PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

A nonprofit corporation engaged in the study of palms and the dissemination of information about them. The society is international in scope with world-wide membership, and the formation of regional or local chapters affiliated with the international society is encouraged. Please address all inquiries regarding membership or information about the society to The International Palm Society, Inc., P.O. Box 1897, Lawrence, Kansas 66044, U.S.A.

PRINCIPES

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Zombia antillarum painted by Lee Adams. See pp. 42–45.

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Principes, 39(1), 1995, p. 3

Note from the President

How did you like the additional color in the October issue of *Principes*? Not every issue will have that number of color photographs, but we will continue to use internal color to add dimension and value to our journal.

Each of you received a 1994 Membership Roster with your October issue of *Principes*. Hopefully you have now had time to review it. Please be sure that the information included in the Roster about you is correct. If you would like to make any changes or additions, please send changes by mail to the IPS Kansas address or to me and the record will be amended. Perhaps you would like to add your telephone number or an INTERNET address.

I am compiling a list of Email addresses (of IPS members) which will be forwarded electronically to any member on the INTERNET (including GEnie, Compuserve, and other member services). Just provide me with your INTERNET address and I will forward you the list (along with periodic updates).

Our Horticultural Correspondents have received many inquiries. All noncommercial inquiries are being answered. Please remember that the questions must be routed to the correct correspondent and this may take some time. Questions pertinent to palm-related businesses are beyond the scope or intent of this service.

I would like to apologize for the tardiness of recent *Principes* issues. The change in format and increase in color contributed to these delays. Memberships cover four issues of *Principes* for each paid membership year, even though the last issue for 1994 actually arrived in early 1995. Our Editors are working very hard to catch up and we ask for your patience.

Should you have any questions relating to local IPS chapters or to affiliation with the IPS, please contact either Edward Hall (FL) or myself.

It's time to nominate new board members to the IPS Board of Directors. If you wish to nominate a member as a director, please contact Nominating Committee Chairman, Lennie Goldstein in Florida (see Roster) or our Secretary, Lynn McKamey.

Have you ordered your copy (or copies) of the *Palms of Madagascar* book written by Drs. John Dransfield and Henk Beentje. This wonderful book is being jointly published by Royal Botanic Gardens Kew in the United Kingdom and the IPS. Prepublication sales are being handled strictly by Kew Gardens. Order yours now, since the price will go up considerably when the pre-publication sale ends.

The latest offering by the International Palm Society is to give you a ride on the "information highway" of palms and cycads. The IPS has signed a contract with GEnie to provide a full electronic Round Table for the Palm Society. This is designed more for information about palms than it is for IPS business. The IPS Bulletin Board already features:

News about many different types of palms and cycads,
Botanical gardens around the world and their palm and cycads
Culture of palms
Palm seed and plant sources
Palm and cycad books
Uses of palms and cycads

and many other topics. In addition there is a discussion topic and a reference topic on each IPS chapter around the world. Come join us and contribute your thoughts.

GEnie access is easy within the USA and Canada and is also available directly in a number of other countries in which we have IPS members. You should have received a mailing on how to join up. If not, please let me know and we'll send you one.

We are looking for suggestions as to how the IPS might further improve our services. If you have any ideas, let me know. My home address is in the Roster. I can also be reached via INTERNET at either PALM.DUDE@GENIE.COM or CAIN@WGCGPS.COM.

JIM CAIN, President

Principes, 39(1), 1995, p. 4

Editorial

We begin Volume 39 late but with much new information about palms. Carol Lippincott describes for us the restoration of *Pseudophoenix sargentii*, a Florida native palm, to the keys where it originally grew. This story touches on many subjects: on the effects of Hurricane Andrew during the reintroduction, on the cost of wild collected seeds, and on the struggles and hopes that accompany attempts at conservation.

Two of our articles describe new species. Don Hodel has found three new chamaedoreas in Panama—and reports them in his usual efficient and pleasant style. New species are also being found in the Old World—a *Pritchardia* is described by John Dransfield and Yves Ehrhart from a very remote island in the Pacific.

A paper by Charles Clement and Nicklos Dudley reports a study on seed germination for the peach palm, *Bactris gasipaes*. Their experiments show that bottom heat and a sandy type of substrate appear to improve germination.

A second paper on propagation of commercially important palms by Richard Smith and John Aynsley reports the successes in their laboratories on developing date palms by tissue culture of embryos. This is proving a cost-effective method of obtaining special cultivars which are often in short supply.

Clarence Johnson, Scott Zona, and Jan Nilsson have looked into the relationships of bruchid beetles and palms, and document a nice example of coevolution of palms and beetles. Some beetles actually feed almost exclusively on certain palms seeds.

Finally Lester Pancoast has written an intriguing account of artist Lee Adams whom Lester had the fortune to know well. One of Adams' paintings adorns our back cover and two others are featured with the article. Anyone interested should note that prints of some of the Adams paintings are available at the Bookstore at Fairchild Tropical Garden and from the South Florida Chapter. Prices are $20.00 each, or for groups planning to resell, 10 or more may be had for $15.00 each.

All members will be interested in the President's Note and news of the Chapters.

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 39(1), 1995, pp. 5–13

Reintroduction of Pseudophoenix sargentii in the Florida Keys

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This is an article about restoring wild palms in their wild places. As a horticulturist, I delight in the cultivation of palms from around the world. As an ecologist, I live with a profound sense of loss, knowing that some palm species may exist only in gardens, their natural habitats destroyed.

As former Curator of Endangered Species at Fairchild Tropical Garden, I know that botanic gardens are more than just pretty places. Palm collections such as Fairchild's provide a tantalizing example of the diversity of palms that have evolved in dynamic natural systems. Yet palms grown in the controlled simplicity of a garden are at an evolutionary dead-end. Therefore, the collections and scientific resources of botanic gardens should be used to re-establish rare palms in appropriate natural habitats, where species can continue to evolve with a myriad of mingling plants and animals.

Reintroduction of plants into conservation areas is becoming a more common practice in efforts to prevent extinction of endangered species (Falk and Olwell 1992). Transplanting of an endangered species might take place if a site is being cleared and the plants would otherwise be destroyed, or for restoration of a wild population that has dwindled due to human activities. While championing endangered species reintroductions, I do not advocate jaunts into the woods to add to the flora of an area or to spread around species which one personally thinks should be more abundant. The motive for reintroduction should be more than an impulsive urge to right a wrong. Reintroduction should be a carefully planned and documented experiment in restoring a lost or abused member species in a native plant community.

Scientific staff of The Nature Conservancy, an international conservation organization that manages numerous nature preserves, recently developed an elegantly simple dichotomous key to help in deciding when species reintroductions are appropriate (Gordon 1994). First, is the species really threatened? Are there protected populations? Is there protected habitat within the known range of the species? Has the original cause of species decline been identified and eliminated? Are verifiable and legal propagules available? Is site management within the requirements or tolerance of the species?

These questions will be addressed in the following description of a relatively straightforward reintroduction project for a threatened palm species in south Florida. While not the perfect model, it is an example of a stepwise process that we hope will result in a thriving and self-sustaining palm population in the wild.

A Rare Florida Native: *Pseudophoenix sargentii*

Pseudophoenix sargentii H. Wend. ex Sargent, the Sargent's cherry palm, was first discovered in 1886 on Elliott Key, an island ten miles from the shores of Miami, Florida, and was first described from specimens collected there (Sargent 1886). Soon thereafter, *Pseudophoenix sargentii* was found on Sands Key, adjacent to Elliott Key, and on Long Key, about 50 miles southwest of Elliott Key. Even upon discovery, palm populations on these three islands were small, from a few dozen to a few hundred palms.

A thorough and disheartening chronology of the status of this palm species in the Florida Keys, from its discovery through the late 1950's, was published in an early *Principes* article (Ledin et al. 1959) (Figs. 1,2). Hundreds of these attractive palms were dug up from Long Key to be sold as ornamentals, and a scraggly few remained. On Elliott and Sands Keys, all but a few of the palms were cleared for island plantations and homesites.

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1. Many Sargent's cherry palms were inadvertently destroyed in the Florida Keys by early settlers clearing hammock forests for pineapple (shown here), lime, and coconut plantations. Photo by Ralph M. Munroe, courtesy of Historical Association of Southern Florida.

Ten years after Ledin's surveys of *Pseudophoenix sargentii*, the interior of Elliott Key was bulldozed by spiteful developers just prior to federal purchase of the island for the formation of Biscayne National Park. By 1991, when volunteers and I had resurveyed all of the historical locations of the Sargent's cherry palm, no palms were found on Long or Sands Keys, and fewer than fifty palms remained on Elliott Key (for a full account, see Lippincott 1992).

The small Sargent's cherry palm population in subtropical Florida is peripheral to the species' wider distribution along the tropical coastlines of the Bahama Islands, Hispaniola, Cuba, and the Yucatan Peninsula of Mexico. Throughout its range in the northern Caribbean, *Pseudophoenix sargentii* is increasingly threatened by the activities of humans. On most of the shores where it occurs, *Pseudophoenix sargentii* is threatened by imminent development, as impoverished Caribbean nations lure foreign tourists with resorts and vacation homes. Mature palms are frequently dug from natural areas and transplanted into gardens, with few surviving the move. In areas such as Saona Island, a U.S. Coast Guard base where the wild palms are protected from harvest, almost no young palms are found because feral grazers such as goats feast on fruits and seedlings (R. W. Read, personal communication). Reproduction of Sargent's cherry palm is also compromised by excessive fruit collection for livestock feed.

In summary, the survival of wild populations of *Pseudophoenix sargentii* throughout the northern Caribbean is tenuous. In Florida, the Sargent's cherry palm has been reduced in the last century from hundreds of palms on three islands to a few dozen palms on one island. We decided that this palm met the criteria of "threatened," and proceeded to plan for its restoration on the three Florida islands where it once occurred more abundantly.

Although I will use the term "reintroduction" inclusively in this article, the term is strictly defined (IUCN 1984) as the re-establishment of a species which no longer exists at a site, as in this case, the return of Sargent's cherry palms to Long Key, where palm harvesters had extirpated the wild population. Since palms still exist on Elliott Key, replanting on that island is correctly termed "restocking," and is usually done to moderate genetic risks associated with reduced population size.

2. In the late 1950's, Bruce Ledin (left) and Bob Read (right) searched the Florida Keys with Stanley Kiem for wild Sargent's cherry palms. They found only a few survivors on Long and Elliott Keys. Photo by Stanley Kiem.

Habitats Preserved but Poaching Still A Problem

Fortunately, all three of the islands where Sargent's cherry palm once occurred are now publicly owned parks. Sands and Elliott Keys are undeveloped offshore islands in Biscayne National Park, and Long Key is a state recreation area with designated wilderness tracts, linked to the mainland by U.S. Highway 1.

3. Over thirty years after Ledin's surveys, Anne Deaton, Florida DEP biologist, maps a group of Sargent's cherry palms in the dense hammock on Elliott Key. Before Hurricane Andrew in August, 1992, 47 tagged *Pseudophoenix* palms were being monitored in Biscayne National Park.

Within these parks, the palms are protected from overt clearing. However, unscrupulous collectors are known to continue illegally to harvest fruits and seedlings from the wild, even though this species is readily available in the nursery trade. As incomprehensible as it is to me, there is apparently added value in the sale of wild-collected, versus garden-propagated, endangered plants. So since the allure of possessing a plant collected from the wild has not diminished, it was decided that the majority of the palms would be reintroduced into relatively inaccessible areas, and that their exact locations would be known only by park managers and collaborators directly responsible for the palms.

Cooperation and Volunteers

From the beginning, Biscayne National Park's Natural Resources Manager, Richard Curry, was enthusiastic about mapping and monitoring the remaining wild palms in the park. When Dr. Renate Skinner, District Biologist for the Florida Department of Natural Resources (now Department of Environmental Protection, DEP) suggested reintroducing *Pseudophoenix sargentii* to Long Key, the logical source for seed was the extant population on Elliott Key. My work with endangered plants at Fairchild made it possible for me to put together a cooperative agreement signed by the two parks and Fairchild, and an allwin scheme to get this palm back into the wild began.

Before we could reintroduce seedlings, we needed seed carefully collected from Elliott Key, and before we could collect seed we needed to know the current size and condition of the wild population. Beginning in 1990, various volunteers donated their free time to help survey the three islands for wild Sargent's cherry palms. Don Evans, Fairchild's Chief Horticulturist, and Chuck Hubbuch, Fairchild's Curator of Palms and Cycads, and other staff members, wandered through tangled hammock forests in search of the telltale banded trunks of *Pseudophoenix.* DEP biologist Anne Deaton teamed up with DEP Ranger Joseph Nemec and his wife, Marcella, and they located, tagged, and mapped 47 Sargent's cherry palms scattered among the dense hardwood trees of Elliott Key (Fig. 3). They also began periodic visits in hopes of collecting seeds. Finally, with collecting permits in hand, they selectively harvested several hundred seeds from nine parent palms over two years, which were then propagated in the nursery at Fairchild.

Planting Palms in the Wild

The real fun began when the South Florida Chapter of the International Palm Society provided funds in 1991 that allowed Fairchild to hire helpers to reintroduce the nursery-propagated palms and then to monitor them regularly. Rob Campbell, a skilled native plant propagator, accepted the arduous task of planting, which involved loading potted palms, water buckets, soil, tools, maps, and notes onto a boat, traveling across several miles of open water, then trying to ignore the suffocating clouds of mosquitoes and oppressive summer heat while chipping holes in sharp limestone rock crouched in tangled masses of thorny stems. I know that Rob signed on to the project out of sincere concern for the palms, because I doubt that the pay was worth the suffering.

Anne Deaton took responsibility for the reintroduction on Long Key. Before proceeding, she prepared a reintroduction proposal that included the history of the palm in Florida, and plans for documentation, maintenance, and long-term monitoring of the reintroduced Long Key palms. This was the first reintroduction proposal prepared for a Florida state park, and it was both approved by DEP and praised as a model for other park districts.

The palms that we planted in this first attempt included the one year old seedlings as well as several seven year old palms grown from seeds collected on Elliott Key in 1984 by BNP staff and brought to Fairchild for propagation (Fig. 4, left). Although somewhat larger than optimum for transplanting, we decided that they should be repatriated to native soil. As a backup, several of these palms were planted in Fairchild's conservation collection, in case of loss of the wild palms.

The sites selected for planting resemble habitats where the remaining wild palms are found, or are areas known from the literature to have supported Sargent's cherry palms in the past. These sites primarily consisted of mixed-species tropical hardwood hammock on limestone or beach sand substrate, topped with a thin layer of humus and leaf litter. The canopy above the palms varied from about 20% to 100% closed. The planting technique involved minimal alteration of the site or substrate.

The reintroduced palms were watered periodically and fertilized as needed for one year following planting (Fig. 4, right). A year after planting, most of the larger palms appeared healthy, with the exception of the few planted on Sands Key, which were defoliated, probably by marsh rabbits. To our dismay, a third of the 62 one year old seedlings planted on Long Key (mostly at two of the six planting sites) were eaten to ground level by herbivores, probably marsh rabbits again. Anne placed wire-mesh cages around the seedlings and caged the bases of the larger palms, and they have so far escaped further damage.

Lessons from Hurricane Andrew

The eye of Hurricane Andrew passed directly over Elliott Key in August, 1992. The Atlantic Ocean swept across the island, and the wild and recently planted Sargent's cherry palms were battered by a massive tidal surge, whipped to a frenzy by sustained winds in excess of 140 miles per hour (Fig. 5). I kept reminding myself that this species had evolved on the coastlines of northern Caribbean islands, where hurricanes are frequent and severe.

The hurricane emphasized the value of maintaining botanic garden conservation collections of endangered species as a backup to populations in

4. Left, Sargent's cherry palms being returned to the wild. Seeds collected by BNP staff in 1984 were grown at the Fairchild nursery for reintroduction, to bolster the park's dwindled wild population. Right, the first reintroduced palms were visited regularly by Anne Deaton and volunteers for the first year, but required little maintenance after initial planting and watering.

5. Surging ocean and shearing winds of Hurricane Andrew severed 19 of the 47 palms on Elliott Key. However, the surviving Sargent's cherry palms are thriving in the open, sunlit hammock.

6. A. Paul Ochre, Biscayne National Park staff, examines remains of the former National Champion *Pseudophoenix* in the tangle of hurricane debris. B. The new National Champion, over 20 feet tall, towers above the recovering hammock on Elliott Key.

the wild. Minus a few tags, the hundreds of seedlings from Elliott Key palms were safe beneath a heavy bench in the Fairchild nursery. Although the Garden's collection was badly damaged by the storm, I immediately noticed the lack of damage to the *Pseudophoenix* and other northern Caribbean palms; their leaves were barely frayed! In fact, one week after the storm, a Sargent's cherry palm in the Bahama planting burst into full bloom amidst the wreckage.

Four months after the storm, the Nemecs and I began a slow reconnaissance for the palms in Biscayne National Park. Our markers were mostly washed away and other subtle landmarks were unrecognizable. The upper hammock canopy was sheared off, limbs and wreckage littered the forest floor, and a profusion of vines and sprouting branches made passage slow and difficult. I am now convinced that the Joseph and Marcella possess some innate capacity to sense nearby palms, as we were able to relocate almost all of them in spite of the disorienting conditions.

Of the 47 wild palms, 19 of the tallest, including the National Champion (Fig. 6A), were killed when the crown shaft was severed or the trunk was sheared off at about twelve feet, presumably where the palms met the combined assault of waves and wind. Fortunately, dozens of seedlings from five of these deceased palms were still alive in Fairchild's nursery. One dominant survivor, over 20 feet tall (Fig. 6B), now reigns as the new National Champion. Shorter palms fared better, are thriving in the increased sunlight of the bare hammock, and are actively producing robust, deep green leaves. Although the storm uprooted two of the reintroduced palms, the remaining palms appear healthy, in spite of being covered by layers of plant debris.

7. A and B. Monitoring of the reintroduced palms continues, as Dena Garvue of Fairchild Tropical Garden measures the growth of a thriving two year old seedling (7A) and a ten year old palm (7B).

There is much to be learned about the dynamics of hammock forests from this impressive hurricane. It is obvious that the *Pseudophoenix sargentii* which were not directly killed in the hurricane are somehow benefitting from the changes in their habitat brought about by the storm. Do the palms grow best in the more open-canopied hammocks following hurricanes? Do palm seeds have a long dormancy period which is broken by the heat or long wavelengths of light which reach the forest floor after a severe storm? What is the role of periodic inundation of saltwater in providing these palms with a below-ground competitive advantage? Are herbivore populations, such as rabbits, reduced by tidal surges?

