Palms

Journal of the International Palm Society Vol. 48(1) March 2004

THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

Founder: Dent Smith

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FRONT COVER

Nannorrhops ritchieana, Jebel Akhdhar, Oman. See article by J. Dransfield, p. 30. (Photo: J. Dransfield)

Palms (formerly PRINCIPES)

Journal of The International Palm Society

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

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

Annual membership dues of US$35.00 for Individuals and US$45.00 for Families include a subscription to the Journal. Subscription price is US$40.00 per year to libraries and institutions. Dues include mailing of the Journal by airlift service to addresses outside the USA. Single copies are US$15.00 each, US$48.00 a volume, postpaid surface delivery in the USA. Add US$2.00 per issue for delivery to addresses outside the USA, or add US$5.00 per issue for faster delivery via airmail.

Periodical postage paid at Lawrence, KS, USA.

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

PALMS (ISSN 1523-4495)

Mailed at Lawrence, Kansas March 22, 2004

This publication is printed on acid-free paper.

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Hyphaene guineensis growing at Sette Cama, Gabon. See article by Valkenburg and Dransfield, p. 10. (Photo: J. van Valkenburg)

NEWS FROM THE WORLD OF PALMS

Dies Palmarum, the Third European Palm Biennial, was hosted by the Comune di Sanremo, Italy, in early December, 2003. The event brought together speakers and participants from Italy, France, Spain, Morocco, the UK, and the USA for a truly memorable three days of spirited presentations, discussions and tours. Pleasant weather, good food and lively company framed the lectures, which centered around the theme "Insects and Palms." Several speakers addressed the very serious threat posed in Europe by the recently introduced moth, *Paysandisia archon* (see PALMS 47: 179–184. 2002). The threat to both native and exotic palms continues unabated but not unnoticed by both palm growers and entomologists. Insect pests and their management through pesticides, biological controls and horticultural practices were a recurring thread. There is great interest in finding integrated solutions to the pest problems of commercial and ornamental palms.

Not all insects are pests, and two speakers addressed the symbiotic relationships between ants and certain rattans. The fascinating story of pollination in Europe's *Chamaerops humilis* was told to a rapt audience. Other speakers addressed the natural chemical defenses of palms, the use of DNA markers to characterize date palm cultivars and the Convention on Biological Diversity and its impact on palms and palm growers.

The event also marked the publication debut of a new book, *La Potatura delle Palme Ornamentali – Biologia, Ecologia e Gestione*, by B. Moya Sanches, J. Plumed Sancho and C. Littardi. This book is the most up-to-date and comprehensive book on palm horticulture available in Italian and will surely be of tremendous value to horticulturists in the Mediterranean region. The authors are to be congratulated on producing such an important book.

On the third day of the meeting, participants enjoyed a visit to the beautiful gardens of the Villa Hanbury.

Dies Palmarum was organized by IPS member Claudio Littardi, President of the Centro Studi e Ricerche per le Palme, to whom the palm community owes its thanks for his outstanding work on behalf of palm growers and palm biologists worldwide.

Co-Editor Dr. John Dransfield has been awarded the Linnean Medal for Botany by the Linnean Society of London. The medal honors John's contributions to botany, especially tropical botany and the study of palms. Among John's many achievements recounted in the nomination are John's many years of dedicated service to the IPS. The Linnean Medal is one of botany's highest honors, and John's friends and colleagues join together in congratulating him on achieving the prestigious recognition of the Linnean Society.

Plans for the 2004 Biennial in Hawaii are well in hand. The event promises to be an exciting opportunity to see some of the world's finest palm collections and private gardens, to tour Hawaii's spectacular natural areas, to hear presentations from top palm experts from around the world and to meet fellow palm lovers from among the IPS membership. We especially encourage those who have never attended a Biennial to come to Hawaii for this one. We look forward to seeing old friends and making new ones. Aloha!

THE EDITORS

A New Locality for *Marojejya darianii* in Madagascar

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1. A mature individual of *Marojejya darianii* at Iketra. (Photo: J. Dransfield)

Marojejya darianii **has been discovered in a new locality in the Betampona Reserve in Madagascar, over 250 km from the type locality.**

The impressive, entire-leafed palm, *Marojejya darianii* J. Dransf. & N.W. Uhl (Arecaceae, Arecoideae, Areceae, Masoalinae), was first discovered in 1983 (Dransfield & Uhl 1994). The type locality for this species is a small upland swamp in a valley bottom (altitude 400 m) near to the village of Sahavary at the northern end of the Masoala peninsula in north-eastern Madagascar. Another two populations were discovered by Philip Guillery of Projet Masoala near to Iketra (Fig. 1), also on the Masoala peninsula (J. Dransfield, pers. comm.). This paper gives notice of the discovery of a further population of *M. darianii* in the Réserve Naturelle Intégrale No. 1, Betampona, around 40km north-west of the city of Toamasina. This site is more than 250 km south of the type locality. Herbarium specimens were collected from this new population in March 2003 and their identity as *M. darianii* was confirmed by John Dransfield. The conservation status of *M. darianii* is rated as critical (Dransfield & Beentje 1995). The chances for the survival of this unique and magnificent palm have been considerably strengthened by the discovery of a further small population within a protected area.

History of the discovery

The first author became aware of the possible occurrence of *M. darianii* in the Betampona Reserve in December 2001. One of the ANGAP (l'Association Nationale pour la Gestion des Aires Protegées) conservation agents for Betampona, Didier Tsilanizara, had previously (about a year earlier) mentioned sighting a strange palm in the reserve that he had seen nowhere else. At the time no description was forthcoming. However, in December 2001 Didier was examining the Madagascar Fauna Group's copy of *The Palms of Madagascar* (Dransfield & Beentje, 1995) and declared "Voila l'espèce de palmier que j'ai trouvé". The species in question was *M. darianii*. Despite the first author's great excitement and urgent desire to confirm this, the Christmas and New Year holiday intervened. Finally on the 9th of January 2002 the site was visited by a joint MFG/ANGAP team and the occurrence of *M. darianii* was confirmed.

Description of Habitat

All specimens of *M. darianii* were located within an area of approximately 2 ha at an altitude of 290 m. The terrain was flat, which is very unusual at Betampona! Plants were observed close to a very small brook (less than 50 cm in width) and a larger stream (approx. 2 m in width). No plants were observed growing more than 10 m from water.

2. A mature individual of *M. darianii* at Betampona. (Photo: A. Britt)

One mature specimen and numerous young plants grew right at the stream edge and would presumably be submerged at the base during heavy rainfall. A further young plant was found growing in the middle of the small brook.

The surrounding vegetation was slightly degraded primary rain forest, at the edge of more intact forest, with a mean canopy height of 10–15 m. Several large specimens of the distichous palm, *Orania trispatha*, were observed in the same area. Soil was peaty and moist. Several young plants were observed growing amongst scrubby vegetation on previously cleared land (*savoka*) at the forest edge, and the remains of the trunk of a mature tree, which had been recently felled, were discovered in the same vegetation type.

At Iketra this species similarly occurs on flat terrain, but in very narrow valley bottoms (J. Dransfield, pers. obs.). At the type locality it occurs in a peaty swamp on flat terrain in a broad valley bottom (Dransfield & Beentje 1995).

The Conservation status of *Marojejya darianii* — *Adam Britt and John Dransfield*

At present *Marojejya darianii* is known from four confirmed localities.

1. The type locality near Sahavary at the northern end of the Masoala Peninsula. Here the palm occurs in a population estimated in 1986 to consist of 50 mature individuals growing in an upland swamp.

2. and 3. Iketra on the eastern side of the Masoala Peninsula, two colonies discovered by Philip Guillery and his colleagues from Projet Masoala and visited by JD in 1996, one beside the path between Sahamalaza and Tanany Fred consisting of a few immature and two mature individuals (this outside the boundary of the Masoala National Park), and the other about one and a quarter hours direct walk west of Tanany Fred consisting of many (20+) mature individuals and an abundance of juveniles and seedlings (this within the Masoala National Park). Both localities are in flat but narrow valley bottoms. In the second locality in 1996 there had been cutting for palm heart, said to be at least a year and a half previously, but these individuals could have been more recently felled. The second locality seemed pretty remote, yet the palm is known to villagers and has been cut.

4. The newly discovered population in Betampona. Besides these four confirmed localities there have been other unconfirmed sightings. Two students from Université d'Antananarivo who had visited the large and mostly botanically unexplored reserve Ambatovaky inland from Soanierana-Ivongo in 1999 claimed to JD to have seen a colony of *Marojejya darianii*. JD and Bill Baker from Kew saw no sign of it on their visit to the reserve in 1999, but the reserve is very large and they visited only the southern margin. There are also unconfirmed reports of a locality near Toamasina, mentioned in Dransfield & Beentje (1996). Now that we know that the leaf in mature *M. darianii* is distally irregularly pinnate in some populations, the most reliable diagnostic character is the grooved seed (smooth in *M. insignis*). It is possible that such irregularly pinnate leaved populations of *M. darianii* may have been overlooked. For example, in Palms of Madagascar (Dransfield & Beentje 1996) a juvenile irregularly pinnate-leaved palm was illustrated as '*kona be*' from a valley bottom swamp in the Mananara-Avaratra Biosphere Reserve. We now strongly suspect that this is *Marojejya darianii*.

Of the confirmed localities of this palm, three are within protected areas, the fourth (one of the Iketra populations) not so. Using IUCN Red List Categories and Criteria Version 3.1 (IUCN 2001) we suggest that the conservation status of *Marojejya darianii* should be classified as Critically Endangered. This judgment is based upon its extent of occurrence being estimated at less than 100 km^2, with severe fragmentation, evidence of a continuing decline in the number of mature individuals and a population size estimated at fewer than 250 mature individuals with no sub-population estimated to contain more than 50 mature individuals.

Description of specimens

A total of eight mature sized trees were located and examined. Fig. 2 clearly illustrates the conspicuous pointed auricles on the leaf sheaths (Dransfield & Uhl 1984). However, this small population at Betampona differs from specimens on the Masoala peninsula in that the leaves are both basally and distally irregularly pinnate (Fig. 2). In contrast specimens from the Masoala have leaves which are entire with the exception of the distal portion which is irregularly pinnate. Six of the eight trees were in fruit in January 2002. Fruit grows in multiple clusters attached to one or two large interfoliar infructescences. The fruit of five of these trees was green. Dransfield & Beentje (1995) state that the fruit of *M. darianii* is pink when young, turning green and then red. The fruit of the sixth tree was a rusty brown colour. The seeds of fruits collected from this tree were not yet fully formed. One tree was observed with two dead staminate inflorescences, but the remaining specimens were sterile. In March 2003 only one tree was in fruit, the remainder were sterile. The fruits were red in colour (Figs. 3 & 4) and contained seed that was approaching maturity, showing the characteristic deep, broad, mainly longitudinal grooves.

A mean trunk height of 8.75 m was recorded (range: 6–10 m, n = 8), with a crown height estimated at roughly 2 m. The number of leaves in the crown ranged from 18–24. Dead leaves remained attached, hanging downward at the distal part of the trunk. A mean trunk diameter at breast height of 30.0 cm was recorded (range: 26.5–36.5 cm, n = 8). A strangling fig (*Ficus lutea*) was growing on one specimen. The same mature tree growing right at a stream edge had a bulbous trunk base with surface roots. More than 50 young

3 (above). *M. darianii* in fruit at Betampona. 4 (below). *M. darianii* individual fruit cluster. (Photos: A. Britt)

plants were growing in the immediate area, ranging from two-leafed seedlings to plants with mature sized leaves but no trunk (Figs 5 & 6).

Conservation action

One suggestion to improve the conservation of *M. darianii* at Betampona is to transplant seedlings from the current known population to other areas of similar habitat type within the reserve. The presence of *Orania trispatha* could perhaps indicate habitat of suitable quality. It is recommended that research into the feasibility of such a scheme be initiated immediately.

While it is possible that other populations of *M. darianii* may be awaiting discovery at Betampona, the evidence suggests that this palm has very specific habitat requirements and that its distribution is naturally extremely localized. On showing photographs of this species to local people, no-one claimed ever to have seen it. The local name on the Masoala peninsula is "Ravimbe" meaning "big-leaf," but no local name was forthcoming in the Betampona region. It is extremely gratifying to have found *M. darianii* at Betampona, but the small size of the population and the area of occurrence make it extremely vulnerable. The propagation of this palm as part of the proposed living palm collection at the MFGs Parc Ivoloina is strongly recommended.

5 (above). *M. darianii* seedlings at Betampona growing at the edge of a stream. 6 (below, right). *M. darianii* at Betampona with mature-sized leaves but no trunk. (Photos: A. Britt)

Acknowledgments

The authors gratefully acknowledge the support of both ANGAP and the MFG, enabling them to work at Betampona and make this discovery. Special thanks to Didier Tsilanizara (ANGAP, Fontsimavo) for locating this population and to the following who participated in the collection of herbarium material: Jean-Nöel, Razafy Celestin, Razanadahy Arsene (all MFG) and Hanta Vololona Razafindraibe (Parc Botanique et Zoologique de Tsimbazaza). Without the efforts of John Dransfield and Henk Beentje in producing *The Palms of Madagascar*, *Marojejya darianii* would likely have remained undiscovered at Betampona — many thanks!

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Dransfield, J. and H. Beentje. 1995. The Palms of Madagascar. Royal Botanic Gardens, Kew and the International Palm Society.

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Hyphaene guineensis

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1. Regenerating uneven-aged stand *Hyphaene guineensis* in coastal forest.

