

Palms

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The International Palm Society

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FRONT COVER

Ceroxylon alpinum in its natural habitat on the NW slopes of the Ecuadorean Andes. Photo by J.-C. Pintaud. See article p. ##.

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Parajubaea cocoides (left) in the colonial center of Cuenca, Ecuador. Photograph by J.-C. Pintaud. See article page 165.

BACK COVER

A group of *Ceroxylon parvifrons* in Hacienda Gualilagua de Lasso, Machachi. Photograph by J.-C. Pintaud. See article p. 165.



NEWS FROM THE WORLD OF PALMS

In this column, in September 2005, we noted the flurry of reports in the popular press regarding the germination of a 2000-year-old date palm (*Phoenix dactylifera*) seed by Israeli researchers. The reported age of the seed, recovered from the ancient fortress of Masada, shattered all previous seed longevity records. Many palm growers, who have had first-hand experience in the relatively short-lived viability of palm seeds, were sceptical of the news reports. Many of us wondered if the seed was a modern contaminant of the archaeological site, or if a simple greenhouse mix-up could have occurred. A brief report in the prestigious journal *Science* (320: 1464. 13 June 2008) sweeps away all doubts. Sallon et al. described the circumstances around the discovery and subsequent germination of the seed, including the struggle to keep the frail seedling alive. Most importantly, radiocarbon dating of the remains of the seed coat confirmed the astonishing age of the palm seed. The seedling appears to have increased in vigour, and a portrait of the thriving young palm, dubbed the Methuselah Palm, can be seen in the November 2008 issue of *National Geographic Magazine*.

Another publication that has come to our attention will be of great interest to palm growers in areas of Europe and the Middle East where palms are threatened by Red Palm Weevil (RPW). Pinhas et al. (*Computer & Electronics in Agriculture* 63: 131–139. 2008) described the use of acoustic equipment in detecting RPW in date palms. RPW larvae feed inside the stems and terminal buds of palms, destroying palms well before any visual symptoms appear. The authors found that recording devices, coupled with methods similar to those used in speech and voice recognition, were successful in detecting RPW larvae inside palms up to 98.9% of the time.

This technology could be extremely useful to plant quarantine officials, plant pathologists and horticulturists in their battle against RPW.

News recently received from Xavier Metz in Madagascar gives heartening information about the progress towards the long-term conservation of the newly described *Tahina spectabilis*, information that will be of great interest to all those who bought seed of this spectacular palm. The sale of seeds via Toby Spanner's rarepalmseed.com has raised a substantial amount of money to support activities in the village near to the palm. The village committee has spent money in establishing a fire break surrounding the limestone hill at the foot of which *Tahina* grows and in fencing off areas at the foot of the hill to prevent zebu cattle from grazing the developing seedlings. Some of the money has been spent in doubling the size of the village school building and thereby doubling the number of pupils, and also spent in establishing an agricultural implement fund, whereby villagers can borrow to purchase agricultural equipment and pay back with the proceeds of the first harvest. This latter fund is thus revolving and is likely, as with the school, to have lasting benefit for the villagers. Clearly linked to the sale of *Tahina* seeds, the money has demonstrated the value to the community of the palm. Unfortunately, no tree has come into flower this year, so there will be no seeds available next year. Finally, proposals have been made to ANGAP, the nature conservation agency in Madagascar, to make the area where the palm grows into an officially protected area.

And talking of *Tahina*, the palm has recently made it to the 2009 edition of the Guinness Book of Records as the Newest Tree – a rather strange achievement.

THE EDITORS

GROWING PALMS

Horticultural and practical advice for the enthusiast

Edited by Randal J. Moore

Contents

- 🌴 Recycled Water Quality and Palms: Part II
– Randal J. Moore & Michael Marika
- 🌴 Using the “World Checklist of Palms” in
the Garden – Randal J. Moore



Recycled Water Quality and Palms: Part II

Essential nutrients must be in a water-soluble form in order to be available for uptake by the palm's root system. The nutrients may be present in sufficient amounts in the soil but still not available to the palm. For many nutrients, one of the important factors for determining their availability is the pH of the soil and irrigation water.

While somewhat variable depending on the sample time and location, the pH of most recycled irrigation water is moderately alkaline (a pH range of 8.0–8.5). Many soils are also somewhat alkaline, including those in Southern California where this study was undertaken. In general, most palms perform best in a neutral pH range of 6.0–8.0. Certain acid-loving palms prefer a pH of less than 7.0 to as low as 5.5.

The principal effect of a high or low pH in the soil and irrigation water is the relative availability of essential nutrients. The availability of most metals and phosphorus is reduced at high pH (alkaline) conditions. In low pH (acidic) conditions, potassium, phosphorus, sulfur, calcium and magnesium are less available.

Optimal pH ranges have been established that indicate when the availability of the particular nutrient is maximized. There is also partial solubility that gradually declines as pH deviates from the optimal range. The degree of partial solubility outside of the optimal range differs depending on the particular element. Each nutrient that is important in palm horticulture is discussed below with regard to pH availability and recycled water quality.

Nitrogen. The relative availability of nitrogen is maximized for a range of neutral pH values from 6.0 (slightly acidic) to 8.0 (slightly alkaline). Nitrogen is not retained in acidic soils (particularly potting mixes) and is rapidly leached away causing a deficiency.

Of course, Nitrogen is an essential macronutrient that is scarce in some soils and container-grown palms. Nitrogen deficiency causes yellowing of leaves and a reduction in the palm's growth rate. Because recycled water tends to be moderately alkaline, it can reduce the availability of nitrogen to palms.

Phosphorus. A relatively narrow pH range of 6.5 (very slightly acidic) to 7.5 (very slightly alkaline) is optimal for the uptake of phosphorus. As the pH varies from this optimal range, the availability of phosphorus to plants tends to decline rapidly.

Although phosphorus leaches quickly through most soils and is available over a narrow pH range, it is rarely a cause of nutrient deficiency in palms. Most balanced fertilizers contain copious amounts of phosphorus to meet most palms' growing requirements.

Potassium. The availability of potassium to plants is good over a very wide range of pH from 6.0 (slightly acidic) to 10.0 (strongly alkaline). Its availability is only decreased under moderately and strongly acidic conditions. While generally not related to pH, potassium deficiency is fairly widespread in palms. This is normally due to this element's absence in soils. It is not retained well in many types of soil because of leaching.

Sulfur. Similar to potassium, sulfur is highly available over a pH range of 6.0–10.0 and is only suboptimal in very acidic conditions. Sulfur is rapidly leached from most soils. However, it is usually replenished by additional decaying organic matter. It is an important macronutrient needed by palms in fairly large quantities. A deficiency of sulfur generally causes necrotic conditions in the new leaves of palms.

Sulfur decreases the pH of most soils. It is important in reducing the higher pH associated with recycled water. Its deficiency is treated by the application of any sulfur-based fertilizers. Applying sulfur will also make other essential nutrients available that are otherwise non-soluble under highly alkaline conditions.

Magnesium and Calcium. The assumed pH range for maximum availability of magnesium and calcium is 7.0 (very slightly alkaline) to 8.5 (moderately alkaline). The explanation for this optimal range is somewhat complicated. Magnesium and calcium are actually more available at an acidic pH. However, their necessary presence in the soil causes the soil to be more alkaline. Acidic soils can be neutralized by the addition of dolomite (a combination of magnesium and calcium). Therefore, the solubility of these two elements is more commonly related to higher levels of pH. The alkalinity of recycled water, in addition to alkaline soil conditions, can inhibit the availability of these minerals.

Magnesium is well-known as an important mineral nutrient for palms. It is often deficient in sandy soils where it has been easily leached from the soil. While not fatal, the symptoms are commonly yellowing leaf margins. Simply fertilizing with magnesium may not solve a deficiency problem. It may be quickly leached from a sandy soil. Also, there is a proper balance of potassium and magnesium that must be maintained for a deficiency to be prevented. Finally, the soil or irrigation water or both can lead to overly alkaline conditions that inhibit solubility.

Iron. The best pH range for availability of the element Iron is from 4.0 (strongly acidic) to 6.0 (slightly acidic). Its solubility tapers off gradually as the pH of soil becomes more alkaline. While iron deficiency is somewhat common in palms, and iron generally present in the soil, this condition is generally not due to high pH soil or water. The early symptoms usually appear as chlorosis on the new leaves. The common cause of the deficiency is poorly aerated soils.

Manganese. A pH range of 5.0 (strongly acidic) to 6.5 (slightly acidic) is optimal for the solubility of manganese. The availability of manganese declines quickly as the pH of the soil or irrigation water become more alkaline. A main cause of manganese deficiency is high pH soil or water. The use of relatively-high pH recycled water to irrigate palms can introduce this deficiency problem.

Boron. Boron is most available over a pH range of 5.0 (strongly acidic) to 7.0 (very slightly alkaline). However, it is generally available over the entire pH spectrum. Therefore, the use of recycled water would not be a cause of boron deficiency. The problem is normally introduced by a lack of the element since it is readily leached in most types of soil.

Copper and Zinc. Similar to boron, the elements copper and zinc are soluble over the same pH range of 5.0–7.0. However, unlike boron, these elements are not easily taken up in high pH conditions. The solubility of copper and zinc is comparable to that of other metals such as iron and manganese. At high levels of absorption, these metals can become toxic. For this reason, the best soil and irrigation water pH is within the neutral range. Because recycled water is moderately alkaline, it can inhibit the uptake of these elements.

Molybdenum. The availability of molybdenum is greatest over the pH range of 7.0 (very slightly alkaline) to 10.0 (strongly alkaline). Little is understood about the causes of molybdenum

deficiency. The use of recycled water does not appear to present a problem with respect to this element.

A final note on the use of recycled water when irrigating ornamental palms. The irrigation system should meet the government health protection guidelines. In the State of California (Introduction to Health Effects Study, Richard Carlson, San Diego County Department of Environmental Health, presentation to San Diego County Water Authority, 1998). Recycled water is not considered safe to drink, wash hands or inhale (in mist) because of low levels of coliform bacteria. Some of the requirements are: All recycled water valves, pipes and outlets are to be appropriately tagged and color-coded (light purple). Access to valves and outlets must be restricted. Public notice must be posted that recycled water is being used. Irrigation methods should minimize ponding, runoff and overspray. Irrigation should be done at a time of day when it will have a good opportunity to dry before contact is made with the public or animals. – Randal J. Moore, Poway, California, USA and Michael Marika, Park Arborist, City of San Diego, California, USA 🌿

Additional Resources

Broschat T.K & A.W. Meerow. 2000. Ornamental Palm Horticulture. The University Press of Florida.

Shaw D.A. and D.R. Pittenger. s.d. Recycled Water Quality, unpublished white paper. University of California Cooperative Extension.

Using the “World Checklist of Palms” in the Garden

I ordered the *World Checklist of Palms* (Govaerts, R. & J. Dransfield. 2005. Kew Publications, ISBN 1-84246-084-6. 235 pp), hereafter abbreviated *WCP*, after hearing about its publication from John Dransfield during a board meeting of the International Palm Society at Montgomery Botanical Center nearly four years ago. At first, it seemed that a book listing all of the accepted names of palms might be of little use to a palm hobbyist. It also seemed like the book would have a short shelf life since the taxonomists are constantly making changes. Instead, for several reasons, it has become one of the most useful books in my library. Rarely does it sit on the shelf for long, as I so frequently refer to it. I use it whenever I am updating the database of my palm collection, placing a permanent plant sign in the garden or tagging the palms in my nursery. I also often reference it when I am talking about palms with a fellow collector either in person or on-line.

My main use of the *WCP* is to determine the correct spelling of a palm’s name. The names are listed alphabetically by genus and then species. At the time of its publication in 2005, there were 2,364 species in 190 genera. The simple format makes it possible to quickly obtain a correct spelling. For instance, even many taxonomists could not correctly spell a name like *Cryosophila warscewiczii* without some reference.

The *WCP* contains the list of all validly and effectively published names according to the monocot checklist database maintained at the Royal Botanic Gardens, Kew. Usually, this is valuable in determining legitimately recognized species when visiting a palm garden or nursery. The *WCP* is also a listing of accepted names, i.e., those accepted by most palm taxonomists. However, there is some disagreement within the taxonomy community regarding some palm species, and the *WCP* is only one authoritative resource among several.

Following each entry of an accepted name are the associated synonyms (of both the genus and the species) listed chronologically. I find this useful for updating the outdated names in my collection. The taxonomy of any collection is continually changing and the *WCP* is a resource for keeping it current.

Recognized natural hybrids are also included in the *WCP*. An “x” marker is placed before the name to indicate a hybrid. A palm from Florida was given to me as “*Copernicia sueroa*.” I did

not believe this was a legitimate species. After referring the *WCP*, I found that the correctly spelled name is *Copernicia* × *sueroana*, and it is a hybrid of *C. hospita* and *C. rigida*.

If I want to learn more about *Copernicia* × *sueroana*, or any other palm listed in *WCP*, the author is cited along with the place and date of publication. Many palm species were originally published in *Principes/PALMS* making it easy to research if you maintain a personal library. The IPS has also made progress toward publishing an on-line library of *Principes/PALMS* back issues on its website.