Post-Hurricane Reintroduction

By the spring of 1993, the remaining two year old seedlings in the Fairchild nursery had their first few pinnate leaves and were ready to be planted. Again, a representative sample was held back to be planted in the conservation collection at Fairchild. Anne Deaton and a hard-working crew transferred over a hundred seedlings to natural areas on Long Key. Here, caging of young palms to prevent damage by herbivores appears to be crucial to successful establishment. My successor at Fairchild, Dena Garvue, helped to plant more than 50 seedlings on Elliott Key (Figs. 7A, B). Ten months later, every single seedling on Elliott Key is robust and actively growing, with no signs of damage.

Measuring Success

How do you gauge success of an endangered species reintroduction? If the goal is to achieve a self-sustaining population, then success is more than just survival of some planted individuals. Our goal will be met beyond our lifetime, when fourth or fifth generation progeny from these planted palms exist in a viable population with only minimal human intervention. This implies that palm collectors stop harvesting *Pseudophoenix* from the wild in Florida, that no more habitat be cleared for development (especially in these publicly owned parks), and that herbivore populations be maintained at natural levels by their natural predators.

I believe that a large measure of the initial success of this project has been due to cooperation among a federal and a state park and a botanic garden, to devoted volunteers, and to a concerned constituency of palm enthusiasts. However, one of the most difficult chores has been to explain to eager supporters that we cannot take them to see the palms, since increased access leads to unethical collection, which is still a very real threat. To satisfy this legitimate request, we planted several young palms near nature trails, eventually to be incorporated into the parks' interpretive walks. Our hope is that, as they grow and reproduce, these Sargent's cherry palms will become a more common sight in the hammocks, eventually taken for granted as yet another component of subtropical Florida's fascinating native flora.

Acknowledgments

Funding for this reintroduction was provided in part by a grant from the South Florida Chapter of the International Palm Society. In-kind labor and materials were provided by Biscayne National Park, District 5 of the Florida Department of Environmental Protection/Division of Recreation and Parks, and the Conservation Biology Program at Fairchild Tropical Garden. Outstanding volunteers include Anne Deaton, Joseph Nemec, Marcella Nemec, Jim Duquesnel, Jeff Tipsword, Bob Gregg, and Jack Fell.

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Three New Species of Chamaedorea from Panama

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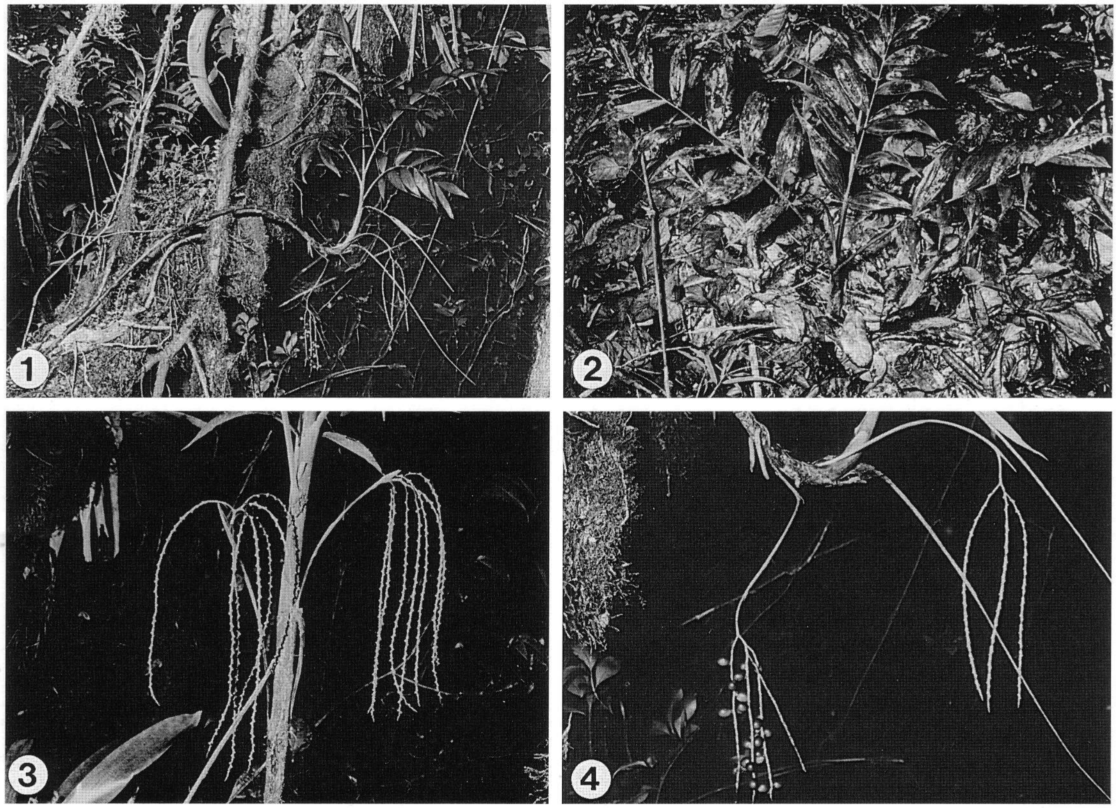
Since the publication of my monograph of *Chamaedorea* (Hodel 1992*a*) and a subsequent article adding several new species (Hodel 1992*b*), field studies in Panama have enabled me to describe and name three new species.

Chamaedorea anemophila Hodel sp. nov. (Figs. 1–4).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter pertinens. *C. dammerianae* Burret affinis sed floribus masculis majoribus petalis tenuibus friabilissimis differt. *C. pittieri* L. H. Bailey affinis sed inflorescentiis foliis brevioribus, rachillis femineis gracilibus cernuis differt. Typus: Panama, Chiriqui, *Hodel et al. 1200* (holotypus BH; isotypi HNT, MO, PMA).

Solitary, slender, erect but sometimes decumbent with age and then leaning on or snaking through adjacent vegetation (Fig. 1), to 4 m tall or long; stem 10–13 mm diam., green, ringed, upper portion often clothed in persistent brown dried leaf sheaths, internodes to 10 cm long, occasionally flowering when appearing stemless (Fig. 2), then stem abbreviated, curved, subterranean, to only 15 cm long, 12–18 mm diam., brown, rough, prominently ringed, nodes strongly congested, internodes 1–3 mm long. Leaves 3–6, erect-spreading, pinnate, ± thick, ± stiff, ± coriaceous, bluish gray-green; sheaths to 19 cm long, tubular, obliquely open apically, ± thick, densely and prominently longitudinally nerved especially when dry with a heavier costa extending onto petiole; petioles (5)10–38 cm long, grooved adaxially, rounded abaxially, lightly white-spotted and nerved laterally especially when dry; rachis 15–30 cm long, angled adaxially, rounded abaxially with a light green or yellowish band extending onto sheath; pinnae 5–8 per side, lower or lower middle ones largest, these 10–19 × 1.75–4.0 cm, apical ones 7–10 × 1.5–2.5 cm, basal ones 9–19 × 1.5–3.0 cm, all pinnae straight, slightly falcate, long-acuminate apically, strongly contracted basally, ± cupped downward, usually drying strongly plicate with a ± conspicuously angled midrib, other nerves not prominent, 2–4 secondary nerves on each side of midrib, tertiaries numerous faint, midrib and secondaries drying green adaxially, yellowish abaxially. Inflorescences 1–2 per plant, mostly infrafoliar, arising from behind dried persistent sheaths (Fig. 3), rarely interfoliar and then only staminate in bud, 15–35 cm long, shorter than leaves; peduncles ascending, to 35 cm long, 5 mm wide at base, 1–2 mm diam. at apex and there drooping, green in flower, orange in fruit where exposed; bracts 4–5(7), prophyll to 4 cm long, 2nd bract to 8 cm, 3rd and 4th to 19 cm, 5th to 19 cm, 6th to 4.5 cm, 7th to 2 cm, uppermost bract exceeding peduncle and extending onto rachis if large or concealed by larger lower bract if small, bracts tubular, green in flower, brown in fruit, thin-papery, longitudinally striate-nerved, lower ones bifid, acute, upper ones obliquely long-open apically, acute-acuminate. Staminate rachis to 7 cm long, 2 mm diam. at base, to 0.8 mm diam. at apex, drying flattened, finely longitudinally striate and ridged; up to 11 rachillae (Fig. 3), to 30 cm long, very slender, 0.5 mm diam., pendulous, finely longitudinally ridged. Staminate flowers with very fragile appearance, in moderate spirals, 2–5 mm distant, ± superficial, leaving narrowly elliptic scars 1.5 mm long, just prior to anthesis flowers 3 × 2–2.5 mm, ovoid, opening to 3 × 4–4.5 mm; calyx 1 × 2.5 mm, cupular, scarcely lobed or only slightly notched, sepals connate nearly to apex, truncate or only slightly rounded, thin, nearly transparent; petals 3–4 × 2–3 mm, ovate, valvate, spreading, distinct nearly to base, thin, faintly few-nerved adaxially; stamens 2–2.5 mm high, conspicuously shorter than pistillode, filaments 0.75 mm long, very slender, anthers 1 mm long, oblong, dorsifixed; pistillode 2.5–3.5 mm high, longitudinally fluted. Pistillate rachis to 2.5 cm long or lacking if spicate or furcate, 0.6–1 mm



1. Old, mature plant of *Chamaedorea anemophila*, *Hodel et al. 1201*, snaking through dense, mossy, cloud forest near Cerro Colorado, Chiriqui, Panama. 2. Young, stemless but flowering plant of *Chamaedorea anemophila* (note pale, slender, barely visible, spicate rachilla emerged lower left of new, vertical leaf spike), *Hodel et al. 1125*, windswept cloud forest near Fortuna, Chiriqui, Panama. 3. Pendulous staminate rachillae of an old plant of *Chamaedorea anemophila* emerged from behind dried, persistent leaf sheaths, *Hodel et al. 1200* (holotype), near Cerro Colorado, Chiriqui, Panama. 4. Few-branched, straight, pistillate rachillae of an old plant of *Chamaedorea anemophila*, *Hodel et al. 1201*, near Cerro Colorado, Chiriqui, Panama.

diam., green in flower, orange in fruit, drying faintly longitudinally striate or ridged; inflorescence with 3–4 rachillae (Fig. 4), or furcate or spicate especially when flowering for first time and/or with little or no above-ground stem evident (Fig. 2), rachillae to 15 cm long, slender, 0.8–1 mm diam., straight or slightly curved, slightly flexuous apically, green in flower, orange and drooping in fruit, drying with longitudinal membranous wings in flower but only faintly so or rounded in fruit. Pistillate flowers with very fragile appearance, light yellow, in moderate spirals, 1.5–4 mm distant, ± superficial, leaving long-elliptic scars 1–1.5 mm long, flowers 2.5–3 × 2.5 mm, ovoid-globose; calyx 0.5–1 × 1.5–2 mm, low-cupular or crownlike, moderately to deeply lobed, sepals imbricate in basal ⅓–½, broadly rounded to truncate apically, thin, membranous especially toward margin when dry, green in life; petals 2.5 × 2.5, broadly triangular, imbricate in basal ⅔–¾, thin, membranous, nearly transparent when dry, acute, erect, faintly nerved; pistil 1.5–2 × 1–2 mm, ovoid, green in life, stigma lobes short, blunt, recurved, shorter than petals. Fruits 11 × 7 mm, obovoid-globose, black; seeds 8 × 6 mm oval shaped.

Distribution: PANAMA. Moist or wet cloud forest usually along windswept ridge tops near or on the Continental Divide; 1,000–2,100 m elevation.

Specimens Examined: PANAMA. Bocas del Toro: Fortuna, along Continental Divide, *Churchill 5540* (MO). Chiriqui: between Quebrada Honda and divide on Caldera-Chiriquicito Trail, *Kirbride & Duke 938* (MO); summit of Cerro Horqueta, *Cochrane et al. 6291* (MO); windswept ridge north of Planos de Hornito and east of road to Chiriqui Grande, *Hodel et al. 1125, 1222,* *1223* (BH, PMA); above Finca Linares on trail to Cerro Hornito, *Folsom et al. 7217* (MO); along Continental Divide on road near Cerro Colorado, *Mori & Kallunki 5946, 5980* (MO), *Folsom & Collins 1755* (MO), *Folsom et al. 4707* (MO), *Folsom 4887* (MO), *Hodel et al. 1200* (holotype BH; isotypes HNT, MO, PMA), *1201* (BH, HNT, PMA); below Continental Divide on road to Cerro Colorado, *Croat 33050, 33432* (MO), *Hodel et al. 1199* (BH, PMA). Veraguas: Cerro Tute, ridge-top cloud forest, *Mori & Kallunki 5251* (MO), *Mori 6267* (MO). Panama: Cerro Jefe, *Dwyer 7090* (MO), *8495* (F, MO).

The epithet of the new species is from the Greek *anemo*, pertaining to the wind, and *philus*, meaning loving, and refers to its low, windswept, cloud forest ridge habitat. In some places, the forest is open and low enough that larger plants of *C. anemophila* actually penetrate or emerge from the broken canopy. While this habitat is unusual, it is shared by several other species of *Chamaedorea* in Panama, including *C. microphylla*, sometimes a companion species in the Hornito area south of Fortuna; *C. correae*, from similar forest near El Valle, Cocle province; and *C. guntheriana*, which inhabits even more extreme elfin, dwarf forest in Panama province.

The habit of *Chamaedorea anemophila* is also unusual but, like its habitat, is not without parallel in the genus. Early in life plants of *C. anemophila* pass through a phase where they have normal, adult-sized leaves but lack a visible stem. However, plants actually possess a short, curving, rooting subterranean stem with highly congested nodes, and they begin to produce much reduced, spicate, furcate, or few-branched inflorescences during this "stemless" phase (Fig. 2). Later, after perhaps as many as several years, they produce a visible, elongated stem to several meters in length with normal-sized and much branched inflorescences (Fig. 1). This stemless phase may be an establishment period to anchor the plant more securely in a relatively harsh environment prior to the development of the elongated, above-ground stem. Plants of the two phases are easily mistaken as distinct species since their habit and inflorescences differ dramatically. Other species of the genus exhibiting this or a similar phenomenon include *Chamaedorea dammeriana* and *C. macrospadix* from Costa Rica and Panama, *C. volcanensis* from Guatemala, and *C. queroana, C. radicalis*, and *C. whitelockiana* from Mexico (Hodel 1992*a*).

Chamaedorea anemophila is somewhat intermediate between *C. pittieri* and *C. dammeriana*. *Chamaedorea pittieri* differs in its smaller habit and thicker stem, long-open, thick, prominently striate leaf sheaths, inflorescences exceeding the leaves, thicker, less fragile petals, and rigid, stiff fruiting rachillae. In the monograph of *Chamaedorea* (Hodel 1992*a*), I tentatively referred collections of *C. anemophila* to *C. pittieri*; Plates 73F and 75B-D depicting *C. anemophila* were identified as *C. pittieri*. *Chamaedorea dammeriana* differs in its thicker, stiff fruiting rachillae and smaller, densely placed staminate flowers with deeply lobed calyx, thicker, less fragile petals, and stamens equalling the pistillode. In the key to subgenus *Chamaedoropsis* (Hodel 1992*a*, p. 120), *C. anemophila* would key out next to *C. oblongata*, found from Mexico to Nicaragua. *Chamaedorea oblongata* differs dramatically in its larger habit, thicker, glossy green leaves, staminate flowers drying black, and thick, stiff fruiting rachillae.

The inflorescences, rachillae, and especially the flowers of *Chamaedorea anemophila* are among the most delicate and fragile in the genus; only *C. microphylla* has flowers which approach or surpass in delicacy and fragility those of *C. anemophila*.

Chamaedorea recurvata Hodel **sp. nov.** (Figs. 5–6).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter pertinens. *C. dammerianae* Burret affinis sed inflorescentiis valde recurvatis differt. Typus: Panama, Chiriqui, *Hodel et al. 1209* (holotypus BH; isotypi MO, PMA).

Solitary, slender, erect, to 2.5 m tall (Fig. 5); stem 1 cm diam., green, prominently ringed, white-spotted, internodes 3–8 cm long. Leaves 3–4, spreading, pinnate, dark glossy green; sheaths to 15 cm long, tubular, obliquely open apically, green, white-spotted, drying longitudinally striate; petioles 10–15 cm long, 3–5 mm diam., ± rounded or slightly flattened adaxially, rounded abaxially; rachis 35 cm long, slightly angled adaxially, rounded abaxially, petiole and rachis green but white-spotted, abaxially drying with paler band extending onto sheath as a slightly raised, narrow costa; pinnae 4–7 per side, middle ones largest, these to 21 × 5 cm, basal ones to 15 × 3 cm, apical ones often confluent, to 12 × 7 cm, all pinnae lanceolate, sigmoid, glossy green and ± obscurely nerved in life, drying thin-papery, nearly

5. Flowering plant of *Chamaedorea recurvata, Hodel et al. 1210*, wet, montane forest, Fortuna, Chiriqui, Panama.

6. Strongly recurved fruiting rachillae of *Chamaedorea recurvata, Hodel et al. 1209* (holotype), Fortuna, Chiriqui, Panama.

transparent, all except apical pair contracted basally, long-acuminate with dominant midrib flanked by three primary nerves on each side, 2–3 secondaries between each primary or primary and midrib, tertiaries numerous, faint, all nerves slightly more conspicuous and pale abaxially, ± raised adaxially and abaxially, sharper adaxially, apical pinnae with 3–5 main nerves, acuminate. Inflorescences 2–3 per plant, infrafoliar, emerging and held well below the leaves on bare stem, few-branched or spicate; peduncles ascending, to 23 cm long, 2–5 mm wide at base, 1.2–1.7 mm diam. at apex, green to brown in flower, orange in fruit where exposed; bracts 5–6, prophyll to 0.8 cm long, 2nd bract to 1.5 cm, 3rd to 3.1 cm, 4th to 7 cm, 5th to 12 cm and exceeding peduncle and concealing shorter 6th one (to 5 cm), tightly sheathing, brown, obliquely open apically, basal 2 bifid, others acute-acuminate, drying papery, finely longitudinally striate-nerved; rachillae or rachis if spicate to 16 cm long, 1.2–1.5 mm diam. at base, 0.5–0.75 mm diam. at apex, strongly recurved (Fig. 6), drooping, green in flower, orange in fruit, drying with conspicuous but fine sharp longitudinal ridges. Staminate flowers in dense spirals, appearing contiguous and petals of adjacent flowers touching at anthesis but actually 1–1.5 mm apart, superficial but leaving slightly raised elliptic scars 0.8 × 0.25 mm, just prior to anthesis flowers 2 × 2.25 mm, corolla bullet-shaped, 2 × 1 mm, drying black; calyx 1–1.2 × 2.2 mm, broadly cup-shaped, moderately to deeply lobed, sepals connate in basal ¼–½, broadly rounded apically, drying light beige, ± thin, transparent, especially along margins; petals 1.8–2 × 1 mm, long-ovate, boat-shaped, valvate, acute, apparently distinct apically nearly to base where briefly connate at anthesis, drying lightly few-nerved; stamens 1.5–1.75 mm high, about equalling pistillode, filaments short, 0.25 mm long, anthers nearly sessile, 1.25 mm long, long-oblong, bilobed, basifixed; pistillode 1.8 mm high, columnar. Pistillate flowers in rather dense spirals, 0.5–2 mm apart, appearing nearly contiguous, ± superficial or only slightly sunken, leaving elliptic scars 1.25 × 0.5 mm, post-anthesis flowers (ovary swollen to ca. 3 mm) 2 × 3–4.5 mm, obovoid; calyx 1.25 × 2.5 mm, broadly cupped, deeply lobed, sepals briefly connate or imbricate basally, broadly rounded apically; petals 2.5 × 2.5–3 mm, broadly ovate or deltoid, imbricate in basal ½, slightly cupped, acute, drying faintly nerved abaxially, conspicuously nerved adaxially, ± thin, especially transparent margins; pistil 2 mm high, long-ovoid, stigma lobes short, recurved, angled. Fruits to 8 mm long, oval, black.

