PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for April

Cover Picture

The pale silvery form of *Trachycarpus nanus*, growing in the wild in China. See pp. 64–72. Photo by Martin Gibbons.

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Principes, 37(2), 1993, p. 63

Editorial

Enthusiasts living in temperate countries have, of course, only a limited number of palm species that can be grown successfully out-of-doors. Of these *Trachycarpus fortunei* is, undoubtedly, one of the most useful and hardy. We editors were taken to task for suggesting in Genera Palmarum that the Chusan or Chinese Windmill Palm is the hardiest. Our critics pointed out that *Rhapidophyllum hystrix* can survive more extreme cold than *T. fortunei*. Undoubtedly, but in one of the editor's gardens on the outskirts of London, *R. hystrix*, after five years in the ground is still only 20 cm tall and has put on only one leaf over the last two years. In the same garden *T. fortunei* shoots ahead, is adding about 20–30 cm of trunk a year, and flowers freely. Clearly for mild, cool climates, *T. fortunei* is the palm of choice. But what of other species in the genus. Martin Gibbons has already described for us the search for *T. takil* (see *Principes* 37(1), January 1993). Now together with Tobias Spanner, he reports on the great excitement of locating colonies of the elusive *T. nanus* in China. Here is another palm with potential for temperate gardens. We particularly like the sound of the glaucous form they discovered. Also in this issue is a description by Philip Cribb of the uses of *T. fortunei* in Yunnan. The Cribb article includes a photograph of a stand of the Chusan palm which may be easily compared with the new photos of *T. nanus*.

With tropical forests under destruction around the world, regeneration patterns and their parameters are of much interest. John Vandermeer has found some surprising patterns in understory palms as they reinhabit a Cacao plantation in Costa Rica. In a second study on palm distribution, Nancy Ayora and Roger Orellana continue their observations on *Coccothrinax readii* and *Thrinax radiata*; their introductory study is in the January 1993 issue. In this issue they show that although the two palms live in the same community, they actually occur in different microenvironments. Those growing the two species will be interested in their different preferences and in the importance of potassium over other chemicals for their growth.

A large number of palms are endangered by current exploitation of the tropics. It is possible that several species or even genera will be lost in the near future. John Dickie, Michael Balick, and Isabelle Linington have experimented to see whether palm seed can be stored in banks as a means of conserving genetic diversity. Their results are important and interesting.

As in 1991 and 1992, the April issue includes a list of palm books and papers published during the year. The number is impressive. We also have a review by David M. Bates of a timely and important palm book, "Subsidy from Nature" by Anthony B. Anderson, Peter L. May, and Michael J. Balick.

The many activities of the Chapters are carefully documented by IPS President Jim Cain. Three items are of special interest: 1) a letter by Chuck Hubbuch discussing the aftermath of Hurricane Andrew, 2) a visitor's view of the 1992 Biennial by Peter Kristensen from Australia, and 3) the dates and plans for the interim Board meeting and the 1994 Biennial.

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 37(2), 1993, pp. 64–72

In Search of Trachycarpus nanus

MARTIN GIBBONS AND TOBIAS SPANNER

The Palm Centre, 563 Upper Richmond Road West, London SW14 7ED, UK and Tizianstr. 44, 8000 München 19, Germany

After a successful expedition to re-locate *Trachycarpus takil* in northwest India (see *Principes* 37(1): 19–25), it seemed a natural step for somebody obsessed with the genus to visit China to look for *Trachycarpus nanus*, that mysterious and diminutive relative of the well known Chusan Palm (*T. fortunei*), often referred to but never photographed and never brought into cultivation.

It was originally "discovered" (to use that presumptuous term) by Father Delavay in Yunnan Province, southwestern China, in 1887, and was first described scientifically by Beccari in 1910. Since then, it does not seem to have attracted much attention, growing away quietly just minding its own business. Here was a wonderful opportunity then, to rescue this interesting palm from obscurity and, possibly, from extinction.

Excited by the prospect of an adventure in a far-off land, we arranged to go in October, when, according to Beccari, the fruits of *T. nanus* ripen. We were helped considerably in our researches by Prof. Chen Sanyang of the Kunming Institute of Botany, who gave us precise locations of where he believed our quarry was to be found, and our expedition was based on his suggestions. Thus we set off, taking separate flights from England and Germany and meeting in Bangkok, Thailand, where we prepared for the long journey north.

The first leg was a flight on China Airways to Kunming, where we arrived at midday. Travel in China is not easy. You cannot buy a return ticket on any form of transport; you buy a single and buy another single back as soon as you arrive. Since every flight is always full (or the flight is simply cancelled), it is a continuous worry knowing whether you are going to be able to get back once you arrive at your destination. This time we were lucky, and after re-confirming our return flight, we bought a one-way ticket on the overnight bus for Xiaguan, which was due to leave in just a few hours. Unfortunately we were too late to get on the "soft seat" bus so settled for the "hard seat" (second class) and prepared for the worst. In this we were not disappointed.

We set off at 7 p.m. from the Kunming bus station, cleverly designed in a half circle so that all the decrepit buses can back up to it and fill the passenger waiting area inside with dense fumes whenever the ancient diesel engines start into life! Our bus was full to bursting with men, women, children, babes-in-arms and suitcases, not to mention assorted bags, bales and bundles (including two rucksacks) filling every available space. We settled down as best we could and prepared for the ten-hour journey. The fare, after all, was only $4.50. On and on through the night we drove, with the occasional stop for nature's calls, and once, at 2 a.m., at a collection of roadside stalls selling anonymous and unidentifiable food. We felt very smug, having brought instant soup, coffee, and creamer for just such an eventuality.

We duly arrived at Xiaguan at 5 a.m., when it was still dark and cold. Feeling fairly dreadful after the cramped night with only intermittent sleep, we hastened straight

away to the bus station where we bought bus tickets for Binchuan, the next leg of the trip. We were lucky in that it was to depart in only 90 minutes, and we spent this time watching the town slowly come to life as the sun rose and drinking steaming mugs of coffee, which never tasted better.

Sharp at 6:30 a.m. we found ourselves on another bus, just as old, just as crowded, but heading out into the countryside now bright with sunshine, and we were able to take our first look around. We soon spotted *Trachycarpus fortunei*—hundreds of them—but all had been stripped for the fibers which the Chinese make into brooms and brushes, rain capes, and door mats. The road became more and more bumpy as cobbles took the place of tar, and the landscape became more hilly. It really was very uncomfortable and we were glad when we arrived some three hours later at Binchuan. Here we tried to get tickets for Shazhi, some 50 miles to the west, off the main north–south road we were travelling up, and the nearest village to Mount Jizu Shan, where we hoped to find *Trachycarpus nanus*. However, we gathered from the dozens of people who clustered around (none of whom spoke a word of English, and we, not a word of Chinese) that there was no bus today, so we decided to walk outside the town and just hope for the best.

Shouldering our rucksacks, we set off, and soon a small truck stopped and bade us climb in the open back, which had a single, hard bench down each side. Delighted with our luck, we set off once again, with every hour bringing us closer to our goal. However, if we thought the previous conveyance uncomfortable, this was ten times more so, and we were literally thrown around in the back and had to hang on for dear life as the truck sped and bounced along the cobbled and potholed road. Two hours later, we arrived, bruised and very sore, at Shazhi, where we were delighted to say goodbye to the "boneshaker."

We stood in the middle of this tiny village at the foot of the tree-covered mountain wondering quite what to do next, but we needn't have worried, for within a few minutes, along came three horses led by a man and two women, who indicated that they would take us up the mountain, something of a local beauty spot and a nature reserve. We tied our rucksacks onto one of the horses and mounted the other two, and, without further ado, off we set. After two "hard seat" buses and the bumpy old truck, our behinds were feeling a little sensitive, a condition not improved by the hard saddles, and soon we were aching as though we'd spent three days on a cattle drive!

We showed the man a photograph of *Trachycarpus*, and to our delight and disbelief he recognized it and pointed up along the track we were following. After an hour or so's painful ride up quite a steep trail, through thick mud, our guide indicated that we should dismount, and this we were most happy to do. He was pointing in amongst the bushes, and suddenly we saw what looked like a young *T. fortunei*. We were disappointed because we thought it *was T. fortunei*, but as we scrambled up to it we saw the erect flower stalks and there was no doubt: we were looking at *Trachycarpus nanus*! Our excitement can only be imagined, but even that heart-stopping moment was topped a few minutes later when our new friend disappeared into the bushes and came back with an infructescence full of ripe fruit. We felt as though we'd struck oil!

The plants were scattered in the undergrowth of rather stunted, relatively dense, evergreen forest, on a steep southwest-facing slope, at an altitude of about 2,200 m (Fig. 1). All the plants were very small, barely 50 cm high, most with only 1 to 3 intact leaves, apparently the result of heavy damage by insects. *Trachycarpus nanus* could easily be mistaken for *T. fortunei* here, developing soft, dark green leaves with leaflets held flat, on long petioles in their shady habitat. Only a very few plants

1. Small plants of *Trachycarpus nanus* growing in shady undergrowth on Mt. Jizu Shan, China. 2. The open hillside habitat of *T. nanus*, where it grows in full sun.

carried fruit, though many were seen with old inflorescences and there were quite a few seedlings around.

The surrounding vegetation comprised laurel-like evergreen trees of many different kinds, some rhododendrons, and a few scattered pines, all densely covered with lichen. Also a small, shrubby bamboo was seen in close association with "our" palms, and, as we discovered later, it was always and only growing where the palms were found. The soil, a heavy reddish clay, was rather acidic, giving the lie to the idea that they only grow on limestone. In this rather moist mountain forest, *T. nanus* grew only on the drier slopes and apparently not below 2,100 m.

After exploring for an hour or two and finding a few more seeds, we made our painful way back down the mountain. There was no transport back to Binchuan on the main road that day, and, as it was getting late, we checked in at a small "hotel" in the village. It had no bathroom or toilets so we took it in turn to shampoo, shave, and shower in a tin bowl of warm water apiece. We then discovered that there was a vehicle going back after all, so we checked out again. It was a similar arrangement as before, the van with the two benches, equally uncomfortable, and again we were bounced around for the two-hour trip back to Binchuan on the main north–south road. Here we found another "hotel"; no showers, no hot water, and hard beds with sheets that smelled worse than we did. However, we were exhausted after over two days with no sleep and passed the night comfortably enough.

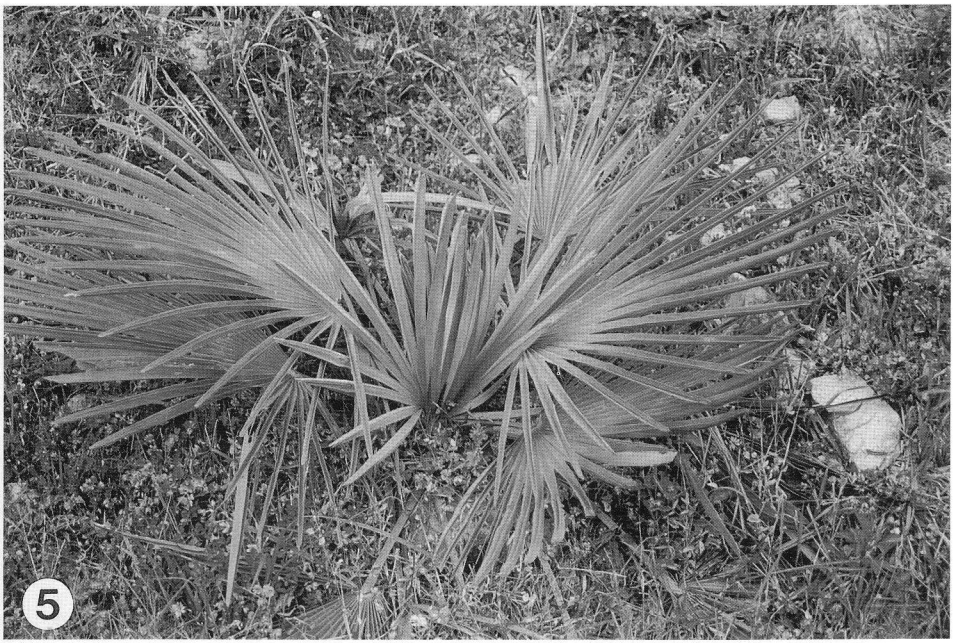
The next morning we woke somewhat refreshed and eager to check out the next locations of *Trachycarpus nanus*. Again we had no success in finding a north-bound bus, and found ourselves in the familiar situation of being in a strange town, surrounded by dozens of people with whom we had not a single word in common, all apparently giving us advice about how to get to our destination, and all pointing in different directions! Shouldering our way out of this crowd we used a compass to locate the right road and walked out of the town heading north, ever north. Before too long we waved down a "boneshaker" which took us a long way through beautiful countryside. We had the sun on our right and the distant view of Mount Jizu Shan on our left as we sped up this quite good road, surrounded by paddy fields, smiling and waving peasants, and village after village where even the most humble building had traditional oriental upswept roof ridges.

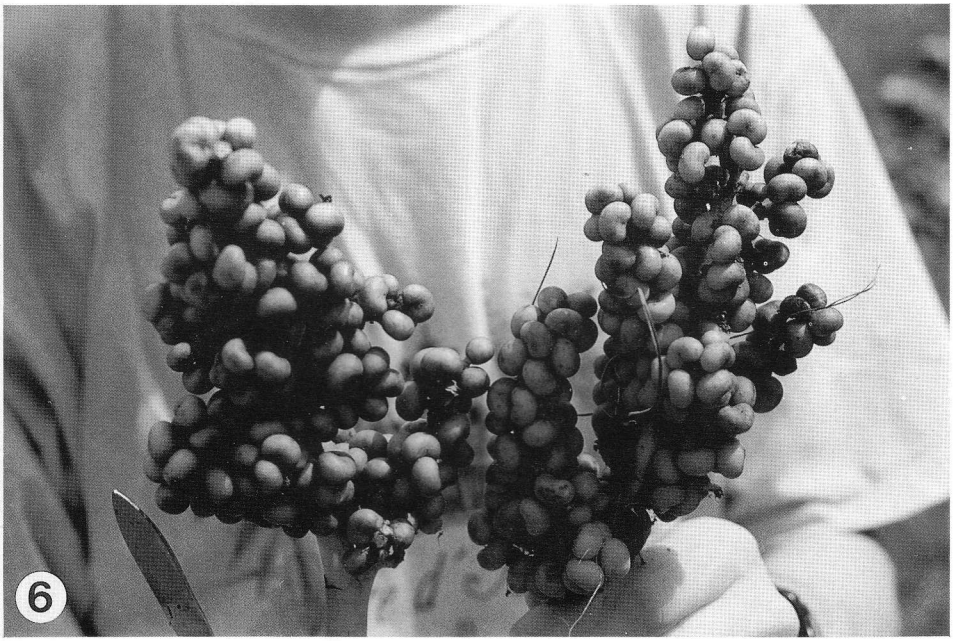
After an hour or so the driver dropped us off and just five minutes later we were in a real bus and on our way again. There are very few foreigners in this part of the world and our appearance at any location, be it hotel, bus, or just on the street, caused great interest. The Chinese are a friendly lot and a smile is always returned with an even bigger smile. The one word they all know is "hello" and we almost got to hate this word, since it was shouted at us countless thousands of times during our stay in that country.

After some 70 or 80 miles, when the landscape became more hilly and barren, we started to see more *T. nanus*, and the difficulty was to decide when to get off the bus for a closer look. After passing one or two particularly tempting clumps, we alighted, waving goodbye to the other passengers, who must have wondered why we were getting off in the middle of nowhere, and walked back to the plants.

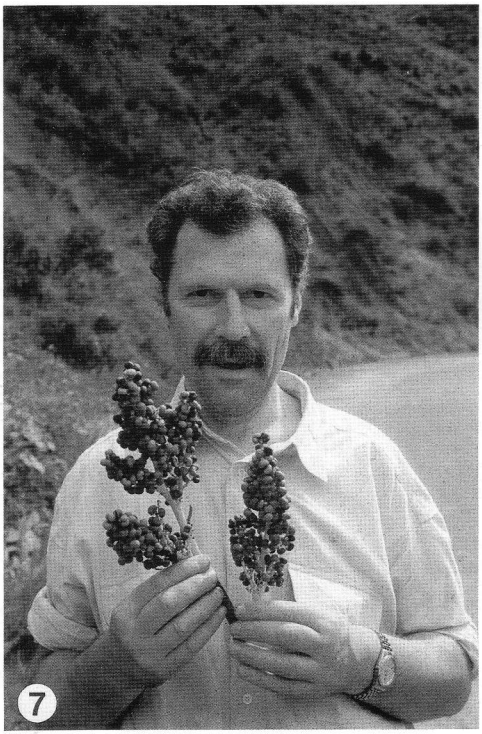
More or less following their direction, we left the road and soon found ourselves surrounded by dozens of beautiful small fan palms. They were growing on steep, stony and dry hillsides above 2,100 m, scattered amongst small, stunted, hard-leaved evergreen shrubs and trees (Fig. 2) or in pasture with their leaves sticking out from the grass (Fig. 3). As the vegetation was very open, most of the palms were growing in only very light shade or enjoying the full sun. We felt that we had found the real thing now. *T. nanus* looked totally

3. *T. nanus* growing in pasture. Note erect infructescence. 4. *T. nanus* seems to prefer sloping sites.





5. The pale, almost silvery form of *T. nanus*. 6. Infructescences of *T. nanus*.



7. Infructescences and ripe seeds of *T. nanus*. 8. The deeply and regularly divided leaf of *T. nanus* shows well in silhouette.

