PRINCIPES

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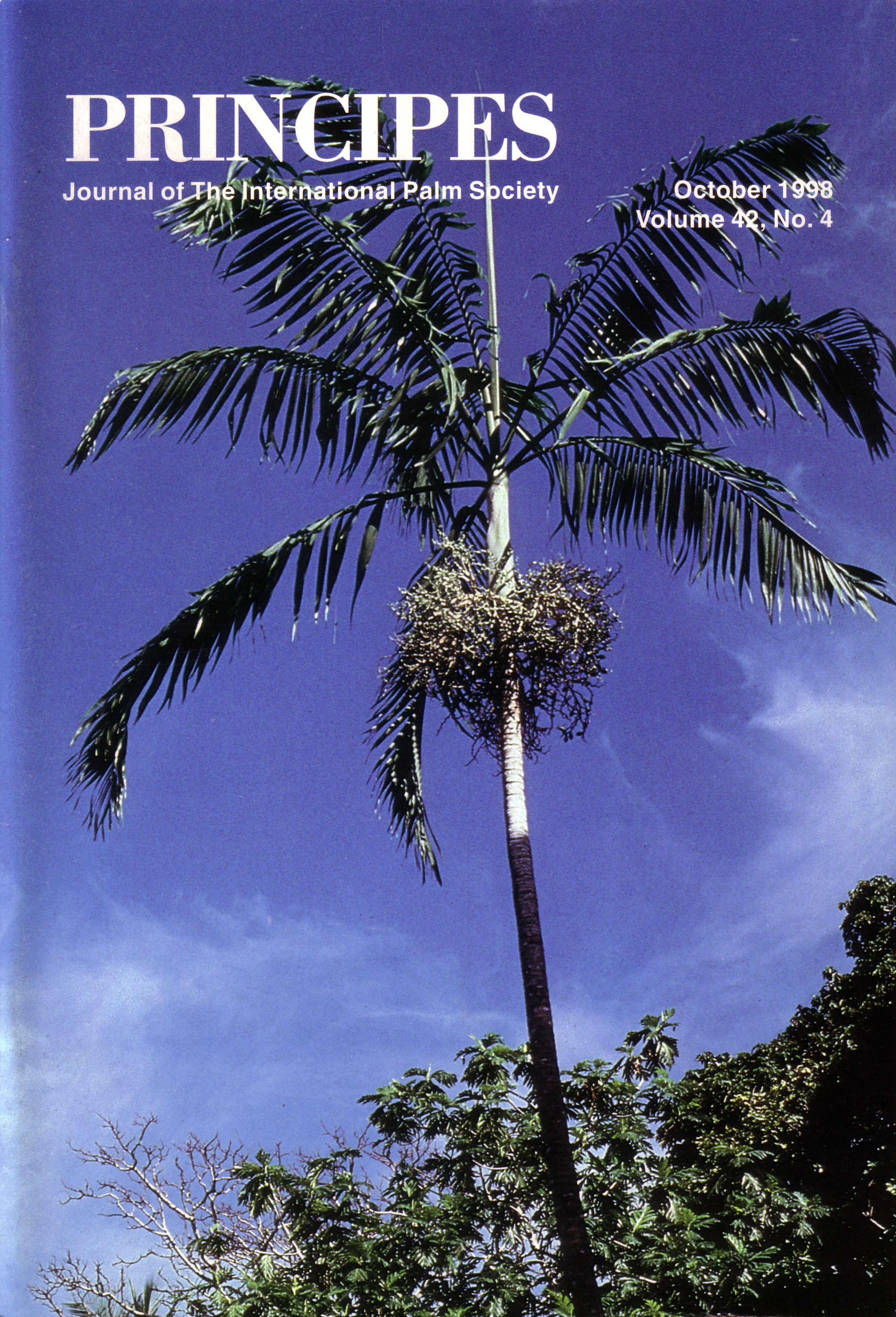

THE INTERNATIONAL PALM SOCIETY, INC.

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Contents for October

Front Cover

Veitchia metiti Becc. This singularly beautiful palm is endemic to Vanuatu. The species was first collected in 1908 and was described by Beccari in 1920. It was lost to science until 1996, when Sam Chanel, John Dowe, Jenny Whyte, and Scott Zona rediscovered small populations of this palm growing on the island of Vanua Lava. Although it is now in the living collection at Fairchild Tropical Garden, this species is still poorly known and uncommon in cultivation.—Scott Zona

PRINCIPES

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Principes, 42(4), 1998, p. 183

Editorial

We wrote this editorial seated in a quiet corner in the shade of a magnificent row of banyan trees in the middle of Nong Nooch Tropical Garden, Pattaya. Our host, Mr. Kampon Tansacha, Director of Nong Nooch, has arranged a Biennial of unsurpassed hospitality and interest, that all attendees will find impossible to forget. We have just toured the superb palm collections and are almost drunk on the sights of thousands of specimen palms, all growing in luxuriant groups that effectively display the real beauty of each species. For a brief account of the first part of the Biennial see p. 209. As we go to press, the Post-Biennial tour to South Thailand is underway. You can look forward to a detailed account of Nong Nooch and its impressive palm collection and of the Post-Biennial tour in future issues of *Principes*.

This issue features articles on utilization of palms, on attractive and little used ornamentals, and on flowering, fruiting, germination, and ecology. We also have suggestions for increasing membership and the report of a symposium.

When we were scanning the new 40 year index to *Principes*, we were surprised to find almost no references to the genus *Chuniophoenix*. Scarcely known at all outside China in the early 1980's, the two species, *C. hainanensis* and *C. nana*, are now quite widespread in cultivation and are proving to be decorative and tolerant, in fact almost perfect ornamentals! Scott Zona has written a clear account of *Chuniophoenix* that should tempt growers to try these lovely palms.

Careful studies of the flowering and fruiting behavior of palms in the wild can often have significance to the horticulturist. They provide information on seasonality and the time when seeds can be expected to mature. Adler and colleagues have studied *Cryosophila warscewiczii* in Panama and given us their finding.

Another study by our Japanese member, Hiroshi Ehara, and his colleagues provides germination information for sago palms.

Svenning and Henrik Balslev continue a series of articles on the diversity and ecology of Ecuadorean Palms with studies emanating from a collaborative program between Arrhus University, Denmark, and the Catholic University of Quito.

John Cressy and Greg Haines write of their own involvement in the IPS and the development of their passion for palms. They include several suggestions on how The Society could go forward into the next millenium and strengthen its membership.

Terrence Walthers provides us with a brief account of the Palm Symposium held within the Society of Economic Botany's main meeting this year in Aarhus, Denmark.

Finally we record with great sadness the unexpected death of Marion Ruff Sheehan, renowned botanical illustrator, who spent a large part of her life producing extraordinarily beautiful diagnostic plates of palms (see pp. 190–193).

John Dransfield

Natalie W. Uhl

Principes, 42(4), 1998, pp. 183–184

President's Message

"Best Biennial ever!" "We had such a fabulous time." "I can't believe what a great event this was." Those were just a few of the hundreds of comments attendees made to me at the 1998 Biennial and Post Tour in Thailand this past September. The event was just superb and we all must thank Kampon Tansacha, his staff, and Nong Nooch Tropical Garden for their fantastic efforts and work in providing our members with such an unforgettable experience. He worked for three years making sure every day was perfect. And it was! Kampon, our hats are off to you for such a great event. Counting speakers and staff, approximately 210 people attended the Biennial and approximately 110 attended the Post Tour. So, not only was this a great Biennial but it had the best attendance of any Biennial yet. For those who were unable to attend, please see the articles below and on page 209 in this issue of *Principes*. Perhaps you will get a taste of the fun we had.

More exciting news! Our next two Biennial Meetings promise to be equally fantastic. The Board of Directors voted to have the 2000 Biennial in New Caledonia with the Post Tour in Far North Queensland, Australia. Our hosts will be the New Caledonian Chapter, Chambeyronia, for the Biennial and the affiliated Palm and Cycad Society of Far North Queensland for the Post Tour. The 2002 Biennial will be in Europe. Fous de Palmiers, the French Chapter of the I.P.S., will be our hosts. It will involve visits to the cities of Hyères Les Palmiers and Nice with many private and public palm gardens. Our Post Tour hosts, the Spanish Chapter La Asociación Espanola de Amigos de las Palmeras, will show us fantastic palm areas in Spain. This will be followed by visits north to Palermo and Rome to see multiple private gardens and villas. The Board wishes to thank Phillippe Cherrier of Chapter Chambeyronia and Steven Swinscoe of Fous de Palmiers for their inviting presentations. Their enthusiasm alone will guarantee success for the next two Biennials. So, please plan ahead to attend each of these events. You won't want to miss either one.

The Board of Directors met in Bangkok just prior to the Biennial. Approximately 17 Directors and five regular I.P.S. members attended and the meeting lasted about 12 hours. Items discussed included everything that has to do with the successful operation of our society. Despite increasing costs of production of *Principes*, the Board voted to hold the dues at $35 for 1999. Our group's success depends mostly upon sustained and new membership. We need your help in recruiting new members to join. We continually hear comments like "I never knew such a group existed." If you don't inform your friends and encourage them to join, palm lovers worldwide will never find out about us. We ask for your help in expanding our membership. Each Director present has promised to get 10 new members before June of 1999. Maybe you can join in and let us know of your success. Contact me if you would like to help with promotion in your area.

The Board also voted to begin a fund-raising campaign. Raised monies would be used to improve *Principes* and promote palm related research. Our Vice President, Horace Hobbs, is Chairman of the Fund-Raising Committee. Your donation may be tax deductible. Please contact Horace or me if you would like to assist in the campaign or if you are interested in making a donation. We can use your help!

As 1998 draws to a close, I hope that all of you had a wonderful year. I certainly did. I also hope that 1999 will be a palmy and gratifying year for all.

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Nong Nooch

At last we had arrived at the undisputable highlight of the 1998 IPS Biennial. Here we found acres and acres of manicured gardens filled with thousands of plant specimens of local and exotic origins. here, we could see acres of thousands of palms spread among a poetic flow of waterways, rocks, and garden paths. Palms are displayed in every form and shape from all corners of the world, some presented as simple specimens, others are in plantations disappearing on the horizon.

Behind all this effort to delight our palm hearts with knowledge and pleasure is a man wise in organization of highly dedicated people who have taken care of every aspect of this conference. His name is Kampon Tansacha, and he has the vision to create this stunning garden which will delight every plant lover in the world!

ROLF KYBURZ

Principes, 42(4), 1998, pp. 185–189

Reproductive Phenology of Cryosophila warscewiczii in Central Panamá

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Palms have been the focus of numerous phenological studies, and many different reproductive patterns have been identified. In areas that experience seasonal changes in precipitation, most species appear to have distinct reproductive seasons (Kahn and Granville 1992). However, some species do not appear to be constrained to seasonal reproduction (Henderson 1995), and even in those species that reproduce seasonally, considerable variation exists within populations. For instance, DeSteven et al. (1987) studied reproductive phenologies of 13 species of palms in central Panamá and described species according to their degree of flowering synchrony. Of the 13 species, three showed highly synchronous flowering, six were moderately synchronous, and four showed little flowering synchrony. Despite the attention paid to palms, the reproductive phenologies of most Neotropical species remain poorly known.

Cryosophila warscewiczii (H. Wendl.) Bartlet is a solitary subcanopy palm that is found in lowland forests from southern Nicaragua to central Panamá (Evans 1995, Henderson et al. 1995). This species attains a height of 10–15 m (Croat 1978, Evans 1995, Henderson et al. 1995), with heights of reproductive individuals exceeding 5 m (DeSteven et al. 1987). Croat (1978) notes that flowering occurs from May to October and that fruits develop between August and December in Panamá. The mostly round fruits are 1–2 cm in diameter, are white when mature, and enclose a single globose seed (Croat 1978, Uhl and Dransfield 1987). Henderson (1984) identified two genera of beetles as probable pollinators of this palm (listed as *Cryosophila albida*) in Costa Rica. DeSteven et al. (1987), based on a study of only four individuals, found this species to display high intrapopulation flowering synchrony. Because little else is known of the reproductive phenology of *C. warscewiczii*, we present results of a four-year study of the reproductive phenology of 137 marked individuals on a small island in the Panama Canal.

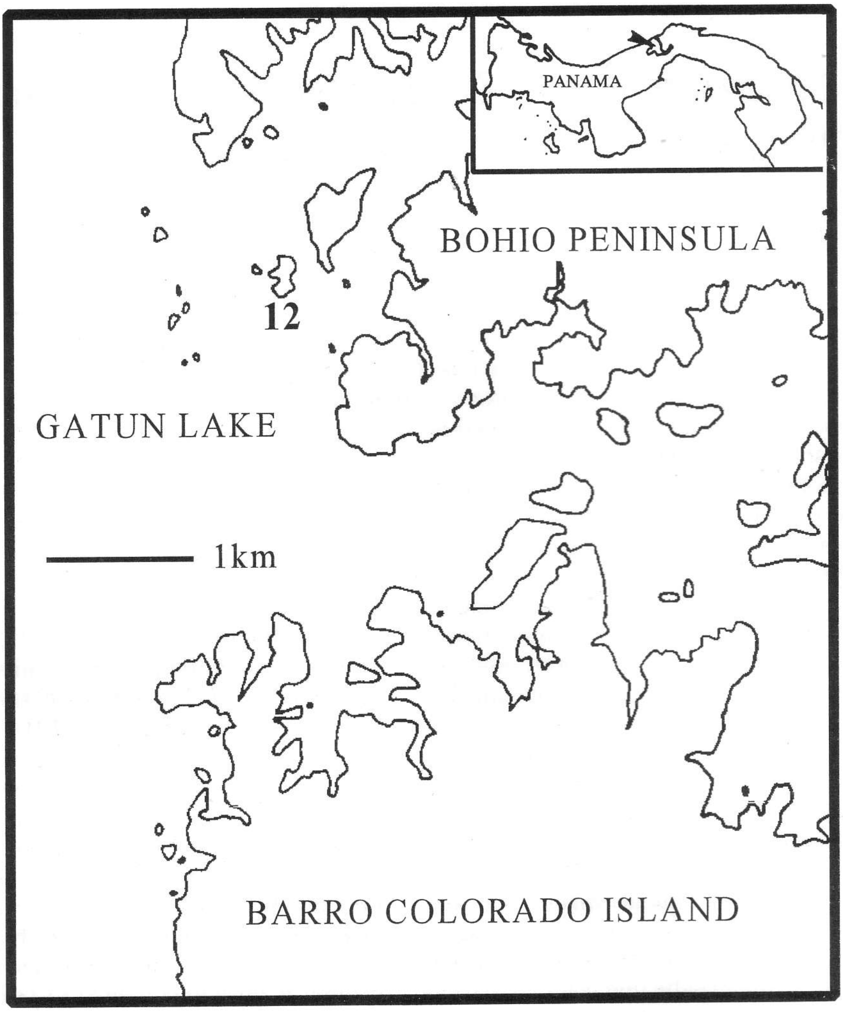
Study Area

The study area was a 1.8-ha island in the Panama Canal (Fig. 1) and was located 2 km north of Barro Colorado Island (BCI), where DeSteven et al. (1987) and Croat (1978) studied the reproductive phenology of *C. warscewiczii*. This island (locally known as Chicha and designated as Island 12 by Adler 1994) was formerly a hilltop that was isolated in 1914 by the rising water levels of Gatun Lake. The lake was created when the Chagres River was impounded during construction of the Panama Canal.

