PALMS

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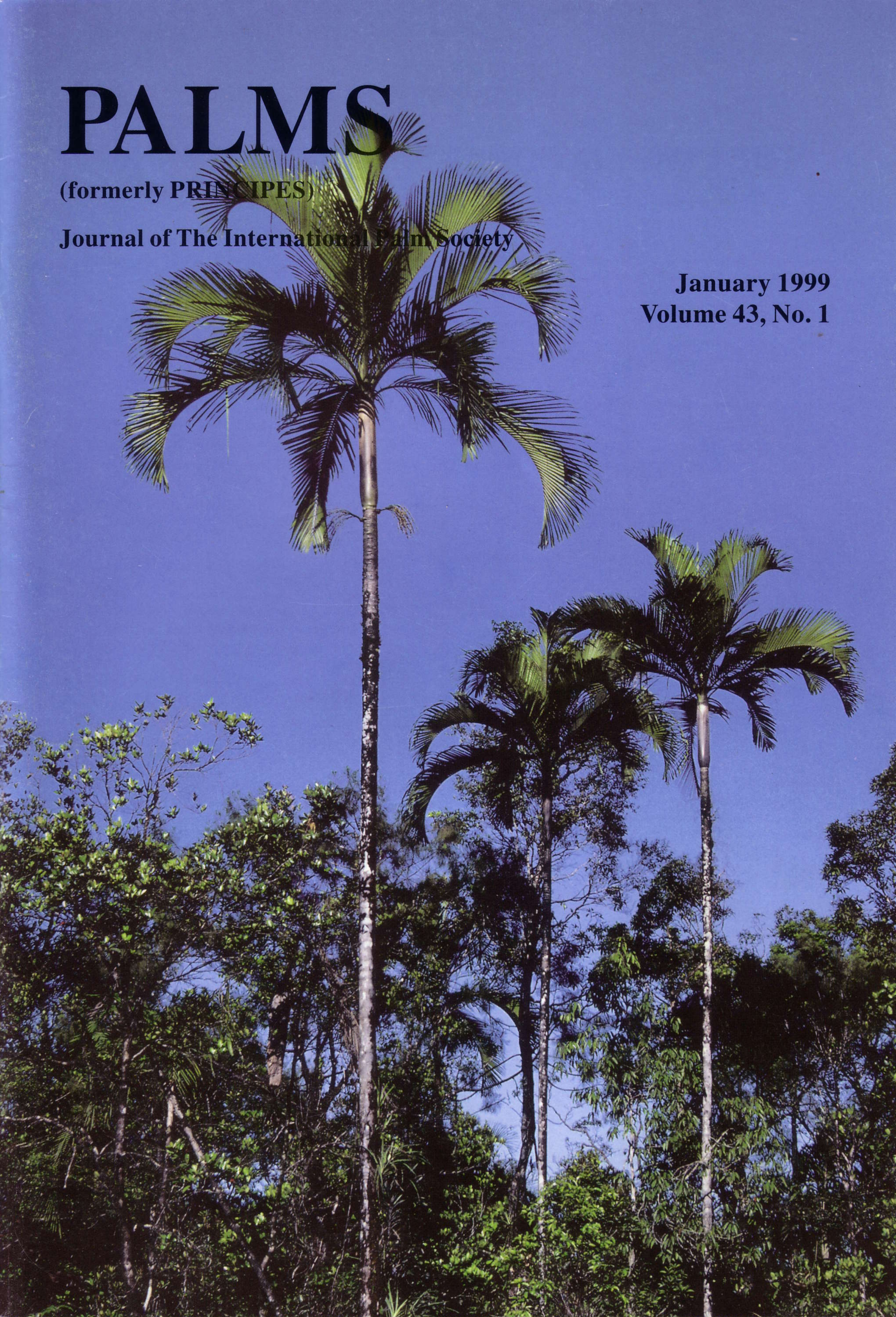

THE INTERNATIONAL PALM SOCIETY, INC.

THE INTERNATIONAL PALM SOCIETY

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Front Cover

Gulubia longispatha, growing in heath forest at low elevation at the foot of Mt. Jaya, Irian Jaya (Photo: Bill Baker).

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Accredited with the International Association for Plant Taxonomy for the purpose of registration of new non-fossil vascular plant names.

EDITORS: Dr. Natalie W. Uhl, 467 Mann Library, Ithaca, N.Y. 14853, nwu1@cornell.edu, (607) 255-7984. Dr. John Dransfield, The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE England, j.dransfield @rbgkew.org.uk, phone 44-181-332-5225.

ASSOCIATE EDITOR: Scott Zona, Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL 33156-4299, zonas@fiu.edu

GARDEN EDITOR: Lynn McKamey, *Rhapis* Gardens, P.O. Box 287, Gregory, TX USA 78359.

HORTICULTURAL EDITORS: Martin Gibbons, The Palm Centre, 563 Upper Richmond Road West, London SW14 7ED, UK; Donald R. Hodel, 5851 Briercrest Ave., Lakewood, CA 90713.

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President's Message

As the New Year is now upon us, I hope that your holidays were happy and that the coming year is bright and friendly for all. I am sure that all of you have noticed the new name of our journal: "Palms (formerly Principes), Journal of the International Palm Society." The Board of Directors voted in September to investigate a title that would be more easily recognized by palm enthusiasts and in libraries and on the internet. On December 15th, the Directors voted to approve this new name. *Principes*, our name since the inception of the I.P.S. is dear to us all, but more often than not confused new palm enthusiasts. The word means "princes," suggesting that palms are "princes" in the plant world. We are hoping that the new name, *Palms*, will make it easier for everyone to understand what we are all about.

For those of us who are in the Northern Hemisphere and outside the tropics, winter is upon us and is always a bit of a challenge. As I live in a community in the farthest south part of California, my garden rarely experiences freezing temperatures. However, it certainly has its limits and I always fear an "arctic blast." Many members throughout the world in colder areas than San Diego are continually facing the challenges of cold weather and freezing. On a regular basis, members of our palm discussion group receive e-mail messages from enthusiasts around the world asking for information on cold hardy palms. It's great to hear people exchange cultural information and experiences growing palms in their localities. This exchange of information helps teach us all about palms. This leads me to explain a few I.P.S. services offered to anyone interested in growing palms.

First I want to tell you about the I.P.S. List Server. This is an internet service that connects several hundred people throughout the world with the purpose of talking about palms and palm-related subjects. A question is raised by someone and responses come from many countries. As a subscriber, you will have e-mail messages almost daily. It is a great way to expand your knowledge and to share what you know. Some distinguished palm specialists and growers participate in the discussions and their presence guarantees that you will educate yourself on palms. As of December 15, we have moved the Server to a new location on the net. To sign up, one accesses the following location: http://www.onelist.com/subscribe.cgi/palmsociety. Once at this location you merely register and within hours you are part of the group. Welcome aboard!

Another useful and enjoyable service is offered on I.P.S. Home Page Bulletin Board. With this service, a question is posed and there is a list of responses in chronological order. As the board gets too full of answers it may be "pruned" down. However, at any given time there are about a hundred topics up for discussion. It is easy to put in your comments. Once in, this is an easy way to learn more about palms and help others from your experience. The main difference between these two services is that the Server comes to you but you must actively go to the Bulletin Board. For a given topic, the Bulletin Board is a much easier place to retrieve all the comments received. To get to the Bulletin Board, go to: http://www.palms.org

Finally, I would like to reiterate the importance of our fund raising. Donations to the Society will help promote improvements with our journal and sponsor palm related research. The International Palm Society, like other non-profit organizations, needs your support. Please contact any officer if you are interested in donating to our Society. We will earmark your gift so that it is used specifically as you wish.

Once again, Happy New Year to all and have a great 1999.

PHIL BERGMAN, PRESIDENT IPS
3233 Brant St., San Diego, CA 92103 USA
Phone: (619) 291-4605. Fax: (619) 574-1595
e-mail: PalmNCycad@aol.com

New Species Described in this Issue
Balaka streptostachys Fuller & Dowe

Palms, 43(1), 1999, pp. 5–9

Growing Palms in the Nineteenth and Early Twentieth Century: The Royal Botanic Gardens, Sydney, 1826–1915

Ian Edwards
2 Bonnie Doon Place, Cronulla New South Wales 2230, Australia

Sydney's Royal Botanic Gardens are on the edge of the central business district, 30 hectares on the shores of Sydney Harbour, in a spectacular setting next to the Opera House. As many will know, Sydney was settled in 1788 as a British penal colony. The Gardens were founded in 1816, on the site of the first farm to be established on the Australian continent. Palms have always been a major feature. However, until the 1950s, the recording of plants that were acquired or planted can best be described as very scrappy. For decades at a time records are entirely absent. All the same, it is interesting to see how much activity there was in the 1800s when it came to collecting palms from around the world. Then, as now, palm lovers were quite optimistic about what might grow for them.

In 1828 a list was made of all the plants in the collection, carefully written into a ledger which is still preserved in the Herbarium library. Among thousands of species were a few palms. The names in the table below are as recorded, with current names, if different, added in brackets.

There is then a gap in the records until 1850 except for a note that in 1840 two palmate palms were transported in tubs from the Island of Bourbon, now Reunion Island. At the place they were planted are two very old *Livistona chinensis*, each with about six meters of serpentine trunk. It is presumed that they are the same palms. Could this be true? It could be. Kyburz (1989) reported that in Italy *L. chinensis* were among palms planted before 1888 and among the "tough old survivors" still alive 100 years later. Jones (1995) says that *L. chinensis* tends to be slow growing in temperate regions, where plants rarely reach 4 m tall.

For a few years from 1850 the annual Director's Report gave details of plant material acquired, including the palms listed below.

<u>1850: From Calcutta Botanic Garden:</u>

Latania borbonica (*L. lontaroides*); *Phoenix dactylifera*; *Caryota urens*; *Sabal species*; *Wal-*

	Description	Common Name	Source	Year
Corypha australis (*Livistona australis*)	Fan Palm	Cabbage Palm	NSW	1820
Seaforthia elegans		Bungalla Palm	NSW	1824
(*Seaforthia elegans* is now *Ptychosperma elegans*, but the palm listed here must have been the Bangalow, *Archontophoenix cunninghamiana*, which for a while was also named *Seaforthia elegans*)				
Seaforthia sp.		Port Macquarie Cane	NSW	1825
(This must be the Walking Stick Palm, *Linospadix monostachya*, which is found in the Port Macquarie area.)				
Cocos mucifera			India	1826
Areca oleracea (*Roystonea oleracea*)			W. Indies	1827
Phoenix dactylifera	Common		Levant	1827
Phoenix farinifera	Small		E. Indies	1827
Chamaerops humilis	Dwarf Fan Palm		S. Europe	1827

Cocos nucifera (Coconut) needs to be much nearer the equator than Sydney to survive outside. *Phoenix farinifera* was probably grown as a possible food source.

lichia caryotoides (most plants cultivated as this are said to be *Arenga sp.*)

1851: From Royal Botanic Gardens, Pamplemousses, Mauritius:

Latania borbonica; *Euterpe oleracea*; *Areca catechu*

Collected from islands of Western Pacific during cruise of HMS Havannah

Areca catechu; *Areca sp.*; *Cocos nucifera*;

Palmaceae, two plants from Mallicolla Island (Probably Malekula Is., Vanuata)

Two plants from New Caledonia

From New Zealand

Areca sapida (*Rhopalostylis sapida*)

1852: From Botanic Gardens, Batavia (Jakarta, Indonesia)

Pinanga coronata

1853–4: From Botanic Gardens, Amsterdam

Livistona chinensis; *Cocos flexuosa* (*Syagrus flexuosa*)

From Singapore

Kabong Palm (*Arenga pinnata*)

1854–5: From Royal Botanic Gardens, Kew

Livistona jenkinsii (= *L. jenkinsiana*); *Chamaerops martiana* (*Trachycarpus martianus*)

From Mauritius

Elaeis guineensis; *Hyphaene shatan* (= *H. coriacea*)

1855–6: From Botanic Gardens, Batavia

Arenga saccharifera (= *A. pinnata*); *Calamus micranthus*; *Pinanga javana*; *Corypha gebanga* (*C. utan*); *Livistona sp.*, Java; *Livistona ? diepenhorsti* (= *L. saribus*),

Euterpe oleracea; *Calyptrocalyx sp.*, Sumatra (genus unknown in Sumatra).

1857: From Ceylon Botanic Gardens

Seaforthia dicksonii (*Pinanga dicksonii*); *Areca sp.* "Dolaloo Palm".

Then there is another gap in the records until the Director's Report for 1870–71, which gives some details of palms in the area since called The Palm Grove: "In the centre of this part of the garden is a collection of palms, which give a very pleasing effect and are perhaps the most attractive feature of any part of the grounds. The first plantation of these was started in 1862 and nearly all of the more hardy lived. These succeeded so well that an adjoining part of the ground was cleared and well trenched, the natural soil which is of a very sandy character being well mixed with town manure and vegetable mould. In this a new plantation was made of other and more tender kinds. Most of these have grown sufficiently well to prove they will stand exposure without any protection. Among the exotic kinds the most successful have been *Cocos plumosa* (*Syagrus romanzoffiana*), several species of *Phoenix*, *Areca madagascariensis* (*Dypsis lutescens* or *D. madagascariensis*), *Livistona oliviformis* (*L. chinensis*), *Latania borbonica* (*L. lontaroides*), *Areca rubra* (*Acanthophoenix rubra*), *Elaeis guineensis*, *Caryota urens*, *Hyophorbe indica*, *Chamaerops martiana* (*Trachycarpus martianus*) and *Copernicia cerifera* (*C. prunifera*)." Those of these species which are no longer growing outside, but might well be worth trying again, are: *Latania lontaroides*, *Copernicia prunifera*, *Acanthophoenix rubra*, *Hyophorbe indica*, and *Elaeis guineensis*.

Although no longer mentioning palms acquired or planted, the Director's Report of 1879 again gives special mention of the progress of the palm garden: "Palms are the most distinctive, and by far the most picturesque and attractive features of the gardens and are in fact rapidly becoming overcrowded. Some have grown into very beautiful specimens and, it is to be feared, too large to transplant. The following have all attained considerable height: *Caryota urens*, *Cocos plumosa* (*Syagrus romanzoffiana*), *Seaforthia elegans* R.Br. (*Ptychosperma elegans*), *Dypsis madagascariensis* Nor., *Areca rubra* Bory. (*Acanthophoenix rubra*), and *Phoenix farinifera*." Neither *Acanthophoenix rubra* nor *Phoenix farinifera* are in the Palm Grove today.

The Director then went on to list the palms that were growing so well as to cause overcrowding: *Livistona* species, *Chamaerops palmetto* Mich. (now *Sabal palmetto*), *Chamaerops martiana* Wall. (*Trachycarpus martianus*), *Chamaerops fortunei* (*Trachycarpus fortunei*), *Sabal blackburniana* Glaz. (possibly *S. bermudana*), *Phoenix sylvestris*, *Phoenix acaulis*, *Cocos australis* Mart. (*Syagrus romanzoffiana*), *Copernicia cerifera* Mart. (*C. prunifera*), *Pritchardia martiana* Hort. (probably in error for *P. martii*), *Kentia forsteriana* (*Howea forsteriana*) and *Kentia belmoreana* (*Howea belmoreana*). He remarked that the other two palms from Lord Howe Island, *Veitchia canterburyana* (*Hedyscepe canterburyana*) and *Kentia moorei* (*Lepidorrhachis mooreana*) did not appear to be suited to open air cultivation, and that it was doubtful if the latter would ever be made to grow except under exceptional circumstances. *Phoenix acaulis* and *Lepidorrhachis mooreana* are not growing outdoors in the Gardens today, but *Hedyscepe canterburyana* is growing well.

