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FRONT COVER

Jubaea chilensis in its natural habitat. See article by Gonzalez et al., p. 68.

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Mauritiella armata, one of the palms Biennial attendees can expect to see in Brazil. See article by J. DeMott, p. 92. Photo by John DeMott.

NEWS FROM THE WORLD OF PALMS

Caracas, Venezuela, is seeing yet another outbreak of the larvae of a butterfly, *Brassolis sophorae* (Nymphalidae). The caterpillars of this species are large, up to 10 cm long, and forage gregariously at dawn and dusk, feeding on a large number of palm species, both native and exotic. The palm most often attacked in Caracas is the native *Roystonea oleracea*, and March and October are the months when the damage is most severe. The areas hardest hit in the city include Chuao, La Trinidad and Las Mercedes, along with Parque del Este, home to more than 1000 *Roystonea oleracea* palms. This pest is harmless to humans, but the voracious larvae can have a devastating effect on palms, defoliating even large palms over the course of a few nights. *Brassolis sophorae* has become a recognized pest of coconut and African oil palm plantations in the region. In Caracas, the periodic plagues of caterpillars are thought to be brought on by a decline in its natural enemies, namely yellow-jacket wasps and the bird *Molothrus bonariensis*. The cause for the decline in both of these predators is believed to be the insecticides used to control the mosquitoes that spread dengue fever. The situation in Caracas is a lesson in the delicate balance between predator and prey, the interconnectedness within the natural world and the tragic, unforeseen consequences of widespread pesticide use.

On the last weekend in April, the ninth annual meeting of EUNOPS (European Network of Palm Scientists) was held in The Royal Botanic Gardens Kew. Attended by 48 people, the meeting provided 22 presentations on many aspects of palms, from structural botany, evolution and classification through to economics and floristics. For the first time there was a contingent from Russia, with five staff members of Moscow University and the Moscow Botanic Gardens. In one particularly important and interesting session, progress in the development of the Palmweb website was presented and discussed. This website, supported by funding from the European Union, aims to disseminate critically compiled taxonomic information on the web. Ultimately it should be the most reliable first port of call for palm-related taxonomic enquiries on the world wide web (www.palmweb.org). The site uses the online World Checklist of Palms as its nomenclatural base, to which are added protologues (first descriptions) and further taxonomic information and maps. Currently the site is still very much under development, but the compilers hope very soon to upload a large number of critically identified photographs to the site. EUNOPS 10 will be held in Montpellier, coinciding with Palms 2010, an international palm symposium.

News has just arrived that on May 23rd, The International Institute for Species Exploration at Arizona State University and an international committee of taxonomists selected *Tahina spectabilis* as one of the top ten new species of all organisms to be described during 2008. Readers of Palms will need little persuading that *Tahina* is a very special palm, but it is wonderful that it is recognized by the international scientific community as one of the top ten most charismatic new species. Further details can be found at www.species.asu.edu/Top10.

THE EDITORS

GROWING PALMS

Horticultural and practical advice for the enthusiast

by Randal J. Moore

Water Conservation

The increasing shortage of available irrigation water is a serious concern for palm growers in many regions of the world. Severe extended droughts combined with mounting population pressure are creating a long-term water crisis. In response, government agencies are instituting a series of water conservation measures. Voluntary goals for reducing water consumption have been in place in many regions with limited results.

As the crisis grows, mandatory water restrictions and tiered-pricing are being implemented. For example, in north San Diego County some water districts are requiring a usage reduction of 20% (based on historical meter readings) and a tiered-pricing structure translating into a cost increase of 40% for large users. These users are also subject to water audits. Understanding the variables that determine water usage and undertaking irrigation system modifications to reduce usage have become part of palm growing in many areas.

Evapotranspiration. Evapotranspiration is a part of the water cycle that is critical to understanding the issue of water management and conservation. Evapotranspiration includes the evaporation of water (from open bodies of water, wetlands, snow cover and bare soil) and the transpiration from vegetation. The physical characteristics of land, water and plant cover will affect the evapotranspiration process.

The main factors influencing the rate of evapotranspiration are solar radiation and wind speed. Several other secondary factors include density and type of vegetative cover, surface area, availability of soil moisture, root depth, reflective land surface qualities and season of the year.

Because solar energy is responsible for vaporizing water, the rate of evapotranspiration is a function of geographic latitude, season of year, time of day and cloud cover. Consequently, areas that receive maximum solar radiation also have the greatest rates of evapotranspiration. For example, in the continental United States the mean annual lake evaporation ranges from 20 inches (50 cm) per year in the Northeast to 80 inches (200 cm) per year in the desert Southwest.

The other major climatic factor that determines evapotranspiration is wind speed. Winds bring heat energy into an area and also remove vaporized moisture. A 5 mph (8 kph) wind will increase evapotranspiration by 20%; a 15 mph (24 kph) wind will increase evapotranspiration by 50%.

A minor factor in evapotranspiration is the type of vegetative cover, particularly if the cover is sufficiently dense and there is adequate soil moisture. Many plants will reduce transpiration during prolonged periods of drought to conserve water. The amount of decrease will depend on the plant's root system and leaf characteristics. The decrease in transpiration by deep-rooted plants or plants with an extensive root system is slight; a greater decrease in transpiration is found with deciduous trees, for example, where during periods of drought leaf curling or shedding often occurs.

Therefore, in areas that are not irrigated, evapotranspiration does not generally exceed precipitation. It will actually depend on the particular soil's ability to hold water because some water will be lost to percolation and run-off. If evapotranspiration is greater than precipitation, soil will dry out unless supplementary irrigation is applied.

Irrigation Audit. The first step is to undertake an "irrigation audit." The audit will test the current irrigation system. Many local water districts are providing water-use audit services or will provide a list of certified auditors. Based on the results of the audit, a list of recommended repairs and improvements will be made.

The audit will also help develop a schedule of seasonal irrigation levels to be used throughout the year. Standardized guidelines for conducting the audit have been developed by the Irrigation Association (www.irrigation.org/certification/pdf/AuditGuidelines_FINAL.pdf). The irrigation audit should provide a plan for converting the current irrigation system to one that is more water-efficient.

1. A flexible pipe system adaptor can be used to relocate irrigation farther into planters reducing overspray onto sidewalks, patios, etc.

Smart Controllers. Adjusting the irrigation controller for seasonal weather changes is an important step toward reducing irrigation system use. "Smart controllers" automatically update the irrigation schedule to reflect changes in watering needs throughout the year. A smart controller will reduce irrigation levels when low evapotranspiration conditions dictate that less water is needed. Then, as evapotranspiration rises the controller automatically increases the irrigation level.

The smart controller is generally set at a default maximum irrigation level based on the highest rate of evapotranspiration that will be achieved within the year. The controller then reduces that amount by a percentage value applied equally to all zones as less water is needed. There are several different methods used by smart controllers for determining watering needs:

Manual Adjustment. Most irrigation controllers have a "%" key that allows for an equal proportional adjustment to all zones. Even adjusting the controller on a monthly basis results in significant water savings.

On-Site Weather Station. The controller is upgraded with a weather station module. It uses real-time data from the on-site weather station to adjust watering times. Some weather stations include an adjustable wind speed sensor that can shut down an irrigation system in very windy conditions to eliminate overspray. A rain gauge in the weather station can shut off the system as soon as it starts raining. And, a freeze sensor stops irrigation in freezing conditions to eliminate ice on landscapes, roads and walkways. One weather station module offered worldwide is manufactured by Hunter Industries (www.hunterindustries.com) is the ET (evapotranspiration) system module that upgrades most Hunter controllers.

Remote Data. The smart controller uses the watering and weather data provided by a remote source. The controller automatically downloads this data from a central data source or regional weather station. The data is provided on a subscription basis. The accuracy of the data is dependant on the proximity of the weather station and if it is historical or real-time data. Also, the timing of downloads (often at night when controllers are not in use for actual irrigation) can impact the accuracy of the data. For instance, in areas of low humidity (such as Southern California) where there is a great variance between daytime highs and nighttime lows, a download done at night can underestimate the irrigation level needed to address high evapotranspiration levels achieved during the day.

Historical Data. The smart controller uses historical weather and watering data to determine the irrigation level throughout the year. The historical data used is based on the user's postal

2. A disassembled brass irrigation value showing the locations where small particles of sand and other debris can lodge and cause water leaks.

code. The irrigation level is generally automatically reset monthly when historical data is used. While this is an imperfect method, it usually results in significant water savings over controllers that are not adjusted. Of course, during abnormal periods of hot or cold weather, the user needs to override the controller. Basing the smart controller on historical data costs less and is often cost-effective for home gardens.

Historical with Sensor. The smart controller uses the historical data to calculate the initial reduction in irrigation levels. Further adjustments are made using a temperature sensor. If daily high temperatures exceed historical "normal" highs, the irrigation level is increased. If the actual daily temperature is lower, irrigation levels are reduced. This method gives an extra level of accuracy over using only historical data.

Moisture Sensor. A moisture sensor (or several of them) is placed in areas serviced by the irrigation system. These sensors measure the actual amount of moisture present in the soil. The irrigation level is then adjusted based on the moisture of the soil. There are different types of soil moisture sensors. While these sensors can potentially make very accurate assessments of irrigation levels, many are difficult to maintain. Some work better with certain soil types and they require frequent calibration and adjustments.

Controller Settings. Along with controlling the seasonal irrigational levels through the use of a smart controller, the system start-up time is also critical. This is especially important if spray irrigation is being used. Less water is lost to evapotranspiration during the early morning hours when the temperature is cooler. Also, there is generally less wind in the morning reducing overspray. Watering in the late afternoon or evenings is not advised because of disease problems that might be induced by having water stay on the plants overnight.

Cycling the irrigation controller is another possible method of maximizing water efficiency. The irrigation controller is programmed so that it irrigates in two or three short cycles as opposed to a single long period of time. The interval between watering cycles allows water to percolate into the ground. For example, instead of irrigating a zone for a single 15 minute length of time, water for 4 minutes and wait 30 minutes repeating this cycle three times. Although the total irrigation time is reduced by 3 minutes, the actual soil moisture level will be greater with cycled irrigation. This is because cycling allows virtually all of the water to percolate into the soil and nearly eliminates all run-off.

System Modifications. If spray irrigation is used, make sure that tall groundcover, shrubs and tree trunks and branches are not blocking or deflecting the irrigation pattern. Water does not force its way through these barriers. Therefore, the broken irrigation pattern results in wasted water. Some areas will receive an inadequate level of irrigation and others will receive excessive moisture. Repairing blocked or deflected spray patterns may require relocating or increasing the height of a riser.

3. An in-line check value can be used with the lowest nozzles on a slope to help prevent "low head drainage."

A significant amount of water is also wasted by overspraying onto sidewalks, streets and curbs. This repeated overspray can also damage hardscape such as asphalt paved streets. If adjusting the existing irrigation system will not eliminate overspray, then the risers or pop-up spray heads should be relocated 4–6 inches (10–15 cm) from the edge of sidewalks,

4. The small stream rotor nozzle is a new technology that can be easily retrofitted into most irrigation systems. They are more efficient and can result in some water conservation.

curbs, patios, etc. in areas with groundcover or turfgrass. Another benefit of relocating irrigation heads into the planting area is less damage will be caused to the spray heads by string trimmers and mower wheels. In areas of mature landscape with no groundcover they can be placed as far as 12 inches (30 cm) from the edge of the planter.

To facilitate relocation of spray heads, flexible risers can be used (Fig. 1). The flexible extension is connected to the existing threaded riser fitting. No new hard piping and very little trenching is required to move the spray heads. Another advantage of flexible risers is that they are less rigid and likely to break if bumped by a person or lawn mower.

Irrigation valves can also become worn or clogged and will leak (Fig. 2). Evidence of a leaking valve can be seen where there is mold or algae growing on sidewalks, curbs or the ground. If a valve is not fully closing it will need to be cleaned, repaired or replaced. Even a small grain of sand caught in a valve can cause it to leak.

Another problem encountered in landscapes where there are slopes is “low head drainage.” When the irrigation system is shut-off, water drains through the lowest spray heads and is replaced by air. The water that drains out is wasted and often flows into the drainage system or creates a muddy area. Low head drainage is evident when the spray heads make noise and spay a mixture of air and water when the system is initially activated. The air that is violently forced out creates a type of “water hammer” that puts stress on the irrigation pipes and spray heads. A possible remedy is to use in-line check valves on the lowest spray heads (Fig. 3).

New rotary spray heads are being introduced that may be more water-efficient than older models. The new small stream rotors are designed to retrofit easily into the older pop-up spray bodies. Two major brands of stream rotor nozzles (Fig. 4) are Rainbird® Rotary Nozzles (www.rainbird.com/landscape/products/rotarynozzles) and Hunter® MP Rotator (www.hunterindustries.com/Products/MpRotator). The claimed benefits of using these nozzles is that water is applied more slowly and uniformly, the pattern can be adjusted to greatly reduce runoff and the stream is more wind-resistant. As a result, up to 30% less water is used.

These are some of the important measures that can be taken in order to reduce irrigation water use in palm gardens and nurseries. There are other conservation steps that may be discussed in a future article. For palm growers in the southwestern United States, Australia and elsewhere, carefully controlling water consumption will become a major challenge in maintaining our palm gardens and nurseries.

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Mike Marika, Park Arborist, City of San Diego, California supplied information on the water conservation measures being taken by the City of San Diego Park and Recreation Department. Gary Levine submitted a detailed account of the water saving steps at his 10-acre palm garden in Escondido, California. Poway Irrigation Supply in Poway, California provided relevant irrigation product information.

Notes on the Uses of Dominica's Native Palms

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The nine native palms of Dominica are used to varying degrees of intensity by the local population. This article describes those uses.

Dominica is the most rugged island in the Eastern Caribbean, with a chain of volcanic peaks extending from the north to the south of the island. Morne Diablotin, the island's tallest mountain, reaches up to 4747 ft (ca. 1447 m) above sea level only five miles (ca. 8 km) from the sea, and constitutes one of the island's eight volcanic centers. The island's rainfall is seasonal, and it is one of the highest in the Caribbean, with some areas in the interior receiving in excess of 300 inches or 7,500 mm annually (Lang 1967).