The subject of this paper is a handsome, easily identified species of *Hyphaene*, *H. guineensis*, which, despite its very distinctive habitat and habit, has remained rather poorly known since its first description in 1827.

The present story started with one of us (JD) watching a television film "Wild Africa" on the BBC in Britain. At one point the film showed elephants and wild pigs feeding on *Borassus* fruits on the shores of the Atlantic in Gabon. Behind the elephants was a wall of tall unbranched fan palms and the beach seemed carpeted with fallen fruits. Despite being identified in the commentary as *Borassus*, the palm trees were clearly not *Borassus aethiopum* and the fruits similarly did not belong

to this species. The fruit obviously belonged to *Hyphaene*. The unbranched trunks suggested that the palm was *H. petersiana*, but the fruit were the wrong shape for that species; furthermore, *H. petersiana* seems to be a palm of alkaline semi-waterlogged soils in inland southern Africa rather than along the coast. JD had a hunch that the palm was probably the poorly known *H. guineensis*, described in 1827 from the West African coast in Gold Coast (Ghana), and a palm that seems to have been forgotten in most local floras. The day after the screening of "Wild Africa," JD's student, Ross Bayton, who is monographing *Borassus*, came into Kew saying "Did you see the program last night? – that wasn't *Borassus*, was it?" Then JvV was appointed to the position of Head of the Herbarium at Libreville in Gabon, and JD alerted him to the possible presence of an interesting and distinctive palm. Shortly after reaching Gabon, JvV was in the field on the Atlantic Coast. At the first boat stop of his trip to the Loango National Park at Sette Cama, he found just what he hoped he would find (Back Cover). No mistake was possible – the numerous stands of 20 m tall fan palms in the National Park were the very species he was looking for (Figs. 1, 2). However, 20 m tall palms are somewhat complicated to collect and it was not until he found an individual flowering and fruiting while still only 8 m tall that he was able to make good collections. These were dried and distributed to the National Herbarium in Libreville, to the National Herbarium of the Netherlands in Wageningen, to Kew and several other herbaria. In Kew they were subsequently matched up with the neotype of *Hyphaene guineensis*.

The history of *Hyphaene* taxonomy

Hyphaene is a seriously over-described palm genus, with well over 90 names published at one time or another. Yet in the field in tropical Africa in a given locality it is often possible to recognize one or two distinct forms of *Hyphaene* that can easily be designated as species. It is finding the correct name for these species that proves to be challenging. The over-description of *Hyphaene* species is almost certainly a result of the way in which material of the genus reached European botanists. Furthermore, most of the botanists who described species in *Hyphaene* had no field experience and so were unaware of the plasticity of fruit form. *Hyphaene* is a prominent feature of many of the drier landscapes in Africa and early travelers could not fail to be impressed by the living palms that often displayed spectacular dichotomous branching and were so important in the local economy. It is thus not surprising that fragments of *Hyphaene* palms soon reached European herbaria. The genus was first described and named based on a single fruit of *Hyphaene coriacea* Gaertn. from coastal Kenya. Subsequent collections of the genus were often very incomplete, and botanists were forced to account for the variation in fruit form by describing ever more species (Beccari 1924). This was compounded further when fruits of *Hyphaene* reached Europe as samples for the vegetable ivory trade for button manufacturing. Eventually, over 90 names were published in the genus. So variable is fruit form that it is sometimes possible in the field to find examples of several "species" within the same infructescence. After fieldwork in East Africa it was possible to reduce the number of names in *Hyphaene* in the region from 75 to three (Dransfield 1986). Broad ranges of fruit form are linked with significant habit differences and the current concept of three variable taxa does seem to work for the most part in East Africa.

The research on *Hyphaene* for the Flora of Tropical East Africa also involved looking at the genus throughout the continent of Africa. Based on the concepts of variation in East African *Hyphaene* it was possible to make suggestions of how many taxa there might be elsewhere in Africa, but for lack of new field information it was felt that a full monograph was premature.

Now that we have excellent material of *Hyphaene* from West Africa we can sort out the identity of *Hyphaene guineensis*, leaving the *Hyphaene* spp of the Horn of Africa as the last major problem in the genus.

The confusion surrounding *Hyphaene guineensis*

Confusion in the botanical literature concerning the identity of *Hyphaene guineensis* as described by Thonning has led to an immense entanglement of names and misinterpreted identities. An elaborate account is given by Furtado (1970). The problem is partially caused by the loss of Thonning's type specimen and the subsequent denial of the presence of *Hyphaene* in lowland humid regions of West Africa. All this ignores the detailed account in the report of the German Loango expedition, where Guessfeldt (1879) and Peschuel-Loesche (1882) clearly mentioned the occurrence of *H. guineensis*, an erect, unbranched, single-stemmed fan palm that grows either alone or in open groups, or in extensive groves in sandy places along the sea-coast and never occurs in forest (fig. 3). The palm is reported to occur from the eastern part of Liberia eastward to the Niger delta and southward to Angola at 9º08' S at Barra de Cuanza (*Bamps et al. 4642* in BR). Subsequent requests from Furtado for material resulted in fruit

This page: 2 (top). Even-aged stand of *Hyphaene guineensis* at 'Jardin des Elephants,' Gabon. 3 (bottom). Juvenile at the seaward fringe of the beach vegetation.

Facing page: 4 (upper left). Stem covered in petiole bases. 5 (upper right). View of the crown showing young and old infructescences. 6 (lower left). Costapalmate leaf as seen from below. 7 (lower right). Carpet of fruits and seedlings at 'Jardin des Elephants.'

collections from a single-stemmed *Hyphaene* from coastal Ghana, whence *H. guineensis* was first described by Thonning. This allowed Furtado to assign a neotype and confirmed the coastal habitat of Thonning's *H. guineensis*. The remaining overrated importance of aberrant fruit forms still obscured the true identity of *H. guineensis*.

The newly collected material of *Hyphaene* in Gabon has allowed us to assess the type specimens of several names in *Hyphaene* and we are now able to circumscribe *H. guineensis* and to show how it can be distinguished from other species in the genus. Because it has such an unusual habitat and seems confined to a rather precise geographical area where other species of *Hyphaene* are unknown, there should be no difficulty in identifying it in the field.

Hyphaene guineensis Schumach. & Thonn., in H.C.F. Schumacher, Beskr. Guin. Pl.: 445. 1827. *Chamaeriphes guineensis* (Schumach. & Thonn.) Kuntze, Rev. Gen. Pl. 2: 728.1891. Neotype: West Africa: Ghana, loc. incert., *Colonial & Indian Exhibition of 1886 No. 92* (K) (see Furtado 1970).

Hyphaene depressa Becc., Palme Borass.: 48. 1924. Type: Congo River, *Naumann s.n.* (Holotype B†; drawing in FI), **synon. nov**.

Hyphaene mateba Becc., Palme Borass.: 47. 1924. Type: Angola, Benguela, *Gossweiler s.n.* (Holotype FI), **synon. nov.**

?*Hyphaene nephrocarpa* Becc., Palme Borass.: 48. 1924. Type: Congo, *fruit received from Colonial Museum, Marseille* (Holotype FI).

Hyphaene doreyi Furtado, Trab. Centro Bot. Junta Invest. Ultramar 15: 451. 1967. Type: Angola, Luanda, Caxito, *d'Orey 3* (Holotype LISC), **synon. nov.**

Hyphaene gossweileri Furtado, Trab. Centro Bot. Junta Invest. Ultramar 15: 452. 1967. Type: Angola, Luanda, Pangila, *Gossweiler s.n. A* (Holotype LISJC), **synon. nov.**

Hyphaene welwitschii Furtado, Trab. Centro Bot. Junta Invest. Ultramar 15: 459. 1967. Type: Angola, *Gossweiler s.n.* (Holotype LISJC), **synon. nov.**

Solitary dioecious pleonanthic tree palm; stems 6–20 m tall, very rarely branched (see illustration in Guessfeldt 1879, description in Pechuel-Loesche 1882) ca. 20–40 cm diam., covered with a lattice of old leaf bases (Fig. 4), later becoming bare, closely ringed with slightly raised leaf scars. Leaves induplicate, costapalmate (Fig. 6), marcescent, later abscising under their own weight, sheath soon becoming open, densely tomentose, later with a conspicuous triangular cleft below the petiole, margins fibrous; petiole robust up to 150 cm long, adaxially channelled, abaxially rounded with central dark bands, young parts covered with pale brown indumentum, the margins armed with robust triangular upward or downward pointed spines, adaxial hastula sometimes symmetrical sometimes oblique, erose, fringed, the prominent costa arching downwards, blade up to 180 cm long, ca. 200 cm wide, the segments up to 110 cm long, divided up to 2/3 their length, interfold filaments conspicuous, blade surface slightly glaucous, waxy, bearing minute dot-like scales and caducous indumentum particularly along the ribs. Staminate inflorescences interfoliar, branched to 2 orders, rachis up to 120 cm long, stalks waxy, covered in caducous rufous tomentum intermixed with stellate hairs; rachillae (Fig. 8) solitary or 2–5 together, up to 50 cm long, ca. 1.5 cm diam.; bracts on rachis silvery outside densely covered with red brown tomentum; bracts of the rachillae blackish brown with a red-brown fringe, densely stellate hairy (exposed upon drying). Staminate flowers with sepals imbricate, 2.5–3 × 1–1.5 mm, narrowly obovate with a rounded apex; corolla bright green, the tube ca. 2 mm high, the lobes 2–2.5 × 1.2–1.5 mm, spathulate and hooded; stamens with filaments pale yellow, connate by their fleshy bases, anthers yellow, dorsifixed, versatile. Pistillate inflorescences (Fig. 5) interfoliar, branched to 2 orders; rachis up to 100 cm long, stalks waxy, covered in caducous rufous tomentum intermixed with stellate hairs; rachillae solitary or 2–3 together, up to 35 cm long, 1–1.5 cm diam.; bracts on rachis silvery outside densely covered with red brown tomentum; rachilla bracts blackish brown with a red-brown fringe below the tepals, densely stellate hairy (exposed upon drying). Pistillate flowers only buds and young fruits observed. Fruit obliquely depressed, obovate/pyriform, flattened at the apex, rounded or obtusely trigonous (Fig. 9), 5–6.5. cm high, 6–7 cm diam., epicarp shining bright orange to red-brown, pitted; mesocarp fibrous; endocarp hard woody and fibrous. Seed irregularly shaped roughly following the outline of the fruit, up to 3 cm diam.; endosperm homogenous with a central hollow.

SPECIMENS EXAMINED: GHANA, loc. incert. (Colonial & Indian Exhibition of 1886 No. 92 (K, P) neotype; Tema Paradise Beach, March 1968, *Hossain GC 37578* (K). GABON. Ogoouè-Maritime, Petit Loango National Park, Oct 2002, *Van Valkenburg & Thomas 2500, 2501, 2502* (K, LBV, MO, P, WAG); Iguela, May 2003, *Van Valkenburg 2512*(K, LBV, MO, P, WAG); between Gamba and Sette Cama, March 2003, *Thomas s.n.* (K, LBV, WAG); between Gamba and Sette Cama (Jardin des Elephants), June 2003, *Van Valkenburg 2513, 2514*. (K, LBV, MO, P, WAG); Sette Cama, 1894,

Dybowski s.n. (F6710 in carpological collections) (P). CONGO (BRAZZAVILLE). Kouilou, Pointe-Noire, June 1989, *Dechamps 13086* (BR). CONGO (KINSHASA). Bas-Congo, Ile du fleuve Congo downstream from Boma, July 1913, *Bequaert 516* (BR); Kanga, Jan 1949, *Donis 2380* (BR),Vista, Sept 1953; *Wagemans 610* (BR, K), Aug 1956, *Dubois 1551* (BR); Luki, April 1971, *De Troch 2* (BR). ANGOLA. Luanda, near Bengo and Dande river, *Welwitsch 6* (K); *Gossweiler 9778* (K); *Gossweiler 42-1902* (K); ?*Gossweiler 161-02* (K); Barra do Cuanza, April 1973, *Bamps et al. 4642* (BR).

LOCAL NAMES: GABON: Doum (Gamba, Sette Cama). CONGO (KINSHASA): N'teva (Kikongo), Mateba (Moansa-Vista). ANGOLA: Ngunza (Cabinda).

USES: Traditionally the leaf segments were used for making coarse bags (for packaging peanuts and oil palm nuts) in Angola and Congo.

Notes

Occurrence in Gabon

Apart from some odd individuals up to 10 km south of Port Gentil, the species occurs from Iguela (1º 54´S) southward in appropriate habitats. It can be found alone in scrub or forest and can be encountered as single aged stands, or even in an open row parallel to the coast as if planted (Fig. 2). Regenerating uneven aged stands appear to be somewhat limited (Fig. 1).

In Gabon so far, *H. guineensis* is reported from sandy soils near the sea subject to saline influences. From 20 m inland from the high tide level on sandbanks up to 100 m inland in mixed relatively open coastal forest with *Manilkara*, *Phoenix reclinata* and *Zingiberaceae*. Photographs and drawings from Congo and Angola show *H. guineensis* in coastal tall grass savannah habitat.

Ecology

Pechuel-Loesche (1882) noted that *H. guineensis* can survive savannah fires without lasting effects; the crown may be completely burned but recovers in six months.

Predation and dispersal

The fruits are a preferred food of elephant, buffalo, pigs and apes. The large mammals are reported to wander about in the vicinity of fruiting groves during the major fruiting season in March–April. The ground underneath the palms tends to be trampled, and elephants are reported to bump into the trees to make the fruits fall. In areas with high densities of buffalo and pigs (such as Loango National Park) the vegetation underneath the even-aged, often senescent stands of *Hyphaene* resembles a closely cropped lawn with old fruits scattered and seedlings up to a 2-leaf stage only (Fig. 7). In areas where hunting and poaching have resulted in a decrease in buffalo and pig, and in stands near human settlements, *Hyphaene* regeneration is abundant. Coconuts tend to disappear soon after human settlements have been abandoned, whereas *Hyphaene* persists.

