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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Principes, 41(2), 1997, p. 63

Editorial

The two color pages in the center of this issue introduce a new feature developed by Scott Zona: the publication in *Principes* of special photos accompanied by short explanations. Members should have received a brochure or seen an announcement in *Principes* about this, and we want to ask you all again to send your best photos and brief descriptions to Scott or to one of the editors.

Articles in this issue describe a new palm, provide accounts of some poorly known and threatened palms, give us new information on the significance of the distribution of species, and add some interesting insights on the history of gardening with palms. The first article by Dylan Fuller, John Dowe, and Michael Doyle describes a new species of *Heterospathe*. The article also includes an assessment of that genus and a discussion of the palms of Fiji. The new species, *H. phillipsii*, is named in honor of Dick Phillips, a plantsman who has often assisted those interested in Fijian plants, particularly palms, and is a special friend to many IPS members.

John Dransfield and Scott Zona discuss the genus *Guihaia*, which has an intriguing history. Described only in 1985, Guihaia is now in flower and fruit at Fairfield Tropical Garden. Two species are known; both are in cultivation and are highly desirable ornamentals. Their seeds have been confused with each other and with *Rhapis*. Some members undoubtedly are growing these palms, although perhaps under incorrect names.

A history of subtropical gardening by Jim Reynolds refreshes us on some of the early collectors of palms and elucidates the thinking that led to the introduction of palms and their initial establishment in British and European gardens. This article is both interesting and timely. With two active IPS chapters in the region, the popularity of palms is reaching a new, and perhaps unexpected, high.

Unusually diverse altitudinal gradients in western Ecuador offer habitats that have been much exploited by palms. Finn Borschenius has studied the distribution of 45 species and finds some possible correlations with climatic conditions that may be useful to those growing the species.

Dypsis decaryi, the triangle palm, is a striking and much appreciated ornamental, but in its native habitats in Madagascar, it is endangered. The factors affecting its distribution in the wild have been determined by Joel Ratisirarson and John Silander and should be useful to conservationists and growers.

NATALIE W. UHL
JOHN DRANSFIELD

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Note from the President

I hope that this issue of *Principes* finds all of you healthy and enjoying the many great articles that the Editors are publishing in our Society's journal. Although new in my term, I have come to appreciate the large amount of work done by a few very dedicated volunteers in producing this journal. One way all of you can contribute is by sending in creative articles to the Editors. We are not only seeking scientific articles, but also ones by members on subjects such as palm horticulture, palm observations, and descriptive articles on visits to palm habitats. Please help keep *Principes* exciting and informative with your contributions.

We will be having our 1997 Midterm Meeting at the Royal Botanic Gardens (Kew) in the United Kingdom this May. Midterm meetings are typically meetings of the Board of Directors to handle business affairs of our Society. If there are any issues you want brought before the Board, please communicate directly with me at the address below or with a Board Member in your locality.

In December 1996 I personally visited Thailand to solidify plans for our 1998 Biennial Meeting. This

was a trip that I made outside the auspices of the I.P.S., but with the purpose of actually previewing what will be seen by members at the meeting. Trust that this will be one of the best biennials ever! Our host for the meeting is Kampon Tansacha and Nong Nooch Tropical Gardens in central Thailand. Kampon and his staff are going to great lengths to make sure that this 1998 Biennial will be a most enjoyable event. As part of the meeting, we will not only be visiting Nong Nooch Tropical Gardens and other nearby palm attractions, but also flying to the very south of Thailand to visit many natural palm habitats. The Post-Biennial Trip will be equally exciting with further excursions through Southern Thailand and plans to visit the famous area of Phuket and possibly a primitive offshore island. To miss this meeting would definitely be a mistake, so begin planning now. Attendees should plan on arriving in Bangkok on September 11, 1998. The Biennial will last approximately eight days with the Post-Trip lasting five to six days. Future issues of *Principes* will have more specifics and all members will be receiving individual notification by mail. Hope to see you all there!

PHIL BERGMAN, PRESIDENT
3233 Brant St., San Diego, CA 92103 USA
email: PalmNCycad@aol.com
phone: (619) 291 4605, fax: (619) 291 4605

Principes, 41(2), 1997, p. 64

A Palm Museum for the New Palmetum in Santa Cruz, Tenerife, Canary Islands

Palm objects are often displayed, but until now there has never been a stand-alone museum devoted exclusively to palms, the products they provide, and other palm-related materials. The Palm Museum, under construction as part of an ambitious project to establish a new Palmetum in Santa Cruz, is therefore an exciting development for palm fanciers. The primary theme of the museum exhibits will be the importance of palms to human society through providing subsistence and manufactured products. Secondary themes under construction include African palms and palms in culture and art. To demonstrate the importance of particularly useful species, special exhibits of the array of products from multipurpose species, such as the coconut, are under consideration.

Members of the International Palm Society who have palm objects they would consider donating, or IPS chapters willing to support the purchase of an object for the Palm Museum collection, are invited to contact me at the address below. I will be glad to provide information on the types of objects and materials we are seeking. Gifts to the Palm Museum will be acknowledged in the exhibit.

DENNIS JOHNSON, Consultant
Tenerife Palm Museum
11 Colgate Street
Pocatello, Idaho 83201 USA
Tele. and Fax 208 232 8090
Email ⟨djohn37@aol.com⟩

E-mail Address for Jim Cain

Please note: Jim Cain will no longer be available on GEnie. His e-mail address is 104706.666@compuserve.com.

Principes, 41(2), 1997, pp. 65–69

A New Species of Heterospathe from Fiji

DYLAN FULLER,[1,3] JOHN L. DOWE,[2] AND MICHAEL F. DOYLE[1]

[1]*South Pacific Regional Herbarium, University of the South Pacific, Suva, Fiji*
[2]*18 Amelia St., Albion 410, Queensland, Australia*

Since the publication of Moore's (1979) treatment of Fiji palms, extensive and more intensive botanical exploration has occurred in many areas of the Fiji archipelago. Even in locations close to developed areas, more thorough examination has revealed a number of novelties, including the new species of *Heterospathe* described in this paper. The most recently described palms from Fiji, *Alsmithia longipes* H.E. Moore (Moore et al. 1982) and *Gulubia microcarpa* Essig (Essig 1982), resulted from collections conducted in 1980. These discoveries, along with recent field work (Fuller and Doyle, unpublished), indicate a significantly larger palm flora than previously recognised.

The indigenous palm flora of Fiji is relatively rich in taxa and includes ca. 30 species distributed among the following 13 genera: *Alsmithia, Balaka, Calamus, Clinostigma, Cyphosperma, Heterospathe, Goniocladus, Gulubia, Metroxylon, Neoveitchia, Physokentia, Pritchardia,* and *Veitchia.* The common and widespread *Cocos* was probably an early aboriginal introduction into Fiji, and as such, is excluded from the above list. Although three of the 13 genera listed above were previously considered as Fiji endemics and monotypic (*Alsmithia, Goniocladus,* and *Neoveitchia*), the recent discovery of a new species of *Neoveitchia* from Vanuatu (Dowe and Cabalion 1996) reduces the number of endemic monotypic genera to two. All native palm species from Fiji are considered endemic to the island group. Most Fiji palms are inhabitants of tropical moist forest, primarily occurring as subemergents.

The genus *Heterospathe* was not previously known to occur in Fiji, although its presence is not surprising based on its western tropical Pacific distribution, which includes the Philippines, Micronesia, eastern Indonesia, New Guinea, Solomon Islands, and Bismarck Archipelago (Uhl and Dransfield 1987), and Vanuatu (Dowe and Cabalion 1996). The affinities of Fiji palms follows the same general pattern as the rest of the vascular flora—essentially a Pacific extension of the Indo-Malesian floristic region, although Polynesian and even Neocaledonian connections exist. Within the southwest Pacific region and at the generic level, the palm flora's closest relationship is with Vanuatu (Dowe and Cabalion 1996).

The remarkable endemism (100%) of Fiji's palms suggests that there has been considerable speciation within the group. Based on its oceanic geologic origins (Rodda 1994), presumably all indigenous taxa in Fiji were dispersed by means of short-distance dispersal from adjacent islands, or by long-distance dispersal from other floristic source areas. The fruits of many Fiji palms appear to be bird dispersed, although at least one taxon (*Metroxylon*) may be water dispersed. Fiji's oldest terrestrial rocks range from about 14–17 million years old (Rodda, personal communication). The age of the islands, combined with their insular nature both in terms of isolation from other islands as well as locally occurring topographic barriers (e.g., mountain ranges) has undoubtedly contributed to the high level of endemism of palms within the Fiji Islands. Many, if not all, of Fiji's native palms probably are the result of speciation events *in situ* (neoendemics), as opposed to being relict species (paleoendemics) which had once wider distributions and are now only restricted to single or few localities.

While some taxa [e.g., *Veitchia vitiensis* (H. Wendl.) H.E. Moore and *Balaka longirostris* Becc.] are common, several species [e.g., *Cyphosperma tanga* (H.E. Moore) H.E. Moore and *Heterospathe phillipsii* sp. nov.] are very rare and confined to single or only a few localities, with some potentially threatened from logging or other land use activities. At present, only one palm species from Fiji [*Neoveitchia storckii* (H.Wendl.) Becc.] is

[3]Present address: The Natural History Museum, Cromwell Road, London SW7 5BD, UK.

internationally recognized as endangered (Gorman and Siwatibau 1975; Lucas and Synge 1978). Because of the diversity and high endemism of Fiji's palm flora, combined with increasing threats to their habitat, efforts must be taken to both document the occurrence of taxa present as well as develop conservation strategies for their long-term preservation.

Heterospathe phillipsii Fuller and Dowe **sp. nov.**

Palma usque 12 m alta. Folia pinnis latis laxis semipendulis medio folii 4.5 cm latis. Inflorescentia ramosa in 4 ordines. Flos staminatus 6 stamina ferens. Fructus ellipsoideus usque 13 mm longus, vestigio stigmatis apicale excentrico. Semen vadose ruminatum. Typus: Fiji, Viti Levu, Veivatuloa District, Namosi Province, 8 km NW of Navua, Natural Forest Management Pilot Project (NFMPP) Reserve, c. 150—200 m altitude, 14 Nov 1995, *Fuller 299* (holotypus SUVA; isotypi BH, BRI). (Figs. 1–3).

Solitary palm to 12 m tall. Trunk erect, to 18 cm DBH, green to brown in upper portion, becoming grey with age in the lower portion, base expanded; leaf scars closely spaced, raised. Leaves 10–12 in a compact crown, to 5 m long, arching to curved below the horizontal, 48–52 pinnae per side, leaf bases not forming a crownshaft; new leaf usually reddish/bronze; petiole 30–50 cm long, green, concave adaxially, convex abaxially, glabrous; rachis ridged adaxially, convex abaxially in lower portion becoming flat in distal portion, glabrous; pinnae lax to semi-pendulous, in one plane, glossy dark green on adaxial surface, paler green on abaxial surface, widely and evenly spaced along rachis, lanceolate, apex acute, midleaf pinnae to 75 cm long, 3.5–4.5 cm wide; midrib prominent adaxially and raised only slightly abaxially; secondary lateral ribs 2–3 on either side of midrib, most prominent on adaxial surface, positioned unequally between midrib and marginal rib; ramenta on abaxial midrib sparse, absent from distal one-fourth of pinnae, basifixed. Inflorescence interfoliar, to 1.8 m long, branched to four orders, axes white-cream, all branches straight, major branches angular in cross section, minor branches terete in cross section, bases of branches with prominent pulvini; peduncle to 30 cm long, elliptic in cross section, 2.5 cm wide by 1 cm thick at the base, to 1.5 cm wide by 0.8 cm thick below attachment of first branch; prophyll 50–60 cm long, fully encircling peduncle at attachment, dorsiventrally compressed, marginally winged, persistent, outer surface with numerous punctiform scales, inner surface glabrous, disintegrating to fibrous strands; peduncular bract 1, greatly exserted from apex of prophyll, attached ca. 5 cm above attachment of prophyll, to 1.8 m long, tubular, fully enclosing inflorescence in bud, apex dorsiventrally spathulate, splitting longitudinally along adaxial surface prior to dehiscence, caducous, outer surface with numerous punctiform scales, inner surface glabrous; rachillae 15–25 cm long, white-cream, terete in cross-section, slightly flexuous, longitudinally striate, sparse brown scales most dense near triads. Flowers in triads in proximal portion, paired or single staminate flowers in distal portion, spirally arranged, sessile, subtended by liplike bracts. Staminate flower white-cream, slightly asymmetric in bud, sepals imbricate to 1 mm long, petals valvate to 3 mm long, stamens 6, anthers dorsifixed, latrorse, versatile; pistillode to 3 mm long, columnar, tapered toward the apex. Pistillate flower white-cream, symmetrical, to 3 mm long, sepals imbricate, to 1.5 mm long, petals imbricate to 3 mm long, stigma trifid, protruding at anthesis. Fruit ellipsoid, to 13 × 7 mm, stigmatic remains prominent, eccentrically apical; epicarp smooth (drying pebbled), red at maturity, mesocarp thin, fibrous, endocarp thin, crustaceous. Seed ellipsoid, attached laterally, to 7 × 4 mm, hilum elongate, extending the length of the seed, raphe branches anastomosing, surface with shallow grooves, endosperm shallowly ruminate; embryo basal. Eophyll pinnate.

Distribution: FIJI. Known from one locality on Viti Levu, 8 km north of Navua in forest that has been selectively logged. This same palm species was originally reported (in 1976) from a separate disjunct area near Naimasimasi Village, Province of Tailevu, some 60 km NE of the extant population. A tree from this disjunct population is presently growing in the garden of Mr R.H. Phillips (*Zona 642*). The palms in this area could have

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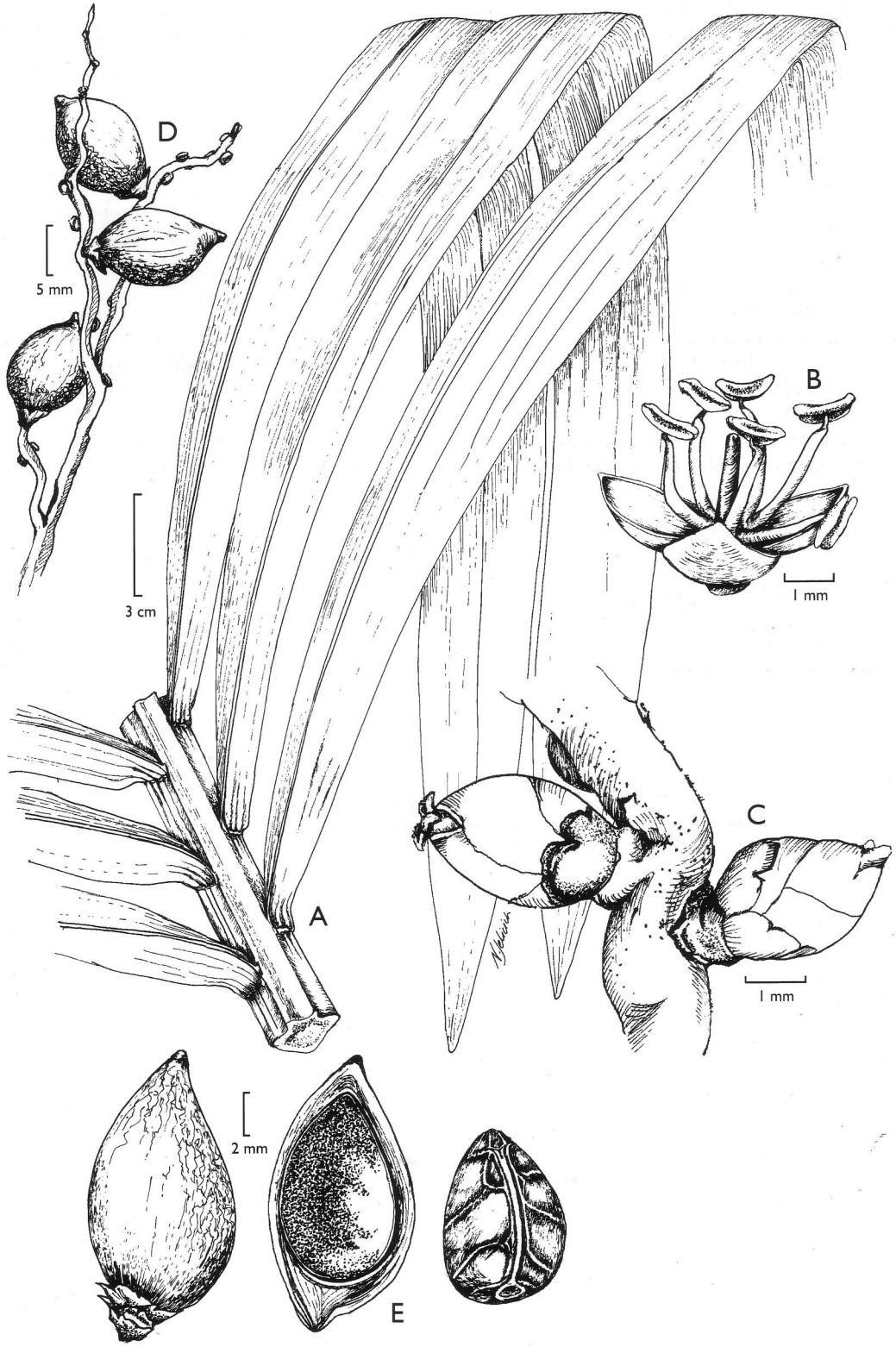
1. *Heterospathe phillipsii.* A pinnae, adaxial view; B. Staminate flower at anthesis; C. Pistillate flowers, at receptivity, attached to rachilla; D. Fruit attached to rachilla; E. Fruit (full and transected) and seed (hilum view) (*Fuller 299*). Illustrations by Nicole Jelicich.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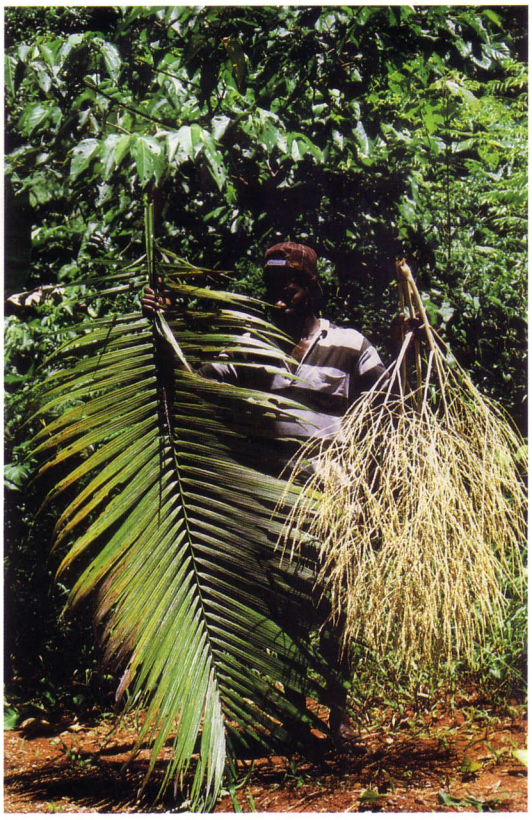

2. *Heterospathe phillipsii*, habit, inland from Navua, Viti Levu. 3. Leaf and inflorescence of *Heterospathe phillipsii*.

been destroyed when the area was clear-felled for planting Mahogany (*Swietenia macrophylla*). A search in 1994 found no trace of the *Heterospathe* palms (R.H. Phillips, personal communication).

Specimens Examined: FIJI. Viti Levu, Veivatuloa District, Namosi Province, 8 km NW of Navua, Natural Forest Management Pilot Project (NFMPP) Reserve, c. 150–200 m altitude, 3 Mar 1995, *Fuller & Doyle 159* (BH, BRI, SUVA, US); 15 March 1995, *Fuller & Doyle 171, 172* (BRI, CAS, SUVA); 21 Apr 1995, *Fuller 177* (SUVA); 21 Apr 1995, *Fuller 179* (CAS, SUVA); cultivated in garden of R.H. (Dick) Phillips, Mara Road, Samabula, Suva, 28 May 1995, *Zona 642* (FTG, SUVA); 10 km inland from Queens Hwy, 29 May 1995, *Zona 643* (FTG, SUVA).

Etymology: Named for Richard (Dick) H. Phillips, horticulturist and amateur botanist, who has been active for many decades in collecting and growing Fiji palms.

Ethnobotany: Vernacular name: *niu niu.* The palm heart is edible and the immature seeds are eaten: they are reported to taste like coconut.

Conservation: Proposed as Threatened: The population consists of an estimated 400–500 adult trees in a single population along a 5 km section of logging road. The area has been selectively logged. The land where *Heterospathe phillipsii* occurs is owned by the Nabukebuke Mataqali (clan) from Nakavu village. The Fiji Department of Forestry has leased most of the palm habitat as part of the NFMPP project for 50 years effective 1 January 1991 (315 ha). Selective logging continues in adjacent rain forest tracts. The palm is cultivated in a few private gardens in Suva while seeds have been distributed to botanic gardens and collectors in Hawaii and Australia.

Heterospathe phillipsii occurs as a semi-emergent element in dense evergreen lowland rainforest, on steep well-drained slopes usually above watercourses at elevations of 80–300 m. Soils are deeply weathered clays with a low natural fertility

(de Vletter 1991). Associated vegetation includes the palms *Balaka longirostris* and *Veitchia vitiensis,* with dominant trees in Myristicaceae (16%), Myrtaceae (9%), Sapotaceae (8%), Clusiaceae (8%), Burseraceae (6%), and Thymelaeaceae (6%). Large *Agathis vitiensis* (Araucariaceae) and a few *Degeneria vitiensis* (Degeneriaceae) are present in the surrounding forest.

