

Palms

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THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

Founder: Dent Smith

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FRONT COVER

Iriarte deltoidea, Río Tiputini, Parque Nacional Yasuni, Ecuador, 150 m elevation. Photo by J.-C. Pintaud.

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This issue of PALMS introduces the above design which will be used on the News From The World Of Palms page and elsewhere in the journal. The artist is long-time IPS member and former Director Lester Pancoast.

BACK COVER

The colorful fruits of *Aiphanes minima* (formerly known as *Aiphanes acanthophylla*) in Puerto Rico. Photo by S. Zona.

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Colpothrinax in the mist... *Colpothrinax aphanopetala* in the cloud forest of Cerro Jefe, Panama, the type locality. See accompanying article, p. 177. Photo by B. E. Hammel.



NEWS FROM THE WORLD OF PALMS

IPS President Horace Hobbs continues his efforts to meet IPS members and chapter affiliates and expects to continue his tours in 2002. Last October, he visited Tampa, Florida, for the annual Palm and Cycad Societies of Florida (PACSOFF) Palm Fest. The event was a huge success, attracting delegates from all over Florida and raising money through a super palm auction. While at the event, President Hobbs took time to proselytize on behalf of the IPS. Although most of the attendees were already IPS stalwarts, he reported that a few new IPS members were enrolled. Shortly thereafter, he flew to San Diego where he joined a twenty-person contingent of les Fous de Palmier on their tour of Southern California palm gardens. Details of the 2002 Biennial hosted by les Fous de Palmiers are still being planned, but by the time you receive this issue of PALMS, information on the event will be available on the IPS website.

The International Palm Society Research and Educational Endowment Board of Directors convened a meeting this past August following the mid-term IPS Directors' meeting in San Diego, California. IPS past-president Jim Cain chairs the Board Endowment Fund Committee and coordinated the compilation and review of the applications. Grant proposals were judged on their scientific or horticultural merit, feasibility and coincidence with the goals and objectives of the IPS. The Board unanimously approved grants totalling approximately \$19,000 for support of seven different palm related projects on three continents.

A grant of \$750 was awarded to continue providing sets of our journal to botanical institutions in Latin America, Madagascar, Indonesia and Thailand, where palms are researched. The IPS provides gift memberships to these eleven institutions so that their libraries will remain current.

Approximately \$1,300 was awarded to Pilar Lopera of the Universidad de Antioquia in Medellin, Columbia to study pollination and hybridization

of *Attalea* palms in Columbia. Ms. Lopera is a graduate student working with noted palm botanist Dr. Rodrigo Bernal. The Endowment awarded \$5,215 to support Ross Bayton's Madagascar field work with *Borassus* palms. Mr. Bayton is pursuing a PhD at The University of Reading, UK and his research will result in a revision of the genus *Borassus*. On the other side of the African continent, the Endowment will support Sally Henderson's study of *Phoenix* in the Cape Verde Islands. Ms. Henderson is a research associate at The Natural History Museum in London, UK and will use the \$1,500 grant to cover the cost of fieldwork. The most pressing question to be addressed is the status of *Phoenix atlantica*.

The Endowment has awarded \$6,750 to Donald Hodel to construct a three-year study of various transplant treatments. Mr. Hodel will be joined by two of his colleagues at The University of California, Dennis Pittenger and James Downer, in examining the effects of leaf removal and leaf tie-up on water transpiration and root mass re-establishment on several commonly-cultivated and transplanted palms. The IPS also funded a study of the population dynamics of *tagua* palm (*Phytelephas seemannii*) in Panama by Dr. Julia Velásquez Runk, Yale University School of Forestry and Environmental Studies and The New York Botanical Garden.

The IPS Research and Education Endowment Fund was established in 1985 in order to fund projects consistent with our mission of scientific inquiry, conservation and education. The International Palm Society is a section 501C3 US corporation and all donations to our Research and Education Endowment Fund are fully tax deductible for US IRS purposes. Please consider the IPS in your annual gift or estate planning. Contact Horace Hobbs, IPS President for additional information. Call toll-free (877) 529-1555, extension 23, or email inquiries to <horacehobbs@pobox.com>.

The Editors

The Palmetum of Santa Cruz de Tenerife

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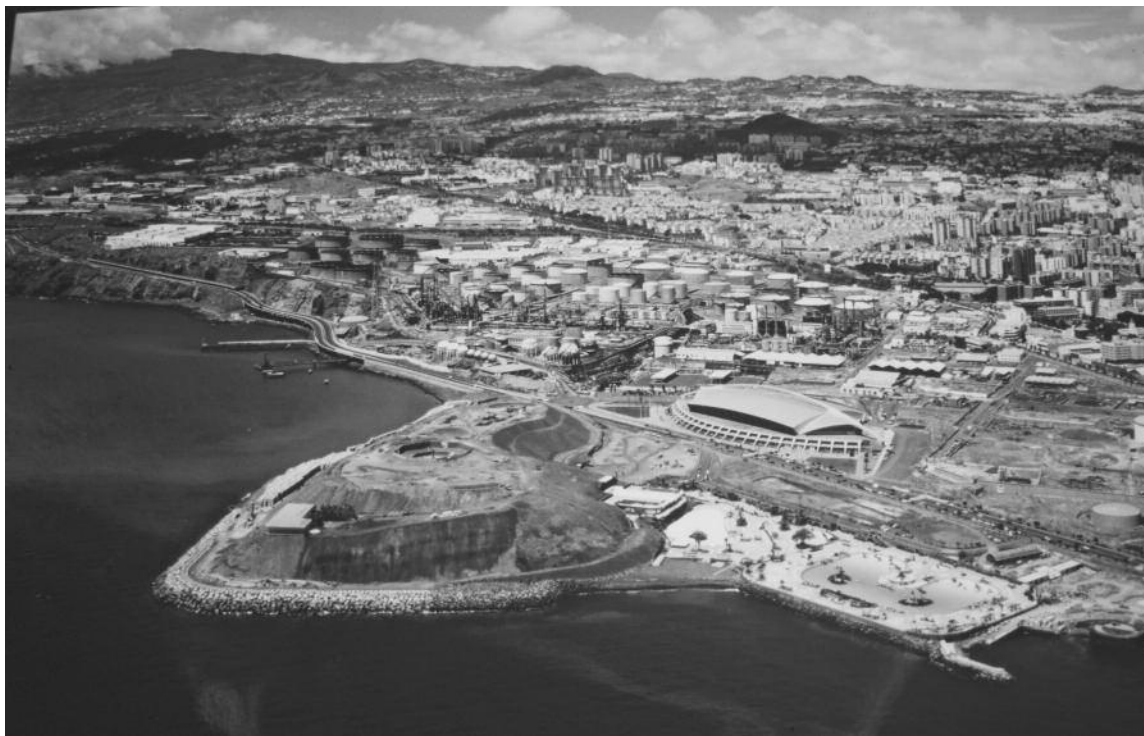
1. This picture, taken in the early 90s, shows the abandoned landfill and the old industrial area. This hell had to be transformed into a paradise.

Tenerife is the largest of the Canary Islands; its warm and even climate and its natural wonders regularly attract millions of tourists from mainland Europe. The capital city of the island, Santa Cruz, is creating a new Palmetum within the new recreational area “Parque Marítimo César Manrique.” The project started six years ago and today is still under development. The garden is being established on an old landfill at the edge of the sea, on the outskirts of Santa Cruz.

When the Palmetum project started, the ornamental palm flora of Tenerife was pretty scarce; just 10 or 15 common palm species were growing in the public gardens of Tenerife. Up to 100 species could be found in the old Jardín Botánico de La Orotava and in private gardens. The ingenious idea of starting a new botanical garden specialized in palms came from Manuel Caballero, head of the Department of Ornamental

Plants in the Instituto Canario de Investigaciones Agrarias. For many years he thought of a palmetum as a smart investment for the future of Tenerife.

Funding came mostly from the European Union. The municipality decided to start this garden in one of the most challenging areas of the island – an old garbage landfill bordering directly onto the



2 . At the end of 1996, the Palmetum was under construction. The swimming pools of the "Parque Marítimo" were ready. The whole area was changing.

sea (Fig. 1). The landfill ceased its activity in 1983, but residual fermentation continues. A gas extraction system was built to prevent the dangerous build-up of methane and other combustible gasses. The Palmetum was planned as part of the Parque Marítimo, an important project directed by the famous artist César Manrique, who passed away before it could be completed. The garden was to be planted on the top of a 42 m tall hill, partially surrounded by the sea. The average annual temperature is 21°C, and the lowest temperature ever recorded on the hill is 15°C. Nevertheless troublesome winds are frequent, and the short rainy season lasts only a few months in winter.

The climate of Tenerife, even and dry, is ideal for many species that cannot be grown on the Mediterranean for lack of winter warmth and would never grow well in many botanical gardens in the tropics due to excessive rain and humidity. The Palmetum, with a mere 500 species, could become one of the most interesting palm collections of the world.

The Development (1996–2000)

Building machines arrived to the landfill in March, 1996. The whole hill with its steep slopes had to be shaped properly. Ponds and streams were

excavated, and the first structures were built (Fig. 2). A layer of good quality soil was brought to coat the whole planting surface. I was hired in the spring of 1996, and my first duty was to propose, out of the 3000 known species of palms, 500 that would thrive in the climate of Santa Cruz. I proposed to give an emphasis to island palms. Scientists in Tenerife are deeply interested in island biology, and most tropical and subtropical archipelagoes are rich in exposed windy slopes, populated by hardy palms often in danger of extinction. I believed that palms from these places would be most likely to thrive in the new Palmetum.

The surface of the hill was divided into geographical areas, to represent the palm floras of the different areas of the globe. The largest area was dedicated to the Antilles, because most Caribbean palms can be grown to perfection in the Canary Islands and also due to the strong cultural ties between the two regions.

There was a rush to obtain large palm specimens in order to populate the hill and satisfy the politicians and the citizens who were eager to see the landfill transformed into a beautiful garden. Adult palm specimens were purchased from local nurseries, as well as from providers in Cuba, Florida, South Africa and Argentina. Five field trips



3 (top). November, 1997. River beds are built. 4 (bottom). Aerial photographs of the top of the hill taken in late 1998.



5 (top). A coconut plantation close to a fair sand “beach” in the Caribbean area. 6 (bottom). The most tender palm species thrive in the shade house. 7 (facing page). *Caryota no* and *Pelagodoxa henryana* in the shade house.



were organized to Cuba, the Dominican Republic, Peru, Florida and New Caledonia, to collect seeds for the collection, to study local palm populations and to purchase palm handicrafts and palm related objects for the proposed Palm Museum. A network of contacts with other botanical gardens specializing in tropical flora was gradually built up and thousands of seeds have been received and sown, thanks to our exchange programs. Seeds of many palm species arrived from institutions in New Caledonia, Hawaii, Brazil, Cuba, Florida, Australia, Indonesia and the Dominican Republic.

The first palm touched the ground in September, 1996, but 1997 and 1998 were the years with the most intensive plantings (Figs 3, 4). Carlos Simón, a young landscaper from the island of La Palma, directed the plantings and also designed three spectacular waterfalls built with immense pieces of volcanic rock. A waterfall in the Caribbean zone pours water onto a white sand “beach” densely planted with *Cocos nucifera* (Fig. 5). Then the water flows into a rocky stream that crosses “Brazil” and eventually dies into the “Malgasy” lake. Palms of the genera *Ravenea*, *Nypa* and *Mauritia* have been planted along the streams in semi-aquatic conditions. Simón’s experiences in the Venezuelan rain forests were the inspiration for the most exotic and natural landscapes on the most artificial hill of the world!

The Structures

Shade House. This building will doubtlessly be the pearl of the project (Figs. 6, 7). A sunken shade house of 2300 m² shelters those species that need a cooler and moister, windless environment, such as the rare palms with entire leaves. It is an octagonal space with stepped terraces. Simón’s imagination enriched its many corners with unique blendings of volcanic rocks, water and palms. Two waterfalls produce a complex network of streams. The most sought after palms of delicate requirements are already in the ground – *Pelagodoxa*, *Verschaffeltia*, *Licuala* and *Marojejya*. Tall specimens of *Areca catechu* are fruiting; *Beccariophoenix* and many *Chamaedorea* spp. thrive under *Cecropia* trees. The main pillar of the dome is used as a support for climbing palms of the genera *Daemonorops* and *Desmoncus*.

Museum. The Canary islanders have a long tradition of living with palms and have a considerable heritage of practical use of the diverse parts of the only native species, *Phoenix canariensis*. The ethnographical museum of palm objects will hold a permanent exhibit of artifacts collected from all over the world. More than 400 accessions have been obtained, thanks to our many contacts. One of the most attractive features is a 3 m long

canoe made of *Iriartea deltoidea*, brought from Iquitos, Peru.

Water Treatment System. Water is not just water – in dry areas agronomists talk about many kinds of “waters.” The Palmetum is equipped with a desalinization plant that maintains high water quality by reverse osmosis. Fertilization tanks provide nutrients and keep the pH under control. One of the ornamental ponds is so deep that it will be used for storing the precious liquid. Irrigation reaches plants by seemingly endless pipelines equipped with sprinklers and drip-emitters. The shade house features a fog system.

The present state of the collection

In December, 2000, the Palmetum boasted about 400 palm species, represented by more than 6000 individuals. The richest collections are those from the Caribbean. The Palmetum probably has the world largest collection of *Thrinax* and *Coccothrinax* species, with more than 1000 plants. Each species is planted in groups, forming “populations” that are reminiscent of their growth habits in the wild.

The collection was evaluated in 1999 by Ben Lyte of the Royal Botanic Gardens, Kew, in a survey of public palm collections of the world for Botanic Gardens Conservation International. Using 1998 data (the most recent available data), Lyte found that the Palmetum was the fifth largest collection in the world. The greatest tribute to the hard work of the Palmetum staff is Lyte’s finding that six of our palm species are “unique records,” not present elsewhere in the surveyed collections even though we tried to spread seeds to other public botanical gardens.

The Palmetum at a Glance	
Annual Average Temperature:	21°C
Record Minimum:	15°C
Rainfall per Year:	230 mm (winter)
Total area of the hill:	120,000 m ²
Height:	42 m
Slopes:	65,000 m ²
Flat area:	55,000 m ²
Area for planting:	45,000 m ²
Shade House:	2,300 m ²
Number of palm species grown:	400
Number of unique accessions:	6
Number of individual palms:	>6000
Objects in the Palm Museum:	> 400
Cost (as of March 2000):	4,190,000 Euros

Besides palms, we grow hundreds of species of other plant families. Some of them came as donations from the Botanic Garden of La Orotava (Tenerife). Others were field-collected in the Antilles to become companion plants to palms in realistic environmental settings such as *Agave*, *Plumeria*, bromeliads, unusual *Ficus* and rare forest trees that will give shelter to palms or will be sheltered by them.

Palms struggled during the first years to recover from the transplant shock on the top of the barren hill. Nowadays, a pleasant environment has developed in the Palmetum, and we are enjoying a spectacularly fast growth rate in most palm species. Pleasant surprises were species of *Veitchia*, *Bismarckia*, *Livistona* and *Cocos*.

The Future

The Palmetum is heading towards an uncertain future. A vast sum of money (4,190,000 Euros)

was spent to bring the Palmetum to its present state. Its development was stopped in early 1999, as the project needed new funds to continue. Only maintenance has occurred since then, with the exception of a five-month period (August to December, 2000), during which time new gardens were developed. I was hired again to landscape almost two hectares of new gardens. During that time, 1050 plants were planted, the area dedicated to the Caribbean was nearly doubled and new areas were created, one for Central America and another for the Islands of the Pacific, with special gardens for New Caledonia and Hawaii. There are political pressures to make the Palmetum economically self-sufficient and to convert it into a theme park or recreational space for tourism. The staff hopes to complete it and make the Palmetum a true self-sustainable botanical garden with a permanent research unit.