Further details of palms growing in the Gardens at that time are given in "The Illustrated Guide to Sydney", 1882 (Fig. 1). "Two fine specimens of the Mauritius Palm, *Livistona mauritiana*" (impossible to guess!), and a *Jubaea*—a large specimen on the lawn of the lower garden. In the Palm Division: *Corypha australis*—a relative of the Talipot of Ceylon—a fine specimen, (*Corypha utan* or *Livistona australis*?); *Seaforthia elegans*, of tropical Australia (*Ptychosperma elegans*); *Cocos plumosa*, 30 feet high or more (*Syagrus romanzoffiana*); and *Cocos flexuosa* (*Syagrus flexuosa*), these Brazilian palms are related to the coconut; *Phoenix reclinata*, a fine plant; *Phoenix dactylifera*, some fine examples; and *Phoenix sylvestris*; *Caryota urens*, from India; *Chamaerops martiana* (*Trachycarpus martianus*) and *Chamaerops excelsa* of Nepal (probably *Trachycarpus fortunei*); *Chamaerops humilis* of southern Europe; *Chamaerops fortunei* of China; *Sabal princeps*, conspicuous; and *Sabal palmetto*. *Areca sapida* of New Zealand (*Rhopalostylis sapida*) and *Areca monostachya* of Java (*Linospadix monostachya*, but not of Java); *Calamus australis*. In the Lower Garden are two well-grown specimens of *Latania borbonica* (*L. lontaroides*)." Today, there is a big old *Jubaea* (Fig. 2) on a lawn in the Lower Garden but no longer any *Latania lontaroides* and *Corypha*. However, specimens of all the other species are still grown.

The *Illustrated Sydney News* of February, 1885 mentions "*Hyophorbe* of Mauritius, *Pritchardia* of the Sandwich Islands (Hawaii), and *Diplothemia* of Brazil (*Allagoptera*)." Plants of these genera are grown today.

A further gap in the records, until a note that in 1900 there was "a plague of Flying Foxes, thousands of them. It is many years since the gardens were visited by a plague of such severity. A number of local sportsmen were called in, who shot large numbers of them. All were killed or flew away within a week." (The next plague, much less severe, was reported in 1915. Today,

1. Sydney Royal Botanic Gardens in the 1880's.

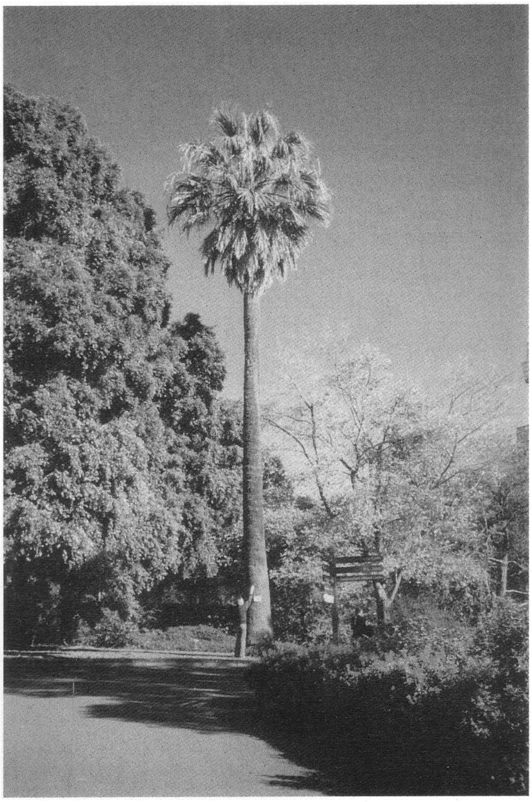
invasions of these now protected fruit bats are dealt with less brutally—but less effectively.)

In 1905 it was noted that a *Washingtonia sonorae* (*W. filifera*) was flowering.

A burst of palm planting is reported between 1908 and 1915, with the director cautioning that "it is premature yet to speak definitely as to whether some of the new tropical kinds will survive." Of the following species, sadly, none is grown today. Some of them (marked *) might be expected to survive as they grow in private collections in Sydney: *Actinorrhytis calapparia*, *Areca triandra**, *Arenga obtusifolia*, *Astrocaryum malybo*, *Astrocaryum mexicanum*, *Attalea guichive* (*Attalea sp.*), *Bactris major*, *Bactris maraja*, *Borassus flabellifer*, *Brahea calcarea*, *Calamus scipionum*, *Calyptrocalyx spicatus*, *Chamaedorea bifurcata* (*C. pinnatifrons**), *Chamaedorea elatior**, *Chamaedorea metallica**, *Chamaedorea sartorii**, *Cocos coronata* (*Syagrus coronata**), *Cocos schizophylla* (*Syagrus schizophylla**), *Corypha gebanga* (*C. utan*), *Daemonorops angustifolia*, *Didymosperma porphyrocarpum* (*Arenga porphyrocarpa**), *Elaeis guineensis*, *Euterpe oleracea*, *Geonoma acaulis*, *Geonoma gracilis*, *Geonoma schottiana*, *Hyophorbe amaricaulis*, *Kentia kersteniana* (*Ptychosperma kerstenianum*), *Korthalsia robusta*, *Latania loddigesii*, *Licuala jeannencyi* (? *Pritchardiopsis*) *Licuala muelleri*, *Licuala peltata*, *Licuala rumphii*, *Licuala spinosa*, *Livistona jenkinsiana*, *Livistona woodfordii*, *Malortiea fenestra* (*Reinhardtia sp.*), *Nephrosperma vanhoutteanum*, *Oncosperma fasciculatum*, *Oncosperma horridum*, *Pholidocarpus kingianus*, *Pinanga acaulis*, *Pinanga patula*, *Pritchardia gaudichaudii*, *Pritchardia hillebrandii**, *Pritchardia pacifica*, *Ptychoraphis augusta* (*Rhopaloblaste augusta*), *Raphia hookeri*, *Raphia pedunculata* (*R. farinifera**), *Serenoa arborescens/serrulata* (*S. repens**), *Thrinax argentea**, *Trithrinax campestris*, *Zalacca edulis* (*Salacca zalacca*).

There were some successes, and the following species planted at that time are still represented

2. *Jubaea chilensis* along a walk in the garden.



3. A tall *Washingtonia filifera*.

in the Gardens: *Archontophoenix alexandrae, Areca catechu, Arenga saccharifica* (*A. pinnata*), *Calamus viminalis, Ceroxylon andicola C. alpinum*. This old palm, which is still there, has been determined by Dr. John Dransfield of Kew as *Polyandrococos pectinata, Chamaedorea ernesti-augusti, Chamaedorea martiana* (*C. elegans*), *Chrysalidocarpus lutescens* (*Dypsis lutescens*), *Cocos bonnetii* (*Butia bonnetii*), *Cocos botryophora* (*Syagrus romanzoffiana*), *Cocos insignis* (*Lytocaryum insigne*), *Colpothrinax wrightii, Dictyosperma album, Erythea armata* (*Brahea armata*), *Erythea brandegeei* (*Brahea brandegeei*), *Erythea edulis* (*Brahea edulis*), *Heterospathe elata, Hyophorbe verschaffeltii, Latania verschaffeltii, Martinezia sp.* (*Aiphanes sp.*), *Licuala grandis, Licuala spinosa, Livistona hoogendorpii* (*L. saribus*), *Livistona rotundifolia, Oreodoxa oleracea* (*Roystona oleracea*), *Oreodoxa regia* (*Roystona regia*), *Phoenix humilis* (*P. loureirii*), *Phoenix humilis* var. *roebelnii* (*P. roebelnii*) *Phoenix rupicola, Phoenix zeylanica* (*P. pusilla*), *Rhapis flabelliformis* (*R. excelsa*), *Rhapis humilis, Sabal acaulescens* (*S. minor*), *Sabal blackburniana* (*S. sp.*), *Sabal ghiesbreghtii* (*S. sp.*), *Sabal havanensis* (*S. sp.*), *Thrinax xanthocarpum* (*Thrinax sp.*), *Trachycarpus martianus, Trithrinax brasiliensis, Wallichia caryotoides* (*Arenga sp.*).

In 1914–15 it was noted that there were fruit on *Phoenix humilis* var. *roebelenii* (*P. roebelenii*) and on *Cocos weddelliana* (*Lytocaryum weddelianum*), which had thus proved hardy enough for growing outside in Sydney. Success was attributed to "deep trenching, with food at the bottom to induce the roots to grow down." There was also mention that "*Pritchardia maideniana*, from the South Sea Islands, precise locality unknown, has been growing in the Gardens for many years under the name of *P. martii*, but Dr. Beccari of Florence, Italy, has pronounced it to be a new species. It flowers and seeds freely every year."

Records became brief as the Great War of 1914–18 continued, and in 1923 the Gardens were taken over by the Department of Agriculture, in whose annual reports the Botanic Gardens rated about one paragraph, mainly about weeds. It was not until the 1950s that a card filing system was established to record plants in the collection. This has been replaced by a computer database. All the palms are on record, with their location on a grid. For the more recent acquisitions there is also a record of when and where they were collected and when planted out. But for most of the older palms-such as a 12 m. *Parajubaea cocoides*, or a *Washingtonia filifera* (Fig. 3) about 20 m tall—their history can only be guessed.

Acknowledgments

I thank Miguel Garcia from the Royal Botanic Gardens Library and Chris Ward from Records for their assistance. Any errors are mine.

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Palms, 43(1), 1999, pp. 10–14

A New Species of Balaka from Fiji

DYLAN FULLER[1] AND JOHN L. DOWE[2]
[1]*Natural History Museum, London, UK*
[2]*Department of Tropical Plant Sciences, James Cook University, Townsville, Queensland, Australia*

Balaka, a genus in the subtribe Ptychospermatinae, has nine species distributed in Fiji and Samoa. The genus is most closely related to *Veitchia, Ptychosperma,* and *Drymophloeus,* but is distinguished by a combination of a leafsheath that is not fully tubular but split opposite the petiole and with margins near the apex lacerate-fibrous, an elongate peduncle, triads distichously arranged on the rachilla, irregularly shaped endocarp, and seed variously ridged and furrowed. Otherwise, the genus is similar with pinnae that are obliquely truncate and praemorse at the apex, staminate flowers symmetrical and bullet-shaped in bud, numerous stamens, anthers versatile, a prominent pistillode, fruit with apical stigmatic remains, homogeneous endosperm, and basal embryo.

Renewed study of the palm flora of Fiji has been ongoing since the early 1990s, with one of us (DF) recently completing a MSc thesis on the family in Fiji. The Arecaceae in Fiji is represented by 12 genera, only one of which is endemic, and 27 species, all of which are endemic. A close affinity with the palm flora of Vanuatu has been demonstrated by the recent description of two new species, *Neoveitchia brunnea* Dowe and *Heterospathe uniformis* Dowe, that are closely related to Fiji taxa (Dowe and Cabalion 1996). *Neoveitchia* was previously considered endemic to Fiji, while the Vanuatu and Fiji *Heterospathe* species appear more closely related to each other than to other species in the Solomon Islands or elsewhere. The most recent description of a new species of Fiji palm was that of *Heterospathe phillipsii* Fuller and Dowe (Fuller et al. 1997), and now there is an additional species of *Balaka,* as herein presented. There also appear to be new species of *Gulubia* and *Cyphosperma* yet to be described for Fiji.

Balaka streptostachys Fuller and Dowe **sp. nov.**

Palma, *Balakae microcarpae* et *B. macrocarpae* affinis, sed truncus robustior usque ad 10 cm diametro. Inflorescentia usque ad 1.5 m longa. Rachilla trigona asymmetrica, tortilis, tortis 40°–60° intermittentibus, tortis 3–5 in quoque rachilla. Flores in 3–8 triadibus distichis inter tortos in foveis vadosis. Flos staminatus albastro tubernatus, 20–35 stamina. Fructus 18–25 mm longus, 8–14 mm latus. Apex endocarpi aliquantum rostrata, pagina endocarpi canalibus vadosis irregularibus. Typus: FIJI. VANUA LEVU: above Nakorutari Village, below ridge above Matani Creek along Raciba Road, *Fuller 338, with E. Jones and T. Bulitavu,* 23 Feb. 1996 (holotypus BRI; isotypi K, SUVA).

Solitary palm, *trunk* erect, 4–7 m tall, dbh 7–10 cm, base not expanded, internodes congested, dark green to grey with age, nodes conspicuous, light green-brown. *Leaves* eight to ten in the crown, held erect, slightly arcuate, regularly pinnate, to 3 m long including petiole and leafsheath, adaxially mid green, abaxially olive green; petiole 35–45 × 2.5–3.5 cm wide, adaxially concave, abaxially rounded, densely tomentose with scattered long dark scales; leafsheath tubular, split longitudinally opposite the petiole in the upper quarter, 30–50 cm long, abaxially green–light brown, densely tomentose with scattered dark scales, adaxially white, glabrous,

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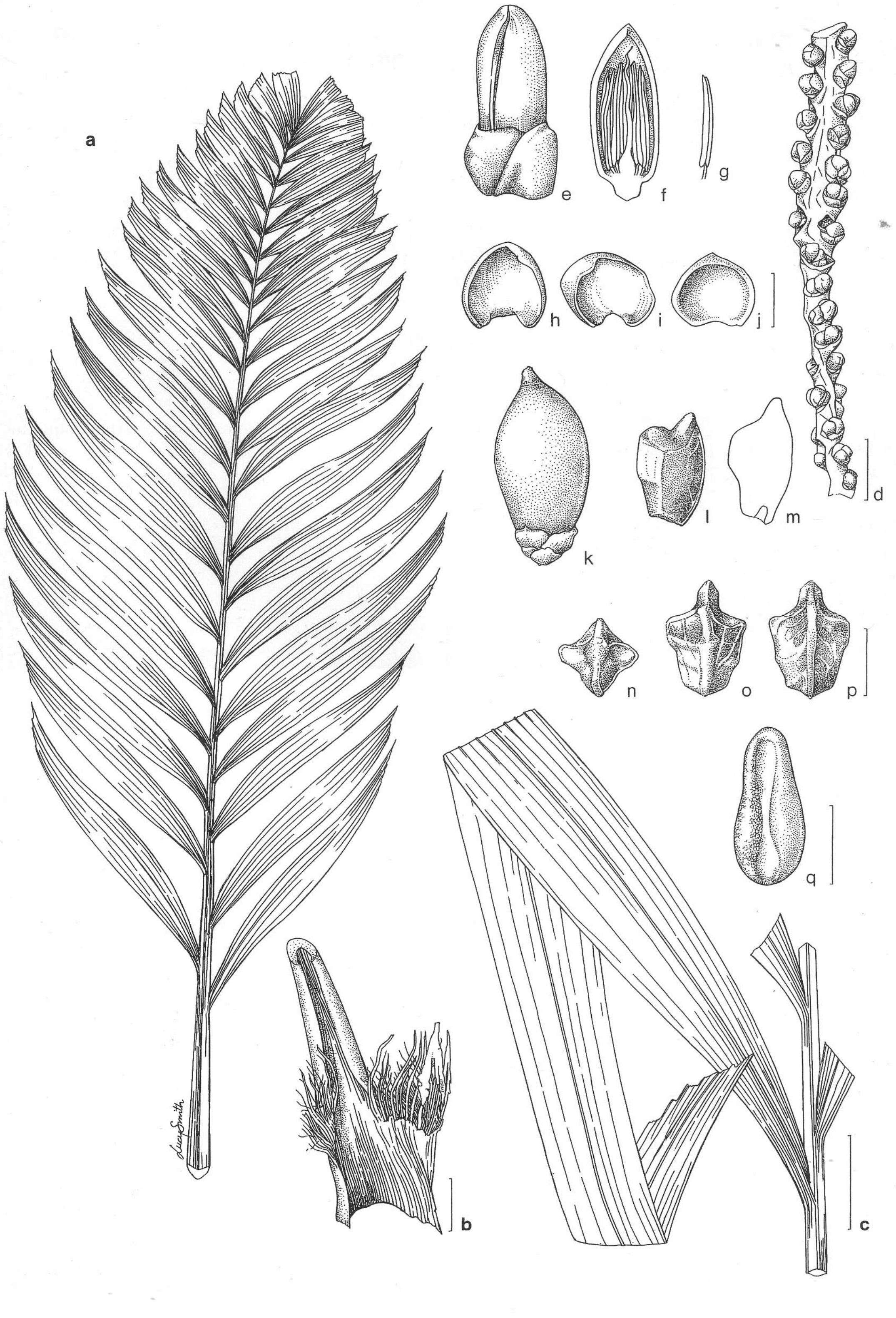
1. *Balaka streptostachys.* a. leaf. b. petiole base and leafsheath apex with lacerate-fibrous margins. c. pinna. d. section of rachilla. e. staminate flower in bud. f. staminate flower in cross-section. g. stamen. h.–j. sepals. k. fruit. l. seed, equatorial side view. m. seed in same view, cross-section with embryo exposed. n. seed, apical view. o. seed, equatorial back view. p. seed, equatorial front view. q. pollen grain. Scale bars: b. 3.5 cm; c. 6 cm; d. 2 cm; e.–j. 2 mm; k.–p. 5 mm; q. 15 µm. Illustration by Lucy T. Smith, a.–d. from *Fuller 338,* e.–q. from *McClatchey and Fuller 1095.*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Lucy Smith