The study island is covered now with second-growth tropical moist forest. *C. warscewiczii* is the third most abundant arborescent plant of mature size on the island and is by far the most abundant palm, forming dense stands composed of both mature and immature individuals. The climate of the area is strongly seasonal, with an eight-month rainy season that is punctuated by a shorter but severe dry season. Less than 10% of annual precipitation falls during the dry season from mid-December until the end of April. Mean annual rainfall on BCI this century is 2612 mm (standard deviation = 446 mm) (Windsor 1990).

Methods

We marked 129 individuals of *C. warscewiczii* of reproductive size in 1991. A serially-numbered aluminum tag was affixed to each individual with grafting tape. We marked an additional four individuals in 1992, one in 1993, and three in 1994. Two marked individuals died between 1992–93 and 1993–94. We also established a permanent grid that covered the entire island, with 20-m intervals between adjacent points within the grid. Marked palms were then mapped



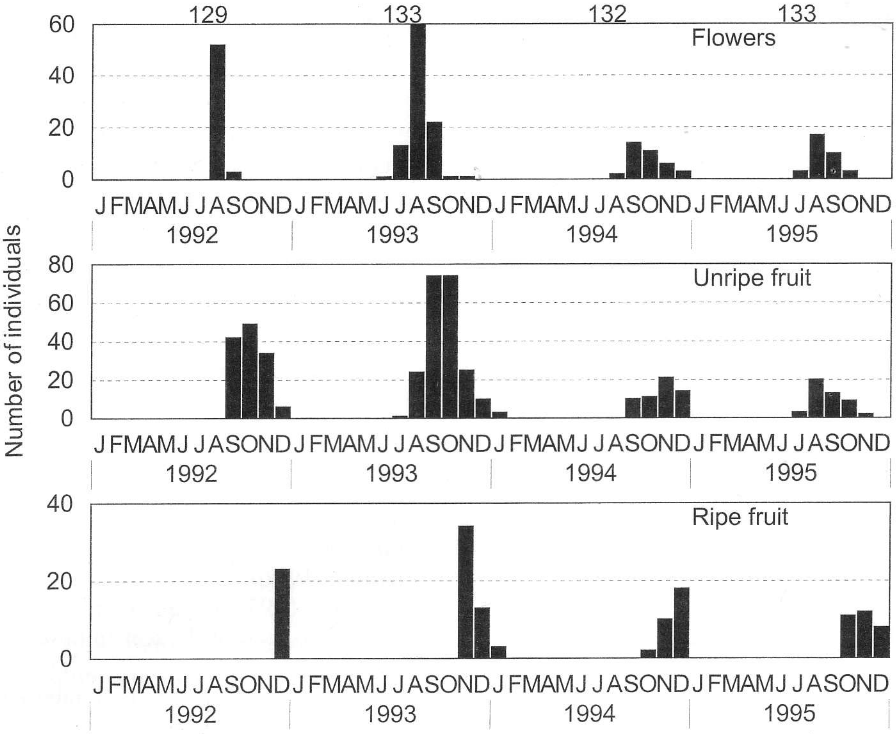
1. Location of the study island within the Panama Canal. The inset shows the location of the study area in central Panamá.

onto this grid. Marked individuals were censused every month from April 1992 through December 1995, and the numbers of inflorescences and either unripe or ripe infructescences produced by each individual were recorded.

We began the analysis by tallying the total numbers of individuals flowering and bearing unripe and ripe infructescences each month. We constructed contour maps of the total number of individuals marked over the four-year period and of the total numbers of individuals bearing ripe infructescences each year. We compared proportions of individuals that produced ripe infructescences (a measure of annual reproductive output) among years by constructing a linear model for repeated measures categorical (count) data. We also constructed yearly histograms showing the numbers of individuals bearing a given number of ripe infructescences. We compared these numbers among years by again constructing a linear model, with categories represented by 1, 2, 3, or ≥4 ripe infructescences. In 1992, no individuals produced more than three infructescences. Because a count of zero prohibits complete parameter estimates, we replaced this zero with a one (Kleinbaum and Kupper 1978).

Results

C. warscewiczii showed only one reproductive period per year within this dense stand (Fig. 2). More individuals flowered in August than in any



2. Monthly numbers of individuals flowering and bearing unripe and ripe fruits. Numbers at the top of the figure indicate the total numbers of marked individuals each year.

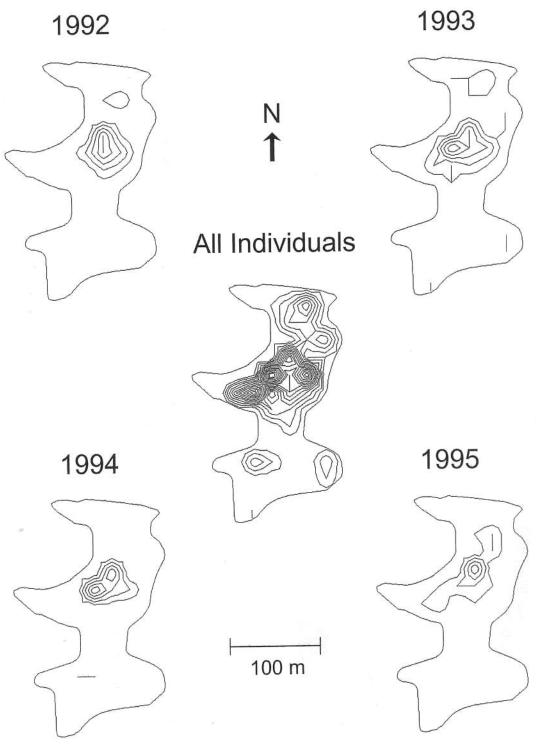
other month each year, except in 1994 when more individuals flowered in September. The flowering season was longest in 1993, and lasted from June through November. Unripe fruits were present from July through January, although most unripe fruits were present from September through November. Ripe fruits were present from October through January, but within any given year ripe fruits were present for a maximum of only three months.

The distribution of mature individuals varied spatially, with the highest densities near the center of the island (Fig. 3). Lesser concentrations also occurred in the southern and northern portions of the island. The distribution of fruiting individuals varied both spatially and temporally (Fig. 3). Fruiting individuals were concentrated in the center of the island (where mature individuals were densest) during each of the four years, but other areas showed varying numbers of fruiting individuals across years, particularly in 1993.

Proportions of individuals with ripe fruit statistically varied among years (0.18 in 1992, 0.31 in 1993, 0.16 in 1994, and 0.17 in 1995 $\chi^2 = 11.49$, df = 3 $P = 0.0094$), which was due to the higher level of fruiting in 1993. The number of ripe infructescences borne by a single individual ranged from one to six (Fig. 4), and the counts of individuals within each infructescence category varied among years ($\chi^2 = 19.34$, df = 9, $P = 0.0225$). Individual production was least in 1992 and 1994, when one was the modal number of ripe infructescences. Production was greatest in 1993, when three was the modal number of ripe infructescences.

Discussion

Individuals within this dense stand of *C. warscewiczii* demonstrated highly seasonal reproductive activity, and our results corroborate those of DeSteven et al. (1987) with respect to the high level of flowering synchrony. Thus, most flowering occurred in a brief period of only two or three months centered around August. DeSteven et al. (1987) noted a mean period of two months in which individuals bore ripe fruit. In our much larger sample of individuals, we found a mean period of only 2.5 months in which individuals bore ripe fruit.



3. Contour maps of the spatial distribution of the total number of marked individuals over the four-year study period (central map) and yearly densities of individuals producing ripe infructescences. Each contour interval represents one palm.

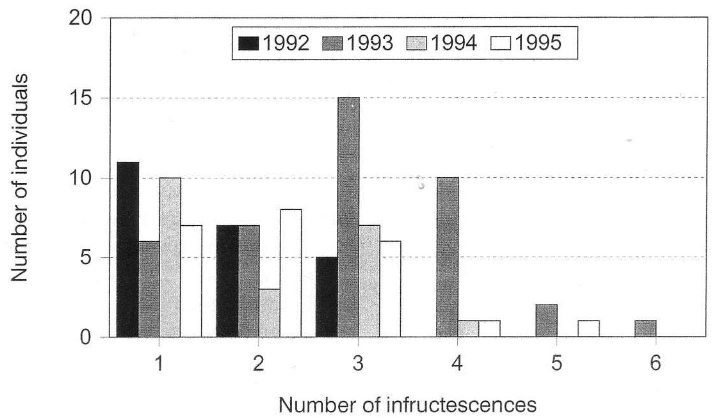
With respect to individual reproductive performance, DeSteven et al. (1987) found that the number of inflorescences produced per individual within a year ranged from only one to three. By contrast, we found a range of one to six ripe infructescences produced per individual within a year. However, a smaller percentage of plants out of the total pool of mature individuals produced ripe fruit in our study (21% vs. 43% in DeSteven et al. 1987). Fruit production over the four-year period varied and was greatest in 1993. While the causes of variation in individual reproductive output remain unknown, we suggest that pollinator diversity and abundance relative to the high density of mature individuals may be lower on this small island than on Barro Colorado Island. A lower pollinator diversity and abundance could account for the smaller percentage of individuals producing mature fruits. Temporal changes in pollinator abundance could also explain the higher fruit production in 1993.

The number of ripe infructescences serves only as a crude index of individual reproductive performance. Seed germination, seedling establishment, and recruitment into the mature age classes ultimately determine individual reproductive success. Seed and seedling predators may have a substantial impact on reproductive success. Rodents are often important predators of palm seeds (Vandermeer 1979, Hoch and Adler 1997, Adler and Kestell 1998). The only species of rodent present on the study island is *Proechimys semispinosus* (Central American spiny rat). *P. semispinosus* have been shown to eat not only the fruits but also the seeds of *C. warscewiczii* (Adler 1995). A year-long study of this rodent on Island 12 in 1991 revealed a mean density of 43.1 individuals/ha, with a maximum of 58.3/ha (Adler 1996). These densities are by far the highest yet recorded for this species (Adler 1996). Continuous monthly censuses through 1997 further demonstrate persistent high densities of *P. semispinosus* (*unpublished data*).

We observed enormous numbers of seeds destroyed by this rodent during each year of the present study. *P. semispinosus* are also abundant and widely distributed throughout the range of *C. warscewiczii*, and we therefore suggest that this rodent is an important determinant of seed survival of this palm. *C. warscewiczii* fruit at the time of lowest community-wide fruit production in central Panamá (Foster 1982). This phenology may render seeds particularly vulnerable to attack by granivorous rodents such as *P. semispinosus* because of low resource availability. However, such rodents may also serve as palm seed dispersers (Forget 1991, Adler and Kestell 1998), and C. *warscewiczii* may experience little competition with other plant species for rodents to disperse seeds. A complex interaction between fruit production and rodent density may therefore largely determine ultimate individual reproductive success of this palm. Further study of the interaction between *C. warscewiczii* and its pollinators and seed predators and dispersers such as *P. semispinosus* would further elucidate determinants of individual reproductive success.

Summary

We studied the reproductive phenology of *Cryosophila warscewiczii* by conducting monthly phenological censuses of 137 marked individu-



4. Yearly numbers of individuals bearing a given number of ripe infructescences.

als on a small island in the Panama Canal. Censuses were conducted from 1992 through 1995. Flowering occurred from June through November but was generally greatest in August. Ripe infructescences appeared from October through January, but within any given year ripe fruits were present for a maximum of only three months. The distribution of fruiting individuals varied spatially and temporally. Production of ripe fruits was greatest in 1993. The number of ripe infructescences borne by a single individual varied from one to six, and the modal number of infructescences varied yearly. We suggest that temporal changes in pollinator diversity and abundance may account for temporal differences in reproductive performance. We further suggest that ultimate reproductive success is strongly influenced by rodent seed predators.

Acknowledgments

We thank Nicole Casteel, Mark Endries, and Andrew Roper for help in the field. This study was supported by grants from the National Geographic Society (4893–92) and the National Science Foundation (DEB9628943) to GHA, and the Smithsonian Institution Scholarly Studies program to Egbert G. Leigh, Jr. and GHA.

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Marion Ruff Sheehan

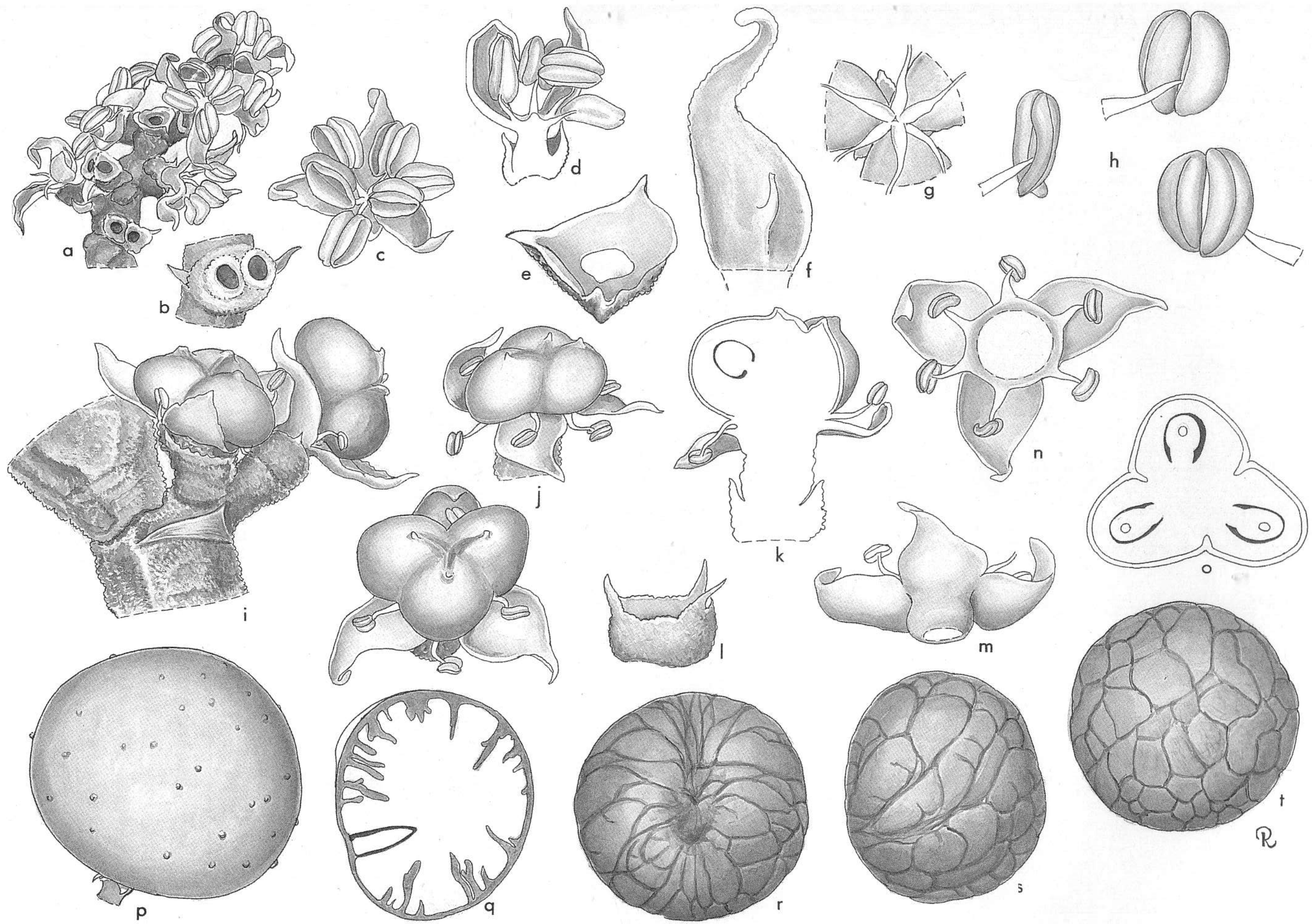
It is with great sadness that the editors report the loss of Marion Ruff Sheehan, who died suddenly and unexpectedly on July 20, 1998, due to complications following open heart surgery. Her distinguished career included a professorship at the University of Florida in Gainesville, the illustration of more than 40 books, and artistic creations of all sorts including plaques, medals, trophies, knitwear designs, and prints. Early on she undertook a major project on palms.