The geographic distribution of each listed species is also provided. The information is regional for widely distributed species but may specify states or provinces for more narrowly confined species. Complications are noted, such as questionable distributions, extinct species, naturalized exotics, etc. I find this useful because my plant signs in the garden include the geographic distribution.

The *World Checklist of Palms* can be ordered on-line at www.kewbooks.com, the website for ordering publication of the Royal Botanic Gardens, Kew. The price is £17.00 plus shipping charge (varies depending on location). The book order is processed in Pounds Sterling and is billed to customers in the currency of their credit card. Overseas orders are sent by airmail.

An on-line *World Checklist of Monocotyledons* is maintained by the Royal Botanic Gardens, Kew and can be accessed at <http://apps.kew.org/wcsp/home.do> at no charge. This database provides the most current taxonomic information on the palm family (and other monocots). The information on a specific species can be searched by entering the full or partial scientific name using the wildcard character (*). – Randal J. Moore, Poway, California, USA 🌴

Andean Palms in Ecuadorean Cities

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1. *Trachycarpus fortunei* and *Araucaria heterophylla* in an old garden in Quito.



A surprising number of native palms are cultivated in cities in the Andes of Ecuador, lending a distinctive appearance to the urban landscape.

Wherever palms can grow outdoors, they are used as spectacular landscape elements in urban areas. However, a few species tend to be used extensively all around the world, this resulting in global homogenization at the expense of local specialities. Andean cities do not escape this trend, as *Phoenix canariensis* tends to be the most widely planted species in many places. It is true that this Mediterranean palm grows sumptuously under the Andean climate and that epiphytes often left growing on its trunk give it a distinct appearance. Other commonly planted introduced species include *Trachycarpus fortunei* (Fig. 1), *Washingtonia robusta*, and to a lesser extent *Chamaerops humilis* and *Livistona australis* (Pintaud 2004). Fortunately, palm landscaping in Andean cities is significantly enriched with native species, especially in the genera *Parajubaea* and *Ceroxylon*. As these species are difficult to grow to maturity and rarely seen outside their native regions, they do give a quite particular and remarkable touch to urban landscape in Andean cities. Moreover, they associate nicely with introduced palm species.

There are many local variations in the use of the native Andean palms, and a particular species can become truly emblematic of a town or village where its use has been specially developed. That is why we decided in this article to associate a palm and a city, with various examples from north to south of Ecuador (Fig. 2).

Ceroxylon ventricosum in Quito

Ceroxylon ventricosum is an impressive palm. It develops a bright white-waxy, prominently ringed, ventricose trunk that can reach 30 m

tall and 60 cm in diameter. The large crown is dark green and has a plumose appearance (Fig. 3). The pinnae are whitish below (as in all *Ceroxylon* species), inserted in groups, spreading in different planes, and have pendulous tips.

This species grows spontaneously in SW Colombia and throughout Ecuador, mostly on western Andean slopes, between 2000 and 3000 m elevation. It is therefore perfect for Quito which is situated at 2800 m elevation. Natural populations of this species occur just 30 km to the SW of the city. The success of this species in cultivation comes from its tolerance to full sun even as a young plant and fast growth (the trunk grows more than 50 cm/year under optimal conditions). It is also reasonably tolerant of drought and air pollution, but needs a good, deep soil and some care to grow well. As a matter of fact, there are several decaying specimens struggling under harsh urban conditions in Quito.

Ceroxylon ventricosum is common but not abundant in the Ecuadorean capital. It is found in public gardens, old mansions, around churches, as well as in private yards. It is available in nurseries in the nearby village of Nayon, where most ornamentals for the Quito area are grown. The most famous planting in Quito is certainly the one in Plaza de

3. *Ceroxylon ventricosum*, habit.



2. Map of Ecuador showing the location of the cities treated in this article.



Argentina, in the north of the city (Fig. 4). *Ceroxylon ventricosum* deserves to be grown more extensively in Quito, as it is so spectacular and well-adapted.

Ceroxylon echinulatum in Sangolquí

This palm itself cannot be seen in this small colonial city located 25 km to the SW of Quito, at 2400 m elevation. *Ceroxylon echinulatum* is a subtropical species with an optimum habitat in cloud forests between 1600 and 1800 m elevation (Front Cover), and is difficult to grow in the inter-Andean corridor. However, its leaves are the object of a feverish activity around the church of Sangolquí and many similar places prior to the Palm Sunday (Fig. 5). The use of *Ceroxylon* leaves for this ceremony is extensive throughout the tropical Andes. As native palms are seriously damaged or even cut down to harvest the youngest leaves, natural populations are depleted, resulting in the endangerment of several species (Borchsenius et al. 1998, Galeano & Bernal 2005, Bernal & Galeano 2006). The leaves sold in Sangolquí come from nearby populations of *Ceroxylon echinulatum* on the NW slopes of the Ecuadorean Andes. In some places, the populations have been so depleted that adult palms can hardly be found now. This situation is not only damaging for the palm itself but also for the yellow-eared parrot

(*Ognorhynchus icterotis*) and the golden-cheeked parrot (*Leptosittaca branickii*), which are associated with *Ceroxylon* and are now endangered. This problem raised serious concerns among bird conservationists in Ecuador and Colombia, and various actions are promoted by NGOs in these countries. For Easter 2007, there was a vast national campaign supported by 17 institutions and NGOs in Ecuador, to inform the public and stop the use of *Ceroxylon* for Easter ceremonies. However, the skills of the people, who weave these ceremonial items in a few minutes just prior to putting them for sale, are valuable. The best alternative to protect *Ceroxylon* and parrots, while maintaining the tradition, would be to use *Phoenix canariensis* leaves instead. *Phoenix canariensis* is abundantly planted in the Sierra of Ecuador, and plantations dedicated to leaf harvesting could easily and rapidly be established, providing a new source of income to growers. Moreover, the fine leaves of *Phoenix* allow a much more delicate and complex work than the coarse leaves of *Ceroxylon*. This activity has been developed to the level of an art in the Mediterranean region. If some Andean weavers could be trained for the use of *Phoenix* leaves by Mediterranean weavers, they would certainly consider it as a good alternative to the use of *Ceroxylon* leaves, resulting in a

4. Row of *Ceroxylon ventricosum* at Plaza de Argentina, Quito.





5 (left). The ceremonial items are weaved immediately before sale from the row leaf material in the streets of Sangolquí during the Holly Week. 6 (right). *Ceroxylon parvifrons*, robust habit in northern Peru (Photo by Fabien Anthelme, IRD).



considerable improvement for the plant, animal and human components of the problem.

Ceroxylon parvifrons in Machachi

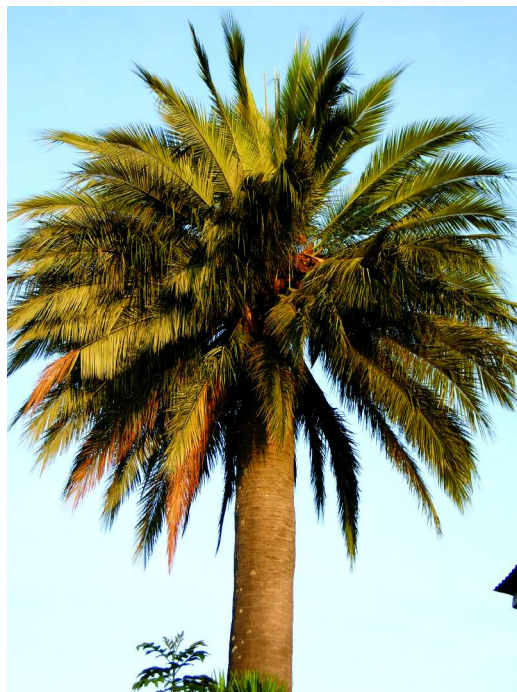
Machachi is a highly productive agricultural center and also an ecotourist destination south of Quito. The village is surrounded by five volcanoes: Cotopaxi, the world highest active volcano (5897 m), Rumiñahui and Paschoa on the eastern side of the Andean corridor; Corazón and Ilinizas on the western side. Paschoa conserves natural inter-Andean forest with its distinctive flora and fauna, and Corazón, although completely bare at the top due to various anthropogenic degradations, supports montane wet forest on its Pacific slope. Among the plant species found at Paschoa and Corazón is *Ceroxylon parvifrons*, which has been converted into the main ornamental palm in the Machachi area.

Ceroxylon parvifrons is a high altitude medium-sized species growing at an altitude up to 3500 m elevation, widespread in the Andes. It is immediately recognizable by its arching leaves with stiffly erect leaflets, a unique feature in the genus *Ceroxylon* (Back Cover). The pattern of scars on the trunk is also remarkable, and the wax cover is thin and caducous.

In the Machachi area, *Ceroxylon parvifrons* can be seen planted everywhere, both in urban and rural settings, as isolated individuals or in impressive groups. The most spectacular planting in the area is that of Hacienda Gualilagua de Lasso, where 36 centenary trees are planted in a fence-like fashion around the hacienda's garden. These palms set seeds freely, which germinate after one and half years, according to local informants. The growth rate is slow during the establishment phase, then it becomes fast in the sub-adult phase, but slows down considerably when the palm begins to flower while reaching 5 or 6 m tall. It then continues to grow slowly up to 12–15 m, forming a zigzag trunk. The contorted slender trunk is rather typical of north Ecuadorean populations. In contrast, in the south of the country and adjacent Peru, the palm is much more robust with a straight trunk and a larger crown of less prominently recurved leaves (Fig. 6).

Jubaea chilensis in Ambato

The southernmost Andean palm is commonly cultivated in the Sierra (Fig. 7), but never to such an extent as in Ambato, city of the central Andes of Ecuador, located at 2400 m elevation. *Jubaea chilensis* is a familiar element of the



7. A beautifully grown specimen of *Jubaea chilensis* in Conocoto, near Quito.

city's urban landscape. Ambato is the main fruit-producing sector in Ecuador, and the seeds of *Jubaea*, known as Chilean *coquitos*, are part of the production. Cultivation of *Jubaea* in Ambato is centered in and around the Mera

family property, whose most prominent member was the writer Juan Leon Mera (1832–1894), author of the national hymn, novels and essays, and also a politician. In 1874, the Mera family built a mansion of typical Spanish style in a 5 ha property, which became the retreat of Juan Leon, where he wrote his masterpieces and where he finally died. It is now a museum and designated a national historical heritage, known as the *quinta de J. L. Mera*. The vast garden is planted with more than 200 native and exotic plant species, many of them rarely cultivated in Ecuador, including massive palm plantings especially of *Jubaea chilensis* and *Parajubaea cocoides*, but also *Phoenix canariensis* and *Trachycarpus fortunei* (Fig. 8). Most impressive is the concentration of *Jubaeas* that has no equivalent elsewhere in Ecuador. The pattern of large scale *Jubaea* planting in the *quinta* is very similar to that found in the chateaux of the Mediterranean region including avenues, line-plantings and regular planting in rows, the latter being rather surprising for a purely ornamental purpose (Pintaud 2002). Juan Leon Mera planted these *Jubaea* around the mansion when it was built in 1874, in honor of his first seven sons (he had 11 in total). In the present day, there are 63 mature specimens, one in the patio, a row of six on the left-hand side of the house, another of four on the right-hand side and a block of 52 specimens in four rows of

8. General view of the *quinta* of Juan Leon Mera with its spectacular plantings of *Jubaea* and *Parajubaea*.





9 (top). Partial view of the *Jubaea* planting in the *quinta* of Juan Leon Mera established in 1874. 10 (bottom). *Parajubaea cocoides* in front of the cathedral of Cuenca.



11. Coconuts in the central square of San Pedro de la Bendita, 1683 m elevation.

12 plants more, two on each side of the rectangular planting (Fig. 9). There is an interesting morphological diversity in this planting. Some specimens have an erect habit, the larger ones show the characteristic shrinking of the upper part of the trunk and there is a great variation in seed shape.

Parajubaea cocoides in Cuenca

As seen in the previous sections of this article, *Parajubaea cocoides* is quite commonly cultivated in the Ecuadorean Andes and it is therefore somewhat arbitrary to associate it specifically with Cuenca. However, the view of the Cathedral with *Parajubaea* around (Fig. 10) is really emblematic and can be seen in all

tourist advertisements for the city. *Parajubaea* similarly enhances the architectural beauty of many historical buildings of the colonial center.

Cocos nucifera in Catamayo and Vilcabamba valleys

Discussing the importance of the coconut in the Andes may seem silly at first. The fact is that Catamayo valley (1150–1280 m), in the southern Andes of Ecuador, is a significant area of coconut cultivation, while Vilcabamba valley (1500–1600 m) is a leisure area where the tropical look of the coconut is appreciated. Coconut plantations are usually located below 500 m elevation, although isolated plants in private yards can be seen fruiting in Ecuador up to 1200 m elevation throughout the Andes. The Catamayo valley is a depression undergoing a dry climate due to a rain-shadow effect, forming a vast, relatively flat plain at the bottom, and totally surrounded by high mountains. This unusual setting is responsible for the existence of a hot and dry climate above 1200 m elevation, often very windy in late afternoon allowing the cultivation of tropical crops by mean of a network of small irrigation channels filled with the water coming from the surrounding mountains. The agricultural activity in the valley is focused on the industrial production of sugar cane, but there is a great diversity of minor crops as well, including plantain, cassava, maize, coffee, pineapple, rice, passion fruit, citrus and various legumes. There is also an interesting selection of ornamental palms, both tropical and subtropical in the area (Table 1). The coconut is cultivated throughout the valley, but at a limited scale. Typically, no more than 1–20 trees are planted around the houses and *fincas*, or along irrigation channels. Most of the production is absorbed by the local market, and what remains is used for domestic consumption. Farmers in Catamayo

Table 1. Ornamental palms cultivated in Catamayo (1280 m elevation).