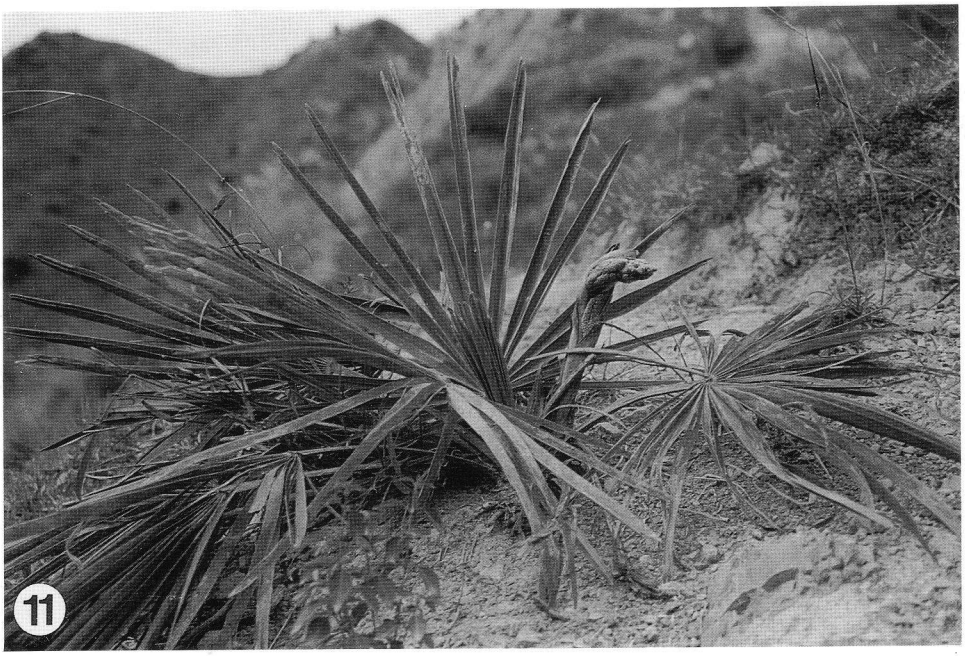
different from those we had seen at Jizu Shan the day before. Not only were they larger and much more attractive, with many perfectly grown, stiff, often glaucous leaves, but they were also absolutely undamaged.

The palms we observed were very variable: They held from half a dozen to over 20 very stiff and deeply divided fan-shaped leaves, 20 to 50 cm long (Fig. 4), with 20 to 30 deeply folded leaflets (Fig. 5). This is probably an adaptation to the drier climate; those we had seen in the moist forest held the leaflets flat. The tips were slightly bifid. The leaf color varied from light green to an almost silvery blue (Fig. 6). The abaxial side, particularly, was clearly glaucous. The petioles were finely toothed and measured from 12 to 25 cm in length. Many plants were found with dried, erect inflorescences, usually one or two, sometimes up to five, slightly exceeding the length of the petiole. Only a very few plants could be found with their stiff, upright inflorescences full with seeds (Figs. 7,8).

Some plants, growing on eroded sites where much of the soil had been washed away, revealed long, curved, horizontal, underground trunks, about 5 cm in diameter and up to 60 cm or more long (Fig. 9), appearing just like the illustration of *T. dracocephalus* (now regarded as synonymous with *T. nanus*) that was reproduced in Myron Kymnach's article in *Principes* 21: 158. These plants must have been very old indeed, as were the one or two we found with short aboveground trunks, up to 30 cm high, which were fibrous in the manner of *T. fortunei* (Fig. 10).

We found *T. nanus* to be most common on the north-, west-, and east-facing slopes,

9. Soil has been washed away, revealing a sinuous, underground trunk. 10. One or two plants had short, aboveground trunks.



11. The erect inflorescence of *T. nanus*.

with only few plants occurring on the drier southern hillsides. In addition, they were extremely local, being entirely absent from neighboring areas that seemed perfect for them. The soil was a slightly acidic to neutral, stony and sandy but crumbly loam. With the exception of the steepest slopes, all of the land was under cultivation, much of it grazed by cattle and goats, which, although undoubtedly finding the adult palm leaves too tough to handle, probably found the inflorescences (Fig. 11) and young seedlings tasty and edible. This would account for the few seeds and total absence of young and juvenile plants. It could be assumed from this that the species is condemned to extinction in the wild, here, if not on Mt. Jizu Shan.

We spent several more days in China, hitch-hiking or travelling by bus or plane, and saw many more palms, but nothing could quite equal the excitement of seeing *Trachycarpus nanus* for the first time. We hope that this unusual, attractive, but little-known hardy palm may soon be distributed around the world, contributing to its survival.

SEED BANK INQUIRIES

Bob Egge has resigned the SEED BANK Directorship. Members should send all IPS SEED BANK inquiries to LYNN MUIR, Chairman IPS Seed Bank Committee, 33802 Valencia Pl., Dana Point, CA 92629.

Principes, 37(2), 1993, pp. 73–79

Successional Patterns of Understory Palms in an Old Cacao Plantation on the Caribbean Coast of Costa Rica

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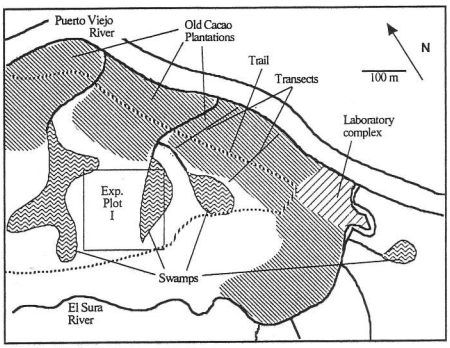
The study of succession in tropical rainforest areas appears to concentrate on two general patterns. First, land originally opened up by agriculture or pasture is treated as the point at which secondary succession begins. Second, treefall gaps initiate a process of succession that has been much studied in recent years. While other patterns are recognized (e.g., hurricanes [Vandermeer et al. 1990, Yih et al. 1991], landslides [Garwood et al. 1979]), the vast majority of work on succession in humid tropical areas is on either very open areas or treefall gaps (e.g., see the review issue of *Biotropica* edited by Ewel 1980). It is worth noting as a point of contrast that a great deal of the deforested area in the humid tropics is currently other kinds of converted lands, specifically those having had a tree canopy or partial canopy as part of their original purpose, areas such as coffee or cacao plantations, in which a canopy of "mother" trees was a common part of the agroecosystem, or abandoned traditional agroforestry systems (Altieri 1990). Studies of post abandonment succession in such systems are rare.

A characteristic component of old growth rainforest in Tropical America is the understory monocotyledonous flora, especially palms. Understory palms frequently provide the overall characteristic appearance of the forest and are even sometimes thought of as indicators as to the "maturity" of the forest (Budowski 1963). A detailed understanding of how they attain their status in the understory during the process of succession is thus of some importance.

A particularly interesting situation arises when the area undergoing succession had a tree canopy cover in the first place, such as old coffee and cacao plantations. It is reasonable to expect that the normal understory palm flora will arrive into such an area, based more on the availability of seeds rather than on the physical conditions created by the general stage of vegetational succession, since dark understory conditions assumed to be required for understory palms already exist. If this expectation is true, the proximity to a seed source, which would probably have to be an old growth forest, may be the critical factor driving succession.

Since understory palms can be both mammal dispersed and bird dispersed, one of the critical consequences of the availability of a seed source (i.e., a reasonably close old growth forest), is how far from that seed source the two types of palms are distributed (within the old plantation) after a particular period of time. That is, after some years of abandonment, are the bird dispersed forms or the mammal dispersed forms found further from the old growth forest in the plantation? One might initially expect those species dispersed by terrestrial mammals to become established



1. Map of the study area. Dark diagonal hatching indicates position of old cacao plantations and wavy hatching indicates swampy areas. All non-shaded area south of the Puerto Viejo River is old growth forest.

closer to the seed source since on average an individual terrestrial mammal does not have the range of an individual bird.

The general purpose of the present study was, therefore, to determine if proximity to old growth forest and method of seed dispersal had any effect on the condition of the understory palm flora in an old cacao plantation in the Caribbean lowlands of Costa Rica, as a contribution to the understanding of successional processes in abandoned plantations. The main hypothesis was that mammal dispersed species are concentrated closer to the old growth forest than are bird dispersed ones.

Methods

Among the many habitats on the property of the La Selva field station (owned and operated by the Organization for Tropical Studies and located on the Caribbean Coast of Costa Rica near the town of Puerto Viejo in the valley of the Sarapiqui River) is an abandoned cacao plantation that abuts old growth forest on one side and the Puerto Viejo River on the other. The plantation appears to have been relatively uniform, and when I first saw it in 1969, it appeared to be little different than an actively producing cacao plantation, with the possible exception that the overstory tree flora was substantially more diverse than normal. Certainly the understory monocot population was virtually non-existent. Since that time it has been abandoned, and today one can still see the old cacao trees, but a naive observer tends to have the feeling of walking in a forest, i.e., succession has proceeded to some degree, some might even suggest to a remarkable degree.

The plantation extends some 700 meters in a strip about 150–170 meters wide, and is cut by two streams (Fig. 1). All the area save the steeper slopes of the two streams were cacao plantation.

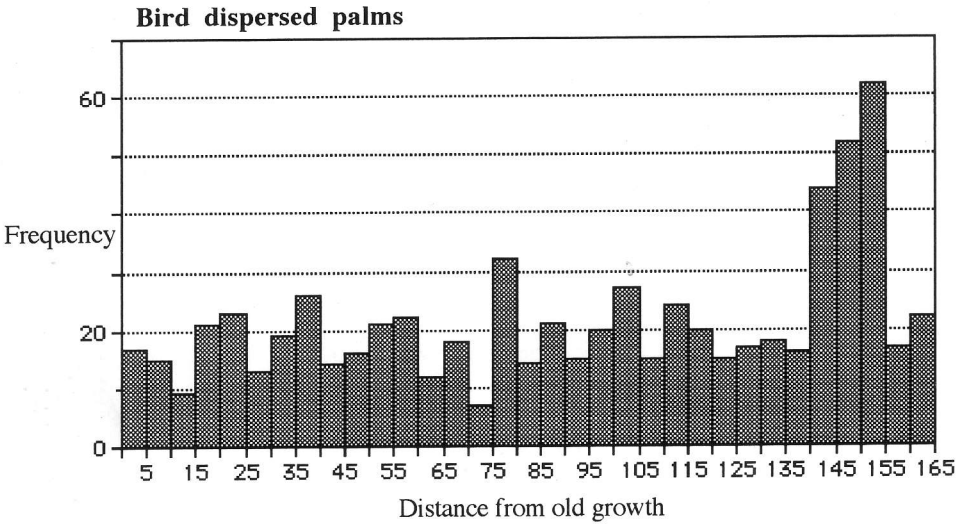
Two transects were taken perpendicular to the long axis of the plantation (see Fig. 1), from the primary forest to the Puerto Viejo River. A meter tape was set out and all understory monocots within five meters of either side of the tape were located and identified.

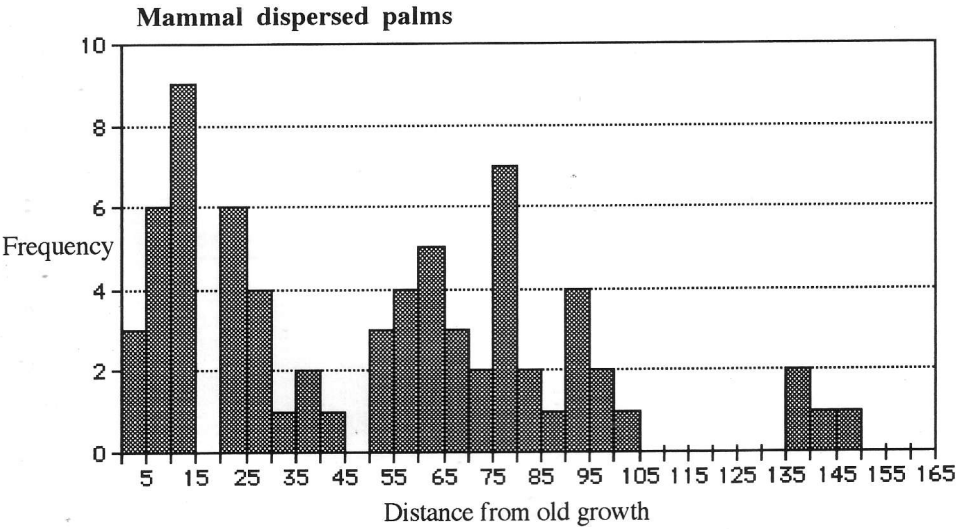
Of the 12 species encountered, two (*Welfia georgii* and *Socratea exorrhiza*) were evidently dispersed by mammals (probably mainly *Dasyprocta punctata*, *Heteromys desmarestianus*, and *Hoplomys gymnurus* Vandermeer et al. [1979]). Several others (*Geonoma cuneata*, *G. interrupta*, *G.* sp., *Chamaedorea exorrhiza*,* *Asterogyne martiana*, *Bactris* sp., *Bactris hondurensis*, *Prestoea decurrens*, *Calyptrogyne sarapiquensis*, and the cyclanth *Carludovica palmata*) have infructescenses that suggest bird dispersal. One other very common species, *Geonoma congesta*, was thought to be also bird dispersed, but partially because of its distribution pattern in this short census, I suggest that its more likely disperser is the terrestrial small mammal fauna, as discussed below.

Results

The combined distributions for mammal dispersed (Fig. 2 top) versus bird dispersed (Fig. 2 bottom) species is shown in Figure

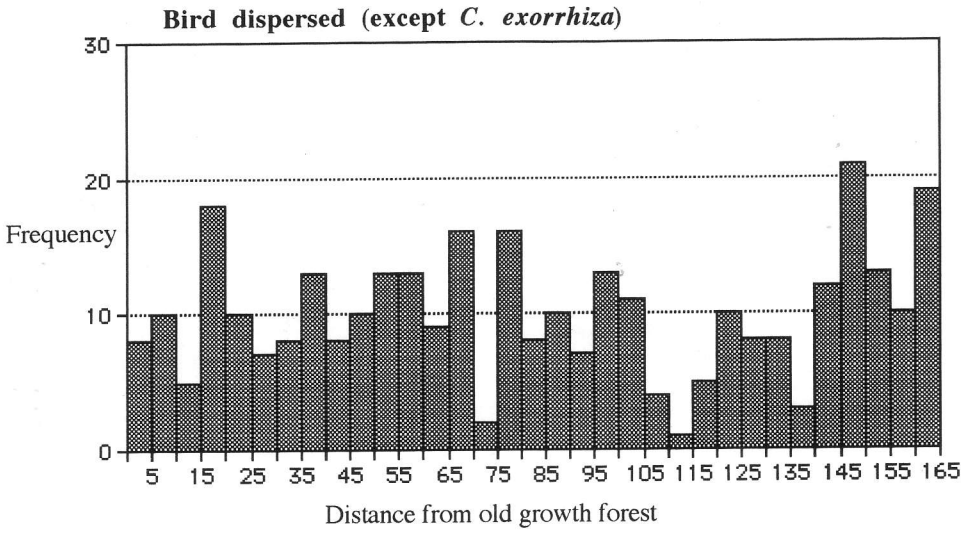
* Now thought to be synonymous with *C. tepejilote* (Hodel, in press).

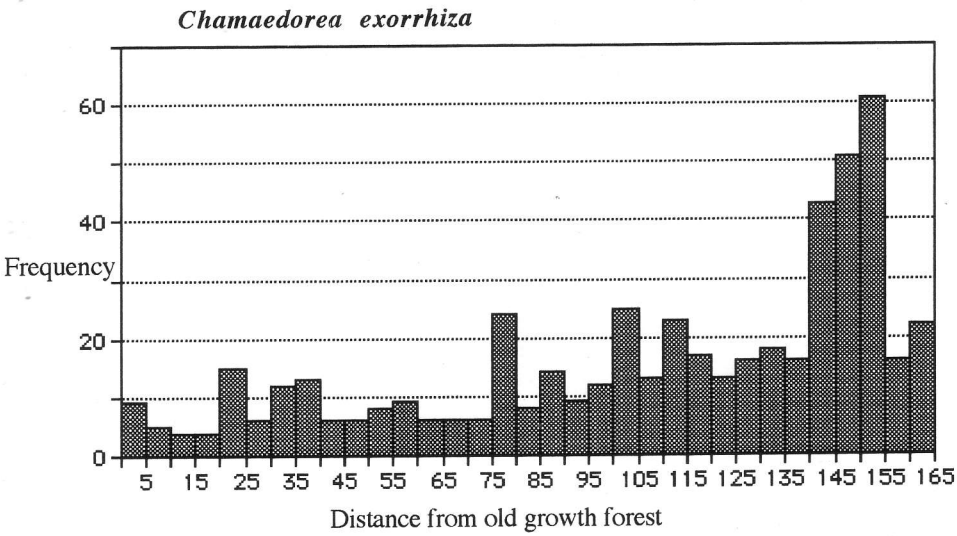




2. Distribution in an old cacao plantation of bird and mammal dispersed understory palms as a function of distance from old growth forest.

2 (because of the special status of *G. congesta*, as indicated above and described below, it is not included in Figure 2). A quick glance at Figure 2 leaves the strong impression that the initial hypothesis was correct, that bird dispersed species tend to be dispersed further from the old growth forest than mammal dispersed ones, and the impression is supported convincingly by a simple t test (see Table 1). But a couple of other patterns are evident and of considerable interest.





3. Distribution in an old cacao plantation of all bird dispersed species except for *Chamaedorea exorrhiza* and the distribution of *Chamaedorea exorrhiza* as a function of distance from old growth forest.

First, it may be noted in Figure 2 top that not only are bird dispersed species distributed throughout the plantation, they seem to be concentrated near the river, rather than near the primary forest as expected. This tendency is due to one species in particular, *C. exorrhiza*. If that species (which was the most abundant species in the census) is removed from the data, the pattern is the same with respect to the major hypothesis (i.e., the bird dispersed species are still more evenly dis-

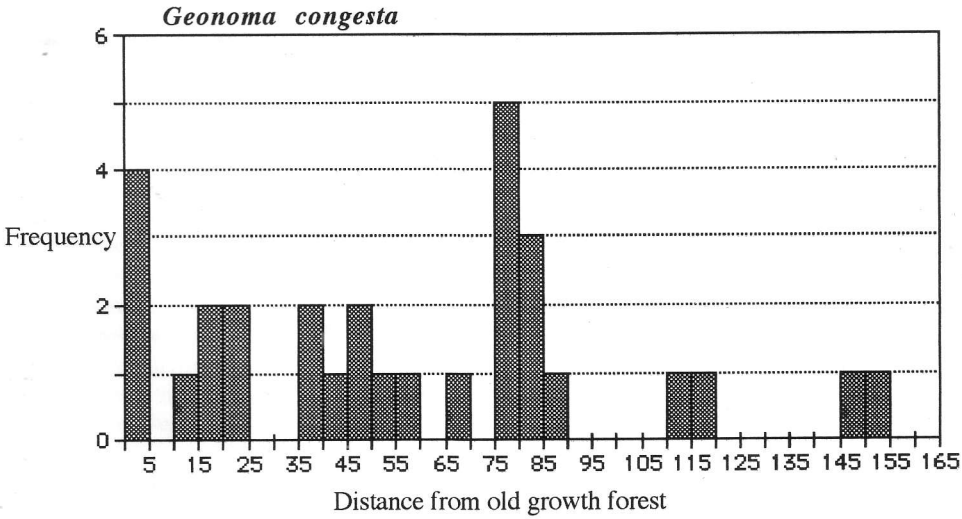
Table 1. Comparisons of mean distance from old growth forest for various categories.

