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PRINCIPES

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Principes, 42(1), 1998, p. 3

Editorial

We are starting 1998 by trying a new format for *Principes.* The news and a schedule for the Biennial in Thailand are together in a center section that can be removed. As you undoubtedly realize we have been experimenting with different ways to do Chapter News and Events. We would very much like your comments.

We are fortunate to begin this new year with articles on several exciting discoveries of and about palms. Martin Gibbons and Tobias Spanner relate how they discovered that the "Windamere palm" was yet another undescribed species of *Trachycarpus,* one that has the widest leaf segments in the genus, and is certain to be eagerly sought after.

Rodrigo Bernal describes a new growth form for palms, as shown in *Phytelephas seemannii.* The species is capable of a "rolling" motion by which it follows light in dense forests and has other features that make it "potentially immortal."

The terrain in New Caledonia is extremely mountainous with hidden slopes and valleys, many not easily accessible. The last treatment of the palms of the island was that of Moore and Uhl in 1984. Jean-Christophe Pintaud, a French student at Toulouse University, is doing a reassessment of the palms as a Ph.D. project. He has spent over two years on the island and has explored many remote areas. In this issue we present a new treatment of *Kentiopsis* by Jean-Christophe and Don Hodel. They have discovered two new palms that form a continuum between *Kentiopsis* and *Mackeea,* a genus described by Dr. Moore in 1978, just two years before he died. Jean-Christophe and Don conclude that, with their new discoveries, *Mackeea* is best considered as a species of *Kentiopsis.* The resulting *K. magnifica* remains the largest palm on the island. The two new palms are also described as species of *Kentiopsis,* a genus now including four species, all of which are large, most attractive, and desirable, as can be seen in the centerfold photos.

Another new and important find is revealed in Rolf Kyburz's article on a visit to Cuba where he saw what appears to be a colony of *Hyophorbe amaricaulis,* growing and reproducing, but mislabelled in the garden. Many will realize that the only surviving tree of the species is not producing viable seeds. Some new information on another interesting palm, *Phoenix acaulis,* is given us in an article by Shri Dhar.

John Dransfield unravels the complex taxonomic history of the genus *Pigafetta* and describes how he came eventually to agree with what the growers had always maintained—that there are two species in the genus. Remarkably, both species were recognized as distinct long ago last century and earlier still, and so there has been no need to describe and name a new species.

We are often reminded that palms may represent some of the oldest seed plants. Aldicir Scariot has studied the dispersal and plundering of seeds of *Acrocomia aculeata* in Brazil. Dispersal of the seeds appears to be mediated by cattle, which may have taken over from large Pleistocene mammals.

Finally, Don Tollefson, in an interview with Dr. Merrill Wilcox, presents excellent information on how to cross *Butia* and *Syagrus.* The resulting hybrid is well known and has many desirable characteristics.

In view of the controversy about ecosane, we will be running several articles on its use in the April issue.

With best wishes for 1998 to all IPS members.

NATALIE UHL
JOHN DRANSFIELD

Principes, 42(1), 1998, pp. 3–4

Note from the President

Since my last message to you, we have finalized plans for the 1998 International Palm Society in Thailand and I wish to formally invite you to attend. Our host, Kampon Tansacha, and Nong Nooch

Tropical Gardens have gone to great lengths to ensure that this will be one of the best Biennials ever! There are some changes from the previous announcement. Please refer to the printed announcement and registration form that are attached to the center of this issue of *Principes* and can be carefully removed for your review and registration.

The dates of the Biennial are as follows. Delegates should arrive in Bangkok on Thursday, September 10, or Friday, September 11. The Biennial formally begins Saturday, September 12 and ends on Friday, September 18 with departure home that same day for those not attending the Post Tour. The Post Biennial Tour of South Thailand begins Friday, September 18 and ends with a return flight to Bangkok on Wednesday, September 23 and departure home on Thursday, September 24. Please note that the deadline for registration is July 15, 1998.

The Biennial will be in Central Thailand and the Post Biennial Tour in Southern Thailand. Native populations of palms will be seen on both. Our original itinerary was altered after much consideration of logistical problems and to make things easier for those attending just the Biennial.