Tropical species

Adonidia merrillii
Cocos nucifera
Dypsis lutescens
Elaeis guineensis
Livistona rotundifolia
Phoenix roebelenii
Pritchardia pacifica
Ptychosperma elegans
Roystonea oleracea

Subtropical species

Phoenix canariensis
Phoenix cf. canariensis × *dactylifera*
Syagrus romanzoffiana
Washingtonia robusta



12. The highest fruiting coconuts in Catamayo valley, struggling at 1702 m elevation.

distinguish two classes of coconuts, the *coco*, which produces large fruits of which the solid endosperm is used in culinary preparations (*cocadas*), and the *pipa*, which produces small fruits of which the liquid is used as beverage.

Farmers said they cultivate two varieties of *coco* and five of *pipa*. The fruits are sold 10c each and retailers get two glasses of coconut drink that they sell at 25c each, from one *pipa* fruit, meaning a benefit of 40c per fruit. Apart from

Table 2. Data on the altitudinal limit of ornamental coconut cultivation in the southern Andes of Ecuador (1500-1800 m elevation).			
Location	Geographic coordinates	Elevation	Observations
Loja-Catamayo road	03°58'52.0"S	1526 m	Healthy immature specimen.
Estación El Peaje	79°19'53.9"W		
Trapiche	04°12'56.0"S	1565 m	Ornamental fence (ca. 15), mature, fruiting irregular.
Casa El Prado	79°13'42.7"W		
Vilcabamba	04°15'39.0"S	1574 m	One subadult, sterile, weak growth under shade.
Parque central	79°13'22.4"W		
Loja-Vilcabamba road	04°10'23.2"S	1675 m	Mature specimens; no fruits.
Private garden	79°12'53.3"W		
San Pedro de la Bendita	03°56'36.0"S	1683 m	Two mature specimens; fruiting irregular
Parque central	79°26'05.2"W		
San Pedro de la Bendita	03°56'43.9"S	1702 m	Ca. 12 specimens in a row; fruiting irregular.
Private garden	79°26'02.5"W		
Sanctuary San Vicente	03°56'55.4"S	1768 m	Immature; growth abnormal.
Private garden	79°26'50.7"W		

the agricultural aspect of coconut production in the bottom of the valley, people in the area are keen on pushing the palm to its extreme altitudinal limit as a challenging weekend gardening activity. Most noteworthy are the two tall coconuts of the central square of San Pedro de la Bendita, at 1683 m elevation (Fig. 11), a row of mature specimens in a private garden nearby at 1702 m (Fig. 12) and a poor but maybe record-holding plant near the sanctuary of San Vicente at 1768 m elevation. Coconut growers at these elevations maintain their plants with a permanent supply of NPK and sodium chloride. With this care, the coconuts do set fruits, but somewhat irregularly, up to 1700 m elevation. In Vilcabamba valley, the highest mature coconuts seen were at 1675 m elevation and were sterile at the time of visit. Individual data about the highest coconuts of the area are given in Table 2.

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LETTER TO THE EDITORS

17 July 2008

To the Editors:

I have read "Time Bombs in Gardens: Invasive Palms in Tropical Islands, with Emphasis on French Polynesia (Pacific Ocean) and the Mascarenes (Indian Ocean)" in the June, 2008 issue of PALMS. I am troubled by its content, though not in the way the authors might have intended. Accepting the article's logic means, I think, an end to palm collecting and a serious reduction or complete elimination of the collections of botanical gardens. An eventual incidental casualty might well be the International Palm Society (though perhaps its journal might be retained as a forum for taxonomists). While everything in the article pertains to palms on islands, everything in the article applies almost as readily to mainland gardens, personal or institutional.

I have more than 100 palms of 70+ species growing in my half-acre lot in Vero Beach, Florida (USDA Zone 9B, or possibly once again 10A). I have been collecting palms for nearly 30 years, the same length of time I have belonged to the IPS. I also belong to Central Florida Palm & Cycad Society and remain a longtime member of the Florida Native Plant Society. I am fully aware of major plant pests in Florida; several palm species are listed as potential pests but are little more than nuisances easily dealt with.

While the article outlines the problems that exotic palms present to the native ecology in the Mascarene Islands and in French Polynesia, its implications extend much further. The article's basic premise (though unobtrusively qualified) is that all exotic palms are actually or potentially "bad." I realize that banning exotics is a very hot, trendy topic in quite a few places around the world; the article's viewpoint is the epitome of political correctness.

Just about all palms in favorable circumstances can produce viable seed. If there are volunteers, these can become a "threat" to the native ecology. Does this mean that the volunteers under my big *Livistona saribus* should be reported as "locally naturalized"? When would this become a bigger problem? When some volunteers appear in a neighbor's yard? Of course, I live in an essentially suburban area in which the native ecology has been mostly bulldozed. Nature, however defined, is at least 10 miles away.

I find disturbing that in the article the terms "locally naturalized" and "widely naturalized" are nowhere defined. I do understand that this is a survey of literature and, thus, very general. But, still, no real definitions of crucial terms.

In many tropical areas, farmers are energetically putting to extinction native species through slash-and-burn agriculture. Thus, there may be little left other than a thoroughly despoiled natural habitat. Botanical gardens have saved some palm species from complete extinction and, with distribution of seed, have secured the longer term survival of these species.

The botanical garden on Mauritius is reported to be a major source of the spread of exotic palm species. Native palm species are noted as threatened, some near extinction. Has human agriculture had nothing to do with their plight? The article establishes no such cause-and-effect. By implication exotic palms, originating in the botanical garden, are the only threat though nowhere is this directly stated. Anyone accepting the innuendo must then look for a solution. One very obvious answer is to remove the exotic palms as a source and to prevent the importation of seed for species not currently grown. Applied to Miami, that might mean that Fairchild Tropical Botanic Garden and Montgomery Botanical Center should eliminate their palm collections as a potential source of damage to the ecology of Miami-Dade County.

A proposal last year in New Zealand to ban the popular *Archontophoenix cunninghamiana* would initially have required that homeowners remove these palms at their own expense. Opponents pointed out that the palm volunteered in "disturbed" habitats, such as urban and suburban landscapes, that it nowhere had been shown to survive in native habitat. The proposal has been tabled, not dropped, and it has been suspected that the ban was proposed without any supporting evidence, the conclusion being foregone.

The necessity of a ban on exotic species is so self-evident to its advocates that empirical data may not be required to prove the case.

The article suggests that the invasive propensity of any new exotic palm species be carefully monitored before their entry is permitted elsewhere. Not a bad idea, however, who is to do the monitoring, at whose expense, for how long? Much easier and cheaper just to ban.

I would hope that the IPS hold a watching brief on any such proposals, wherever these might appear. Otherwise, I suppose that I should be content with growing only the 11 species of palms native to Florida after destroying all my exotics lest these subvert the native ecology and citrus groves of Central Florida.

JOHN D. KENNEDY
Vero Beach, Florida USA

Villa Beccari – One Century Later

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1. Main
entrance
of the
Villa
Beccari.



In the latter part of his life, the great Italian palm botanist, Odoardo Beccari, lived in a fine villa in the outskirts of Florence where he cultivated many palms. This paper explores the gardens of the Villa Beccari and lists which palms remain.

Odoardo Beccari (1843–1920), was one of the most important palm figures of all times. He was born in Florence, where he lived and worked all his life, but he also travelled and collected extensively in the Old World tropics. His published works went even further; thanks to his many collaborators, he produced magnificent palm studies focused on many remote corners of the whole world. A long list of palm names commemorate him such as *Pritchardia beccariana* from Hawaii, *Licuala beccariana* from Papua New Guinea and the genus *Beccariophoenix* in Madagascar. The acronym “Becc.” commemorates him as the author of a plethora of palm names.

“Il Beccari,” as he is now known in Italy, owned a majestic villa in the outskirts of the city (Fig. 1), and about one century ago he planted its gardens with interesting species. He had the opportunity to obtain seeds of the rarest and newest palms of his age and tried some of the ones from colder climates in Florence, both in his garden and in the city botanic gardens, which he directed for years.

Florence in Central-Northern Italy is one of the most beautiful cities of the world but is not the perfect place to grow palms. It is located above latitude 43° North, 77 km away from the sea, and every winter it receives frosts that usually take the thermometers down to -3°C

(27°F) to -10°C (14°F). It may also receive extreme exceptional waves of hot or cold weather. Palms survived through the years up to a catastrophic freeze in 1985, which brought the thermometer down to -21°C (-6°F) in the centre of Florence and to -26°C (-15°F) in Villa Beccari.

The Villa and its park

Villa Beccari, also called Castello del Bisarno, has the general aspect of a castle. It was probably built in the 13th Century as a fortified building to control the nearby Via Cassia and the pass over the River Arno. It has belonged to the Beccari family since 1838, when Giuseppe Beccari, father of Odoardo, bought the property. The building is sited in a wide park divided into three parts. There is a wide lawn in front of the main entrance with large trees in its borders from mediterranean and temperate climates. Scattered close to the house grow two large yet trunkless *Jubaea chilensis*, two isolated *Trachycarpus fortunei*, and a group planting of this same species. In Florence this species grows to perfection when the soil is fertile enough, and in Villa Beccari it germinates and grows freely when allowed to in the shade of deciduous trees.

Two gardens closed by walls embrace the back and the sides of the castle, connected by iron gates to the main lawn. One of them is an Italian garden with symmetrical formal plots, the other is the *giardino d'acclimatazione*, where most of the unusual species were tried. A fourth area is the very large vegetable garden, with no palms or trees.

A beautiful iron gate leads into the Italian garden divided in plots bordered by low *Buxus* hedges. Palms are represented by a 14 m tall *Trachycarpus fortunei* (Fig. 2) and an old yet small sized *Nannorrhops ritchiana* with glaucous-green leaves (Figs. 3 & 4). The latter species is extremely tolerant to adversities of any kind. Its trunk can be upright, creeping or subterranean and there are specimens producing branches with multiple heads, with abundant tomentum in the leaf bases and persistent reins in the leaves. Each head blooms once in its life and dies after fruiting, while new stems take over. The clump at Villa Beccari was planted by Beccari in 1887. It grew slowly and in 1912 the 25 year old specimen was 3 m tall and 4.5 m in diameter with no exposed stems (Bean 1912). As time passed it became much larger but its arborescent stems

2 (left). An old *Trachycarpus fortunei* by the back patio, Villa Beccari. 3 (right). *Nannorrhops ritchiana*.



were killed by the 1985 freeze and it had to resprout from its base. The resulting growth of new suckers was very dense and in the 1990s the clump became too large for its plot. The owners decided to reduce it roughly to the original size and removed various heads. The actual size of the 118 years old specimen is 3×4 m (trunk to trunk, excluding leaves), its height is about 3 m and it is split in two groups. It has a total of 23 heads, with 8 and 15 heads in each group with an uncounted number of trunkless suckers. A few trunks have surpassed 1 m of height and the smaller group has bloomed recently. This admirable survivor can be compared to a *Nannorrhops* of roughly the same age which grows in the botanical garden of Rome. In Rome, the much milder climate allowed it to keep the scrambling aerial stems which now attain 10 m in length, as illustrate in a past issue of Palms (Morici 1999).

The next iron gate leads into the *giardino d'acclimatazione*, which is beautifully secluded by brick walls and has more arborescent species. A giant *Jubaea chilensis* (Fig. 5) towers above this courtyard. This palm, about 25 m tall, is the perfect complement to the walls of the monumental villa and is a living

monument to Odoardo's passion. The specimen is more than 113 years old, because Roster in 1922 described it as being about ten meters tall and more than 30 years old. It has wide scars on the upper part of the trunk, probably coinciding with the hardest freezes. In the winter of 1985 it lost all its leaves. An old *T. fortunei*, almost 20 m tall, grows close by.

Old plants of *Chamaerops humilis* are scattered in the garden and at least one of them belongs to one of the varieties described by the Italian botanist. It is a healthy female specimen of *Chamaerops humilis* var. *dactylocarpa* (Fig. 6). I had never seen one before and I was gladly surprised to see that its bright yellow-orange fruits are truly reminiscent of dates as its name suggests, as they are longer than any other form of this variable species. The clump measures 5 m in diameter and is 2.5 m tall.

Some large *Trachycarpus fortunei* grow along a wall and one of them is different. Two of them are solitary palms, almost 20 m tall, and the fourth is an 8 m tall clumping individual. It has four fertile female trunks, between 3.5 and 6.5 m tall, a fifth sterile trunk 1.5 m and a few trunkless shoots. Beccari obtained seeds of this

4 (left). *Nannorrhops ritchiana*, Villa Beccari. 5 (right). *Jubaea chilensis*, Villa Beccari.