Distribution: PANAMA. Extremely wet forest and cloud forest on the Pacific slope near the Continental Divide; 1,100–1,700 m elevation.

Specimens Examined: PANAMA. Chiriqui: mountains above Fortuna Dam Camp, *Folsom 5394A* (MO); *Hammel 2118* (BH, MO); *Hodel et al. 1209* (holotype BH; isotypes MO, PMA), *1210* (BH, PMA); north of Fortuna Dam reservoir, *Churchill 5901, 6122* (MO).

The specific epithet is from the Latin *recurvatus*, meaning recurved, and is used here in reference to the strongly and conspicuously recurved inflorescences (Fig. 6), a diagnostic feature of the species.

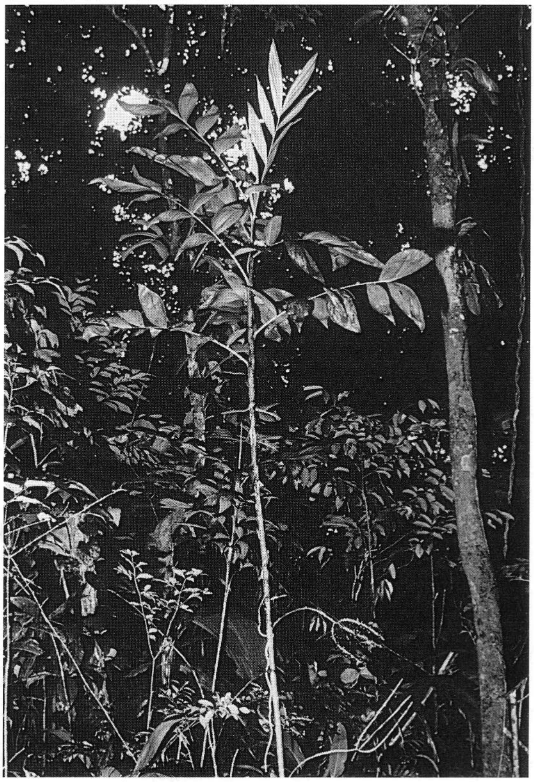
Chamaedorea recurvata is known from only a few collections, all from very wet forest in the vicinity of Fortuna Dam in western Panama. *Chamaedorea recurvata* is closest to *C. dammeriana*, but the latter differs in its straight rachillae, remotely placed pistillate flowers, more numerous leaves, and staminate flowers with a less prominent calyx and broader petals. When only fruiting material is at hand, *C. recurvata* could be confused with some members of *Chamaedorea* subgenus *Stephanostachys* with few-branched or spicate inflorescences that tend to curve, such as *C. allenii* from Panama and *C. crucensis* from adjacent Costa Rica. However, these two differ in their truly contiguous pistillate flowers with much more prominent calyces. Also, staminate material of the latter two species differs in having straight but drooping or pendulous rachillae and contiguous flowers with very prominent calyces.

Chamaedorea recurvata would key out next to *C. microphylla* or *C. parvisecta* and *C. whitelockiana* in the key to subgenus *Chamaedoropsis* in Hodel (1992*a*). However, the recurved inflorescences readily distinguish it from the latter two species.

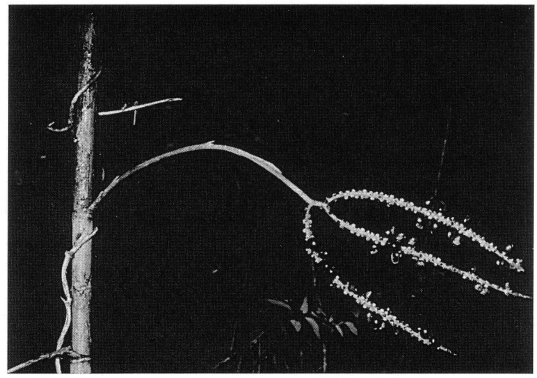
Chamaedorea subjectifolia Hodel **sp. nov.** (Figs. 7–8).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter pertinens. *C. correae* Hodel & Uhl et *C. guntherianae* Hodel & Uhl affinis sed habitu erecto multo majore multum, foliis majoribus, pinnis et rachillis pluribus differt; *C. dammerianae* Burret affinis sed inflorescentiis valde infrafoliaribus, floribus femineis persistentibus differt. Typus: Panama, Panama, *Hodel et al. 1238* (holotypus BH; isotypi MO, PMA).

Solitary, to 3.5 m tall (Fig. 7), erect; stem 1–2.5 cm diam., green, ringed, internodes 10–15 cm long. Leaves 5–8, spreading, pinnate, ± thick, slightly coriaceous; sheaths to 17 cm long, tubular, briefly and obliquely open apically, longitudinally striate-nerved; petioles to 8 cm long, 3–4 mm diam., green and ± flattened adaxially, pale green and rounded abaxially; rachis to 32 cm long, green and angled adaxially, pale green and rounded abaxially; pinnae 4–5 per side, lower ones to 14.5 × 3 cm, middle ones to 21.5 × 5 cm, apical pair to 20.5 × 8 cm, glossy green adaxially, paler abaxially, lanceolate, sigmoid, acuminate, contracted basally, ± cupped downward, basal and middle pinnae with slender raised conspicuous midrib adaxially, 2–5 primary nerves on either side of this, 1–2 secondaries between each primary and/or midrib, tertiaries numerous, faint, apical pair of pinnae 3–5 nerved, all nerves paler, raised and more conspicuous abaxially. Inflorescences 1–3 per plant, infrafoliar, held well below the leaves on bare stem or stem with old persistent disintegrating leaf sheaths (Fig. 7); peduncles to 20 cm long, 7 mm wide and ± flattened at base, 3–4 mm diam. at apex, straight, erect, green in flower, orange where exposed and nodding in fruit; bracts 5, prophyll to 3 cm long, 2nd bract to 4 cm, 3rd to 7.5 cm, 4th and 5th to 11 cm, 5th about equalling peduncle, all tubular, thin-papery, drying brown and finely longitudinally nerved, 1st–3rd bifid, acute, 4th and 5th obliquely long-open, acute-acuminate; rachis 1–2 cm long or lacking. Staminate with 3–6 rachillae, to 18 cm long, 1 mm diam., pendulous, greenish, very slightly undulate when dry. Staminate flowers yellow-green, in dense spirals, 0.5–1 mm distant, superficial, leaving elliptic scars 1 mm long, flowers 2 × 2 mm, obovoid; calyx low-cupular, 0.4 × 1–1.5 mm, moderately lobed, sepals connate in basal half, acute apically; petals 2 × 1–1.25 mm, ovate, acute, distinct nearly to base; stamens 0.8 mm high, half as tall as and forming a rather tight ring around pistillode, filaments 0.3 mm long, 0.25 mm wide, anthers 0.3 mm long, oblong, bilobed, dorsifixed near base; pistillode 1.6 mm high, truncate apically, swollen basally, slightly longitudinally fluted. Pistillate with 2–5 rachillae (Fig. 8), to 15 cm long, 1.5–2 mm diam., spreading to erect, parallel, stiff, orange in fruit. Pistillate flowers in ± dense spirals, 1–2.5 mm distant, superficial or when removed leaving slightly raised elliptic scars 1.25 mm long, unpollinated flowers persistent on rachillae through fruiting stage (Fig. 8), flowers 2 × 2.5 mm, globular; calyx 0.8 × 2.5 mm, cuplike, shallowly lobed, sepals connate in basal ⅔, broadly rounded to straight apically,



7. Fruiting plant of *Chamaedorea subjectifolia, Hodel et al. 1238* (holotype), El Llano-Carti Road, Panama. Note the inflorescences held well below the leafy crown.



8. Infructescence of *Chamaedorea subjectifolia, Hodel et al. 1238* (holotype). Note unpollinated pistillate flowers persisting on rachillae with mature fruits.

margins thinner; petals 2 × 2 mm, broadly rounded-triangular, imbricate nearly to apex, briefly acute; pistil 2 × 2 mm, globose, stigma lobes short, recurved, acute. Fruits 9 × 6 mm, black; seeds 7 × 5 mm brown. Eophyll bifid.

Distribution: PANAMA. Wet lowland to premontane forests and cloud forest; 50–1,000 m elevation.

Specimens Examined: PANAMA. Colon: trail from Alto Pacora to Cerro Brewster, *de Nevers et al. 6228, 6241* (CAS). Panama: Cerro Jefe, *Dressler 4889* (BH), *Gentry 4880* (MO); El Llano-Carti Road, *Hodel et al. 1238* (holotype BH; isotypes HNT, PMA), *Knapp 1377* (CAS), *Mori & Kallunki 2886* (MO), *Mori et al. 4559* (MO). San Blas: near confluence of Rio Cangandi and Rio Titamibe, *de Nevers et al. 4693* (MO); between Cangandi and Rio Nergala, *de Nevers et al. 6518* (MO); El Llano-Carti Road, *de Nevers et al. 5040*; trail along Continental Divide, *McDonagh et al. 282* (BM).

The epithet of the new species is from the Latin *subjectus*, meaning placed below, and *folia*, meaning leaves, and refers to its inflorescences held conspicuously below the leaves. Label data of *de Nevers et al. 6518* states the vernacular name used by Kuna Indians for *Chamaedorea subjectifolia* is *bor*.

Chamaedorea subjectifolia appears restricted to the central part of Panama east of the Panama Canal. There it infrequently occurs in wet lowland, montane, and cloud forests on the Atlantic slope up to and just over the relatively low Continental Divide.

In flower structure, *Chamaedorea subjectifolia* is closest to *C. guntheriana* and *C. correae* but these two differ in their much smaller habit and size of their various organs and their commonly bifid leaves (or if pinnate, with many fewer pinnae). In fact, seedlings of *C. subjectifolia* are nearly identical to those of *C. guntheriana*. In habit, *C. subjectifolia* could be confused with *C. dammeriana*, especially where their ranges briefly overlap in central Panama. However, *C. dammeriana* differs in its interfoliar inflorescences and more remotely placed pistillate flowers which fall away if unpollinated. In the key to subgenus *Chamaedoropsis* (Hodel 1992*a*, p. 120), *C. subjectifolia* would key out next to *C. dammeriana*.

Acknowledgments

Michael H. Grayum reviewed the manuscript and offered valuable suggestions. Curators of BH, HNT, MO, and PMA lent specimens and/or provided facilities for study. The Smithsonian Tropical Research Institute facilitated my field work in Panama. Jim Benzie, Lou Hooper, and Chuck Hubbuch were admirable companions during field work in Panama.

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PHOTO FEATURE—Branched Leaves in Neodypsis decaryi

Ralph Velez of Westminster, California, has sent us photographs of most unusual leaves of a plant of *Neodypsis decaryi*, with branched rachises. The two photographs reproduced here show how the primary leaf rachis branches, and one photograph illustrates how the branch actually forks to produce two rachises. According to Ralph, this branching occurs on every leaf. The palm in question has yet to produce a trunk or any signs of flowers or fruit.

1. Unusual *Neodypsis decaryi* leaf with branched rachis. 2. In this leaf the branch rachis is forked.

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Effect of Bottom Heat and Substrate on Seed Germination of Pejibaye (Bactris gasipaes) in Hawaii[1]

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The pejibaye palm (*Bactris gasipaes* Kunth) is being introduced into Hawaii as a new crop to supply fresh heart of palm to the gourmet market (Clement et al. 1993). The successful germination of seed is the initial step in establishing this species in Hawaii, but low germination rates were obtained in the first seed introductions. Consequently, a pair of experiments was designed to test the effects of bottom heat and different substrates on germination, in the hope of improving germination during the second introduction. The effect of progeny genotype is highlighted here, as the interaction of genotype with the different experimental treatments was pronounced.

The pejibaye has been categorized as a species with recalcitrant seeds (Ferreira and Santos 1992). Its seeds lose viability quickly upon drying, even slightly. Ferreira and Santos (1992) found that a loss of 10% moisture content significantly reduces germination percentage and a loss of 20% reduces it to zero.

Heat treatment is used to enhance percentage, uniformity, and speed of seed germination in African oil palm (Hartley 1977) and some other palms (Rees 1963). Although a preliminary trial at the National Research Institute for Amazonia (INPA), Manaus, Brazil, suggested that heat treatment did not improve pejibaye seed germination (D. B. Arkcoll, pers. comm., 1984), it was thought worthwhile to test this treatment again in Hawaii.

Cardoso (1944) pioneered the use of saw-dust as a germination substrate for numerous Amazonian fruit species, including pejibaye. The substrate is commonly used by S. A. N. Ferreira and colleagues at INPA in their continuing research into pejibaye seed biology. Sand of various kinds has also been widely used for palm germination (Jordan 1970).

The objective of these experiments was to determine the effect of heat and substrate on germination of pejibaye in Hawaii to guide future practice and research.

Material and Methods

Nineteen open-pollinated half-sib progenies were received from INPA. The Benjamin Constant population (14 progenies) is a component of the Putumayo 'macrocarpa' landrace, while the Yurimaguas population (5 progenies) is a hybrid, with genes from the Putumayo and Pampa Hermosa 'mesocarpa' landraces (Mora Urpí and Clement 1988). Both have high frequencies of spinelessness on the stem and petioles and are of interest for the improvement of pejibaye for heart of palm production (Clement 1988, Clement et al. 1993). During the first introduction to Hawaii (1991), germination of the Benjamin Constant progenies averaged 54% and that of the Yurimaguas progenies averaged 58%.

The seeds were depulped at INPA, soaked for two days (with a daily change of water), cleaned, treated with Benomyl (from a batch not implicated in the recent phyto-toxicity problem), dried (some in shade, some in front of an air conditioner), bagged in plastic, boxed in styrofoam and shipped to the U.S. They were fumigated at the USDA Plant Quarantine Station in Miami and sent by Federal Express to Honolulu. The seeds were received on 5 March 1992, re-cleaned, floated to obtain a preliminary idea of quality, treated with Captan, and re-bagged. The seeds that floated were separated and not used in these experiments.

[1] Hawaii Institute of Tropical Agriculture and Human Resources Journal Series Number 4018

The first experiment compared two substrates: a black volcanic cinder that passed through a 6 mm mesh and a 3:1 (v:v) mixture of redwood bark chips and #2 horticultural perlite. These substrates were placed in galvanized nursery flats (60 × 40 × 10 cm), under 20% shade mesh, with two 5-minute sprinkler irrigations per day, at the University of Hawaii Magoon Nursery, Honolulu. The experiment was a factorial (2 substrates by 16 progenies), in a completely randomized design, with 4 replicates of 10 seeds each. The seeds were sown in lines on 12 March, with 2 cm between seeds and 5 cm between lines, at a depth of 1 cm.

The second experiment compared bottom heat and no heat, in a 3:1 (v:v) mixture of redwood bark chips and volcanic cinder. The substrate was placed in plastic nursery flats (60 × 30 × 8 cm), under ≈20% shade mesh, with two 5-minute sprinkler irrigations per day, at the Windward Palms Nursery, Kahaluu, Hawaii. Half of the trays were put on rubberized thermostatically controlled heating pads and kept at ≈35° C. While 35° C is unlikely to be optimal, it is near the top end of temperatures used in other palms and well below the 40° C used in African oil palm. The experiment was a factorial (2 heat treatments by 10 progenies), in a completely randomized design, with 5 replicates of 10 seeds each. The seeds were sown on 14 March, as above.

Germination was evaluated weekly for three months after the first germinated seeds were observed. For analysis, the germination percentage was transformed by arcsine (Little and Hills 1978). In the analysis of variance, each experimental factor was considered to have been randomly chosen from a population of possible factors, so that the main factors were tested by their interaction rather than by the experimental error (Little and Hills 1978). Each experiment was also analyzed as a 2 (treatments) × 2 (populations) factorial.

Results and Discussion

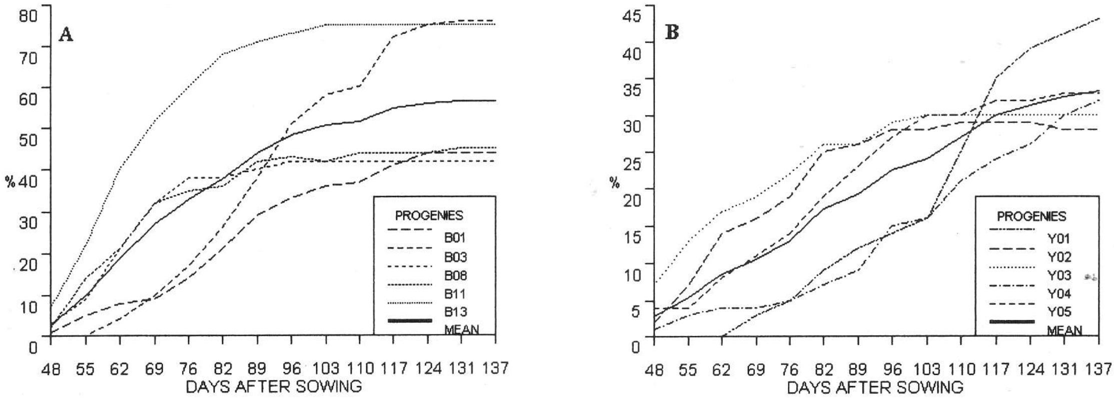
Germination was lower than expected, with the Benjamin Constant progenies averaging 56% in the heat experiment and 63% in the substrate experiment, and the Yurimaguas progenies averaging 33% and 37%, respectively. There was, however, enormous progeny variation in both experiments, ranging from 37 to 84% in the Benjamin Constant population and 24 to 45% in the Yurimaguas population. The maximum observed in the Benjamin Constant is what is expected from fresh seed in good condition (Ferreira 1988), which shows that most of the seed in this experiment suffered viability depression from various pre-experimental factors.