Natural vegetation covers an estimated sixty percent of the 289.8 sq. mile (750 sq. km) island, with approximately 20% of the land area legally protected in a system of national parks and forest reserves. The island's vegetation types include elfin woodland and montane forest at the higher elevations, and tropical rain forest and secondary rain forest at middle elevations. Semi-evergreen forest, xeric woodland and littoral woodland occur at the lower elevations, while fumarole vegetation, beach vegetation, wetlands (including freshwater swamp, montane swamp, marsh and small patches of mangrove) add to the variety of the island's natural vegetation (Hodge 1954, James 1990).

Included in its diverse flora are at least nine indigenous species of palm, and these are distributed in all of the island's major vegetation types (Zona at al. 2003).

Dominica's native palms contribute significantly to the island's rich cultural heritage, and at least thirteen areas around the island are named after native palms. Moreover, islanders use, or have used, the indigenous palms for food, beverage, handicraft, thatch, basketry, floral arrangements and even in religious celebrations.

Dominica is also home to the last remaining Carib Indians or Kalinago, who once ruled the entire Caribbean Archipelago (Honychurch 1995). Today, the majority of these Caribs reside on the island's north-east coast, where handicraft production using raw materials from native palms and other plants is an important economic activity for this segment of the island's population.

Zona et al. (2003) briefly described the human uses of Dominica's indigenous palms. Here, I provide a more detailed account of the utility of these palms. My primary data sources are Hodge (1942) and Hodge and Taylor (1957).

The species are presented below in alphabetical order by scientific name, but the local name(s) of the palms – as used in Dominica – will precede the scientific name. The modern local names of the palms are mostly of Kwéyòl origin, and these are written in the standard Kwéyòl alphabet adopted for Dominica (Konmité Pou Etid Kwéyòl 1991), and not in the French-style spelling that was used earlier.

For example *Kokoyé*, the Dominican Kwéyòl name for the overtop palm, will be used in lieu of "Cocoier."

***Gouglou* or *Glouglou* (*Acrocomia aculeata*)**

Originally called *iauála* by the Kalinago, the *gouglou* or *glouglou* is Dominica's largest species of native palm, and one of the island's two currently recognized species of spiny palm. Though now uncommon on Dominica, this palm is still popular in some of the west coast villages. Children eat the mature fruits as a snack food (Fig. 1). The sticky, yellow pericarp or pulp is usually eaten off the endocarp, which is then broken open with a hard object in order to get to the much favored coconut-like endosperm.

Hodge and Taylor (1957) reported that at one time, and possibly up to the early 1900s, the Caribs made a fermented beverage from *gouglou*. It was produced by tapping the inflorescence bud near the base of the latter, collecting the juice, and allowing it to ferment. An earlier account by the 17th Century French Missionary and historian Fr. Raymond Breton, makes reference to the Caribs using the sharp, longer spines from the palm's stem in cording cotton, and these were described as being as "long as the finger" (Breton 1665).

In 2003, a young Dominican craftsman revealed that he had carved out the skirting for a local drum from a short log cut from the stem of an old *gouglou* palm.

***Gwigwi* or *Grigri* (*Aiphanes minima*)**

Dominica's other species of spiny palm is locally known as *gwigwi*, but this species is smaller, taller, and generally more spiny than the *gouglou*. Populations of *gwigwi*, which were known to the Caribs as *ròkri* have been documented in seasonal forest only at San Sauveur, Café, and near the Layou River, though a smaller but less spiny form of the palm (locally called *gouglou zonbi* in some communities) is distributed in several rain forest areas in the northern half of the island.

School children from the east coast villages of Good Hope, San Sauveur and Petite Soufriere often cut an entire infructescence from a *gwigwi* palm and share the over 1,700 edible, bright red, ripe fruits with their friends (Fig. 2). The orange pulp is eaten, after which the tough pitted endocarps are broken in order to get to the oily, coconut-like endosperm. In some cases, children boil the seeds in order to soften the endosperm. Hodge and Taylor (1957) noted that the Caribs formerly used *Aiphanes* for the same uses as *gouglou*. They also reported that the Caribs used to fell gwigwi palms to obtain the fruits and nuts.

1. Fruits of *glouglou* (*Acrocomia aculeatata*).

I was unable to find any present day uses of the smaller (rain forest) form of the palm, although the fruit tastes similar to that of the larger *gwigwi*.

***Latannyé*, *Natannyé* or *Balyé* (*Coccothrinax barbadensis*)**

Dominica's only native fan palm – *latannyé* – commonly is cultivated in the Tete-Morne to Grand Bay and Petite Savanne areas in the south of the island, and to a lesser extent in Penville in the north.

Latannyé is one of two native palms whose current local names originated from the Carib name for the species. Dominica's indigenous peoples originally called the palm haráta or alatani (Hodge & Taylor 1957). The name *latannyé* appears to have been derived from the latter Carib name.

Another current local name for this palm, which was once common in Dominica's littoral woodlands, originates from its current major use, i.e. for making house brooms (Fig. 3). The palm is called *balyé* in some communities in the north of the island such as Penville, Capuchin, and the hamlets of Grand Fond and La Haut. Balyé is also the Dominican Kwéyòl word for broom. Villagers of Tete Morne, Capuchin and Penville earn income from the production of brooms, which are fashioned from the palm's broad fan-like leaves. Three different styles of house broom are made with the leaves, and the styles refer to the method of fastening the shredded palm leaves or strips of leaves onto the broom handle.

Latannyé leaves also are used to make other craft items, such as coasters, table mats, and men's carry-all side-bags (called *djola*). The leaves have also been used in large floral arrangements and for decorating. Some of the costumes worn during the pre-Lent Carnival (Mardi Gras) have been made from strips of leaves tied to a string to form a sort of skirt. Entire leaves also have been used in designing the spectacular costumes for contestants in local pageants.

In the early days of Dominica's Rastafarian movement, some young men with dreadlocks wore skirts made from *latannyé* leaves. The palm's sword leaf (locally called the *tjè* – meaning "the heart" in Kwéyòl) is also used for making straw hats. Villagers from Petite Savanne reported that at one time the hats (*chapo pai-latannyé*) were sold in the neighboring French island of Martinique.

Short logs cut from the stem of the palm have recently been used as house pillars in Petite Savanne, and longer logs are sometimes used as sidings (borders) for vegetable plots in that village. Logs hewn from old palms are also used occasionally as fuel wood in bay oil distilleries in that village, which boasts itself as one of the cultural capitals of Dominica.

The dried petiole of the *latannyé* leaf is used in maintaining fires, while young children use strips of this material for making toy bird cages. Children from Petite Savanne sometimes suck the ripe, dark purple, juicy fruits and eat the brown latannyé seeds as a snack.

Hodge and Taylor (1957) listed several historical uses for *latannyé*. They reported that the Caribs formerly made bows from the trunk of the palm, and that the large leaves were used to cover huts and shelters. Hodge (1942), as well as Hodge and Taylor also noted that the petiole of fresh mature leaves would be split into two and woven into a sort of game basket or sack. It was also reported that at the time, the villagers of Penville weaved bags or sacks from the petiolar material, and these were used for squeezing grated cassava (manioc). Hodge (1942) mentioned that the large leaves were also used for making table tops.

Latannyé palms have been used in landscaping on Dominica to a limited extent and, up until 2005, some sub-adult palms graced the grounds of the Roman Catholic Church at

2 (left). Fruits of *gwigwi* (*Aiphanes minima*) are small but plentiful. 3 (right). Brooms made from the leaves of *Coccothrinax barbadensis*.

Grand Bay in the south of the island. The occasional tree has also been observed near the Vieille Case Roman Catholic Church, on the front lawn of the Portsmouth Anglican Church, and near residential houses at Roger, San Sauveur, Boetica, Penville and Laudat, among other areas on the Nature Isle. Three young saplings were planted at the Dominica Botanic Gardens in 2006, to add to the palm collection.

***Palmis* (*Euterpe broadwayi*)**

Palmis, which originally was called *uése* by the Caribs, is Dominica's tallest and possibly one of the two most widely distributed native palms on the island. It is well known, and currently has at least three local uses on the island. The leaflets of this rain forest palm are used for making house brooms. The midribs from the leaflets are removed, and the laminae are then tied to a piece of string, and the material is secured to the end of the broom stick in a set pattern. The finished broom is similar in appearance to one of the styles woven from *latannyé*. Brooms are made in similar fashion from the leaves of the introduced screwpine (*Pandanus pacificus*).

The reddish-brown prop roots (locally called *wasin palmis*) are cut, peeled and scraped, then split into two or three strands and used for making the frame for shoulder baskets or carry-alls; these are called *kontan* in Dominica's Kwéyòl language. The edible heart of the felled palm is extracted from the relatively long and near cylindrical crownshaft (Fig. 4), and may be eaten raw or cooked. Hodge and Taylor (1957) also noted that the leaflets from young palm trees were once folded and plaited, and used for thatch, while ridge caps for dwellings were sometimes made from the trunk of the palm.

***Yanga* (*Geonoma interrupta* var. *interrupta*)**

Yanga, Dominica's only native clustering palm, is the island's smallest native palm, with mature stems sometimes being less than 4 cm in diameter. The stem is usually light colored, often very smooth, and bears very prominent nodes or leaf scars. This palm is found mostly in the rain forest, and its present-day Dominican name is of Carib origin.

Yanga leaves were considered, at one time, to constitute one of the best thatching materials for the island's Carib Indians (Hodge & Taylor 1957). The petiole was notched below the leaf blade, and this was hooked over the thatching

4. The crownshaft of *Euterpe broadwayi*.

rod. The leaves were then arranged layer above layer until the ridgepole was reached. Some persons on the island still use this method of thatching today, but this is primarily for demonstration purposes only.

***Yanga Moutany* (*Geonoma undata*)**

Yanga moutany, whose local name means mountain *yanga*, is one of the two species of palm that are found in Dominica's elfin woodland and upper montane forest. Its stem is larger than that of the *yanga* from the rain forest, and usually supports epiphytes. Its leaves are not as heavily divided as those of the rain forest *yanga*, but they may also be used for thatching.

Palmis Moutany* or *Palmis Wouj* (*Prestoea acuminata)

Possibly two varieties of *Prestoea acuminata* occur on Dominica. The *palmis wouj*, (*P. acuminata* var. *montana*), whose inflorescence branches are red upon opening, is restricted to the montane thicket and elfin woodland. The other variety, with its inflorescence that first emerges white before turning red or tinted, appears to exhibit some level of variability, and is widely distributed in the island's rain forest. This form may be Dominica's most abundant and widely distributed palm.

It was reported in the wider Penville/Cold Soufriere area, where the rain forest form of the palm dominates the vegetation on the windward slopes, that the heart of the palm is eaten, in similar fashion to that of *Euterpe broadwayi* and the *palmis wouj*. In the area mentioned, *P. acuminata* is simply known as *palmis*, but this ought not to be confused with *Euterpe broadwayi*. The heart of the montane form of the palm is consumed in the Laudat area.

Buccaneer Palm (*Pseudophoenix sargentii*)

A single population of the locally endangered Buccaneer Palm occurs on Dominica, above the villages of Mero and St. Joseph on the island's west coast. Until the 1960s, a few women from those villages harvested the spear leaves of juvenile buccaneer palms, stripped the material, boiled and dried it, then plaited the material and sold it to a major handicraft outlet in Roseau – the capital city of Dominica, where the bales of "straw" would be fashioned into hats. Currently there is no harvesting of leaves of this palm on the island.

***Kokoyé* or *Yataw*, Overtop Palm (*Syagrus amara*)**

Dominica's Kalinago people still refer to the overtop palm by its original Carib name, *iátaho,* which is pronounced "ya-taw." The Carib Territory – located in the eastern district – is within the local distributional range of the palm, but in other areas where this species occurs on the island it is known as *kokoyé*. The palm occurs in the littoral woodland, dry forest and semi-evergreen forest as well as the lower limits of the rain forest. The base of the palm's stem is bell-shaped, resulting in a rapid then gradual taper up to a crown of approximately 15 to 20 bi-planar pinnate leaves.

On Dominica, *kokoyé* probably rivals *latannyé* in terms of its importance and the variety of its uses. In villages such as Capuchin, Cocoyer, Penville in the north, and Bense and other communities in the northeast, the leaflets of the sword leaves of *kokoyé* are stripped, boiled in bundles, bleached with a small amount of liquid chlorine and soap, and then dried in the sun. These strips are then plaited and subsequently used for fashioning into a variety of items such as hats, caps, ladies' side bags, dish holders, glass holders, shopping bags, traveling bags, purses, table mats, floor mats, house brooms, bottle wraps, wall plaques and even document cases (Figs. 5 & 6). The flexible mid-rib of the leaflet (called the "bone" of the leaf in Kwéyòl) is used to make the frame for most of the *kokoyé* craft items. In the local Kwéyòl language, the primary raw material made from the *kokoyé* leaves is called *pai-blan*, meaning white straw, but in some cases this material is mixed with small amounts of straw from the darker brown dried screwpine (*Pandanus* sp.), or intertwined with dried coconut straw to form design patterns (Fig. 7). Relatively fresh strips of leaflets are also used in the annual Palm Sunday procession of the Roman Catholic Church on the island.

It was reported that a matriarch from the northern village of Penville, Theresa "Fifi" Laville, who was in her 80s in 2006, began making craft items from *kokoyé* leaves from age 15. This has been her main source of income, selling her intricately woven items in the capital city, and even training other ladies from her village in the art of weaving strips of *kokoyé* leaves into works of art.

The kernel of the orange-colored fruit, which resembles a miniature coconut, is edible, though somewhat bitter. It was sometimes used as a snack by children. The stems of the felled trees are sometimes split into two and used as the siding for charcoal pits. One example of landscaping using the *kokoyé* palm on Dominica can be seen on the grounds of the Holy Redeemer Retreat House at Eggleston, a short distance from the capital (James 2005).