6. *Chamaerops humilis* var. *dactylocarpa*, Villa Beccari.

clumping form of *T. fortunei* collected from four mother-plants growing in Sunset Park, Los Angeles. He never described it as a new species but the invalid name *T. caespitosa* Becc. has been used. Beccari supposed that the clumping *T. fortunei* was something new and wrote a letter to his friend G. Roster about a possible new species. The note was published by Roster in 1915 as an announcement of a new species named *T. caespitosa* Becc. but it lacked a proper description. Beccari's note explains that the palm was introduced in California by a Japanese horticulturist and that it is similar to *T. fortunei*. He noted differences in the upright clumping habit, in its flowers being smaller than any other then-known species and in its seeds which are more reniform than in *T. fortunei*, twice larger than high, reminding those of *T. takil*. He also mentioned that one clump originating from a single seed can have different sexes on different stems while each stem is individually unisexual. As time passed he probably realized that the differences were not enough to describe it as a new taxon, and in fact, these plants are now considered merely clumping forms of *T. fortunei*.

Besides palms, the gardens host some plants which are worth mentioning; there is an old tree of *Lagerstroemia indica* and a majestic columnar cactus (Fig. 7) planted very close to a wall. It grew to about 8 m helped by the

protection of the roof flap. A group of an uncommon tulip species survived in front of the greenhouse until 2002, even though the Botanical Garden of Florence tried to the plants. *Tulipa beccariana* was discovered by Beccari in the hills of Tuscany, when he still was a teenager (Cellai Ciuffi et al. 1999).

What did we lose with the freezes?

More palm species might have existed in the gardens, but no complete reports have ever been published until 1999 (Cellai Ciuffi et al.). According to Roster (1913–15), there were various plants of *Trachycarpus takil* Becc. which started to flower in 1902, but none of them is left. Bean (1912) and Roster (1913–15) published pictures of a beautiful 4 or 5 m tall plant in the Villa. At least one of them was still alive in 1985 when it was killed by the frost (Cellai Ciuffi et al. 1999). A hybrid between *Phoenix canariensis* and *P. dactylifera* was being tried in 1922 (Roster). A *Butia capitata*, probably planted in the early years of the century, died in early 1980s. One old specimen of this palm still lives in the center of Florence in the large courtyard in front of the Herbarium of the University, where Odoardo spent many years of his working life. A large solitary *Phoenix* survived to 1985 but died some 12 years later. It was senescent, and its trunk, which had deep cavities excavated by frost, broke during a regular winter. It was similar to



7. A columnar cactus growing against the Villa Beccari.

P. sylvestris, and it is unclear if it was or not the hybrid mentioned before (F. Oste pers. comm.). Beccari planted both species of *Washingtonia*; *W. robusta* died at an unknown date, and *W. filifera* died in 1985 (F. Oste pers. comm.).

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I wish to thank above all the descendants of Odoardo, his nephew Franco Odoardo Beccari, and his wife Nise, who opened the gates of the Villa in October 2002 and permitted me to share this experience with the readers of our journal. I am grateful to Paolo Luzzi, curator of the Botanic Garden of Florence. The nurseryman Federico Oste, who often visited these gardens during the past years, contributed by sharing his personal experiences and memories.

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Photo Feature



The Hyacinth Macaw (*Anodorhynchus hyacinthinus*), an endangered species, has one the most specialized diets of all psittacine birds: it feeds entirely on palm nuts (seeds). Palms are excellent food resources because they produce huge quantities of large seeds throughout the year and are thus dependable larders for the macaws. From the palm's point of view, the bird is a seed predator, destroying the reproductive output of the palm. The macaws are thorough and deliberate in their quest for food, and the hulls of cracked endocarps litter the ground beneath the palms whenever macaws are feeding. In this photograph, a family of Hyacinth Macaws is feeding on the seeds of *Attalea maripa* in southern Pará (Amazonia), Brazil. The bird is threatened primarily by trapping for the illegal pet trade, but changes in land use have also reduced the number of palms and of large trees in which the birds nest. – CARLOS YAMASHITA, São Paulo, Brazil.

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Rhapis puhuongensis, A New Species from Vietnam

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1. *Rhapis puhuongensis*
growing in its natural
habitat. Photo: Andrew
Henderson.

Rhapis puhuongensis, a fan palm recently discovered in central Vietnam, is described as new. This beautiful palm, with its slender stem and dwarf habit, is distinctive in the unusual outline of the leaves, which are undivided for 2–4.5 cm and have linear segments.

In March 2007 a collaborative field trip was undertaken by the Royal Botanic Gardens Kew (Kew) and the Vietnamese Institute of Ecology and Biological Resources (IEBR). The aim of the trip was to collect plant specimens in central and north Vietnam to enrich our understanding of the flora of this little studied part of the world. Whilst working in Pu Huong Nature Reserve, Melinda Trudgen, one of Kew's palm specialists, collected a flowering specimen of a beautiful, slender, dwarf fan palm, which was later identified as a new species of *Rhapis* L.f. ex Aiton. Another team, comprising Andrew Henderson of the New York Botanic Garden and staff from IEBR was active in Vietnam shortly afterwards, in May 2007. They found a specimen with very similar habit and leaves in the Herbarium at Pu Mat National Park, which they also identified as a new *Rhapis*. Despite thorough searching within the National Park, the team was unable to locate the intriguing palm in the wild.

Both teams were highly excited by their discoveries, and as photographs were emailed around the world, they quickly realized they had independently discovered the same new species at virtually the same time. Fortunately Andrew was still in Vietnam and, in collaboration with Tran Phuong Anh from IEBR, was already making new plans to attempt to find the species in the wild. In August 2007, using GPS coordinates supplied by Melinda (who was back in Kew by this time), Andrew and the team from IEBR were successful in relocating the population found by the Kew-IEBR team. The population was now fruiting and a new specimen was collected. With both flowers and fruit now available we had everything we needed to describe it as a distinctive new species.

Rhapis puhuongensis M.S. Trudgen, T.P. Anh & A.J. Hend., **sp. nov.** Palma pygmaea, habitu caespitoso; folio palmiformi pumilo, lamina maxima 13.5 cm, indiviso per 2–4.5 cm, usitato singuli plica per segmentum. *R. vialii* affinis, a qua imprimis folio segmento et fructu vulgo 2–3 carpidium maturo differt. Typus: VIETNAM. North Central Vietnam, Nghe An Province, Quy Hop District, Pu Huong Nature Reserve, limestone hills with degraded vegetation behind the Pu Huong Nature Reserve office, 19° 20'N, 105° 10'E, elevation 300 m, 18 March 2007, X.P. Vu, V.D. Nguyen, H.Q. Bui, C.T. Nguyen, R. de Kok, T. Utteridge, A. Moore, M. Briggs, M.S. Trudgen, V.C. Nguyen & D.D. Tran, HNK 1748 (Holotypus HN, isotypi K, NY, P, AAU).

Dwarf clustering fan palm. Stem slender, to 1.2 m tall, 5–8.0 mm diam., 3.4–4.4 mm diam. without sheaths, internodes 13–30 mm long, nodes distinct, tattered remnants of leaf sheath persistent on upper stem, terminating in a crown of 9–12 (15) leaves. Leaf sheath closely sheathing the stem, to 7 cm long, forming a mesh of narrow fibers; ligule papyraceous, 10–15 mm long, often persistent at maturity; petiole slender, 1.2–1.6 mm wide, 12–16 cm long when mature, margins minutely toothed; leaf blade acutely to obtusely deltoid in outline, up to 13.5 cm from petiole apex to tip, folds 14–15, undivided for 2–4.5 cm, then splitting between the folds into 13–15 linear segments, each segment 8–11 cm long, 3–6 (9) mm wide, mildly cucullate, usually with one fold except a central segment with two folds, segment margins scabrid, segment apices split along and between folds to form shallow teeth, small (ca. 0.5 mm) caducous hair-like scales scattered on adaxial and abaxial folds (primarily near the petiole), transverse veinlets conspicuous; adaxial hastula small, semi-circular, 1 × 1 mm, densely tomentose on young leaves, glabrous on mature leaves, abaxial hastula absent. Inflorescences interfoliar, up to 5 per stem, slightly pendulous, to 24.5 cm (from point of attachment to stem), branched to 2 orders, with a primary branch bearing 2–4 rachillae within each of 3 rachis bracts; prophyll tubular, 9–14 cm (exserted from sheaths for 3–7 cm), 2 keeled, sheathing, sometimes with indument along the keels, splitting along abaxial side, overlapping the start of the first rachis bract; rachis bracts (2) 3, overlapping, tubular, 2–6 cm, sometimes with an incomplete distal rachis bract, occasional scattered indumenta, tomentose at tip, split 1/3–1/2 length from tip; peduncle 8–10 cm, 2/3 within sheaths; rachis to 12.5 cm (elongating to 22 cm in fruit), slender, 0.7–1.1 mm diam.; rachillae to ca. 19 mm (elongating to 67 mm in fruit), 0.3–0.6 mm diam., peachy-pink, dark brown when dry, with pale caducous indumenta, each rachilla with 18–20 shortly pedicellate flowers, 0.5–2.2 mm apart (elongating to 1.2–7 mm apart in fruit); pedicels 0.2 × 0.4 mm (elongating to 0.8 × 0.6 mm in fruit), subtended by an elongate triangular bract. Flowers unisexual. Male flowers not seen. Female flowers appearing hermaphroditic, with well developed gynoecium and staminodes, subtended by an elongate triangular bract, pedicels 0.2 × 0.4 mm (0.8 × 0.6 mm in fruit), proximal flowers obovoid grading to spherical at the rachilla tip, 1.65 ×



2. *Rhapis puhuongsensis*. A. Habit; B. Leaf; C. Leaf sheath; D. Detail of Leaf tip; E. Pistillate inflorescence; F. Rachilla with pistillate flowers; G. Pistillate flower on rachilla; H. Pistillate flower in longitudinal section; I. Petal of pistillate flower with stamodes attached; J. Fruit on rachilla. A-J from X.P. Vu *et al.* HNK 1748, K from Henderson & Ninh Khac Ban 3423. Scale bar: A = 8 cm; B, C = 3 cm; D = 1.8mm; E = 2.5 cm; G,H,I, = 0.8mm; J = 5 mm. Drawn by Lucy T. Smith.

1.15 mm; calyx peachy-pink, cupular, sepals 3, 1.4–1.6 × ca. 0.75 mm, connate for 2/3 length, very slightly ciliate at the distal tip and sometimes along center of abaxial surface;

corolla tubular, petals 3, 1.2 mm long (immature), connate for at least 3/4 length; staminodes 6, filaments adnate to petals, ca. 0.25 × 0.2 mm, sterile anthers 0.33 × 0.18 mm;

3 carpels developing, apocarpus, each carpel asymmetrically conic, flattened adaxially with an abaxial bulge, $0.25 \times 0.075\text{--}0.2$ mm. Fruit ovoid to spherical, green when immature, yellow or white when mature, to 6×4.5 mm, 1–3 carpels maturing, borne on a receptacular-stalk to 4.1 mm. Fig. 1–5.

Additional specimens examined: VIETNAM. North Central Vietnam, Nghe An Province: Quy Hop District, Pu Huong Nature Reserve Headquarters in Quy Hop Town, about 1 km on trail behind Headquarters, disturbed forest on steep slopes of limestone outcrops, $19^{\circ}20'N$, $105^{\circ}10'E$, ca. 250 m elevation. 15 Jul 2007, *Henderson & Ninh Khac Ban 3423* (HN, NY, K); Pu Mat National Park, Khe Tre, 1 Jul 1998, *Anon 153* (HPNP).

Distribution and Habitat: North Central Vietnam, Nghe An Province, in low forest on limestone hills; 250–300 m.

Conservation status: Data deficient. It is not possible to give a precise conservation status at present, due to limited information on range and habitat. The only fertile population located by the authors was growing near a path regularly used by local people, as access

between their homes and Quy Hop. The vegetation was already degraded and although some protection may be provided by staff from the Pu Huong Nature Reserve, who are actively revegetating the area, there is certainly a risk that this location will become too disturbed for the palm to persist. Another small population was located nearby (approx. 7 km), in severely degraded vegetation near fields and with much human activity. The status of the population at Pu Mat is unknown.

Cultivation: Various species of *Rhapis* have been in cultivation since the 17th Century, and they are widely regarded as easily cultivated (Hastings 2003). We believe this species could become highly desirable, most probably as a container plant, due to its small ornamental leaves and lovely peachy-pink inflorescences (Figs. 1, 3 & 5). A small number of individuals have been transplanted and are in cultivation at IEBR, where they are doing well.

Etymology: The species is named after the type locality, Pu Huong Nature Reserve.

Taxonomic discussion: The leaves of *Rhapis* are unusual amongst palms because they are divided into segments between, rather than

3 (left). Young inflorescence of *Rhapis puhuongsensis*, showing the peachy pink colour of the rachilla and flowers. Photo: Melinda Trudgen. 4 (right). Fruit of *R. puhuongsensis*, showing the receptacular-stalk and the development of 1–3 free carpels. Photo: Andrew Henderson.