The period from sowing to first germination varied from 40 to 60 days and in all treatments most progenies had finished germination by 140 days after sowing. These data are in accord with Cardoso's (1944) observations for seed sown in earth, but longer than he found for seed sown in saw-dust. The heat treatment and the volcanic cinder generally promoted germination before the other treatments, but a few progenies did not follow this trend. Rees (1963) states that heat accelerates germination, but the 7–8% enhancement observed in our experiment was not statistically significant. Progenies varied considerably in the time required for first germination and in the duration of the germination period, with some Yurimaguas progenies starting latest and taking longest in the redwood/perlite substrate.

There are two general types of cumulative germination curves in both populations (Fig. 1). The more common curve (type I) rises rapidly, stays above the population mean for most of the period, and then flattens out. The less common curve (type II) starts slowly, stays below the mean for most of the period, and then rises more rapidly before flattening out. The type II curve may represent vestiges of dormancy. In domesticates, like pejibaye, dormancy is frequently eliminated or reduced from that found in wild populations (Hawkes 1983). Clement et al. (1989) observed pronounced dormancy in *B. dahlgreniana*, a probable progenitor of pejibaye, but dormancy is not normally observed in pejibaye itself.

The effect of heat treatment on germination of Yurimaguas progenies with a type I (Y03) or a type II curve (Y01) is presented in Figure 2. It is clear that progeny Y03 responded in a similar fashion to the two treatments (Fig. 2A), while progeny Y01 behaved differently in each treatment (Fig. 2B). The same type of differential response was observed in all the type II germination curves in both populations.

At the *population* level in both experiments, there was a significant treatment effect ($p < 5\%$), with bottom heat and volcanic cinder superior to no heat and the redwood/perlite mixture. There were no interactions between the populations and the treatments in either experiment. It is possible

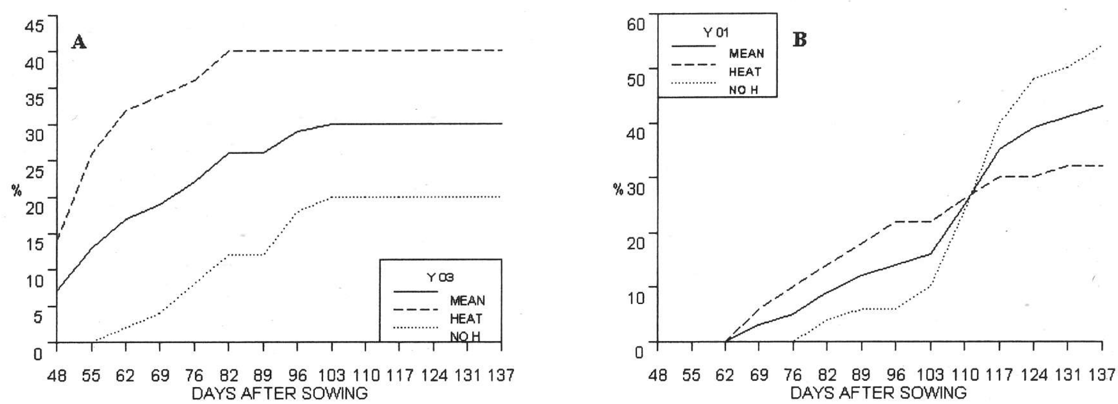


1. Variation in cumulative seed germination of pejibaye in the bottom heat experiment. A. Benjamin Constant. B. Yurimaguas.

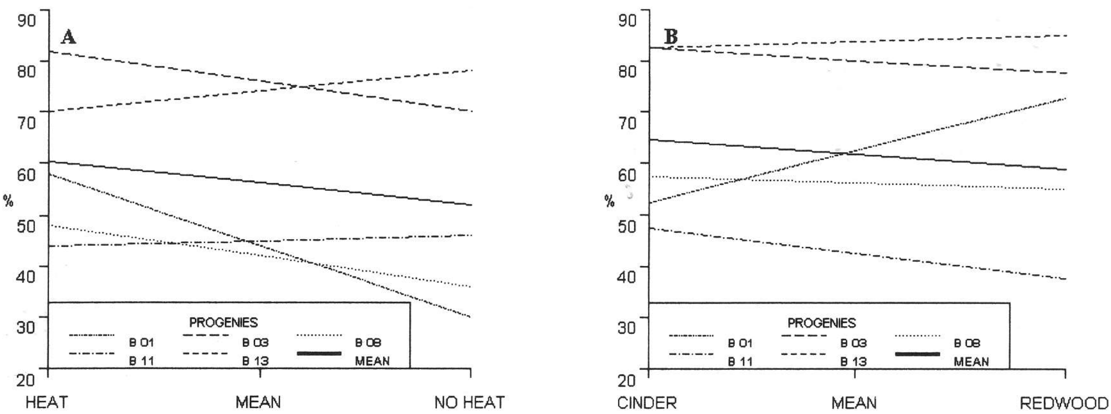
that the two experiments measured a similar response, since the volcanic cinder probably absorbed more heat during the day than the redwood substrate. The fact that the volcanic cinder yielded a slightly higher mean germination than the heat treatment suggests that ≈35° C may be higher than optimum for pejibaye. A complicating factor in this comparison, however, is that each treatment probably had different water relations; the volcanic cinder drained quickly and dried more thoroughly than the redwood substrate. Separating the heat effect from the water effect will require further experimentation.

At the *progeny* level there was no significant effect of treatments, principally because this was masked by strong interactions between the progenies and the treatments (Fig. 3). Although the volcanic cinder substrate was warmer than the redwood/perlite substrate, individual progenies did not behave identically in the two experiments, suggesting that other substrate conditions (e.g., water relations) also affect germination.

Although the results reported here suggest that bottom heat and a sandy-type of substrate yield favorable results with pejibaye, the two experiments actually raise more questions than they answer. For example, the question of an ideal substrate for pejibaye is once again open, rather than decided by Cardoso (1944). Also, the optimum temperature for germinating pejibaye needs to be determined. S. A. N. Ferreira (pers. comm., INPA, 1992) has also pointed out that genotypic variation, such as that observed here, can mask the effects of the treatments applied. This is quite



2. Variation in pejibaye seed germination response to bottom heat. A. Type I germination curve (progeny Y03). B. Type II germination curve (progeny Y01).



3. Interactions between progeny genotype and seed germination treatments in pijibaye from the Benjamin Constant population. A. Bottom heat experiment. B. Substrate experiment.

clear in this study, where progenies interacted strongly with treatments. Ideally, several progenies from several populations should be used before generalizations are made about pejibaye.

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Bruchid Beetles and Palm Seeds: Recorded Relationships

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ABSTRACT

New World Bruchidae in the tribe Pachymerini, subfamily Pachymerinae, almost exclusively feed in the seeds of palms and are therefore commonly referred to as palm bruchids. We have found that these seed beetles have moderate preferences for different taxa of palms. The bruchid genus *Caryobruchus* shows definite preference for palms in the tribes Corypheae, Phoeniceae, and Hyophorbeae. Seeds of the Phytelephantoideae and Cocoeae are fed upon by the genera *Caryoborus, Speciomerus,* and especially species of *Pachymerus.* Thus palm bruchids do show specificity for host plants, and the records reported in the literature are likely to be fairly accurate.

Among the many threats to the health and life of seeds, bruchid (seed) beetles (Coleoptera: Bruchidae) are some of the most ubiquitous and formidable. These beetles lay their eggs on seeds or fruits, and their larvae feed inside seeds, usually destroying the seeds in the process. From a plant's point of view, a seed has only two purposes: to package the embryo for dispersal and to nurture the embryo until it can establish itself as a seedling. From the bruchid's perspective, a seed is a nursery-cum-cafeteria, rich in food resources and often well protected from the environment. In short, it is the perfect place for bruchid larvae to feed. The conflict between these differing agenda has led to some of the most interesting coevolutionary relationships in biology.

The first taxonomic revision of the bruchid tribe Pachymerini of the New World was recently published by Nilsson and Johnson (1993). Included in their revision were published and unpublished host records for these beetles, probably all of which feed on palm seeds. With better understanding of bruchid taxonomy and relationships, we are now in a position to examine the host records of these beetles. An examination of bruchids and their palm hosts is the subject of this paper.

A significant barrier to this undertaking is that most host records are not substantiated by seeds or voucher specimens of the palms from which the beetles were reared. Consequently, the accuracy of the historical records cannot be verified. Also, many of the names of the palms have been changed since the original host records were published or placed on insect labels. Many of the published names of the palm hosts are not those in current use.

After assembling the host records and correcting for the outdated bruchid and palm taxonomy, we found, simply by examination, that there were distinct relationships between genera of seed beetles and some of the host genera of palms. Thus, even allowing for some spurious host records, we have probably established that there are distinct host preferences between palm bruchids and their hosts.

Plea for Bruchids Reared from Palm Seeds

We strongly encourage palm growers and specialists to collect the insects that emerge from the seeds of palms and send them along with a sample of the seeds to either CDJ, SZ, or JAN. Now that the classification of palm bruchids has been largely completed, we can identify the bruchids with a high degree of certainty. This is of value to palm growers in controlling the insects. Also, now, more than ever, ecological studies of these interesting plants and insects will be of greater value since names can be applied to both plants and insects.

Bruchid Beetles

Beetles in the family Bruchidae feed in the seeds of about 33 families of plants, but most feed in

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the Leguminosae. The reasons for host specificity to any family are not easily ascertained, but some possible reasons are discussed below.

Bruchids are in the superfamily Chrysomeloidea, a superfamily that includes the leaf beetles and the longhorned wood borers. The larvae of the leaf beetles feed in or mine the leaves, roots, and stems. The larvae of the longhorned wood borers feed in wood and roots. According to Johnson (1981) it is likely that the chrysomeloid ancestors of bruchids radiated onto the seeds of the Leguminosae (or possibly its ancestors) shortly after it arose and then later evolved the ability to feed in seeds of other families. All known seed beetles feed on, and usually live in, seeds.

The family Bruchidae consists of about 1,500 described species grouped in the subfamilies Amblycerinae, Bruchinae, Eubaptinae, Kytorhininae, Pachymerinae, and Rhaebinae (Southgate 1979). About 80% of bruchid species are in the Bruchinae, 10% in the Amblycerinae, 9% in the Pachymerinae, with the other 1% assigned to the other three subfamilies.

The life histories of bruchids vary considerably in egg laying, larval entry, and larval feeding behavior. The general life cycle is that the adult lays an egg on a fruit or seed, and the first stage (instar) larva bores through the fruit and/or seed coat and enters the seed. The first stage larva is highly modified to enter seeds and has many spines and often well developed legs for this purpose. Once it has entered a seed it molts into a legless grub and begins to feed. A larva usually molts three more times as it continues to feed inside the seed; usually only one, but sometimes several seeds are eaten. Bruchids usually pupate inside the seed that the larva has fed upon, but those that feed on several seeds may build a pupal chamber by gluing several seeds together, or some may leave the seeds and spin a cocoon in which they pupate. The larva starts and usually the adult finishes making a round exit hole in the seed and perhaps the fruit through which the adult exits. Adult bruchids feed on pollen and nectar and are not known to feed on seeds or fruits. Some species of bruchids may complete many generations in a year, but most species of bruchids complete only one or a few generations per year. In the laboratory or in stored seeds, bruchids may complete many generations without the adults feeding; however, it has been shown that adult bruchids will lay more eggs if provided with ample food and water. They are suspected to feed on flowers, pollen, and nectar in the field.

About 84% of the hosts of bruchids are in the Leguminosae (Johnson 1970). Most of the other hosts are in the families Convolvulaceae (4.5%), Arecaceae (4.5%), and Malvaceae (2%). The other 5% are in 29 other families. Of the 5%, the Combretaceae, Rhamnaceae, Sterculiaceae, and especially the Tiliaceae host more bruchids than the other families.

Seed beetles in the subfamily Pachymerinae are medium to large size seed predators consisting chiefly of "primitive" forms. They appear to be naturally distributed in the tropics and subtropics of all continents except Australia, and extend into temperate zones in some areas. Palm bruchids are confined to the tribe Pachymerini, all of which are endemic to the Americas. Two species are now established in Africa as the result of human introductions. Most species of Pachymerini are tropical, but species occur as far north as Texas and as far south as Argentina. The Pachymerini almost exclusively feed in palm seeds and are therefore commonly called palm bruchids. *Pachymerus abruptestriatus* (Gyllenhal), however, has been reported to feed in the seeds of *Diospyros* sp. (Ebenaceae) (Bondar 1941). This record may be spurious. The remaining two tribes of the Pachymerinae are native to the Old World and most feed upon seeds of Leguminosae, some in the Combretaceae, with some questionable reports from the Umbelliferae and Pandanaceae.

Bruchid–Host Interactions

Early coevolutionary studies between bruchids and their hosts were conducted by Janzen (1969) who suggested traits that Leguminosae possess that seem to protect their seeds from seed beetles. Center and Johnson (1974) suggested countermechanisms by bruchids to these plant traits. Interactions between bruchids and toxic seeds have been discussed by several authors, but the research of Janzen (e.g., 1977, 1978) and Rosenthal (e.g., 1990) are especially enlightening. Ecological and coevolutionary studies of palm bruchids and palms known to us were made by Janzen (1971), Wilson and Janzen (1972), Smith (1975), Brown (1976), Bradford and Smith (1977), Wright (1983), and Smythe (1989).

Methods

The data we analyzed in this paper are listed in Table 2 and were gathered mostly by CDJ and JAN from specimens and the literature. SZ updated the names in Table 2. The data in Table 2 were

Table 1. Bruchid beetles that have been reported to feed in seeds of Arecaceae. Palm taxa are grouped by subfamily, tribe and genus. Cocos nucifera *(coconut) is an unlikely host for palm bruchids so record is unlikely and must be verified. * = Introduced into the New World. ** = Records are from hosts cultivated outside their native range.*

Host Plant	Palm Bruchids
ARECACEAE	
Coryphoideae	
Corypheae—31 genera; Cosmo. (26% of genera attacked)	
Thrinax	
T. morrisii H. Wendl.	*Caryobruchus gleditsiae*
Coccothrinax	
C. argentata (Jacq.) Bailey	*C. gleditsiae*
C. martii (Griseb. et Wendl.) Becc.	*C. gleditsiae*
Livistona	
**L. chinensis* (Jacq.) R. Br. ex Mart.	*C. gleditsiae*
Serenoa	
S. repens (Bartram) Small	*C. gleditsiae*
Brahea	
Brahea sp.	*C. rubidus*
	C. veseyi
B. armata S. Wats.	*C. veseyi*
B. brandegeei (Purpus) H. E. Moore	*C. veseyi*
Copernicia	
Copernicia sp.	*C. gleditsiae*
	Pachymerus thoracicus
C. alba Morong ex Morong & Britton	*P. thoracicus*
C. hospita Mart.	*C. gleditsiae*
C. prunifera (Miller) H. E. Moore	*P. bactris*
	P. sveni
C. rigida Britton & Wilson ex Britton	*C. gleditsiae*
	Caryobruchus sp.
C. sueroana León	*C. gleditsiae*
C. tectorum (Kunth) Mart.	*P. cardo*
C. macroglossa Wendl. ex Becc.	*C. gleditsiae*
Washingtonia	
***W. filifera* (Linden) Wendl.	*C. gleditsiae*
***W. robusta* Wendl.	*C. gleditsiae*
Sabal	
Sabal sp.	*C. curvipes*
	C. gleditsiae
	C. maya
	Speciomerus ruficornis
S. bermudana L. H. Bailey	*C. gleditsiae*
	Caryobruchus sp.
S. causiarum (O. F. Cook) Becc.	*C. gleditsiae*
	Caryobruchus sp.
S. domingensis Becc.	*C. gleditsiae*
	Caryobruchus sp.
S. etonia Swingle ex Nash	*C. gleditsiae*
	Caryobruchus sp.
S. maritima (Kunth) Burret	*C. gleditsiae*
	Caryobruchus sp.
S. mauritiiformis (Karst.) Griseb. & H. Wendl.	*C. gleditsiae*
	Caryobruchus sp.
S. mexicana Mart.	*C. curvipes*
	C. gleditsiae
	Caryobruchus sp.
	Speciomerus ruficornis
S. minor (Jacq.) Pers.	*C. gleditsiae*
	Caryobruchus sp.

Table 1. Continued.

Host Plant	Palm Bruchids
S. palmetto (Walt.) Lodd. ex J. A. & J. H. Schult.	*C. gleditsiae*
	C. marieae
	Caryobruchus sp.
S. pumos (Kunth) Burret	*C. curvipes*
	Caryobruchus sp.
S. rosei (O. F. Cook) Becc.	*C. gleditsiae*
	C. veseyi
	Caryobruchus sp.
S. uresana Trel.	*C. gleditsiae*
	Caryobruchus sp.
S. yapa C. Wright ex Becc.	*C. gleditsiae*
	Caryobruchus sp.
Phoeniceae—1 genus; African/Asian (100%)	
Phoenix	
**P. sylvestris* (L.) Roxb.	*C. gleditsiae*
Borasseae—7 genera; African/Asian (0%)	
Calamoideae	
Calameae—19 genera; African/Asian (one species in the Americas) (0%)	
Lepidocaryeae—3 genera; American (33%)	
Mauritia	
M. flexuosa L.f.	*Caryoborus gracilis*
Nypoideae—1 genus; Asian (0%)	
Ceroxyloideae	
Cyclospatheae—1 genus; American (0%)	
Ceroxyleae—5 genera; Cosmo. (0%)	
Hyophorbeae—5 genera; American (20%)	
Chamaedorea	
Chamaedorea sp.	*Caryobruchus gleditsiae*
C. elegans Mart.	*C. marieae*
	C. maya
C. seifrizii Burret	*C. gleditsiae*
Arecoideae	
Caryoteae—3 genera; Asian (0%)	
Iriarteeae—6 genera; American (17%)	
Dictyocaryum	
D. fuscum (Karst.) H. Wendl.	*Caryoborus gracilis*
Podococceae—1 genus; African (0%)	
Areceae—86 genera; Cosmo. (5%)	
Euterpe	
Euterpe sp.	*Pachymerus bactris*
E. oleracea Mart.	*P. sveni*
Oenocarpus sp.	*Caryoborus gracilis*
O. bataua Mart.	*C. gracilis*
Areca	
**A. triandra* Roxburgh ex Buchanan-Hamilton	*Pachymerus cardo*
Cocoeae—22 genera; mostly American (3 African) (59%)	
Butia	
B. capitata (Mart.) Becc.	*P. bridwelli*
Cocos	
C. nucifera L.	*P. bactris*
	P. nucleorum
Syagrus	
S. coronata (Mart.) Becc.	*P. bactris*
	P. nucleorum
S. flexuosa (Mart.) Becc.	*P. bactris*
S. romanzoffiana (Cham.) Glassman	*P. bactris*
	P. cardo
	P. nucleorum

Table 1. Continued.

