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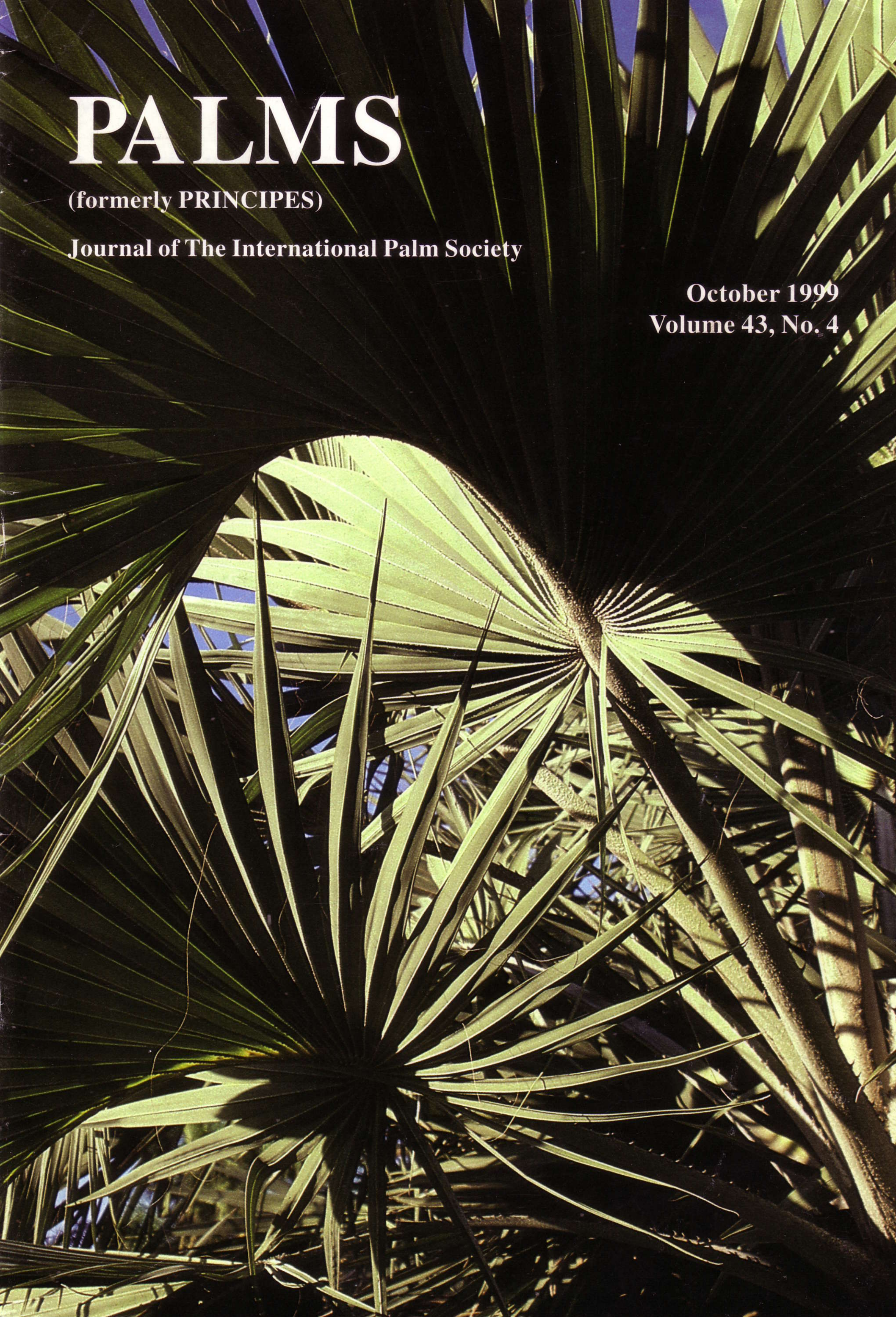

THE INTERNATIONAL PALM SOCIETY, INC.

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Front Cover

Hyphaene coriacea at the Montgomery Botanical Center. Photo by John Dransfield

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President's Message

As we head into the new millennium, I trust that all of you have assured that your palms are Y2K compatible and that you have stockpiled lots of fertilizer, microelements, and pruning shears. Kidding aside, the year 2000 promises to be a very exciting and successful year for all Society members. We will be having a fabulous Biennial in New Caledonia, and exciting Post Tour in Northern Queensland, and more great issues of *Palms* with its new emphasis on material that interests you.

I have been involved with palms for about 25 years. I remember when I drove 150 miles to get my first seedling of *Pritchardia*. I remember my excitement when I got my first *Wodyetia bifurcata*. I also remember when *Neodypsis decaryi* was the new rage and *Ravenea rivularis* promised to be the "palm of the future." Now these species are commonplace and even available at the average local home-improvement center. What does this imply? It illustrates the continually growing interest in palms. The last several decades have not only seen a tremendous increase in the species available to palm enthusiasts, but also an increasing number of species that can be successfully grown in our members' localities. It is not unusual for a member in Southern California to be successfully growing over 250 species outdoors. This is dramatically different from what it was like in the mid-1970's.

I think in the coming years we will see even more interest in palms, especially from "new areas" of the world as new enthusiasts evolve. I have been getting an increasing number of inquiries about palms and the I.P.S. from distant places where we don't even have members. We anticipate several new Chapters in the next two years. The I.P.S. sponsored Internet palm discussion group continues to expand, with members from outside the usual palm growing areas.

All this means that palms are sought after and popular and that people want to create a botanical environment around their homes with palms as the spotlight. Therefore, I think that palms and the I.P.S. have a bright future. By telling your friends and neighbors about our group, you can help create this future. I thank you in advance and wish you a prosperous and thriving New Year.

PHIL BERGMAN, PRESIDENT IPS
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NEW SCHEDULE FOR *PALMS* IN 2000

Starting with the first issue in 2000, *Palms* will be mailed in the last month of each quarter rather than in the first. Thus, the first issue will be mailed in March, the second in June, the third in September, and the fourth in December. Savings in postage are expected to result from this change. We have delayed this last issue of 1999 to shorten the time between this and the first of the new millenium.—Eds.

Palms, 43(4), 1999, pp. 161–165

Flowering and Fruiting Phenology in Certain Palms

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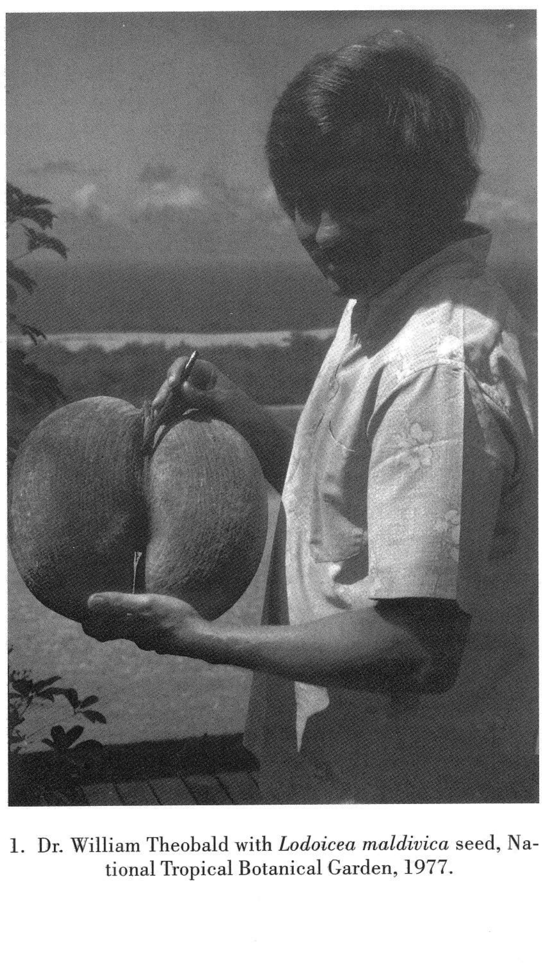
ABSTRACT

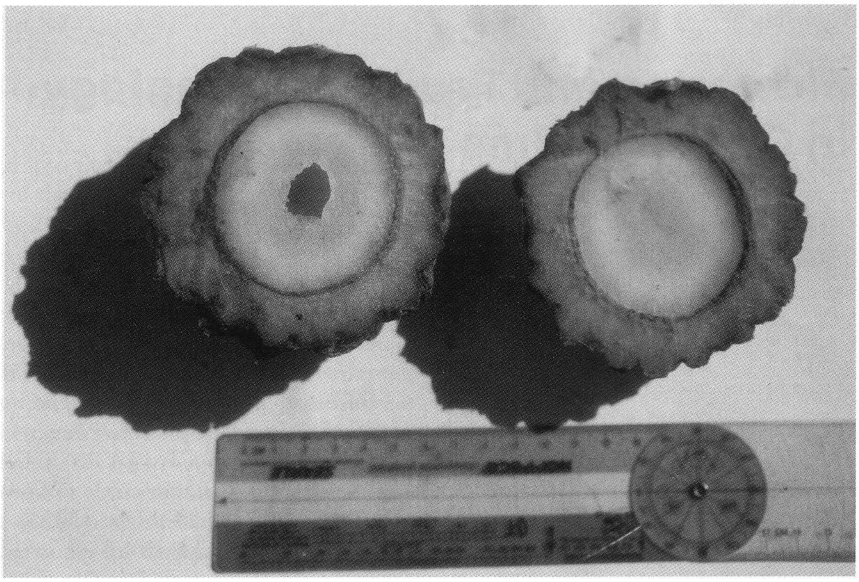
The period of time between pollination and fruit maturation is reported here for selected palm species at the National Tropical Botanical Garden Hawaii (NTBG). Mature fruit diameters are also recorded. The species studied occur in the Arecoideae, Ceroxyloideae, and Coryphoideae. Data obtained from the literature are included and discussed. The literature shows that the major economic species (the date, coconut, and oil palm) have been researched extensively, while only limited and diffuse information exists for the remaining palms. The hypothesis tested here is that the correlation between length of time between pollination and fruit maturation is proportional to fruit size in palms. Results of original data and what is found in the literature show that this correlation does not exist.

A better and more complete understanding of this phenomenon would be beneficial to botanists in organizing field collecting expeditions, and to scientists involved in pollination studies. It would help palm growers to calculate seed production, and aid them in controlled pollination work. It might also contribute to a better understanding of treating pests and diseases that are associated with either the flowering or fruiting stages of palms. Finally, it would provide a more comprehensive understanding of the natural history of palms. But existing information on palm flower and fruit phenology is limited. Access to palms in the wild is often difficult. When palms are studied in the wild it is often during a single visit, and although vouchers may record the phenological status, the entire process of fruit development from the time of pollination cannot be known.

How long does it take palm fruits to develop? Burkill (1966) reports that the biggest palm fruit belongs to the double coconut, *Lodoicea maldivica,* which weighs 20–30 kg at maturity. One might expect this giant to take longer to mature than any other fruit, since the double coconut is the largest seeded plant (Fig. 1). Corner (1966) reports that it takes six years from time of pollination to fruit maturation. Soon (1997) recorded eight years for the same species growing at Singapore Botanical Gardens. Burkill (1966) reports that ". . . the palm flowers at 15 years and as the fruits take three years to ripen, fruits first occur at 18 years." McCurrah (1960) suggests the fruit takes one year to develop to full size and five years to "mature," but the source of his information is not given. Other examples include data collected on the flowering and fruiting phenology of *Corypha umbraculifera* in the Fairchild Tropical Garden, which took 450 days to produce ripe fruit 4 cm in diameter (Fisher et al. 1987). Another study of *Corypha utan* by Tomlinson and Soderholm (1975) showed that mature fruits develop to 1.5 cm in diameter in 41 days. In Fiji, *Pelagodoxa henryana* took 2.5 years (913 days) to produce mature viable fruit



1. Dr. William Theobald with *Lodoicea maldivica* seed, National Tropical Botanical Garden, 1977.



2. *Pelagodoxa henryana* mature fruit in longitudinal section measuring 10 cm in diameter. Fruit was collected from NTBG accession #770290.001. Photo by M. H. Chapin.

in cultivation (Phillips 1996). He states, "The long delay between pollination and maturity of the seed has surprised me. Perhaps it is that these palms are not common so no one has checked this point, but I have seen nothing in any literature that commented on this long period of development." Phillips did not record the fruit size; however, my own observations at the National Tropical Botanical Garden show that fruits of *Pelagodoxa henryana* measure 10 cm in diameter at maturity (Fig. 2).

How does one establish this information for any palm? Can one test the hypothesis that the larger a palm fruit, the longer it takes to develop? The periodic flowering and fruiting behavior of palms is not well understood. Events such as the time of flowering and the length of time between pollination and fruit maturation may correlate with climatic or environmental factors such as temperature, water, nutrients, and light (Zalom et al. 1983). Here, I present some original data that provide a partial answer to the question and allow comparison with information about other palms derived from the literature.

