Celebrating 50 Years of Palms

Palms

Journal of the International Palm Society Vol. 50(2) Jun. 2006

THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

Founder: Dent Smith

The International Palm Society is a nonprofit corporation engaged in the study of palms. The society is international in scope with worldwide membership, and the formation of regional or local chapters affiliated with the international society is encouraged. Please address all inquiries regarding membership or information about the society to The International Palm Society Inc., P.O. Box 1897, Lawrence, Kansas 66044-8897, USA. e-mail palms@allenpress.com, fax 785-843-1274.

FRONT COVER

Acanthophoenix rousselii sp. nov., in Trois-Mares on the Roussel estate. This species is formally described by Nicole Ludwig in this issue. See page 82.

Palms (formerly PRINCIPES)
Journal of The International Palm Society

An illustrated, peer-reviewed quarterly devoted to information about palms and published in March, June, September and December by The International Palm Society, 810 East 10th St., P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

Manuscripts for PALMS, including legends for figures and photographs, should be typed double-spaced and submitted as hard-copy and on a 3.5” diskette (or e-mailed as an attached file) to John Dransfield, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom. Further guidelines for authors are available on request from the Editors.

Annual membership dues of US$35.00 for Individuals and US$45.00 for Families include a subscription to the Journal. Subscription price is US$40.00 per year to libraries and institutions. Dues include mailing of the Journal by airlift service to addresses outside the USA. Single copies are US$10.00 postpaid to anywhere in the world.

Change of Address: Send change of address, phone number or e-mail to The International Palm Society, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA, or by e-mail to palms@allenpress.com

Claims for Missing Issues: Claims for issues not received in the USA should be made within three months of the mailing date; claims for issues outside the USA should be made within six months of the mailing date.

Periodical postage paid at Lawrence, KS, USA.
Postmaster: Send address changes to The International Palm Society, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

PALMS (ISSN 1523-4495)

Mailed at Lawrence, Kansas June 13, 2006

This publication is printed on acid-free paper.

CONTENTS

Features

Fruits of *Hydriastele boumae* illustrated by George Bennett from *Palms of the Fiji Islands* by Dick Watling. See story p. 63.

BACK COVER

Veitchia simulans, illustrated by George Bennett from *Palms of the Fiji Islands* by Dick Watling (ISBN 982-9047-02-4), which is available from the International Palm Society Bookstore (books@palms.org) or the author (watling@connect.com.fj)

NEWS FROM THE WORLD OF PALMS

The Florida Nursery, Growers and Landscape Association announced its Plants of the Year for 2006. Among the underused but proven performers on the list are two palms, *Phoenix sylvestris* and *Thrinax radiata*. The Plants of the Year program was initiated to assist both growers and consumers in identifying superior plants for Florida gardens.

"The Palms," a symposium hosted last year by the Royal Botanic Gardens, Kew, and the Linnean Society of London, brought together most of the world's leading palm botanists in honor of Dr. John Dransfield's retirement from Kew. The published proceedings of that symposium will be available for free downloading from the publisher of the Botanical Journal of the Linnean Society, the scientific journal in which the proceedings appear. Full texts of the articles, ranging from the latest molecular phylogenies to fossil finds in Ethiopia and conservation of palms in the Philippines, are available through June and July from www.blackwellpublishing.com. To see the appropriate issue, go to the Blackwell home page, and in the upper right corner, search for "Botanical Journal of the Linnean Society."

Experts estimate that more than 300 million palm leaves are harvested and imported into the USA for the Christian holiday celebration of Palm Sunday. Demand of that magnitude is threatening many small palms, such as species of *Chamaedorea*. Now a project, sponsored by the University of Minnesota's Center for Integrated Natural Resources and Agricultural Management, which is working with non-governmental organizations in Guatemala and Mexico, is teaching palm harvesters how to gather the leaves with less waste and fewer middlemen. The project aims to conserve both the palms and the harvesters' livelihood. Palm leaves harvested sustainably are sold in the USA at a premium price of US$0.22 per leaf, which is more than double what leaves typically cost, but it includes a 5-cent surcharge that helps the Latin American communities with community development projects. More information on CINRAM's Eco-Palm project can be found on their website http://www.cinram.umn.edu/ecopalms/overview.html.

Recently, there have been some fascinating message threads on the IPS interactive Message Board, Palmtalk (www.palms.org), discussing unidentified species of *Dypsis*. These relate to palms that have been imported from Madagascar by nurserymen as seed and subsequently sold to customers. The names attached to these palms are provided by the seed collector in Madagascar and are not always correct, or they may carry fictional names of no botanical standing. It is also becoming apparent that names, whether legitimate or spurious, may be inconsistently applied by nurserymen. Many of these palm species are nearing or have reached maturity, and among the unidentified palms are some truly amazing ornamentals. One, in particular, is a large tree species of *Dypsis* with a beautiful, clear orange crownshaft that has just begun to flower in Hawaii – it is a really handsome ornamental that should have great horticultural potential. However, it has yet to be identified. We would like to encourage growers of these new ornamentals to consider submitting good quality images of their mysteries to the editors of PALMS for possible inclusion in the journal – a printed image with some documentation would provide a permanent record of these exciting developments in the palm horticulture, of more lasting value than the fleeting appearance on the electronic bulletin board.

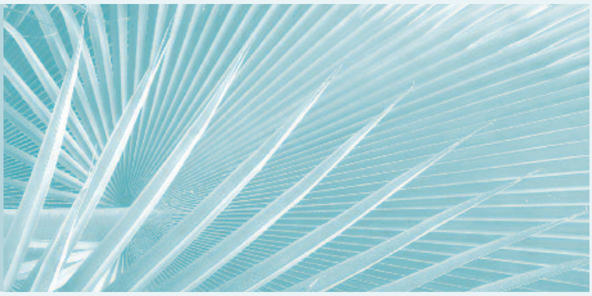
THE EDITORS

GROWING PALMS

Horticultural and practical advice for the enthusiast

Edited by Randy Moore

Contents



After the Hurricanes of 2005

The 2005 Atlantic Hurricane Season was the busiest on record. The storms seemed to create a "hurricane highway" running directly through southern Florida. The Miami area saw its fair share of traffic from this highway. Four hurricanes struck the area, with Katrina and Wilma being the most destructive.

The palm collection of Fairchild Tropical Botanic Garden fared better than other Garden collections. However, our Arboretum and Rainforest took the brunt of the storms. The immediate death toll among palms was 122 or about 3% of our collection. Fortunately, we lost only two taxa (species of which we had only one plant): *Chamaedorea klotzschiana* and *Hydriastele costata*. Rapid assessment (triage) by the horticulture staff within days of the storm determined which palms could be saved and which were damaged beyond expectation of recovery (Fig. 1).

It is difficult to generalize about which genera withstood the storms better than others. We saw significant losses among the *Caryota*, *Hydriastele* and *Ptychosperma*. Although they remain standing, our *Attalea* species probably look the worst, with most of their remaining leaves broken and hanging. Genera showing the least damage once winds subsided include *Coccothrinax*, *Hyophorbe*, *Sabal* and *Veitchia*. This came as no surprise as all four genera are from cyclone-prone areas. Our understanding of where to plant certain species has improved since the storms. For example, *Thrinax radiata* growing in high rocky areas handled the storm well, but snapped at the base when growing in low moist areas.

1. A specimen of *Pseudophoenix sargentii* was assessed within days of the storm. The red tag signified that this palm was deemed unsalvageable.

Many palms that fell have been propped up with bracing, including a massive *Corypha umbraculifera*,


2. A huge *Hyphaene compressa* was hoisted back into place with a crane.

planted in 1960 and a huge, multi-headed *Hyphaene compressa* (Fig. 2). Fortunately, Fairchild received help from other botanic gardens during the clean-up, including Atlanta Botanical Garden, Marie Selby Botanical Gardens, Bok Tower Gardens and Walt Disney World. From the palms that could not be saved, Fairchild's palm biologists collected herbarium and DNA samples.

Though the hurricanes are long gone, we are still trying to prevent palm deaths caused indirectly by the storms. Much of our canopy was lost, leaving understory plants to bake in the famous Florida sunshine. In particular, our *Chamaedorea* collection lost most of its overhead cover and will struggle until the canopy regrows.

We thought we would lose our grand female *Borrassus aethiopum*, erected after it fell in Hurricane Andrew (featured on the October 1992 cover of *Principes*). This time, its crown snapped in Hurricane Wilma, and the youngest leaves in the crown were lost, including the spear leaf. We left it standing so the remaining fruits could ripen and the offspring could be used to replace

3. The terminal bud of the female *Borassus aethiopum* showed signs of regrowth several weeks after the crown was blown off.

the mother plant. It surprised us when a new spear leaf started emerging from the one-meter deep pit in the crown (Fig. 3). Now, six months after the hurricane, the newest leaves can be seen from the ground (Fig. 4).

It is difficult to see so many years of hard work undone so quickly, but we can happily report that the debris has been removed and that the garden is safe. It is only a matter of time before the new season's growth bursts forth. As for the open spaces left where plants once stood, we view these as opportunities for expanding our collections by adding new species. Fairchild's palm collection still remains one of the world's best, with more than 670 taxa on display. For more information on Fairchild's palm collection, visit our Fairchild Guide to Palms at www.fairchildgarden.org/palmguide. – *Christie Jones, Miami, Florida, USA*

4. The new spear leaf of the female *Borassus aethiopum* is now visible from the ground.

How Effective are Mycorrhizas on Palms?

Here in Florida some growers have suggested that commercial mycorrhizal products have done wonders for their gardens and palms. Others found no apparent effect. So is it worth the cost and extra effort to add mycorrhizas to potted palms or older palms already established in the ground? Unfortunately, there is no clear answer. To understand the issue better, a review of the present state of botanical and horticultural information is in order.

What are mycorrhizas and where do they occur?

Mycorrhizas are symbiotic relationships between beneficial soil fungi and the roots of plants. The fungus, which cannot make its own food, receives organic nutrients (sugars and amino acids) from the photosynthetic plant, and the plant receives mineral nutrients and water from the fungus. There are reports that the fungus also protects the plant from toxic effects of heavy metals and reduces attack by disease fungi.

There are two main types of mycorrhizal fungi. One forms visible mushrooms or underground truffles. These so-called ectomycorrhizal fungi cover the surface of small lateral roots with a sheath visible to the naked eye, much like the coating of white fungus on the surface of brie cheese. Many temperate trees such as pine, beech, oak and eucalyptus have this type of mycorrhiza. However, the more common arbuscular mycorrhiza are found in most herbaceous crop plants and most other trees, including palms. In these roots, the fungus invades the inside of roots but is not visible on the root surface (Fig. 1). The fungi also do not form visible reproductive bodies (mushrooms). Therefore, their presence can only be verified after processing the roots in the laboratory by clearing, staining and observing them with a microscope. Inside the cells of the root, the fungus forms tiny tree-like structures, called arbuscules (hence their name), which are the places where nutrients and water are exchanged between the two organisms (Figs. 2 & 3). The majority of land plants have arbuscular mycorrhizal fungi (AMF), which are found in every sort of vegetation type. A good review of the biology of all mycorrhizas is found in Smith and Read (1997. *Mycorrhizal Symbiosis*. Ed. 2. Academic Press).

Some circumstances can result in AMF decreases or total absence in soil. Heavy fertilization and repeated tillage reduces the presence of AMF in plant roots. Soil that has lacked vegetation (recently cleared urban sites, new volcanic soil, land slide areas, mine tailings or restored beach sands) also lack mycorrhizal spores. Plants grown in a sterile nursery usually lack mycorrhizas and may not be naturally colonized for a long time. However, any nursery stock planted into soil next to other vegetation (including grass) may become colonized after a few months by natural AMF already present in nearby roots.

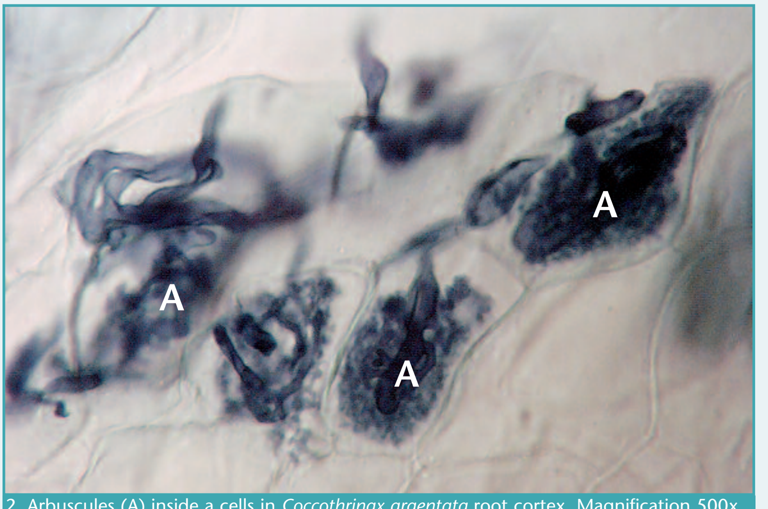
1. *Coccothrinax argentata* root that was cleared and stained to show arbuscular mycorrhizal fungal coils inside the hypodermis cells. Magnification 500x.