Marion's career began in the L.H. Bailey Hortorium of Cornell University where she had important roles in both the institution and palm studies. In 1946 she was hired by Liberty Hyde Bailey to be the artist in the Hortorium. Combining the work with graduate studies, she was awarded an MS by Cornell in 1950. At the Hortorium she contributed detailed plates for several major works including all three editions of Hortus, the Manual of Cultivated Plants, and an important book on plant taxonomy written in the late 1940's by the Hortorium's first director, the late Dr. G. H. M Lawrence. There also she met Dr. H. E. Moore, Jr., who engaged her to do plates of palm flowers and fruits for a Genera Palmarum. She was involved in this project from 1962 to the book's publication in 1987.

One of Marion's outstanding characteristics was her constant search for ways to do things better. On one trip to Florida, we took a dissecting 'scope for her use. Eventually she bought a jeweler's saw and spent hours cutting the hard fruits and seeds. She became expert at slicing each one at the exact angle that revealed the tiny embryo. The real fun came when she had to tackle the double coconut, having only one fruit to work with. She finally took it to the carpentry shop on campus and used a very fine crosscut saw. I was rooming with her at a conference in Miami in 1964 when she and Dr. Moore decided that wash drawings rather than ink alone would better portray the contours of the palm materials. She told me at the time that she was pleased and excited about the decision to use a wash technique, but it meant more work as the 30 some plates already in hand, mostly of coryphoid genera, had to be redone.

Marion's observations on the often complex structure of palm flowers and fruits were excellent and sometimes revelations. She was dedicated to teaching people about plant structure and was determined to have a well illustrated glossary in Genera Palmarum, which she largely planned as well as executed. It took her an average of eighteen hours to complete the sketches for a plate, each part carefully drawn to scale. The sketches on tracing paper were then sent to Dr. Moore (and after his death to myself and John Dransfield) for checking against original materials. Once the sketches were returned, she still had to transfer them to drawing paper and add the wash. It was always a real pleasure to receive the pristine and beautiful completed plates. Dr. Moore was very proud of them and once told me that there were no palm plates their equal. They will long continue to be an important resource for those engaged in many levels of palm work (see Fig. 1). Marion also contributed the water colors in GP and illustrations for papers on palms by L.H. Bailey and others.

Marion's palm work was only one of many significant accomplishments in a most productive life.We at Cornell are both proud and fortunate that her work began here. Her talent has always been at our disposal; despite many committments, she never refused a request. At the time of her death she was working on a plate of *Lemurophoenix,* a spectacular palm, described from Madagascar in 1991. While at Cornell she met a graduate student who became her husband, Dr. Thomas Sheehan, a noted Horticulturist and orchid specialist. Along with him she became deeply involved with orchids and the orchid community. Marion and Tom were coauthors of the longest running series in the *American Orchid Society Bulletin* (now *Orchids*), "Orchid Genera Illustrated," appearing every other month for the past 31 years. The series will end in January 1999 with number 186. Marion was the recipient of two of the American Orchid Society's highest awards: the Gold Medal of Achievement (April 1995) and with her husband, the Certificate of Meritorious Achievement in Orchid Education. More about Marion can be found on the AOS web page at: HTTP://orchidweb.org.



1. **Kerriodoxa**, a palm described from Thailand in 1983. a, portion of staminate inflorescence ×4½; b, portion of staminate inflorescence, flowers removed to show scars and bracteoles ×9; c, staminate flower ×9; d, staminate flowers in vertical section ×9; e, staminate calyx ×15; f, staminate petal with adnate stamen filament, interior view ×15; g, stamen filaments, sepals, and parts of petals, top view ×15; h, stamen in 3 views ×15; i, portio of pistillate inflorescence ×6; j, pistallate flower in 2 views ×6; k, pistillate flower in vertical section ×6; 1, pistillate calyx ×6; m, pistillate corolla ×6; n, pistillate corolla and staminodial ring ×6; o, ovary in cross section ×6; l, pistillate calyx ×6; m, ×1; r, s, t, seed in 3 views ×1. *Kerriodoxa elegans*: a–o, *Bhoonab s.n.*; p–t, *Dransfield 5421*.

2. Marion Sheehan working on a painting of parrots and orchids with the parrot in attendance.

Her legacy remains apparent in the L.H. Bailey Hortorium where two prints of red and blue parrots and orchids hang in the main office (Fig. 2), and her pencil sketches of botanists adorn the current director's room. She is even known to our beginning students through large water colors of flowers designed for and used every year in the plant taxonomy class to characterize plant families. Many of us own prints or books she illustrated and will enjoy them for years to come. She will be sorely missed not only as a creative illustrator, but also as a special, much valued friend.

NATALIE UHL

CLASSIFIED

Principes, 42(4), 1998, pp. 193–194

Palm Society Membership: Looking Ahead To the 21st Century

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In less than 50 years the International Palm Society has become truly global in its support of research, publications, new chapters, and new understandings of palms. The discovery of new species and the economic effects of palms on different cultures and societies continue to be topics of discussion in *Principes,* magazines, and sometimes the media in general. However, as we approach the next century it seems to us important for the International Palm Society to recall that the organization was founded not only by the need for scientific inquiry, but also by the love of palm enthusiasts who wanted more information on how to grow palms in their own gardens in a particular region. Dent Smith wrote early-on to Pauleen Sullivan that the Palm Society was founded not just for researchers but for "dirt gardeners." Even so, the Palm Society has often changed lives and even careers for many members who have become researchers, commercial growers, seed experts, or even just world travelers to see palms in habitat. As we approach the next century, it is important for our organization to discuss ways for our membership to continue to grow and to reach out to a wide-range of palm interests so that our publications, research, and explorations will remain secure and go forward. In short, the Palm Society's future depends on new members and our organization's recognition that the membership has diverse interests.

We discovered the Palm Society by chance on a rainy April afternoon in 1977 at Strybing Arboretum and Botanical Gardens in San Francisco. To escape a surprise downpour we settled into an unexpected afternoon in the library where book after book relating to palms was brought to us by an amused and charming librarian. "You boys ought to join the Palm Society!" she finally said. We smiled and laughed. "You mean, like reading palms and fortune telling?" we joked. "No, there really is a Palm Society and we have a group right here in the Bay Area. I think I have a phone number." She returned with the phone number of Warren Dolby in Oakland who we later learned was one of the original members of the Society.

That phone call the same evening changed our lives. Warren invited us to his garden in the Oakland hills, an acre of landscaped trails, fountains, pools, and views, with mature palms and tropicals that was as magical as it was overwhelming. Ever the host and noticing our amazement, Warren immediately said, "Join the Palm Society and you'll have it all too!" Within two years we bought the property next to Warren and our mutual gardens were part of the Biennial Tour in 1984. Moreover, we began to learn that we were not the only "palmnuts" and our journeys to discover palms began in earnest to Hawaii, Florida, Mexico, the Caribbean, Australia, Asia and on and on. It was a joy to learn about the early founders of the Palm Society, to read Harold Moore's pathfinding work, and eventually to meet and talk with Lucita Wait, Dick Douglas, Paul Drummond, Mardy Darian, Natalie Uhl, and John Dransfield.

Although our knowledge of palms has grown immensely, we remain primarily palm enthusiasts. Happy to attend lectures and learn more (we can recite Latin names now with great ease), but are still overwhelmed by the beauty of a single palm in the twilight of a local garden or a hillside of ceroxylon palms in the mountains of Ecuador. And we have continued to think about palms as the focal point of our new Southern California garden that replaces one lost (along with Warren's) in the Oakland Firestorm of 1991.

Thus, we suggest to our membership as we enter this new century, that we consider our organization's need for new people . . . new members who share a variety of enthusiasms for palms: growing palms, cultivating palms, helping scientific inquiry, and perhaps just enjoying knowing more about palms and responding to their beauty and diversity. We suggest that our members talk about their interest in palms with friends, and help potential new members not to be initially overwhelmed with conversations punctuated with botanical names and the latest "must have" palm craze. "He who dies with the most palm species wins!" has become the mantra for some members and that is certainly a worthwhile lifelong goal for some. However, we suggest that we all will win if we can find new ways to secure a growing membership that includes the hobbyist, the dirt gardener, the tropical landscaper, the grower, the researcher, as well as the most competitive collector who wants the biggest, most mature and spectacular palm garden in the world.

In the past years, we have made a concerted effort to bring potential new members into the Palm Society. Our friend, Doris Devine, grows palms in her Chicago apartment and enjoys the palms at nearby Lincoln Park Conservatory. (She traveled with the Society to Australia and will be at the biennial in Thailand.) We met Gary Carr at a recent dinner party and happened to mention the Palm Society. He was amazed there was such an organization and had been developing a palm garden on his own by saving palms he found being discarded from the hallways of Beverly Hills office buildings! He came to the last meeting, joined immediately, and, of course, is now speaking fluent "Palmese." (We think he would be surprised that some of our members call gardens with familiar palms, as opposed to the latest Madagascar palms, "trash gardens.") If we look only to those who can afford large collections and elaborate gardens with rare palms at the local chapter level, we are going to miss experiencing the joy and creativity of those with different gardening and landscaping goals that feature or just include palms—and their different and equally important reasons for joining the Palm Society.

In looking ahead to the next century, we suggest that the Palm Society continue to explore new ways to help our membership grow and flourish. Certainly, new members are the lifeblood of any such organization. We need the growers, the scientists, and the enthusiasts to continue our efforts on all levels. If we cease to actively include a continuum of interests—researcher to hobbyist—the organization will be less dynamic and less enriched.

We encourage all members to bring a guest to the next chapter meeting and welcome them. As your life was changed by membership in the Palm Society, perhaps there will be some one standing next to you in a line or at a party and you will mention your love of palms, and thereby change their lives: "Oh, did you know there is an organization called the Palm Society!" Perhaps *Principes* would like to consider asking for ideas via a "Forum on Membership" from its chapters about how local organizations can help the Palm Society membership grow in the 21st Century. What has proved effective and what else might we consider to spread the word about the Palm Society? Ideas might include notice of our organization at local colleges, arboretums, gardens, nurseries or horticultural/gardening events as well as our websites on the Internet. Local media often look for stories related to botanical interests. Membership applications should continue to be included in each *Principes* and local newsletters. Like other societies, perhaps gift memberships should be encouraged. Our theory, however, is that it is still the individual member mentioning the Palm Society to a friend or new acquaintance that has primarily increased our membership and continued our mission over the past 50 years.

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Palms and People: A Symposium Summary

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From July 13–17, 1998, The Society for Economic Botany held their annual meeting at The University of Aarhus in Denmark. The University of Aarhus has and continues to be a major center for studies on Ecuadorean palms. The meeting was coordinated by Dr. Henrik Balslev and sponsored by the University and the Department of Systematic Botany. On July 16, a full-day symposium called "Palms and People" consisted of fifteen speakers representing more than ten countries. Over 90 scientists attended. In addition to the palm symposium, the conference included a number of other talks and posters that focused on current palm-related research activities in the tropics and subtropics worldwide.

The Palms and People Symposium contained a wide range of research projects in various fields of palm biology, including ethnobotany, archaeology, biochemistry, sustainability of palm resources, and conservation. Throughout the symposium, the economic significance of the world's palm flora for food, construction, technology, crafts, medicine, and ritual practices of indigneous people was stressed. Specific species were studied to determine how they are being used by indigenous cultures, such as *Chamaerops humilis* for crafts in Portugal, *Prestoea acuminata* for food in Ecuador, *Borassus aethiopum* as the main source for making palm wine by the Bassari ethnic group in the Republic of Guinea, and *Astrocaryum aculeatum*, *Euterpe oleracea*, *Euterpe precatoria*, *Jessenia bataua*, *Mauritia flexuosa*, and *Oenocarpus bacaba* for food in Amazonia.

Several speakers discussed their in-depth studies seeking to identify which species of palms are used, and how, by various cultures and communities. The Embera and Wounaan artisans of Panama's Darien region use *Phytelephas seemannii* for carvings and *Astrocaryum standleyanum* for basketry. Indigenous people in Western Amazonia use 22 species representing 12 palm genera for food, medicine, construction, ritual practices, and technology. Two isolated rainforest-dwelling communities in Borneo make use of 63 palm species, while in the main markets of Puerto Ayacucho, Venezuela, food and products from 9 palms species were reported for sale. The consumption of fruit pulp derived from *Euterpe oleracea* has a socio-economic importance in the Amazon estuary region where it is one of the major components of the daily diet of the inhabitants. In recent years, the consumption of the fruit pulp has become quite fashionable in Rio de Janeiro where more than 120 tons of fruit per month are sold in fitness and body-building centers for the high nutritive quality of the pulp.

Increasing road development which facilitates trade and the mixing of cultures, deforestation causing the loss of the local flora, and the increasing movement of young generations to the cities are resulting in the loss of basic botanical and traditional knowledge on the uses of local plants. Many of the symposium speakers discussed various methodologies and indices for documenting the temporal changes in indigenous knowledge of plant use.

With deforestation of rainforests, tribal population growth, and the need to change the acceptable quality of life, indigenous cultures are increasingly trying to develop non-timber forest plant products (NTFPP), particularly palms, for commercial purposes. Rising tourism in the tropics is also stimulating the production of NTFPP. In the majority of cases, native stands of palms are used for harvesting the necessary materials for the production of local and commercial goods; agroforestry production of palms for future material is not being done. Field studies suggest that the increasing harvesting from palm populations will not be sustainable for the local

Contributors and their email address	Contributors country	Title of talk or poster
	Palms & people symposium	
Teresa Almeida email: talmeida@cygnus.ci.us.pt	Portugal	Uses of the 'Broom-Palm' (*Chamaerops humilis* L.) in Portugal.
Patti Anderson email: anderson@botany.ufl.edu	Florida	Harvesting and conservation of the palm *Iriartea deltoidea* in Ecuador.
Hanne Christensen email: hc@nepcon.dk	Denmark	Palms and people in the Bornean rain forest.
Christiane Ehringhaus email: cehrin@mdnet.com.br	Brazil and New York	Tapping palm diversity in Western Amazonia: cultural differences between indigenous, rubber tapper and ribeirinho use of palms.
Christiane Ehringhaus email: cehrin@mdnet.com.br	Brazil and New York	Measuring palm utility: discussion and proposal of a socio-ecological use value (SEV) in ethnobotany with an example of palms.
Francis Kahn email: fkahn@ecnet.net	Ecuador	New strategies for palm fruit trade in Amazonia.
Helle Knudsen email: h.knudsen@cgnet.com	Colombia	Demography and palm-heart extractivism of *Prestoea acuminata* (Arecaceae) in Ecuador.
Jette Knudsen email: jtk@chemecol.gu.se	Sweden	Potentials of floral scent compounds in palms.
Gasper Morcote email: gmorcote@ciencias. ciencias.unal.edu.co	Colombia	A review of archaeological records of palm vestiges in the New World.
Henrik Pedersen email: reco-hbp@post4.tele.dk	Denmark	Mapping the potential for palm extractivism in Ecuador.
Bienvenue Sambou email: enrecada@telecomplus.sn	Senegal, Guinea, and Denmark	Palm wine exploitation by the Bassari threatens *Borassus aethiopum* in Guinea.
Helen Sanderson email: h.sanderson@ rbgkew.org.uk	United Kingdom	Palm resources at Kew for economic botany research.
Liselotte Skarp email: langelott@hotmail.com	Sweden	Impact of harvesting fruits and palmito on population structure in natural stands of the Acai palm (*Euterpe precatoria*) in Rondônia, Brazil.
Terry Sunderland email: afrirattan@aol.com	United Kingdom	The rattan palms of Central Africa and their economic importance.
Lucie Thione email: enrecada@telecomplus.sn	Senegal	Impact of leaf and fruit harvest on the production of *Borassus aethiopum* in Senegal.
Jaana Vormisto email: jaavor@utu.fi	Finland	Use and economic value of the palm *Astrocaryum chambira* in the village of Brillo Nuevo, Peru.
	Other related talks and posters at conference	
Cecilia Angberg email: tropicaldog@hotmail.com	Sweden	Variables influencing fruit production in natural stands of the Acai palm (*Euterpe precatoria*) and the Buruti palm (*Mauritia flexuosa*) in the Brazilian Amazon.
Fusun Ertug email: fertug@ibm.net	Turkey	Plants used in handicrafts in Central Turkey.
Ana Narváez email: narvaezc@[150.185.65.7]	Venezuela	Products derived from palms (Arecaceae) at the Puerto Ayacucho markets in Amazonas State, Venezuela.
Robert Pemberton email: bobpem@netrunner.net	Florida	Naturalization patterns of horticultural plants in Florida.
Julie Runk email: velasquj@tivoli.si.edu	Panama	Non-timber forest products used for crafts in Panama's Darien: preliminary findings.

communities dependent on these palm products. Various methods were recommended by the speakers to ensure the future sustainablity of native palm populations by managing native stands for long-term harvest.