Materials and Methods

Documentation of the flowering and fruiting stages of eight tropical palm species growing in cultivation is provided here. They grow in the tropical climate at Kauai, Hawaii in the National

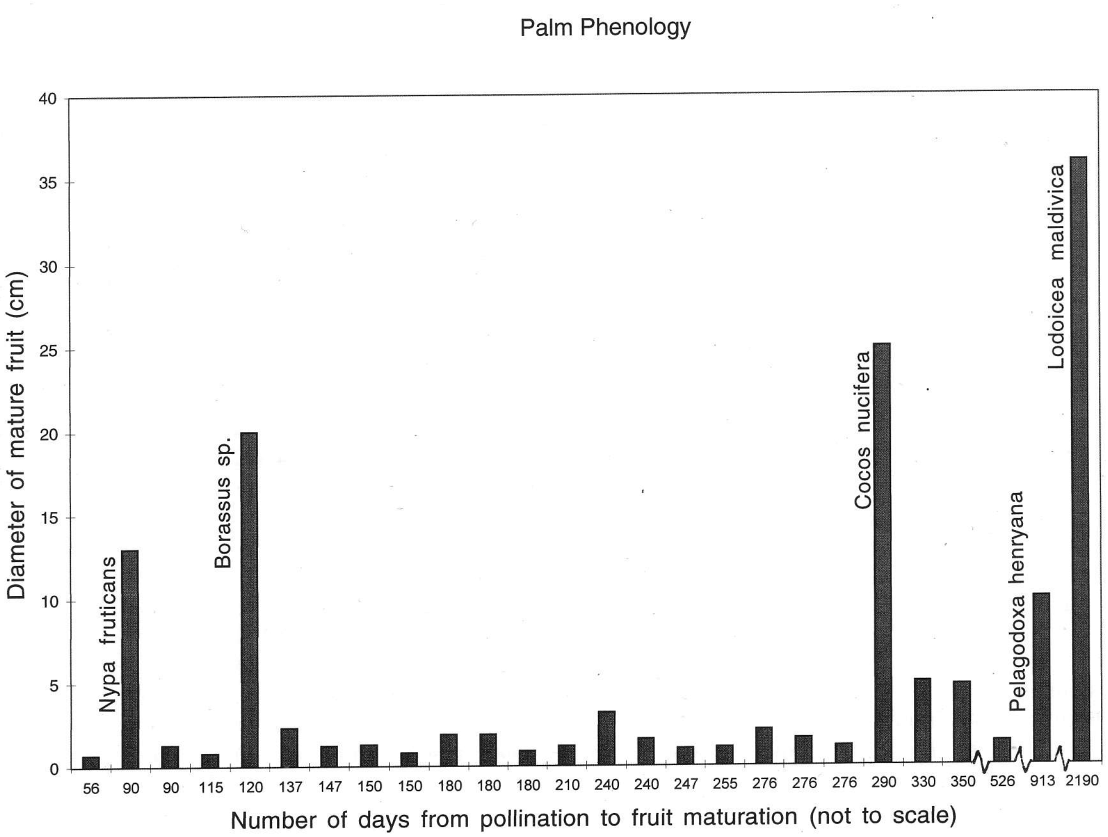
Table 1. Fruit maturation time and mature fruit size for palm species examined in this study.

Taxon	Subfamily	Date begin/ date end	Total number of days	Mature fruit diameter (cm)
Hyophorbe lagenicaulis	Ceroxyloideae	06 Aug. 97–07 Jan. 99	526	1.4
Hyophorbe verschaffeltii	Ceroxyloideae	06 Aug. 97–09 Apr. 98	247	1.0
Licuala paludosa	Coryphoideae	06 Aug. 97–08 May 98	276	1.2
Lytocaryum weddellianum	Arecoideae	06 Aug. 97–20 Dec. 97	137	2.3
Phoenix loureiri	Coryphoideae	06 Aug. 97–28 Nov. 97	115	0.8
Pritchardia kaalae	Coryphoideae	06 Aug. 97–08 May 98	276	2.2
Pseudophoenix sargentii	Ceroxyloideae	06 Aug. 97–08 May 98	276	1.6
Sabal mexicana	Coryphoideae	12 Jul. 97–06 Dec. 97	147	1.2

Table 2. Fruit maturation time and mature fruit size (after Corner 1961).

Taxon[1]	Subfamily	Total number of days[2]	Diameter[3] (cm)
Actinorhytis sp.	Arecoideae	330	5.0
Areca catechu	Arecoideae	240	3.2
Borassus sp.	Coryphoideae	120	15–20
Coccothrinax sp.	Coryphoideae	180	1.3–1.9
Cocos nucifera	Arecoideae	270–300	20–25
Corypha sp.	Coryphoideae	270–390	3.8
Lodoicea maldivica	Coryphoideae	2,190	30.5–36
Nypa sp.	Nypoideae	90	10–13
Phoenix sp.	Coryphoideae	180	1.9
Ptychosperma sp.	Arecoideae	90	1.3
Sabal sp.	Coryphoideae	150	0.8–1.3
Washingtonia sp.	Coryphoideae	150	0.8

[1] Scientific names derived from common names after Corner (1961).
[2] Transposed from Corner (1961) yearly and monthly data.
[3] Transposed from Corner (1961) measurement in inches data.



3. The relationship between the diameter of mature fruit and the time required for fruit maturation in palm species discussed in this paper.

Table 3. Fruit maturation time and mature fruit size (Murray 1971).

Taxon	Subfamily	Total number of days	Diameter (cm)
Chamaedorea alternans	Ceroxyloideae	255	1.1
Chamaedorea pochutlensis	Ceroxyloideae	210	1.2
Chamaedorea sp.	Ceroxyloideae	180	0.9
Hyophorbe lagenicaulis	Ceroxyloideae	240	1.6
Thrinax floridana	Coryphoideae	56	0.7

Tropical Botanical Garden (NTBG), Lawai Valley, which has an average annual rainfall of 65 inches and an annual average temperature of 73.3°F (National Weather Service). Soils consist of highly weathered volcanic basalt, clay soils with iron oxides, aluminum, and magnesium. The soil pH ranges from 5.6 to 6.5.

Samples were taken from flagged inflorescences on individual palms at weekly intervals. Criteria for fruit maturity were based on the appearance of fruit changing color, dropping off, becoming pulpy, or dehiscing. Samples were fixed in FAA as they were collected, and correspond to an herbarium voucher deposited in the NTBG herbarium (PTBG). Measurements of the fruit diameters were taken at maturity at the widest point using calipers. The results are given in Table 1.

Results

The literature reflects a concentration of phenological studies of the commercially important palm species coconut (*Cocos nucifera*), oil palm (*Elaeis guineensis*), and the date palm (*Phoenix dactylifera*), but only limited and diffuse examination of the remaining taxa.

DeMason et al. (1989) reported that *Phoenix dactylifera* reaches fruit maturation after 200 days, while Corner (1966) documented 180 days. Ikemefuna et al. (1984) and Corner (1966) found that *Elaeis guineensis* takes 180 days from pollination to produce mature fruit. Corner (1966) reported *Cocos nucifera* required 300 days from flower to fruit maturation. Although many of the remaining species of palms are also important commercially in the landscape industry and have great value as minor economic plants, less information is available on their flowering and fruiting periods. Scariot (1995), for example, conducted a detailed study on the phenology of *Acrocomia aculeata.* He focused on the relationship of the flowering time to fruit set over the reproductive season. His results indicated that *Acrocomia aculeata* took 90 days for its fruit to ripen after pollination. Corner (1966) reported on a variety of palm species, and included the time it took them to produce mature fruit, as well as the width of the fruit (Table 2). His sources were not cited. Murray (1971) collected data on five species. Their fruiting phenology is shown in Table 3.

Discussion

Although a great deal of phenology research has been conducted on the three most important commercial species within the Arecaceae, the remainder of the family (composed of over 2,650 species) has had only a diffuse and limited amount of study. With the limited data available, it is still possible to draw some conclusions. Of the species included in this study and those cited, we can see that a correlation does *not* exist between maturation time or the length of ripening time and fruit size (Fig. 3).

Although carrying out studies of this nature is difficult in wild populations, botanical gardens and palm nurseries are ideal laboratories for detailed and controlled experiments on palm flower and fruit phenology. More studies are required to understand what similarities and differences exist between species grown in cultivation and palms in the wild, while factoring in other variables such as climate, soil, water, and temperature.

Palms have a great deal to offer humankind as food, medicine, oils, and other products, yet much remains to be understood about their natural history. Although the taxa reviewed here represent only a fraction of the entire palm family, it is hoped that this information will contribute to the work of those who study, grow, and seek a better understanding of these extraordinary plants.

Acknowledgments

This study was supported in part by a grant from the International Palm Society Endowment

Fund. Acknowledgment is given to Professor P. B. Tomlinson for valuable help during this study, and to the National Tropical Botanical Garden for providing materials and facilities.

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Palms, 43(4), 1999, pp. 166–169

The Small Palm (*Allagoptera campestris*) in Misiones, Argentina

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ABSTRACT

In this study the population structure of *Allagoptera campestris* in Teyú Cuaré, Misiones, Argentina, is described. This population was affected by fire the previous year and by the development of a *Pinus* plantation. For this study three sites were considered: a forested area and a grassland, both affected by fire, and another grassland with no evidence of fire. Ten plots of 100 m at each site were monitored, registering the height and the presence of reproductive organs for each palm. The highest density was found in the pine plantation site, and some hypotheses to explain this are provided. Average height and number of palms with infructescenses were significantly higher in the site unaffected by fire. Recurrent fire may be altering population structure, reproductive success and long-term conservation of this species. The reduction in the distribution area of *A. campestris* caused by livestock grazing and forestry, even within the protected area, may be threatening the survival of this species.

Allagoptera campestris is a small palm (0.3–1 m) apparently stemless, but with a creeping and rhizomatous stem to 20 cm below the soil surface (Fig. 1). The species is well described by Moraes (1996).

In Argentina *A. campestris* is found in open areas called "campos" (fields) in the south of Misiones province (Moraes 1996). In the 1960's Martinez Crovetto (1963) cited five palm populations in this province, and asserted that they were already being altered by fires at that time. At present they have been affected by livestock grazing, agricultural activities, and forestry. Only one of the populations is protected in the Teyú Cuaré Natural Monument, where we conducted this study.

Fire is one of the main factors affecting seasonal savanna and grassland landscapes such as campos in Misiones. Studies conducted at the Brazilian cerrado show the influence of fire in the survival of plants, their aerial parts, germination, mortality, and vegetative and sexual reproduction (Almeida 1996). However, the effect of fire as a modeling factor depends on the frequency and intensity of occurrence (Klink and Solbridge 1996). In palm construction the absence of secondary thickening from a peripheral vascular cambium promotes fire-resistance and accounts for their frequent abundance in fire-climaxes. However, the association between palms and fire has never been fully scrutinized (Tomlinson 1990). Barbosa Rodríguez (1899) suggests that fire is one of the factors determining the variability in the length of the reproductive organs of *Allagoptera*.

The object of this research is to describe the structure of a population of *A. campestris* partially affected by fire that occurred a year before the study and where there is an area with a *Pinus* plantation.

Study Area

This population of *Allagoptera campestris* is within the Teyú Cuaré Natural Monument, an area of 78 ha. The Natural Monument is located in the Departamento de San Ignacio, Misiones, Argentina, on the Paraná River. The palm population covers 80 ha. This population is included in the campos district, Paranaense phytogeographic province (Cabrera and Willink 1980).

The climate is subtropical with thermic but not rainfall seasonality. Mean annual temperature is 20 C, with probable freezing over two months. Mean annual precipitation is 1782 mm (Cabrera 1976). According to Martínez Crovetto (1963) vegetation communities of the campos district are of primarily the result of edaphic factors and they must be linked with the existence of a layer of rock, 1.5 and 3 m below soil level which acts as a barrier between the upper horizon and the phreatic layers.

The soil is acid. The analysis of two samples from depths of 0–10 cm, collected during the study, showed an acid pH (4.6–4.9), with low or-

1. *Allagoptera campestris* in Teyú Cuaré "campo".

2. Measuring the height of *A. campestris*.

ganic matter content (2.3–1.06%), and nitrogen (0.1–0.056%). Available phosphorus was low (8–6.4 ppm) and available potasium was deficient (0.19–0.1 K. me/100 gr) (Bustos et al. unpubl. data).

Historically these "campos" have been largely used, first by Amerindians (Guaraníes), then by the Jesuits who took advantage of these areas without forests to build their missions. Nowadays they are used for livestock grazing, agriculture, and forestry as well as for human settlements. People of the region indicated that every year, in August and September, they burn the grasslands to improve the quality of pasture for livestock. This is a traditional activity deeply rooted in the practices of the people of the region; unfortunately the effect on the ecosystems and the actual effect of fire on pastures have not yet been studied.

Methods

The study was conducted in February 1996. Three different sites were chosen based on the human activities developed in them—a *Pinus* plantation and a grassland both affected by a fire in August 1995 and another grassland with no evidence of fire. In each site we sampled 10 plots of 100 square m each, placed in two transects randomly located, that made a total of 0.1 ha per habitat. The height of all palms to the distal portion of the longest leaf were measured and the presence of reproductive organs were also registered (Figs. 2 and 3).

To assess the statistical significance of differences in height and density the Kruskal-Wallis test was applied.

