parent species. The relatively long generation time in *Coccothrinax* and *Thrinax*, and the logistic difficulties of crosses for experimental synthesis of the hybrid (Read 1975), are sufficiently prohibitive that this criterion cannot be evaluated. An additive chemical profile for marker parental compounds is also typical of hybrids but is here considered essentially equivalent to morphological intermediateness for practical comparisons. Other criteria relating to polyploid hybrids, e.g., chromosome number, pairing behavior, etc., could not be applied. Previous chromosome counts of *T. morrisii* and of *C. argentata* (Read

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1. Habit of the putative hybrid.

1963, 1964, 1965, 1975; Venkatasubban 1945) report $n = 18$ and a relatively uniform karyotype. This is apparently the case for most Coryphoid palms (Read 1965). A polyploid origin is therefore unlikely.

Materials and Methods

Morphological intermediateness was tested by selecting 22 characters thought to differ between the parental species (Table 1). Character states were recorded for populations of the parental species and the putative hybrid from Big Pine Key, Monroe County, Florida. Two fully expanded, apparently healthy leaves not showing signs of senescence were randomly selected from mature plants (i.e., plants with at least one inflorescence at any stage of development). For leaf anatomy characters, a rectangular sample of lamina tissue measuring 2–3 cm on a side was removed after drying. The samples were rewetted for several days in 5% NaOH and stained with basic fuchsin for cross sections. Vouchers are deposited

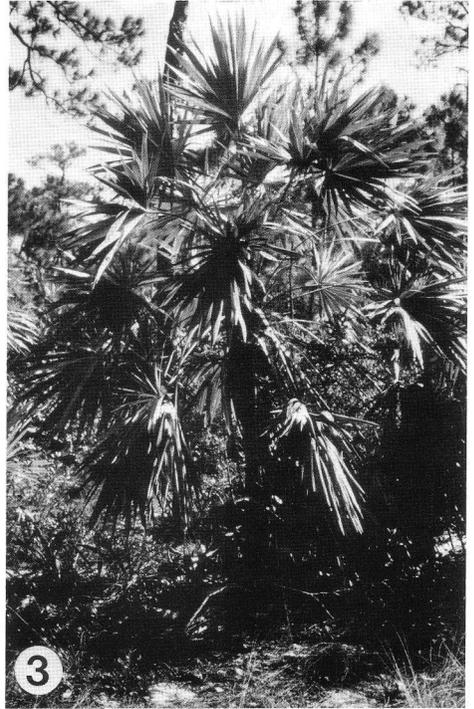
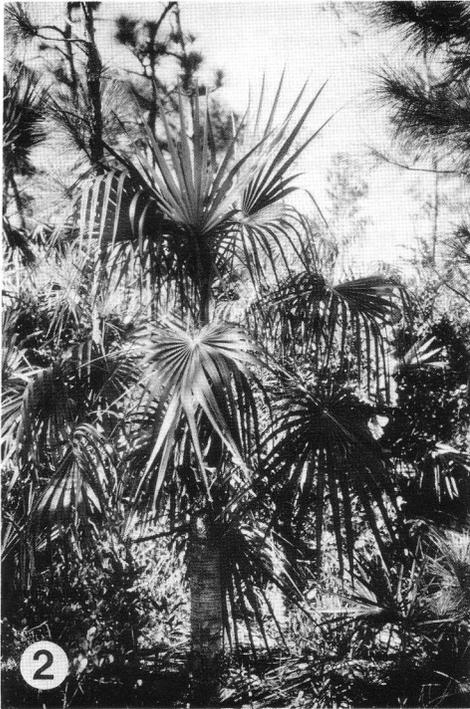
at the herbarium of Fairchild Tropical Garden (FTG).

Results

Intermediateness and apparent heterosis is indicated for all of the characters of gross morphology examined. The scatter diagram (Fig. 4) illustrates several of these intermediate characters. Other characters showing this pattern include: presence or absence of transverse veins, segment shape ratio (distance to widest point along the segment/segment width), greater palman length (distance from the hastula to the sinus between the two central segments), degree of segment splitting, frequency of split petiole bases, and shapes of the adaxial and abaxial hastulas. The ranges of character state expression in three characters, lamina outline, lamina folding, and segment habit are considerable, and differences are in the form of frequencies of character states.

Heterosis is indicated for five characters: petiole apex width, adaxial hastula length, central segment length, lesser palman length (distance from the hastula to the sinuses between segments adjacent to the central segments), and distance to the point of maximum segment width. However, the heterosis is mostly statistical and strongly indicated only for adaxial hastula length and segment length. For the other heterotic characters the intermediate's range of expression is entirely within the range of expression exhibited by *T. morrisii* (Table 1).

All three anatomical characters (20–22, Table 1, Fig. 5) showed intermediateness. Small, abaxial fiber bundles in *C. argentata* are contained entirely within the hypodermis. In *T. morrisii* these bundles only occasionally interrupt the hypodermis. The bundles in the putative hybrid interrupt, but are not contained entirely within the hypodermis. *Thrinax morrisii* is characterized by a mesophyll consisting almost entirely of palisade cells and *C.*



2. Habit of *Coccothrinax argentata*. 3. Habit of *Thrinax morrisii*.

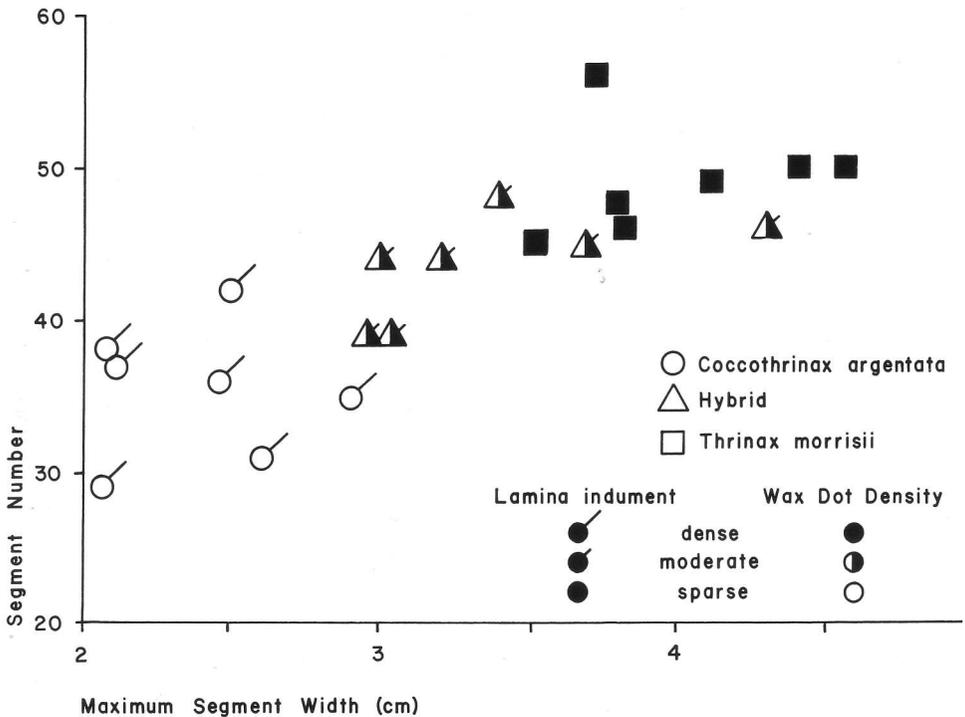
argentata by a mesophyll of both palisade and spongy mesophyll cells. The putative hybrid exhibits a mesophyll of largely palisade cells and a more or less distinct spongy layer. Fibers surrounding secondary veins in *C. argentata* extend from the abaxial to the adaxial epidermis, interrupting the hypodermis both abaxially and adaxially. In *T. morrisii*, these same fibers rarely extend across the entire width of the mesophyll and generally do not interrupt the hypodermis. The putative hybrid exhibits a condition closer to that seen in *C. argentata*, but the fibers generally do not interrupt the hypodermis.

Field studies verified the putative hybrid's occurrence in the geographical range of overlap and in habitats ecologically intermediate between the parental species. Hybrids are known from 22 locations on Big Pine Key, and from one for-

mer location on No Name Key (Monroe Co., Florida). The putative hybrids only occur in mixed populations of *C. argentata* and *T. morrisii*, and in all cases less than five meters from plants of both parental species. The putative hybrids are not known from areas or habitats occupied by only one of the parental species. The mixed nature of the parental populations can be taken as evidence of ecological intermediateness. *Coccothrinax argentata* occurs in coastal pinelands or strand habitats in the lower Florida Keys and along the eastern coast from southern Dade County, Florida, north to Lake Worth in Palm Beach County (Fig. 6). *Thrinax morrisii* occurs in wooded areas, hammock edges and in mangrove and tropical strand habitats from Key Largo southward (Fig. 6). *Coccothrinax argentata* co-occurs with *T. morrisii* only in the slash pine flatwoods

Table 1. Means and ranges of expression in characters examined for *Coccothrinax argentata*, *Thrinax morrisii*, and their putative hybrid. ("mostly" means more than 80% of the samples).