Within the population, adult palms are evenly scattered. Regeneration is good with both immature trees (1–3 m tall) and seedlings being common. Flowering and fruiting occur throughout the year in an apparently cyclical non-seasonal manner, with most individuals flowering and fruiting concurrently. Pollination may be achieved by small wasps or bees as these have been observed at the flowers. Dispersal appears to be mainly gravity driven, although Masked Shining Parrots *(Prosopeia personata)* have been observed foraging on the palms.

Heterospathe phillipsii is distinguished from other species of *Heterospathe* by the following combination of characters: tall solitary trunk, pinnae broad and lax, inflorescence branched to four orders, staminate flower with six stamens, fruit ellipsoid with prominent, eccentrically apical stigmatic remains, and the endosperm only shallowly ruminate. The species appears most closely related to the *H. woodfordiana* Becc. group from the Solomon Islands, and to *H. uniformis* Dowe from Vanuatu. This assemblage of species includes moderately tall palms with staminate flowers with six stamens and elongate/ellipsoid fruit. The New Guinea *Heterospathe* (ca. 16 spp.) tend to be rather small arborescent or acaulescent/clustering palms with moderately branched inflorescences (1–3 orders) and with most species having more than six stamens, while those from the Philippines (ca. 11 spp.) tend to be rather small clustering palms with six stamens. The occurrence of *Heterospathe* in Fiji significantly, but not unexpectedly, extends the distribution of the genus. Other outliers occur in the Moluccas, Micronesia, and Vanuatu.

Acknowledgments

Partial financial assistance for this study was made possible by a research grant from the University of the South Pacific to MFD and DF. We wish to thank Mr. Richard (Dick) Phillips for bringing this new species of *Heterospathe* to our attention as well as his ongoing encouragement and support for botanical research in Fiji. We also wish to thank Nicole Jelicich for her time and effort preparing the drawings, Dorian Fuller for help with the Latin diagnosis, Professor Peter Newell for all his helpful advice, both tangible and intangible and Marika Tuiwawa for his assistance with the ethnobotany. Finally, *vinaka vaka levu* to the people of Nakavu Village and the Fiji Department of Forestry for their stewardship of this rare palm.

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Guihaia in Cultivation: A Case of Mistaken Identities

JOHN DRANSFIELD
Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK

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

China is the source of so many of the world's ornamental trees and shrubs that we should not be surprised to learn that China has also given the world palms of great horticultural merit. *Trachycarpus* and *Rhapis* are familiar and widely cultivated genera, but one of China's newest gifts is *Guihaia*. It is a genus of two species of small fan palms of the subfamily Coryphoideae whose clos-

1. *G. argyrata* has erect, spine-like fibers at the base of the leaves. 2. *G. grossefibrosa* has confluent fibers at the base of the leaves. Note the glaucous petiole bases.

3. The beautiful leaves of *Guihaia argyrata* are deep green above and silvery white below. 4. The leaves of *Guihaia grossefibrosa* are divided nearly to the hastula.

Table 1. Vegetative characteristics of mature plants of Guihaia *in cultivation at Fairchild Tropical Garden.*

Characteristic	*G. argyrata*(n = 4)	*G. grossefibrosa*(n = 4)
Petiole length	72–100 cm	25–80
Petiole width	1.2–2.4 cm (base) 0.7–1.2 cm (apex)	0.6–1.7 cm (base) 0.4–0.9 cm (apex)
Petiole color	Green	Green, glaucous or chalky at base
Sheath fibers	Stiff, erect, separate	Soft, clasping, confluent
Blade diameter	68–99 cm	49–84 cm
Palman diameter	4.5–12 cm	<1–3.5 cm
Segment number	23–34	16–21
Segment length	33.5–49 cm	25.5–43.5 cm
Segment width	2.5–5.2 cm	1.2–2.8 cm
Abaxial indumentum	Dense	Sparse

est relatives are *Rhapis* and *Maxburretia* (Uhl and Dransfield 1987, Uhl et al. 1995).

Specimens of *Guihaia,* mistakenly identified as *Rhapis* and *Trachycarpus,* had been collected from southern China and adjacent Vietnam as early as 1929 (Dransfield et al. 1985). In the mid-1980s China began to open its doors to botanists, and it was in 1984 that one of us (JD) saw *Guihaia* in the wild and worked with Professor Lee Shu Kang and Mr. Wei Fa Nan to describe the genus as distinct from other Asiatic coryphoid palms (Dransfield et al. 1985). The two species, *Guihaia argyrata* (Lee & Wei) Lee, Wei, & J. Dransf. and *G. grossefibrosa* (Gagnep.) J. Dransf., Lee & Wei, grow in crevices of steep karst limestone hills; in this way, they strongly resemble members of the genus *Maxburretia,* which itself is almost unknown in cultivation. *Guihaia* is immediately distinguishable from *Maxburretia* in its leaf, which is divided into segments whose plication is reduplicate (/\ in cross section) rather than induplicate (\/ in cross section).

Once described, the genus became very much in demand, and batches of seeds were exported from China. At the same time, seeds of *Rhapis* species were being exported in large quantities from Chinese provincial agricultural and forestry agencies. These batches of seeds were imported by many commercial growers in the USA and Australia, but it soon became obvious that the seeds were neither those of *Rhapis excelsa* nor any other *Rhapis* species (McKamey 1989). As soon as the seeds germinated, the seedlings were identified as *Guihaia* (it was assumed, *G. argyrata*).

Fairchild Tropical Garden (FTG) acquired small plants of what were thought to be *G. argyrata* in 1987 and again in 1989. With the passage of time, the plants matured and thrived. While visiting FTG, one of us (JD) made an unexpected discovery: both species of *Guihaia* are in cultivation!

The two species, *G. argyrata* and *G. grossefibrosa,* occur in the Guangxi and Guandong Provinces in southern China, although it is not known whether both species co-occur in mixed populations. The seeds are similar (but not identical) in size and shape, so those of *G. grossefibrosa* could have easily masqueraded under the name "*G. argyrata.*" The mistaken identity was felicitous, because we now have both species growing side by side and available for comparison.

One of the most striking features of *Guihaia* is the morphology of its leaves, which have reduplicate plication. Induplicate plication is the rule in the Coryphoideae, so the anomalous condition of *Guihaia* is all the more peculiar. Close inspection reveals, however, that the leaves of *Guihaia* are fundamentally no different from those of other coryphoid genera. Early in the development of the leaf, the divisions that define the leaf segments are superimposed on an undivided, plicate leaf primordium. In most genera, the divisions occur at the upper folds, but in *Guihaia* the divisions fall along the bottom folds. Thus, each segment (except those at the margins) has a reduplicate fold. The marginal segments are either half-segments or one-and-one-half segments. Occasionally, one can find a half-segment on one side and a one-and-one-half segment on the other side.

Elsewhere in the subfamily, variations to the induplicate theme are found in only a handful of genera. *Rhapidophyllum* and *Rhapis* have leaf segments that are not divided exactly on the upper fold; in these two genera, many of the divisions fall between the upper and lower folds, creating segments that are really one-and-a-quarter segments or two-and-three-fourths segments. In *Licu-*

ala leaf division is also unusual. In all except the entire-leaved species, the blade splits along the bottom folds to give segments that usually consist of several folds but that have reduplicate plication.

FTG's *Guihaia* palms are still young, and none of the plants has a stem more than a few centimeters tall. Despite their small stature, a few plants have flowered and borne fruit. The taller stature of *G. grossefibrosa* (stem ca. 1 m tall vs. <0.5 m in *G. argyrata*) noted by Dransfield et al. (1985) is not yet apparent on FTG's plants. Some individuals of both species are producing shoots at the base of their trunks, indicating that they are caespitose (clustering) palms.

One of the most obvious differences is in the leaf sheath fibers that clothe the stem (Figs. 1–2). In *G. argyrata* the fibers are usually stiff, erect, and sharp, reminiscent of the fibers of the needle palm, *Rhapidophyllum hystrix*. The fibers of the margin of the leaf sheath are usually free and distinct. In contrast, *G. grossefibrosa* has sheaths in which the marginal fibers are confluent and appressed to the stem, not free and projecting. A small number of FTG's plants with the facies of *G. argyrata* have the soft, clasping fibers of *G. grossefibrosa*.

In young plants, the base of the petiole is green in *G. argyrata*, whereas it has chalky white indumentum in *G. grossefibrosa*. With these characteristics, one can identify even young, sterile palms. As the plants get older and larger, the coloring of the petiole becomes less pronounced. Plants with large leaves have thicker petioles than plants with small leaves. The petiole sometimes bears scales along the edges of its underside, but this character is highly variable.

The leaves of the two species are quite variable in size (Figs. 3–4). The leaf blades of FTG's plants growing in light shade are about twice the size of those in full sun. The smaller, sun-grown plants also have fewer segments per leaf (16–19), while those in the shade have as many as 34 segments per leaf. The segments of *G. argyrata* are wider than those of *G. grossefibrosa* (Table 1). Sun-grown plants of both species tend to have strongly folded segments, while those of shade-grown plants are nearly flat. In *G. grossefibrosa*, the segments are free almost to the hastula, but in *G. argyrata*, the segments are not as deeply divided (Table 1).

The underside of the blade is conspicuously silvery or bronzy in *G. argyrata* but less so in *G. grossefibrosa*. The color is caused by multicellular scales on the underside of the leaf. The two species differ in scale density, but there does not appear to be any fundamental difference in scale type. In *G. grossefibrosa*, the green surface of the leaf is visible between the scales, but in *G. argyrata* it is completely obscured.

Along with the peculiarity of reduplicate plication, *Guihaia* exhibits another curious trait: the central segment of the leaf usually has two folds. This character can be seen in the plant illustrated on the cover of *Principes*, vol. 29(1). Most of the plants in cultivation at FTG have the double-fold central leaf segments, although sometimes one or more leaves are produced in which the central segment has only a single fold.

The problem of FTG's exceptional plants, like a *G. argyrata* with soft leaf sheath fibers, calls into question the origin of the plants and the possibility of hybridization. These species have not been thoroughly studied in the wild, so we cannot say whether the variation we see in FTG's plants is natural, nor do we know if these plants hybridize, either in their natural habitats or in gardens. Until we have genetic proof of hybridization, we can only surmise that both species of *Guihaia* are somewhat variable and that within each species no two individuals are exactly alike.

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"Palm Trees Shivering in a Surrey Shrubbery"—A History of Subtropical Gardening

JIM REYNOLDS
Vandusen Botanical Garden Association, 5251 Oak Street, Vancouver, British Columbia, Canada

From the earliest times, gardeners have been preoccupied with cultivating exotic plants in alien climates (Huxley 1978). Henry VIII's gardener successfully grew fruit such as figs, peaches, and apricots against the warm, south-facing brick walls at royal palaces. Not much later, Sir Francis Carew was growing orange trees outdoors in southern England. Extraordinary measures were needed to keep these delicate trees alive. In winter, wooden huts were erected around them and they were heated with stoves when frosts threatened (Rose 1989). However, despite these early beginnings, the use of hardy palms and other "exotic" plants in the temperate garden really owes its origins to eighteenth and nineteenth century European botanical expeditions and to the Victorian vogue for botany and plant collecting. This article traces that history to the present-day use of such plants in the Pacific North West.

Palm Pioneers and Plant Collectors

Interest in palms and other tropical plants grew as European nations extended their influence in tropical areas of the world. In particular, the Dutch presence in the Far East led to an increase in European knowledge of palms. In the latter part of the 17th century, Rumphius (1627–1702) compiled his books on the flora of Amboina in the Moluccas Islands, describing about 50 species of palms. Alexander von Humboldt added greatly to this knowledge through his voyages of scientific investigation to the Spanish Colonies in South America, adding, among others, the genus *Jubaea*, which is usually considered to be the hardiest of the feather palms. Humboldt's travels and publications stirred up interest over South America, which led, in turn, to the expedition in 1817 to 1820 of Carl von Martius (1794–1868), the "Father of Palms." One of the results of this expedition was the *Historia Naturalis Palmarum*, which took him from 1823 to 1853 to complete and which is described by Prof. Corner as "the most magnificent treatment of palms that has been produced" (Corner 1966). The half-hardy palms *Brahea* and *Trithrinax* were included. The year 1850 saw the publication of another great palm book, *Palms of British East India* by William Griffith (1810–1845). Other British palm pioneers of the 19th century included Alfred Wallace (1823–1913), Henry Bates (1823–1892), and Richard Spruce (1817–1893). A major contribution was made to the study of palms by the Italian botanist Odoardo Beccari (1843–1920) in the latter part of the 19th century and early 20th century.

In the 18th and 19th centuries, plant collectors went on many exciting and dangerous voyages around the world to bring back specimens for European collectors. One of the most famous was Sir Joseph Banks (1743–1820) who went with Captain Cook on his first voyage around the world. When he became unofficial director of Kew Gardens, he sent out other plant collectors who added many more of the plants with which we are now familiar. From Britain, many of the plants were then sent to other tropical regions. For example, the Malaysian rubber industry owes its origin to seedlings sent to the Singapore Botanical Gardens by Kew Gardens. Kew was also important in spreading the cultivation of bananas around the world. A major breakthrough in plant collecting took place in 1827 when the Wardian case was invented and plants could be more safely transported (Allen 1969). Deenaugh Goold-Adams notes that, "the use of the Wardian case—meant that the more delicate tropical plants and the wonders of China had a chance of surviving the journey. The use of the Wardian case turned the trickle of new introductions into a flood" (Goold-Adams 1987).

One of the earliest plant collectors was Robert Fortune who made successful expeditions into China and Japan (Coats 1969). Although Dr. Von Siebold sent seeds of the Windmill palm (*Trachycarpus fortunei*) from Japan to Holland in 1830, it was Robert Fortune who was responsible for their successful introduction as a staple of subtropical gardening. He first saw the palm on the islands of Chusan off the coast of east China and collected young plants in 1849 on a trip into the interior. China had been off-limits to European collectors until the end of the Opium War in 1842 and in 1849, Europeans were still restricted to 30 miles from a treaty-port. Fortune wanted to collect green tea plants, which were far from the coast so, in order to go undetected, he wore a Chinese costume and had his head shaved in the Chinese style to conceal that he was a foreigner. On the journey by boat to the tea district, he came across the palm that was to be named after him. He arranged to send some young plants via Hong Kong and Calcutta to William Hooker at Kew. He requested "that he would forward one of them to the garden of His Royal Highness Prince Albert at Osborne House, Isle of Wight." It is interesting to note that, in 1871, William Robinson wrote that a Chusan palm in Her Majesty's gardens at Osborne "had stood out for many winters and attained a considerable height" (Robinson 1871). Over a hundred years later in 1989, Roy Lancaster observed that trees from Fortune's introductions are still alive and well outside at Kew, Osborne House, and elsewhere Lancaster (1989).

The Victorian Passion for Plants

The many exotic plants found by the plant collectors were eagerly welcomed by the European middle classes, especially in Britain. The Victorians had a passion for plants:

Plants—especially fecund, exotic plants, found on heroic adventures in the far corners of the globe—were one of the symbols of the Victorian Age. As Britain's industrial base grew more prosperous and her Empire spread, so the British public became more obsessed with nature in all its varieties. It was not such a paradoxical fascination as it might seem at first sight. Partly it was a reaction against the accelerated drift of the population towards the industrial cities, partly a sheer revelling in "The Wonders of Creation". Nothing was more encouraging to an aggressively expansive and optimistic people than the ceaseless parade of new resources and natural marvels that its explorers and entrepreneurs were bringing home from the colonies. It seemed like a divine blessing on the nation.

Mabey (1989)

Exotic plants such as palms provided a link, however weak, to wondrous lands:

Only in purple light of dreams may dwellers in temperate climates conjure up, perhaps, for themselves pictures of indescribable magnificence of the vegetation that springs up beneath the glowing sun of the tropics. The individual plants themselves that languish imprisoned in our hot-houses can but faintly suggest ideas of their full and majestic development in their native lands.

S. Moody (1864)

The association of palms with religion was part of their fascination for some Victorians. In 1864, *The Palm Tree* by S. Moody was published. In it, she notes the many scriptural references to palms, writing that "it has been the writer's earnest aim throughout to endeavour, by unfolding the countless lovely analogies suggested by her subject, to interest the reader in The Palm Tree - Servant of God and friend of man." Sometimes this association seems to have gone too far. One 19th century enthusiast wrote:

This distinguished form of the palm, superior to all other plants, the noble bearing, the stem striving to reach the skies—its nourishing fruits, the materials for clothing and shelter - all these combined to create the sense of a higher being inherent in it, if not a godhead then surely the dwelling of the same.

Minter (1990)

In Europe, many of the newly introduced plants were housed in greenhouses ranging from the great Palm House at Kew built between 1844 and 1848 to more modest suburban home conservatories built for the expanding middle class created by the Industrial Revolution (Minter 1990, Warren 1991). The development of those glasshouses was the result of the repeal of Britain's Glass Tax in 1845 and the growth of new industries producing cheaper glass. Heat was provided by stoves and so these conservatories were often called stove houses or stoves. One author notes that

the Victorians liked to heat their conservatories. It was a matter of ambition and pride to be able to grow and display the most exotic, rare, and tender plants and then to be able to take tea amongst them.

Marston (1992)

The design of many of these conservatories was very elaborate and the survivors bear witness to the skills of Victorian craftsmen.

Although the passion for palms never surpassed the craze for ferns, palms had a special fascination for the Victorians as reflected in the growth of the Kew collection. Six palm species were grown at Kew in 1768, ten by 1787, 20 in 1813, 40 in 1830, and 420 in 1882 (Minter 1990). This public

collection was eclipsed by that of Loddiges' Nursery in Hackney between 1820 and 1845, which in the latter year had upwards of 200 types of palms. The customers for such a nursery required considerable wealth. A writer commented in 1838, "The culture of palms—is less a matter of nicety than expense. They require a powerful moist heat, a large mass of rich earth in the pot, tub or bed and ample space for the leaves—it would require to have the roof elevated by degrees to sixty, eighty or a hundred feet" (Minter 1990). The development of subtropical gardening, which reduced the need for large conservatories may have been, in part, due to a desire to enjoy palms and other exotic plants without this great expense.

The Beginnings of Subtropical Gardening

The use of palms and other exotics in the temperate garden started in Germany and France. According to one source, the first attempt to use *Canna* as subtropical bedding plants in temperate latitudes was made in 1846 by M. Année, a former French consular agent in Chile (Perry 1979). Reports of the use of *Canna* and *Maranta* in outdoor flower beds came from Germany in the 1850s (Carter 1984, Elliott 1986, Stuart 1988). These tender plants displayed outside only during the summer and autumn were supplemented by the hardier pampas grasses and bamboos. This style was then developed in the public parks of Paris and began to influence British gardeners. One such gardener was John Gibson who was the superintendent of Battersea Park in London. He had been a plant hunter in India and had introduced many new plants to England. By 1864, he had established at Battersea Park a subtropical garden containing palms, tree ferns, and foliage plants, such as *Solanum* and *Canna.* In her history of London's parks, Mireille Galinou (1990) records that Gibson's experiments were soon followed in other parks and the Dell in Hyde Park came to rival Battersea for its display of large and ornamental leaves. Encouraged by such examples, there were gardeners bold enough to carry out and succeed with subtropical gardening as far north as Scotland (Davies 1991). Nurseries and seed purveyors took the opportunity to supply this new interest in subtropical gardening. The firm of Barr and Sugden came to be associated with subtropical plants (Galinou 1990). One of the earliest writers to recognize the growing influence of subtropical gardening was a leading horticultural writer of the period, Shirley Hibberd. He had previously written on the merits of foliage plants in *The Fern Garden* (1869) and *New and Rare Beautiful-Leaved Plants* (1870). In 1871, the first addition of The Amateur's Flower Garden was published. This contained a chapter on "The Subtropical Garden" in which Hibberd explained some of the difficulties involved as well as the attractions of this type of gardening. He notes that the subtropical garden as then understood, was "an importation from Paris of limited and indeed almost questionable value. The nearer we go to the tropics for material, the nearer do we verge towards the impossible in the endeavour to adapt them to the average conditions of a British summer." However, subtropical gardening was not to be condemned on account of such difficulties. It was new and mistakes were to be expected. The solution was to include hardy plants, "when we have made some progress in the artistic disposition of palms, ferns and musas in the open ground, we shall not be slow to discover that many hardy plants may be associated with them to the advantage of artistic effect. Thus subtropical gardening always tends to subarctic gardening."

The Influence of William Robinson

The subtropical garden was popularized in England by the writings of William Robinson who is sometimes known as the Father of English gardening (although he was Irish!) (Hadfield 1980, Allan 1982). In 1867, at the age of 29, he went to Paris to cover the Paris Exhibition for *The Times.* In *Gleanings from French Gardens* (1868) and *The Parks, Promenades and Gardens of Paris* (1869) he gave his support to the growing trend. However, like Hibberd, he was very critical of using the more tender plants, which failed to make much growth in the relatively cool English summer.

In 1871, Robinson's book *The Subtropical Garden* was published. In the Preface, he states that the book was written with a view to assist the newly awakened taste for something more than mere color in the flower-garden, by enumerating, describing, indicating the best positions for, and giving the culture of, all our materials for what is called "subtropical gardening." This was not a very happy or descriptive name and was adopted from its popularity only. Fortunately, a number of plants not from subtropical climes could be

employed with great advantage. Subtropical gardening was defined as "the culture of plants with large and graceful or remarkable foliage or habit, and the association of them with the usually low-growing and brilliant flowering-plants now so common in our gardens." He claimed to have put together the most complete selection of such plants that was possible from plants then in cultivation and that most of the subjects were described from personal knowledge of them, both in London and Paris gardens.