Two specimens were collected and identified by M. Moraes of the Herbario Nacional de Bolivia.

Results

The highest density of palms was observed at the forested site, although there were no significant differences with the density in the other two habitats. Mean height and the number of palms showing infructescences were higher in the grassland not affected by fire (Table 1).

Significant differences were found in the height of palms between the habitats affected and not affected by fire (P0.005, Kw: 10.5.).

3. Infrutescence of *A. campestris*

Discussion

Palms in the burned sites (grassland and plantation), though resprouted, still showed burned woody bracts and leaves. This might be an explanation for their lower height and lack of infructescences. Though *A. campestris* tolerates fires, recurrent fires may be altering the structure of this population and its long-term reproductive success as their seeds are destroyed every year.

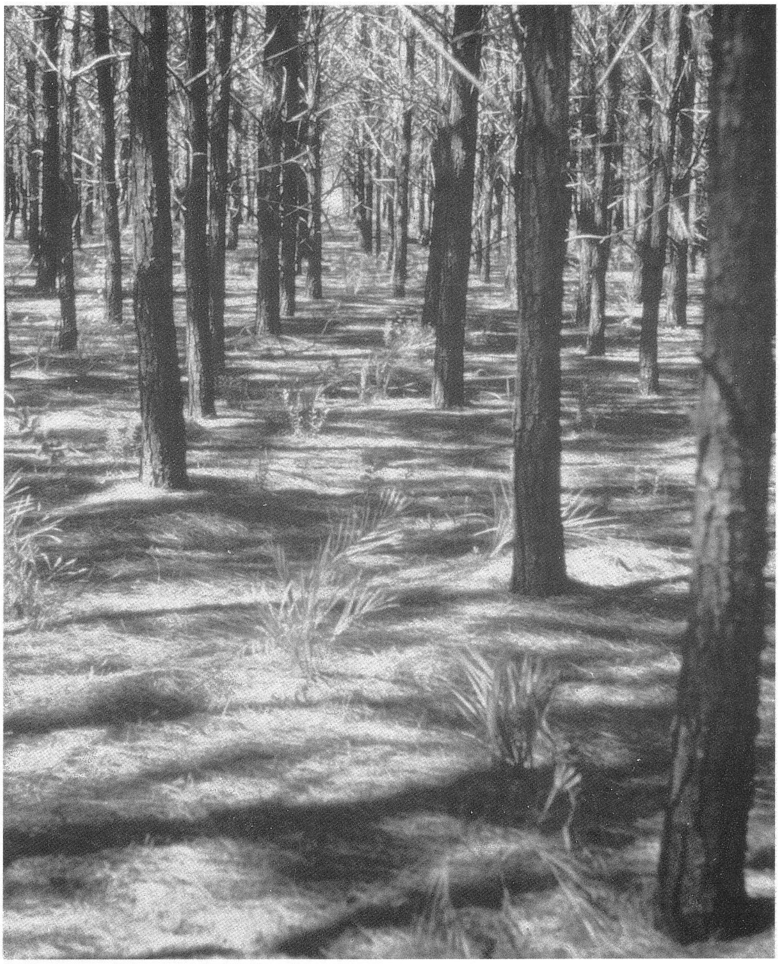
A. campestris shows the highest density in the Pine plantation site. This might be the result of the breaking up of the soil before the planting of the pines; this activity may have fragmented the palm rhizomes, each segment then resprouting. On the other hand the Pines increase litter cover at ground level with pine needles, the canopy reduces light intensity, and together with pine root biomass may all inhibit grassland species and favor either directly or indirectly the presence of *A. campestris*. Further studies on these subjects will undoubtedly contribute to our knowledge of the ecology of this beautiful palm and help develop strategies for its conservation.

The presence of *A. campestris* populations south in the Paranaense Forest isolated from the cerrado populations to the north, may indicate a wider distribution of the cerrado in the past when possibly drier and seasonal climatic conditions may have been predominant.

In Argentina *A. campestris* is not effectively conserved by the system of protected areas. The majority of the "campos" have been transformed. For example, in January 1997 we visited the "campo" in Loreto in the South of Misiones province, of special interest as there, besides *A. campestris*, also *Butia yatay* var. *paraguariensis*

Table 1. Density of palms. Numbers of individuals with infructescences and mean height of the palms in the three studied sites.

Habitat	Density (ind./0.1 ha)	Infructscences (ind/0.1ha)	Mean height (cm)
Burnt grassland	185	2	59
Unburnt grassland	190	36	69
Forested-burnt site	310	1	55



4. Burnt forestation with *A. campestris* as a dominant element of the understory.

is found. Those palm populations are also being replaced by a *Pinus* plantation.

Acknowledgments

Financial support for this research came from CONICET's fellowship. I want specially to thank Hugo Chavez for his collaboration during field work, for showing me the palm population and encouraging me to study these palms. I would like to also thank Monica Moraes for the identification of the collected specimens and Alfredo Grau for the discussion of the ideas and correction of the manuscript.

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Palms, 43(4), 1999, pp. 170–172

Seed Anomalies in a *Butia* × *Syagrus* Hybrid

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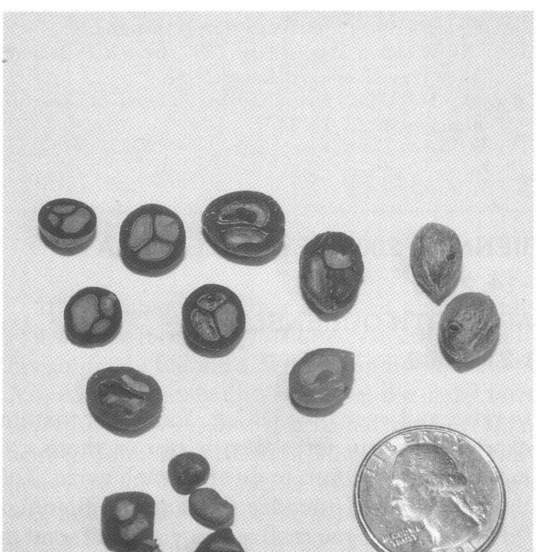
Butia species are known to hybridize with *Syagrus, Lytocaryum, Jubaea,* and other genera within the subtribe Butiinae (Boyer 1992). The progeny of the crosses usually exhibit characteristics intermediate between the parents. The cross between *Butia capitata* and *Syagrus romanzoffiana* has been given the horticultural name of ×*Butiagrus nabonnandi.*

×*Butiagrus* plants, formerly called *Butiarecastrum* (*Butia* × *Arecastrum*), are considered sterile (Jones 1987, Wilcox 1998); whereas *Jubaea* × *Butia* progeny may be fertile, producing viable seed (Wilcox 1998). Although all three genera (*Butia, Jubaea,* and *Syagrus*) have chromosome numbers of $n = 16$ (quoted in Uhl and Dransfield 1987), we have not found a refer-

1. ×*Butiagrus* tree in Lakeside Garden Palmetum, Oakland, California USA

2. Seeds of ×*Butiagrus* tree in Figure 1. Upper right: entire seeds with fibrous mesocarp. Lower right: entire seeds cleaned to endocarp. Left: halved seeds split longitudinally and in cross section.



3. Normal seeds of *Butia capitata*.

ence to the chromosome number of the hybrid, but assume it to be also $n = 16$. Nevertheless, this does not explain why the *Butiagrus* hybrids are apparently sterile.

Seeds from fallen fruits of a ×*Butiagrus* tree (Fig. 1), located in the Lakeside Palmetum at the Lakeside Garden, Oakland, California USA, have been collected for a number of years by several palm enthusiasts, but have failed to germinate despite their normal appearance. When the fruit is removed and the seeds cleaned to the hard endocarp (right side, Fig. 2), the seeds sink when placed in water, a misleading indication that the seeds may be normal and fertile.

Daniel Sekella sliced clean seeds from the hybrid into longitudinal and cross-sections, by fastening a hacksaw in a vise and carefully moving the seed by hand against the hacksaw blade. Split seed-halves were smoothed with fine sandpaper. Internally, the seeds were entirely filled with the hard, dark-brown endocarp (left side, Fig. 2). Neither endosperm nor embryo were present. Normally, *Butia* seeds contain hard, white endosperm, occupying one or more cavities within a thin or thick but hard, brown endocarp (shell) (Fig. 3).

The original ×*Butiagrus* plant was obtained from Merrill Wilcox by Allan Bredeson, and was

4. Normal seeds of *Syagrus romanzoffiana*.

planted from a five-gallon container in the spring of 1982. A second, smaller plant from a two-gallon pot was donated by Merrill Wilcox, and planted in December 1983. It has flowered for several years, but never set fruit. There are no other fruiting hybrids of known origin in the San Francisco Bay area whose seeds are available for study. We observed two populations of *Butia* seeds, and found them to be normal. Seeds from two *Syagrus romanzoffiana* trees located in northern California were abnormal, just like the seeds from the hybrid tree. One of these trees is known not to produce viable seeds. Seeds collected from a third tree in Walnut Creek, California, known to produce viable seeds, were normal (Fig. 4); as were seeds from a fourth tree, from Stockton, California.

The finding of a solid endocarp in apparently normal-looking seeds from a ×*Butiagrus* tree provides one reason why the seeds do not germinate. The extent of this anomaly in a population of the hybrid trees is yet to be determined. The finding of the same anomaly in *Syagrus romanzoffiana* seeds was unexpected.

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MARK YOUR CALENDAR NOW FOR BIENNIAL 2000 NEW CALEDONIA OCTOBER 8–14, 2000 AND POST BIENNIAL TOUR FAR NORTH QUEENSLAND OCTOBER 15-21, 2000

Be sure to reserve the dates for these two fabulous events. The Biennial will begin in New Caldedonia on October 8, 2000 and end on October 14. The Post Tour will follow the next day and last approximately 6 days. I.P.S. Chapter Chambeyronia will be our hosts in New Caledonia and Affiliated Society Far North Queensland Palm and Cycad Society will be hosting the Post Tour. It is recommended that you arrive in New Caledonia at least one day early so you can have a day to relax and overcome jet lag. You might want to extend your trip for a day or two as there are many exciting things to do after each event. For those of you who attended the fantastic Biennial 98 in Thailand, you realize that you don't want to miss these two events. These both plan to be unforgettable. Watch for specifics and registration form in the center insert in the next issue of *Palms*.—PHIL BERGMAN

Palms, 43(4), 1999, pp. 173

A Freak Form of *Dypsis lutescens*

IPS member Shri Dhar has sent photographs of a strange form of *Dypsis lutescens* cultivated in his garden in Calcutta. With its undivided leaves it looks completely different from the usual form of *Dypsis lutescens*, but specimens that Shri Dhar sent to John Dransfield at Royal Botanic Gardens Kew for identification displayed the scales, wax and texture typical of this species. *Dypsis lutescens* is very variable and some of the distinctive forms have been selected and clonally propagated, particularly in Thailand and the Philippines (see front cover of PALMS Vol. 43(2) (April 1999). Shri Dhar would like to hear from any members who can throw more light on this extraordinary palm (Shri Dhar, 20 Ballygunge Park Road, Calcutta 700 019, India).

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Control of Royal Palm Bug, *Xylastodoris luteolus* (Hemiptera: Thaumastocoridae), With Imidacloprid: A Refinement in the Method

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Abstract

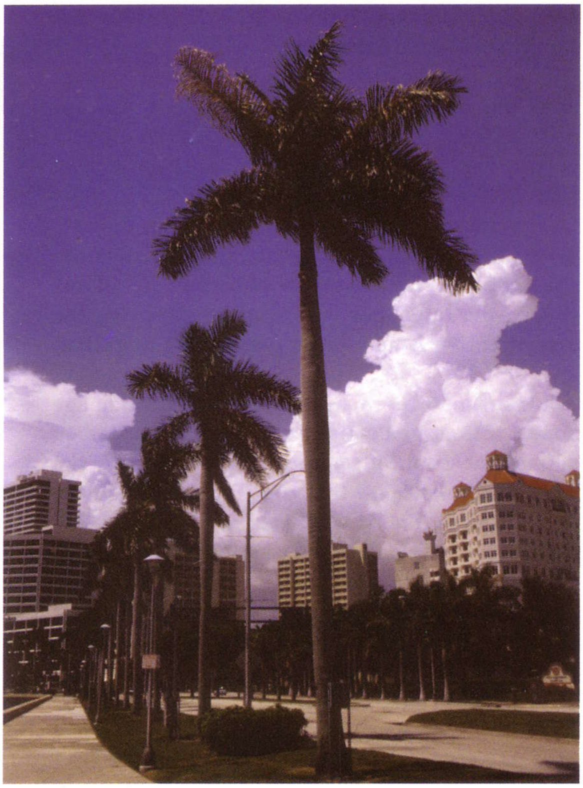
Imidacloprid at 45, 22.5, and 11.3 g per palm applied as a root drench in late winter was effective in preventing damage to royal palms (*Roystonea regia* (Kunth) O. F. Cook) by the royal palm bug, *Xylastodoris luteolus*, Barber (Hemiptera: Thaumastocoridae) in a test in Florida, USA. Based on damage assessment, the treatment was effective for at least five months during the spring, i.e., the main season of activity of this insect on royal palm foliage.