Character	<i>C. argentata</i>	Hybrid	<i>T. morrisii</i>
1. Petiole base split	no	mostly yes, rarely no	yes
2. Petiole apex width (cm)	1.40 (0.9-1.9)	1.72 (1.2-2.0)	1.47 (0.6-2.0)
3. Abaxial hastula shape	straight to broad-rounded, apical tooth present or absent	straight to obtuse-rounded, apical tooth present or absent	rounded, deltoid apical tooth mostly absent
4. Adaxial hastula shape	obtuse to rounded triangular, apical tooth present	obtuse to acute rounded, apical tooth present	obtuse rounded, apical tooth mostly absent
5. Adaxial hastula length (cm)	0.6 (0.5-0.8)	1.2 (1.0-1.5)	0.7 (0.5-0.9)
6. Abaxial lamina indument density	dense	moderate	scattered & few
7. Wax dots present	absent	few to absent	present
8. Transverse veinlets	absent	obscure but present	obvious
9. Segment number	35.0 (29-42)	44.4 (39-48)	49.2 (45-56)
10. Lamina outline	¾ to >1 orbicular	¾ to >1 orbicular	1 to >1 orbicular
11. Lamina form	flat or with 1 raised group of segments	mostly with several groups of raised segments	mostly more than 1 group of raised segments
12. Segment habit	arching to mostly drooping or pendent	mostly drooping or arching-pendent	straight to arching
13. Central segment length (dm)	5.72 (5.2-6.4)	8.18 (7.5-9.0)	6.77 (6.0-7.9)
14. Central segment maximum width (cm)	2.34 (2.1-2.6)	3.52 (3.0-3.7)	3.93 (3.5-4.6)
15. Distance of maximum segment width from hastula (dm)	2.06 (1.75-2.23)	3.49 (2.92-4.45)	3.34 (2.89-4.08)
16. Shape ratio character 13/character 15	2.80 (2.37-3.20)	2.4 (1.68-2.93)	2.04 (1.91-2.38)
17. Greater palman length (dm)	1.13 (0.80-1.91)	2.97 (2.67-3.54)	3.06 (2.75-3.68)
18. Lesser palman length (dm), second sinus either side of the central segments	1.07 (0.52-1.87)	2.8 (2.34-3.37)	2.74 (2.49-3.26)
19. Degree of splitting character 17 × 100/character 13	16.68 (10.8-36.9)	39.22 (33.0-51.6)	45.1 (40.7-47.2)
20. Abaxial fiber bundle intrusion into the hypodermis	bundles contained entirely within the hypodermis	bundles not contained within, but interrupting the hypodermis	bundles occasionally interrupting the hypodermis
21. Secondary vein fiber bundles extending across and interrupting the hypodermis	bundle fibers extending across entire mesophyll and interrupting the hypodermis	bundle fibers extending across entire mesophyll and not interrupting the hypodermis	bundle fibers not extending across entire mesophyll, nor interrupting the hypodermis
22. Mesophyll of all palisade cells	mostly equal layers of spongy and palisade cells present	mostly unequal layers of spongy and palisade cells present	all palisade cells present



4. Scatter diagram for four characters showing intermediateness in the putative hybrid between *Coccothrinax argentata* and *Thrinax morrisii*.

and bordering habitats of the lower Florida Keys, these presumably represent ecologically intermediate habitats.

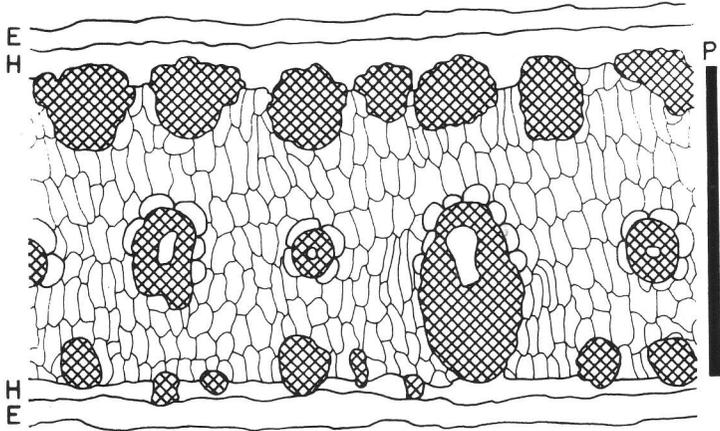
Discussion and Conclusions

Of the 22 morphological characters examined, 14 exhibited intermediateness in the putative hybrid (6-12, 14, 16, 17, 19-22, Table 1), five exhibited apparent heterosis (2, 5, 13, 15, 18), and three exhibited questionable intermediateness (1, 3, 4). Field studies have shown the putative hybrid to occur in the geographical and ecological ranges of overlap for the parental species.

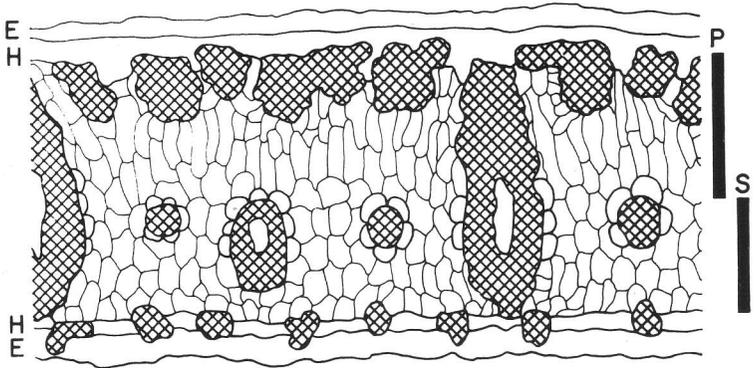
Although the evidence for the presence of hybrids is convincing, another possible, but unlikely, parentage exists for the hybrids. Three other palm species occur on Big Pine Key, *Serenoa repens* (Bar-

tram) Small, *Sabal palmetto* (Walter) Lodd. ex J. A. Schultes, and *T. radiata* Lodd. ex J. A. & J. H. Schultes. The first two species differ dramatically from the hybrids in a number of morphological features and are very unlikely to be part of the hybrid's parentage. *Thrinax radiata*, however, because it is congeneric with *T. morrisii*, represents a possible parent. *Thrinax radiata* is not abundant on Big Pine Key, being represented by only four individuals in a single location. At this location, the plants are growing in a roadside area where there is evidence of dumping and the plants may represent accidental introductions. The species does not co-occur with the hybrids anywhere on Big Pine Key or No Name Key. The hybrid is also absent from locations where *T. morrisii* and *T. radiata* do co-occur such as Big Coppitt Key. Therefore, *T. radiata*

Thrinax morrisii

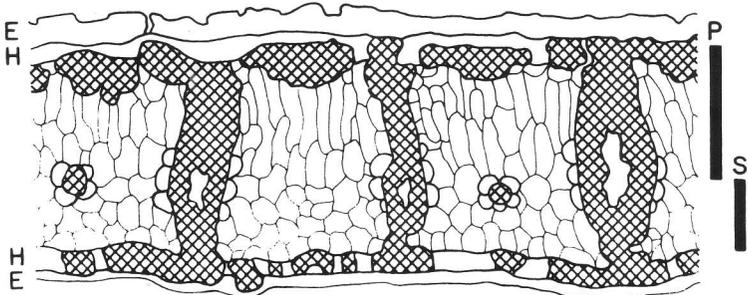


Hybrid



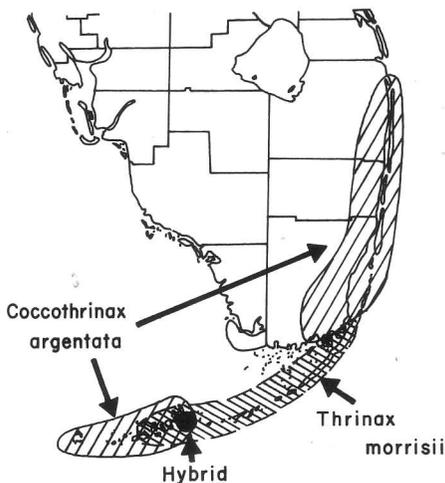
100 μ m

Coccothrinax argentata



does not meet the criterion of geographical co-occurrence with either *C. argentata* or *T. morrisii*. Additionally, morphological characters of the hybrid do not indicate *T. radiata* to be one of its parents whether *T. morrisii* or *C. argentata* is taken to be the second parent. For example, *T. radiata* has glabrous abaxial leaf surfaces, and the hybrids suggest a parent with a dense abaxial indument. Additionally, the characters of greater palman length, segment number, and central segment maximum width contradict a hypothesis with *T. radiata* as one of the parental species (see Read 1975 for more details on *T. radiata*).