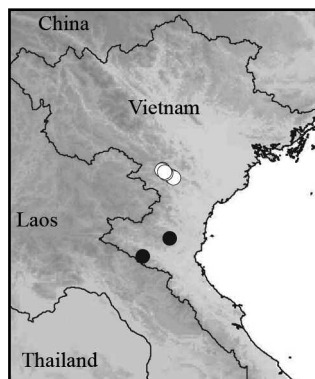
5. Leaf of *Rhapis puhuungensis*. Photo: Andrew Henderson.

along, the folds in the leaf. The presence of this type of leaf splitting in our new species, together with distinctive floral characteristics (such as the fusion of the anther filaments to the petals), clearly place it within *Rhapis*. The distinctive leaves allow this species to be easily distinguished from other *Rhapis* species

(Hastings 2003, Averyanov et al. 2006) because they are small, have an unusual deltoid outline, are undivided for 2–4.5 cm and are then divided into mostly single-fold segments (Fig. 5). At a maximum of 13.5 cm, the leaf blade is at least 4.5 cm smaller than other known *Rhapis* species.

This species seems to most closely resemble *Rhapis vidalii* Aver., T.H.Nguyễn & P.K.Lôc, another dwarf understory palm, which was recently described and is distributed in north-central Vietnam (Fig. 6). Vegetatively they are easily distinguishable because the leaves of *R. vidalii* are at least 1/3 larger, are suborbicular in outline and the blade is segmented from near the base (Averyanov et al. 2006). The division of the leaves into predominantly single fold segments is shared by both species, but is otherwise unknown within *Rhapis*. The species can be distinguished florally as the inflorescence structure of *R. puhuongensis* is more robust and less pendulous than the lax inflorescences of *R. vidalii*. The corolla of the available flowers of *R. puhuongensis* is almost entirely enclosed within the calyx whereas the corolla of *R. vidalii* is exerted above the calyx for 3-5 mm. The fruit of both species are borne on a receptacular-stalk, the similarities of which suggest that the corolla of mature *R. puhuongensis* flowers may be exerted in a similar fashion to those of *R. vidalii*. Only one carpel normally develops into a mature fruit in *R. vidalii*, whereas two or three often develop in *R. puhuongensis* (Fig. 4).

Rhapis was described by Uhl and Dransfield (1987) as being dioecious or polygamous and by Hastings (2003) as dioecious or rarely hermaphroditic. A recent study of *Rhapis* floral morphology (Giddey 2007) found only one instance of hermaphrodite flowers, in some, but not all flowers of *Rhapis laosensis* Becc. Morphologically, the female flowers of *R. puhuongensis*, which have well developed staminodes, appear to closely resemble the hermaphrodite flowers of *R. laosensis*. In the hermaphrodite flowers studied by Giddey (2007), the stamens sit within the petals, above and without touching the gynoecium. The staminodes of this species sit in a similar position, although in this case they do appear to touch the gynoecium. The staminodes of typical female flowers in *Rhapis* (e.g., *R. excelsa* (Thunb.) Henry) sit between the gynoecium and the corolla, only rarely curving around above the gynoecium (Giddey 2007). We initially interpreted our flowers with their well-developed staminodes as hermaphroditic, however on further investigation no viable pollen grains were located. This is possibly due to the flowers available for study being



6. Distribution map of *Rhapis puhuongensis* (black dots) and the closely related species, *Rhapis vidalii* (white dots).

somewhat immature, but nonetheless means that we feel it most appropriate to describe the flowers as being unisexual, only appearing to be hermaphroditic.

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New Species of *Calamus* (Palmae) from Vietnam

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1. *Calamus acaulis*,
short-stemmed habit
and clustered pinnae.



Nine new species of *Calamus* from Vietnam are described and their relationships discussed.

Calamus is the largest genus of palms, currently thought to contain 374 species (Govaerts & Dransfield, 2005). There is no revision of the entire genus, except for the century-old works of Beccari (1908, 1913). The standard work on Vietnamese *Calamus* has been the *Flore Générale de l'Indo-Chine* (Gagnepain & Conrard, 1937), based on earlier works by Beccari (1908, 1910, 1913) and Magalon (1930). The treatment of *Calamus* in both Gagnepain and Conrard (1937) and Magalon (1930) has been criticized by Evans et al. (2002). These authors have reviewed most of the available *Calamus* specimens from the Indochina region and presented a new synopsis. Evans et al. recognize 18 species from Vietnam, and we follow this here in describing the following nine new species.

In order to put these new species in the context of the whole genus, we also attempt to place them in subgroups. The subgeneric classification of *Calamus* is in a state of flux (Beccari, 1908; Furtado, 1956; Dransfield, 1979; Kramadibrata, 1992; Baker et al., 2000), and Beccari's (1908) system, as modified by Furtado (1956) and Dransfield (1979), is still used pending a modern treatment of the problem. Beccari recognized 16 informal groups of species, and we use these to place the new species.

Calamus acaulis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a *Calamo acanthophyllo* ocreis prominentibus dense brunneo-setosis, paribus apicalibus pinnarum per longitudinem sui paene totam junctis et pinnis ad margines minute setosis, venis esetosis praeditis differt. Typus. Vietnam. Phu Yen: Tuy Hoa District, route number 1 at Ca Pass near border with Khanh Hoa, 12°51'N, 109°23'E, ca. 100 m, 22 Jul 2007, A. Henderson & Ninh Khac Ban 3451 (Holotypus: HN! Isotypi: K! NY!). Fig. 1.

Stems solitary, non-climbing, short and subterranean or visible above ground for about 5 cm, 3–3.5 cm diameter without sheaths, green. Leaves 9–12; leaf sheaths open, green with brown tomentum, with scattered, yellowish spines to 6 cm long, borne singly or in small groups; ocreas prominent, 4–10 cm long, densely brown bristly; knees absent; flagella absent; petioles 46–60 cm long, spiny as the sheaths; rachis 53–64 cm long, with few, straight spines abaxially; cirri absent; pinnae 21–25 per side of rachis, 22–30 cm long, 2–2.5 cm wide at the middle, lanceolate, borne in distant clusters of 2–6 pinnae, each pinna of a cluster spreading in a different plane, the

apical pair joined for almost their entire length, minutely bristly on the margins, not bristly on the veins, yellowish at the bases. Staminate inflorescences to 1 m long, erect, branched to 3 orders, with at least 7 partial inflorescences; prophylls 14 cm long; partial inflorescence bracts tubular, not splitting laterally, with a prominent lobe at the apex; rachillae not known in their entirety; rachillae bracts 1.5 mm high, apiculate; floral bracteoles cupular, 2-lobed; old staminate flowers 3 mm long; calyx 1.5 mm long, split for half its length into 3 lobes; corolla 3 mm long, split to the base into 3 valvate petals; pistillate inflorescences 77 cm long, erect, not flagellate, branched to 2 orders, with 4–5 partial inflorescences; prophylls not known; partial inflorescence bracts tubular, splitting laterally as the fruits develop; rachillae 1–13, 1–3 cm long; rachillae bracts 1.5 mm high, apiculate; floral bracteoles cupular, 2-lobed; flowers 3.5 mm long (post-anthesis); calyx 2 mm long, split for about half its length into 3 lobes; corolla 2.5 mm long, split for most of its length into 3 valvate petals; fruits immature, yellowish.

Local names and uses: None recorded.

Distribution and habitat: Known only from Phu Yen in central Vietnam, on steep rocky slopes in disturbed forest.

Notes: The specimens cited here will key in Evans et al. (2002) to *Calamus acanthophyllus* Becc. *Calamus acaulis* differs from that species in its prominent, densely brown bristly (versus obscure, non-bristly) ocreas; apical pair of pinnae joined for almost their entire length (versus not joined); and pinnae with minutely bristly margins and non-bristly veins (versus conspicuously bristly margins and veins). However, the short, green stem observed on one specimen of *C. acaulis* indicates that a taller stem could develop. If this were the case, it would key to *C. thysanolepis* Hance. It differs from that species in its solitary (versus clustered) stems and apical pair of pinnae joined for almost their entire length (versus not joined).

The staminate flowers of *C. acaulis* appear not to be always distichously arranged, but sometimes in groups. Unfortunately the staminate inflorescence is too old to observe this easily.

By its non-climbing habit, eflagellate sheaths, ecirrate leaves, eflagellate inflorescences, and non-pedicellate floral bracteoles, *Calamus*

acaulis appears to belong to Beccari's (1908) Group II. Another non-climbing Vietnamese species is included in this group – *Calamus dongnaiensis* Pierre. *Calamus acaulis* differs from this in its solitary (versus clustered) stems and apical pair of pinnae joined for almost their entire length (versus not joined).

Additional specimens examined. VIETNAM. PHU YEN: Tuy Hoa District, route number 1 at Ca Pass near border with Khanh Hoa, 12°51'N, 109°23'E, ca. 100 m, 22 Jul 2007, *Henderson & Ninh Khac Ban 3452* (HN, NY).

Calamus bachmaensis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a *Calamo dioico* petiolis longis, ocreis brevibus, pinnis lanceolatis plus minusve regulariter dispositis, paribus basalibus trans vaginas non retrocurvis atque paribus apicalibus ad bases sui coalitis differt. Typus. Vietnam. Thua Thien-Hue: Bach Ma National Park, 16°14'N, 107°52'E, ca. 100 m, 12 Apr 2007, *A. Henderson, Nguyen Quoc Dung, Phan Doan Vong, Phan Quyet, & Le Van Bo 3263* (Holotypus: HN! Isotypi: K! NY!).

Stems clustered, climbing, 10 m tall, 1.3 cm diameter with sheaths. Leaf sheaths closed and tubular, green, without tomentum, with densely arranged, reddish-brown, flattened spines to 1 cm long, interspersed among many smaller spines; ocreas ca. 1 mm high, densely covered with reddish-brown, needle-like spines to 0.8 cm long; knees obscure; flagella 1 m long; petioles 8–15 cm long, with recurved spines on the margins and abaxially; rachis 24–25 cm long, spiny as the petioles; cirri absent; pinnae 4–6 per side of rachis, 14–30 cm long, 2–3.5 cm wide at the middle, lanceolate, more or less regularly arranged, the apical pair joined at their bases for ca. one third their length, sparsely bristly on the margins and veins adaxially. Staminate inflorescences to 80 cm long, pendulous, flagellate, branched to 2 orders, with 1–3 partial inflorescences; prophylls 15–17 cm long, tubular, split at apex only, scarcely spiny; partial inflorescence bracts tubular, not splitting laterally; rachillae 6–9, 2–5 cm long; rachillae bracts 1.5 mm high, apiculate; floral bracteoles cupular, 2-lobed; staminate flowers 5.5 mm long; calyx tubular, 2.5 mm long, briefly 3-lobed; corolla 5.5 mm long, split almost to the base into 3 valvate petals; stamens 6; filaments inflexed at the apices; pistillode minute; pistillate inflorescences 80–104 cm long, pendulous, flagellate, branched to 2 orders, with 1–2 partial inflorescences; prophylls 17 cm long; partial inflorescence bracts tubular, splitting

laterally, densely spiny on outer surfaces; rachillae 14–19, 1.5–4 cm long; rachillae bracts 1 mm high, apiculate; floral bracteoles cupular, 2-lobed; old pistillate flowers 2 mm long; calyx 2 mm long, briefly 3-lobed at the apex; corolla 1.5 mm long; fruits immature.

Local names and uses: *may cam tre, may tre.*

Distribution and habitat: Central Vietnam in Thua Thien-Hue in Bach Ma National Park, in lowland forest on limestone soils at low elevations.

Notes: In Evans et al. (2002) the specimens cited here will key to *Calamus dioicus* Lour. The neotype of this (*Pierre 4834*, designated by Evans et al., 2002) comes from the southern part of Vietnam, “in montibus Chiao-Xhan,” in present-day Bien Hoa. Identical specimens have been recently recollected from nearby Dong Nai (*Henderson et al. 3402, 3406*). Interpreted from the neotype and these two recent collections, *Calamus dioicus* is a small rattan having distinctive leaves with 4 cm long, membranous ocreas, no petioles, and linear pinnae arranged in three (rarely two), distant groups along the rachis with the basal pair of pinnae swept back across the sheath and the apical pair of pinnae not joined. We have examined another specimen of *C. dioicus* cited by Evans et al., *Poillane 5042* at P and VNM, and these are also an exact match. However, we have not seen the P sheet of *Poillane 5042* with a staminate inflorescence, which Evans et al., because of the long inflorescence, considered might belong to another species. However, Gagnepain and Conrard (1937) described this inflorescence as 1.5 m long, and we have seen such long staminate inflorescences of *C. dioicus* in the field.

Evans et al. (2002) cited another specimen of *Calamus dioicus* (*Newman 158*) from Bach Ma National Park, at least 500 km north of Bien Hoa and Dong Nai. However, this, and an additional specimen from Bach Ma (*Henderson et al. 3263*) differ from *Calamus dioicus* in their 1 mm long ocreas, 8–15 cm long petioles, and lanceolate pinnae more or less regularly arranged with the basal pair of pinnae not swept back across the sheaths and the apical pair of pinnae joined at their bases for ca. one third their length. These two specimens are recognized here as a new species, *C. bachmaensis*.