Previously, we reported results of tests of imidacloprid for control of the royal palm bug, *Xylastodoris luteolus* Barber (Hemiptera: Thaumastocoridae), on Cuban royal palms (*Roystonea regia* (Kunth) O. F. Cook (Howard and Stopek 1998). This species of insect damages royal palms mostly in spring and early summer, after which the insect populations apparently decline until the following spring. The method that we tested involved drenching the root zones with imidacloprid at a rate of 42.5 g per palm. Palms given a single treatment in January were protected from bug damage in the spring and early summer, remaining free of royal palm bug damage for more than a year. One palm treated with 21 g of imidacloprid, i.e., half of the above rate, likewise remained free of the damage, serving as inconclusive evidence that this lower rate may be effective against this insect.

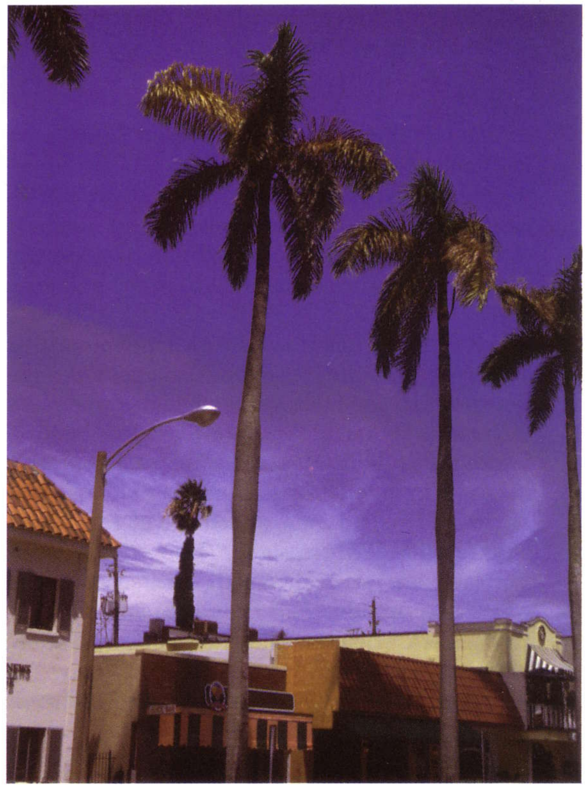
Applied at 42.5 g, imidacloprid costs over US$30 per palm at prices then current. This would be a prohibitive cost in many cases, especially where numerous royal palms are involved. We thus conducted an experiment comparing imidacloprid at approximately the rate tested last year and at two lower rates, and the results are reported in this paper.

Methods

The experiment was conducted on Cuban royal palms growing on Flagler Drive, West Palm Beach, Florida (Fig. 1). This avenue is in the city's central district and borders a large lake, Lake Worth. Soil and other environmental conditions where the palms grown are similar to those in the previous experiment (Howard and Stopek 1998). The 36 palms selected for study each had a trunk height of ca. 14 m and were in a single row at a spacing of ca. 15 m. Four treatments were tested, including imidacloprid at 45, 22.5 and 11.3 g, and an untreated control. We used a randomized complete block experimental design: the palm planting was divided into nine successive groups (blocks) of four palms each. One of the four treatments was assigned randomly to each of the palms in each block, so that there were nine replications per treatment. Merit 75WP (Bayer Corporation) was applied as described previously (Howard and Stopek 1998). The drenches were applied on 17 February 1998. Since royal palm bugs attack young fronds as they are unfolding, damage assessment was conducted by examining the four youngest fronds of each palm for evidence of damage by this bug. We made most of the observations of palm foliage from the ground, frequently using binoculars to study damage symptoms in greater



1. Royal palm bug control experiment, West Palm Beach, August 1998. Untreated royal palm in foreground has royal palm bug damage, while adjacent palms were treated with imidacloprid and were not damaged by the royal palm bug.



2. Royal palm in Palm Beach, August 1998, with severe royal palm bug damage from the past spring.

detail. Occasionally, we verified damage diagnoses by using a hydraulic lift truck to get up into the crowns and examine foliage closely for the presence of royal palm bugs. The palms were examined monthly until August. On that date, a conclusive difference was seen between treated palms and untreated controls. An additional examination was conducted in November 1998 to verify that there was no further bug damage.

The data were tested with a chi-squared test for an association between imidacloprid treatments and the presence or absence of royal palm bug damage.

Results and Discussion

Prior to application of treatments on 17 February, there was no damage due to royal palm bugs. No damage that could be unequivocally attributed to this insect was apparent until 13 May, when bug damage was visible on three of the untreated palms but on none of the treated palms. In June and July, there was indistinct damage that we tentatively diagnosed as royal palm bug damage on four additional untreated palms, but no bug damage on treated palms. [Thus, for the first five months there was no conclusive difference between treatment and controls.] When the palms were examined on 27 August, i.e., 191 days after application of imidacloprid treatments, seven of the nine untreated palms had damage due to royal palm bug. In contrast, the fronds of all of the treated palms remained free of royal palm bug damage (Fig. 1).

Control of some insect pests of palms and trees cannot be achieved by treating individual plants. If, for example, the insect pest is highly mobile, entire blocks may have to be treated, and plants on the periphery of the block may sustain some damage. In this study, the palms free of bug damage, i.e., those that were treated, were 15 m distant from untreated controls which were severely damaged. This indicates that it should be possible to achieve control with the method described here, whether or not the bugs are controlled on nearby palms (e.g., on a neighbor's property).

The fact that two of the untreated palms were not damaged by royal palm bugs was not unexpected. Based on our observations at various localities in southern Florida where large numbers of royal palms are attacked by this bug, usually some of the palms escape damage for unknown reasons.

All of the palms treated with imidacloprid at all three rates were free of bug damage. Since the lowest rate is the most economical, we compared the results at this rate with the untreated control, finding that there was a significant association between imidacloprid treatments at the lowest rate tested and absence of damage by royal palm bugs (chi-square test, $P<0.001$).

Based on research mostly with dicotyledonous plants, imidacloprid tends to accumulate in new growth. (Dr. John Page, Bayer Corporation, *personal communication*). This is probably true in palms, and may be one reason that this chemical was effective against royal palm bug, which feed on the new, opening fronds.

We did not sample bug populations, and therefore did not obtain data indicating how long it took for the treatments to affect bug populations. The appearance of damage would not be an accurate indicator of when the insecticide was effective, because there is probably much variability in the period between when the bugs feed and when the damage becomes visible. Imidacloprid is known to be absorbed and accumulated slowly by many kinds of plants (Dr. John Page, Bayer Corporation, *personal communication*). Presumably, the treatments in this experiment were not effective for at least a month.

The earliest that bug damage was observed was on three palms in May. In August, the damage on most of the untreated palms was on the third youngest frond, and on two to four successively older fronds. The two youngest fronds were free of damage. Since royal palms produce a new leaf approximately once a month (Baranowski 1958), the royal palm bug activity had apparently declined by June. It also appeared that bug feeding was intense on some untreated palms for up to five months, since there were five damaged fronds on some of the untreated palms. Examinations in November revealed that royal palm bug damage had been confined to the spring season, as expected.

It was encouraging that the lowest dosage level was effective. This dosage, 11.3 g, was applied as 15 g (0.52 oz.) of Merit 75W. At current prices, the insecticide at this rate would cost from $7.00–10.00 per palm per year.

The imidacloprid drench treatment that we tested is a preventative treatment. Because the substance is known to be absorbed by plants slowly, the later that it is applied in spring the less effective it may be in preventing bug damage.

Unfortunately, by applying it before damage appears, treatments may sometimes be wasted on palms that would not have been attacked by the bugs, since we know that some palms escape attack. In fact, highly destructive populations of royal palm bugs have been unpredictable, occurring at intervals of variable periods of years (Baranowski 1958, Reinert 1975). In the past several years, the bugs have damaged royal palms extensively each spring throughout southern Florida. Thus, preventive treatments may be worthwhile each spring until we see evidence that this high level of bug activity has diminished.

Royal palms have been planted abundantly in landscapes as urban areas have expanded in southern Florida in recent years, and currently there are probably more of these palms in this region than at any previous time. The present frequency of this palm in the landscape may be one factor influencing the increased activity of the royal palm bug. Additionally, the weather may have been more favorable for this insect. There has not been an extensive, severe frost in southern Florida since 1989.

During the spring season, damage by royal palm bugs may cause complete necrosis on three to six fronds. The fronds produced from summer until the following spring are generally not attacked by this bug. Thus, in late spring or early summer, both the youngest and oldest fronds of a palm that was attacked during the current and previous spring season are necrotic, and the fronds in the middle of the crown are green. The loss of these fronds presumably has a negative effect on the palm's vigor, but this has not been quantified. Certainly, the extensive necrosis caused by this bug is detrimental to the palm's aesthetic value, which is important in urban environments (Fig. 2).

(Continued on p. 181.)

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Where There is no Beer: *Arenga pinnata* and Sagueir in Sulawesi, Indonesia

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Those who have lived or worked in isolated areas of the tropics may be familiar with the classic medical self-diagnosis and treatment guide—"Where There is No Doctor" (Werner 1977). While invaluable, this reference has always seemed to beg for a companion guide—something that reviews locally available alternatives for where there is no beer.

Humans have utilized carbohydrates to make alcoholic beverages since prehistoric times. Corn, wheat, and potatoes are widely used throughout temperate regions, while rice, cassava, and palms are commonly used in the tropics. In Southeast Asia, three palms in particular are widely used for the production of alcoholic beverages: coconut (*Cocus nucifera* L.), nipa (*Nypa fruiticans* Wurmb.), and the sugar palm (*Arenga pinnata* (Wurmb.)Merr.)

In the Philippines, coconut palm beer, known locally as "tuba", is ubiquitous. As the world's premier producer of copra (dried coconut), it is not surprising that tuba can be found in virtually every Filipino village and market, and it is a rare day that doesn't end with villagers clustered around their homes sipping tuba. But the drinking of tuba appears to be primarily a Filipino phenomena; little is consumed in other Southeast Asia countries. Even where coconut is abundant, such as Central and North Sulawesi, the trees are rarely tapped for alcohol.

In swampy coastal areas throughout insular and mainland Southeast Asia, the extensive monotypic stands of nipa palm are tapped to produce a toddy. Brown (1920, citing Gibbs, 1911) reported that over ten million liters of alcohol were produced annually in the Philippines in the early 1900s and over 85% of this was from the nipa palm. Nipa palm is considered to be superior to almost any other plant for the production of alcohol as the sap has a sugar content of 14–17% and can produce up to 15,000 liters of 95% alcohol per hectare (Whitten et al. 1987). Nevertheless, since the end of World War II, the commercial production of nipa alcohol has declined (Mastaller 1997). Today nipa toddy is produced in relatively small quantities in the Philippines and Indonesia.

While coconut and nipa palm toddy are certainly tasty and provide serviceable alternatives to beer, they are, in my opinion, no match to the smooth refined taste of "sagueir," Indonesian for the toddy produced from the sugar palm. Indeed, Burkill (1966) concluded that *Arenga pinnata* is "without rival for toddy". My experience, based on years of sampling and countless tastings, affirms Burkill's observation—sugar palm "sagueir" reigns supreme.

This paper reviews the production of palm toddy as currently practiced in forest villages in Central Sulawesi, Indonesia. I consider how "sagueir" is produced, how trees are managed to maximize and sustain production, and the role of "sagueir" among village households.

Arenga pinnata

The sugar palm, *Arenga pinnata*, is a single stemmed hapaxanthic, monoecious feather palm, 7–12 m tall which occurs from northeastern India through Malesia to the Philippines (Purseglove 1972). In Central Sulawesi, sugar palms are abundant and widely distributed throughout forests and cultivated fields (Fig. 1). If the trees are established, they are retained when forests are cleared for agriculture and thus are particularly common in and around villages. Sugar palms are occasionally cultivated as well, further increasing the density of this stately palm. A typical rural scene in contemporary Central Sulawesi may not differ much from that observed by Alfred Russell Wallace when he resided in

1. *Arenga pinnata* retained in hillside farm, Central Sulawesi.

2. Bamboo ladder used to access *Arenga pinnata* for daily tapping and sagueir transport tube.

3. Sagueir collecting tube being attached to male inflorescence of *Arenga pinnata*; note small bamboo tube (center bottom) that conveys excess sagueir into second bamboo tube.

Macassar (now Ujung Pandang), South Sulawesi in November, 1857. Wallace (1989) observed great quantities of *Arenga saccharifera (pinnata)* throughout South Sulawesi and reported that the palm was used for the production of both beer and sugar. While in Macassar, Wallace stayed with the Mesman family and noted that their palms provided a year-round supply of "sagueir." Unfortunately, Wallace did not comment on how he found the beverage.