Horticulture Column

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Q. I do not want to use sphagnum or sedge peat, since I am concerned about the damage to peatlands caused by peat extraction for the horticulture industry. Can you suggest a good general purpose potting mix for palms that does not contain peat? Gillian Drake, Miami, Florida.

A. Every palm grower should be aware of this issue. In the northern countries including Canada and the UK, where most large scale commercial peat mining occurs, this issue is an increasingly well-known environmental concern. The need to protect the unique and limited peatland habitats is already causing governments to regulate the mining industry. A number of environmental agencies in the UK are urging the public to use alternatives to peat for gardening. This year the UK's leading home and garden store chain announced it is phasing out all peat-based products, going completely "peat-free."

So what is the alternative? The most popular substitute is coir dust, the leavings from the stripping of coconut fibers (coir) for manufacturing of ropes, mats and other coir products. Coir dust accumulates in great piles

outside coir mills, is very slow to rot and creates a disposal problem for the mills. Along with its slow decomposition rate, coir dust has the necessary qualities of moisture retention and air porosity to make it a useful organic ingredient in potting media.

After formal studies comparing growth of several nursery crops (including *Ravenea rivularis*) in coir, peat, sphagnum and sedge peat, Alan Meerow (1995) found coir to an acceptable substitute for peat. Coir usually works as an equal parts substitute for peat in a standard potting mix. The Royal Botanic Garden at Kew now uses coir instead of peat in all their main potting mixes. According to David Cooke at Kew, they had some initial problems with different watering patterns and the quality of coir dust used. At Fairchild Tropical Garden, coir has been tried informally as a direct substitute for peat in a general purpose potting mix – 50% coir, 20% perlite and 30% composted pine bark – used with a variety of plants including palms. The coir mix showed promise, with growth success comparable to the peat mix. The problem was the coir in this mix began to decompose more quickly, a condition

(continued p. 176)

Chemical Control of *Lixas* and Leaf Blight Disease of Coconut

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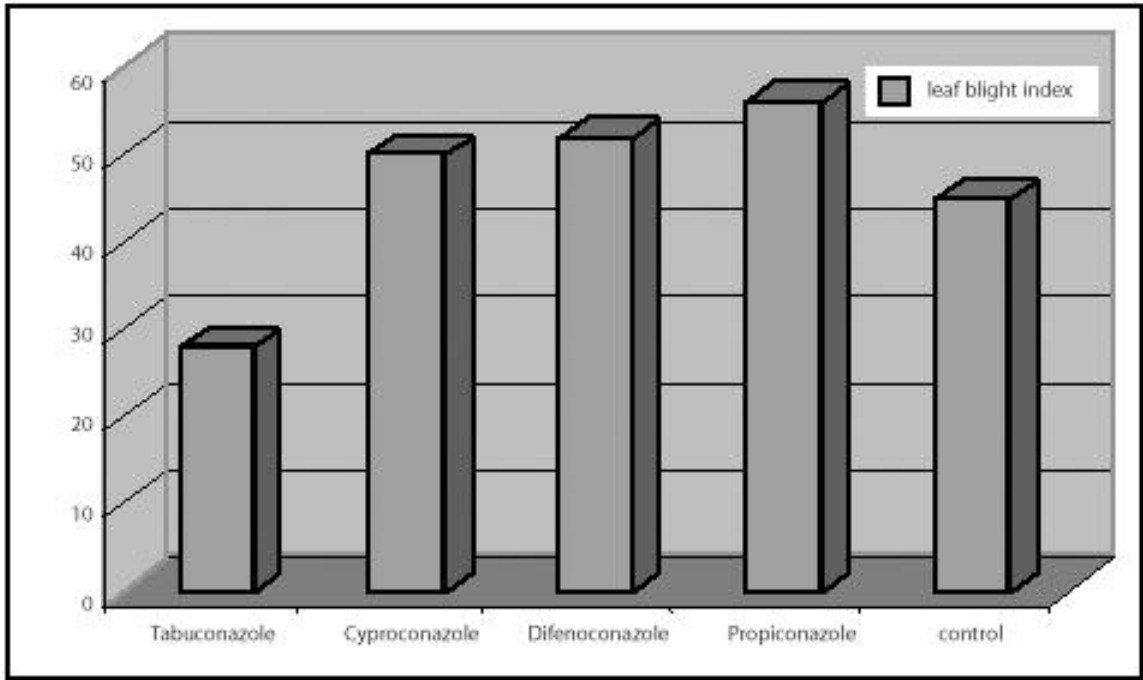
The coconut is the most important crop in the coastal region of north-eastern Brazil. This region accounts for 92 per cent of all coconut grown in the country. On average, coconut production is 3,377 fruits/ha (Cuenca 1989), the consequence of irregular rainfall distribution, low yielding varieties and attack by a number of insect pests and diseases.

Three foliar diseases are responsible for enormous losses in different coconut growing regions of Brazil. *Lixa pequena* or small verrucosis, caused by *Phyllachora torrendiella* Subileau (*Catacauma torrendiella* Batista), was described in 1948 (Batista 1948). The first symptoms of this disease are small black, charcoal-like fruiting bodies formed superficially. This formation, known as a stroma (plural stromata), is either found isolated, in lines or in a diamond shape on the leaflets and midribs. Eventually, the plant tissue around the stromata forms brown, necrotic lesions, which enlarge to about 8 × 3 cm. Numerous brown areas coalesce, the leaflets become necrotic and the whole leaf collapses. *Lixa pequena* occurs mainly in areas not located near the sea-shore and is widespread in the different coconut regions (Warwick 1989, Renard 1988).

Lixa grande, also known as large verrucosis, is caused by *Sphaerodothis acrocomiae* (Mont.) von Arx & Müller (*Coccostroma palmicola* (Speg) von Arx & Müller) (Joly 1961). The stromata of this fungus are brown, larger and more superficial than those of the previous fungus (Warwick & Leal 1999). This fungus appears to be more prevalent

than *P. torrendiella* in drier areas and does not occur in the northern part of country. Palm species native to Brazil are natural reservoirs for the two fungi (Warwick & Leal 2000).

Leaf blight disease was first described by Souza Filho (1979) in the State of Sergipe, and the fungus isolated was *Lasiodiplodia theobromae*; in Pará State, however, it is more common to observe *Bothryosphaeria* on the lesions (Subileau 1993). The disease was observed on the lower leaves that become brown and die prematurely, leaving coconut bunches without support. Leaf browning spreads from the tip to the base (the symptom develops in a so-called "V" formation), and there is no transition area from the brown tissue to the green area. Inoculations performed with *L. theobromae* produced necrotic lesions typical of leaf blight disease only when the tissues were wounded or the pathogen was inoculated on top of *lixas* lesions, indicating that *lixas* infection makes an opening for the later invasion of *B. cocogena*. Other studies have shown that this fungus is specific to coconuts and is different morphologically from other *L. theobromae* isolates (Warwick et al. 1994).



1. Average incidence of coconut leaf blight with the different fungicide treatments.

It is suggested that these three fungi are responsible for the reduction in assimilating leaf area and consequently for the low production of coconuts in Brazil. The objectives of the present studies were to study: (i) suitable systemic fungicides for the control of the diseases, and (ii) the translocation and persistence of these chemicals in coconut fruits.

Methods

The experiment was conducted in the County of Neópolis, State of Sergipe, on a green dwarf coconut plantation, seven years old, in a zone most affected by *lixas* and leaf blight. The density of the plantation was 205 trees/ha.

Field control trials involving the fungicides cyproconazole (40 ml/20 l of water), difeconazole (20 ml/20 l), propiconazole (40 ml/20 l), tebuconazole (40 ml/20 l) were carried out on dwarf green coconuts, every 15 days, six times,

using 20 plants per treatment and leaving 20 plants without treatment. After two months from the last treatment damage assessment was conducted.

The *lixas* were evaluated by counting the number of stomata in six leaflets from leaf 14. The number of naturally contaminated *lixas* stomata by hyperparasite fungi was also measured to establish if the fungicide could harm the natural biological control.

For the leaf blight, a disease index was used based on dividing the leaves infected by *L. theobromae* by the total number of coconut leaves multiplied by 100.

The study on translocation and persistence of the four fungicides in coconut fruits was undertaken using the plants that had been sprayed. Nut water from 8-month old was assayed.

Table 1. Number of <i>lixas</i> stomata and colonized stomata on leaflets of the leaf 14 on plants sprayed by fungicide on the Platô de Neópolis, Sergipe			
Fungicide	<i>lixa grande</i>	<i>lixa pequena</i>	colonized stomata
Cyproconazole	112.8	101.1	9.1
Tebuconazole	150.6	125.8	10.5
Difeconazole	119.6	69.8	9.8
Propiconazole	128.6	79.6	1.5
Control	362.2	189.6	9.6

Results and Discussion

The average number of stomata of *lixa grande* and *lixa pequena*, as well the number of stomata colonized by hyperparasitic fungi, can be observed on Table 1. For *lixa grande*, the more efficient fungicide was cyproconazole, reducing the number of stomata in 70% followed by difenoconazole (67%), propiconazole (65%) and tebuconazole (59%). The efficiency for the control of *lixa pequena* was different, better performance was obtained with difenoconazole (63% of stomata reduction), propiconazole (58%), cyproconazole (47%) and only 44% for tebuconazole.

The only fungicide to affect the hyperparasite fungi was Propiconazole, so it should not be used when an integrated pest control program is in place.

In Fig. 1, the reduction in attack of leaf blight obtained by the fungicide application can be observed. The best control was obtained with Folicur (tebuconazole), producing a reduction of 37% of disease incidence while there was no reduction with other fungicides.

The studies of residues of the fruit water showed no evidence of contamination by the chemicals.

When the small reduction of disease incidence and the price of fungicides is considered, the chemical application should be used only with special consideration.

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Landscaping with Palms in the Mediterranean

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1. *Phoenix canariensis* reinforcing the architecture of a Greek-style building.

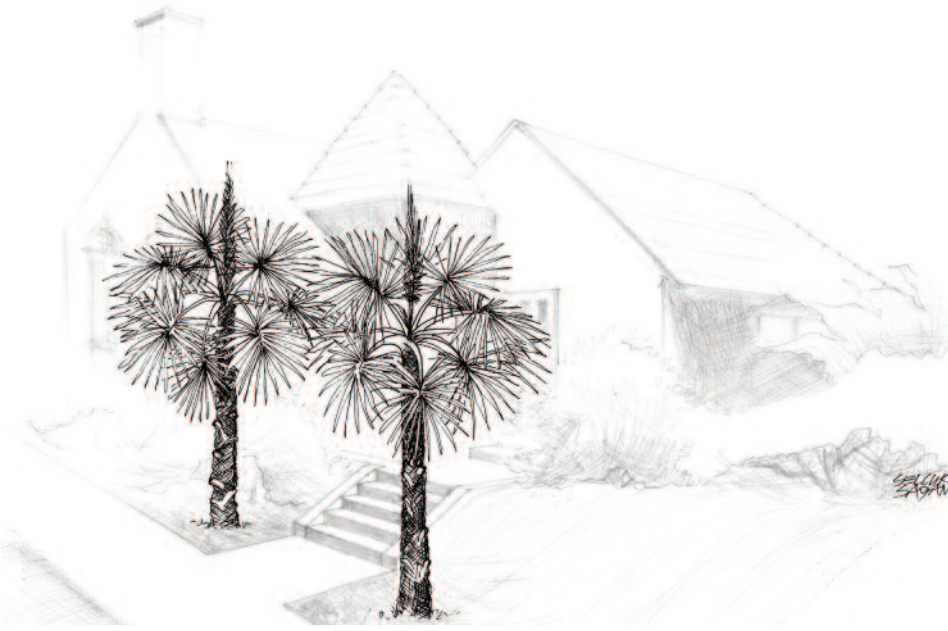


Palms are one of the most frequently used plant materials in landscape design in warm climates because their characteristic habits immediately set them apart from other plants.

According to Meerow (1994), their beauty, durability and variety rank palms among the most highly valued of all landscape plants in subtropical and tropical regions. By their very bold, exotic and dramatic nature, palms easily command the most visible, high-profile and strategic locations (Hodel 1996). As landscape plants, palms are prized for their unique architecture and the intricate texture and form of their leaves and stems (Meerow 1994). Unlike most other plants, palms

have a vertical accent. According to Muirhead (1961), spaces effectively landscaped with palms must be shaped by the structural use of palms in combination with other plant forms, paving, lawns, water and buildings.

The three determining factors for growing palm trees in temperate climates are temperature, rain and frosts (Esener 1999). It is not possible to define hard and fast conditions required for their growth,



2. Symmetrical planting of *Trachycarpus fortunei* in the entrance zone of a non-symmetrical building.

because these change according to species. Generally palms are slow-growing plants. They appear as the vertical elements of landscape, and changes in height are seen only after long periods of time. Under regular maintenance conditions, the size and number of leaves, thickness of the trunk and root volume do not change or change only very slowly.

The use of palm trees in landscape design is closely related to architectural concept and hard landscape design. Therefore, architectural and landscape architectural design should work together so as to create the desired effect. In this

way, with a soft landscape of palms, the interface between the buildings and surrounding landscape will no longer be a problematic discontinuous transition area; palms can provide a gradual transition between the big building masses and green spaces. Random use of palm trees can neither express a particular idea nor integrate with the architectural design.

Types of Palm Use in Landscaping

Symmetrical Uses

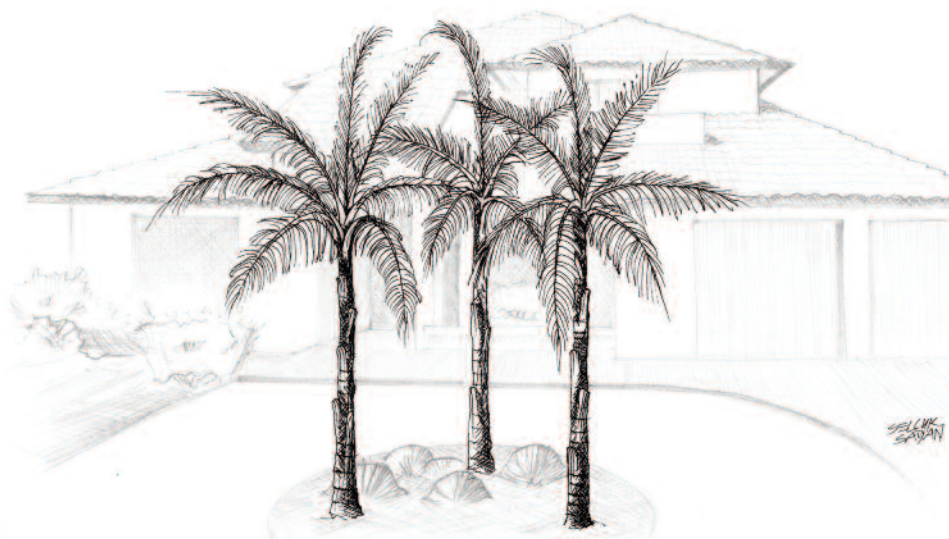
Palms can be used as symmetrical elements in the formal design. Symmetrical designs are usually



3. A group of *Washingtonia robusta* can be seen from long distances.

4. The right scale for focal use: three

Syagrus romanzoffiana in the middle point of a driveway.



implemented at the entrances of symmetrical buildings or in the landscape design of classical and neo-classical gardens. Palms are especially suitable for reinforcing the design of completely symmetrical buildings (Fig. 1). They can be used mostly as single specimens or in groups consisting of odd numbers of individuals. In some cases even when the building is not symmetrical, palms that have symmetrical habits can be used in order to give formality to the entrance area (Fig. 2).