Compared with other proposed intergeneric palm hybrids (cf. Balick et al. 1987), these plants are unusual in at least two respects. First, they are apparently sterile, the inflorescences abort (i.e., they do not fully extend and the flowers do not emerge from the peduncular bracts), while hybrids between *Attalea* and *Orbignya* and others in the *Attaleinae* (Balick et al. 1987) are fertile. Second, the putative hybrids exhibit a morphology more like one parent than the other, in this case *T. morrisii*. In addition to the characters listed in Table 1, the inflorescence architecture and indument are more like those of *Thrinax* than *Coccothrinax*. This suggests that these plants may only represent stressed individuals of *T. morrisii*. However, in other populations of *T. morrisii* no individuals have been found that possess character states typical of the putative hybrid, e.g., the denser abaxial indument. Additionally, typical plants of *T. morrisii* often occur less than two meters from the putative hybrids and show no signs of stress. *Thrinax morrisii*, however, exhibits a wide degree of morphological variation (Read 1975) and a detailed analysis throughout its range and in a variety of habitats will



6. Florida distributions for *Coccothrinax argentata*, *Thrinax morrisii*, and their putative hybrid.

be needed to evaluate this alternative to hybridity further.

This study has provided support for the hypothesis of hybridity. The plants are morphologically intermediate between their proposed parental species in a number of morphological characters, and occur wherever the two parental species co-occur in ecologically intermediate habitats. However, the data have also suggested that these plants represent stressed individuals of *T. morrisii*, though only by not refuting this alternative. More investigation of these plants will be needed to establish their origin.

Acknowledgments

I thank D. Holle (Refuge Manager, National Key Deer Wildlife Refuge, Big Pine Key, FL) for permission to sample on refuge property, Dr. R. W. Sanders (Fairchild Tropical Garden, Miami, FL) for comments and suggestions on the manu-

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5. Diagrammatic lamina cross sections for *Thrinax morrisii*, *Coccothrinax argentata*, and the putative hybrid. Shaded areas represent fiber and vascular bundles. E = epidermis, H = hypodermis. Vertical bars represent the extent of palisade (P) and of spongy (S) mesophyll. Scale bar applies to all three sections.

script, and especially Ann Williams (Big Pine Key, FL) for bringing the hybrids to my attention and for help with various aspects of the field work.

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LETTERS

Dear Friends,

I inadvertently omitted acknowledging in the *Chamaedorea* articles published in *Principes* in 1990 Inge Hoffman's support of my work with this group of palms. First as Director of the Seedbank and later on her own, she enthusiastically supported my field work in Mexico and Central America. I apologize for this oversight and extend my sincere, although belated, appreciation for her support.

DONALD R. HODEL

attended over the years have palm-related personalized license plate messages on them. For example, the license on my pickup reads "PALM NUT."

I am making a collection of pictures of such license plates, and invite all readers with palm-related messages on their plates to send me a snapshot for inclusion in a pictorial essay I am planning for *Principes*.

GARY WOOD

Dear Editor,

I have noticed that many of the vehicles at various palm society functions I have

Identification of Amazonian Palm Genera from Vegetative Characters

FRANCIS KAHN

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ABSTRACT

Two keys for identification of thirty-eight Amazonian palm genera based on vegetative characters applied to seedling, juvenile, and adult plants are provided. They treat palms with accessible leaves (less than 10 m in height), and those with inaccessible leaves (over 10 m in height), respectively.

The first key which deals with all palms, the leaves of which are accessible, i.e., palms less than 10 m in height, can be used successfully to identify seedlings, juveniles, and sterile palms at the genus level. The key starts with the morphology of the blade (Fig. 1): 1) palmate or "fan-like" (*Chelyocarpus*, *Copernicia*, *Itaya*, *Lepidocaryum*, *Mauritiella*, *Trithrinax*), or costapalmate, i.e., with a short, curved rachis in the blade (*Mauritia*), 2) blade entire and bifid, or having only two segments or pinnae (seedlings of many genera and some adults of *Bactris*, *Chamaedorea*, *Geonoma*, *Wendlandiella*), 3) blade entire, not bifid (seedlings of several genera and adult form of *Manicaria*), and 4) leaf pinnate, or "featherlike" (seedlings, juveniles, and adults of most genera).

The form of the entire or bifid blade and of leaflets (Fig. 2) is treated next in the key. For instance, the presence of pinnae, which are pointed at the tip or truncate and broad apically (wedge-shaped), allows the separation of *Aiphanes* and the *Iriarteeae* (*Catoblastus*, *Iriartea*, *Iriartella*, *Socratea*, and *Wettinia*) from other genera. The presence or absence of spines is also used, together with four other characters: 1) the color of the underside (abaxial) of the blade (white in *Astrocaryum*

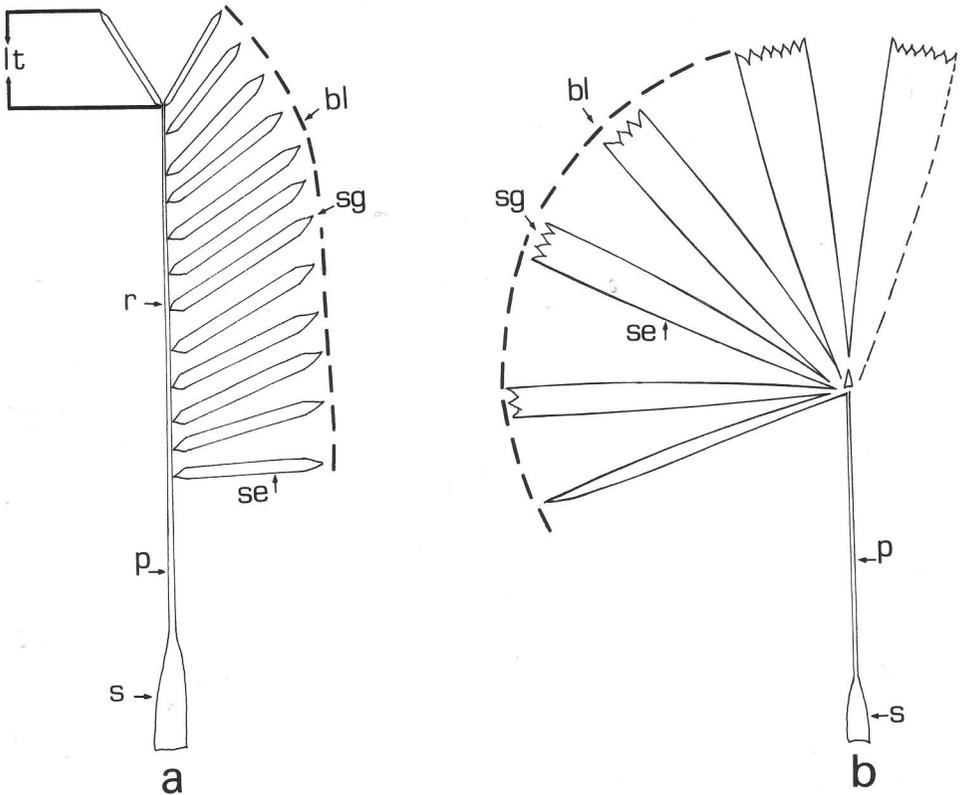
and *Jessenia*, glaucous in *Acrocomia* and *Oenocarpus*, green in most genera, or green with brownish longitudinal stripes in *Attalea*, *Maximiliana*, *Orbignya*, and *Scheelea*); 2) the form of the pinnae (linear, lanceolate, or S-shaped); 3) the tip of the pinnae, either symmetric (acute or slightly bifid) or asymmetric (obliquely notched); and 4) the ribs (main nerves) prominent above and/or below. Other characters, such as the sheath tubular or split, and the arrangement of the pinnae either in one plane or oriented in several directions, are then considered. In several cases, complementary characters are given to make the choice easier at the key dichotomy.