Part I of the book consists of an introduction and some general considerations. He strongly criticizes the love for 'rude colour" which had led to the adoption of a few varieties of plants for culture on a vast scale, to the exclusion of interest and variety, and of beauty or taste. Subtropical gardening had taught the beauty of form. However, the example set by Gibson at Battersea Park was not to be completely adopted. "The radical fault of the 'Subtropical Garden', as hitherto seen, is its lumpish monotony and the almost total neglect of graceful combinations. —The subjects are not used to contrast with or relieve others of less attractive part and brilliant colour, but are generally set down in large masses." The key was to combine foliage plants and flowers: "The fact is, we do not want purely 'subtropical gardens' or 'leaf gardens' or 'colour gardens' but such gardens as, by happy combinations of the material at our disposal, shall go far to satisfy those in whom true taste has been awakened - and, indeed, all classes."

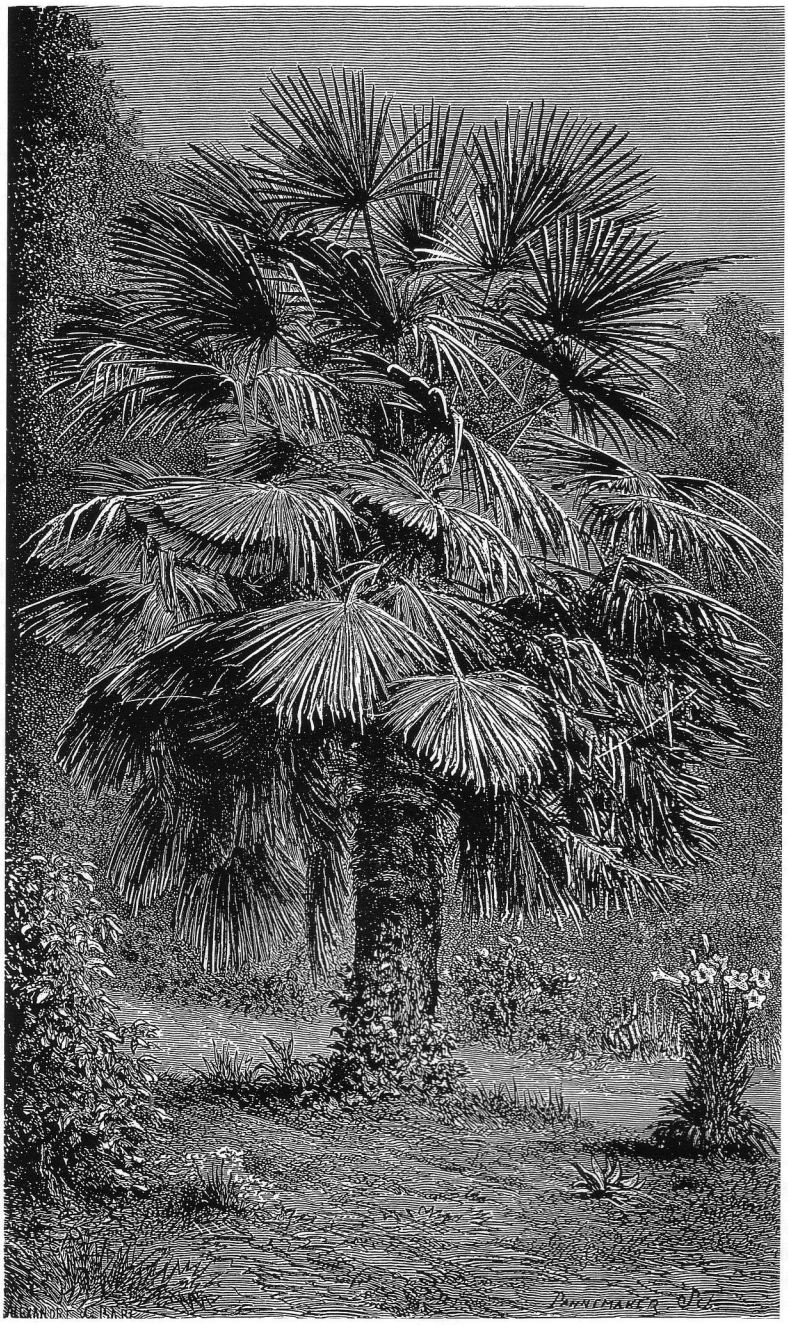
Robinson stressed that subtropical gardening was by no means limited to tender plants or the warmer parts of the country. Some plants such as dracaenas, aloes, and some of the palms could be used for winter decoration in the conservatory and planted out in the summer. But people without a conservatory or hot house could still enjoy the beauty afforded by plants of fine form such as pampas grass, yuccas, the arundos, acanthus, and the "hardy palm" (presumably *Trachycarpus fortunei* [Fig. 1] then described as *Chamaerops fortunei*) that "has preserved its health and greenness in sheltered positions, where its leaves could not be torn to shreds by storms, through all our recent hard winters."

Part II consisting of about 170 pages forms the bulk of the book and is an alphabetical listing of both hardy and tender plants. It describes each plant and gives advice on how they may be best arranged and on their culture. Included are nearly all of the "subtropical" plants still grown today, although the names may have changed in some cases. Many palms are listed: e.g., *Chamaedorea, Chamaerops exelsa* (*C. humilis*), *Chamaerops fortunei* (*Trachycarpus fortunei*), *Chamaerops palmetto* (*Sabal palmetto*) and *Jubaea spectabilis* (*J. chilensis*).

In 1879, Robinson founded his magazine *Gardening Illustrated* in which he advertized *The Subtropical Garden* and continued to write on subtropical gardening. In the January 7, 1882 issue, he published an engraving (subsequently reproduced in *The English Flower Garden*) of a *Trachycarpus fortunei* with a very fine crown of fronds (Fig. 1). The engraving was taken from a photograph taken two or three years before in the grounds of Lamoran Rectory, Probus, Cornwall. It was planted in the spring of 1853 (i.e., only a few years after Robert Fortune introduced the species from China) and, 19 years later, had attained a height of 16 feet 6 inches, the stem 6 feet from the ground, measuring 3 feet 6 inches in circumference. It was a female plant and had several times flowered and produced well-developed fruits. In another part of the ground was a male plant of the same species, about 10 feet high and equally well furnished.

In 1883, Robinson's most important book was published. *The English Flower Garden* became a classic and has continued to influence gardening to the present day. A chapter entitled "Beauty of Form in the Flower Garden" was a summary of Part I of *The Subtropical Garden.* Included in the detailed descriptions of plants were several of the subtropical plants more fully described in his earlier book.

Robinson had a strong influence on the gardens of the late-Victorian and Edwardian period. According to David Otterwill, nowhere were his ideas put to more dramatic effect than in his native Ireland (Otterwill 1989). Subtropical gardening had already been practiced in that country, for instance at Fota Gardens. "But in places like the southern coast of County Kerry off the Kenmore estuary, 'Robinsonian' gardens flourished beyond his wildest dreams." They included Lord Lansdowne's at Derrean, and the island garden created by Samuel Heard at Rossdohan with its tree ferns and bamboos. Both gardens were begun in the 1870s. From about 1900, the Earl of Dunraven transformed Garinish Island at Parknasilla into another subtropical garden. In *Yesterday's Gardens* published by the Royal Commission on Historical



1. The "Hardy Palm," a figure from Robinson, *Gardening Illustrated*, January 7, 1882.

Monuments in England, some of the photographs illustrate subtropical gardening at the turn of the century. For example, there is a photograph of a group of tree ferns at Clandon Park in Surrey (Forsyth 1983).

Subtropical Gardening Enthusiasts

The fashion for subtropical gardening continued until the First World War. One enthusiast was Henry Cooke who wrote *A Gloucestershire Wild*

Garden describing his garden (Challis 1988). Cooke had been Surgeon General in the Indian Army and had been influenced by the vegetation in India. On his retirement in England, he developed a large garden with a view over the Cotswolds and the River Severn. He planted *Trachycarpus*, yuccas, bamboos, agapanthus, cannas, gingers, phormiums, datura, and *Musa ensete* as well as hardier foliage plants such as arum lilies, ligularias, hostas, and polygonums.

Another enthusiast who also lived in Gloucestershire was Canon Ellacombe who created a garden at Britton Vicarage near Bristol during the second half of the 19th century and contributed a series of articles to the *Guardian* newspaper during the years 1890–1893 (Ellacombe 1895). These articles were published in 1895 in a delightful book called *In A Gloucestershire Garden.* He devotes a chapter to hardy palms and bamboos, which he describes as "beautiful objects in any garden, they are easily obtained, and when once established are most easy of cultivation; yet it is a most unusual thing to see a good collection of them." He notes that it was only in recent years that either palms or bamboos had a place in English gardens. The following passage illustrates the status of palm cultivation in England at that time:

I said that there were 1200 different species of palms; but of this large number only three or four can be at all considered hardy in England. The hardiest is without doubt the Chusan palm, Trachycarpus fortunei, *introduced a little over forty years ago by Fortune. It was not at first tried as a hardy plant, but the experiment was soon made (I believe first at Osborne), and it was found to be perfectly hardy; and when it has been established eight or ten years it will commence flowering, and will generally flower every year. It is a very beautiful and graceful plant. All it asks for is protection from wind, and it should be planted where it can have some screen from the prevailing winds, but it does not mind frost or snow. In my own garden it grows about ten feet high, and forms splendid leaves. The only other species that can be considered hardy is* Chamærops humilis, *but it will not compare with* C. fortunei *and is not so hardy.* Jubæa spectabilis, *from Chili, will grow in Cornwall, and* Pritchardia filifera *has survived some winters in very favoured places.* Brahea nitida *is said to be the hardiest palm in the Riviera, and* Cocos australis *at Genoa, but I have not heard of their being grown out of doors in England, and* Erythæa armata (Brahea roezelii), *from the Rocky Mountains, may perhaps prove hardy. The cultivation of the hardy palms is perfectly easy. The Arabs say that they require to have their feet in cold water and their head in a furnace. This combination we cannot give them, nor is it necessary; they only require to be planted in good soil, to be protected from wind, and not disturbed, and when once established they give no further trouble, and they give a continual delight to the grower.*

The Revisionist Robinson

The Subtropical Garden was published when Robinson was 33 and the first edition of *The English Flower Garden* when he was 45. In 1926 when the 14th edition of the latter book was published, Robinson was 88 years old, an invalid confined to a wheelchair and considerably more conservative in his views on subtropical gardening and the use of palms. In the Preface to that edition, he wrote:

The first editions of this book were burdened with much about the ways of flower-gardening current at the time—Experience has taught me to throw overboard all tender plants and devote the book to hardy things only, that may be planted in the open air on every fine day in the fall or winter. —Tropical weeds that give a little showy colour for a few months and plants that do not flower in cold districts if at all; —palms never at home in look in our clime. This is not a theory but a record of what took place in my garden for many years past.

A chapter on "Beauty of Form In the Flower Garden" still appeared but stressed the use of hardy plants only. He claimed that "the sub-tropical as a system of flower gardening has failed throughout our country generally, and can only be carried out well in the south of England and the warmer countries of Europe." Although the illustration of the *Trachycarpus fortunei* from Lamoran Rectory still appeared as did a descriptive entry on that palm, Robinson discouraged the growing of palms:

In our flower gardens Palms can only be seen in a small state; nor can they in pots and tubs give one any idea of the true beauty of the Palm on the banks of the Nile or the Ganges. But, worse than this, the system leads to the neglect of the many shrubs and trees of the northern world, which are quite as beautiful as any Palm.

Robinson's dramatic change of mind on the merits of subtropical gardening may have owed as much to his personality as to his experience. One writer states that "in character, Robinson was as contradictory in behaviour as in his gardening" (Hadfield 1980). Another writer describes him as cantankerous, chauvinistic, and belligerent and notes that he "could sometimes run with the hare and hunt with the hounds" (Otterwill 1989). One biographer wrote:

As Robinson grew older he is reported to have become full of inconsistencies. When he rode round his estate the workmen never knew whether they would get a rise or be dismissed. He had been a heavy smoker and enjoyed good wine and suddenly one night took all the drink out into the garden and threw the bottles down a well - and burnt his pipes. It is also said that after this he rather unkindly served wine for his visitors and offered them cigarettes, even provided them with ashtrays, but that if anyone should be foolish enough to accept this part of

2. "Group of house plants out for the summer, Harrow Lodge, Dorking" from *The English Flower Garden* (4th edition, Robinson 1893).

his hospitality they would receive a notice on their breakfast tray the next morning giving them the time of the next convenient train to London

Massingham (1982).

In any event, his change of mind was in tune with the times. The end of the Victorian and Edwardian periods saw the decline of subtropical gardening, much to the pleasure of another biographer:

And so vanished the preposterous Musa ensete, *the Abyssinian Banana, and other horrors. The plants that remained were indeed the English flower garden.*

Allan (1982)

Other writers have noted the supposed incongruity of subtropical gardening with the English Flower Garden. Anthony Huxley comments that, "it is a little odd that in Robinson's famous book, *The English Flower Garden,* there should be a place for an engraving of subtropical bedding, a very unnatural form of display enjoyed in earlier, less cost conscious decades" (Huxley 1978). In their book on the English garden, Laurence Fleming and Alan Gore refer critically to his ideas on design: "But oddest of all is in *The English Flower Garden*, where there is an engraving from a photograph of "A group of house plants planted out for summer" at Harrow Lodge, Dorking [Fig. 2]. It represents a banana tree, a *Cordyline australis* and three palm trees shivering in a Surrey shrubbery." (Fleming and Gore 1979)

The Decline of Subtropical Gardening

Conservatories and subtropical gardening fell out of favor after the First World War. The high cost of heating and labor led to the disappearance of many of the private greenhouses and conservatories. Deenagh Goold-Adams notes, "During the first quarter of the twentieth century the conservatory was in a constant state of decline. Thousands were pulled down as the reduced gardening staffs struggled to maintain the large and elaborate gardens of a bygone age" (Goold-Adams 1987). Peter Marston, the designer of many modern conservatories in England, notes "By the Twenties, the conservatory had almost disappeared; few new ones were built and existing ones frequently fell into disrepair and were pulled

down. —For the next fifty years little interest was taken in them. Indeed, when I started the company that is now Marston & Langinger in the early 1970s, the idea of the conservatory had so far retreated from public consciousness that I kept having to explain that we did not build music schools!" (Marston 1992).

In 1970, Christopher Lloyd echoed the aged Robinson's revisionist view on the use of palms in England. In his book, *The Well-Tempered Garden,* he refers to windmill palms as "the dowdily pretentious hardy palms one sees in holiday resorts. —when young and no more than 4 or 5 ft high, they can look pleasing and I should not be against recommending them provided you were strong minded enough to chuck them out as soon as they were past their first youth. Most often you see them as gaunt trees with hideous, thick furry trunks surmounted by bundles of old, unshed leaves and finally a tuft of live ones that is quite out of scale with the obesity that has gone before" (Lloyd 1970).

Many of the subtropical gardens so carefully planted in the 19th century were neglected or became the victims of vandalism. The garden of Henry Cooke became overgrown. When visited a few years ago by Myles Challis, little remained except some bamboo, two windmill palms, which towered almost into the tree tops, some rhododendrons, and a few other things that had stood the test of time (Challis 1988). Very little now remains of the garden at Britton Vicarage created by Canon Ellacombe. In an article in the December 1989 issue of *The Palm Quarterly,* Colin Macleod describes the fate of the garden of an old estate called "Glenoran" near Glasgow. The garden had been left to run wild. Macleod found four windmill palms. Three palms between 15 and 20 feet in trunk had been burnt by vandals and only charred trunks remained. The fourth was about 20 feet and he was successful in moving it to his new home sixty miles away. It is thought to originate from a Himalayan plant and seed collecting expedition, the acquisitions of which contributed to the planting of the garden in 1865.

The Tradition Continued

Of course, not all the Victorian subtropical gardens were allowed to fall into neglect. In 1932, Eleanour Sinclair Rohde noted that subtropical gardening was "now to be seen in perfection in various parts of Cornwall, Dorset and Hampshire" (Rohde 1932). Various subtropical gardens can still be seen at Crarae Glen Gardens, Logan Botanical Gardens, and Inverewe in Scotland. The last was begun in 1862 by Osgood MacKenzie. The southwest of England has several subtropical gardens and Tresco Abbey Garden in Cornwall, which dates from 1832 can boast a wide variety of palms such as *Phoenix canariensis, P. reclinata, Rhopalostylis sapida, Jubaea chilensis,* and *Livistona australis.* In her book, *The Milder Garden,* Jane Taylor notes that in a garden in Torquay, on the south Devon coast of England, the Chilean palm, *Jubaea chilensis,* has formed a splendid tall tree (Taylor 1990). Three specimens were planted in about 1900 and one was measured at 23 feet in 1972. In a public park in Torquay grows a good specimen of *Phoenix canariensis,* which also thrives in some Cornish gardens. A specimen of *Phoenix reclinata* once grew to 30 feet at Penzance on the Atlantic tip of Cornwall. Even the date palm (*Phoenix dactylifera*) has been found growing on a rubbish tip in Cornwall, young plants presumably germinated from the discarded seeds of a box of imported dates. One of the features of the garden at Borde Hill, Sussex, began in 1893, was the Round Dell, a steep-sided hollow in which windmill palms were planted. Richard Bisgrove notes that they found such a congenial home that they still survive among self-sown seedings of various ages (Bisgrove 1990). In the May 1992 issue of the journal of the Pacific North West Chapter of the Palm Society, the *Hardy Palm International,* Irish palm enthusiast Philip McErlean describes some of the exotic plants to be found at Mount Stewart Gardens in County Down, Northern Ireland.

Apart from such gardens, books and individuals have also kept up the tradition of subtropical gardening. The 1951 *Dictionary of Horticulture* published by The Royal Horticultural Society contains a fairly detailed entry under "Sub-Tropical Garden," which is defined as "a flower garden or pleasure ground devoted during the summer to plants with stately foliage, arranged with a view to represent tropical vegetation" (Royal Horticultural Society 1951). It suggests several plants that might be used to create such a garden, including a number of palms, *Ricinus, Nicotiana, Solanum,* some forms of *Zea mays,* bananas, tree ferns, cycads, bamboos, fatsias, ficus, hostas, phormium, pampas grass, and *Arundo donax.* It may be noted, in passing, that this entry was largely based on George Nicholson's *Illustrated Dictionary of Gardening*

published between 1884 and 1887 and that the 1992 edition of the R.H.S. Dictionary has no entry at all on subtropical gardening. Despite his criticism of tropical bedding noted above, Christopher Lloyd's 1973 book *Foliage Plants* recommended the use of several of these plants because of their aptitude for "making summer seem summery" (Lloyd 1973). In 1988, *The Exotic Garden* by Myles Challis was published. I reviewed this book in the August 1994 issue of the *Hardy Palm International.* Suffice it to say that, in my view, it represents the bible of modern subtropical or exotic gardening. The summary on the dust jacket describes it as "the first book this century to cover what was known in Victorian times as 'sub-tropical' gardening." Myles Challis noted that "so far as I am aware I am the only person in this country (England) indulging in it seriously." However, there were others who were maintaining or reviving the tradition of subtropical gardening. For example, in her book *Architectural Foliage* (1991), Jill Billington noted that "there is great fun to be had in combining exotic-looking foliage plants together under a temperate sky and they can be extremely stylish." She describes many of the plants familiar to William Robinson or Henry Cooke. This is also evidenced by the many contributions made to *The Palm Quarterly,* which was published between September 1983 and June 1990. In addition to growing hardy palms, many contributors were growing other border-line exotic plants such as the Japanese fiber banana (*Musa basjoos*), *Cycas revoluta,* and *Cordyline australis.*

Tamar Myers

In any history of the growth of palms and other exotic plants in temperate areas, a very special mention must be made of *The Palm Quarterly* and Tamar Myers who was its editor for most of its seven-year life. (Peter Purdom was editor for a time.) In the November 1994 issue of the *Hardy Palm International,* she describes herself as "the irascible but lovable woman who grew palm trees in brutal climates while longing for the balmy shores of some tropical island." She contributed many of the articles herself and demonstrated a wide knowledge of palm cultivation in cold climates as well as a very strong and humorous personality and a good writing style which makes it a pleasure to read the *Quarterly.* To give an example, she describes her increasingly conservative approach to palm protection as follows: "Not for me, any longer, are the perpetually pitiful, partly putrefying, pulp of perennially punished palms." In addition to numerous accounts of growing palms in climates as severe as Ohio and Quebec and tips on palm protection and cultivation, *The Palm Quarterly* contained articles on such diverse topics as making palm jelly; the experiences of a biology professor who specialized in palm trees but was mistaken for a fortune-telling palmist; a haunted palm tree; trips to unlikely palm growing areas; and a palm cross-word puzzle. Contributors wrote from many parts of the United States, Canada, and Europe. One of them was Martin Gibbons who went on to establish The Palm Centre in London, specializing in palms for indoor and outdoor use. As detailed in the November 1994 issue, the *Hardy Palm International* took on a broader role in 1990 when *The Palm Quarterly* stopped publishing. Under editor Nick Parker it has proven to be a worthy successor.