Many symposium speakers indicated the urgent need for further studies to examine the socio-economic potential of the products generated from palms. Only with this information, can native populations be managed and conserved while local communities continue to harvest the necessary products from these populations in a sustainable way. Developing a sustainable resource strategy requires a basic understanding of the life-history and ecology of the palm species. In addition, the management and conservation of the currently available natural resources need immediate evaluation and a viable option for developing an agroforestry system needs to be developed and presented to these communities.

Other talks at the symposium covered topics such as the potential use of floral scent compounds in palms and a review of palm remains recorded at archaeological sites throughout the New World. The archaeological review supported the idea that humans have played an important role in the dispersal of some palm species in the neotropics. Sixteen genera and at least 35 species of palms have been recorded at archaeological sites from Mexico to south Brazil. Christiane Ehringhaus used palms as a test case for developing a value (SEV, the socio-ecological use value) that reflects the utility of a species for social groups and the availability of the useful resource in an area. Studying the palms in Ecuador, Henrik Pedersen discussed integrating bioclimatic modeling of palm distribution and the Analytical Hierarchy Process as a tool to evaluate and map the extractive potential of 14 taxa of commercially exploited palms in Ecuador. Helen Sanderson from the Centre for Economic Botany at Kew discussed the significant palm resources currently available at the Royal Botanic Gardens for economic botany studies.

The Palms and People Symposium was a great success. It brought together economic botanists and individuals from related fields to discuss vital issues facing the economics of indigenous human communities, conservation of palm species, and sustainability of traditional plant-based knowledge. Dr. Henrik Balslev is currently coordinating with the speakers to edit and produce a volume of the papers presented at the symposium.

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Chuniophoenix in Cultivation

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Among the genera of Asiatic Coryphoideae, *Chuniophoenix* is certainly one of the most enigmatic. These attractive palms are still uncommon in nurseries and on seed lists, but our experience at Fairchild Tropical Garden (FTG) suggests that they deserve to be more widely grown.

There are only two species in the genus. *Chuniophoenix hainanensis* Burret (Figs. 1,2) was the first species to be described. Burret (1937) named the genus after Professor W. Y. Chun, then-director of the Botanical Institute, College of Agriculture, Sun Yatsen University (now Zhongshan University), Guangzhou, China. The species epithet refers to the palm's island home, Hainan.

Three years later, Burret (1940) described a second species, *Chuniophoenix nana* Burret (see Back Cover), from Vietnam in the vicinity of Hanoi. The specific epithet means "dwarf," and describes the habit of this palm. A third species, *C. humilis* C. Z. Tang and T. L. Wu, was described in 1977 from Hainan (Tang and Wu 1977), but this name is a taxonomic synonym of *C. nana*. Plants cultivated under the name *C. humilis* should be called *C. nana*.

Both species have been growing in FTG since 1985. As they are mature and fruiting, we have the opportunity to compare the two species with each other, as well as with other coryphoid palms. FTG has one mature plant of *C. hainanensis* and several mature plants of *C. nana*.

Although molecular evidence (Uhl et al. 1995) and technical details (Uhl and Dransfield 1987) point to *Kerriodoxa* as the closest relative to *Chuniophoenix*, the two genera are dissimilar in a number of obvious ways and would never be confused. Unlike *Kerriodoxa*, both species of *Chuniophoenix* are caespitose (suckering) palms. The leaves of *Chuniophoenix* lack hastulae, whereas those of *Kerriodoxa* have hastulae. The leaves of *Chuniophoenix* also lack the white scales on their undersides that are so characteristic of *Kerriodoxa*. It is the inflorescence of *Chuniophoenix* that immediately distinguishes it from *Kerriodoxa* and all other genera of the Coryphoideae. The peduncular bracts are green (becoming brown with age), tubular and tightly clasping around the jointed rachillae. Even the bracteoles that subtend each flower or flower cluster are tubular and clasping. Burret (1937) and Uhl and Dransfield (1987) noted the resemblance of the *Chuniophoenix* inflorescence to those of certain Calamoideae.

The two species of *Chuniophoenix* are readily distinguished from each other, even in the vegetative condition. The obvious difference is size: *C. nana* has stems <2 cm in diameter and leaf blades <40 cm in diameter, but *C hainanensis* has stems ca. 15 cm in diameter and leaf blades ca. 120 cm in diameter. The habit of *C. nana* is reminiscent of species of *Rhapis*, with tight clusters of stems each <l.5 m tall. FTG's *C. hainanensis*, flowering for the first time at eleven years old, has stems <0.5 m tall; their ultimate height is unknown but probably not >3–4 m.

The petioles of both species are unarmed, deeply channelled on the upper side, and rounded below. In *C. hainanensis* they are vested with a powdery white indumentum on the abaxial surface and are 80–90 cm long. The petioles of *C. nana* are glabrous and 28–39 cm long. In *C. nana*, the leaf sheath is tubular and unsplit. The leaf sheaths of FTG's specimen of *C. hainanensis* are also unsplit, although those of much older specimens in the South China Botanical Garden, Guangzhou (Fig. 2), are split as in *Thrinax* (J. Dransfield, personal communication).

Both species possess costapalmate leaves. The costa extends briefly into the blade, but the leaf is noteworthy in lacking a hastula. The segment apices are acute, not bifid as in many other genera. The lamina color of both species is blue-green, but not glaucous, on both surfaces. The leaves of *C. hainanensis* typically have 40–43 segments per leaf, and those segments are 59–64

1. *Chuniophoenix hainanensis* growing in full sun at Fairchild Tropical Garden. 2. *Chuniophoenix hainanensis* at South China Botanical Garden bearing numerous inflorescences. Note split leaf base in the center of the photograph (photo courtesy of J. Dransfield).

cm long and 4.0–4.5 cm wide. The leaves of *C. nana* have only 21–23 segments, and they are grouped in six or seven clusters of three and five segments each. The individual segments are 26–35 cm long and ca. 1 cm wide.

The inflorescences of both species are borne among the leaves, one per node. That of *C. hainanensis* is longer, to ca. 100 cm, and branched to two orders; whereas the inflorescence of *C. nana* is ca. 40 cm long and only once branched. In *C. nana,* the flowers are borne singly (rarely paired) along the rachillae, but in *C. hainanensis* flowers are borne in small clusters along the rachillae. Both species blossom in winter and early spring (November–April) in Miami.

The flowers of these palms are similar in size and shape, but dissimilar in fragrance and color (and perhaps in pollinators). The flowers are ca. 9.5 mm across, with a loose, membranous, cupulate calyx, and three strongly reflexed petals. There are six stamens, the inner whorl of which is strongly fused to the upper surfaces of the petals for about half the length of the filaments. A single cylindrical gynoecium is found in the center of the flower. The flower of *C. nana* is white with yellow anthers and is sweetly scented. That of *C. hainanensis* is burgundy red with yellow anthers and a greenish-yellow gynoecium, and it has a sour, slightly unpleasant aroma.

Uhl and Dransfield (1987) reported that some plants are polygamodioecious (bearing both bisexual and unisexual flowers). All of FTG's plants are hermaphroditic. The flower clusters in

C. hainanensis often appear to be composed of functionally carpellate and functionally staminate flowers, because the older, pollinated flower in the cluster often has a swollen ovary and empty anther sacs, while the younger flower still has an unfertilized ovary and anthers bursting with pollen.

Fruits ripen ca. 10–11 mo after flowering. Both species produce soft, juicy to mealy fruits, which are bright orange-red when ripe. The surface of the fruit is smooth but becomes finely verrucose (warty) when dry. The stigmatic scar is minute and apical. Most fruits have only one seed with a lateral hilum, but exceptional fruits of *C. nana* have been found with two seeds. Fruits of *C. hainanensis* are obovoid to pyriform, 21.1–26.2 mm long and 18.1–22.9 mm in diameter. Fruits of *C. nana* are globose to oblate-spheroidal, 12.2–16.1 mm long and 12.0–17.7 mm in diameter.

Both species have seeds that are oblate-spheroidal, but in *C. nana* the seeds are also slightly flattened on the hilum side. Seeds are 10.0–13.3 mm long and 11.5–15.1 mm in diameter in *C. hainanensis* and 7.4–10.9 mm long and 8.7–12.1 mm in diameter in *C. nana*. The endosperm is ruminate in *C. hainanensis* but homogeneous in *C. nana*. Germination in these species is remote tubular. The eophyll in both species is strap-shaped and plicate, with an acute apex.

Chuniophoenix was reported to have a remarkably low chromosome number, $n = 5$ (Hsu and Huang, cited in Uhl and Dransfield 1987). This count, however, is likely in error, as Röser and colleagues (1997) reported that in *C. nana* $2n = 36$ (and by inference, $n = 18$), which is the usual number found in the Coryphoideae (Röser 1993).

Both species seem well-adapted to Miami's climate, and both are reported to be hardy as far north as Orlando, Florida (Bobick, in Tollefson 1997). *Chuniophoenix hainanensis* is forgiving of Miami's strong sun and highly alkaline soils; it is undamaged by brief exposure to temperatures as low as −3°C (26°F) (Noblick, *in press*). *Chuniophoenix nana* requires some shade and is more prone to micronutritional deficiencies in our limestone soils. The latter species makes an elegant houseplant, although it still appreciates applications of micronutrients. At FTG, both species appear to be relatively free of serious pests, but Southeastern Lubber Grasshoppers [*Romalea microptera* (Beauvois)] sometimes feed on the leaves of *C. nana* and can cause considerable damage if left unchecked. They can be controlled by hand-picking and administering the *coup de grâce* under foot.

Chuniophoenix is a genus of unusual fan-palms with tremendous horticultural potential. These attractive palms add another choice to the landscaper's palette, and they should grow as well for others as they do at FTG.

Acknowledgments

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The Making of a Dugout Canoe from the Trunk of the Palm Iriartea deltoidea

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The trunks of certain palm species are used in a variety of ways to furnish commercial and subsistence products. The coconut palm trunk, for example, is a source of sawn lumber for general construction purposes, and the wood can also be crafted into panelling, furniture, and parquet flooring. Entire trunks of a number of different palms are cut and used as framing in building construction, as well as for posts, pilings and power transmission poles. Hollowed-out portions of some palm trunks are made into water conduits, blowguns, drums, fermentation vats, water barrels, water troughs, dugout canoes, and even coffins.

Information on palm trunk canoes was sought through a bibliographic search on the subjects of palms and useful plants in general. Only a few references were found on making this unusual type of canoe in Asia and Latin America.

Miller (1964) states that in Indonesia sugar palm (*Arenga pinnata*) trunks are occasionally made into a very durable canoe (*perahu lesung*). Dastur (n.d.) reports that the hollowed-out trunk of the palmyra palm (*Borassus flabellifer*) is used as a dugout in India.

Latin America has the greatest reported incidence of palm canoe-making, and it appears to be the only region where the practice persists. However, John Dransfield informs me that in 1996 he photographed in Madagascar a trunk of *Ravenea musicalis* hollowed out to act as a dugout canoe, but as this palm is known from but one river, this use is unlikely to be very important in the country. The swollen portion of the Cuban belly palm (*Colpothrinax wrightii*) is sometimes made into a canoe (Moore 1960). Pio Corrêa (1987) mentions the making of a trunk canoe as one of the many uses of the mirití palm (*Mauritia flexuosa*) in Brazil.

Dugout canoe construction in the Amazon Basin, exploiting the huacrapona palm (*Iriartea deltoidea*), is documented by Bodley and Benson (1979), Henderson (1990), Karsten (1856), Lévi-Strauss (1948), Pio Corrêa (1987), and Wallace (1853). To serve for canoe-making, palms must be of sufficient diameter to produce a vessel able to accommodate a person or persons as well as cargo, and have a tough, durable rind. Diameter is the most important factor. Three of the palms mentioned above have cylindrical trunks of large diameter: *Arenga pinnata* is 40–50 cm, *Borassus flabellifer* grows up to 1 m, and *Mauritia flexuosa* is 30–60 cm. In the two ventricose palms, *Colpothrinax wrightii* has a trunk diameter of 30–40 cm, and is twice as large at the swelling; *Iriartea deltoidea* is 30 cm, and is up to 70 cm at the swollen portion. (An earlier and sometimes still-encountered name for this palm is *Iriartea ventricosa*. The species name refers to its swollen feature.)

As compared to the hard outer trunk rind, the interior tissue of larger trunked palms is relatively soft, which facilitates its excavation. In *Iriartea deltoidea*, the inner tissue in the swollen trunk portion is so soft that chunks can be extricated easily, and it is so saturated that water can be squeezed from it by hand.

A week-long visit was made to Iquitos, in the Peruvian Amazon Region, for the express purpose of acquiring a palm trunk canoe for the Palm Museum being established in Santa Cruz de Tenerife, Canary Islands. It was decided to procure a palm canoe as a unique large object for exhibit. This article is intended to capture a photographic record and description of the canoe-making.

On September 30, 1997, we proceeded to the

1. *Iriartea deltoidea* palm exhibiting its swollen trunk midsection, a common feature among lowland populations below about 300 m in elevation. Photo by Jane MacKnight. 2. *Iriartea deltoidea,* showing its characteristic stilt roots. Guillermo Criollo is wielding the axe. Photo by Jane MacKnight.

3. The swollen section of the palm trunk is marked with a machete prior to being hollowed out. Photo by Jane MacKnight. 4. Cutting through the tough outer rind. Photo by Jane MacKnight.

5. The softer inner material of the trunk is easily removed with a hatchet or machete. Photo by Jane MacKnight. 6. A view toward the bow of the nearly-completed canoe. Photo by Jane MacKnight.