Unfortunately, Evans et al. (2003) used *Pierre 4834* and *Newman 158* to provide a description

of *Calamus dioicus* – their description thus becomes a mixture of *C. dioicus* (leaves) and *C. bachmaensis* (leaves and staminate inflorescences).

By its climbing stems, flagellate sheaths, ecirrate leaves, flagellate inflorescences, tubular partial inflorescence bracts, and non-pedicellate floral bracteoles, *Calamus bachmaensis* belongs to Beccari's (1908) Group V.

Additional specimens examined. VIETNAM. THUA THIEN-HUE: Bach Ma National Park, Khe Don, 200 m, 19 Jan 1990, *Newman 158* (K).

Calamus centralis Henderson, N. K. Ban & N. Q. Dung, *sp. nov.*, a *Calamo palustri* habitu tenero, pinnis paucioribus et rachillis staminatis pistillatisque brevioribus differt. Typus. Vietnam. Nghe An: Pu Huong Nature Reserve, 19°19'N, 105°03'E, ca. 200 m, 8 May 2007, A. Henderson, Bui Van Thanh, Tran Duc Dung, Chu Van Dai, & Vu Ba Hung 3352 (Holotypus: HN! Isotypi: K! NY!). Fig. 2.

Stems clustered, climbing, to 20 m long, 0.8–1 cm diameter with sheaths. Leaf sheaths closed and tubular, green, without tomentum or with mottled brown tomentum, with few, scattered, yellowish-green or brown, flattened spines to 2 cm long, sometimes shorter spines interspersed; ocreas obscure, membranous; knees prominent; flagella absent; petioles absent or 2–3 cm long; rachis 38–82 cm long, with solitary or paired, recurved spines abaxially; cirri 40–76 cm long; pinnae 3–7 per side of rachis, 10–27 cm long, 1–4.5 cm wide at the middle, linear-lanceolate, distantly and irregularly arranged, the basal pair swept back across the sheath, minutely bristly along the margins with longer bristles at the apices, the veins not bristly. Staminate inflorescences to 36 cm long, erect or arching, not flagellate, branched to 2 orders, with 5–10 partial inflorescences; prophylls 1–5 cm long; partial inflorescence bracts tubular, not splitting laterally, with a prominent lobe at the apex;



2. *Calamus centralis*, leaf sheaths and inflorescence.

rachillae 1–10, to 1 cm long; rachillae bracts 1 mm high, apiculate, ciliate; floral bracteoles cupular, 2-lobed; staminate flowers 5 mm long; calyx tubular, 3 mm long, split for about half its length into 3 lobes; corolla 5 mm long, split almost to the base into 3 valvate petals; stamens 6; filaments inflexed at the apices; pistillode minute; pistillate inflorescences 28–30 cm long, erect, not flagellate, branched to 2 orders, with 4–5 partial inflorescences; prophylls 4 cm long; partial inflorescence bracts tubular, not splitting laterally; rachillae 4–6, 1–2 cm long; rachillae bracts 2 mm high, apiculate, ciliate; floral bracteoles cupular, 2-lobed; pistillate flowers 4.5 mm long; calyx 4.5 mm long, briefly 3-lobed at the apices; corolla 4 mm long, split for about half its length into 3 valvate petals; staminodes 6, the filaments cupular; fruits not known.

Local names and uses: *may*, *may mat*.

Distribution and habitat: Central Vietnam in Nghe An and Ninh Binh, in lowland forest on limestone soils.

Notes: The specimens cited here will key to *Calamus palustris* Griff. in Evans et al. (2002). *Calamus centralis* and *C. palustris* occur together in central Vietnam, and are most easily distinguished by the more slender stems of *C. centralis* (stems 0.8–1 cm diameter versus stems to 5 cm diameter), its fewer (3–7 versus 12–25) pinnae, shorter (to 1 cm long versus to 3.5 cm long) staminate rachillae, and shorter (1–2 cm long versus to 6 cm long) pistillate rachillae.

By its climbing habit, eflagellate sheaths, cirrate leaves, eflagellate inflorescences, tubular partial inflorescence bracts, *Calamus centralis* appears to be a member of Beccari's (1908) Group XV.

Additional specimens examined. VIETNAM. NINH BINH: Nho Quan District, Cuc Phuong National Park, trail near Bong, 20°35'N, 105°60'E, ca. 300 m, 5 May 2007, *Henderson et al.* 3334 (HN, NY). **NGHE AN:** Pu Huong Nature Reserve, 19°18'N, 105°07'E, ca. 250 m, 7 May 2007, *Henderson et al.* 3347 (HN, NY); Pu Huong Nature Reserve, 19°19'N, 105°03'E, ca. 200 m, 8 May 2007, *Henderson et al.* 3352 (HN, NY); Pu Huong Nature Reserve, Cuom Village, 19°24'N, 104°58'E, ca. 300 m, 10 May 2007, *Henderson et al.* 3358 (HN, NY); Pu Mat National Park, road from Con Cuong to Thac Kem, 18°57'N, 104°48'E, ca. 100 m, 12 May 2007, *Henderson et al.* 3368 (HN, NY); Pu Mat National Park, road from Con Cuong to Thac Kem, 18°57'N, 104°49'E, ca. 100 m, 14 May 2007, *Henderson et al.* 3373 (HN, NY).

Calamus crispus Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a *Calamo tetradactylo* ocreis brevibus, petiolis nullis, pinnis nitidis viridibus ad margines conspicue setosis, apicibus crispatis differt. Typus. Vietnam. Thua Thien-Hue: Bach Ma National Park, ca. 8 km from the summit, 16°13'N, 107°51'E, ca. 530 m, 13 Apr 2007, A. Henderson, Nguyen Quoc Dung, Phan Doan Vong, Phan Quyet, & Le Van Bo 3273 (Holotypus: HN! Isotypi: K! NY!).

Stems clustered, climbing, to 10 m tall, 1.5–1.8 cm diameter with sheaths. Leaf sheaths closed and tubular, green with brown tomentum, with scattered, green, downward-pointing spines to 1 cm long, with crescent-shaped, concave bases; ocreas 1 mm long; knees present; flagella 120 cm long; petioles absent on older plants; rachis 28–35 cm long, with solitary or paired, recurved spines marginally and abaxially; cirri absent; pinnae 9–10 per side of rachis, 9.5–14 cm long, 1–3 cm wide at the middle, broadly lanceolate, clustered in remote groups of 2 or 3 pinnae and spreading in different planes, glossy green, curled over at the apices, the basal pair of pinnae swept back across the sheath, the apical pair of pinnae joined for more than half their length, with conspicuous, yellow bristles along the margins, the veins not bristly. Staminate inflorescences 90–130 cm long, arching, not flagellate, with 8 partial inflorescences; prophylls 14 cm long, spiny; partial inflorescence bracts, tubular, not splitting laterally, spiny; rachillae ca. 20, 1 cm long (unexpanded); rachillae bracts 1 mm high, acuminate; floral bracteoles cupular; staminate flowers (immature) 1 mm long; calyx 1 mm long, split for about half its length into 3 lobes; corolla 1 mm long, split for most of its length into 3 valvate petals; stamens 6; pistillate inflorescences not known.

Local names and uses: *may tat*, *may tom*.

Distribution and habitat: Central Vietnam in Thua Thien-Hue and near Da Nang City, in Bach Ma National Park and Ba Na-Nui Chua Nature Reserve, on steep slopes in lowland rain forest at 500–800 m elevation.

Notes: In Evans et al. (2002) the specimens cited here will key to *C. tetradactylus* Hance. In Bach Ma National Park, where *Calamus crispus* and *C. tetradactylus* are sympatric, *C. crispus* differs most obviously from *C. tetradactylus* in its very short (versus well-developed) ocreas, lack of a petiole (versus well-developed petioles), basal pair of pinnae swept back across the sheath (versus not swept back), and glossy green pinnae with conspicuously bristly

margins and curled apices (versus green pinnae without conspicuously bristly margins and curled apices).

By its climbing habit, flagellate sheaths, ecirrate leaves, flagellate inflorescences, tubular inflorescence bracts, and non-pedicellate floral bracteoles, *Calamus crispus* appears to belong to Beccari's (1908) Group V.

Additional specimens examined. VIETNAM.

Da Nang City, Hoa Vang District, Ba Na-Nui Chua Nature Reserve, 16°00'N, 108°01'E, ca. 800 m, 18 Apr 2007, *Henderson et al.* 3290 (HN, NY); Da Nang City, Hoa Vang District, Ba Na-Nui Chua Nature Reserve, road to summit 16°00'N, 108°01'E, ca. 900 m, 23 Apr 2007, *Henderson et al.* 3317 (HN, NY).

Calamus fissilis Henderson, N. K. Ban & N. Q. Dung, *sp. nov.*, a speciebus aliis generis *Calami* cirris atque bracteis inflorescentiae paene ad basem fissis differt. Typus. Vietnam. Thua Thien-Hue: Bach Ma National Park, 16°14'N, 107°52'E, 100 m, 12 Apr 2007, A. Henderson, Nguyen Quoc Dung, Phan Xuan Phuong, & Le Van Bo 3266 (Holotypus: HN! Isotypi: K! NY!). Fig. 3.

Stems clustered, 7–10 m long, 1 cm diameter with sheaths. Leaf sheaths closed and tubular, green with dense, reddish-brown tomentum initially, with brown, flattened, horizontally spreading spines to 1 cm long, borne in short rows; knees present, obscure; ocreas obscure, less than 0.3 cm long, membranous; flagella absent; petioles absent or to 0.5 cm long; rachis 28–30 cm long, with few, recurved, solitary spines abaxially; cirri present, 40–45 cm long; pinnae 9–11 per side of rachis, 16.5–20 cm long, 1–1.2 cm wide at the middle, linear-lanceolate, regularly and distantly arranged, minutely spiny along the margins. Staminate inflorescences 10–19 cm long, arching, not flagellate, branched to 2 orders, with 3–6 partial inflorescences; prophylls 4–6 cm long, sometimes subtending the first partial inflorescence; partial inflorescence bracts 3–3.5 cm long, densely brown tomentose on the outer surfaces, split almost to their bases before anthesis; rachillae 1–5, 1–1.5 cm long; rachillae bracts 1.5 mm high, acuminate; floral bracteoles cupular; staminate flowers 3 mm long; calyx 2–2.5 mm long, cupular, shallowly lobed at the apex, glabrous except for



3. *Calamus fissilis*, leaves and inflorescences.

tomentum on lobes; corolla 2.5–3 mm long, split to the base into 3 valvate petals, glabrous; stamens 6, 2 mm long; pistillode absent; pistillate inflorescences and fruits not known.

Local names and uses: *may cam*; the canes are used for tying.

Distribution and habitat: Known only from central Vietnam in Thua Thien-Hue and near Da Nang City, on steep slopes in lowland rain forest.

Notes: In Evans et al. (2002) the specimens cited here will key to the couplet containing *Calamus guruba* Buch.-Ham. and *C. hypoleucus* (Kurz) Kurz. These two species belong to Beccari's (1908) Group VI, having the partial inflorescence bracts split open and becoming laminar. However, this group has flagellate sheaths and ecirrate leaves, unlike the eflagellate sheaths and cirrate leaves of *C. fissilis*. By its combination of eflagellate sheaths, cirrate leaves, and deeply splitting partial inflorescence bracts, *C. fissilis* does not fit into any of Beccari's groups.

Additional specimens examined. VIETNAM. Da Nang City, Hoa Vang District, Ba Na-Nui Chua Nature Reserve, 16°00'N, 108°01'E, ca. 800 m, 18 Apr 2007, *Henderson et al.* 3289 (HN, K, NY).

Calamus kontumensis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a speciebus aliis generis *Calami* prophylo alte in pedunculo inserto, bracteis partialibus inflorescentiae findentibus laceratisque atque basibus bracteolarum floralium tumidis et inaequis differt.

Typus. Vietnam. Kon Tum: Kon Plong Distr., Hieu Mun., Mang La Forest Enterprise, 14°39'N, 108°39'E, 1100–1200 m, 23 Apr 2000, *L. Averyanov et al.* VH 5697 (Holotypus: HN! Isotypus: MO!).

Stem branching not known, climbing, to 3 m tall, 0.8–0.9 cm diameter with sheaths. Leaf sheaths closed and tubular, brown tomentose initially, with scattered, yellowish, black-tipped, flattened spines to 1 cm long, or spines absent; ocreas 0.5 mm long, membranous, not bristly or spiny; knees present; flagella 20–22 cm long, with tattering bracts; petioles 9–10 cm long; rachis 15–23 cm long, with solitary, recurved spines abaxially; cirri absent; pinnae 5–6 per side of rachis, 7–13.5 cm long, 1–3 cm wide at the middle, broadly lanceolate, clustered in remote pairs, the apical pair of pinnae briefly joined at their bases, the veins

and margins not bristly except for a few bristles at apices of pinnae. Staminate inflorescences not known; pistillate inflorescences 25–50 cm long, not or only briefly flagellate, branched to 2 orders, with 1–4 partial inflorescences, these inserted well below the mouth of the partial inflorescence bract; prophylls 5–9 cm long, inserted 1.5–6 cm above the base of the peduncle, not spiny or with a few, straight spines, splitting and tattering almost to the bases; partial inflorescence bracts tubular, splitting and tattering almost to the bases, not spiny; rachillae 1–4, 2–7 cm long, zigzag, densely brown tomentose; rachillae bracts 1.5 mm high, acuminate; floral bracteoles cupular, lobed, borne on swollen, uneven bases; pistillate flowers not known; fruits 0.7 cm diameter, globose, prominently rostrate, brown, with the perianth forming a pedicellate base; endosperm homogeneous.