Host Plant	Palm Bruchids
S. schizophylla (Mart.) Glassman	*P. bactris*
	P. nucleorum
S. vagans (Bondar) Hawkes	*P. bactris*
	P. nucleorum
Attalea	
Attalea sp.	*Speciomerus giganteus*
	S. ruficornis
	P. bactris
	P. cardo
A. funifera Mart. ex Sprengel	*P. bactris*
	P. nucleorum
A. lapidea (Gaerther) Burret	*P. bactris*
	P. nucleorum
A. spectabilis (Mart.) Burret	*P. cardo*
A. tessmannii Burret	*P. cardo*
A. victoriana Dugand	*P. cardo*
Scheelea	
S. gomphococca (Mart.) Burret	*P. cardo*
S. martiana Burret	*Speciomerus giganteus*
	Pachymerus bactris
S. brachyclada Burret	*P. cardo*
S. excelsa Karst.	*S. giganteus*
S. leandroana Barb. Rodr.	*Pachymerus cardo*
S. liebmannii Becc.	*S. giganteus*
S. macrolepis Burret	*S. giganteus*
	Pachymerus cardo
S. maracaibensis (Mart.) Burret	*P. cardo*
S. rostrata (Oersted) Burret	*S. giganteus*
	P. cardo
S. zonensis L. H. Bailey	*S. giganteus*
	P. cardo
Orbignya	
Orbignya sp.	*P. bactris*
	P. nucleorum
O. cohune (Mart.) Dahlgren ex Standley	*P. bactris*
	P. cardo
	P. nucleorum
O. phalerata Mart.	*P. bactris*
	P. cardo
	P. nucleorum
	S. giganteus
Maximiliana	
Maximiliana sp.	*Caryoborus serripes*
M. maripa (Correa) Drude	*P. cardo*
Elaeis	
**E. guineensis* Jacq.	*P. bactris*
E. oleifera (Kunth) Cortes	*P. cardo*
Acrocomia	
Acrocomia sp.	*Speciomerus revoili*
	P. nucleorum
A. aculeata (Jacq.) Lodd.	*S. revoili*
	P. bactris
	P. cardo
	P. nucleorum
A. totai Mart.	*S. revoili*
	P. nucleorum
Aiphanes	
A. aculeata Willd.	*P. cardo*
Bactris	
B. caryotifolia Mart.	*P. sveni*

Table 1. Continued.

Host Plant	Palm Bruchids
B. cuesa Crueger ex Griseb.	*P. cardo*
B. maraja Mart.	*P. sveni*
B. guineensis (L.) H. E. Moore	*S. ruficornis*
	P. bactris
B. gasipaes Kunth	*P. cardo*
Desmoncus	
Desmoncus sp.	*P. sveni*
D. polyacanthos Mart.	*P. bactris*
Astrocaryum	
Astrocaryum sp.	*Caryoborus serripes*
	S. ruficornis
A. huicungo Dammer ex Burret	*C. serripes*
A. standleyanum L. H. Bailey	*P. bactris*
Geonomeae—6 genera; American (0%)	
Phytelephantoideae—3 genera; American (33%)	
Phytelephas	
Phytelephas sp.	*Caryoborus chiriquensis*
P. aequatorialis Spruce	*C. chiriquensis*
P. macrocarpa Ruiz & Pavon	*C. chiriquensis*

used to produce Table 1. Table 1 shows host preferences even though published data were originally thought to be marginal in validity. These data show relationships between classifications of both bruchids and palms.

Some early host records are meaningless. For example, species of palms formerly placed in *Cocos* are now disposed in more than five different genera. Thus, "*Cocos* sp." as a host record is rather uninformative. Other puzzling records are those that use names with no botanical standing (viz., *nomina nuda*, invalid combinations, typographical

1. Seeds of *Copernicia* sp. with *Caryobruchus gleditsiae* emerging from an exit hole in the seed on the left and a bruchid exit hole in the seed on the right. Note the typical round exit holes made by these insects. Photo by S. Zona.

Table 2. Recorded hosts for New World species of palm bruchids (Pachymerini). Most host records reported by Nilsson & Johnson (1993) were from seeds and plants collected by and identified by others. Because CDJ has used the host records of Zacher (1952) for studies in bruchids that feed in legumes and has found many of them to be reliable, we feel Zacher's records to be more reliable than most others that have been published. We do not know, however, where he obtained many of his records. The reports by Udayagiri & Wadhi (1989) and other authors are mostly from the literature. In this table, the names of the host plants are as written in the original publications. For ease of reference to the literature we think that the names reported in the literature should be presented here even though some are nomina nuda *or invalid. Therefore, we have placed valid names in this table followed by the invalid names in parentheses followed by the literature citation in which the invalid name was reported.* Nomina nuda *are in quotes and not italicized. Names of palm bruchids are in bold.*

Caryoborus chiriquensis Sharp

Host Plants.—Phytelephas sp.: Nilsson & Johnson 1993:16. *P. aequatorialis*: Nilsson & Johnson 1993:16. *P. macrocarpa*: Zacher 1952:470; Udayagiri & Wadhi 1989:239.

Caryoborus gracilis Nilsson

Host Plants.—Dictyocaryum fuscum: Nilsson & Johnson 1993:17. *Oenocarpus* sp.: Nilsson & Johnson 1993:17 (as *Jessenia* sp.: Nilsson & Johnson 1993:16). *O. bataua*: (as *Jessenia bataua*: Nilsson & Johnson 1993:17). *Mauritia flexuosa* (as *M. flexulosa*: Nilsson & Johnson 1993:16). Palm Seeds: Nilsson & Johnson 1993:17.

Caryoborus serripes (Sturm)

Host Plants.—Astrocaryum sp.: Bridwell 1929:154; Zacher 1952:469; Udayagiri & Wadhi 1989:238; Nilsson & Johnson 1993:20. *A. huicungo*: Nilsson & Johnson 1993:20. *Maximiliana* sp.: Zacher 1952:470.

Caryobruchus curvipes (Latreille)

Host Plants.—Cocos sp. (?): Bridwell 1918:493. *Sabal* sp.: Bridwell 1929:156; Zacher 1952:470; Zona 1990:614. *Sabal* sp. (as *Inodes* sp.: Bridwell 1929:156; Udayagiri & Wadhi 1989:239). *S. mexicana* (as *Inodes texana*: Bridwell 1918:493; Zacher 1952:470; Udayagiri & Wadhi 1989:239). *S. pumos*: Nilsson & Johnson 1993:23.

Caryobruchus gleditsiae (Johansson and Linné)

Host Plants.—Chamaedorea sp.: Nilsson & Johnson 1993:25. *C. seifrizii*: Nilsson & Johnson 1993:25. *Coccothrinax argentata*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *C. martii*: Woodruff 1968:1. *Copernicia* sp.: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *C. hospita*: Nilsson & Johnson 1993:24. "Copernicia inderoglossa": Nilsson & Johnson 1993:25. *C. macroglossa* (as "*C. torrans*" and *C. torreana*: Nilsson & Johnson 1993:25). *C. rigida*: Nilsson & Johnson 1993:25. *C. sueroana*: Nilsson & Johnson 1993:25. *Livistona chinensis*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *Phoenix sylvestris*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *Sabal* sp.: Riley & Howard 1892:166; Cushman 1911: 504; Zacher 1952:470; Udayagiri & Wadhi 1989:239; Zona 1990:614; Nilsson & Johnson 1993:28. *S. bermudana*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:24. *S. causiarum*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *S. domingensis*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25 (as *Inodes neglecta*: Nilsson & Johnson 1993:25). *S. etonia*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993: 25. *S. maritima* (as *S. florida*: Nilsson & Johnson 1993:25). *S. mauritiiformis* (as *S. glaucescens*: Woodruff 1968:1; as *S. mauritiaeformis*: Woodruff 1968:1). *S. minor* (as *S. glabra*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:26). "Sabal longipedunculata": Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *S. mexicana*: Nilsson & Johnson 1993:25 (as *Inodes texana*: Zacher 1952:468; Udayagiri & Wadhi 1989:239; as *Sabal texana*: Nilsson & Johnson 1990:53). *S. minor*: Paxson 1961:75; Woodruff 1968:1; Nilsson & Johnson 1990:53. *S. palmetto*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Zona 1990:615; Nilsson & Johnson 1993:25 (as *S. parviflora*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25). *S. rosei*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *S. uresana*: Pfaffenberger & Johnson 1976:34; Nilsson & Johnson 1990:53; Zona 1990:615; Nilsson & Johnson 1993:25. *S. yapa*: Woodruff 1968:1; Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25. *Serenoa repens*: Woodruff 1968:1. *Thrinax morrisii* (as *T. microcarpa*: Nilsson & Johnson 1990:53; Nilsson & Johnson 1993:25). *Washingtonia filifera*: Nilsson & Johnson 1990:53. *W. robusta*: Nilsson & Johnson 1993:26. Palm Seeds: Nilsson & Johnson 1993:25.

Caryobruchus marieae Nilsson and Johnson

Host Plants.—Chamaedorea elegans: Nilsson & Johnson 1993:28. *Sabal* sp.: Nilsson & Johnson 1990:55. *S. palmetto* (as *S. parviflora*: Nilsson & Johnson 1990:55; Nilsson & Johnson 1993:28).

Caryobruchus maya Nilsson

Host Plants.—Chamaedorea elegans: Nilsson & Johnson 1993:28. *Sabal* sp.: Nilsson & Johnson 1993:28.

Caryobruchus rubidus (Chevrolat)

Host Plants.—Brahea sp.: Nilsson & Johnson 1993:31.

Table 2. Continued.

Caryobruchus veseyi (Horn)

Host Plants.—Brahea sp. (as *Erythea* sp.: Bridwell 1929:157). *B. armata* (as *Erythea armata*: Nilsson & Johnson 1993: 32). *B. brandegeei* (as *Erythaea brandegeei*: Zacher 1952:469 and *Erythea brandegeei*: Bridwell 1929:157; Udayagiri & Wadhi 1989:241; Nilsson & Johnson 1993:32). *Sabal rosei*: Nilsson & Johnson 1993:32.

Caryobruchus sp.

Host Plants.—Copernicia rigida: Zacher 1952:470. *Sabal bermudana*: Zona 1990:614. *S. causiarum*: Plant Quarantine Dec. 1932:194; Zona 1990:614. *S. domingensis*: Zona 1990:614. *S. etonia*: Zona 1990:614. *S. maritima*. Zona 1990:614. *S. mauritiiformis*: Zona 1990:614. *S. mexicana*: Zona 1990:614. *S. minor*: Zona 1990:614. *S. palmetto*: Zona 1990:614. *S. pumos*: Zona 1990:614. *S. rosei*: Zona 1990:614. *S. uresana*: Zona 1990:614. *S. yapa*: Zona 1990:614.

Speciomerus giganteus (Chevrolat)

Host Plants.—Attalea sp.: Bridwell 1929:150; Zacher 1952:469; Udayagiri & Wadhi 1989:240; Nilsson & Johnson 1993: 36. *Orbignya phalerata* (as *O. martiana*: Zacher 1952:469; Udayagiri & Wadhi 1989:240; as *Scheelea phalerata*: Silva 1977:2; as "Babassu nut": Nilsson & Johnson 1993:36). *Scheelea excelsa*: Bridwell 1929:150; Zacher 1952:470; Udayagiri & Wadhi 1989:241. *S. liebmannii*: Nilsson & Johnson 1993:36. *S. macrolepis*: Nilsson & Johnson 1993:36. "Scheelea orbignya": Zacher 1952:469; Udayagiri & Wadhi 1989:240. *S. martiana* (as *Attalea excelsa*: Zacher 1952:469). *S. rostrata*: Janzen 1971:93; Janzen 1980:947; Udayagiri & Wadhi 1989:239; Nilsson & Johnson 1993:36. *S. zonensis*: Zacher 1952: 470; Udayagiri & Wadhi 1989:239; Nilsson & Johnson 1993:36.

Speciomerus revoili (Pic)

Host Plants.—Acrocomia sp.: Bridwell 1929:150; Zacher 1952:469; Udayagiri & Wadhi 1989:238. *A. aculeata* (as *A. sclerocarpa*: Silva 1977:2). *A. totai*: Nilsson & Johnson 1993:38.

Speciomerus ruficornis (Germar)

Host Plants.—Astrocaryum: Bridwell 1929:151; Zacher 1952:469; Udayagiri & Wadhi 1989:240. *Attalea* sp.: Silva 1977: 3. *Bactris guineensis* (as *B. minor*: Silva 1977:3; Udayagiri & Wadhi 1989:241). *Cocos* sp.(?): Bridwell 1918:493. *Sabal* sp. (as *Inodes* sp.: Bridwell 1929:156; Udayagiri & Wadhi 1989:239). *Sabal* sp.: Bridwell 1929:156; Zacher 1952:470. *S. mexicana* (as *Inodes texana*: Bridwell 1929:156; Zacher 1952:470; Udayagiri & Wadhi 1989:239).

Pachymerus abruptestriatus (Gyllenhal)

Host Plants.—Diospyros sp.: Bondar 1941:303; Zacher 1952:469; Prevett 1966b:187; Udayagiri & Wadhi 1989:242; Nilsson & Johnson 1993:45.

Pachymerus bactris (Linné)

Host Plants.—Acrocomia aculeata (as *A. sclerocarpa*: Bridwell 1929:160; Zacher 1952:469; Silva 1977:4; Udayagiri & Wadhi 1989:244). *Astrocaryum standleyanum*: Nilsson & Johnson 1993:47. *Attalea* sp.: Bridwell 1929:160. *A. funifera*: Zacher 1952:469; Udayagiri & Wadhi 1989:245. *A. lapidea* (as *Cocos lapidea*: Zacher 1952:469; Udayagiri & Wadhi 1989: 245). *Bactris guineensis* (as *B. minor*: Zacher 1952:469; Udayagiri & Wadhi 1989:243; Nilsson & Johnson 1993:47). *Cocos nucifera*: Zacher 1952:469; Udayagiri & Wadhi 1989:245. *Copernicia prunifera* (as *C. cerifera*: Bridwell 1918:493; Hoffmann 1945:25; Zacher 1952:469; Udayagiri & Wadhi 1989:243; as Carnauba-Palme: Zacher 1952:470). *Desmoncus polyacanthos*: Zacher 1952:470; Udayagiri & Wadhi 1989:243. *Elaeis guineensis*: Zacher 1952:469; Silva 1977:3; Udayagiri & Wadhi 1989:244, 245. *Euterpe* sp.: Zacher 1952:469; Udayagiri & Wadhi 1989:243. *Orbignya* sp.: Zacher 1952:470. *O. cohune* (as *Attalea cohune*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *O. phalerata* (as *O. martiana*: Zacher 1952:470; Udayagiri & Wadhi 1989:245). *O. speciosa* (?, according to current palm classification, the valid name for this species is either *O. phalerata* or *O. cohune*): Udayagiri & Wadhi 1989:244, 245. *Scheelea martiana* (as *Attalea excelsa*: Zacher 1952:469; Udayagiri & Wadhi 1989:244). *Syagrus coronata* (as *Cocos coronata*: Udayagiri & Wadhi 1989:245). *S. flexuosa* (as *Cocos campestris*: Zacher 1952:469; Udayagiri & Wadhi 1989:243). *S. romanzoffiana* (as *Cocos romanzoffiana*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *S. schizophylla* (as "Licurioba campanemae": Zacher 1952:470; Udayagiri & Wadhi 1989: 245). *S. vagans* (as *Cocos vagans* Zacher 1952:469; Udayagiri & Wadhi 1989:245).

Pachymerus bridwelli (Prevett)

Host Plants.—Butia capitata: Prevett 1966a:83; Nilsson & Johnson 1993:49; (as "Butiaca pitata" Udayagiri & Wadhi 1989:238).

Pachymerus cardo (Fåhraeus)

Host Plants.—Acrocomia aculeata (as *A. sclerocarpa*: Nilsson & Johnson 1993:52). *Aiphanes aculeata* (as *Martinezia caryotaefolia*: Nilsson & Johnson 1993:52). *Areca triandra*: Nilsson & Johnson 1993:51. *Attalea* sp.: Nilsson & Johnson 1993: 51. Cohune palm (= *Orbignya cohune*?): Nilsson & Johnson 1993:52. *Attalea spectabilis* (as *Orbignya spectabilis*: Nilsson & Johnson 1993:52). *A. tessmannii*: Nilsson & Johnson 1993:52. *A. victoriana*: Nilsson & Johnson 1993:52. "Attalea paramaca": Nilsson & Johnson 1993:52. *Bactris cuesa*: Nilsson & Johnson 1993:52. *B. gasipaes* (as *Guilielma utilis*: Nilsson & Johnson 1993:52). *Copernicia tectorum* (as "Copernicia tectornya": Nilsson & Johnson 1993:52). *Elaeis guineensis*: Prevett 1966b: 186; Prevett 1967:5; Prevett 1968:239; Udayagiri & Wadhi 1989:243; Nilsson & Johnson 1993:51. *E. oleifera* (as *Elaeis*

Table 2. Continued.

melanococca: Nilsson & Johnson 1993:51). "Englerophoenix sp.": Nilsson & Johnson 1993:52. *Maximiliana maripa* (as *M. caribaea* and *M. regia* Nilsson & Johnson 1993:52, 51). "Orbignya graciosa": Nilsson & Johnson 1993:51. *Orbignya phalerata* (as *Attalea speciosa*: Nilsson & Johnson 1993:52). *Scheelea brachyclada*: Nilsson & Johnson 1993:52. *S. gomphococca* (as *Attalea gomphococca*: Nilsson & Johnson 1993:52). *S. leandroana*: Nilsson & Johnson 1993:51. *S. macrolepis*: Nilsson & Johnson 1993:52. *S. maracaibensis*: Nilsson & Johnson 1993:52. *S. rostrata*: Janzen 1971:93. *S. zonensis*: Nilsson & Johnson 1993:52. *Syagrus romanzoffiana* (as *Cocos romanzoffiana*: Nilsson & Johnson 1993:51).

Pachymerus nucleorum (Fabricius)

Host Plants.—Acrocomia sp.: Nilsson & Johnson 1993:54. *A. aculeata* (as *A. sclerocarpa*: Nilsson & Johnson 1993:54). *A. totai*: Nilsson & Johnson 1993:54. *Attalea funifera*: Zacher 1952:469; Udayagiri & Wadhi 1989:245. *A. lapidea* (as *Cocos lapidea*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *Cocos nucifera*: Zacher 1952:469; Udayagiri & Wadhi 1989: 245. *Elaeis guineensis*: Zacher 1952:469; Silva 1977:3; Udayagiri & Wadhi 1989:245. *Orbignya* sp.: Zacher 1952:470; Nilsson & Johnson 1993:54. *O. cohune* (as *Attalea cohune*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *O. phalerata* (as *Attalea speciosa*: Nilsson & Johnson 1993:54, *Orbignya martiana*: Zacher 1952:470; Udayagiri & Wadhi 1989:245 and *O. speciosa*: Zacher 1952:469; Udayagiri & Wadhi 1989:245; and as Babassu nuts: Nilsson & Johnson 1993:54). *Syagrus coronata* (as *Cocos coronata*: Udayagiri & Wadhi 1989:245; Nilsson & Johnson 1993:54). *S. romanzoffiana* (as *Cocos romanzoffiana*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *S. vagans* (as *Cocos vagans*: Zacher 1952:469; Udayagiri & Wadhi 1989:245). *S. schizophylla* (as "Licurioba campanemae": Zacher 1952:470; Udayagiri & Wadhi 1989:245).