The Pacific North West

The history of palm growing in the Pacific North West was summarized by Nick Parker in the April 1994 issue of *Principes* (Parker 1994). He notes that a windmill palm was planted in Bremerton, Washington in 1939 and is now more than 30 feet high, probably the tallest palm north of California. Palms were planted in Beacon Hill Park in Victoria in the 1950s but have been replaced with new trees. Trees planted in Stanley Park, Manitoba Street in Vancouver and Rumble Street in Burnaby between 1966 and 1968 may still be seen. Interest in palm cultivation in Vancouver has increased due to the efforts of dedicated individuals such as Gerard Pury, Richard Woo, Rudi Pinkowski, and Nick himself. The extent of this increase can be seen in two articles by Richard Woo. In an article in the December 1984 issue of *The Palm Quarterly,* he notes his recent interest in growing palms outdoors on a year-round basis and the limited choice of palms in Vancouver. In his article in the November 1994 issue of the *Hardy Palm International,* he says that "it's wonderful to see how palms and other exotic plants are taking hold in the Pacific Northwest. —Fifteen years ago you couldn't buy a 10 gallon size *Trachycarpus fortunei* in Vancouver. And now they are coming in from California by the truckload, huge palms in wooden crates." In the same issue, Michael Ferguson notes that a local store had recently imported *Jubaea chilensis, Butia capitata,*

and *Phoenix* species with trunk diameters of more than a foot. Their more recent imports have added *Brahea armata* and *Sabal minor.*

Conclusion

I hope that the above account will demonstrate that subtropical gardening is not a short-lived fad but a style of gardening that goes back about 130 years. It may have fallen generally out of favor in Europe since the First World War but it appears to have commenced a revival in the Pacific North West. As always, time will tell. One Seattle writer, Arthur Lee Jacobson, is optimistic that the future will see a greater variety of palms in the area:

Local palm enthusiasts (especially members of the Palm Society) have and are planting other kinds of palms in Seattle. But it is too early to write an authoritative account of the kinds expected to be most successful here. Certainly some kinds much more handsome than the common Windmill Palm will feature in our future landscapes".

Jacobson (1990)

This optimism is shared by members of the local chapter of the International Palm Society.

Acknowledgments

An earlier version of this article appeared in the *Hardy Palm International,* the journal of the Pacific North West Chapter.

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Coccothrinax barbadensis in Antigua

CARLO MORICI

Departamento de Biología Vegetal (Botánica), Universidad de La Laguna, 38071 Tenerife, Canary Islands, Spain

The island of Antigua, some 360 km east of Puerto Rico, is located almost at the northern extreme of the chain of the Lesser Antilles and represents a very nice sample of the island chain. A good part of the island population belongs to the Rastafari religion and is proud of their reddish dreadlocks. English is spoken with a tasty Caribbean accent and the whole island shines in a tropical atmosphere.

The landscapes of Antigua appear quite dry, except for some secondary rain forest present in the south. A part of the island has always been xeric, as shown by the presence of some native cacti such as *Melocactus intortus* and *Cephalocereus royenii*, but the land now occupied by a savannah-like vegetation, mostly composed of *Cymbopogon citratus* (a lemon-scented grass), was originally covered by some more developed vegetation, at least a "*Bursera simaruba* seasonal forest" or a dry scrub.

Antigua falls within the natural distribution of *Coccothrinax barbadensis*, a well-known palm that originally occurred in all the Lesser Antilles, including some larger islands such as Puerto Rico at the northern limit of its range and Trinidad, Tobago, and Margarita at the southern end. R.W. Read in his work published in 1979 lamented that this palm had been exterminated in the wild in many of the lesser Antilles.

A quick tour of Antigua would make one think that the native palm is totally extinct on the island; however, some very old and tall isolated specimens survive here and there, totally unable to reproduce themselves. The seedlings cannot become established because of the absence of shelter from surrounding vegetation.

The environmental deterioration on the island has been mostly due to overexploitation of land by cattle grazing. Cows and horses were introduced by the earliest European colonists who also burned most of the forest to provide pasture for the cattle, which became, in the following centuries, the main richness of the island, together with sugarcane. Nowadays many cows are still happily wandering in the Antiguan fields and roads.

Surprisingly and thankfully a very healthy stand of *C. barbadensis* survives in an unusual location: the old cemetery of the island and the adjoining garden of the small cathedral. These two plots were the only sacred territories and therefore are prohibited to cows. They are half abandoned and plants grow with little interference by men. In the graveyard the palms are at their best: some *Coccothrinax* are literally and macabrely coming up from the tombs. This may provide opportunities for palmistic transcendental interpretations.

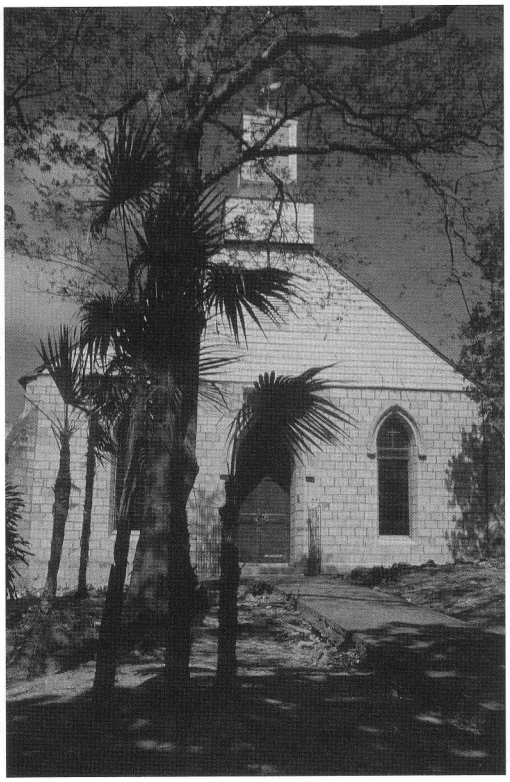
The palms regularly set seed and succeed in reproducing themselves. Seedlings grow easily inside the sacred areas and even outside, but those that grow outside the fence never reach maturity because the occasional passing animal enjoys its green parts as a meal.

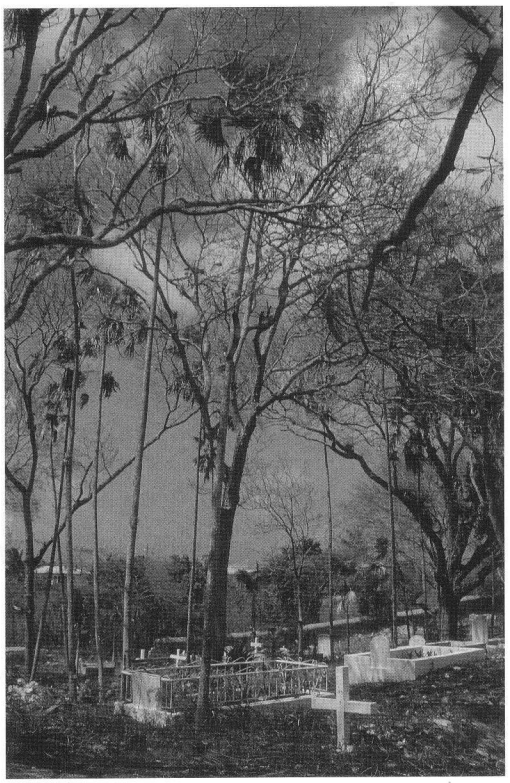
In this case a small fence would be enough to protect part of the unused land around the "prohibited sacred plots" and to double in a few years the size of the population of *Coccothrinax* and of other plant species that share its fate.

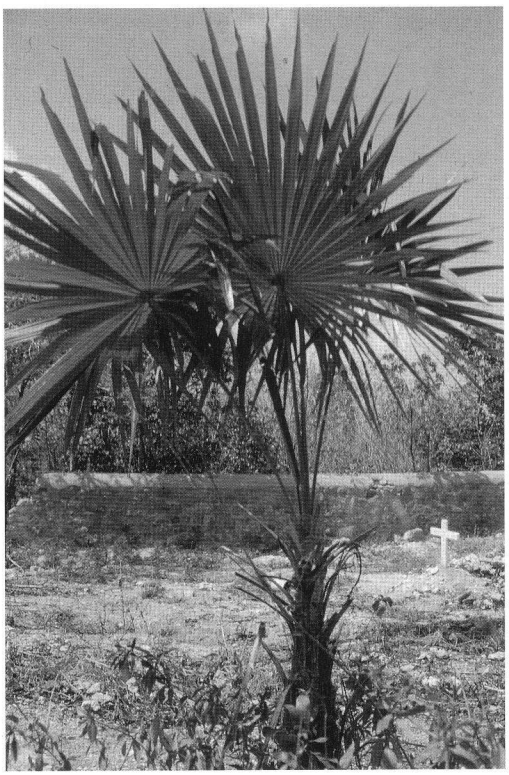
Free introduced herbivores are the worst "living" menace to ecosystems after man, especially in small islands, where the land is limited and great predators are usually absent.

In another Caribbean island, Nevis, I have seen an enchanting hill coated with a perfectly mown lawn and spotted with tall and beautiful coconut trees. The authors of this marvel were a group of goats that "ate" all the rain forest and its regrowth. This charming disaster was luckily limited to a small area and Nevis has one of the most beautiful forests of the Lesser Antilles.

I cannot end this report from Antigua without mentioning that in an area called All Saints, in the center of the island, there is a breathtaking population of many thousands of escaped *Phoenix reclinata*, whose origin is totally unknown. Paul







1. *Coccothrinax barbadensis* outside the Cathedral in Antigua. 2. *Coccothrinax barbadensis* surviving in a cemetery, Antigua. 3. *Coccothrinax barbadensis*, juvenile plant.

Richnow and I thought they were *P. theophrasti*, but *Flora of the Lesser Antilles* reports: "*Phoenix spinosa* Schum. (= *P. reclinata* Jacq.) was reported in Antigua by Grisebach (Fl.Br. W. Ind. Isl. 513 1864)." The seeds are not very fleshy but local people eat them occasionally.

Other palms noted were *Acrocomia aculeata* and (imported?) *Sabal causiarum*. Some imported *Attalea* sp. were thriving in the *Cymbopogon* savannah and many other beautiful and sometimes rare exotic palms were growing in the gardens designed by Paul, whose job is as a landscape architect.

Acknowledgments

A great "thank you" to Paul Richnow, who hosted me at his home in Antigua, giving me the possibility to visit and appreciate the island. I wish also to salute my Miamian friend Paul Drummond, who provided me the *Palmae* abstract of the book mentioned below.

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Principes, 41(2), 1997, pp. 86–89

CHAPTER NEWS AND EVENTS

Palm & Cycad Society of Southwest Florida

1996 ended with the October 26 meeting held at Sam and Hattie Lou Smith's place on the Orange River in Buckingham. The Smiths drew a large turn-out of palm and cycad enthusiasts who came to tour several acres of palms, cycads, bromeliads, and orchids planted under a canopy of huge oaks.

The first meeting of 1997 was held February 22 at the home of Dick Fankhausers in McGregor Woods. After Dr. Frank Martin gave a talk on Edible Palms, the group toured Dick's garden as well as his neighbor Ray's collection.

During the business meeting, the following topics were discussed.

Newsletter—the chapter is looking for someone to write or help out with the newsletter. Since there were no volunteers at this meeting, Sally Betts will continue as editor for the time being.

A community project—Palm and Cycad garden showplace.

Compiling a list of rare palm and cycad specimens in the area;

Development of the chapter logo.

Raffle plants—attendees are encouraged to bring items for the raffle. A suggestion was made that the chapter purchase a couple of quality plants from the proceeds of the previous raffle. We would like to have a plant raffle at each meeting to cover chapter expenses. Attendees are encouraged to bring raffle plants (which do not necessarily have to be a palm or cycad), horticultural items, books, etc.

The April 26 meeting will be held at the home of Dr. Bob Read. Dr. Read will be speaking on Tropical Rainforest Palms of Costa Rica. He will also give us a tour of his own personal rainforest.

New members and guests are welcome to attend meetings. There is a $10 initial membership fee to help defer the costs of the newsletter. Meetings are held on the fourth Saturday of even numbered months; there will be no meetings during the months of November and December, due to the holidays.

GERI PRALL
Email: JACK-AVALON@worldnet.att.net

News from The Palm Society of South Texas

The Palm Society of South Texas (PSST) IPS chapter held a field trip to northern Mexico in early December, spending four days looking at palms. Very large stands of *Brahea dulcis* and *B. decumbens* were visited, as well as other palm venues.

The members in the Texas Coast Bend area met with the Corpus Christi Botanical Gardens on Feb-

ruary 1 to discuss possible plans for a "palm area" in the gardens and PSST participation.

The PSST chapter met in the lower Rio Grande Valley on March 15–16. The meeting began with a luncheon at the Palm Court Restaurant in Brownsville, hosted by owner and PSST member Joe Baldwin. After lunch, members and guests visited the Sabal Palm Grove Wildlife Sanctuary located in the southmost area along the Rio Grande. The Sanctuary is run by the Audubon Society and contains the largest stand of *Sabal mexicana* anywhere! It is also filled with an incredible number of bird species and other wildlife. After the visit to the sabal grove, members visited Joe's garden and numerous Brownsville nurseries. Many dined that evening at Arturo's restaurant in Nuevo Progresso, Mexico. Sunday morning featured a tour of the extraordinary gardens of Dial Dunkin in Harlingen.

In April the PSST will hold their second palm sale at the Corpus Christi Botanical Gardens. A chapter meeting is also planned in April at the home of Jeff Hensley in Corpus Christi. The June meeting will be held at the home of Thad and Alice Magyar's home and gardens in Santa Rosa—for a tour of the Magyar Gardens.

JIM CAIN (from PSST mailings)

News from the Mackay Branch, PACSOA

Several members of the Mackay Group attended the Palm & Cycad Symposium in Townsville, which began on October 11. All enjoyed the meeting very much.

The Sunshine Coast Group of PACSOA held their last regular meeting of 1996 on November 24 at the Farleigh Mill Palm Gardens. The group then held their year-end "break up" on December 8 at the Woodturners. Members and guests toured the plantings at the Farleigh gardens, which have shown great progress due to the work of branch members over the years.

A Botanical Jewel in South Africa

The well-known Durban Botanical Gardens was, until recent times, the leading public palm garden in South Africa originating from humble beginnings in the mid-1800s. The palm collection initiated by Mark J. McKen commenced with the planting of a group of *Hyphaene coriacea* behind the tea kiosk, which dates from the 1870s.

There is, however, a new jewel that in years to come will outshine the old. We are talking about the *South African Palm Society Palmetum* at Hectorspruit.

The main difference between the two gardens besides their age is that the new garden has opted to plant the rarer palm specimens first to allow plants to develop to a stage where larger, commoner plants can be introduced into the garden. Although the collection at the Palmetum is young in comparison to other botanical institutions, it already boasts an impressive selection of choice botanical curiosities. The newly described *Satranala decussilvae* is represented; the endangered *Attalea crassispatha* was obtained from Fairchild; and all five species of *Trithrinax* were obtained from a recent South American expedition to collect them. Genera newly added to the collection include: *Desmoncus, Lepidocaryum,* and *Medemia,* among others; species newly added include *Mauritia carana, Syragrus smithii, S. cocoides,* and *Syragrus* sp. from Acailandia. These are all doing well in the nursery and awaiting delivery to the garden.

The return of Bernhard Fisher from South America has given development of the garden new impetus and adding the activities of Peter Wunderlin, Mark Bradshaw, and others, promises to make 1997 a productive year. The sterling work done by Maureen Svacha, curator of the garden, is to be commended. DISA estates is once again thanked for the generous donation of the large tract of land on which the Palmetum is located.

We hope that in later years our botanical garden will be yet another drawcard for the palm-oriented visitor to South Africa—a time that we anxiously await.

Donations of seeds can be sent to: Maureen Svacha, % DISA Estates, Private Bag 501, Hectorspruit 1330, Republic of South Africa. These will be gratefully accepted.

ADRIAN VAN RENSEN

Central Florida Palm and Cycad Society (CFPACS) Update

Changes continue to abound for the Central Florida Chapter. As agreed almost unanimously by its membership, the chapter is now called "The Central Florida Palm and Cycad Society." As part of the chapter's revitalization, several committees were formed to explore new sources of funding, ways to increase our membership, and methods for getting current members more involved in their

chapter. One of these committees also drew up a new set of bylaws for the chapter, which was presented to the membership. After an open discussion of these proposed bylaws at the last general meeting, the new Board of Directors met, implemented the suggested changes, and approved a final set of bylaws. These were then distributed to the membership. Another committee was organized to improve the quality of the chapter's bulletin and examine the opportunities available for IPS chapters on the WEB. We have taken advantage of the WWW space provided by the IPS and now have a CFPACS home page at "CFPACS.palms.org" or it can be reached via the link through the IPS home page. After seeing the success of the IPSC (PALMS-ALL) List server on the Internet, provided as an email exchange program by the IPS, we have now set up our own list to deal with problems and general conversation that is of interest to our chapter. If you would like to join, the list is CFPACS@palms.org. This revitalization is well underway and the membership is looking forward to a more active Central Florida Palm and Cycad Society.

ELIZABETH STRYJEWSKI

News from the Palm Beach Chapter

The Palm Beach Chapter has held elections and new officers are: Dale Holton—President, Pat Encinosa—1st Vice President, Richard Radcliff—2nd Vice President, Ed Napoli—3rd Vice President, Don Bittel—Treasurer, and Ruth Sallenbach—Secretary. Congratulations to all.

Our Christmas party was a great success. Santa made an appearance and gave away a great many goodies to all the good palm enthusiasts. Everyone left with at least two or three new additions for their garden. At the time of this writing we are still keeping our fingers crossed that it will be a mild winter. Our temperatures have been very warm, which is almost too good to be true; knock on wood (palm wood). Our spring sale will be held at Morikami Park in Delray Beach on April 8 and 9.

PAUL CRAFT

Palm & Cycad Society of Southwest Florida News

The Palm and Cycad Society of Southwest Florida met on September 24, and Alan Anderson hosted a tour of the Waterfront Condominiums' gardens in Naples. Through his knowledge of palms, Alan has created a delightful landscape garden for members of his condominium to enjoy.

On October 26, the Chapter toured the beautiful garden of Sam and Hattie Smith on the Orange River in Fort Myers. The Smiths have extensive collections of palms and bromeliads on 15 well-shaded acres.

ROGER AND SALLY BETTS

News from Broward County, Florida

The Broward County Palm & Cycad Society (BCP&CS) had a full Fall agenda. A workday was scheduled on November 9 at Flamingo Gardens. Members worked in the nursery potting up and fertilizing one-third of the total inventory! The following week (on November 16), the chapter held their Annual November Picnic at the Garden. The weather was blustery and the food was fantastic, thanks to VP Dean Lashbrook's great gastronomic selection. About 100 members attended and over 200 young palms were given away, including *Euterpe edulis, Zombia antillarum,* and *Acanthophoenix crinita.*

In early November, BCP&CS was presented an ward of appreciation by the Cooper City Commission for landscaping and helping to beautify the city.

On January 23, Paul Craft, a well-known palm grower, gave a beautiful travelogue on his palm sight-seeing trip to Cuba.

CHARLENE GRALL

Louisiana Chapter Subscription Information Update

The Louisiana Chapter of the IPS would like to update the information relating to their chapter publication, *Et Ceteras,* as it appears in the IPS *1996 Membership Roster* (Supplement to *Principes,* Vol. 40, No. 4, October 1996) to read as follows:

> *ET CETERAS,* the Louisiana Chapter newsletter, is 10–16 pages (5.5 inch by 8.5 inch size), published four times per year and devoted to both articles of interest and the happenings of the local chapter. Subscription and membership fees are payable to JACK A. CHISHOLM, the Chapter Treasurer, and should be mailed to Jack A. Chisholm, 5718 Prince Lane, New Orleans, LA 71026 USA. Subscription fees are as follows:

Outside U.S.A., payable in US$, $10 per year, postage included.
Within U.S.A., $8.00 per calendar year, postage included.

Please correct your records accordingly.

WILBUR LEGARDEUR

Pacific Northwest Chapter News

The Pacific Northwest Palm & Exotic Plant Society is working on a three-year plan and project to turn the highly populated and visited English Bay beach front into Canada's only outdoor exotic botanical garden. The PNWP&EPS is approaching the city Park Board for their approval.

Meetings for 1997 began with the Northwest Flower and Garden Show at the Washington State Convention Center in Seattle on February 5–9, followed by the Society's Annual Spring Plant Sale on March 23 at the Van Dusen Gardens in Vancouver, and a general meeting held the following day. There will also be a general meeting at Van Dusen Gardens on May 26. Visitors are welcome.

MICHAEL FERGUSON

News from the Hawaii Island Chapter

The Hawaii Island Palm Society offers this report on our latest planning effort at the Panaewa Rain Forest Zoo, December 7, 1996. Over 35 individuals contributed approximately 150 hours of volunteer labor, from planning to planting, to this latest installment in our efforts to make the zoo the site of an important palm collection. The focus this time was on larger palms, in two mass plantings. Twenty-six *Wodyetia bifurcata* (15-gallon size) were planted along the entrance to the zoo, and 13 *Cyrtostachys renda* (15- to 25-gallon) were planted along the main walkway, just inside the zoo entrance. Even with the holes dug by a backhoe, it was a huge job assembling the plants, muscling them into place, backfilling, and tidying up. The work was done in near-Arctic conditions (at least that's how it felt to us), as a cold front with temperatures near 70°, and wind and hard rain crossed the island during the work. Members also weeded and fertilized existing plantings. Afterwards, we enjoyed lunch and cold drinks together, and then headed home to change into dry, clean, warm clothes. Members of the International Palm Society who visit Hilo should make an effort to visit the collection. Maps and brochures identifying the palms are available at no charge from the zoo.

HIPS will soon supply photographs of us doing this work, which will be placed on the Hawaii Island Palm Society homepage of the IPS internet web site. Our homepage can be found in the "affiliates" page of the IPS at:

http://www.palms.org/pages/locchp01.htm,

form whence you can take the link to our chapter page. A sample of a recent newsletter is also on-line there.

Our zoo-planting project is funded through the Kaulunani Hawai'i The Beautiful Urban Forestry Grant Program and the U.S. Forest Service. The amount of the new grant is $4,905, and we match this with in-kind donations of labor, plants, and fertilizer.

KEN BANKS

→

Left
Clinostigma samoense H. Wendl.