7. The completed palm trunk canoe. Photo by Jane MacKnight.

field from Iquitos in pursuit of a palm canoe, accompanied by a team of four local, skilled woodsmen. Prior reconnaissance had identified a landowner willing to sell one of his *Iriartea deltoidea* palms for our purposes; the price put on the palm was ca. $7.70. The property was ca. 20 km south of Iquitos on the road to Nauta. The farm grew sugarcane, but had some remaining forest patches containing large specimens of the desired palm.

About 1 km from the nearest road a candidate palm was found in the forest (Fig. 1) and was cut down with an axe (Fig. 2). The felled palm measured 24.4 m from ground level to the base of the crown, and its stilt roots accounted for 1.8 m of the palm's height.

The next step was to select and cut away the swollen trunk section to be fashioned into the canoe. The separated trunk section was examined carefully to determine where the excavation should be made, after which an outline was cut into the surface with a machete to guide the process. The larger end would be the stern of the canoe. The swollen portion of the trunk is shown in Fig. 3. It is 4.5 m long and has a diameter at the lower end of 40 cm and at the upper end of 30 cm. At the thickest point, the diameter is 51 cm.

Just visible in the lower right of Fig. 3 is the cylindrical section of the trunk extending from the swelling to the stilt roots; it measured 12.7 m in length. In the upper left there is visible the portion of the trunk above the swelling, which is also cylindrical. It is 5.4 m long. Having at hand a felled palm, the palm heart was extracted. The fresh product proved to be of excellent quality, comparable to the fresh chonta salads served in Iquitos restaurants, which are derived from palm hearts gathered from wild stands of *Euterpe precatoria*.

Using an axe, hatchet and machete, the work crew proceeded to hollow out the swollen trunk section (Figs. 4, 5, and 6). The exterior rind was the most difficult to cut and required an axe. A hatchet and machete were employed to remove the softer inner pulp. The finished canoe is shown in Fig. 7. The stern is cut off nearly straight, but the bow is tapered. Hardwood cross pieces are wedged between the gunnels to enlarge the opening.

The palm canoe was constructed with a labor

input of about one man-day. Normally, the process would extend over two days, primarily to permit spreading further the gunnels through the use of gradually longer sticks. A wider opening provides additional space and gives the canoe greater stability.

From the site in the forest, the palm canoe was skidded to the road, loaded aboard a truck, and transported into the city of Iquitos. At a local carpenter shop, a strong wooden box was constructed to enclose the canoe, and it was shipped to Tenerife without any damage.

We were fortunate to make contact with Guillermo Criollo from Iquitos, an expert on palm canoe construction who guided the process. He had learned the technique in the Bora village on the Río Ampiyacu where he grew up. Criollo told us that the canoes are made to carry people and cargo downstream to market towns, and are then abandoned. Palm canoes are not used for fishing or other purposes. In addition to the Bora, other Amazonian ethnic groups reported to make palm trunk canoes are the Matzés and Aguarunas.

Palm canoes are temporary watercraft. Since the bow and stern are composed of soft material, those parts of the canoe are the most vulnerable to deterioration. Keeping the canoe in water is essential to prevent drying and cracking. Karsten (1856), in his brief account of palm canoe-making, states that along the Pacimoni River, clay is used to stop up the canoe ends.

A palm trunk is said to make a poor canoe because it is heavy and difficult to maneuver. At best, a palm canoe may have a useful life of two or three months. But it serves its purpose in situations of downstream travel, especially on small streams. The greatest advantage is the minimal amount of labor required to make a palm canoe, as contrasted to the larger and more durable dugouts made from tropical hardwoods. The process of making a hardwood dugout requires considerable labor and time, since the core wood must be slowly burned out to form the cavity.

The Tenerife Palm Museum and the surrounding Palmetum are expected to be opened in the year 2000. Palm enthusiasts are invited to visit the Museum to see the canoe described here, as well as the many other useful and ornamental palm objects which will make up the permanent exhibit.

Acknowledgments

The authors wish to thank Manuel Caballero Ruano, Andrés Gomez, and Jane MacKnight for their assistance.

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Left
Metroxylon warburgii (Heim) Becc.

Like most species in the genus, *Metroxylon warburgii*, one of the sago palms, is hapaxanthic, meaning that it dies after flowering. This palm was photographed in 1996, in Western Samoa, but by now this individual is long gone. The bright yellow flowers attract nectar-feeding birds, such as the Scarlet Honeycreeper (*Mysomela cardinalis*). The fruits are the size of tennis balls and are covered with shiny, chestnut brown scales. The seeds germinate readily under moist conditions.—Scott Zona

Right
Mauritia flexuosa L. f.

This photograph was taken in September, 1997, in an almost permanently flooded swamp about 8 km from Iquitos, Peru, along the road to Nauta. The local name for the palm is *Aguaje*, because it is always associated with water (*agua*). It is one of the most widely used palms in the area. This species is dioecious, and the specimen in the photograph is a staminate (male) plant.—Manuel Caballero Ruano

Principes, 42(4), 1998, pp. 209–211

Thailand 1998

Everywhere we went huge banners welcomed "THE INTERNATIONAL PALM SOCIETY!" We were in Thailand at the invitation of Kampon Tansacha, the very talented director of Nong Nooch Tropical Garden. A caravan of six red buses led by a police escort carried IPS members during our September Biennial. The buses were part of being treated "ROYALLY"—a comment heard from many people.

Our busy week began on Thursday, September 10, with the Board of Directors' Meeting, followed on Friday by registration of 190 attendees from 39 countries and a welcome dinner at the Rama Gardens Hotel near the Bangkok airport. It was the largest Biennial ever.

On Saturday at 8 am, the hour we left on every morning, we began our first tour which consisted of three parts—the huge Chatuchak Markets where we viewed fresh vegetables and an unusual array of tropical fruits and garden plants and two private gardens of mature palms. The home of retired Police Colonel, Charlie Peganen, held a splendid collection of palms and cycads. Among them were beautiful specimens of *Nypa, Copernicia macroglossa, C. baileyana, Satakentia liukiuensis, Livistona muelleri, L. rotundifolia, Cyrtostachys, Ptychosperma, Licuala,* and *Rhapis subtilis.*

Our third visit that day was to the Prasart Museum and garden, a private collection of special Thai antiques housed in a variety of small replicas of Thai houses and temples and in a setting of beautiful palms including *Corypha, Borassodendron, Kerriodoxa, Johannesteijsmannia, Ptychosperma schefferi, Siphokentia beguinii, Heterospathe,* several unusual forms of *Dypsis lutescens,* and many more.

On Sunday we traveled to Khao Yai National Park, the first national park in Thailand, designated in 1962, and consisting of 2000 sq. kilometres. The Director General of the Division of Forestry, Dr. Plodprasop Suratsuvadee, flew to the park by helicopter to greet us. Thanks to Kampon Tansacha, the director is also a palm lover. After a box lunch, the party was divided into two groups for treks into the forest. Shortly after we entered the forest, a monsoon downpour overtook us but our competent hosts (Nong Nooch staff members) immediately appeared with armfuls of red umbrellas which saved many from a drenching. A bouncing row of red umbrellas negotiating a swaying suspension bridge with *Daemonorops smidtiana* hanging from the trees beside and large, lovely leaves of *Livistona* sp. down the river is a sight many of us will never forget. Despite the rain several palms were visible from the bus, including *Myrialepis paradoxa, Areca triandra, Plectocomia barthiana, Calamus* sp. and *Licula poonsakii.* Still wet when we arrived at the Juldis Khao Yai Resort Hotel, we were greeted with hot tea and coffee and even a gift of dry slippers.

Monday was a travel day to Pattaya close to our major destination of Nong Nooch Tropical Garden—the garden that drew us to Thailand. We were bused to Nong Nooch about 5:00 pm for the treat of our lives (see p. 210, 211 for two views of the garden). It is almost impossible to express our awe at the beauty and expanse of the magnificent gardens terraced by huge boulders, the seemingly endless rows of elegantly grown palms, and the beauty and breadth of the plant nursery.

For the next two days we were guided around the Nong Nooch Tropical Garden—a complex of over 500 acres with an entertainment center as well as meeting rooms, guest facilities, and restaurants. The gardens are spectacular and will only become more so in years to come.

During the week, between sumptuous feasts of Thai delicacies and the overwhelming experience of viewing more palms than we had ever before seen in one place, we listened to speakers and enjoyed their beautiful slides. A list of the talks can be found in the inserts on the Biennial in January and April *Principes.*

This Biennial will never be duplicated. We have been entertained by Thai dancers, wrestlers, and elephant shows, elegantly fed and transported, received gifts of seeds, liquid refreshments, and ice cream at frequent intervals, and even provided with a nurse who traveled with us. We are now spoiled beyond belief. As one attendee (Ed Saloner) said, "the palm world will never be the same."

SUE ROWLANDS

Principes, 42(4), 1998, pp. 212–217

Germination Characteristics of Sago Palm Seeds and Spine Emergence in Seedlings Produced from Spineless Palm Seeds

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Abstract

The effects of air temperature and physical treatment on seed germination of sago palm were examined. Germination percentage of non-treated seeds was 10–20% at 25°C. Seeds removed from the husk and sarcotesta showed higher germination rates (40%) when incubated in water at 30°C; water was renewed every day. Seedling establishment and spine emergence in seedlings produced from spineless palm seeds were studied. Primary root-growth occurred two to three days after germination. A coleorhiza-like organ emerged around six days after germination and the epiblast emerged two to three days later. Emergence of coleoptile and first leaf respectively coincided with the emergence of the first and second roots from the coleorhiza-like organ. Differentiation of petiole and leaflets was observed from the third leaf stage. Spine emergence was observed from the first leaf stage in 28% of seedlings.

Sago palm can be propagated from both vegetative organs and seeds, using axillary buds at the lower leaf positions and adventitious buds from the subterranean stem and suckers. Use of suckers is preferred, as farmers claim that seedlings are slower in establishment by about one to two years, when compared to sprouting material from suckers (Jong 1995). Recently, the use of seedlings has increased slightly because of a shortage of planting materials in Sarawak, Malaysia (Jong 1995) and Riau, Indonesia. There are many reports on the poor germinability of sago palm seeds (Alang and Krishnapilly 1986, Flach 1984, Jaman 1985, Johnson and Raymond 1956, Jong 1995, van Kraalingen 1984). Johnson and Raymond (1956) reported that viable seeds are not easy to obtain. However, there are few reports (Alang and Krisnapilly 1986, Jaman 1985, Jong 1995) on the improvement of germinability, since sago palm has been usually propagated from suckers. In this study, we aimed to clarify germination characteristics of seeds of spineless sago palm, particularly the effects of air temperature and removal of the husk and sarcotesta on germination to investigate the enhancement of germinability.

Jong (1995) examined the germination of sago palm seeds at five different stages of maturity, and reported that well-developed seeds (Stage 4-5) had greater germinability than immature seeds (Stage 1-3). Alang and Krishnapillay (1986) and Schuiling and Flach (1985) also suggested that seed maturity was important for germination in sago palm. Accordingly, we reported the effects of air temperature and physical treatment on the germination of well-matured seeds of *Metfoxylon*. Moreover, we studied seedling establishment and the emergence of spines in seedlings that were produced from seeds of the spineless sago palm.

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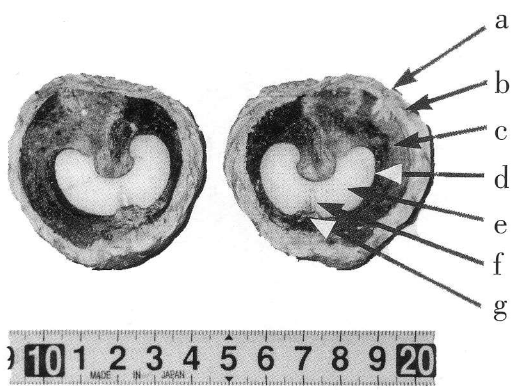
Material and Methods

Fruits of spineless sago palm (*Metroxylon sagu* Rottb.) were collected at Batu Pahat in Johor of Malaysia. Fresh weight and size (longest diameter, shortest diameter and height) of 67 pollinated fruits and 14 unpollinated ones were measured. According to the suggestion by farmers who have cultivated sago palms, pollinated and unpollinated fruits were divided. Pollinated fruits were sown one each in the furrow of a rockwool block (5 × 5 × 8 cm height), inserted into a 180 ml plastic bottle, and placed in an air conditioned room. Air temperature was maintained at



1. Vertical section of sago palm seed. a. exocarp, b. mesocarp, c. sarcotesta, d. testa, e. endosperm, f. embryo, g. operculum.

25°C, and the relative air humidity was controlled at 75%. The fruits were well-watered each morning and evening. After the 10th and 40th days, 35 and 30 fruits respectively were removed from the husk (exocarp and mesocarp) and sarcotesta (Fig. 1), and germination counts were made. Then, fresh weight, longest diameter, shortest diameter, and the height of seeds (embryo and endosperm with testa and operculum) were measured. Ungerminated seeds without the husk and sarcotesta were submerged completely in distilled water. Distilled water was renewed every day. Germination tests were continued for 10 days or 40 days more at 30°C air temperature, and then germination counts were made.

Some of the germinated seeds were transferred individually to 200 ml beakers filled with distilled water to study seedling establishment. The rooting and leaf emergence were continuously observed every day. Distilled water was renewed every day. The other germinated seeds were transplanted individually to 0.5 l plastic bottles filled with vermiculite and the Kimura B culture solution (Baba and Takahashi 1958) at full strength. The culture solution contained (mg l^{-1}) 48.2 $(NH_4)_2SO_4$, 15.9 K_2SO_4, 65.9 $MgSO_4$, 18.5 KNO_3, 59.9 $Ca(NO_3)_2$, 24.8 KH_2PO_4 and 3.5 FeO_3. The initial pH of the culture solution was adjusted to 5.5 before applying. Culture solution was supplemented every day and renewed once a week. The bottles were placed in the air conditioned room at 30°C and 75% relative humidity. Light was applied for 12 h/d at an intensity of 24klx. Seedling growth and the emergence of spines in seedlings produced from the seeds of spineless sago palm were recorded.