Fresh fruits have a fruity fragrance, resembling ripe pineapple or by some described as smelling of gingerbread. No sign of fruits in elephant dung could be found, so it is not clear whether elephants merely nibble at the fruits and spit them out or swallow them after munching. Obviously it is the fibrous mesocarp that is consumed; the very hard endosperm of various *Hyphaene*, enclosed in the thick woody endocarp, was formerly used as palm ivory (Fig. 4).

Germination

Like all other members of the tribe Borasseae, *H. guineensis* has remote germination. During germination the young seedling is pushed down as far as 30 cm and 2-leaf stage seedlings dug up had roots over 50 cm long. This may well be an adaptation to the relatively dry habitat. Germination trials at Kew showed two out of five seeds germinating after 75 days.

Additional name

Hyphaene luandensis Gossw. (Bol. Serv. Agric. Comerc. Coloniz. Forest. 1935: 77. 1935) published without description and hence a nomen nudum without botanical standing, almost certainly refers to *H. guineensis*.

Acknowledgments

We thank the keepers of the herbaria at Florence, Meise and Paris for allowing us to consult their collections and the librarians at the National History Museum, London and at Meise for much help in the tracing of obscure literature. Dr. Pauwels at Meise is gratefully acknowledged for sharing his field experience of Congo (Kinshasa). JvV thanks the staff of WWF at Gamba, Gabon, for logistic support and for sharing their field knowledge.

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8 (top). Detail of male inflor-escence showing rachillae and flowers. 9 (bottom). Fruits, outward appearance, cut to show mesocarp, endocarp and endosperm; and old decayed fruits showing endocarp structure/texture.

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Liberty Hyde Bailey: Pioneer of Palm Systematics

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1. Liberty Hyde Bailey surveying the ocean among the coconut palms. All photographs courtesy of the Bailey Hortorium.

Liberty Hyde Bailey played a key role in the development of palm systematics. He published prolifically, he founded the L.H. Bailey Hortorium that includes the most significant palm herbarium in North America, and his protégé, Harold E. Moore Jr, went on to become pre-eminent in palm botany.

To him the palm is a gift divine,
Wherein all uses of man combine—
House, and raiment, and food, and wine.
— Greenleaf Whittier

Born in 1858 and raised on a farm in South Haven, Michigan, Liberty Hyde Bailey was a precocious youngster with an affinity for plants and animals with which he often startled his parents, such as the milk snakes he hatched in the oven. His mother's flower garden and his father's orchard catalyzed his love affair with horticulture. By the age of ten, he had become such a skilled grafter that neighbors employed him to graft their trees. Bailey was consumed with the desire to expand his horizons beyond his experiences at home and thus books became his portals to science. Asa Gray's *Field, Forest, and Garden Botany* played a pivotal role in shaping the young Liberty's interest in systematic botany. He avidly studied taxonomic keys and descriptions used in plant classification, and eagerly awaited the opportunity "to make [Gray's] book [alive]." Luckily, Mrs. Lucy Millington, a practiced botanist from New York, was in town during the following spring of 1876, when she kindly received Bailey's request to identify a grass-like plant in the genus *Carex*. Bailey was later invited to listen to her accounts of botanical excursions in the Adirondacks and accompany her on collecting trips in South Haven.

In 1877, L.H. Bailey (Fig. 1) honed his skills in horticulture and botany as a student at Michigan Agricultural College (now Michigan State University in East Lansing). William J. Beal, professor of horticulture and botany at Michigan Agricultural College, employed Bailey to collect botanical and zoological specimens for the college, and participate in experiments with corn cross-pollination and the breeding of apple and potato varieties. When Asa Gray, the father of American botany, asked Beal to help him find an individual with "the markings of a botanist," Beal recommended his promising assistant, Liberty Hyde Bailey. Elated at the possibilities at Harvard, Bailey worked as Asa Gray's herbarium assistant, organizing herbarium specimens and studying cultivated plants at the Arnold Arboretum, the renowned Sargent estate, and the Arlington market gardens; he also wrote for the *American Cultivator*. After his two-year Harvard appointment, he was appointed the Chair of Horticulture and Landscape Gardening at his alma mater, Michigan Agricultural College. The next three years were productive, filled with lectures, experiments, and public recognition. His appointment at M.A.C. ended in 1887 when he took up the post of Chair of Practical and Experiment Horticulture in the College of Agriculture at Cornell. It was at Cornell that Bailey's career reached its pinnacle.

As the chair of horticulture and later the dean of the College of Agriculture at Cornell, Bailey executed his vision of an ideal horticulture department. His inspiring courses in horticulture and botany were popular among students. He established several new departments in the College of Agriculture, including plant physiology, plant pathology, entomology, and landscape archi-

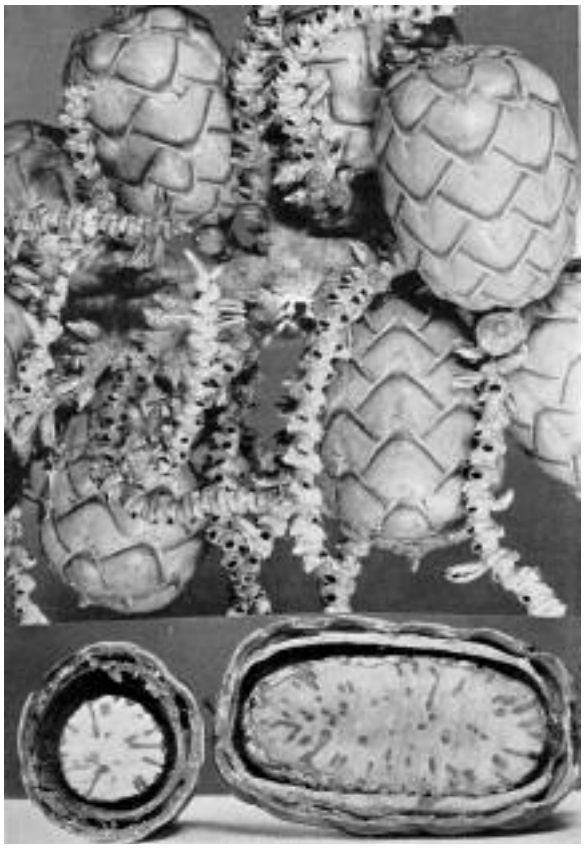
2. L.H. Bailey and Ethel Zoe Bailey sailing on the Orinoco River in Venezuela in 1921.

3 (left). Bailey and Ethel Zoe posing in South America. 4 (right). Bailey along the Demerara, British Guiana, 1922.

tecture. Cornell Plantations, today a premier university-affiliated garden and arboretum, was born from Bailey's philosophy that no horticulture department was adequate unless it included a living outdoor laboratory manifested in gardens, orchards, and greenhouses. From his diligent pen, he produced over 60 books throughout his career by incorporating botanical knowledge applicable to horticulture (Seeley 1990). *The Cyclopedia of American Horticulture* (1900), a four-volume work with handsome illustrations, and *Hortus* (1930) stand as testaments of his versatility as an editor, writer and scientist. But horticultural taxonomy held a dear place in Bailey's heart. Of all the plants he worked with, *Rubus* (brambles), the cultivated species of *Brassica* (cabbage), and the Cucurbitaceae (the gourd family) fascinated him most.

Palms did not attract Bailey until his early fifties. His biographer Philip Dorf (1956) recounted an amusing anecdote to account for Bailey's motivation to devote more than thirty years of his life to palms. During a holiday on the northern coast of Jamaica in 1910, Liberty Hyde Bailey and his wife were relaxing on the second-floor balcony of their hotel when Mrs. Bailey, leaning over the railing to examine a palm tree on the lawn, asked her husband to identify it. When he professed his ignorance, she disparaged him: "You don't know? I thought you called yourself a botanist." Bailey later commented, "I presume the dear lady believed that there were two or three or perhaps four different kinds of palms, and that therefore it was inexcusable for a botanist not to know one from another." Little did Mrs. Bailey know that palms were to become an obsession of her husband for the remainder of his life. She could not have foreseen accompanying him to such far-flung places, such as Mexico, Brazil, the West Indies, Florida and southern California.

Not for the weak-hearted, palm collecting was suited only to those who could withstand severe weather, heights and shortages of water and food. Once he and his daughter Ethel (Figs. 2–4) waded all day in deep water of the Amazon River for *Raphia taedigera* (*R. vinifera* var. *taedigera*) (Figs. 5, 6), the only palm species native to both the Old and New Worlds (Bailey 1933b). Local people were astounded that a man would go there, especially accompanied by a woman, because the swamp where this species grew was difficult to navigate. Once he ventured into a forest so thick and dim



5 (left). Bailey's photograph of *Raphia taedigera*'s long flower arms. Note the hands or clusters of flowers emerging from the bracts or spathelets. 6 (right). *Raphia taedigera* fruits

that he got lost only twenty feet away from a narrow pathway, but his bravery was rewarded with new, unidentified slender palms. Another time, Bailey narrowly escaped with his life when a tidal wave overwhelmed him at Trinidad. Yet he returned again to this island nation in 1946, when officials asked him to prepare an inventory of the native palms (Bailey 1947).

Bailey wisely cautioned that palms could not be collected simply using a pen-knife. A collector had to be equipped with a good pair of binoculars, heavy pruning-shears and knives, a machete, saw, sturdy cutting hooks for climbing and steel tape for measuring, as well as ladder and ropes. The need for various equipment and extra men prompted him to call palms "the big game of the plant world." In spite of these challenges, he carried out his palm-collecting expeditions in his sixties and seventies, even up to his early nineties! These strenuous forays into tropical regions of America reinvigorated him as if he were an "Indiana Jones" character in search of lost treasure. He (Bailey 1933a) once remarked:

> The sense of conquest is in it. Not often is a collector able to obtain complete material in one assault. The plant may be at the moment sterile, or only in fruit or flower…but this lack has the advantage of stimulating the collector to go back in another season or year to complete the work.

In 1948, Cornell University had to defer his 90th birthday party because Bailey was celebrating the occasion instead in the West Indies where he found two new species in the genera *Euterpe* and *Acrocomia*. Later on 29 March 1948, when the party was held, Bailey reminisced: "Some six weeks ago I flew out of South America….I came down through the clouds on a shore of a virginal and spice-fragrant island to celebrate my anniversary.

I drove twenty-three miles across that island to the capital…I knew [the palms] were new species…It brought back to me the days of my youth in the woods" (Bailey 1948). Bailey's foreign conquests were aided by the advent of commercial air services in the post-World War I years, which he was among the first to use for his South American and Caribbean collecting trips.

In addition, he advocated the use of photography as a tool in plant identification, especially palms, whose often huge sizes could not be accurately portrayed in herbarium specimens. On his travels, Bailey incurred the wrath of hotel managers when he used up the hotel's water supply for developing and rinsing his negatives. His photographs often illustrated his publications, reflecting a unique balance of art and science (Figs. 7–10). They made it easier for readers to visualize the faraway, exotic locales where these palms flourished. Other botanists would rely on the photographs for reference especially when shrivelled flowers or fruits in herbaria proved of limited use for identification. Nonetheless, when space permitted, botanical illustrations of major features usually complemented his text. For instance, Bailey used photos of the talipot palm (*Corypha umbraculifera*) (Fig. 11), coconut palm (*Cocos nucifera*) (Fig. 12) and the royal palm (*Roystonea* sp.) (Fig. 13) to depict the three types of flowering: *suprafoliar* (borne terminally above the leaf crown), *interfoliar* (amongst the foliage, axillary to existing leaves), and *intrafoliar* (axillary, at the base of the crownshaft).

At a time when most herbaria were unsuccessfully mounting gargantuan sections of palms onto herbarium sheets approximately 30 × 45 cm, Bailey advocated loose storage of palm petioles, leaves, fruits, and flowers in boxes (Fig. 14). For those intent on using herbarium sheets, he devised a method in which specimens are folded to the size of the herbarium sheet and placed loose in folded sheets of mounting paper (60 × 90 cm) (Figs. 15–17). This method would be modified to fit the bulk or size of the specimen, creating a neat folder to be put into the cabinet. Bailey wryly suggested that pieces of palms too big for cases or herbarium

7 (left). Cabbage palmetto (*Sabal palmetto*) in the Okeechobee region, Southern Florida. 8 (right). Canopy of *Attalea* sp. against the dark woods.

9 (left). Vigorous young tree of Seychelles-nut (*Lodoicea maldivica*) first planted in 1896 in Jamaica. 10 (right). *Latania lontaroides* on Trinidad, native to the Mascarenes.

sheets be hung on walls as "mementos of zestful journeys" (Bailey 1946).

Through his numerous scientific papers on palms, mostly published in *Gentes Herbarum*, Bailey wrote eloquently of their majesty. In the preface for his first such paper, "Palms, and their characteristics" (1933a), he began:

> The traveller from cold countries is electrified when he lands on a tropical shore with palms abundant in the scene... These plants provide the accent in many noted and historic landscapes. A single palm may make an otherwise tame scene to be a picture... The palms represent what is commonly considered to be the noblest family of plants; and yet they are to this day perhaps the least perfectly known, in general, of any of the great groups of vegetation... Yet here is a family of plants that must be much better known in the interest of improved tropical agriculture, and of commerce in many useful commodities.