Do they occur in all palms?

Although no comprehensive surveys of the palm family have been conducted, AMF have been found in every species that has been studied. The first well documented description of a mycorrhiza in a palm and its beneficial effect on palm growth was given for the peach palm (*Bactris* *gasipaes*) by Janos (1977. Principes 21: 12–18). Later, St.John (1988. Adv. Econ. Bot. 6: 50–55) presented an historical review of AMF in palms. Since then, other reports have appeared that found AMF in all the three main commercial palms (date, African oil, and coconut) and many wild palm species (reviewed in Fisher and Jayachandran, 1999. Plant & Soil 217: 229–241; and 2005. Mycorrhiza 15: 580–588).

Do mycorrhizas promote palm growth?

There are several reports of controlled experiments that show addition of AMF to potted palms increased growth as measured by size or dry weight (St. John, 1988; Blal et al., 1990 Biol. & Fert. Soils 9: 43–48.). I carried out some experiments on native Florida palms that indicate AMF promote growth, but only under very special conditions. AMF improved growth only when the seedlings were grown in pots with native soil that was not fertilized. This native sandy soil had low levels of phosphorus and other nutrients. AMF promoted growth and increased the uptake of phosphorus in these palms, similar to the effect of AMF on rare non-palms that were tested on the same native infertile soil (Fisher and Jayachandran, 2002. Internat. Jour. Pl. Sci. 163: 559–566). However, if extra phosphorus or fertilizer was added, growth of the palms was increased with or without AMF. Thus, palms are apparently not dependent upon AMF except when they are growing in nutrient deficient soils.



2. Arbuscules (A) inside a cells in *Coccothrinax argentata* root cortex. Magnification 500x.

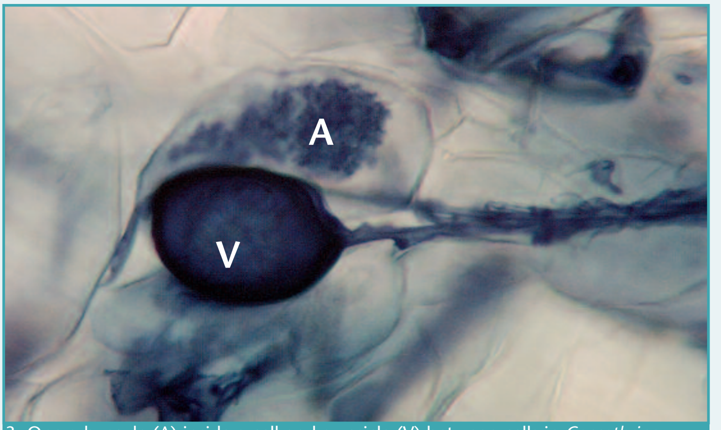
AMF appear to help native Florida palms gather the low levels of nutrients (and perhaps moisture) found in naturally poor soils. Palms may require AMF to survive in the wild but not when grown in pots or in the soil of gardens where they are fertilized. This fact may already be obvious to palm growers: Most palms grow perfectly well in sterilized soil mixes with added fertilizer. Nutrient deficiencies or poor growth are commonly related to the wrong soil pH, temperatures or light intensity, not a lack of soil microorganisms.

How effective are commercial mycorrhizal products?

There are now a number of horticultural supplements that use micorrhizas as part of their formulation, but I have not tested any of them with controlled blind tests. Most have labeling that show the product is a mix of AMF (sometimes both ectomycorrhiza and arbuscular mycorrhiza spores), beneficial soil bacteria, nutrients (humic acids, inorganic fertilizer), wetting agents, etc. Any one of these components could promote growth and health of the plant. Experimentally evaluating the role of mycorrhizas alone in such mixtures would not be easy.

Another difficulty with commercial products is their live biological ingredients that must be stored properly from the time of manufacture until the grower correctly applies it to the plant. Missteps in handling, shipment or storage reduce the activity of the product.

Recently, Corkidi et al. (2004. Jour. Environ. Hort. 22: 149–154) examined the effectiveness of ten commercial mycorrhizal products (five named brands and five anonymous products) on the growth of corn seedlings (*Zea mays*). They found that corn seedlings responded differently to each product and to artificial nursery soils having various levels of mineral nutrients. The results were complex, but the workers concluded that AMF products often depressed plant growth in these greenhouse experiments. Effects were also confounded by other components of the product (presumably growth promoters) beside AMF.



3. One arbuscule (A) inside a cell and a vesicle (V) between cells in *Coccothrinax argentata* root cortex. Magnification 500x.

In a second study, Corkidi et al. (2005. Jour. Environ. Hort. 23: 72–76) examined the effects of four commercial products (only three were identified) on seedlings of sweetgum (*Liquidambar styraciflua*) growing in a fertilized nursery potting mix. The infectivity by the fungus and growth promotion by the products varied, but all products promoted growth to some degree. They concluded that differences in AMF species and particular growing conditions could account for the variation in effectiveness. Unfortunately, I do not know of any similar comparisons that were done with a palm.

Generally, AMF are not strongly host specific; a given AMF species should be able to colonize any number of plant species. However, recent research has shown that some AMF species are more effective than others for a particular plant and that local native species of AMF can be better adapted to local soil conditions than exotic AMF. There is still a lot to learn about this fascinating but very complex symbiosis between fungi and palm roots. – *Jack B. Fisher, Fairchild Tropical Botanic Garden, Coral Gables, Florida USA*

More on Frost Cloth

As an addendum to the article on Frost Protection (PALMS 49: 161, 162. 2005), I have several further observations about the use of frost cloth on palms.

Frost cloth (also known as horticultural fleece) is commonly available in three grades. In the nursery trade, the grades (stated in degrees Fahrenheit) are known as 2-, 4- and 8-degree frost cloth. 8-degree frost cloth produces temperatures that will be 8°F (ca. 4°C) warmer under the cloth than above the cloth. The majority of nursery owners uses the 8-degree frost cloth. Most nurseries pull the heavy cloth off their plants right after a freeze event is over.

Hobbyists will likely use the lower grades (2- and 4-degree frost cloth) because they are thinner and let more light in under the cloth. The lighter cloth can be kept over the plants for many successive days. Palm planting can be started earlier because the plants will be just a little warmer for a longer period before springtime.

Palm growers get a twofold benefit from using frost cloth. Along with providing a warmer temperature inside, the frost cloth also lowers the damaging affects of wind on palms. Many marginally hardy palms are damaged by cold winds, even if the temperatures do not go below freezing. The growth rate of palms can be set back by cool temperatures, cold wind or any time that fertilizer is not being constantly released during the year. Using frost cloth even during cold events that do not go below the freezing mark definitely encourages faster growth in palms. It also helps promote healthy new growth during the spring and summer as opposed to stunted growth that can happen long after the cold days are over.

It is often reported that putting the cloth directly on top of plants will not cause any damage to the plants under the cloth. However, from personal experience, I have noticed that the plants will burn where the leaves have directly touched the cloth. I recommend making a tent by using stakes to lift the cloth over the plants. If the palm is tented, the cloth does not directly touch the tops thereby reducing burn. – *Tom Broome, Polk City, Florida, USA*

Hydriastele boumae, a New Palm from the Island of Taveuni, Fiji

DICK WATLING
Environment Consultants Fiji,
Box 2041,
Government Buildings,
Suva, Fiji

1. *Alsmithia longipes*, the type locality for this iconic palm is in the Bouma National Heritage Park.

Bouma in north-eastern Taveuni is home to *Alsmithia longipes*, a monospecific genus endemic to Fiji. Recently described is another iconic palm, *Hydriastele boumae*, which has been named for the Bouma community in recognition of its pioneering community-managed conservation area.

The garden island of Taveuni is one of Fiji's finest treasures. In a Pacific archipelagic nation, national treasures generally evoke images of coral reefs, sun and sand. Indeed Taveuni is surrounded by some of the world's best diving. But for real people, it is the forest-clad hills rising to Mt. Uluiqalau at 1241 m which are the center of all interest.

On the northeast coast of Taveuni, is the Vanua of Bouma, a close-knit community of four villages with an enormous landholding, nearly all of it forested and including the crater lake, Lake Tagimaucia, at over 800 m. Bouma is renowned throughout Fiji as being one of the wettest places in the country; indeed Lake Tagimaucia may not need any feeding streams as it receives over 10 m of rain annually.

Discovery of *Alsmithia longipes*

It was to Bouma that the pre-eminent palm botanist, Harold E. Moore traveled in March 1980 with Dick Phillips, Fiji's palm guru and enthusiast, and Saula Vodonivalu of the University Herbarium. They were making their way to Bouma to follow up Saula's prior observation of an apparently new species of palm. In those days, there was no road to the largest village of Lavena, and they had to walk several miles before reaching the village in the evening. Their timing was unfortunate, for by midnight they were in the middle of a severe tropical cyclone which passed right over the village. Dick Phillips' wrote later that "we had the first wind, then the complete calm and almost clear skies, then the second wind." Cyclone Tia was very destructive, as they clearly saw when they ventured out in the morning; the village was a complete mess and great swathes of the forest on the surrounding hills were stripped of leaves. Four or five houses in the village lost their roofs, but there were no casualties as most villagers had slept in the well built Catholic church. Despite the clearing up that needed to be done, they were able to commandeer some assistance to go and find the palm. It was no easy feat as broken branches and fallen trees blocked the path. Dick wrote that he was not unhappy with this as it slowed progress down to a rate with which he felt comfortable. They duly found the palm, and in due course Hal Moore described it as *Alsmithia longipes* – a monospecific genus endemic to Fiji (Moore et al. 1982), naming it for Dr. Albert C. Smith, who at the time was engaged in the production of the outstanding six volume *Flora Vitiensis Nova*, a comprehensive treatise on Fiji's flora and the standard botanical reference for Fiji today.

Alsmithia is a remarkable palm with a bright red, newly emerged leaf (Fig. 1), coloring that lasts about a week, and large red fruit (Fig. 2). Interestingly the latter are highly fragrant, unique amongst Fiji's palms, and one immediately wonders if it is connected with a special dispersal mechanism.

(Editors' note: following conclusive molecular evidence, *Alsmithia* has recently been transferred to *Heterospathe* as *H. longipes* (Norup 2005).)

Another undescribed palm – overlooked

We do not know whether it was the cyclone, the thrill of discovery of a new palm, low cloud or continuing rain cloaking the upland ridges, but Hal, Dick and Saula obviously never had a good look at Bouma's high ridges leading up to Mt. Koroturaga. Because on those ridges, clearly visible to the naked eye are large numbers of an emergent palm, and they would have immediately recognized the characteristic

2. Fruit of *Alsmithia longipes* are quite large (4.0 cm) and very fragrant.

3. A lone Bouma Palm *Hydriastele boumae* with Qamea island beyond.

silhouette of a '*Gulubia*' (now *Hydriastele*; Baker & Loo 2004), a species not known from the island. Indeed, on the same visit to Fiji, Hal Moore collected another new palm first located by Saula Vodonivalu, on Viti Levu, Fiji's largest island. This was subsequently described as *Gulubia microcarpa* (Moore et al. 1982) but is now *Hydriastele vitiensis*.

Perhaps it was the "discovery" of *Alsmithia*, which was well reported locally, more likely it was the increasing number of visitors coming to the magnificent waterfall at Bouma. But it was about this time that protection for Bouma's forests became mooted in conservation circles, and this became crystallized when a logging proposal by a Korean logger was rejected by the Bouma community in about 1990.

The Bouma National Heritage Park

It was in 1991 that I first went to Bouma, following an inspection of some horrific logging elsewhere on Taveuni. I had long wanted to attempt a crossing of one of Fiji's last remaining wildernesses – immediately south of Bouma is the Ravilevu Nature Reserve which encompasses most of the southeastern slopes of Taveuni's central ridge. To this day there are no paths across it, and certainly no management, despite it having been a Nature Reserve for over 50 years and one of Fiji's most important conservation areas. Our guides were familiar with the first 5 km which took us about half a day to cross, but it took us another two and a half days to cross the remaining 10 km. Mercifully, we had fine weather, but it was very tough going because of the highly incised topography. My primary interest at the time was birds, but I was amazed to find a rattan (*Calamus vitiensis),* which I was very familiar with from work in south-east Asia but was unaware of its existence in Fiji. Out of curiosity more than anything else, I took a picture of the large red fruits of *Alsmithia* but was otherwise unaware of its significance. On that crossing was a British volunteer working with the Native Land Trust Board, the agency which

4. The leaves of the Bouma Palm remain entire or nearly entire before it breaks into the canopy.

5. *Balaka seemannii*, a delicate understory palm common throughout the forests of Taveuni and Vanua Levu.

6. *Calamus vitiensis*, abundant in the forests of Bouma and throughout Taveuni but absent from Vanua Levu and known from only two localities on Fiji's largest island of Viti Levu.

has a custodial responsibility for land management on behalf of Fijian landowners, and it was he who was the catalyst for the Bouma National Heritage Park. It was a concept that subsequently, the landowners readily accepted and with help from the New Zealand government, the Park has become a community managed conservation area with a guest house, forest and coastal walks, magnificent waterfalls, as well as a marine protected area with wonderful diving.