The Biennial itself will begin in Bangkok with an unforgettable tour of Chatujak markets and a visit to Khun Pasat's Garden. We will then venture to the Khao Yai Nature Reserve about 120 km from Bangkok. There we will see native populations of *Licuala, Areca, Calamas, Plectocomiopsis, Korthalsia, Arenga,* and *Livistona.* We will then go to Pattaya and visit Nong Nooch Tropical Gardens. Planned there are many garden tours, excursions, cultural events, an elephant show, guest speakers, and a memorable special event, Loi Khratom, on the lake at Nong Nooch Village. The Biennial will culminate with a tour of the Grand Imperial Palace back in Bangkok.

The Post Tour departs by airline south from Bangkok to Narathiwat and the Sungai Ko-lok district. We will visit the Proh Toh Deang Nature Reserve to see species of *Eleiodoxa, Licuala, Areca, Calamus, Pinanga,* and *Nenga* and the Balahala Reserve to see species of *Pholidocarpus, Orania, Oncosperma, Iguanura,* and different *Licuala* and *Pinanga.* Another flight will take us to the Phuket area where we will see more stands of native palms, including *Salacca, Kerriodoxa, Pinanga,* different *Licuala,* and *Cycas clivicola.* There will be free time in Phuket for sightseeing, beaches, shopping, and for those so inclined more palm habitats at nearby Phang Nga.

Please note that your registration fee includes your hotel costs and many meals as described in the attached registration information. We have negotiated very competitive rates for the hotels utilized, all of which are quite nice. I am sure that you will find the registration fees are quite appealing considering the value you will be receiving during both events. Remember to register promptly and I hope to see all of you in Thailand next September.

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Biennial Registration

See the center insert for full information and registration forms for the September 1998 IPS Biennial in Thailand.

Principes, 42(1), 1998, pp. 5–8

Seed Dispersal and Predation of the Palm Acrocomia aculeata

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Dispersal can increase the probability that a seed will find an adequate site in which to establish, thus reducing the level of seed predation and introducing the plant to another still unoccupied habitat. The seed stage represents one of the periods of highest mortality in the life cycle of many plant species and substantial reduction of seed crop due to predation may affect the distribution and abundance of plants. Mammals can be quite effective at transporting seeds and increasing the probability that a seed will find an adequate site. In disperser-free habitats, seeds may lie under parent tree and rot (e.g., *Acrocomia*, Janzen 1983a). However, seed dispersers may also act as seed predators or increase the risk of predation by attracting predators.

This study addresses three issues: the possible role of wild and domestic animals as seed consumers and dispersers, their possible effect on seed predation, and the rates of seed predation by bruchid beetles on the palm *Acrocomia aculeata* (Jacq.) Lodd. ex Mart. in Central Brazil. It complements other studies on pollination, phenology, and fruit set (Scariot et al. 1991, 1995).

Methods

The study was conducted on a privately owned farm, Fazenda Taboca, located 45 km (15°35′S, 47°45′W) from Brasília, Brazil. The elevation at this farm is 1,000 m. Mean annual rainfall is 1,566 mm and the temperature ranges from 19° (June) to 23° C (September). *A. aculeata* is an arborescent spiny palm reaching up to 16 m in height and occurring as the dominant tree species in pastures of the grass *Hyparrhenia rufa*. Flowering occurs from August to December, with the peak of open inflorescence (>50%) occurring from mid-October to mid-November (Scariot 1987, Scariot et al. 1991, 1995). The fruits are globose-spheric, weighing 20–64 g, and measuring 28–49 × 26–49 mm. Generally, there is one seed per fruit, but sometimes two and even three seeds occur. Several aspects of the reproductive biology have been discussed elsewhere by Scariot (1987) and Scariot et al. (1991, 1995).

"Tomahawk" traps (490 × 170 × 160 mm), with fruits of *Acrocomia aculeata* as bait, were used to capture possible dispersers. One hundred forty-three traps per night were used in the pasture and 454 traps per night in the gallery forest. Success was the number of animals captured divided by the total number of traps used per night. Captured animals were released after identification. Adjacent gallery forest was included in the study because there were few wild animals in this region due to deforested areas, and some plants of *A. aculeata* may occur in forest edges. The role of domestic animals in dispersal was observed using binoculars, during the day and by naked eye at night.