The important point of symmetrical uses is to achieve the equivalent growth among trees or tree groups. Horticulture practices should be equally applied to all palms in the symmetrical design. Otherwise some palms may grow faster than others and the planting may over time lose its symmetry.

Palms suitable for most symmetrical uses are *Brahea armata*, *Caryota urens*, *Jubaea chilensis*, *Phoenix canariensis*, *Phoenix dactylifera*, *Trachycarpus fortunei* and *Washingtonia robusta*.

Groves, Groups or Clumps

Many species of palms grow in groves or forests in their natural habitats. In landscape design, the use of palms in groups is intended to have a tropical effect. At the same time, a group of palms highlights a particular place in the whole landscape that can be seen from long distances (Fig. 3). As the number of palms increases, the characteristic habit of each individual palm becomes less apparent. It is important to be careful about the number of trees that form the group

and distances from buildings, as the group should integrate, not overpower the buildings. Also, when palm trees of the same height are planted in a group, an unpleasant view of dense trunks may appear in time because of the competition for



5. Tall *Washingtonia robusta* palms in front of a two story building not only spoil the proportion but also reduce the imagined accent.



6. *Phoenix dactylifera* palms planted along a promenade by the sea, accenting the coastline.

light. Such a landscape of dense trunks looks like a building standing only on columns. The solution for this case is to plant trees of different heights in the beginning or to supply the group with new and shorter trees among previously-planted ones.

Some species suitable for group uses are *Acoelorrhaphe wrightii*, *Phoenix reclinata*, *Phoenix theophrasti*, *Phoenix canariensis*, *Sabal palmetto* and *Syagrus romanzoffiana*.

Solitary and Focal Point Uses

Solitary uses of palms are usually applied in two cases. The first is to show the extraordinary habit of palms, and the second is to exhibit a rare palm

species, which might have interesting stem texture or leaf form. With solitary uses, palms may appear as dramatic and interesting plants that stand out from the surrounding landscape design, but care must be taken as large solitary specimens can visually dominate the gardens in which they are planted.

Palms can be focal points in either outdoor or indoor landscaping. Focal uses generally emphasize classical and formal designs, but they also have a place in the informal design concept. A focal point that is positioned in the appropriate place can attract attention with a magnificent palm species planted in it (Fig. 4). Form, scale,

color and texture of the palm species are closely related to architectural and landscape architectural concepts. For example, for a focal point surrounded by one- or two-story buildings, people should look up to see a twenty-meter high palm (Fig. 5). A rough textured palm tree would make a lively contrast in a focal point between buildings constructed with smooth surfaces of a minimalist design. A giant clustered *Phoenix* as the focal point of a small garden or dwarf palm species planted in a large space will both spoil the proportion and reduce the desired focal effect.

Palms suitable for usually solitary use are *Acoelorrhaphe wrightii*, *Archontophoenix alexandrae*, *Butia capitata*, *Caryota urens*, *Chamaerops humilis*, *Jubaea chilensis*, *Dypsis decaryi*, *Phoenix canariensis*, *P. reclinata* and *P. roebelenii*.

Lines, Rows and Avenues

Palms are unequalled as impressive borders for avenues, streets or paths and can be used in formal or informal rows (Fig. 6). In this type of use, harmony with the surrounding landscape is important whether it is natural or man-made. However, avenues of tall palms can form a pleasing, even striking, contrast with low, horizontal architecture.

Palms can also be used as space dividers giving form to large volumes of air (Muirhead 1961). A

large area can be divided into small spaces with palms planted in rows (Fig. 7). Also they can be planted on the borders of large areas in order to provide a visual boundary. This type of use can create a landmark accent and defines a particular place. Palms in lines or rows not only point out a street, avenue, pathway or border from very long distances, but also surround the place as a third dimension in the sky.

Most suitable palms for avenues or uses in lines are *Phoenix canariensis*, *Phoenix dactylifera*, *Syagrus romanzoffiana* (equivalent to *Roystonea* species in tropical regions), *Washingtonia filifera* and *W. robusta*.

Conclusions

Palms are important elements of soft landscape design because of their characteristic habit. Strong accents can be created in landscape design with their interesting forms. Palms are trees of drama and interest; as a consequence of their extraordinary habit, they should be considered as a different category in landscape design. They are slow-growing plants, and most of them are impressive in the vertical line formed by a crown on a long trunk. In this way they demarcate a space or avenue, border or focal point in the landscape. This is the "accent impact" of palm trees.



7. *Washingtonia* palms used as space dividers in a large area.

On the other hand, palms are the universal symbol of the tropics in the popular imagination. They are the emblem of hot weather, sea and vacation time in peoples' minds. Outdoor and indoor spaces are immediately given an exotic ambience by the use of palms.

Palm species given here as examples for each group should not restrict designers. They were chosen for their accepted typical characteristics in particular uses and their relationship with surrounding landscape. The aim of this systematic evaluation of palm uses in soft landscape design is to point out a beginning in the process of designing with palms.

Acknowledgments

The author is especially grateful to Dr. Ragip Esener (owner of the Palm Center in Köycegiz) and to

his brother for their valuable comments on the manuscript.

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(*Horticulture Column, continued from p. 167*)

suggesting that the quality of the coir material, as well as proportions and watering, needed fine-tuning.

What should you consider for palm growing in a coir mix? Try a standard, well-draining potting mix for palms, substituting coir for the peat. An example is: 40% peat (coir), 40% composted pine bark, 20% sand. Fertilize as normal for container palms. Coir dust is often sold in compressed bricks or blocks, available from orchid and general horticulture suppliers, as well as internet sources. Soil companies may have loose coir and can make mixes to order. Most coir dust comes from Sri Lanka, generally a reliable source of coir dust with consistent texture and low salinity.

MEEROW, A.1995. Growth of two tropical foliage plants using coir dust as a container medium amendment. *HortTech* 5: 237–239.

Q. Homeowners in my community are concerned about the hazard presented in a high wind or hurricane by *Washingtonia* palms. Rumor is that *Washingtonia* fared worse than most other palms during Hurricane Andrew, in 1992. As a result, a group of homeowners is eager to see the palms removed. Is there any truth to the rumor? Should the palms be removed? Paul Rice, Palm City, Florida.

A. Based on records at Fairchild Tropical Garden and observation of Miami's urban landscape, I have found that *Washingtonia* palms were among the more wind resistant of tall palms during Hurricane Andrew. At Fairchild Tropical Garden, where the Category Four hurricane hit almost directly, losses of *Washingtonia* were quite low, only three out of 34 mature *Washingtonia robusta* in the garden were blown down. As with *Roystonea*, there seemed to be few, if any, losses along the streets in Miami, demonstrating that great stature does not necessarily pose a greater threat in high force winds. While *Roystonea* tended to be largely defoliated, *Washingtonia* retained all but the oldest leaves. Palm crowns usually offer little resistance to wind, so the risk of palm stems snapping or entire palms uprooting is less than with many broadleaf trees commonly planted in Florida landscapes. These are just some general observations from my experience here in Miami. I know of no serious research on the topic. There are also, of course, individual site conditions to consider in assessing the risk. The health of your plants is an important factor; weak or damaged palms are more likely to topple in a storm than healthy palms.

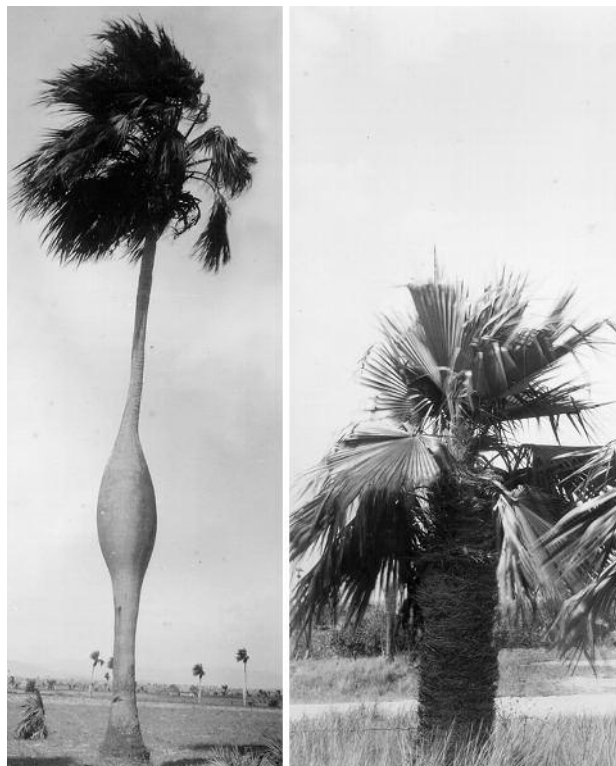
ERRATUM

In the advertisement for Lucy Smith's Palms of North Queensland prints [PALMS 45(3): 133], the incorrect web address was given. The correct web address is www.lucytsmith.com. We sincerely regret the error. – S. Zona

Monograph of *Colpothrinax*

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1. *Colpothrinax wrightii*,
Consolación del Sur, Cuba.
Left. Adult with swollen,
naked trunk. Right. Persistent
leaf-sheath fibers enclosing
non-swollen trunk of juvenile.
(photos by L. H. Bailey)



Colpothrinax is a genus of three species of fan palms, all highly desirable ornamentals that are nevertheless rare in cultivation. The Cuban belly palm or *palma barrigona* (*C. wrightii*) is restricted to Cuba, *C. cookii* is found in the rain forests of Guatemala, Belize, and Honduras and *C. aphanopetala*, previously confused with *C. cookii*, is described and named for the first time in this article; it is found only in the forests of southern Nicaragua, Costa Rica, and Panama. The two mainland American species differ in details of their flowers that together suggest a difference in the way they are pollinated.

While living in Costa Rica in 1989 doing field work towards a taxonomic revision of *Cryosophila*, I was shown an entire unmounted infructescence of a specimen of *Colpothrinax* that had recently been collected in a remote area of the Talamanca mountains in Costa Rica (*Chacón* 290). This was the first collection of *Colpothrinax* from Costa Rica, although it had been collected frequently in

neighboring Panama. At that time, the only other Central American collections of *Colpothrinax* had been made in Guatemala almost 90 years previously at the type locality of *C. cookii*. I did not have immediate access to that type material, but the new Costa Rican specimen did match the Panamanian specimens I examined. A few years later, back in St. Louis, I was given three palm



2. *Colpothrinax aphanopetala*, margins of Laguna Cote, Costa Rica. Left. Emergent adult with naked trunk. Right. Persistent, ferruginous leaf-sheath fibers enclosing trunk of juvenile. (photos by R. J. Evans)

specimens for identification that had recently been collected in Belize (Allen 15220, 15450; Holst 4333). Although these specimens were clearly *Colpothrinax*, it was readily apparent that they were not the same species as those from Panama. If either of these two taxa was the true *C. cookii*, then it was almost certainly the one from Belize – after all, the type had been collected in nearby Guatemala. This proved to be the case, once I was able to examine the type specimens. In the past five years, additional collections of *Colpothrinax* have been made in Costa Rica and Belize, as well as new country records for Nicaragua and Honduras. All of the material from northern Central America (Guatemala, Belize, and Honduras) corresponds to *C. cookii*, whereas the specimens from southern Central America (Nicaragua, Costa Rica, and Panama) represent a new species, here described.

Materials and Methods

Measurements were taken primarily from dried herbarium specimens. Flower and fruit measurements are from dried material rehydrated overnight in a solution of glycerin alcohol, 10%

aerosol OT, and distilled water (10:3:90) in a 60°C oven (Martens and Uhl 1980). Leaf blade samples for anatomical studies were similarly rehydrated, sectioned freehand, and mounted in Hoyer's solution. Preparation and electron-microscopy of pollen from anthers removed from herbarium specimens were carried out by Madeline M. Harley, in the Palynology Unit, Royal Botanic Gardens, Kew, and follow the procedures outlined by Harley (1990). All of the original micrograph negatives are deposited at K.

The following conventions apply to the taxon descriptions and key. Trunk height and dbh, petiole length, and flower, fruit and inflorescence axis color are from measurements and/or observations made on living material in the field (either by the author or taken from herbarium specimen-label data). Flower and fruit measurements are from rehydrated herbarium material. The descriptions of all other characters are based on dried herbarium specimens. Petiole width is measured at the juncture of the petiole and the blade (usually not perpendicular to the axis of the

petiole because the two opposite lateral margins of the blade do not join the petiole at the same level); hastula length from an imaginary line across the petiole connecting the points where the two opposite lateral blade margins join the petiole; costa length from the same imaginary line to the first branch point along the narrowing costa at which the resulting two ribs are of more or less equal width [even though the central abaxial rib (what was proximally the costa) will continue to branch a few more times much more distally]; hastula and widest single-fold segment width at the widest point; prophyll width across adaxial keels at the widest point; floral bracteole width at the point just distal to the basal lobes that surround the rachilla spur to which the flower is attached; receptacle length between the attachment of the flower to the rachilla spur and the bases of the carpels; calyx length from the bottom of the basal lobes; corolla and stamen length from the bases of the carpels; and stamen-cup diameter at the point where the corolla lobes become free from the stamen-cup. First-order branch number is the number of branches off the primary inflorescence axis which are subtended by

a cochleariform bract with a tubular base, plus one [all the remaining distal primary branches which are unbranched (simple rachillae) or once-branched and subtended by a linear, narrow (2–3 mm wide) bract considered *in toto* as a single (the apical-most) first-order branch]. Primary rachis bract length pertains to the larger cochleariform primary bracts. Petiole length is measured to the nearest one-half meter. The following dimensions are to the nearest one-half centimeter: costa length; depth of lateral-most leaf-blade division; inflorescence prophyll length and width; peduncular and rachis bract lengths; first-order branch primary-axis, peduncle, prophyll, and rachis lengths; and rachilla length.

Taxonomic History

The genus *Colpothrinax* was established with a brief description in a generic key to the palmate-leaved palms (Wendland 1879). Although no specimen was cited, this description was presumably based on a specimen collected in 1865 or 1866 by Charles Wright (*Wright 3964*) in western Cuba (see discussion under *C. wrightii*). The genus remained monotypic for almost a century until *Colpothrinax cookii* (1969) was described.

3. Fertile *Colpothrinax aphanopetala*. Left. Erect, young inflorescences, Cerro Jefe, Panama, type locality. (photo by B. E. Hammel) Right. Leaning infructescences of various ages, margins of Laguna Cote, Costa Rica. (photo by R. J. Evans)



Beccari (1907) concluded, in his treatment of American coryphoid palms, that the Caribbean *Colpothrinax* was not sufficiently different from the Polynesian genus *Pritchardia* to warrant its segregation, and he therefore placed *Colpothrinax* into synonymy under *Pritchardia*. However, only a few taxonomists since (e.g., Beccari and Rock 1921) have agreed with this opinion. As Read (1969) demonstrated, the two genera, though morphologically similar, are clearly distinct. However, the contention that *Colpothrinax* and *Pritchardia* are closely related, despite their widely disjunct distributions, is supported by recent cladistic analyses (Uhl et al. 1995). Borhidi (1996) considered it likely that *Colpothrinax* and *Pritchardia* had a common ancestor, and presented this as evidence for a Jurassic location of the Caribbean tectonic plate between the Pacific Ocean and the Tethys Sea, prior to the Caribbean plate drifting into the Tethys Sea as the South American continent rotated and separated from Africa.