Comparison	Student's t	df	Probability
Bird Dispersed vs. Mammal Dispersed	6.92	774	<.001
Bird Dis (except *C. exorrhiza*) vs. Mammal Dis	5.21	401	<.001
Bird Dis (except *C. exorrhiza*) vs. *G. congesta*	2.81	359	<.01
Mammal Dispersed vs. *G. congesta*	.775	98	>.4

tributed throughout the plantation than the mammal dispersed ones, see Figure 3 top), but the bias towards the river rather than the forest disappears. By plotting the data for *C. exorrhiza* separately (Fig. 3 bottom) it is clear where the bias came from in the first place. This species is clearly more abundant near the river, a fact considered further in the discussion.

Second, there is a "hump" in the distribution of the mammal dispersed species towards the middle of the transects. This hump corresponds almost exactly with the position of the path through the old cacao, as indicated in Figure 2 bottom (see also Figure 1 for the position of the path). It is a reasonable hypothesis, further discussed below, that ground mammals utilize this path in their normal peregrinations and thus tend to concentrate seeds near it.

The distribution of *Geonoma congesta* is something of an anomaly, as suggested above, and as plotted in Figure 4. First, its distribution corresponds far more to the mammal-type distribution than the bird-type, being more concentrated near the old growth forest. According to t-tests, *G. congesta* does not differ from the mammalian pattern, but does so from the bird pattern, see Table 1. Second, there is a hump in its distribution, corresponding to the position of the path through the cacao grove, as easily observed in Figure 3. These two observations suggest that *G. congesta* is not bird dispersed as originally assumed, but rather is dispersed by the same small ground foraging mammals that disperse



4. Distribution in an old cacao plantation of *Geonoma congesta* as a function of distance from old growth forest.

Welfia georgii and *Socratea exorrhiza*, a point discussed further below.

Discussion

The principal hypothesis of this note is supported quite strongly by the data, as evidenced by a glance at Figure 2 and the first two row entries in Table 1. In a 20 year period, bird dispersal resulted in the habitat being essentially fully seeded with relevant understory palm species, although population densities appear to be somewhat smaller than in the neighboring old growth forest (except for *C. exorrhiza*, as discussed below). It is possible to tentatively conclude that a seed source (i.e., patch of old growth forest) within 165 meters is sufficient for substantial recovery of the bird dispersed understory within a 20 year period. The existence of several fruiting individuals of several of the species (*Asterogyne martiana, Calyptrogyne sarapiquensis, Prestoea decurrens, Geonoma interrupta*) suggest that the elapsed time has been sufficient for a second generation to have begun.

The picture is different for the mammal dispersed species. The major concentration of individuals remains near the border of the forest, and no flowering or fruiting individuals were sighted (including *G. congesta*). The problem of seed source is thus clearly a larger problem for mammal dispersed species than for bird dispersed ones, not a particularly surprising observation. It would appear that in order to achieve the same degree of "recovery" of the understory palm flora that apparently had been achieved by the bird dispersed species during the past 20 years, one would need a far greater number of patches of old growth forest to serve as seed sources.

On the other hand, the pattern of distribution, with respect to the path in the cacao grove, suggests other practical means of effectively extending the seed source. Since the path apparently provided something of an avenue into the cacao grove (perhaps because its cleared understory was simply easier to navigate, perhaps because that same characteristic made danger from predators such as snakes less likely, or perhaps some other mechanism), it is reasonable to hypothesize that dispersal avenues might be created in such plantation systems. Exactly what attributes those avenues ought to possess is hardly addressed by this short study, but it would seem a worthwhile venture to engage in futher studies aimed at elucidating what habitat factors might be modified in order to create such avenues. From the present study it can be tentatively suggested that human-used pathways appear to offer such avenues for at least some dispersing mammals.

The species *Geonoma congesta* presents an interesting situation. I had assumed, from conversations with local naturalists, that the species was distributed by birds. But its pattern of distribution corresponds closely to that of the other two mammal dispersed species, both in terms of its concentration near the old growth forest edge and its concentration near the trail, and one is tempted to suggest that the species is mammal dispersed. *G. congesta* is a multiple stem understory palm, with a branched infructescence the fruits of which turn black when they are mature. Casual handling of ripe fruits causes them to dehisce almost immediately, something that would be more of an advantage to a seed that was to be dispersed after falling to the ground, rather than before. Furthermore, extensive observations by Doug Levy (personal communication) on frugivory by understory birds failed to record a single instance of birds eating *G. congesta* fruits. Additionally, studies by Israel and Roth (1991) found that small piles of *G. congesta* fruits left on the ground both in old growth forest and old cacao plantation were taken by mammals, mainly at night, but sometimes during the day also (a total of 53 fruits were removed of 265 placed on the forest

floor over a three day period [Israel and Roth 1991]). On one occasion I observed an agouti in the late afternoon nosing around one of the fruit piles left by Israel and Roth, although my observation fell short of actually observing the agouti remove one of the fruits.

The pattern exhibited by *Chamaedorea exorrhiza* is the opposite of expectations. Since all species were known to be members of the "primary forest" understory, finding a bias of the population far from the old growth forest called for speculations as to why birds would carry seeds of this particular species especially further away from their origin. The story appears to be almost the reverse. While I did not gather quantitative data on the size of individual palms encountered, it was relatively clear that the bulk of the adult fruiting trees of this species were themselves found near the river. It thus appears that despite the fact that *C. exorrhiza* is thought of as a member of the "primary forest" understory palm flora, its main habitat appears to be the river's edge, and the occasional individuals encountered in the primary forest are those that are brought by birds from the high populations at the river's edge. Thus, while the species is typically one of the rare understory species of primary tropical rainforest, it also occupies another habitat in which it is anything but rare. This pattern fits in well with Rabinowitz's classification of rarity, being a case of rare in some habitats, but common in others (Rabinowitz 1981). Deforestation would thus not threaten this species at all, but modifying river courses could. For example, if the banks of the Puerto Viejo were deforested for cattle pasture or banana plantations, the existence of *C. exorrhiza* as a primary forest species could very well be affected, despite the preservation of all neighboring old growth forests. Here, as elsewhere, activities outside of a species' designated habitat could have strong and surprising effects in that habitat.

Acknowledgments

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Principes, 37(2), 1993, pp. 80–81

PALM BRIEF

Pritchardia munroi: Attempts to Save a Species from Extinction

In 1975, the world population of the endemic Hawaiian palm, *Pritchardia munroi*, consisted of one living specimen in a remote mixed dry forest on the island of Molokai, the very plant used by Dr. Joseph Rock to describe the species in 1921.

In December of 1975, Waimea Arboretum sponsored an expedition to Molokai in the hopes of obtaining seeds or at least photographs. With the assistance of Molokai forester Noah Pekelo and a four-wheel drive vehicle, Waimea's Erling Hedemann, Jr., Keith Woolliams, and Tom Shaw were able to reach a ridge overlooking the lone surviving palm. A hike over rough terrain to the *Pritchardia* was rewarded with an unexpected abundance of ripe seed. Photographs were taken of the pig-damaged palm with soil eroded from its base.

In an attempt to save the species through cultivation, seeds were sent to sixteen institutions in various parts of the world and to the Palm Society Seed Bank for distribution to members.

In 1989, a survey was undertaken by Waimea to determine the status of *Pritchardia munroi* Rock (Accession Number 75s2295). Replies came in from institutions in the Canary Islands, Thailand, and locally, confirming that there are now a total of 17 plants of *Pritchardia munroi* in existence around the world from the 1975 collection. Five more plants exist from subsequent collections, bringing the world total to at least 22, with the possibility that more specimens have not been reported.

And what of the parent plant?

It still stands on Molokai. More soil has

1. The sole surviving *Pritchardia munroi* is on Molokai. Photo by Keith Woolliams.

eroded from its base, and it has suffered from fourteen more years of mammal damage. However, with funds provided by the State Department of Land and Natural Resources, the International Palm Society, The Smithsonian Institute, and Waimea Arboretum Foundation, a wire exclosure now prevents pigs, goats, and deer from harming the parent plant further.

Not all institutions have yet responded. If you have plants of this species, especially from the 1975 distribution, Waimea would be interested to hear from you at 59-864 Kamehameha Highway, Haleiwa, Oahu, Hawaii 96712.

SHIRLEY GERUM
Research Associate
Waimea Arboretum
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Principes, 37(2), 1993, p. 81

PALM BRIEF

Move Over Johnny Appleseed—Make Way For The Palm Society (The Seed Bank at Lyon Arboretum)

Thursday mornings, early, volunteers Dorothy Henkle, Pat and Jim Godfrey, Luci Nicolai and John Stall (Fig. 1) gather in the greenhouse to clean, dry and count palm seeds collected by Ray Baker and other staff members. The following week they will package that day's lot and prepare it for shipping, then clean some more. Orders for palm seeds come from around the world—even Russia!—as palms can grow in most well-watered areas and are even conservatory favorites. The record keeping of who sent how much money to have how many seeds sent to where, and when they were shipped, is a formidable job in itself. As Council VP Wilson Lee says, "Lyon Arboretum works with the world. We're not a Mom and Pop store anymore."

1. Palm seed cleaners (l to r) Pat Godfrey, Luci Nicolai, Dorothy Henkle, John Stall and Jim Godfrey wear rubber surgical gloves to prevent irritation to their hands.

Of enormous economic importance, palms and their products are needed for construction, food, furniture, mats, oils and waxes as well as landscaping. Among the family's 2,800 species are found some of nature's extremes (trivia time, here) such as the 40-pound seed of the double coconut and the 20-yard-long fronds of the raffia palm.

One of the International Palm Society's two seed distribution centers, Lyon Arboretum was selected because of its extensive palm collection, which "may well rank among the best in the world," according to Dr. Natalie Uhl of Cornell University. A second center at Fairchild Tropical Garden in Florida has ready access to Caribbean palms. The movement of palm seeds is restricted because of the diseases "lethal yellowing" and "cadang cadang."

Until late last summer, the seeds were cleaned by (sometimes) intense manual (and occasionally, foot-ual) labor; but, to the job of the palm seed seekers/cleaners, the International Palm Society has just provided LA with an automatic seed-cleaning machine. Also to be used in LA's other seed exchange program, it will save wear and tear on tempers and fingers and speed up distribution.

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Physicochemical Soil Factors Influencing The Distribution of Two Coastal Palms in Yucatan, Mexico

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Coccothrinax readii Quero and *Thrinax radiata* Lodd ex J. & Schult. are two palm species closely associated with some vegetation types in the Yucatan Peninsula, Mexico. These species are widely distributed in all the northern and western coastal sand dune scrub and in several semievergreen tropical forests. At present, their abundance has decreased due to landscape deterioration.

We have previously described (Ayora and Ayora 1988, Orellana and Ayora 1993) the population structure of *C. readii* and *T. radiata* in a preserved community of sand dune scrub in Uaymitún, a study area located on the northern coast of the Yucatán Peninsula. This community is one of the last natural conserved vegetation areas in the region. The main purpose of these reports is to analyze the characteristics of the two species of palms in reference to their environment and to provide the necessary information to undertake conservation activities to preserve germplasm.

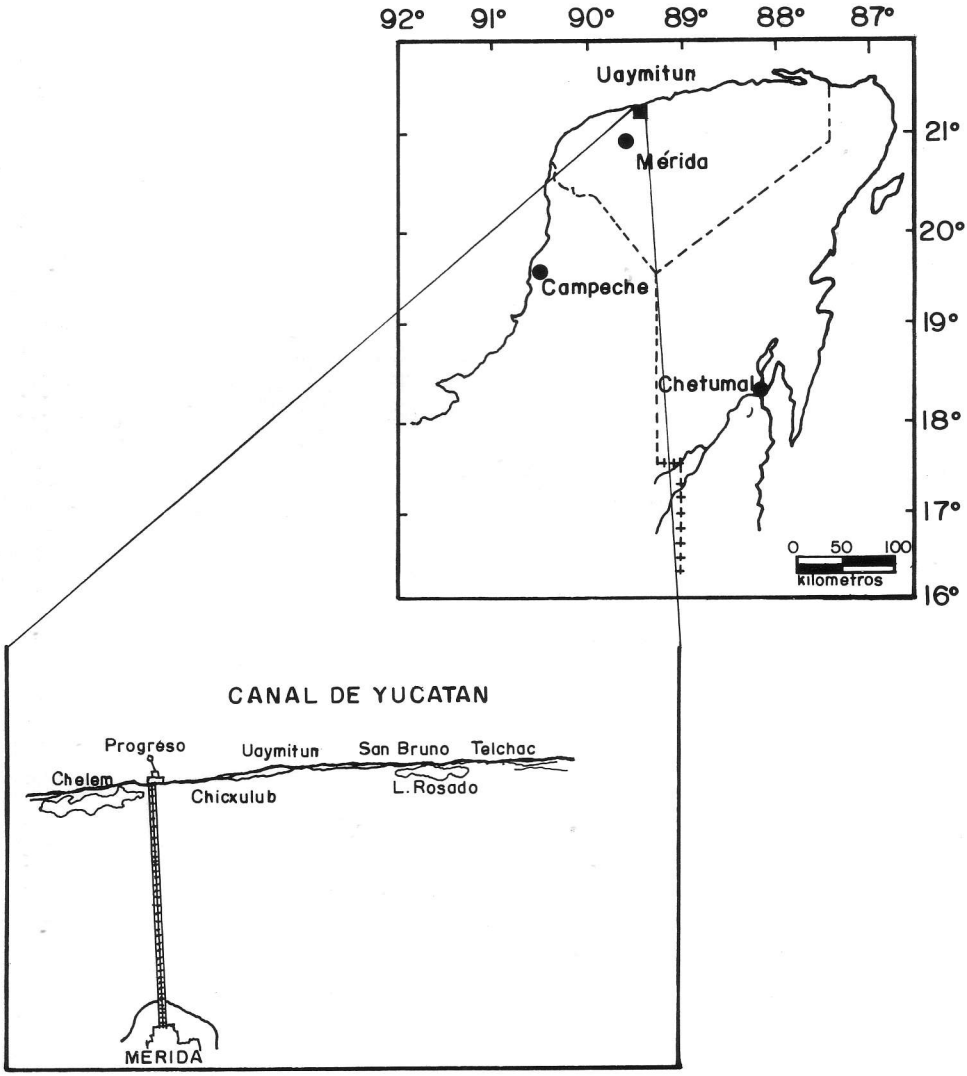
This paper is the second part of a report series designed to gather enough elements to evaluate the ecological status of these two wild palm species in the state of Yucatán, México. One species, *C. readii*, is endemic and is threatened because of the reduction of its habitat. The other, *T. radiata*, although not threatened, is affected in its natural population; therefore we consider it a vulnerable species.

The objective of this paper is to establish the relationship between physicochemical factors influencing the soil characteristics and the spatial distribution of both palm species in the sand dune scrub community of Uaymitún.

Antecedents

The study area is located in Uaymitún 89°30′W and 21°19′N, on the northern coast of Yucatán, México (Fig. 1). It is a zone covered with sand dune scrub with low diversity values (4.28 bit units) and dominated by *Coccothrinax readii* (14,570 ind./ha), combined with *Bravaisia tubiflora* Hemsl. (Acanthaceae) (7,810 ind./ha) and *Agave angustifolia* Haw. (Agavaceae) (3,810 ind./ha). *Thrinax radiata*, the other palm species, occupies the eleventh position of importance value in this community, with 1,520 ind./ha. Figure 2 shows a partial view of the community where *C. readii* and *T. radiata* are associated. In a previous paper (Orellana and Ayora 1993), the study area was described.

Predominance of the first three species mentioned above shows a low diversity community, in which hypothetically soil physicochemical factors are restrictive and act as elements that favor growth of some species. The dominant species are the best adapted to these environmental restrictions (*sensu* Odum 1972; Pielou 1978, 1979; Pianka 1982). Espejel (1986, 1992) described in a broad study the relationships



1. Study area in the northern Yucatán Peninsula.

between sand dune communities and soils in Yucatán. She pointed out that there are several gradients on the sand dune vegetation which correspond with salinity gradients, microtopography, and subterranean stream systems.

Starting with the premise that both palms share the same habitat, which includes climate and the same sandy soil, but have different density, spatial pattern distribution, height, rate of survival and fruit production, we supposed that maybe some particular soil physicochemical factors are of importance in the observed development for both species.

To establish which would be the main soil elements that influence the distribution of these palms, a physicochemical analysis was carried out with samples of the sand dune scrub substrate. Considering presence-absence and abundance of both species (*C. readii* and *T. radiata*), they were

2. A landscape view of a community of sand dune scrub in Uaymitún, where both palm species, *C. readii* and *T. radiata*, can be appreciated.

correlated with the resulting 16 variables from the physicochemical analysis. It is also important to consider first that dead biomass produced by both species which will eventually form organic matter in soil is quite variable; *Thrinax radiata* patches are associated with high organic matter content, while *Coccothrinax readii* grows on light soils with relatively low concentrations of this component.

Material and Methods

Samples were collected at Uaymitún, Yucatán. From each of the 10 (10 × 10 m) plots established in the previously reported population analysis, 1 kg sand soil samples were collected. One sample was collected from the surface, another at 20 cm depth and the third at 40 cm depth (total = 30 samples for the whole area). Figure 3 shows the plot distribution in the study area and the abundance of the two species in the 10 plots along the transect, as well as the main microtopographic changes and the presence and density of the combined populations of *C. readii* and *T. radiata*.