Arenga pinnata Sagueir Production

The tapping of *Arenga pinnata* for the production of "sagueir" can commence when trees begin to flower at about 7–10 years of age and the large quantities of starch stored in the trunk are converted to sugar (Purseglove 1972). Only male inflorescenses are tapped as female inflorescenses produce little sap (Burkill 1966). In Central Sulawesi, tappers typically construct a simple bamboo platform and ladder to access the palm crown and facilitate daily sap collection (Fig. 2). Collection of sap begins with the selection of a vigorous male inflorescence consisting of a heavy, stout peduncle with numerous flower spikes. Prior to sap collection, the peduncle is beaten repeatedly for several days with the side of a machete or wooden mallet to stimulate sap flow. Burkill (1966) reports that beating of the peduncle results in the rupturing of internal tissues, creating "something approaching an inflammation" that raises internal temperatures, thereby facilitating sap flow. The end of the peduncle containing the flower spikes is then cut off and the collection begins.

Central Sulawesi collectors utilize pairs of bamboo tubes (approximately 5–7 liters each) for sap collection (Fig 3). The primary bamboo tube has a small hole near the top that is fitted with a smaller bamboo tube which takes the overflow into the second collection tube. The mouth of each bamboo tube is stuffed with thick, dense, black fibers from *Arenga pinnata* leaf sheaths (gamuti fibers, Purseglove 1972) to exclude flies, rats, and fruit bats. The last two are of particular concern because they are very fond of the sap and will consume it all in short order if they are given the opportunity.

Collectors take great care to keep their bamboo tubes as free as possible of bacteria and yeast so as to prevent spoilage and more rapid fermentation of sap into vinegar. The tubes are cleaned daily and several slices of fresh wood are placed in each tube to enhance the flavor and color of the sap, and to retard fermentation. *Schleichera oleosa* Merr. (Bayur in Indonesian) is the preferred wood, but some collectors use *Koordersiodendron pinnatum* Merr. (Siuri) as well. Burkill (1966) observed that bamboo is the least hygienic of possible vessels and that pots or tins are preferable. In recent years, the widespread availability of plastic containers has resulted in a shift away from bamboo in some areas, but most tappers in forest villages on Central Sulawesi continue to use bamboo.

Collectors in Central Sulawesi gather the sap once a day, usually in mid to late-afternoon after completion of other agricultural work. Burkill (1966) reported that tappers visited trees twice a day in the early 20th Century which would probably yield a higher quality "sagueir" with less fermentation. Irrespective of how frequently the sap is collected, each time the tree is visited several millimeters are cut off of the end of the peduncle and it may be be beaten again to maintain sap flow.

A typical *Arenga pinnata* in Central Sulawesi produces approximately 5–6 liters of sap each day and there is reportedly little variation in yield or taste between wet and dry seasons. This is somewhat surprising, but may result from the fact that most of the tapped trees are located near streams or rice paddies and thus are not likely to be affected by reduced water availability during the dry season. Exceptionally large and vigorous trees may produce as much as 10 liters per day. These yields are high in comparison to reported average sap flows of 3.5 liters per tree per day elsewhere (Purseglove 1972). Irrespective of tree size or vigor, there is usually only a single tap per tree. Fresh sap contains up to 15% sucrose (Purseglove 1972) and a single peduncle can be tapped daily for 2–3 months. After three months, collectors report that yields begin to decline and the inforescence dies. At this time, collectors typically select another male inforescence and begin the process anew. Flowering continues without interruption for about two years after which the entire palm dies and a new individual must be selected (Purseglove 1972).

Household Consumption and Sale of Sagueir

The inhabitants of forest villages in Central Sulawesi are primarily Christian (Salvation Army) and thus, unlike their Muslim neighbors, are ready consumers of alcoholic beverages. Young men are the principal consumers of "sagueir," but women and elderly people occasionally partake as well. In the village of Moa, "sagueir" sells for Rp 400 per liter (approximately US $0.05 at the current exchange rate). Most "sagueir" produced in Moa is consumed by households or immediate friends (i.e., it is not sold). However, several households tap two or more trees and produce up to 20 liters each day. These households regularly sell "sagueir," earning up to Rp 8000 daily, which is more than the average daily wage labor rate for agricultural work. Nevertheless, even among these households, "sagueir" contributes a relatively small proportion of total household income and is significantly less important than the production of perennial cash crops (i.e., coffee and cacao) and annual food crops.

Arenga pinnata yields a fine, smooth and refreshing alternative for where there is no beer. "Sagueir" also facilitates simple, inexpensive daily socializing and is a source of supplementary income for some households. While "sagueir," like beer, may be abused by some, particularly teenage boys, its relatively low alcohol content, propensity to ferment into vinegar after a few hours, and limited availability seem to prevent widespread drunkenness. Over the many field seasons I have lived and worked in the forests of Sulawesi, I am certainly grateful for *Arenga pinnata* and my late afternoons sipping "sagueir."

Acknowledgments

I am especially grateful to Daud of Moa for sharing his knowledge and experience, and for consistently producing exceptionally tasty "sagueir." I thank Jill Belsky for helpful comments on a draft of this manuscript. This work was supported by USAID grant HRN-5600-G-00-3047-00.

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(Continued from p. 176)

Acknowledgments

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Centerfold: *Coccothrinax munizii* in its natural habitat, between Cajobabo and Jauco, Cuba. (Photo by Carlo Morici)

Palms, 43(4), 1999, pp. 184–189

Venture to Vanua Balavu: Collecting *Pritchardia thurstonii* in its Native Habitat

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The territorial waters of Fiji cover almost 250,000 square miles of the southwest Pacific Ocean, but just 3% of this is dry land, scattered over more than 300 islands.

Fifty-seven of these islands can be found in the Lau Group, which are themselves scattered over more than 44,000 square miles. These islands lie almost equidistant between the main island of Fiji (Viti Levu, home of the country's capital Suva and its international airport at Nadi) and the neighboring Kingdom of Tonga. As such, the islands of Lau have evolved a unique culture, comprising a blend of Polynesian (from the Tongan influence) and Melanesian (from the Fijian side). Remote and seldom visited by tourists, they remain a pristine corner of this quintessential South Pacific paradise.

Only a handful of the Lau islands are inhabited, and these are home to around 14,000 Fijians (approximately 2% of the population). The geology of the area differs from that of the majority of the other Fijian islands. Most of the Lauan islands are formed from masses of limestone, raised from depths of the ocean by volcanic activity to heights of over 300 m above sea level.

It is largely as a result of this unique geology that this group of islands is home to their very own indigenous palm, the fan palm *Pritchardia thurstonii* F.v. Mueller and Drude. *P. thurstonii* occurs on only a handful of islands in Lau (one of which is inhabited. The others are all tiny limestone islets, many mushroom-shaped). This palm seems to thrive in the apparently inhospitable environments of these small limestone islets, where the environment is hot and dry, with severe erosion from both waves and rain. Amazingly, the palms grow right down to the edge of the sea, and are subject to salt spray from large waves.

P. thurstonii was named after Sir John Bates Thurston, a planter who made the first herbarium collection of this palm in 1886 while visiting the "eastern islands [Lau Group]" of Fiji (*Thurston s.n.* [lectotype MEL, isolectotype K]). He also introduced many ornamental and economic plants to Fiji in a garden he established on Princes Road in Suva, which was later owned by the wealthy Hedstrom family, and is now home to the Australian Embassy. Thurston later became the first Governor of Fiji after the cession of Fiji to Great Britain in the late 19th century. He also has the honor of having Fiji's main botanical gardens named after him, Suva's Thurston Gardens, which are home to a very good collection of both native and non-native palms, including an infamous mature *Pelagodox henryanna* Becc. (Phillips 1996).

Until 1995, only four collections of *P. thurstonii* existed in herbarium collections worldwide. These included Thurston's original 1886 type collection, and three other collections made in 1924 and 1934. Edwin Horace Bryan Jr. collected *P. thurstonii* in 1924. Bryan was a member of the Whitney South Seas Expedition of the American Museum of Natural History, and had the opportunity to make plant collections in Fiji from July to September of 1924. Members of the Expedition went ashore on practically every island in Lau; and even today, some of Bryan's specimens represent the only herbarium material available from several of the seldom-visited Lau islands (Smith 1979). Bryan collected *P. thurstonii* on Ogea Driki (*Bryan 389* [BISH]) and Sovu Vanua Balavua (*Bryan 589* [UC, US]). Then in February 1934, during his first collecting trip to Fiji, Albert Charles Smith visited Fulanga and collected *P. thurstonii* (*Smith 1230* [A, BISH, UC]). For an account of an A. C. Smith's first Fijian collecting trip, see Smith (1934).

P. thurstonii is a moderate-sized fan palm with a grey trunk up to 10 m high with costapalmate leaves, which do not form a crownshaft. The crown of arching leaves usually includes 15–20 leaves up to 1.2 m long. The interfoliar inflorescence is up to 3 m long and exceeds the leaves arching downward. Flowers are small, only 5–7 mm long, and a very distinct pale yellow color. The fruit is also small, about 7 mm in diameter, globose (round) in shape, and red at maturity.

In 1995–96 we were fortunate enough to be living in Fiji's capital of Suva. One of us (DF) was living the student life working on a MSc studying the unique palms of Fiji (Fuller 1997), while the other (EJ) was working as an account manager for a marketing and PR firm in Suva. As part of DF's thesis research it was important to gather up-to-date field data and make new collections of all indigenous Fijian palms. Thus, a trip to Vanua Balavu had been planned for sometime in 1996 before we both left the paradise of Fiji to return to life in the UK. A local friend and fellow IPS member Rob Stone had recommended Vanua Balavu because he had seen *P. thurstonii* in great numbers on the Sovu Islets while captain of his tuna boat. Rob was also kind enough to put us in touch with long-time contacts on Vanua Balavu, which proved invaluable.

In order to visit the Lau Group, one needs to be an invited guest, as tourists aren't generally allowed without prior arrangements. We had arranged through Rob's contacts to stay with the brother of the chief of Lomaloma village (the island's main village) in his guesthouse for the princely sum of around $10 per night.

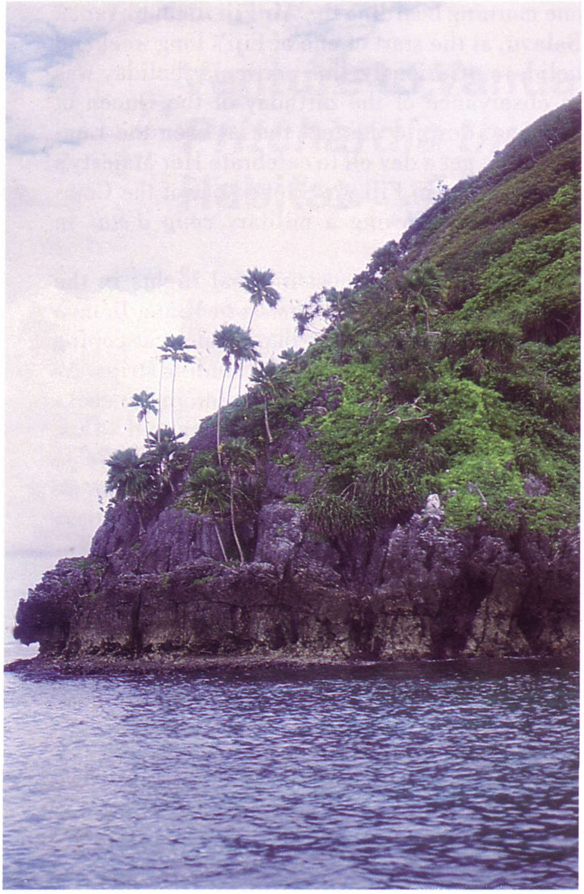
Until quite recently, the islands of Lau were only accessible after a long sea voyage, or on infrequent copra-collecting ships. However, since the late 1970s, four of the islands of Lau have been served by regular air service from Nausori on the main island of Viti Levu. These include Vanua Balavu, in whose lagoon lie the tiny Sovu Islets, which are home to this elusive palm. Inquiries were made through the office of Air Fiji, one of two airlines operating in this part of Fiji, and so we were booked on one of the three weekly flights to Vanua Balavu for late February 1996. Fulanga and Ogea Driki remain accessible only by charter boat or charter amphibious plane.

And so it was that we found ourselves early one morning boarding the Air Fiji flight to Vanua Balavu, at the start of one of Fiji's long weekend holidays. (Curiously, this particular holiday was in observance of the birthday of the Queen of England, despite the fact that a) even the English don't get a day off to celebrate Her Majesty's birthday and b) Fiji was kicked out of the Commonwealth following a military *coup d'etat* in 1987.)

In common with most internal flights in the country, the aircraft to ferry us to Vanua Balavu was a Twin Otter, a make that is adept at coping with even the roughest of grass landing strips. As we boarded, our pilot could be seen in the cockpit, checking his flight plan. He turned to us, eyes bloodshot and weary, and inquired, "We go to Labasa today?" We all panicked slightly as we realized we must be on the wrong flight (Labasa is the main town on Fiji's second island, in an entirely different direction from Vanua Balavu). "Errr, we thought we were going to Vanua Balavu?" The pilot checked his flight plan and sighed. There was a long pause and then he started to nod his head. "*Io* [yes]. We go to Labasa tomorrow." Thus reassured, we taxied down the luxuriously smooth tarmac of Nausori airport and were soon airborne, leaving behind us the rain-soaked island of Viti Levu.