Morphology

Trunk. Individuals of *Colpothrinax* are single-stemmed, almost always erect, understory to canopy palms. Adults of *C. wrightii* have trunks that are distinctly swollen proximally to about one-half meter in diameter (Fig. 1, left). The trunks of *C. aphanopetala* (Fig. 2, left) and *C. cookii* are more or less columnar. Young *Colpothrinax* characteristically have their trunks completely enclosed in a thick mat of interwoven, persistent leaf-sheath fibers (Figs. 1, 2; right). On older (i.e., larger) individuals this mat has usually been lost, and the trunk is bare (Figs. 1, 2; left). Sometimes in *C. aphanopetala* and *C. cookii*, particularly in closed forest, the upper portion of the adult trunk remains partially to completely enclosed in the fibrous mat.

Leaves. The leaves are spirally arranged in a spreading crown and number from about 10 to 30 per individual. The basal sheaths disintegrate and fray over time into a ferruginous, fibrous network. The hastula is broadly to very depressed-triangular in outline.

The leaf blade is shortly costapalmate and flabelliform, with a glossy, ceraceous adaxial surface and a whitish, lepidote abaxial surface. Plication is induplicate. The blade in *C. wrightii* is divided along all adaxial ribs, such that all segments consist of only one fold, whereas in *C. aphanopetala* and *C. cookii*, the blade is not divided along some of the lateral adaxial ribs. The lateral divisions are much deeper than the central divisions.

In *C. aphanopetala* and *C. cookii* the leaves of adults and juveniles with more or less adult-sized blades differ from one another. The petioles of such juvenile leaves are longer and thinner than those of adult leaves. The juvenile leaves have smaller hastulae that are cup-shaped and elevated well above the plane of the blade and often have involute margins, whereas the hastula of adult leaves is flat and usually appressed to or sometimes slightly elevated above the blade and the margins are usually undulate. Most significantly, the costa of juvenile leaves is considerably shorter than that of adult leaves (see Read 1969, Fig. 3).

The vascular bundles of the leaf blade are more or less equidistant from each surface. The bundles are either girdered [attached by bundle sheath extensions to each (the larger bundles) or just the abaxial (the smaller bundles) hypodermis] or ungirdered. The girdered bundles in *C. wrightii* are of 3 size classes: small (s), medium (m), and large (l); bundles of different sizes alternate with each other along the width of the blade in a specific repeating pattern. For example, between two l bundles the pattern are (including the l bundles): l, s, m, s, l. In *C. aphanopetala* and *C. cookii* there are 4 size classes: s, m, l, and extra large (xl); and the repeated pattern of bundles distribution (between two xl bundles) is: xl, s, m, s, l, s, m, s, xl. The ungirdered bundles are smaller than the smallest girdered bundles. There are 3–7 ungirdered bundles between adjacent girdered bundles in *C. wrightii* and 1–3 in *C. aphanopetala* and *C. cookii*.

Inflorescences. The inflorescences of *Colpothrinax* are interfoliar. There may be as many as eight inflorescences with flowers or fruit present at the same time. Initially the inflorescence grows erect or nearly so (Fig. 3, left), then it leans gradually (Fig. 3, right).

The primary inflorescence axis is permanently enveloped in a number of ferruginous, lanate bracts. Each first-order branch has its own typically bicarinate prophyll and 0 to 2 peduncular bracts (the proximal branches have 2, the medial 1, and the distal 0). The inflorescence primary-axis rachis bracts are largest near the base of the rachis, and gradually decrease in size distally. The proximal first-order branches are twice- or sometimes 3-times-branched. The branch axes are yellowish (Fig. 4) or pinkish (*C. aphanopetala*; Fig. 3, left). The degree of branching and size of the first-order branches decrease distally, such that the apical branches are simple rachillae inserted directly onto the primary inflorescence axis.

Rachillae are generally longest near the base of the rachis of each first-order branch and shortest

Table 1. Morphological differences between the Cuban *Colpothrinax wrightii* and its Central American congeners.

	<i>C. wrightii</i>	<i>C. aphanopetala</i> and <i>C. cookii</i>
Trunk	Distinctly swollen	Columnar
Leaf		
Blade	Divided centrally 1/3–1/2 to base, laterally >90%	Divided centrally 1/2–2/3 to base, laterally <90%
Hastula	4.8–5.8 cm wide, elevated above the blade	1.9–4.3 cm wide, usually appressed to blade
Petiole	3.7–4.6 cm wide at attachment to blade, adaxial surface glaucous	2.1–3.9 cm wide at attachment to blade, adaxial surface tomentose
Sheath	Fibers coarse and glaucous	Fibers fine and tomentose
Corolla	Petals distinct (but adnate basally to stamen-cup), free portion deciduous, with a clear line of abscission	Connate (and adnate to stamen-cup) basally, lobes persistent, without a line of abscission
Stamens	Filaments connate basally for 1/2–3/4 their length, stamen-cup greatly exceeding calyx-cup	Filaments connate basally for 1/3–3/5 their length, stamen-cup shorter than or ± equal to calyx-cup
Pistils	3.5–4.9 mm long	2.5–3.5 mm long
Styles	2.2–3.4 mm long	1.4–2.2 mm long
Fruits	1.1–1.6 cm diam.	1.6–2.1 cm diam.
Seeds	0.7–0.9 cm long × 0.9–1.1 cm diam.	1.0–1.3 cm long × 1.2–1.5 cm diam.

apically. The rachillae are tomentose; their trichomes are longer and tend to be lighter in color in *C. wrightii* than in its two congeners. Spirally arranged along the rachillae are short, flower-bearing spurs, each of which is subtended by a single, short bracteole.

Flowers. *Colpothrinax* flowers (Figs. 5, 6) are sessile and borne singly on short rachilla spurs. The flowers are perfect and possess a cup-like, fleshy, yellow or reddish (*C. aphanopetala*) calyx with three short free lobes. The corolla is yellowish or pinkish (*C. aphanopetala*). The corolla is adnate to the stamen-cup basally and the petals are either deciduous (*C. wrightii*) or persistent. The androecium consists of six membranous to fleshy stamens, the filaments of which are connate basally into an epipetalous cup. The gynoecium consists of three distinct carpels united by their styles.

Pollen of *Colpothrinax* is monosulcate, and the grains are broadly ellipsoidal in polar view. The grains of *C. wrightii* are typically larger than those of its two congeners. In *C. wrightii*, the tectum on the nonapertural face is foveolate (Figs. 7a–c, left), whereas in *C. aphanopetala* and *C. cookii*, the tectum is coarsely perforate to reticulate (Figs. 8a–d, left). Dransfield et al. (1990) described the

pollen of *Colpothrinax* as being the most distinctive among all 40 genera of coryphoid (ca. 400 species) palms, primarily on account of the exine and tectum on the non-apertural side of the grain being much thicker than on the apertural side. However, this statement was based on pollen sections made from a single collection of *C. wrightii* (Wright 3964), and does not hold up when pollen grains from other collections are examined. The transmission electron micrograph of the *C. wrightii* pollen grain section published in Dransfield et al. (1990, Fig. 25) is reproduced here (Fig. 7a, right). The thicker exine and tectum on the non-apertural side is clearly evident. Pollen grains from other collections of *C. wrightii* (Figs. 7b, 7c; right), however, as well as from *C. cookii* (Figs. 8a, 8b; right) and *C. aphanopetala* (Figs. 8c, 8d; right) do not have this characteristic. The pollen exine and tectum from these collections are of more or less uniform thickness throughout the grains.

Fruits and seeds. *Colpothrinax* fruits usually develop from only one carpel. They are more or less globose and dark brown to black when mature (Fig. 9). There is one oblate seed per fruit and it is free from the endocarp except at the small, basal hilum. The embryo is located laterally somewhat towards the base opposite the raphe.



4. First-order inflorescence branch of *Colpothrinax cookii*. Near Santiaguito, Honduras. (photo by R. A. Ocampo)

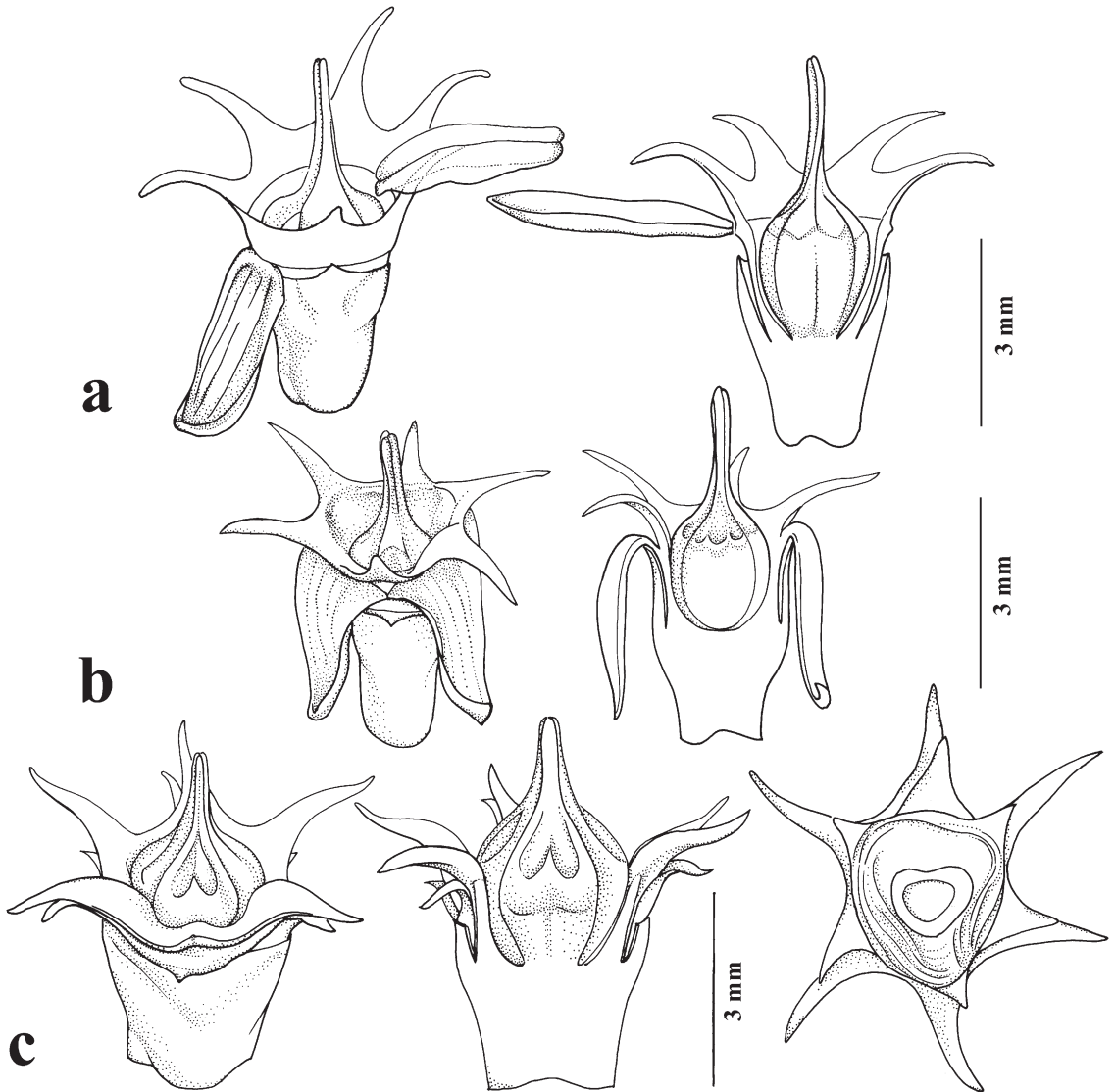
Relationship of *Colpothrinax* to other genera

Colpothrinax belongs to the palm subfamily Coryphoideae, a presumably natural group characterized, with few exceptions, by palmate or costapalmate, induplicate folded leaves. The greatest concentration of unspecialized palm character states is found in the Coryphoideae. However, preliminary results from ongoing, cladistic, family-wide analyses of palm genera, combining morphological, anatomical, and

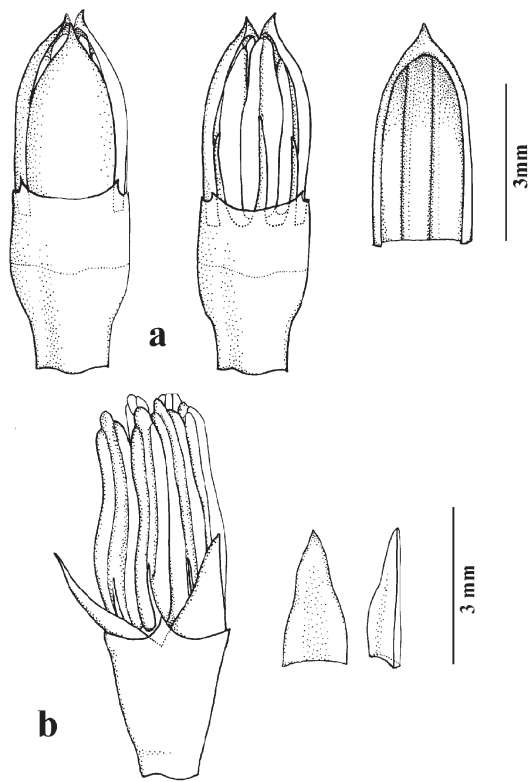
molecular data raise doubts about the long-held assumption that the subfamily is sister to all other palms (Uhl et al. 1995). *Colpothrinax* is allied with a group of coryphoid palms, the subtribe Livistoninae, characterized by flowers with carpels that are distinct basally but united by their styles. This character state, however, is possibly plesiomorphic, and the Livistoninae are paraphyletic (Uhl et al. 1995). Within the Livistoninae, the combined morphological and molecular data (as well as the molecular data

alone) suggest a *Colpothrinax*–*Pritchardia*–*Copernicia* clade sister to the remainder of the genera in the subtribe (Uhl et al. 1995). Within this clade, *Pritchardia* and *Copernicia* are hypothesized as closest relatives, with *Colpothrinax* as the sister group of these two (Uhl et al. 1995). However,

these relationships are not supported if the morphological data are considered alone (Uhl et al. 1995). Nonetheless, *Colpothrinax* can be segregated from *Pritchardia* and *Copernicia* by its embryo, which is lateral rather than basal in the seed.