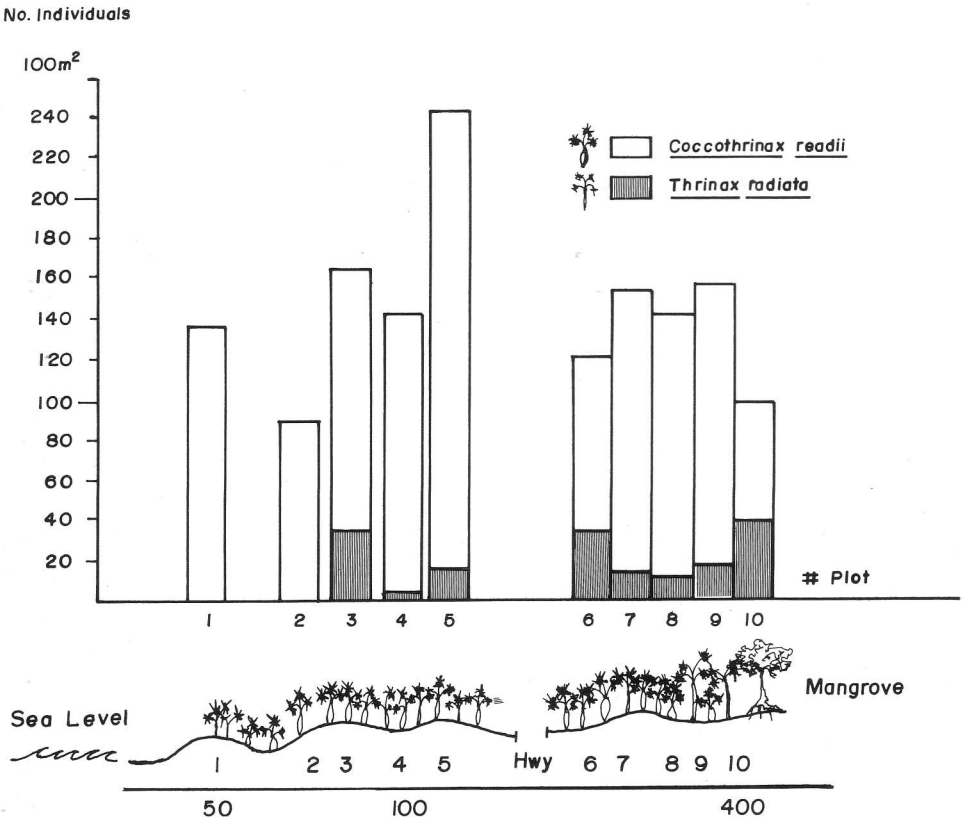
Soil Analysis

The analyzed data are listed in Table 1. Each variable used in the analysis is marked with a successive number (X1, X2, X3, etc.). Determinations were made using the following methods (Chapman and Pratt 1979, Dept Agrología 1972): a) texture using the Boyoucos method, b) salinity using the conductivity meter, c) organic matter by Walkley and Black's method, d) phosphorus determination by Olsen's method, e) cationic exchange capacity by saturation with ammonium acetate, f) calcium and magnesium saturation with sodium acetate, and nitrogen by the Kjeldahl method. Laboratory analyses were carried out at the Agrology Laboratory of the Chemistry Faculty of the Universidad Autónoma de Yucatán in Mérida.

For statistical analysis we initially estab-

Table 1. Variables used on the sandy soil analysis in Uaymitún, Yucatán.

Coefficient No.	Variable	Units
X1	Depth	cm
X2	Sand	%
X3	Loam	%
X4	Clay	%
X5	pH in water (paste)	
X6	pH in extract	
X7	Conductivity (paste)	mmhos/cm
X8	Conductivity in extract	mmhos/cm
X9	Organic matter	%
X10	Available phosphorus	ppm
X11	Cationic exchange capacity	me/100 mg
X12	Calcium	me/100 mg
X13	Magnesium	me/100 mg
X14	Sodium	me/100 mg
X15	Potassium	me/100 mg
X16	Nitrogen	%



3. Study area profile and abundance differences between *C. readii* and *T. radiata* along a transect where 10 plots (10 × 10 m) were established from the seashore (north) to the mangroves (south).

lished two individual presence and abundance matrices, one for *C. readii* data and the second for *T. radiata*, contained in each of the 10 plots. These were independently correlated with the obtained matrix of 30 soil samples. Sixteen variables were analyzed and another two matrices were constructed. We employed multiple regression analysis as a discriminant and hierarchical method to know the importance of the 16 variables. This method correlates the dependent variable (number of individuals of the species per plot) with the independent variables (X1, X2, X3, . . . , X16).

Multiple regression and correlation coefficients (Edwards 1985, Pfaffenberger and Patterson 1981) were employed to determine which of the soil variables would be more correlated with presence and density of each of the two palm species in this specific community. The most important variables presented higher positive or negative values. The results were evaluated using the program STATPRO in an Apple plus-dos computer.

Results and Discussion

The information obtained from the soil analysis indicates that the localized presence and pattern of the two species may be influenced by important differences in the mechanical properties of the soil as well as nutrient concentrations related with depth.

Even though both species develop in the same community, they grow on soils with different nutrient concentrations as shown by the obtained data analysis. This could partially explain the distribution pattern, density, and population structures that both species attain in the area. Population sampling of both species in the Uaymitún community follows the abundance distribution according to the sequence of plots along the seashore and the mangrove in a north–south direction (see Fig. 3).

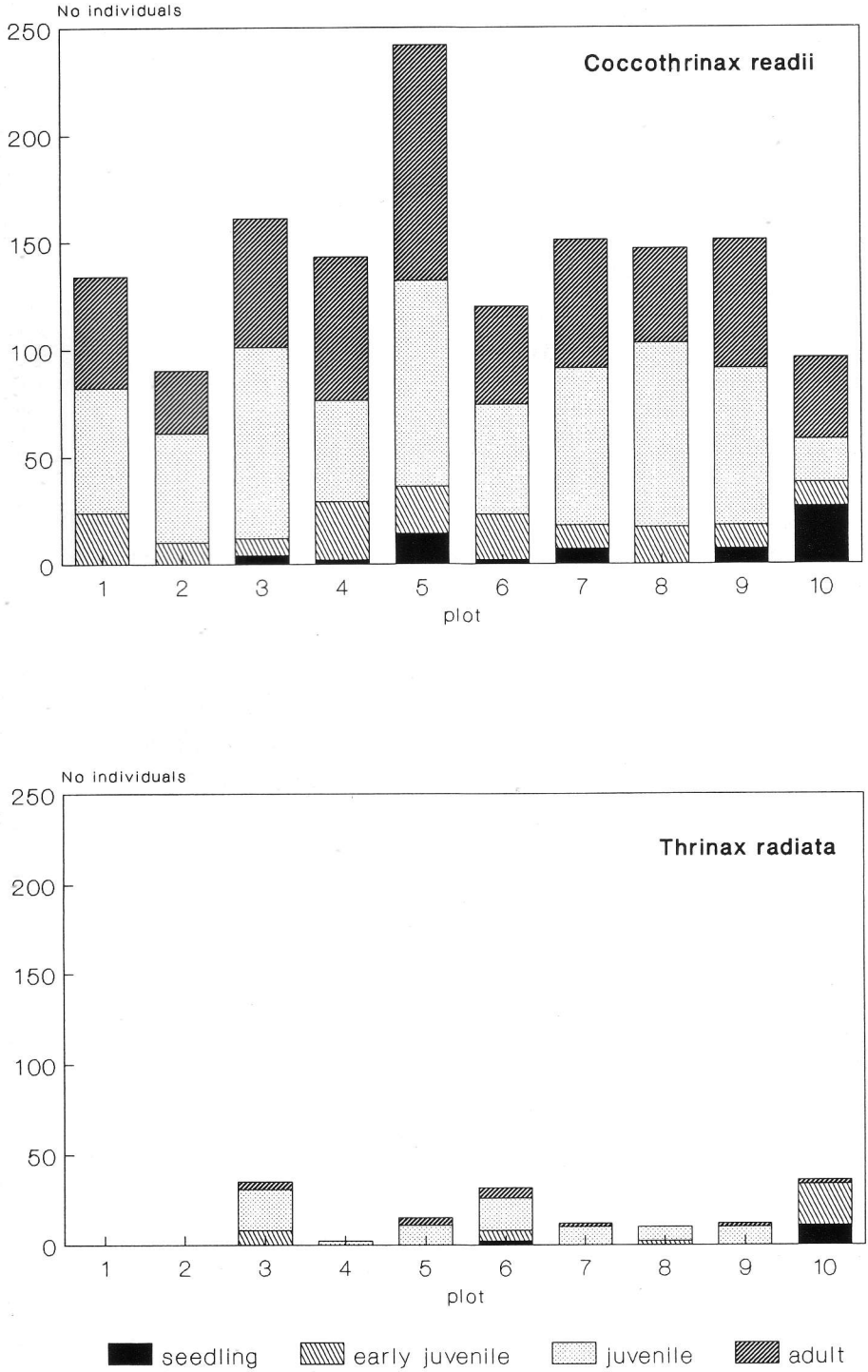
Figure 3 shows the 10 plots along the whole transect from behind the first mobile dune to the mangroves. Overall *C. readii* abundance may be appreciated, especially in plot No. 5. *T. radiata* is more abundant in the last five plots near the mangroves and also in depressions where this species tends to form patches in areas where there is considerable organic matter accumulation, as best represented in plots 3 and 10. It is very important to note that both palm species contribute to the soil formation at the microenvironmental level, especially *T. radiata*.

Figure 4 points out the life cycle stage distribution of both palms in the ten plots. *C. readii* is represented mainly by adults; on the other hand, *T. radiata* has more juvenile individuals. Only in the last plot (No. 10) near the mangroves do both species tend to represent population structure with good regeneration.

Figures 5 and 6 show the typical soil profiles of areas where *C. readii* and *T. radiata*, respectively, grow. The profile corresponding to *C. readii* is lighter with relatively little organic matter, while the *T. radiata* profile presents a darker superficial level which corresponds to a relatively high organic matter accumulation that can be observed.

Table 2 shows the average, standard deviation, and variation coefficient of the 16 soil parameters considering the 10 samples at each of the 3 depths. The data show that the main physicochemical activities are carried out at the superficial levels of the sand dune. With respect to texture, it was observed that in general all samples correspond to sandy soils in which loam concentrations show larger differences than sand and clay fragments. The sand particles tend to increase in size at the lowest levels, with the lowest concentrations of soluble particles in the 40 cm samples.

The results obtained indicate that soil texture (sand, loam and clay percentages) is an important factor for the presence of both species, since it determines the avail-



4. Population structure of *C. readii* and *T. radiata* in the 10 analyzed plots along a transect from the seashore to the mangrove.

5. A typical soil profile beneath a community with abundant *Coccothrinax readii*. Organic matter level is very superficial. 6. Soil profile beneath *Thrinax radiata* patches. These communities are present in hollows with considerable quantities of organic matter and consequently darker profiles.

ability of free air and light penetration into the soil. Variations of both factors, air and light, are important for germination processes and root-system development of several plants (Daubenmire 1974, Hartman and Kester 1980, Hepher and Roberts 1985, Ortíz and Ortíz 1980, Fenner 1985). Clay is composed of a mixture of minerals which may differ in composition and properties. On the other hand, sand grains and loam can be more homogeneous. Because of the properties of clay, an important part of the nutrients is contained in the water layer that covers these particles (Millar and Turk 1982, Ortíz and Ortíz 1980).

Saturated paste and extract pH data indicated that all samples were composed of alkaline soils (pH higher than 9). Organic matter concentration showed the widest variation both horizontally and in depth, diminishing drastically at lower depths (34.3% at 0–20 cm, 7.27% at 20–40 cm and 0.35% at 40 cm). As organic matter decreases with depth, so does fertility, if we consider the quantities of nitrogen, phosphorus and potassium that show a decrease in the vertical gradient. Salinity is a parameter that can be appreciated with the decreasing concentrations of soluble cations at the lowest levels of depth; this is shown by the calcium, magnesium, sodium and conductivity data of Table 2.

Fertility in soils depends on adequate concentrations of nitrogen (N), phosphorus (P) and potassium (K). If we analyze the data in Table 3, we can see that N and P are approximately of the same values for presence and population density of both species.

Table 2. Averages, standard deviations and variation coefficients of the soil variables used when considering the 10 sampled plots in Uaymitún.

Variable	1st Level (0 cm)			2nd Level (20 cm)			3rd Level (40 cm)		
	X	σ	CV	X	σ	CV	X	σ	CV
Sand	87.80	4.35	0.05	91.53	1.65	0.02	91.14	2.94	0.03
Loam	5.35	3.24	0.61	2.59	0.99	0.38	2.81	1.80	0.64
Clay	6.41	1.14	0.18	6.08	1.26	0.21	6.07	1.33	0.22
pH water	9.34	0.12	0.01	9.51	0.29	0.03	9.77	0.23	0.02
pH extract	9.78	0.11	0.01	9.81	0.09	0.01	9.72	0.17	0.02
Conductivity paste	0.91	0.33	0.36	0.52	0.24	0.47	0.35	0.06	0.16
Conductivity extract	1.97	1.44	0.73	1.23	0.64	0.52	0.83	0.20	0.24
Organic matter	34.30	22.02	0.64	7.27	5.40	0.74	0.35	0.06	0.16
Phosphorus (available)	10.00	5.48	0.54	3.53	2.32	0.66	2.87	1.47	0.51
Cationic exc. capac.	21.58	15.64	0.72	9.23	4.07	0.44	7.68	1.73	0.23
Calcium	21.87	13.74	0.63	7.71	2.69	0.35	5.97	1.05	0.18
Magnesium	8.33	7.02	0.84	2.46	1.52	0.62	3.86	3.26	0.84
Sodium	2.57	1.26	0.49	1.32	0.75	0.57	1.36	0.49	0.36
Potasium	0.17	0.13	0.79	0.11	0.09	0.85	0.08	0.06	0.68
Nitrogen	0.40	0.34	0.87	0.15	0.10	0.69	0.11	0.10	0.87

From the multiple regression analysis we correlated the spatial, physical, and chemical properties of the sampled soils along the transect, arranged the variables hierarchically, and gave some explanation for the individual density found in both species in the selected site. Higher positive coefficient values indicate a higher importance of the corresponding soil factor correlated with presence and abundance of either palm species; lower positive or negative values suggest variables of less importance for the establishment of the *C. readii* and *T. radiata* populations. Table 3 shows

Table 3. Obtained multiple regression analysis coefficients from presence-abundance C. readii *and* T. radiata *respectively.*

No.	Variable	Coeff Value with Respect to *C. readii*	Coeff Value with Respect to *T. radiata*
Constant		−12,196.70	−1,618.59
X1	Depth	−0.60	0.19
X2	Sand	117.23	18.18
X3	Loam	104.06	19.38
X4	Clay	149.68	17.81
X5	pH in water	18.36	−12.52
X6	pH in extract	43.07	−13.52
X7	Conductivity paste	−124.19	6.84
X8	Conductivity extract	35.17	2.25
X9	Organic matter	0.06	−0.91
X10	Available phosphorus	2.34	0.46
X11	Cationic exchange capacity	−0.52	−1.28
X12	Calcium	−0.40	2.25
X13	Magnesium	0.71	0.56
X14	Sodium	20.59	−4.56
X15	Potassium	−157.72	90.15
X16	Nitrogen	58.47	15.04

the coefficient values of the independent variables X1, X2, X3, . . . , Xn obtained from the multiple regression analysis made with both matrices (first from *C. readii* and then from *T. radiata*) which form the two equations. In the case of *C. readii*, the highest coefficient value is the clay percentage (149.678), while in the case of *Thrinax radiata* it is potassium (90.1533). These results suggest that there is some restriction with regard to presence and growth of individuals of this species at the microhabitat level, maybe influenced by the cation concentrations. However, in one species (*T. radiata*), potassium is the most important parameter according to the coefficient value obtained. Its concentration aids the growth of individuals of this species. In the multiple regression analysis, we did not obtain high values for organic matter. We suppose that because the data are very heterogeneous in the 30 samples, this is a parameter with one of the highest standard deviation values (0.64). Assuming all these aspects, we suppose that one species is more restricted to the environment (*Thrinax radiata*); it is well established in the community only when microenvironmental conditions favor organic matter formation.

Although the soils influenced by the mangroves offer more organic matter, they also present drainage and aeration problems because of the amounts of clay and loam. We considered mangrove influenced soils and sand dune oligotrophic soils restrictive, the first for *C. readii* and the second for *T. radiata*; thus in the latter *C. readii* has a limited distribution while *T. radiata* adapts better since its roots, hypothetically, can support more anaerobic conditions. The distribution of these two species in the semievergreen forests follows the same pattern (Olmsted, pers. comm.).

Conclusions

Considering the results, we concluded the following:

1. *Coccothrinax readii* and *Thrinax radiata* in the sand dune scrub share the same plant community, even though both species grow in different microenvironmental conditions which are influenced by physicochemical parameters such as some cation concentrations.

2. *Coccothrinax readii* is able to grow in more oligotrophic conditions while *Thrinax radiata* develops in soils with considerable organic matter accumulation. The latter species contributes to soil fertility, liberating high quantities of dead leaves during its life cycle.

3. In this study potassium turned out to be the cation which has the main influence on the pattern distribution of *C. readii* and *T. radiata*.