2. a. *Balaka streptostachys* in habitat, Vanua Levu, Fiji. b. Inflorescence with staminate flowers in bud.

margins at the apex lacerate-fibrous, fibers coarse and thick; rachis densely tomentose with scattered dark scales, proximally channelled, becoming ridged distally adaxially, abaxially rounded proximally, flattened distally, diamond-shaped in cross-section at mid rachis. *Pinnae* in one plane, regularly arranged, sub-opposite, 18–22 per side, obliquely truncate at the apex, apically dentate; mid-leaf pinnae elongately falcate, 83–95 × 6–8 cm wide, tapered from the middle toward the apex and the base; basal pinnae 90–110 × 6–7 cm wide; distal pinnae increasingly elongate to compactly cuneate toward the leaf apex, apical pair basally joined for one-sixth to one-fourth their length; mid rib prominent on both sides in all pinnae, secondary ribs almost as prominent abaxially only, two to six each side of pinna, marginal veins thick, lower marginal vein tomentose. *Inflorescence* interfoliar becoming infrafoliar in age, 1–1.5 m long, branched to three orders; axes densely silver tomentose when young, densely red-brown tomentose at maturity; prophyll boat-shaped, 35–40 cm long, fully encircling the peduncle at attachment, persistent; peduncular bract one, 70–78 cm long, attached 27–30 cm above attachment of the prophyll, narrowly tubular, persistent and withering to a fibrous papyraceous state; peduncle elongate, 60–65 × 2.0–3.5 cm wide, laterally compressed, elliptical in cross section; rachilla 16–30 × 0.4–0.5 cm wide, irregularly angled in cross-section, densely tomentose, triads in shallow pits, three to eight triads ranked linear-distichous, rachilla with 40°–60° twists at intermittent intervals, with three to five twists per rachilla. *Flowers* in triads for entire length of the rachilla; staminate flowers bullet-shaped in bud, 6–7 mm long, symmetrical, white; sepals triangular, 3 mm long, margins smooth; petals elongate, 6 mm long, 2–3 mm wide, apically pointed, thick, apically valvate; stamens 20–35; filaments thin, 3–4 mm long; anthers linear, 4 mm long, dorsifixed, versatile; pistillode elongate, 4–5 mm long, flask-shaped. *Pollen* elliptical in

3. *Balaka streptostachys*, leaf portions overlaid with section of infructescence with maturing fruit. Photo credits: 2a. and b. J. Marcus; 3. R. H. Phillips.

polar view, long axis ca. 36 µm, short axis ca. 15 µm, monosulcate, exine tectate, finely reticulate. *Fruit* irregularly ovoid, tapered toward the apex, 18–25 × 8–14 mm wide, orange-red at maturity, stigmatic remains apical on a beaked cone; epicarp smooth, drying moderately granular; mesocarp 2–3 mm thick, fibrous; endocarp longitudinally ridged, four-angled in cross section, apex with a moderate beaked extension, surface with numerous irregular shallow channels; seed similarly shaped as endocarp; hilum longitudinal; endosperm homogeneous; embryo basal. *Eophyll* bifid. (Fig. 1).

Distribution. Fiji. Vanua Levu, known from a single location S of Labasa on the logging road toward Mt. Sorolevu, at 300 m elevation; grows as an understory palm in lower montane rainforest in a boggy area.

Additional Specimens Examined. FIJI. Vanua Levu, above Nakorutari Village, below ridge above Matani Creek along Raciba Road, *McClatchey and Fuller 1095/185, 1099/189,* 13 May 1995 (FTG, SUVA).

Etymology. From the Greek *strepto* (twisted) and *stachys* (spike) in reference to intermittent 40°–60° twists in the rachilla, with the sections between the twists otherwise straight. This character has not been observed in other species of *Balaka.*

Ethnobotany. No native Fijian name or uses for this palm have been recorded.

Conservation Status. Proposed for IUCN Red List threatened category — Critically Endangered. There are 50–60 adult trees in the single known population of this unusual palm. This area has been selectively logged, and future logging is imminent. Dick Phillips (*personal communication*) has two seedlings of this taxon in cultivation in Fiji.

Notes. Balaka streptostachys (Fig. 2a) is distinguished by its comparatively greater trunk diameter, to ca. 10 cm, than that of similar species such as *B. microcarpa* and *B. macrocarpa.* The inflorescence is distinctive in that the rachillae are densely tomentose, have 40°–60° twists at intermittent intervals, and are angular in cross-section (Figs. 2b,3). Triads are ranked distichously, three to eight per section between the twists in the rachilla. The endocarp and seed are ridged and angular as with other *Balaka* species, though the arrangement with a single prominent longitudinal ridge, extended "wings" and quadrangular in cross-section is distinctive. An informal description of this species was included under the name of *Balaka* "robusta" in Fuller (1997) and again in Doyle and Fuller (1998). The species was first observed by Timoci Bulitavu, while working on construction of a logging road. Subsequently he showed it to palm horticulturist, Dick Phillips of Suva, Fiji, in early 1994, and again to Phillips along with DF and Will McClatchey in 1995.

Balaka streptostachys occurs as an understory palm species in mixed evergreen-lower montane rainforest. The single known population is growing on very wet, spongy ground in a flat section of the Mt. Sorolevu foothills. This area receives well over 3000 mm of rain per year. The associated vegetation includes the palms *Alsmithia longipes* H.E. Moore (new island record [*McClatchey and Fuller 1101/191,* 13 May 1995, and FTG, SUVA]), *Balaka macrocarpa* Burret and *Physokentia thurstonii* (Becc.) Becc. Higher up the slopes starting at c. 500 m large numbers of *Gulubia microcarpa* Essig (new island record [*McClatchey and Fuller 1117/210*, 17 May 1995, FTG, SUVA]) can be found and *Clinostigma exorrhizum* (H. Wendl.) Becc. occurs above 900 m on the slopes and the top of Mt Sorolevu.

Acknowledgments

We wish to thank Timoci Bulitavu for discovering this unique palm, and Will McClatchey for helping get DF to the type location. We also want to thank Mr. R. H. (Dick) Phillips, Dr. Michael F. Doyle, Dorian Fuller, and Lucy Smith for assistance with this work. Partial financial assistance for this study was provided by a research grant from the University of the South Pacific to DF; additional ground travel was made possible by the Fairchild Tropical Garden, and a complimentary inter-island flight was provided by Sunflower Airlines of Nadi, Fiji.

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Palms, 43(1), 1999, p. 15

CYCAD '99

August 7–10, 1999

An international conference of cycad enthusiasts, growers, and scientists

Sponsors: The Fairchild Tropical Garden, the Palm Beach Palm and Cycad Society, and the Montgomery Botanical Center.

Participants: All persons interested in the horticulture, conservation, and science of cycads, a group of beautiful, rare, and endangered plants that have existed since the age of dinosaurs.

Cycad '99 will feature submitted talks and posters on scientific topics, invited presentations on horticultural topics, tours of the extensive collections at the Fairchild Tropical Garden and the Montgomery Botanical Center, and opportunities to meet and socialize with cycad enthusiasts from around the world. This is a first call to those who wish to have further information and registration materials sent to them.

Call for Papers

Submitted abstracts will be reviewed and selected for either an oral paper or poster presentation by the Research Committee (Drs. Jack Fisher, Dennis Stevenson, and Terrence Walters). Full presentations of talks and posters will be processed after the meeting as manuscripts for peer review and publication by the New York Botanical Garden Press (most likely as a volume of *Mem. N.Y. Bot. Gard.*).

Agenda and Logistics

The tentative schedule for this four-day conference includes horticultural topics (Days 1–2), scientific topics (Days 2–4), formal tours of the collections (Days 1–4), business meetings of the Cycad Society and IUCN cycad specialist groups (Day 3), and receptions and a banquet. Other attractions include the local flora: Florida is the home of the coontie (*Zamia pumila*, also known as *Z. floridana*, and by other names), the only cycad native to the USA; and almost all of the world's other cycads, which are cultivated in Miami's subtropical climate. Everglades National Park, Miami Beach (South Beach), and the Florida Keys are within driving distance.

A block of rooms is reserved at a hotel near the meeting site, and bus service will be provided. Detailed information will accompany the registration packet. The registration fee is not yet determined.

Registration/Information

To receive registration and abstract submission forms, please send your name, mailing and email addresses, telephone and fax numbers, to

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Palms, 43(1), 1999, pp. 16–17

A New Locality for Phoenix theophrasti on Crete

A. IGERSHEIM AND C. WECKERLE
Institute of Systematic Botany, University of Zürich, Zollikerstrasse 107, 8008 Zürich, Switzerland

Several solitary *Phoenix theophrasti* trees or groves are well-known in coastal areas on Crete (Greuter 1967, Barclay 1974, Vamvoukakis 1988, Turland 1992, and Rackham and Moody 1996). A large, new native population is now reported from the district of Agios Vasilios in the province of Rethimnon. It is situated ~12 km east of Moni Preveli gorge, where a previously known, large population of *Phoenix theophrasti* exists. These palm trees usually grow along moist gorge floors, shallow valleys and stream banks, near springs, and on coastal rocks or cliffs at an altitude under 230 m (Turland et al. 1993), often with great distances between scattered localities (see Rackham and Moody 1996; Fig. 6.13).

The new specimens are ~2 km east of the small village of Agios Pavlos at an altitude of ~100 m (Figs, 1, 2), growing along a small rivulet (probably seasonally dry) in a very shallow valley with sandy ground. The dense grove has a length of ~30 m and consists of numerous trees with crowns up to ~2.5 m (Fig 3). Associated species are *Calicotome villosa* (Poiret) Link, *Imperata cylindrica* (L.) Raeusch., *Sporobulus pungens* (Schreb.) Kunth, *Phlomis fruticosa* L., *Pistacia lentiscus* L., *Pyrus spinosa* Forssk., *Sarcopoterium spinosum* (L.) Spach, and *Vitex agnus-castus* L. Several solitary palm trees are also scattered up- and downstream, along the nearby shallow valleys, and in the areas between. Two palm trees grow by the rocks (Fig. 4) on the beach next to a rivulet.

According to present knowledge, this new population brings the total number of naturally occurring *Phoenix theophrasti* localities on Crete to ten (see also Rackham and Moody 1996; Fig. 6.13).

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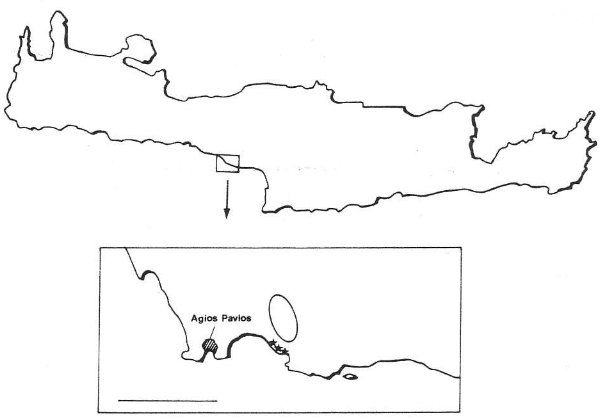

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2. View is east from the village of Agios Pavlos toward the larger site of *Phoenix theophrasti* (circled area). Coastal solitary palm trees are indicated by stars. 3. Dense grove of palm trees at an altitude of ~100 m. 4. Coastal area with two solitary palm trees (arrows).

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1. Location of study area east of the small village of Agios Pavlos. The area of the larger site of *Phoenix theophrasti* is circled. Coastal solitary palm trees are indicated by stars. Scale bar: 6 km.

Palms, 43(1), 1999, pp. 18–19, 48–50

Occurrence of Hermaphroditism in the Male Date Palm[1]

C. Sudhersan and M. Abo El-Nil

Department of Biotechnology, Kuwait Institute for Scientific Research, P. O. Box 24885, Safat 13109, Kuwait.

Abstract

The occurrence of hermaphrodite flowers on male date palm trees has been documented in several cases in Saudi Arabia and Kuwait. Some of these flowers produced viable seeds which germinated into morphologically normal plants. An imbalance of plant growth regulators may be the most probable mechanism for the occurrence of this phenomenon.

The flowers in palms can be bisexual, unisexual, and then monoecious or dioecious. The date palm (*Phoenix dactylifera* L.), belonging to the family Arecaceae, is a dioecious species producing dimorphic flowers. However, fruiting male palms (Leak 1914) and occurrences of occasional apparently bisexual flowers (De Mason and Tisserat 1980) have been reported in this species. In this paper we report a unique occurrence of hermaphroditism and viable seed formation in male date palms.

The authors noticed in Saudi Arabia and Kuwait that normal, healthy male date palms sometimes produce inflorescences with complete bisexual flowers (Fig. 1), and observations on those male palms are the subject of the present communication.

Observations

Early observations were made between 1989 and 1996 on a healthy 20-year-old male date palm of about 5 m in height and 50 cm in diameter that was growing at the Date Palm Tissue Culture Laboratory of the Ministry, Agriculture and Water Research Center, Riyadh, Saudi Arabia. Every year, male inflorescences appeared early in February. In 1995, all the normal male inflorescences were removed to pollinate female trees. After the removal of the male inflorescences, six new inflorescences appeared in July. Two inflorescences were removed from the tree at an early stage of development for microscopic examination, and the remaining four were left on the tree for fruiting (Fig. 1A).