The modern day use of *iátaho* by the Kalinago people appears to be limited only to hat-making occasionally. Hodge and Taylor (1957) noted that at one time, the young leaves of the palm were plaited in similar fashion to those of the *palmis* (*Euterpe broadwayi*), and used by the Caribs as thatch. They also reported that the cabbage or young shoot of the palm is edible, but at the time of their writing it was not being eaten by the Caribs. In the past, the shoot was tapped and fermented into a wine. They noted further that the fruits were formerly used for making a fermented drink, while the oil made from the kernel was mixed with the reddish-orange dye that is prepared from *roucou* seeds or annatto (*Bixa orellana*); the Caribs used this mixture for body painting during Columbian times.

Side Trade Connected with Local Palms

Some level of secondary trade occurs with at least two of the Dominica's native palms. Broom-makers from the southern village of Grand Bay sometimes purchase *latannyé* (*Coccothrinax barbadensis*) leaves from the

5. Craft items made from *Syagrus amara*.

6. A basket made from *Syagrus amara* (lighter material) and *Pandanus* sp. (darker material).

village of San Sauveur. Some broom-makers at Tete Morne also purchase leaves from owners of cultivated trees in their community, and may sometimes pay young men to harvest broom sticks from the nearby forest on a job basis. In the northern half of the island, craft makers from Penville sometimes pay between EC $50.00 and $80.00 (US $18.50 to $30.00) for a bag of *kokoyé* or *iátaho* leaflets. *Kokoyé* craft-makers from Savanne Paille in the northwest sell the "bone" or mid-ribs of the *kokoyé* palm leaves to craft-makers from Penville who appeared to make greater use of the palm than their counterparts.

Discussion

Dominica's native palms are a small but important component of the island's indigenous plant diversity, being represented in all of the major vegetation types on this Caribbean island. Collectively, the traditional uses of these species constitute an important component of the island's rich cultural heritage, from the early days when the Kalinago ruled the Caribbean up to the present day.

The traditional uses of at least four of the species, viz. *Euterpe broadwayii* and *Prestoea*

7. A woman weeving *Syagrus amara* and *Pandanus* sp. fibers.

acuminata for their edible "cabbage," *Coccothrinax barbadensis* for house pillars and *Syagrus amara* for siding for charcoal pits, requires the chopping down of the tree. However, this unsustainable practice is not widely employed on Dominica and currently cannot be considered to pose a threat to any of these species on the island.

Currently there is no action plan that is being implemented specifically for the protection of any of Dominica's native palms. However, five of the species, viz. *Aiphanes minima, Geonoma undata,* G. *interrupta*, *Prestoea acuminata* and *Euterpe broadwayii*) may be found in two of Dominica's three national parks as well as in the island's two forest reserves. The commercial harvesting of trees is not permitted in the island's national parks system, while the forest reserves currently serve primarily as protection forest. Following the recent documentation of the extent of the *Pseudophoenix* population on Dominica and the assessment of the local threats to that species, a Plan-of-Action for the conservation of that palm on the island was prepared.

And while some of the original uses of Dominica's native palms have all but disappeared, it is expected that Dominicans will continue to use these palms in innovative and creative ways for a long time to come. Other uses of Dominica's palms have not yet been documented.

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Ecology and Management of the Chilean Palm (*Jubaea chilensis*): History, Current Situation and Perspectives

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The Chilean palm, *Jubaea chilensis* (Front Cover), one of the most emblematic tree species of the Chilean flora, has suffered a gradual reduction of its population numbers in the last 150 years, with the estimated 120,000 palms that exist today being no more than 2.5% of the existing population found at the beginning of the 19th Century. From an economic point of view, this plant has been one of the most prized species in the central zone of Chile due to its two valuable products – its sap, the basis of the traditional palm honey industry, and its seeds (mini-coconuts), which are also an important product for the food industry. Along with a history of extensive use, there has been a drastic reduction of the accompanying native vegetation due to anthropogenic activities, thus reducing the appropriate habitats for the natural regeneration of this species. Given its current ecological condition and the need to implement strategies that ensure its conservation, it is necessary to evaluate current knowledge of the palm. This article gives a general background of the species, i.e. biogeography, ecology and history of use, and general recommendations are provided to ensure its persistence in the central zone of Chile.

In Chile, the palm family is represented by two monotypic genera: *Jubaea* and *Juania*; *Jubaea chilensis* (Molina) Baill. (Chilean palm) is distributed in the central area of the country, and *Juania australis* (chonta) is found exclusively in the Juan Fernández archipelago (Muñoz 1962, Gay 1853).

The history of *Jubaea chilensis* is linked to the geological history of South America. Successive global climate changes along with the Andean orogenesis resulted in the confinement of tropical elements to the western slope of this mountainous range (Villagrán & Hinojosa 2005). As a consequence of these geological changes, a particular floral composition of the Mediterranean zone has emerged with coexisting elements such as those with austral-antarctic and tropical origins.

The current geographic distribution of the Chilean palm is very restricted, confined to an area from the south of the Limari river (IV Region) to the surrounding areas of Curicó (VII Region), always along the Coastal Range of Chile. Serra et al. (1986) point out that it is difficult to specify geographic limits since the populations of this species have been strongly fragmented by the action of man (Bordeau 1992).

The northernmost limit is in the Hacienda Las Palmas, IV Region (31°15'S, 71°35'W), whilst its southernmost limit is the locality of Tapihue, VII Region (35°22'S, 71°47'W) (Fig. 1). Nowadays, there are around 15 localities where we may find the Chilean palm (Tab.1); however, in only three localities are the population numbers important: Ocoa (aprox. 60,000 individuals), Cocalán (35,000 individuals) and Las 7 Hermanas (7,000 individuals), thus representing more than 90% of the total (Serra et al. 1986, Rundel & Weisser 1975, Michea 1988).

1. Geographical distribution of Chilean Palm.

In spite of the interest generated by *J. chilensis* in our country, scientific knowledge of this species in key aspects of its biology, such as reproduction, population regeneration or the biological interactions in which it is involved (pollination, frugivory and herbivory), are surprisingly scarce. Nothing is known about the population genetics of this species or of its reproduction systems. This lack of information is serious since this knowledge is essential to elucidate how to assure the persistence of this species under natural conditions.

The indiscriminate harvest of seeds (mini-coconuts), which in many populations results in the extraction of the total nut production, has been identified as the main cause of the reduction of the population numbers (Serra et al. 1986). In fact, the large majority of remaining populations are dominated by senescent individuals with a low or null proportion of juveniles (Michea 1988), suggesting that the major limitations of the recruitment of new individuals occurs in the early stages of the life cycle (Marcelo 2007).

The conditions for successful seed germination are well known under nursery settings (Infante

1989, Arrué 2000, Solari 2002), suggesting that the species has no serious physiological constraints for germination. There is only one study (Serra et al. 1986) that suggests that germination and subsequent survival of the seedlings are strongly dependent on the plant cover of the sclerophyllous forest, since the regeneration of new individuals in bare soil is non-existent. Recent field experiments support the existence of this nurse effect (Marcelo 2007). On the other hand, the seeds of the Chilean palm are actively consumed by native (e.g., *Octodon degus*; Zunino et al. 1992, Yates et al. 1994) and introduced rodents, an important mortality factor that requires evaluation. Also, seedlings are actively consumed by exotic rabbits, which is thus an additional limitation for regeneration (Marcelo 2007).

Once individual palms surmount the ecological barriers imposed on seeds and seedlings, no further mortality factors (excepting the death of individuals for human use) are critical for the juveniles and adult plants. Once the trunk is formed (at 25–30 years of age), the Chilean palm presents a notable resistance to fire. In fact, the mortality of adult specimens as a result of fire is almost zero even though the current occurrence of fires in Central Chile is extremely high (Montenegro et al. 2004)

Conservation and Management

Given the disappearance of the Chilean palm in vast areas of Central Chile, the authorities tried to protect the species inside Protected Wildlife Areas 35 years ago. These efforts resulted in the protection of the largest population in the area of Ocoa of the Campana National Park (Fig. 2). The population of Cocalán, the second in size, has remained in private ownership, and although this area was also declared a National Park, this situation has not been resolved legally.

The Chilean palm has occupied a very significant role in rural culture. The extraction

Tab. 1. Natural Populations of Chilean Palm. Estimates were based on known inventories, published data and the authors' observations.

	LOCALITIES	Long.	Lat.	No. of palms (estimated)
1.	Sector OCOA: including "Parque La Campana, Hacienda Las Palmas de Ocoa, Oasis La Campana y Palmas de Vichiculén-Llay Llay"	32º57'	71º04'	70,308
2.	Sector COCALÁN: including "Hacienda Las Palmas de Cocalán, La Palmería", and surrounding areas	34º12'	71º08'	35,500
3.	Sector VIÑA DEL MAR-VALPARAISO: including "Las Siete Hermanas, Subida Santos Ossa" and surrounding areas	33º04'	71º31'	7,200
4.	"Cuesta Los Guindos- Cuesta Alhué"	33º58'	71º14'	2,500
5.	"San Miguel de Las Palmas"	34º25'	71º47	2,000
6.	"La Candelaria"	34º51'	71º29'	1,900
7.	"Tunel de Las Palmas, Pedegua"	32º09'	71º09'	1,300
8.	"Tilama, Pichidangui"	32º05'	71º08'	50
9.	"Tapihue, Pencahue"	35º15'	71147'	17
10.	"La Serena"	29º54'	71º15º	3
11.	"Limahuida, Los Vilos"	31º44'	71º09'	2
12.	"Paredones, El Asiento, Talamí" and dispersed individuals			200
	TOTAL			120,980

of palm sap, the basis for the production of palm honey, constitutes a traditional activity which has maintained the same characteristics for more than 200 years. Traditionally, sap harvest has resulted in the sacrifice of the specimens. Once the individuals are uprooted, their apex is cleared, and the exudation occurs through the apical meristem. The sap harvest takes a whole summer season, and approximately 400 liters of sap are obtained per specimen giving an average of 90 kg of sugar concentrate. This concentrate is stored for aging and to increase its yield in the manufacture of the industrial product, which also contains sucrose, sap and water. With a concentrate aged for 20 years, the volume of palm honey obtained may be more than 20 times the concentrate volume.

In the exploitation of the palms for the production of honey, it is necessary to distinguish two different types, each one with a different spatial as well as temporal effect: home-made honey production, the more traditional way of extraction, and the industrial production, currently carried out by the private enterprise Cocalan Palm Honey Ltda. at Cocalán. The production of home-made honey was without doubt very important in the past. This form of exploitation, which resulted in massive extractions of plants (Vicuña Mackenna 1877) has been traditionally ignored in terms of the negative ecological impact on the species and on the entire ecosystem. However, it was an important activity for a very long time and especially during some periods in which there was a shortage of other types of sugars required for human consumption. It is quite possible that requirement for the palm sap may have been extremely strong in the past, particularly in areas of Central Chile with a large number of rural population concentrated due to seasonal agricultural activities.

The exploitation of the sap at an industrial level has had a continuous development since 1878 only in the localities of Ocoa and Cocalán. This industrial exploitation seemed not to affect natural populations negatively, since it is precisely in these localities where the major populations are found at the present day. Furthermore, both of these localities always had controls on the access of illegal exploitation. In 1980, more rigorous controls were established through Management Plans supervised by the National Forest Corporation (CONAF) and the Agriculture and Livestock

2. Typical population structure of Chilean palm in areas oriented to the production of fruits.

Service (SAG). In Cocalán, the average extraction of individuals did not exceed 30 specimens per year, a number by far sufficient to satisfy the demand for palm honey in the national market. In fact, this population is the only one that presents a population structure with a greater proportion of young individuals with respect to older ones, a pattern that strongly suggests good regeneration and largely contrasts with the population structure observed in other localities where adult individuals are largely dominant (Fig. 3).

Threats to the conservation of the Chilean Palm

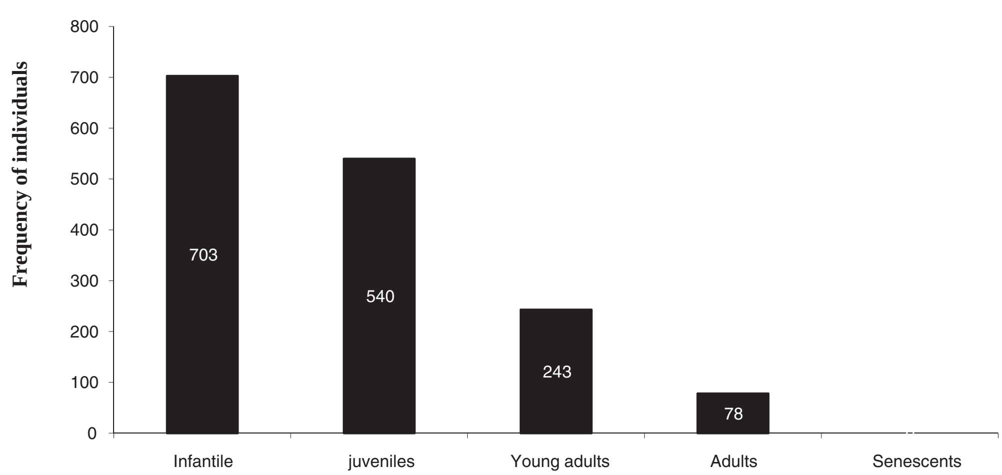
We can identify two human activities that are consistently pushing this species to an extinction vortex: the harvest of nuts and the reduction of native vegetation.

Harvest of young nuts: There is no doubt that the Chilean palm has an abundant seed production and although its germination is difficult, there should be no problem in terms of its self-propagation. However, the great demand for seeds for human consumption allows us to assume that the uncontrolled fruit harvest has probably been the most important cause of its disappearance in certain areas. In fact, this activity, of which specific details are unknown, is carried out in almost all the existing palm populations with the exception of Cocalán, where there has been a certain control on behalf of the company. In Ocoa, the fruit harvest control ceased in 1970 when the lands came under the administration of the Campana National Park. The administrators of the park have established a protocol to regulate the activity, which includes the park, seed collectors and the private company "Oasis La Campana." This company sells to collectors a proportion of nuts in order to produce large numbers of seedlings for ornamental purposes. The rest of the seeds are presumably returned to the park for natural regeneration. In other palm populations there exists no control of nut extraction, and the entire seed crop is harvested by people.