Local names and uses: None recorded.

Distribution and habitat: Central Vietnam in Kon Tum, in primary, broad-leaved, closed, evergreen, wet, mountain forest on steep sandstone slopes at 1100–1200 m elevation.

Notes: The specimen cited here will not key in Evans et al. (2002). *Calamus kontumensis* is a distinctive species, differing from other Indochinese *Calamus* in its prophyll inserted high on the peduncle and splitting and tattering partial inflorescence bracts (although in this it is remarkably similar to *C. bousigonii* Becc. subsp. *smittinandii* J. Dransf.). By its climbing habit, flagellate sheaths, ecirrate leaves, and swollen, uneven bases of the floral bracteoles ("involucrophores pedicellate" of Beccari), *Calamus kontumensis* might belong to Beccari's (1908) Group VIII. However, this group is said to have regularly arranged, elongate pinnae, flagellate inflorescences, and ruminant endosperm, none of which are found in *C. kontumensis*. Nor are its floral bracteole bases nearly as pronounced as those, for example, of *C. peregrinus* Furtado, a member of Group VIII. *Calamus kontumensis* is therefore not placed in any of Beccari's groups.

Calamus lateralis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a *Calamo melanacantho* pinnis apicalibus longioribus, setis in paginis adaxialibus pinnarum longioribus et bracteolis floralibus prominentibus differt Typus. Vietnam. Dong Nai: Cat Tien National Park, trail to Crocodile Lake, lowland forest, 11°26'N, 107°26'E, 150 m, 27 May 2007, *A. Henderson, Bui Van Thanh, Vu Van Duy, Nguyen*



4. *Calamus lateralis*, leaf sheaths with reddish-brown tomentum and no spines.

Ngoc Quynh, & Phan Van Phuc 3400 (Holotypus: HN! Isotypi: K! NY!). Fig. 4.

Stems solitary, to 70 m long, 4–5.5 cm diameter with sheaths. Leaf sheaths closed and tubular, green with dense reddish-brown tomentum initially, without spines or with few, scattered, to 1 cm long spines; knees present, swollen; ocreas obscure; flagella to 5 m long; petioles 19–30 cm long, covered laterally and abaxially with recurved spines to 0.5 cm long; rachis 80–140 cm long, abaxially with spines as the petiole; cirri absent; pinnae 39–51 per side of rachis, 27–39 cm long, 1.5–2.2 cm wide at the middle, lanceolate, regularly arranged and spreading in the same plane, with 1 cm long, brown, yellow-based bristles on the two lateral veins adaxially, sometimes these on the mid-vein. Staminate inflorescences to 1.7 m long, erect or arching, not flagellate, branched to 3 orders, with to 8 partial inflorescences; prophylls not known; partial inflorescence bracts closely sheathing the main axis, without spines or with a few, recurved spines; rachillae number not known, 2.5 cm long; rachillae bracts 1 mm high, acuminate; floral bracteoles

cupular, scarcely lobed; staminate flowers not known, arranged alternately and distichously along the rachillae; pistillate inflorescences to 2.8 m long, including an elongate flagellate extension to 1.8 m long, branched to 2 orders, with 2–5 partial inflorescences; prophylls not known; partial inflorescence bracts splitting laterally; rachillae 21–28, 2–10 cm long; rachillae bracts 1.5 mm high, acuminate; floral bracteoles cupular, scarcely lobed; pistillate flowers not known; fruits 2.5–3.5 cm long, 2 cm diameter, ellipsoid, orange, with the perianth forming a pedicellate base; endosperm ruminant; embryo lateral.

Local names and uses: *may xanh*, *may tu* (Vietnam). Produces one of the best quality, large diameter canes in Vietnam.

Distribution and habitat: Cambodia and southern Vietnam; lowland rain forest in Vietnam, semi-evergreen forest in Lao, at low elevations.

Notes: In Evans et al. (2002) the specimens cited here will key to *Calamus poilanei* Conrard. *Calamus lateralis* bears a close resemblance to

5. *Calamus spiralis* leaf sheaths.



C. poilanei, but differs in its fruits with ruminant (versus homogeneous) endosperm and lateral (versus basal) embryo. Ruminant endosperm and a lateral embryo is an unusual combination in *Calamus* (Beccari, 1908), and occurs in two Indochinese species placed in Beccari's Group IX – *C. gracilis* Roxb. and *C. melanacanthus* Mart.

Calamus lateralis presumably belongs in Group IX. It clearly differs from the slender, clustered stemmed *C. gracilis*, but is more similar to *C. melanacanthus*. This latter is poorly known, and we have seen only three, incomplete specimens from Tanintharyi in Myanmar, all of them lacking leaf sheaths and notes on stem branching. It is unlikely on biogeographic grounds that the two populations represent the same species, there being no precedent in palms for a species being disjunct between coastal Tanintharyi in Myanmar and southern Vietnam and adjacent Cambodia (with the subspecific exception of *Calamus bousigonii*, with subsp. *smitinandii* J. Dransf., in Peninsular Thailand, and subsp. *bousigonii* in Cambodia, southeast Thailand, and central and southern

Vietnam). Nevertheless, judging solely from the incomplete specimens of *C. melanacanthus*, *Calamus lateralis* differs in its longer apical pinna (27 cm versus 4 cm), longer bristles on the adaxial pinnae surfaces (1 cm versus 0.3 cm), and in its floral bracteoles (raised and forming an almost pedicellate base to the fruits versus flat against the rachilla). *Calamus lateralis* also appears to be a larger palm, with a stem to 70 m long and 4–5.5 cm diameter. *Calamus melanacanthus* is described on the label of one specimen as having a stem 10 m long and 2.5 cm diameter.

Additional specimens examined. CAMBODIA. MONDULKIRI: Keo Seimaa Distr., near Lapakhe village, O Pam valley, 12°07'N, 106°55'E, 140 m, Evans 96 (K). VIETNAM. DONG NAI: Cat Tien National Park, road to north of park headquarters, 11°26'N, 107°23'E, 150 m, 25 May 2007, Henderson et al. 3392 (HN, NY); Cat Tien National Park, trail to Crocodile Lake, 11°26'N, 107°26'E, 150 m, 27 May 2007, Henderson et al. 3398 (HN, NY), Henderson et al. 3399 (HN, NY), Henderson et al. 3400 (HN, NY).

Calamus nuichuaensis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a speciebus aliis generis *Calami* habitu non scantenti, vaginis eflagellatis, foliis non cirratis, bracteis partialibus inflorescentiae profunde findentibus et dispositione florali pistillata non disticha differt. Typus. Vietnam. Ninh Thuan: Ninh Hai District, Nui Chua National Park, near summit of mountain, forest on rocky slopes, 11°48'N, 109°10'E, ca. 800 m, 27 Jul 2007, A. Henderson, Ninh Khac Ban, & A Ruc Cui 3468 (Holotypus: HN! Isotypi: K! NY!).

Stems solitary, non-climbing, to 5 m tall, 3 cm diameter without sheaths, green. Leaf sheaths open, brown with brown tomentum, with dense, yellowish-brown spines to 6 cm long, borne singly or more often in small groups; ocreas to 3 cm long, densely black bristly; flagella absent; petioles 60 cm long, spiny as the sheaths; rachis about 1 m long, reddish-brown tomentose, not spiny abaxially; cirri absent; pinnae 33 per side of rachis, 46 cm long, 1.8 cm wide at the middle, linear, regularly arranged and spreading in the same plane, with a single vein, scarcely bristly on the margins, with black bristles on the vein abaxially near the apices. Staminate inflorescences not known; pistillate inflorescences to 1 m long, arching below the leaves, branched to 1 or 2 orders, with at least 15 partial inflorescences; prophylls to 15 cm long; partial inflorescence bracts to 7 cm long, densely covered adaxially with soft, black bristles to 1 cm long, splitting to the base but $\pm$ persistent in fruit; rachillae 1 or 2, 2 cm long, densely brown tomentose; rachillae bracts 3 mm high, long acuminate; floral bracteoles cupular, scarcely lobed; flowers not known, the dyads closely spaced, borne in 2 parallel rows along one side of the rachilla; fruits 2 cm diameter, depressed globose, reddish-brown; endosperm ruminate; embryo basal.

Local names and uses: *sui*; no uses recorded.

Distribution and habitat: Known only from southern Vietnam in Ninh Thuan in Nui Chua National Park, on steep slopes in lowland rain forest at 800 m elevation.

Notes: The specimens cited here will not key in Evans et al. (2002). By its non-climbing habit, eflagellate sheaths, ecirrate leaves, deeply splitting partial inflorescence bracts, and non-distichous pistillate flower arrangement, *Calamus nuichuaensis* does not fit into any of Beccari's (1908) groups.

Calamus spiralis Henderson, N. K. Ban & N. Q. Dung, **sp. nov.**, a Calamo palustri statura minore atque spinis vaginæ foliaris aggregatis basaliter bulbosis differt. Typus. Vietnam. Thua Thien-Hue: Bach Ma National Park, 16°14'N, 107°52'E, 100 m, 15 Apr 2007, A. Henderson, Nguyen Quoc Dung, Phan Xuan Phuong, & Le Van Bo 3280 (Holotypus: HN! Isotypi: K! NY!). Fig. 5.

Stems climbing, clustered, forming large clumps, to 15 m long, 0.7 cm diameter with sheaths. Leaf sheaths closed and tubular, green with gray tomentum, with scattered groups of spines, each group bulbous-based with 3 (rarely more) black spines to 0.25 cm long, the central spine of a group longer than the two lateral ones, the groups denser at the sheath apex, sometimes with a few, longer, needle-like spines present at sheath apices; knees present, obscure; ocreas 0.5 cm long, with groups of spines as the sheath apices; flagella absent; petioles 0.5–1 cm long; rachis 9–20 cm long, with few, recurved, solitary spines abaxially; cirri 55 cm long; pinnae 3 per side of rachis, 13–18.5 cm long, 1.5–2 cm wide at the middle, linear-lanceolate, irregularly and distantly arranged, the basal pair of pinnae swept back across the sheath, not spiny on veins, spiny on margins near the pinnae apices. Staminate inflorescences not known; pistillate inflorescences 40 cm long, erect, not flagellate, branched to 1 or 2 orders, with 1 or 2 partial inflorescences; prophylls 10–13 cm long, closely sheathing the peduncle, split only apically; partial inflorescence bracts splitting only apically, closely sheathing the rachis; rachillae 5–7, 1–2 cm long; rachillae bracts 1.5 mm high, acuminate, glabrous; floral bracteoles cupular, not lobed; pistillate flowers 4 mm long, arranged distichously but irregularly along the rachillae, appearing spirally arranged in life; calyx 3.5 mm long, tubular, split for about half its length into 3 lobes, glabrous; corolla 3 mm long, split for about two thirds its length into 3 valvate petals, glabrous; staminodes 6; ovary 2.5 mm long; fruits 2.3 cm long, 1.4 cm wide, ellipsoid, reddish-brown, the scales faintly channeled, the perianth not tubular and pedicellate; endosperm homogeneous; embryo basal.

Local names and uses: *may cam mo*; the canes are used for tying.

Distribution and habitat: Known only from central Vietnam in Bach Ma National Park in Thua Thien-Hue, on steep slopes in lowland rain forest. It is apparently a rare plant in the Park.

Notes: In Evans et al. (2002) the specimens cited here will key to *Calamus palustris*. *Calamus spiralis* is clearly not that species, differing in the smaller size of all its parts (except the fruits – which do resemble those of *C. palustris*), and in its bulbous-based groups of leaf sheath spines.

By its climbing habit, eflagellate sheaths, cirrate leaves, eflagellate inflorescences, and tubular partial inflorescence bracts, *Calamus spiralis* appears to be a member of Beccari's (1908) Group XV.

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A New *Areca* from Western New Guinea

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1. Leaves of *Areca mandacanii* showing irregular leaflet arrangement; Martinus Iwanggin provides scale.



A new species of *Areca* related to *A. catechu* has been discovered in swampy areas in western New Guinea. This remarkable palm has future potential not only as a nut-crop species, but also for its ornamental horticulture value.

As part of the Palms of New Guinea project (Baker 2000, 2002), the author conducted a field trip to the area of Teminabuan (south of Sorong) in the Bird's Head Peninsula of

Western New Guinea in 2003. During the field trip, many interesting palms were encountered and collected, such as the newly described genus *Dransfieldia* (Baker et al. 2006) and the

rediscovery of *Hydriastele flabellata* (Becc.) W. J. Baker & Loo (Heatubun 2005) – this latter beautiful undergrowth palm was originally collected by Beccari almost 132 years ago and the type locality has already vanished within the town center of Sorong. Among the other species found was a new species of *Areca* described in detail here.