Results and Discussion

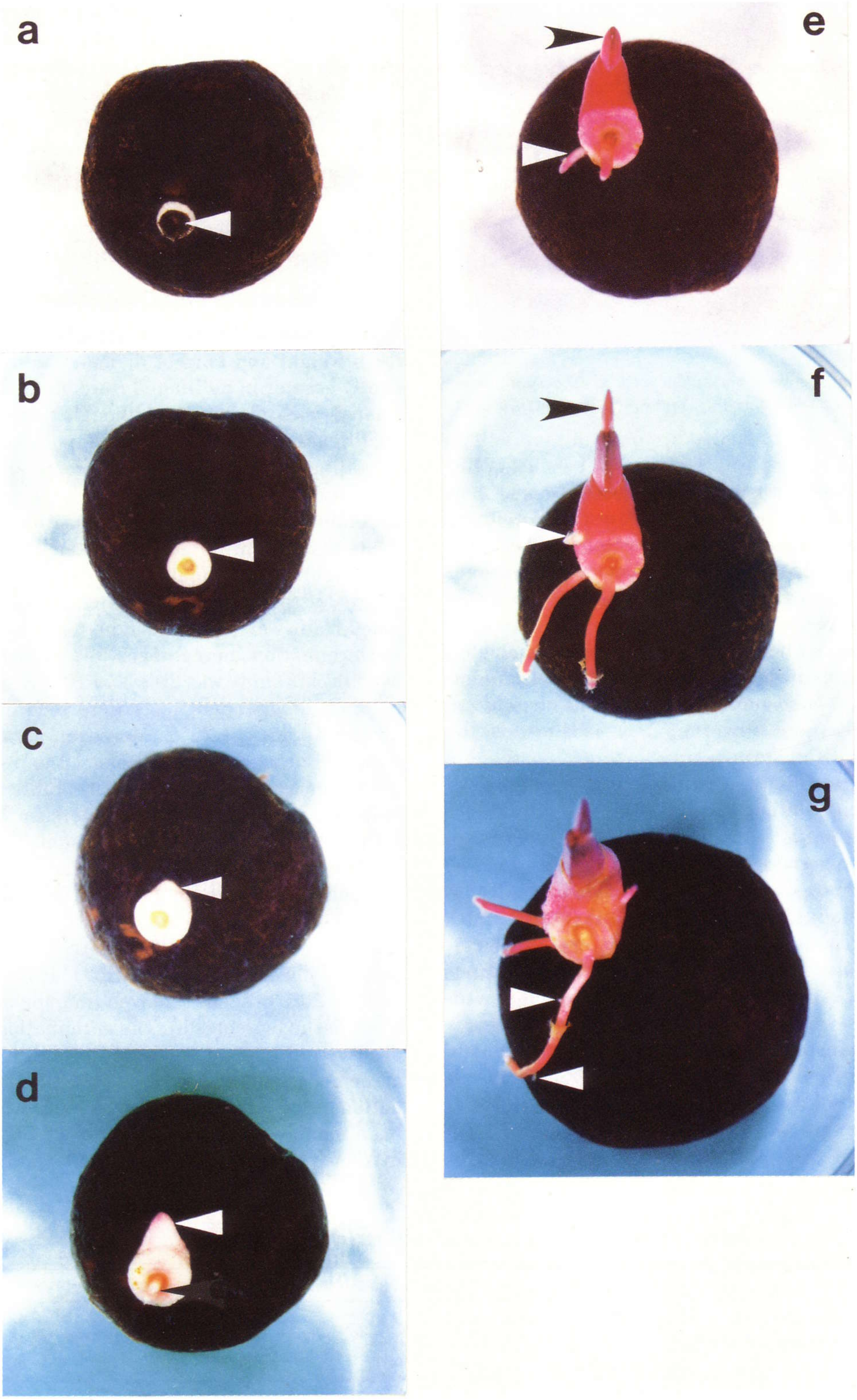
Germination characteristics. The values of fresh weight and longest diameter were significantly greater in pollinated fruits than in unpollinated ones (Table 1). Although there was no significant difference between pollinated and unpollinated fruits in shortest diameter, clearly pollinated fruits were heavy and large compared with unpollinated ones considering the results of fresh weight and longest diameter. In contrast, the height of unpollinated fruits was significantly greater than that of pollinated ones. Unpollinated fruits were slim and light.

Germination percentages of mature seeds used in this study was 20% and 10% respectively when independent tests were recorded after 10 and 40 days at 25°C. Moreover, germination recorded around 40% between 10 and 40 days after transfer from 25°C to 30°C (Table 2). Germination percentage did not increase between 10 and 40 days after sowing. Presumably, viable seeds were vigorous enough to germinate rapidly. According to Jong (1995), germination of well-matured, non-treated seeds was ca. 5% after six weeks at 25–30°C; <10% of seeds removed from the husk (exocarp, and mesocarp), and ca. 20% of seeds removed from the husk and fresh tissue (sarcotesta). The germination values observed in this study (Table 2) were in general agreement with those of Jong (1995). The germination percentage was higher in seeds which had been removed from the husk and sarcotesta than in non-treated seeds; this result was in good

Table 1. Fresh weight and size of pollinated and unpollinated fruits.

Sample type	Fresh weight (g)	Longest diameter (mm)	Shortest diameter (mm)	Height (mm)
Pollinated fruit (n = 67)	54.0 ± 0.6	55.6 ± 0.2	47.3 ± 0.2	48.5 ± 0.3
Unpollinated fruit (n = 14)	36.1 ± 0.9	52.0 ± 0.7	48.8 ± 0.9	52.5 ± 0.9
Probability (t-test)	<0.001	<0.001	0.055	<0.001

Values indicate mean ± standard error.


a
b
c
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e
f
g

Table 2. Germination percentage under different air temperatures.

Incubation time (d)	Germination at 25°C (%)	Cumulative germination after 25°C → 30°C (%)	n
10	20	40	35
40	10	37	30

agreement with the earlier findings of Alang and Krishnapillay (1986), Jaman (1985), and Jong (1995).

Transferring seeds from 25°C to 30°C resulted in 20–27% increase in germination, and a final germination level for the seeds without the husk and sarcotesta of around 40% (Table 2). In contrast, Jong (1995) recorded lower germination in seeds without the husk and fresh tissue at 25°C–35°C. The possibility that small temperature changes within this range affect the germination percentage was further investigated with well-matured fruits collected in Bangka Island of South Sumatra, Indonesia. Five fruits were removed from the husk and sarcotesta, and were submerged completely in distilled water at 35°C air temperature. Germination recorded 20% by Day 21 and did not increase thereafter up to 40 days in the test. The results suggest that air temperature affects germinability of sago palm seeds in the range 25°C–35°C, and that germinability can be reduced by not only low air temperature but also by excessively high air temperature.

Seeds without the husk and sarcotesta which were submerged completely in distilled water at 30°C have a higher germination percentage than do sago palm seeds sown in sand trays (Jong 1995). Schuiling and Flach (1985) suggested that germination requires high humidity but may be sensitive to excessive moisture. Jaman (1985) reported that the germinability was generally improved when sago palm seeds were husked and dipped in water.

Continuous soaking of gramineous seeds in water generally reduces germination when the water is not renewed. The reason for this tendency may be the failure to remove germination inhibitors that would have been leached from seed (and/or seed coat) into the water (Morita et al. 1997). In the current experiment, we renewed water every day at 30°C and observed the same germination percentage as that previously observed for seeds treated with 10^{-3} M GA in sand tray, i.e. about 40% germination six weeks after sowing (Jong 1995). If germination inhibitors effused from the seed prevent sago palm germination, water volume and renewal of water might be important parameters controlling the germination percentage. Anyhow, removing the husk and sarcotesta, and dipping the seed in water, certainly improve germinability in this species.

Although Jong (1995) recognized that loosening the operculum improved seed germinability, we could not improve germinability by scarification in a preliminary experiment. There were no significant differences in fresh weight and size between germinated seeds and ungerminated ones (Table 3). Therefore, we considered that the maturity level of ungerminated and germinated seeds was the same. The effects of air temperature, physical treatment of seeds and of moisture

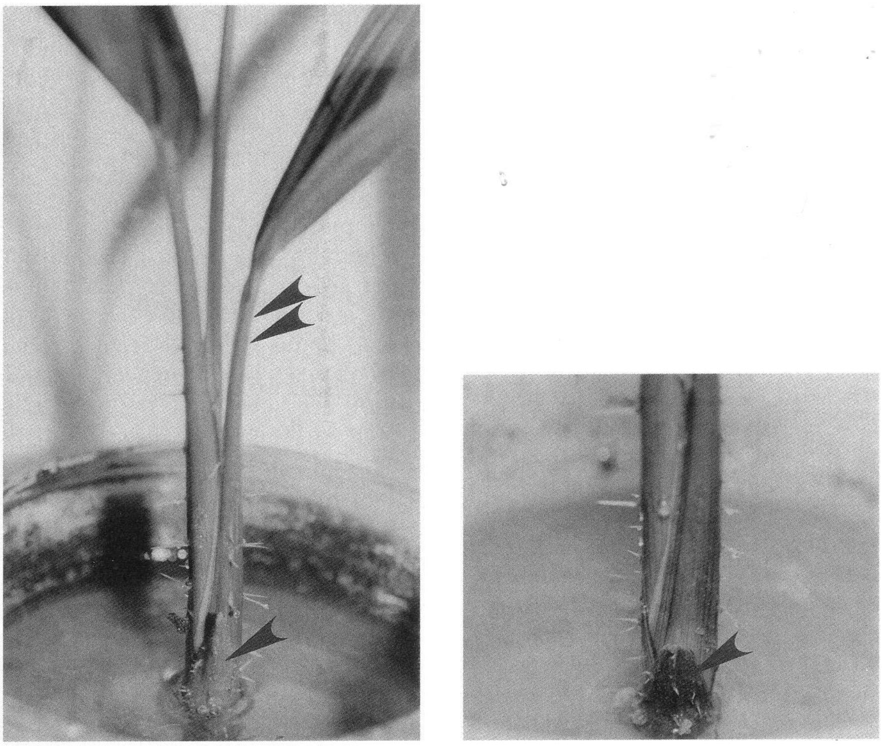
Table 3. Fresh weight and size of germinated and ungerminated seeds.

Sample type	Fresh weight (g)	Longest diameter (mm)	Shortest diameter (mm)	Height (mm)
Germinated seed at 25°C	10.0 ± 0.6	26.8 ± 0.7	25.8 ± 0.8	21.0 ± 0.6
Germinated seed at 30°C	10.0 ± 0.6	26.5 ± 0.5	25.9 ± 0.6	20.7 ± 0.5
Ungerminated seed	10.4 ± 0.5	26.9 ± 0.4	26.1 ± 0.3	20.8 ± 0.4

Seed fresh weight consists of weights of embryo, endosperm, testa, and operculum.
Diameter and height of seed are those of embryo and endosperm with testa and operculum.
Values indicate mean ± standard error.

←

2. Process of seed germination, rooting, and shoot emergence. a) Δ indicates operculum, b) Δ indicates coleorhiza-like organ, c) Δ indicates epiblast, d) Δ indicates epiblast, ▲ indicates primary root, e) ▲ indicates coleoptile, Δ indicates first root from coleorhiza-like organ, f) ▲ indicates first leaf, Δ indicates second root from coleorhiza-like organ, g) Δ indicates branched root from primary root.



3. Spiny seedlings produced from seeds of spineless mother palm. ▲ indicates first leaf, ▲▲ indicate third leaf. Second leaf is hidden by fourth leaf and is not shown.

condition of media on water absorption by seeds, stimulation of enzyme activities, and endogenous inhibitor activity might be the subject of further studies on the development of improved germination conditions for sago palm.

Seedling growth. The growth of young seedlings from seeds germinated at 30°C was observed and their typical appearance at some stages is shown in Fig. 2 (p. 205). Although the time to germinate varied from one to 23 days among 15 seeds, the timing of subsequent rooting and shoot emergence were similar. Seed germination was recognized when the operculum was pushed up (Fig. 2a). A coleorhiza-like organ emerged around six days after germination (Fig. 2b). After a further two or three days, the epiblast began to elongate (Fig. 2c). The primary root emerged during the elongation of the epiblast (Fig. 2d), and was dependent on the removal of operculum; late removal of the operculum delayed emergence. The first root from the coleorhiza-like organ and coleoptile emerged two to three days after emergence of the primary root, which appeared immediately after the operculum was removed (Fig. 2e). Further root emergence from the coleorhiza-like organ occurred two to three days later (Fig. 2f). The first leaf emerged on the same day that the second root grew from the coleorhiza-like organ (Fig. 2f). A branched root developed when the second root was elongating and the third root was emerging from the coleorhiza-like organ (Fig. 2g).

Hisajima et al. (1991) used liquid medium of the modified Murashige and Skoog's (MMS) medium to grow multiple shoots of sago palm from embryo cultures, which reached 20–25 cm within three to four months. Mineral content in the culture solution that we used was fairly low if compared with liquid MMS medium (Hisajima 1991), although our seedlings were able to grow well and their plant length was ca. 6 cm four weeks after germination.

There is little known about seedling growth at the very early stage in sago palm. Detail investigations of morphological and physiological characteristics of young seedlings might be the subjects of further studies, and should be carried out using many plants under various conditions to get good seedlings. Nevertheless, it is remarkable that roots and leaves emerged at regular intervals in the current experiments.

In the seedlings observed (Fig. 3), the first and second leaves had no leaflets, and the third had two leaflets. Differentiation of petiole and leaflets was clearly observed from the third leaf stage. Although we used seeds of spineless sago palm, spines were observed on the first leaf and on subsequently emerging leaves (Fig. 3) in 28% of the seedlings. The ratio of spiny seedlings to spineless seedlings was ca. 1:3. Jong (1995) noted that, irrespective of whether the parent palm was spiny or spineless, both spiny and spineless seedlings were produced, although the result was not quantified. In the current experiment, we clarified that spiny seedlings were produced from some seeds of spineless sago palm, and that the spines emerged at the first leaf stage. However, we cannot currently explain the meaning of these findings. We have been conducting randomly amplified polymorphic DNA (RAPD) analysis of spiny and spineless sago palm (Ehara et al. 1997). The next report will consider in greater detail the genetic comparison of spine emergence.

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PALM LITERATURE

ROBERT LEE RIFFLE, The Tropical Look. 1998. Timber Press, Portland, Oregon. $49.95. The Tropical Look is available through Digital Raingardens in association with Amazon.com at http://www.raingardens.com/shopfor/books.htm for $34.97.

Robert Lee Riffle is also a frequent visitor at these message boards:
Tropical Attitudes Gardening Message Board: http://www.raingardens.com/wwwbb/wwwboard.html
International Palm Society Message Board: http://www.palms.org/bboard/

Many of us in the International Palm Society have undoubtedly known for a long time that numerous "tropical looking" palms and other plants can endure freezing temperatures. Members will go to extreme measures to grow palms outside, even if we must protect them during the winter. Now, Robert Riffle has written a book which provides an extensive list of tropical-looking plants that may be grown in subtropical and temperate regions.

Anyone who likes to garden with a tropical twist must have the "The Tropical Look." It is one of the best references to join our collection of gardening books and features plants which will be of interest to gardeners whose climates reach a maximum low temperature of 10 degrees.

(Continued on p. 226)

Principes, 42(4), 1998, pp. 218–226

The Palm Flora of the Maquipucuna Montane Forest Reserve, Ecuador

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ABSTRACT

Eleven species of palms occur at altitudes of 1 000–2 800 m in the Maquipucuna reserve and adjacent areas in the Ecuadorian Andes. Of these, at least five have lower upper altitudinal limits in Maquipucuna than elsewhere in Ecuador, possibly due to the Massenerhebung effect. Nine species represent Andean elements, while two species represent lowland elements. The species vary from abundant to very rare in the area. The palms provide edible fruits, palm heart, and leaves for Palm Sunday. The eleven species are described and a field key based on sterile characters is given.

RESUMEN

Once especies de palmas están presentes en altitudes entre los 1 000 m y 2 800 m en la reserva de Maquipucuna y áreas adyacentes en los Andes del Ecuador. De éstas, por lo menos cinco tienen, en Maquipucuna, límites altitudinales superiores más bajos que en el resto del Ecuador, posiblemente debido al efecto Massenerhebung. Nueve especies representan elementos andinos, mientras que dos especies representan elementos de bajas altitudes. Las especies varían entre abundante y muy rara en el área. Las palmas proveen frutos comestibles, palmito y hojas para Domingo de Ramos. Se proveen descripciones de las once especies y se incluye una clave de campo basada en caracteres vegetativos.

While the majority of neotropical palm species occur in tropical lowland rain forests, the Andean highlands above 1 000 m are home to ca. 14% of all neotropical palm species (Moraes et al. 1995). In this paper we present the palm flora of a montane forest in the Ecuadorian Andes.