The inflorescences appeared normal and enclosed within a single prophyll. The rachis was flattened and about 50 cm long with numerous rachillae (Fig. 1B and C). Each rachilla had from 25 to 30 bisexual flowers. The flowers were sessile, and each flower had three sepals, three petals, three to six stamens, and three carpels. All three carpels developed uniformly in the case of unpollinated flowers (Fig. 1D and E), while only one developed in the case of pollinated flowers. At the early stages of development, the infloresences were pale greenish in color which later turned dark green (Fig. 1C). The fruits attained a yellow color as they matured (Fig. 1E). Each fruit was 25 mm in length and ranged from 14 to 16 mm in diameter. Most of the fruits were parthenocarpic, while some developed viable seeds. Both parthenocarpic and seed-bearing fruits were fleshy and sweet, simi-

(continued on page 48)

[1]Kuwait Institute for Scientific Research publication No. 5162

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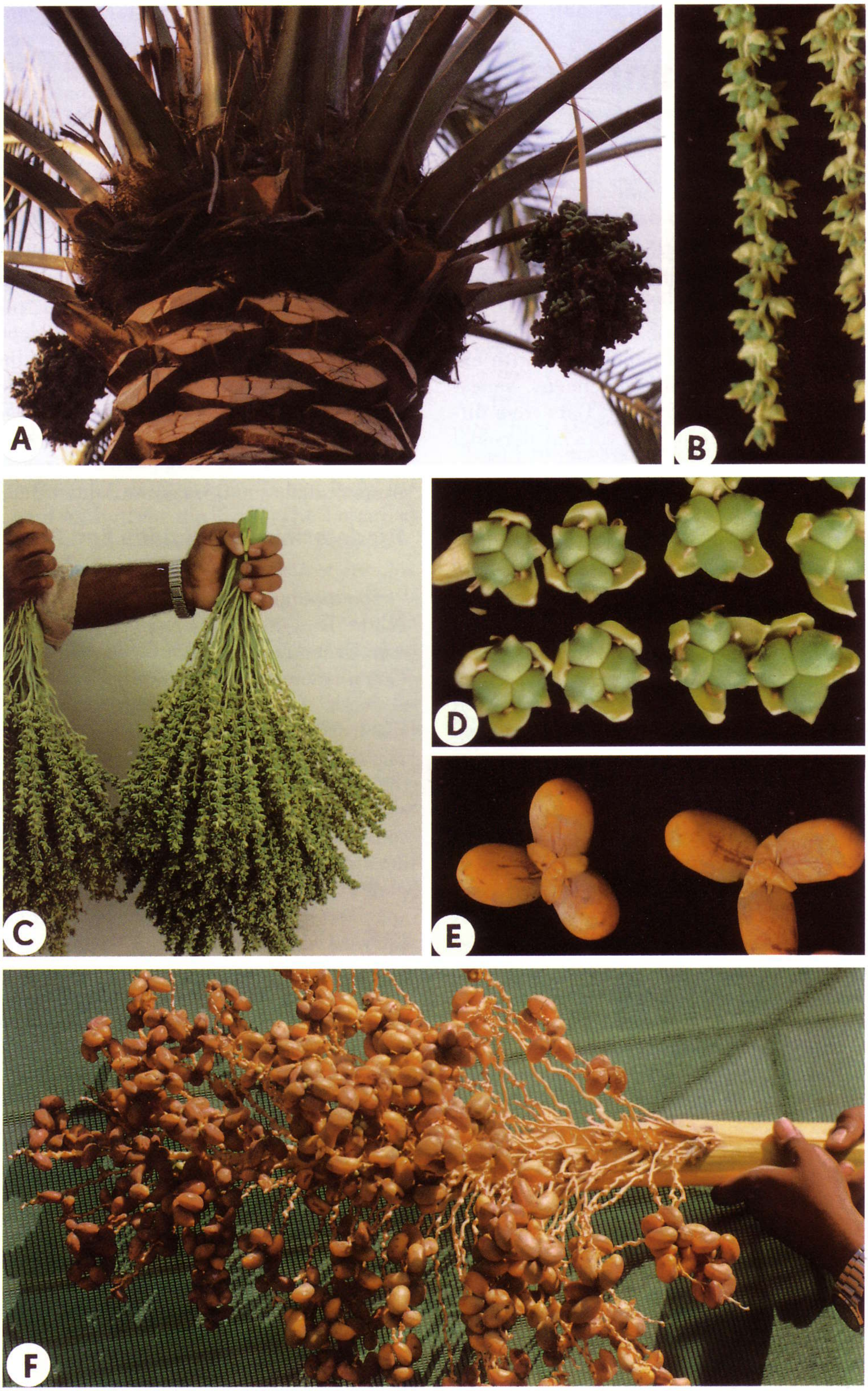
1. Development of hermaphrodite inflorescences with long rachises on a male date palm tree growing in Riyadh, Saudi Arabia. A. Complete inflorescences on the tree, B. Close-up of the developing rachillae, C. Numerous developing rachillae with hermaphodite flowers, D. Unpollinated (parthenocarpic) fruits, E. Maturing fleshy fruits, and F. Full inflorescence with matured fruits.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Palms, 43(1), 1999, pp. 20–24

Death and Longevity of Palms

Carlo Morici
Departamento de Biologia Vegetal (Botánica), Universidad de La Laguna 38071 Tenerife, Canary Islands, Spain

The processes of senescence and death in palms have never been studied extensively. Most ornamental palms are very long-lived plants, and few people in the past made records about their longevity and death. This paper deals with exceptionally long-lived palm specimens, senescence, and the process of dying. Data from different sources are intermingled with my personal observations.

Why Does a Palm Die?

The simplicity and the efficacy of the "one bud–one stem" system suggest that palms could grow indefinitely, but all living things must die. Most biology textbooks show the generalized growth curve: most living beings develop slowly at first, then faster until they reach a maximum growth rate. The rate then decreases slowly until the organism attains its maximum size and dies. In fact, there is a basic law in biology: as the size of an organism grows, it becomes a brake to its own further development.

Palms are a good example of this behavior: a young *Washingtonia robusta* (measured in La Laguna, Tenerife) can produce 50 cm of trunk each year, while the same palm thirty years later may grow as slowly as 10 cm per year and maintain that low growth rate the rest of its long life. Typically, the death of an old palm starts with the progressive impoverishment of its crown. The trunk tapers, leaves grow smaller and weaker, sometimes yellowing. Seed production may be affected. The narrower top of the trunk can be observed after the death of the plant.

Perhaps the problem in palms lies in the proportion between crown and trunk. Tomlinson (1990:163) highlighted that palm stems are "overbuilt." The trunk that looks proportionately oversized in youth becomes dramatically undersized in proportion as the plant grows. Palm stems lack secondary thickening, but to endure the increased mechanical pressure, they strengthen the cell walls of their trunk fibers and vascular elements by the addition of lignin and cellulose, thereby increasing overall rigidity (Tomlinson 1990:163). As this strengthening occurs, the available space in their old "pipes" is reduced, and occlusions and malfunctions occur in the sclerotized vascular bundles. At the same time, photosynthesis cannot supply enough products to and through the enormous mass of trunk and roots. As a result, the whole tree is underfed, and the bud produces a weaker shoot that grows thinner and thinner until death occurs.

Predetermined Suicides and Premature Deaths

Some palms show a different kind of natural death. They have a *hapaxanthic* flowering system. Each stem flowers just once and then dies. This phenomenon is a sort of programmed natural death: as soon as the stem reaches flowering size it self-destructs for the sake of reproduction. The most famous hapaxanthic palms are those of the genus *Corypha*, which end their life with a spectacular mass of flowers. Nevertheless, in some hapaxanthic palms, the flowering process does not coincide with the death of the whole plant. Multi-trunked or branching hapaxanthic species, such as *Nannorrhops ritchiana* and *Caryota mitis*, continuously replace the dying stems with new shoots.

Death is not always associated with old age. In many cases, young lives are suddenly interrupted. Damage caused by nature can be fatal to palms, such as unexpected cold, heat, drought, or flood. These accidents are not exclusive to cultivated individuals; in their natural habitats also palms are subject to fatal damages.

A palm can die if broken by strong winds, smothered by vines, destroyed by wild fires, lightning strikes, or attacked by pests. Many palm species that grow as emergent specimens in savanna or scrub habitats seldom achieve old age due to lightning strikes. All the Cuban *guajiros* clearly explain that most *Roystonea* palms never grow over 20 m because they are uprooted by hurricanes or struck by lightning well before.

S. Zona (*personal communication*) proposes lightning strikes as the major cause of death for *Sabal palmetto* in the Everglades, Florida. In the Mediterranean, most cultivated *Phoenix* spp. die this kind of violent death from high wind, while washingtonias and sabals resist high wind much better.

Some Important Recorded Cases of Palm Longevity

Only a few palm species are really long-lived, and only a few specimens of these species survive more than a century. In the following paragraphs I present what I consider the most interesting cases.

Palma di Goethe. This is the oldest recorded living palm tree in the world, and it is still growing in the oldest botanical garden in the world: the Orto Botanico di Padova in Padua, Italy, the oldest garden, but not the first. (The botanical garden of Pisa was established two years before, in 1543, but later was moved to another area.) A metallic label under the specimen states that it was planted in 1585. The nickname of this *Chamaerops* was given after Goethe studied plant structural metamorphosis in this specimen. The German poet made his trip to Italy in 1787, more than two hundred years ago, but at that time the plant was already centuries old. Coincident with the onset of the Industrial Revolution at the end of the 19th century, the palm started to look unhealthy, and a pyramidal greenhouse was built over it. The structure seems to have worked, as the specimen is still thriving and is now 413 years old!

Palma Mater and other roystoneas. This *Roystonea oleracea* was planted in the Rio de Janeiro Botanical Garden in 1809 by the King of Portugal during the inaugural ceremony. It died, struck by lightning in 1972, 163 years of age and 38.7 m high (Johnson 1976).

In the Jardín Botánico de La Orotava (Tenerife), a *R. regia* planted around 1860 died in 1998, due to a fungus that attacked it in January (Santos, *personal communication*). Zona (1996) cited the height achieved by some elderly royal palms and calculated crude growth rates of some of them.

California Landmark N°68. In San Diego County, California, a *Phoenix* sp., planted in 1769 was killed in 1958 by a fungus infection. It was 188 years old and 24.4 m tall, and had been declared "California Landmark N°68" for its majesty (the "Editors' Corner" of *Principes,* 1958).

Jubaea *and* Trachycarpus *in Kew.* In 1962, Russell reported that in the Temperate House at Kew there were at least two centenary palms: a *Jubaea chilensis* sown in 1847 and a *Trachycarpus fortunei* planted in 1849. The *Jubaea* was then moved to the central, higher part of the greenhouse because of its size (Russell 1962). This huge plant is still alive in the recently restored temperate house. In 1982, Queen Elizabeth II planted a seedling from this palm, which must be the largest greenhouse plant in the world, and is now 150 years old (J. Dransfield, *personal communication*).

An ultracentenary date plantation in California. In a 1986 bulletin of the California Rare Fruit Growers Society, W. Wood writes that many date palms were planted as a crop at San Diego de Alcalá, Mexico, one or two years after 1796, the date of the establishment of the first mission in that area. These palms are now around 200 years old.

The mother of all cultivated oil palms in Indonesia. In the Kebun Raya Bogor, Indonesia, there were some very old and tall *Elaeis guineensis* (McCurrach 1960). The tallest one died in 1993 or 1994 (R. Schuiling, *personal communication*) and had on its trunk a metal plaque saying, "The mother plant of all oil palms in SE Asia. Introduced in 1848." It was around 30 m tall.

The Nannorrhops *in Rome.* A huge plant of *Nannorhops ritchiana* grows on the palm hill of the Botanical Garden of Rome. The palm is around 120 years old (G. Fabrini, *personal communication*) and has many heads. The specimen is composed of two main stems, 8 and 10 m long, which scramble on the ground, and a few erect stems, between 3 and 5 m tall. It has flowered many times, producing fertile seeds.

Elderly Washingtonia *palms.* In San Marino, California, two *Washingtonia filifera* were planted in the late 1840s as seedlings, dug out from a native stand in a canyon near Palm Springs (Hodel 1996). The palms are still there after almost 160 years, and are probably the oldest *Washingtonia* palms in cultivation (Hodel 1996). All the *Washingtonia* palms of southern Europe are much younger: the first *Washingtonia filifera* seeds arrived in Europe around 1874. The botanical garden in Palermo, Sicily, immediately obtained seeds, probably collected by Roezl (Roster 1915); and the first European *Washingtonia filifera* bloomed in Giardino Pubblico


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5. One of the many trunks of the centenarian *Nannorrhops ritchiana* grown at the botanical garden of Rome.

Garibaldi in Palermo in 1892 (Ostinelli 1893). The first seeds of *W. robusta* reached Europe in the early 1880s (Roster 1915).

Copernicia baileyana *in Hispaniola.* On the island of Hispaniola, in La Delgada, 10 km W of Santiago de Los Caballeros, grows a 15 m tall *Copernicia baileyana*. A Cuban immigrant from the province of Camagüey, Juan de la Cruz Martínez, moved to Hispaniola toward the end of the 19th century and introduced seeds of this species from Cuba slightly after 1883. (L. Mera, *personal communication*). This specimen regularly produces fertile seeds and progeny. Seedlings and mature offspring of the centenary specimen are growing in the same area, where the "Yarey Cubano" was planted 115 years ago.

Longevity in Different Species and the Art of Estimating Age

Some palm species are predisposed to live longer than others: as a general rule, the slower the growth, the longer the life of a palm. An old *Brahea* has probably seen more years than any old *Veitchia*. Paradoxically, most palms reach older ages in hostile climates where their growth is slowed down by climatic adversities: *Syagrus romanzoffiana* could probably live longer in a warm, temperate, dry town in southern Spain than on a tropical island.

Chamaerops, as the Palma di Goethe demonstrates, is designed to be long-lasting. It is slow growing, hardy under extreme conditions, and

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1. This pot-grown *Astrocaryum mexicanum* cultivated in the greenhouse of the botanical garden of Florence, Italy, was planted between 1900 and 1920. 2. A *Copernicia baileyana*, at Fairchild Gardens, Miami, six months after Hurricane Andrew. Stochastic events play an important role both on cultivated and wild palms. 3. The trunk of a *Livistona*, in Jardín Botánico de La Orotava (Tenerife). Each ring corresponds to one year. 4. A dead *Roystonea regia*, on the property of Montgomery Botanical Center, Miami.

able to renew itself by continuous sucker production, having virtually an infinite life.

There are many rumors about the longevity of the "Coco de Mer," *Lodoicea*. This massive slow grower is said to live to several centuries, and older specimens are thought to be more than 1000 years old, but no precise information is available.

In the past 20 years, some efforts have been made to estimate palm height and age by counting leaf scars on the stems. The results are quite surprising: *Lodoicea* was shown to reach a maximum age of just 350 years (Savage and Ashton 1983), while some Malayan *Iguanura wallichiana*, 2 m tall, were shown to be 100 years old (Kiew 1972). The prize is won by extremely elderly specimens of *Livistona eastonii* in the Australian desert, calculated to be 720 years old (Hnatiuk 1977)! In 1995, Abrahamson estimated the age of a plant of the dwarf clumping palm *Serenoa repens* at 510 years.

According to these calculations, *Astrocaryum mexicanum* in the wild can reach only 70 years of age (Sarukhan 1978). Records of a 6 m tall pot-grown specimen of this species in the greenhouse of the botanical garden of Florence, Italy, show that it was planted between 1900 and 1920. It is now 78–98 years old and in perfect health, with the promise of an even longer life. This datum supports the hypothesis that in some instances, cultivated palms may live longer than those of the same species in the wild. However, cultivated hapaxanthic palms may complete their life cycles and die far faster than in the wild, because cultivation accelerates their life cycles.

More recent studies on palm demography recognize the usefulness of these computed estimations, but admit that they must be taken as merely indicative because of a wide range of error that cannot be eliminated. In 1993, K. Oyama found that *Chamaedorea tepejilote* in the wild might take between 26 and 35 years to reach its maximum height of 450 cm. Some plants with 56 scars on their trunks were only 177 cm tall, while others with a similar number of scars reached 460 cm. Oyama brought evidence that the counting of leaf scars to estimate age makes sense only if applied to populations. It is not an effective method in the study of individual specimens. Recently, R. Bernal (1998) introduced a new concept in the study of palm life. He described the growth of some solitary palms that can be considered "potentially immortal." He found that the South American species *Phytelephas seemannii* and *Elais oleifera* grow indefinitely by falling to the ground periodically and then resuming upright growth in a potentially unending cycle.

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Principes

Principes is the nominative plural of the Latin *princeps*, a prince. The botanist, Endlicher, in 1837 in his Genera Palmarum, was the first to use Principes as a name for the group (order) of plants that includes the palms. Botanists of the Nineteenth Century such as Martius and Drude took up the name for the palms. *Principes* is a most appropriate name as palms are indeed princes among plants. As the names of flowering plant families became more formalized, almost all names at the rank of family ended in -aceae, taking their names from the type genus in the family. These days, the palms are usually referred to the Arecaceae (after the type genus *Areca*), although the alternative name, Palmae, can still be used according to the rules of botanical nomenclature. At the level of order, also, there has been a trend towards uniformity in the ending of names, and ordinal names end in -ales. So Arecales is preferred over the grand old name Principes. The name *Principes* for our journal is not self-explanatory, and we often found ourselves needing to explain its meaning. We even had to remove an intrusive letter "l" from the antepunultimate position because word processing spelling checkers were forever replacing *Principes* with Principles. While many of us retain a strong affection for the name *Principes*, the general consensus of the Board of Directors was that our journal needed to carry a name that immediately identifies our Society.