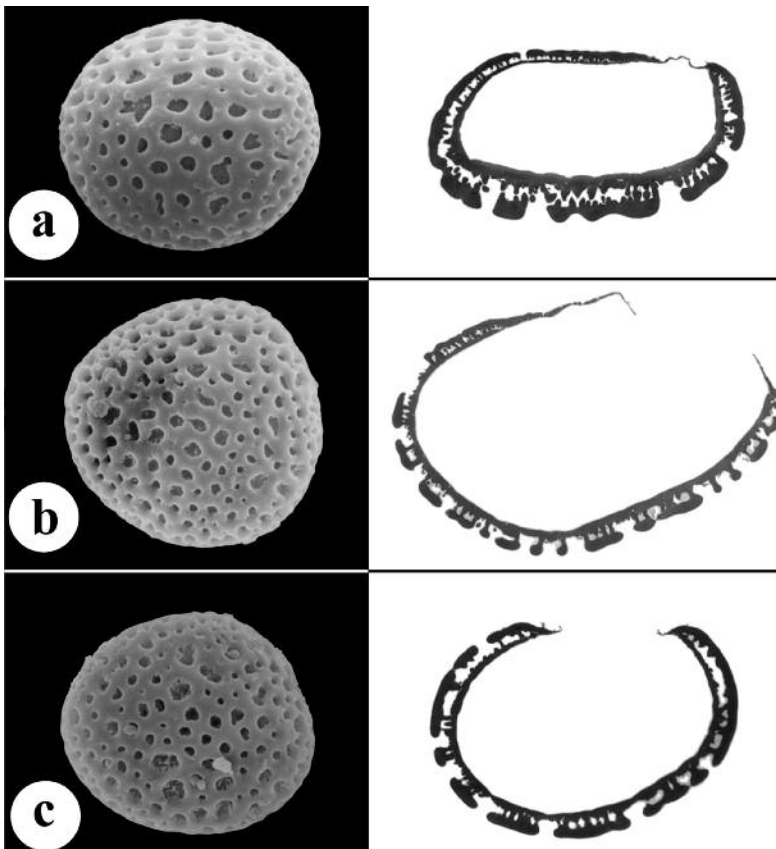


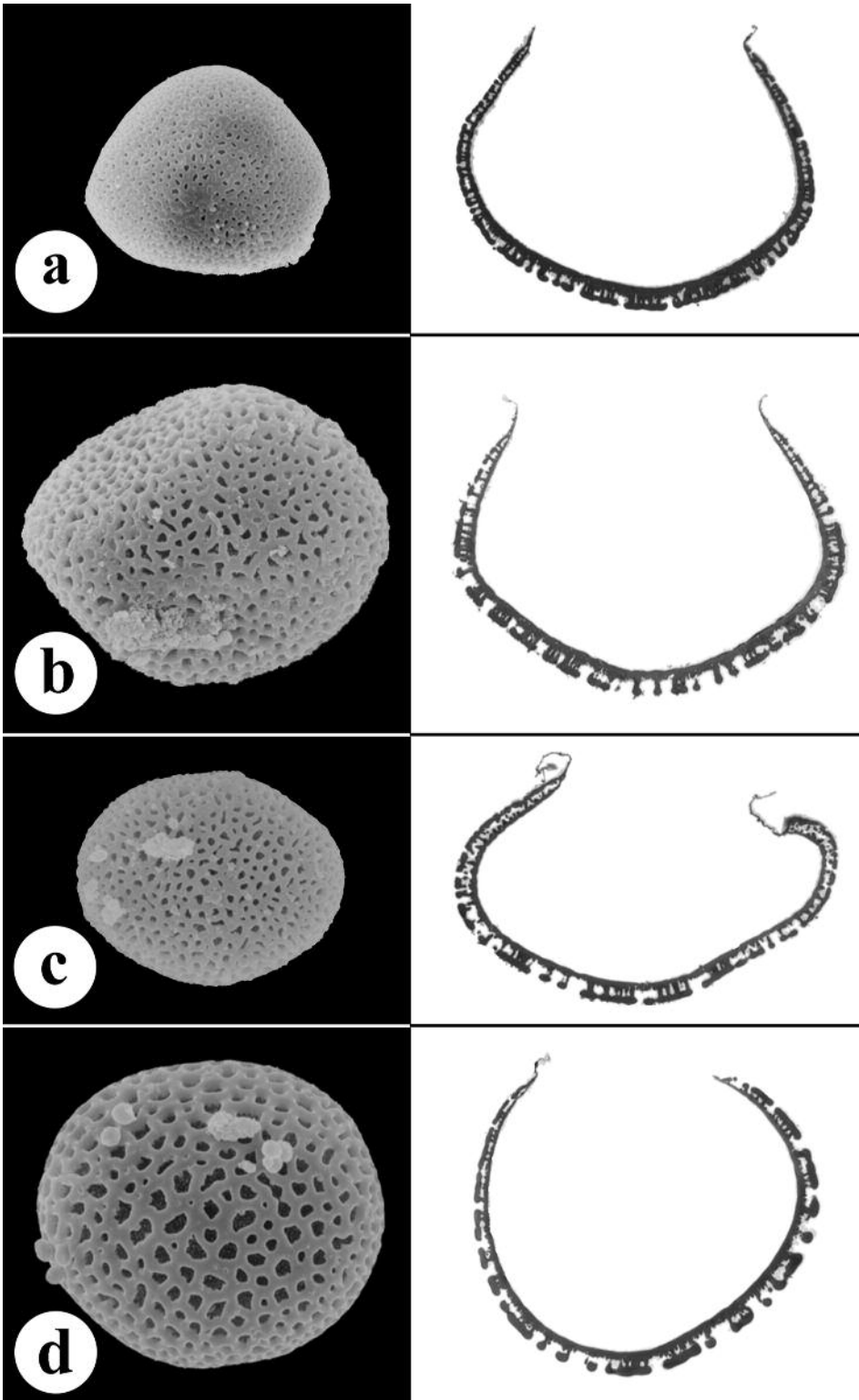
5. Flowers of *Colpothrinax*. a. *C. wrightii* (Curtiss 364): left, flower (all but one anther removed), showing single remaining corolla lobe detaching along line of abscission; right, flower in longitudinal section (all anthers removed), with single remaining corolla lobe. b. *C. cookii* (Holst & Meadows 5747): left, old flower, showing persistent corolla lobes; right, old flower in longitudinal section. c. *C. aphanopetala* (Read et al. 79200): left, old flower; middle, old flower in longitudinal section; right, old flower from below, showing small calyx and corolla lobes.



6. Flowers of *Colpothrinax*. a. *C. cookii*, flowers at anthesis (Evans 2312): left, flower, showing fleshy corolla lobes just beginning to open; middle, flower with one corolla lobe removed; right, corolla lobe. b. *C. aphanopetala*, immature flower taken from unopened inflorescence bud (Rivera & Petruzzi 2897): left, flower; right, corolla lobes.

7. Pollen grains of *Colpothrinax wrightii*: left, whole grains, non-apertural face; right, whole grain exine sections, aperture at top. a. *Wright 3964*, type; SEMG (scanning electron micrograph) $\times 1,650$, TEMG (transmission electron micrograph) $\times 1,600$. (micrographs by C. Batchelor) b. *Bailey 12504x*; SEMG $\times 2,000$, TEMG $\times 2,000$. (micrographs by M. M. Harley) c. *Moore 6092*; SEMG $\times 2,000$, TEMG $\times 2,000$. (micrographs by M. M. Harley)





8. Pollen grains of *Colpothrinax*: left, whole grains, non-apertural face; right, whole grain exine sections, aperture at top. a. *C. cookii*, Evans 2312; SEMG $\times 2,000$, TEMG $\times 2,000$. b. *C. cookii*, Holst & Meadows 5747; SEMG $\times 3,000$, TEMG $\times 2,000$. c. *C. aphanopetala*, Rivera & Petruzzi 2897; SEMG $\times 2,000$, TEMG $\times 2,000$. d. *C. aphanopetala*, Read et al. 79200; SEMG $\times 3,000$, TEMG $\times 2,000$. (all micrographs by M. M. Harley)



9. Fruits of *Colpothrinax aphanopetala* (Hammel 4401), Cerro Jefe, Panama, type locality. (photo by B. E. Hammel)

Taxonomy

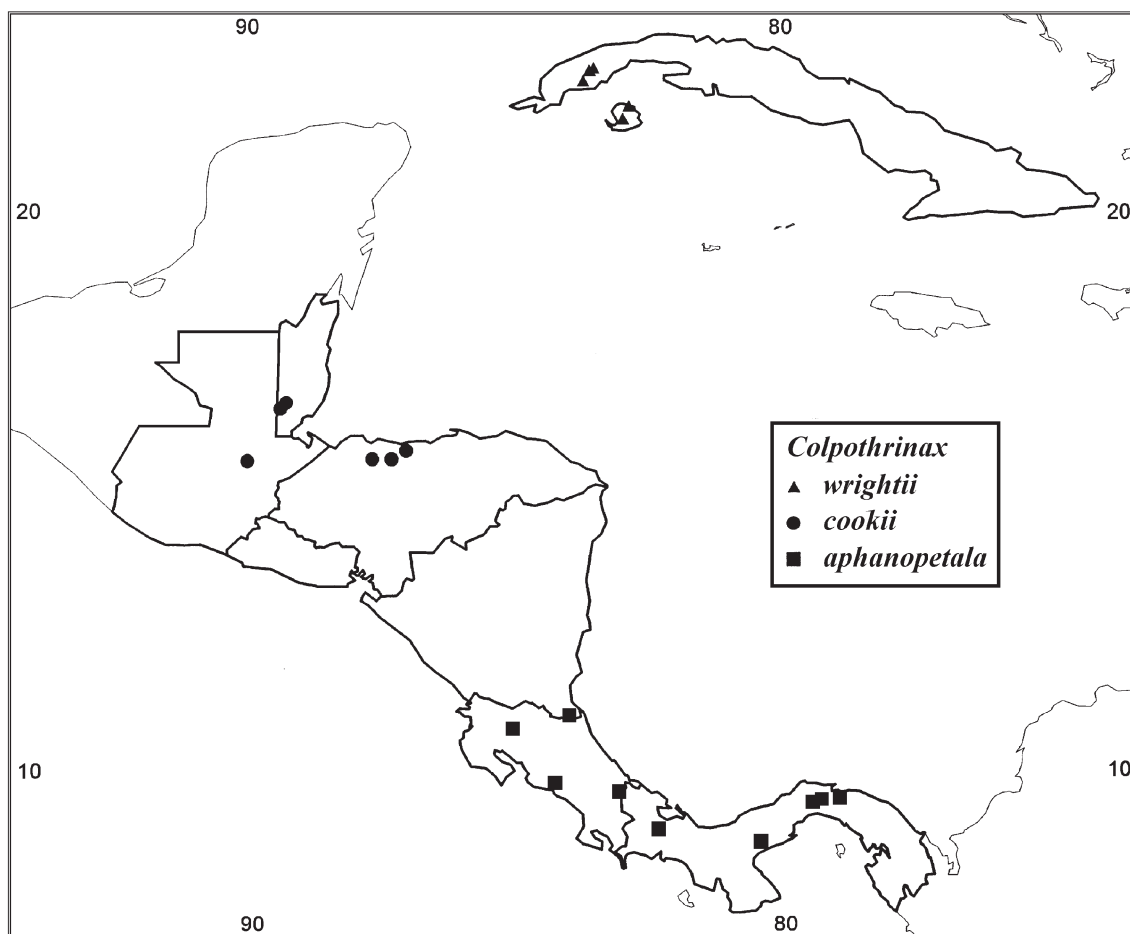
Colpothrinax Griseb. & H. Wendl., in H. Wendl., Bot. Zeitung (Berlin) 37: 148. 1879. Type: *Colpothrinax wrightii* Griseb. & H. Wendl. ex Siebert & Voss ("*wrightii*").

Single-stemmed tree palms. Trunk usually erect, columnar or swollen proximally (*C. wrightii*), usually naked; trunks of juveniles often enclosed in a mat of persistent leaf-sheath fibers. Leaves in a spreading crown, shortly costapalmate, usually 10–30 with an additional 1–3 marcescent; petiole glaucous (*C. wrightii*) or tomentose adaxially; sheath ferruginous, disintegrating and fraying into interwoven fibers; hastula broadly to very depressed-triangular in outline, appressed to or

elevated above the blade, the free margins hyaline, undulate or plane (*C. wrightii*); blade with induplicate plication, divided between all ribs into single-fold segments (*C. wrightii*) or into single-fold segments except for lateral-most 1(–5) segments of each blade half, which consist of (1)2(–4) folds; depth of splitting increasing from central to lateral divisions; central division extending $1/3$ – $2/3$ to base; lateral-most blade division extending $2/3$ – $>90\%$ to base; folds per blade half 25–45; widest single-fold segment 3.4–6.0 cm wide; adaxial surface glossy, ceraceous; abaxial surface whitish, lepidote. Inflorescences interfoliar, to ca. 5(–8) with flowers or fruit, erect or nearly so initially, then leaning gradually, 5–10



10. *Colpothrinax aphanopetala*, near Fortuna Dam, Panama. (photo by B. E. Hammel)



11. Distribution of the species of *Colpothrinax*.

marcescent; orders of branching 3(4); primary-axis slightly bent, mostly $\pm$ cylindrical (except becoming increasingly compressed towards base); inflorescence bracts ferruginous, lanate, with trichomes papillose, beige to rufous, wavy, twisted, compressed, basally broadened, persistent; prophyll strongly bicarinate adaxially, split centrally abaxially (sometimes also adaxially) to near the stem axis, basally sheathing and truncate, usually acuminate apically, persistent; peduncular bracts 4–7, the basalmost bicarinate or centrally carinate adaxially, the remainder $\pm$ carinate adaxially (at least distally); rachis bract and first-order branch size (branch primary-axis and prophyll length, and number of higher-order branches, including rachillae) largest near base of rachis, then gradually decreasing distally; each rachis bract subtending a first-order branch; first-order branches (5?)–6–12; prophyll persistent; proximal first-order branches with 2 persistent bracts on the unbranched primary-axis, medial with 1, distal with 0; rachillae (ca. 20)–ca. 40–50 per basal first-order branch, <10–ca. 20 per apical

first-order branch, usually longest near base of the rachis of each first-order branch, shortest apically, tomentose, the trichomes whitish to ferruginous, often bifid apically; rachillae with spirally arranged spurs, each bearing a solitary, sessile flower and subtended by a single bracteole; bracteoles lanceolate to ensiform, base hastate, partially enclosing rachilla spur. Flowers perfect; calyx cup-like, fleshy, free distally from corolla for $1/4$ – $2/3$ its length; corolla connate basally (for $1/5$ – $1/2$ its length) or free (*C. wrightii*), corolla lobes 3, persistent or deciduous with a clear line of abscission (*C. wrightii*); stamens 6, membranous to fleshy, filaments, connate basally for $1/3$ – $3/4$ their length into an epipetalous cup; stamen-cup adnate to corolla basally, shorter than or $\pm$ same length as calyx-cup or much longer than (*C. wrightii*) calyx-cup, free filaments broad basally, attenuate above, anthers yellow; pollen broadly ellipsoidal, monosulcate, the tectum on non-apertural face coarsely perforate to reticulate or foveolate (*C. wrightii*); gynoecium with 3 distinct carpels, styles connate. Fruit usually developing from 1 carpel,

± globose, dark brown to black when mature; stigmatic residue apical; epicarp smooth, thin; mesocarp fleshy, with longitudinal anastomosing fibers adjacent to the crustaceous endocarp. Seed 1 per fruit, free from the endocarp except at the small basal hilum, oblate, raphe as long as the seed, rather broad and ± sculptured; endosperm homogeneous; embryo lateral, slightly below equator towards the base, opposite the raphe.

Key to the Species of *Colpothrinax*

1. Trunk abruptly swollen ± medially; leaf blades divided centrally 1/3–1/2 to base, laterally >90% to base; corolla lobes not connate basally, deciduous, with a clear line of abscission; stamen-cup greatly exceeding calyx-cup; fruits 1.1–1.6 cm diam.; originally in lowland dry pine forests (almost all now converted to savannas or pastures), 0–ca. 200 m; Cuba. 3. *C. wrightii*

1. Trunk columnar; leaf blades divided centrally 1/2–2/3 to base, laterally <90% to base; corolla lobes connate basally, persistent, without a line of abscission; stamen-cup less than or ± equal to calyx-cup; fruits 1.6–2.1 cm diam.; (lowland–) premontane(–lower montane) wet forests, 350–1,600 m; Central America.