The second key deals with tall palms, the leaves of which are inaccessible. Characters of the leaves, of the trunk, of the roots, and physiognomy of the crown are used.

The Scope of the Keys

These keys are to be used in primary and secondary forests in all ecosystems of the Amazon valley. They were first developed from studies conducted in Brazil and Peru. They can be used, however, in the peripheral Andean region of Bolivia, Colombia, Ecuador, Venezuela, and in the Guianas. Thirty-eight genera are treated. Characters used to separate them refer to Amazonian native species, except for *Cocos* (*C. nucifera*) and two species of *Elaeis* (a native species, *E. oleifera*, and the introduced African oil palm, *E. guineensis*).

Most of the genera included occur



1. a, pinnate leaf; b, palmate leaf (the same terms are used for costapalmate leaf). Details: bl, blade; lf, leaf tip; p, petiole; r, rachis; sg, pinna (a) or segment (b); se †, edge of pinna or segment; s, sheath.

throughout the Amazon basin: *Astrocaryum*, *Attalea*, *Bactris*, *Desmoncus*, *Elaeis*, *Euterpe*, *Geonoma*, *Hyospathe*, *Jessenia*, *Mauritia*, *Mauritiella*, *Maximiliana*, *Orbignya*, *Scheelea*, *Socratea*, *Syagrus*, and *Cocos*. Many genera are also located in western Amazonia: *Aiphanes*, *Catoblastus*, *Chamaedorea*, *Chelyocarpus*, *Dictyocaryum*, *Iriartea*, *Itaya*, *Pholidostachys*, *Phytelephas*, *Prestoea*, *Wendlandiella*, and *Wettinia*. Some reach central Amazonia: *Iriartella* and *Lepidocaryum*; a few display limited distributions in central Amazonia: *Barcella* and *Leopoldinia*; and others occur in central and eastern Amazonia: *Acrocomia* and *Manicaria*. *Raphia* is found only in the eastern part, while *Copernicia* and *Trithrinax* are

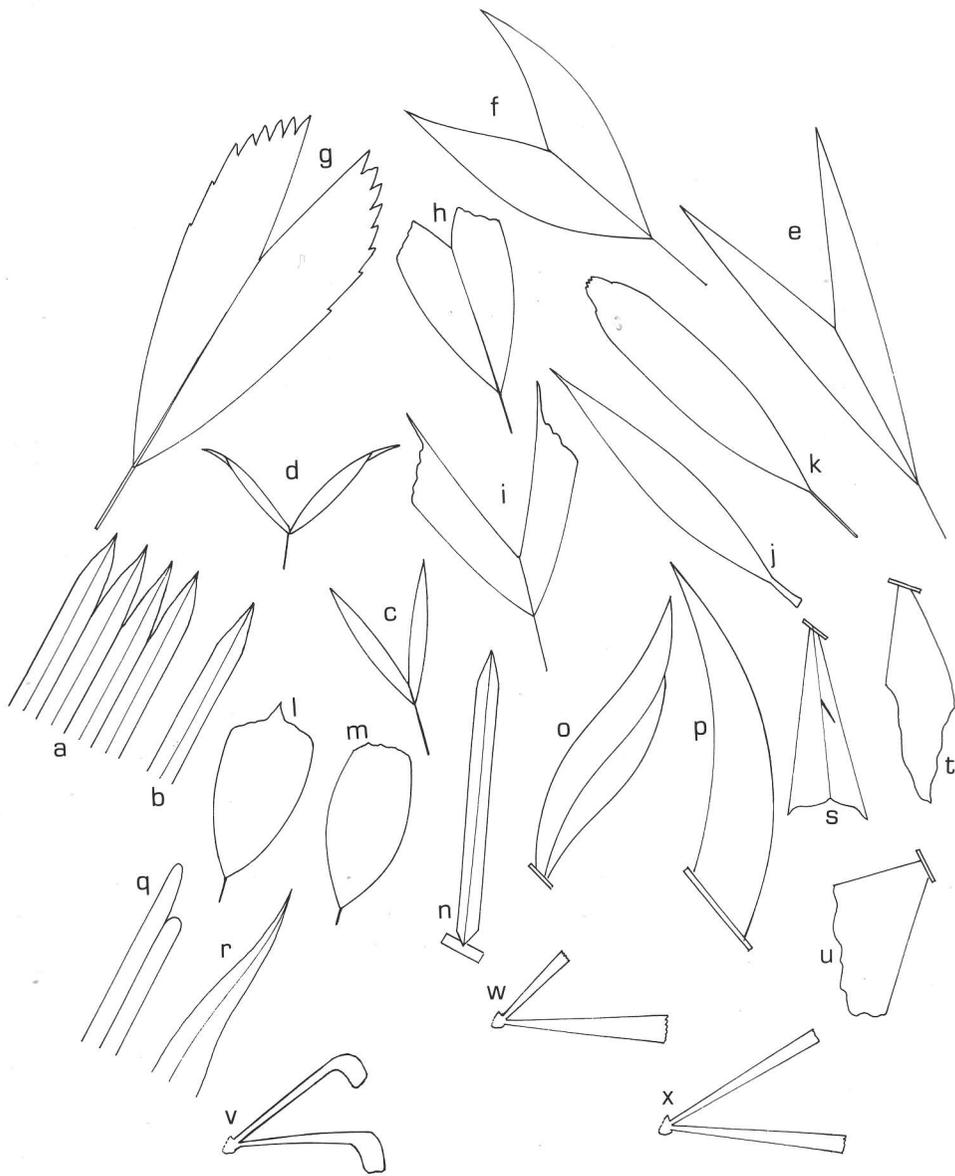
found in the southern part of the Amazon basin.

It was impossible to separate the seedlings and juveniles of the *Attalea-Maximiliana-Orbignya-Scheelea* complex. Furthermore, some adult genera such as the related *Geonoma* and *Pholidostachys* cannot be clearly distinguished on vegetative characters. A slight confusion also occurs between the seedlings of *Chelyocarpus* and *Itaya*, but the value of the key is not much reduced because these two genera are infrequent and limited to western Amazonia, as is also *Pholidostachys*. The genus *Asterogyne* is only known from a very small area of French Guyana and may be confused with *Geonoma*.

Key 1

Leaves accessible
(palms less than 10 m in height)

- 1a. Leaves palmate (fan-shaped) or costapalmate (with a short, curved rachis in the blade), 3 segments or more. 2
- b. Leaves with only 2 segments or pinnae, or blade entire and bifid. 13
- c. Leaves with blade entire; pointed, not bifid. 35
- d. Leaves pinnate (featherlike). 43
- 2a. Leaves costapalmate; sheath diameter more than 30 cm. *Mauritia*
- b. Leaves palmate; sheath diameter less than 30 cm. 3
- 3a. Blade divided into segments multi-pointed, several-folded (Fig. 2a) with several ribs, white beneath. 4
- b. Blade divided into segments one-pointed (Fig. 2b), connate or not basally, each with one or several ribs, white, green, or glaucous beneath. 5
- 4a. Petiole split basally in the sheath; this splitting opposite the petiole (see old leaves). *Itaya*
- b. Petiole not split basally in the leaf sheath; this closed. *Chelyocarpus*
- 5a. With spines on the upper surface of the rib(s) (select the youngest leaves). 6
- b. Without spines on the upper surface of the rib(s). 8
- 6a. Blade white beneath; spines on the stem. *Mauritiella*
- b. Blade green beneath; without spines on the stem. 7
- 7a. Segments one-ribbed, connate at base forming two groups separated by a central division at the base; blade often in a horizontal plane, but the youngest leaf usually with segments \pm erect; spines on midrib above. *Mauritia*
- b. Segments many-ribbed, not oriented in a marked horizontal plane; spines present on the upper surface of the ribs and on blade edges (select the youngest leaves). *Lepidocaryum*
- 8a. Blade white beneath. 9
- b. Blade green beneath. 10
- c. Blade hazy glaucous beneath, with 3-4 leaflets, each usually with two bright green margins beneath. ...
..... *Oenocarpus*
- 9a. Rib(s) prominent beneath; lower surface of the blade usually covered with a continuous layer of thin, white, membranous scales which rub off on contact; 3-4 segments, not markedly erect.
..... *Chelyocarpus, Itaya*
- b. Rib(s) not prominent beneath; blade dusty white beneath, petiole of the youngest leaves also dusty white; segments of the youngest leaf markedly erect. *Mauritiella*
- 10a. With triangular, laterally flattened spines, curved toward the apex as well as toward the base of the leaf. *Copernicia*
- b. Without spines on the edge of the petiole. 11
- 11a. Fibers of the sheath joined in a spiny expansion. *Trithrinax*
- b. Fibers of the sheath not joined in a spiny expansion, or sheath not fibrous. 12
- 12a. Midrib prominent above. *Mauritia*
- b. Midrib of each one-pointed segment prominent beneath. *Chelyocarpus*
- 13a. Leaflets or halves of bifid blade with tips pointed (Fig. 2c,d,e,f). 14
- b. Leaflets or halves of bifid blade clearly truncate, denticulate or multi-pointed (Fig. 2g,h,i). 30
- 14a. 2 leaflets connate at base, far longer than wide, or blade bifid. 15
- b. 2 leaflets not connate at base, wide, length about two to four times the width, usually light green, soft, flexible, not rigid. *Desmoncus*
- 15a. With spines, at times sparse, on outer edge of leaflets or halves of bifid blade, and, in some cases, on blade above and on sheath. 16
- b. Without spines on edge of leaflets or halves of bifid blade, or on other leaf parts. 19
- 16a. Blade white beneath. *Astrocaryum*
- b. Blade green or glaucous beneath. 17
- 17a. Blade glaucous beneath, light green above; reddish, shiny spines on sheath, rachis and blade.
..... *Acrocomia*
- b. Blade green beneath. 18
- 18a. Spines short, broad basally, up to 3-4 mm long, generally whitish, sometimes with brown tips, located on upper surface of ribs and on leaflet edges. *Lepidocaryum*
- b. Spines or spiny hairs, slender, never swollen at base, often dark, grouped on the outer edge near the