The Maquipucuna montane forest reserve, Bosque Protector Maquipucuna, lies on the western slopes of the Andes, ca. 40 km northwest of the Ecuadorian capital, Quito. It is owned by Fundación Maquipucuna, a private environmental organization. Established in 1988, the reserve encompasses ca. 4 500 ha at altitudes from 1 200 to 2 800 m above sea level (Webster and Rhode, unpublished manuscript). Most of the protected area is covered by pristine forest, but in areas below 1 500 m the landscape is a mosaic of mature forest, secondary forest and scrub, and newly abandoned pastures. The natural vegetation includes lower montane rain forest below 2 500 m and upper montane rain forest above 2 500 m (Webster 1995). The vegetation above 1 500 m also qualifies as cloud forest, having a persistent cloud cover (Fig. 1) (Webster and Rhode, unpublished manuscript). The lower montane rain forest in the Maquipucuna reserve has a 25–30 m tall canopy. Characteristic features are the prominence of the canopy tree, *Otoba gordoniifolia* (DC.) Walp. (Myristicaceae) and the abundance of understory palms (Fig. 2). Above 1 800 m, the vegetation grades into upper montane forest, i.e., the forest is lower and temperate taxa are more prominent, while some tropical taxa, such as palms and *Otoba gordoniifolia*, disappear (Webster and Rhode, unpublished manuscript) (Fig. 3). The flora of the Maquipucuna reserve and adjacent areas includes 1160 species (Webster and Rhode, unpublished manuscript). No long-term climatic data exist for the Maquipucuna area, but two adjacent villages, Nanegal and Nanegalito, have annual precipitations of 3 000–3 500 mm; and the climate is seasonal, with a dry period from June/July through September/October (Sarmiento 1994). Mean annual temperature is estimated to be ca. 18°C at 1 200 m and ca. 10°C at the highest point, nearly 2 800 m above sea level (Webster and Rhode, unpublished manuscript).

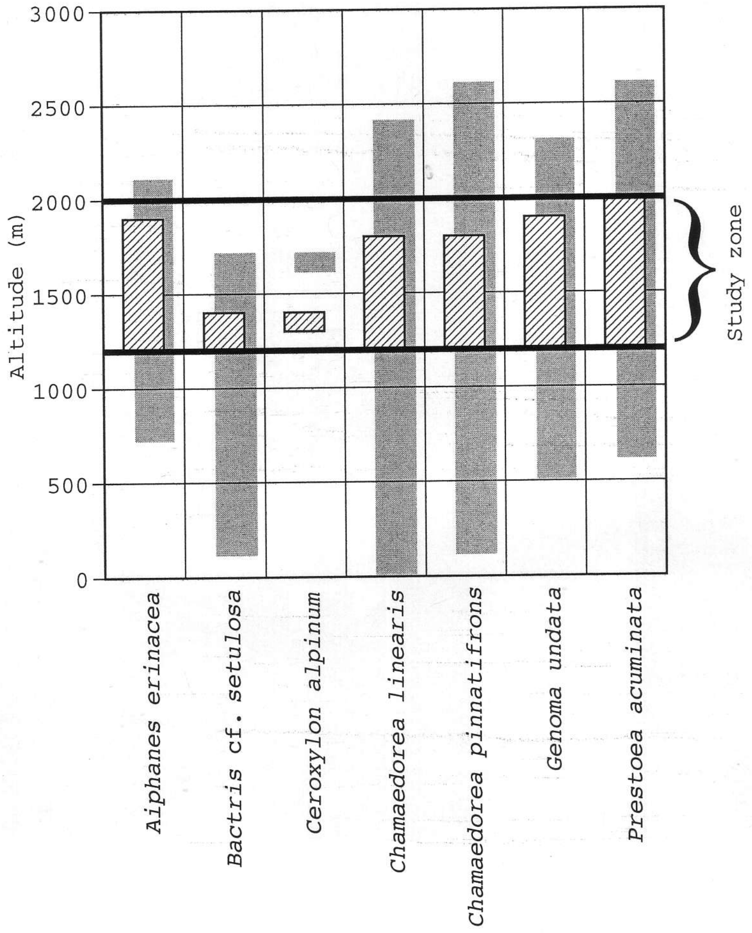
As part of our research on the ecology of Ecuadorian palms, one of us (J.-C. Svenning) studied the factors determining local scale distribution of palm species in the northwestern part of the reserve, near the Thomas Davis Scientific Station.

Within the reserve, we found eight species of palms (Table 1). Three additional species grow along the Río Alambi, just west of the Maquipucuna reserve (and above 1 000 m) (Table 1). Figure 3 shows the altitudinal distribution of palm species near the scientific station. It is interest-


1. Cloud forest with *Prestoea acuminata* near summit of Cerro Sosa. 2. *Aiphanes erinacea* in forest below the cloud forest zone.

ing to note that all the species found within the area, except *Prestoea acuminata* (not considering the very rare *Ceroxylon alpinum*) have upper altitudinal limits 200–1 000 m below those given for Ecuador by Borchsenius et al. (in press). This could be due to differences in the species' environmental requirements throughout their range or to environmental differences along the Ecuadorian Andes. Our study area is restricted to the two mountains, Cerro Sosa and Cerro Santa Lucia, and includes their summits at 1 900–1 950 m, which is much lower than the main mountain ranges of the Ecuadorian Andes (Fig. 3). The lower altitudinal boundaries might be due to a reverse *Massenerhebung* effect (the phenomenon whereby vegetation zones are found at lower elevations on lower mountains relative to taller mountains at otherwise similar sites) (Kappelle 1995).

When we compare the Maquipucuna palm species list to that of Andean palms (Moraes et al. 1995), it is obvious that the Maquipucuna palm flora is a typical Andean palm flora composed mainly of taxa centered in the Andes, but also including lowland taxa that rarely ascend to more than 1 500 m. *Ceroxylon* is endemic to the Andes, while *Aiphanes* is strongly Andean-centered. *Chamaedorea pinnatifrons* is widespread both in the lowlands and highlands of the western neotropics; *Chamaedorea linearis, Geonoma undata,* and *Prestoea acuminata* are widespread in the Andes; *Bactris* cf. *setulosa* and *Socratea rostrata* represent a premontane element, while *Oenocarpus bataua* and *Phytelephas aequatorialis* are distributed mainly in the tropical lowland (Henderson et al. 1995, Moraes et al. 1995).



3. Altitudinal distribution of the palm species near the Thomas Davis Scientific Station (striped) and in Ecuador (grey). The heavy lines indicate the altitudinal limits of our study area near the field station.

Our descriptions of the palm species from Maquipucuna focus on characteristics that are useful for identification in the field. We provide a key based on sterile characters (Table 2). Local names given in Table 1 are those used by the mestizo inhabitants of the area.

Aiphanes chiribogensis *Borchs. & Balslev*

Aiphances chiribogensis Borchs. are solitary trees with male and female flowers on the same individual. The stem ≤3 m tall and 3–6 cm in diameter. Leaves are pinnately divided, with grouped leaflets that are narrowly wedge-shaped and jagged at the tip; the sheath is often violet inside. Inflorescence is often branched from the base, with pendulous flowering branches with a long sterile part near the base.

Although we did not observe *Aiphanes chiribogensis,* it has been collected within the reserve above the Río Pichan at 2 000 m (Webster and Rhode, unpublished manuscript). This species is endemic to the western slopes of the Ecuadorian Andes.

Aiphanes erinacea *(H. Karst.) H. Wendl.*

These are clustering trees (Fig. 4) with male and female flowers on the same individual, often with >10 clustered stems, 2–6 m tall and 2.5–5 cm in diameter. Leaves are pinnately divided with grouped triangular leaflets with broad jagged tips and longitudinal folds; the underside of the blade is whitish. The inflorescence has a long stalk and numerous spreading flowering branches. Both stems, leaves, and inflorescence

Table 1. Palm species occurring in the Maquipucuna zone. Systematic classification follows Uhl and Dransfield (1987), while scientific species names follow Borchsenius et al. (in press).

Subfamily	Tribe	Species	Common Name(s)
Ceroxyloideae	Ceroxyleae	*Ceroxylon alpinum*	Palma de ramo
	Hyophorbeae	*Chamaedorea linearis*	Chonta verde
		Chamaedorea pinnatifrons	Molinillo
Arecoideae	Iriarteeae	*Socratea rostrata*	—
	Areceae	*Prestoea acuminata*	Palmito
		Oenocarpus bataua	—
	Cocoeae	*Aiphanes chiribogensis*	—
		Aiphanes erinacea	Chontilla Chonta
		Bactris cf. *setulosa*	Chonta fina Chonta
	Geonomeae	*Geonoma undata*	Corozo
Phytelephantoideae	—	*Phytelephas aequatorialis*	Tagua

stalks are strongly armed with numerous yellow spines. Seedlings are easily distinguished from other palm seedlings in the area by the combination of the whitish underside of the bifid leaf blade and the presence of small bristles at the blade margin.

This species is common near the scientific station. It often occurs in dense populations, probably because stems bent to the ground may establish a new cluster several meters away from the parent clump. Clonal reproduction appears to be more common than sexual reproduction; only a few seedlings were observed in spite of abundant fruiting.

Bactris *cf.* **setulosa** *H. Karst.* (Chonta fina, Chonta)

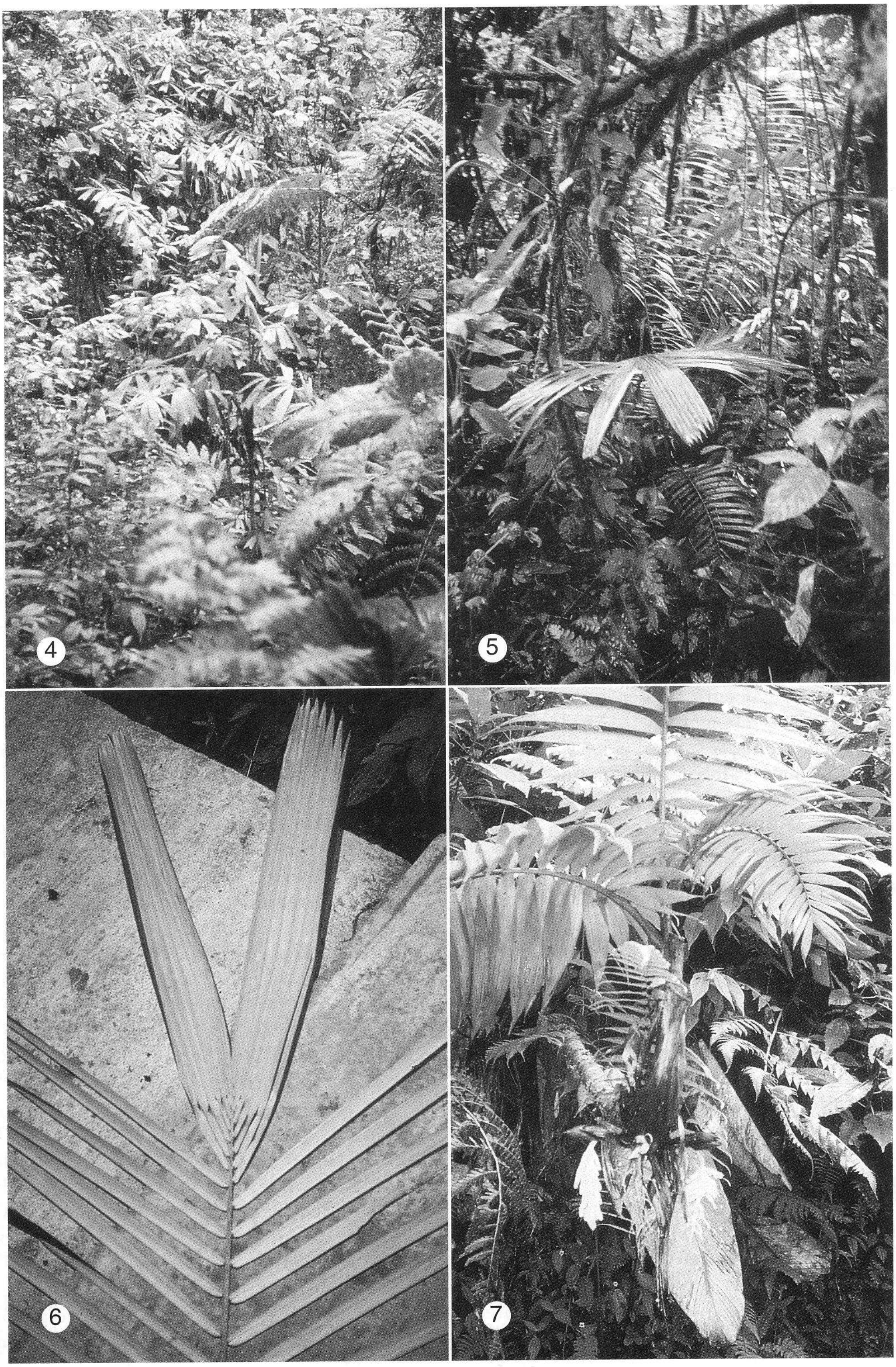
These are clustering trees with male and female flowers on the same individual. There are often 10 or more stems in a cluster, each one up to 10 m tall and 10–15 cm in diameter. Leaves are pinnately divided with many irregularly spaced linear leaflets that spread in different planes. Inflorescence is pendulous with numerous branches and a large, cowl-like bract. Stems, leaves, and inflorescences are strongly armed with numerous spines. Seedlings can be recognized by the combination of the green underside of the bifid leaf blade and by the presence of bristles at the blade margin.

We found only a few individuals of this species in the reserve, but it is common in forest remnants and pastures at slightly lower altitudes just outside the reserve. *Bactris* cf. *setulosa* is highly valued by the local population for its edible fruits. The local name, which loosely translated means "fine palm," refers to its utility. For this reason, it is often left when the forest is cleared for pasture, and there appears to be some interest in cultivating this species.

Ceroxylon alpinum *Bonpland* (Palma de ramo)

Ceroxylon alpinum are solitary trees (Fig. 5) with male and female flowers on different individuals. Stems are ≥20 m tall, ca. 20 cm in diameter, and are covered with a thin, waxy layer. Leaves are pinnately divided with many regularly spaced linear leaflets along the midrib which spread horizontally; their undersides have a thick, whitish tomentum, and the tips of the leaflets are asymmetrical. The apical leaflets are joined at the tip (Fig. 6). Seedlings are characterized by the whitish underside of the bifid leaf blade, the two halves of which are relatively short and broad, and by the absence of bristles along the blade margin.

The leaves of this species are highly valued and are used in religious processions on Palm Sunday (*Domingo de Ramos*), hence the local name "Palma de ramo." Several inhabitants have planted it for this use as well as its beauty. Within the area around the scientific station we found only a few seedlings and one juvenile of this species, but no adults. *Ceroxylon alpinum* appears to be rare or absent also in the neighboring areas. This near-absence is mysterious, because it is common elsewhere in the reserve at similar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5
6
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altitudes. The survival of this species may be severely threatened by the disappearance of its natural habitat throughout its entire range (Ecuador, Colombia, Venezuela) due to deforestation (Henderson et al. 1995).

Chamaedorea linearis *(R. & P.) Mart.* (Chonta verde)

These are solitary trees (Fig. 7) with male and female flowers on different individuals. The stem is smooth and green, 2–10 m tall and 2–8 cm in diameter. The local name, which means "green palm," refers to the color of the stem. Leaves are pinnately divided and totally glabrous; leaflets are linear to somewhat sigmoid, spaced regularly along the midrib and spreading horizontally. There are usually >10 leaflets per side. There are several inflorescences per node. *Chamaedorea* seedlings have glabrous bifid leaves and are easily distinguished by their serrate leaf margins. We were not able to identify reliable characteristics that separate seedings of *Chamaedorea linearis* from those of *C. pinnatifrons. Chamaedorea linearis* is very common near the scientific station.