2. Inflorescence branches pink; calyx reddish, 2.7–3.4 mm long, free distally from corolla for 0.9–1.7 mm (1/4–1/2 its length); corolla 2.9–4.2 mm long, the lobes connate basally 1/3–1/2 their length, mostly pinkish, never touching, attenuate with acute apices, membranous, adaxially plane with slight apical thickening; stamen-cup 2.4–3.0 mm diam., fleshy, with walls 0.3–0.6 mm thick; gynoecium 1.6–2.1 mm diam., the carpels reddish; isthmus Central America (southern Nicaragua, Costa Rica, Panama), 350–1,000 (–1,400) m. 1. *C. aphanopetala*

2. Inflorescence branches yellow; calyx yellow, 3.5–5.4 mm long, free distally from corolla for 1.9–3.7 mm (1/2–2/3 its length); corolla 4.0–6.0 mm long, the lobes connate basally 1/5–1/3 their length, mostly yellow, valvate with parallel sides and mucronulate apices, fleshy, adaxially furrowed with involute and/or thickened margins, forming a hood apically; stamen-cup 1.5–2.2 mm diam., membranous to slightly fleshy, with walls to 0.3 mm thick; gynoecium 1.1–1.6 mm diam., the carpels cream-colored; northern Central America (Guatemala, Belize, Honduras), 700–1,200 (–1,600) m. 2. *C. cookii*

1. *Colpothrinax aphanopetala* R. J. Evans, **sp. nov.** a *C. wrightii* trunco columnari differt; a *C. cookii* calyce rubello, curto; corolla plerumque curta, marginibus loborum adjacentium nunquam contiguis, lobis membranaceis; tubo staminum lato; gynoecio lato, carpellis rubellis differt.

Typus: PANAMA, Panamá, Alrededores de Cerro Jefe, ca. 900 m, 24 January 1996, *Galdames et al.* 2419 (holotypus: PMA!; isotypi: SCZ!, US)

Trunk (12–)15–ca. 20 m tall, erect [2.5–10(–15) m tall, sometimes decumbent basally, on Cerro Jefe, Panama], 15–25(–40?) cm dbh, columnar, usually naked, sometimes, particularly in closed forest, upper portion partially or completely enclosed in a mat of persistent leaf-sheath fibers; trunks of juveniles less than ca. 6–8 m tall usually completely enclosed in this mat; mat, when present, usually 20–30 cm thick. Leaves 12–ca. 30; petiole (0.5–)1–1.5(–2) m long, 2.1–3.9 cm wide at attachment to blade; sheath tomentose, the trichomes of two intermixed types: 1) soft, stellate trichomes, ca. 0.5 mm long, basally ferruginous, with free, white distal ends and 2) coarser, longer, wavy, twisted, compressed trichomes, these longer trichomes sparsest, shortest (ca. 1.5 mm long), and lightest in color (± tannish) on the basal portion of the sheath, becoming progressively denser, longer (to 9 mm long), and darker (rufous) distally; sheath disintegrating and fraying into fine, loosely woven, pendulous, filiform, typically ± terete fibers, 0.3–0.5 mm diam.; hastula appressed to or slightly elevated above the blade, 1.6–3.0 × 1.9–4.3 cm, 1.1–1.6 times as wide as long, very broadly to depressed-triangular, usually cuspidate apically; costa (12.0–)17.5–28.0 cm long; blade 95–152 cm long centrally, 36–74 cm long laterally, divided into single-fold segments, except for lateral-most 1(–5) segments of each blade half composed of 1–2(3) folds; central division extending to within 33–70 cm of (1/2–2/3 to) base, the lateral-most division extending to within 6.5–10.5(–23.5) cm of [ca. (2/3–)7/8 to] base; folds per blade half 26–35; widest single-fold segment 4.1–6.0 cm wide. Inflorescences with flowers or fruit to ca. 5, plus ca. 5 marcescent per individual; primary-axis 1.5–1.9 m long; inflorescence bracts lanate, with trichomes 2–8 mm long; peduncle 0.4–0.7 m long; prophyll 18.0–28.0 × 7.0–10.0 cm; peduncular bracts 4–6, 21.0–43.5 cm long; rachis 1.1–1.3 m long; rachis bracts 9.5–49.0 cm long; first-order branches (5–?)8–12; axes creamy pink, their primary-axes 11.5–77.0 cm long, with unbranched proximal portion 6.5–48.0 cm long, the branched distal portion 2.5–38.0 cm long; prophyll 9.5–46.0 cm long; rachillae typically 30–50 per basal first-order branch, <10 per apical first-order branch, 2.0–15.0 cm long, tomentose,



12. Unidentified species of syrphid fly visiting flowers of *Colpothrinax aphanopetala*, Cerro Jefe, Panama. Flowers at staminate anthesis. (photo by B. E. Hammel)

the trichomes (tannish to) ferruginous, 0.2–0.3 mm long; flower-bearing spurs 0.2–0.4 mm long, the subtending bracteole 0.5–1.2(–1.6) mm long, 0.3–0.9 mm wide basally. Floral receptacle 0.9–1.7 mm long; calyx 2.7–3.4 mm long, free distally from corolla for 1/4–1/2 its length, reddish with some yellow distally, the lobes 0.3–0.9 mm long; corolla 2.9–4.2 mm long, connate basally for 1/3–1/2 its length, mostly pinkish, creamy yellow marginally below apex, adjacent lobes never touching, the lobes attenuate with acute apices, membranous, adaxially plane with slight apical thickening, persistent, filaments 2.0–3.8 mm long, connate basally for 0.6–2.0 mm (1/3–3/5 their length), cream-colored, stamen-cup shorter than or $\pm$ same length as calyx-cup, 2.4–3.0 mm diam., anthers 2.7–4.4 $\times$ 0.8–1.1 mm; pollen 25–30 $\times$ 20–30 μ m, tectum on non-apertural face coarsely perforate to reticulate; gynoecium 2.5–3.5 $\times$ 1.6–2.1 mm, carpels 1.1–1.8 $\times$ 0.9–1.4 mm, reddish, styles 1.4–2.0 mm long, cream-colored. Fruit 1.6–2.1 cm diam. Seed 1.0–1.3 $\times$ 1.2–1.5 cm. (Figs. 2, 3, 5c, 6b, 8c & d, 9, 10, 12).

DISTRIBUTION: Extreme SE Nicaragua and on both the Caribbean and Pacific slopes in Costa Rica and Panama, 350–1,000(–1,400) m, typically in premontane, sometimes lowland, wet forests (Fig. 11).

ADDITIONAL SPECIMENS EXAMINED: NICARAGUA. Río San Juan. Reserva Indio Maíz, Municipio de San Juan del Norte, Cerro El Gigante, 10°46'N, 83°53'W, *Rueda et al.* 4537 (MO), 9042 (MO). COSTA RICA. Alajuela. Cordillera de Tilarán, northern margins of Laguna Cote, 10°34'30"N, 84°54'30"W, *Evans et al.* 2751 (BH, MO); Guatuso Cantón, Cordillera de Tilarán, Laguna Cote, 5 km norte de Finca Cote Hotel Ecolodge, 10°35'20"N, 84°55'50"W, *Rivera & Petrucci* 2897 (INB, MO, US). Limón. Parque Internacional La Amistad, Fila Tsiurábeta, entre Ríos Urén y Lari, 9°27'30"N, 83°00'00"W, *Chacón* 290 (CR, INB); Reserva Indígena Talamancá, 9°27'00"N, 82°59'30"W, *Hammel et al.* 17623 (CR). Puntarenas: Cantón de Parrita, Fila Chonta, camino de San Marcos de Tarrazú a Cerro Cura, La Virgen, y Fila Chonta,

9°35'N, 84°10'W, Hammel *et al.* 21192 (INB); Cantón de Parrita, Cuenca del Pirris-Damas, Fila Chonta, Sector SE, 9°35'05"N, 84°10'25"W, Morales & Abarca 6298 (INB, MO). PANAMA. Chiriquí. Fortuna Dam area, along Quebrada Los Chorros, to N of reservoir, 08°45'N, 82°14'W, Churchill & Churchill 6035 (MO, US). Coclé. continental divide N of Penonomé on road to Coclesito, small patch of forest at roadside, Hammel 4033 (MO). Panamá. On road near slopes of Cerro Jefe, Antonio *et al.* 3384 (MO); Cerro Jefe, Carrasquilla 2134 (PMA), Dressler 2898 (BH, US), 3607 (PMA, US), Henderson & Bernal 2054 (NY, PMA), Henderson & Ferreira 3046 (NY, PMA), Moore *et al.* 10519 (BH); Cerro Jefe, summit near radio towers, 09°14'N, 79°23'W, Churchill 3930; 2.4 mi beyond Cerro Jefe on road to Altos de Pacora, along flat area before reaching summit, Croat 22669 (K, MO, NY); Cerro Jefe, along road W of hilltop, Hammel 4401 (BH, MO); road to Cerro Jefe, at turnoff to Alto Pacora, Henderson & Herrera 702 (BH, K, NY); E slope of Cerro Jefe, 10.5 km by road NE of Cerro Azul, Nee 11451 (BH, MO); summit of Cerro Jefe, Read *et al.* 79200 (US). San Blas. El Llano—Cartí, 5 km beyond Nusagandi, Henderson 083 (PMA); Road El Llano—Cartí Road, 24.5–25 km from Interamerican Hwy., near continental divide, Mori & Kallunki 5560 (MO); El Llano—Cartí Road, 22–24.5 km from Interamerican Hwy., 9°19'N, 78°55'W, de Nevers & Herrera 4260 (MO); Cerro Brewster, 9°18'N, 79°16'W, de Nevers *et al.* 4023 (MO), 5567 (MO, PMA), 6305 (NY).

HABITAT: *Colpothrinax aphanopetala* is most frequently encountered on the upper slopes and crests of ridges of premontane wet forests above 700 m elevation (Fig. 10), in association with *Euterpe precatoria* Mart. However, *C. aphanopetala* has been found to as low as 350 m elevation and sometimes occurs in areas with little or no topographic relief. For example, at Laguna Cote in Costa Rica *C. aphanopetala* is restricted to the low-lying, partially inundated margins of the lake, where it grows in saturated soil and emerges above a low-forest dominated by *Astrocaryum alatum* H. F. Loomis and *Heliconia*. Another noteworthy population of *C. aphanopetala* is that on Cerro Jefe in Panama. Adult *C. aphanopetala* in the windswept low-forest on Cerro Jefe are approximately half the size of typical adults elsewhere. The same phenomenon also appears to have produced the smaller-than-average *C. aphanopetala* found on the low, but isolated, often storm-swept Cerro El Gigante, which is only about 30 km inland from the Caribbean coast in extreme southeast Nicaragua.

LOCAL NAMES: *udirbi* ("Kuna"), *guágara*. [These names are cited on a single collection of *C.*

aphanopetala from Panama (de Nevers and Herrera 4260). The name *guágara* was probably mistakenly attributed to *C. aphanopetala*, as it is commonly used in Panama and Costa Rica for the sympatric palmate-leaved palm *Cryosophila warscewiczii* (H. Wendl.) Bartlett.]

Colpothrinax aphanopetala is easily and unambiguously identifiable when in flower, even if only in bud, or in fruit. The red calyx, small, pink-tinted, membranous corolla lobes (unique among all palms in the subtribe Livistoninae), which are persistent in fruit, and three distinct, red carpels are diagnostic (Fig. 12). The pinkish higher-order inflorescence branches (Fig. 3, left) also distinguish *C. aphanopetala* from both *C. wrightii* and *C. cookii*.

The trunk of *C. aphanopetala* is not swollen as in *C. wrightii*. Based on the available data (i.e., the relatively few, mostly incomplete herbarium specimens), *C. aphanopetala*, however, cannot be distinguished reliably from *C. cookii* when sterile. Although *C. aphanopetala* appears to have smaller leaf blades that are more deeply divided, at least laterally, and shorter petioles with smaller hastulas, the overlap between the two taxa for these characters is too great for them to be of any practical utility for identification purposes. This does not necessarily indicate, however, that *C. aphanopetala* and *C. cookii* have not diverged vegetatively. Extensive fieldwork involving detailed observations and measurements of individuals from multiple populations throughout the ranges of both species would probably yield subtle morphological differences in vegetative (and other reproductive) characters that cannot be represented adequately on herbarium sheets. This has proven to be the case with other genera of coryphoid palms (e.g., *Cryosophila*, see Evans 1995; *Thrinax*, see Read 1975). Fortunately, the floral morphologies of *C. aphanopetala* and *C. cookii* are so strikingly different that as long as flowers or fruit (with their persistent calyx and corolla lobes) are present, herbarium specimens are sufficient for easy and unambiguous identification to species.

The reddish flowers of *C. aphanopetala* are visited by large numbers of a variety of bees [e.g., *Trigona* (Apidae: Meliponinae)] and flies (e.g., Syrphidae) during anthesis, suggesting one or both of these groups of insects as potential pollinators. One species of syrphid fly (Fig. 12) has been observed visiting flowers at various stages of floral maturation making them particularly likely pollinators since the stigmas do not appear to be receptive until after the anthers have fallen. Due to the small size of the corolla lobes in *C. aphanopetala*, the reproductive parts are never

enclosed within the corolla as is the case with the probably beetle-pollinated *C. cookii*.

The only reported use for *C. aphanopetala* has been the leaves for thatching (*de Nevers & Herrera 4260*).

The specific epithet refers to the small, membranous, and not readily apparent corolla lobes of this species.

2. *Colpothrinax cookii* Read, *Principes* 13: 13. 1969. Type: GUATEMALA, Alta Verapaz: Sepacuite coffee estate, north of Panzós, on the northern slope of the principal range of mountains crossed leaving the Polochic Valley, 1200 m, 22 March 1902, *Cook & Griggs 116* (holotype: US!; isotype: BH!).

Trunk (5–)10–20 m tall, erect, 15–25 cm dbh, columnar, usually naked, sometimes, particularly in closed forest, upper portion partially or completely enclosed in a mat of persistent leaf-sheath fibers; trunks of juveniles less than ca. 6–8 m tall usually completely enclosed in this mat; mat, when present, usually 20–30 cm thick. Leaves 15–ca. 30; petiole (1–)1.5–2.5(–3) m long, 2.3–3.4 cm wide at attachment to blade; sheath tomentose, the trichomes of two intermixed types: 1) soft, stellate trichomes, ca. 0.5 mm long, basally ferruginous, with free, white distal ends and 2) coarser, longer, wavy, twisted, compressed trichomes, these larger trichomes sparsest, shortest (ca. 1.5 mm long), and lightest in color ($\pm$ tannish) on the basal portion of the sheath, becoming progressively denser, longer (to 9 mm long), and darker (rufous) distally; sheath disintegrating and fraying into fine, loosely woven, pendulous, filiform, typically $\pm$ terete fibers, 0.3–0.5 mm diam.; hastula appressed to or slightly elevated above the blade, 2.3–3.4 $\times$ 2.4–3.9 cm, 0.7–1.4 times as wide as long, broadly to very broadly triangular, usually cuspidate apically; costa 16.5–38.5 cm long; blade 131–170 cm long centrally, 62–136 cm long laterally, divided into single-fold segments, except for lateral-most segment of each blade half, composed of 2(–4) folds; central division extending to within 46–67 cm of (1/2–2/3 to) base, the lateral-most division extending to within 11.5–19.0 cm of (ca. 4/5 to) base; folds per blade half 25–35; widest single-fold segment 4.3–5.0 cm wide. Inflorescences with flowers or fruit to ca. 5(–8), plus ca. 5(–7) marcescent; primary-axis 1.2–2.1 m long; inflorescence bracts lanate, with trichomes 2–8 mm long; peduncle 0.2–0.8 m long; prophyll ca. 25 $\times$ 8.0–10.0 cm; peduncular bracts 6–7, 27.0–45.0 cm long; rachis 0.9–1.4 m long; rachis bracts 14.0–47.0 cm long; first-order branches 9–12; axes creamy yellow, their primary-axes 12.0–58.5 cm

long, with unbranched proximal portion 2.5–37.0 cm long, the branched distal portion 6.0–32.0 cm long; prophyll 10.5–40.5 cm long; rachillae typically 40–50 per basal first-order branch, 10–20 per apical first-order branch, 3.0–15.5 cm long, tomentose, the trichomes (tannish to) ferruginous, 0.2–0.3 mm long; flower-bearing spurs 0.2–0.8(–1.2) mm long, the subtending bracteole 0.7–2.0 mm long, 0.4–1.0 mm wide basally. Floral receptacle 0.7–1.7 mm long; calyx 3.5–5.4 mm long, free distally from corolla for 1/2–2/3 its length, creamy yellow, the lobes 0.5–0.8 mm long; corolla 4.0–6.0 mm long, connate basally for 1/5–1/3 its length, mostly creamy yellow, the lobes valvate, with parallel sides and mucronulate apices, fleshy, adaxially furrowed with involute or thickened margins, forming a hood apically, persistent; filaments 2.1–4.0 mm long, connate basally for 1.1–2.0 mm (2/5–3/5 their length), cream-colored, stamen-cup shorter than or $\pm$ same length as calyx-cup, 1.5–2.2 mm diam., anthers 2.3–3.5 $\times$ 0.9–1.3 mm; pollen 25–30 $\times$ 20–30 μ m, tectum on non-apertural face coarsely perforate to reticulate; gynoeceum 2.5–3.4 $\times$ 1.1–1.6 mm, carpels 1.1–1.6 $\times$ 0.7–1.3 mm, cream-colored, styles 1.5–2.2 mm long, cream-colored. Fruit 1.6–2.1 cm diam. Seed 1.0–1.2 $\times$ 1.3–1.5 cm. (Figs. 4, 5b, 6a, 8a & b).