THE EDITORS

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Left
Brahea salvadorensis H. Wendl. ex Becc.

This species is the southernmost representative of the genus, extending what is essentially a Mexican genus as far south as Nicaragua. This specimen, photographed outside Tegucigalpa, Honduras, grew at 1200 m elevation. There is some disagreement as to the identity of *B. salvadorensis*; Henderson et al. (Field Guide to the Palms of the Americas. 1995) suggested that it may be comfortably accommodated within a broadly defined *B. dulcis* (Kunth) Mart. *Brahea salvadorensis* is unlike *B. dulcis* in that it is always caulescent when mature, with clean, solitary trunks up to 4 or more meters tall. The species is poorly known in cultivation but may be more amenable to humid climates than its congeners from drier areas of Mexico.

SCOTT ZONA

Right
Pinanga yassinii J. Dransf.

The headwaters of the Belait and Ingei rivers in Brunei Darussalam in northern Borneo are demarcated by a series of north-facing sandstone escarpments that form the international border with Sarawak, Malaysia. The vegetation on these escarpments consists mostly of Bornean heath forest—kerangas. The escarpments are nowhere very high, rarely exceeding 150 m elevation, yet the heath forest has a remarkably montane appearance. This area is the only known locality of the smallest species of *Livistona*, *L. exigua* J. Dransf. that was featured in Principes 28. Growing with the *Livistona* is this handsome species of *Pinanga*. *P. yassinii* has stems that rarely exceed 1 m tall. The narrow entire bifid leaves have a very thick texture and are strikingly plicate (folded). The palm is named for Haji Yassin bin Ampuan Salleh, the retired Director of Forestry in Brunei. So far the palm is known only from Brunei but it seems inconceivable that it does not also occur in neighboring Sarawak.

JOHN DRANSFIELD

Palms, 43(1), 1999, pp. 28–34

The Production and Use of White Leaves from Date Palm (Phoenix dactylifera) in Elche, Spain

Susi Gómez Vives and Michel Ferry
Estación Phoenix, Hort del Gat, 03203 Elche, Spain

The date palm grove at Elche (Fig. 1), with more than 150,000 trees, is an important agrosystem, a type unique in Europe. It is located in the region of Valencia, Spain, at longitude 0°47′30″ W and between latitude 38°9′ and 38°21′N (Ferry 1995).

Most of the date palms are grouped in *huertos*, creating a landscape similar to a date palm grove. Despite being legally protected, conservation of the date palm groves is uncertain because date palm cultivation has lost most of its economic importance over the last fifty years. A better knowledge of the palm groves from the cultural, historical, technical, amenity, economic, and environmental points of view is indispensable to find solutions to halt its destruction or, if possible, to develop new ideas for its management and use (Ferry and Greiner, in press).

Excluding the plantations of date palms for date production in Kizil Arvat, Turkmenistan, for which we lack information, Elche is the most northern locality for a date palm grove (Munier 1973). Because of this northern location, the date palms of Elche are in a situation very marginal for fruit production.

In fact, at present, there is another product much more important than fruit in this palm grove — white palm leaves, *las palmas blancas*. The production of white leaves is based on the following biological principles: in normal conditions, a palm tree produces each year about 15 new green leaves in the ecological and cultural conditions of Elche. If from their very inception these leaves are protected from the sun, they grow but remain white. These white leaves can be cut without killing the tree because the date palm is capable of recovering its normal leaf production after a few years.

An original and ingenious method has been developed to produce white leaves. These leaves have an unusual destination—a religious commemoration of the arrival of Jesus Christ at Jerusalem, the procession of Palm Sunday, the first Sunday of Holy Week in the Christian world (Figs. 2, 3). The white leaf is also an important element of a very ancient, religious, theatrical, and musical representation played each year in the Catholic basilica of Elche: the Mystery of the Assumption of Mary.

Except for Bordighera in Italy where there is also production but on a very small scale (Bessone 1992), south-east Spain is the only place in the world where white palm leaves are produced (Gómez and Ferry 1997). In Elche, this activity is carried out by about ten long-established families. They have inherited this traditional business from their parents down through the centuries. We can find the first reference to the white palm trade in a town council certificate of 1492 (Ramos 1970), but it is supposed to predate even that time.

This ancient activity has created a cultural inheritance with its own peculiar vocabulary and expressions, but mainly, a set of specific, unique tools perfectly adapted to the task they perform, from the special shoes and ropes the workers use to climb up the trees and tie the leaves, to the cutting tools, simple ones made of wood and steel, but very well-designed for each task (Fig. 4).

The White Palm Leaf Process

The white palm leaves are obtained by inhibiting chlorophyll production in the leaves by shielding them from the light. To do this, a special technique was invented many centuries ago; some of the tasks of this process are performed on the tree and others must be done at home after the harvest. The traditional house of the families involved in this activity has been adapted to these tasks, having additional constructions besides the main house.

1. The date palm grove of Elche. 2. Representation of Jesus Christ arriving at Jerusalem. 3. The procession of the Palm Sunday in Elche. People welcoming Jesus. 4. Genuine tools of the palmerers: the soga to climb; the corda to tie the ladder, the corbella to cut and prepare the leaves.

The most risky procedures are carried out by a limited number of specialist workers, called *palmerers* (Fig. 5). They perform various operations at the top of the tree in very dangerous conditions as the trees are very often more than 15m tall at present in the palm grove of Elche.

Production and Harvest Processing

At least two men are needed to perform the tasks in the field; the most skilled one climbs the date palm and the other assists him from the ground. Throughout the year the palmerers have to climb the tree several times to do the following things:

—at the beginning of the year, the tying up (*Nyugar*) of the palm leaves: the palmerer climbs the tree using a special rope peculiar to Elche (*soga*). There, he cuts with the *corbella* the older leaves and inflorescences of the tree; the remaining leaves are then grouped tightly, the palmerer making sliding knots with another rope (*vencill*) to make a cone. He then uses a very special tool, the *forquella* (Fig. 6). Next, the palmerer leaves the climbing rope and assures its security with a belt and a rope fixed at the base of the cone; he then surrounds the cone with the leaves he had cut before to maintain an erect cone (*faixa*) and to give added protection to the inside leaves from the light; one meter from the top of the cone, the leaves are untied to maintain partial photosynthetic activity and the production of new leaves inside. This task is normally performed between January and May.

—during the summer, setting the cowl (*tapar*): with the use of a 4 m ladder that he has to lift up to the cone of leaves with a rope (Fig. 7), the palmerer covers the top of the cone with a black plastic cowl (Fig. 8), (in the past made of dry leaves, called *vellet* (Fig. 9)). This procedure completely protects the cone of leaves from light.

—at the beginning of the next year, the harvest of leaves (*Tallar*): the palmerer partially cuts the cone at its base, and takes out the largest white palm leaves from inside the cone, throwing them to the ground (Fig. 10). After that,

5. A palmerer climbing up a tall date palm. 6. A palmerer tying up the leaves to form a cone. 7. A palmerer climbing up the ladder to set up the cowl. 8. Setting up the plastic cowl.

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9. Setting up the traditional cowl of dried leaves. 10. A palmerer cuts and removes the white inside leaves. 11. A palmerer at the top of the date palm tree after cutting the cone of leaves. 12. Date palm landscape after the harvest.


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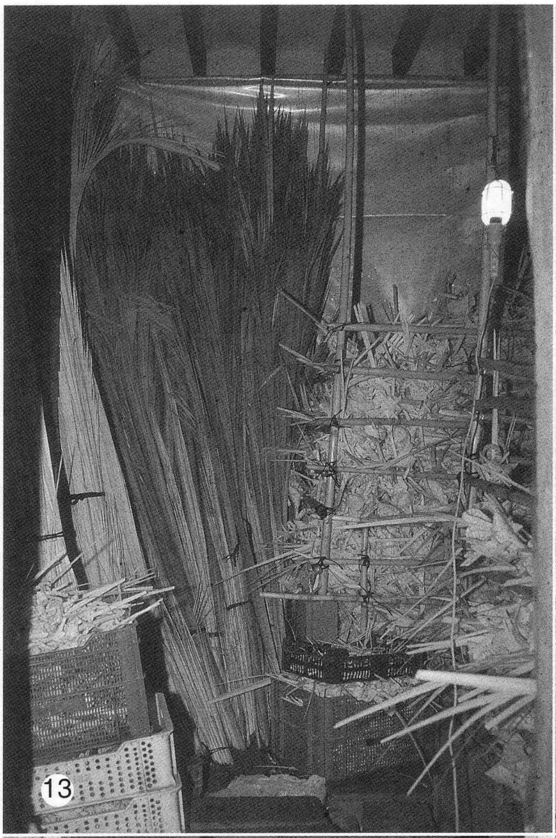

13. The storage room. 14. The *palmas lisas*. 15. The plaiting of the leaves at home. 16. The plaited white leaves for the competition.

he completely cuts the cone and drops it (Fig. 11). This procedure is perhaps the most dangerous moment of the operation, as the palmerer loses his support by cutting the leaves. This task is performed from January till Easter. One tree can produce about 15 white leaves inside the cone, what is more or less the average green leaf production of date palms in Elche.

Postharvest Treatment, Conservation and Handicrafts

All of the following procedures are carried out in the family house. After they have been harvested, the leaves are classified according to their size and their whiteness: first, second, third, and fourth class for white ones from 3.5 m to 0.80cm; *entrefina* and *batalla* are ones not completely white, with the top green (Galiana and Agulló 1983). Part of the harvest is now sent to Barcelona and the other part remains in Elche where it is treated.

The first treatment consists of brushing and submerging the leaves in a bleach bath for two days to clean them and to enhance their yellow color. In fact, they are called white leaves, but they are more yellow than white. The palms are straight with leaflets closed to the rachis. They have a flexible and fresh aspect with a nice golden color.

To maintain them in that state till the day of sale, a new technical process was added about 20 years ago. The leaves are placed in special closed rooms where the humidity is maintained very high by flooding the floor (Fig. 13). This high humidity is indispensable to avoid the drying out of the leaves. Sulphur is burned and the rooms are totally sealed in order to protect the leaves from insects, to reinforce their brilliant yellow color, to protect them from fungi, and to avoid their rotting.

Some of the leaves are sold without any more treatment; they are called *palmas lisas* (Fig. 14). The inferior-quality leaves are usually plaited (*palmas rizadas*) at home, by various members of the family (Fig. 15). As they have only one or two months to perform the plaiting, they are assisted by friendly neighbors and relatives. This is considered to be a social activity. In Elche, some of the plaited leaves are artistically worked for traditional destinations such as local competitions (Fig. 16), the Spanish royal family, the British royal family, the Pope, and other national and international personalities.

In a traditional family of white leaf producers, there is a distribution of tasks: usually the women and the children are the artisans who do the plaiting (*rizado*) of the leaves, often making real pieces of art; while some of the men climb the trees, and the oldest or unskilled men assist them from the ground. Usually these families must also engage two or three palmerers to harvest all the date palm leaves in time for Palm Sunday.

The Market for the White Palm

About 250,000 white palm leaves are produced each year in this region. The peculiarity of the white leaves is that they represent a product used for only one day a year for a religious purpose; consequently the leaves are sold once a year and there is not a permanent market for them.

Producers sell a part of the harvest in Elche directly in the local markets, especially the week before Palm Sunday, and the municipality sets aside special places for these leaves (Fig. 17). However, the largest part of the harvest, 90% according to a recent estimate (Greiner 1994), is sold outside the municipality.

The majority of the production is sent to other Spanish cities, principally to Barcelona, but at least 80,000 leaves are exported directly to foreign countries, mainly to Great Britain but also to Belgium, France, and the Vatican. Leaves are also exported abroad from Barcelona (Brotóns 1989).

Conclusions

The palm grove of Elche is the symbol of the city. The tradition of producing white leaves is a part of the cultural and historical past of its pop-

17. The market of white leaves. 18. A peculiar landscape in Elche region.

ulation, and the Palm Sunday procession is still very much alive. Also, the production of white leaves has an important economic value.

However, the present situation for this activity is uncertain due to general degradation of the palm grove and the increase in the cost of labor. As the date plantations have not been renewed, most of the trees are very old, very tall and in bad condition, making them less useful for white palm leaf production.

The traditional craftsmanship is in recession due to the social, cultural, and economic changes that have occurred in the last decades in the Mediterranean region of Spain (Barber and Guardiola 1995); the younger people in the families of artisans prefer to look for other jobs less risky and better paid than being a palmerer.

Concerning the traditional processing, some improvements must be experimented with in order to limit the biological stress and landscape degradation. A part of the palm dies because of the process; each year, about 25,000 trees are processed giving a strange aspect to the palms (Figs. 12, 18). They will need five years to recuperate their natural landscaping value. Instead of cutting all the leaves as is traditionally done, keeping the external leaves would be a positive way of aiding recovery. Increasing the number of external leaves by limiting the pruning to the dry ones, contrary to what is usually done in Elche, would also be beneficial.

A large number of nurseries for ornamental date palms have been created during the last twenty years. Some of the palm trees in these nurseries will probably be kept in place and could be used for white palm leaf production in the future. We can suppose that the market will remain steady in the future if production costs do not increase too much. Technical and economic research must be done to establish the validity of intensive and, perhaps, mechanized, plantations for white leaf production.

New markets of white palm leaves must be investigated. We think that one market could be the production of plaited palm leaves as ornamental objects to be sold year round.

Furthermore, a solution must be found quickly to solve the problem of pests attacking white palm leaves, in particular red scale (Gómez and Alcazar 1996a). Its peculiar biology in the palm tree, for technical, economic, and environmental reasons, makes chemical control difficult. Moreover, the urban location of nearly half of the palm groves in the city itself would make the use of pesticide hazardous to the health of the people. A research project on the biological control of this pest has been initiated (Gómez et al. 1995, Gómez and Ferry 1996b, Gómez et al. 1996c). A local predator, *Lindorus lophantae* Blaisd. has been identified (Gómez et al. 1994).

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Saw Palmettos (Serenoa repens): The Need for Patience and Water Uptake by the Stem

FRANCIS E. PUTZ
Department of Botany, University of Florida, Gainesville, Florida 32611-2009 USA

MICHELLE PINARD
Department of Forestry, University of Aberdeen, Aberdeen AB24 5UA, Scotland

Saw palmetto (*Serenoa repens* (Bartr.) Small) has many characteristics of the ideal horticultural plant (Bush and Morton 1963) but is notoriously difficult to transplant. While there have been notable successes in bringing wild saw palmetto plants into cultivation, there is some truth to the saying that "the only way to kill it is to try and transplant it" (Foster 1964, but see Tanner et al. 1988). Although extensive areas in Florida are dominated by this species (Maehr and Layne 1996), increased interest in native species for horticultural use and increased demand for saw palmetto fruits for medicinal use (Bennett and Hicklin 1998) provide incentives for developing transplantation methods.

Saw palmetto is a small-statured palm native to the southeastern USA that grows in a wide variety of habitats, including wet sites and those that are quite xeric and nutrient-poor (Abrahamson 1995). Saw palmettos tolerate partial shade but grow in full sun as well. Although upright individuals of this usually prostrate palm occasionally occur, even the tallest plants seldom exceed 3 m, and hence, are unlikely to interfere with electrical transmission lines or block street lights.