Although the harvest of nuts is regarded as the main threat to the long-term persistence of the palm, currently there is no information on the total production of seeds per individual, population or species; there is no information on the total number of seeds extracted for human use, and if the nut production of palms in inaccessible places (not consumed by people) is enough to assure the necessities of native rodents, which use these resources during winter. The knowledge of these numbers will be crucial to manage this resource in a sustainable manner and also to elucidate if this extraction is affecting other levels of the food web.

Reduction of the vegetation cover: As of the second half of the 19th Century, following the discovery of gold in California and Australia (from 1848 to 1852), there was a massive change of land use in Central Chile. Large amounts of forested areas were eliminated with the purpose of producing wheat. This land use change resulted in a drastic reduction of the sclerophyllous forest, the dominant native vegetation of Central Chile. The reduction of

3. Typical population structure of Chilean palm in areas where they are devoted to sap production .



the cover of native vegetation resulted in reduction of the microhabitats that favored seed and seedling survival of the Chilean palm. Unfortunately, unlike other native trees, such as *boldo* (*Peumus boldus*), *peumo* (*Cryptocarya alba*), *litre* (*Lithraea caustica*) and *quillay* (*Quillaja saponaria*), this palm does not regenerate vegetatively. In summary, the elimination of the sclerophyllous forest for agriculture and forestry has been a serious cause of the disappearance and/or reduction of the numbers of the Chilean palms particularly in Central Chile, because of constraints to natural regeneration. The conservation of the sclerophyllous forest certainly will help the conservation of the Chilean palm.

The Chilean Palm: proposals for sustainable management

Although the importance of this species as a valuable natural resource has been largely recognized, isolated initiatives began only during the 1970s. The first study that examined the potential of the Chilean palm as a resource was an undergraduate thesis at the University of Chile entitled "Inventory and production study of the Chilean palm, *Jubaea chilensis* (Mol.) Baillon., Hacienda Ocoa, Valparaiso" (Rubinstein 1969). This pioneer investigation received limited attention. This is unfortunate as from this study emerged important recommendations. Specifically, the author concluded that because of (i) the high productive potential of *Jubaea chilensis*, based not only on the production of honey but on the products derived from the fruit and leaves and (ii) the real potential of this species for reforestation and recovery in arid and semi-arid ecosystems, it provides a good opportunity for an economically sustainable activity, which at the same time provides social benefits as it may constitute a source of employment in a region where the cost of owning land is high and the large labor force is poor.

More sustainable initiatives other than nut harvest and sap extraction are still in initial stages in Chile. In the cities, it is used as an ornamental plant thus replacing the exotic palm *Phoenix canariensis* currently found in parks and avenues. Until a few years ago there were no nurseries dedicated to the production of seedlings and saplings of *Jubaea chilensis*. Only in recent years has this enterprise begun, but the availability of plants is still low, and the prices are high. Additionally, there is no study that assures an acceptable level of survival in a massive plantation. Currently, the Hacienda Las Palmas de Cocalán is the only place in the world where there is an integrated sustainable productive management of a natural forest of Chilean palm under the supervision of public agencies (CONAF, SAG). This activity that begun in 1982 has been concentrated on the extraction of the sap to produce honey, extracting about 30–34 individuals per year. More recently, other initiatives have been conducted in other localities to commercialize young and adult palms for ornamental purposes as well; this is the case of the Oasis La Campana S.A., situated close to La Campana National Park, and the nursery of the Agrícola Santuario Las Palmas Company adjacent to the Las Palmas de Cocalán.

Although a lot of experience has been accumulated in recent years using the Chilean palm as a sustainable resource, it is still unavailable to owners of small farms with dry and poor-nutrient soils inadequate for most agriculture but very suitable for the culture of the Chilean palm. We suggest that the culture and economic use of the Chilean palm is viable for these people. First, palm culture does not require great extensions of land, and young plants do not require special care for survival and growth. In fact, some experience shows that specimens growing without fertilizers, pesticides or irrigation have shown a development that allows 40–45 year rotations for sap production and nut production. Secondly, there exists the basic knowledge to improve germination and survival of seedlings and saplings under controlled conditions. Thirdly, small farmers do not have so many other economic options, so these initiatives may become a unique opportunity improve their quality of life.

A plantation for the purposes of producing sap for the manufacture of palm honey is perfectly compatible with the culture of young and juvenile plants (5–15-year olds) for ornamental purposes. The demand for this type of product is increasing very fast, and prices are attractive for export. Moreover, preliminary results suggest that the palm honey may be extracted without killing individuals, such as occurs in the Canary Islands with *Phoenix canariensis*. In this case, the production takes place during a period of 4 to 9 months with an average of 8 to 15 liters per day, depending on individual variation (Mesa Noda 2001). From our experience, individuals may be "milked" every five years with no further problems of survival and growth.

Conclusion

The Chilean forestry activities have been sustained almost exclusively by exotic plants of rapid growth, such as *Pinus radiata* and species of the genus *Eucalyptus*. Currently, there is a need for a focused promotion towards the sustainable management of native forest and at the same time towards the diversification of species used in forestry. A project based on the Chilean palm is evidently outlined within the policy of a native species which occupies a territory that has no alternative use. Furthermore, it constitutes a genuine intent to recover an emblematic native species such as our Chilean palms for conservation and management.

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Preliminary Observations and Analyses of Pollination in *Coccothrinax argentata*: Do Insects Play a Role?

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1. Habit of silver palm (*Coccothrinax argentata*) in pine rocklands habitat. Note silvery underside of leaves and cream-colored inflorescence.

We examined the reproductive biology of the rare and endemic palm, *Coccothrinax argentata*, in the pine rocklands of southern Florida. In addition to conducting visitor exclusion experiments, we observed five species of insects visiting the flowers of *C. argentata* and found large quantities of *C. argentata* pollen on their bodies. These preliminary results suggest that insects collect pollen from this species and may play a role in its pollination. Understanding the breeding system and pollination biology of the silver palm will facilitate effective management strategies of this rare palm.

Palms have traditionally been associated with anemophily, or wind pollination (Henderson 1986). Delpino (1870) was one of the primary proponents of this theory, relating the "primitiveness" of anemophily to the palm family. Many botanists (Drude 1889, Kerner 1895, Rendle 1904, Cook 1927) continued the myth popularized by Delpino, despite some considerations that palms could be insect- and wind-pollinated (Coulter & Chamberlain 1915, Kugler 1955). The hypothesis of anemophily in palms also arose as a result of their inflorescence and pollen morphology – typically massive inflorescences producing small, inconspicuous flowers and large quantities of pollen. As Henderson discussed in his review, Good (1956) even went so far as to describe palms as the tropical counterparts of catkin-bearing dicotyledons. Later studies maintained that palms are primarily anemophilous in the temperate zone (Baker & Hurd 1968, Stebbins 1974), highlighting the need for field studies that empirically test this assumption. The general hypothesis of anemophily in palms has been abandoned and evidence now suggests that entomophily, or a combination of both may be more common among palms (Dransfield et al. 2008).

Coccothrinax argentata (Jacq.) L. H. Bailey, Florida silver palm (Fig. 1), is a rare palm endemic to south Florida and the Bahamas. It grows in the pine rocklands (Fig. 2), a fire-dependent habitat occurring on outcroppings of limestone, as well as in hardwood hammocks and on coastal dunes. Urban development and long-term fire suppression pose major threats to the pine rocklands, with less than 2% of the original habitat remaining outside of Everglades National Park (Snyder et al. 1990). The range of *C. argentata* extends from southern Florida (northern limit near Boca Raton) to the Florida Keys and the Bahamas (Wunderlin & Hansen 2003), although Davis et al. (2007) identified populations of southern Florida and the Florida Keys to be morphologically distinct.

Little is known of the silver palm's reproductive biology, despite the important role its fruits play in the diet of many animals. Florida's Key deer depend on the fruit as a primary food source, although the deer do not excrete intact seeds and are ineffective seed dispersers (Zona 1997). In contrast, birds, turtles (Liu et al. 2004), and small mammals are considered to be effective seed dispersers of this species. To our knowledge, no study has

2. Pine rocklands habitat. Three palm species dominate the understory: saw palmetto, *Serenoa repens* (foreground, left), silver palm, *Coccothrinax argentata* (background, center), and cabbage palm, *Sabal palmetto* (foreground, right).

been published on the pollination biology of this species, although the few studies that mention its pollination biology suggest anemophily (Zona 1997).

We conducted a preliminary study on the reproductive biology of *C. argentata*, with the aims of elucidating its breeding system and determining if it is strictly wind-pollinated. Specifically, our research addressed three primary questions: (1) Is *C. argentata* self-compatible? (2) Does *C. argentata* set fruit without floral visitation? and (3) Do insects visit inflorescences and which are effective pollinators? The research presented in this paper forms part of a multi-species study on the reproductive biology of three sympatric palms in the southern Florida pine rocklands.

Materials and Methods

Species description. *Coccothrinax argentata* (Arecaceae: Coryphoideae) is a relatively short (stature of mature mainland plants ranges from 0.5–1.8 m) and slow-growing palm. Individuals bear a small, single stem that can occasionally develop into multiple stems. Its leaves are palmate and deeply divided, with induplicate plication and unarmed petioles that do not split at the base.

Coccothrinax argentata produces small, white flowers containing 7–12 twisted stamens and one unilocular carpel, with an inconspicuous uniseriate corolla. Flowers are borne singly along the rachillae. Inflorescences are interfoliar and take about three weeks to expand, finally emerging from a single, silky, pubescent peduncular bract similar in color to the underside of the leaves. The inflorescence is subtended by a peduncular bract and is branched, with many rachillae. Flowers last less than one week, with stigmas and anthers quickly shriveling and drying up thereafter. Anthers become notably twisted after stigma receptivity has passed. Pollen is white, in contrast to the yellow pollen of *Sabal palmetto* and *Serenoa repens*. We observed a strong, sweet odor emerging from the receptive flowers. Flowers open before 08:00, and we observed the highest amount of insect activity and most notable odor between 08:00 and 10:00. Fruits of *C. argentata* are globose, smooth and purplish black at maturity, one-seeded, and measure 0.6–1.2 cm in diameter.

Study site. We conducted our fieldwork in the pine rocklands, an ecosystem endangered by habitat destruction and fragmentation. The pine rocklands in southern Florida are dominated by the Slash pine, *Pinus elliottii* var. *densa* in the canopy, and native palm species as well as over 250 herbaceous species in the understory (Snyder et al. 1990). Our study area, Navy Wells Preserve (latitude 24.4347, longitude -80.5030), serves as the groundwater recharge area for the Florida Keys water supply (USGS 2004). This large fragment of pine rockland lies just outside of Everglades National Park and is managed by Miami-Dade County. A dirt road bisects the 101.2 ha preserve. In addition to *C. argentata*, two other native palm species are abundant at this site and are fire-adapted: *Sabal palmetto*, cabbage palm, and *Serenoa repens*, saw palmetto. We chose to conduct our fieldwork at this site because it had been recently burned and, like other pine rocklands plant species, silver palm survives and even thrives after a fire (Cooley 2004, Carrington & Mullahey 2006). All field observations and experiments were conducted between February and July, 2008.

Flowering and fruiting phenology. We observed *C. argentata* in bloom at this site from late February through April, although a few individuals bloomed in May. Fruit set occurred from May through the summer months, coinciding with the seasonal rains. Phenological data of *C. argentata* in cultivation at the Montgomery Botanical Center (MBC) in Miami, Florida, suggest similar patterns, with a flowering peak occurring from March through May, although a second flowering peak seems to occur from September through November (Larry Noblick, unpublished data). As we observed at Navy Wells, the MBC populations of *C. argentata* begin to set fruit in June, but continue through December. Although these data reflect *C. argentata* in cultivation, and not growing wild in the pine rocklands, they are still relevant because both habitats share the same climate. Furthermore, these data are useful since phenological data of this species, as well as those of *Sabal palmetto* and *Serenoa repens,* are scarce. We observed that the flowering and fruiting activity of silver palm coincided with that of the other two species, also abundant at this site.

Floral visitors and nectar collection. We conducted pollinator watches on flowering silver palm individuals located throughout the site. All pollinator watches were carried out on sunny and partly cloudy days between 09:00 and 13:00 for twenty 10-minute intervals. Insect appearance and behavior was recorded, noting how long visitors stayed on flowers and if they made contact with the stigma. The number of visits by different insects was also recorded. Visitors were collected and identified. We also tested for the presence of floral nectar in *C. argentata* using a hand-held light refractometer (Bellingham and Stanley "Eclipse").

Pollen analysis. Visitor specimens were examined using the dissecting microscope to view pollen loads, and pollen was sampled with dissecting needles and fine brushes (cleaned between specimens). Pollen from the insects' bodies was dropped into fuchsin gel on a microscope slide for examination under the light microscope (Dafni et al. 2005). We compared the pollen with known samples in our reference collection to determine what species of pollen were on each insect's body.

Breeding system. To determine the breeding system of *C. argentata*, we performed a pollen limitation experiment using a treatment and control (Kearns & Inouye 1993). The autogamy treatment consisted of bagging peduncular bracts before inflorescences had emerged and leaving the bags on until fruit set. The control plants were not bagged and represented open pollination. Fine nylon mesh (with threads less than 0.1 mm apart), breathable bags that did not permit pollen or insects to enter were used. All plants were tagged, and the date of bagging was recorded.

Fruit initiation was apparent within one month of bagging. The number of fruits per rachilla and per inflorescence was counted, along with the number of flowers and buds. Fruit set was calculated as the proportion of flowers that set fruit per inflorescence.