2. a, segment multi-pointed, several folded; b, segment or pinna one-pointed; c, 2 pinnae in a closed-V shape; d, 2 pinnae in an open-V shape, each twisted outwards; e, blade entire and bifid, each half with straight margins; f, blade entire and bifid, each half S-shaped; g, pinna or half of bifid blade regularly multi-pointed toward the tip; h, blade bifid and divided for less than half its length, each half truncate or irregularly toothed; i, blade bifid and divided for more than half its length, each half truncate or irregularly toothed; j, blade entire, not bifid, far longer than wide, with tip pointed; k, blade entire not bifid, far longer than wide, with tip truncate or denticulate, not sharply pointed; l, blade entire, not bifid, margins rounded, with tip pointed; m, blade entire, not bifid, margins rounded, with tip not pointed; n, pinna straight, linear-lanceolate; o, p, pinna S-shaped; q, r, tip of pinna asymmetric, obliquely notched; s, pinna truncate, with broad tip, usually with spines; t, u, pinna wedge-shaped or like a fish fin, without spines; v, blade entire not longitudinally divided pinnae slightly erect, tip drooping; w, upper parts of longitudinally divided pinnae shorter than the lower parts, tip not drooping; x, upper parts of longitudinally divided pinnae not shorter than the lower parts, tip not drooping (v, w, x, leaf viewed in cross section).

- tip of each half of bifid blade, occasionally on blade above; usually longer spines on sheath, petiole and rachis below, these brown or black, rarely whitish then flattened. *Bactris*
- 19a. Leaflets white beneath. 20
- b. Leaflets or half of bifid blade green beneath. 22
- c. Leaflets hazy glaucous with 1-2 bright green margins beneath. *Oenocarpus*
- d. Halves of bifid blade green beneath with greyish or brownish stripes along the ribs and the margins; outer margins denticulate toward the tip. *Attalea, Maximiliana, Orbignya, Scheelea*
- 20a. Two leaflets in closed-V shape, connate at base for 3 cm or more, rachis short but well-marked (Fig. 2c). *Jessenia*
- b. Two segments in open-V shape, connate at base for less than 3 cm long, without rachis; each leaflet slightly twisted outwards (Fig. 2d). 21
- 21a. Ribs prominent beneath; segments with layer of white membranous scales beneath which rub off on contact. *Chelyocarpus, Itaya*
- b. Ribs not prominent beneath; segments dusty white beneath; petiole usually dusty white. *Mauritiella*
- 22a. Petiole and rachis yellow, or very light-green, or whitish; in cultivated areas. *Cocos*
- b. Petiole and rachis green. 23
- 23a. Pinnae linear-lanceolate, or halves of bifid blade with margins straight (Fig. 2c,e). 24
- b. Pinnae or halves of bifid blade S-shaped (Fig. 2f). 27
- 24a. Pinnae or halves of bifid blade rather wide (more than 2 cm), one or several ribs. 25
- b. Pinnae narrow (less than 2 cm), several ribs. 26
- 25a. With 2 pinnae; and a distinct, long petiole between the sheath and the rachis. *Euterpe*
- b. With blade entire and bifid; and a short petiole, or without petiole, then the sheath continues into the rachis. *Elaeis*
- 26a. Ribs (3) prominent above and beneath; sheath tubular, shorter opposite the petiole (obliquely open). *Wendlandiella*
- b. Several ribs prominent above; sheath split opposite the petiole (select old, green leaves). *Geonoma*
- 27a. Sheath split opposite the petiole (select old, green leaves). *Geonoma, Pholidostachys*
- b. Sheath not split opposite the petiole, tubular in young as well as in old leaves. 28
- 28a. Ribs prominent above and beneath on pinnae. 29
- b. Ribs prominent above on pinnae, not beneath. *Hyospathe*
- 29a. Outer margins of blade emarginate (or wavy). *Chamaedorea*
- b. Outer margins of blade regularly linear and curved, not emarginate. *Wendlandiella*
- 30a. Tip of pinnae or of halves of bifid blade regularly multi-pointed (Fig. 2g). 31
- b. Tip of pinnae or of halves of bifid blade irregularly toothed, not regularly multi-pointed (Fig. 2h,i). 32
- 31a. With brownish or greyish stripes on the blade below; blade length less than 1 m. *Attalea, Maximiliana, Orbignya, Scheelea*
- b. Without brownish or greyish stripes on the blade beneath; blade length up to several meters. *Manicaria*
- 32a. Pinnae one-ribbed, with the two margins straight; with spines on sheath, petiole, rachis, and/or blade. *Aiphanes*
- b. Pinnae or halves of bifid blade many-ribbed, with the inner (or upper) margin straight, and the outer (or lower) margin wavy, irregularly toothed; without spines. 33
- 33a. Blade divided for less than half its length (Fig. 2h); sheath, petiole, and blade pilose. *Iriartella*
- b. Blade divided for more than half its length (Fig. 2i); leaf not pilose. 34
- 34a. Blade white beneath. *Dictyocaryum*
- b. Blade green beneath. *Socratea*
- 35a. Leaf length less than 2.5 m. 36
- b. Leaf length more than 2.5 m, blade often torn along the nerves (leaf tip usually slightly bifid). *Manicaria*
- 36a. Blade far longer than wide, linear-lanceolate (Fig. 2j,k). 37
- b. Blade round, or with length about two or three times the width (Fig. 2l,m). 40
- 37a. Tip of blade pointed, prolonged by a narrow apex (Fig. 2j); petiole short or not distinct between sheath and blade. *Elaeis*
- b. Tip of blade not sharply pointed, or roundly blunt (Fig. 2k), or regularly denticulate. 38
- 38a. Blade white beneath, usually with small, slender spines on edge, and on sheath and petiole. *Astrocaryum*
- b. Blade green beneath with longitudinal brownish or greyish stripes; without spines. *Attalea, Maximiliana, Orbignya, Scheelea*
- c. Blade green beneath, without brownish or greyish stripes; without spines. 39
- 39a. Tip of blade roundly truncate, pilose; blade length less than 0.3 m. *Iriartella*