Acknowledgments

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Trachycarpus fortunei and its Uses in Northwestern Yunnan, China

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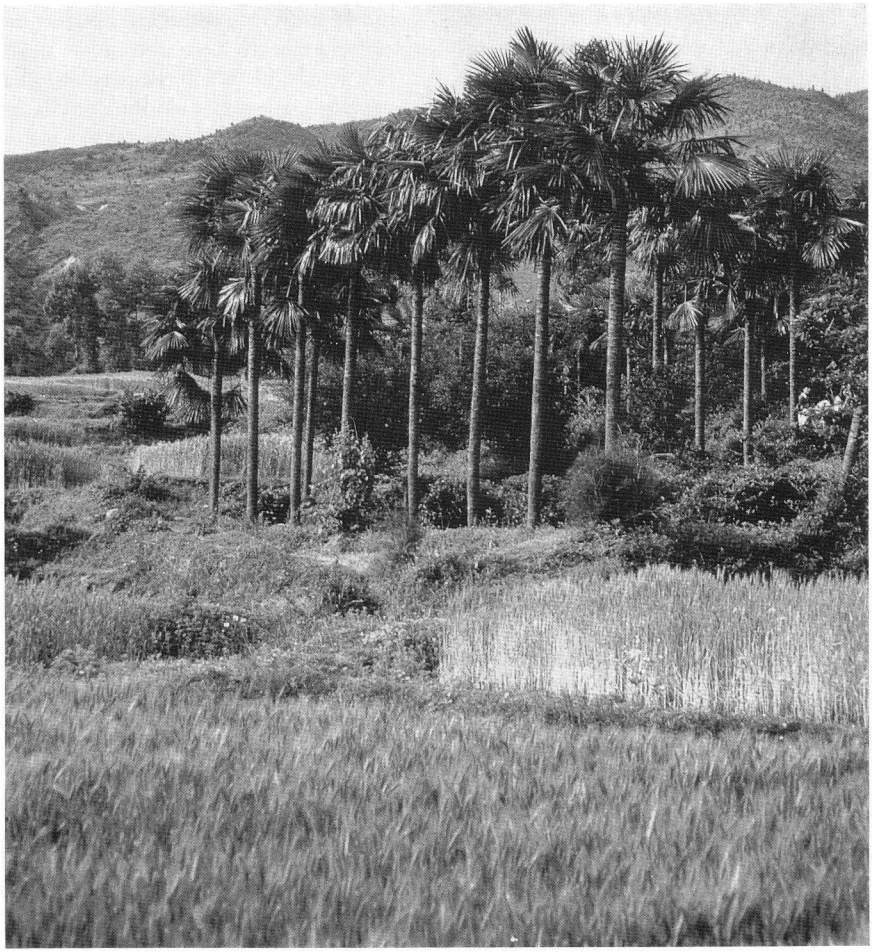
The most ubiquitous palm in western China is the Chusan palm, *Trachycarpus fortunei*. In northwestern Yunnan it is widely planted, not so much for its orna-



1. A stand of *Trachycarpus fortunei* growing with potatoes and tea, on the slopes of Tsang Shan between Xiaguan and Dali, northwestern Yunnan. Photo Phillip Cribb, May 1987.

2. Cloaks made from *Trachycarpus fortunei* leaf bases on sale in the street market, Dali, northwestern Yunnan. Photo Phillip Cribb, June 1992. 3. Brushes made from the leaf bases of *Trachycarpus fortunei*, on sale in the street market of Dali in northwestern Yunnan. Photo Phillip Cribb, June 1992.

mental qualities for which it is valued in southern Britain but for its more mundane uses.

I first became aware of these on a visit to Dali in northwestern Yunnan in 1987. The Tsang Shan range, which rises to over 4,000 m behind the city of Dali, was one of the richest collecting localities of such famous plant hunters as Pere Delavay, George Forrest, and Frank Kingdon-Ward. It remains a mecca for botanists and I was paying homage by climbing up to the forest that remains on the upper flanks of the range. En route I met an elderly Bai man who spoke a few words of English that he had learned as a boy in pre-Communist days at the mission school in Dali. I was intrigued by his cape, which appeared to be made of rough animal skins. However, on closer inspection it proved to be made of vegetable fiber and, by a mixture of sign language and his few words of English, he explained that it was made of the fibrous leaf bases of the Chusan palm. Indeed, the palm was growing near by at the edges of a field at about 2,000 m altitude with the strange interplanting of tea and potatoes.

On subsequent visits to northwestern Yunnan in 1990 and 1992, I have noticed that Chusan palm cloaks and also fine brooms are sold in street markets in Dali and neighboring towns, the cloaks currently fetching the princely sum of 5 yuan. The cloaks are quite waterproof and padded so that heavy loads can be carried more easily. They are still widely worn by the local Bai and Lissu people, but such is the pace of change in China and particularly in Yunnan that I doubt if these utilitarian cloaks will be made for much longer. Plastic mackintoshes and umbrellas seem to be rapidly replacing the cloaks.

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Studies on the Practicality of ex situ Preservation of Palm Seeds

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Palms are among the most economically important plant families throughout their extensive distribution in the tropics and subtropics. There are hundreds of palm species of economic utility, including the familiar examples such as coconut and African oil palm, that are currently so important in international commerce (Balick and Beck 1990).

Many of these species are little known outside their natural distributions but account for a substantial economic trade. For example, in 1979 Brazil reported over $100,000,000 of commerce derived from the harvest and sale of oil, wax, beverages, foods, fibers, charcoal, and other commodities derived from six genera of native palms: *Astrocaryum*, *Attalea*, *Copernicia*, *Euterpe*, *Mauritia*, and *Orbignya* (Balick 1985). Not included in this economic survey was the impact of palm products at the subsistence level, for example, the use of palm leaves as thatch for homebuilding. If a subsistence farmer is unable to find an appropriate thatch for his house, zinc or other similar roofing must be purchased at a substantially greater cost. Although current studies attempting to place values on these substitute products are under way in the Neotropics, there is little doubt that the total value of palm products for subsistence activities far exceeds the value of the commodities that enter the economic system. Thus, intense pressure on native palm resources, as well as habitat destruction, is resulting in a massive reduction in the genetic diversity of this plant family.

The storage of seeds at low (air dry) moisture content and at low (sub-zero) temperatures offers a convenient and cost-effective means of conserving plant genetic resources in the medium and long term. It is the basis for the operation of a number of seed banks worldwide, in which useful seed storage lives are expected to be on the order of at least many tens and probably many hundreds of years (Roberts 1989). Success of this technology depends upon the ability of seeds to withstand drying to quite low moisture contents (<10% on a fresh weight basis). Low seed moisture content not only removes the possibility of damage due to freezing injury in subsequent deep-freeze (−20° C) or cryogenic (e.g., liquid nitrogen, −196° C) storage, but also itself promotes, along with reduced temperature, increased longevity in orthodox seeds (Roberts 1973).

The conservation and effective utilization of palm germplasm is beset by the same problems facing other tropical families. *In vivo* collections, both in the wild and in repositories, are subject to diseases, bud mutations, human encroachment, and poor management, as well as being expensive in terms of management inputs and space. The application of *in vitro* methods of *ex situ* conservation has several associated technical problems, including the

relatively frequent need for subculture and the fact that a single protocol is unlikely to be useful for diverse genotypes (Towill and Roos 1989).

In many areas of the Neotropics, entire palm populations have been destroyed; significant threats exist at the species level (e.g., *Attalea crassispatha*, see Henderson and Aubry 1989). If these palm resources are to be preserved for utilization and enjoyment by future generations, an increased level of action is needed in the conservation arena. For example, Brazil has a program to preserve the germplasm of economically important native palms, both *in situ* and *ex situ* (Coradin and Lleras 1988). This paper explores the possibility of *ex situ* conservation of members of the palm family in seed banks.

One group of plants, including several important tropical plantation species, bears seeds classified as recalcitrant (Roberts 1973). The main characteristic of such seeds is their inability to withstand any degree of desiccation and so they cannot be kept at sub-zero temperatures. Their lifespans are relatively short and cannot be extended by the methods presently employed to preserve germplasm in seed-banks or cryogenic stores.

Many palm species are propagated primarily by seed (Broschat and Donselman 1988) and, although Corner (1966, p. 183) maintains that palm seeds in general cannot withstand any degree of drying, the seeds of several species (e.g., date palm) are amenable to storage at freezing temperatures in the air-dry state (Al-Madeni and Tisserat 1986). However, there are also examples, such as coconut, of recalcitrant seed behavior among the Palmae (Chin and Roberts 1980), as well as at least one instance of apparently recalcitrant seeds (oil palm) being subsequently shown to be desiccation tolerant under certain conditions (Grout et al. 1983, Ellis et al. 1991). This paper reports on a study aimed at classifying seed storage behavior in a wide range of palm species, mostly having little or no previous work reported on them, with the aim of obtaining a reliable estimate of the proportion having seeds amenable to seed-banking or cryogenic storage.

Materials and Methods

Seeds of fourteen palm species were collected from sites in the United States, Central and South America, and Southeast Asia and sent to Wakehurst Place for investigation. The opportunistic nature of the collections meant that samples were often low in numbers of seeds, and the great distance they were transported meant that sometimes seeds were in poor condition on arrival at Wakehurst Place. Thus, the difficulties (including sporadic fruiting, obtaining export permits, and the time taken to transport seeds to the laboratory) inherent in working with tropical tree species precluded a rigorous experimental and quantitative analysis of all the palm seed samples received.

On arrival, fruits and seeds were stored moist in ventilated polythene bags at 16° C for up to one week before experimental treatments were begun. Where necessary, fleshy pericarps were removed by washing in tapwater. In *Orbignya cohune* the substantial, hard endocarps were removed by progressive and careful application of pressure in a large engineer's vice, with further pressure splitting the seed to permit removal of the embryonic axis.

In the control lots, seeds or embryos were set to germinate without any drying, i.e., at the relatively high moisture contents at which they arrived. Seeds or embryos were dried to low moisture content in a room at 15% relative humidity and 15° C in monolayers for periods up to four weeks. Throughout this paper, moisture contents are quoted on a percentage fresh weight basis. Measurements were made gravimetrically by weighing samples

(whole seeds were quartered) before and after drying at 103 ± 2° C for about 17 hours. Equilibrium relative humidities were measured using a Michel S-4020 dewpoint hygrometer.

Germination tests consisted of incubating seeds (and embryos in the case of *O. cohune*) on 1% (w/v) distilled water agar in either 9 cm polystyrene petri dishes or polystyrene sandwich boxes, in incubators maintained at 26° C, or fluctuating diurnally (33/19° C) with a 12-hour thermoperiod, illumination on a 12-hour photoperiod being provided by "warm-white" (Sylvania) fluorescent tubes. Incubation was continued until it was obvious that no further germination would or could occur. Palm seed germination is often quite protracted (Loomis 1958, Ellis et al. 1985) and in this work incubation periods varied from five weeks (*Washingtonia filifera*) to more than one year (*Acoelorraphe wrightii*). The tests were monitored at regular intervals, and germinated seeds (embryo extension >2 mm) were counted and removed. Whenever incipient drying out made it necessary, seeds were re-sown on fresh substrate.

In vitro techniques were also applied to embryos or seeds of *Orbignya cohune*, *Daemonorops verticillaris*, and two *Pinanga* species. After extraction from fruits, seeds were disinfected for 2 minutes in 70% ethanol, followed by 50% bleach for 20 minutes. They were then rinsed five times in sterile distilled water. Embryos were excised under aseptic conditions and individually cultured on 1 ml of MS (Murashige and Skoog 1962) medium containing 0.6% agar and 0.25% activated charcoal, in glass tubes sealed with polypropylene covers secured by rubber bands. For disinfection of excised embryos of *O. cohune*, a weaker (10–20%) solution of bleach was used. Cultures were incubated at 26° C in darkness. After 40 days, germinating seeds or embryos were transferred to fresh medium and incubated at 29° C with a 12-hour photoperiod.

For topographical tetrazolium staining of excised *Orbignya cohune* embryos, they were imbibed on paper towel wetted with distilled water for 24 hours at laboratory temperature (20–22° C), and then incubated in buffered 1% solution of 2,3,5-triphenyl tetrazolium chloride (Moore 1973) for 24 hours at 31° C in darkness. Embryos were scored as viable when they showed an overall even carmine red staining.

Results

Table 1 provides the results of the desiccation experiments. A full discussion of the results for eleven of the fourteen species examined here is presented in Dickie, Balick, and Linington (1992). Results for *Geonoma deversa*, *Jessenia bataua* and *Salacca zalacca* are added.

One species, *Acoelorraphe wrightii*, gave uncertain results. Germination of fresh seeds, as well as of seeds dried to <5% moisture content for 28 days, was erratic over a 15-month period. The viability of fresh seeds was 79% versus 17% viability for dried seeds. The greatly reduced rate of viability in the preserved seeds needs further quantification and study. However, it is felt that seed banking and cryopreservation will pose problems because of the above mentioned losses due to the drying process prior to freezing.

Discussion

Of the fourteen species of the Palmae examined so far in this investigation, the seeds of only two (*Sabal mexicana* and *Washingtonia filifera*) appear to be immediately amenable to seed bank storage or cryopreservation as means of *ex situ* conservation of genetic resources. This finding supports the commonly held view (J. Dransfield, pers. comm.) that considerable difficulties would be involved in attempts to conserve most palms *ex situ* as seeds. However, it is in contrast to data extracted from a recent literature search by Hong (1991), in which, of 21 palm species

Table 1. Palm species examined and their suitability for ex situ *cryopreservation.*

Species	Source of Sample	Tolerance to Desiccation
Acoelorraphe wrightii (Griseb. & H. Wendl.) H. Wendl. ex Becc.	Hattieville, Belize District, Belize	somewhat
Attalea crassispatha (Mart.) Burret	Haiti	no
Daemonorops verticillaris (Griff.) Mart.	Kepong, Selangor, W. Malaysia	no
Desmoncus orthacanthos Mart.	Cayo District, Belize	no
Geonoma deversa (Poit.) Kunth	Madre de Dios, Peru	no
Jessenia bataua (Mart.) Burret	Madre de Dios, Peru	no
Orbignya cohune (Mart.) Dahlgren ex Standley	Cayo District, Belize	no
Pinanga malaiana (Mart.) Scheff.	Pahang, West Malaysia	no
Pinanga aff. *polymorpha* Becc.	Pahang, West Malaysia	no
Sabal mexicana Mart. Becc.	San Antonio, Texas, USA	yes
Salacca zalacca (Gaertn.) Voss ex Vilmorin	Village market, Malaysia	no
Schippia concolor Burret	Cayo District, Belize	no
Washingtonia filifera (L. Linden) H. Wendl.	San Antonio, Texas, USA	yes
Zombia antillarum (Desc.) L. H. Bailey	Fairchild Tropical Garden, Florida, USA	no

referred to, sixteen were reported as having orthodox seeds.

Extrapolating, it could be estimated that only about 24% of palm species would bear seeds difficult to store (cf. 86% from the present study), but the work reported in the literature appears biased towards species from dry habitats (e.g., *Sabal* spp. and *Phoenix* spp.). Indeed, the results of the present study suggest that it is only those species regarded as belonging to dry habitats (*Sabal mexicana* and *Washingtonia filifera*) that bear truly orthodox seeds, easy to store at low temperatures in the air-dry state. In contrast, the remaining species examined here are characteristic of comparatively moist habitats, and it appears that the seeds of none of them would be easy to preserve at low temperatures, largely because of their inability to withstand desiccation. Of the difficult seeds, some would be truly recalcitrant, while others may belong to an intermediate category in which a certain level of desiccation is tolerated but below which loss of viability occurs. Ellis et al. (1991) have demonstrated this type of behavior in seeds of at least one palm (*Elaeis guineensis*). The work presented here has not allowed clear differentiation between recalcitrant and intermediate seed storage behavior in the species examined, although the evidence available might point to the seeds of *A. wrightii* being intermediate and those of *O. cohune* being recalcitrant (Dickie et al. 1992).

The information on seed storage behavior generated in the present study, together with that compiled by Hong (1991), represents only 31 of a total of over 2,600 palm species. As well as being very small, the sample underrepresents species from moist habitats, which probably make up the great majority of palm species. Clearly, more work is needed to establish an adequate and unbiased database of palm seed storage characteristics, which could be used to assess the utility of *ex situ* storage in individual palm species conservation programs. In the meantime, it may be possible to suggest a rule of thumb whereby those species of definitely dry habitats are highly likely to bear seeds that are amenable to dry, cold storage, whereas those from relatively moist habitats are likely to be difficult or impossible to store. Even the latter group will contain species with intermediate seed storage behavior (Ellis et al.

1991), which will allow medium-term preservation of viability in optimum environments. Also, the work of Chin et al. (1988) raises the possibility that, for species whose seeds are difficult to store, there are nevertheless *ex situ* conservation possibilities in the cryopreservation and *in vitro* culture of their excised embryos.

Acknowledgments

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PALM LITERATURE

THE SUBSIDY FROM NATURE: PALM FORESTS, PEASANTRY, AND DEVELOPMENT ON AN AMAZON FRONTIER. Anthony B. Anderson, Peter L. May, and Michael J. Balick. xxv. 233 pp. illus. Columbia University Press, New York. 1991. ISBN 0-231-07222-8. $35.00.

This timely and important book is an outgrowth of the authors' long-term collaborative study of the babassu and their concerns for the future well-being of the people whose lives are so intricately intertwined with this remarkable palm. The name babassu (in Portuguese babaçu, which was derived from the indigenous Tupi-Guarani linguistic stock, ba = fruit and açu = large) refers to two species, *Orbignya phalerata* and *O. oleifera*, and their related hybrids. The first named species, the most widespread of the two and the principal focus of the book, ranges from Amazonian Brazil to Bolivia, with disjunct populations in the Guianas; while the latter is of a restricted range centered in the Brazilian state of Minas Gerais.

A source of oil-rich seeds and a myriad of other products, the babassu provides economic sustenance, or, as the authors prefer, a subsidy from nature, to a large proportion of the peasantry of rural Amazonian Brazil. In many ways the relationship between these people and the babassu is a metaphor for the larger problems that face humankind—poverty, environmental degradation, population pressures, and disparate ownership of and access to resources, among others. But the metaphor is also one of hope, one that suggests with awareness and responsiveness to human and environmental needs that the human condition can improve. The authors build on this hope in presenting a far-ranging discourse on the role of the babassu in nature and as a model for development and management of plant resources, especially those of secondary forests.

The book is introduced with a preface by Malcolm Gillis, followed by an introductory chapter describing the state and management of tropical forests, with particular attention given to secondary and palm forests, extractive reserves, and, not unexpectedly, the babassu. The second chapter provides a grounding in the natural and human ecology of the Brazilian state of Maranhão, the region that provided the primary babassu study sites and data sets, and a discussion of the palm's economics. The third and longest chapter in the book is concerned with the natural history of the babassu; while the fourth and fifth deal with its place in household and market economies, respectively. The sixth chapter turns to the prospects for the future economic and social development of peasantry in a babassu environment. The book concludes with a "postscript" chapter, appendices, notes, references, and index. Throughout, black and white photographs and accompanying graphs, diagrams, and tables enhance the text.