Statistical analysis. We conducted an independent samples T-test to test for differences in fruit set and number of fruit among the treatment and control. Number of fruit was calculated as the number of fruit produced per inflorescence whereas fruit set was calculated as the proportion of flowers that set fruit per inflorescence. A nonparametric test (Mann-Whitney U) was used because the error variances were significantly different for number of fruit (Levene's test, $t = -7.624$, $df = 22.755$, $p<.001$) and fruit set (Levene's test, $t = -1.706$, $df = 20.030$, and $p<.104$), and transformation was unsuccessful. Normality tests (including histograms and box plots) also showed the data to be non-normally distributed. One reason for this type of distribution could be because of small sample size ($n = 41$). All statistical analyses were performed using SPSS (Chicago, Illinois, USA).

Results

Floral visitors. Floral visitation peaked from 09:00 to 11:00, and decreased significantly by 13:00. We observed five different species visiting the inflorescences of *C. argentata* including three bees: *Apis mellifera* (Hymenoptera: Apidae), *Megachile georgica* (Hymenoptera: Megachilidae), and *Xylocopa micans* (Hymenoptera: Apidae); flies, *Plecia nearctica* (Diptera: Bibionidae); and ants, *Pseudomyrmex mexicana* (Hymenoptera: Formicidae). During the twenty ten-minute interval watches, we found *Apis mellifera*, the European honeybee, to be the most abundant visitor. Honeybees tended to stay on each inflorescence longer than the other bee species, which tended to forage more quickly and visit a larger number of inflorescences. All visitors made contact with the stigma as they crawled around the flowers and visited the flowers repeatedly, suggesting that they were not just "passing by." During our pollinator watches, we actually observed several of the visitors collecting pollen, notably *X. micans* and *A. mellifera* (Figs. 3–5). Furthermore, we could see ample quantities of pollen on their bodies as they "worked" the flowers (Fig. 6).

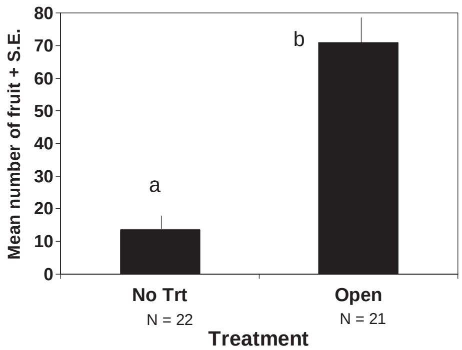
During previous fieldwork on wildflower species in the pine rocklands, we and other members of our lab have consistently observed (though have not yet quantified) that palms in bloom recruit visitors disproportionately, leaving nearby wildflowers unvisited. We observed the same phenomenon in our field site: insect activity was concentrated at palm inflorescences, among them, those of *C. argentata*. This pattern may reflect ample nectar with high nectar concentrations in the native palm species of this habitat, notably *Serenoa repens* and *Sabal palmetto*. Though flowers of *Coccothrinax* are fragrant, we did not detect any nectar in the inflorescence using micro-capillary tubes and refractometer. Further anatomical study is warranted.

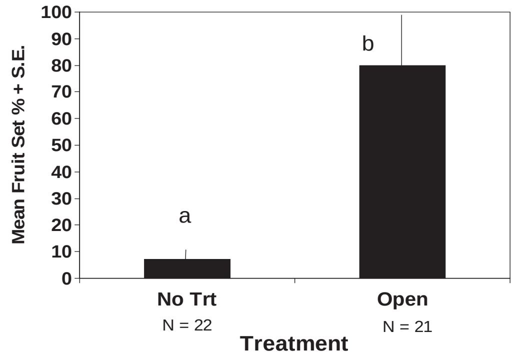
Pollen analyses. Analyses of visitors' bodies under the dissecting microscope demonstrated large quantities of pollen, especially for the hymenopteran species, whose corbiculae or "pollen baskets" allow for pollen storage and hairy bodies promote pollen adherence (McGavin 2001). Slides of pollen sub-samples from the bodies of *X. micans* and *A. mellifera* revealed almost exclusively *C. argentata* pollen grains (>50 pollen grains), except for a few

3 (upper left). Honey bee (*Apis mellifera*) collecting pollen from silver palm flowers. 4 (upper right). Pollen-filled corbiculae on legs of pollen-collecting honey bee. 5 (lower left). Carpenter bee (*Xylocopa micans*) hovering in front of silver palm flowers. 6 (lower right). Carpenter bee collecting pollen from silver palm flowers. Note pollen-covered back and legs.

pollen grains from neighboring wildflowers, presumably Asteraceae. Likewise, a sub-sample of a corbicula from *A. mellifera* consisted entirely of *C. argentata* pollen grains (>100 pollen grains).

We found pollen grains to be slightly oblong with minor edges. They are medium-sized, averaging 20–30 µm in diameter and 5–10 µm smaller than pollen of the other two palm species at the study site.





7 (left). Mean and standard deviation of number of fruit produced by *C. argentata* at Navy Wells after pollinator exclusion experiment. "No Trt." refers to the pollinator exclusion treatment and "Open" refers to the control. Treatments with different letters represent significant differences (p<.05) using a Mann-Whitney U test. 8 (right). Mean and standard deviation of percentage fruit set of *C. argentata* at Navy Wells after pollinator exclusion experiment. "No Trt." refers to the pollinator exclusion treatment and "Open" refers to the control. Treatments with different letters indicate significant differences (p<.050) using a Mann-Whitney U test.

Breeding system and fruit set. The bagged autogamy treatment produced significantly fewer fruit (Z = -5.251, p<.001) and lower fruit set (Z = -5.468, p<.001) than the control open pollination (Figs. 7 & 8). The fact that the bagged flowers set some fruit indicates that the species is self-compatible. However, since this fruit set was still significantly lower than the open pollinated plants (Fig. 9), it may be that fruit set is better with pollen from other individuals and the plants are facultatively xenogamous.

Our pollinator watches and analyses of visitors' pollen content lead us to believe that the inflorescences from which visitors were excluded probably set fruit as the result of self-pollination within the bags, perhaps moved by the wind. The bags that we used, a very fine nylon mesh, would not have allowed pollen to pass through them, but wind and other things may have jostled the flowers and moved the pollen.

Herbivory. While removing bags to count fruit, we noticed that several of the inflorescences had been damaged by herbivores and the bags were full of frass. Furthermore, during our pollinator watches, we also noticed the following herbivores on the leaves and inflorescences of *C. argentata*: the echo moth, *Seirarctia echo* (Lepidoptera: Arctiidae), the banana weevil, *Pachnaeus litus* (Coleoptera: Curculionidae), and the cabbage palm caterpillar, *Litoprosopus futilis* (Lepidoptera: Noctuidae). Carrington and Mullahey (2006) observed *L. futilis* on saw palmetto and noted that it uses other Florida palm species, including the silver palm, as a host. The caterpillars live inside the peduncular bracts, consuming the buds and immature flowers and sometimes even the entire inflorescence. The authors cited heavy damage and occasional mortality of saw palmetto inflorescences caused by *L. futilis*. Throughout our fieldwork, we also monitored significant damage to inflorescences of saw palmetto and sabal palm, presumably caused by the cabbage palm caterpillar given that we commonly observed its presence on these species. We noted that the silver palm inflorescences were damaged less by *L. futilis* than were the inflorescences of the more common palms.

Discussion

We set out to answer three primary questions: (1) Is *C. argentata* self-compatible? (2) Does *C. argentata* set fruit without floral visitation? and (3) Do insects visit inflorescences and which are effective pollinators? The results from our bagging experiment suggest that *C. argentata* is self-compatible and can set fruit without floral visitation, given that the autogamy treatment did set fruit. However, bagged inflorescences exhibited significantly lower fruit set than the control, highlighting the importance of insects and, perhaps, pollen from other individuals for pollination. We have not eliminated the possibility of agamospermy, but think it unlikely as many bagged inflorescences set no fruit at all.

The results from this study are preliminary, for we have only studied one population of silver palms for less than half a year. However, they provide evidence that *C. argentata* is more than just wind-pollinated. Five species, representing three orders of insects, were observed visiting the flowers and collecting pollen. Furthermore, when analyzed under the dissecting microscope, visitors' bodies (notably *X. micans*, *A. mellifera* and *M. georgica*) carried large quantities of pollen. A majority of pollen grains carried by insect visitors to the flowers was pollen of *C. argentata*.

Studies on other Coryphoid genera provide evidence of entomophily. Henderson (2002) described two contrasting pollination systems for this subfamily, weevil pollination and bee, fly and wasp pollination, although exceptions exist. Dufay and Anstett (2004) found that *Chamaerops humilis* engages in a nursery pollination mutualism with the weevil, *Derelomus chamaeropsis*, whereby females are pollinated by "deceit." *Cryosophila* and *Rhapidophyllum* are also weevil-pollinated (Shuey & Wunderlin 1977, Henderson 1984). Several species of *Licuala* are pollinated by flies, wasps, and bees; Halictidae and Apidae appear to be the most efficient pollen collectors and pollinators (Barfod et al. 2003). Similarly, Zona (1987) identified bees, including *Megachile* spp., *Augochloropsis metallica*, *Xylocopa micans*, and *Apis mellifera*, as the most important pollinators of *Sabal etonia*. It is worth noting that in our fieldwork, we observed several of these genera pollinating *C. argentata* and all of these genera also pollinating *S. palmetto* (Khorsand Rosa & Koptur, unpublished data). Thus, entomophily may be more common among the Coryphoids than anemophily.

It is likely that *C. argentata* is insect- and wind pollinated, or amphiphilous (Lewis et al. 1983). The combination of biotic and abiotic pollination does occur in other genera of Arecaceae including *Cocos, Phoenix*, *Elaeis* and *Attalea*, although wind may play a larger role in fruit set than insects (Scholdt & Mitchell 1967, Syed 1979, Lewis et al. 1983, Anderson et al. 1988, but see Dransfield et al. 2008). In a comparative study of the pollination biology of *Attalea speciosa* (as *Orbignya phalerata*) in open pasture and secondary forest, Anderson et al. (1988) found that wind supplements insect pollination, and the combination of these two syndromes permits for adaptability to a broad range of ecological conditions. In open pastures, anemophily may result in higher fruit set than entomophily. Thus, habitat may influence the proportion of transferred pollen grains and the pollination mechanism.

9. Silver palm bagged for pollinator exclusion. Note control (unbagged) infructescence full of unripe fruit, in contrast to treatment (bagged) infructescence with fewer fruit.

Even if *C. argentata* is amphiphilous, wind may not provide an effective means of pollen transport among isolated conspecifics, consequently lowering seed set (Koptur 1984). Thus, insects may play a key role in maintaining genetic diversity of *C. argentata*. Although native bees may act as important pollinators of rare pllants, non-native bees, such as *A. mellifera,* may still contribute significantly to the reproductive success of *C. argentata* in isolated fragments. Honeybees can colonize isolated and small fragments because the entire colony can fly tens of kilometers (Gould & Gould 1988).

In the absence or reduction of native bees in fragmented habitats such as the pine rocklands, honey bees may also act as key pollinators because they are able to pollinate flowers that do not fit the "insect pollination syndrome" better than other insects. Although the flower morphology of this species (like that of many other palm species) does not fit the insect-pollination syndrome, honey bees may visit flowers to satisfy their resource needs and even adapt to the small flowers if competition with other pollinators is low. Thus, flower morphology can be misleading, and pollination syndromes may not accurately reflect the ecological circumstances of the specific location in which the species grows.

Finally, anemophily has been traditionally associated with large quantities of small, dry, smooth pollen grains that are spread individually or in small groups (Dafni 1992). The pollen morphology of *C. argentata* from our analyses leads us to question this long-standing assumption. Our results corroborate the wind-pollination hypothesis given the smooth, dry surface of pollen grains and the large quantities of pollen dispersed as individual units. However, pollen grains are medium sized and are transported on insects' bodies. Other palm genera such as *Cocos* have relatively large pollen grains (Lewis et al. 1983), and are now considered to be pollinated by wind and insects (Dransfield et al. 2008). According to Henderson (1986), several studies provide evidence that in addition to wind, insects and nectarivorous bats collect pollen from *C. nucifera* (Start & Marshall 1976, Cock 1985). Thus, like flower morphology, pollen morphology does not necessarily indicate the pollination vector.

The silver palm was originally assumed to depend on abiotic pollination, and although wind may play a part in its breeding system, our study demonstrates that insects, including bees, can adapt to the flower morphology for resource exploitation. This study, though preliminary, exemplifies how we can challenge traditional assumptions about pollination mechanisms by coupling data collection and analysis with field observations.

Acknowledgments

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The Palms of Buton, Indonesia, an Island in Wallacea

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The palms of Buton, an island near Sulawesi in the biogeographic region known as Wallacea, are of interest due to their ecological importance and isolated geographical position. The Lambusango Forest in the south of Buton is the site of a conservation project funded by the Global Environment Facility of the World Bank. The palms of the forest have not yet been identified even though some rattans are of considerable economic value. Identifying the palms is a necessary step in the conservation of the forest and also provides information on the biogeography of the species present.

Islands in Wallacea, the region between South East Asia and New Guinea, have always been separated by sea from the continental land masses and so were originally colonized by living organisms from both these continents (Whitten et al. 1987). Buton lies at the tip of the south east peninsula of Sulawesi (Fig. 1). It is separated from Sulawesi and its close neighbor Muna by straits of shallow water less than 10 km wide. Buton is 150 km in length and 50 km wide at the part of the island where the Lambusango Forest is situated. It has a seasonal climate with a dry season from August to November. The forest extends from sea level to the highest parts of the island at 700 m; thus it lacks high altitude habitats. The forest covers more than 60,000 hectares and has had various degrees of conservation status since 1982. There has been no permanent habitation in the forest since then, but local people collect rattan and other forest products, including some timber. As a result there is almost continuous canopy cover, with rattan trails in many parts of the forest. A major influence on the forest vegetation is the type of underlying rock. Karst limestone is the main rock type, but some areas are underlain by ultramafic (ultrabasic) rocks (Whitten et al. 1987). The limestone erodes to give fertile soils whereas the ultramafic rock gives soils with very low fertility (de Vogel 1989).

Fieldwork was done in the months of July and August during the years 2002 to 2008.