Pachymerus sveni Nilsson

Host Plants.—Bactris caryotifolia: Nilsson & Johnson 1993:55. *B. maraja* (as "B. masaja": Nilsson & Johnson 1993:55). *Copernicia prunifera* (as *C. cerifera*: Nilsson & Johnson 1993:55). *Desmoncus* sp.: Nilsson & Johnson 1993:55. *Euterpe oleracea*: Nilsson & Johnson 1993:55.

Pachymerus thoracicus Prevett

Host Plants.—Copernicia sp.: Nilsson & Johnson 1993:58. *C. alba* (as *C. australis* Zacher 1952:470; Prevett 1966b:190; Silva 1979:249; Nilsson & Johnson 1993:58). "C. orientalis": Prevett 1966b:190; Udayagiri & Wadhi 1989:245; Nilsson & Johnson 1993:58.

errors, etc.). These problematic records are not included in Table 1 but are retained in Table 2 to try to make sense of the names in the palm bruchid literature.

The percentage of genera per tribe that are fed upon by bruchids is in parentheses in Table 1.

Results and Discussion

Interactions between Palms and Palm Bruchids. As the palm bruchids are American, it is not unexpected that they have no host records from those subfamilies and tribes that are African and/or Asian (Borasseae, Calameae, Nypoideae, Caryoteae, and Podococceae). Species of *Phoenix*, an African-Asian genus and the only genus of the Phoeniceae, host bruchids when these palms are cultivated in the Americas. It is curious that some American tribes have seldom or never been reported to host bruchids. Bruchids are not known to feed in the seeds of members of the Cyclospatheae, Ceroxyleae, or Geonomeae. Host records from the Hyophorbeae, which includes the diverse and widespread *Chamaedorea*, are surprisingly rare. The Areceae are predominantly African-Asian-Pacific, but four of the ten American genera are fed upon by bruchid beetles.

The bruchid genus *Caryobruchus* shows definite preference for palms in the tribes Corypheae, Phoeniceae (cultivated), and Hyophorbeae. The typical bruchid extreme generalist is *C. gleditsiae* which has been reported to feed in seeds of nine different genera.

The seeds of Phytelephantoideae and especially Cocoeae are fed upon by the genera *Caryoborus*, *Speciomerus*, and especially species of *Pachymerus*. That these three genera of bruchids feed in similar plants may not show any phylogenetic affinities between bruchids and the phylogenetic affinities of palms. Although a thorough phylogenetic analysis was not made of the palm bruchids by Nilsson and Johnson (1993), *Caryoborus* and *Speciomerus* seem to be more closely related to *Caryobruchus* than to *Pachymerus*.

The four groups most fed upon by bruchids, the Cocoeae, Corypheae, Phytelephantoideae and Lepidocaryeae, have seeds that are quite different in terms of seed morphology and chemistry. Most palm seeds contain significant amounts of lipids (triglycerides) and/or mannans (polysaccharides). Mannans, in one form or another, are characteristic of palm seeds (Daud and Jarvis 1992). Cocoeae have oil-rich endosperms and heavy endocarps. Corypheae have thin endocarps and oil-poor endosperms. Phytelephantoideae have thick, woody pericarps, thin endocarps and oil-poor endosperms. Lepidocaryeae have fruits that are oily and juicy, the endocarp is thin, and the seed not especially oil-rich. The epicarp is covered with hard, shiny overlapping scales. Because species of *Pachymerus* feed predominantly in Cocoeae (Table 1), it may be that most species are adapted to feeding in seeds rich in oil and with heavy endocarps. Apparently *Caryobruchus*, *Speciomerus*, and *Caryoborus* are mostly adapted to seeds with little oil and with thin endocarps.

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LETTERS

Dear Dr. Uhl:

I read with great interest the interview with Ralph Velez in the April, 1994, *Principes*, regarding the growing of tropical palms in temperate environments.

I have long contended that we here in Central Florida can grow almost any palm that can be grown in Southern Florida, provided the grower is willing to spend an average of two to five nights each winter protecting them from the cold.

Enclosed is a list of the palms presently in the ground at my home, the most remarkable probably being a 27′ *Roystonea regia* which has been in the ground 14 years.

RONALD L. HUMPHREY
113 Wildwood Avenue
Ormond Beach, FL 32176, USA

History of Palms in the Ground at 113 Wildwood Avenue, Ormond Beach, Florida

Botanical Name	#	Date(s) Planted	Common Name
Serenoa repens	1	Before 1971	Saw Palmetto
Sabal palmetto	2	Before 1971	Cabbage Palm
Washingtonia robusta	1	07-15-72	Washington Palm
Butia capitata	2	09-09-72	Jelly, Pindo
Phoenix canariensis	1	02-03-73	Canary Isle Date
Phoenix reclinata	1	02-22-75	Senegal Date
Roystonea regia	2	08-16-80, 08-28-93	Cuban Royal Palm
Phoenix roebelenii	3	03-31-90, 04-01-90	Pygmy Date Palm
Syagrus romanzoffiana	2	10-08-90	Queen Palm
Cocos nucifera	2	03-02-91, 06-03-94	Coconut Palm
Rhapis excelsa	3	11-23-91	Lady Palm
Chrysalidocarpus lutescens	2	11-23-91	Areca Palm
Ravenea rivularis	3	09-11-92, 05-14-93, 04-06-94	Majesty Palm
Archontophoenix cunninghamiana	2	04-05-93, 03-01-94	Piccabeen Palm
Veitchia merrillii	2	04-30-93	Manila Palm
Chamaedorea radicalis	1	08-28-93	Radicalis Palm
Neodypsis decaryi	1	09-04–93	Triangle Palm
Acoelorrhaphe wrightii	1	09-06-93	Paurotis Palm
Hyophorbe verschaffeltii	2	09-20-93, 06-29-94	Spindle Palm
Livistona chinensis	1	09-30-93	Chinese Fan Palm
Syagrus × *Butia*	1	03-01-94	Butyagrus Hybrid
Wodyetia bifurcata	1	03-01-94	Fox Tail Palm
Syagrus schizophylla	1	06-30-94	Arikury Palm
Total	38	(23 different species)	

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A New Species of Pritchardia from Mitiaro, Cook Islands

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The island of Mitiaro lies at 19°52′S, 157°42′W in the Cook Islands group in the Southwest Pacific Ocean. It is remote, indeed. The island is a coral atoll of a mere 25 km². In view of its remoteness, it has rarely been visited by botanists. One of us, Yves Ehrhart, a forester working for the Centre Technique Forestier Tropical in the Cook Islands, collected samples from a small population of a fan palm on Mitiaro, occurring as an apparently natural, self-regenerating population. The collections were sent to Kew, to John Dransfield, for naming. Shortly after the collections arrived at Kew, further collections of the same palm were sent by Cecilia Luttrell, a British student who had visited the Cook Islands as part of an undergraduate expedition. With copious material and excellent photographs available, there should have been little difficulty in naming the palm. However, this was not to be.

The habit and highly characteristic way in which the corolla lobes fall off the flower at anthesis show that the palm is a species of *Pritchardia.* Of course, this is scarcely surprising in view of the distribution of the genus through a wide swathe of the Pacific Ocean. Deciding to which species it belongs was the problem.

As we assembled this manuscript, we began to uncover further problems and confusion in the species of *Pritchardia* occurring in the Western Pacific. Dr. McKee drew our attention to a reference to the Mitiaro palm in Art Whistler's account of the palms of Samoa (Whistler 1992). Whistler refers, in passing, to the presence of *Pritchardia vuylstekiana* H. Wendl. in Mitiaro. On our writing to Whistler, he in turn drew our attention to the first mention of the Mitiaro palm by Gill (1885). Whistler (pers. comm.) compared his own collection from Mitiaro (*Whistler 5926*) with material named *P. vuylstekeana* collected from Makatea, Tuamotu Archipelago (the type locality of *P. vuylstekeana*) in the Bishop Museum in Honolulu, and he felt that they were a good match.

However, fruit size is of considerable importance in *Pritchardia.* In Wendland's description of *P. vuylsteckeana,* the origin of the palm is clearly cited as being Pomutu in the Danger Archipelago (Tuamotu), but the fruit is unambiguously described as being oblong, 24 × 20 mm (Wendland, in André 1883). The small fruit size (5–7 mm diam.) in the Mitiaro plant seems thus to preclude *P. vuylsteckeana.* Fruit characters and the lack of woolly indumentum on the flower-bearing branches suggest that the Mitiaro palm belongs to the group of species related to *P. pacifica* (Beccari and Rock 1921) that includes *P. pacifica, P. thurstonii* and *P. maideniana,* this last species described from material cultivated in the Royal Botanic Garden, Sydney. Inflorescence size and structure in the Mitiaro palm are similar to those of *P. pacifica,* but the fruits are far too small for that species and more closely resemble those of *P. thurstonii.* However, the inflorescences of *P. thurstonii* are longer than the leaves and are thus very characteristically exserted from the crown. Inflorescences in the Mitiaro palm do not behave in this way. The leaf division and the fruit size also seem to preclude *P. maideniana.* Thus the Mitiaro palm does not fit obviously into the range of variation of any described species of the genus.

Differences between recognized species in *Pritchardia* are notoriously fine; there is a great need for the critical work (Read and Hodel 1990) on the genus that has been accomplished in Hawaii, to be extended to the whole genus throughout the Pacific. Such revisionary work is essential to clear up the confusion over the identity of *P. vuylstekeana* and to sort out the relationships between the species of this extraordinarily widely dispersed genus. In the meantime, the Mitiaro palm requires a name as a basic reference point. We believe that we have no alternative but to describe the Mitiaro palm as new and name it here *Pritchardia mitiaroana*, reflecting its known distribution. If in the future it is shown to be conspecific with an already named but at present poorly understood taxon, then we hope, at least, that by describing and naming the Mitiaro palm we shall have helped to characterize it and draw attention to a beautiful palm, growing in one of the most remote parts of the world.

Photographs indicate that the palm is of considerable beauty and it is to be hoped that it can be introduced into cultivation and the wild population safeguarded against accidental damage from fire that could occur, if the island were ever to become a tourist attraction.

Pritchardia mitiaroana J. Dransf. & Ehrhart **sp. nov.** (Figs. 1–8)

Fructu et rachillarum structura *P. pacificae* et *P. thurstonii* affinis sed a *P. pacifica* fructu multo minore et *P. thurstonii* inflorescentia a corona foliorum non exserta differt. Typus: Insulae Cook, Mitiaro, *Ehrhart s.n.* 26 April 1991 (Holotypus K; isotypus P).

Solitary, rather robust, stocky, pleonanthic hermaphroditic fan palm. Stem at maturity 4–6 m tall, slightly ventricose, widening to 30–35 cm diam. at 1.5 m above the ground, then tapering slightly to ca. 25 cm diam. at 2.5 m height, diameter then constant to the base of the crown, the stem surface grey brown, obscurely ringed with leaf scars, smooth or with irregular shallow vertical fissures in young palms or near the stem apex. Crown comprising 16–23 expanded leaves, one leaf three-quarters expanded, a sword leaf and two or more dying or dead leaves, juvenile palms (up to 3.5 m tall) with ca. 16 leaves, adult palms (up to 5 m tall) with 23 leaves, the leaves held stiffly; petiole 80–90 cm long, ca. 20 cm wide at the base, the base clasping the stem, tapering to 6 × 1.2 cm at ca. 50 cm above the base, tapering gradually to 3 × 1 cm at the insertion of the blade, the margins smooth, the surfaces somewhat waxy, glabrous; leaf base fibrous, terminating in a triangular ligule ca. 50 cm above the base, the fibres soft, pale grey brown; adaxial hastula bluntly triangular, 4 × 3 cm, ± symmetrical, abaxial hastula absent; leaf-blade bright green, briefly costapalmate, 100–110 cm long at the mid-point, held ± flat or folded into a shallow "m", 52–56 folds in leaves of juvenile palms, 60–66 folds in leaves of mature palms, the blade split to ca. 30 cm deep into stiff induplicate segments, the segments ca. 5.5 cm wide at the base of the splits, inter-segment fibers present in newly expanded leaves; adaxial surface of blade glabrous, abaxial surface covered in a thin layer of white wax and bearing abundant evenly distributed punctiform dark brown scales. Inflorescences solitary in each leaf axil, shorter than and hence obscured by the leaves, branching to 3–4 orders, the inflorescence somewhat lax, not congested, 10–12 inflorescences and infructescences present at the same time (appearing one after the other during several months, with apparently no flowering during the cool season); peduncle ca. 60 cm long, flattened at the base where ca. 3 × 1.5 cm, distally elliptic in cross section, ca. 2.0 × 1.3 cm; prophyll ca. 22 × 5.5 cm, tubular, 2-keeled, tattering apically, densely white tomentose; peduncular bracts 5–6, up to ca. 40 × 4 cm, tattering as the prophyll and bearing white tomentum; inflorescence rachis somewhat zig-zag; rachillae numerous but scarcely crowded, pale yellowish-green, straight or somewhat curved, up to 10 cm long, ca. 2 mm diam., glabrous, bearing solitary flowers ca. 4 mm apart, each subtended by a fragile brown ligulate acuminate membranous rachilla bract, ca. 1.7 × 0.1 mm; flower scar ca. 0.7 mm diam. Flower bud 6.5 × 2.8 mm; calyx with a basal tube, 3.5 mm long, with three short triangular lobes to 0.5 mm long, glabrous, faintly striate; corolla tubular below, circumscissile just below the mouth of the calyx tube, the lobes accrescent, ca. 4 × 2 mm, striate, glabrous, the inner surface marked with anther impressions; stamens 6, filaments united in an epipetalous ring ca. 1.6 mm high, with free filaments to 1.5 mm; anthers medifixed, versatile, ± oblong, 2.5 × 1 mm introrse; gynoecium with 3 carpels free in the wedge-shaped ovarian portion to 2 × 1 mm, apically connate in a style to 2 × 0.8 mm. Fruit rounded, to 7 mm diam., borne on the persistent calyx, the calyx lobes and androecial ring explanate; style and carpel remains excentrically apical; epicarp smooth, glabrous, green becoming brown; mesocarp ca. 0.6 mm thick; endocarp crustaceous, ca. 0.1 mm thick. Seed basally attached, ca. 5.5 mm diam., testa very thin, brown; endosperm homogeneous, embryo subbasal.

Distribution. Cook Islands, Mitiaro.

Specimens Examined. COOK ISLANDS. Mitiaro: Takaue Village, 2 to 2.5 km south of village, alt. 11 m, *Yves Ehrhart s.n.* 26 Apr 1991

1. *Pritchardia mitiaroana*: the main population on Mitiaro, Cook Islands. 2. *Pritchardia mitiaroana*: view into the crown. (Photographs by Yves Ehrhart.)

3. *Pritchardia mitiaroana*: group of palms in *makatea* scrub. 4. *Pritchardia mitiaroana*: young leaf. 5. *Pritchardia mitiaroana*: detail of trunk of adult palm. 6. *Pritchardia mitiaroana*: detail of another adult trunk, showing cracking of trunk surface. (Photographs by Yves Ehrhart.)

7. *Pritchardia mitiaroana*: detail of young infructescence. 8. *Pritchardia mitiaroana*: part of infructescence. (Photographs by Yves Ehrhart.)

(Holotype K; isotype P); 28 July 1991 *Luttrell 126* (K).

Pritchardia mitiaroana occurs in several small groups and isolated trees scattered on the western and southwestern side of the island, in the inner *makatea* (*makatea* is the Polynesian name for the soils and geographic areas located on raised coral limestone reefs). No single plant species predominates in any area. The vegetation is low scrub, about 3 m tall, consisting mainly of *Guettarda speciosa*, *Pandanus tectorius*, *Pisonia grandis*, *Xylosma gracile*, *Capparis cordifolia*, *Timonius polygamus*, *Myrsine cheesemanii*, *Geniostoma sykesii*, *Ixora bracteata* and *Cassytha filiformis*. The soils (Wilde 1981) have formed from the *makatea* limestone rock *in situ* and from rock fragments. There is little sand, and very little organic matter accumulates between the rock fragments. It is very sharply drained. According to USDA Soil Taxonomy, it is a sandy-skeletal carbonatic isohyperthermic lithic Rendoll. Climatic data are scarce but data from the neighboring island suggest that the mean annual rainfall is about 2,000 mm distributed throughout the year, the driest months being June to August and the wettest December to February. Temperatures range from 21.5° C to 26.9° C with the coldest months being the driest. Mean relative humidity is about 85%.

Acknowledgments

We thank Dr. H. S. McKee for bringing the two authors together and for reading the manuscript. We also thank Cecelia Luttrell for providing a specimen and Art Whistler for very valuable comments.

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An Artist of Palms Remembered

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One hot July day of 1953, I drove unannounced into the Kampong in Coconut Grove, Miami, Florida to see Dr. Fairchild's trees. Mangos and unusual fruit were everywhere; if the aroma had been any stronger it would have made one ill. Walking among the trees and the mosquitos, I was challenged in a soft southern accent, "Can I help you?"

He and I explained who we were. He said Doctor and Mrs. Fairchild were in Canada, that they usually invited him, his wife and three daughters to live on the Kampong while he painted (Figs. 1, 2). "Come see my studio and talk a spell while I work." I had met Lee Adams, described to me by a friend as a possible "Audubon of Tropical Plants." At 34, he was eight years older than I.

The studio was a small, aged shack called "The Wampery" after a Wampi tree growing beside it. The doors and windows were open. Water dripped from every eave because Lee had placed a sprinkler on the roof peak to cool the air. He painted on a tilted pane of heavy plate glass, on a large paper kept wet by a surrounding mound of wet rags. On an easel was hung a colossal panicle of shiny blue green fruit of *Livistona chinensis.* A parrot squawked.

As we talked I watched that deft brush place and lift color, forming one perfect seed, then the next. It amazed me that this could be done on wet paper, and while talking entertainingly to a visitor about his work and about his conversations with "Doctor."

A rain squall covered the sun, and Lee invited me "up to the house" to meet his family and to have a drink. As we walked through the exotic rock arch entry, sky and bay turned yellow-pink with tropical light. Mimi Adams was beautiful, the girls charming. We talked about plants and art and people. I remember thinking, "Lee Adams has found paradise."