Hydriastele boumae

In late 1998, I was commissioned to help Bouma set up some forest walking tracks, train guides and develop some interpretive material. On my first visit to the forests above Vidawa village, I came across a palm with large entire leaves which I had never seen before in Fiji. I noted that as soon as the palm reached the canopy, it developed normal pinnate fronds. I noted too that this palm was emergent and common on the spur ridges all the way up to Mt. Koroturaga. I photographed the palm and then took it to Dick Phillips whom I had got to know well and who had been trying to wean me away from birds towards palms. His excitement on seeing the photograph was tangible, and he then showed me another old faded photograph taken from somewhere else on Taveuni. He explained it was a *Gulubia*, and almost certainly a new species. Dick was amazed (and probably disbelieving) to hear that the palm was common all over upland Bouma, and he encouraged me to go back and make a proper collection. It was not until mid-1999 that I could do this, and by then Dick Phillips had died, a truly sad and untimely passing, as it robbed the country not only of a remarkable palm specialist, but a generous enthusiast who helped anyone interested in gardening, especially those interested in palms.

By this time my interest in palms had developed strongly and in collaboration with Marika Tuiwawa, the Curator of the South Pacific Regional Herbarium in Suva, collections of the palm were sent to Kew. It was then that I learned that the systematics of *Gulubia* with three other genera (*Gronophyllum*, *Hydriastele* and *Siphokentia*) was being looked at by a team headed by Bill Baker and that the Taveuni *Gulubia* was of great interest (Baker & Loo 2004). By this time I had seeds planted out in my garden and doing very well, so I was able to provide Bill with fresh material for his molecular systematic research, from this taxon as well as the described species (*Gulubia microcarpa* = *Hydriastele vitiensis*). However, further collections were required, and on one occasion, I traveled back to Bouma with Aleks Maljkovic, an experienced tree climber who assured me that she could shin up any palm. I was not so sure, as I had tried to get the villagers to climb the palm without any success, while they could all but run up coconut trees, the smooth, slippery trunk of this upland palm had been beyond them. So there was great mirth when I told them that because they had failed, I had to get a woman to do it! Aleks duly sauntered up the palm with a couple of circular ropes and a harness. The only hitch came when a particularly large specimen of the Giant Forest Gecko, *Gehyra vorax*, was found to be coming down the palm towards her. Alex was not particularly impressed, whilst the villagers thought this was hilarious. All ended well, the gecko jumped off on to another tree and Aleks brought down some valuable material.

Bill Baker duly described *Hydriastele boumae* (Figs. 3, 4), naming the new palm after the Bouma community, who have embarked on a community conservation project which protects some of the finest forests and reefs in Fiji (Baker & Loo 2004). Naming this iconic palm after the Bouma community is a fitting tribute to a remarkable community which lives very much 'at the end of the road' and which has very few development options. Logging is one of these, but this has been rejected and the community has chosen to conserve the forests and explore the 'ecotourism development option.' It is not an easy course for an isolated community to follow, yet a growing number of tourists now travel to Bouma, and in 2002 it received the British Airways Tourism for Tomorrow Award in the Protected Area category.

The Bouma palm is most conspicuously an emergent palm, common on the high ridges up to and including Mt. Koroturaga, but it is also found within the forest at lower altitudes, in some places down to 100 m above sea level. The palm has also been recorded in one small area on the other side of the island of Taveuni, on the ridge across Lake Tagimoucia, otherwise the whole population is found within the `Vanua of Bouma.' I pondered this restricted distribution at some length one afternoon while I watched the mature fruit of the palm being eaten by three frugivorous birds in quick succession – first came the large Barking Pigeon, *Ducula latrans,* that perched on the top of a mass of ripe fruit and greedily plucked off and swallowed a large number of ripe fruit. At the same time a Polynesian Starling, *Aplonis tabuensis,* was searching for more easily removable fruit at the bottom of the infructescence. A little while later, a splendid male Orange Dove, *Ptilinopus victor*, one of the world's most brilliantly colored birds, flew in for a good meal. With all these birds feeding on the mass of fruit in each infructescence why is the Bouma Palm not found all over the island? Why indeed not on the neighboring islands of Qamea, Laucala or Rabe, or across the Somosomo Straits on Fiji's second largest island of Vanua Levu? There is no easy answer for that, and it is not unique; indeed 12 of Fiji's 24 endemic palms have similarly restricted or even more restricted ranges. Currently 25 native Fijian palms are recognized, two of which remain to be described (Watling 2005). All but one of the palms are endemic, the exception is the rattan *Calamus vitiensis* (Baker et al. 2003). In addition to the Bouma Palm and *Alsmithia longipes*, the forests of Bouma contain *Veitchia simulans* (Back Cover), *Balaka seemannii* (Fig. 5), *Calamus vitiensis* (Fig. 6), *Physokentia thurstonii* and *Clinostigma exorrhizum*. I fully expect *Cyphosperma trichospadix* to be there as well, but so far we have found it only to the north of Lake Tagimoucia. Together, these comprise all of Taveuni's native palm flora, and nearly one third of the whole of Fiji's. With the Ravilevu Nature Reserve located immediately adjacent to the Bouma National Heritage Park, there is some reason to be optimistic for their long term conservation.

Acknowledgments

Special thanks to Isake Tale and the villagers of Vidawa, Korovou and Lavena who made working in their forests a thoroughly enjoyable experience, and to Marika Tuiwawa, Curator of the South Pacific Regional Herbarium who assisted whenever and wherever he could. Aleksandra Maljkovic and Kirsty Swinnerton were good company and great palm spotters high up on Mt Koroturaga, even if we were supposed to be looking for lorikeets. Aleks was responsible for collecting the flowers and fruit

for the type collection. At my suggestion Bill Baker kindly named the palm for the Bouma Community.

Literature Cited

BAKER, W.J., R.P. BAYTON, J. DRANSFIELD AND R.A. MATURBONGS. 2003. A revision of the *Calamus aruensis* (Arecaceae) complex in New Guinea and the Pacific. Kew Bulletin 58: 351–370.

BAKER, W.J. AND A.H.B. LOO. 2004. A synopsis of the genus *Hydriastele* (Arecaceae). Kew Bulletin 59: 61–68.

MOORE, H.E., R.H. PHILLIPS AND S. VODONIVALU. 1982. Additions to the palms of Fiji. Principes 26: 12–125.

NORUP, M. 2005. *Alsmithia* subsumed in *Heterospathe* (Arecaceae, Arecoideae). Novon 15: 455–457.

WATLING, D. 2005. The Palms of the Fiji Islands. Environmental Consultants Fiji, Suva. 192 pp; 26 maps; 54 col. ill.

CLASSIFIED

Dransfieldia Deciphered

William J. Baker
Royal Botanic Gardens, Kew
Richmond, Surrey, TW9 3AE, UK
and
Scott Zona
Fairchild Tropical Botanic Garden
11935 Old Cutler Road
Coral Gables, Miami, Florida
33156-4242, USA

1. *Dransfieldia micrantha* in the foothills of the Wondiwoi Mountains (*Baker et al. 1066*). One stem removed from a clump, Rudi Maturbongs provides scale. (Photo by William J. Baker)

The palm family's newest genus was discovered through hard-won field collections, detective work in libraries and herbaria, painstaking morphological comparisons and modern molecular analyses. *Dransfieldia micrantha* is a beautiful tropical palm from the forests of New Guinea. Its story, which began over 130 years ago, can now be told.

In early 2000, a joint team of botanists from the Royal Botanic Gardens, Kew and the University of Papua made a palm-hunting expedition to the Wandammen Peninsula in western Indonesian New Guinea. The team of collaborators consisted of Rudi Maturbongs, Jack Wanggai, Charlie Heatubun and Matthias Sagisolo (University of Papua), Himmah Rustiami (Herbarium Bogoriense) and Bill Baker and Sasha Barrow (Kew), as well as a local forestry officer and various field assistants. Using an impressive sea-going dugout canoe as our base, we traveled around the coast of Wandammen Bay over two weeks, making forays into the Wondiwoi Mountains, which run the length of the Peninsula, as well as exploring some of the rivers that drain into the bay. The palm diversity of the area proved not to be very high – around 35 species were collected in all – but included some significant finds, such as *Orania regalis*, not known in the wild since the type collection in 1827 (Baker et al. 2000), and a beautiful new species of ocreate rattan, *Calamus wanggaii* (Baker & Dransfield 2002). Most important, however, was the collection of material of a perplexing palm, the story of which is told herein.

We made our third camp of the expedition in a clearing on the banks of the Sikama River, a tributary of the Wosimi River, the main waterway flowing into the southern end of Wandammen Bay. Among the modest collections from two days spent in the area was a peculiar arecoid palm that did not seem to fit any genus native to New Guinea. It was a slender, clustering species with a long, narrow crownshaft, with dark purple inflorescences born below the leaves and bullet-shaped male flowers with numerous stamens. Based on these rather superficial characters, we thought that it might be an undescribed *Ptychosperma*. However, a confusing anomaly remained – the leaflet tips of our palm were pointed, lacking the jagged margins that are characteristic of all *Ptychosperma* species as well as all other genera of the subtribe Ptychospermatinae.

2 (left). Male flowers. Note their small size, a feature that is reflected in the epithet "*micrantha*" ("small-flowered"). 3 (right). Female flowers, recently pollinated. (Photos by William J. Baker)

4. Inflorescences. (Photo by William J. Baker)

On returning to Kew, material was sent to *Ptychosperma* expert Scott Zona at Fairchild Tropical Botanic Garden, as well as to his colleague Carl Lewis, who was conducting a DNA-based study of the Ptychospermatinae at the time. Scott concurred with our initial instincts, and we planned to describe the palm as an unusual new species of *Ptychosperma*. Subsequent events, however, were to change the course of the story.

In July 2002, the first author visited the Museo di Storia Naturale dell'Università in Florence to look at New Guinea palm material in the historic herbarium of the legendary Italian botanist Odoardo Beccari. During a systematic examination of all relevant genera, some material came to light that matched the mystery palm perfectly. The specimen had been collected by Beccari himself in June 1872 at Ramoi, near Sorong, in far western New Guinea and had also formed the basis of Beccari's description of *Ptychosperma micranthum* (Beccari 1877). The specimens from Wondiwoi and another made in 1997 on Waigeo Island by Charlie Heatubun were the first scientific records of this palm in the wild for more than 130 years.

Though satisfied that our judgment of the mystery palm's generic placement matched Beccari's, we were disappointed that the species was not new, and we were embarrassed that we had overlooked a species previously described. We had narrowly escaped the unpardonable blunder of describing as new a species that had already been named by the Florentine master himself! If the ghost of Odoardo Beccari still roams the Museo, it must have sighed in relief. Taxonomic calamity averted and now in possession of a name for this unusual species, we went to the library to examine the literature on this palm.

Ptychosperma micranthum has endured a complex taxonomic history. Just six years after Beccari's publication, Sir Joseph Hooker, then Director of Kew, proposed a transfer to the genus *Rhopaloblaste* (Hooker 1883). While this placement is entirely erroneous, the species lacking many of the key characters of that genus (Banka & Baker 2004), Hooker clearly felt strongly about it; the Kew library copy of volume one of *Malesia*, in which Beccari published *P. micranthum*, contains graffiti in Hooker's own hand next to the description: "not a *Ptychosperma*." The species remained in limbo for close to a century until it was revisited by Hal Moore, who moved it into *Heterospathe* (Moore 1970), a surprising decision given that this genus never displays a well-defined crownshaft and that the material in Florence, which Moore himself annotated, includes a clearly identifiable piece of crownshaft. The fact that such botanical luminaries as Beccari, Hooker and Moore had such wildly different taxonomic opinions should have alerted us to the fact that this was indeed a very unusual palm. Nevertheless, *Heterospathe micrantha* remained the accepted name for the genus. Foolishly, we did not think to question the judgment of Hal Moore, and consequently we accidentally overlooked its all-important synonym in *Ptychosperma*.

Enter Carl Lewis with shocking news from the lab. His DNA analyses were turning up strong and consistent evidence that *P. micranthum* was *not* a *Ptychosperma*, nor was it closely related to any of the Ptychospermatinae. This preliminary evidence was followed up by Maria Norup during her Masters research at Kew and the University of Aarhus (Denmark) (Norup 2004, Norup et al. in press). Maria's DNA analyses of the entire Indo-Pacific tribe Areceae (Dransfield et al. 2005) confirmed Carl's findings and also demonstrated that, while *P. micranthum* belonged to the Areceae, it showed no close relationship to *Rhopaloblaste* or *Heterospathe*, or indeed to any other genus in the tribe.

At this point we realized that we had identified a previously unrecognized lineage of palms and that a new genus was required to accommodate it. A word from our Indonesian colleagues suggested an obvious inspiration for the name. *Dransfieldia* honors John Dransfield, world palm authority, former head of palm research at Kew and longtime co-editor of this journal, in recognition of his enormous contributions to our knowledge of SE Asian palms and palm biology as a whole. Thus, the genus *Dransfieldia* was born (Baker et al. 2006).