Palm enthusiasts may well be drawn to the natural history of the palm, for here one finds a rich description of the babassu. There are the expected discussions about systematics and ecology, but more awaits the reader. Discourses on hybridization; floral biology, including the complexities of sexual expression and pollination systems; seed biology with attention given to dispersal, predation, and germination; and growth and productivity are presented in detail. These set the stage for a fascinating discussion of the babassu's largely successful adaptation to human landscape, but with caveats for the future as the greater management of pasture lands and increased human activity are likely to influence the

palm negatively. Least satisfactory from a biological and potential breeding viewpoint is the material dealing with hybridization, for we are not told if the hybrids formed between *O. phalerata* and *Maximiliana maripa* (× *Markleya dahlgreniana*), between *O. phalerata* and *O. eichleri* (*O.* × *teixeirana*) or *O. oleifera* and *Attalea compta* (× *Attabignya minarum*) are known only as first generation hybrids (F_1's) or if they yield segregates and back cross types. Such knowledge is crucial in evaluating systematic relationships and has practical implications for future improvement of the babassu as a crop.

The babassu is best known as a source of vegetable oil and this aspect of the palm, including the difficulties of cracking the stony endocarp and extracting the seeds tends to dominate any discussion of babassu economics. But here the economic concerns are not so constrained, and a wealth of information concerning the broad uses of the babassu is integrated into a rich and enlightening discussion of peasant and rural life, first in relation to household economies, then as part of the market driven economy. All of this, coupled with knowledge of the babassu's biology, lead the authors into the future. They evaluate the potential of the babassu both as a domesticated crop and as a crop that continues to be harvested from spontaneous or genetically enhanced stands that are encompassed within the broader scope of the managed landscape. Throughout they remain mindful of the impact that management alternatives and external factors, such as governmental policies, have on peasants and, indeed, on their very existence.

One might read this book dispassionately, viewing it as a source of information about the babassu and as an exposition on the problems of rural life in the developing regions of the world. The authors, however, invite a much stronger reaction. By this I don't mean some of the lesser annoyances of the book. For example, the incongruity of distribution maps appearing on pages 9 and 39 (Figs. 1.2 and 3.1), or the authors' propensity to tell the reader, over and over again, what was said earlier and what will be said later in the book. On the contrary, I am more concerned with fundamental questions concerning the future of humankind and strategies for resource management. I blanch when the authors (page 2) seemingly dismiss the connection between population growth and poverty, or (also on page 2) imply that Brazilian food production could equal that of the United States, if only land and resources were distributed equably. I am not convinced that management of babassu stands is equivalent to the management of secondary forests, in that babassu stands exhibit many characteristics of agricultural monocultures (or their associated weeds?). Although the authors recognize that the future of babassu is problematic given the ever changing selection parameters of national and international politics and economics, they are hopeful that babassu will remain a significant element in the peasant economy. Yet, is the perpetuation of peasantry in a relatively stable but marginal economic state a valid goal, or should the goal be genuine social and economic advancement? Given the current state of the world, perhaps only the former is realistic, even if we could agree on what constitutes basic social and economic justice.

The foregoing comments are offered less as criticism than as an indication of the different interpretations that may be given to the same or similar situations by those who share the authors' passionate concern for the future of humankind. This is one of the great strengths of the book. It describes the ferment and reality of much of the developing world and in thoughtfully considering alternative development pathways, invites each of us to evaluate our individual prescriptions for the betterment of the world and its inhabitants. Knowledge of the babassu and other palms important to rural peoples, such as the lontar (*Boras-*

sus flabellifer) on the Indonesian islands of Roti and Savu, not only gives understanding of the dimensions of the problems facing developing tropical regions but also an appreciation of the potential role of palms in finding solutions.

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PALM RESEARCH, 1992

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Please bring to our attention any item that should be included here. In general, we are excluding research on the agronomy of important cultivated species (oil palms, date palms, rattans and coconuts).

New Books

A Guide to The Cultivation of Rattan. Edited by Wan Razali Wan Mohd, J. Dransfield and N. Manokaran. Malayan Forest Records No. 35. Forest Research Institute Malaysia. ISBN 983-9595-10-6. 1992. 293 pp. Price unknown.

A detailed account of the botany, biology, cultivation and economics of rattan.

Bamboo and Rattan: Traditional Uses and Beliefs. By J. M. Piper. Oxford University Press. ISBN 0-19-588998-3. 1992. 88 pp. Price unknown.

An attractive small hard-cover book, well illustrated in half-tone and color.

Betrock's Guide to Landscape Palms. By Alan Meerow. Betrock Information Systems, Inc., Florida. 1992. ISBN 0-9629761-1-3. 153 pp. $30.00.

An excellent guide to the commonly cultivated landscape palms in subtropical areas of the United States.

Chamaedorea Palms. The Species and Their Cultivation. By Donald Hodel. The International Palm Society. ISBN 0-935868-56-9. 1992. 338 pp. $59.95.

A wonderful horticultural-taxonomic revision of *Chamaedorea*, with many color plates. A review will appear elsewhere in *Principes*.

Flora Reipublicae Popularis Sinicae. Tomus 13(1). Angiospermae: Monocotyleonae: Palmae. By S.-J. Pei, S.-Y Chen and S.-Q. Tong. Beijing Science Press. 1991. vii, 172 pp.

A floristic account of all the palms of China (in Chinese)—important and long-awaited.

100 macam palem di Indonesia. By M. B. H. Visser. Privately published, Malang, Indonesia. 1991. 57 pp. Price unknown.

An account (in Indonesian) of 100 different native and cultivated palms in Indonesia, complete with a key.

Palmeras. By J. A. del Cañizo. Ediciones Mundi Prensa, Madrid. 301 pp. Price unknown.

Palmiers pour les climats temperès. By A. Moiniè. Marly-le-Roi, Editions Champflour. 1992. 160 pp. $45.00.

A most attractive account of subtropical palms (in French).

Palms for Human Needs in Asia. Edited by Dennis Johnson. A. A. Balkema, Rotterdam. ISBN 90-6191-181-8. 1991. 258 pp. $43.35.

Eleven chapters by various authors on palm utilization and conservation in India, Indonesia, Malaysia and the Philippines.

Palms in Forest Ecosystems of Amazonia. By Francis Kahn and Jean-Jacques de Granville. Springer Verlag, New York. ISBN 0-387-54399-6. 1992. 226 pp. $139.00.

A very nice compendium of the authors' work on the ecology of Amazon palms. The price is ridiculous, and will effectively prevent most interested parties from owning the book.

Rattan (Canes) in India, a Monographic Revision. By S. K. Basu. Rattan Information Centre, Kepong, Malaysia. ISBN 983-9592-11-4. 1992. 141 pp. Price unknown.

A most useful account of the rattans of India.

Rattans of Bangladesh. By M. K. Alam. Bull. Forest Research Inst. Chittagong, Pl. Taxon. Ser. No. 7. 1990. 34 pp. Price unknown.

A small booklet describing the rattans of Bangladesh.

Rattans of the Western Ghats: A Taxonomic Manual. By C. Renuka. Kerala Forest Research Institute, India. 61 pp. Price unknown.

A taxonomic account with a useful general introduction.

The Rattans of Sarawak. By John Dransfield. Royal Botanic Gardens, Kew. ISBN 0-947643-41-9. 1992. 233 pp. Price £12.00.

An illustrated guide for foresters, botanists, and ecologists to the taxonomy of the rattans of Sarawak.

Zur Stammanatomie der Rattanpalmen. By G. Weiner. University of Hamburg. 1992. By G. Weiner. Price unknown.

A doctoral dissertation, published in the form of a small book.

General Interest Articles in 1992

ATAROFF, M. AND T. SCHWARZKOPF. 1992. Leaf production, reproductive patterns, field germination and seedling survival in *Chamaedorea bartlingiana*, a dioecious understory palm. Oecologia 92: 250–256.

AMBWANI, K. AND M. KUMAR. 1991. Occurrence of viscin threads in *Daemonorops ruber* Bl. (Palmae). Phytomorph. 41(1–2): 95–97.

BASU, S. K. 1989. *Calamus pseudofeanus* S. K. Basu: a new rattan species from South India. J. Econ. Taxon. Bot. 13(1): 133–136.

BORGTOFT PEDERSEN, H. 1992. Use and management of *Aphandra natalia* (Palmae) in Ecuador. Bull. Inst. Français d'Etudes Andines 21: 741–753.

BOSWORTH, B. AND J. BIRCH. 1992. Palms, cycads and geology: a tour of the western Gulf area of Queensland and into the Northern Territory. Palms & Cycads 35: 2–11.

CABRERA, R., C. PRENDES AND C. D. LORENZO. 1991. Contribucion al estudio de la Anatomia-Histologia de la palmera canaria (*Phoenix canariensis* Chab.) 2. El estipite y la hoja. Vieraea 20: 113–122.

CALLOT, G., A. CHAUVEL, J. ARVIEU, H. CHAMAYOU, A. GUYON AND L. ROGER. 1992. Mise en évidence de kaoliite et de silice dans les structures cellulaires de l'épiderme et du cortex de racines de palmier en forêt d'Amazonie. Bull. Soc. Bot. Fr.-Actual Bo. 139: 7–14.

CHAZDON, R. 1992. Patterns of growth and reproduction of *Geonoma congesta*, a clustered understory palm. Biotropica 24: 43–51.

COUTURIER, G. AND F. KAHN. 1992. Notes on the insect fauna on two species of *Astrocaryum* (Palmae, Cocoeae, Bactridinae) in the Peruvian Amazon, with emphasis on potential pests of

cultivated palms. Bull. Inst. Français d'Etudes Andines 21: 715–725.

DE GRANVILLE, J.-J. 1992. Life forms and growth strategies of Guianan palms as related to their ecology. Bull. Inst. Français d'Etudes Andines 21: 533–548.

DELASCIO-CHITTY, F. 1992. Las palmas del Rio Carapo, estado Bolivar, Venezuela. Acta Bot. Venez. 16(1): 59–62.

DICKEY, J., M. BALICK AND I. LININGTON. 1992. Experimental investigations into the feasibility of *ex situ* preservation of palm seeds; an alternative strategy for biological conservation of this economically important plant family. Biodiversity and Conservation 1: 112–119.

DRANSFIELD, J. 1992. Observations on rheophytic palms in Borneo. Bull. Inst. Français d'Etudes Andines 21: 415–432.

DURÁN, R. AND M. FRANCO. 1992. Estudio demográfico de *Pseudophoenix sargentii*. Bull. Inst. Français d'Etudes Andines 21: 609–621.

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ENRIGHT, N. AND A. WATSON. 1992. Population dynamics of the Nikau Palm, *Rhopalostylis sapida* (Wendl. et Drude), in a temperate forest remnant near Auckland, New Zealand. New Zealand J. Bot. 30: 29–43.

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HOLBROOK, N. AND T. SINCLAIR. 1992. Water balance in the arborescent palm, *Sabal palmetto*. 2. Transpiration and stem water storage. Plant Cell Environ. 15: 401–409.

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KINNAIRD, M. 1992. Competition for a forest palm-use of *Phoenix reclinata* by human and non-human primates. Conservation Biology 6: 101–107.

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Taxonomic Research

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KAHN, F. AND B. MILLÁN. 1992. *Astrocaryum* (Palmae) in Amazonia. A preliminary survey. Bull. Inst. Français d'Etudes Andines 21: 459–532.

KRAMADIBRATA, P. AND J. DRANSFIELD. 1992. *Calamus inops* (Palmae: Calamoidea) and its relatives. Kew Bull. 47: 581–593.

Current Research

Dr. Scott Zona, University of Florida, is preparing a revision of *Roystonea*. His work is funded by a grant from the National Geographic Society.

Jens Christian Svenning and Henrik Balslev, Department of Systematic Botany, Aarhus University, have started a study of the demography of *Iriartea deltoidea* in Amazonian Ecuador.

Aino Askgård, Anders Barfod, Department of Systematic Botany, Aarhus University, and Don Hodel, University of California, are carrying out comparative studies of floral morphology in *Chamaedorea*.

Tage Burholt and Anders Barfod, Department of Systematic Botany, Aarhus University, are studying pollination of *Licuala spinosa* in contrasting habitats.

Andrew Henderson, New York Botanical Garden, and Professor Gloria Galeano, Herbario Nacional, Bogotá, have recently completed a revision of *Euterpe* and *Prestoea*, funded by the National Science Foundation. Henderson has begun a revision of *Bactris*, funded by a grant from the National Science Foundation. Both works will be published in *Flora Neotropica*.

Mónica Moraes, Herbario Nacional de Bolivia, and Andrew Henderson received a grant in 1992 from the United States Agency for International Development to study sustainable use, diversity, conservation status and economic potential of Bolivian palms.

MID-TERM IPS BOARD AND COMMITTEE MEETINGS

French Quarter, New Orleans—October 1993

The Mid-Term meetings of the IPS Board of Directors will be held on Friday, October 8th, and Saturday, October 9th, at the Royal Sonesta Hotel (lovely southern elegance) on Bourbon Street in the French Quarter. Individual Committee meetings will be held on Friday afternoon and the full Board of Directors meeting (with reports from committee

meetings) on Saturday. Our Louisiana and Gulf Coast Chapters are planning an exciting 4–5 day schedule! More details will be provided at a later date, but it is important to arrange hotel bookings now. A tentative schedule follows.

THURSDAY Oct. 7th—afternoon private garden tour with catered meal.

FRIDAY Oct. 8th—morning tour of a portion of Jean Lafitte National Historic Park and Preserve south of New Orleans to see flora and fauna of the area swamps! Transportation will be provided. Afternoon IPS Committee meetings followed by dinner/fais-do-do dancing at Mulatte's, a popular "authentic" Cajun place.

SATURDAY Oct. 9th—Director's meeting at the Royal Sonesta with continental breakfast and lunch for directors included. A list of suggested restaurants for dinner will be provided.

SUNDAY Oct. 10th—select from French Quarter activities, or take an optional day tour to Maxwell Stewart's 10-acre palm garden and estate in Mobile, Alabama, with lunch stop in Biloxi. Mobile is about a three-hour drive from New Orleans. You may return to New Orleans that evening with the group or elect to fly home from Mobile. Route to Mobile will be along the colorful Gulf Coast highway, offering a nice introduction to this area for those not familiar. Transportation will be provided for those needing it.

MONDAY Oct. 11th—possible morning garden tour for those who spend Sunday night in New Orleans. Many things to do in New Orleans—world class aquarium, jungle zoo, riverboat rides, antique/boutique shopping, relaxing at Cafe du Monde with beignets and cafe au lait—and every kind of night life imaginable.

While this is primarily a business meeting of the IPS Board of Directors and standing Committees, all IPS members are welcome to attend and observe. However, it is imperative that a reasonable count be obtained as soon as possible. If you wish to attend this meeting, please make your room reservations directly with the hotel as soon as possible and also advise the IPS Secretary, LYNN MCKAMEY, P.O.B. 287, GREGORY, TX 78359 or FAX (512) 643-3111 so that conference and catering numbers can be preplanned. Be sure and include any guests you may bring in your count.

Only a limited number of rooms have been blocked for the IPS, so it's important to make your reservations as soon as possible. The Royal Sonesta reservations numbers are telephone (504)-5586-0300 or fax (504)-586-0126. Other suggested hotels are the three sister hotels: Place d'Armes, Hotel Conti or Hotel St. Marie (1-800-366-2743 for all three). If you have any questions or need additional information, please contact Lynn McKamey or Jim Cain.

1994 IPS BIENNIAL MEETING TENTATIVELY SCHEDULED FOR CARACAS, VENEZUELA

Plans are coming along nicely for 1994 IPS Biennial Meeting planned for Caracas, Venezuela in northern South America during 1994. The Instituto Botanico (and Botanic Garden) Foundation in Caracas has graciously agreed to assist the IPS in hosting this event and tentative arrangements are being made with hotel(s) and a company to oversee the planned horticultural tours and side trips. A general travel agent has been selected to handle the meeting.

Caracas has numerous fine palm plantings and several native palm habitats (both cloud

forest and tropical coastal) near enough to the city to be included as simple day trips (and thus part of the main meeting timetable). In addition, the plan is to offer a suite of additional in-country excursions as Pre and/or Post-Biennial trips.

The city is in a high valley—high enough to mitigate the tropical temperatures, keeping average maximum daily temperature around 75°F (24°C). This doesn't vary much with the season. Caracas is often quite congested by traffic, *but* our planned Biennial meeting site will be somewhat isolated from the central hustle-bustle. Access to other destinations is easy and inexpensive by readily available taxis. There are many lovely parks (full of palm trees, wild sloths, and numerous birds) within the city. There are also great restaurants serving delicious food at quite reasonable prices, as well as many lovely museums, shops, and historical buildings.

Caracas is a European-style city and the birthplace of Simon Bolivar, father of South American liberty, and originally from Spain. Although Venezuela has been in the news occasionally over the last year, the city did not experience any significant disruption of services and visitors were never endangered.

The final meeting details will be worked out in the near future, but all IPS members are encouraged to start making their plans to attend!