Chamaedorea pinnatifrons *(Jacq.) Oerst.* (Molinillo)

This is a solitary tree with male and female flowers on different individuals. The stem is smooth, green, 1.5–3 m tall, and 1–2 cm in diameter, often with abundant adventitious roots on the basal part. Leaves are pinnately divided and totally glabrous; leaflets are sigmoid, broad, spaced regularly along the midrib and spreading horizontally. There are not more than eight leaflets per side, and only a single inflorescence at each node. The seedlings are similar to those of *Chamaedorea linearis*.

Chamaedorea pinnatifrons is present but not common near the scientific station. The basal part of the stem with its numerous adventitious roots has been used by the local population for whipping food; thus the local name, which means "little mill."

Geonoma undata *Klotzsch* (Corozo)

Geonoma undata are solitary trees (Fig. 8) with male and female flowers on the same individual. Stems are light brown, 2–10 m tall, and 5–10 cm in diameter. Leaves are irregularly pinnately divided into broad leaflets of unequal sizes and the leaflets are spread in a horizontal plane. A brown covering is present on the petiole and midrib. The inflorescence is three or four times branched with somewhat swollen branches, with the flowers sunken into pits. Seedlings have bifid leaves in which all secondary veins, and both the inner and outer margin of each of the two leaf blade halves, bend outward away from the line of symmetry. This species is present, but not abundant, near the scientific station.

Oenocarpus bataua *Mart.*

This is a solitary tree with male and female flowers on the same individual. The stem is >20 m tall and 20–40 cm in diameter. Leaves are erect, giving the crown an obconical shape; they are very large (to 10 m long), regularly pinnately divided into many more or less pendulous leaflets. Leaflets are linear, with a long, slender, terminal point. Their undersurface is white; and leaf sheaths have abundant large, stiff, black fibers and smaller, softer, brown fibers. Inflorescence is distinctly like a horsetail, with a short peduncle and numerous close-together pendulous branches. Seedlings have a bifid leaf blade, the two halves of which are slender and long with a whitish underside, and lack bristles along the blade margin.

We have observed only a single, very tall individual of this species left in a deforested area at ca. 1 200 m, close to a small village at the Río Alambi, between the larger villages of Nanegal and Nanegalito.

Phytelephas aequatorialis *Spruce* (Tagua)

The tagua is a solitary tree with male and female flowers on different individuals. The stem is usually a few meters tall but may reach 15 m in height; it is ca. 20 cm in diameter and rough from the persistent leaf sheaths. Leaves are 6–8 m long, regularly pinnately divided into numerous linear leaflets; the leaflets are usually placed in clusters, spreading in different planes. Male inflorescences are 1–2.5 m long, pendulous, slender, cylindrical, and yellow. The infructescence is a round head, ca. 30 cm in diameter, of large fruits covered with woody, warty projections. Seedling leaves are pinnately divided, which is

←
4. *Aiphanes erinacea* dominating the understory. 5. The single juvenile *Ceroxylon alpinum* found during our survey. 6. Apex of a juvenile *Ceroxylon alpinum* leaf. 7. An adult *Chamaedorea linearis* with a very bent stem.

8. *Geonoma undata* and *Aiphanes erinacea* left in a pasture. 9. Tall individuals of *Prestoea acuminata*.

unique among the palm species of the Maquipucuna zone.

This palm is quite common in the Río Alambi valley at 1100–1300 m, but it does not occur near the scientific station. Its seeds have an extremely hard, white endosperm, the so-called "vegetable ivory." In Ecuador, vegetable ivory is called *tagua,* hence the local name. As this material can be used for handicraft, there is some local interest in cultivating the palm. Fundación Maquipucuna has a program to integrate native plant species in the local agriculture, and this is one of the species included in this project.

Prestoea acuminata *(Willd.) H. E. Moore* (Palmito)

These are clustering trees (Fig. 9) with male and female flowers on the same individual and >10 stems in a cluster. Stems are 3–10 m or more tall and usually ca. 10 cm in diameter. Leaves are pinnately divided into numerous slender linear leaflets, each terminating in a long slender point; the leaf sheaths are partially closed and form a prominent tubular crownshaft below the crown. The crownshaft is sometimes purple; there is a reddish-brown tomentum on the petiole. The peduncle is much shorter than the main axis of the inflorescence. Seedlings have bifid leaves in which the outer secondary veins and the outer margins bend outwards, while the inner (towards the plane of symmetry) secondary veins and the inner margins bend inwards. The tomentum on the petiole is obvious even in the seedlings.

Prestoea acuminata is abundant near the scientific station and is highly valued by the local population as a source of palm heart, which is the edible young apical meristem. For this reason, there is some local interest in cultivating this species. Cultivation would probably not be too difficult, as the palm appears to grow well in open places. Seedlings were abundant close to

Table 2. Key to stemmed individuals of the palm species of the Maquipucuna zone.

1.	Spines on stem or leaf or at least small dark bristles at the blade margin.	→ 2
1.	No such spines or bristles.	→ 4
2.	Leaflets wedge-shaped with a jagged tip; stem <6 cm in diameter.	→ 3
2.	Leaflets linear, with a regular, slender tip; stem usually 10–15 cm in diameter	*Bactris* cf. *setulosa*
3.	Sheath and petiole with yellow spines; stems usually clustered.	*Aiphanes erinacea*
3.	Sheath and petiole with black spines, and stems always solitary.	*Aiphanes chiribogensis*
4.	Stem ≥15 cm in diameter.	→ 5
4.	Stem <10 cm in diameter.	→ 8
5.	Stem with a basal cone of thick stilt roots; leaf sheaths forming a conspicuous crownshaft.	*Socratea rostrata*
5.	Stem without thick stilt roots, but may have numerous slender adventitious roots; crownshaft absent.	→ 6
6.	Stem rough from persistent leaf sheaths and the underside of leaflets green.	*Phytelephas aequatorialis*
6.	Stem smooth; underside of the leaflets whitish.	→ 7
7.	Stem with a waxy covering; leaflets with an asymmetrical tip not terminating in a slender point; leaf sheath glabrous.	*Ceroxylon alpinum*
7.	Stem without a waxy covering; leaflets with a symmetrical tip terminating in slender point; leaf sheaths with abundant long stiff black fibers and short soft brown fibers.	*Oenocarpus bataua*
8.	Leaves irregularly divided into broad segments of unequal sizes and the trunk brown, not green.	*Geonoma undata*
8.	Leaves regularly divided into rather slender leaflets, and the trunk green or brown.	→ 9
9.	Leaflets terminating in a long thread-like point; trunk usually brown but sometimes green, usually ~10 cm in diameter.	*Prestoea acuminata*
9.	Leaflets not terminating in a slender point; trunk always green, <8 cm in diameter.	→ 10
10.	Stem 1–2 cm in diemater, leaflets broad and sigmoid; ≤ eight per side.	*Chamaedorea pinnatifrons*
10.	Stem 2–8 cm in diameter, leaflets linear to somewhat sigmoid; >10 per side.	*Chamaedorea linearis*

adult stems in an abandoned home garden. The clonal nature of the palm facilitates its cultivation, because clumps will not be killed by harvesting one or a few of the stems. It is also promising that there is a national and even international market for *Prestoea acuminata* palm hearts (Balslev and Henderson 1987). The vernacular name *palmito* is the Spanish word for palm heart.

Socratea rostrata *Spruce*

S. rostrata are solitary trees with male and female flowers on the same individual. The stem is <25 m tall and 15–30 cm in diameter. The tree is supported by a cone of thick stilt roots, which is unique among the palm species at Maquipucuna.

The leaves are 1.5–3.5 m long and rather short compared to the height of the plant, and regularly pinnately divided. Each leaflet is longitudinally split into 2–10 unequal segments spreading in different planes, which gives the leaf a bushy appearance. The leaflet segments are often golden-brown below; leaf sheaths are closed and form a conspicuous crownshaft. Inflorescence has a rather short stalk and pendulous branches; as the branches are more loosely placed than in *Oenocarpus bataua,* the inflorescence is not horsetail-like. Seedlings are unique in the area by having bifid leaves with a jagged outer margin.

The palm is quite common in the Río Alambi valley at 1 100–1 300 m, sometimes nearly dominating the remnant forest patches.

Acknowledgments

We would like to thank the Fundación Maquipucuna for allowing us to work within the reserve, and for their efficient and kind help. We would especially like to thank the Foundation's scientific assistant, Mr. Arsenio Barrera, for providing much of the ethnobotanical information. We also thank INEFAN for research permits, and Pontificia Universidad Católica del Ecuador for various research facilities. Finally, we thank the Center for Tropical Biodiversity (Danish Natural Science Research Council, grant #11-0390) and the Faculty of Natural Sciences at the University of Aarhus for economic support.

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PALM LITERATURE *(Continued from p. 217)*

Riffle believes that the tropical look has an "irresistible appeal," is achievable far away from the tropical climates, and is underutilized by gardeners outside zones 10 and 11. As he aptly describes this type of gardening, "it is the stuff dreams are made of." Riffle defines the tropical look as "all plants with relatively large or boldly shaped foliage and flowers, and all plants with colored or variegated leaves and large and spectacular flowers or flower clusters." A true tropical plant will not tolerate any frost. Thankfully, many of the 2,000 plants and 400 color photos in this book are not tropical in the true sense of the word.

The author includes plants based on a criterion of "tropical looking landscape subjects whose appeal is of at least a reasonably permanent status." Palm trees, of course, are the quintessence of the tropical look, and 57 varieties of palms are included in the book. The palms which are susceptible to lethal yellowing are identified, and cycads, which many people mistakenly believe to be palms, are also included.

Aside from finding information on almost every plant my husband grows in his garden, my reasons for liking this book are many. A pronouncer guide is provided to help overcome those verbal stumbling blocks when referring to plants by their botanical name. A foreword emphasizes the importance of botanical names, and I appreciate the helping hand in integrating these important references into my daily vocabulary. A list of common names is provided only in the index, so a person looking for "Canary Island date palm" will be at a disadvantage until such time that the botanical name of *Phoenix canariensis* is the first one that comes to mind.

Each plant listed has a quick reference guide and a detailed description. The quick reference includes a brief description of the plant's appearance, its zone rating, sun and water preferences, soil requirements, and methods of propagation. The author describes plants in ways that make them sound like his personal friends. Phrases such as "spectacularly beautiful," "gracefulness of form," and even "checkered

(Continued on p. 228)

Principes, 42(4), 1998, pp. 227–228

Astrocaryum carnosum and A. chonta (Palmae), New Host for the Weevil Dynamis borassi (Curculionidae: Rhynchophorinae)

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Many species of rhynchophorine weevils use palms as the host for larval development. This is the case with *Dynamis borassi* (Fabr. 1801). Larvae bore into the palms and after several instars develop into adults in about two months (Giblin-Davis *et al.*, 1996). These larvae are considered to be pests of coconut trees, *Cocos nucifera* L., on which they live in the inflorescence and the stem (Wattanapongsiri, 1966; Gerber *et al.*, 1990). They cause the death of *Syagrus schizophylla* (Martius) Glassman and *S. vagans* (Bondar) Hawkes (Bondar, 1940; Landeiro, 1941). *Dynamis borassi* is attracted also by the fruit of *Astrocaryum standleyanum* Bailey (Giblin-Davis *et al.*, 1997).

The present note describes the ocurrence of *Dynamis borassi* on two Amazonian palm species, *Astrocaryum carnosum* Kahn et Millan and *A. chonta* Martius, and provides new information on the biology of the weevil. Previous works have shown the high diversity of the insect fauna which lives on *Astrocaryum* species (Couturier and Kahn, 1989, 1992). Many of these palms form dense stands in most forest ecosystems of Amazonia (Kahn and Granville, 1992). They can be considered as an important source of potential pests for cultivated palms.

The genus *Dynamis* (Curculionidae: Rhynchophorinae) includes three species, all from the Neotropics: *D. borassi*, *D. nitidulus* (Guerin, 1844) and *D. peropacus* Champion, 1910 (Wibmer and O'Brien, 1986).

Individuals of *D. borassi* were observed and collected on two species of the palm genus *Astrocaryum* in Peruvian Amazonia; the larvae are found in the inflorescences and eat the rachillae before the opening of the peduncular bract :

1) On *A. carnosum* in the Upper Huallaga River Valley, San Martín, 20 km from Uchiza (8°17′S, 76°26′W), near the oil palm plantation Palmas del Espino S.A., adult specimens of *D. borassi* were obtained from pupalcells collected in damaged inflorescences on November 21, 1996. Moreover some adults of *Billaea* (=*Paratheresia*) *rhynchophorae* (Blanchard, 1937), Diptera, Tachinidae, emerged from one of these pupalcells. This parasit of the larvae was found previously on two other species of Rhynchophorinae: *Rhinostomus barbirostris* (F.) (Emden, 1949) and *Rhynchophorus palmarum* (L.) (Bennet & Maharaj, 1969). *B. rhynchophorae* is reported herein as a parasite of larvae of the genus *Dynamis*.

2) On *Astrocaryum chonta*, in the Lower Ucayali River Valley (4°55′S, 73°40′W) near Jenaro Herrera village, only adults of *D. borassi* were collected on October 29, 1986 and August 29, 1987; empty pupalcells and damage of the larvae in an inflorescence were visible on the palm.

This note confirms Couturier and Kahn's observation (1992) on these palm species.

The specimens of *Dynamis borassi* are deposited in the following collections: Dr. C.W. O'Brien, Tallahassee Fl.; Muséum national d'Histoire naturelle, Paris; Museo de Entomologia de la Universidad Nacional Agraria La Molina, Lima.

The specimen of *Billaea rhynchophorae* are deposited in the Smithsonian Institution, Washington and in the Muséum national d'Histoire naturelle, Paris.

Acknowledgments

The authors thank Dr. Norman E. Woodley (USDA, NMNH, Washington) who kindly identified the Tachinidae; and Carlos Arribas and Ricardo Vera for their helpful assistance in the field. The field work was supported by the international agreement ORSTOM, France/IIAP, Peru, and by Palmas del Espino S.A. Research support for Dr. C.W. O'Brien was partially provided by a research program (FLAX 97007, CSREES (Cooperative States Research, Education, and Extension Service, U.S.D.A.).

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past" make the plants seem more like companions than something to stick in the ground in hopes it will grow.

He also provides helpful advice in attaining the tropical look in subtropical climates and includes a zone map for both the United States and Europe. Further help is provided by lists based on categories such as aquatics, bamboo, bromeliads, drought tolerance, erosion control, fast-growing, ferns, fragrance, palms, salt tolerance, shade tolerance, "cactusy" look, and palms, of course. The color photos, many taken by the author himself, put the finishing touches on this outstanding piece of work.

I first encountered Robert Lee Riffle through the internet when he became a regular visitor on my "Tropical Attitudes Gardening Message Board." Most of the questions involve palm trees, but numerous other plants are discussed there as well. As the months went by, I was continually impressed with his ability to answer the assortment of questions with such good information.

When the new IPS website was launched in April, he became a regular visitor on that bulletin board too. His answers are always filled with good advice, humor, and an obvious desire to share his wealth of knowledge on plants that he knows and loves so well. I had often wondered how he knew the answers to so many varied questions, so when I held the book in my hands for the first time and saw that it is an encyclopedia, I said "Aha! That's how he's able to answer all those questions!" It deserves a prominent display in any palm tree lover's book collection.

JANA MEISER

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Back Cover

Chuniophoenix nana grown as a container plant, bearing clusters of orange-red fruits. See pp. 198–200. Photo by Scott Zona.