Careful studies of the morphology of *Dransfieldia* have revealed that what at first appeared to be a rather nondescript palm is in fact highly distinctive (Baker et al. 2006). The genus is diagnosed by a combination of features – its slender stem, the well defined crownshaft, longitudinal ridges on the upper surface of the leaflets, the pointed (not jagged) leaflet tips, the inflorescence borne below the crownshaft that retains its prophyll and has a peduncle longer than its rachis, the bullet-shaped male flower buds with many stamens,

5. *Dransfieldia* (left) and Dransfield (right), at Fairchild Tropical Botanic Garden. (Photo by S. Zona)

the outer stamens being bent over in the bud, and the apical position of the remnant stigma on the fruit. The combination of a crownshaft and a persistent prophyll alone is unusual in the Areceae, being found elsewhere only in *Roscheria* and some species of *Drymophloeus* and *Dypsis*, none of which resemble or are related to *Dransfieldia*. There is no doubt that *Dransfieldia* bears a superficial resemblance to *Ptychosperma*, but it is readily distinguished from this genus and all other members of subtribe Ptychospermatinae by its pointed leaflet tips, the ridges on the leaflets and the stamen morphology. A thorough discussion of the morphology of *Dransfieldia* in relation to other genera of Areceae may be found in Baker et al. (2006).

Dransfieldia follows *Sommieria* and *Brassiophoenix* as the third palm genus endemic to New Guinea. In the wild, *Dransfieldia* appears to be widely distributed over the Kepala Burung (the Bird's Head or Vogelkop Peninsula) and adjacent areas, such as Waigeo Island, Etna Bay and the Wondiwoi Mountains, all in the west of the Indonesian part of New Guinea. Migliaccio (2001) reported that it (as *Heterospathe micrantha*) also occurs in Papua New Guinea; we are not aware of any specimens from that country and suspect that the report is a misinterpretation of the rather confusing names used for the political divisions of New Guinea. Although *D. micrantha* is relatively widespread, logging and other land clearance activities in the region undoubtedly pose a serious threat to the future of the species.

Ironically, palm growers beat us to the re-discovery of the palm in the wild. The palm has been in trade, under the name *Heterospathe micrantha*, since the late 1990s. We are not sure of the precise origin of the plants, though they must certainly be coming from seeds collected from the wild in Indonesian New Guinea.

Dransfieldia micrantha is an ornamental palm that is certainly worth cultivating for its elegant, slender habit and colorful leaves and inflorescences. We have seen cultivated plants growing beautifully on the island of Hawaii with only modest protection from the sun and wind. A well-established plant grows in the "Windows to the Tropics" Conservatory at Fairchild Tropical Botanic Garden, where it has shady, moist conditions to match its rainforest understory origins. Seeds from the Wondiwoi expedition germinated easily at Kew, growing on successfully in a well-drained, fibrous mix.

The recognition of *Dransfieldia* is not just a story of intrepid jungle exploration and the traditional taxonomist's craft. It is a thoroughly modern tale that shows the combined power of fieldwork, historical collections and literature, herbarium research, careful morphological analyses and high-tech DNA evidence. On their own, none of these approaches would have yielded a clear answer, but together they provided an unexpected but truly satisfying solution.

Literature Cited

Baker, W.J., C. Heatubun and A.P. Keim. 2000. *Orania regalis* rediscovered. PALMS 44: 166–169

Baker, W.J. and J. Dransfield. 2002. *Calamus longipinna (Arecaceae*: *Calamoideae)* and its relatives in New Guinea. Kew Bull. 57: 853–866.

Baker, W.J., S. Zona, C.D. Heatubun, C.E. Lewis, R.A. Maturbongs and M.V. Norup. 2006. *Dransfieldia* (Arecaceae) – A new palm genus from western New Guinea. Syst. Bot. 31: 61–69.

Banka, R. and W. J. Baker. 2004. A monograph of the genus *Rhopaloblaste* (Arecaceae). Kew Bull. 59: 47–60.

Beccari, O. 1877. Malesia, vol. 1, part 1. R. Instituto Sordi-Muti, Genova.

Dransfield, J., N.W. Uhl, C.B. Asmussen, W.J. Baker, M.M. Harley and C.E. Lewis. 2005. A new phylogenetic classification of the palm family, Arecaceae. Kew Bull. 60: 559–569.

Hooker, J.D. 1883. Ordo 187. Palmae. pp. 870–948 *in* G. Bentham and J.D. Hooker, Genera Plantarum, vol. 3, part 2. Lovell Reeve and Co, London.

Migliaccio, C. 2001. The genus *Heterospathe* in cultivation. PALMS 45: 15–21.

Moore, H.E., Jr. 1970. The genus *Rhopaloblaste*. Principes 14: 75–92.

Norup, M.V. 2004. A Molecular systematic study of *Heterospathe* and *Rhopaloblaste* (Arecaceae, Areceae). Masters Thesis, University of Aarhus, Denmark.

Norup, M.V., J. Dransfield, M.W. Chase, A.S. Barfod, E.S. Fernando & W.J. Baker. in press. Homoplasious character combinations and generic delimitation: a case study from the Indo-Pacific arecoid palms (Arecaceae). American Jour. Bot.

Effect of Leaf Removal and Tie-up on Transplanted Large Mexican Fan Palms (*Washingtonia robusta*)

DONALD R. HODEL
University of California
Cooperative Extension
4800 E. Cesar Chavez Ave.
Los Angeles, California 90022
USA
drhodel@ucdavis.edu

JAMES DOWNER
University of California
Cooperative Extension
669 County Square Dr., # 100
Ventura, California 93003
USA

AND

DENNIS R. PITTENGER
University of California
Cooperative Extension
Botany & Plant Sciences
Riverside, California 92521
USA

Several combinations of leaf removal and/or tie-up during transplanting had no effect on establishment and survival of Mexican fan palms (*Washingtonia robusta*) with well developed trunks.

Reduction of transpirational water loss is the reported benefit of leaf removal and tie-up when transplanting palms, and is a commonly recommended practice (Nixon & Carpenter 1978, Broschat 1991, Costonis 1995, Zaid 1999, Broschat & Meerow 2000). Indeed, leaf removal and tie-up have been shown to reduce transpirational water loss of palms (Hodel et al. in prep.). Such water loss is important because roots lost or damaged during transplanting are unable to take up water or do so at a much reduced level to replenish water stored in the palm trunk (Holbrook & Sinclair 1992a, 1992b).

In a recent paper, though, we showed that leaf removal and tie-up when transplanting juvenile, trunkless specimens of *Phoenix canariensis* and *Syagrus romanzoffiana* did not affect their establishment and survival (Hodel et al. 2003). Based on these results we theorized that larger palms transplanted with a well developed trunk would respond similarly if not better because they have functionally critical reservoirs of water stored in their trunks. The objective of this experiment was to determine the effect of leaf removal and tie-up on transplanted specimens with well developed trunks of *Washingtonia robusta*.

 PALMS 50(2): 76–81

Materials and Methods

We conducted this experiment from May to October 2003 with field-grown *Washingtonia robusta* at a commercial palm nursery in Borrego Springs in the southern California low desert. This area is part of the North American Colorado Desert and averages 16.8 cm of rain annually with typical summer daytime high temperatures of 38–46ºC and nighttime lows of 20–28ºC. Temperatures during the study were within these ranges. The soil at the site was a Rositas fine sand with the pH 7.7, EC 5.02 DS/m, CEC 1.4 meq/100g, organic matter 0.24%, nitrate nitrogen 31 ppm, and total nitrogen less than 0.04%.

The study consisted of six treatments of various combinations of leaf removal and tie-up on transplanted and untransplanted palms. The palms had been planted 1.8 m apart in rows 1.8 m apart, had 1.5–2.8 m of trunk, and were four to five meters tall. We randomly selected six palms in each of four adjacent rows on which to perform the treatments. The six treatments were:

transplanted, no leaf removal, no tie-up;

transplanted, no leaf removal, tie-up;

transplanted, leaf removal, no tie-up;

transplanted, leaf removal, tie-up (standard industry practice);

not transplanted, leaf removal, no tie-up;

not transplanted, no leaf removal, no tie-up (control).

1. Digging and removal of palm with crane, typical root ball, May 2003.

2. Transplanted treatment with leaf tie-up, July 2003.

Each row was a block in which the six treatments were completely randomized, thus there were 24 palms total in the study (six treatments × four replicate rows).

The palms were transplanted and leaves removed and tied up according to typical nursery practices. Using hand shovels, the nursery staff excavated the palms that were to be transplanted, lifted them clear of the soil with a crane (Fig. 1), and laid them on the ground where we performed the designated leaf removal and tie-up treatments (Fig. 2). Leaf removal consisted of removing 50% of the total number of green leaves in the crown, all of which were from the lower part of the crown and were the oldest green leaves. Leaves were tied up on the distal part of the petiole near the blade, using nylon twine. The palms were then planted back in the hole from which they were removed. For palms not transplanted, we performed the leaf removal and tie-up treatments using a ladder to gain access to the crown of leaves.

Drip irrigation was used to irrigate the palms immediately after transplanting and throughout the study to ensure that the soil was kept moist. No fertilizers or herbicides were applied during the study.

At treatment application in May 2003 we marked the newest leaf and recorded the number of leaves prior to removal, number of leaves removed, and leaves remaining after removal. Three critical factors for assessing palm transplant success are:

Table 1. Effect of leaf removal and tie-up on mean number of new leaves produced and mean number of green and brown leaves (with percent of green and brown leaves in crown in parentheses) on transplanted large *Washingtonia robusta* palms, Borrego Springs, CA, May to October, 2003.

Treatments			Number of Leaves		
Transplant	Leaf Removal	Leaf tie-up	new	green	brown
		July 17, 2003			
1Yes	No	No	1.8D	3.5D(22)	12.5A(78)
2Yes	No	Yes	2.5CD	4.8CD(31)	10.5AB(69)
3Yes	Yes	No	4.5BC	2.5D(27)	6.8BC(73)
4Yes[z]	Yes	Yes	1.3D	7.5C(65)	4.0CD(35)
5No	Yes	No	6.8A	12.8B(100)	0.0D(0)
6No[y]	No	No	6.5AB	20.0A(100)	0.0D(0)
		October 16, 2003			
1Yes	No	No	3.5B	6.5B(34)	12.5A(66)
2Yes	No	Yes	3.8B	7.5B(42)	10.5AB(58)
3Yes	Yes	No	4.3B	7.8B(53)	7.0B(47)
4Yes[z]	Yes	Yes	4.3B	9.5B(66)	4.8B(34)
5No	Yes	No	9.3A	23.8A(100)	0.0C(0)
6No[y]	No	No	10.0A	27.3A(100)	0.0C(0)
		Cumulative			
1Yes	No	No	5.3B	—	—
2Yes	No	Yes	6.3B	—	—
3Yes	Yes	No	5.8B	—	—
4Yes[z]	Yes	Yes	5.5B	—	—
5No	Yes	No	16.0A	—	—
6No[y]	No	No	16.5A	—	—

Mean number of new, brown, and green leaves within a column in the same date followed by different letter are significantly different according to Fisher's Protected Least Significant Difference Test, $P<0.001$.

[z]Standard industry practice (SIP).

[y]Control.

survival;

number of new leaves produced, which is a measure of growth;

number and ratio of green and brown leaves in the crown, which is an assessment of the esthetic quality of the palm.

Thus, in July 2003, about half way through the study, and October 2003, at the end of the study, we recorded the number of new leaves produced for each interval and the number of green and brown leaves present on each palm. We classified brown leaves as those having more than half the blade area brown.

We conducted analysis of variance tests (ANOVA) and compared means for number of new leaves and number of green and brown leaves in July and October and cumulative number of new leaves over the course of the study using Fischer's Protected Least Significant Difference Test.

Results

Survival. All palms in this study survived and established successfully.

Number of new leaves produced. Untransplanted treatments produced significantly more leaves than transplanted treatments for the last half of the study and cumulatively over the course of the study (Table 1). Within the four transplanted treatments, there were no differences in number of leaves produced over the last half of the study and cumulatively over the course of the study. However, by July differences among the treatments were not as well defined. At that time the transplanted leaf removal/no tie-up treatment was intermediate between and not significantly different from the untransplanted control (no leaf removal/ no tie-up) and the transplanted standard industry practice (SIP) (leaf removal/tie-up).

Number of green and brown leaves. Untransplanted treatments had significantly more green leaves in their crowns in July and October than transplanted treatments (Table 1). Among the transplanted treatments, the SIP (leaf removal/tie-up) had the most green leaves in July although it was not significantly different from the no leaf removal/tie-up treatment. By October, though, there were no differences in number of green leaves among the transplanted treatments.

In July there were no significant differences in number of brown leaves in the crowns between the two untransplanted treatments and the transplanted SIP (leaf removal/tie-up) although by October untransplanted treatments had significantly fewer brown leaves than all transplanted treatments. Differences in the number of brown leaves among the transplanted treatments in July and October were not as clearly defined although the SIP (leaf removal/tie-up) and the leaf removal/no tie-up treatments had fewer brown leaves than the no removal/no tie-up treatment.

Discussion

No treatment improved survival or increased leaf production of the transplanted palms, indicating that, while leaves are a source of water loss, the reservoir of water in the trunk and/or the ability of the palm to regulate transpirational water loss more than compensated for the loss or reduction of water uptake by roots damaged or lost during transplanting.