And in addition to their eloquence, his papers on palms remain valuable for their detailed information on morphology and other diagnostic features. They elucidate palm terminology to readers not acquainted with such plants. When there was no accepted term to describe a feature, Bailey aptly would suggest one. He first proposed the word *crownshaft* for the tight column of leaf sheaths at the stem tip of many species, and explained that that it was composed of lengthened leaf bases enclosing the terminal bud or apex. His subjects were extensive, covering the diverse palms of Panama to the king palms of Australia (*Archontophoenix*; Bailey, 1935b). Notes on palm etymology, natural history, and geography were included along with the technical descriptions of their structures. *The Royal Palms—Preliminary Survey* (Bailey 1935a) cited quotes from naturalists offering profuse praise on this regal genus, *Roystonea*. Some papers, such as *Certain Ptychospermate Palms of Horticulturists* (1935c), addressed the nomenclatural problems that existed among various species. Other papers attempted to provide a coherent overview or a brief monograph of a poorly known genus in hope of encouraging other botanists to fill in the missing pieces. Bailey's systematic study of American palmettos (*Sabal*) aimed to fill that purpose (Bailey

11 (left). Great flower-crown of talipot palm (*Corypha umbraculifera*) of India; a tree 30 years from seed on Jamaica.
12 (right). Interfoliar fruiting structures of the coconut (*Cocos nucifera*) on Trinidad.

1934, 1944). Because horticultural concerns remained an integral part of his papers, cultivated palms, such as *Howea*, *Rhapis*, and *Washingtonia*, were of particular interest. He mentioned palms that he thought deserving of wider cultivation. In *Palms of Seychelles* (Bailey 1942), he wrote:

> It is a pleasure to assemble a descriptive account of palms representing a single group of islands. This is apparently the first separate horticultural attempt for the Seychelles... When we grow palms we should be conscious of their native regions; such knowledge adds to the interest of growing them and we should be able to handle them with added confidence. If any of these Seychellan palms are in danger of becoming extinct on their islands we have the privilege of preserving them elsewhere.

Bailey further cautioned that this paper was not intended to be a monograph of Seychellois palms, but the taxonomy was included to aid interested gardeners or other individuals in identification if the need should arise. These two points were reiterated in another paper, *Palms of Mascarenes* (1942). Here the link between botany and horticulture was emphasized, elevating the importance of horticultural taxonomy emblematic of Bailey's scientific papers. For instance, Bailey included instructions for germinating the seeds of *Lodoicea maldivica*, the *coco-de-mer*, one of the world's natural wonders, after providing its taxonomic history.

His contribution to palm botany was commemorated in March 1942 at Fairchild Tropical Garden, where the palm glade was named in his honor. Fitting also was his immortalization in the name for a Cuban palm, *Copernicia baileyana*, considered one of the stateliest palms for its imposing white trunk and large, fan-shaped glaucous leaves.

In 1951 when Bailey approached the age of 93, he proposed an ambitious project to describe all the known palms (Uhl & Dransfield 1987):

> I plan to define what is a palm. I plan to explain what are not palms even though we call them so. I plan to talk about their distribution over the face of the earth and to

13 (above). *Roystonea borinquena.* 14 (right) Palm herbarium.

> define what a palm is, so that if a man or woman has a specimen, that plant may be determined. And then I expect to make a classification of all the genera, and to describe every genus. It would be a 'Genera Palmarum.'

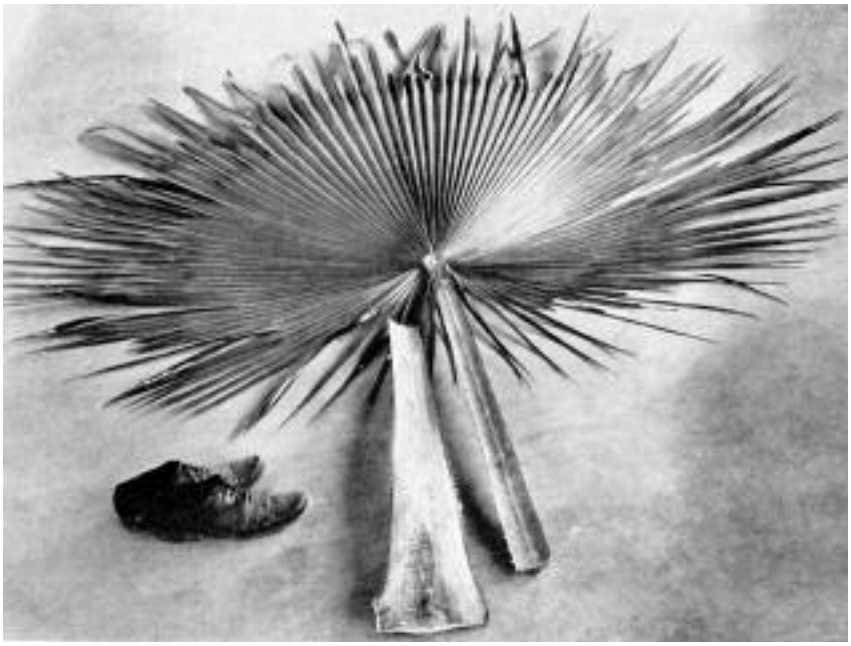
It was an idea that grew out of his correspondence with Dr. J. Horace McFarland, a well-known horticulturist who ran Mount Pleasant Press, the publishing company behind the country's seed and nursery catalogs (personal correspondence 1947):

> My "great palm" is yet a pictorial idea and not a reality. I have now had great experience with this group of plants and I feel myself under obligation to spend a few years in the effort to put it into book form. Not even this plan is yet worked out, but I know just how I shall begin and how the departments will work themselves into shape as the effort progresses. I cannot even begin it this year, yet many of my efforts are working towards its fulfillment.

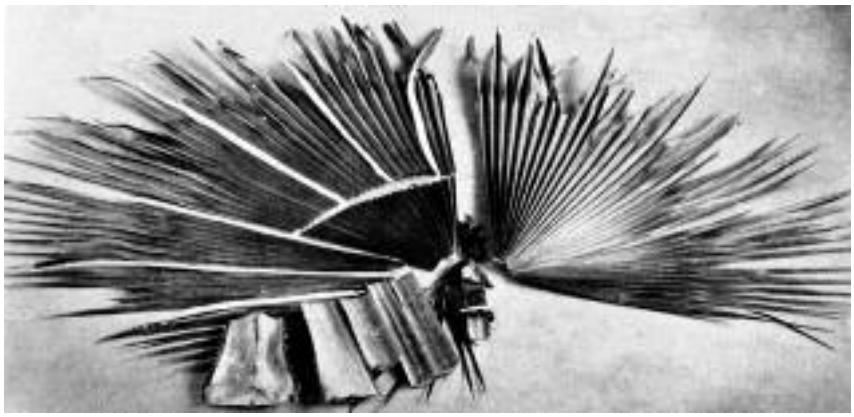
Sadly, he and his successor at Cornell, Dr. Harold E. Moore, Jr., did not live to see the project *Genera Palmarum* come to fruition. But Natalie Uhl and John Dransfield, palm specialists at the Bailey Hortorium and the Royal Botanic Gardens at Kew, respectively, collaborated to complete *Genera Palmarum* in 1987. Largely based on Bailey's and Moore's research, this handsome volume, a comprehensive treatment of palm genera accompanied by Marion Sheehan's beautiful and accurate illustrations, undoubtedly would have fulfilled Liberty Hyde Bailey's wish. Indeed, a fitting tribute must be paid to this botanist as the fiftieth anniversary of his death approaches in 2004. Bailey's work paved the way for other botanists to study palms.

Acknowledgments

I thank Dr. Natalie Uhl, Bob Dirig and Sherry Vance of Bailey Hortorium, Dr. Kenneth Mudge, Associate Professor of Horticulture at Cornell, as

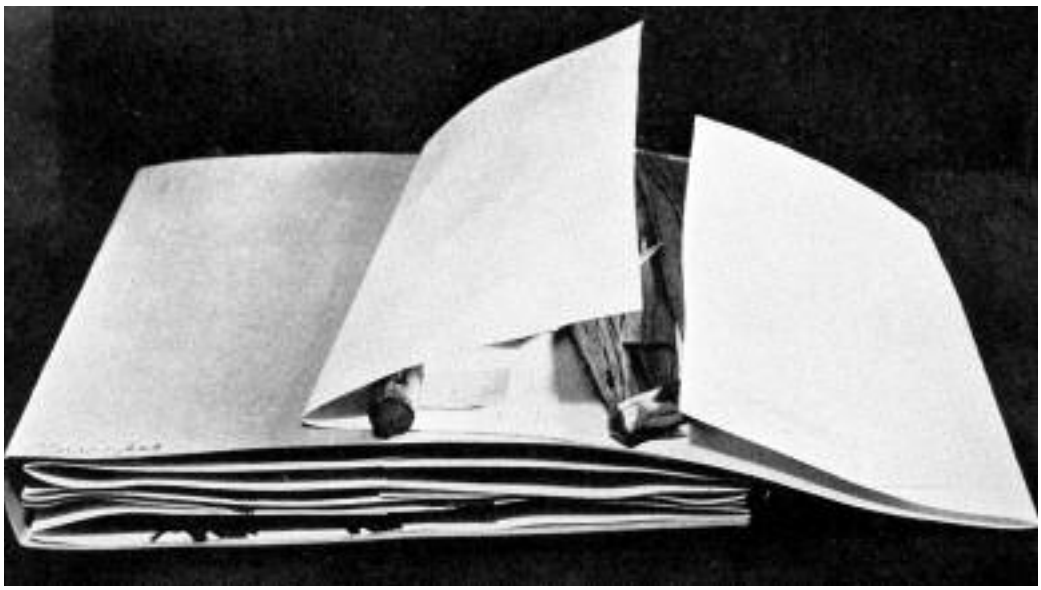


15 (top). Fan leaf of medium size, freshly collected; Corypha, planted in Cuba.



16 (middle). Leaf shown in Fig. 15 with right half to be discarded, and the other half cut into pieces that are to be folded and pressed; petiole in pieces, that are to be kept.

17 (bottom). Folded herbarium sheet (above) and an extension genus-cover.



well as Douglas Goldman for their kind assistance in locating relevant materials and providing critical remarks on the manuscript.

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A New Species of *Chamaedorea* from Colombia

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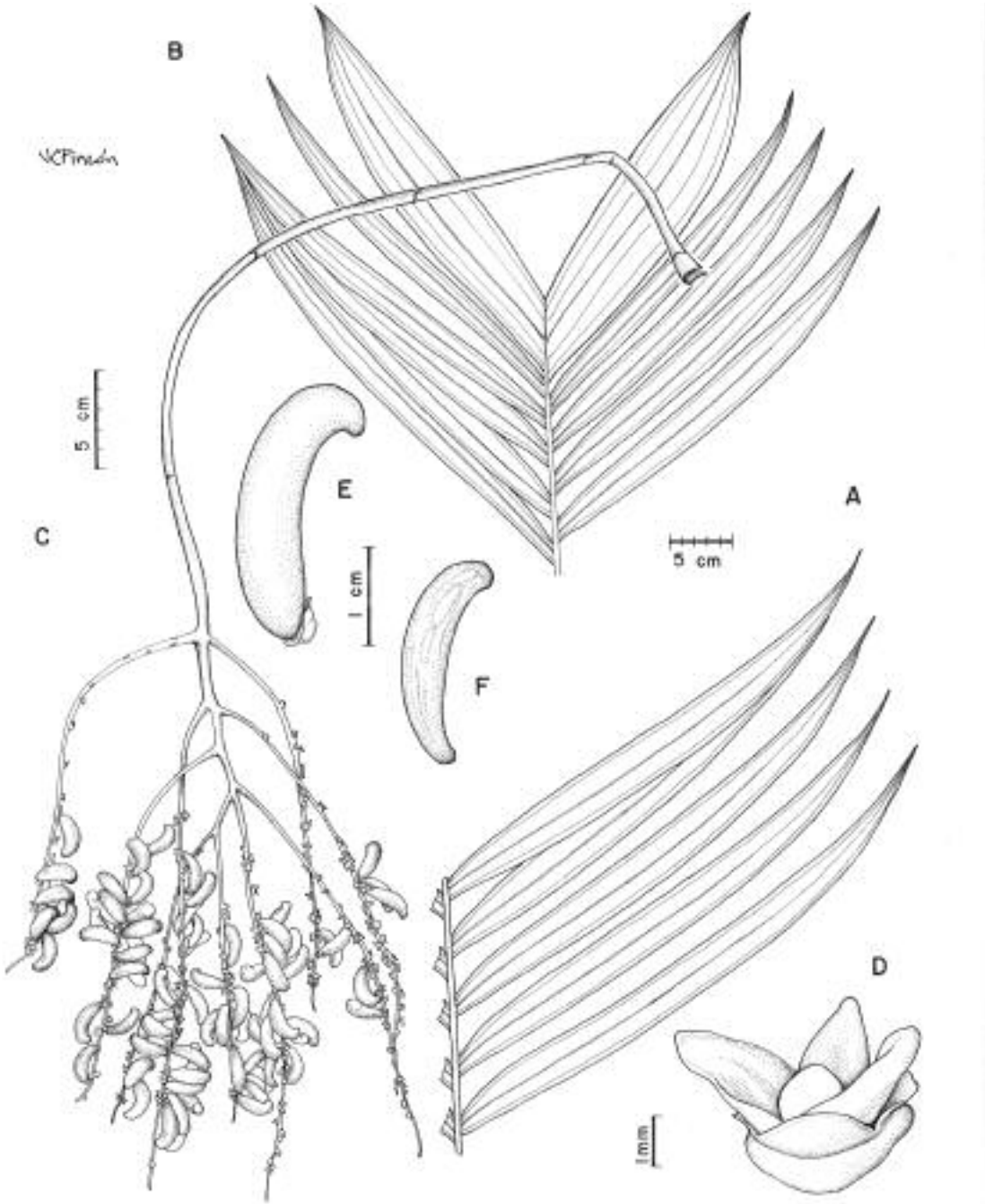
An undescribed species of *Chamaedorea* has been found during the preparation of the palm treatment for the Flora of Colombia.