Palms, excluding the rattans

Table 1 lists the eleven species of palm found in the wild in southern Buton, together with their known distributions. I would like to thank W. J. Baker, J. Dransfield, J. P. Mogea

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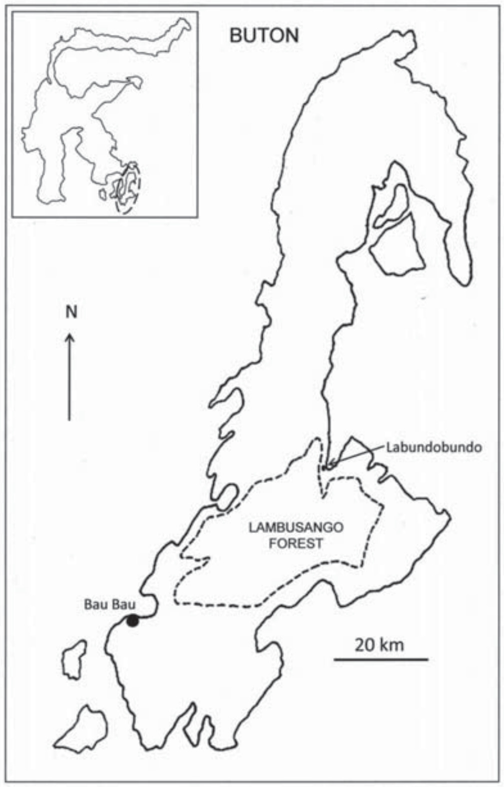


1. Map of Buton with the conserved area of the Lambusango Forest outlined (dashed line). The inset shows Sulawesi with Buton indicated by the oval.

and H. Rustiami for identifying many of the species. Specimens in the herbaria at Kew and Bogor have been examined to confirm the identifications and also to identify otherwise unrecognized species. All the species are found in forest habitats, with the exception of the coastal species *Nypa fruticans*. Three of the species, *Areca catechu*, *Arenga pinnata* and *Cocos nucifera,* are not native to Sulawesi (Govaerts & Dransfield 2005) but are relics of cultivation. The first two are now naturalized in some parts of Lambusango Forest, but there is little sign that *C. nucifera* is reproducing naturally, probably due to continued harvesting by local people.

Palms excluded from Table 1, since they are found only in cultivation, are *Borassus flabellifer*, *Metroxylon sagu* and *Salacca zalacca*. Although *Borassus flabellifer* is a native of Sulawesi (Govaerts & Dransfield 2005) it has not been observed in the wild on Buton, and in this account it is treated as an introduced species. Palms grown as ornamentals in villages surrounding the forest include *Dypsis lutescens* and *Roystonea regia*.

A species of *Pinanga* was found to be common in many forest areas. It has a single stem with a diameter of 5 to 10 cm and grows to 10 m at maximum. The crownshaft is dark green, with pale red infructescence branches and fruits usually turning dark red to black when ripe. It has been identified as *P. rumphiana*, a species not previously recorded on Sulawesi. The identification was made by comparison with specimens of *P. rumphiana* (e.g. *JPM3140*, *EFdV3271*) in the herbarium at Kew. The species on Buton matches the herbarium specimens in infructescence and fruit characters and corresponds to written descriptions of stem and leaf, although it tends to be somewhat smaller. Voucher specimens from Buton have been deposited in the Bogor herbarium. An infructescence is shown in Fig. 2.

In the survey described here it was noted that some species grow mainly or exclusively in a particular type of soil whereas others grow in a range of different soils. The pH values of soils derived from the two types of rock were measured using standard techniques (Chalmers & Parker 1989). Soils on limestone were found to have a mean pH of 6.19 ($n = 15$), whilst soils on ultramafic rocks have a mean pH of 5.06 ($n = 22$). These two sets of values are significantly different ($t = 5.59$, $p < 0.001$). Raw soils formed directly from limestone have

2. *Pinanga rumphiana* infructescence with unripe fruit. The fruit will turn dark red or black when ripe.

Table 1. Palms growing in the wild in the Lambusango Forest area, Southern Buton, excluding rattans.

Species	Local Name	Known Distribution[1]
Areca catechu L.	Pinang	Philippines (introduced to Sulawesi)
Areca vestiaria Giseke	Galanti	Moluccas, Sulawesi (N,C,S,SE)
Arenga pinnata (Wurmb) Merr.	Areng, Enau	S China, Indochina, W Malesia, Philippines (introduced to Sulawesi)
Caryota mitis Lour.	Ka Baru Baru	SE China to Indo-China to Malesia (incl. Borneo, Philippines, Java, Sulawesi)
Cocos nucifera L.	Kelapa	Moluccas, Philippines (introduced to Sulawesi)
Hydriastele selebica (Becc.) W.J. Baker & Loo	Paw Nuvu	Sulawesi (SE)
Licuala celebica Miq.	Wiuu	Sulawesi (N,C,S,SE)
Livistona rotundifolia (Lam.) Mart.	Lanu	Java, Lesser Sunda Is., Moluccas, Philippines, Sulawesi
Nypa fruticans Wurmb	Nipah	S & SE Asia to Caroline Is.
Oncosperma horridum (Griff.) Scheff.	Lambakara	Pen. Thailand to W. & C. Malesia (incl. Borneo, Philippines, Sulawesi)
Pinanga rumphiana (Mart.) J. Dransf. & Govaerts	Sampu	Moluccas (Halmahera, Bacan, Buru, Seram)

[1] Information from Govaerts and Dransfield (2005) and Mogea (2002).

pH values above 7, whereas soils formed directly from ultramafic rock have pH values below 5. However, in flat areas the build-up of organic matter results in lower pH in limestone soils and higher pH in ultramafic soils. Some species are found mainly or exclusively in areas with ultramafic rocks. These include *Areca vestiaria* (Fig. 3), *Hydriastele selebica* and *Oncosperma horridum*. No species is found exclusively in limestone soils, but *P. rumphiana* is more common in areas with limestone base-rocks, growing in a variety of situations including thin soils on hillsides and also on alluvium in river valleys. Perhaps surprisingly, most species manage to grow in both types of soil.

Rattans

Table 2 lists the 19 species of rattan found in the Lambusango Forest. The local names given are those used in the village of Labundobundo, but these can vary between neighboring villages. The name *tohiti* is notorious for being applied to different species in different localities (Dransfield & Manokaran 1994). In the area of the Lambusango Forest it is normally applied to *Calamus leptostachys*, but in Labundobundo it is usually given to the species otherwise called *hoa* (*Calamus mindorensis*). *Calamus subinermis* (*kakiki*) is also sometimes sold as *tohiti*.

The *Calamus mindorensis* plants on Buton (Fig. 4) have a white indumentum on the lower surface of the leaflets (Fig. 4C). Inspection of the herbarium specimens in Kew shows that those from south east Sulawesi have indumentum (e.g. *Angsana & Dali 031/IDRC*, *Clayton 20*), whereas those from central Sulawesi do not (e.g. *Angsana & Dali 060*, *Musser R2*).

Two species were not identified. *Calamus* sp. 1, *batu*, is a member of section Phyllanthectus (Furtado 1956), as judged by the structure of the inflorescence (J. Dransfield, pers. comm.). A striking feature of this species is its white fruits (Fig. 5). It is common on limestone soils and is able to survive in thin soils on steep limestone hillsides, where it must be subjected to drought during the dry season.

The other unidentified species (*Calamus* sp. 2) is known locally as *kabe* (Fig. 6). It has multiple, thin stems, narrow (1.5 cm),

Table 2. Rattans of the Lambusango Forest, Southern Buton.

Species	Local Name(s)	Known Distribution[1]
Calamus koordersianus Becc.	Torumpu	Sulawesi (N,S,SE)
Calamus leiocaulis Becc. ex K. Heyne	Jaramasi Merah	Sulawesi (C,S)
Calamus leptostachys Becc. ex K. Heyne	Pisi, Tohiti	C. Sulawesi (N,C,S), Buton
Calamus macrosphaerion Becc.	Bulu	Sulawesi (N,C,S)
Calamus minahassae Warb. ex Becc.	Kai Sisau, Tadiasa	Sulawesi (N,C,S)
Calamus mindorensis Becc.	Hoa, Tohiti	Philippines, Sulawesi (C, SE)
Calamus ornatus Blume var. *ornatus*	Lambang	Pen. Thailand to W & C Malesia (inc. Borneo,Java, Philippines, Sulawesi (N,C,S,SE))
Calamus pachystachys Warb. ex Becc.	?	Sulawesi (S)
Calamus paucijugus Becc. ex K. Heyne	Jaramasi Putih	Sulawesi (N,S)
Calamus pedicellatus Becc. ex K. Heyne	Ngasa	Sulawesi (S)
Calamus robinsonianus Becc.	Malu	Moluccas, Sulawesi (S)
Calamus siphonospathus Mart. var. *dransfieldii* Baja-Lapis	Buta, Bulu Rusa	Sulawesi (N), Philippines
Calamus suaveolens W.J. Baker & J. Dransf.	Lakumpa	Sulawesi
Calamus subinermis H. Wendl. ex Becc.	Kakiki	N. Borneo, Philippines, Sulawesi (N)
Calamus symphysipus Mart.	Umbol	Philippines, Sulawesi (N,C,S)
Calamus zollingeri Becc.	Batang, Mombi	Sulawesi (N,C,S,SE)
Calamus sp. 1	Batu	
Calamus sp. 2	Kabe	
Daemonorops robusta Warb. ex Becc.	Noko	Maluku, Sulawesi (N,C,S,SE)

[1] Information from Govaerts and Dransfield (2005) and Mogea (2002).

irregularly spaced leaflets and a distinct fringe of thorns around the top of the leaf sheath (Fig. 6). Voucher specimens of *hoa*, *batu* and *kabe* have been deposited in the Bogor herbarium.

Two distinct types of *C. zollingeri* grow sympatrically in the forest. The form known as *batang* (Fig. 7) has shorter internodes (20–25 cm) and more closely spaced leaflets (5 cm), whereas *mombi* has longer internodes (30–50 cm) and more widely spaced leaflets (10 cm) (Fig. 8). The thorns on the stems are more darkly colored on *batang* than on *mombi*. However, both types are sold as *batang*. The herbaria at Kew and Bogor both hold specimens of *C. zollingeri* that match *batang* in spacing of leaflets and also other specimens that match *mombi*. Why the two types stay separate from each other is an unanswered question. One possibility, that they are fertile

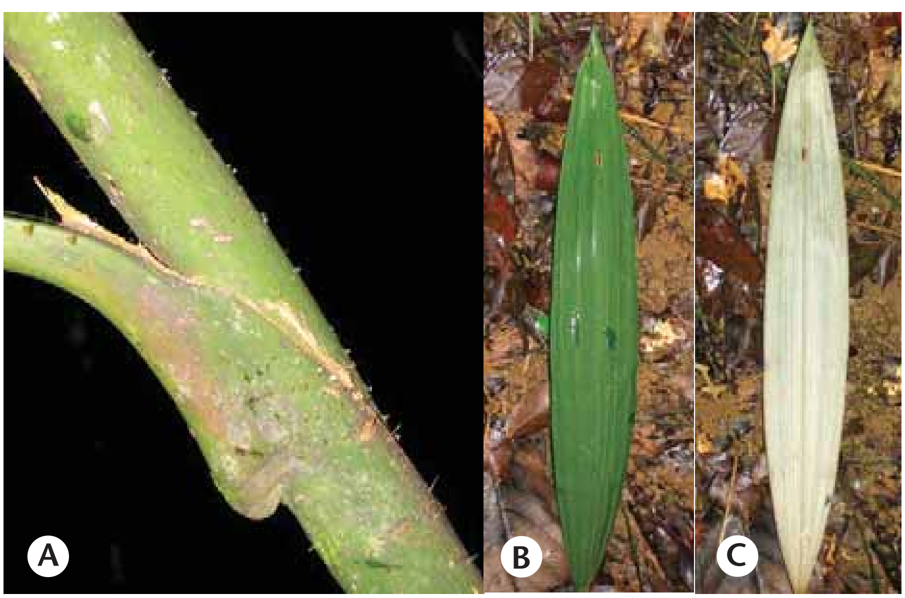
3. *Areca vestiaria*. Leaves in the foreground with two fertile trees above.

at different times of the year, as has been shown to be the case for varieties of *Geonoma cuneata* (Borchsenius 2002), does not seem likely since both types have been found in fruit in July and August.

Most species of rattan are widespread in the Lambusango Forest and are able to grow on both limestone- and ultramafic-derived soils. However *C. koordersianus*, *C. pachystachys* and *C. pedicellatus* show a marked preference for ultramafic soils, whereas *C. siphonospathus* and *C. zollingeri* along with *Calamus* sp. 1 (*batu*), show some preference for limestone-derived soils and are able to grow on thin, raw soils of this type.

Local men collect rattan from the forest for sale to companies for furniture manufacture. The species most commonly collected is *Calamus zollingeri*, since it is both valuable (750 Rupiah/kg in 2005) and common. The other species that is collected on a large scale is *C. ornatus*, which is less valuable (550 Rupiah/kg) but nevertheless also common. Other species which have about the same value as *batang* include *C. subinermis*, and *C. leptostachys*, but these are not usually collected commercially since they are difficult to find in quantity. *Calamus mindorensis* is of comparable quality to *C. zollingeri* but is not usually required by the rattan processing companies since it needs to be boiled in diesel oil for twice as long as *C. zollingeri* to remove the sap and gums it contains. Species with approximately the same value as *C. ornatus* include *C. symphysipus*, *C. koordersianus* and *C. siphonospathus*. *Daemonorops robusta* gives a poor quality cane

4. *Calamus mindorensis* (*hoa* or *tohiti*). A. The "knee" – the junction between the leaf sheath and petiole, showing the small, sparse spines on the sheath. B. Upper surface of a leaflet. C. lower surface of a leaflet.



and is rarely collected. These estimations of quality and relative values of the different rattan species are in general agreement with those reported from Central Sulawesi by Siebert (1997). The thin-stemmed rattans *C. leiocaulis* and *kabe* are collected for local use as bindings and to make baskets, bracelets and mats. *Calamus zollingeri*, when split, is used for the same purposes. *Kabe* is not collected for commercial purposes since its collection is banned by the Indonesian Forestry Department because it was once rare. The ban seems to have been effective, as the species is now relatively common and in places hangs in impenetrable festoons.