Any transplanting, regardless of leaf removal or tie-up treatments, stressed the palms, though, and resulted in some of the existing leaves dying and turning brown, leading to more brown leaves in the crown than either untransplanted treatment. However, among the transplanted palms, the two leaf removal treatments resulted in fewer brown leaves than the no removal/no tie-up treatment. Thus, the primary benefit of leaf removal when transplanting *Washingtonia robusta* is probably an esthetic one because it reduces the number of brown leaves in the crown by eliminating them before they would have turned brown and died anyway from transplant stress and shock.

The percentage of green and brown leaves in the crown provides a more accurate portrayal of the esthetic quality of the palms than simple leaf numbers because, due to variations in crown size and leaf removal treatments, the palms had different number of leaves in their crowns at the onset of the study. The untransplanted palms had 100% green leaves in their crowns in July and in October (Table 1). Among the transplanted treatments, the SIP (leaf removal/tie-up) had more than double the percentage of green leaves in its crown in July (65%) than the others although by October the differences were not as great.

Summary and Conclusion

No treatment improved survival, resulted in more new growth and green leaves, or eliminated browning of leaves of large, transplanted *Washingtonia robusta* by the end of the five-month study. Thus, leaf removal and leaf tie-up do not improve transplant success with this species. However, leaf removal may improve the esthetic quality by eliminating leaves that will probably die and turn brown from transplant stress, thus increasing the ratio of green to brown leaves in the crown.

Acknowledgments

We thank Joe Ellis, owner, and John Hogan, manager, of Ellis Farms in Borrego Springs, California for use of their field-grown *Washingtonia robusta* to conduct our study.

LITERATURE CITED

BROSCHAT, T.K. 1991. Effects of leaf removal on survival of transplanted sabal palms. J. Arbor. 17: 32–33.

BROSCHAT, T.K. AND A.W. MEEROW. 2000. Ornamental Palm Horticulture. University Press of Florida. Gainesville, FL.

COSTONIS, A.C. 1995. Factors affecting survival of transplanted sabal palms. J. Arbor. 21: 98–102.

HODEL, D.R., D.R. PITTENGER AND A.J. DOWNER. 2003. Effect of leaf removal and tie-up on juvenile, transplanted Canary Island date palms (*Phoenix canariensis*) and queen palms (*Syagrus romanzoffiana*). Palms 47: 177–184.

HOLBROOK, N.M. AND T.R. SINCLAIR. 1992a. Water balance in the arborescent palm, *Sabal palmetto*. I. Contribution of stem structure, tissue water release properties, and leaf epidermal conductance. Plant, Cell, and Envir. 15: 393–399.

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

NIXON, R.W. AND J.B. CARPENTER. 1978. Growing Dates in the United States. USDA Inform. Bull. 207. Washington, D. C.

ZAID, A. (Ed.). 1999. Date Palm Cultivation. UN FAO Plant Production and Protection Paper 156. Rome.

Acanthophoenix in Réunion, Mascarene Islands

NICOLE LUDWIG
P.O. Box 6
97429 – Petite Ile
La Réunion
France
nicole.ludwig@wanadoo.fr

1. Old plantation of *Acanthophoenix rubra* at Anse des Cascades (alt. 5 m).

The islands of Réunion, Mauritius and Rodriguez constitute the Mascarene archipelago. The island of Réunion, or La Réunion in French, is the largest and the youngest of the group, at only three million years old, with an active shield volcano named Piton de la Fournaise. It is home to two known species of *Acanthophoenix* and a third species, *A. rousselii*, described herein.

2. A wild population of *Acanthophoenix crinita* in Hauts de Bois Blanc; from late morning the fog sets up and maintains high humidity. (Photo by Nicolas Talibart)

Uninhabited when the first French settlers landed in 1642, Réunion was mainly covered by tropical rain forest on the windward side and semi-dry ecosystems on the leeward side. More than 350 years later, the native vegetation has been thoroughly disturbed by human and agricultural pressure. Deforestation has made space for farming and human establishment, so that some of the endemic species, including palms, once abundant are nowadays endangered, at least in the wild.

By the end of the nineteenth century, on the other hand, at a time when palm populations were much more abundant than nowadays, Jacob de Cordemoy recognized two distinct species of *Acanthophoenix* in his Flore de La Réunion: *Acanthophoenix rubra* or *palmiste rouge* (Fig. 1) in the lowlands of the windward side (southeast and east coasts) and *Acanthophoenix crinita* or *palmiste noir* (Fig. 2), occurring at 800–1800 m, in the mountainous back country.

In Flore des Mascareignes, Moore and Guého (1980) treated *Acanthophoenix* as a monotypic genus with *Acanthophoenix rubra* its sole species. Endemic to Réunion and Mauritius, *A. rubra* was regarded as an extremely variable species and rare in the wild in Mauritius. Moore and Guého (1980) claimed that this species is still well represented in Réunion by some wild populations in remote locations and also in palm groves, especially in the sections of Saint-Philippe and Bois Blanc. Although they reported some differences between lowland and highland populations, they stated that there was "no real discontinuity" among the *Acanthophoenix* populations. This conclusion was formulated after their visit to a few sites, including the ONF (National Forest Service) nursery in Basse Vallée (alt. 610 m) and the René Huet plantation in La Crête (alt. 630 m). The Huet plantation was started in 1961 with both *Acanthophoenix rubra* and *A. crinita*. Forty years later, most of the palms are hybridized, which was probably already true by the time of Moore and Guého's visit. No doubt it has led to confusion in the taxonomy of *Acanthophoenix*.

Observations conducted in the field and examination of flowers and seeds lead the present author to conclude that there are three species of *Acanthophoenix*, with differences in vegetative feature, inflorescences, fruits, seeds, seedlings and young plants. In addition to the previously recognized *A. rubra* and *A. crinita*, a third species should be recognized. This *palmiste*, which is herein described as *A. rousselii* (Front Cover), is a close relative of *A. rubra* and occurs, at present, only on the Roussel family estate at Trois-Mares, at 600–850 m elevation. It was pointed out by Thérésien

3. *Acanthophoenix rubra*: stem base shaped like an elephant's foot on an old specimen at Anse des Cascades.

Cadet some 30 years ago, but with his untimely death this third species of *Acanthophoenix* was forgotten for decades.

Taxonomic Account

Acanthophoenix H. Wendl., Ann. Gén. Hort. 6: 181. 1866.

A genus of three species endemic to the Mascarene Islands.

1. *Acanthophoenix rubra* (Bory) H. Wendl., Fl. Serres Jard. Paris 2(6): 181. 1866.

2. *Acanthophoenix crinita* (Bory) H. Wendl., Ann. Gén. Hort. 6: 181. 1866.

3. **Acanthophoenix rousselii** Ludwig, **sp. nov**., a *A. rubra* staminibus plerumque 9 vice 11 vel plus, fructu curvato vice ellipsoideo differt, a *A. crinita* staminibus 9 vice 6, fructu multo majore et eophyllo pinnato vice bifido differt. Type: Réunion. Roussel Estate, Trois Mares, Le Tampon, on the side of a field path, alt. 610 m, 20 Apr 2006, *N. Ludwig 974-1*. (Holotype: REU; isotypes: K, P)

Solitary pleonanthic monoecious palm with erect trunk to 15–25 m tall and 20–30 cm diam., surface light gray, rather smooth, only slightly marked with leaf scars; trunk base swollen in a characteristic "elephant foot." Leaves pinnate, 15–20 in crown; crownshaft conspicuous, , sheaths 90–120 cm long, 45 cm wide at the base, up to 6 mm thick, abaxially dark brown, covered with dense fur-like black hair 6–8 mm long, except on half length median axis where glabrous; petiole and rachis 2.50–3 m long, glabrous or with a fine indument abaxially in the distal part; leaflets 70–80 pairs, pendulous and regularly attached on both edges of the rachis, leaflet tip acute, olive green color on both surface, leaflet midrib adaxially armed with thin reddish-brown bristles 2–4 cm long, thin flexuous dot-like scales on abaxial side of midrib. Inflorescences infrafoliar, first enclosed in a tough unarmed brown prophyll; inflorescences ivory-colored, pendulous, 100–110 cm long, branching to 2 orders with 50–70 rachillae; peduncle base enlarged in a crescent shape where attached to the trunk; peduncle and rachis armed with strong sinuous black spines 2–3 cm long; rachillae bearing densely arranged triads of flowers, two staminate flowers flanking one pistillate flower, all sessile

opposite page

4 (upper left). *Acanthophoenix rubra*: this five or six year old specimen shows leaf sheaths armed with strong black spines. 5 (upper right). *Acanthophoenix rubra*: the leaf sheaths become unarmed on specimens aged height or nine years and older. 6 (lower left). *Acanthophoenix rousselii*: close up of a leaf sheath covered by dense fur-like hair. 7 (lower right). *Acanthophoenix crinita*: swollen leaf sheath with stiff bristles inserted on verrucose base.

8 (above) *Acanthophoenix crinita*: close-up of leaf sheath showing stiff bristles ressembling tenrec fur. 9 (below). *Acanthophoenix crinita*: spathe opening on young inflorescence on the right and infrutescence on the left.

and glabrous. Staminate flowers 12 × 12 mm, ivory white turning to light yellow except pistillode and basal part of filaments pink-colored; sepals 3, narrow triangular with acute tip, 1.5 mm long; petals 3, elliptic, valvate, 7 × 3 mm; stamens 9 (sometimes 8) with white sagittate anthers 3–4 mm long and coiled filaments 8 mm long; pistillode 2–3 mm with trifid tip. Pistillate flowers ivory-white, globose to subspherical, slightly asymetrical, smaller than staminate flowers 4.5 × 3–4 mm; sepals and petals similar, membranous, imbricate. Mature fruit black with persistent beige or light brown perianth, ellipsoidal and slightly curved, 15–20 × 8 mm; mesocarp thin, dark purple; endosperm homogenous, embryo basal.

This species has a limited distribution within the town limits of Le Tampon. It grows in Trois Mares at an altitude of 600–850 m, in remnants of a transitional lowland forest ecosystem specific to the leeward side of the island.

Etymology: The specific epithet honors the Roussel family who owns the 202 hectare (500 acre) property where the species was first identified.

Morphology

Stems.

All *Acanthophoenix* palms are single-stemmed palms with the characteristic "elephant foot"

10 (above). *Acanthophoenix rubra* immature infrutescence broken off by a gust of wind at Anse des Cascades. 11 (below). *Acanthophoenix crinita*: rachilla section with staminate flowers and pear-shaped pistillate flowers (× 4.5). (Photo by Marc Gérard and Nicole Ludwig)

base (Fig. 3). The older the specimen, the more swollen the stem base; although it appears that the swelling is more accentuated in *Acanthophoenix rubra*. This characteristic allows for a larger root system to be in contact with the ground and may give more stability to the palm, an adaptation that may help it to resist cyclone-force winds.

The stems of *Acanthophoenix rubra* and *A. crinita* show circular leaf scars along almost their entire height but more distinctly toward the crown. Narrow cracks perpendicular to leaf scars are visible except in the upper portion where intervals between scars are smooth. Another distinctive feature of *A. crinita* worth mentioning is that the leaf scars are often subtended with a row of short spines. The leaf scars of *Acanthophoenix rousselii* are less distinct and longitudinal cracks not frequent, so that the stem looks quite smooth.

Acanthophoenix crinita grows very slowly, and a 40-year old specimen was found on René Huet's property at La Crête with a stem only 2.3 m high. Another the same age reached 3 m, not including the leaves.

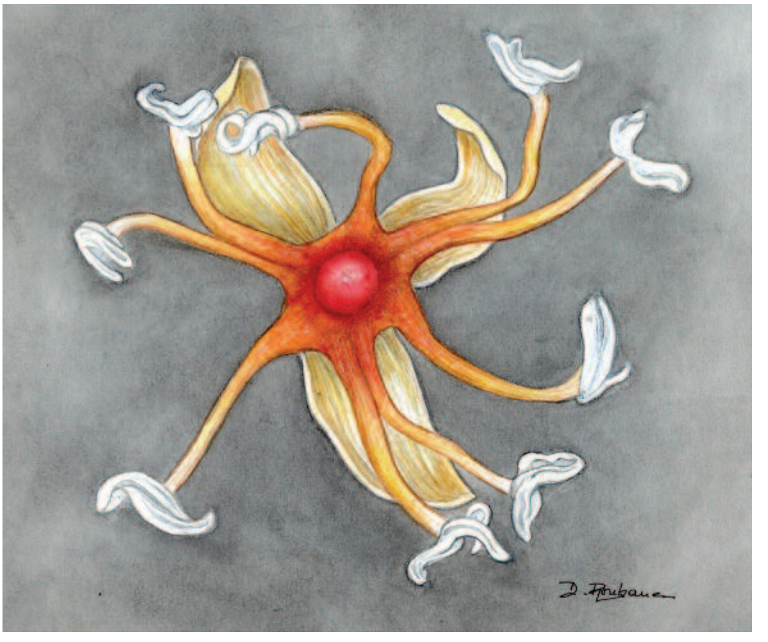
Leaves

Leaf sheaths at the stem apex form a crownshaft with variable appearance. In *Acanthophoenix rubra* the crownshaft is tubular or slightly swollen, reddish-brown. Young specimens, less than eight or nine years old (Fig. 4), have sheaths armed with strong,

12. Rachilla of *Acanthophoenix rousselii*: with colorful staminate flowers and sub-globose pistillate flowers (× 5). (Photo by Marc Gérard and Nicole Ludwig)

straight, black spines up to 10–12 cm long inserted on a swollen base. On older palms, the sheaths become unarmed and as smooth as velvet (Fig. 5). Leaf sheaths of *Acanthophoenix rousselii* are dark brown, densely covered with short soft hair (Fig. 6). The crownshaft of *Acanthophoenix crinita* often looks swollen (Fig. 7), with the outer sheaths pushed out by young inflorescences; sheaths are brown or light brown and covered with stiff hairs reminiscent of "tangue" (tenrec) fur (*Tanrec ecaudatus*) (Fig. 8).