- b. Tip of blade neither rounded nor sharply pointed, not pilose, blade length up to 2.5 m. *Syagrus*
 c. Tip of blade regularly denticulate. *Manicaria*
- 40a. Tip of blade pointed (Fig. 2l). 41
 b. Tip of blade not pointed (Fig. 2m). 42
- 41a. Blade pilose beneath (not always obvious, then can be confused with *Wettinia*; difference can be made in identifying adult palms if present; stem no more than 5 cm in diameter, and leaf with less than 17 pairs of pinnae). *Catoblastus*
 b. Blade not pilose beneath (adult stem more than 6 cm in diameter, and leaf with more than 17 pairs of pinnae). *Wettinia*
- 42a. Blade petiole and sheath strongly pilose. *Iriartella*
 b. Blade petiole and sheath not strongly pilose. *Iriartea*
- 43a. Pinnae pointed at tip, linear-lanceolate or S-shaped (Fig. 2n,o,p). 44
 b. Pinnae (or part when divided longitudinally) truncate at tip, lanceolate to wedge-shaped or like a fish fin (Fig. 2s,t,u). 66
- 44a. Pinnae much longer than wide. 45
 b. Pinnae wide, narrow basally, with length about two to four times the width, sub-opposite, 2-4 pairs per leaf blade usually light green, soft, flexible, not rigid; rarely armed with small hooks or spines on the rachis and sheath. *Desmoncus*
- 45a. With spines on pinna edges. 46
 b. Without spines on pinna edges. 48
- 46a. Pinnae white beneath; spines strongly flattened, usually black, sometimes whitish. *Astrocaryum*
 b. Pinnae glaucous beneath; spines not strongly flattened, often reddish brown. *Acrocomia*
 c. Pinnae green beneath. 47
- 47a. Spines or spiny hairs grouped at the edges near the tip or disposed regularly along pinna edge, sometimes on the blade above, black or dark brown, slender, no more than 1 cm long, often shorter, usually longer on sheath, petiole and rachis (absent in some small species), dark, not flattened, sometimes whitish with brown tip when strongly flattened. *Bactris*
 b. Spines whitish or brownish, 2-4 mm long, swollen basally, regularly disposed on the edges along the pinnae, and on the midrib above. *Raphia*
- 48a. Pinnae lanceolate (Fig. 2n); (if 3-4 ribs prominent above and below on a few narrow pinnae, 2-3 pairs per leaf, see 65b). 49
 b. Pinnae S-shaped (Fig. 2o,p). 62
- 49a. Rachis continuing into a cirrus with strong hooks in a V-shape; pinnae sub-opposite to opposite; sheath and petiole often with prickles basally swollen or with slender spines. *Desmoncus*
 b. Rachis not continuing into a cirrus with hooks. 50
- 50a. Tip of pinnae symmetric on both sides on the midrib (select pinnae from several leaves, Fig. 2b). 51
 b. Tips of pinnae asymmetric, obliquely notched, with acute or rounded tip (Fig. 2q,r) (see also 60a). 57
- 51a. Pinnae green beneath. 52
 b. Pinnae white beneath (select the youngest leaves), wide (more than 6 cm), serrate in cross section, normally arranged in one plane; sheath with erect, knitting-needlelike, black projections, 20 cm and more long. *Jessenia*
 c. Pinnae hazy glaucous beneath, generally less than 6 cm wide, normally oriented in the same plane, or in groups of 2-6 in different directions; the rachis and petiole of youngest leaves dusty red (the youngest leaf often with red blade); sheath fibrous at margins, sometimes forming a muff around the stem, often reddish brown, without knitting-needlelike projections. *Oenocarpus*
- 52a. With hooks on the petiole margins. *Elaeis*
 b. Without hooks on the petiole margins. 53
- 53a. Pinnae arranged in one plane. 54
 b. Pinnae oriented in several directions perpendicular to the rachis; leaves finely pinnate. *Syagrus*
- 54a. Pinnae obviously serrate (like a saw) in cross section (see the basal parts); petiole triangular in cross section; fibers at leaf bases. *Barcella*
 b. Pinnae not obviously serrate in cross section; petiole round basally, not strongly triangular in cross section. 55
- 55a. Sheath split, yellow to whitish as petiole, rachis and midrib. *Cocos*
 b. Sheath not split, tubular, yellow, orange, or green. 56
- 56a. Pinna tip flat; sheath yellowish to orange, covered by sheath remnants of dead leaves in juvenile plants. *Euterpe*
 b. Pinna tip carinate, sometimes flat in seedlings (confusion with *Euterpe* possible); sheath greenish. Genus limited to the western Amazonia and on the Andean piedmont. *Prestoea*
- 57a. Pinnae green beneath. 58
 b. Pinnae hazy glaucous beneath. *Oenocarpus*

- c. Pinnae green with longer tips brownish or greyish below (see pinnae of several leaves). *Attalea, Maximiliana, Orbignya, Scheelea*
- d. Pinnae white beneath. *Jessenia*
- 58a. With hooks on petiole margins. *Elaeis*
- b. Without hooks on petiole margins. 59
- 59a. Pinnae oriented in several directions; segment edge rough (like a small hack-saw); rachis often continuing into only one slender pinna. *Syagrus*
- b. Pinnae arranged in one plane; pinna edges smooth. 60
- 60a. Midrib prominent on both upper and lower surfaces on pinnae, parallel nerves prominent below; midrib with orange or brownish scales beneath; pinnae sub-opposite forming an upward V-shape toward the tip and a downward V-shape toward the base; rachis continuing into a short and narrow pinna (these characters are obvious; sometimes pinna tips are not strongly asymmetric). *Phytelephas*
- b. Midrib prominent above, not below on pinnae. 61
- 61a. Pinna tip slightly bifid, sometimes symmetric, several nerves parallel to the midrib and more prominent on pinna above than below; sheaths of dead leaves persistent and forming a muff of fibers around the stem. *Leopoldinia*
- b. Pinna tip not bifid, carinate; several nerves parallel to the midrib and prominent below; without a persistent fibrous muff around the stem, this with well-marked internodes. *Prestoea*
- 62a. Leaf tip bifid with tip of each half one-pointed. 63
- b. Leaf tip bifid with tip of each half multi-pointed. *Manicaria*
- 63a. Sheath split opposite the petiole (select old green leaves). *Geonoma, Pholidostachys*
- b. Sheath tubular, never split opposite the petiole. 64
- 64a. Ribs prominent above and beneath on pinnae. 65
- b. Ribs prominent above, not beneath on pinnae. *Hyospathe*
- 65a. Pinnae generally more than 2 cm wide, markedly S-shaped, with asymmetric tip, the lower part shorter than the upper; internodes like a truncate inverted cone; stem diameter more than 1 cm. *Chamaedorea*
- b. Pinnae narrow (no more than 2 cm wide), not markedly S-shaped, with symmetric tips, usually with 3-4 prominent ribs; 2-3 pairs of pinnae; internodes cylindrical; internodes cylindrical; stem diameter less than 1 cm. *Wendlandiella*
- 66a. With spines on the sheath, petiole, rachis, and on the stem; pinna tip truncate and broad (Fig. 2s). *Aiphanes*
- b. Without spines; pinna wedge-shaped or like a fish fin (Fig. 2t,u). 67
- 67a. With irritant hairs on the sheath. *Iriartella*
- b. Without irritant hairs on the sheath. 68
- 68a. Pinnae undivided and arranged in one plane. 69
- b. Pinnae longitudinally divided, parts oriented in several directions. 73
- 69a. Leaf tip bifid. 70
- b. Leaf tip not bifid. 71
- 70a. Pinnae green beneath. *Socratea*
- b. Pinnae white beneath. *Dictyocaryum*
- 71a. Leaf tip pointed. 72
- b. Leaf tip not pointed. *Iriartea*
- 72a. Blade pilose beneath (not always obvious, then could be confused with *Wettinia*; consider adult palms if present; stem no more than 5 cm diam., and leaf with less than 17 pairs of pinnae). *Catoblastus*
- b. Blade not pilose below (adult stem more than 6 cm diam., and leaf with more than 17 pairs of pinnae). *Wettinia*
- 73a. Upper parts of divided pinnae slightly erect but with drooping tips (leaf viewed in cross section) (Fig. 2v), green beneath. *Socratea*
- b. Upper parts of divided pinnae straight and slightly erect (leaf viewed in cross section). 74
- 74a. Upper parts shorter than the lower (leaf viewed in cross section) (Fig. 2v), green beneath. *Iriartea*
- b. Upper parts not shorter than the lower (leaf viewed in cross section) (Fig. 2x), white beneath. *Dictyocaryum*

Key 2

Leaves inaccessible
(palm height more than 10-12 m)
(Binoculars helpful)

- 1a. Leaves palmate (fan-shaped) or costapalmate (with a short, curved rachis in the blade). 2
- b. Leaves pinnate (featherlike). 4