Known as "niu vao" ("wild-" or "forest coconut"), this large elegant palm is native to the islands of Western Samoa. The genus *Clinostigma* is widespread throughout the western Pacific, but there is some disagreement among botanists as to the number of species of *Clinostigma* present in Western Samoa. There may be as many as three species, or just one species that is variable in fruit size. Further studies of *Clinostigma* in its native habit, across elevations and geographic ranges, are much desired. This species is used occasionally for construction (thatch and timber). It is abundant on the islands of 'Upolu and Savai'i and occurs within protected areas. The species does not appear to be at risk.—Scott Zona

Right
Pinanga rupestris J. Dransf.

This beautiful little palm is known only from Bako National Park, a wonderful area of lowland Dipterocarp forest, heath forest, and open heath land, situated on the north coast of Borneo, near Kuching in Sarawak, Malaysia. Much of the Park consists of a gently undulating plateau on sandstone, but the plateau ends abruptly in sheer sandstone cliffs near the beach. At the foot of the cliffs there is often a jumble of massive sandstone blocks. *Pinanga rupestris* grows in deep shade, rooted in crevices in the vertical faces of these massive sandstone blocks and the cliffs behind, and its stems hang down over the rock faces. Like the rheophytic *P. rivularis* with which it shares a number of floral features, *P. rupestris* produces abundant suckers at the base of the stem, the suckers originating from the internodes, rather than from the nodes, the more usual position of branches in *Pinanga. Pinanga rupestris* is rarely seen in fruit, and it is difficult to imagine how seeds of the palm are dispersed to suitable new habitats.—John Dransfield

CHAPTER NEWS AND EVENTS (*Continued from p. 89*)

News from the Sunshine Coast Branch, P.A.C.S.O.A.

The Sunshine Coast Group of PACSOA held their last regular meeting of 1996 on December 2 at the Nambour Band Hall.

The group held their year-end Christmas party on December 7 at Mike and Sharon's nursery "Palm Fascinations." There was good social company among other palm and cycad enthusiasts, and various prizes of rare and unusual palms and cycads were given away. The main raffle plant was *Lepidorrachis mooreana* (Little Mountain Palm), with second prize being a *Dypsis bejofa* donated by Leo and Jean Gamble. A number of other plants and seeds were on sale.

News from Western Australia

The Palm & Cycad Society of Western Australia (PACSOWA) met at the Leederville Town Hall, Cambridge Street, Leederville on November 18, 1996. The meeting featured a slide show of large *Zamia* and *Ceratozamia* specimens photographed by Bill Gaynor while in the U.S. recently. In addition, Darryl Hardie gave a brief talk on *Ptychococcus*, an unusual genus of palms newly introduced into Western Australia from New Guinea.

An informal discussion on a species or genus of palm or cycad is now part of each monthly meeting. Members are requested to bring along potted specimens for discussion. Latan palms, genus *Latania*, were discussed at the November 1996 meeting.

Ken Lee organized the bobcat man to move the new deliveries of mulch for the Gascoyne Park workday on 23 November. The Park also needed to be fertilized. In addition, Alan Lane (Palm Lane Nursery) donated over 100 palms for the Park.

A Christmas Party was held in lieu of a December general meeting. This year's Christmas party was held at Peter and Lorri Skinner's on December 8. No January meeting was scheduled.

DARRYL HARDIE

1996 News from Northern California Chapter

Our first Chapter meeting was held on March 16th at the Embassy Suites Hotel in Pleasant Hill. The hotel has a large atrium with an extensive collection of palms and subtropical companion plants. After a leisurely social hour among the palms near the hotel's Taos Grill and bar, the attendees retired to the banquet room for a dinner of poached salmon and filet mignon. Our guest speaker was Richard Smith, who discussed his experiences with tissue culture of *Phoenix dactylifera* for the commercial production of dates. The discussion was accompanied by many of Richard's slides taken in the laboratory and in Saudi Arabia. Richard made this presentation last fall at the World Palm Symposium at the Fairchild Gardens. The topic was also published in the January 1995 issue of *Principes* [see Vol. 39, page 47; "Field performance of tissue cultured date palms (*P. dactylifera*) clonally produced by somatic embryogenesis"].

The first garden meeting held by the Northern California Chapter in 1996 was on Saturday, April 27th, at the home and garden of Gary and Kara Gragg in Martinez. Approximately 40 members and guests attended the meeting. The youngest by far was Jared Gragg (age 4½ months), who was probably bored by all the palm, cycad, and succulent talk and was forced to attend the auction (on Gary's lap). The weather was perfect; temperature in the low 80°s and a warm breeze blowing all afternoon. The weather was the complete antithesis of that of our meeting held almost one year ago to the day at Dr. Herb Weber's garden in Greenbrae, when it drizzled all afternoon and the temperature was about 60°. Gary Gragg's garden is on a west-facing hillside that originally supported two or three native oak trees and not much else. Today there is a large expanse of colorful aloes, cactus, and subtropical flowering vines and shrubs planted in and around the sandstone outcrops. Lower down the hill, around and sheltered by the house, is a more conventional palm garden: green lawn, *Syagrus*, *Archontophoenix*, *Chamaedorea*, and also Hong Kong orchid trees, golden trumpet vines, and many other subtropicals not usually grown in Northern California. After touring the garden, partaking of the *hors d'oeuvres*, wines, ales, and engaging in much palm chatter, we terminated the afternoon with a palm auction and

(*Continued on p. 112*)

Principes, 41(2), 1997, pp. 93–99

Palm Communities in Western Ecuador

FINN BORCHSENIUS

Institute of Biological Sciences, University of Aarhus, Department of Systematic Botany, Herbarium, Universitetsparken building 137, DK-8000 Aarhus C, Denmark

Western Ecuador is, in spite of its modest area of ca. 80 000 km^2, one of the most heterogeneous regions of South America with respect to climate and vegetation types. It joins the Chocó wet forest region stretching from Panamá through western Colombia to northern Ecuador, the isolated Túmbez dry forest region of northwestern Peru–southwestern Ecuador, and the premontane moist and wet forest belt on the lower part of the western slopes of the Andes mountains. The region is characterized by strong climatic and altitudinal gradients, which result in the formation of several narrow vegetation zones, which tend to run in a northwest–southeast direction. Especially in the extreme north and south abrupt changes from wet evergreen forest to dry deciduous *Ceiba trichistandra* savanna may occur over very short distances. Fragmentation of the vegetation zones by local cloud forest formation in the Andean foothill region and in the Cordillera de la Costa, at elevations as low as 600–800 m, further adds to the biogeographic complexity. Plant species endemism is high throughout the region, especially in the moist and dry forest zones (Borchsenius 1997a). Unfortunately human pressure on the vegetation is also high, and the forests of western Ecuador are severely threatened (Dodson and Gentry 1991).

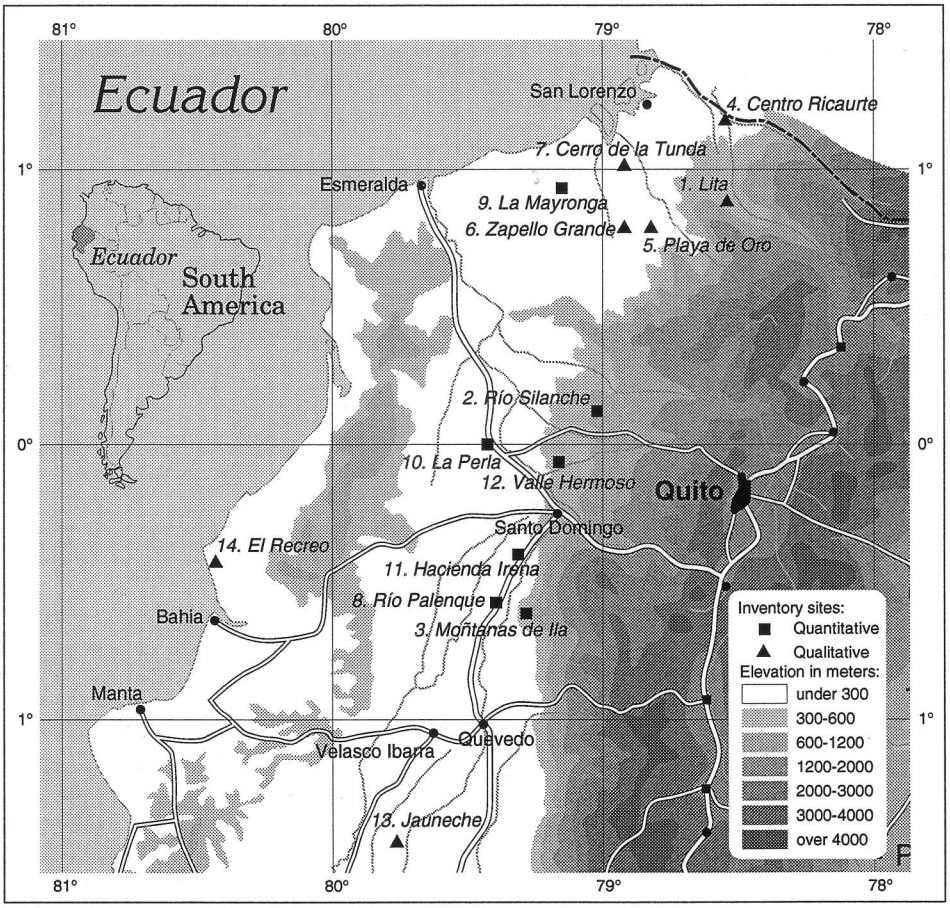
The present paper presents information on the palm communities at 14 localities in western Ecuador, with the aim of describing the qualitative and quantitative changes produced over small distances. In addition, the potential value of palms as indicator organisms for the overall climatic regime is discussed. Palms in the neotropics in general present several interesting features that make them promising indicator organisms: they are abundant in the vegetation; their species diversity is sufficiently high to allow both qualitative and quantitative differences in community structure to be detected; and their taxonomy is worked out sufficiently well to allow reliable identification of the taxa involved.

Materials and Methods

Qualitative inventories were compiled for 14 localities in western Ecuador (Fig. 1), representing six life zones in the sense of Holdridge et al. (1971). The inventories are based on revisions of herbarium collections kept in Aarhus University (AAU), the Departamento de Ciencias Biológicas of the Pontificia Universidad Católica del Ecuador (QCA), and Herbario Nacional del Ecuador (QCNE), together with visits to most of the sites during 1992–1994. A list of the localities, together with basic data on these, is provided in Table 1.

Quantitative inventories, based on transects of 0.1 ha placed in mature, undisturbed forest, were made for seven of the localities, mostly in the moist forest zone (Fig. 1). Each transect was 200 m long and 5 m wide, and divided into subfields 5 × 5 m square. All palm individuals present were identified, and referred to size class (>10 m tall, 3–10 m tall, 1–3 m tall, <1 m tall) and stage (adult, juvenile, seedling). Seedlings were only counted in every fourth subfield. In the final data table (Table 3) and in the computation of quantitative similarity indices, seedling numbers were left out, as it became obvious that seedling populations fluctuate greatly over the year, depending on fruit maturation and germination season for the dominant species. Seedlings are, however, included in tables concerning overall numbers of individuals and in comparisons with other studies. For three of the seven transects, the number of dicot trees in two size classes were also counted (diameter at breast height 5–10 cm, or > 10 cm) in order to provide a rough estimate of the structural importance of palms in the forests.

Naming of taxa follows Henderson et al. (1995), with the following exceptions: *Socratea hecatonandra* and *S. montana* are here included in *S. rostrata*, and *Geonoma irena* is separated from *G. cuneata* as a distinct species following Borchsenius (1997b). Herbarium vouchers of all taxa are deposited at the herbarium of Aarhus University



1. Map of western Ecuador showing the location of the 14 study sites listed in Table 1.

(AAU) and the herbarium of the Departamento de Ciencias Biológicas of the Pontificia Universidad Católica del Ecuador (QCA). A list of representative specimens collected at the different sites is available from the author upon request.

Similarity between sites was assessed by means of similarity indices calculated in the computer program r-Package (Legendre and Vaudor 1991). Cluster analyses based on similarity matrices were performed in the same program, using the unweighted arithmetic average algorithm (UPGMA). The similarity indices used were: the qualitative index of Sørensen, $IS_s = 2c/a + b$, where c is the number of species shared between two sites and a and b are the total numbers of species found at each of the two sites; and the quantitative index of Steinhaus, $IS_w = 2W/A + B$, where W is the total number of individuals belonging to species shared between the two sites, and A and B the numbers of individuals found at each site.

Results

The qualitative inventories for the 14 sites in this study contained a total of 45 species (Table 2), corresponding to 83% of all species (54) so far known to western Ecuador. The seven transected moist forest remnants contained a total of 28 species, of which 26 were recorded in the transects themselves. Alpha diversity for individual sites ranged from 3 to 6 at the two driest locations in the southwest (El Recreo and Jauneche), to 19 in the wet premontane forest at Lita in the north. The number of species recorded in each of the seven 0.1-ha transects ranged from 6 to 13, with the highest value recorded at the most rainy and humid site in the Montañas de Ila.

Table 1. Study sites. For each site geographical location, elevation in meters, annual precipitation in millimeters estimated from available climatic data, lifezone (Holdridge et al. 1971), and relevant references are given. Lifezone abbreviations. PPf: premontane pluvial forest. PWf: premontane wet forest. TWf: tropical wet forest. TMf: tropical moist forest. TDf: tropical dry forest. TVDf: tropical very dry forest.

Study sites	Abbr.	Geo. location	Elev.	Prec.	Lifezone	Ref.
1. Lita	Lit	78°33′W, 00°53′N	800	6 000	PPf	
2. Montañas de Ila	Sil	79°01′W, 00°07′N	700	3 700	PWf	(1)
3. Río Silanche	Ila	79°18′W, 00°38′S	600	3 000	PWf	
4. Centro Ricaurte	Ric	78°32′W, 01°10′N	200	5 900	TWf	(2)
5. Playa de Oro	Oro	78°50′W, 00°48′N	300	6 000	TWf	
6. Zapallo Grande	Zap	78°55′W, 00°48′N	100	5 200	TWf	
7. Cerro de la Tunda	Tun	78°55′W, 01°01′N	50	3 300	TMf	
8. Río Palenque	Pal	79°22′W, 00°35′S	200	2 900	TMf	(3)
9. La Mayronga	May	79°10′W, 00°55′N	100	3 100	TMf	
10. La Perla	Per	79°25′W, 00°01′S	250	3 300	TMf	
11. Hacienda Irena	Ire	79°18′W, 00°23′S	280	2 900	TMf	
12. Valle Hermoso	Her	79°10′W, 00°04′S	420	3 700	TMf	
13. Jauneche	Jau	79°45′W, 01°27′S	100	1 500	TDf	(4)
14. El Recreo	Rec	80°26′W, 00°26′S	50	600	TVDf	

1: Jørgensen and Ulloa (1989). 2: qualitative inventory based on collections in Herbario Nacional del Ecuador (QCNE). 3: Dodson and Gentry (1978). 4: Dodson et al. (1985).

The numbers of individuals in different size classes found at the seven transects are given in Table 4. Overall density of palms was highest at the premontane cloud forest site in the Montañas de Ila with 508 adult or juvenile individuals/0.1 ha plus 1 020 seedlings, and lowest at the La Mayronga site with 74 adult or juvenile individuals/0.1 ha plus 65 seedlings. The relative proportion of juvenile and adult palms varied considerably between lifeforms (Fig. 2). Solitary palms had a higher proportion of juvenile and seedling individuals than cespitose palms. Finally, comparison of the total number of palms and dicot trees in comparable size classes for three localities (Table 5) shows that palms make up a substantial component of the total tree stratum at these sites.

Cluster analysis based on a matrix of qualitative similarity for the 14 inventoried sites (Fig. 3) shows a division into four groups: (1) three premontane sites located at 600–900 m elevation (Lita, Río Silanche, and Montañas de Ila); (2) three northern lowland wet forest sites with 5 100–6 000 mm annual precipitation (Centro Ricaurte, Playa de Oro, and Zapallo Grande); (3) six lowland moist forest sites with 3 100–3 300 mm annual precipitation (Cerro de la Tunda, Río Palenque, La Mayronga, La Perla, Hcda. Irena, and Valle Hermoso); and (4) two dry forest sites with 600–1 500 mm annual precipitation (Jauneche and El Recreo). Characteristic species defining the groups were *Aiphanes erinacea, Socratea rostrata* (group 1), *Asterogyne martiana, Geonoma congesta* (group 2), *Desmoncus cirrhiferus* (group 1–2), *Geonoma irena* (group 3), *Astrocaryum standleyanum, Attalea colenda* (group 3–4), and *Syagrus sancona* (group 4). Species found in most of the region, except the two driest sites, included *Geonoma cuneata* and *Wettinia quinaria,* both with a preference for the wetter sites, together with *Iriartea deltoidea, Synechanthus warscewiczianus,* and *Wettinia aequalis,* all with a preference for lowland sites. Only *Bactris setulosa* and *Phytelephas aequatorialis* occurred at sites in all four groups, the latter with a preference for moist forest sites.

Qualitative similarities between the seven transected forest remnants resulted in a grouping pattern similar to that observed for all 14 sites with a basal grouping in the two premontane sites and the remaining five lowland moist forest sites (Fig. 4A). Quantitative comparisons, however, show a different pattern, where geographically close sites tend to have higher similarity values, e.g., Valle Hermoso/La Perla, and Río Palenque/Hcda. Irena (Fig. 4B). This comparison also stresses the dissimilarity between the most western site at La Mayronga, and the two eastern, premontane sites Montañas de Ila and Río Silanche. In addition, a marked dissimilarity is noted between the two latter sites, not evident in the qualitative comparison, due to dominance of *Wettinia quinaria* and *Iriartea deltoidea* in the first, vs. *Wettinia aequalis* and *Socratea rostrata* in the latter.

Table 2. Palm taxa recorded at 14 sites in western Ecuador (Table 1). Sites 1–3: premontane wet to pluvial forest. Sites 4–6: tropical wet forest. Sites 7–12: tropical moist forest. Sites 13–14: tropical dry to very dry forest.

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Aiphanes hirsuta	x													
Aiphanes macroloba	x													
Bactris hondurensis	x													
Chamaedorea deneversiana	x													
Chamaedorea pinnatifrons	x													
Wettinia oxycarpa	x													
Geonoma tenuissima		x												
Hyospathe elegans		x												
Socratea rostrata	x	x												
Aiphanes erinacea	x	x	x											
Desmoncus cirrhiferus	x	x		x	x	x								
Geonoma cuneata var. *gracilis*	x	x			x									
Geonoma leptospadix	x			x										
Pholidostachys synanthera	x				x									
Geonoma cuneata var. *cuneata*	x	x	x		x	x	x	x	x					
Prestoea decurrens	x	x	x	x		x	x							
Aiphanes tricuspidata		x	x		x		x							
Geonoma cuneata var. *procumbens*	x	x	x	x								x		
Pholidostachys dactyloides	x	x	x	x		x	x	x			x			
Wettinia quinaria	x		x	x	x	x		x			x			
Iriartea deltoidea			x		x	x	x	x	x	x	x	x		
Oenocarpus bataua			x		x		x	x	x	x		x		
Synechanthus warscewiczianus		x		x	x	x	x	x	x	x	x	x		
Bactris setulosa		x	x		x	x	x	x	x	x	x	x	x	
Geonoma cuneata var. *sodiroi*	x	x									x			
Chamaedora linearis	x		x					x		x	x			
Wettinia aequalis		x	x					x			x	x		
Geonoma congesta				x										
Geonoma linearis						x								
Asterogyne martiana				x	x									
Geonoma deversa				x			x							
Oenocarpus mapora						x			x					
Euterpe precatoria				x	x	x	x							
Prestoea ensiformis							x	x						
Socratea exorrhiza				x	x	x	x	x	x	x				
Bactris coloradonis							x							
Geonoma interrupta										x	x			
Welfia regia										x		x		
Geonoma irena							x	x	x		x			
Phytelephas aequatorialis						x	x	x	x	x	x		x	
Astrocaryum standleyanum							x	x	x	x	x		x	
Attalea colenda							x	x	x	x			x	x
Bactris coloniata													x	
Syagrus sancona													x	x
Aiphanes eggersii														x
Total species	19	15	12	12	13	14	17	15	11	11	12	7	6	3

Discussion

Alpha diversity recorded at the various sites in this study is lower than that encountered in climatically comparable parts of the Amazon region. Kahn et al. (1988) and Kahn and Mejia (1991) reported values of 26–35 species of palms on areas of 0.5–0.72 ha of terra firme in the central and western part of the Amazon basin, which significantly outnumbers even the whole-area qualitative inventories for the most wet and species-rich

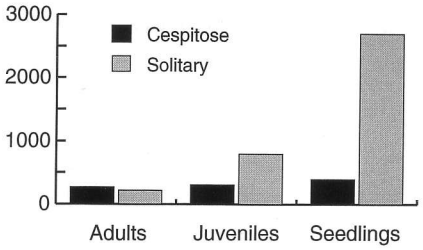
Table 3. Numbers of individuals (excl. seedlings) of 26 palm taxa in seven transects of 0.1 ha. (Table 1).