The leaves are pinnate with 40–60 pairs of leaflets, which are acute, pendulous and regularly arranged on both sides of the rachis. The petiole is short with a flat adaxial side and a convex abaxial side. It becomes unarmed on adult or sub-adult palms, though in *Acanthophoenix crinita* there may be some persistent lateral bristles. In this species, the petioles and rachis are covered with a fine waxy indument that can be rubbed away easily. The petioles and rachis of *A. rubra* and *A. rousselii* are glabrous. In the three species the



13. Staminate flower of *Acanthophoenix rousselii.* Watercolor painting by Deborah Roubane.

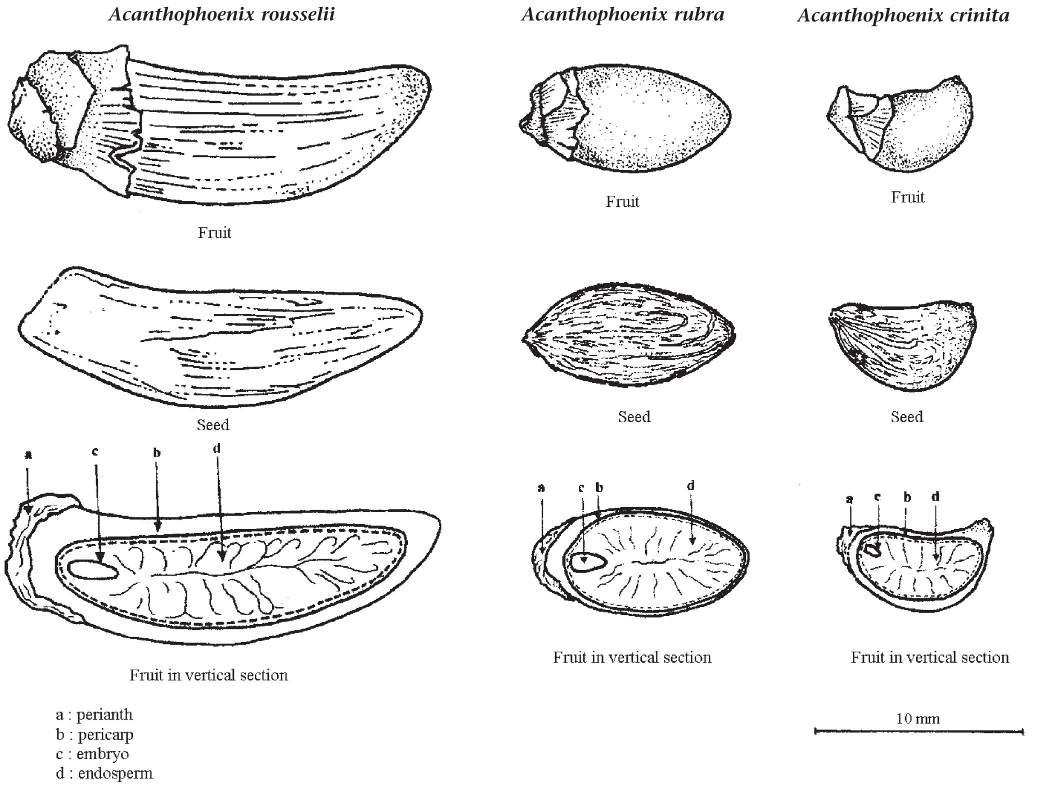
leaflet midrib is adaxially armed with thin reddish-brown bristles and bears small dot-like scales on abaxial side.

Inflorescences

The inflorescences are infrafoliar, at first completely enclosed in a tough, unarmed prophyll, green with reddish traces in *A. rubra*, brown in *A. rousselii* and dark brown in *A. crinita* (Fig. 9). The ivory-colored inflorescences are long, pendulous, branching to two orders with 25–70 rachillae. The peduncle base is enlarged into a crescent shape where it clasps the stem. The peduncle and rachis are armed with strong black spines, straight in *A. rubra* (6–8 cm long) (Fig. 10), shorter and curved in *A. rousselii* and *A. crinita* (2–3 cm long), with spine length decreasing toward the apex of the rachis.

The rachillae bear densely arranged triads of flowers, two staminate flowers flanking one pistillate flower. Staminate flowers have three short triangular sepals and three elliptic, valvate and ivory white petals that are sometimes orange spotted. Stamen number is variable, the rule seems to be: six stamens for *A. crinita* (Fig. 11), nine stamens for *A. rousselii*

14. Section of rachilla of *Acanthophoenix rubra* with staminate flowers removed to expose globose pistillate flowers (× 4.5). (Photo by Marc Gérard and Nicole Ludwig)



15. Comparisons of fruits, endocarps and seeds of three species of *Acanthophoenix*.

and twelve stamens for *A. rubra*. In *A. rubra* and *A. rousselii* the filaments are flexuous and often coiled in bud; the anthers are elongate, basally sagittate and spiraled after dehiscence. In *A. crinita* anthers and filaments are shorter. Anthers are white, while filaments can be ivory white, orange or pink, even bi-colored in *A. rousselii* (Figs. 12 &13). The presence of a pistillode, more or less trifid, is nearly constant. At anthesis, *A. crinita* male flowers show sagittate anthers and rather thick filaments barely longer than petals; the cone-shaped pistillode has a slightly curved apex. *Acanthophoenix rousselii* male flowers show the outer whorl of three stamens with regular filaments, the inner whorl of six stamens with filaments connate in pairs up to one-third their length and a bright pink, ovoid pistillode.

Pistillate flowers are smaller than staminate flowers. They are globose in *A. rubra* (Fig. 14), sub-globose in *A. rousselii* and pear-shaped in *A. crinita*. The perianth consists of three white, membranous, imbricate sepals and three similar petals embracing the base of the ovary. Pollination is performed by bees and starts at the end of the austral winter.

Fruits

When mature, the fruits are black and the persistent perianth is beige or light brown. The mesocarp is thin, dark purple and contains tannins. In the seed, the embryo is basal and the endosperm homogenous. Shape and size of fruits and seeds differentiate the three taxa, as emphasized in Fig. 15.

Seed dispersal and germination

The dispersal of *Acanthophoenix crinita* seeds is performed by the Réunion bulbul (*Hypsipetes borbonicus*), an endemic bird that lives in forest environments from 100 m to 2000 m altitude; however, the red-whiskered bulbul (*Pycnonotus jocosus*), a species of Indian origin and present in Réunion for 30 years, is spreading in the montane rain forest and taking over as a seed disperser.

Acanthophoenix rubra seeds are dispersed nowadays by the red-whiskered bulbul and other exotic species of the local bird fauna including the common myna (*Acridotheres tristis*), the spot-backed weaver (*Ploceus cucullatus*) and the red fody (*Foudia madagascariensis*). Despite the presence of these

16. Young plants under forest canopy, at the foot of an adult specimen of *Acanthophoenix rubra* in the Jardin des Epices in Saint-Philippe.

exotic birds in Réunion, seed dispersal of *A. rubra* is quite limited.

As for *Acanthophoenix rousselii* seeds, their larger size (20 × 8 mm) precludes dispersal by the extant bird fauna. Extinct species such as Réunion pink pigeon (*Nesoenas duboisi*), Mascarene blue pigeon (*Alectroenas nitidissima*) and the Mascarene black flying fox (*Pteropus niger*) may have played an important role as dispersal agent of *A. rousselii* seeds in the past.

All species of *Acanthophoenix* bear large amounts of seeds, and seedlings are found at the foot of or nearby adult specimens (Fig. 16). Dispersal away from adults appears rare, even in the presence of exotic birds that act as seed dispersers.

Because of the economic interest of the *palmiste rouge*, a study on germination ability of seeds was led by CIRAD (Centre de coopération internationale en recherche

17. Eighteen month old *Acanthophoenix rubra* (left) and *A. crinita* (right) in a greenhouse of the City of Paris. (Photo by Franck Hoedts)

Table 1. Characteristics of *Acanthophoenix* species summarized and compared.

	A. rubra	*A. rousselii*	*A. crinita*
Stem			
height (m)	15–25	15–25	8–10?
diam. (cm)	20–30	20–30	10–20
color	red-brown	light gray	dark brown
surface	rough	smooth	very rough
leaf scars	very distinct	less distinct	very distinct, spiny
Leaves			
leaves in crown	15–20	15–20	10–15
leaf length (m)	2.5–3.0	2.5–3.0	2.0–2.3
sheath length (cm)	90–120	90–120	60–80
sheath color	reddish brown	dark brown	brown or light brown
sheath indument	black spines, 10–12 cm when young, unarmed when adult	dense fur-like hair	stiff hair, like tenrec fur
petiole	unarmed, no waxy indument	unarmed, no waxy indument	few setae on both edges, waxy indument
leaflets	70–80 pairs	70–80 pairs	40–60
color, abaxial	grayish or whithish	olive green	dark green
color, adaxial	yellow green	olive green	dark green
Flowering & Flowers			
season	Oct., Nov.	Oct., Nov.	Aug., Sept.
yrs to 1st flowering	15–18	15–18	10–12
stamens	(11–)12(–15)	(7–)9(–10)	(5–)6(–9)
Fruits			
fruit maturation	May, June	May, June	April, May
fruit length (mm)	8–10	15–20	6–7
fruit diam. (mm)	6	8	5
Seedlings			
sheath	reddish brown, armed with reddish or light brown spines to 2cm	greenish, armed with brown spines to 2 cm	blackish, armed with black spines to 2 cm
petiole & rachis	reddish brown, armed with reddish or light brown spines, no waxy indument	green or reddish with reddish or brown spines, no waxy indument	green, armed with dark brown or black spines, dense waxy indument
leaflets	5–7 pairs	5–7 pairs	1–3 pairs
leaflet shape	linear with acuminate apex	linear with acuminate apex	terminal leaflet elongated oval with acute, rarely acuminate apex; other leaflets lanceolate with acuminate apex
leaflet size	10–12 cm long, 6–8 mm wide	10–12 cm long, 6–8 mm wide	terminal: 15–18 cm long, 25 30 mm wide; others: 18–20 cm long, 14–18 mm wide
abaxial color	whitish	olive green	dark green
adaxial color	light geen	olive green	dark green

18. A wild population of *Acanthophoenix crinita* in Hauts de Bois Blanc (altitude 1200 m). (Photo by Nicolas Talibart)

agronomique pour le développement) and Frédéric Normand in 1992. The experiment was done on samples of 300 units, either fruits or seeds. All samples were subjected to different treatments before sowing. The seed containers were wrapped in microporous black plastic film in order to retain optimal moisture and temperature conditions. The first seedlings appeared three months later, but the germination rate, after 250 days, remained rather poor.

CIRAD's experiments had three conclusions: Seeds must be fresh and newly collected; seed germination rate reaches 13% after 24 hours soaking in warm water; and seed germination rate does not exceed 4% if the pericarp is not removed. These germination rates seem to be lower than what we might expect, especially for sown fruit. Inhibiting factors in the fruit pericarp might explain this poor rate, but this explanation is doubtful, since *Acanthophoenix rubra* has a very thin layer of flesh. What is more, in Saint-Philippe, palm grove owners sow entire fruit and not cleaned seeds. The rate of seed germination depends mainly on the maturity of seeds when harvested (not too early and not too late). Seeds must be collected on trees and sown right away.

Observations on *Acanthophoenix rousselii* germination, both in the field or in shade house, have been made for three years by Eloi Boyer. In June 2001, 10,000 fruit were collected in Trois-Mares and sown at once, without prior cleaning or soaking, on moist seed beds consisting of half leaf-mould and half sifted soil. The first seedlings sprouted five months later. By August 2002 seeds of the same sample continued to germinate, so that germination period may extends over one year. About 2400 young palms have been obtained from 10,000 seeds, which is a germination rate of 24%. The rate may be improved if the seeds are cleaned and soaked before sowing.

In June 2002 at Trois-Mares, on the Roussel estate, we counted 350 young plants distributed over one square meter surface at the foot of three adults of *Acanthophoenix rousselii*. They arose from spontaneous sowing of the previous year. However, the germination conditions on this site are not exactly natural conditions since the land is plowed, fertilized and watered frequently. The regular practice of truck farming, while respecting small patches around palm trees, establishes favorable conditions for palm regeneration, but on fallow land, seedlings are rarely seen at the foot of adult palms.