- 2a. With spines on the trunk; most often multi-stemmed palms; leaf palmate. *Mauritiella*
 b. Without spines on the trunk; single-stemmed palms; leaf costapalmate or palmate. 3
- 3a. Leaf costapalmate, without spines on the petiole. *Mauritia*
 b. Leaf palmate with triangular, laterally flattened spines on the petiole. *Copernicia*
- 4a. Pinnæ lanceolate with tip pointed. 5
 b. Pinnæ with truncate tip, narrow and long to wedge-shaped. 19
- 5a. Prickly palms (if no spines on the trunk, see sheath, petiole, or rachis—for tall palms, look at dead fallen leaves). 6
 b. Unarmed palms. 9
- 6a. Pinnæ oriented in several directions (leaves ragged). 7
 b. Pinnæ regularly arranged in one plane. *Astrocaryum*
- 7a. Extremity of basal leaves lower than their point of insertion; with spines on the trunk, except in old palms, these not strongly flattened; upper pinnæ slightly erect with drooping tips. 8
 b. Extremity of basal leaves well above their point of insertion (crown funnellike); spines on the trunk most often strongly flattened; pinnæ straight, tips not drooping. *Astrocaryum*
- 8a. Trunk diameter more than 20 cm; numerous leaves radiating out to form a spherical crown.
 *Acrocomia*
 b. Trunk diameter under 20 cm; basal leaves markedly arching. *Bactris*
- 9a. Pinnæ oriented in several planes or directions (ragged leaves). 10
 b. Pinnæ arranged in one plane. 13
 c. Pinnæ of each side drooping in two parallel, vertical planes; sheath yellowish to orange; often with red roots from trunk base, those bearing small, white, spiny roots. *Euterpe*
- 10a. Sheath and basal part of petiole of dead leaves persistent under the crown for more than one meter. 11
 b. Sheaths of dead leaves not persistent under the crown. 12
- 11a. Leaves in crown arranged in 4–6 vertical series (see the vertical superposition of petioles from beneath).
 *Maximiliana*
 b. Leaves many, not arranged in obvious vertical series. *Scheelea*
- 12a. Leaf sheaths dark green, brown to reddish, fibrous, forming a prominent net below the crown; pinnæ glaucous beneath. *Oenocarpus*
 b. Leaf sheaths greyish, not forming a prominent net below the crown; pinnæ green beneath, oriented in several directions perpendicular to the rachis making the leaf bottle-brushlike. *Syagrus*
- 13a. Sheath and petiole base of dead leaves persistent under the crown; leaves ascending to suberect, large (8–10 m long) with numerous pinnæ (200 pairs and more), the tip of the leaf curving in the manner of a cock's tail feather. *Attalea*, *Orbignya*, *Scheelea*
 b. Sheath of dead leaves not persistent under the crown. 14
- 14a. Large leaves, more than 4 m long; trunk diameter more than 20 cm. 15
 b. Medium-sized leaves, less than 4 m long; trunk diameter less than 20 cm. 17
- 15a. With hooks on the margin of the petiole. *Elaeis*
 b. Without hooks on the margin of the petiole. 16
- 16a. Extremities of basal leaves above their point of insertion or at the same level, rarely below (crownlike an open funnel); pinnæ tend to hang at an acute angle from the rachis. *Jessenia*
 b. Extremities of basal leaves lower than their point of insertion; numerous leaves radiating out to form a spherical crown, often with a slightly free space between an upper and a lower group of leaves; sheath, petiole, rachis, and midrib yellowish to whitish. *Cocos*
- 17a. Sheath tubular. 18
 b. Sheath not tubular, usually fibrous at margins. *Oenocarpus*
- 18a. Internodes well-marked. *Prestoea*
 b. Internodes not distinctly marked. *Euterpe*
- 19a. Pinnæ undivided, arranged in one plane; medium-sized palms. 20
 b. Pinnæ longitudinally divided to the base, parts oriented in several directions; tall palms. 21
- 20a. Leaf tips entire (select the youngest leaves). *Wettinia*
 b. Leaf tips bifid. *Socratea*
- 21a. Upper parts of divided pinnæ slightly erect with drooping tips (Fig. 2v), green below; numerous stilt roots regularly spaced forming a rather open cone up to 3 m in height, each stilt root light-brown bearing small, white, hornlike, sharp, spinelike roots; root cap small at the apex of growing roots. *Socratea*
 b. Upper parts of divided pinnæ slightly erect with tips straight, not drooping. 22
- 22a. Upper parts of divided pinnæ shorter than the lower parts (Fig. 2w), green below; stilt roots at a very acute angle with the trunk forming a rather closed cone up to 2 m in height, each stilt root dark-brown, bearing white, spinelike roots; large cap covering root apex in growing stilt roots; stem usually with conspicuous swelling in low western Amazonia; stem without swelling in the Andean piedmont. ... *Iriartea*

- b. Upper parts of divided pinnae not shorter than the lower parts (Fig. 2x), white below; stilt roots at a rather obtuse angle with the trunk forming an open cone up to 1 m in height, each stilt root light-brown, bearing white, spinelike roots. *Dictyocaryum*

Acknowledgments

These two keys are the result of ten years work with palms in the Brazilian and Peruvian Amazonia in projects supported by international agreements: ORSTOM-France/CNPq-Brazil, ORSTOM/IIAP, and ORSTOM/Museo de Historial Natural

(UNMSM)-Peru. I would like to thank F. Halle who urged me to write them, as well as all my colleagues and students who tested them in the field. I am indebted to C. Peters and to H. Clark for their helpful assistance with the English manuscript.

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Principes, 34(4), 1990, pp. 208-212

CHAPTER NEWS AND EVENTS

Northern California Palm Society Summer Meetings

The Northern California Chapter of the Palm Society met at Herb Weber's palm and rhododendron garden in Greenbrae in Marin county on Sunday, May 6, 1990. The palms and rhododendrons complement each other perfectly in Herb's fine hillside garden.

Florida First Coast Chapter

The Florida First Coast Chapter of the IPS held their June meeting at the FCCJ South Campus Palm Garden combining a work party in the garden with a lunch,

meeting, and a palm sale. The garden is on the road to recovery from last winter's freeze. There were a few significant losses including a nice *Butia* × *Syagrus* hybrid, but the largest of the three Queen Palms (*Syagrus romanzoffiana*) has put out nice new growth. The group met in August for an afternoon meal meeting at Kyle and Jeanette Brown's home jointly with the Jacksonville Bromeliad Society Slides were shown of the recent IPS Biennial in Hawaii.

Louisiana Chapter

The Summer meeting of the Louisiana Chapter took place at the residence of

Charles "Shep" Field, 5330 Bancroft Drive, New Orleans, on August 26, 1990 starting with a lunch at 12:30.

The previous meeting was held on May 20 at the home of Mal and Mich Mele in Covington, Louisiana. More than 33 persons attended in great weather. After lunch, the group inspected part of Mal's plant collection available for sale. This was followed by a short business meeting and a spirited palm auction. Several new members were added to the local chapter.

The 1990 Fall meeting is scheduled to take place on October 21 in conjunction with the Gulf Coast Chapter of the IPS at the home of Maxwell Stewart, 2557 West Road, Mobile, Alabama.

Gulf Coast Chapter Summer Meeting

The Gulf Coast Chapter of the IPS held their 1990 summer meeting on July 22 in Panama City, Florida at the East Bay Community Building and the Frank Storli residence. The meeting started with a BBQ rib luncheon at noon, followed by a regular business meeting and subsequent palm auction and sale. A special guest at the meeting was Ken Rudisill, the new Bay County Horticultural Agent.

South Florida Chapter Summer Meetings

On July 21, the South Florida Chapter met at the Institute of Food and Agricultural Services (I.F.A.S.) in Fort Lauderdale, Broward County. Following an open meeting of the Chapter Board of Directors, the chapter was addressed by Tim Brochat with a "Research Update and Observations on Drought Tolerant Palms." The group then toured the I.F.A.S. facilities.

The August 15 meeting was held at Fairchild Garden at 7:30PM. Bill Theobald discussed his trip to Haiti to establish a coconut breeding program and global

implications of Lethal Yellowing. The September 8 meeting was a field trip and chicken cookout at Chapman Field with plants and seeds available for distribution.

In addition to the above, chapter volunteers held Zoo Workdays every other week (Aug 19, Sept 9, 23, Oct 7, 21). In the Summer 1990 issue of *The Palm Report*, the South Florida Chapter Newsletter, the Chapter President, Lester Pancoast recognized several chapter volunteers for their efforts on behalf of the chapter membership as well as on behalf of palms. *Principes* would like to repeat these laudits for the general IPS membership to further recognize these local workers. "Anne Throssell for years has prepared refreshments for our meetings. Mike Kambour, a busy doctor, spends hours keeping our books intelligible. Ken Johnson drives to Tampa to rescue an *Areca vestiaria* (bought by Marge Corbin) for planting at Dade County Metrozoo. Teddie Buhler, Lenny Goldstein, and Bill Theobald are eternal givers of palm information. Meanwhile, Murray Corman superbly managed 'the most successful spring sale at Flamingo Garden ever' in spite of the freeze, and Mark Levandoski has scaled similar heights with the fall sale at Fairchild. These sales ride also on the backs of palm-loving volunteers." We would like to express our "Thank you!" to all of these hard workers and the many others like them in other IPS chapters around the world.