The rate and intensity of predation were determined using 14 boxes. A box consisted of a wood frame (400 × 200 × 150 mm) covered with wire mesh. The mesh size (15–20 mm) allowed insects access to the inside of the box, while impeding the entrance of larger animals. The boxes were placed in the pasture on 13 October 1985, under the crowns of individuals of *Acrocomia aculeata*. The boxes, each with 20 fruits, were paired, one with intact fruits and the other with fruits from which pulp was partially removed to mimic fruits chewed by cattle. The boxes were placed approximately 0.5 m from the trunk at an angle of 180° to each other. All the previously fallen fruits under the canopy were collected and removed on the day that the boxes were placed in the field. No oviposition was ever observed on the fruits while they were still attached to the infructescences. On each of the first five days after placing these boxes, and later at irregular intervals, I recorded the number of fruits in which beetles had oviposited and the number of eggs per fruit. When oviposition on the fruits was finished, I collected the fruits and opened them to check the seeds and identify the predators.

Results

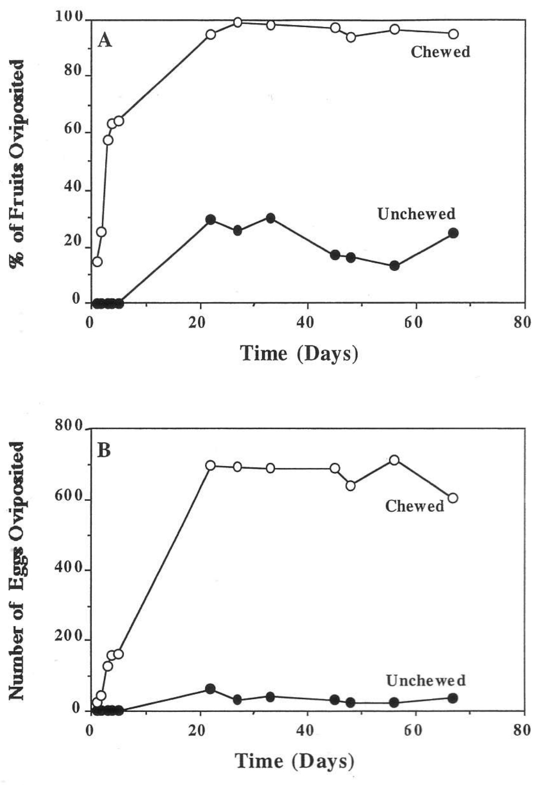
Only a few species of animals were captured and not all of them may consume the fruits of *A. aculeata.* The species of vertebrates captured were *Didelphis albiventris* (opposum, 31), *Nectomys squamipes* (water rat, 8); *Cebus apella* (capuchin monkey, 1), and *Turdus* sp. (thrush, 2). Overall capture success rate was 7.0%, being higher in the gallery forest (8.3%) than in the pasture (2.8%). Of the domestic animals that fed on fruits of *Acrocomia aculeata,* only adult cattle ingested them, while horses, pigs, and young cattle only chewed the fruits, removing the epicarp and mesocarp. Fruits ingested by adult cattle were regurgitated at night in piles of up to 85 fruits. Cattle regurgitated seeds mixed with residues of grasses, and the seeds usually had either portions of the epicarp and/or mesocarp attached, or only the endocarp.

The bruchid beetles *Pachymerus* sp. and *Caryobruchus acrocomiae* (Pachimerinae, Pachimerinii) preyed on seeds of *A. aculeata.* The adult *C. acrocomiae* feeds on pollen, remaining during the day under dead leaf sheaths and in the leaf sheath of *A. aculeata.* At night they oviposit on fallen fruits. After oviposition the larvae perforate the exocarp and mesocarp (if present), and finally the endocarp, reaching the seed. More than one larva can reach the seed, but only one reaches the adult stage, which suggests that the first larva reaching the seed cannibalizes the others. By the final instar, the larva consumes almost all (*Pachymerus* sp.) or all (*C. acrocomiae*) of the seed. An operculum, visible from outside the fruit, protects the insect from contact with the external environment and opens when the adult bruchid emerges. In the experimental seeds *Pachymerus* sp. (13 individuals) was more abundant than *C. acrocomiae* (6 individuals).

After three days on the ground >50% of the chewed fruits in boxes had at least one bruchid egg, and after 27 days, 99% had eggs deposited on them, suggesting that chewed fruits had a higher level of oviposition than unchewed fruits (Fig. 1A). The high number of eggs per fruit (up to 15) suggests that female bruchid beetles do not discriminate among fruits with or without eggs during oviposition (Fig. 1B). Cattle destroyed some boxes and removed the fruits, reducing the final number of fruits in boxes to 97 chewed and 75 nonchewed. Of 101 seeds in 97 chewed fruits, 76.2% were preyed by insects, 19.8% were intact, and 4% were nonviable (absent, rotten, etc.). Of 75 seeds in 75 nonchewed fruits only 10.6% were preyed by insects and 89.4% were intact. Thus, chewed fruits had a significantly higher predation level than nonchewed fruits ($\chi^2 = 77.17$, df = 1; $P < 0.001$). Eggs of bruchids may be washed away by the rain. This may account for the observed decreased percentage of fruits oviposited (Fig. 1A) and number of eggs layed (Fig. 1B), which after some time increases again as the layed eggs accumulate.