Biogeography

Buton occupies a semi-isolated position at the tip of the southeastern peninsula of Sulawesi, although has been connected by land to Sulawesi during the repeated ice ages of the last 2 million years (Voris 2000). Van Balgooy (1987) presented evidence that Sulawesi is a single unit floristically and that it has been easier for plant species to reach Sulawesi from the north (Philippines), east (Moluccas) and south (Lesser Sunda Islands), than from the west, across Wallace's line from Borneo. The question arises: to what extent is Buton typical of Sulawesi floristically? Of the 25 palm species identified in southern Buton, 12 are Sulawesi endemics (Govaerts & Dransfield 2005), indicating that Buton is a part of Sulawesi from a floristic point of view. When the total ranges of the remaining 13 species are considered, it is seen that Buton shares nine species with the Philippines, six species with the Moluccas, five species with Borneo and four species with Java. Only one species, the widely distributed *Livistona rotundifolia*, is also recorded from the Lesser Sunda Islands (Govaerts & Dransfield 2005). Conclusions are uncertain because these numbers are small, but they give no indication of a particular geographic source of palms on Buton, other than Sulawesi itself, nor do they provide any evidence that Buton is on a migration track leading to Sulawesi.

There would appear to be disproportionately more species of *Calamus* on Buton, compared with the other palm species present on Sulawesi. Sixteen *Calamus* species present on Sulawesi have been found on Buton, leaving 11 Sulawesi species apparently absent, whilst only 9 other palm species were found, leaving 25 unfound. This difference in proportion is statistically significant (Chi square = 6.69, p = 0.010), and achieves even greater significance if *batu* and *kabe* are included with the *Calamus* species. This excess of *Calamus* might be a sampling effect caused by more time spent

6. The unidentified rattan species known as *kabe* (*Calamus* sp. 2).

5. The unidentified rattan species known as *batu* (*Calamus* sp. 1). Part of an infructescence with mature fruit.

7. *Calamus zollingeri*. The form known as *batang* growing into the canopy.

looking for palms in forests than in other habitats, but there is little indication of a similar excess of species in the other rattan genera (*Daemonorops* and *Korthalsia*), with only one species from these genera found on Buton out of seven species known on Sulawesi. The lack of suitable habitats on Buton might explain the absence of some palms known on Sulawesi, particularly those adapted to montane or ever-wet habitats. An alternative explanation is that species of *Calamus* might be better able to reach Buton than other palm species, and so recolonize after local extinction. This could be because the palatability and small size of *Calamus* fruits makes them edible for birds such as the Imperial pigeon and the fruit dove (Zona & Henderson 1989), so the seeds would be more easily dispersed by birds to remote regions than the seeds in larger fruits of some other palms. There is evidence (De Deckker et al. 2003) that Sulawesi experienced lower rainfall and lower temperatures during the recent ice ages. This may have resulted in lowland forests on Buton being reduced to fragments in which many palm species went extinct due to unsuitable environmental conditions or inability to maintain viable population sizes. With the ending of the last ice age and the subsequent rise in sea levels, *Calamus* species may have been better able than other palms to recolonize. Much further work would be needed to test this hypothesis.

Acknowledgments

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8. Tips of young leaves of forms of *Calamus zollingeri* known as *mombi* (left) and *batang* (right), showing the characteristic difference in leaflet spacing.

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CLASSIFIED

The 2010 IPS Biennial: Brazil

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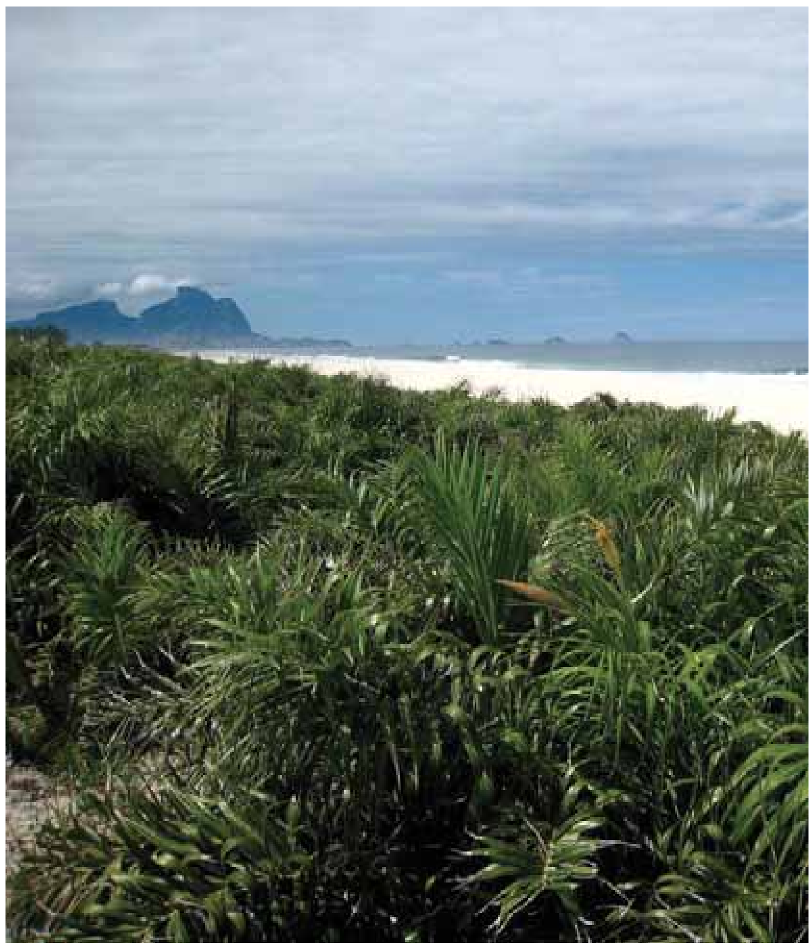

Allagoptera arenaria grows in the coastal dunes near Rio de Janeiro. Photo by John DeMott.

Those lucky enough to attend recent IPS biennials know that exciting destinations have become the norm, but the 2010 biennial meeting is shaping up to be the most exciting destination ever: Brazil.

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Brazil is home to a rich palm flora, spectacularly landscaped gardens and a handful of dedicated IPS members. Five years ago, when the IPS Board received a proposal from the Brazilian team to host a biennial meeting, the Board responded enthusiastically. Years of planning and organizing will culminate in the 2010 IPS Biennial in Rio de Janeiro, Brazil. This will mark the first occasion that the IPS has met in Brazil.

For this Biennial, which includes several tours of natural forests, Dr. Andrew Henderson is preparing a field guide to the palms of the state of Rio de Janeiro to assist participants in identifying the native palms seen on tours.

Brazil requires visas for citizens from the USA, Mexico and Australia, among others. All biennial participants should check with their travel agent for visa requirements.

Friday, 16 April 2010. The IPS Board members arrive on this day, one day ahead of most participants.

Day 1. Saturday, 17 April 2010. Arrival of the biennial meeting participants. Attendees will be arriving at the Rio de Janeiro International Airport and will be met by bilingual guides from OPCO Tours & Events, the official tour operator for the 2010 Biennial. Attendees will be shuttled to the Windsor Barra Hotel, located in front of Barra da Tijuca beach where *Allagoptera arenaria* (Fig. 1) occurs in its natural habitat. A welcoming dinner and social event will occur in the evening.

The Board meeting, which is open to all members of the IPS, will take place on Saturday, starting in the morning and finishing in the afternoon. At Board meetings, the directors make decisions on the management of the Society, future Biennial meeting sites, and disbursement of endowment fund grants.

Day 2. Sunday. 18 April 2010. Today begins the tours. Participants will travel in four air-conditioned coach buses. The full day will be devoted to tours of Boa Esperança ranch. the property of Jill Menzel, who has a real passion for plants and one of the most impressive gardens in the Rio de Janeiro area. The ranch is two hours from Rio de Janeiro.

Over the past six years, Jill has planted a large number of native and exotic palms on her ranch, and they have made incredible growth, but she also has preserved a large tract of Brazil's Atlantic Coastal Forest, an extremely fragmented and endangered ecosystem. Visitors to her ranch will have the rare opportunity to see the endangered Golden Lion Tamarin, which is native to the region and protected in the forest on the ranch. Palms indigenous to the area include *Attalea* (Fig. 2), *Astrocaryum*, *Bactris*, *Geonoma* and *Syagrus*

During the course of the day, each bus group will visit a commercial farm where *Bactris gasipaes* is cultivated for fruits. We shall see a demonstration of the uses of *Bactris* and have the opportunity to purchase products.

The afternoon will end with a Brazilian barbecue at the ranch. The buses will return all participants to the hotel.

Day 3. Monday, 19 April 2010. The buses will travel as two groups traveling in opposite directions. Group one will travel just thirty minutes from the hotel to the historic Botanical Garden of Rio de Janeiro; group two will proceed to Tijuca National Park (Parque Nacional da Tijuca). Both groups will enjoy a picnic lunch together at the park.

2. *Attalea humilis* is a small species from the Atlantic Coastal Forest. Photo by Andrew Henderson.

This garden, created in 1808, is known for its famous and much-photographed royal palms. Known as the Avenue of Royal Palms, the entrance is lined with a 134 soaring palm trees. The garden covers over 142 ha (350 acres), but only about 40% is cultivated. The remainder is natural forest. The garden is home to hundreds of palm species. The garden was also recognized by UNESCO as a Biosphere Reserve in 1992.

Tijuca National Park is just thirty minutes from the garden. The park surrounds the Corcovado Mountain (with its 30-m tall statue of Christ the Redeemer) and is the largest urban forest in the world. The 3238 ha (8000 acre) rainforest was once cleared for grow coffee, sugarcane and pasture, but from 1862 to 1874, thousands of trees – both native and exotic – were replanted. Over time, native species recolonized the land, and now the forest supports a rich community of native flora and fauna.

Many genera and species of palms can be seen in the forest, including *Attalea*, *Astrocaryum*, *Bactris*, *Geonoma* and *Syagrus*. Look for the very unusual *Bactris caryotifolia* (Fig. 3).

Day 4. Tuesday, 20 April 2010. The destination for this day is the home and garden of the famed artist and landscape designer Roberto Burle Marx. His famous Copacabana promenade mosaic, completed in 1970 on Rio de Janeiro beach, is now an icon of the city. His garden and home have been turned into a museum and cultural center since Burle Marx's death in 1994. Burle Marx is known for his bold use of color, abstract form and local materials, including palms, aroids and bromeliads, many collected by Burle Marx himself on field excursions to the surrounding forests.

Day 5. Wednesday, 21 April 2010. The day will be devoted to a tour of Serra dos Órgãos National Park, less than two hours from the hotel. The park protects some 11,000 ha (27,182 acres) of natural forest over a range of 200–2263 m elevation. This famous locality includes many palm species. It is notable for the diversity of *Geonoma*, and the aptly named *G. elegans* is common here. Look out for other poorly known species of *Geonoma* and especially for the elusive *Lytocaryum weddellianum*. The beautiful *Euterpe edulis* also occurs here. Other palms include species of *Bactris*, *Desmoncus* and *Syagrus*.

Day 6. Thursday, 22 April 2010. On this day, participants will have a chance to see and explore the Rio Tropical Islands. Just 1.5 hours south of the hotel, the islands, scattered across Sepetiba Bay, are renowned for their natural beauty. Tour boats will ferry participants to the islands, where guides will lead tours of the nature trails. We shall see many species here, starting with *Allagoptera arenaria* in the dunes. Look out especially for species of *Syagrus* (Fig. 4), as well as more *Geonoma* and possibly a few *Attalea* species (Fig. 5).

3. *Bactris caryotifolia* has distinctively shaped leaflets. Photo by Andrew Henderson.

Day 7. Friday, 23 April 2010. This day will be devoted to optional outings and activities (some activities may incur an extra charge). Participants can choose to spend the day by the pool, or enjoy shopping at local markets, snorkeling, city tours and local museums. All participants should plan to be back at the hotel for the farewell banquet, where we thank our local hosts, say our good-byes to friends old and new, and make plans for the 2012 Biennial.

Day 8. Saturday, 24 April 2010. Departure day. Airport shuttles from the hotel will be provided.

4 (above). *Syagrus oleracea* is a majestic palm in the wild. 5 (right). A lone *Attalea* towers over a pasture. Photos by John DeMott.

Optional tour packages are being organized for those wishing to extend their stay in Brazil. One, led by Dr. Andrew Henderson, will be his "Palms of the Amazon" eco-tour, which departs from Manaus, Brazil. This tour is scheduled as a pre-Biennial tour. Another option will be a pre-Biennial tour to see the palms of Uruguay. An additional tour of the famous Iguaçu Falls is also being arranged. The full details of these optional tours will be announced on-line as soon as the details can be finalized. Look for further details on the Biennial itinerary and optional pre- and post-Biennial tours in the next issue of PALMS and on the IPS website.

The Rio Biennial is a once-in-a-lifetime opportunity and not to be missed. Look for registration materials in the next issue of PALMS and on-line at www.palms.org. We look forward to seeing the IPS in Rio!

Trachycarpus takil – Lost and Found, for Now

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1. Some of the taller *Trachycarpus takil* remaining at Kalamuni. Note the open crown on the larger mature plant.

In the absence of evidence to the contrary, most people have long assumed that *Trachycarpus takil* is very similar in appearance to *T. fortunei*, with only subtle differences separating them. Having now – finally – tracked down the living trees in northern India, we discover that they are in fact very different, and easily distinguishable. We reveal how a 120 year old mistake has muddied the water and why confusion has reigned ever since.