There is no study on the optimum germination conditions of *Acanthophoenix crinita*. In the Plaine des Palmistes area, many seedlings are visible at the foot of trees where birds nest. They eat the tiny fruit of *A. crinita* and partial digestion in the birds' guts removes the flesh and softens the woody endocarp, assisting germination.

Seedling morphology

Twenty to twenty-four months after germination, young plants of *Acanthophoenix rubra* and *A. rousselii* show four to five leaves and much similarity. Differences with *A. crinita* are much more obvious (Fig. 17). Another difference is visible in specimens five years old and older. *Acanthophoenix rubra* and *A. rousselii* have recurved leaves while *A. crinita* has erect leaves.

Table 1 summarizes the morphological characteristics for the three different *Acanthophoenix* palms.

Distribution of *Acanthophoenix*

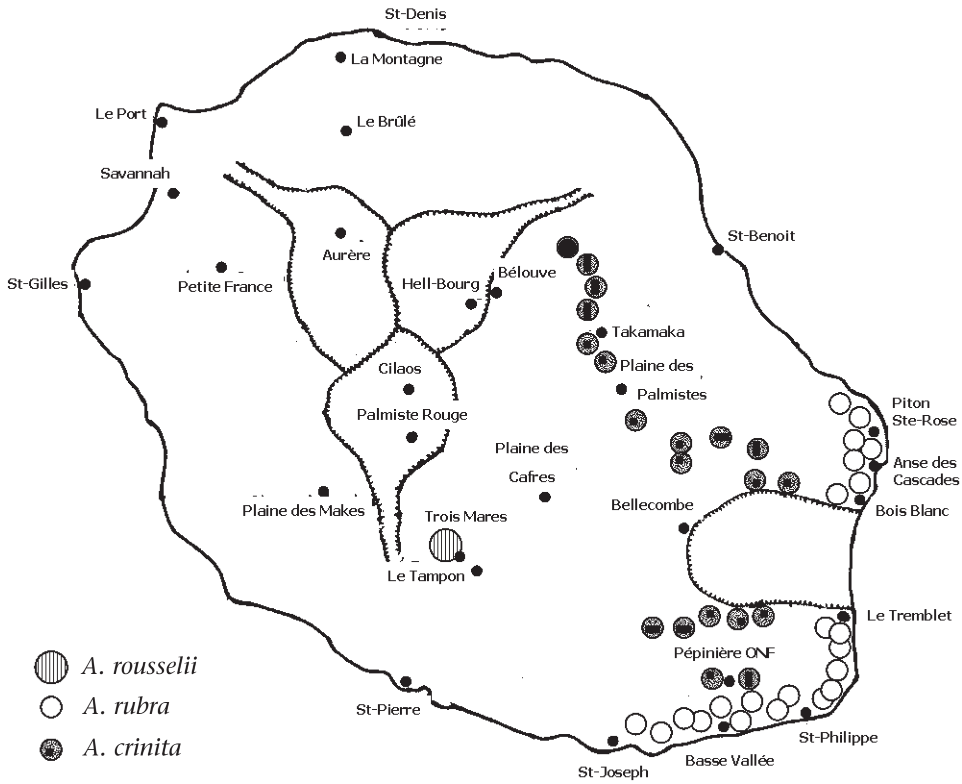
In the late eighteenth or early nineteenth centuries, the French naturalists who traveled through Réunion Island agreed that palms were plentiful in the local environment. The first person to give a detailed description of the different species was Bory de Saint Vincent who visited the island from August to December 1802. In the Chaudron district, nowadays downtown Saint-Denis, a city of over 160,000 inhabitants, he noted, while crossing a plantation, that "it was covered with *palmistes* that seemed to have been protected when the land was cleared." But he lamented that "*palmistes* have become uncommon near housing estates and will be soon relegated in out of reach locations, the only way to save it from human gluttony." His was a sad premonition of what was to come.

Of the palms that Bory saw in coastal lands or at low altitude (< 600 m), he did not specify if they were *palmistes blancs* (*Dictyosperma album*) or *palmistes rouges* (*Acanthophoenix* spp.), except in the Tremblet area, on the southeast coast, where the presence of *A. rubra* was explicitly noted. He reported the plentiful presence of *A. crinita* in the highlands above Saint-Denis, at Plaine d'Affouche, on the upper Plaine des Cafres, especially at Piton Villers, and of course, at Plaine des Palmistes, whose "name comes from the incredible quantity of *palmistes* that can be found; they are extremely numerous and tight." However, Bory stayed too short a time in Réunion, and nobody pointed out the *palmiste* from Trois Mares (*A. rousselii*), which was probably confused with *A. rubra*.

Two hundred years later, *palmiste* survival prospects are worrying, and the wild populations have suffered considerable declines. By the end of the nineteenth century, the first authorized forestry agent cut 65,000 adult specimens of *Acanthophoenix crinita* from Plaine des Palmistes in order to sell the hearts! In the 1960s the ONF, though in charge of forest environmental protection, continued to deliver harvesting permits to the inhabitants of Plaine des Palmistes. In the present state, the wild populations of *A. crinita* are distributed as follows: 1) Isolated specimens or small groups of *palmistes* in the southeast submontane rainforest above 800 m: at Basse Vallée, Saint-Philippe and Bois Blanc. In these areas, more or less accessible, poaching for palm cabbage still occurs, though it is in decline. Unfortunately this illegal practice slows down the process of establishing notable populations of *A. crinita*. 2) Scattered populations in the upper Langevin Valley above Cap Blanc, toward Nez Coupé du Tremblet, Hauts de Sainte-Rose, Ilet Patience and Takamaka Heights. They occupy remote locations difficult of access in the mountain rainforest (> 1000 m) and in the *Pandanus montanus* wet thicket ecosystem (1400–1800 m).

Table 2. Distribution of *Acanthophoenix* species

Species	*A. rubra*	*A. rousselii*	*A. crinita*
Ecosystems	Lowland rain forest on wind ward side of the island	Transitional low-land forest on leeward side of the island	1) Mountain rain forest 2) *Pandanus montanus* wet thicket eco-system on windward highlands
Altitude (m)	< 600	< 850	1) 850–1400 2) 1400–1800
Presence in Mauritius	yes	no	no



19. Distribution of Acanthophoenix populations in Réunion.

In short, the wild populations of *Acanthophoenix crinita* grow in the mountain rainforest or Mesothermic Hygrophilous Ecosystem (Cadet 1980). Its weather characteristics are: cool temperature (annual average temperature < 17°C), frost may occur several days a year toward altitude upper limit, average rain fall of 4000 mm per year at 1500 m, cloud cover and frequent fog (Figs. 2 & 18).

Once abundant on Réunion Island, as reported by early botanists, *Acanthophoenix rubra* does not exist in the wild any more. The beautiful palm grove at Anse des Cascades is the oldest plantation of *A. rubra* on the island. Also in Bois Blanc, on the forest edge in the upper section of chemin de l'Indivis, visitors may notice old *palmistes rouges* growing in old, abandoned fields. Nowadays, the species is commonly grown as a cash crop and in gardens around houses, on the southeast and east coast, from Saint-Joseph to Sainte-Rose. *Acanthophoenix rubra* cultivation requires a minimum average rainfall of 3000 mm per year (4300 mm in Saint-Philippe) and an annual average temperature of 24°C. These weather characteristics describe the Megathermic Hygrophilous Ecosystem or lowland tropical rainforest, well represented in the Mare Longue forest nature reserve in Saint-Philippe.

Acanthophoenix rousselii has a restricted distribution inside Le Tampon town limits. Besides its presence in a few gardens, it grows in Trois-Mares between 600 and 850 m. In 2001, 76 adult specimens were recorded, most of them 80 years or more old, scattered on the Roussel estate's 202 hectares (500 acres). Cyclone "Dina," which hit Réunion in January 2002, knocked the crowns off a few vulnerable palm specimens, while others were completely defoliated by groups of spot-backed weaver-birds (*Ploceus cucullatus spilonotus*). By the end of year 2003, the population of *Acanthophoenix* in Trois-Mares had declined to 64 adults. On the Roussel estate, *Acanthophoenix* palms grow together with numerous trees or palms, including *Dictyosperma album* var. *album,* endemic either to Réunion or the Mascarene Archipelago. These are huge specimens, which were preserved when the land was cleared in the late nineteen century.

In the past, it is likely that *Acanthophoenix rousselii* had a much larger distribution area covering the west coast lowlands from Saint-

20. A new plantation of *Acanthophoenix rubra* in Basse Vallée (alt.300 m) on land previously planted with *Pandanus utilis* whose stumps are still visible.

Pierre to Saint-Denis, with possible incursions in Cirque de Cilaos and Cirque de Mafate. In Cirque de Cilaos, a village named Ilet Palmistes Rouges is located on the edge of the megathermic semi-dry zone. During the dry months, the lack of rain is made worse because of the presence of a poor soil that does not retain the water. The village name refers to a red *palmiste* population, of which nothing remains. The local conditions do not allow *A. rubra* to grow and the "missing" palm may have been *A. rousselii*. It would also be advisable to search for the hypothetical presence of *A. rousselii* toward Aurère, in the Cirque de Mafate, where a wild population of *Dictyosperma album* var. *album* remains in an out of reach location.

Ecological, distributional and altitudinal characteristics of the three species of *Acanthophoenix* are summarized in Table 2. The different species are distributed in separate areas (Fig. 19), so that the possibility of hybridization in the wild remains remote. Individual palms with features intermediate between the three types of *palmistes* are extremely rare. Exceptions are in Basse Vallée, on the site of the former ONF nursery and on the Leichnig plantation; also in La Crête (Saint-Joseph district) on the René Huet plantation where *A. rubra* and *A. crinita* are grown together.

Future prospects for *Acanthophoenix* palms in Réunion Island

The threats to *Acanthophoenix* palms and possible extinction of wild populations have already been mentioned, but because they have a major effect on the evolution of the island flora, they bear repeating. These reasons are: the over-harvesting of palm cabbage for three centuries, the progressive disturbance and destruction of forests at low and intermediate altitudes for growing coffee trees or the intensive farming of sugar cane, the extinction of bird species that used to perform seed dispersal and the introduction on the island of animal pests and diseases that prevent good regeneration.

As long as wild populations survive as remnants, the Réunion *Acanthophoenix* species are not threatened with total extinction. *Acanthophoenix rubra* cultivation was re-established in Saint-Philippe some 25 years ago to fulfill consumer demand for palm cabbage, a delicacy in Creole cooking, and to stop poaching. At the beginning, *palmiste rouge* was usually cultivated under forest canopy, on slopes and on marginal lands. In recent years, with the technical assistance of the CIRAD, farmers have started a program of growing palms in open fields, sometimes associated with a companion crop (Fig. 20).

Rescue of *Acanthophoenix rousselii* came from a recent private initiative, after this palm was clearly differentiated from *A. rubra*. We are grateful to Eloi Boyer, whose work in the past three years has consisted of surveying fructification and harvesting the seeds as soon as they matured, sowing seeds and transplanting seedlings that sprouted under "mother palms" in order to grow the young palms in a shade house. Currently, the encouraging results of this palm rescue have yeilded some 4500 young plants – a very positive beginning! A program of donation of young *A. rousselii* palms to private individuals ready to respect an agreement of proper cultivation has just begun. These palms are not supposed to end up in a cooking pot! Careful distribution of ex situ collections is also required to avoid risk of hybridization and planting out of their phytogeographic zone.

Conservation status of *Acanthophoenix crinita* is quite satisfactory, even if the wild populations from the heights above Saint-Denis and Sainte-Marie, Plaine d'Affouches or Plaine des Cafres died out a long time ago. The wild populations in *Pandanus montanus* wet thicket ecosystem in the eastern highlands survive in good condition and a re-introduction attempt is under way. On private properties at Plaine des Palmistes, the presence of old specimens (70 years old and over) is not unusual, and they must be considered as survivors of a wild population. In the past 15 years the number of palm groves has increased, and in the village near the community hall, *A. crinita* is widely used for park landscaping purposes.

In the late seventies the ONF led a program of planting *Acanthophoenix crinita* in Basse Vallée. A palm nursery started to operate near the forest station, and young specimens were planted in 1979 on a land already partly reforested with *Cryptomeria*. Twenty-five years later, the result is disappointing, and the palms are less than 3 m tall. Perhaps the *Cryptomeria* forest cover, the mediocre soil and the low altitude (600 m) of the station are to blame for the slow growth of the palms.

Mass production of young palms in nurseries (Fig. 21) would allow, sooner or later, the re-introduction of *Acanthophoenix* species in their respective forest ecosystems. However, this is a premature undertaking as long as wild cabbage harvesting is not completely eradicated. The awareness of protecting the local floral heritage is reaching more and more people, especially through associations working for conservation of nature. Growing awareness brings hope for the future of *Acanthophoenix* species in Réunion.