Taxa	Site						
	2 (Ila)	3 (Sil)	8 (Pal)	9 (May)	10 (Per)	11 (Ire)	12 (Her)
Geonoma tenuissima	17						
Hyospathe elegans	12						
Socratea rostrata	218						
Aiphanes erinacea	3						
Geonoma cuneata var. *gracilis*	136						
Geonoma cuneata var. *cuneata*	30	81	18	4			
Prestoea decurrens	1	12					
Aiphanes tricuspidata		1					
Geonoma cuneata var. *procumbens*	5						28
Pholidostachys dactyloides	8	64	12			1	
Wettinia quinaria		67				1	
Iriartea deltoidea		6		7	33	17	33
Oenocarpus bataua		1		18	1		7
Synechanthus warscewiczianus	12		80	10	19	16	12
Bactris setulosa	4	4	3		4	6	
Geonoma cuneata var. *sodiroi*	1					6	
Chamaedorea linearis		7	2		1	2	
Wettinia aequalis	61		41			108	50
Oenocarpus mapora				1			
Socratea exorrhiza				10	8		
Geonoma interrupta						3	
Welfia regia					111		74
Geonoma irena						45	
Phytelephas aequatorialis			7	7	1		
Astrocaryum standleyanum			2	6		1	
Attalea colenda				11			
Total							
Adults	180	69	75	7	28	86	37
Juveniles	328	174	90	67	150	120	167

localities in northwestern Ecuador. Similarly, Balslev (pers. comm.) found 22–27 species in five plots of 0.25 ha of terra firme forest in the Yasuní National Park in Amazonian Ecuador. In the eastern, more seasonal part of the Amazon at Río Tocantins, Kahn et al. (1988) reported 13 spp. on 3.84 ha, an alpha diversity of the same general level as that encountered in this study. Nevertheless, due to climatic heterogeneity and differences in species composition of the palm flora at different sites in western Ecuador, the region as such ends up with an overall diversity of 54 species, not much lower than that of eastern Ecuador (65 species).

Table 4. Numbers of palm individuals in five size classes in seven 0.1-ha transects.

Site	Size class				Total	Seedl.
	>10 m	3–10 m	1–3 m	0–1 m		
Montañas de Ila	35	48	87	338	508	1 020
Hcda. Irena	11	44	13	138	206	400
Río Palenque	0	48	60	57	165	208
La Mayronga	5	8	20	41	74	65
Río Silanche	21	32	51	138	243	368
Valle Hermoso	19	38	65	82	204	744
La Perla	20	21	58	79	178	296
Total	111	239	354	873	1578	3 101



2. Numbers of adult, juvenile, and seedling individuals of solitary (14 spp.) and caespitose (12 spp.) palms, summed for the seven 0.1-ha transects.

While alpha diversity is modest in the region, palm density is high, even compared to the more diverse moist Amazonian forests. The average value of 518 individuals (including seedlings) per 0.1 ha for the seven transects in this study falls within the range of 323–986 individuals per 0.1 ha reported for central and western Amazon terra firme sites by Kahn et al. (1988), and the highest value recorded here, of 508 adult and juvenile palms plus an estimated 1 020 seedlings on 0.1 ha at the Montañas de Ila site, marks a new record of palm abundance in the literature. Another remarkable difference between the findings of this study and those from the Amazon is the high density of large tree palms more than 10 m tall, up to 20–35 trees per 0.1 ha for the four most palm-rich sites, vs. 1–5 tall tree palms per 0.1 ha for terra firme, and 2–20 for swamp forest in northeastern Peru (Kahn et al. 1988, Kahn and Mejia 1990). The results emphasize the extraordinary structural and ecological importance of palms in the moist and wet forests of western Ecuador.

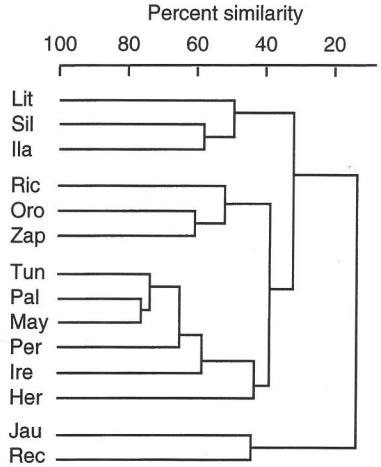
The quantitative inventories reveal striking changes in community composition over quite small geographic distances. In some cases this involves a substitution of dominant species, while the overall species lists remain fairly similar. A good example of this is provided by the two premontane localities Río Silanche and Montañas de Ila with dominance of *Wettinia quinaria* plus *Iriartea deltoidea*, and *Wettinia aequalis* plus *Socratea rostrata*, respectively. Another example comes from the *Welfia regia* dominated forest remnants at La Perla and Valle Hermoso. While the presence or absence of that species makes little difference in the qualitative similarity indices, the tremendous abundance of this palm in the forests is strongly reflected in the quantitative indices, whose values are very similar for the two sites and well separated from other lowland moist forest

Table 5. Numbers of palms and dicot trees in comparable size classes in three 0.1-ha transects.

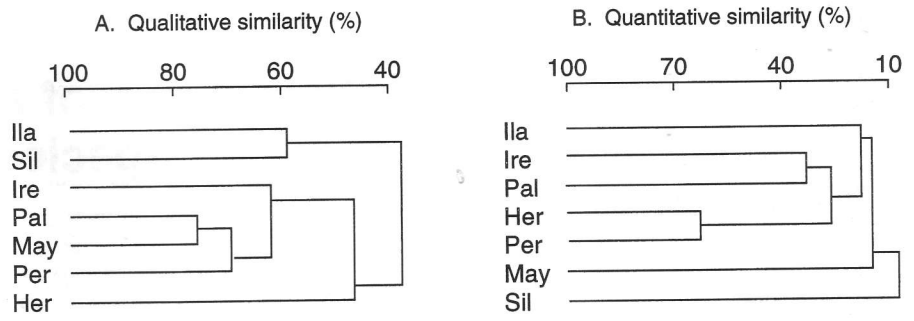
Size class	Río Silanche	Valle Hermoso	La Perla
Palms 3–10 m tall	32	38	21
Trees 5–10 cm dbh	45	27	35
Palms > 10 m tall	21	19	20
Trees > 10 cm dbh	50	33	27

sites, which they resemble qualitatively. A transect size of 0.1 ha is evidently not enough to get a detailed quantitative image of the palm community and the internal variation at a given locality. Nevertheless, it will provide an overall pattern of dominant or frequent species at a site, and due to the factors discussed above, several small transects will probably give a better impression of overall palm distribution and abundance than few, detailed studies involving larger areas. Besides, it actually proved difficult to locate just 0.1 ha of forest with intact canopy in several of the sites visited in this study, a fact that rather accurately illustrates the present conservation status of the west Ecuadorean moist forests.

In spite of the preliminary nature of this study, the results indicate that some palms do have distributions that seem to reflect climatic conditions rather accurately, at least if western Ecuador is regarded separately. Species restricted to one or a few lifezones include *Asterogyne martiana* and *Geonoma congesta* (tropical wet forest), *Aiphanes*



3. Dendrogram resulting from UPGMA cluster analysis of a qualitative similarity matrix for 14 sites in western Ecuador. Site abbreviations according to Table 1.



4. Dendrograms resulting from UPGMA cluster analysis of similarity matrices for seven sites in western Ecuador. (A) Qualitative similarity. (B) Quantitative similarity based on numbers of individuals (excl. seedlings) in one 0.1-ha transect per site.

erinacea (premontane wet forest), *Desmoncus cirrhiferus* (tropical and premontane wet forest), *Geonoma irena* (tropical moist forest), *Astrocaryum standleyanum*, *Attalea colenda* (tropical moist to dry forest), and *Syagrus sancona* (tropical dry forest). Other species of interest, particularly from a quantitative point of view, include *Wettinia quinaria* (dominant in wet forest types), *Synechanthus warscewiczianus* (dominant in moist forest types), and *Wettinia aequalis* (dominant in tropical moist forest close to the Andes and in some wet premontane forest types). The extreme dominance of *Socratea rostrata* at the Montañas de Ila site is apparently related to frequent cloud formation at that locality. The species appears suddenly at a certain altitude, and replaces *Iriartea deltoidea* as dominant in the forest canopy over an elevation interval of a few hundred meters. In the area of the Río Silanche locality the same phenomenon occurs at approximately 1100 m elevation.

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Factors Affecting the Distribution of a Threatened Madagascar Palm Species Dypsis decaryi

JOELISOA RATSIRARSON[1] AND JOHN A. SILANDER, JR.

Department of Ecology and Evolutionary Biology U-42, University of Connecticut, Storrs, CT 06269-3042

ABSTRACT

The complex interactions of human disturbance, environmental requirements, seed dispersal agents, seed predators, and herbivores appear to have an important role in the limited distribution of a threatened palm, *Dypsis decaryi*, in southeast Madagascar. Human activities limit the growth and the recruitment of new individuals throughout much of its range. Seed dispersal agents tend to deposit seeds near the parent plant where seed predation is heavier than elsewhere. The success of dispersed seeds depends on the conditions where seeds are deposited. In nature, dispersed seeds deposited in sites with intermediate light and moderate moisture levels have a better chance of escaping predators, germinating, and becoming established.

Dypsis decaryi (Jum.) Beentje & J. Dransf. (Neodypsis decaryi Jum.) (Family Arecaceae, Subfamily Arecoideae, Tribe Areceae),[2] a rare, threatened palm species, is restricted in southeastern Madagascar to a narrow zone (about 20 km wide) between the humid rain forest of the southeast and the dry spiny forest of the southwest (see Fig. 1) (Du Puy et al. 1992, Ratsirarson 1993*b*, Eboroke 1994). *D. decaryi* appears to function ecologically as a "keystone species" (Ratsirarson and Silander 1996; see also Gilbert 1980, Terborgh 1986). It is locally dominant and shows asynchronous, continuous flower production throughout the year, providing crucial food resources for pollinators during certain periods of the year. *Dypsis decaryi* can also be considered a keystone species anthropologically. Local people rely on it for many resources (Ratsirarson 1993*a*). Leaves are harvested for thatching (Fig. 2); inflorescence bracts are collected for making baskets, hats, mats, etc., and the fruit mesocarp is eaten. Seeds are heavily collected and exported for tropical horticulture use.

The main purpose of this study was to determine the effects of variation in microenvironmental conditions, biotic interactions, and human disturbances on the distribution and performance of *Dypsis decaryi*. Specifically, this study examined: (1) the importance of variation in light and water availability on germination, (2) the role of seed dispersers, seed predators, and herbivores on species distribution patterns, and (3) the effect of human activities on germination and seedling establishment. We focus on the early stages of the life cycle (seed, seedlings) because these represent critical phases in the life history of plants and may provide a key to understanding observed distribution patterns.

Methods

Field Sites. The field site was located in the Andohahela Nature Reserve in southeastern Madagascar, in the third of the three noncontiguous parcels (25°01′S, 46°09′E). This 500-ha reserve was established in 1939 to protect one of the few flourishing populations of *Dypsis decaryi* (Fig. 3). Today, this is the only substantial population throughout the range of the species where significant regeneration is occurring and a complete range of age and size classes can be found (Ratsirarson 1993b). Several small, isolated populations of *Dypsis* can also be found along ephemeral watercourses in the second parcel of the reserve, where some successful recruitment also occurs. In existing populations elsewhere, seedling and juvenile stages are rare or absent.

Granitic bedrock is the most abundant parent material at the study site and the soils are shallow oxisols with a low pH (Jenkins 1987, Nicoll and Langrand 1989). The emergent, discontinuous

[1]Present address: Departement des Eaux et Forets ESSA, Universite d'Antananarivo, B.P. 3044, Antananarivo, Madagascar.

[2]All the six genera, including *Dypsis* in the Dypsidinae subtribe, have recently been changed to *Dypsis* (Dransfield and Beentje 1995).

1. Distribution of *Dypsis decaryi* in Madagascar. Patterned area indicates the current natural distribution of the palm.

canopy is dominated by *Dypsis decaryi* (Fig. 4). The shrub layer subcanopy is dominated by species adapted to the seasonally dry local conditions and include members of the Apocynaceae, Euphorbiaceae, Didieraceae, and Rubiaceae (Nicoll and Langrand 1989, Eboroke 1994; Ratsirarson, unpublished data).

Light and Water Availability. Critical threshold light levels and water conditions may determine whether seeds germinate, and seedlings or juveniles survive (Uhl and Dransfield 1987). A germination experiment was initiated in June 1992, using a nursery plantation near the field site. The effects of three different treatments (seed presoaking, shading, and watering regime) on seed germination were examined. This information can be used not only to understand the optimal condition for seed germination and the subsequent effects on the distribution of the palm, but also to enhance ex situ conservation of the species (Chazdon 1988). Mature fruits were collected randomly from the natural range of the species and air dried for approximately 10 weeks. Seeds were sown in test beds of locally available, loamy soils (approximately equal mixtures of silt, clay, and sand). Germination (emerging leaves) was recorded weekly and followed over five months with results tallied at 30, 60, 90, 120, and 150 days after sowing. The percentage of seeds germinating three months after sowing and the time required (in days) for 50% of seeds to germinate in each treatment were recorded.

Three levels of seed pretreatment were chosen: a control (no soaking) (G1), seeds soaked in water for 24 hours (G2), for 72 hours (G3), or soaked in boiling water for five minutes (G4). We selected these pretreatments because they stimulated germination in other palms (Nagao and Sakai 1979, Doughty et al. 1986, Broschat and Donselman 1988). Three different levels of shading were provided: no shading (S1), shading at 20 cm (heavy shading) (S2), and shading at 40 cm (moderate shading) (S3) above the ground. Grass culms were cut and arranged horizontally (approximately 8 cm thick) on a wooden framework to provide the shading, which is a standard, local plantation practice. Equipment to measure light levels in these treatments was not available. Three different levels of watering were chosen: no supplemental watering (W1), watering once a day (W2), and watering twice a day (W3). Watering was continued throughout the experiment. In total, this constituted a $4 \times 3 \times 3$ factorial design (36 treatments). Forty seeds were used in each treatment. Each treatment was replicated twice. A three-way analysis of variance statistical design was used to analyze the data.

Fruit and Seed Dispersal. The predicted seedling recruitment (i.e., dispersal) profile of the palm was determined using a seedling recruitment model, in order to understand the effective dispersal patterns in *Dypsis* (Ribbens et al. 1994). Two transects of 100 m each were established through the palm population inside the reserve. The number of the palm seedling recruits in each successive 2×2 m quadrat along the transects was counted. Seedling recruitment was predicted as a function of adult size (height) and distance from potential parents, using a maximum likelihood statistical analysis. This approach determines the best match between the observed and the predicted seedling distributions (see Ribbens et al. 1994 for details). The height of the adult individuals, which is the best predictor of reproductive output (Ratsirarson 1993b), within 20 m

Table 1. Effect of seed pretreatment on germination of Dypsis decaryi.

Seed treatments		Percentage of seeds germinating after 90 days (N = 18)		Number of days to 50% seeds germination (N = 18)	
No. presoaking (G1)	Average	29.3	a*	110.22	a
	SD	22.3		24.62	
	Range	0–72.5		60–170	
Presoaking in water for 24 hours (G2)	Average	21.27	a	128.33	a
	SD	21.8		36.86	
	Range	0–62.5		60–200	
Presoaking in water for 72 hours (G3)	Average	38.9	b	99.55	b
	SD	23.3		27.3	
	Range	7.5–82.5		55–160	
Presoaking in boiling water for 5 minutes (G4)	Average	0.00		0.00	
	SD	0.00		0.00	
	Range	0.0–0.0		0.0–0.0	

* Statistically significant differences among values are indicated with different letters using Duncan's multiple range test at the 5% level.

from the transect was recorded, and the distance between the center of the quadrat and the adult individuals was taken. The mapping of adult palms relative to the seedling transect quadrats was accomplished by triangulation from compass bearings and observed distances along the transect.

Seed Predation and Herbivory. Some of the *Dypsis* seeds on the ground were consumed by either scolytid beetles (*Lanurgus* sp.) or nocturnal mouse lemurs (*Microcebus murinus*, Miller). The beetles bore through the bony endocarp and lay their eggs inside the seeds (Fig. 5). The larvae develop inside while feeding on the endosperm and the seed embryo. The emerging females leave after mating within the seeds and search for new seeds on which to oviposit (see Ratsirarson 1993b). The percentage of seeds infested by these beetles was counted in July 1992 inside successive 1 × 1 m plots, laid out along a transect through a stand of 30 parent plants.

Mouse lemurs crack open the dry seeds, and eat the endosperm (Fig. 6). An experimental study on seed predation was initiated to determine whether the escape of the seeds from lemur predation was habitat-dependent. Seed removal was studied in a two factorial design with the treatments being beneath or away (i.e., adult individuals at least 10 m away) from parent plants, and in an opening (gap) or covered (non-gap) site. A gap is defined as a cleared area at least 5 m in diameter. All non-gap sites were more than 20 m away from a gap area. The resulting combination of factors are referred to as: open with *Dypsis decaryi*, open without *Dypsis decaryi*, covered with *Dypsis decaryi*, and covered without *Dypsis decaryi*. A pile of 50 seeds was set on the ground at each site in June 1992. Each treatment was replicated 10 times. Seeds were censused after 7, 14, 27, 32, and 50 days. Based on our earlier studies, any removed seeds were most likely eaten by nocturnal mouse lemurs (see also below).

Results

Light and Water Availability. The time needed for 50% of seeds to germinate varied from 55 to 200 days (Tables 1–3). The percentage of germinating seeds after 90 days was greater (40%) for seeds presoaked in water for 72 hours than for the other treatments (Table 1). Soaking in boiling water was lethal. The percentage of germinating seeds after 90 days and the time required for 50% of the seeds to germinate were greater in treatments without shading (Table 2). Watering twice a day increased the percentage of germinating seeds after 90 days, and decreased the time required for 50% of the seeds to germinate (Table 3). Open sunlight and supplemental watering are thus important factors promoting seed germination. Presoaking, shading, or watering treatments alone had a highly significant effect on the time needed for germination as well as the percentage seed germination (Table 4). The interaction between shading and watering showed significant effects on seed germination after 90 days, but no effect on the time needed for germination (Table 4). For seeds that were not pretreated (G1 treat-

Table 2. Effect of shading on germination of Dypsis decaryi.

Seed treatments		Percentage of seeds germinating after 90 days (N = 18)		Number of days to 50% seed germinations (N = 18)	
No shading (S1)	Average	55.0	a*	89.4	a
	SD	15.9		31.34	
	Range	22.5–82.5		55–170	
Light shading (40 cm from the ground) (S3)	Average	21.1	b	120.06	b
	SD	17.0		26.46	
	Range	0.0–57.5		80–200	
Heavy shading (20 cm from the ground) (S2)	Average	13.8	b	128.67	b
	SD	10.5		23.92	
	Range	0–35		97–180	

* Statistically significant differences among values are indicated with different letters using Duncan's multiple range test at the 5% level.

ment), germination was accelerated when planted in full sunlight with supplemental watering (Table 5).

Fruit and Seed Dispersal. The local distribution of *Dypsis decaryi* adults was significantly aggregated (Ratsirarson 1993b). The predicted seedling recruits tend to be concentrated beneath the parent plants (Fig. 7). A significant correlation was seen between the observed and the expected recruitment in each quadrat along the transect ($r = 0.577$; $p < 0.01$, see Ratsirarson 1993b for details). Mean dispersal distance was calculated by distributing expected recruits around a standardized parent plant and determining the average distance from parent to recruit (see Ribbens et al. 1994 for methods). The mean dispersal distance calculated was quite small, 2.78 m. Fruits are small in size (mean diameter = 1.41 ± 0.12 cm, N = 150) and can secondarily be moved by gravity, water, and/or by a variety of vertebrates including ring-tailed lemurs (*Lemur catta*), mouse lemurs (*Microcebus murinus*), black parrots (*Coracopsis vasa*), and wild pigs (*Potamocherus larvatus*) (Ratsirarson, unpublished data), but in any case the viable seeds are apparently not moved far from the parent plant.

The behavior of animal dispersal agents was observed during the peak fruit production. During the fruiting season, ring-tailed lemurs (*Lemur catta*) and mouse lemurs (*Microcebus murinus*) consume the edible parts of the fruit (mesocarp), and drop the unharmed seeds near the parent plant. Lemurs are territorial with restricted home ranges. The territory of ring-tailed lemurs (*Lemur catta*) in the Beza Mahafaly reserve, for example, was reported to be limited between 400 and 900 m^2 (approximately a radius of 10–16 m) (Ratsirarson 1987). The limited territories in this important dispersal agent may severely restrict the effective dispersal of the seeds. Black parrots (*Coracopsis*

Table 3. Effect of watering on germination of Dypsis decaryi.

Seed treatments		Percentage of germinating seeds after 90 days (N = 18)		Number of days 50% of seeds germinate (N = 18)	
No watering (W1)	Average	22.5	a*	128.28	a
	SD	22.4		36.13	
	Range	0–82.5		55–200	
Watering once a day (W2)	Average	29.9	a	105.33	b
	SD	24.6		22.91	
	Range	0–72.5		55–145	
Watering twice a day (W3)	Average	37.5	a	104.5	b
	SD	21.2		30.71	
	Range	7.5–72.5		60–80	

* Statistically significant differences among values are indicated with different letters using Duncan's multiple range test at the 5% level.