Chamaedorea ricardoi R. Bernal, Galeano & Hodel **sp. nov.**, *C. angustisectae* Burret similis sed foliis minoribus, pinnis paucioribus, rachillis masculinis brevioribus, floribus masculis flavis, calycibus masculis leviter lobatis, fructibus majoribus differt. Typus: Colombia. Antioquia: Municipio de San Carlos, corregimiento Alto Samaná, vereda Miraflores, finca El Desespero, 6 h SW from Alto Samaná, 6º05' N, 74º52' W, 880–920 m, 25 Oct 1989, *Callejas et al. 8539* (Holotypus HUA; isotypus COL). Fig. 1.

Solitary understory palm 2.2–8 m tall. Stem ca. 3 cm in diameter, green. Leaves 6–10; sheath 12–33 cm long; petiole 9–65 cm long; rachis 34.5–ca. 84 cm long; pinnae 6–19 per side, regularly arranged and spreading in one plane, linear, falcate at the apex, long-acuminate, thin, membranous, with a lateral vein on either side of the midrib, these 1–4 mm from the margin, both the midrib and the lateral veins raised and prominent above and below; a secondary vein between the midrib and lateral vein, slightly prominent on both sides; proximal pinnae 19–40 × 1.5–2.4 cm; middle pinnae 24.5–50 × 2.4–3.1 cm; apical pinnae wider than the remaining ones, 27–40 × 5–11.2 cm. Inflorescences 3–4 per plant, infrafoliar. Staminate inflorescence with peduncle 12–13.5 cm long, 4–5 mm wide at apex, 8 mm wide at base; prophyll 2–2.2 cm long, ca. 6 mm wide; peduncular bracts 5, distal-most exceeding peduncle for 2 cm and concealing rudimentary 6th one, 2.2–9 cm long, membranous, light brownish, striate-nerved; rachis 8–9 cm long, minute and sparsely tuberculate; rachillae 15–17, slightly spreading, longitudinally ridged, the proximal one to 13.5 cm long, the distal one to 9.5 cm, ca. 1 mm diameter at the middle, the proximal rachilla simple or furcate. Staminate flowers 2–5 mm distant proximally, 1–3 mm distant distally, leaving slightly raised rounded-elliptic scars 0.5–0.75 mm long, oblong in bud, 2.8 × 2 mm, at anthesis 2.5 × 2.5–3 mm, yellow; calyx cupular, 1–1.5 × 2.5 mm, ± thin and transparent, sepals connate in basal 3/4–4/5, broadly rounded apically; petals 2.5 × 1.5–1.7 mm, elliptic to oblong, valvate, free



1. *Chamaedorea ricardoi*. **A** middle leaf segment; **B** apical leaf segment; **C** infructescence; **D** pistillate flower; **E** fruit; **F** seed. From *Callejas et al. 8539* (COL). Drawn by Juan Carlos Pinzón.

nearly to base and there briefly imbricate and connate, acute and incurved apically, nerveless, minutely glandular-punctate; stamens 6, equaling petals, 2.5 mm high, filaments 1–2 mm long, anthers 0.5–0.8 mm long, dorsifixed near base; pistillode 2–2.5 mm high, columnar, sharply longitudinally ridged, truncate, trifid, and slightly flared in apical 0.5 mm, lobes erect. Pistillate inflorescence unknown. Infructescence with green axes and orange immature fruits, the axes turning orange in ripe fruit; peduncle 42–48 cm long, 6–7 mm wide at apex, 3 cm wide at base, light yellow and sparsely black punctate when dry, with 5–7 bract scars including prophyll; rachis 6.5–10.5 cm long; rachillae 7–13, the proximal ones to 25 cm long, the distal ones to 8 (–18) cm long, 2–3 mm

in diameter near the middle, ± curved-ascending with prominent minute tubercles like those of the rachis. Fruits 1–3 mm distant, strongly falcate, 1.8–2.5(–2.8) cm long, (0.6–)0.8–0.9 cm in diameter, black at maturity; seeds strongly falcate, 1.7–2.3 cm long, 0.4–0.6 cm in diameter. Sepals and petals thickened and persistent in fruit; calyx 1–1.5 × 3.5–4 mm, cupular, sepals connate in basal 1/2, truncate to widely rounded apically; petals 2.5–3 × 3–4 mm, imbricate in basal 1/3, acute apically; stigma lobes distinct, angled, acute.

DISTRIBUTION AND HABITAT: Known only from a small area in the middle valley of the Magdalena River and the adjacent slopes of the Cordillera Central in Antioquia, northwestern Colombia, in wet tropical forest (IGAC 1977), between 325 and 920 m elevation.

ETYMOLOGY: The epithet honors Ricardo Callejas, a leading Colombian botanist, who collected the type specimen.

CONSERVATION STATUS: The collections of *Chamaedorea ricardoi* are from three localities encompassing (extent of occurrence *sensu* IUCN 2001) an area less than 300 km². The region has been severely deforested after the construction in the 1980s of a road linking Bogota and Medellin, the two largest cities in Colombia, resulting in a continuous decline in the quality of potential habitat. When these parameters (IUCN criteria B1abi, ii, iii; see table 6 in Calderón et al. 2002) are taken into account, *C. ricardoi* must be catogorized as endangered (IUCN 2001). That there are no national parks or reserves in the area exacerbates its endangered status.

SPECIMENS EXAMINED. COLOMBIA. Antioquia: San Luis, Cañón del Río Claro, sector norte, margen izquierda, 325 m, 5°53′ N, 74°39′ W, 3 May 1984 (fl), *Cogollo 1680* (JAUM, MO); San Luis, carretera de la autopista Medellín-Bogotá al corregimiento El Prodigio, ca. 25 km de la autopista, 500-630 m, 6°06′ N, 74°48′ W, 23 May 1990 (fr), *Cogollo et al. 4563* (JAUM, MO).

In the most recent key to the subgenera of *Chamaedorea* (Hodel 1992), *C. ricardoi* keys out either to *Moreniopsis* or *Chamaedoropsis* because of its fruits with thickened and persistent petals and solitary staminate flowers with apically free, erect petals. Unfortunately, the available collections lack information about the number of staminate inflorescences per node, a character that separates both subgenera. However, the most similar species, *Chamaedorea angustisecta* Burret, belongs to subgenus *Moreniopsis*, which leads us to infer an affinity of *C. ricardoi* with this South American subgenus. *Chamaedorea angusti-secta*, which grows on the Amazonian slopes of the Andes and adjacent lowlands in Peru, Brazil and Bolivia, up to 700 m elevation, differs from *C. ricardoi* in its larger leaves (rachis 130–155 cm vs. 34.5–84 cm), with more pinnae (30–39 per side vs. 6–19), staminate inflorescence with longer rachillae (11–24 vs. 8–13.5 cm), orange flowers (vs. yellow), deeply lobed calyx (nearly to the base vs. only in apical 5/8–3/4, and smaller fruits (15–18 mm vs. 20–25 (–28) mm). Moreover, the ranges of the two species are separated by more than 1200 km.

The falcate fruits of *Chamaedorea ricardoi* are particularly remarkable because they are uncommon in the genus. Such fruits are known only in *C. angustisecta*, *C. falcifera* from Guatemala, and occasionally (especially when immature) the widespread *C. pinnatifrons*.

Acknowledgments

We thank Ricardo Callejas (HUA) and Alvaro Cogollo (JAUM) for facilitating loans of specimens and the Missouri Botanical Garden for supporting a visit by Rodrigo Bernal to MO. Juan Carlos Pinzón prepared the line drawing.

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Nannorrhops in Oman

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1. The road from the coast climbs steeply into the dramatic limestone scenery of Jebel Akhdhar, Oman.

In Oman, *Nannorrhops ritchieana* grows in extraordinarily inhospitable places, representing one of the most extreme habitats of any palm species.

Oman may seem an unusual holiday destination for a tropical-palm botanist and a tropical-bamboo specialist – the choice smacks of perverseness, as if we were going out of our way to find the most arid and desolate destination possible. However, Oman has dramatic and astonishingly beautiful scenery, is a mere seven hours flight from London, and most significantly, my nephew Malcolm works there as a geologist for PDO, Petroleum Development Oman. When political turmoil in Madagascar caused my wife and me to cancel our plans for fieldwork there, Oman seemed the obvious place to go to escape dreary November 2002 in Britain and to see my nephew and his wife, Marianne. We put in for ten days annual leave and booked our flights. Then colleagues at Kew began the inquisition; where are you going and why on earth Oman? My colleague Shahinah

2 (top). *Nannorrhops ritchieana* growing in the crevices in the limestone bedrock in the bottom of a wadi. 3 (bottom). *Nannorrhops ritchieana*, showing dead inflorescence, with a species of *Aloe* in the foreground.

Ghazanfar learned that we would be in Oman; she immediately told us of two mystery palms. Suddenly I had the perfect explanation for incredulous colleagues – we were off to visit relatives and clear up a palm mystery.

Shahinah has been working for some time on the Flora of Oman and has an excellent knowledge of the native plants and vegetation. On a recent visit she had traveled along a brand new dirt road that winds its way up into Jebel Akhdhar, the range of

mountains that runs parallel to the coast to the west of the capital, Muscat. At high elevation (ca. 2000 m above sea level) she had seen a low fan palm growing in a dried-up wadi and nearby a date palm that she was convinced was not *Phoenix dactylifera*. The obvious solution to the first mystery was that the palm must be *Nannorrhops*, long known to occur in Oman (*Nannorrhops arabica* now included as a synonym of *N. ritchieana* was first described from the Hadramaut, just over the border in Yemen). Shahinah was convinced, however, that this was not *Nannorrhops*. By now I was in a state of high excitement about our forthcoming holiday. Emails were exchanged with Malcolm and Marianne in Muscat, who, amazingly, said that they had already planned to take us camping in the mountains along the very road mentioned by Shahinah. It looked as if all was set for a thrilling trip. What could a mystery fan palm in Arabia be? Surely not *Livistona carinensis* that occurs over the border in Yemen, as the habitat of the Oman fan palm (high elevation on limestone rocks) seemed completely wrong. Could it be an enormous range extension for *Chamaerops*? We just had to wait and see.

We left cold, wet and windy London in a morning in mid November and by late evening were basking in the warmth of Muscat. Early next morning we left Muscat with Malcolm and Marianne in their 4WD together with their neighbors in a second vehicle, driving along the main coastal highway to the west. To our left, spectacular mountains rose above the coastal plain, the bare eroded rocks astonishingly varied in color, from chocolate colored ultramafics to gray and brilliant white limestones. Near Barka, we turned south towards the mountains, passing the imposing fortress at Nakhl and on to just beyond Al Awabi where we turned off the tarmac onto a dirt road up into dramatic scenery. The road wound along the wadi bottom with scattered *Zizyphus* trees and the odd grove of dates, the mountains rising to over 2000 m on either side. Ahead we could see the black-topped mountains of Jebel Akhdhar. Our road followed the wadi bottom for the first part but then climbed dramatically to escape narrow gorges (Fig. 1). Periodically we passed small picturesque villages with date groves and small fields of vegetables, but away from the villages and valley bottoms, the vegetation seemed extremely sparse, more particularly because this was, after all, the end of the dry period of the year.

Near Hat we joined the new section of road that climbs to the summit of Jebel Akhdhar and links up with the valleys around Nizwa on the other side. If anything the scenery was even more dramatic. As we drove along the final ascent across a cliff face, we began to see open woodland of *Juniperus* and *Olea* (wild olive) with a scattered undergrowth of *Euryops pinifolius* and *Teucrium muscatensis*. As we turned the corner onto the summit plateau with spectacular views, there was an ominous clunk, and the clutch cable on Malcolm's 4WD broke. By now it was 4 pm and we were left debating what we should do. There was talk of splitting up, camping on the summit and other alternatives, but eventually common sense prevailed and we decided that we should drive down in convoy to Nizwa in search of a garage. Malcolm managed to get the clutchless vehicle moving in third gear and we began our descent. At dusk we passed a small dry wadi with a fan palm in the bottom but did not dare stop for fear of not being able to get up the hill on the other side. However, at least the palm existed!

The following day, we were back again in the morning, clutch mended and although the clutch cable snapped yet again, we used one of the two vehicles to get back up onto Jebel Akhdhar. Very soon we were back at the dry wadi in sight of the palm (Fig. 2). Perhaps not surprisingly, it was *Nannorrhops ritchieana* after all and I believe that the mystery *Phoenix* was nothing more than stunted feral date palm, *Phoenix dactylifera*.

On Jebel Akhdhar *Nannorrhops* seems to be confined to a band between 1600 and 2100 m above sea level. The underlying rock is limestone. It is scarcely abundant and seemed always to be growing in the bottoms of shallow wadis that, presumably, during rains briefly carry run off. Debris caught among the fronds suggested that during flash floods *Nannorrhops* may be partially submerged. The palm is extremely stunted compared with the individuals one often sees in cultivation. Yet clumps with leaves no longer than 35 cm and with scarcely evident trunks had already produced inflorescences. Signs of flowering were common, but all inflorescences were dead (Fig. 3). Illustrations of the palm growing elsewhere in Oman suggest that it can reach 2 m in height under apparently more favorable conditions. Grazing by goats is intense on Jebel Akhdhar and leaves in many clumps of *Nannorrhops* had been chewed and partially mutilated. We saw no sign of young seedlings.