Saw palmettos are an important component of natural ecosystems (e.g., van Rees and Comerford 1986) and have played a role in human history. The aromatic flowers provide pollen and nectar for honey-producing bees, and the fruits are fed upon by a wide variety of mammal and bird species. Although the fruits were apparently also a staple food of Native Americans, early European visitors did not find them savory: "We tasted them, but not one amongst us could suffer them to stay in our mouths, for we could compare the Taste of them to nothing else but rotten Cheese steep'd in Tobacco juice" (from a 17th century book by Jonathan Dickinson in Small, 1926). Recent evidence that extracts from saw palmetto fruits are effective in the treatment of benign prostatic hyperplasia (Braekman 1994, Plosker and Brogden 1996) has focused public attention on a species that was once detested by rangeland managers and others.

Across the southeastern portion of the USA, thousands of saw palmettos are torn out of the ground each year during site preparation for plantation forestry, agriculture, and suburban sprawl (for reviews see Hilmon 1969, and Tanner et al. 1986). Foresters complain that it is hard to kill saw palmettos with controlled fires (Burton and Hughes 1961), and that some of the plants they wrench out of the ground and pile in windrows survive even this extreme treatment. Add to these observations the relative ease with which large cabbage palms (*Sabal palmetto*) trees are transplanted (Menge and Brown 1992) and the conclusion is that one possible solution to the proliferation of exotics in roadside plantings and the excessive costs of turf management is to transplant saw palmettos. We made a concerted effort to do this and enjoyed only limited success, but in the course of our experiments, discovered what we believe to be an unusual mode of water uptake.

To elucidate factors influencing saw palmetto transplantation success, we compared the survival of transplanted individuals of different sizes. Due to the larger storage capacity in larger plants (Holbrook and Sinclair 1992), we expected that size would be positively related to transplantation success. We also compared stem-water contents, nonstructural carbohydrate concentrations in stems, and pre-dawn leaf-water potentials of transplanted and control plants. Based on the results of these studies, we carried out an additional experiment without soil contact, using rootless stems that were kept moist on a greenhouse bench.

Methods

We transplanted saw palmettos of three stem lengths (18–32, 34–54, and 56–98 cm) from a slash pine (*Pinus elliottii*)-dominated flatwood in the Austin Cary Memorial Forest, about 10 km north of Gainesville, Florida (*N* = six plants per size class; Fig. 1). To mimic the common fate of saw palmettos wrenched from the ground by root rakes during site preparation for pine plantation establishment, we also excavated seven large plants after cutting their stems about 50 cm back from the apex; we transplanted the leaf-bearing portion of the stems. Root remnants 10–15 cm long were present on all plants, but we did not attempt to dig up entire root systems because saw palmetto roots grow to great lengths and depths. Furthermore, in contrast to some other palm species (Broschat and Donselman 1984), once damaged, roots of saw palmettos seem to die back to the trunk. We cut the expanded leaves off each plant, set the stems 1 cm below the ground surface, covered the experimental garden with 50% shade cloth, watered at three-day intervals during rain-free periods, and waited one year before excavating the plants to assess growth and survival.

We measured leaf production and growth of large roots (0.5–1.1 cm diameter) emerging from the stems of transplanted individuals after one year. We also tested the hypotheses that, in comparison to similar-sized individuals that remained in the Austin Cary Forest, transplanted saw palmetto plants have lower stem-water contents, lower pre-dawn water potentials, and lower stem contents of nonstructural carbohydrates. We estimated water contents with

1. A recently excavated saw palmetto in the largest size category. Note that many other individuals have fewer roots near the leaf-bearing end of the prostrate stem.

100–200 g fresh weight samples from the inner portions of each stem. Pre-dawn water potentials were measured using individual pinnae with a pressure chamber (Koide et al. 1989). Total non-structural carbohydrate contents of stem tissue samples were estimated with an enzymatic procedure using spectrophotometry (the Nelson–Somogyi Method, as described by Spiro 1966). To test the hypothesis that saw palmetto stems absorb substantial quantities of water directly (i.e., without passage through roots), we excavated additional plants from the same site, removed all their roots and all but the five youngest leaves, and set them on a greenhouse bench constructed of coarse metal screening. Half of the plants (selected at random) were sprayed with water daily, while the other half were not watered. The watering treatment was applied to six small and five large plants; the control group included five small and six large individuals. We monitored leaf survival weekly until all of the leaves turned brown.

Results and Discussion

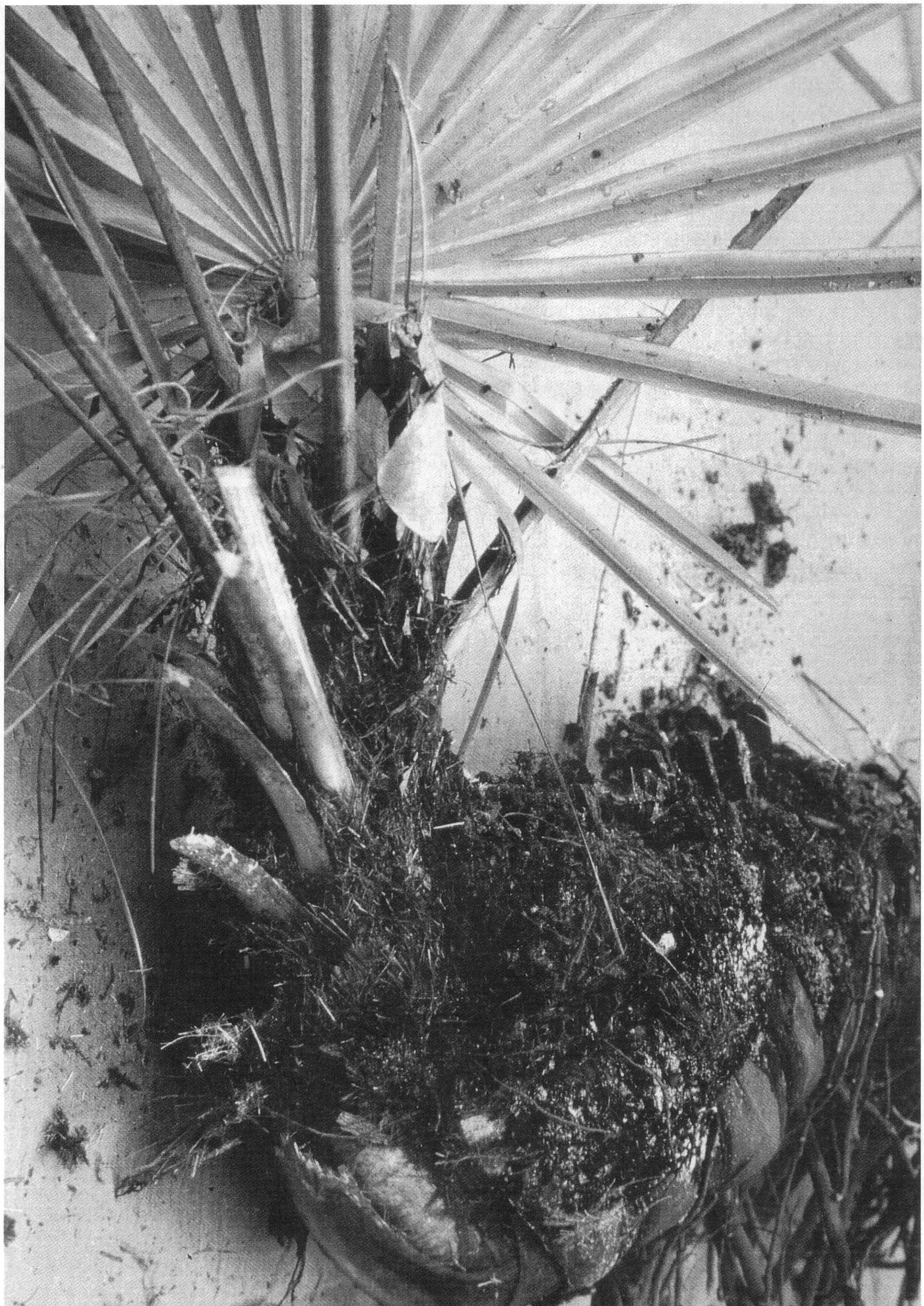
In spite of what we considered rather lavish care, none of the saw palmettos we transplanted flourished over the one-year observation period. Four of the 18 intact transplants (two small and two medium-length individuals) died, as did three of the six plants with stems that we cut. Over the same period, no plant completely expanded a new leaf (no differences between stem size classes), and only five plants produced new roots (no difference in root growth between stem size classes). The plants that did not die maintained only a single green leaf each; there were no differences in leaf expansion rates between size classes. Contrary to our expectations, there was no statistically significant difference in non-structural carbohydrate contents in the stems of plants that remained in the forest ($\bar{x}$ = 23.8% dry weight, SE = 5.70, N = 10) with those that we transplanted (28.2% dry weight, SE = 2.23, and N = 18). There was also no difference in stem water content between saw palmettos in the forest and transplanted individuals ($\bar{x}$ = 66% and 70% dry weight, SE = 2.02 and 1.34, N = 12 and 20, respectively). Pre-dawn water potential measurements ($\bar{x}$ = −0.085 and −0.991 MPa, SE = 0.015 and 0.136, N = 10 and 11, respectively for forest and transplanted individuals), however, indicated that the leaves of transplanted individuals suffered substantial water stress even though they were well watered for a year and were planted in partial shade.

In addition to our controlled experiment, the Gainesville City Arborist planted ten of the saw palmettos we excavated in pots in her nursery. Her plants were kept in more or less saturated soil; after two years they were all still alive, were well-rooted, and supported full coronas of leaves. Apparently we were not sufficiently patient, and perhaps should have watered more frequently. Other reports of successful palmetto transplantation efforts generally specify that watering needs to be ample and regular (e.g., Foster 1964).

While we have not determined why so much time is required for saw palmettos to produce new roots, we believe we have some insights to share on the water relations of this species. These insights are based on the finding that most of the virtually rootless transplanted individuals were still alive after 12 months. Although these rootless plants did not develop large transpiring surfaces, they did each retain a green leaf. Based on this observation, we hypothesized that saw palmettos take up water through their stems.

Rootless saw palmetto plants set on a greenhouse bench retained green foliage much longer if watered daily than if not watered at all (median intervals until last leaf browned were 76 and 14 days, respectively; Mann-Whitney U-test, $P < 0.05$). The differences in leaf retention time between large and small plants were also substantial, both in the watered and control plants (medians for large and small watered plants were 140 and 36 days; medians for large and small control plants were 21 and 14 days). The longest-lived plant was a large, rootless individual that was watered daily; its last leaf turned brown after 231 days. This difference was expected, based on the results of Holbrook and Sinclair (1992) with *Sabal palmetto*, but the longevities of the rootless but irrigated plants were surprising, considering that the vapor pressure deficits in the greenhouse were often extremely high. The only explanation we can offer is that the saw palmetto stems absorbed sufficient quantities of water to satisfy the plants' transpirational demands.

Water uptake by saw palmetto stems helps explain how rootless plants survived for such long periods of time, but might also be relevant to the water relations of intact plants. Water stored in cabbage palm stems, for example, was shown to



contribute to a favorable leaf–water balance during periods of high transpirational demand (Holbrook and Sinclair 1992), and helps explain how large, rootless cabbage palms are so readily transplanted. Water uptake by palm stems close to the leaves circumvents major axial resistances to water flow, and hence might also be important. Water uptake by the crown zone of palm stems may be facilitated by several structural features. The leaf-bearing portion of palm stems is neither heavily sclerotized nor otherwise hydraulically sealed. The overlapping bases of attached living and dead leaves might serve as sponges holding water near the stem surface. And if the bases of these leaves are gutter–shaped in cross-section, the contribution of crown uptake to palm–water balance could be substantial (Fig. 2).

As for transplanting saw palmettos, we recommend patience and plenty of water. Although reestablishment of transplanted saw palmettos is slow, given that the larger plants may be 500 or more years old (Abrahamson 1995), the effort seems worthwhile when the alternative is death by bulldozer.

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2. Looking downwards into a saw palmetto crown. Palms with wider petioles that are gutter-shaped in cross-section would funnel even more rain water towards the shoot apex.

Palms, 43(1), 1999, pp. 40–44

Distribution Update: Sabal minor in Mexico

Douglas H. Goldman
Department of Botany, University of Texas, Austin, Texas 78713-7640 USA

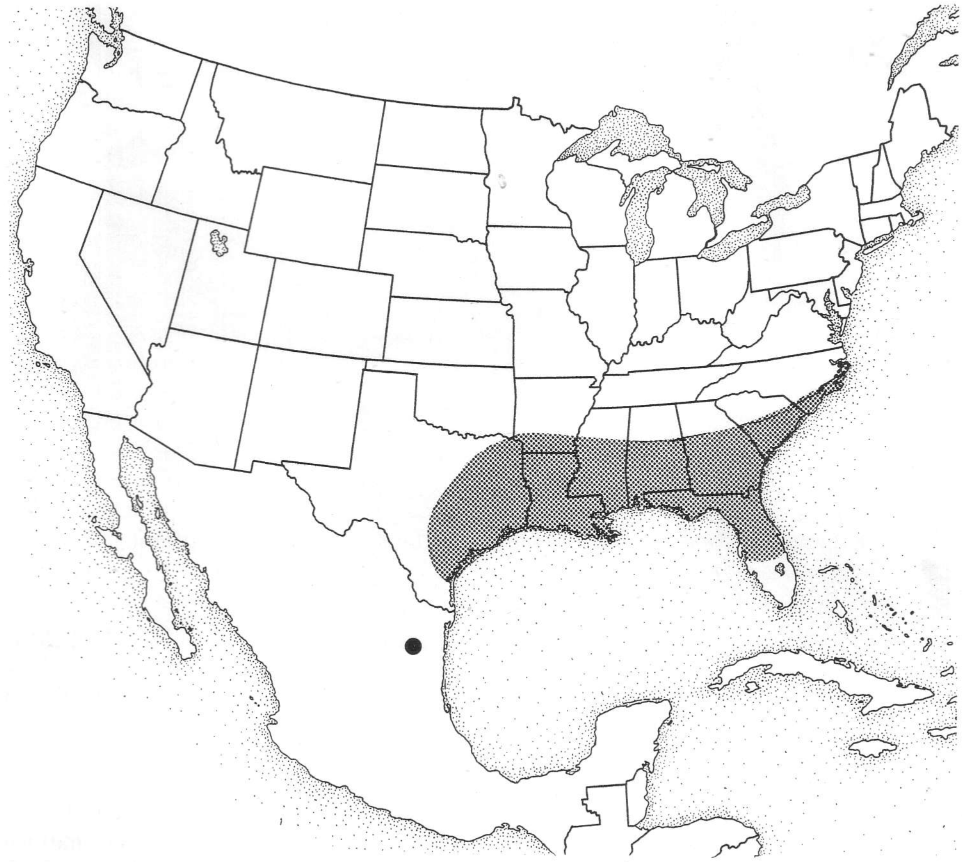
Sabal minor (Jacq.) Pers. is primarily an acaulescent species, restricted to the southeastern and south-central United States (Fig. 1), found from North Carolina, south to central Florida, and west to southeast Oklahoma and central and south Texas (Vines 1960, Radford et al. 1968, Correll and Johnston 1970), and is typically found in bottomlands (Godfrey and Wooten 1979, Zona 1996). This species reaches its southern limit in the south-central United States in the coastal bend region of Texas (Jones et al. 1961, Jones 1975).

In the spring of 1996 I travelled to northeastern Mexico. This part of the country, particularly some of the more humid mountain ranges, is known for its shared floristic components with the eastern United States (Dressler 1954, Martin and Harrell 1957). A region famous for this is the area around Rancho del Cielo near Gómez Farías, Tamaulipas (Hernández et al. 1951, Johnston et al. 1989). The only palm noticed in this area was probably *Chamaedorea radicalis* Mart.