Discussion

An advantage of seed dispersal by several species is an increase in the number of possible habitats and the number of seeds dispersed (Gautier-Hion et al. 1985, Howe and Primack 1975). However, due to their small size and feeding behavior, the wild animal species captured in this study can be considered only as possible dispersers. As a result of environmental disturbance and hunting, the number of species and the abundance of wild fauna have been drastically reduced in the study area. In fact, in this area the wild fauna were represented only by small animals that are not important for the dispersal of *Acrocomia aculeata.* In the Pantanal (a wetland area in Mato Grosso and Mato Grosso do Sul states, Brazil), where fruits of *A. aculeata* are smaller than in my study sites (personal observation), endocarps were found to constitute 63% of the volume of 69 fecal samples of *Cerdocyon thous* (crab-eating wolf, J. C. Dalponte, personal communication). Schaller (1983) also found endocarps in 22% of 36 fecal samples of *C. thous* in the same area. These observations implicate *C. thous* as a disperser of *A. aculeata* in the Pantanal, and perhaps in other areas where fruits are smaller than in my study area. In the Pantanal region, the macaws *Anadorhincus hyacinthinus* and *Ara chloroptera* feed on seeds and transport rachillae of *A. aculeata* with fruits attached, which eventually fall during the flight (C. Yamashita, personal communication). However, in



1. Oviposition by bruchid beetles on fruits of *Acrocomia aculeata* either chewed or not chewed by cattle. (A) Percentage of fruits oviposited. (B) Number of eggs per fruit.

my study area these species do not occur. Bates (1944) reported the vulture *Cathartes* sp. eating *Acrocomia* fruits, although nothing else is known about this species as a potential disperser.

Among domestic animals, only adult cattle that ingest the seeds and disperse them by regurgitation have importance as dispersers. This observation differs from Janzen's (1983a) observations in Costa Rica where he reported that the seeds were dispersed in the feces of cattle. The fact that horses, pigs, and young cattle partially remove the pulp without ingesting the seeds reduces the potential of additional dispersal because these fruits attract less or no attention from potential dispersers.

Long-distance dispersal or the wide distribution of this palm in the Neotropics are not explained by wild or domestic animals except for the adult cattle cited here. However, *Acrocomia aculeata* occurs only in disturbed habitats and it is possible that cattle herds moving along roads, in pasture lands and between farms are the major contemporary seed dispersers. It is also possible that the wide geographic distribution results in part from use by Amerindians (Kozak et al. 1979, Hill et al. 1984, Baleé 1989), as South American Indians used seeds of *A. aculeata* (Levi-Strauss 1963), and the Chaco Indians used seeds of *A. totai* (Métraux 1963) as food. Also, Turner and Miksicek (1984) found a mineralized seed of *Acrocomia* in Maya sites in Guatemala, which suggests possible ancient use of the species by these people in Central America. Lentz (1990) suggested that it was introduced in some sites in Mexico and Central America by the Maya. It is also possible that *Acrocomia* is one of the large-seeded plant species whose fruits were consumed and dispersed by large Pleistocene mammals (Janzen and Martin 1982). According to this hypothesis, cattle are now an ecological analogue of these Pleistocene dispersers.

The strong odor from recently chewed fruits may serve as a cue for oviposition. The high rate of oviposition on individual fruits may be due to low fruit abundance in comparison to the female bruchid population. Indeed, a bruchid female can lay 50–100 eggs, serving an equal number of fruits (Janzen 1980). Oviposition on recently fallen fruits increases the probability that the first larva to reach the seed may have a competitive advantage over subsequent larvae. However, female bruchids that lay eggs on intact fruits may have a competitive disadvantage in relation to those that use chewed fruits, as intact fruits are still available for fruit eaters that could destroy the eggs and young larvae. Thus, early oviposition can be advantageous for the insect in areas with either no or low density of fruit eaters. Conversely, regurgitated seeds may attract fewer consumers; in this way there is less risk for oviposited eggs or young larvae, but larvae have to face strong competition to reach the seed because oviposition is significantly higher.