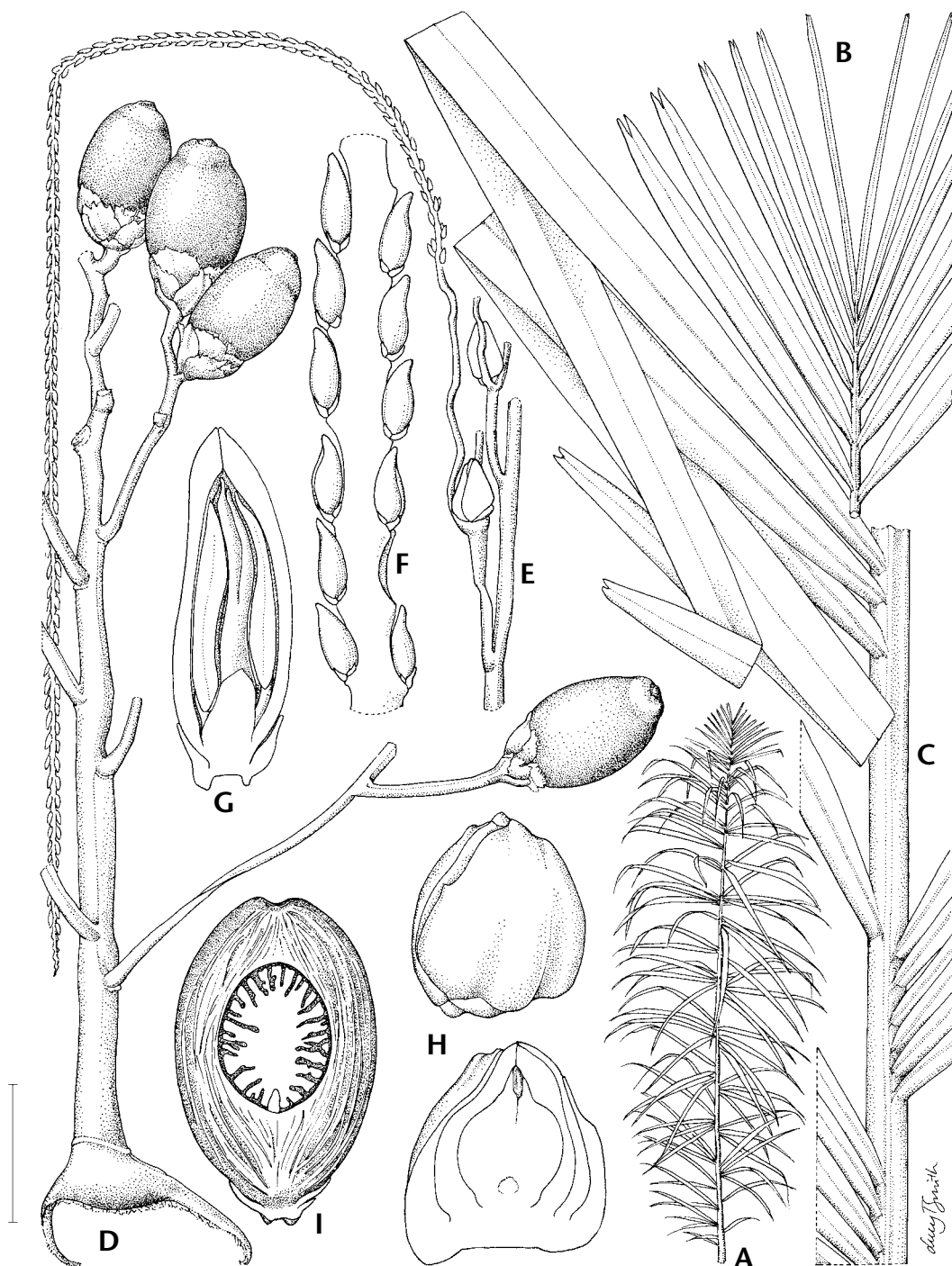
***Areca mandacanii* Heatubun sp. nov.**, habitu *A. catechu* L. similis, sed plica foliolorum solitaria, lineari, irregulariter disposita incisura acuminata, fructibus grandibus, ellipsoideis, seminibus globosis, differt. Typus: Indonesia, West Papua Province, Sorong Selatan Regency, Teminabuan District, Sayal Village, Maampou forest, Feb. 2003, *Heatubun* 423 (Holotypus BO!; isotypi K!, MAN!).

Solitary, moderate pleonanthic, tree palm. *Stem* up to 15 m tall, 8–10 cm diam.; internodes 13–30 cm long, dark green, shiny, nodal scars conspicuous, white. *Leaves* 8 in crown, pinnate, appearing plumose, 200–250 cm long (including petiole); sheath tubular, ca. 92 cm long, smooth, light green; crownshaft well defined, up to 152 cm long and up to 15 cm diam.; petiole short to 6 cm long, channelled adaxially, rounded abaxially; rachis somewhat arching, with adaxial longitudinal ridge,

rounded abaxially; blade with irregularly arranged leaflets, divided into 13–15 groups, ca. 60 leaflets on each side, held in several planes, near petiole small and gradually becoming larger, terminal leaflets regularly arranged (ca. 13 or 14 leaflets); leaflets somewhat arching, single-fold, linear, 55–60 cm long, 2 cm wide, tip acuminate, notched, split to 3 cm long and pointed in a few leaflets near the petiole, papery, green adaxially and light green abaxially. *Inflorescence* infrafoliar, ca. 60 cm long at anthesis, protandrous, branching to 2 or 3 orders; peduncle 5 cm long, green with numerous minute red-brown dots; prophyll 64×6 cm, borne about 1/3 way up the peduncle, lanceolate, 2-keeled, papery, cream to light brown, entirely enclosing the inflorescence, then splitting longitudinally and falling before staminate anthesis; rachis green to whitish green; rachis bracts not persistent; rachillae numerous, 37 cm long, covered by light brown to chocolate-brown thick indument, highly contrasting with the rachis, first branching rachillae ca. 50 cm long, elongate. *Staminate flowers* small, triangular, 4.5×2.5 mm, asymmetric; sepals 3, low, about 2×1 mm; petals 3, strongly keeled, 4.5 mm long, ca. 1.25 mm wide at basal; pistillode 2.5×0.5 mm, trifid, dark brown; stamens 6, 1.5

2. Reproductive organs of *Areca mandacanii*: young inflorescence with staminate and pistillate flowers (left); young fruits and rachilla covered with brown indumentum (right).





3. *Areca mandacanii*: A. leaf; B. apical portion of leaf; C. mid portion of leaf; D. infructescence with immature fruits; E. portion rachillae showing position of staminate and pistillate flowers; F. staminate flowers on rachillae; G. staminate flower in section; H. pistillate flower whole and in section; I. fruit in section. Scale bar A = 62.5 cm; B, C, D = 4 cm; E, I = 3 cm; F = 7 mm; G = 1.6 mm; H = 1 cm. A from photograph, B-E & H from *Heatubun* 423, F, G & I from *Heatubun* 413. Drawn by Lucy T. Smith.

mm long, sagittate; anthers 1.5 mm long, arrow head shape, creamy, longer than the filaments, twisted basally; filaments 0.5 mm

long, dark brown. *Pistillate* flowers larger than the staminate, triangular, 10–13 mm diam., sitting on the branch-nodes; sepals 3,



4. Fruits of *Areca mandacanii*: immature fruits (far left) and mature fruits (near left).

imbricate, triangular, 10–13 mm long, 10–12 mm wide, 1–3 mm thick, asymmetrical, thicker at base, cream to light green; petals 3, imbricate, triangular, 13 × 10 mm, 0.5 mm thick, cream; staminodes ovate, 10 mm high, 9 mm wide, pointed, brown coloured at the tip, fleshy. *Fruits* ellipsoidal, 65–70 × 42–45 mm, with conspicuous woody discoid depression at apex, shallowly concave, 10–12 cm diam., stigmatic remains persistent in centre of depression, perianth persistent; epicarp smooth, shiny, ca. 0.5 mm thick, dark green when young, turning to golden yellow or light orange when mature; mesocarp fibrous, ca. 10 mm thick, but much thicker at the base of fruit (below the seed), where ca. 20 mm thick; endocarp very thin, adhering closely to seed; seed subglobose, ca. 28 × 25 mm; endosperm deeply ruminate; embryo basal.

Distribution. Bird's Head Peninsula of Western New Guinea.

Specimens Examined. INDONESIA: West Papua Province, Sorong Selatan Regency, Teminabuan District, Sayal Village,

5. Fruit of *Areca mandacanii* (left) compared with fruits of two different varieties of *A. catechu* (center and right).



Maampouw forest, 10 m asl., 21 Feb 2003, *Heatubun et al.* 423 (Holotype BO!, isotypes K!, MAN!); *Heatubun et al.* 413 (K! (spirit collection), MAN!); *Heatubun et al.* 424 (MAN!); West Papua province, exact locality unknown, *Maturbongs s.n* (K!, MAN). **CULTIVATED:** Indonesia, West Papua Province, Manokwari, Reremi, 75 m asl., 10 Apr 2008, *Heatubun & Iwanggin* 902 (MAN!).

Habitat. This palm grows in forest transitional between swampy areas and lowland rain forest, where the soils are temporarily inundated by water. Other palms that occupy the same habitat are *Areca macrocalyx*, *Calyptrocalyx* sp., *Drymophloeus litigiosus*, *Licuala beccariana* and *Sommieria leucophylla*.

Local Name. Nggafa (Sayal dialect) and/or *Pinang Hutan* (Indonesian for forest betel nut).

Uses. The stem of this palm is used for flooring by local people for their houses and the seed is chewed as a substitute for betel nut (*A. catechu* L.).

Conservation Status. Data Deficient. This species has been reported from a very restricted area in the Bird's Head Peninsula of Western New Guinea. Further population studies would be needed to assess the conservation status of this palm.

Notes. *Areca mandacanii* is similar to *A. catechu* in habit and inflorescence structure, but can immediately be distinguished by the leaf with single-fold leaflets, irregularly arranged in groups in several ranks, with tips acuminate and notched rather than the broad leaflets with several folds, arranged in a single plane and more or less regularly arranged, characteristic of *A. catechu*.

The structure of the inflorescence and flowers indicate that *A. mandacanii* belongs to subgenus *Areca* (subgenus *Blumeoareca*) section *Oeotheanthe* (*sensu* Furtado)) together with *A. catechu*. In this infrageneric classification

(Furtado 1933), subgenus *Blumeoareca* (correctly subgenus *Areca*) is characterized by the inflorescence branched to two or three orders, with many rachillae, staminate flowers unilateral or alternate-distichous, sepals free or sometimes united, stamens six, the pistillate flowers seated on the axis of the basal branches, subdistichous or subopposite or spiraled on the rachilla.

Despite the variation and complexity of morphological characters in New Guinean *Areca* species, the new species is quite different from the widespread *A. macrocalyx* Zipp. ex Blume and its relatives especially in inflorescence form, which in the *A. macrocalyx* complex is congested.

The attractive leaves and fruits make this species instantly identifiable from other New Guinean *Areca*. The irregular arrangement of leaflets (several planes) is reminiscent of *Woodyetia bifurcata*, the Australian foxtail palm. The fruit size, aroma and colour (yellowish golden) also make this palm of great interest to palm growers.

This palm is named for Mr. Dominggus Mandacan, the regent of Manokwari and the chief of the Arfak tribes, who has paid so much attention to the development of scientific activities in the Vogelkop (Bird's Head Peninsula) area, including botanical research, and who also supported our expedition in many ways.

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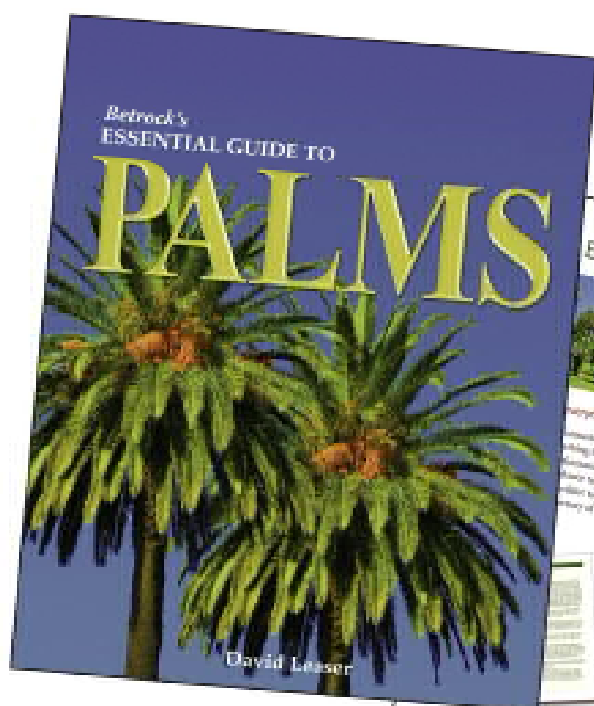


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