Warning to Coconut Tree Buyers in South Florida

The South Florida Chapter has relayed a report that 20,000 coconuts from Puerto Rico have been brought to Miami and are being sold as "Lethal Yellow Resistant." Bill Theobald examined many of these nuts and said that almost all which he saw were the "Jamaica Tall" variety and thus *not* resistant. Buyers should be cautious of any such offers!

Palm and Cycad Society of Mackay Summer Activities

The Palm and Cycad Society of Mackay (a chapter affiliate through PACSOA) held a meeting each month during the summer of 1990. In May, 22 members and 7 visitors attended the meeting at Percy's Restaurant. In June, 15 members and 9 visitors toured the garden of Russ and Robyn King, experiencing some breathtaking views. *Ravenea rivularis* seedlings were distributed. Members toured the garden of Ern and Merle Buchanan on July 15 with the August 19 meeting following at the home of Betty and Lew Dovey in West Mackay. On top of this busy schedule, the group has agreed to accept an invitation to exhibit at the Mackay and District Horticultural Society on September 15 and 16. This busy group deserves applause for their efforts to further palm and cycad culture in their Queensland area "down under."

North Queensland Plans Birthday Party!

The North Queensland Palm Society of PACSOA will hold their annual plant sale on September 23 in conjunction with the 3rd Birthday of the Townsville Palmetum. Guided walks will also be offered to the interested public. This will hopefully get a good response after the late July convening in the city of "CYCAD '90—INTERNATIONAL CONFERENCE," focusing local attention on cycads and palms.

Queensland Group Plant Palms at Model Railway Site

About 15 members of the North Queensland Palm Society of PACSOA spent the day of May 6 planting about 80-100 palm seedlings to enhance the area. Additional working bees at the area are planned for fertilizing and caring for the seedlings.

JIM CAIN

The 1990 Biennial in Hawaii

On Saturday and Sunday, June 16th and 17th, some 150 members of The International Palm Society from the mainland USA and several countries, including the United Kingdom, Mexico, France, Germany, Fiji, Peninsular Malaysia and others, made their way to the Nanioloa Hotel in downtown Hilo. After being joined by about 40 Hawaiian members, the group constituted the largest Biennial ever. The festivities began with a pleasant reception on Sunday evening when fresh flower leis and good food and drinks provided the right setting for greeting old friends and making new ones. Early the next morning the buses departed for the private palm collection of President Jules Gervais. Under a handsome group of *Pigafetta* the large size of the group was very evident as Jules resorted to a bull horn to issue directions. We saw many beautiful specimens, some of the special ones including a large *Neoveitchia storckii*, *Phoenix paludosa*, several *Normanbya*, a large *Heterospathe*, *Laccospadix australasica*, and an especially nice *Calyptrocalyx spicatus*. The next stop of the morning was at Plants of Paradise with Jerry Hunter. We marveled at the large volume of palms in the shade houses, an impressive example of the importance of palms in the trade. The variety of palms being grown was also surprising; a number such as *Asterogyne martiana*, *Basselinia gracilis*, and species of *Calyptrogyne* and *Geonoma* have not been long in cultivation. We went on to a tour of the Nani Mau Gardens and a refreshing buffet lunch there. Board members then reported for their first meeting and others had a free afternoon. That evening Don Hodel spoke on the intricacies of *Chamaedorea* and his forthcoming book after which Silvia Olvera Fonseca discussed the role of the coconut in Mexico.

Talks continued the following morning with Director Bil Theobald speaking about the palms of the National Botanical Garden

on Kauai and commenting on Hawaiian pritchardias followed by Norman Bezona from the University of Hawaii discussing palm collecting in Indonesia. Early in the next afternoon buses left for the spectacular setting of Hilo's Tropical Botanical Garden and collected everyone later for one of the highlights of the meeting, a visit to Donn Carlsmith's Onomea. There the many palms including again elegant specimens in groups of *Pigafetta*, and others, *Roystonea oleracea*, *Clinostigma*, *Caryota*, and a large collection of spiny palms, *Phoenixophorium*, *Verschaffeltia*, *Nephrosperma*, *Oncosperma*, *Calamus*, and *Aiphanes* made the palm tour a treasure hunt with surprises at every turn. The beautiful setting above Onomea Bay, the gracious hospitality of Jean and Donn, the buffet supper featuring Soontaree Gervais's delicious curry, and the Hawaiian musical that followed were greatly enjoyed by all.

Board members had their second meeting on Wednesday morning while others were at leisure. A banquet by the sea at the Hilo Y. C. was scheduled for the evening. The Hilo part of the Biennial ended with a report by President Gervais on the state of the IPS and a feature talk by Dr. John Dransfield on the palms of Madagascar with special emphasis on conservation.

Before dawn on Thursday those participating in the final two days in Hawaii boarded an interisland flight for Oahu. There a bus drove us to a parking area below the Harold E. Lyon arboretum where we were greeted in pouring rain by Director Yoneo Sagawa. The rain soon lessened and we made our way up to the lovely area in the Ko'olau mountains that is the Lyon. Friends of the garden provided brownies, coffee and maps of the well prepared trails where thanks to the dedication of Ray Baker we enjoyed a collection of palms that may well rank best in the world, and as well, beautiful plants of gingers, aroids, heliconias, costus, ferns and other

collections. There were many palms to be relished—the pritchardias and veitchias, groves of *Clinostigma samoense* and *C. ponapense*, these striking *Heterospathes delicatula* with purple inflorescences, *Chamaedorea poeppigiana*, *Pinanga speciosa*, *P. philippinensis*, *Gronophyllum pinangoides*, and especially nice clumps of *Linospadix monostachya* and *L. epetiolata*. After a delicious Hawaiian lunch prepared by the friends of the Lyon, the group went on to Foster Botanical Garden to see a different collection of palms including a large *Pelagodoxa* in fruit, a female *Lodoicea* also in fruit, especially large specimens of *Nephrosperma*, and a huge *Orbignya cohune*, one of the historically recognized trees of Hawaii.

Friday we once again headed early for the airport, this time for a flight to Kauai. At Lihue buses waited to take us to the National Tropical Botanic Garden. Director Bill Theobald explained the plans and goals for the huge and impressive garden and led us down the great valley with many palms to be seen along its slopes. An elegant lunch and palm seeds waited in a large tent near the beach of a lovely cove and all too soon we were heading back for the airport and flights home, or on to Singapore for the postbiennial trip which is reported below by Norman Bezona. Throughout the tour, our many schedules and desires were competently and cheerfully handled by Trudi Zelko and her staff at Hawaii 2000.

Some of the results of the Board meetings and the report on IPS as given at the banquet by President Gervais are of importance to all members and are summarized here. The Society now has 17 chapters worldwide and by December 1990 is expected to have 3,100 members; about 25% from overseas and 75% from the U.S. Jim Cain, Chapter Chairman, with the assistance of Stacy Peacock and Paul Anderson have established a newsletter exchange between Chapters. Jim also provides a chapter column for *Principes*.

The large size and international scope of The Society necessitate some changes in its management. Three alterations were made in the Bylaws. 1) The number of directors will increase from 27 to 31. 2) We now have a second vice-president to assist the other officers; David Tanswell of Australia was elected to that post by the Board. 3) Finally to eliminate last minute nominations and a resulting lag in preparing ballots for vote, a new system was approved for the election of directors. Under the new rules, a notice will be published in *Principes* calling for members to suggest nominations for directors. The nominating committee will then prepare a final slate which will be based on regional membership and those recommended.

Other items of interest include the decision to publish Don Hodel's *Chamaedorea* book. The book is not in manuscript and

being reviewed and edited. A new publication, a series of volumes on palm species, is being considered by the Board. Because of increased postage and printing costs, we can expect IPS dues to increase \$5.00 in all categories, effective in 1992. The new organization of the Seed Bank is now in place. Members should be aware that its purpose is to serve them and foster exchange between botanic gardens but not to compete with commercial sources of seed. Orders to the Seed Bank must now be prepaid in order to avoid the cost of billing. The newly appointed officers of IPS for 1990-1992 are president Jules Gervais, Vice-Presidents Jim Cain and David Tanswell, Secretary Lynn McKamey, and treasurer Ross Wagner.

NATALIE W. UHL

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Chamaedorea seifrizii decorated as a Christmas tree. Photo by Walter H. Hodge.