It was elsewhere on this trip, while I travelled through a very narrow and deep pass in the front range of the Sierra Madre Oriental, that I made a surprising discovery. Travelling eastward from an area of semidesert, I entered the pass which contained subtropical pine-oak thorn woodland at around 300 m elevation. Above the road on the north side of the pass, I noticed several very large palmate leaves half-hidden in vegetation at the top of some steep slopes and low cliffs. I expected that it would be a species of *Brahea*, possibly *B. decumbens* Rzed., which I had noticed on dry hills elsewhere on this trip. I also recognized that it could be young specimens of *B. dulcis* Mart., and a specimen of what was possibly that species, with a trunk several meters tall, grew along the river below the road near this site. Upon examining these plants above the road, however, I noticed that they were essentially acaulescent, unlike *B. decumbens* or *B. dulcis*. Several of the plants had inflorescences in bud, indicating that these were mature individuals. The inflorescences emerged from among the petioles, and were branched to two orders, with small side-branches emerging from the main axis. Furthermore, the leaves were weakly costapalmate, weakly filiferous, medially divided into two halves nearly to the base, and had unarmed petioles (Fig. 2). These characters allowed me to recognize these plants immediately as specimens of *Sabal minor*, a surprise considering their locality of about 225 miles south-southwest of the nearest known population. My collection record is as follows:

Sabal minor (Jacquin) Persoon. Small palm, with trunk 0–12 cm tall. Leaves weakly costapalmate, about 4 feet long. Plant about one week from blooming. Growing on a steep limestone mountainside about 6–9 m above a road, in a dry subtropical pine-oak forest. Growing with *Pinus* sp., *Quercus* sp., *Randia* sp., *Acacia* sp., *Smilax bona-nox, Toxicodendron radicans* and *Dioon* sp. 26 km west of Linares, along Mexican Route 60. Nuevo León, Mexico. First record for Mexico. Coll. Doug Goldman, #900. March 12, 1996.

The closest to Mexico that this species has been previously known to occur in abundance is near the town of Ingleside, San Patricio County, Texas, by Corpus Christi Bay (Jones 1975), or about 165 km from the Mexican border. A specimen also exists from just north of the Kleberg County line in Nueces County (TEX: *M.C. Johnston* 541709, 17.9.1954), perhaps 130 km from the Mexican border. Although apparently appropriate habitats are rare south of this area for over 250 km due to the dryness of much of the coastal bend region and the Rio Grande plains, they do exist, particularly near the Rio Grande River. However, *S. minor* has never been recorded from this area, although *S. mexicana* Mart. is locally

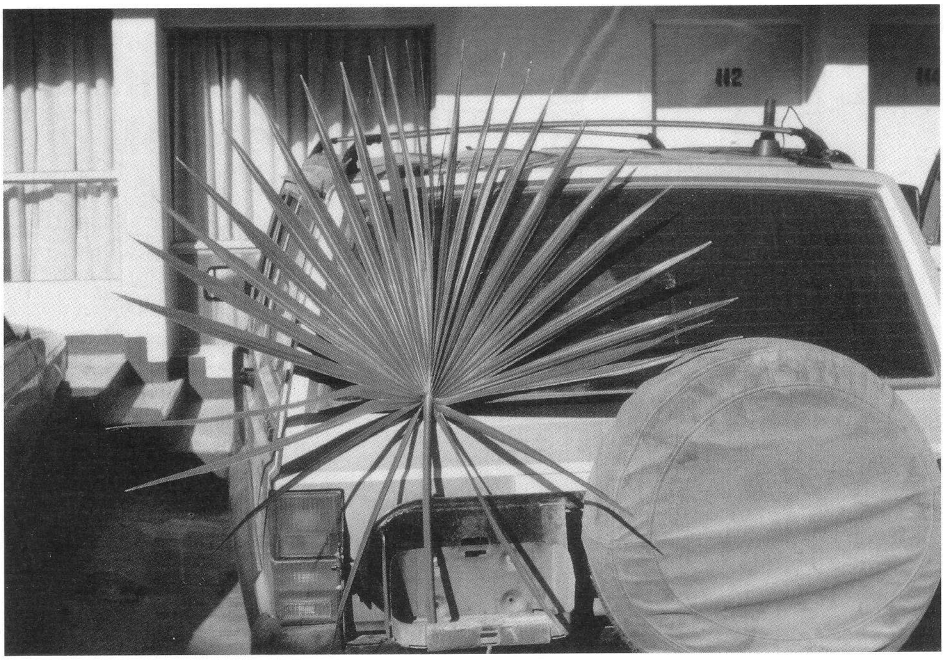


1. Distribution of *Sabal minor* in the southeastern and south-central United States. The large dot indicates the new collection locality for the species in Mexico.

abundant there (Vines 1960; Correll and Johnston 1979; Lockett 1991; Lockett and Read 1990, 1991).

An older, sterile specimen of what appears to be *S. minor* from the same general vicinity as my collection has been deposited at the University of Texas herbarium (TEX), although it was placed in a folder of undetermined specimens of *Brahea*. The collection information with this specimen is as follows: Mexico, Nuevo Leon, Highway 60, 23 km west of Linares, elevation 34 m, 26.3.1964, *D. Ahshapanek* 326.

The only other species of *Sabal* to occur in this region of Mexico is *S. mexicana* (Zona 1990, Henderson et al. 1995), a large caulescent species. It could be suggested that the specimens of *S. minor* that I observed might be dwarfed specimens of *S. mexicana* growing as such because of a harsh habitat. This is unlikely, as I have numerous times observed dwarfed specimens of *S. palmetto* (Walt.) Lodd. ex Schult. and *S. minor*, and noticed how their defining characteristics are maintained despite their diminutive stature. In some seasonally flooded pine-rockland savanna habitats in the Everglades ecosystem of southern Florida, I have on several occasions observed *S. palmetto* only a meter tall with miniature leaves and inflorescences but still maintaining its typical characteristics for these structures, although considerably smaller. I have also observed two populations of extremely tiny reproducing plants of *S. minor*, one in the Florida Panhandle (*Goldman* 509, BH) and another in east Texas (*Goldman* 512, BH), and despite the minute size of their leaves and inflorescences, the plants were typical. The Florida Panhandle population is briefly discussed by Ramp (1989). Therefore, if



2. Photo of the abaxial surface of the intact leaf from the collection of *S. minor* from Mexico (*D. Goldman* 900, MEXU; photos at BH, K, TEX).

the population of *S. minor* from Mexico was actually dwarfed *S. mexicana,* I would expect it still to maintain its highly costapalmate, filiferous leaves that are not medially divided into two halves, with larger inflorescences branched to three orders. The morphological characteristics of the different species of *Sabal* are clearly defined in the monograph by Zona (1990).

Of particular curiosity with regard to the Mexican population of *S. minor* is its habitat. Since this species is found primarily in bottomland habitats in the United States, it is surprising to find it in such a dry, subtropical upland habitat. However, in parts of the Edwards Plateau of central Texas, *S. minor* is occasionally found in dry, open, upland habitats, often at or near the top of small limestone mesas (Lockett 1991, Lockett and Read 1991). Such sites in central Texas are semi-dry to dry grasslands and oak–juniper savannas. Clearly this species has a significant tolerance for xerophytic conditions.

While examining literature with regard to palms native to the United States and northeastern Mexico, I became aware of a species of *Brahea, B. moorei* L.H. Bailey ex H.E. Moore, that might be readily mistaken for *S. minor. B. moorei* is a small, acaulescent species, and Bailey indicated in the original description that it was initially mistaken for *S. minor* when it was first discovered in the field (Moore 1951). This species is native to the type of habitat where I found *S. minor,* and the locality of my collection is within the range of *B. moorei* (Moore 1951, Henderson et al. 1995).

Based on descriptions in the literature of both *B. moorei* (Moore 1951) and *S. minor* (Zona 1990), and examinations of herbarium material at BH, K, and TEX, I easily concluded that the population I observed in Mexico was definitely *S. minor,* showing all the distinguishing features of that species. There are numerous features clearly distinguishing these two species. *Brahea* is typically distinguished from *Sabal* by having pubescent rachillae, ovoid fruit, apically fused carpels, and armed petioles (with some exceptions to the latter); while *Sabal* has glabrous rachillae, spherical fruit, entirely fused carpels, and unarmed petioles (Uhl and Dransfield 1987).

However, numerous other features distinguish *B. moorei* from *S. minor.* The leaves of *B. moorei* are bicolored, being dark green on the adaxial surface and whitish on the abaxial surface. They are flat, with a very short costa of about 2 cm, a short, blunt, rounded hastula, and are not medially divided into two halves. The segments are less than 50 cm, and are no more than 28 mm wide at halfway their length. The petioles are unarmed and are 1 cm wide or less just below the blade. The leaves of *S. minor* are not bicolored, having roughly the same shade of green on both the adaxial and abaxial surfaces. They are flat to slightly undulate, weakly costapalmate, with a costa up to 20 cm long, an obtuse hastula to 4 cm long, and are medially divided into two halves. The segments are up to 84 cm long and up to 4 cm wide at halfway their length. The petioles are also unarmed, but can be up to 2.6 cm wide.

The inflorescences of *B. moorei* are pubescent throughout except for the bracts, and are branched to three or four orders. The sepals are rounded at the apex, the petals are broadly triangular, and both the calyx and corolla are puberulent on their outer surfaces. The filaments are broadly triangular, and the anthers are up to 1.5 mm long. The flowers open quite wide, and the developing fruit are densely puberulent. The inflorescences of *S. minor* are glabrous throughout, and are branched to two (or rarely, three) orders. The sepals are acute at the apex, the petals narrowly triangular, and both the calyx and corolla are glabrous on both surfaces. The filaments are narrow, and the anthers are 1 mm long or less. The flowers open narrowly and appear elongated relative to *B. moorei,* and the developing fruit is glabrous.

My specimen of *S. minor* consists of an inflorescence in early bud and two leaves, one with its segments mostly removed. Both leaves are bifid, not bicolored, and the intact leaf has pinnae up to 70 cm long, about 4 cm wide at halfway their length. The costa for this intact leaf is 9 cm long, while for the clipped leaf it is 17 cm long. The hastulas are slightly elongate and acute, and the petioles just below the blade are about 1.8 cm wide. The inflorescence is completely glabrous, including the buds, and is branched to two orders. Furthermore, the sepals are acute at the apex. It is very clear that this is a specimen of *S. minor* and not that of *B. moorei.* In addition to these morphological observations, a recent study of the amplified fragment length polymorphisms (AFLP's) of total genomic DNA in *Sabal minor* has confirmed that my Mexican collection is indeed that species (Goldman, *unpublished data*).

Perhaps what is most remarkable about the discovery of *S. minor* in Mexico is that the locality at which it was found is along the edge of a very well-travelled road. Because of the well-known biogeographic interest in this general region of the country, it is certain that many botanists have passed through this area numerous times. Yet this palm has eluded their attention, or more likely been ignored, considering how easily visible it is along the road. If species like this can still be found with such ease along a major highway, it draws considerable interest as to what might yet be discovered in the many relatively inaccessible valleys in this region of Mexico.

Specimens examined: Brahea moorei: MEXICO: Mexico, *Coulter* 1583 (K). NUEVO LEÓN: Dulces Nombres, *F.S. Meyer and D.J. Rodgers* 2553 (BH). TAMAULIPAS: Gómez Farías, Rancho del Cielo, *A.J. Sharp, R.E. Shanks, J.N. Wolfe, and E. Hernández X.* 52277 (BH); Hidalgo, El Mirador, *Hinton* 25033 (TEX); Dist. Jacala, La Placita, *H.E. Moore* 2639 (BH); Dist. Jacala, La Placita, *H.E. Moore and C.E. Wood* 3891 (BH); Dist. Jacala, *H.E. Moore* 5013 (holotype, BH); Dist. Jacala, between Jacala and Tepetates, *H.E. Moore* 5038 (BH). Jaumave road, southwest of Ciudad Victoria, *R. McVaugh* 9861 (BH); road to Jaumave, *H.E. Moore* 8007 (BH, K); on the road to Jaumave, *H.E. Moore and A. Valiente M.* 6161 (BH).

Sabal minor: MEXICO: NUEVO LEÓN: Highway 60, 23 km west of Linares, elevation 34 m, *D. Ahshapanek* 326 (TEX); 26 km west of Linares, along Mexican Route 60, *D. Goldman* 900 (MEXU; photos at BH, K, TEX). USA: FLORIDA: Calhoun County, Blountstown, *D. Goldman* 509 (BH). LOUISIANA: Cypremort Point, *B.C. Tharp* s.n. (TEX). OKLAHOMA: McCurtain County, Harris, *R.A. Scott* 107 (TEX). TEXAS: Gonzalez County, *E.R. Bogusch* 1345 (TEX); Hardin County, 6 km north of Kountze, *D. Goldman* 512 (BH); Liberty County, Cleveland, *M.L. Bomhard* s.n. (BH); Travis County, *W.R. Carr* 12847 (TEX); Nueces County, *M.C. Johnston* 541709 (TEX).

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CLASSIFIED

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How Many Species of Brassiophoenix?

SCOTT ZONA
Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, Florida 33156 USA (address for correspondence) and Department of Biological Sciences, Florida International University, Miami, Florida 33199 USA

FREDERICK B. ESSIG
Department of Biology, University of South Florida, Tampa, Florida 33620 USA

Brassiophoenix Burret is a genus of elegant, understory palms from the lowlands of Papua New Guinea. Because of its small stature and broad, three-lobed leaf segments, the genus is now popular in cultivation in the tropics and subtropics. As its popularity has grown, so has interest in its taxonomy. One question continues to plague botanists and growers alike: how many species are there in the genus *Brassiophoenix*?

The genus was established by Burret in 1935 when he described *B. drymophloeoides* Burret (Fig. 1). Another species, now known as *B. schumannii* (Becc.) F. B. Essig, was first described by Beccari in 1889 as a species of *Actinophloeus*, a genus now synonymous with *Ptychosperma*. Essig (1975) recognized the true generic identity of *A. schumannii* Becc. and transferred it to *Brassiophoenix*, bringing to two the number of species in the genus.

In his 1975 paper, Essig differentiated the two species in the following way: *Brassiophoenix schumannii* has pale yellow-orange fruits and dense, dark hairs on its inflorescence branches; whereas *B. drymophloeoides* has red fruits and white, woolly or sparse dark hairs. Essig's treatment was followed by Uhl and Dransfield (1987).

Hay (1984) questioned the wisdom of recognizing two species on the basis of fruit color and inflorescence pubescence. He suggested that, at the very most, only two varieties were justified. He stated categorically that "There is only one species of *Brassiophoenix*." Hay did not, however, make any taxonomic changes.

Ferrero and Dowe (1996) and Ferrero (1997) went further and synonymized *Brassiophoenix drymophloeoides* under *B. schumannii*. Ferrero (1997) stated that "The characters used to separate the two species are vague, based on confusing field notes and insufficient material from limited areas." He went on to assert unequivocally that there is only one species.

It is true that herbarium collections of palms are often incomplete, although the problem is greater with large palms than with small, understory palms. It is also true that New Guinea is still poorly explored; undoubtedly the distribution of *Brassiophoenix* is not yet fully known. We believe, however, that despite imperfect herbarium collections, there is sufficient evidence to warrant the recognition of two species in *Brassiophoenix*—two species with discrete geographical distributions and unequivocal morphological differences. The names of these two species, however, have been confused in the literature and in cultivation.

The vegetative features of both species appear to be similar. Moreover, we have yet to find any floral features by which to differentiate the species. In order to identify the two species, one needs fully formed fruits. The differences are best seen in the endocarps, which are straw-colored (when clean), not black, as reported by Hay (1984) and Ferrero and Dowe (1996).

Figure 2 illustrates the known distribution of *Brassiophoenix* in mainland Papua New Guinea based on herbarium holdings at the Arnold Arboretum, the Bailey Hortorium, Fairchild Tropical Garden, Kew, and New South Wales (abbreviated as A, BH, FTG, K, and NSW; see Appendix 1). The genus is not known from Irian Jaya, the Indonesian half of New Guinea, although additional exploration is greatly needed and may eventually find the genus there. Likewise, the genus is not known to occur in the Bismarck Archipelago or other off-shore islands.