DISTRIBUTION: Belize, Guatemala, and Honduras, 700–1,200(–1,600) m; typically in premontane, sometimes lower montane, wet forests on the Caribbean slope (Fig. 11).

ADDITIONAL SPECIMENS EXAMINED: BELIZE. Cayo. Vicinity of Doyles Delight, southern Maya Mountains, 16°30'N, 89°03'W, *Allen 15220* (MO). Toledo. Vicinity of Doyles Delight, southern Maya Mountains, 16°29'N, 89°02'W, *Allen 15450* (MO, US); southern Maya Mountains, Bladen Nature Reserve, ridge just south of the main divide of the Maya Mountains, 16°29'40"N, 88°59'33"W, *Davidse & Holland 36808* (BH, F, MEXU, MO); southwestern Maya Mountains, Columbia River Forest Reserve, Little Quartz Ridge, 16°24'25"N, 89°06'07"W, *Holst 4333* (MO, US); Columbia Forest Reserve, Little Quartz Ridge, slopes on SW end, 16°23'56"N, 89°06'55"W, *Holst & Meadows 5747* (BH, K, MO, NY). GUATEMALA. Alta Verapaz. Sepacuite, *Cook & Doyle 156* (US), *163* (US), *166* (US), *174* (US); near the Finca Sepacuite, *Cook & Griggs 115* (US), *117* (US). HONDURAS. Atlántida. narrow crest of ridge leading up to Pico Bonito from the NE (from near the Río Bonito at its confluence with large quebrada), 15°38'N, 86°52'W, *Evans 2547* (MO); Cordillera Nombre de Dios, fila de la Lora, between Quebrada El Manchón and Quebrada San José, ca. 2 km N of El Manchón, 15°28'N, 87°07'30"W, *Evans et al.*

2743 (BH, MO). Yoro. ridgetop above Río Texíguat, near Cerro Cabeza de Negro, along trail from San José de Texíguat (at the Río Guán Guán) to Campo Nuevo, 15°28'N, 87°26'30"W, *Evans* 2312 (BH, COL, EAP, F, FTG, GH, INB, K, MO, NY, PMA, US).

HABITAT: *Colpothrinax cookii* is restricted to the upper slopes and crests of ridges of premontane wet forests above 700 m elevation and, like *C. aphanopetala*, often occurs in association with *Euterpe precatoria* Mart.

LOCAL NAMES: *guanu* (Belize); *xan* ("Kekchi", Guatemala), *shan* (Guatemala); *suyate*, *suyate Colorado*, *caral*, *guano* (Honduras).

Colpothrinax cookii differs from *C. wrightii* in its cylindrical, non-swollen trunk, larger fruits and seeds, and more persistent corolla lobes which do not have a basal line of abscission. Its large, fleshy, yellow petals and yellow higher-order inflorescence branches (Fig. 4) differentiate it from *C. aphanopetala*. *Colpothrinax cookii* cannot, however, be differentiated from *C. aphanopetala* when sterile. Although *C. cookii* often has larger leaves (blades and petioles) than *C. aphanopetala*, this tendency is not useful for identification purposes (see discussion under *C. aphanopetala*).

Both staminate and pistillate anthesis in the strong-smelling, creamy yellow flowers of *C. cookii* appear to occur while the reproductive parts are still enclosed within the unopened corollas, suggesting beetle pollination (Henderson 1986).

The leaves of *C. cookii* are sometimes used for thatching and for making brooms. Local people in Honduras and Belize (Gerrit Davidse, pers. comm.) have admitted to setting fire to the mat of highly flammable leaf-sheath fibers enclosing the trunks of some individuals merely for the pyrotechnic display.

Read (1969) named *Colpothrinax cookii* in honor of Orator Fuller Cook, who, along with R. F. Griggs, first collected this species (*Cook & Griggs* 115, 116, 117) and also first recognized that it represented a new taxon.

3. *Colpothrinax wrightii* Griseb. & H. Wendl. ex Siebert & Voss ("wrightii"), Vilm. Blumengärtn. ed. 3, 1: 1147. 1895 ["1896"]. *Pritchardia wrightii* (Griseb. & H. Wendl. ex Siebert & Voss) Becc., *Webbia* 2: 203. 1907. Type: CUBA. Pinar del Río. pinales and savannas, September 1865 or 1866, *Wright* 3964 [neotype: GH!; isoneotypes: B (destroyed, photo at BH!, FI-B), GOET (photo at MO!), K!, NY!].

Trunk 6–12(–15) m tall, erect, 15–20 cm dbh, swollen beginning 2–3 m above ground, 30–40(–50) cm diam., naked; trunks of juveniles

less than ca. 3–5 m tall usually enclosed in a mat of persistent leaf-sheath fibers, 5–10 cm thick. Leaves usually 10–20; petiole ca. 1–1.5 m long, 3.7–4.6 cm wide at attachment to blade; sheath glaucous, disintegrating and fraying into a coarse, fibrous, nonpendulous network, the individual fibers somewhat serpentine and twisted, typically compressed, 0.6–0.8 mm broad; hastula elevated above the blade, 1.7–2.8 × 4.8–5.8 cm, 2.1–2.8 times as wide as long, depressed to very depressed-triangular, obtuse and ± notched apically; costa 19.5–25.0(–38.5) cm long; blade 142–171 cm long centrally, 39–44 cm long laterally, divided into single-fold segments; central division to within 76–111 cm of (1/3–1/2 to) base, the lateral-most division extending to within 1.5–2.5(–3.5) cm of (> 90% to) base; folds per blade half 36–45; widest single-fold segment 3.4–5.0 cm wide. Inflorescences with flowers and fruit to ca. 5, plus ca. 10 marcescent per individual; primary axis ca. 1.5 m long; inflorescence bracts lanate, with trichomes 2–3 mm long; peduncle ca. 0.4 m long; prophyll ca. 20 × 5 cm; peduncular bracts ca. 6, 22.0–54.5 cm long; rachis bracts 10.5–65.5 cm long; first-order branches 6–10; axes creamy yellow initially, becoming orange in fruit, their primary-axes 3.0–73.0 cm long, with unbranched proximal portion 2.0–54.5 cm long, the branched distal portion 1.0–27.0 cm long; prophyll 8.5–44.5 cm long; rachillae typically 20–50 per basal first-order branch, <10 per apical first-order branch, 3.5–17.5 cm long, tomentose, the trichomes whitish (to ferruginous), 0.4–0.5 mm long; flower-bearing spurs 0.2–0.4 mm long, the subtending bracteole 0.8–1.7 mm long, 0.5–0.9 mm wide basally. Floral receptacle 0.8–1.2 mm long; calyx 2.3–3.3 mm long, free distally from corolla for 1/4–1/2 its length, yellow, with lobes 0.2–0.7 mm long; corolla 5.3–6.2 mm long, yellow, the lobes valvate, with parallel sides and mucronulate apices, fleshy, adaxially furrowed with involute or thickened margins, forming a hood apically, deciduous, with a clear line of abscission; filaments 3.2–4.5 mm long, connate basally for 2.0–2.7 mm (1/2–3/4 their length), stamen-cup much longer than calyx-cup, 1.5–2.7 mm diam., anthers 2.2–3.9 × 0.8–1.2 mm; pollen 30–40 × 25–35 µm, tectum on non-apertural face foveolate; gynoecium 3.5–4.9 × 1.2–2.0 mm, carpels 1.1–1.6 × 0.7–1.3 mm, styles 2.2–3.4 mm long. Fruit 1.1–1.6 cm diam. Seed 0.7–0.9 × 0.9–1.1 cm. (Figs. 1, 5a, 7).

DISTRIBUTION: Southwestern Cuba and the nearby Isle of Youth (formerly Isle of Pines), 0–ca. 200 m; semidry savannas and grasslands (formerly pine forests) on white sand (Fig. 11).

ADDITIONAL SPECIMENS EXAMINED: CUBA. Cienfuegos. Harvard Botanical Garden, Soledad,

Bailey 12366 (BH), *12367* (BH), *Jack 8269* (BH, GH, US), *Moore 6092* (BH). La Habana. Isla de Pinos [Isla de la Juventud], San Pedro, *Britton & Wilson 14548* (BH, NY, US); Isla de Pinos, near Nueva Gerona, *Curtiss 364* (BH, GH, K, MO, NY, US). Pinar del Río. Consolación del Sur, *Bailey 12504* (BH), *Bailey 12504x* (BH), *Bailey 12516* (BH), *Roig s.n.* (BH); vicinity of Herradura, *Britton et al. 6464* (NY); between Pinar del Río and Coloma, *Britton et al. 9675* (K, NY); Herradura, *van Hermann 301* (NY), *León 14651* (GH), *León 15934* (GH), *Shafer 424* (BH, NY); near Consolación del Sur, *Moore 6807* (BH).

HABITAT: The climate where *C. wrightii* occurs is classified as dry tropical (Borhidi 1996). The area has a 5–6 month dry season with an annual precipitation of only 750–1,600 mm. However, during the rainy season (approximately April to September) some lands are periodically inundated (Zona et al. 2000). *Colpothrinax wrightii* originally occurred on white sand in open pine (*Pinus tropicalis* Morelet) forests, in association with the understory palm *Acoelorrhaphe wrightii* (Griseb. & H. Wendl. ex Becc. (Borhidi 1996). These forests have now virtually all been converted to savannas or pastures as a result of logging and subsequent burning and/or grazing. It was usually the pines in the original forest that were targeted by loggers. However, *C. wrightii* has also been much exploited locally, the swollen “pot-belly” of the trunk being used for such things as water containers, furniture, and even beehives (Alain 1961; Moya & Leiva 2000). Non-destructive uses include removing leaves for thatching and gathering fruits for feeding pigs (Moya & Leiva 2000; Zona et al. 2000). Despite the elimination of its natural habitat and its exploitation *C. wrightii* has continued to survive in populations of scattered individuals in the shrub and grasslands and the species was recently given special protection regulating its use (Moya and Leiva 2000).

LOCAL NAMES: *barrigona*, *palma barrigona* (“pot-bellied palm”), *palma barrigona de la Vuelta Abajo* [to distinguish from (*palma*) *barrigona de sierra*, *Gastrococos crispa* (Kunth) H. E. Moore, another Cuban endemic] (Sauvalle 1871, 1873; Roig y Mesa 1928).

Colpothrinax wrightii is characterized by its swollen trunk. This feature, in combination with its costapalmate leaves, distinguishes *C. wrightii* from all other Cuban palms. The only other Cuban “pot-belly” palm, *Gastrococos crispa* (Kunth) H. E. Moore has pinnate leaves. Within *Colpothrinax*, the small fruits and seeds of *C. wrightii* are also diagnostic, as are the clear line of abscission at

the base of the deciduous corolla lobes and the relatively long stamen-cup.

The deciduous corolla lobes and long stamen-cup of *C. wrightii* flowers are also characteristics of the flowers in *Pritchardia*, suggesting these to be the ancestral *Colpothrinax* states and therefore the persistent corolla lobes and short stamen-cup of *C. aphanopetala* and *C. cookii* flowers are derived.

Charles Wright collected plants for Asa Gray at Harvard University, throughout the island of Cuba, during the years 1856–1867 (Howard 1988). In September 1865 or 1866, he collected a palm (*Wright 3964*) known locally as “palma barrigona” in the Vuelta Abajo area of western Cuba. A specimen of this palm was sent to Hermann Wendland, Director of the Royal Gardens in Herrenhausen, Germany for determination. Apparently, Wendland considered this palm to belong to a new species and genus and informally assigned to it the name *Colpothrinax wrightii*. Wright was given this information, and he, in turn, forwarded it to Francisco Sauvalle, a rich landowner and amateur botanist. Sauvalle included the name (attributing it to Wendland and A. H. R. Grisebach) without description, along with the local Cuban name, in his *Flora Cubana* (1871) [entry 2382 (2381 in the 1873 edition)]. This list was essentially an update and revision of Grisebach’s *Catalogus Plantarum Cubensium* (1866) that incorporated new taxa collected by Wright during his last two years in Cuba, and not seen by Grisebach. Subsequently, O. C. de Kerchove de Denterghem also used the name *Colpothrinax wrightii* in his *Les Palmiers* (1878), but again without description. The genus *Colpothrinax* was not formally established until the following year (Wendland 1879), and the first valid publication of *Colpothrinax wrightii* (misspelled as “*wightii*”) did not appear for another 16 years (Siebert and Voss 1895). Although Siebert and Voss ascribed the name to Grisebach and Wendland, they cited no specimens as the basis for their description. Quite possibly they never saw a specimen, their description being based solely on information provided by Wendland and/or Grisebach. The most likely specimen they might have seen was formerly deposited in the Krug and Urban Herbarium in Berlin, where both Siebert and Voss resided at the time of their publication of *Colpothrinax wrightii*. Although this specimen was destroyed, it was photographed by Beccari (photo at BH, which indicates the negative as being at FI-B). Andreas Voss was formerly University Gardener at Göttingen (1882–1890), so he potentially could have seen the specimen of *Wright 3964* in Wendland’s herbarium in nearby

Herrenhausen. However, there are no annotations by either Siebert or Voss on any known extant specimens of *Wright 3964* (nor on the sheets photographed at B). Therefore, unless new information becomes available that clearly demonstrates Siebert and Voss based their description on *Wright 3964* at B, or GOET (where the Wendland Herbarium is now housed), or some other herbarium (it is certain they did not see the sheets of *Wright 3964* kept by Gray at Harvard University), lectotypification is not possible. Therefore Glassman's (1972) designation of the GH specimen as type is interpreted as neotypification.

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An Interesting Population of *Phytelephas* from Panama

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1. A typical example of a female *Phytelephas seemannii*; note prostrate stem to the right of the palm base.



The only reported species of phytelephantoid palm in Panama is *Phytelephas seemannii*. Here, evidence is provided for an unusual population of *Phytelephas* from Panama.