BOOKSTORE

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

BETROCK'S GUIDE TO LANDSCAPE PALMS (A. W. Meerow, 1992, 153 pp. all color) 30.00

BRAZILIAN PALMS, Notes on their uses and Vernacular Names (C. Pinheiro and M. Balick, 1987, 63 pp.) 9.25

CHAMAEDOREA PALMS: THE SPECIES AND THEIR CULTIVATION (D. Hodel, 1992, 350 pp., 550 color photos) 59.95

COCONUT PALM FROND WEAVING (Wm. H. Goodloe, 1972, 132 pp.) 8.95

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

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

DESERT PALM OASIS (J. W. Cornett, 1989, 47 pp., 41 pp. color) 8.95

DISEASES AND DISORDERS OF ORNAMENTAL PALMS (A. R. Chase and T. K. Broschat, 1991, 56 pp., color on each page) 29.00

ECUADORIAN PALMS FOR AGROFORESTRY (H. B. Pedersen and H. Balslev, 1990, 105 pp.) 15.00

EXOTICA (4) (A. Graf, 1982, pictorial encyclopedia, 2 vols., including 250 plant families, 16,600 illust., 405 in color, 2590 pp.) 187.00

FLORA NEOTROPICA INTRODUCTION AND THE IRIARTEINAE (A. Henderson, 1990, 100 pp.) 23.00

FLORA OF TROPICAL EAST AFRICA, PALMAE (J. Dransfield, 1986, 52 pp.) 23.00

FLORE DES MASCAREIGNES (La Reunion, Maurice Rodrigues, 1984, 31 pp.) 8.00

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

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

GENERA PALMARUM (N. W. Uhl and J. Dransfield, 1987, 610 pp.) 79.00

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

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

KEY GUIDE TO AUSTRALIAN PALMS (L. Cronin, 1989, 180 pp., 85 pp. color) 21.00

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

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

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

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

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

PALMIERS, POUR LES CLIMATS TEMPÉRÉS (Alain Moinié, 1991. in French, 157 pp. in French, lots of black & white photos.) 45.00

PALMS AND CYCADS AROUND THE WORLD (J. Krempin, 1990, 267 pp., 267 pp. color) 45.00

PALMS AND CYCADS AROUND THE WORLD (J. Krempin, 1990, 267 pp., 267 pp. color) 45.00

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

PALMS IN AUSTRALIA (David Jones, 1984, 278 pp., over 200 color photographs) 40.00

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

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

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

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

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

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

SECRET OF THE ORIENT DWARF RHAPIS EXCELSA (L. McKamey, 1983, 51 pp.) 5.95

THE MINIATURE PALMS OF JAPAN (Y. Okita and L. Hollenberg, 1981, 40 pp., 40 color photos) 9.95

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

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

THE STRUCTURAL BIOLOGY OF PALMS (P. B. Tomlinson, 1990, 477 pp.) 120.00

TROPICA (A. Graf, 7000 color photos, 1138 pp.) 165.00

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

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

PALM PAPERS (Postage Included)

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

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

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

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

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

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

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

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

* New arrival

The palm books listed above may be ordered at the prices indicated plus $2.50 extra per book to cover packaging and postage. (California residents please add 7.25% sales tax.) Foreign checks must be in U.S. dollars and payable on a USA bank. In some countries it is possible to send International Money Orders through the Post Office. No VISA cards. Please include your International Palm Society membership number. Send check payable to The International Palm Society to Pauleen Sullivan, 3616 Mound Avenue, Ventura, CA 93003, U.S.A. ALL SALES FINAL.

Principes, 37(2), 1993, pp. 108–109

A Visitor's View of the 1992 IPS Biennial

The following is reprinted from the January issue of Principes Minor, the magazine of the Sydney [Australia] Chapter of the International Palm Society. These are the views of Peter Kristensen, who came to the meeting with his wife Lynn, and are endorsed by the editor. A few notes have been added [by Jim Cain, in brackets].

Although ravaged by a hurricane only two months before, Florida still provided an excellent venue for the '92 Biennial. Lynn and I overnighted in Los Angeles and were able to have breakfast with Don Hodel and preview his excellent new book on Chamaedoreas. Don gave us some interesting insights into the research, writing, and production of his book.

That afternoon we flew to Florida, arriving at 8:30 p.m. After collecting our baggage and organizing a hire car, we left the airport at 9:30. It was then that the accommodation shortage in Miami became apparent, as we spent the next four hours looking for a room. The hotels were full of builders, plumbers, insurance assessors, etc., all busy putting Miami and areas south back on its feet again. We eventually found a room in a less than perfect hotel in an area known as "Little Cuba."

After a good night's sleep (any sleep is good) we headed off on a week's trip to see as much of Florida as possible before the Biennial started.

We proceeded north from Miami, taking the scenic coastal highway A1A. As you headed out of Miami, the hurricane damage rapidly diminished and the Royal Palms [*Roystonea* sp.] looked normal again. We took a couple of days, overnighting at some nice little places, to reach the Kennedy Space Center at Cape Canaveral. *Sabal palmetto* is quite abundant up this coastline, also *Serenoa repens*, but in fewer numbers. Passing through such places as Fort Lauderdale and Palm Beach, it's very obvious how much money is in the area as the houses are opulent and the landscaping wonderful.

After Canaveral, we turned west and had a day at Orlando, visiting the Epcot Center, also with some tasteful landscaping. After this, it was Tampa, Fort Myers and Naples on the Gulf Coast.

Fort Myers has more Royals than I have ever seen in one place—reputedly, 17,000 lining the avenues and highways. Naples is probably one of the nicest areas we saw in Florida—green, landscaped and with a nice atmosphere.

A quick 2½ hour drive across Florida on the Everglades Parkway (also known as "Alligator Alley") brought us back to Miami for the Bahamas cruise [an optional side trip of the IPS Beinnial]. We passed literally millions of *Sabal palmetto* and acres of *Serenoa repens* on this drive. It was very interesting to see. For once we were early, and, while waiting at the dock we were approached by a man who noticed the palm tree motif on Lynn's T shirt. This man turned out to be Jim Cain [yours truly], who, we were later to learn, would be the next International Palm Society President. We had lunch at a nearby restaurant with Jim and his wife Elizabeth before departing on the "Brittanis" for Nassau. The cruise was uneventful except for "Manuel," the waiter. I know now who John Cleese based his character on in the show "Fawlty Towers."

"The Retreat," former home of Arthur and Margaret Langlois, and now administered by the Bahamian National Trust, is 11 acres of woodland east of Nassau. Palm Society members were led on a tour of the gardens, which are in the process of being rejuvenated by the Trust. Of spe-

cial note were *Syagrus amara*, *Pelagodoxa henryana*, *Gastrococcos crispa* (the Cuban Belly Palm), *Satakentia liukiuensis*, *Copernicia macroglossa*, *Areca vestiaria* (formerly *A. langloisiana*) and *Phoenicophorium borsigianum*. Back in Miami, we headed for the annual "Palm Sale" [of the South Florida IPS Chapter] at Fairchild. The weekend sales were a record and totalled over U.S.$70,000. Next a quick four hour drive to Key West. Nicknamed Cayo Hueso (Bone Island) by the Spaniards and later anglicized as Key West, it boasts the warmest climate in the continental U.S. It has a Bohemian atmosphere and is full of charm. Just driving to Key West is an adventure as you drive over 65 km of bridges including one 7 miles (11.2 km) long.

Back to Miami for the Welcome Party and the Biennial begins!

The first tour was to the garden of Erik Beers, northwest of Miami [in Broward County] and about 18 miles from the ocean. The 5-acre property has many mature specimens but is limited due to the freezing conditions sometimes encountered there. Erik has some nice *Coccothrinax crinita*, *Dictyosperma*, *Livistona*, *Sabal* (including a beautiful blue *S. uresana*) and *Latania*. He also has a small lake near the house surrounded by some stunning *Phoenix reclinata* × *roebelenii*. After Erik's, we traveled to Flamingo Gardens for a tour of the gardens [led by David barZvi] and dinner [BBQ and Key Lime Pie]. Flamingo has quite a few medium sized plants but in a few years will be quite something. *Ravenea*, *Neodypsis*, and *Livistona* were quite common. Dr. Alan Meerow presented a slide show and talked of his new book "Guide to Landscape Palms."

The following day, it was off to Fairchild Tropical Gardens for a day of lectures, lunch, more lectures, and then a garden tour with Chuck Hubbuch, Curator of Palms.

The next tour was to Palm Beach and the "summer house" of one of Florida's richest men. His house was actually on both sides of the coastal highway with a tunnel connecting the two halves. The house was undergoing extensive renovations and consequently many large palms were in large pots waiting to be put in the ground. A staff of three horticulturalists (1 orchid, 2 palm and cycad) looked after the garden. The collection will be of Caribbean species. A beautiful lunch was served at the Norton Sculpture Gardens where there is a fine collection of palms [put in and cared for by the Palm Beach Chapter of the IPS]—many young specimens but also some older ones. A lecture at Mauts Garden followed, by Barry Noblick on the palms of Brazil.

The final day saw two slide presentations by Don Hodel, one on "Unusual species and habitats of *Chamaedorea*," the other on "Palms of French Polynesia," centered on his mother-in-law's garden which he has planted with many rare and beautiful palms. This show took the format of showing the same palms in various years and so showing their rate of growth—with various family members for scale.

All in all, the Biennial was another great success and, given the problems associated with Hurricane Andrew, the organizers cannot be thanked enough.

PETER KRISTENSEN
Gymea Bay, NSW, Australia

Principes, 37(2), 1993, pp. 110–111

Letter from Chuck Hubbuch of Fairchild Describing the Aftermath of Hurricane Andrew

The following is also reprinted from the January issue of Principes Minor, the magazine of the Sydney [Australia] Chapter of the International Palm Society. This is a letter from Chuck Hubbuch to Peter and Lynn Kristensen, which I think we should all take a moment and read.

November 15, 1992
Dear Peter and Lynn,

As I write this, I know you are still on the International Palm Society's Costa Rica tour and I must admit that I envy you. I would love to be there now. It was great to see you both at the IPS Biennial meeting last week. The lectures were informative. But, as you know, the most valuable part of events like this is always meeting new people and seeing old friends.

You asked for more information about the damage to Fairchild Tropical Garden by Hurricane Andrew. As you saw, the Garden is battered and scarred, but recovering nicely. The trees have leaves once again, Birds, raccoons, and staff are starting to go about their normal lives.

Of course, it all began about two and a half months before your visit with Hurricane Andrew's rapid development in the Caribbean. There is so much to tell about the storm itself. It devastated the northern part of the Bahama Islands, although we saw on the tour that the capital city of Nassau was virtually undamaged. The storm hit the southern tip of the Florida peninsula early in the morning on Monday, August 24. The eye passed several miles south of the city of Miami and Fairchild Tropical Garden (FTG). Days later, newspaper writers wrote to say how fortunate we were that the hurricane struck the area of the Florida coast with the lowest population. I can assure you that the thousands of us who once lived there did not feel so lucky. Officially, the hurricane produced winds of approximately 165 miles per hour. If so, there must have been a lot of tornadoes with much higher winds adding to the destruction produced by the hurricane. On the other hand, we were fortunate that there was very little tidal surge and the storm moved past us quickly. It could have been much worse.

I am glad that FTG did not bear the brunt of the storm. The damage was bad enough as it was. We had to replant or right and brace over 300 palms, including several old *Copernicia baileyana*. So far, only eight of the braced palms have died. To date, we have lost about twenty percent of the palm collection, nearly one thousand palms. Our inventory indicates that only forty-one palm species are completely lost. This still leaves a substantial palm collection of about four thousand palms of over six hundred species.

Over four hundred volunteers poured through our gates to assist in our cleanup and rescue operations. Palm Society volunteers from much of Florida came to help especially from the new chapters in Broward and Palm Beach counties. With their assistance, the Garden was able to re-open to the public on October 3, less than six weeks after the hurricane. We had a very busy weekend as our members and neighbors came to see how we fared. Donations and offers of assistance have come in from around the world.

Scientists and students from over forty institutions in the United States and Europe

came to study the effects and collect research materials from the dead and dying plants. Some of the information, knowledge, and materials they gathered will be used in anatomical studies, taxonomy, and medical research. Undoubtedly, some of it will add to our knowledge of palms.

For example, how many ways can a palm die? I think I saw most of them as we cleared away debris. Small understory plants were crushed under massive trunks and branches. Dwarf coconuts and *Zombia antillarum* clumps are among those that simply broke free from their roots and blew around the ground like large umbrellas. The trunks of many *Livistona* species and *Wodyetia bifurcata* broke off as high as three meters above the ground. The terminal buds of several *Neodypsis decaryi* and some *Phoenix canariensis* simply blew out of the crown, leaving a ring of green lower leaves but no growing point. Crowns were broken from the trunks of palms which were thrown to the ground. Do you remember the *Dictyosperma album*, the "hurricane palm" plants? In the garden, all of the tall plants developed permanent ninety degree curves or they broke. They obviously weren't named for resistance to wind.

Since the hurricane, insect pests and fungal problems have appeared. I expect to see more in these stressed plants. The bitterest losses came after the hurricane, when trucks or heavy equipment drove over surviving plants or when workers' chain saws moved faster than their brains. Admittedly, there have been few of these accidents. They just seemed so senseless. So, I have been busy applying insecticides and fungicides and trying to resist employeecide.

Not too surprisingly, palms came through the storm better than most other trees. I am sure you remember the healthy *Veitchia*, *Hyophorbe* and *Roystonea* plants. They survived and are recovering very quickly, along with low growing species like *Chamaedorea cataractarum* and *Phoenix roebelenii*. Tall, old specimens of *Latania*, *Coccothrinax*, *Copernicia*, and *Thrinax* often blew over. But younger plants survived with little damage.

The rains we had after the hurricane, and during the Biennial, were helpful for the palms. One of the surprises for me was that our underground irrigation system was nearly destroyed. Many of the large trees that fell over carried a length of irrigation pipe into the air with their root systems. We are still working to get it into operation again. The best news was the survival of our plant records. Without them, this would no longer be a scientific institution.

As you saw, the nursery still has a large collection of healthy young plants, including many species new to the Garden. Next spring, we will begin replanting. Some of our older palms have already replaced their battered crowns with new leaves. I think Fairchild Tropical Garden will be a place of beauty again within the next year.

Although the storm's efforts were tragic, the recovery effort was an education to us all. While I do not wish to do this again, it has opened wonderful new planting spaces, pruned overgrown trees, and, maybe most importantly, shook most of the complacency from the staff. I think we all look at the Garden from a new perspective, certainly with a greater appreciation for the forces of nature.

I look forward to seeing you both again in Venezuela at the 1994 IPS Biennial. Send me a photo of your home landscape when you have a chance. Your hillside planting project sounds very interesting.

All the best,

Chuck

Principes, 37(2), 1993, pp. 112-119

CHAPTER NEWS AND EVENTS

News from the Pacific Northwest Chapter

The 1992 annual elections and general meeting for the Pacific Northwest Palm and Exotic Plant Society were held on November 30th in Van Dusen Gardens in Vancouver. Twenty-eight (28) members were in attendance. Note that membership in PNWP&EPS has now risen to 121. Mel Franks was elected President of the group, while Nick Parker continues as Editor of The Hardy Palm International.

Guest speaker for that meeting was Danny Uzimirski, who discussed the art of growing Bonzai palm trees. This was followed by a slide show by Pat McEwan, featuring recent trips she and her husband had taken to Kew Gardens in England and to northern Florida. Refreshments were served.

Meetings for 1993:

The group met on Monday, February 22, 1993, to discuss plant postmortems following the cold winter and to make plans for Spring. Note that the temperature in the Vancouver area dropped below freezing on December 28th and did not rise above that mark for more than a few hours until January 10th. A low of 6.8° F (−14° C) set a new record for January 6th. It was somewhat less frigid further south in Victoria and Seattle, but still quite chilling.

The next scheduled general meeting is to be held on May 18th at Van Dusen Gardens in Vancouver and will feature a plant sale. Additional meetings for 1993 are planned there for August 23rd and November 29th. The group plans a summer BBQ meeting at a date and location to be announced.

As in 1992, the PNWP&EPS will have a booth at the 1993 Pacific National Exhibition in Vancouver from August 20 through September 6th.

Hawaii Island Palm Society

The first palm event of 1993 was the Member's Auction on Sunday, January 24th, at Onekahakaha Beach Park. Things kicked off at noon with a pot luck lunch. This was followed by a short business meeting which included election of new officers and a discussion of the Chapter's palm planting project at the Panaewa Zoo. Fifty percent of the auction proceeds went to the Chapter and fifty percent to the grower.

New Chapter officers elected for 1993 are: President—Paul Supp, Vice President—Charles Trommer, Secretary—Mitzi Christensen, and Treasurer—Helen Carlson.

Southern California News

The Southern California Palm Society met on Saturday, March 27th, in Orange County. First stop on the three garden tour was at 10:00 a.m. in Laguna Beach at Robert Bunkhall's home at 2421-5 S. Coast Highway. His roomy beachfront garden of between one and two acres boasts a coconut that has been in the ground for over 5 years, many *Howea*, a large *Gaussia* (*Opsiandra*) *maya*, *Neodypsis* "darianii" and various sundry tropical palms, overlooking the Pacific Ocean. After a self-guiding tour of the garden, the raffle was held about 10:45 a.m., followed by a pot-luck luncheon. After lunch, the garden of Lynn and Juanita Muir was visited. Lynn has put a lot of his large specimen palms into the ground. Added to the already mature established palms, these made for quite a treat. From the Muir garden, the tour moved on to the third destination, the home and garden of Bob and Jennifer De Jong at 119 Avenida Dominguez, San Clemente. Their home boasts perhaps the largest Traveler's Palm in California and the *Hedyscepe canterburyana* alone was worth the trip. In addition to a variety of other palms, Bob has most notably fruiting *Parajubaea coccoides*, a *Chambeyonia*

macrocarpa with trunk, and a true *Neodypsis lastelliana.*

The Ventura/Santa Barbara Section of the Chapter made arrangements for a special tour of Lotusland on Saturday, April 17th, 1993, at 1:30 p.m. The tour was limited to sixty people, with advance tickets required. Ventura College opened their nursery for a sale of surplus palms from 8:00–11:30 a.m. and again one hour after the tour. Over 100 species were at the sale.

The group's next meeting will be held at 11:00 a.m. on May 22nd at Palomar College in San Marcos. The College boasts a relatively young but promising garden, with many special palm additions. The meeting will begin in the Palm Terrace, part of the Arboretum, then move to Room P32 for two entertaining guest speakers. Contact any Southern California officer for additional information.

Louisiana Chapter News

The first Chapter meeting for 1993 was held on March 21st at 1:00 p.m. at the Audubon Institute on Zoo grounds in Audubon Park in New Orleans. Chapter President John Voss provided a slide presentation featuring various palm photos collected by him in the New Orleans area and Lori Voss followed with slides of the San Antonio Botanic Garden (TX). Refreshments were provided. At the conclusion of the meeting, members toured the Zoo.

The Spring meeting is tentatively scheduled for May, hosted by Mal and Mich Mele in Covington, Louisiana. With several acres of park-like grounds, greenhouses and a large assembly room, the Chapter is afforded a meeting site par excellence. Details will be provided later or can be obtained from Wilbur LeGardeur in New Orleans.