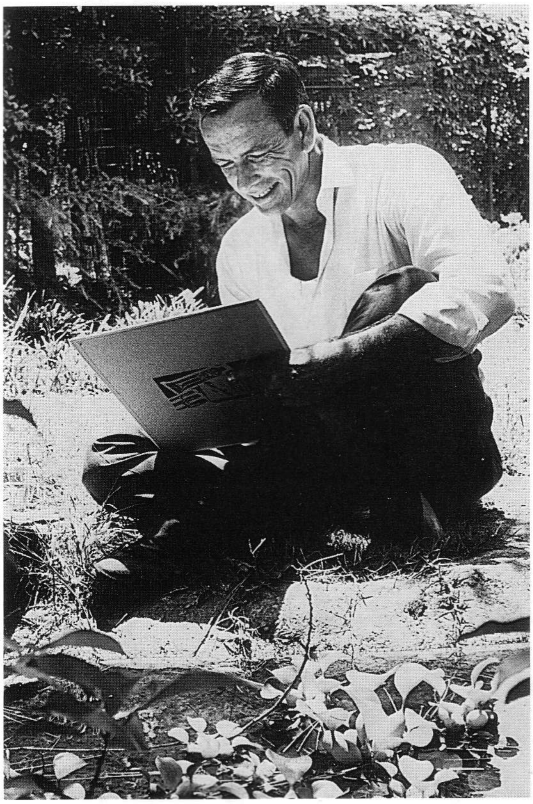
As part of the discussion that splendid evening at the Kampong, I told Lee that I also used watercolors, without any effort to achieve realism, but rather in an abstract expressionist way, chasing the essence of a subject or mood. There was a hint of annoyance that I might be saying that he did not achieve the essence of his subjects, but I hastened to say that his work was so superbly composed and presented that it filled me with pleasure. He graciously requested to see my work, and later when he did, was moved to say, "Isn't it strange that the two of us are trying to express ourselves in such different directions?" He was a kind person, and gentle.

Only recently, through reading an archive of correspondence, mostly letters exchanged with Nixon Smiley, do I realize the extent that Lee Adams had no use for the art movements of the day, classifying all of them as "mumbo jumbo." He never used the phrase to me; as a friend he might not. But as a largely self-taught artist, he resented the disdain of the avant garde. He wanted to be botanically accurate, scientifically precise, and also to be recognized as an artist. He was a superb technician, able to convey "essence" with such success that his works are treasured by fortunate owners, paintings that bring prices which would astound and please him today.

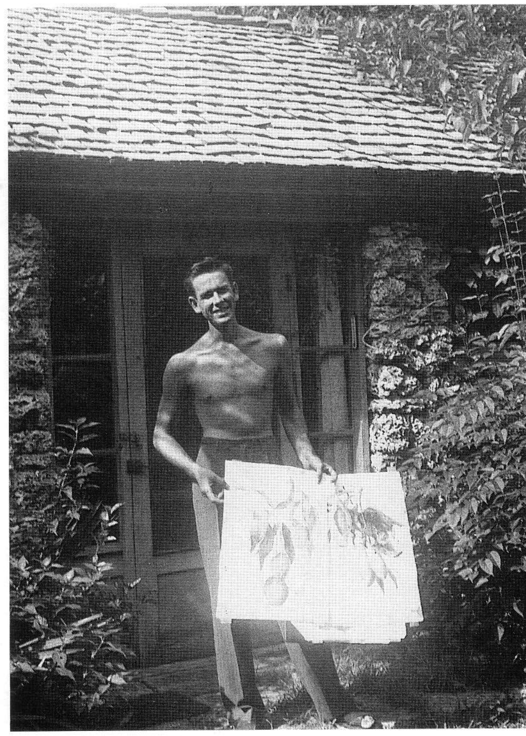
Growing up in Jacksonville, Florida, Lee was a frail child who suffered from asthma. He was so ill at age six that he had to remain in bed for a year. To keep him occupied, his mother supplied him with paints and paper. Because of his illness the family moved to nearby Mandarin on the St. John's River, a place of cleaner air, giant live oaks, spanish moss, and sabal palms.

As Lee continued his interest in painting, he began to observe the wild things around him, especially plants and birds. When his health improved in his middle teens, he decided to study biology and botany in college so that his art could become scientifically correct.

A wealthy art connoisseur who lived at Rollins College saw some of Lee's early work there, and at once arranged a meeting with his friends, David and Marian Fairchild in Coconut Grove. The gregarious Fairchilds were to have a great influence on his life, plunging him into a newly intellectual world. Dr. Fairchild convinced him that he should



1. Lee Adams working on a painting.



2. Lee Adams holding two watercolors in front of Tom's (Thomas Barbour's) House at the Kampong.

paint "all" of the tropical fruits, and arranged for the United Fruit Company to invite him to spend several months at its Lancetilla Botanic Garden to do so.

The fruit paintings were admired but not purchased. The fruits were strange to look at and were identified with still lives, no longer in vogue. Lee found that by including Lancetilla birds with the fruit, the paintings began to sell. In 1949 he married Mimi Stockton, from a well known socialite family in Jacksonville, and they spent their honeymoon at the Kampong and in Central America.

Three girl children followed. Dr. Fairchild died in 1954. It was no longer easy to bring small children to Miami to visit for several weeks at a time, and the most pressured painting schedule could not produce enough work to cover expenses.

In Miami the Adamses had met Nixon Smiley, a widely read newspaper writer who for a number of years was Director of Fairchild Tropical Garden. In 1956 he wrote to Lee to ask if he might be interested in painting the palms at Fairchild as he had painted tropical fruits, suggesting that the forms and colors were worthy of his talents. The following year Lee made his first attempt, at *Ptychosperma macarthurii,* which required several days. Smiley was thrilled with the result, but Lee rejected it, starting immediately on *Aiphanes acanthophylla.* This was to be the first of what was to become a series of 20″ by 30″ watercolors, which would include a new *Ptychosperma macarthurii,* to hang in the Nell Montgomery Garden House at Fairchild Garden.

As the palm paintings accumulated, they caused generous response, but no one wanted to pay $300 for a palm painting. In 1961 an angel, a geologist who knew nothing about palms except that his father had collected them, made a commitment. Dr. Arthur Montgomery offered to pay for four paintings per year, at $300 each. He also asked that Dr. Harold E. Moore, Jr., of Cornell University, select the species to be painted. This worked well because Hal and the Adamses were warm friends.

3. *Copernicia macroglossa*, showing a close up of an inflorescence branch, as painted by Lee Adams.

The two men planned paintings of twenty genera, selecting from each genus a species both representative and interesting. These were done during the following years, the Montgomery Collection being completed by 1966. Friends urged him to boost his prices to $500 and $800 by 1963–64, but he completed the twenty paintings at the earlier agreed price.

After completing his contract, Lee made no further effort to paint palms. The market for rare plant paintings was limited, and he stayed with subjects which he could sell where he lived, such as common birds and plants, even animals which would excite "the joy of recognition" in a buyer. But those of us who were close to him understood that he was looking forward to a time when he would be free to paint subjects he wanted to paint.

That time was never to come. In November of 1971, Lee and Mimi died instantly in an automobile accident in Jacksonville.

To put a value on the Montgomery Collection today is hypothetical; the originals are not for sale at any price. Someday they should be engraved a la Audubon, to be offered as elephant folios. Until then, Fairchild Garden has entered an agreement with the South Florida Chapter of IPS to share costs and sales of superbly printed reproductions, one each year, until all are available to the public at minimal cost (see Front Cover and Fig. 3).

NOTICES

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Principes, 39(1), 1995, pp. 47–52

Field Performance of Tissue Cultured Date Palm (Phoenix dactylifera) Clonally Produced by Somatic Embryogenesis

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ABSTRACT

Phoenix dactylifera (date palm) plants from tissue culture, derived from somatic embryos, fruited within four years from field planting of small plants with leaf length of 100 cm and 1.5 cm diameter at base. Fruit of commercial quality was available in year six and by year eight commercial quantities of fruit production were being approached. Fruit from the tissue culture derived plants, cultivar Barhi, was indistinguishable from fruit of plants which had originated from suckers ("offshoots"). The technical feasibility of clonal propagation of date palm by tissue culture was confirmed and the agronomic acceptability of the tissue culture product was demonstrated. These results justify commercial scale-up of the micropropagation procedure using somatic embryogenesis to provide a rapid cost-effective means of obtaining elite date palm planting material, particularly of cultivars in short supply.

The date palm is clonally propagated by suckers ("offshoots") that develop at the base of established trees. For some highly desirable cultivars, the number of suckers produced during the lifetime of the tree cannot meet market demand. Clonal propagation by tissue culture has the potential to produce plants at a competitive cost and in the large numbers needed to meet the demand. Date palm can be propagated both by somatic embryogenesis and via axillary buds (Reynolds and Murashige 1979, Tisserat and DeMason 1981, Poulain et al. 1979, Drira and Buvat 1983). Gabr and Tisserat (1985) concluded, on the basis of some preliminary results, that mass cloning of palms is only possible through somatic embryogenesis. There is little doubt that micropropagation by somatic embryogenesis is more efficient in terms of rates of multiplication and production costs than micropropagation by axillary branches and is, therefore, a commercially more attractive means of micropropagation of the date palm. However, because of problems that have been experienced with oil palm plants derived from somatic embryos, the large-scale introduction of date palm plants produced by this process requires that producers have quality assurances of phenotypic uniformity and agronomic performance (Corley et al. 1986). This paper describes some preliminary results on the development and fruiting of plants derived from somatic embryos of the cultivar Barhi, an elite cultivar currently in great demand but in short supply.

Materials and Methods

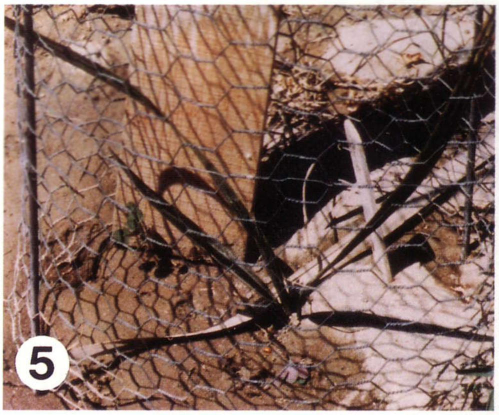
In the summer of 1982, suckers of the cultivar Barhi, from USDA Date and Citrus Research Station, Indio, California, were dissected and established in culture using procedures based on those of Tisserat (1981). Plants derived from somatic embryos that developed from callus were acclimatized in a high humidity environment in a growth room and grown to field planting stage in a greenhouse. Small plants grown in one gallon containers, having about 1.5 cm base diameter with only undivided juvenile leaves about 100 cm long, were planted out eight meters apart in the field in Indio, California in the fall of 1984 (Fig. 5). Maintenance followed standard field practices for date palm suckers.

Results and Discussion

Somatic embryos developed between three and six months from initiation of cultures and plantlets ready for acclimatization were available within 12 months of culture initiation (Figs. 1,2). Up to ten thousand plantlets can be produced from one sucker in two years making this an attractive clonal production system for the date palm.

Acclimatization in a controlled high humidity environment permitted high establishment rate

1. Date palm somatic embryos derived from callus of young leaf explants. 2. Plantlets derived from somatic embryos ready for acclimatization. 3. Growth of date palm plants from tissue culture. 1—about one month from culture; 2—about four months from culture; 3—about 12 months from culture; 4—about 18 months from culture; 5—about 30 months from culture. 4. Tissue culture plant at a size ready for field planting.



5. Tissue culture plant (date palm cultivar Barhi) established in the field in April 1985. 6. Plant shown in Figure 5 three years later showing first fruit in the khalal stage. 7. Barhi fruit in the khalal stage from tissue culture compared with fruit from a tree derived from a sucker ("offshoot").

with the small number of losses attributed to root damage or plants too small to survive (Tisserat 1981). After progressive reduction of humidity to ambient levels, plants could be transferred to a greenhouse, with negligible losses, after 4 to 8 weeks in acclimatization. Plants were ready for field planting after 9 to 14 months in the greenhouse and plants approaching the typical size used in conventional sucker ("offshoot") propagation were produced in two to three years (Figs. 3,4). Improved handling practices and a good growing environment will reduce the time period for growing plants up to size for field planting.

About 10% of the young plants potted from tissue culture exhibited slow growth or no growth at all. In many cases this was associated with shoot tip abortion and with the development of a terminal inflorescence. Ammar et al. (1987) have observed this development in seedlings grown in vitro which, they concluded, may be associated with endoge-

8. Barhi trees produced by tissue culture in the sixth year showing formation of several good-sized bunches. 9. Barhi tree produced by tissue culture in the eighth year. 10. Barhi fruit from tree shown in Figure 9 with commercial quality fruit in the khalal stage.

nous hormonal effects possibly cytokinins. The visual symptoms enable simple culling at the nursery stage and in only one case out of many thousand have we failed to pick up this development at the nursery stage. This rare development has not proved to be of any practical significance in the micropropagation of date palm by somatic embryogenesis.

No losses were sustained in the transfer of plants to the field despite the small size of the plants, leaf length 100 cm and base 1.5 cm, relative to suckers (Figs. 4,5). The high rate of success is attributed to the strong root system of the container-grown plants (Fig. 4). First fruiting shown in Figure 6 occurred in four years (four growing seasons) from the small plant depicted in Figure 5. Climatic conditions are important because comparable plants grown in Bahrain fruited one year earlier. The four-year time period was much less than the 8–10 years reported by Ammar et al. (1987) for seed-derived date palms to flower and bear fruit.

The overall form and appearance of the tissue culture trees were comparable to those of suckers except for a higher propensity for sucker development at the base of the tree. All the trees from tissue culture had five or more suckers in comparison to Barhi plants from suckers which were observed to form four or more suckers in only about 30% of the trees at the same location. Although some of the suckers grew to a size suitable for propagation, some of the suckers of the micropropagated trees aborted at an early stage. Some aborted suckers were associated with inflorescence formation from the terminal bud. Some of the inflorescences even formed pathenocarpic fruit. Similar developments have been observed in plants derived from suckers (Swingle 1927, Hilgeman 1954). Swingle (1927) noted that up to 10% of suckers of Deglet Noor exhibit these abortive suckers so the development is not unusual and is not specific to plants derived from tissue culture. This development has not visibly affected tree performance.

The fruit that formed on the trees derived from somatic embryos was indistinguishable from fruit of trees derived from suckers (Fig. 7). The important low astringency character and yellow color of Barhi fruit in the immature khalal stage was retained. The fruit abnormalities observed in oil palm by Corley et al. (1986) have not been observed in any date palm tree from tissue culture.

The first bunches which developed in year four had few fruits per inflorescence and suffered damage because of their proximity to the ground (Fig. 6). By year six, however, trees with up to seven bunches of high quality commercial fruit were observed (Fig. 8) and, by year eight, trees were close to full commercial production (Figs. 9,10).

Conclusions

The results demonstrate the technical and commercial feasibility of clonal propagation of date palm by tissue culture and the agronomic acceptability of the tissue culture product. These results justify scale-up of the micropropagation procedure using somatic embryogenesis to provide a rapid cost-effective means of obtaining elite date palm planting material of cultivars in short supply. The relatively low cost of elite varieties of date palms from tissue culture and provision of strong plants with well-established root systems will provide growers with a much more attractive means to propagate date palm than propagation by suckers. Replacement of old date palm plantations, particularly seedling plantations, with high quality planting material is now possible using micropropagated plants.

Acknowledgments

The authors would like to acknowledge the late John Carpenter for his support of the program and the supply of planting material. Appreciation is also extended to Ben Laflin for expert maintenance of the plants in the field.

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PALM BRIEF

Pritchardiopsis Lives!

Perhaps because it sounds like a personal patronym (which it is not!), I have long had an interest in the endemic New Caledonian palm *Pritchardiopsis jeanenneyi*, the only fan palm native to that palm-rich island of the south-west Pacific. Yet it seemed that my interest came too late. According to Langlois in the Supplement to Palms of the World (1976), this palm had literally vanished, a victim of multifarious stresses including mining, forest clearing, and consumption of its "cabbage" by convicts at the Bay of Prony penal colony. In the course of three trips to New Caledonia, I was too busy with other faunal and floral preoccupations, and made no effort to "rediscover" *Pritchardiopsis*.

But all was not lost. Having recently obtained copies of Dowe's Palms of the South-west Pacific (1989) and Moore and Uhl's The Indigenous Palms of New Caledonia, I learned that a single mature specimen of *Pritchardiopsis*, surrounded by about thirty of its offspring, and all confined to a single hectare, had been located in a remote area near Baie de Prony, at about 200 m altitude, in the later 1970's. The identification had been confirmed by botanists at ORSTOM in Noumea.

Before my most recent expedition to New Caledonia in December 1991, I wrote ahead to my colleague Jean-Louis d'Auzon of the Association pour la Sauvegarde de la Nature Neo-Caledonienne, of which I am a member, and asked if it would be possible for our chartered ship to visit Baie de Prony to see what we could find. But time did not allow; our expedition was taking us north from Noumea, to Belep and the d'Entrecasteaux Islands, and Baie de Prony was to the south. But d'Auzon did draw my attention to the existence of four specimens in cultivation in the ORSTOM gardens in Noumea.

The author with *Pritchardiopsis* in the garden at ORSTOM in New Caledonia. Photo by S. Pritchard.

I was able to visit the gardens in my last days in New Caledonia. The plantings were unlabelled, and, while gardeners and scientific staff were extremely courteous, there was nobody able to direct me to the *Pritchardiopsis* specimens. So I had to find and identify them myself. The description in the Langlois book had indicated that the leaf of *Pritchardiopsis* was distinctive in being wedge-shaped (only about one-sixth orbicular), and only about 18 inches long, with a 12–15 inch petiole. But Beccari's material, on which this description was based, was clearly immature; the illustration of the mature tree in Dowe's book showed leaves about a meter wide, with 1.5 m petioles, and more than 75% orbicular.

Finally I found the little grove of about four young trees—healthy and beautiful, and with leaves identical to those in the photograph of the single mature wild specimen (Fig. 1). So *Pritchardiopsis* not only lives, it may even have a future!

Another seemingly extinct monotypic genus of palm was rediscovered by John Dowe while researching in Vanuatu for his Palms of the Southwest Pacific: *Carpoxylon macrospermum* was found in cultivation in 1987 on the island of Espiritu Santo, and with rumored existence on two other islands, although probably indeed extinct on Aneityum. Man's impact on natural ecosystems and rare species of the South Pacific has been so disastrous that we hardly deserve this "second chance" with species that we hardly cared about until it was almost too late. To throw away this opportunity now would be truly unforgivable.