Suffering drought for much of the year, subjected to intense insolation and high temperatures during the day and frosted at night during the winter months, the habitat of *Nannorrhops* on Jebel Akhdhar must be one of the least hospitable occupied by palms.

Floral Biology and Insect Visitors of the Understory Palm *Synechanthus warscewiczianus* at the Pacific Coast of Colombia

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***Synechanthus warscewiczianus*, an understory palm growing near Tumaco, on the Pacific coast of Colombia, is shown to be pollinated principally by flies.**

Synechanthus is a genus of small understory palms of the wet forests of Central America and the northwest of South America. It belongs to the tribe Hyophorbeae in the subfamily Ceroxyloideae (Uhl & Dransfield 1987), and consists of two species (Moore 1971) – *S. fibrosus* and *S. warscewiczianus*. The latter is distributed at elevations below 1400 m, from the Atlantic coast of Nicaragua to the Pacific coast of Ecuador. It has no known commercial use and is only locally used by some indigenous people who are reported to eat the cooked fruits and use the leaves to dye textile black. It is apparently not as common in cultivation as its relative *S. fibrosus*. So far no detailed study of the pollination of this genus has been published. This paper provides data on the reproductive biology and insect visitors of *Synechanthus warscewiczianus* (Fig. 1) in Colombia.

Study Site

This study was carried out during July and August 1999 in a slightly disturbed primary wet forest (bosque húmedo tropical in Holdridge's [1982] system) at 50 m elevation in Finca Guacaray near Tumaco in the Department of Nariño, at the Pacific coast of south-western Colombia (1º26' N, 78º36' W) (Fig. 2). The finca comprises an area of 236 ha, out of which about 100 ha are wet forests. Annual rainfall in this area is 3279 mm (average for 1995–1997, measured at the finca) and temperature ranges between 22ºC and 32ºC, with an average of 27ºC.

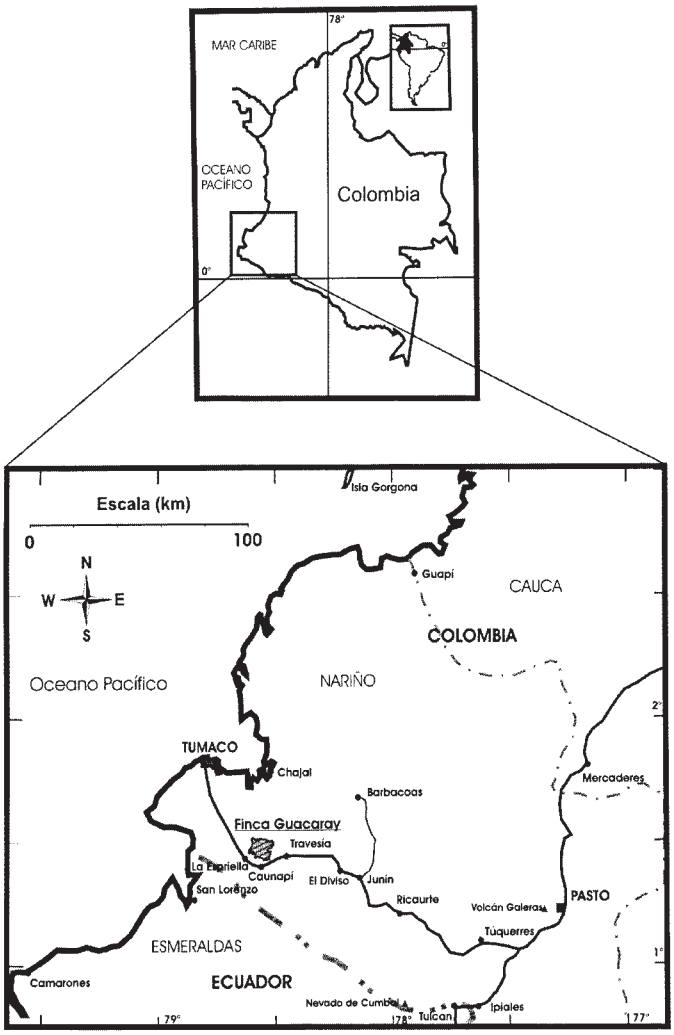
Methods

We numbered all 30 individuals of *S. warscewiczianus* found in the finca and marked them with red flagging tape. Every inflorescence,

1. Recently opened inflorescence of *Synechanthus warscewiczianus*, as well as an infructescence with ripe fruits and one with immature fruits.

either open or in bud, received a number according to the individual and the stem it belonged to. We marked individual staminate and pistillate flowers with a water-based felt-tip pen in order to study their development, and we placed a white cloth under some inflorescences at staminate anthesis to determine the time of abscission of staminate flowers. The highest inflorescences (ca. 4.5 m above ground) were reached by means of small wooden scaffolds. For each individual, the following measurements were taken, when possible: height, diameter (dbh, only for stems over 1m), number of green leaves, number of ramets and number of their leaves, presence of a root cone, length of peduncle, length of rachis, number of rachillae, length of rachillae (average of 15 rachillae per inflorescence), number of staminate flowers per acervulus (average of 15 counts per inflorescence), number of pistillate flowers per rachilla (average of 15 counts per inflorescence), number of developed fruits per rachilla (average of 15 counts per inflorescence).

These figures were used to estimate the total number of staminate and pistillate flowers per inflorescence, and to calculate fruit-set. We tested the presence of nectar using glucose testing paper (Gluco-cinta™, Eli Lilly and Company, Indianapolis, USA). For 18 inflorescences at pistillate anthesis we measured the distance to the nearest palm at staminate anthesis. We observed inflorescences at anthesis at least once per day throughout the day and sometimes at night, at intervals of 0.5–6 hours, depending on their state of development. We observed insect visitors for longer periods of time during all phases of anthesis, and collected in alcohol individuals of every visiting species for further identification.



2. Location of the study site

Some species received generic or species numbers that reflect the respective specialist's own numbering sequence (see Acknowledgments) or that we used for unidentified taxa. We captured separately 13 of the most frequent visitors in order to study their pollen loads. In order to evaluate the occurrence of wind pollination we placed three Vaseline-covered slides on the rachillae of four inflorescences at pistillate anthesis, belonging to four different individuals. We placed six of these slides radially at distances of 0.5 m and 1 m near two inflorescences at staminate anthesis. They were exposed for at least 5 hours without rain. These slides were observed afterwards under a microscope in order to identify and count any pollen grains transported by the wind. Reference pollen was collected from anthers and whole staminate flowers. Morphometric characteristics of this pollen were analyzed. Vouchers of the palm were deposited at COL and PSO.

Results

*Morphology***.** *Synechanthus warscewiczianus* is a small-sized, monoecious undergrowth palm with stems up to 6 m in height (x = 3.8; 1.3 SD; n = 45) and 3.5 cm in diameter (x = 2.8; 0.3 SD; n = 38). Studied palms had 4–11 living leaves per stem (x = 8.1; 1.8 SD; n = 45). Most individuals at the finca (80 %) were cespitose (many, however, with only a few basal shoots), and the majority (83 %), either solitary or cespitose, had a small root cone not exceeding 40 cm in height and 30 cm in diameter. Inflorescences are infrafoliar and they are enclosed in bud by 5–6 peduncular bracts, which dry and become fibrous upon the opening of the inflorescence. The upper part of the stem bears inflorescences and buds at every node, in successive stages of development. The inflorescences measure up to 73 cm (x = 58 cm; n = 21), and they are borne on a long peduncle (x = 41 cm; 7.0 SD; n = 23). The rachis is 9–23 cm long (x = 16.8; 4.2 SD; n = 21) and bears 19–98 unbranched rachillae (x = 70; 22.3 SD; n = 21), each 17–36 cm long (x = 28.5; 5.7 SD; n = 285), and about 2 mm thick. Basal rachillae are the longest. The flowers are arranged in alternating rows (acervuli) on opposite sides of the rachilla, and each rachilla has about 60 acervuli, each with 0–2 pistillate flower proximally and 6–10 (x = 7.8; 1.1 SD; n = 240) staminate flowers distally. Flowers of both sexes are yellowish at anthesis and produce small amounts of nectar but have no perceptible scent. Pistillate flowers are often lacking from the distal acervuli of each rachilla, resulting in about 10 % of exclusively staminate acervuli. In contrast, some of the basal acervuli sometimes have two pistillate flowers, but only one of these develops into fruit. Each rachilla bears 15–101 pistillate flowers (x = 55; 24 SD; n = 255), and 95–1140 (x = 430) staminate flowers. Thus, the number of flowers per inflorescence is very variable – 1264–74,094 staminate flowers (x = 41,491; 22907 SD; n = 16) and 160–8400 pistillate flowers (x = 4420; 2559 SD; n = 17). The staminate/pistillate sex ratio is 14.8/1 (SD 14.8; n = 16).

The results of a Pearsons product-moment T-test reveal an important component of plant height and a less important component of stem diameter as determinants of the morphologic characteristics of the inflorescences – number of pistillate and staminate flowers per inflorescence, number of rachillae and length of rachis and rachillae (Table 1). This means that taller (and therefore older) palms and those with thicker stems produce bigger inflorescences with more flowers of both sexes. A similar situation has been found to occur in different species of palms (Listabarth 2001). Correlations between rachilla length and plant height and stem diameter are the strongest, with values of 0.555 and 0.608 respectively. In this population we did not find a significant correlation between stem diameter and staminate flowers per acervulus. Correlations between plant height and number of rachillae and length of rachis respectively are high and positive (Table 1). Finally, we found a highly significant correlation between stem diameter and plant height, suggesting sustained primary growth.

In nine infructescences 0–40 fruits developed per rachilla (x = 5.2; 3.3 SD). Thus, fruit-set was 9.4 %. The pollen grains of *S. warscewiczianus* are elliptic and monosulcate (with a longitudinal germinal slit, called sulcus). This sulcus is well defined, nearly as long as the grain itself. The exine is tectate and more or less even, without

Table 1. Comparison of coefficients of correlation (Pearson) between plant height, stem diameter and morphologic measurements for a population of *Synechanthus warscewiczianus* at the Pacific coast of Colombia (only p < 0.05 are shown).

	Length of rachillae	Length of peduncle	Number of rachillae	Length of rachis
Plant Height	0.555		0.533	0.541
DBH	0.608	0.252	0.534	0.425

spines. The grains are 16–27 µm long (x = 23.1; 1.6 SD; n = 100) and 11-20 µm (x = 15.7; 1.7 SD; n = 100) wide (measured in plain view). The length-width ratio is 1.5 (0.2 SD; n = 100).

*Phenology***.** Early development of the inflorescence buds started among the leaves, but the lowest leaf fell off when the enclosed bud did not exceed 3.5 cm. Further growth was slow – during the 30 days of this study the upper buds did not grow at all, whereas the lower, largest buds grew 6–15 cm (x = 10.2 cm; 3.2 SD; n = 24). Upon attaining a length of 46–73 cm, the peduncular bracts started to split longitudinally at the distal end, and the inflorescence opened completely within the next three weeks. At the time of opening all flowers were closed and the rachillae were bright yellow (Fig. 1). They turned green after exposure and then became yellowish again during anthesis. The inflorescence buds were held upright and they leaned gradually to the ground during flower and fruit development.

Synechanthus warscewiczianus is protandrous, and anthesis proceeds basipetally. On the first day of anthesis, only 1–12 (–20) staminate flowers opened at the distal end of those acervuli located at the distal end of the rachillae. In the next few days more and more flowers opened in daily pulses, until all the distal flowers of all acervuli had opened. At the maximum pulse about 8000 staminate flowers opened in one day. The staminate phase lasted 18–25 days (x = 21.2 days; 2.3 SD; n = 12). The last flowers to open were those of the basal acervuli and basal rachillae. This was followed by a pause of 3–5 days (x = 4.2; 0.7 SD; n = 13) during which there were no flowers open. The pistillate phase of the inflorescence lasted 5–9 days (x = 6.6 days; 1.6 SD; n = 8), with the maximum pulse after 2–3 days. The pattern of opening was the same as in the staminate phase.

The staminate flowers opened in the morning between 6.00 and 13.00 hours, with a peak from 10.00 to 11.00 hours. They were at anthesis only for a few hours and abscised in the afternoon of the same day. Individual flowers opened in 10–15 minutes, the anthers flexing back like a steel spring. The pistillate flowers opened during the whole day, from 6.00 to 18.00 hours with a maximum before 9.00 hours. The individual pistillate flowers took much longer than the staminate ones to open completely. During the pause phase of the inflorescence, pistillate buds increased in size and developed their final color. The stigmas remained whitish-yellow and moist for about 2–3 days and were probably receptive that long. Thereafter, they turned brownish and dry, but did not fall off. A few days later it was already possible to distinguish between fertilized and unfertilized flowers, as the former started to develop into fruits.

Out of all 30 individuals found in the finca, 60% flowered and 53% bore developing fruits. The presence of inflorescence buds and infructescences in all stages of development suggests that flowering in this species takes place throughout the year. The distance from an inflorescence at pistillate anthesis to one at staminate anthesis was never shorter than 13 m (x = 21.7; 7.5 SD m; n = 15). In the finca we found three subpopulations of *S. warscewiczianus*. They consisted of 15, 12 and 3 individuals, respectively, and were separated from each other by a distance of at least 1200 m. We found no individuals of this species in the forest between the three patches. In the smallest subpopulation, only one inflorescence came into anthesis during the study period, and did not develop any fruit.