An hour and a half later, the island of Vanua Balavu and its surrounding islets came into view. These islands were named "The Exploring Isles" by Captain Charles Wilkes in 1840, after the official title of his famous U.S. Exploring Expedition (Derrick 1957). From the air, the main island looks something like a boomerang. We could see that it was covered in lush grassy hills with sheer limestone cliffs, giving way in places to sandy, coconut palm (*Cocos nucifera*)-fringed coves. The surrounding lagoon could be seen stretching out for several miles—clear, still turquoise waters broken eventually by the reef, identified by a thin line of surf in the distance.

Our landing was surprisingly smooth given the fairly rudimentary runway. On disembarking, we soon determined that our ride to town was waiting for us, in the form of a tractor and trailer. (Fortunately for us, one member of our group, Chris, had spent two years working in a Fijian village as a Peace Corps teacher, and was fluent in Fijian. While Fijians all learn English at school, the official language of the country, any efforts to converse in Fijian are greatly welcomed.)



1. *Pritchardia thurstonii* dominates the vegetation on Sovu Levu.

The journey to the main village, Lomaloma, took around 20 minutes. Along the way we saw hundreds, maybe thousands of coconut palms. Lomaloma was Fiji's first port, regularly visited by sailing ships trading in the Pacific. In its heyday during the 1860s and 70s, it had many hotels, shops, and Fiji's first botanical gardens. Today, little remains of its grandeur—there are no hotels, and the botanical gardens have largely reverted to their natural state (although we noticed a few cultivated individuals of both *P. thurstonii* and *P. pacifica* palms on the site of the old botanical gardens, now used as school playgrounds).

Just one store remains, selling essential items only, and there are no banking facilities to be found anywhere in the Lau group. However, the village was immaculately kept, with manicured lawns and flowering bushes planted at regular intervals along the road. The single-story houses were whitewashed and the roofs constructed either from traditional thatch or the increasingly popular corrugated iron, painted in bright colors. The village runs along the seashore and coconut palms dominate, swaying in the breeze to complete the picture—one that could grace the cover of any tourist brochure. Brightly colored fishing boats were moored in the bay, and men and women could be seen searching the low tide mark for sea urchins (a delicacy when baked over hot coals).

In addition to its store, Lomaloma has one school, a rugby pitch, and two churches. It also has a cooperatively owned copra mill, which makes the whole village smell of coconut. Coconut oil became an important commodity in the mid-19th century, as demand for edible oils expanded to Europe. Lauans had been producing coconut oil for domestic consumption, as well as for their trade with Tongans, long before this commodity was in demand in Europe. By the mid-19th century, a barter-type exchange was set up, whereby coconut oil was traded by Fijians for iron, cloth, etc. supplied by European traders. Copra is still one of the islands' most important products, although trade has suffered recently from the international decline in copra prices (Bayliss-Smith et al. 1988).

Our driver took us to the home of our hosts *Ratu* Delai Lomaloma (*Ratu* is a Fijian title given to people of chiefly status) and his wife Ilisapeci (the Fifian form of Elizabeth, pronounced Elisapethi). Our accomodation was a traditional style *bure* (house) with thatched roof, although the rounded roof bore more relation to a Tongan house (or *fale*) than a Fijian *bore*. In fact, the Tongan influence on the local culture is very apparent. In the mid-19th century, Tongans conquered the island and built the village of Sawana next to Lomaloma. Fifth-generation Tongan descendants still live in Sawana. Tongan place names are common throughout the Lau Group, and a uniquely Lauan dialect has developed, a sort of Fijian with sprinklings of Tongan pronunciation.

Shortly after arriving we approached our hosts' main house, and having been invited in (after removing our shoes—it is considered very rude to wear footwear inside any building), we presented the Ratu with a *sevusevu* (a ritual present) of dried *yaqona*. *Yaqona*, or kava as it is more commonly known, is an infusion prepared

2. *Pritchardia thurstonii* along the shore on Sovu Levu.

3. Close-up of *Pritchardia thurstonii* on Sovu Lailai.

from the mildly narcotic root of *Piper methysticum*. As paying guests, there was no obligation for us to make such a presentation. However in Fijian tradition, it is customary for any guest to make such an offering, and the gesture is greatly appreciated. Kava is prepared in the ceremonial *tanoa* bowl. The powdered root, wrapped in a piece of cloth, is mixed with water to produce a liquid that looks like muddy bath water (and tastes not too dissimilar). The drink is passed around in *bilos*—cups made from half a coconut shell. After a couple of *bilos*, one feels disinclined to do anything much, other than sit and talk.

Dinner that evening set the tone for our stay. Fijians are generally not renowned for their gourmet cooking, and on the main islands in particular, the traditional diet of fresh fish and fresh vegetables is spurned in favor of tinned fish, corned beef and easy-cook noodles. Mercifully, this trend has yet to spread to Vanua Balavu. We were presented with a feast of reef fish, fresh from the sea and baked in coconut milk, with breadfruit, *dalo* (a starch-filled tuber) and *rourou* (similar to spinach). There was food enough for a small army, and Ilisapeci urged us to second and third helpings, exclaiming that we would surely never find husbands or wives if we didn't put on some weight. (In Fiji, big is beautiful—a refreshing change from the diet-obsessed western world.)

Over dinner we discussed our plans for collecting *P. thurstonii*. *Ratu* Delai suggested that his brother, Timo (short for Timoci), who owned a fishing boat, might be able to take us out to the Sovu Islets the following day. Permission had first to be sought from our hosts' cousin, whose family owns the island. In Fiji, the ease with which you can get things done is very much a question of who you know. But as long as you know someone you'll probably get by—everyone seems to be related somehow. Such permission was duly sought and obtained. We had already found that obtaining permission for trips like these tended to be a formality. However, the Fijian culture is steeped in ritual and tradition, and failure to observe the etiquette could cause serious offense.

We negotiated with Timo for our trip to the islets. He agreed to take us out to the islets for around $50, in his 18-foot fishing boat powered by a single 25-horsepower engine. Alarmed by the whiteness of our skin and the intensity of the sunshine, Ilisapeci insisted on lending us each one of her home-made hats, woven locally from *Pandanus.* As the sun bore down on us during the two-hour outward trip we all took shelter under our hats, which we tied on with sarongs to prevent the sea breeze from whipping them off us.

As we approached the islets, we could begin to make out clusters of the fan palms we had come to see. It soon became apparent that there was no shortage of these palms, which dominated the vegetation on two of the three tiny islets (Fig. 1). Each islet had razor-sharp limestone cliffs, and the shore was undercut by wave action which had formed a shelf above the tide zone, from which palms apparently grew out of the bare rock. The largest of the three islands (Sovu Levu) was very steep, measuring less than 500 meters long while reaching an elevation of over 100 meters.

We stopped the boat a few feet from the shore of Sovu Levu, but the actual shore was about 2 meters above the boat and with waves crashing around us in the shallow water, so Timo pulled the boat out from the shore about 10 meters distance. Thus, DF had to swim for the island carrying his boots and shirt in a plastic bag and try climbing up the extremely sharp, undercut limestone shoreline. Having managed to get to the first ledge wearing only sport sandals, he then changed into proper hiking boots. While sitting on the ledge it became apparent why the locals don't spend much time on Sovu Levu, as a massive swarm of starved mosquitoes descended and started biting. Quickly, DF climb up to the second level ledge and found a spot where he could reach the top of a palm growing on the bottom ledge below. He was able to make a collection of a complete inflorescence with flowers in bud and two leaves. Retreating down the ledges proved harder than going up, so he dropped the specimen in the water and jumped in swimming for the mosquito free zone of the boat, pulling the now wet specimen with him.

We circled Sovu Levu in boat and did a census of mature trees, counting over 300 adult trees on this one tiny islet (Fig. 2). However, it was noticeable the lack of immature trees and seedlings, indicating that recruitment may occur rarely or over a long period of time.

Next, we broke for lunch on the beach of the second largest islet called island Sovu Lailai, which was also home to a colony of blue-faced boobies. These birds have rarely seen people and were nesting in bushes at eye level. They seemed entirely unperturbed by our presence, allowing us to photograph them from a few feet away. One immature youngster bore an uncanny resemblance to Sesame Street's Big Bird (though not quite the same color).

After lunch we took some time to snorkel just off the island. The reef contained some of the most beautiful soft corals anyone of us had seen, with a multitude of fish in all myriads of color and a profusion of giant blue clams. These flawless corals provided a dramatic contrast to many of the dead and grey sections of reef that can be found close to some of Fiji's tourist resorts, where damage from reef walkers and careless divers has killed off large quantities of coral. The sight of a small reef shark sent us scurrying back to the beach.

Sovu Lailai only had a small number of *P. thurstonii* trees growing on it and these were not the dominate tree species, as this is a flatter islet with richer soil due to the nesting bird colony, this seemed to make sense (Fig. 3). The majority of the 25 or so adult trees were growing on the steeper north side of the islet.

After our lunch break we headed to the third and smallest Sovu islets, which is called Sovu Lailai Lailai. This islet is even steeper than Sovu Levu, but about one-third as big and completely dominated by *Pritchardia* palms. The first level of the limestone was less than a meter up, but was deeply undercut by the ocean waves. Three of us scurried up this time to the first ledge of the islet. Unfortunately we found the rest of the limestone cliffs on these islet to be impenetrable and so we couldn't make another collection. We noted that next time we would need to bring a ladder and some proper climbing gear in order to reach the palms safely.

Once back in the boat from Sovu Lailai Lailai, we could see an enormous thunderhead storm gathering on the horizon. Timo, turned the boat around and headed back for Lomaloma as quickly as the small engine would take us. However, just minutes into our journey, the storm was upon us and we all got thoroughly drenched. The small boat seemed at times to be in danger from filling with rain water, and we took turns frantically bailing out as much of the water as we could using whatever receptacle came to hand.

Luckily, the sun soon reemerged and the rest of our stay was dry and bright. We spent our other days on Vanua Balavu exploring the main island and chartering Timo and his boat to take us to the Bay of Islands—another smattering of stunning mushroom shaped islets covered in lush vegetation including the cycad species *Cycas rumphii* f. *seemannii.* The only other palm species we saw on Vanua Balavu other than coconuts was *Veitchia joannis* growing on the highest slopes of Korolevu the tallest peak, which reaches about 250 m in elevation. One fascinating thing we did observe on Vanua Balavu was fruit bats feeding on the flowers of the coconut palms.

At the end of our trip we found ourselves reluctant to return to the (relative) hustle and bustle of Suva. Ilisapeci and Delai escorted to us to the airport, where we had to endure the indignity of being publicly weighed before we could board the aircraft. We tried to blame it on the scales, but it appeared that we had each managed to gain a few pounds during our short stay, thanks to our hosts' breadfruit and coconut fish. As our Twin Otter aircraft trundled down to the end of Vanua Balavu's grass airstrip, we waved farewell to Ilisapeci and Ratu Delai who stood grinning by the side of the runway, delighted that they had managed to substantially improve our marriage prospects in such a short space of time.

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1, 2: *Coccothrinax munizii,* in its natural habitat, photographed at the end of the rainy season, Cuba.

Palms, 43(4), 1999, pp. 190–193

Coccothrinax munizii

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Coccothrinax munizii, from the southeastern tip of Cuba, is one of the most unusual palms of the subtribe Thrinacinae. It grows in a place where nobody would expect to find a palm, a hot and dry strip of soilless coral rock and has developed some features that its relatives lack (see centerfold).

Why so Peculiar?

With its leaves so small and very narrow, it is a most unusual looking species of *Coccothrinax* (Figs 1, 2). The genus *Coccothrinax* displays a great diversity of leaf shapes and one of the distinctive characters is the degree of orbicularity of the leaf (i.e., the portion of surface of a hypothetical circle covered by the leaflets). *C. munizii* leaves are only 1/3 orbicular, some other species cover the whole circle with their segments touching the petiole and a few even overlap the outermost leafets, covering up to 5/4 of the circle. *C. munizii* leaves are also stiff and silvery and the sheath has hardened spinelike extremities. The stem is one of the thinnest of the genus and can be only 5 cm in diameter (Fig. 5) and more than 10 m tall.

These features of leaf and stem are probably adaptations to the xeric habitat. *C. munizii* is one of the most obviously xeromorphic of all palms, showing adaptations to very warm, dry and windy conditions. It is the dry extreme of a whole range of variation found in the polymorphic genus *Coccothrinax*.

The most striking characters of its reproductive parts, quite rare in the genus, are the homogeneous endosperm and the muricate, or minutely warty, ovary and fruit.

C. munizii, together with its Hispaniolan counterpart, *C. ekmanii,* stand alone in subsection *Haitiella* of the section *Coccothrinax.* Recently, Henderson et al. (1995) suggested to reduce dramatically in size the genus *Coccothrinax* and proposed the synonymy of *C. munizii* Borhidi with *C. ekmanii* Burret, from Hispaniola.