The seeds of *A. aculeata* are poorly defended chemically (Janzen 1983b). However, they can escape predation in space via dispersal, and via morphology. Escape via dispersal may be affected in populations that have high levels of cattle chewing on fruits. However, fruits falling on the small, dispersed shrub patches occurring in the pasture may not suffer high bruchid oviposition as they cannot be reached by cattle (personal observation). Escape via fruit morphology arises due to the hard endocarps, which eliminate a large number of generalists (Janzen 1971), but do not impede predation by specialized bruchids such as *Caryobruchus acrocomiae* and *Pachymerus* sp.

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Amazon Palm Safari—August 4–15, 1997

In mid-August, 14 members of the International Palm Society, led by Dr. Andrew Henderson, Associate Curator of the New York Botanical Garden, participated in a palm-searching excursion along the Rio Negro in Brazil. Taking advantage of the Amazon dry season, the group arrived in Manaus after a five-hour flight from Miami where we were met and transported to a double-decked river boat, the "Harpy Eagle," our home base for the next ten days. Complete with air-conditioned, double cabins, this all-wood, typical Amazonian river boat, measuring 22 m long with a draft of 1.2 m, was constructed in local Amazonian shipyards.

Our modus operandi while on the river was to cruise upstream by night, anchor in the morning, and begin palm excursions in two motorized launches for hiking ashore or for taking trips up the multitude of streams and tributaries.

(Continued on p. 22)

Principes, 42(1), 1998, pp. 9–10

Hyophorbe amaricaulis in Cuba?

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After attending the IPS Biennial Meeting in Caracas, Venezuela last year, I flew to Cuba. It had been a wish of mine for many years to visit this Caribbean Island nation, partly because I had always been interested in this country for its very rich history. This, after all, had been the base of the Spanish conquest of the Americas, ever since Columbus landed there in 1492.

The main reason for my visit, however, was the rich palm flora, in general, and in particular the genus *Copernicia.* Explorations of such a nature are always best started off in a country's botanical garden. Here, as in most gardens around the world, I found the botanists in charge to be most helpful, informed, and delighted to talk about palms.

I had long walks in the National Botanical Garden of Havana. It became obvious to me that in the given time I had, it would not be possible to see as much as I had hoped. The largest of all Caribbean Islands, Cuba is more than 1400 km from one end to the other by road, and presumably, the palms I wanted to see were not growing along the highway. In the end, I got as far as Sancti Spiritus, one of the very old Cuban cities some 490 km east of Havana from where I had to turn around and get back to the capital and home to my country.

But this is not an account of the beautiful native palms I saw, nor about the wonderful Cuban people I met along this journey. Rather, it is about the discovery of perhaps the only viable colony of what I believe to be *Hyophorbe amaricaulis.*

Some 250 km east of Havana is the city of Cienfuego, a center of industry with a population of about 125,000. From there Cuba's immense sugar production is exported. Some distance from the city is the Botanical Garden of Cienfuego. It is spread over 90 ha, lies 50 m above sea level and has an annual rainfall of 1400 mm. The garden was founded by Edwin F. Atkins, who was one of the first North Americans to buy and further develop a sugar plantation in 1833. By 1901 part of the estate was dedicated to research and study of plants, initially mainly sugar cane varieties. In 1919 the garden became part of the University of Harvard and in 1962 it came under the administration of the Cuban Academy of Sciences. There are some 2000 different types of plants belonging to 670 genera. About 70% of all the plants are exotic. About 280 types of palms can be found here and virtually all Cuban indigenous palms can be studied in the garden. This in general terms is a very fine botanical garden and for students of palms it is excellent.

Very early one morning in June I arrived at the entrance to the garden. After walking for several hours in the garden, I came across a group of palms that looked unfamiliar to me. The label said: *Hyophorbe lagenicaulis*! There was one thing I was very sure of, and that was that this label was wrong! During my travels, I had seen many times specimens of old (60–90 years old) *H. lagenicaulis,* including specimens in the Botanical Garden of Pampelmousse in Mauritius and the Botanical Garden of Durban in South Africa. A specimen of about 70 years of age would have a trunk of about 2–3 m height, tapering to a small crownshaft with reddish, rather short petioles and leaflets. Also the trunk seems to invite a host of small animals, from rats to woodpeckers, giving the palm almost always a very gnarled and rather grotesque appearance.