Table 4. ANOVA: effect of presoaking, shading, and watering on Dypsis decaryi *germination after 90 days, and on the time required (in days) for 50% of seeds to germinate.*

Treatment	df	*P* values: Germination after 90 days	*P* values: Germination time
Presoaking	2	0.000	0.006
Shading	2	0.000	0.000
Watering	2	0.001	0.013
Presoaking × Shading	4	0.832	0.827
Presoaking × Watering	4	0.319	0.523
Shading × Watering	4	0.021	0.603
Presoaking × Shading × Watering	8	0.106	0.723

Table 5. Effect of shading and watering on the germination of Dypsis decaryi *seeds (non-pretreated).*

Treatment	Percentage of seeds germinating after 90 days ($N = 6$) [Mean ± SD (Range)]	
No shading (S1)	55.00 ± 17.53 (30–72.5)	a*
Moderate shading (S2)	15.41 ± 9.00 (5–25)	b
Heavy shading (S3)	17.50 ± 10.72 (0–30)	b
No watering (W1)	23.33 ± 26.25 (0–72.5)	a
Watering once a day (W2)	29.59 ± 21.81 (5–65)	a
Watering twice a day (W3)	35.00 ± 21.15 (12.5–72.5)	b

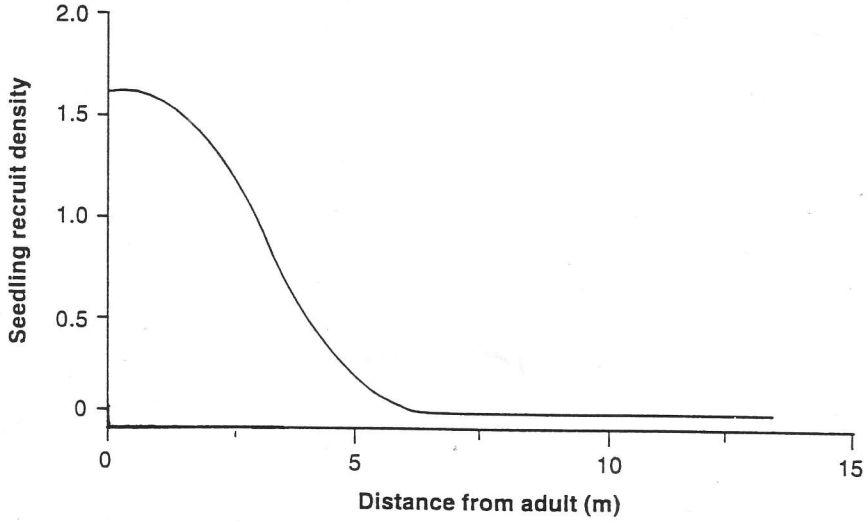
* Statistically significant differences among values are indicated with different letters using Duncan's multiple range test at the 5% level.

vasa) consume the edible parts of the fruits, and also tend to drop the undamaged seeds around the parent plant. Wild pigs (*Potamocherus larvatus*) ingest *Dypsis* fruits and deposit the seeds in their feces, often more than 30 m from the closest parent plant. However, the seeds passing through the pig's digestive system fail to germinate (0% of the seeds planted from wild pig's feces germinated after 10 months; Ratsirarson, unpublished data).

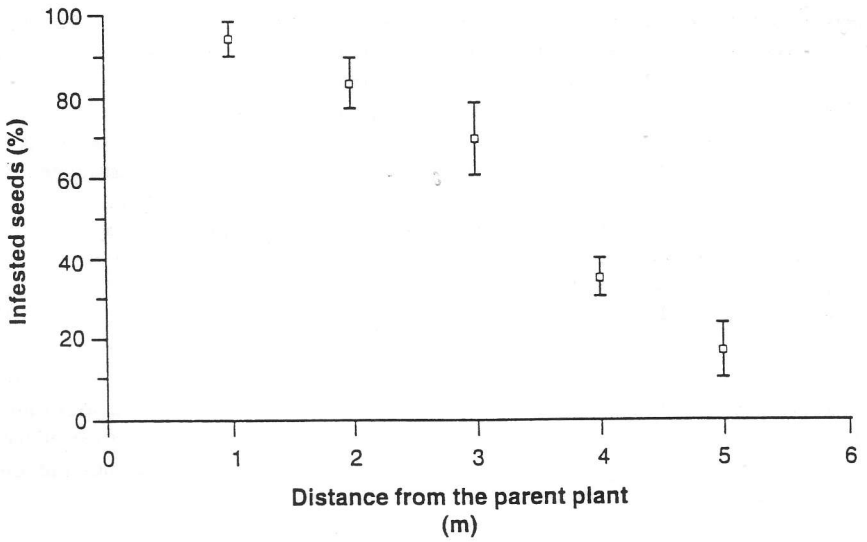
Seed Predation and Herbivory. The average percentage of seeds infested by *Lanurgus* sp. (Scolytidae) beetles inside the 1-m² plots was 92% at 1 m from focal plants. Infestation declined with distance from the parent (Fig. 8). No other insects were observed to feed on *Dypsis decaryi* seeds.

Seeds are also preyed upon by the nocturnal mouse lemurs (*Microcebus murinus*). Their tracks and feces were obvious on remaining seeds. Live traps were used to capture these lemurs using seeds as bait. Three mouse lemurs were caught in 46 traps that were set out beginning in June 1992 and followed for 2.5 months.

Seed disappearance from the seed removal trials was followed over 50 days. Seed removal by mouse lemurs differed among treatments. A chi-



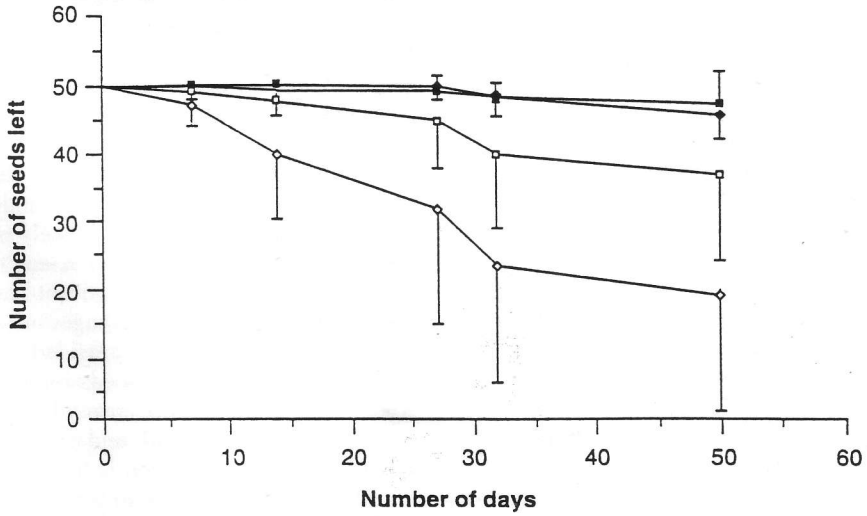
7. Predicted recruitment profile. The predicted density of recruits per m² is shown as distributed around a standardized parent plant of 3 m height.



8. Seed infestation by scolytid beetles as a function of distance from the parent plant. Points represent the average percentage of seeds infested by scolytid beetles inside successive 1 × 1 m plots, at varying distances from parent plants. Error bars are ±1 SE, $N = 30$.

square (χ^2) goodness of fit analysis showed a significant association between seed removal and treatment at the 27th ($\chi^2 = 9.12$, df = 3, $p < 0.05$), 32nd ($\chi^2 = 12.11$, df = 3, $p < 0.01$), and 50th ($\chi^2 = 16.32$, df = 3, $p < 0.01$) census days (Fig. 9). This significant association appears to be due to the effect of the closed canopy with no *Dypsis decaryi* cell. Seed removal underneath the canopy was significantly greater than in the gap area from the 27th day of census onward.

The effect of insect herbivory on non-seed stages also appears to be significant in *Dypsis decaryi.* Seedlings and juveniles were susceptible to rhinoceros beetle (*Oryctes pyrrhus,* Scarabeidae)



9. Seed removal by mouse lemurs (*Microcebus murinus*). Points represent the number of remaining seeds at different census periods. The four treatments were: seeds placed under a closed canopy, without *Dypsis* present (filled squares (■); seeds placed in an open gap, with *Dypsis* nearby (filled diamonds ◆); seeds placed under a closed canopy, with *Dypsis* (open squares □) and seeds placed in an open gap, without *Dypsis* (open diamonds ◇). Error bars are 1 SE.

attack. The beetles dig into the plant, consume the sap, and destroy the apical meristem. Approximately 95% of juvenile, and 20% of seedling mortalities are caused by rhinoceros beetles (Ratsirarson 1993*a*, *b*).

Human Disturbance. Human activity is one of the most important factors controlling the current viability and the distribution of *Dypsis decaryi* (Ratsirarson 1993*a*). Local people cut and frequently burn much of the area outside the protected reserve for agricultural practices (mainly tobacco and maize plantations). Few or no seedlings and juveniles are to be found outside protected areas (Ratsirarson 1993b). Although adult individuals are resistant to fire (Fig. 10), seedlings and juveniles are very sensitive (Ratsirarson 1993*a*, *b*). The absence of younger stages (seedlings and juveniles) in the unprotected populations limits natural regeneration. In addition, *Dypsis decaryi* does provide important needs for local people. Leaves and seeds of most individuals outside the reserve and some individuals inside the reserve are heavily harvested (Ratsirarson 1993*a*, Ratsirarson et al. 1996).

Discussion

Poorest germination occurred when seeds were neither pretreated nor given supplemental watering, which is most likely the conditions of the seeds in their natural habitat. Soil moisture and light resources seem to be important keys to understanding the distribution of *Dypsis decaryi*. In semi-arid zones, like the site occupied by *Dypsis decaryi*, a moderate level of shading may provide that critical moisture level for germination that otherwise would be low in full sunlight. Partial shading under some tree or shrub cover with some moisture supply appears to be the optimal environmental situation for *Dypsis decaryi* establishment. Seeds in full sunlight may desiccate rapidly and fail to germinate. This is perhaps why individuals are largely excluded from the drought-stressed conditions of the drier spiny forest region. In the eastern edge of the spiny forest zone, *Dypsis decaryi* is found only along ephemeral watercourses. Locally, individual palms tend to be concentrated either on rocky slopes in which water seepage is sometimes available or along temporary watercourses. In the adjacent rain forest, *Dypsis decaryi* seeds may germinate readily but seedlings may be poor competitors under the continuous low light levels found there. This may explain the absence of *Dypsis decaryi* from the nearby wet forest communities. Interspecific interactions (e.g., competition for light resources) were not explicitly examined in this study but may play important roles in the distribution of this palm.

The low mean dispersal distance (about 3 m) in *Dypsis decaryi* probably reflects (1) the limited availability of dispersal agents (seeds tend to passively fall below parent) or (2) the very limited effective range of dispersal agents (Hubbell 1979, Howe and Smallwood 1982, Howe 1990). Observations on the main dispersal agents indicate either narrowly restricted territories or home ranges (i.e., *Lemur catta* and *Microcebus murinus*), or a tendency to feed on the fruit mesocarp and drop the seeds below local foraging sites, near the parent plants.

In the past longer distance dispersal may have been accomplished by now extinct megafauna dispersal agents, including the giant lemurs (*Archaeolemur* spp.) and the elephant birds (*Aepyornis* spp.). Bone and egg fragments of *Archaeolemur* spp. and *Aepyornis* spp., respectively, have been reported from a cave (Andrahomana), within the current distribution of *Dypsis decaryi* in the southeast of Madagascar (Walker 1967). Based on the cranial and dental morphology of *Archaeolemur* spp., they appear broadly convergent with *Papio* baboons, and were likely to have preferred a wooded habitat, had a frugivorous diet, and possessed a greater home range than the present lemur species (Martin and Wright 1967, Tattersall 1973, Dewar 1984). *Aepyornis* spp. were reported to be mainly vegetarian (Wetmore 1967). These elephant birds were likely generalist herbivores and frugivores (Dewar 1984). Cracraft (1974) interpreted the robustness of *Aepyornis* as evidence of forest habitat preferences. These extinct megafauna species (*Aepyornis* spp. and *Archaeolemur* spp.) and *Dypsis decaryi* likely occurred in the same ecological communities, and the fruits of *Dypsis* may have been a significant component of their diet. The larger home ranges or territories of these megafauna may have provided a greater dispersal range for the palm seeds in the past, and a wider distribution than is currently observed.

Most of the seeds fall underneath the parent plant where seed predation is high. Seed dispersers play an important role in the escape from seed predation (Janzen 1971, 1972). The removal of seeds from the vicinity of the parent may thus increase the probability of recruitment since seed predators concentrate their activities under the

parent plant (Howe et al. 1985). Palms appear to be more susceptible to seed predation than other flowering plants, not only because of the size of the seed resource, but also apparently because of more limited dispersal (Vandermeer et al. 1979, Tomlinson 1990). In *Euterpe globosa,* Janzen (1971) reported that when the densities of the scolytid beetle *Cocotrypes carpophagus* were at their maximum, the beetles may destroy all the seeds produced. Willson and Janzen (1972) also found that more than 80% of *Scheelea rostrata* seeds near parent plants were destroyed by a species of bruchid beetle.

Seed removal by nocturnal lemurs appears to be greater underneath a closed canopy than elsewhere. This result may be related to the arboreal behavior of *Microcebus murinus,* which may be better protected from potential predators underneath closed canopies (Richard and Dewar 1991). Removal of seeds left in a gap area was very low. Mouse lemurs (*Microcebus murinus*) are reported to have a wide range in diet (Richard and Dewar 1991), from plant parts (e.g., fruits, seeds, flowers, leaves) and insects (moths, mantises, spiders) to small vertebrates (birds, chameleon, mice) (Petter et al. 1977). Seeds may be an important dietary component of these lemurs during certain periods of the year. More than 5% of *Dypsis decaryi* seeds were seen destroyed by lemurs (as evidenced by seed fragments remaining) within 1 m of the parent plant (Ratsirarson, unpublished data). The lower seed removal rate observed under *D. decaryi* canopies, compared to other closed-canopy conditions, undoubtedly reflects the fact that seeds present naturally underneath the parent plants were not removed prior to the experiment. This inflated the local density of seed in the *D. decaryi* canopies treatment. Here lemurs were probably removing experimental as well as resident seeds.

There was a clear survival advantage to dispersal of *Dypsis decaryi* away from the parent plant. However, the advantage of dispersal is related to the habitat in which the seed is deposited (Howe et al. 1985). The optimal environment for seed survival does not appear to be the optimal environment for germination. Seeds dispersed and deposited in a completely open area may desiccate and fail to germinate, while seeds deposited below a closed canopy are less likely to survive given the lower light level and the higher predation levels by mouse lemurs. The trade-off between dispersal and predation depends mainly on the microhabitat of the sites where the seeds are deposited which in turn determines the distribution of the palm. In addition, *Oryctes pyrrhus* beetle herbivory appears to have an important effect on early stages (seedling and juvenile) of development of *Dypsis decaryi* populations. Rhinoceros beetles are reported to be a common cause of mortality in many palm species. For example, one of the main threats to the *Borassus aethiopium* palm population in Senegal has been reported to be the large-scale attack by rhinoceros beetles (*Oryctes* spp.) (Sambou et al. 1992). Risk of adult *Dypsis decaryi* mortality to rhinoceros beetle attack appears to be very low (much less than 1%) in contrast (Ratsirarson, unpublished data). Human activities also severely limit the current distribution of this palm. Intensive leaf harvest (up to 100% of leaf number in each adult individual) and the heavy seed collection (up to 100% of seed produced per individual) significantly limit growth and the natural regeneration of *Dypsis decaryi* (Ratsirarson et al. 1996).

In sum, the limited natural distribution of *Dypsis decaryi* in southeast Madagascar seems to be due to the complex interaction of environmental requirements, human disturbance, and the effects of seed dispersers, seed predators, and herbivores. The widespread human destruction of natural habitat (cutting and burning) associated with the local intense harvesting of palm resources (leaves, seeds) limits the growth as well as the recruitment of new individuals. Although adult individuals are resistant to the effect of fire, early stages of the life cycle are very sensitive. Fruit and seed dispersal are limited and seedling recruitment is concentrated underneath the parent plant. The current main animal dispersal agents (lemurs, parrots) deposit seeds near their foraging sites close to adult palms. Seed mortality by seed predators (scolytid beetle, mouse lemurs) is higher underneath parent plants and under closed canopy than elsewhere. Thus, seeds dispersed away from adult

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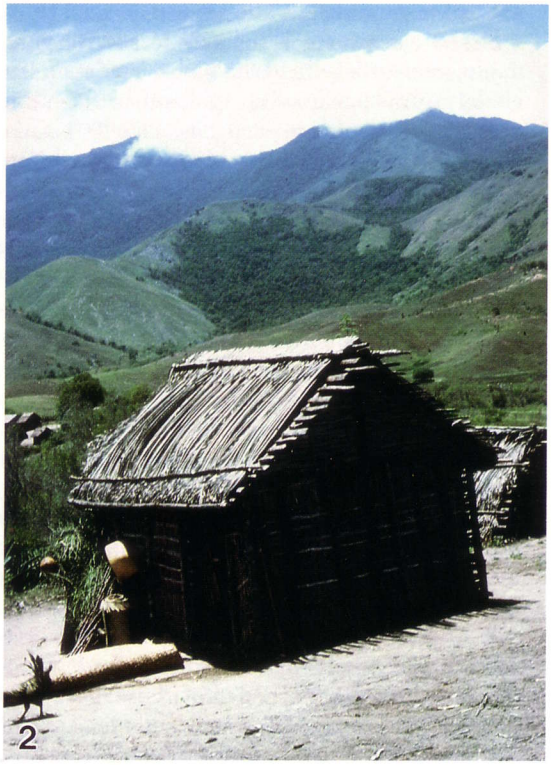
2. *Dypsis decaryi* leaves used in thatching local village homes. View is east toward the wet, montane forest zone. 3. Population of *Dypsis decaryi* in the third parcel of Andohahela Reserve. 4. Emergent canopy of *Dypsis decaryi* over the spiny shrub understory in Andohahela Reserve. View is west toward the arid zone.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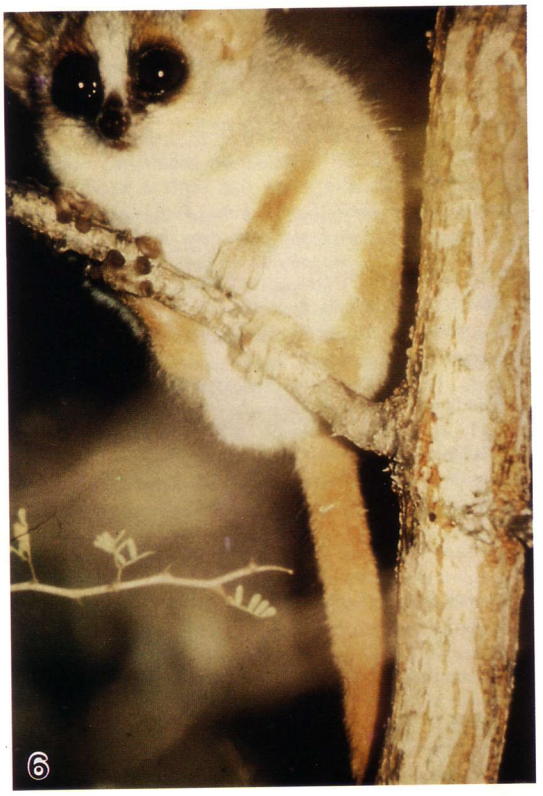

5. Oviposition holes by scolytid beetles (*Lanurgus* sp.) in *Dypsis decaryi* seeds. On the right are seeds cracked open with an adult *Lanurgus* sp. indicated by the arrow. Mature seed size is approximately 1.40 cm in diameter. 6. The mouse lemur *Microcebus murinus* is the main vertebrate seed predator and disperser. 10. Effects of human disturbance on *Dypsis decaryi*. Repeated burning at this site has left charcoal scars on the trunk of this individual. Adults can tolerate a moderate level of repeated fires, seedlings and juvenils cannot.

Dypsis decaryi may have a higher chance of survival. Subsequent to dispersal, successful germination and recruitment depend on the microhabitat where seeds are deposited.

Acknowledgments

We acknowledge the D.E.F. (Direction des Eaux et Forêts-Ministère des Eaux et Forêts) in Madagascar for granting permission to work in the protected reserve of Andohahela. Special thanks are due to S. O'Connor, A. Rajerison, A. Ramananjatovo, J. V. G. Rasolonirina, and J. Ratsirarson for their invaluable help and assistance in Madagascar. We thank R. L. Chazdon, R. Dewar, K. Holsinger, R. Kobe, T. Murray, S. W. Pacala, E. Ribbens, and A. F. Richard for their useful suggestions and comments on the manuscript. J. R. acknowledges the encouragement and help in many different ways from R. Dewar, V. Rakotozafy, A. F. Richard, and M. Schwartz.

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PALM LITERATURE

SUBHADRABANDHU, S. AND S. SDOODEE (eds.) *Fifth International Sago Symposium.* Hat Yai, Songkhia, Thailand, 27–29 January 1994. *Acta Horticulturae* 389. June 1995. 278 pp. Dfl. 88.00 softcover.

Eleven of the 19 papers in this fifth symposium proceedings are devoted to sago starch as an industrial raw material and to secondary palm products. Ethanol, protein-enriched sago starch, and glucose syrups are examples of starch products discussed. Sago leaf pulp for papermaking and sago pith residue as a green manure represent the latter product group. Various aspects of sago palm cultivation are dealt with in six papers on topics such as research needs, agroforestry, and seedling production. Two presentations covered economics: a cost-benefit analysis of sago production and a study of starch productivity.

This excellent volume represents another milestone in the ongoing attempt to transform the sago palm (*Metroxylon sagu*) into a major commercial species. Prospects of achieving that goal are promising.

To enhance the utility of this review, information on the four preceding international sago symposia, held between 1976 and 1990, is given below[1]; a sixth symposium took place in 1996[2]. Since 1990, periodic information on sago palm developments has also been furnished by a sago newsletter[3].

1. Tan, K. (ed.) *Sago-76: Papers of the First International Sago Symposium.* 330 pp. Kemajuan Kanji, Kuala Lumpur, Malaysia, 1977; Stanton, W.R. and M. Flach (eds.) *Sago: The Equatorial Swamp as a Natural Resource.* Proceedings of the Second International Sago Symposium. 244 pp. Martinus Nijhoff, The Hague, Netherlands, 1980 (see review in *Principes* 27(1):49–50, 1983); Yamada, N. and K. Kainuma (eds.) *The Third International Sago Symposium: Sago-'85.* 233 pp. Tropical Agriculture Research Center, Yatabe, Tsukuba, Ibaraki, Japan, 1986; Ng Thai-Tsiung, Tie Yiu-Liong and Kueh Hong-Siong (eds.) *Towards Greater Advancement of the Sago Industry in the '90s.* Proceedings of the Fourth International Sago Symposium. 225 pp. Ministry of Agriculture, Sarawak, Malaysia, 1991.
2. The Sixth International Sago Symposium was convened December 9–12, 1996 in Pekanbaru, Indonesia. The theme of the symposium was "Sago: The Future Source of Food and Feed." Proceedings will be published.
3. *Sago Communication* is published three times per year by Tsukuba Sago Fund, 791–27 Inaoka, Tsukuba, Ibaraki 305 Japan.