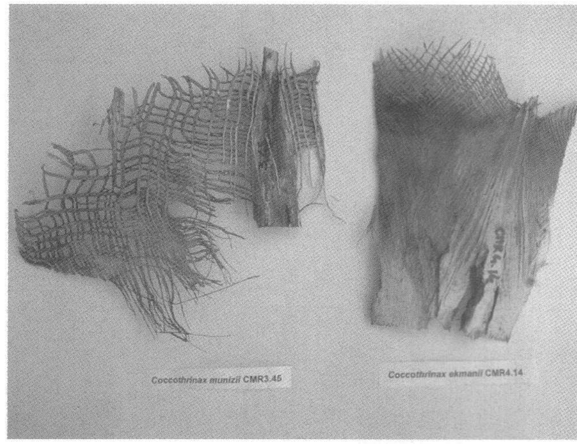
C. ekmanii is a more widespread species, maybe less abundant, from limestone soilless areas of Hispaniola. The most striking difference I have noted between the two species is that the sheath fibers of *C. ekmanii* are much less robust than those of the Cuban species (Fig. 4). Whether this is sufficient to retain the two as distinct species seems doubtful but, until a detailed study is carried out, I feel it better to continue to use *C. munizii* for the palm from Cuba.

Its Native Habitat

Coccothrinax munizii grows in a narrow strip of coast in the southern part of the Guantánamo Province, where the average yearly rainfall is only 700 mm and the average annual temperature is 27–28°C (80–83°F) (Inst. Cub. de Geod. y Cart 1978 and Borhidi 1991). Furthermore it is restricted to the dogtooth rock of the "terrazas levantadas". These sea-facing limestone slopes are ancient coral banks which have been tectonically uplifted to different levels and then partially eroded. From a close view, they still look like coral reefs taken out of the water, but seen from a distance they resemble a giant staircase with 30–100 m tall steps. The most striking fact (for a plant) is that they harbor very little soil (Fig. 3). The scant vegetation that share these cliffs with *C. munizii* is mostly composed of specialized xerophytes, such as *Agave albescens* Trelease, *Melocactus harlowii* (Britt. & Rose) León or *M. acuñai* León and the pachycaulous shrub *Plumeria lanata* Britt. Borhidi (1991, p. 567) listed the most abundant/dominant species that grow in this plant association of xeric limestone.

Two more *Coccothrinax* species grow in the same low rainfall area; *C. hioramii* grows on the nearby hills on sandy soil and the other species, as yet unidentified, grows at the bottom of the terraces, where soil accumulates. Neither of

3. *Coccothrinax munizii*: a young plant growing in a fissure of the limestone.



4. Fibers of *Coccothrinax munizii* compared with those of *C. ekmanii* in the Herbarium ORT (Tenerife).

these two species shows the extreme adaptations of the soilless specialist *C. munizii.*

Adaptations to an Exposed Habitat and Comparison with *Thrinax ekmaniana*

Curiously but not surprisingly, the most xeromorphic *Coccothrinax* shares some characters with the most xeromorphic species of the genus *Thrinax,* which is *T. ekmaniana* (Burret) Borhidi & Muñiz, also from Cuba. They both have extremely thin trunks and wedge-shaped leaves. Also their seeds are very small, between 3 and 4 mm in diameter and their eophylls (the first leaves of the seedlings), as observed in plants grown at the Palmetum of Santa Cruz, barely exceed 1 mm in width. Eophylls of all the other Caribbean Thrinacineae that I sampled (18 species) are about three times larger, between 3 and 6 mm wide (except *T. compacta* which has eophylls 2 mm wide and a few species with much wider eophylls). *Coccothrinax boschiana,* a new species from Hispaniola described in 1997 by M. Mejía and R. García, is another saxicolous specialist from exposed locations. Its eophylls are as thin as those of *T. ekmaniana* and *C. munizii.* The eophylls of these three species are the thinnest I have observed in palms. *C. munizii* and *T. ekmaniana* in their habitats probably are among the slowest growers of the palm family, but no demographic studies have been published. The tallest specimens of *C. munizii,* that exceed 10 m in height, could be very, very old.

Conservation Status

C. munizii is probably in the safest place in the island. The driest area of Cuba has the lowest human density and the lowest population growth (Inst. Cub. de Geod. y Cart 1978). *C. munzii* is the only Cuban *Coccothrinax* that I have seen that grows near a road and shows no signs of exploitation. The whole environment is apparently intact and pristine and the distribution area is sufficiently large—about 50 km long and, in some places 5 km wide. The palms grow on the "terrazas levantadas" by the thousands and are doubtlessly non transplantable for marketing as their roots are tightly anchored within the solid rock. The only apparent menace to *C. munizii* is the possible introduction of alien weeds. A weedy grass, *Pennisetum setaceum,* is causing problems to the native vegetation of the dry parts of the Canary Islands. This species, or a similar one, could spread quickly in the semi-desert areas of Cuba and fill all the fissures in the rock where *C. munizii* seedlings get established.

Acknowledgments

The financial support from the Palmetum of Santa Cruz de Tenerife to conduct the field trips to Cuba and the Dominican Republic is gratefully acknowledged. I wish also to thank Dr. Carlos Pérez Morales, director of the "Centro de Extensión Agrícola" of Santa Clara and the staff of the Botanical Garden of S. Domingo who helped to locate *T. ekmaniana* and *C. boschiana* populations respectively.

5. *Coccothrinax munizii:* thin trunk of an adult plant.

6. *Coccothrinax munizii:* detail of the thick sheath fibers.

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PLEASE Contribute to the Horticultural Column

Members are invited to contribute, or make suggestions for the Horticulture Column. I also invite members to submit horticultural questions and answers. I'll try to respond to all the questions personally, whether they are used in the column or not, and as quickly as possible in case prompt action is necessary.—Bernie Petersen

Palms, 43(4), 1999, pp. 194–199

Satakentia Revisited

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Japanese palms are not numerous, essentially confined to the southernmost archipelagos of Bonin, Volcano, and Ryukyu, but are nevertheless quite interesting and to some extent, still not well known. The most widespread of them is *Livistona chinensis,* represented by different varieties in each island group. However, apart from *Livistona chinensis* var. *boninensis* which is widespread and very abundant in the Bonin Islands and distinctive in the large, obpyriform, glossy green fruits, the other varieties are undescribed (a putative one in the Volcano Islands) or of doubtful if not unknown origin (Moore and Fosberg 1956). Since *Livistona chinensis* is one of the most widely cultivated palms, it should deserve further investigation. Another distinctive and elegant palm from this region is *Clinostigma savoryanum,* endemic to the humid uplands of the Bonin Islands. *Clinostigma,* one of the most widespread Pacific palm genera, reaches its northern limit there, well north of the Tropic of Cancer. The most striking Japanese palm, however, remains undoubtedly *Satakentia liukiuensis.* This massive palm, described as a distinct and monotypic genus by Moore in 1969, is confined to two nearby islands, Ishigaki and Iriomote, in the southern Ryukyu Islands, close to Taiwan. Three decades later, a bronze plate honors the work of H. E. Moore, Jr., at the entrance of a paved trail leading to the largest stand of *Satakentia* at Yonehara on Ishigaki island. The site is declared as a National Treasure and is the island's major tourist attraction. Each day, hundreds of Japanese tourists, brought by big buses, come to admire the famous palm and learn from the preserve's guides, the story of *Satakentia.* The palm is also increasingly planted along streets, roads, and in gardens all around the island, of which it has become the emblematic tree.

Satakentia is typically a Pacific element, curiously endemic to these small islands that otherwise bear an essentially Asian flora, including *Arenga engleri,* as far as palms are concerned. Since the study of Moore, *Satakentia* was believed to be closely related to and scarcely distinct from *Clinostigma* (Moore 1969, Uhl and Dransfield 1987). However, during the course of field studies on both genera in February, 1997, it appeared to us that this was highly questionable, and that, on the contrary, these two genera were probably quite distant within the large and diverse subtribe Iguanurinae, to which they belong. The palm that we collected on Ishigaki island (*Pintaud & Setoguchi 447,* K) had an inflorescence enclosed in its bracts, showed a flattened and bicarinate prophyll much shorter than the protruding first peduncular bract (Fig. 1 A,B), this one complete, rostrate and including

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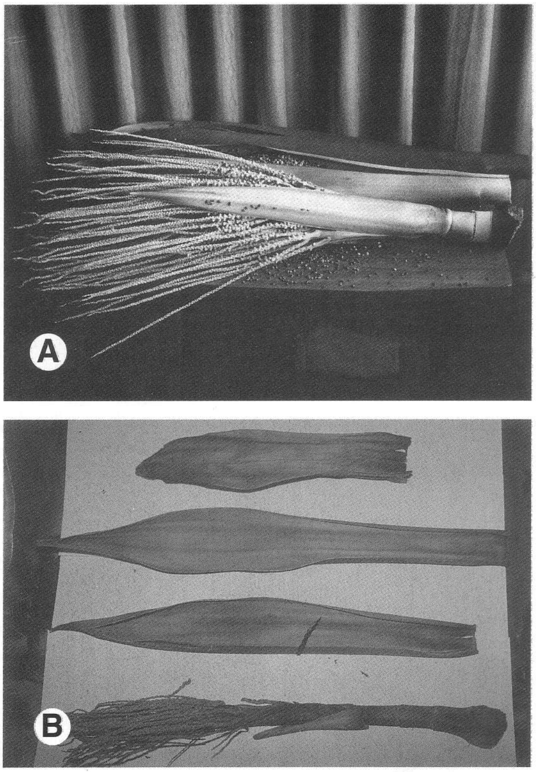
→

1: Four portrait pictures 1 A, B. Well developed crownshaft of *Satakentia liukiuensis* with a chartaceous ligule in the distal part of the leaf sheath and infrafoliar inflorescences with short prophyll and protruding first peduncular bract. (Pintaud & Setoguchi 447). 1 C. (Moore's 1969 Fig. 5). Individual with numerous infructescences and an inflorescence in bud showing first peduncular bract splitting abaxially and second one inside (Moore et al. 9382). 1 D. Gregarious population of *Satakentia* at Yonehara, Ishigaki island.


A
B
C
D

a second, also complete and similar peduncular bract, and a third and even fourth, incomplete but prominent additional ones (Fig. 2 B). This condition was different from that described by Moore (1969) who stated that the inflorescence of *Satakentia* had a complete, rostrate prophyll enclosing a similar first peduncular bract, like *Clinostigma*. He noted however, the large additional, incomplete, peduncular bracts. The reason for this discrepancy is obvious when looking at Moore's picture showing the inflorescence and its bracts (Fig. 2 A). Compared with our Figure 2 B, it is clear that the prophyll is missing in Moore's collection (*Moore et al. 9382*). In fact, the inflorescence bud collected by Moore was at an advanced stage of development, after the falling of the prophyll, since the first peduncular bract had already split abaxially, exposing the second one, on the tree collected by Moore (Fig. 1 C). What Moore called the prophyll corresponds evidently with the first peduncular bract of our collection and therefore Moore was misled in interpreting the inflorescence structure. Moreover, the inflorescence from Moore's collection deposited at BH shows three annular scars, the first corresponding with the overlooked prophyll and the following ones to the two complete peduncular bracts. Another collection made on the mature tree of the Tsukuba Botanical Garden's glasshouse (*Pintaud & Higuchi 448*, K) showed the same inflorescence structure as in our first collection on Ishigaki, proving that it is constant and diagnostic. Only the size of the incomplete additional peduncular bracts is variable, as noted by Moore (Fig. 2 A,B). This inflorescence structure is very rare in Iguanurinae, since it is found in only one other palm, *Carpoxylon macrospermum* (Dowe and Uhl 1989, Dowe et al. 1997), endemic to Vanuatu. It is also very different from that of *Clinostigma* which really has a prophyll enclosing a similar first peduncular bract, followed by 2–3 inconspicuous, ridge-like bracts. There are a number of other differences between the two genera, which are summarized in Table 1. So, with this new information, what are the affinities of *Satakentia* and *Clinostigma*? A cladistic analysis of the whole Iguanurinae based on morphological characters (Pintaud, 1999) suggests that *Satakentia* is a rather unspecialized and isolated member of the subtribe while *Clinostigma* belongs to a more derived group including *Carpoxylon* which has already been recognized as close to *Clinostigma*



2 A. Dissected inflorescence (Moore et al. 9382) showing complete first and second peduncular bracts and incomplete but very prominent third one, the prophyll is missing (Fig. 3, lower, in Moore 1969). 2 B. Dissected inflorescence (Pintaud & Higuchi 448) showing from top to bottom prophyll, first and second complete peduncular bracts and the third one, much reduced.

(Dowe and Uhl 1989). Therefore, the similarity in inflorescence structure between *Satakentia* and *Carpoxylon* should be regarded as a convergence rather than as a sign of a close affinity.

Ecology of *Satakentia*

Moore said about the Yonehara grove in Ishigaki that "these trees appear to be essentially the same age and have probably grown from seedlings left when mature palms were cut for the cabbage or edible bud during World War II" while the trees he saw on Iriomote "were larger than those at Yonehara and very impressive, being in an undisturbed habitat away from evidence of human activity." In fact, Moore's statement about the Yonehara stand is incorrect. There is evidence that this grove is also natural and not the result of human disturbance. Moore's

Table 1. Synopsis of differences between Satakentia *and* Clinostigma.