*Pollination***.** The Vaseline-covered slides placed near the inflorescences at anthesis did not receive any pollen grain of *S. warscewiczianus* and received very little pollen of other plants. At least 76 species of insects and other arthropods, belonging to seven orders (Table 2), visited the flowers at anthesis, but only 48 species visited flowers of both sexes. The vast majority of visitors (71) came to the staminate flowers. During the opening of the bracts there were no visitors other than the omnipresent ants and some spiders. In the first days of anthesis, visitors were sporadic. Even at full anthesis there were days without any visitor, especially during rainy days. At night we did not observe any visitors, except for some mosquitoes resting and flying around the rachillae, probably attracted by the flashlight.

The first visitors to arrive at staminate flowers at anthesis were bees (Apidae), which came in small numbers (up to 10 at a time) and busily collected pollen and nectar. They flew spirally around the inflorescence and inspected the rachillae for about 15 seconds each, depending on the amount of pollen available. The activity of the bees was highest in the mornings and decreased as time passed by. Another important visitor group were beetles. They were represented by seven families, out of which Curculionidae and Chrysomelidae were the most diverse. The most conspicuous beetles were the black and yellow *Pyrophorus* sp. 1 (Elateridae), about 3 cm long, and *Cholus* sp. 1 (Curculionidae). The beetles sucked nectar or fed on floral tissue, and some of them were observed only once and in small numbers. The most frequent species were the Alticinae sp. 1 (Chrysomelidae) and Galerucinae sp. 1

Table 2. Insect visitors to staminate and pistillate flowers of *Synechanthus warscewiczianus* at the Pacific coast of Colombia

	Staminate inflorescence	Pistillate inflorescence
Hymenoptera		
Apidae		
Trigona branneri	O	
Trigona tetragona dorsalis	XX	O
Trigona sp. nov.	O	O
Partamona aequitoriana	XX	O
Noguerapis mirandula	O	
Ptilotrigona lurida mocsarya	O	O
Trigonisca sp. 1	O	
Trigonisca sp. nov.	O	O
Formicidae		
Camponotus sp. 1	O	O
Ectatoma sp. 1	O	O
Ectatoma sp. 2	XX	O
Gnamptogenys sp. 1	O	O
Hypoponera sp. 1	XX	XX
Pseudomyrmex sp. 1	XX	XX
Atta cephalotes		O
Paraponera sp. 1	O	O
Paraponera sp. 2	O	
Vespidae		
sp. 1	O	O
sp. 2	O	
Coleoptera		
Chrysomelidae		
Alticinae sp. 1	XX	O
Alticinae sp. 2	O	
Galerucinae sp. 1	O	O
sp. 1	O	
sp. 2	O	
Curculionidae		
Terires sp. 1		O
Phyllotrox sp. 1		O
Cholus sp. 1	O	
Elateridae *Pyrophorus* sp. 1	O	
Cerambicidae sp. 1	O	
Carabidae sp. 1		O
Meloidae sp. 1		O
Lampyridae *Cratomorphus* sp. 1	O	
larva sp. 1	O	O
larva sp. 2	O	O
Diptera		
Conopidae sp. 1	O	
Muscidae		
sp. 1	XX	O
sp. 2	XXX	XXX
Syrphidae		
Metasyrphus sp. 1	O	
Ocyptamus sp. 1	O	
Copestylum sp. 1	XX	XX
sp. 1	O	O
sp. 2	O	O
sp. 3	O	
sp. 4	O	O
sp. 5	O	

Table 2. Continued

Leptogastridae		
Leptogaster sp. 1	O	O
sp. 2	O	O
Platystomatidae sp. 1	O	O
Empididae		
sp. 1	XXX	XXX
sp. 2	O	O
Drosophylidae		
sp. 1	XXX	XX
Drosophila	XXX	XXX
Syringogastridae *Syringogaster* sp. 1	O	
Otitidae sp. 1	O	O
Mycetophilidae sp. 1	XX	O
Sciaridae sp. 1	XXX	XX
Phoridae sp. 1	O	
Simulidae sp. 1	XX	XX
Diptera sp. 1	O	O
Orthoptera		
Tettigoniidae sp.1	O	O
Gryllidae sp. 1	O	O
Dictyoptera		
Anthocoridae sp. 1	O	O
Arachnida		
unidentified spiders (12 sp.)	O	O
Homoptera sp. 1	O	O
Hemiptera		
Miridae	O	
Pseudoscorpionidae	O	

O = < 5 individuals/inflorescence (simultaneously)

XX = 5–25 individuals/inflorescence

XXX = >25 individuals/inflorescence

(Chrysomelidae), which used the inflorescences as a place to copulate and feed on rachis and floral tissue, but did not move much. There were never more than ten of them, and they were the only species which sometimes remained overnight on the inflorescences.

The most frequent visitors to flowers of both sexes were flies, represented by 25 species in 13 families. Of these, the Syrphidae were the most diverse, with eight species. Muscidae, Drosophilidae, Empididae, and Leptogastridae had two species each. The Drosophilidae sometimes arrived in hundreds to suck nectar and apparently to eat pollen and they used the site to copulate and seemingly to oviposite, although we never observed any Diptera eggs or larvae. The Muscidae sp. 1, Leptogastridae sp. 2, Syrphidae sp. 2, and Syrphidae sp. 3, all of them fat and sometimes metallic-colored flies, came by the dozens, but frequently they were sedentary and with little interest in the flowers. At staminate and pistillate anthesis, it was often possible to find about ten Simulidae sp. 1 and *Copestylum* sp. 1 (Syrphidae) moving rapidly among the flowers and the rachillae, and flying around the inflorescences. They licked nectar and repeatedly touched the anthers and the stigmas. The Muscidae sp. 2, the only species of Sciaridae, and Empididae sp. 1 came frequently in dozens to both sexes to suck nectar and eat pollen, moving from flower to flower. All other species of Diptera came infrequently, in small numbers and did not show much interest in the flowers themselves. Most other visitors were occasional.

Discussion

Due to the absence of pollen grains of *S. warscewiczianus* on the 24 Vaseline-covered slides

placed near inflorescences at anthesis, we conclude that wind pollination of this species, if any, is probably insignificant. As a matter of fact, wind in the habitat of the palm is rarely of any significant strength. The production of nectar and the appearance of the inflorescences also indicate entomophily, as do the numerous insect visitors.

Out of the 48 species of insects and other arthropods that visited flowers of both sexes, only beetles, bees and flies deserve any discussion as potential pollinators. All other visitors were occasional or did not move frequently among the flowers. The two chrysomelid beetles (Alticinae sp. 1 and Galerucinae sp. 1) can be ruled out as efficient pollinators, because they came only in small numbers and rarely moved between inflorescences – they remained inactive for hours on the rachis, and only rarely visited the flowers. Their role as pollinators, if any, is probably occasional.

Bees were frequent and collected pollen on the staminate flowers but rarely visited pistillate flowers, where they just licked some nectar and went off. Sometimes they only circled the inflorescence without landing on it.

The most common visitors in both staminate and pistillate phases were the flies. The Muscidae sp. 1 and the Mycetophilidae sp. 1 visited flowers of both sexes but their role as pollinators, if any, is probably minor, as they mostly rested among the rachillae. Although the Mycetophilidae are known to carry out pollination in different plant species (Vogel 1978), they have only recently been recorded on palm flowers (Borchsenius 1993).

Drosophilid flies came in hundreds, moved frequently among flowers and rachillae, licked nectar from the flowers, which they frequently touched with their bodies, and used the rachillae as a place to copulate. They have the ability to fly long distances (Bernal & Ervik 1996), but those captured at pistillate flowers did not carry any pollen grains of *S. warscewiczianus*. In other studies, drosophilids have also been found to carry no pollen or only small amounts, when visiting pistillate flowers of the palms *Aiphanes erinacea* (Borchsenius 1993), *Aphandra natalia* (Ervik 1993) and *Phytelephas seemannii* (Bernal & Ervik 1996). Although in some cases they do effect pollination, for example in *Nypa fruticans* (Essig 1973) or *Geonoma macrostachys* (Olesen & Balslev 1990), Schmid (1970) and Borchsenius (1993) ruled them out as pollinators of *Asterogyne martiana* and *Aiphanes erinacea*, respectively. We follow their considerations, but include the drosophilids as potential secondary pollen vectors.

The remaining flies appear to have a more relevant role, and they deserve a more detailed discussion. At both phases of anthesis there were always about ten individuals of Simulidae sp. 1 and *Copestylum* sp. 1 (Syrphidae) running and flying actively among the flowers. They came to lick nectar and maybe to eat pollen. The other syrphids were uncommon and sedentary when visiting the flowers. Syrphid flies and especially the most common *Copestylum* are well known as efficient pollinators of many plant species (Schmid 1970, Borchsenius 1993, Zona 1987). Although Simulidae are not often observed as visitors to palm flowers, they were the only species that carried pollen of *S. warscewiczianus* on their bodies, although in small amounts. The Sciaridae sp. 1, Empididae sp. 1 and Muscidae sp. 2 were common at both phases too, with 25–100 individuals at a time and were highly active around the flowers, eating nectar and pollen, and copulating. They often touched anthers and stigmas with different parts of their bodies. The Sciaridae have been recorded as pollinators in some plants (Vogel 1978) and contribute to it in *Aiphanes erinacea* (Borchsenius 1993). The Empididae have been reported as palm flower visitors in *Asterogyne martiana* (Schmid 1970) and *A. erinacea* (Borchsenius 1993). We therefore suggest that *Copestylum* sp. 1 (Syrphidae), Simulidae sp. 1, Sciaridae sp. 1, Empididae sp. 1 and Muscidae sp. 2 could be the principal pollinators of *S. warscewiczianus* at the study site, because of their high numbers and their activity around the flowers of both sexes.

Fly pollination in *S. warscewiczianus* is not surprising, as this palm exhibits many traits of the myophilous pollination syndrome described by Faegri & Van der Pijl (1979), Henderson (1986) and Borchsenius (1991) – the simple, open form of the small flowers with no depth effect, the easily accessible anthers and stigmas, the yellowish color of the flowers and the rachillae, which is preferred by some flies, the absence of any scent, the diurnal anthesis with relatively long individual phases and the small number of flowers open at a time. Henderson (1986) suggested that fly pollination is frequent in small undergrowth palms. Although the predictive value of pollination syndromes has been challenged (e.g., Consiglio & Bourne 2001, Listabarth 2001) and it is deemed wise to apply them with caution unless complemented with empirical studies and data (Johnson & Steiner 2000), in the case of *S. warscewiczianus*, the pollination syndrome appears to be a good indicator of its pollination mechanism.

In *S. warscewiczianus* fruit set is very low (0.094), compared to the average fruit set of monoecious

plants (0.58) (Sutherland 1986). In spite of its low fruit set, however, the average number of fruits per infructescence was high, and sexual reproduction appears to be predominant in this species. This is supported by the high viability of seeds (Bernal pers. obs.). The high proportion of cespitose individuals with only one flowering stem, combined with the temporal separation of staminate and pistillate phases in the inflorescence precludes geitonogamy and favors xenogamy.

Acknowledgments

Special thanks go to M. Naranjo-Berg for encouraging this study in his finca, and J. P. Pantoja-Pantoja and his family for the help during fieldwork. The University of Applied Sciences Eberswalde supplied microscope and laboratory facilities. We thank L. A. Nuñez-Avellaneda for his help in determination of insects. We are also grateful to the following specialists who identified the visitors: D. Roubik and V. Hugo-González (Apidae), C. O'Brien (Coleoptera: Curculionidae), and E. Palacio (Hymenoptera, Formicidae).

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Transfer of *Syagrus campicola* to *Butia*

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Syagrus campicola (Barb. Rodr.) Becc. was first described in the genus *Cocos* by the Brazilian botanist, João Barbosa Rodrigues (1900). Later it was transferred the genus *Syagrus* by Beccari (1916). Recent work on the species in studying the relationships of this species to other Butiinae (*Syagrus, Butia, Allagoptera, Lytocaryum*, etc.) shows that this species should be transferred to *Butia*. Characteristics the leaf anatomy, peduncular bract and endocarp pore position agree with those of *Butia*. Although the combination appeared in print several years ago (Henderson et al. 1995), the formal nomenclatural transfer had not been made. The new combination is made here.

Butia campicola (Barb. Rodr.) Noblick, comb. nov.

Cocos campicola Barb. Rodr., Palm. Hassler. Nov. 6. 1900. *Syagrus campicola* (Barb. Rodr.) Becc., Agric. Colon. 10: 465. 1916. (Type: *Hassler 5057*)

Acknowledgments

Montgomery Botanical Center funded my 1991–1994 post-doctoral position at Fairchild Tropical Garden and my 1996 and 2002 collecting trips to Paraguay. Sincere thanks to Fairchild Tropical Garden where I am a research associate. The impetus for validating this transfer was provided by the National Science Foundation Grant # 0212779 and friends.