DENNIS JOHNSON

CHAPTER NEWS AND EVENTS (*Continued from p. 92*)

sale. The auction was conducted by Paul Leondis (in the rare absence of Darold Petty, who missed the meeting due to illness). Paul, one of the few palmophiles known to reside in Berkeley, was able, with his erudite and witty banter on palms and cycads, to coax the attendees to contribute $392 to our treasury. The membership of the Northern California Chapter is spread over many counties. At this meeting we had attendees from Santa Cruz, Merced, San Jose, and Mendocino counties, besides the immediate Bay Area.

On Saturday, July 20th, the Northern California Chapter held its third meeting of 1996 at the University of California Botanical Garden in Berkeley. Our host for the meeting was Judith Finn, the assistant manager of the botanical garden. The day was one of those rare, unbearably hot, 90° + summer days that rarely happen in the Berkeley hills, but we persevered. After an informal tour of the Botanical Garden we held a short business meeting in the new conference center (non air-conditioned) and then Tim Gregory gave a presentation on cycads suitable for Northern California gardens. The presentation was accompanied by a large selection of potted cycads from Tim's collection and also specimens belonging to Paul Leondis and the Botanical Garden. Tim also had excellent slides of many of the cycads, that he had taken on his trips to Mexico and Australia. Some of his cycads discussed as suitable for Northern California were *Dioon edule, D. califanoi, Ceratozamia mexicana, C. latifolia, Cycas revoluta, Encephalartos frederici-guilielmi, E. princeps, E. lehmannii, Macrozamia communis,* and *M. moorei.* After Tim's presentation we held our customary palm auction, which raised $375 for the treasury. Approximately 45 members attended the meeting.

Our last meeting of the year was held on October 20th at the garden of Brian Bruning in the Oakland hills near Mills College. Brian's garden is in one of the very temperate microclimates found scattered throughout the East Bay hills where subtropical plants thrive. *Bougainvillea, Jacaranda, Heliconia,* to name just a few examples of the near tropical plants one does not expect to see north of Santa Barbara, are found in Brian's garden. Growing in his front yard is one of the larger *Parajubaea cocoides* in Northern California. The day was an ideal one for garden viewing, the temperature being in the mid-70°s. It was one of those late fall days for which Northern California is known. October 20th was also the fifth anniversary of the disastrous Oakland Hills fire that destroyed over 3,000 homes just a few miles north of Brian's neighborhood.

After spending much time at Brian's *hors d'oeuvres* and beverage sideboard we held a short business meeting and an auction of palms and companion plants. The auction raised $200 for the chapter treasury. Approximately 35 members attended the meeting. Our members in Northern California are scattered over a large geographical area. The majority live in the seven counties surrounding the San Francisco Bay. There are several members in the Sacramento/Stockton area, the far north counties, Santa Cruz, Fresno, and the central valley counties. I always ask who has traveled the farthest to attend one of our meetings and this year the honor goes to Mr. Martin Howell of San Luis Obispo who attended the last two meetings.

I would like to thank Richard Smith, Gary and Kara Gragg, Judith Finn, Tim Gregory, and Brian Bruning for making 1996 another successful year for the Northern California Chapter.

DANIEL P. SEKELLA

Southern California Chapter Meetings

Our November meeting was held at the garden of Leland Lai in the hills above Malibu. His is a young garden, but he has planted quite a variety of palms. Over 150 enthusiastic members participated in the bidding on palms in our annual "Concoction Auction" where the donors share one-third of the value of the plants sold with the chapter. The auction raised over $1,900 for the chapter! Over 300 palms were provided by 12 growers.

Our annual banquet was held in Laguna Beach on January 18. The event was attended by 120 members and guests, who were entertained by Jeff Marcus, IPS Board member from Hawaii. Jeff showed slides of many palms he has photographed throughout the Pacific.

Our March meeting was held in the Palm Desert area. Although the climate there is severe, there are some palms that grow better there than any-

where else in southern California and we enjoyed the meeting.

GARY WOOD

News from South Florida Chapter

The South Florida Chapter of the IPS conducted a January 25 tour of the private gardens of Miami Beach.

A South Florida Chapter general meeting was held in early February at Fairchild Tropical Garden. The Chapter also hosted the Central Florida Chapter for a tour of private palm gardens and Fairchild Tropical Gardens on March 1 and 2.

RICK LEITNER

Florida First Coast Chapter News

The Florida First Coast Chapter met together with the South-East Palm and Exotic Plant Society for fellowship and a spring palm tour on Saturday, April 27, 1996. Approximately 25 people were present, coming from as far away as South Carolina. The tour began at the FCCJ Palm and Cycad Garden, a garden that is about nine years old, displaying 55 species of palms and eight species of cycads. Many palms are reaching maturity and are fruiting. Exceptional specimens of *Livistona speciosa, Butia capitata, Phoenix sylvestris,* and *P. theophrasti* were a treat for the visitors. The next stop for the tour was the cloverleaf planting at the intersection of University Blvd. and the Hart Bridge Expressway, with 50 *Washingtonia robusta* and *Phoenix canariensis.* The group then proceeded to Ed Brown's garden. Among 50 species of palm were a large *Dypsis decaryi, Jubaeopsis caffra,* and a grove of *Livistona chinensis* and *Washingtonia robusta.* Ed also has a rain forest area with plantings of *Ceroxylon, Rhopalostylis sapida, Chamaedorea microspadix,* and *Linospadix monostachya.* The tour ended at Matt and Joanne Encinosa's garden, which has a magnificent specimen of *Archontophoenix cunninghamiana* "Llawa," almost 25 feet tall, as well as significant plants of royal palms, *Acrocomia aculeata,* 10-foot twin windmill palms, and a *Trachycarpus nana.* This visual feast was surpassed only by the barbecue luncheon prepared by the hosts. Palms were exchanged and sold.

New officers were elected at the April, 1996 meeting. George Baker, Jr. replaced Ed Brown as President and Steve Marud replaced George Baker, Jr. as Vice-President. Matt Encinosa and Joel Timyan remained as Treasurer and Secretary, respectively.

Bazell Palm Service donated six *Washingtonia robusta,* each with 3 feet of clear trunk, to finish out the northeast cloverleaf at the Hart Bridge Expressway. These were installed on April 23/24 and we look forward to a healthy spring and summer growing season.

A Fall maintenance meeting was held by Chapter members at the FCCJ Palm and Cycad Garden. Several hardy members turned up in the light drizzle to clean and trim the palm displays. New plantings of *Phoenix dactylifera,* one with 10 feet of clear trunk, and *Washingtonia robusta* are part of the landscape surrounding the new Arts Complex.

The city of Jacksonville has been going palm crazy lately with all the new plantings of palms by the city and business community. Approximately two miles of *Washingtonia robusta* have been planted in the median of A1A from the Duval County line to the cross roads at Marsh Landing. *Phoenix dactylifera* appears to be the most popular species, as shown by the following sitings during the latter part of 1996—nine that were planted by Prudential Insurance Co. along the new parking lot on Prudential Drive; those planted along Monroe Street at I-95 to Jefferson Street; a dozen that were planted at the J. Turner Blvd. interchange at St. Luke's Hospital; 10 that were planted at the old Gulf Life tower along the river walk; and two planted at the newly renovated Hilton Hotel along the south bank of the St. John's River.

About 15 people attended a potluck at Steve and Belinda Marud's on October 19, 1996. Among many points of interest were palms normally considered too sensitive for Jacksonville's climate, including several *Roystonea* sp. with 8-foot trunks, which have been in the ground for three years, Majesty Palms (*Ravenea rivularis*), and potted coconuts (*Cocos nucifera*). Three large Queen Palms (*Syagrus romanzoffiana*) adorn both front and back yards, with the largest having 20 feet of clear trunk. Other large specimens included *Livistona chinensis, Washingtonia robusta, Washingtonia* sp., and fruit trees such as bananas, tangerines, tangelos, navel oranges, Sutsuma, and grapefruits.

A general tour of the new expansion at the Jacksonville Zoo was attended on October 26, 1996 by about 17 members of the First Coast Chapter. The tour culminated with a session led by Doug Gates, showing plans for further zoo expansion. Sugges-

tions by Chapter members as to which palms to utilize and possible palm donations near the Great Apes exhibit were discussed.

JOEL TIMYAN

News from the Sydney Branch Chapter

The Sydney Branch of P.A.C.S.O.A. met on November 18 at Maiden Theatre, Royal Botanic Gardens, Sydney. Peter Byrne presented a slide show on the 1996 International Palm Society Biennial meeting held in southern California in August. The meeting was followed by an auction.

The Christmas Party was held at the home of Richard and Monica Szeniak in Rossmore on November 30. A good time was had by all.

The *Principes Minor* issue for November 1996 (No. 83) focused on the genus *Pritchardia.* The first 1997 issue of *Principes Minor* (No. 84) featured the genus *Livistona,* with numerous discussions on this genus.

JIM CAIN

News from Fous De Palmiers, for the Second Semester, 1996

Our association had a stand at the International Garden Festival in Chaumont sur Loire from June 15 through October 20. The Operation *Jubaea* continued, generating from the time it began in May more than 2,000 letters to our headquarters. With luck and loving care, we look forward to seeing a legacy of *Jubaea* growing throughout France, testimonial to future generations of our passion for palms.

We were also present for the Plant and Garden Days in Marseilles September 14–15. Thierry Roy gave a conference that dealt with the subject of acclimatization of 15 different species of palms in France. The same weekend, Violette Decugis and Sylvette Viale attended the Flore Passion plant show at the Villa Rotschild in Cannes.

Paul Milhau and Alain Jamet have tried "in vitro" experiments with an inflorescence of *Butia* harvested from a palm growing in Toulon. We'll keep you posted if the results are conclusive. Paul is in charge of the *Fous de Palmiers* seed bank.

One hundred members got together for our General Assembly at the Domaine du Rayol on the Riviera on Sunday, September 21. We were welcomed by president Alain Hervé who spoke of the phenomenal growth of the association with some 150 new members. While no votes were taken, the year's activities were related by secretary Alain Jamet, followed by the financial report by treasurer Bruno Caro. Vice President Jacques Deleuze told members about the IPS biennial in southern California, which he attended. The meeting was followed by lunch overlooking the Mediterranean at the restaurant Maurin des Maures. The highlight of the day was the guided tour of the gardens by Jean-Laurent Felicia. A part of the Fous de Palmiers' palm collection has been donated to Le Rayol. Unfortunately, the visit was cut short by a downpour, sending members running for cover.

On the weekend of October 5 and 6, Patrick Marty and Steve Swinscoe continued the *Jubaea* campaign begun at Courson with a stand at the Château de Gaujacq. They distributed over 50 *Jubaea* seedlings and freshly harvested seeds as well. This was an opportunity for many members from throughout southwestern France from the Pyrenées to Médoc to Dordogne to meet, and share palm experiences. The campaign continued at the autumn rendezvous at Courson, also in October. Mireille Requiston showed her works on the theme, Portraits de Palmiers, at an art exhibition in Paris, October 10–14.

During the course of the year, the Alain Moinie palm collection was distributed. The more delicate palms had already been donated to the Hanbury garden in La Mortola, Italy, two years ago and this year the remainder were divided up between the cities of Hyéres Les Palmiers and Le Pradet. In

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Bactris jamaicana L. H. Bailey

This palm is one of three species of *Bactris* found in the Greater Antilles. *Bactris jamaicana* is endemic to Jamaica; it was described by Bailey in 1938 based on characteristics of the fruits and leaves. Its closest relatives are *B. plumeriana* Mart., from Hispaniola, and *B. cubensis* Burret, from Cuba (Salzman and Judd. 1995. *Brittonia* 47: 345–371); together they form the Antillean clade, which is closely related to the lineage that includes the peach palm or pejibaye, *Bactris gasipaes* Kunth. *Bactris jamaicana* occurs in scattered populations on limestone and lateritic soils in the Cockpit Country, John Crow Mountains, and the Central Plateau, but it is nowhere common. *Bactris jamaicana* can grow to be 15 m tall in clumps of more than 30 stems. One seldom finds young seedlings in pastures and other disturbed habitats. Hence, successful reproduction in the wild appears to be rare and infrequent, and habitat disturbance may directly contribute to the decline of this species.—Scott Zona

Hyéres, the palms were planted in the Olbius Riquier garden. In La Pradet, the creation of the first public palmetum in France was made official, planting and labeling the collection in the Parc Cravero, watched over by century-old *Jubaea*.

The Board of Directors met in Hyéres on October 26. Relations with IPS were discussed and it is planned for the future to equip some board members with modems to facilitate communications. With the upcoming mid-term IPS Board of Directors meeting planned for May 17–19 in London, it was decided to invite interested directors to discover the palms of the Riviera on May 22–24, to be followed by our General Assembly May 25 in Monaco.

Our Secretary Alain Jamet resigned in November. With the help of his wife Micky, they transformed the secretariat, assuring regular communication with our members, producing an up-to-date roster, and organizing two major trans-Atlantic trips to California and Florida. They look forward to devoting more time to their fabulous palm collection overlooking the city of Toulon and the Mediterranean. Daniel Jaquemin, recently-retired Director of the century-old nursery, Pépinières du Gros Pin, offered his services as interim secretary.

We were happy to see the publication of two new books in French, *Lexicon Palmarum* and *Palmiers de la Côte d'Azur*, a re-edition of the hard-to-find book by Chabaud, first published in 1915.

The Palmier No. 15, our journal, came out in December, with color on the front and back covers for the first time and 36 pages altogether. It included a botanical study by Thierry Roy about the secrets of seeds, and an article by Pauleen Sullivan translated by René Coativy about *Dypsis decipiens*, and a report by Jacques Deleuze concerning the genus *Linospadix*. News of the association followed, along with letters, the latest in books available, and classified ads.

Activities for 1997 include visits to Le Rayol and Les Cedres on the Riviera, Kew in London, and the greenhouses of Chevreloup near Paris, as well as our annual presence at Courson, Gaujacq, and Chaumont in the Spring.

Please note the October 1996 IPS Membership Roster contained erroneous information. Our journal, until further notice, appears twice a year with the same format as *Principes*. It is available with *Fous de Palmiers* membership for 200 French Francs. Those interested should send a bank draft to IPS Chapter Correspondent Steve Swinscoe.

STEVE SWINSCOE

European Palm Society 1996 Meeting in Rome

The last days of August and beginning of September saw the long-awaited arrival of the third European Palm Society "get-together."

In late August, 54 members and their families from 11 countries checked into the excellent Turner Hotel, just by the ancient city wall of central Rome, our base for the next four days of scheduled activities. For many of us, it provided an ideal opportunity to renew old friendships and forge new ones. A carefully arranged and tempting program of events had been put together by our host in Rome, member Dario Peso. Bright and early the next morning we assembled for the coach to our three gardens chosen for the day. These were all located in Rome itself. Our trip to the first stop, Villa Sciara, saw the coach winding through the spectacular heart of Borne, taking us across the river Tiber and providing a mini sightseeing tour in itself. Villa Sciara is a large garden, perched on a hillside overlooking Rome. We were met by Paola Lanzara who provided some history of the garden and led a tour of the main planted area. The original villa and walls that surround the garden were constructed around 1600 by Prince Barbarisri.

The garden is home to large old specimen plants, many of which are palms. Principal among these are two fruiting *Jubaea*, providing a good opportunity to collect some seed, many *Butia capitata*, showing the variability that can be seen in these palms, and large *Washingtonia*. It was a good introduction to the gardens of this city.

We next headed to the Piazza Cavour in the heart of Rome, making a brief stop enroute to pay homage to a large *Livistona chinensis*. The Piazza is surrounded by busy roads, but provides a quiet place to sit and have lunch or a welcome drink. The weather during our stay was great with warm, sunny days and lovely summer evenings, perfect for garden vistas. The palms in the Piazza were carefully placed in a pattern and again were large and well-established specimens. Especially notable were the tall *Brahea armata* carrying their long infructescences, quite spectacular, as well as a number of *Phoenix*, again showing great variability in appearance.

From here we continued to our final destination

and picnic lunch, the Villa Torlonia, which provided welcome service as a public park. Again a property with a long history, the Villa's most famous occupant must surely have been Mussolini, who would have seen the garden in its better days. Elsewhere on the property stands what remains of a once great conservatory. It must have been a truly spectacular sight when fully glazed. Amazingly we could determine high up and back amongst the ruins, the foliage of a large cycad, probably *Encephalartos horridus.* How long has it survived on just rainwater?

Notable plants in this garden are many large clumps of *Chamaerops humilis,* several individuals of which had fallen, only to continue to grow in the manner of large *Serenoa repens*! A group photo in fact was taken with us all sitting along such a trunk. Numerous and sizable *Sabal* also grew here as did at least one large *Brahea edulis,* which was carrying ripe fruit. Again, numerous *Phoenix* palms, especially around the entrance where they accompanied an Egyptian obelisk, made an incredible sight. Most were in fruit and each tree's fruits varied in color, encompassing all shades of red, orange, and yellow.

August 31 saw an early start for the nursery of Tor San Lorenzo, south of Rome and apparently the largest in Europe. Normally open only to trade customers, we were treated to a tour of this enormous nursery and a chance to select purchases from palms, cycads, cacti, succulents, and much, much more.

We left here after a few hours for a five-course lunch at a special restaurant, before taking a short walk down to Dario's house. Here we were treated to a tour of his wonderful garden, enjoying drinks and snacks in the warm afternoon sunshine and, for those with the energy, a splash in the pool. The garden proved the ideal place for everybody to mingle and relax, enjoying the plants, conversation, and Dario and his family's warm hospitality. Dario has been adding many plants to his garden and has a great collection, not just of unusual palms, but superb shrubs and trees, a number of which carry great fruit.

Martin Gibbons, Toby Spanner, and I presented two illustrated talks back at the hotel that evening. My own covered the cycads I encountered in South Africa, while Martin and Toby's featured their recent expedition to South America.

The morning sunshine saw us head back into central Rome for the famous Botanic Garden. Normally closed at this time of year we were lucky to have arranged a special opening. We were met again by Paola who provided some background to this very long-established garden. A large collection of plants are maintained here. It was possible to enjoy the arid garden, home to a good and varied collection of *Agave, Yucca,* and *Dasylirion.* Aquatic gardens with pools of lotus and papyrus, beds of medicinal plants, and a glasshouse were home to more tropical vegetation. The garden boasts a good collection of palms, including a mature "leaning" *Jubaea.* A huge, snake-trunked *Nannorrhops,* over 200 years old and beginning to form a second head to the main trunk, indicating a forthcoming flower spike, is the main attraction to the palm garden. Almost certainly this is the largest "Nanny" in the world, its recumbent main trunk bearing numerous "scars" of past flowerings.

Here too are tall *Trachycarpus,* some with clean trunks and neat "rounded" leaves, though not thought to be *T. martianus.* A number of *Brahea* grow here also, notable among these being a stately *B. dulcis,* a magical species with perfect leaves and stunning coloration. Underused, perhaps because of their spiny nature, *Trithrinax* also grow here, superbly architectural species. All in all it was a lovely garden to visit, a real "must see."

Our final day saw the long drive down to Naples and the private garden of the university. We arrived mid-morning and were given a tour of the main plant collections. These are arranged by botanical groupings and included primitive conifers, cycads, a brilliant and atmospheric "sunken" tree fern garden, a rock garden for succulents, variegated plants, and of course palms! Perhaps the widest selection of specimens occurred here—numerous *Chamaedorea*, for example.

Very well maintained and with all plants looking healthy, it was certainly a highlight of the trip for me and well worth the long drive to see. Naples itself has a very mild climate and is more humid than Rome. It owes this to its position on the bay and allows, for example, large clumps of *Strelitzia nicolai* to form, which would be cut back to the ground by frost elsewhere.

The meeting was voted a great success by all who attended, offering friendship, great gardens, and a superb city with so much to see. I was certainly disappointed to leave, but did so with fond memories!

TONY KING

Principes, 41(2), 1997, p. 118

LETTER

November 20, 1996

Dear Mr. LeGardeur and Members of the Palm Society,

I am writing now to acknowledge formally the receipt of two *Phoenix canariensis* donated by you most generously in memory of Miriam Bomhard. Various building renovations prohibited the planting of these trees last season, but rest assured that neither Miriam Bomhard nor the palms themselves are forgotten. Tom Armitage is keeping them safely for planting in June of 1997. As soon as a plaque is made, I will send a picture to you.

I am fortunate not only to have learned more about Miriam Bomhard and your own generosity but also to have learned something of palms—through you. For my ability to name the vision from my window, which I can now identify as a mature *Phoenix canariensis*, I thank you.

And of course, thank you for your interest in Miriam Bomhard and the place she played in Newcomb College, as well as in expanding the world of knowledge about palm trees.

Sincerely,

SUSAN TUCKER
Curator of Books and Records
Newcomb Center for Research on Women
Tulane University
New Orleans, Louisiana

Photo Credits Due

In the January issue of *Principes* (Vol. 41, No. 1) photo credits should be given for the two color photos in the Invitation to join the International Palm Society. Credit for the picture of the tropical forest belongs to Don Hodel, and credit for the miniature "Lady Palm" in enameled pot belongs to Lynn McKamey.

BOOKSTORE UPDATE

APRIL 1997

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3616 Mound Avenue
Ventura, CA 93003 U.S.A.

Back Cover

Guihaia grossefibrosa, displaying the white underside of the leaf. See pp. 70–73 in this issue.