Brassiophoenix occurs in northern and southeastern populations, separated by the central

1. *Brassiophoenix drymophloeoides* growing at Fairchild Tropical Garden

cordillera and highlands that traverse Papua New Guinea. Figure 2 illustrates cross-sections of the endocarps and seeds from both populations. The northern populations have nine-lobed endocarps, while the southeastern populations have five-lobed endocarps. The seeds of the northern populations are correspondingly more deeply lobed than those of the southeastern populations.

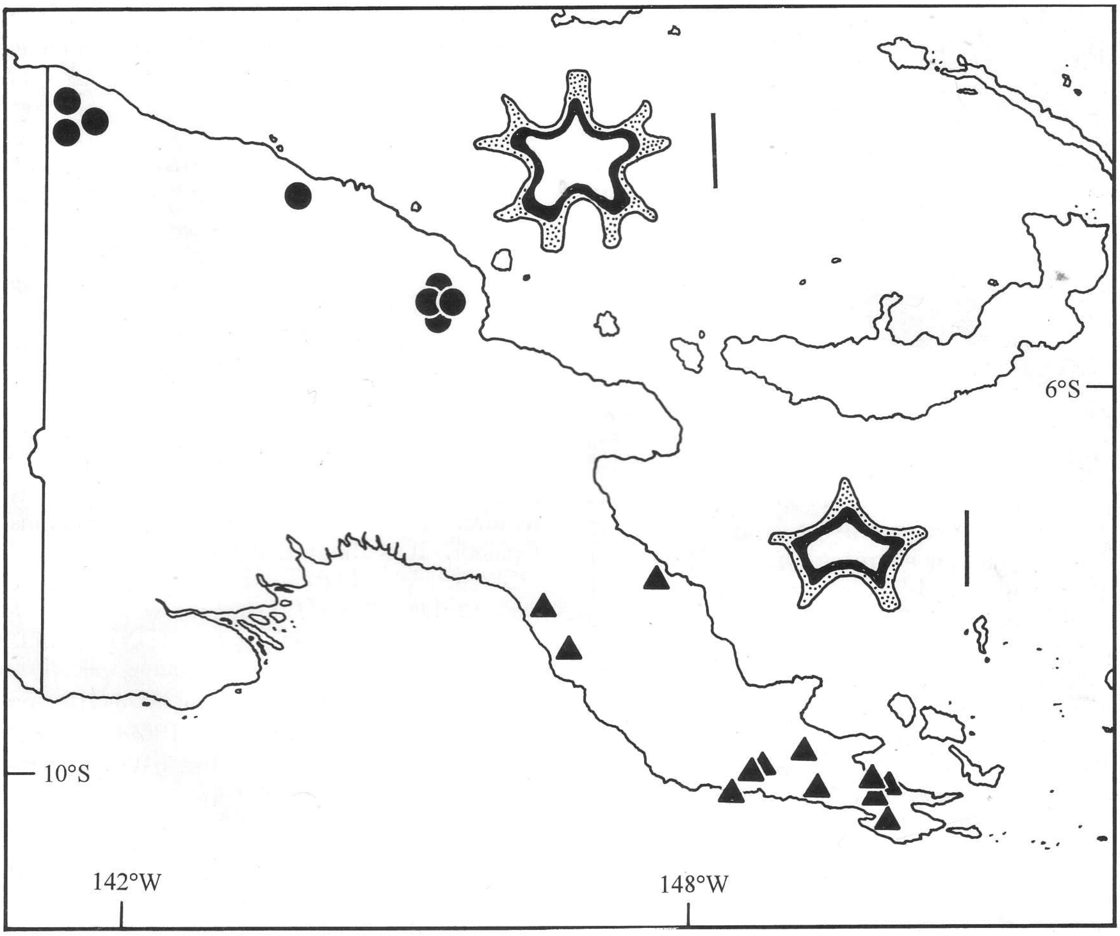
The holotype collection of *B. drymophloeoides* is held by the Arnold Arboretum herbarium. That specimen, *Brass 5665* from Kubuna, Central Province, has five-lobed endocarps, so the name *B. drymophloeoides* must apply to the southeastern species with five-lobed endocarps. This species occurs in Milne Bay, Morobe, and Central Provinces. Fairchild Tropical Garden has grown this species for many years under the erroneous name *B. schumannii.*

The holotype collection of *B. schumannii, Hollrung 264,* came from East Sepik Province, but regrettably this specimen was destroyed during the World War II bombing of the Berlin herbarium. In its place, Essig (1975) designated a neotype, *Lauterbach 857,* from Madang Province. All of the collections examined from the northern provinces, including Madang, have nine-lobed endocarps. Thus, the name *B. schumannii* is the correct name for the species with nine-lobed endocarps. It occurs in West Sepik, East Sepik, and Madang Provinces. Fairchild Tropical Garden has one mature plant of *B. schumannii,* grown from seed collected in West Sepik Province, but it has not borne fruit.

Among plants at Fairchild Tropical Garden, the inflorescence branches of both species of *Brassiophoenix* are densely covered with both white and dark brown pubescence when young. As the rachillae age, the white pubescence is lost, leaving the dark, coarse hairs. As the fruits mature, the rachillae may become glabrous (smooth). It is likely that these developmental changes led to misplaced confidence in rachillae pubescence as a specific character trait, when in fact both species have the same kinds of pubescence.

Specimens of *Brassiophoenix drymophloeoides* cultivated at Fairchild Tropical Garden (seed source: Milne Bay Province) have fruits that are a pale yellow-orange or apricot color when they fall to the ground. No additional color development occurs after the fruits have fallen. Label data from most wild collections indicate that collectors find only green fruits, but the label from one collection, *Darbyshire 964,* claims that the fruits are "Scarlet-red when mature." This statement may have been in error, since no other red-fruited specimens have been observed. One wild collection of *B. schumannii, Kerenga LAE 56487,* is said to have "Fruit turning orange." It is not clear from the recorded data whether orange is the ultimate color of the ripe fruits. Clearly, herbarium records of fruit color have led to confusion and justify Ferrero's (1997) distrust of the character. Fruit color may not differ in the two species, but additional observations of living plants are greatly desired, particularly from the locality of the Darbyshire collection.

We conclude that there are two species of *Brassiophoenix.* They are reliably distinguished on the basis of endocarp lobing, and they are geographically separated. Regrettably, the names of the two species have been confused in cultivation. The more commonly cultivated species with five-lobed endocarps must be called *Brassiophoenix drymophloeoides.* True *B.*



2. The distribution of *Brassiophoenix drymophloeoides* (triangles; five-lobed endocarp) and *B. schumannii* (circles; nine-lobed endocarp) in Papua New Guinea. Cross sections of endocarps (stippled) and seeds (white) were drawn from *Brass 5665* and *Kerenga LAE 56487*. Scale bars = 1 cm.

schumannii is less common in cultivation, at least in Florida, and has nine-lobed endocarps.

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Appendix 1. Specimens examined. Asterisks indicate specimens with fully formed endocarps.

Brassiophoenix drymophloeoides

PAPUA NEW GUINEA. Central Province: Kairuku Subprovince, Maipa village, *Darbyshire 964** (BH, K), Kubuna, *Brass 5665** (A); Abau Subprovince, Cape Rodney, Mori River, *Henty NGF 38558* (BH), Minari logging area, *Katik LAE 62143* (BH), Mori River, Yano logging camp, *Wiakabu and Giyowosa LAE 70454* (BH), 12 km N of Amazon Bay, *Pullen 7645* (BH); Milne Bay Province: Raba Raba Subprovince, Biniguni, *Streimann NGF 28561** (A, BH, K), Biniguni camp, *Brass 23853** (A, BH), Mayu camp, Mt. Suckling, *Leach LAE 56015* (BH), Kwagira River, *Brass 24034* (BH), Sagarai Valley, inland from Mullins Harbour, *Womersley NGF 19272* (BH); Morobe Province: Lae Subprovince, Mo River, SE of Ana village, *Essig LAE 55161** (BH). USA. Florida, Miami, cultivated at Fairchild Tropical Garden, *Read 809** (FTG), 65–664E, *Coons 1389* (FTG), 3172 (seed source: PNG, Milne Bay, Peria Creek, *Brass*

24034), *Essig 710123–1* (BH, FTG), *Donachie s.n.* (BH), and *Read 1476* (BH, FTG), seedling from 3172, *Zona 774** (FTG).

Brassiophoenix schumannii
PAPUA NEW GUINEA. Madang Province: Madang, Baitabag village conservation area, *Baker and Utteridge 570** (BH, FTG, K), Gogol River forestry camp, *Essig and Katik LAE 55052* (BH), same locality, *Katik LAE 62106* (BH), Gogol Valley, Sapi River catchment, off road 213, *Clunie et al. LAE 63531** (BH); East Sepik Province: Angoram Subprovince, 1.4 km N of Angoram on road to Gavien, *Essig LAE 55108* (BH); West Sepik Province: Vanimo Subprovince, Warastron forestry station, *Kerenga LAE 56440** (K, NSW), Blackwater logging area, *Kerenga LAE 56487** (A), road to Bewani village, *Kyburz K-PNG-V17** (FTG).

(continued from page 19)

lar in texture and taste to normal date fruits (Fig. 1F).

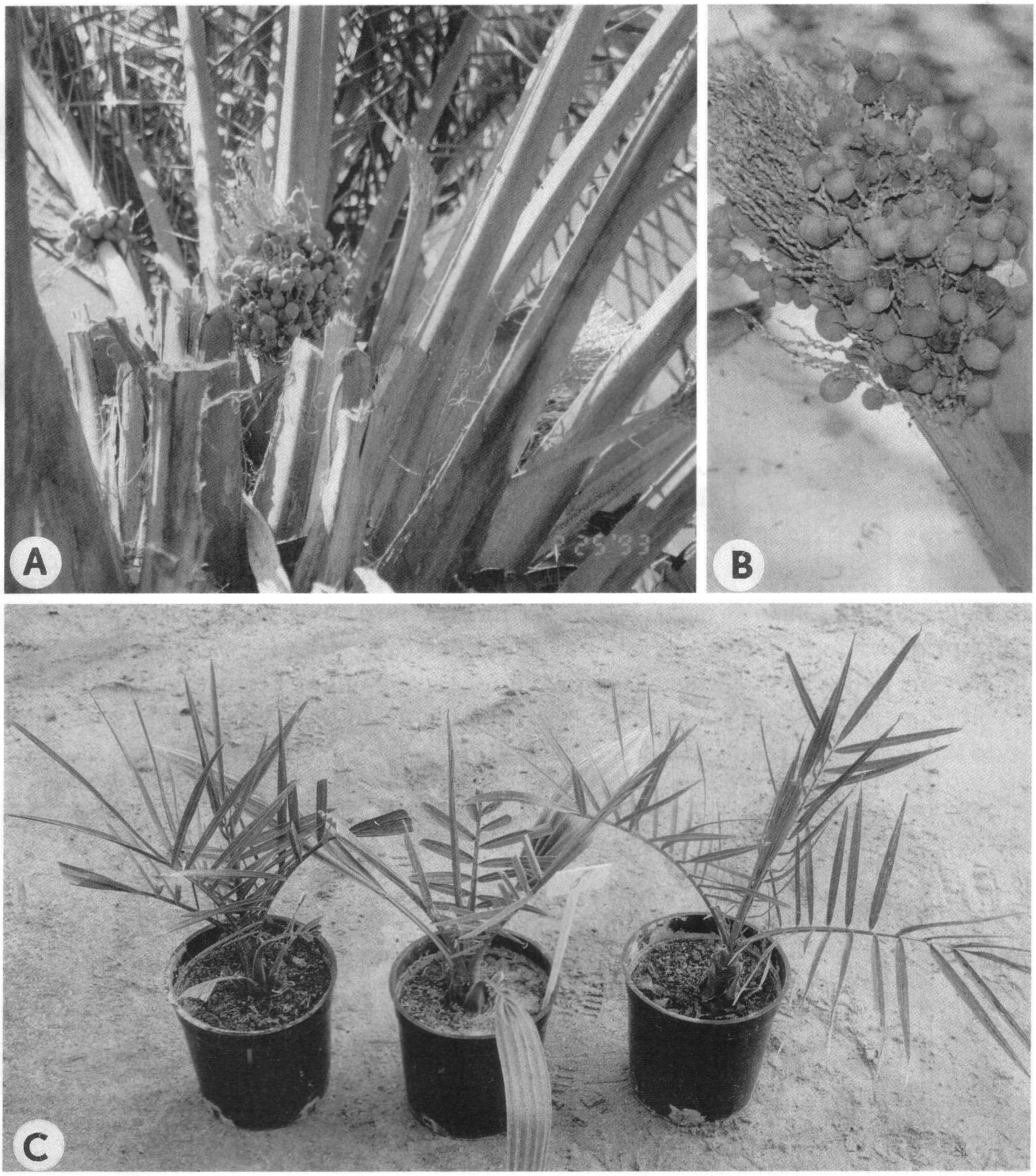
A similar occurrence of a male palm with hermaphrodite flowers was also observed in the same year on a male tree growing on a farm in the Buraidah area of Saudi Arabia. In Kuwait, the same phenomenon was observed in February 1993 (Fig. 2A), in which seeded fruits that were smaller than normal fruits developed on male infloresences (Fig. 2B). Developed seeds were collected, cleaned, dried and then germinated on moist filter paper in petri dishes. Germination was 77% and the germinated seeds were then planted in soil and kept in a greenhouse. The germinates grew into plants showing normal leaf morphology (Fig. 2C). In 1997, three plants were established in the field for further growth and sex determination. In April 1997, it was observed again that a male date palm growing in a residential area in Kuwait had parthenocarpic fruits. Hence, this hermaphroditism in date palm is not a rare occurrence.

Discussion

Occurrences of bisexual flowers have been reported in the date palm (Leak 1914, De Mason and Tisserat 1980). However, the production of inflorescences with complete bisexual flowers and germination of seeds from such fruits, after the removal of normal male inflorescences in male date palms, has not been reported. Leak (1914) pointed out that in his observation on a fruiting male tree, the change was not completely monoecious, but a whole series of intermediate and hermaphrodite flowers were produced. In the current observations, the infloresences had complete bisexual flowers.

The exact trigger for the change of a male tree to a hermaphrodite in the date palm is not yet known. However, several studies have been done on the genetic and hormonal regulation of sex expression in many other plants, mainly dicotyledons, in particular *Cannabis sativa* L. and *Cucumis sativa* L. (Zeevart 1978, Pharis and King 1985). Hormonal balance was shown to affect sex expression in these plants (Heslop-Harrison 1956, Galun et al., 1963). Applications of exogenous gibberellins have increased the production of male inflorescences at the expense of the femaleness in monoecious oil palm, and applications of auxins have increased femaleness (Corley 1976). In cucumbers, application of an aqueous solution of silver nitrate as a spray produced seeded fruits in otherwise parthenocarpic cucumber. Silver nitrate as an inhibitor of ethylene formation in plant tissue indicated an ethylene effect on the sex-determining process in plants. Hormonal imbalance may be one of the reasons for the development of infloresences with hermaphrodite flowers in date palms. Further studies are necessary to confirm this view.

The viable seeds produced by these hermaphrodite trees are useful for date palm breeding aimed at the development of superior date palm cultivars with hybrid vigor or seed-propagated true-to-type plants. Further studies are necessary to find out the exact reason and the triggering mechanism for the development of such kinds of hermaphrodite inflorescences after the removal of normal male inflorescences, which may enable date palm breeders to produce viable seeds from male trees in a consistent manner.



2. Parthenocarpic fruits developing on hermaphrodite flowers on a male tree growing in Kuwait. A. Hermaphrodite inflorescence with fruits, B. Close-up of the maturing fruits, and C. Plants produced from seeds formed inside fruits of a male tree in Kuwait.

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Sommieria elegans in full fruit, growing in lowland forest near Timika, Irian Jaya. (Photo: John Dransfield).