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Syagrus coronata and *Syagrus vagans*: Traditional Exploitation in Bahia, Brazil

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***Syagrus coronata* and *S. vagans* are important palms in the lives of local people in northeastern Bahia, Brazil. In this paper their uses are described in detail.**

Several palm species native to Brazil are sources of products used in the commerce and subsistence of local people. In the northeastern state of Bahia, where 15 palm genera grow naturally, approximately 50% of the state is covered by semi-arid vegetation called *caatinga*. The dry season often lasts 7–11 months, and at times rain fails to fall for several years. For a large proportion of the local people the socio-economic conditions are extremely harsh, and in such circumstances palm species frequently become very important subsistence sources. Among these, *Syagrus* stands out, with eight species occurring in the *caatinga*. *Syagrus coronata* (Mart.) Becc. ('*licuri*') and *S. vagans* (Bondar) Hawkes ('*licurioba*'), especially the former, are important economic resources for Bahian people, the contribution of both sometimes accounting for 90% of the people's income (Heiser 1977, Johnson 1982, 1987a, Bondar 1939a, Noblick 1986). *Syagrus coronata* reaches up to 10 m tall, with stems up to 20 cm in diameter. The mature fruits ranging from yellow to orange, with a bony endocarp and a white, oily endosperm. *Syagrus vagans* has an underground stem growing 15–30 cm from the soil surface, with a diameter 10–15 cm and length reaching several meters. The mature fruit is green, with white and oily endosperm but an endocarp not as bony as that of *licuri*.

Sousa (1587) was the first to comment on the usefulness of *Syagrus coronata* fruits as food. Bondar (1938, 1939a, b, c, 1941, 1942) carried out studies on the taxonomy, economic uses, chemistry and conservation of the species. *Syagrus coronata* is still the source of products for the wax and soap industries, and local people manufacture many folk products from the leaves, stems and petioles. In the past few years, the palms have come to be regarded as weeds in the Brazilian

1. *Syagrus coronata, licuri,* in Bahia, Brazil.

semi-arid regions and have been cut down and eradicated by local farmers.

The relationship between *Syagrus* and local people in the Bahia semi-arid *caatinga* is no different now than it was in Bondar's times. The palms are exploited by poor families using traditional methods. The aim of this present paper is to explore the roles of *Syagrus* species in the daily activities of people from the Bahian *caatinga*.

Material and Methods

The present study was carried out in two localities: 1) Itatim Municipality (12º42'S, 39º41'W), with open *caatinga* vegetation, mean annual temperature 24.3ºC, mean annual precipitation 551 mm and approximately 10,000 inhabitants; 2) Mairi Municipality (11º43'S, 40º09'W), with vegetation intermediate between *caatinga* and seasonal forest, mean annual temperature 23.6ºC,

2. *Syagrus vagans, licurioba*, in Bahia, Brazil.

mean annual precipitation 796 mm and approximately 20,000 inhabitants (CEI 1994). The procedures adopted followed Martin (1995), and the list of uses was made by folk characterization.

Results and Discussion

Bondar (1939 a,b,c) proposed the name *licuri* for *Syagrus coronata* (Fig. 1). Although *licuri* is the name most frequently used, other names such as *ouricuri*, *aricuri*, *nicuri*, *coqueiro dicori*, *coqueiro-cabeçudo-alicuri* and *baba-de-boi* are also used occasionally. In semi-arid Bahia, *S. vagans* is called *licurioba* (Fig. 2), but other names are used as well, such as *ariri*, *pindoba* and *licurioba-das-caatingas* (Noblick 1986).

Several parts of *licuri* plants are exploited by people in semi-arid Bahia for the manufacture of objects that are sold, and they play an important role the

Table 1: Botanical and common names used in Itatim and Mairi (Bahia, Brazil) for some parts of *licuri* plant.

Part of Plant	Common Name (Portuguese)
stem	trunk ("tronco")
young leaf	eye ("olho")
old leaf	straw ("palha")
closed inflorescence	busa ("busa")
open inflorescence	bunch ("cacho")
fruit	coco ("coco")
endocarp	husk ("casca")
nut	coquinho ("coquinho)

local subsistence economy. For each part, a common name is used. A list of several exploited parts of palms and corresponding common names are given in Table 1

Palm leaves in the economy of Itatim

Products from *licuri* and *licurioba* leaves are the chief subsistence source for Itatim people. Among all artifacts manufactured locally, hats stand out for the huge amounts that are steadily commercialized in the public market and along the Itatim sector of BR-116, a road that spreads out from the north to the south of Brazil. The commerce of hats is of such regional importance that it has elicited a spontaneous economic hierarchic stratification of Itatim society (Fig. 3). Five strata can be recognized in the city, members of one hierarchy showing no ambition to shift from one stratum to another.

Young leaves ("eyes," see Table 1) are collected when the trees are over five years old. Throughout the year, a leaf of each tree is cut once a month and left to dry in the sun. Leaflets are detached, and 40–50 of them are gathered in tight bundles to be sold in the public market. Such work is carried out by *collectors*, the poorest women and children, who live in rural areas. Each collector sells on average ten bundles a week to members of the immediate upper class corresponding to the *threaders*, who manufacture fiber strands from leaflets for hat production. Threaders are women with a living standard as poor as the collectors. They sell their products to *seamstresses*, women who weave hats from the fiber threads, on average 20 pieces a week. Although still poor, these women enjoy a better living standard than do members of the two lower strata. Their houses are located in the city, although the head of the family is normally a man earning a low salary as a land laborer.

The entire Itatim hat production is sold to only two *intermediate dealers*. Both men are rich local farmers who sell hats to dealers from nearby cities or to *road stand dealers* living at the margins of BR-116 road. This last class is composed of men who sell hats from simple stands along the road. Among road stand dealers, all family members are involved in hat-selling, but such activity is only part of their occupation. The children attend school, and the men spend most of their time in other jobs. At least half of their income stems from hat-selling. There is a seasonal fluctuation in hat-selling, which is more intense when more tourists are around, mainly in June, when the main religious festivities take place in northeast Brazil, and in December–February, a period when most Brazilians take their annual vacation and many people from other parts of the country go to the northeast driving along BR-116.

The above classes of workers and dealers constitute a productive chain, in which profits tend to increase from the lower to the upper strata, although the peak income is reaped by the intermediate dealers. Approximate average weekly incomes derived from hat manufacture and commerce are (in US$): $1.00 for collectors, $1.10 for threaders, $2.50 for seamstresses, $100.00 for intermediate dealers, and $50.00 for road stand dealers.

For the economy of the Itatim population, *licuri* leaves have an importance that far exceeds Bondar's evaluation made in the 1930s and 1940s. The exploitation of the plants' potential could be even more profitable if associations or unions at each professional category were created, along with the establishment of stands of cultivated *licuri* plants around Itatim for leaf production. Such measures could have a positive impact on the local economy, making hat production and commercialization more profitable and possibly reducing the huge income disparities among the various hierarchical classes of producers and dealers.

Fruit processing and nut commerce in Mairi

When pulp is mature (yellow to orange), *licuri* fruits are eaten fresh. They may used as food for

humans, cattle, or chickens. However, inhabitants of the *caatinga* prefer not to feed chickens with *licuri* nuts, even though very often they cannot afford to buy corn for this purpose. It is a reality that apparently arises simply due to an unjustifiable prejudice.

During dry seasons, *licuri* kernels are the only source of income in Mairi. Nuts are obtained by gathering the fruits, removing the pulp and cracking the endocarp to expose the kernel. All these steps are carried out by women and children.

Two methods of collecting *licuri* nuts can be observed. One consists of forcing the fruits to drop from mature infructescences. The fruits are given to cattle, so that pulp extraction and endocarp cracking proceed in the animals' stomach. The bovines chew the fruits and then leave the kernels on the ground. Such kernels, known locally as '*ox licuri,*' are gathered for nut extraction.

The other method consists of cutting the panicles from the trees or, alternatively, in cutting and felling palms just for the purpose of harvesting the fruits. This latter procedure is obviously highly destructive and favors the perpetuation of inferior phenotypic trees, because good fruits are consumed and the fruits from inferior trees are not harvested and give rise to new inferior trees.

The kernels are sold to local markets and distributed for soap production in Bahia State. There are serious problems related to the exploitation of *licuri* fruits, among which the scarcity of hand labor and the income derived from fruit processing, which is exceedingly low. One laborer cracks on average 6 kg per day of *licuri* and sells the product to the local markets at US$ 0.20 per kilogram. The markets sell the nuts to the soap factory at twice that value.

During the fruiting season the commercialized production corresponds to about 25 tons of processed nuts. Although *licuri* fruits more than once a year, in periods between two consecutive fruiting peaks, fruit production is irregular. Fruits are seldom available, and contrary to common sense and market laws, fruit prices go downhill. Two factors explain this paradox: the low quality of the fruits at those periods and the coincidence with the beginning of *babassu* (*Orbignya martiana*) fruiting season in Maranh„o State, when soap producers start to purchase *babassu* nuts from that state. Mechanical procedures for cracking *Syagrus* endocarps are available, but the separation of kernels still has to be done manually. Hence, during low fruiting seasons it is economically not advantageous to keep the cracking machines in operation.

Licuri and *licurioba* are used for several other purposes in the Bahia semi-arid region (Tab. 2). In addition to the use for hat manufacture, the leaves of *licuri* are used to make baskets, brooms, collars for dogs, strings to fasten grafts and tie fish and props to accommodate cattle and game meat. Leaves of both palm species are also used to make hammocks and roofs for rural houses. From the petioles of *licuri*, people manufacture bird cages, and the flowers and fruits of both species are used as cattle fodder. The fresh kernel of both species is eaten by people and used as pig fodder, while *licuri* kernel is used to prepare chicken, bovine and goat feed. *Licuri* kernel is also used to make rosaries, flour, a sweetened food, in addition to being used as raw material for oil extraction. Residues of *licuri* kernel extraction and its endocarps are used as fuel.

The links between *licuri* and people from the *caatinga* are poorly known. At least part of the blame for such ignorance can be assigned to the local people, because they are unaware of the enormous importance of the palms in their daily lives. In spite of the fact that the palms are consciously used, people are still unconsciously moved by the old and socially deep-rooted idea that palms are weeds. This idea has contributed to an increase in destructive harvesting practices. As long ago as 1942, Bondar made claims about the danger of deforestation losses of local *licuri* stands.

Although people in the *caatinga* neglect the value of *licuri* and *licurioba* as important sources of income, such palms are very important for the economy of all social strata of vast areas of Bahia State. In fact, we hope that the data presented here may be useful for the development of strategies to revitalize the local economy. In addition, multidisciplinary work should be implemented in the communities to establish strong conservation procedures for the palms and

Table 2: Some uses of *licuri* in Itatim and Mairi (Bahia, Brasil).

Leaves	**Petiole**	**Flower**	**Fruit**	**Nut**
hats	hutch	forage	*in* natura	*in* natura
broom			cooked	oil
matting				ration

3. Hats made from *licuri* sold at the roadside.

to introduce new and inexpensive technologies for the rational exploitation of palm products.

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PALM LITERATURE

THE PALM BOOK OF TRINIDAD AND TOBAGO, INCLUDING THE LESSER ANTILLES. Paul L. Comeau, Yasmin S. Comeau and Winston Johnson. The International Palm Society, 2003. ISBN: 0-9740870-0-9. Price US$39.95, soft bound. Pp 108.

One of the features I often regret about popular palm books is that they are large and heavy, and they do not always make good company in my backpack. Smaller books, like our *Field Guide to the Palms of the Americas*, are sometimes too comprehensive, so, when you travel into a particular area, you are carrying along lots of information on species that you are not likely to find in that area. That is why I now favor books aimed at smaller political or geographical regions. *The Palm Book of Trinidad and Tobago*, concise and lavishly covering the 22 species native to these Caribbean islands, is one such book.

The book includes useful guides for identification, including a user-friendly, schematic, pictorial key. The information provided for each species is quite complete, including a concise description and paragraphs listing the distinguishing features and the species that are likely to be confused with it, common names, general distribution, habitat, uses, as well as information on known or suspected pollinators and dispersers, and a complete discussion of the species' status and distribution. The accompanying map for each species shows the distribution in great detail, a valuable tool for adventurous palm-watchers. The abundant color photos will be of great aid in identifying the palms in the field, and they provide a beautiful visual tour for those who cannot make it to the islands. Particularly useful among the photos are those of the seedlings, not often available in most works of this kind.

Several additional chapters contribute to the value of the book – a discussion of palms exhibiting peculiar distributions (although one might disagree with the hypothesis put forward on the distribution of *Euterpe oleracea* and *Manicaria saccifera*), a chapter on the palms of the Lesser Antilles, one on introduced palm, a glossary (perhaps too detailed and including terms like bee, beetle, ecology or macaw), and two interesting chapters explaining the origin of the scientific and common names – a nice addition that will help people to appreciate both Latin and local names of palms, and will avoid the unnecessary coinage of English names for them.

The taxonomy and nomenclature of the book are updated, yet I found two changes that will be needed. First, the wild relative of the peach palm (*Bactris gasipaes*) is cited as *Bactris macana*, a name currently considered as a synonym of *Bactris gasipaes* var. *chichagui* after Henderson's revision of the genus in 2000. The other misapplied name was just beyond the authors' control. The palm they call *Astrocaryum aculeatum* should be called *Astrocaryum tucuma*. The name *Astrocaryum aculeatum* has been misapplied to the cuyule or tucumá palm for many years, but I have shown, in a paper currently in press in the journal Taxon, that this name was actually given by Georg Meyer to a small palm of the Amazon, currently known under the wrong name *Astrocaryum gynacanthum*. These changes make evident the fast pace of our understanding of neotropical palms.

The Palm Book of Trinidad and Tobago will be a valuable tool for increasing awareness of palms among the inhabitants of these tropical islands, and will be a nice companion for palm fans visiting the region.

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ERRATUM

Hodel, D. S., D. R. Pittenger, A. J. Downer & W. E. Richie. 2003. Effect of leaf removal and tie up on juvenile, transplanted Canary Island Date Palms (*Phoenix canariensis*) and Queen Palms (*Syagrus romanzoffiana*). PALMS 47: 199–184.

On page 184, in the first column of Table 6, the names of the two palm species are transposed.

CLASSIFIED