The genera of subfamily Phytelephantoideae are distributed from Panama to Bolivia. Although neighboring Colombia contains five species of phytelephantoid palms, only one species is recognized from Panama, *Phytelephas seemannii* Cook (Fig. 1). Barfod (1991) recognized two subspecies of *P. seemannii* (ssp. *brevipes* and ssp. *seemannii*), based on stem habit and the variable characters of staminate rachis length and number of fruit locules. Henderson et al. (1995), however, considered that subspecific separation was unwarranted because stem habit is a variable character.

Throughout 1997 and 1998 I worked in eastern Panama, studying the natural history, demography, growth, and reproduction of *Phytelephas seemannii*, known locally as *tagua* (Velásquez Runk 1999). I also studied the socioeconomics of Wounaan and Emberá art produced from the seeds of *P. seemannii*. During that research, I found virtually all *tagua* populations to fit within a combined description of *P. seemannii* ssp. *brevipes* and *P. seemannii* ssp. *seemannii* – palms with decumbent stems or occasional palms with inclined stems. In 1997 we came across a population of phytelephantoid

palms with erect stems in a floodplain area of Comarca Cémaco (an Emberá and Wounaan indigenous reservation) of northeastern Panama (Fig. 2). None of these individuals had decumbent stems. In addition, local residents and artisans considered them to be different from the typical *tagua*. Because of subsequent political instability in the area of this stand, I have not been able to return to collect these palms, but rely here upon photographs and familiarity with the typical *P. seemannii*. The purpose of this note is to bring attention to this unusual population of phytelephantoid palm.

Phytelephas seemannii

Phytelephas seemannii typically has a prostrate, creeping stem, although occasionally individuals are found with an erect, inclined stem (Fig. 1). This varied growth form for *P. seemannii* was analyzed by Bernal (1998b) in Colombia. Bernal attributed the creeping aspect of the stem to be a result of "oblique orthotropic growth combined with gradual subsidence due to the crown's own weight, accumulated litter, or the impact of falling branches." As the stem grows and the crown rotates toward areas of higher light, the torque may become too strong, and the stem becomes uprooted or breaks (Bernal 1998b). This explains why *P. seemannii* palms exhibit a creeping habit with curved stems or erect, yet inclined, stems. In the former case, the palm crown is typically only 1 m off the ground and in the latter case, the crown is typically only 2–4 m off the ground; the growth form does not permit the existence of tall palms. The stem of the inclined palm of Fig. 1 demonstrates no internode elongation and broad nodes (Fig. 3).

Phytelephas seemannii is a lowland rainforest palm. In Panama, *tagua* palms are often found in high-density stands, or *taguales*, that may contain from 270–450 mature individuals per hectare (Velásquez Runk 1999), with the highest densities of individuals on sub-montane sites (Dalling et al. 1996). *Phytelephas seemannii* also is found sparsely distributed along creeks, rivers, and flood terraces, where its heavy seeds presumably have been dispersed by floodwaters (Velásquez Runk 1999; Bernal, pers. obs. in Henderson et al. 1995). In north-western Colombia, the typical distribution for *P. seemannii* is in dense stands along floodplains (Bernal 1998a).

Interesting *Phytelephas* Population

During a trip to scout sites for permanent research plots for *tagua*, we came across an unusual population of palms. They were clearly phytelephantoid – dioecious, with pinnate leaves,

strongly dimorphic flowers, and large, club-like infructescences. We determined that they belonged to the genus *Phytelephas* because they did not have the rounded petioles of *Ammandra* or the fibrous leaf sheaths and scaly petioles of *Aphandra*. All palms had erect stems to 15 m tall (Figs. 2). Although stem habit may be seen as a variable character, no individuals in this population were seen with decumbent or prostrate stems. At 15 m the stems were significantly taller than the 4 m maximum for *P. seemannii*. In addition, the leaf bases of these palms appear distinct from those of typical *P. seemannii* as evidenced by the nodes (Fig. 4). This difference is particularly noticeable when compared to the inclined stem of typical *Phytelephas seemannii*. Our local guides seemed to think this was a faster growing palm than the decumbent *P. seemannii*. Visually, staminate and pistillate inflorescences appear similar to those of *P. seemannii*. Based entirely on photographic records that unfortunately reveal few details of the flowering parts, Barfod (pers. comm.) tentatively suggests that the pistillate inflorescence may differ from the typical *Phytelephas seemannii* by having curled tepals. This population of palms did not fit the



2. Guides Yofry Garabato and Alber Chocho beside a female palm from the unusual population of *Phytelephas*.



3 (left). Stem portion of *Phytelephas seemannii*. 4 (right). Stem portion from a palm in the unusual population of *Phytelephas*.

description of other known *Phytelephas* species, although it is perhaps closest to a revised description of *P. aequatorialis* (Bernal, pers.comm.).

In addition to the stem, the other distinctive character of this palm is the seed. At this site, we found relatively few seeds when compared to other *taguales*. I later learned that *tagua* carvers prefer the seeds from this area because they consider them larger (Fig. 5). Most noticeably, the umbo of the seed is distinctly larger and protrudes much more over the seed than in typical *P. seemannii*. Although this might be considered a variable character, in thousands of seeds that we weighed and measured in our *P. seemannii* permanent plots as well as seeds collected in other *taguales*, we did not find seeds with this large, protruding umbo. In addition, if during interviews I found that artisans or vendors possessed a large seed with a protruding umbo, it was invariably from this area of north-eastern Panama, ranging from just south-west of the continental divide to the Caribbean. Carvers also said that these seeds were easier to carve than seeds of typical *P. seemannii*.

The palms were found in the flood terrace and adjacent slopes of a small river, with a density of approximately 200 mature individuals per hectare (although sparsely distributed individuals were

seen further down-river). In a similar floodplain habitat of south-eastern Panama, only typical, decumbent *Phytelephas seemannii* palms were found. It is interesting to note that these taller palms are found west of the continental divide (N 8° 40'25.69", W 77° 36'55.86" within the Comarca Cémaco of Darién Province, location determined with a GPS unit). One might speculate that *P. seemannii* has a Pacific-slope distribution and the erect palm has a more Caribbean-slope distribution. The only Caribbean slope site that I was able to visit was further west at Río Guanche, near the city of Colón. In that site, only typical *P. seemannii* was seen. The collections cited in Barfod (1991) from the Caribbean slopes are mostly incomplete, historical specimens. Unfortunately, several subsequent attempts to collect this palm were unfruitful, as political instability in this area has increased since early 1997. Collecting on the Caribbean side remains a possibility within the Comarca de San Blas (Kuna Yala). Future collectors need to co-ordinate their efforts with the indigenous leadership (*Congresos*) on both sides of the *Comarca* border (that border coincides with continental divide). Further collections and research on these palms would be extremely useful to support indigenous leadership in managing them for the artesanal carving industry.



5. Left, seed of *Phytelephas seemannii* and right, seed from the unusual population of *Phytelephas*. Note the pronounced umbo of the seed on the right. (Photo by John Tuxill).

Conclusion

I present recent evidence from Panama of an interesting population of *Phytelephas*. These palms present similar leaf and inflorescences to *P. seemannii*. However, they have an erect stem, different nodes, greater height, and larger seeds with a protruding umbo. Further research is necessary to determine whether a distinct subspecies or species of *Phytelephas* occurs on the eastern edge of the Comarca Cémaco and the Caribbean slope of Panama.

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Pinanga andamanensis – a Vanishing Endemic Palm of the Andaman Islands

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The pristine tropical rain forests of the Andaman and Nicobar Islands are the abode of several endemic and endangered organisms. According to current information, there are about 3000 plant species in the flora, of which 2000 are Angiosperms (Balakrishnan & Ellis 1996), including two endemic species of *Pinanga*.

The Bay Islands or the Andaman and Nicobar Archipelago constitute about 320 islands and islets, situated far off from the eastern coast of India, between the longitudes 92°–94° E and latitudes 6°–14° N in the Bay of Bengal. These islands offer a total land area of 8249 km² with a coastal line of 1962 km. The islands lie close to the Equator, and have a tropical humid climate, with an average temperature ranging from 22°C to 33°C with mean relative humidity 82% and annual average rain fall varying from 300 cm to 380 cm, that facilitates luxuriant growth of tropical rain forests. The Andaman rain forests are of a wet evergreen type with minor variations in accordance with the amount of rainfall, altitude, wind speed, soil type etc.

The palms occurring among the islands of Andaman and Nicobar show a remarkable degree of endemism and have a wide range of distribution from the saline mangroves to the hilltops. From an economic point of view, the insular rattans, especially *Calamus andamanicus*

Kurz and *C. longisetus* Griff., are the best raw materials for rattan industry. The Bay Islands and their palms are of great interest. The insular rain forests of these islands are considered to be one of the centers of origin of popularly cultivated palms such as the coconut and areca nut (Balakrishnan & Nair 1979; Mathew & Abraham 1994). The apparent wild occurrence of coconut and areca nut palms (Kurz 1876) with several intraspecific variants in the uninhabited islands of the Archipelago and the occurrence of a wild crab, popularly known as 'Robber Crab' (*Birgus latro* L.), that feeds on coconut kernel represent significant evidence in suggesting that these islands may be one of the centers of origin of these widely cultivated species.

According to current information, the Bay Islands are known to host about 43 species of palms, including six exotic species, in 19 genera (Vasudeva Rao 1986, Mathew 1998). Thirty seven species in 14 genera are indigenous, with 21 being endemic. About 16 species are categorized as rare or endangered.



1 *Pinanga andamanensis* Becc. under *ex situ* conservation at field gene bank, TBGRI, Trivandrum.

Pinanga Bl. is represented in the Andaman and Nicobar Islands by only two species, *Pinanga andamanensis* Becc. and *P. manii* Becc., and both are endemic (Balakrishnan, 1977). Records of *Pinanga kuhlii* Bl. (Parkinson 1923) and *P. costata* Bl. (Kurz 1877), now both regarded as synonyms of *P. coronata* (Bl. ex Mart.) Bl., from the Andaman Islands presumably refer to *Pinanga andamanensis*. Since specimens are not traceable, our knowledge of the occurrence of this species is confined only to the type collection (Basu 1986) until recently.

Pinanga andamanensis and *P. manii*. are critically endangered and are known to occur only in small populations on South Andaman and Nicobar Islands. The former is found growing in evergreen forest patches of South Andaman while the latter survives in evergreen and semi-evergreen forest and has an extended distribution to the Great Nicobar Island. Their restricted geographical distribution with very limited existing populations means that they have been included in the Red Data Book of the Indian plant species (Basu 1988).

Pinanga andamanensis was described by Odoardo Beccari in 1934 based on an old collection made in the latter part of 19th century by E.H. Man, who was the assistant superintendent of the Andaman Administration during the British regime. After the type collection, this species had not been reported until 1992 (Mathew & Malick 1992). While working on the flora of the South Andaman Islands, Mathew and Malick came across some unidentified herbarium specimens collected by D.K. Hore in 1982 from the Mount Harriet hill ranges at Botanical Survey of India, Port Blair (PBL). Critical studies revealed that these specimens belong to *Pinanga andamanensis*, confirming the existence of this endemic and critically endangered insular palm previously thought to be extinct.

Conservation Scenario

According to current information, endemism in the palm flora of the islands is over 50% and a sum of 40% of the total palm species are thought to be in some way rare or endangered (Mathew & Abraham, 1994). However, no detailed survey was conducted so far on the actual population status of the insular palms. The insular palms are characterized by small gene pool, reduced outbreeding, natural geographical barriers to the extension of their range and frequent catastrophic events such as cyclones, earthquakes, volcanic eruptions, etc. The restricted ranges highlight the urgent need for a detailed survey and mapping of insular populations of palms and measures for their *in situ* and *ex situ* conservation.

Realizing the necessity of insular germplasm conservation, the Tropical Botanic Garden and Research Institute (TBGRI), located at the foothills of the Southern Western Ghats, has made an attempt to conserve endemic and endangered insular palms of the Andaman Islands and to preserve their germplasm in the field gene bank established at the institute. A team of scientists from the institute conducted exploration during April–May in 1994 with the intention to locate natural populations of *Pinanga andamanensis* using the recent report by Mathew and Malick based on the few herbarium collections by Hore from the Mount Harriet hill ranges. During an intensive floristic survey of the Mount Harriet hill ranges we were able to locate a population of *Pinanga andamanensis* on the way to Old Maduban at an altitude about 456 m. Mature fruits were collected and carefully brought to TBGRI. Several germination trials under different conditions were carried out resulting in successful germination. About 20 individual plants were planted at field gene bank plots (Fig. 1). The climatological features of the Western Ghats and the Andaman Islands are similar, even though they have been widely separated by the Bay of Bengal, and these palms thrive at the TBGRI field gene bank.

Taxonomic description

Pinanga andamanensis Becc. in Martelli, l.c. Atti. Del. Soc. Tosc. Sci. Nat. 44: 121. 1934; Balakr., Bull. Bot. Surv. India 19: 132. 1978; Basu, J. Econ. Taxon. Bot. 7: 493. 1985; Nayar & Sastry, Red Data Book 2: 34. 1988; Mathew & Malick, Bull. Bot. Surv. India 34: 227–229. 1992; Mathew, J. Econ. Taxon. Bot. 22: 254. 1998.

Unarmed palms 5–6 m tall with slender distinctly ringed stems 10–15 cm diam. Leaves similar to areca palms; leaflets 50–65 × 2–3 cm, falcate to linear lanceolate with acuminate apex, binerved. Inflorescence monoecious, infrafoliar, distichously branched with flowers in triads of two lateral male flowers with a middle female one, flower clusters arranged longitudinally in two rows. Male flowers 4–5 mm diam., obliquely triquetrous, pinkish; sepals 3–4 × 1–2 mm, ovate with acute apex, valvately arranged; stamens 2–3 mm long basifixed with linear anthers. Female flowers much smaller than male flowers, 1–2 mm across, globose hidden between male flowers; sepals 1–1.5 × 0.5–1 mm, orbicular or broadly ovate with acute apex, imbricately arranged; petals 1–2 × 0.5–1 mm, broadly orbicular; ovary 1–2 × 0.5–1 mm, ovoid with 3 stigma. Fruits 1–2 × 0.5–1 cm, ellipsoid to ovoid bright red turning black.

Pinanga is a closely allied genus of *Areca* L., having a geographical distribution centered along the

regions of Indo-Malayan and Southeast Asian countries. The genus consists of about 120 species (Uhl & Dransfield 1987). The insular species look like areca nut palms and are rather difficult to distinguish them at first sight. However, they can be distinguished by the inflorescence, flower arrangement and fruits. *Pinanga andamanensis* is a shade-loving plant found growing in the undergrowth of the evergreen forest of the Andaman Islands. It is a beautiful ornamental palm with bright red fruits and it can be introduced in gardens as an avenue palm. Flowering and fruiting of the palm in the Andamans is during the months of September to May.

The Mount Harriet hill ranges, some of the highest peaks of the Andaman Islands, cover an area of about 77 km² with dense evergreen and semi-evergreen virgin forests. An area of about 32.54 km² between the longitudes 92°43'41" to 92°47'11" and latitudes 11°43'57" to 11°51'55" of the hill ranges has been declared as a National Park. The recently-discovered natural population of *Pinanga andamanensis* occurs within the area demarcated as the National Park and is thus well protected *in situ*. However, frequent monitoring and regular collection of seeds for artificial germination and reintroduction to their natural habitat is recommended for their survival and conservation. In this context it is also relevant to note that the existing individuals of the population occur along the steep slope of the mountain and that no seedlings were found in their vicinity. This is perhaps due to the heavy rains, which may wash out the fallen fruits, or they may be infertile due to some other reasons in their natural habitats. Reproductive ecology should be monitored and studied in detail.

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