	Satakentia	*Clinostigma*
Roots	slender, exposed to form a very prominent root-boss	thick, robust, not exposed or variously exposed, often forming stilts
Ligule of sheath	very prominent, chartaceous	inconspicuous
Ramenta on midrib on abaxial surface of pinnae	medifixed, twisted, brown	medifixed, flat, closely appressed to the lamina, membranous-transluscent
Peduncle of inflorescence	slender, elongate	very short, inflated
Indument of inflorescence	very shortly but densely brown -lepidote-tomentose	inflorescence glabrous
Prophyll	much shorter than first peduncular bract	similar to and enclosing first peduncular bract
First peduncular bract	thick, woody	thin, herbaceous
Second peduncular bract	complete, rostrate, enclosing the inflorescence in bud	very small, much reduced, often to a low ridge
Third and forth peduncular bracts	incomplete but very prominent, chartáceous	inconspicuous or lacking
Rachillae	rather stout	very slender
Triad bracts	rounded	acuminate
Second bracteole	sepal-like	not sepal-like
Third bracteole	rounded	deltate
Staminate bud	nearly symmetrical	markedly asymmetrical
Staminate sepals	rounded	lanceolate
Staminate petals	boat-shaped	deltoid, nearly flat
Pistillode	as long as stamens, swollen, capitate	very short, broadly conical, trifid
Staminodes	3	(5-) 6
Perianth residue on fruit	prominent	small

picture (Fig. 3 B), shows a part of the Yonehara grove with numerous *Satakentia* emerging above the forest canopy, just as it is today (Fig. 3 A). Palms which germinated during Word War II are quite unlikely to reach such a size after 20 years and the fact that the trees present today are not taller indicates that they were already mature when the photograph was taken in 1966, and that the population is stable. Moreover, *Satakentia* presents a gregarious syndrome similar to that described by Pintaud and Hodel (1998) for *Kentiopsis* species growing in natural conditions in New Caledonia: a dense population of mature trees of similar size (and probably age) with little juvenile establishment beneath due to continuous fall of dead leaves and synchronous phenology of all individuals with production of massive amounts of small fruits with readily germinating seeds. The gregarious behaviour of *Satakentia* is also evident in clearly undisturbed conditions on Iriomote, as illustrated by Moore (Fig. 3 C). The establishment of each stand of *Satakentia* has occurred over a very limited time span, and there are stands of different ages as Moore noticed. The factors initiating these major periods of regeneration are not certain. It is possible that the establishment follows large tree fall gaps or landslides caused by the frequent typhoons which affect the island. When an open area appears, the Satakentia palms might be able to colonize it rapidly due to their efficient reproductive system. In normal conditions, there is insufficient regeneration to allow the future replacement of the existing trees, the numerous seedlings that germinate each year are killed by the dead leaves of the adults within the stands and are also usually unable to establish themselves in the dark understory of the adjacent rain forest.

Conservation Status

The extent of *Satakentia* in Ishigaki is very limited. It occurs only at the Yonehara site, with a main area of gregarious patches and scattered, isolated trees not far away, in rain forest on sandstone hill slopes. Remnant small patches of forests on the flat lowlands including some *Satakentia* and isolated remnant trees indicate that

3 A. The *Satakentia* grove at Yonehara as it is today. 3 B. The same grove photographed by Moore in 1966 (Fig. 2 in Moore 1969). 3 C. A gregarious stand of *Satakentia* on Iriomote, photographed by Moore (Fig. 9 in Moore 1969).

the species was formerly more widespread in these areas which are nowadays mostly converted to sugar cane fields or otherwise very disturbed and devoid of natural vegetation. The forests on the island are only conserved on hill slopes which are not suitable for cultivation. The remaining population at Yonehara is protected as a National Treasure but the boundary of the preserve includes only the main grove and should be extended in order to include all the forested area where *Satakentia* is likely to occur and regenerate. This is particularly important for a gregarious species showing probably the most active regeneration after unpredictable natural events which can affect any part of its actual or potential habitat.

On Iriomote, *Satakentia* occurs in isolated, mostly gregarious populations in undisturbed forest, the island biota being much less alterated than in Ishigaki, and declared as a National Park. In conclusion, we can assess the conservation status of this palm as Low Risk but Conservation Dependant (LRcd) according to the new IUCN Red List categories (1994).

Acknowledgments

We are grateful to Dr. Masanobu Higuchi for assistance in Tsukuba Botanical Garden, to the Tokyo Metropolitan University for facilities to work in Japan for JCP, to Natalie Uhl at the L. H. Bailey Hortorium, Cornell University, where Moore's collections were studied, to John Dransfield for suggesting the title and to the redaction of Principes for reprinting the pictures from Moore's article on *Satakentia.*

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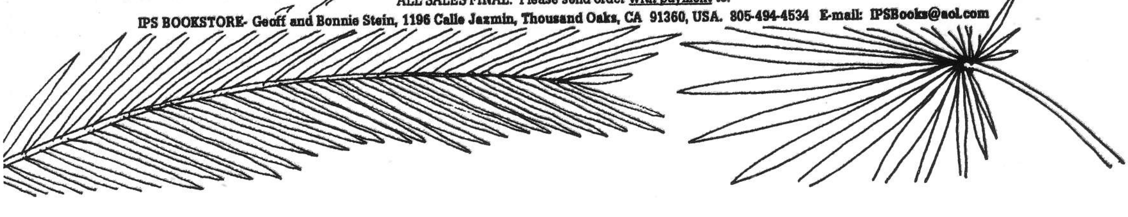

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HORTICULTURAL COLUMN

Growth Rates—is it a Tortoise or a Hare?

BERNIE PETERSON
2410 Stanford St., Cocoa, Florida 32926

Have you ever been asked to describe the growth rate of a palm in terms of feet or centimeters of height per year? Anyone who has been involved with horticulture for any length of time knows that plants do not usually grow at a measured pace, and that some grow faster than others, and some have a surprisingly irregular pace of growth.

For the past twelve years or so I have observed two palm species in my yard in central Florida that seem to have very different growth rates; *Copernicia alba* and *Sabal mauritiiformis*. *C. alba* is the southernmost member of its genus and is found in southern Brazil, Paraguay, Bolivia, and northern Argentina, it is the only *Copernicia* which occurs naturally outside of the tropics. It is not surprising then that it is the most cold hardy of the genus *Copernicia*, and it is the fastest grower as well. *S. mauritiiformis*, on the other hand, is the most tropical species of a genus of tough and often very cold-hardy palms. *S. mauritiiformis* is native to parts of Central America and northern South America.

C. alba grew rapidly in my back yard, almost from the time it was planted, and began to form an above ground trunk in only one year or two, the only other fan-leaved species that I know which forms an above ground trunk so quickly are the two species of *Washingtonia* and *Livistona decipiens*. Since *C. alba* is a smaller palm than those other fast growers, it has great potential as a landscape plant.

The early development of my *S. mauritiiformis* was very slow. Young sabals have an underground stem which somewhat resembles a saxophone in shape and which is sometimes referred to as a "tillering heel". Sabals can spend quite a few years at the rosette stage of development as their tillering heel grows larger and plows a foot or two downwards and to one side before they begin to produce a woody above-ground trunk.

For a number of years there seemed to be no contest in a race between *C. alba* and *S. mauritiiformis*. The *Copernicia* was adding about fifteen inches of trunk per year and had grown to about 14 feet, a quick measured pace that will slow when it reaches flowering size. Meanwhile the *Sabal* seemed a laggard, it was green and healthy, and produced new leaves regularly but it had increased in size by only a few feet after 8 years. During the summer of 1997 with its below ground development complete, and its resources gathered the *S. mauritiiformis* began to make its move, and now only two years later the once tortoise-like *S. mauritiiformis* is overtaking the *C. alba* in overall height and probably will provide shade for it in 2000. In this case both species could be considered fast-growing as long as a time frame of a decade or so is provided.

All of us observe the plants in our own gardens casually and over a period of years, one person's casual observation may help another understand what is happening with one of the palms. Share your experiences with us.

Q. Should soil amendments be used when planting a palm in the ground? Libby Besse, Florida

A. The old adage was to "plant a 50 cent tree in a five dollar hole", or in other words amend the soil to a great degree and even a small tree, or palm will thrive. It is doubtful whether this old adage is worth following, however. There have been a number of field tests which have sought to determine whether the addition of soil amendments actually help a young plant become established. The tests in general fail to prove any benefit from the use of soil amendments, but in most cases there was no harm done by them either. As far as I know palms were not included in these tests.

One thing that is known for certain is that it is a bad practice to amend the soil beneath the roots of a newly planted palm, the organic amendments will decompose and the disturbed soil will settle with the result that the palm will settle to a lower position. Also, drainage problems or root suffocation could be the result. It is best to try to dig the hole in such a way that the plant will be at the correct depth, and to simply use the soil which came out of the planting hole to fill around the roots of the new plant. It is acceptable to loosen the native soil around the planting site, if it is compacted to allow for root penetration. The most valuable amendment to most planting sites will be water. Organic matter can be provided in the form of mulch applied over the root zone of newly planted and existing palms. This is the way that soils in the forest are enriched with organic matter. There may, of course, be situations where soil amendments are useful; for adjusting ph for example, and in some cases even soil replacement is called for.

Horticulture can be a little like cooking; some of us have recipes that we have used for years and which have given results which we are satisfied with. There's probably no need to change your recipe simply because a test somewhere has shown it to be less than ideal. The important thing is that it works in your case. I stopped using soil amendments years ago although my soil is very poor; I spend that extra money on the best available fertilizers and I mulch my plants. I think I get good results.

Q. I bought a Coconut palm, on a whim, while on my honeymoon in Maui two years ago. I kept it in a shallow container of water where it has consistently grown new leaves. Recently, I planted it into a large pot with soil composed mostly of potting soil, but with some sand and organic compost added. "Palmer", (yeah I named him, so what), has been spending some time outdoors lately. Most of the leaves have turned brown and dried up, although there is one new leaf that appears to be okay except for a small yellow spot at the tip. "Palmer" gets a lot of light and has never been subjected to temperatures below 70 degrees F, (22 C). I don't know what kind of fertilizer to use and I'm now concerned about the soil composition. Shane Wilson, Missouri

A. The browning of "Palmer's" leaves is probably the result of sudden exposure to full sun. It would only take a short period of time in full sun to damage leaves that had developed while the palm was indoors. A few hours would do it. It would have been best, perhaps, to have left the sand and organic compost out and just used a commercially available potting soil. It is important that both soil and container allow for good drainage. For palms that will be spending a lot of time indoors I suggest that the pot size be increased in small increments when repotting, say from a 3 gallon to a 5 or 7 gallon size. As for fertilizer, use a balanced, soluble houseplant fertilizer, such as 20-20-20, at from ¼ to ½ the recommended rate every 2 months.

Losing so many leaves is quite a setback for a young palm, but it sounds as though it does have one good leaf and by the end of the growing season it should have 3 or 4 and be an attractive plant again.

Q. I have a *Hyphaene petersiana* that has developed a second trunk. I thought this was a non-branching palm, was I sold something different? Rod Anderson, Arizona

This question is answered by John Dransfield.

A. *H. petersiana* is almost always solitary and unbranched—it is often bellied (*H. ventricosa* is a later synonym). Sometimes, however, you see paired trunks, of the same size, from the same stool—I interpret this as dichotomous branching underground when the palm was still at rosette stage. Very rarely the trunk actually branches dichotomously above ground. This is how the species behaves in the wild. The trouble is that there are lots of fruiting Hyphaenes in gardens all round the world, carrying names of very dubious value—old synonyms, or obviously the wrong name for the plant that is growing. Then these fruits are distributed and some could well be hybrids. My bet is that your plant is probably not true *H. petersiana*, though I wouldn't stake my life on it!

Q. Sometimes I gather seeds to swap, but only a few at a time depending on the source. And at times I receive more than I can plant at once. What is the best way to save palm seeds for a few months, keeping them as fresh as possible? L. Steve Rohrmayr, Hawaii

A. An article in *Principes* 32:3, by Broschat and Donselman examined a number of factors affecting the germination of palm seeds including storage techniques. Seeds were sealed in plastic bags and stored at temperatures around 23 degrees C, after first having been cleaned, air-dried in an environment with 80-90% humidity and treated with a seed protectant fungicide, (thiram). Seeds of *Dypsis lutescens* treated this way were successfully stored for a year or more, *Syagrus romanzoffiana* could be stored for up to 4 months, *Phoenix roebelenii* 8 months and *Roystonea regia* 9 months.

It might also be worth mentioning that in a study of the germination of seeds of *Attalea speciosa* (*Orbignya phalerata*), by Carvalho et al in *Principes* 32:55, refrigeration was found to be detrimental to germination.

Clearly the length of time that palm seeds can be successfully stored depends on the species, and with particularly valuable seeds every effort should be made to clean and plant them quickly.

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Back cover

An arrangement featuring palms by Mayna Hutchinson beautifies a room at the Montgomery Botanical Center. For another of Mayna's artistic designs see p. 189.