In 1990 when Wilko Karmelk of Holland and one of us (M.G.) set off on the first of many trips investigating T*rachycarpus,* we did not know that the mystery we were about to uncover would not be finally solved until 15 years later. That first trip to check out *Trachycarpus takil* was to an area in northern India on the borders of Nepal and Tibet once known as the Kumaon District (now part of the newly created province Uttarakhand). In those days we were rather naïve and hardly knew what we were looking for, nor how we would recognize it if we found it. All we had to go on was the line from Beccari (1931) about the plant's occurrence on "Mt. Takil," at 2400 meters, where it "grows in damp oak forests in a region where snow covers the ground from November to March." The full story of this trip can be read in Principes (Gibbons 1993), but in summary, all we found on the mountain, correctly Mt. Thalkedar, were a couple of hundred young plants. All the adults had apparently been cut down for their trunk fibers, which were made into ropes. We did find one mature tree in a nearby village, but because of our hazy knowledge of the genus, wrongly assumed it to be *T. martianus*.

Not far from Mt. Thalkedar is the hill station of Naini Tal, used by the British early last century as a resort town away from the heat of the plains. In its streets and outside several prominent buildings such as the boat club we found many *Trachycarpus* — which at the time we assumed to be *T. fortunei* — but no more examples of any other *Trachycarpus* species. We were more confused than ever. In terms of shedding light on the subject, we found we, like Omar Khayyam's young philosopher, "came out by the same door wherein we went."

Since then we have been back to the area a few times, each time adding a little more to our store of knowledge about this elusive and mysterious species. Despite the gains, however, we felt there was some fundamental issue with which we could not get to grips; different plants with features that didn't quite match up. At one time we felt we had made a mistake in assuming the street trees in Naini Tal to be *T. fortunei*. Why should they be *T. fortunei* we reasoned, when *T. takil* grows (or at least grew) in the wild just a few miles distant? And yet we couldn't really claim to be able to identify any major differences between them and the familiar *T. fortunei*.

In another garden founded by the British and where many *Trachycarpus* are cultivated, the evidence appeared to point even more clearly towards *T. takil*. This garden is located in Chaubattia, near Ranikhet, somewhat north of Naini Tal, and is today a Government Apple Garden and Fruit Research Centre. Beccari (1931) wrote that Mr. G.B Osmaston, Conservator of Forests in Naini Tal, and Mr. E.A. Smythies, Assistant Conservator, "…supplied me with samples from plants cultivated in the Chaubattia Garden and brought there in 1877 from Badkot, 20 miles north of Chaubattia, where this palm was growing in a cool, moist valley…." At least one of the plentiful *Trachycarpus* found in the garden today could be old enough to be that very plant dug up in Badkot. It is a female plant, and, so we reasoned, the smaller specimens found everywhere in the garden, would most likely be its offspring and hence must all be *T. takil* (see also Singh et al. 1995, Kulkarni & Pawar 1996, Rana et al. 1996).

In truth, no author seemed particularly clear about the differences between *T. fortunei* and *T. takil*. Even Beccari, who described *T. takil* as a new species (Beccari 1905, 1920), was equivocal, admitting that many of the differences were, at best, slight. We were later to realize why. As evangelists for the genus, we were under pressure to come up with

2. *Trachycarpus fortunei* cultivated in Naini Tal, exhibiting the characteristic dense crown.

3. Straplike ligules of cultivated *Trachycarpus* in the Chaubattia Garden.

something definitive but were less confident than we probably sounded. Some of the features we came up with to tell *T. takil* apart were the asymmetrical base of the lamina (the "twisted hastula"), the brittle leaf sheath fibers and the creeping habit of the young trunk that Beccari (1931) mentioned. We even feared that the two species might have to be "lumped" into one before we could clear up the mystery.

It was obvious that the species in the wild was under threat. The "great numbers, forming clumps and rows, the trees rising from 30 to 50 feet high, each with its superb crown of large flabelliform leaves rattling loudly in the breeze" described by the discoverer of the species, Major Edward Madden, during his visit there in March 1847 (Madden 1853), had long since been cut down for the trunk fibers for rope-making. The locals did not understand that the fibers could be harvested for rope-making year after year, without the necessity of killing the trees. Would the palm become extinct before being properly classified?

On that first trip, in 1990, we had met a young scientist, Dr. Kholia, who was studying Indian ferns. Unbeknown to us, in the intervening years (and, he later explained, as a result of our visit) he had "converted" to palms and from time to time had done further research on *T. takil*. He emailed us in January 2005 to ask our opinion about it and over the course of the next few months he visited some known and some rumored locations of this species in the wild. His tantalizing, sometimes weekly bulletins persuaded us to plan a trip back to India to see if we could finally solve the mystery surrounding this palm, and we met up with him, after 15 years, in October 2005.

Over the course of the busy week that we spent with Dr. Kholia, the highlight was certainly visiting a small population of adults and seedlings. Kalamuni (or Kalimundi) is a steep limestone ridge above Gini Village in Pithoragarh District, over which a small pass road winds between the towns of Girigaon and Munsyari. While adjacent slopes have long been cleared of any forest, the Kalamuni ridge is still mostly covered by majestic *Cupressus torulosa*, large evergreen oaks and massive *Rhododendron* trees. Scattered among them on SW, W and N facing slopes around 2200 m a.s.l. were mostly juvenile *Trachycarpus* and some mature, reproducing trees (Fig. 1). The climate here is "warm temperate" with pleasant temperatures throughout the year, excepting the occasional cold spells during winter that may be accompanied by frost and even snow, although the latter would unlikely remain for more than a few days at a time at this altitude.

It was on seeing these trees (the first mature, wild *T. takil* that we had ever seen) that the differences between it and *T. fortunei* became apparent to us. Later we went back to the town of Naini Tal and realized that we had been correct the first time in identifying the street trees there as *T. fortunei* (Fig. 2). Alas, we learned the Indian authorities had apparently also assumed them to be *T. takil* and had collected seeds to plant back in the wild to buttress the flagging wild populations (Dr. Kholia, pers. comm.).

So what exactly are the differences? Beccari (1905) in his original description highlighted the difference between the ligules of the two species. The ligule is the exposed tip of the leaf sheath. It is the leaf sheaths that produce the distinctive fibers that clothe the trunk of *Trachycarpus* palms. In *T. fortunei*, the ligule is long and splits readily into narrow straps that form a rather untidy mass at the apex of the trunk (Fig. 3). In *T. takil*, the ligule is very short and shallowly triangular (Fig. 4), which results in a much tidier trunk apex and leaf sheath fibers that are tightly clasping. This is clearly different from *T. fortunei*, and actually more like *T. martianus*. Secondly, the crown of *T. takil* is much more "open" than that of *T. fortunei* due to the fact that there are far fewer leaves. One can see through the crown of the former while in the latter the leaves grow much more densely and the crown normally cannot be seen through. Once these two most apparent differences are clearly explained the species can be easily distinguished.

Beccari mentions the stem of young plants growing obliquely, a feature that has been much elaborated on subsequently. However, while young plants do indeed initially produce a creeping, often saxophone-shaped stem, this feature can also be observed in many *T. fortunei* and other *Trachycarpus* and may to some extent be caused by environmental factors. It is this same feature that we, and others, had observed on young plants grown from seed obtained in Naini Tal (*T. fortunei* as we now know) that had also contributed to our misidentification.

Despite usually being compared with *T. fortunei*, it seems that *T. takil* is most closely related to *T. oreophilus* (Stührk 2006), which we described from northern Thailand (Gibbons & Spanner 1997) (and of which we consider *T. ukhrulensis* [Lorek & Pradhan 2006] of northeast India synonymous). For this reason we include it here for comparison. Table 1 shows the main vegetative distinguishing features between *T. fortunei*, *T. takil* and *T. oreophilus*.

Beccari based his 1905 description on a male plant, which grew from seed sent to him in 1887 by Mr. J. F. Duthie, the superintendent of the Botanical Garden of Saharanpur, India. Beccari was a well-known botanist of his time who willingly gave palm seedlings to both botanical and private gardens (S. Quercellini, pers. comm.). There is no record of what happened to the other seeds, although we do know that there were at one time several *T.*

4. Short, triangular ligules on *Trachycarpus takil* at Kalamuni.

Table 1. *Trachycarps fortunei*. *T. takil* and *T. oreophilus* compared.

	T. fortunei	*T. takil*	*T. oreophilus*
Diameter of woody trunk	10–25 cm	(15–)20–25 cm	10–16 cm
Number of live leaves	to 100	ca. 20	ca. 20
Leaf sheath appendage (ligule)	long, ribbon-like	short, triangular	individual fibers not forming a ligule
Hastula	ca. 1.5 cm	1–2.5 cm	1–3 cm
Leaf blade width	95–110 cm	100–120 cm	ca. 100 cm
Abaxial leaf blade colour	pale, slightly waxy	pale bluish, strongly waxy	pale, slightly to strongly waxy
Leaf blade segmentation	irregular for ca. 3/4	irregular to regular for more than 1/2–3/4	regular for more than 1/2
Segment number	40–51	45–62	55–70
Segment width	3–4 cm	3–5.5 cm	2.5–4 cm
Central segment length	55–80(–90) cm	67–78 cm	58–70
Embryo	back of seed	side of seed	back of seed
Eophyll	ca. 10 cm long, 4-plicate	ca. 10 cm long 2-plicate	ca. 15 cm long, 2-plicate

takil growing in both Rome and Florence, a few of which remain to this day.

There is an old specimen at the Botanic Garden in Rome, recorded as being there in 1897 in a directory by P. R. Pirotta, the first Director, and there are a few in the grounds of La Sapienza University. Though their provenance is unknown, it is not impossible that they are the same as Beccari's palm. We are indebted to Dr. Sergio Quercellini and his research of *T. takil* for this valuable information.

Major Madden also distributed seeds to several of the leading nurseries of his day in Ireland and the U.K. (Morley 1972) so it is possible that some of these still survive, though there are no records.

Beccari's description of the female inflorescence and flowers was drawn from samples sent to him by Messrs. Smythies and Osmaston, Conservator and Assistant Conservator of Forests in Naini Tal, which came from plants cultivated in the Chaubattia Garden, not far from Naini Tal. As pointed out earlier, all the palms there have turned out to be *T. fortunei*; there are no *T. takil* present. Beccari's description of the female inflorescence is equivocal: "spadices very similar in every respect to *T. excelsa* (*fortunei*)," "flowers a trifle large," etc. Having seen the trees (or their descendents) from which those flowers may have come, we propose the explanation that Beccari may have been sent samples not of *T. takil* but of *T. fortunei* and unwittingly based his description on them. We feel it is no coincidence that the trees in both Naini Tal town and Chaubattia Garden are *T. fortunei* especially when one takes into account Messrs. Osmaston and Smythies' connections with both.

We are aware of a few cultivated examples of *T. takil* in India, at Munsyari, Kausani, and Barabe (on Mt. Thalkedar). Further, we saw a tree in the Lakeside Gardens in Shillong (Meghalaya), which could well be the same species.

In cultivated plants, it seems that once the growth of a trunk sets in, yearly growth rates are around 25 cm or more. In older, tall trees, growth apparently slows considerably and internodes become very short. It is worth noting that tall, old plants usually attain a larger crown with wider leaves that hold considerably more and wider segments. The establishing phase of young plants appears to be quite slow. Some cultivated plants in Italy retain a massive skirt of dead leaves, a feature not observed on mature trees in the wild or in cultivation in India. Climatic conditions could play a role here as well as brush fires. In general, plants in cultivation present a slightly more robust habit.

It would be an interesting project to record and identify the several trees in Rome and Florence. Lorek (2006, 2007) attempted an inventory of the plants in Beccari's garden in Florence, but we feel with misleading results. Morici (2008) claimed that all *T. takil* in the garden have perished but, like Lorek, overlooked a mistake in an unpublished paper by Cellai Ciuffi et al. (1999) that misidentified a palm that perished in the harsh winter of 1985 (clearly a *Washingtonia*) as *T. takil*.

We strongly suspect that most if not all other plants labeled "*T. takil*" in cultivation around the world are, in fact, *T. fortunei* or, in some cases, *T.wagnerianus* (Stähler & Spanner 2007).

There has been considerable discussion on the status of this species (Singh et al. 1995, Kulkarni & Pawar 1996, Rana et al. 1995, 1996, Husain & Garg 2004, Gibbons et al. 2008). In the wild, we are aware of just three populations of *T. takil*, two of which contain only juveniles, the third with several adults and many juveniles. Recently there have been reports and photographs of a larger population of wild trees in the general area of the small population we saw at Kalamuni (Riphagen, pers. comm.). This is exciting indeed and perhaps worthy of a trip to check it out. It is not unlikely that there are other, unknown, populations in more remote areas, perhaps even over the close-by border in Nepal, but this is purely speculative.

Nevertheless, *T. takil* must be considered threatened (IUCN 2001) and its future seems in serious doubt, it having gone from "great numbers" to extreme rarity in a little over a hundred years. Serious efforts should be made by the authorities in India to conserve those trees that are left. This should begin with an understanding of the clear differences between it and *T. fortunei*, followed by the removal of all *T. fortunei* seedlings that have apparently been transplanted into the wild. These efforts should also include the controlled collection of seeds from wild populations for cultivation and perhaps an eventual re-introduction into the wild. Finally, it is crucial to gain the support of villagers local to where *T. takil* clings on in the wild in an effort to prevent any more trees from being cut down. Dr. Kholia has first hand experience of this destruction; he has monitored the young plants on Mt. Thalkedar, watched them grow over a period of several years to around 50 cm of trunk, and then seen them cut down for their few pitiful fibers. Harvest not destroy! If provision of free rope would take the pressure off, we are confident that there are a number of individuals and palm societies who would be delighted to contribute funds.

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Genera Palmarum 2 Wins Award

In early May, the Council on Botanical and Horticultural Libraries announced that *Genera Palmarum: the Evolution and Classification of Palms*, published by the Royal Botanic Gardens Kew in association with the IPS and the LH Bailey Hortorium had been given the 2009 Annual Literature Award. The award recognizes both the authors and the publisher of a work that makes a significant contribution to the literature of botany and horticulture. *GP2* has won the Technical Category. Larry Currie, Librarian of the California Academy of Sciences Library noted that "the high production quality of this book, coupled with the comprehensive coverage of the subject, will certainly make this the standard reference on palms for many years to come."

Copies of this award-winning reference book are available from the IPS website, www.palms.org.