In October of 1993, the Chapter will host the IPS Board of Directors meetings to be held at the Royal Sonesta Hotel in New Orleans. See related article on the Board Meetings elsewhere in this issue.

CHAMAEROPS Introduces Color Printing

Chamaerops, the publication of the European Society, introduced full color printing in the January 1993 issue. The issue has six full pages of excellent color photographs (24 total pages). In addition, the issue features a beautiful color cover showing a mountainous *Trachycarpus* habitat (Doi Chiang Dao) in northern Thailand.

For information on membership in the European Palm Society, contact Martin Gibbons, % the Palm Centre, 563 Upper Richmond Road West, London SW14 7ED, United Kingdom.

New Palm Group in Coastal Queenland

The Palm and Cycad Societies of Australia (PACSOA) announce another new branch based in the central Queensland city of Rockhampton. The new branch of PACSOA is already operational and adds to the existing network along coastal Queensland.

Mackay (PACSOA) Activities

The Mackay Palm and Cycad Society (PACSOM) of PACSOA met on November 29th at the home of Gary and Chris Marsh with fifteen members in attendance. Grub/cocoon damage of *Archontophoenix alexandrae* were discussed. Keith Boyden showed several specimens of the pests taken from infected trees. Possible damage and recommended treatments were discussed. The district plantings are generally very stressed by drought, which is the worst recorded in the past 75 years! Numerous palms were awarded during the "palm competition." These included: *Thrinax excelsa, Acoelorraphe wrightii, Licuala ramsayi, Ptychosperma macarthurii, Carpentaria acuminata, Thrinax floridana, Coccothrinax argentea, Archontophoenix cunninghamiana* var. "*Eungella*," *Phoenix rupicola, Pritchardia*

thurstonii, *Livistona australis*, *L. decipiens* and *Heterospathe woodfordiana*. The meeting was followed by a festive tea and talk of holiday plans.

Another working part was held at the Farleigh Plot on December 6th from 9:00 a.m., followed by a BYO barbecue lunch. During this work session, a good specimen of *Raphia farinifera* was planted. This plant had been donated by Mike Cubitt of Mackay Lattice Nursery.

The Annual General Meeting for 1993 was held on February 28th at the home of Gwen and Les Shailer at 2 p.m. (address is lot 7, Muggleton Street, SARINA). Details of this meeting were unavailable at press time.

The PACSOM birthday celebration is scheduled for May 2nd, at the home of Lois McGregor in Slade Point. This year the format will be a "Street Fete and Garden Party" with numerous sales stalls, refreshments and garden tours for all.

Sunshine Coast [Australia] News (PACSOA)

The Annual General Meeting was held on Monday, February 1st, 1993 at 7:30 p.m. at the Nambour Band Hall on Daniel Street. Stan Walkley was the guest speaker, followed by a big sale of palms and cycads. While the palms available were too numerous to list, cycads available included *Cycas wadei*, *C. thourasii*, *C.* sp. Philippines, *C. chamberlainii* × *C. taiwaniana*, *Stangeria eriopsis*, *Zamia fischeri*, *Z. splendens*, *Z. manicata*, *Dioon mejiae*, *D. califanoi*, *Encephalartos ameulans*, *E. gratus*, *E. horridus*, *E. lehmannii*, *E. msinga*, and *E. ngoyanus*. Palm and cycad seeds were also available for sale.

Sydney Branch of PACSOA Chapter News

The Sydney Branch of PACSOA held their 1992 Christmas Party at the magnificent home of John and Judy Reid at Castle Hill. The day looked ominous as the heavens opened up about 3 p.m. but the sun came out and a fine afternoon followed, allowing the guided garden tours to be held as scheduled.

The group met on January 19th at the Royal Botanic Gardens in Sydney. After election of officers, Peter Kristensen and Ian Edwards showed slides of palms in the United States, seen on their recent trip to the IPS Biennial in South Florida.

Additional meetings planned for 1993 are to be on March 16th, May 18th, July 20th, September 21st, and November 16th. Meetings are held at the Maiden Theatre of the Royal Botanic Gardens at 7 p.m.

News from the Southern Queensland Group (PACSOA)

The Annual General Meeting was held on January 18th, 1993. At this meeting Office Bearers for 1993 were elected as follows: President—Tom Turner, Vice President—George Vaivarins, Secretary—Marie Jarvie, Treasurer—Brian Jenkinson, Newsletter Editors—Peter Beer and Michael Bett, and Bookstore—Ted van Ginneken.

The group also met on February 15th at the Bread House, Gregory Terrace, to finalize plans for the Annual Show. The 1993 Annual Palm and Cycad Show was held at Mt. Coot-tha on March 13 and 14 (Saturday and Sunday). Plant display themes this year included "Palms in the Landscape," "Madagascar Palm Species," "The Genus *Chamaedorea*," "*Rhapis excelsa*" and "Cold Tolerant Palms and Cycads." Posters on the "Morphology and Distribution of Cycads" and on the "Townsville Palmetum" were also featured.

A general meeting was also held March 15th, possibly featuring a slide show by Jenny Birch on a recent visit to the Gulf country in northwest Queensland. This will be followed by a raffle.

North Queensland News

The North Queensland Palm Society elected new officers at its Annual General Meeting on December 6th. The new executive slate is: President—Joe Schmidt, Vice President (and Seed Bank)—Terry Hart, Secretary—Fred Hogg, Treasurer—Rowan Carr, and Librarian—John Dowe.

The NQPS February 1 meeting featured John and Julie Roach, formerly of Adelaide Botanic Gardens and now with Parks Service, Townsville City Council. The slide presentation was on "The Adelaide Botanic Gardens Tropical Conservatory: Its History, Construction and Plants." This is the largest such structure in the southern hemisphere and has an interesting and varied collection of tropical plants. The meeting also featured a brief talk on Chamaedoreas, "a relevant subject considering the recent release of Don Hodel's magnificent work on the genus." This was followed by supper, plant raffle, and general discussion.

The first outing of the year was held on Saturday, February 6th, and was comprised of a tour of members' gardens in the Upper Ross River Area. The group met at 1:00 p.m. at the home of Lorraine Tooth, 1536 Ross River Road, Kelso, touring her garden for about one and a half hours. Following afternoon tea, attendees moved on to Fred and Margaret Hogg's house and garden up the road at #1575. From there, a tour of Geoff Jones' garden at 94 Hammond Way, Kelso, rounded out the day's tours.

Additional meetings for 1993 include April 5, June 7, August 2, and October 4 and 6, all starting at 7:30 p.m.

Western Australia Group Meets

The 1992 Christmas Party was held at Gascoyne Park with 75 adults and 30 children attending. The children were suitably entertained. BBQ was enjoyed by all, as were tours of the Park.

At the January 1993 meeting, members of the Palm and Cycad Society of Western Australia brought along a very nice selection of cycads of varying shapes and sizes. Joe Tomlinson and Ken Adcock led discussions on the various specimens which included a few species each of the genera *Dioon*, *Encephalartus*, *Macrozamia*, *Stangeria*, *Cycas*, *Zamia*, *Ceratozamia* and *Lepidozamia*. A bag of *Dioon spinulosum* seed were donated by Pat Orriell for this meeting's raffle. John Banasiewicz gave a short talk on the use of *Chamerops humilis* as a pot plant as well as in landscapes. A perfect pot specimen was on display.

The Rhapis Study Group met at Norm and Gwen Patterson's place on February 7th. Some members went home with newly potted *Rhapis* bargains, following Gwen's splendid afternoon tea.

P&CSWA held their February 15th meeting at the Leederville Town Hall. The meeting program featured a panel of experts to answer various questions on pests, diseases, potting, culture and other topics. Ken Adcock gave a 5 minute talk on one of his favorite palms at this meeting and a large cycad was donated as a raffle prize by Alan Lane. During business discussions, a new Gascoyne Park Committee of ten members was elected. The March 1993 meeting was devoted to another Electronic Quiz night at the Dianella Hotel, with numerous prizes and great fun.

The group will run a "second annual" palm and cycad display at the Karrinup Shopping Centre from May 3–8, 1993. The 1992 display was quite successful.

For visitors to Western Australia, the Gascoyne Park palm garden is located at the corner of Gascoyne Street and Timberlane Drive in Woodvale. There are about 2,000 palms—with some in for three or more years and others more recently planted. They are set amongst Jarrah, Wandoo and Red Gums. The Park is looking good apart from limited damage to a few plants by kangaroos and cockatoos.

P&CSWA "Busy Bee" days were held at Gascoyne Park on January 23rd and February 21st. Part of the January day's efforts went to replace three palms which had been stolen from the garden. At the these events, general cleanup was the order of the day, followed by a BBQ picnic. Additional plantings are planned for 1993.

Palm Beach Palm and Cycad Society

The Palm Beach Palm and Cycad Society held a general meeting on February 3rd at Mounts Botanical Gardens. Richard Briscoe showed a video on his recent trip to Costa Rica, featuring the palms at the Wilson Botanical Garden. A palm auction followed. Work days were held on February 6th and March 13th at the Norton Sculpture Garden.

On February 19–23, the Chapter participated in the Chelsea America Flower Show in the West Palm Beach. This event is modeled after the famous Chelsea Flower Show in England. The Palm Beach Chapter exhibition showcased a 50-foot by 75-foot garden landscaped completely with palms and cycads. Many were large specimen plants. The group wanted to take this opportunity to show the thousands of attendees that there are more palms and cycads than the few commonly seen in the area. It also showed different ways in which these plants can be used in the landscape.

At the March 3rd meeting, David McLean presented a lecture on uncommon palms in the landscape, especially *Chamaedorea* species. An auction followed the meeting.

Scott Zona will give a presentation on *Roystonea* at the April 7th meeting at Mounts Botanical Gardens. Scott has done extensive research on this genus.

The Spring Sale is planned for April 17–18 at Morikami Park in Delray Beach. Numerous plants, fertilizer, books and t-shirts will be available for sale. There will also be a large display area.

Central Florida Chapter Activities

The Central Florida Palm Society held its Spring Sale on March 13th at Leu Gardens in Orlando.

The Chapter also held a field trip in conjunction with the Palm Beach Chapter on March 27th. The group met at the Cricket Creek Nursery in Loxahatchee at 9:30 a.m. The field trip then moved to Gemini Garden in Manalapan. This is a unique private garden featuring palms of the Caribbean. From there the tour continued to the Norton Sculpture Garden to see over 300 species of palms, and finally back to Cricket Creek to see how all those 500 species of palms and cycads are grown.

South Florida News

Work days continue at the Metro Zoo. February 14th saw mulching of planted palms and cleanup of the nursery. On February 28th, coconut palms were replanted along the entrance road. Additional work days are planned for March 14th and 28th. In addition, the Division of Forestry is assisting area schools in planting environmental study areas. The South Florida Chapter members have been donating native palms of a size suitable to survive on a school ground.

New officers were elected for the South Florida Chapter in January. These are: President—Ken Johnson, Vice President—Bill Theobald, Treasurer—Marcos Urra, Recording Secretary—Lenny Goldstein, and Corresponding Secretary—Debra Chalot. New local board members are Debra Chalot, Dan Keys and Bob Shultz.

The South Florida Chapter met on February 17th at Fairchild Tropical Garden, but details were not available at press time.

Chapman Field Losses in South Florida

The Walled Garden and Palm Collection at the USDA Chapman Field facility were

devastated by Hurricane Andrew. The Division of Forestry's Coconut Orchard is essentially gone. Except for a front page color photo in the Miami Herald there wasn't much press coverage of the damage at Chapman Field. The photo was a 36-foot sailboat in the midst of fallen coconuts. The caption did not identify the site, but it was the Coconut Orchard. Damage to the palms in the lowlands was due to a strong storm surge that snapped the palms at the base, making it impossible to save them by righting. The state has applied for FEMA funds to replant the coconuts, and this will begin as soon as the money is released.

The USDA palm collection was also destroyed by the storm surge. Unfortunately, funds will not be provided for their replacement. The Division of Forestry will provide the manpower for finishing the cleanup and replanting of the palm collection. However, there are no replacement palms available on site and very few funds available for purchasing palms.

Donations of palms are being requested to replace the palm collection and to plant inside the Walled Garden. The Walled Garden area was originally built in the 1930's to resemble ruins. Its purpose was to house shade tolerant and cold sensitive plants. It has tremendous potential for showing off palms and before the hurricane was to be part of the 1992 Biennial tour. The South Florida Chapter has held three workdays there and these will now be restarting. Most of the shade is gone and a lot of debris needs to be removed by hand. If anyone can help with labor or palms, please call Bill Theobald at (305)-252-4416 at work or (305)-251-0246 at home.

Broward County Palm and Cycad Society Activities

This enthusiastic new group won the kudos of the Fairchild Tropical Garden staff for their quick response and hard work in assisting with the cleanup following Hurricane Andrew. Chuck Hubbuch and other garden staff members really appreciated the hard work of these volunteers, as well as those from the many other groups who came to the assistance of the FTG in this time of need.

The Broward County members also assisted greatly with the IPS Biennial in November in support of the beleaguered South Florida Chapter. Biennial attendees toured Eric Beer's Palm Garden (and, per Liz Cain, admired his arms!), guided by Eric. This was followed by a tour of Flamingo Gardens, led by David barZvi. After feasting on BBQ and key lime pie at dusk, the visitors were captivated by nuances of landscape palmery presented by the group's own accomplished author, Dr. Alan Meerow.

The last General Meeting of this enthusiastic new group was held on January 28th, 1993, at the Broward County Extension Office on College Road. Speaker for this meeting was Steve Callies, Plant Protection and Quarantine Officer with the Port of Miami. Steve's specialty is the importation of plant material, thus what he said was valuable to the "hunters/gatherers" in the audience. Steve kept the discussion humorous, in line with the overall disposition of the group. In addition to the program, a palm auction was held and a Door Prize palm given away.

Officers of the Broward County Palm and Cycad Society are: President—George Zammas, Vice President—Jeff Serle, Treasurer—Susan Gibson, and Secretary—Mia Keegan. Affiliation with the IPS is planned as soon as necessary procedures and approvals are completed.

March activities centered around the Flamingo Gardens first Annual Mardi Gras held on March 13 and 14. The highlight was a nearly authentic replica of the New Orleans Café du Monde, which featured biegnets, café au lait, and hot chocolate. Plant distribution and a Rare Plant Auction were held on Sunday. Good Cajun and Creole food, masks, costumes, art, frivolity and plants were had by all! [Note that the

next IPS Board of Directors meeting will be held in October in New Orleans.]

News from Texas

The Rainforest Pyramid conservatory and 3D IMAX Theater of the Moody Gardens in Galveston opened on schedule on March 27–28 with ISLANDFEST, a Grand Opening Celebration. This event featured tours of the Rainforest Pyramid and a Saturday night concert with laser fireworks show. 50,000 people attended.

Initial counts show approximately 83 palm and cycad species in the initial planting of the conservatory. These are spread over a wide range of genera and a number of others are planned for later plantings. In addition to the plants in the Conservatory, a large number of moderately cold-tolerant palm species continue to be planted outdoors at Moody Gardens. According to Galveston member Henry Homrighaus, a large mature *Brahea* × *Syagrus romanzoffiana* cross is in flower outdoors near the greenhouses.

The Moody Gardens mission is to benefit Hope Therapy Programs at Moody Gardens; animal and horticulatural therapy, education and employment for the physically and emotionally disabled.

The Palm Enthusiast: The South Africa Palm Society Journal

The *Palm Enthusiast*, journal of the South African Palm Society, similar in size to *Principes*, with around 30–40 pages per issue. The issues are published every 4 months (or 3 times per year), generally with one issue per year in color and the other two in black and white.

The November 1992 issue was 44 pages in length, black and white, with numerous photographs. It featured an excellent article by John L. Dowe from Queensland, Australia, on "Extra Tropical Palms—A Statistical Overview." In addition to the statistical inferences, lists of Northern and Southern hemisphere extra-tropical palms were provided. "The Coconut Palm in East Africa—East African Tall" was covered in great detail by M. Schuiling and H. C. Harries of Tanzania. "In Search of *Syagrus*, Part 2" by Bernard Fischer covered the portion of the expedition from Serra do Cipo National Park in Minas Gerais northward to Diamantina. The first portion of the trip was covered in the June 1992 issue of the *Enthusiast* and the Bahia portion of the expedition will be covered in a later issue. The June issue also included a color pamphlet, "The Palms of Rio's Jardim Botanico," as an enclosed insert for all subscribers.

Local chapter news in the November issue announced a Pretoria members' social (beer and sausage evening) on the farm of Robbie Robbertse to be held on the 5th of December 1992 at 3:00 p.m.

See further details in your current IPS roster for subscription/membership fee information. Please send enquiries and membership fees to Adelaide Bradshaw, 30 Charbury Road, Lynnwood Manor 0081, Republic of South Africa.

The next issue of *Principes* will feature a review of *Palms and Cycads*, the journal published by the Palm and Cycad Society of Australia (PACSOA).

JIM CAIN

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NOMINATIONS AND ELECTIONS OF DIRECTORS

The Nominating Committee is preparing the slate of nominees for Directors for election in 1994, to serve for a period of four years. Members in good standing may propose candidates for nomination by writing to the Chairman of the Nominating Committee or the Secretary of the Society.

The letter must be accompanied by the written consent of the proposed candidate to serve if nominated by the committee and elected by the membership, and it must be seconded, also in writing, by another member. Each proposed candidate and incumbent director must complete and return a questionaire provided by the Secretary. If the above conditions are met, the Nominating Committee shall consider the candidate for selection as a nominee on the final ballot.

The Nominating Chairman will use the tally of membership according to regional distribution of members as a guideline to obtaining and selecting representation worldwide. No one region shall have more than nine (9) directors serving on the board at any one time. Voting for Directors by our membership shall be by mail only. Ballots shall be mailed in time for the results to be announced at the 1994 Biennial Meeting in Caracus, Venezuela.

The Nominating Committee Chairman is now accepting suggestions for Director nominees. Proposals and letters of consent must be received by October 1, 1993. Please forward to Norman Bezona, P.O. Box 936, Kailua, HI 96740, USA.

Back Cover

Trachycarpus nanus sometimes develops a short trunk. Photo by Martin Gibbons.