21. Patrick Fontaine among young *Acanthophoenix rubra* in the Jardin des Epices nursery, Saint-Philippe.

Acknowledgments

I express sincere thanks to John Dransfield for advice. I thank Eloi Boyer, Marc Gérard and Lauricourt Grosset for the assistance they provided in the field. Also Eloi Boyer welcomed me in his greenhouse, where he grows young specimens of the *Acanthophoenix* from Trois-Mares, Marc Gérard helped me take close-up photographs of flowers and Lauricourt Grosset gave thoughtful comments on the manuscript. I thank Gaston Roussel who revealed historical information on the family estate in Trois-Mares. I am grateful to Deborah Roubane for her beautiful watercolor of *Acanthophoenix rousselii* staminate flower and to Thierry Hubert for computer assistance. Thanks are also due to Steve Swinscoe who proof-read my English manuscript.

LITERATURE CITED

BORY DE ST-VINCENT, J.B.G.M. 1804. Voyage dans les Quatre Principales Iles des Mers d'Afrique. Paris.

CADET, TH. 1980. La Végétation de l'Ile de La Réunion. Saint-Denis de La Réunion.

CORDEMOY, E. JACOB DE. 1895. Flore de l'Ile de La Réunion. Paris.

MOORE H.E. AND L.J. GUÉHO. 1980. *Acanthophoenix* and *Dictyosperma* in the Mascarene Islands. Gentes Herbarum 12 (1): 1–16.

MOORE, H.E. AND L.J. GUÉHO. 1984. Flore des Mascareignes – Palmiers. Maurice, Paris et Kew.

NORMAND F. AND P. HUET. 2000. Fiche Technique Palmistes. CIRAD Réunion 2000.

PROBST J.M. AND P. BRIAL. 2002. Récits anciens de Naturalistes à l'Ile Bourbon. Nature et Patrimoine, Le Port, La Réunion.

JIM SPECHT
1930–2006

Jim Specht's name may not sound familiar to many readers; he has not been active in the International Palm Society since mid-1980. Prior to this, he was very active, and held the presidency of the California society in the 1960s. In 1967 Jim was instrumental in creating the first California newsletter, which has evolved into *The Palm Journal*.

When I first began to notice palms and their exotic beauty, Jim Specht was one of the first two people I contacted (Ed Moore was the other). Jim was very helpful in getting me started in my early gardening adventures, and especially generous with his time and encouragement. Jim introduced me to stable litter as a mulch in the garden; I continued to use this as long as it was available from local stables. Unfortunately those mulch sources go directly to landscapers or nurseries now, and I am unable to obtain any.

Jim lived in the San Diego State College area near La Mesa. He had palms in his garden that were totally foreign to me in the early 1960s. At that time, only 20–30 palm species were available for us to grow. Jim introduced me to *Copernicia*, *Acrocomia*, *Dypsis lutescens* and *Ptychosperma*. Jim and Alice were both teachers in the Santee school district; prior to that, he was an engineer and then an auditor for the City of San Diego. I attribute his skillful designs, his ability to instruct me and others and his great organizational skills on setting up the newsletter and being local president to those teaching skills and organizational talents. He also was quite a tennis player, so he did more than gardening in his free time. Around 1989, Jim and his wife Alice built a new home on Mountain View Drive, near Normal Heights. I was astounded that he could leave his paradise home to start all over. However, he quickly created a new show place. Then in 1993, he and Alice moved to the big island near Hilo. They built a house there, and landscaped it quickly and fabulously as well. In 1995, his health began to decline, and he and his wife moved back to San Diego to be closer to their two sons. This time they moved to Rancho Bernardo. He had developed Alzheimer's disease, and it became very difficult for Alice to care for him around the clock. Eventually Alice and their sons moved Jim Specht to a fulltime care facility nearby.

Jim was very generous with his time and his plants. He donated numerous plants to the San Diego Zoo and Balboa Park; the large *Ravenea rivularis* above Palm Canyon is one of his plants.

In 2005, the Southern California Palm Society chapter honored him at our January Banquet with a Lifetime Achievement Award. I was one of many local palm society members who received valuable information from Jim Specht, and I know he made strong associations with other palm growers in Hawaii during his brief stay there.

JIM WRIGHT

Unusual Branching in *Manicaria*

Jack B. Fisher
and
Scott Zona
Fairchild Tropical Botanic Garden
11935 Old Cutler Road
Coral Gables, Miami, Florida
33156 USA
jfisher@fairchildgarden.org

1. *Manicaria saccifera* at FTBG. There are two sets of twin shoots; one pair has 10 and 9 expanded leaves, while the other pair had 10 and 10 expanded leaves. One shoot is hidden in this photo. E = enclosing leaf.

Observations of a cultivated specimen of *Manicaria saccifera* Gaertn. revealed that the stem of this species branches dichotomously.

Axillary branching – a shoot growing from a bud located in the axil, or angle, between the leaf and stem – is the most common way in which vascular plants branch. Branching from axillary buds allows plants to form extensive above-ground canopies. When the branching arises from axillary buds at or below ground, the plant can grow clonally, forming clusters of stems or colonies of plants. Axillary branching is also the same process by which most inflorescences arise in flowering plants. In this respect, palms are no different from other vascular plants.

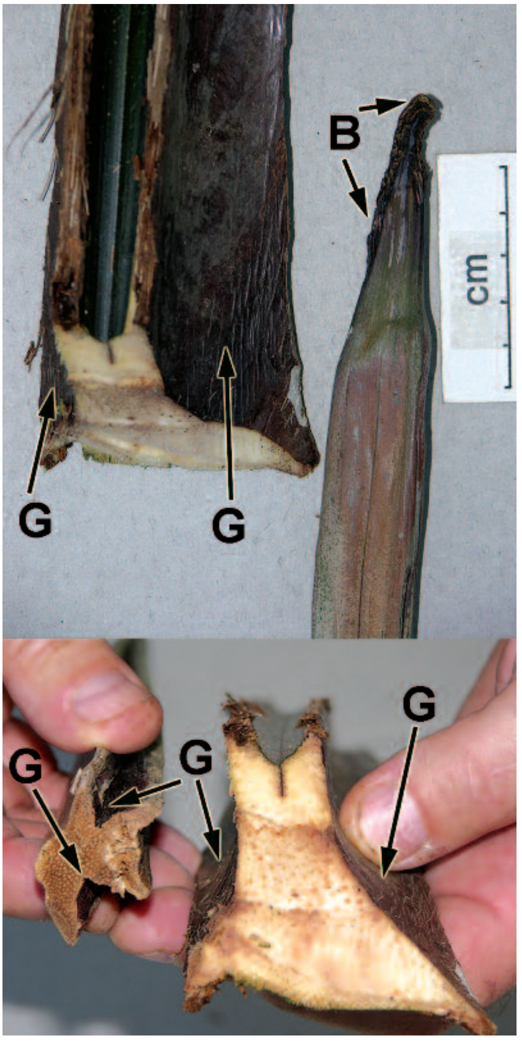
Deviations from axillary branching are unusual and account for the distinctive architecture of certain palms. A few palms initiate small plantlets or bulbils on the tips of long inflorescences (*Salacca*). Others form new shoots from buds in one or more positions at a stem node but not in the leaf axil, as in *Dypsis lutescens* (H. Wendl) Beentje & J. Dransf. and some rattans. In still other palms, the stem divides by the division of the growing point (the apical meristem) and forms twin apical buds. This apical division is known as dichotomous branching, although branches

2. The enclosing leaf (E) between two twin shoots with two grooves (G), each facing a young shoot.

are not always equal in size. When it occurs at ground level, two equal shoots are seen as in *Chamaedorea cataractarum* Mart. (Fisher 1976) or in *Nypa fruticans* Wurmb (Tomlinson 1971). When dichotomous branching occurs above ground, the stem is forked as in *Hyphaene*. Interestingly, although stems may be produced by different means, inflorescences are always initiated from axillary buds (Fisher & Maidman 1999).

Now another palm can be added to the list of those with unusual branch development. We have discovered dichotomous branching in a twelve-year old specimen of *Manicaria saccifera* growing in the "Windows to the Tropics" conservatory at Fairchild Tropical Botanic Garden (FTBG). The plant (accession 93-495A) was still juvenile with no bare trunk and had not yet flowered. The leaves were about 4 m long and had the typical irregularly pinnate adult form. The clump was twice divided, producing four equal shoots (Fig. 1).

3. The enclosing leaf. Upper. Base of leaf showing grooves (G) and the leaf tip with very reduced leaflets of two small fused blades (B). Lower. Cross sections along the petiole showing the two grooves (G).



The leaf between the shoot pairs, the last leaf produced before the division, was unlike other leaves (Fig. 2). In both branch pairs, this last leaf of the original shoot, called the "enclosing leaf" by Fisher and Maidman (1999), had two grooves on its petiole, was reduced in length and showed signs that the upper region was composed of two vestigial blades that were fused back to back (Fig. 3). We observed two enclosing leaves, corresponding to the second round of dichotomous branching (the enclosing leaf from the first dichotomizing event had long since disintegrated). A voucher specimen of the two enclosing leaves (*Zona & Fisher 1073*) is preserved in the herbarium at FTBG. All other leaves on this plant had only one groove on the adaxial (upper) surface of the petiole, extending from the sheathing leaf base to the single, fully formed blade. Each of the new shoots were equal in size and had about the same numbers of leaves (Fig. 1).

This species has been consistently referred to as being "single-stemmed" by Kahn and de Granville (1992) and others (Wessels Boer 1965, Borchsenius et al. 1998, Stauffer 2000). However, Henderson (1995) described *M. saccifera* as being "solitary or cespitose, occasionally branched (?dichotomously)." Henderson appears to have made the first observation of the unusual type of branching.

The enclosing leaf of *Manicaria* is similar in form to enclosing leaves of *Nypa, Chamaedorea cataractarum*, *Hyphaene* spp., *Nannorrhops* and *Allagoptera,* all of which have dichotomous branching (Fisher & Maidman 1999). Interestingly, dichotomous branching seems to be associated with unstable substrates. *Nypa fruticans*, *Chamaedorea cataractarum* and *Manicaria saccifera* grow in wet environments. *Nypa* is a mangrove species. *Chamaedorea cataractarum* is a rheophyte, and *Manicaria* occurs in estuaries and along river banks. *Allogoptera arenaria* (M. Gómez) Kuntze grows in shifting sand dunes along maritime coasts, as do some *Hyphaene* species. *Nannorrhops ritchiana* (Griff.) Aitch. grows in sandy, desert habitats. Dichotomous branching may allow these palms greater stability in situations in which wind or water erodes or deposits soil at their roots (Dransfield 1992). The list of dichotomously branching palms also includes certain rheophytic *Pinanga* species (Dransfield 1992), some *Dypis* and *Oncosperma* species and the swamp-dwelling *Raphia sudanica* A. Chev. (Fisher & Maidman 1999).

We assume that, as in other species with dichotomous branching, the inflorescences of *Manicaria* will arise from lateral, axillary buds, the situation found in all palms. We await flowering of the specimen to verify this assumption.

Acknowledgments

This work was supported in part by National Science Foundation Grant 0515683.

Literature Cited

Borchsenius, F., H. Borgtoft Pedersen and H. Balslev. 1998. Manual of the Palms of Ecuador. AAU Reports 37, Dept. of Systematic Botany, University of Aarhus, Denmark.

Dransfield, J. 1992. Observations on rheophytic palms in Borneo. Bull. Inst. Fr. Études Andines 21: 415–432.

Fisher, J.B. and K.J. Maidman. 1999. Branching and architecture in palms: value for systematics. Mem. New York Bot. Gard. 83: 35–46.

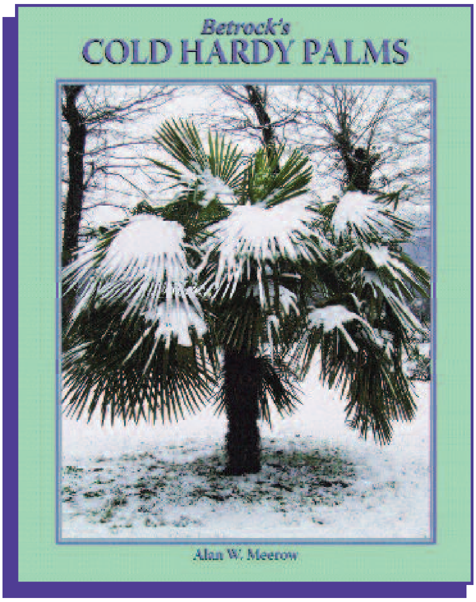
Henderson, A. 1995. The Palms of the Amazon. Oxford University Press, New York.

Kahn, F. and J. de Granville. 1992. Palms in Forest Ecosystems of Amazonia. Springer-Verlag, Berlin.

Stauffer, F.W. 2000. Contribución al estudio de las palmas (Arecaceae) del Estado Amazonas, Venezuela. V. Tratamiento sistemático. Scientia Guaianae 10: 35–120.

Tomlinson, P.B. 1971. The shoot apex and its dichotomous branching in the *Nypa* palm. Ann. Bot. 35: 865–879.

Wessels Boer, J.G. 1965. Flora of Suriname. Vol. V. Part I. Palmae. E.J. Brill, Leiden.


Betrock's
COLD HARDY PALMS
Alan W. Meerow


Scientific Name: Phoenix sylvestris
Common Name(s): toddy palm, wild date palm, India date

Celebrating 50 Years of Palms