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CHAPTER NEWS AND EVENTS

News from Southern Queensland, Australia

Make your plans to attend the 1995 Annual Show and Sale at the Mt. Coot-tha Botanic Gardens in Brisbane on March 4 and 5. The associated dinner (on March 4) will be held at the Indooroopilly Golf Club (about 2 kilometers from the Gardens). Mr. Loran Whitelock of California will be the featured speaker at the Saturday dinner with a presentation on "aspects of cycads". Loran is one of the most knowledgeable cycad experts in the world and known as an interesting speaker.

The South Queensland Group, P.A.C.S.O.A., met on September 19. Len Butt paid tribute to Harold Caulfield, who passed away last August. Harold was a very knowledgeable person who made a great impact on horticulture in the Brisbane area during his years as Curator of the Botanic Gardens. At this meeting, Will Kraa displayed two unusual palms: *Rhapidophyllum hystrix* from the United States and *Coccothrinax crinita* from Cuba. Cheryl Basic gave a very informative presentation on two botanic gardens in Hawaii and two bromeliad collections.

The group held an outing on Sunday, October 16, at the City Botanic Gardens. A regular meeting was also held on November 21 at the Bread House.

The 1994 Christmas Party took place on November 27 at the home of Jeanne and John Price in the Grange. Within this seeming suburban surrounding, members and guests were surprised as to the size of the land and the range of trees behind their residence.

News from New South Wales, Australia

On November 15, the Sydney Branch of PACSOA held a general forum on Palms and Cycads, with a wide variety of plant problems and questions discussed. Some members brought in rare specimens for discussion. They met with renowned cycad expert Ken Hill making a presentation on "The Cycads of New South Wales".

The Sydney Branch Christmas Party was held at the home of Ian and Norma Edwards on December 3. Members and guests enjoyed an informal walk around their large garden, followed by BBQ.

News from North Queensland

The North Queensland Palm Society held a field trip to the Cairns-Mossman area on October 29 & 30, 1994. The meeting began on Saturday morning at Terry Mead's El Arish Nursery and his private garden which features many rare and unusual Madagascan palms. The group then departed El Arish for a lunch in Cairns. This was followed by a tour of Flecker Botanic Gardens, conducted by Peter Shannahan, Botanic Gardens' Interpretive Officer. A barbecue was held that afternoon, then the group drove to Mossman to stay in the White Cockatoo Motel.

On Sunday, the tour departed Mossman for Allan Carle's Botanical Ark at Wyanbil. This is a magnificent garden featuring rare fruit trees, palms and gingers. Later in the morning, Maria Boggs, proprietor, gave a conducted tour of Maria's Palmetum, Australia's largest palm collection. Lunch was taken on the way to the Licuala State Forest palm grove walk, near Mission Beach. That completed the organized activities and the group returned to Townsville.

The North Queensland Palm Society held their Annual General Meeting on December 4, 1994, in the Gazebo, The Palmetum, Townsville.

The December, 1994, issue of Mooreana, published by the Townsville City Council, advises that the Anderson Park Botanic Gardens Conservatory was reopened in August of 1994, after being closed for almost one year for renovation and replanting. The pond, which had developed a crack in the base, was repaired, as were parts of the shade cloth which covers the roof. The soil in many of the beds was excavated and replaced. Many new species of plants were added to the already impressive collection housed in the Conservatory. Among these were the palms *Chamaedorea stolonifera, Iguanura wallichiana, Lepidocaryum tenue* and *Pinanga crassipaes;* the cycads *Ceratozamia keunsteriana, Dioon lineare, Encephalartos concinnus, E. lehmannii* and additional plants of *Stangeria eriopus* and *Zamia fischerii;* the gingers *Alpinia henyri, A. hookeriana, A. maclurei, A. novae-pommeraniae, A. oceania, A. oxyphylla, A. polyantha, A. stachyoides, Costas verschaffeltius, Tapeinochelos hollrungi, T. queenslandia, T. recurvata, Zingiber longipedunculata* and *Z. monglasence;* as well as many aroids and a small number of *Nepenthes.*

The Conservatory is open to the public from Tuesday through Friday between the hours of 9 a.m. and 3 p.m.

Sunshine Coast (Australia) News

The Palm & Cycad Society, Sunshine Coast Group of Queensland, Australia met on December 5 at the Nambour Band Hall, Nambour. The program on Palms of Cuba was given by Rolf Kyburz, who visited Cuba following the International Palm Society Biennial meeting in Venezuela. Rolf also gave a rundown on the latest international palm news. A *Cycas rumphii* (12-inch pot) donated by Argi Matus was the Raffle Prize.

The Sunshine Coast Group held their Christmas Party at the Jack Harrison Park at Wappa Falls on December 11. A good time was had by all.

News from Western Australia

The Palm & Cycad Society of Western Australia met on October 17 at the Leederville Town Hall. Beverly Poor from Watering Concepts gave an informative talk on everything you ever wanted to know about watering plants.

This IPS affiliate society also met on November 21 for a *Rhapis* discussion night, with members each bringing a *Rhapis* to the meeting. These were discussed and tips given. Vince La Rosa also gave a brief talk on the foxtail palm, *Wodyetia bifurcata.* Vince also donated a *Wodyetia* seedling for the meeting raffle.

The Society Christmas Party was held at S & A Nursery in Gnangara on Saturday, December 10. Hosts Sam and Angie gave a tour of the nursery and gardens to see the palms and cycads. Catering was provided for 75 adults and 30 children. A huge butt of beef was cooked over a spit and was a great success.

Several workdays were held at Gascoyne Park during October and November to care for the new plantings. Irrigation, fertilizing and weeding were accomplished before the southern summer heat. Sixteen people attended the October workday.

Updates: the Secretary for the Western Australia society for 1995 is Karen Surace and the Treasurer is Ray Crump. The President remains Neil Jones.

News from South Australia

The Palm & Cycad Society of South Australia (P.A.C.S.O.S.A.) met on November 6 at the Tea Tree Gully Garden Centre, Tea Tree Gully. This relatively new nursery specializes in palms and cycads and already has one of the largest collections in the state. From there, the group went on to Ivan Iljcesen's home at 25 Butler Crescent, Banksia Park, to check out his beautifully landscaped garden. The following palm seedlings were offered for sale following the meeting: *Chamaedorea ernesti-augustii, Oraniopsis appendiculata, Hedyscepe canterburyana,* and *Wallichia densiflora.*

A working bee/breakup show was planned at the Waite Arboretum for December 3 to plant the palms and cycads donated by the Society.

The September 1994 issue of the P.A.C.S.O.S.A. Newsletter featured an interesting article on the Mecca Date Gardens of Alice Springs—Australia's first date plantation. It was noted that Australia currently imports over A$6 million of dates annually from California and the Middle East.

News from Gold Coast Tweed (Australia)

The Gold Coast Tweed Palm & Cycad Society of PACSOA held a luncheon meeting on October 15 at Mullumbimby Palm Gardens. The Mullumbimby Palm Park is part of the gardens along the banks of the Brunswick River. All palms were very well labeled with name and place of origin. This greatly enhanced the palm viewing.

This was followed by a tour of the Pelldale Wholesale Palm Nursery at The Pocket, just west of Billinudgel. Two palms created much interest. A *Ravenea rivularis*, approximately 1.5 meters (4.9 feet) tall, is throwing variegated fronts, with yellow and green stripes up the petiole and sheath. It is being keenly watched for other developments. The other palm was *Beccariophoenix*, which some of the members quickly added to their collection.

The group held their Christmas function on December 11, 1994, at the home of King and Maureen Newman near Murwillumbah. Various palm and cycad seedlings were distributed at the meeting. Maureen is also the editor of the local society Newsletter and provided tips on how to use palm and cycad fronds and infloresences in Christmas decorations.

News from New Zealand

The Palm and Cycad Society of New Zealand (P&CSNZ) met on November 2, featuring an evening of discussion and debate on this interesting leaf form. Numerous plants and slides were brought of palms with fishtail leaves, including *Arenga*, *Aiphanes*, *Caryota*, *Wallichia*, etc. Plants were also available for sale.

A "Christmas Cruise" was held on Sunday, December 4 on board the "Te Aroha". The "Te Aroha" is the last of the "Mosquito Fleet", solid Kauri ships that serviced river settlements and ports around New Zealand's coast. Built in 1909, she is 96 feet (29 meters) long with 115 ton displacement, has crossed the Cook Straight over 10,000 times and is fully restored. A brief stop was made at a Gulf island and a barbecue lunch was served.

The P&CSNZ will meet on February 1, 1995 at the Auckland College of Education, Epsom, Auckland to hear John Pettit speak on "Cairns and Roundabout". John will present slides and a talk about the myriad of palms and cycads he saw on his trip there in 1994.

The group will hold a field trip to Whangarei on Saturday, April 1, 1995 to see the palms around these "northern latitudes". Details will be provided later. If interested in attending, contact Gary Knox, (09)-479-2072 in Auckland.

Southern California News

The November 19 meeting of the Southern California Chapter of the International Palm Society was held in San Diego, with tours of two private gardens not previously toured by the Chapter. The meeting began with a visit to the garden of Dennis Willoughby (4438 Pescadero) in the western Point Loma area of San Diego. Dennis' garden features the largest number of *Livistona* species planted out in Southern California as well as many other thriving genera. This was followed by a late morning tour of the nearby garden of Lee and Cindy Cooley (4408 Osprey), which featured large *Roystonea regia*, *Gaussia maya*, *Prestoea montana*, large *Pinanga* and many other mature palms. Following lunch, a lecture was held at the Bahia Hotel on Mission Bay Drive. David Beest, well-known palm author and nurseryman from Florida, spoke about wild palm species seen on adventures into eastern Mexico.

The Southern California Chapter's Annual Banquet was held on January 21, 1995 at the Hyatt Newporter hotel in Newport Beach. Bill Dickenson again led a tour of the Hyatt Newporter's extensive palm collection starting at 10:00 a.m. This was followed by a delicious buffet. Attendees were then able to enjoy Ken Foster's slide presentation covering his palm collecting over 25 years in some 34 countries.

John Tallman has taken over from Phil Bergman as President of the Southern California Chapter of the International Palm Society. The group now has grown to about 700 members, which is the largest membership of any International Palm Society chapter.

Subscription rates have increased for The Palm Journal of the Southern California Chapter, IPS. Subscription rate for six issues per year is now as follows for active IPS members: US$20 chapter dues for U.S. residents, US$27 per year for residents of Mexico or Canada, and US$30 for overseas subscribers, plus US$10 additional for optional airmail delivery. Send checks in U.S. funds payable to the Southern California Chapter and mail to IPS, So. Cal. Chapter, 1601 Via Sage, San Clemente, CA 92673.

News from the South Florida Chapter

The South Florida Chapter held what may be "The World's Largest Palm Sale" at Fairchild Tropical Gardens on November 5 & 6, 1994. Sales exceeded US$105,000! The sale raises funds for the Chapter and for Fairchild Tropical Gardens, and also distributes over 1,000 species of palms to the community. Many thanks to all the volunteers whose efforts didn't go unnoticed. Debra Chalot, Marcos Urra, Ken Johnson, George Zammas, Paul Drummond, Rick Leitner, Dan Keys, Teddie Buhler, Jo Deville, Don Evans, Scott Zona, Lester Pancoast, Bill Theobald, and many others deserve recognition for their hard work. Thanks also to the many vendors who complied with all the rules and regulations without hesitation. The event also generated quite a few new memberships in both FTG and the IPS.

The South Florida Chapter of the IPS was also represented at this year's Ramble at Fairchild Tropical Garden on December 3 and 4. Vendors were selling palms, answering questions and handing out IPS membership information.

A Holiday Social was held at Fairchild Garden on December 21, with light food, drink, and spirit.

Fairchild Tropical Garden is holding a special exhibit of Palm Watercolors by Lester Pancoast from December 17, 1994 through January 31, 1995. The exhibit is in the Nell Montgomery Garden House, Fairchild Tropical Garden. Lester and Helene held a preview of the exhibit on the evening of December 16th. Lester is a trustee of Fairchild Tropical Garden and an active member of local and international palm and heliconia societies. He has served as President of the South Florida Chapter and is currently a member of the IPS Board of Directors. We offer our congratulations to Lester on this showing.

A field trip will be held on January 21 to several residential gardens not typically available for viewing. Details are available from Ken Johnson.

News from Broward County, Florida

On November 20, the Broward County Palm & Cycad Society (BCP&CS) held their Society Picnic and Barbecue at Eric Beers' garden. This wonderful garden was also featured during the November 1992 Biennial meeting of the International Palm Society. It's a sight to behold.

Members also participated in the Fairchild Tropical Garden Ramble on December 3 and 4.

The Broward County chapter has been awarded a $5,000 grant to prepare a video under the Florida Department of Forestry "Hurricane Andrew Reforestation Grant". The group is soliciting input to the script and creative ideas on where and what to present. If anyone would like to contribute ideas, contact Dean Lashbrook at (305)-581-8112.

News from the Palm Beach (Florida) Chapter

The Palm Beach Palm & Cycad Society met on November 2 at Mounts Botanical Gardens. Dr. Robert Read discussed new developments of the interesting genus *Coccothrinax*. At this meeting, members brought in the *Archontophoenix alexandrae* liners given out in May 1994 by Paul Craft. The seedlings were judged on caliper and grade, with the winner receiving a 3-gallon palm of his choice from Palm Nuts, compliments of Paul.

On December 7, the group held their Christmas Party and auction.

A workday was held at Norton Sculpture Gardens on November 12, providing regular maintenance trimming, fertilizing, and weeding. Time was available for all to enjoy the numerous palms and cycads planted there.

October 1995 IPS Board Meeting in Central Florida

The Central Florida Palm Society (CFPS), affiliated Chapter of the IPS, will host the fall 1995 meeting of the Board of Directors of the International Palm Society. The meeting will convene on October 26 at the Sarasota Hyatt.

On Thursday evening, the group will tour the Besse's palm and cycad collection and then go to dinner at the Field House on Sarasota Bay.

Most of Friday will be consumed in board meetings. However, the group will tour Selby Gardens in the late afternoon, followed by a cocktail party and a dinner at Selby. CFPS and other IPS members are invited to attend the Selby event for the cost of the dinner. Scott Zona will be the featured after-dinner speaker.

On Saturday, the group will head for St. Petersburg and Tampa to join the CFPS in its fall meeting. After a brief tour of the Gisella Kopsick Arboreturn, the group will head to Ben and U. A. Young's residence. They will help conduct a plant auction and enjoy the excellent plant collection with the CFPS members.

Registration information will be sent out soon to all IPS Directors and Committee members. Other IPS members are welcome to attend. Make your plans now if you wish to attend. Contact Ed Hall or Libby Besse if you have any questions.

News from the Hawaii Island Chapter

Hawaii Island Palm Society members and friends met on October 14 to hear Ken Foster review twenty-five years of palm collecting around the world. Ken reviewed a career collecting palms in 34 countries. At this meeting, Ken Herrick, Director of Libraries of the University of Hawaii at Hilo, accepted the Chapter's donation of a nearly complete set of *Principes*. This set was given to the chapter by the IPS. By placing the set in the university library, the chapter ensures that it will be protected and easily accessible. Individual members will supply any missing issues not available from the IPS. The full set will then be bound (subsidized by the Hawaii Island Chapter) and placed in the periodicals section of the library. The group also discussed plans for using the recently received $1,500 grant from the Kaulunani Hawaii the Beautiful Urban Forestry Grant Program. The money will be used for the palm planting project at the Panaewa Zoo. Snacks were served as always, and door prize plants awarded.

On November 5, the group held a field trip to Ho'owaiwai Farms. This is a nursery specializing in landscape materials, exotic fruit trees and palms. Owner Liloa Willard has landscaped 70 acres with broad lawns and some of the rarest and most interesting palms in the world. Ho'owaiwai Farms is located approximately two miles up Kieie Homestead Road just past Papaikou.

The society met on December 2 to hear Charles Clement, of the University of Hawaii Manoa College of Agriculture. Mr. Clement discussed his work with *Bactris gasipaes* and associated efforts to promote culture of this species in Hawaii for edible heart of palm. He has searched the jungles of South America for the most desirable varieties of this palm and has documented his adventures on film. The palm planting project at the Panaewa Zoo and the upcoming Palm Sale at the Mo'oheau Bandstand were also discussed at this meeting.

News from Texas

The Texas Chapter met on the stormy afternoon of September 10 at Darren Oeschler's lakeside garden in Seabrook, south of Houston. The day had been filled with thunderstorms with rain and attendance was smaller than normal. It worked out fine for the 15–20 people who came out, with no rain actually falling after 4 p.m., although the garden was pretty wet. This garden features a wide assortment of very large palms that Darren has transplanted from Galveston and the Galveston Bay Area. Darren also had some large concrete planters, painted to look like terracotta! They really did and were quite attractive, full of palms and other tropicals. Apparently they weren't easy to move, weighing over 1,000 pounds each. The garden is right on the water, with a protected wetlands directly across the channel. Many interesting birds rest there. All this water also helps keep the microclimate warmer in the winter.

The October meeting and Members' Sale was held on October 15 at the home of Horace Hobbs and his wife Cynthia. Numerous nice palm seedlings and a few special specimen plants were available for sale to members.

A special Palm Tour of the southern Rio Grande Valley of Texas was held by the Texas Chapter on November 12–13, with about 20 attendees. The group started the tour with Dial Duncan's garden in Harlingen, with refreshments also provided. The group paused for lunch at Palm Court Restaurant, 2235 Boca Chica in Brownsville. This restaurant is owned by Palm Society member Bob Baldwin, whose garden at 1364 Willow Drive was the next stop on the tour. This was followed by a visit to the waterfront home and garden of Dr. Enrique Trapp on Acacia Lake Drive in Brownsville. After a brief stop at the Sheraton Inn (Brownsville), the caravan returned to Harlingen for a tour of Stewart Place Nursery and Bence Nursery, both on Hwy 83. An interesting *Syagrus romanzoffiana* with very unusual fruit was seen at Bence Nursery. The vans returned to the Sheraton to complete Saturday's tour.

Following a full breakfast on Sunday morning, attendees visited the Audobon Society's *Sabal* Palm Grove Sanctuary located along the Rio Grande River just south of Brownsville. This native palm stand has the "biggest *Sabal texana* [*S. mexicana*] you've ever seen!"—and lots of them. This was a wonderful place to see unusual birds and native plants. Rare wood ducks and other water birds play around a large enclosed pond, which is equipped with birder's observing stations. The native *Sabal* trees form the predominant large vegetation in the grove, with numerous other plants in the understory. The grove represents a slice of native mature palm forest which has always been undisturbed by the surrounding farms.

The group moved from the *Sabal* Sanctuary to a tour of the Palm Gardens Nursery, 345 Galveston, in Brownsville. Lunch was served at Pete Heinz's wholesale nursery on Sol Road to complete the Sunday festivities. The group then dispersed, with the Houston members returning via Southwest Airlines.

CLASSIFIED

Back Cover

Coccothrinax argentata, a painting by Lee Adams. See pp. 42–45.