The palms in this group, however, had a different look. Superficially, I thought there was a certain amount of "family traits," like the tapered trunk, small number of leaves, and "fleshy" petioles. But what set it apart from *H. lagenicaulis* are a taller and less severely tapered trunk and a green color in crownshaft, petioles, and leaves. Leaving this group of palms I concluded that perhaps factors such as age, climactic conditions, and soil type may have changed the appearance of the palms to such an extent that they did not resemble a typical 70 year old *H. lagenicaulis.*

That notion, however, disappeared very quickly some distance away when we came across another group of palms, which looked exactly what one would expect old *H. lagenicaulis* to look like. The label on that group read: *Hyophorbe amaricaulis.*

I had been aware of the lonely plight of what is believed to be the last surviving individual of *H. amaricaulis* in the Curepipe Botanical Garden in Mauritius. More than 12 years ago I had been there to look at and photograph this very palm. I was also aware, that a considerable amount of effort, time, and money had been extended in trying to ensure the survival of this species. This individual in the Curepipe Garden apparently produces seeds with embryos, but it seems that the fruit does not mature properly. Efforts by various institutions with tissue propagation work have so far not been successful.

The hot midday sun suddenly seemed even hotter! I realized that we might have a case of switched names on some seeds that were shipped from somewhere for the collection of this garden by some enthusiastic plant-lover. Back we went for another look. It was definitely neither *H. lagenicaulis* nor *H. verschaffeltii.* So what about *H. vaughanii,* which is also very rare and on the brink of extinction? Again, I had seen this palm 12 years ago in Mauritius and also in the Durban Botanical Garden. I remember thinking at the time, that this palm looked like a stretched version of *H. lagenicaulis,* with reddish crownshaft and leaves, but with a much taller trunk.

What made me even happier was to be told that this group frequently produces viable seeds and that in fact a batch of seedling plants had recently been planted out in the garden. Upon inspecting them, again I could conclude that what I saw in those 1-m plants was nothing like the three *Hyophorbe* species I had grown in my nursery over the years. Both my guide and I were very eager to have a look at the meticulous planting records kept at the garden library. And there it was: Seeds of both *H. lagenicaulis* and *H. amaricaulis* were sent from Mauritius in I think the year 1923!. Somewhere between the collection of the seeds and the planting of the small palms in the garden the names became mixed up and as a result this viable group of *H. amaricaulis* had grown happily under an alias.

Sometime later I came across an article by P. S. Wyse Jackson, Q.C.B. Cronk, and J. A. N. Parnell published in *Botanic Gardens Conservation News,* Vol. 1, No. 6, July 1990, entitled "*Notes on a critically endangered palm from Mauritius, Hyophorbe amaricaulis* Mart." In this paper the authors describe the history of this palm and the efforts that have been made to stop this supposedly last specimen of this palm in the Curepipe Garden from dying and with it this species altogether. The paper also mentions that in a survey of botanical gardens around the world the name of this palm appeared in gardens in India, Cuba, USA, Ghana, Canada, Ireland, Australia, and the UK. When the survey was completed in 1990, all records turned out to be based on misidentification because of earlier reference works that had the two species, *H. lagenicaulis* and *H. amaricaulis,* confused with each other.

Conclusion

It seems to me that when it came to checking the existence of *H. amaricaulis* as recorded in the Garden Archives, it indeed turned out to be *H. lagenicaulis,* since the two names somewhere along their early existence had been mixed up. It remains for botanists to go to Cienfuego in Cuba and identify this palm. I hope that one day someone will write a sequel to this story and announce that this palm has definitely been saved for posterity.

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Phoenix acaulis

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Early this year I accompanied Inge Hoffmann on a search for the little known palm *Phoenix acaulis* in its natural habitat near Dehra Dun, north of Delhi, India. We were joined in our search by Dr. Som Dev Sharma, from Dehra Dun, who knows the whole area intimately. Dr. Sharma arranged permits for us to enter the forest. Near Dehra Dun *P. acaulis* is restricted to a small area not much more than 4 km long. The palm occurs as clumps scattered in forest clearings. The clumps consist of both male and female plants. On excavating one clump we found that the stems grew vertically down, and so the fruits on the female plant are held at ground level. Roots penetrate the sandy ground to great depths in search of water. I have transplanted a few plants to my garden in Calcutta where at present a male and a female have survived.

1. Excavated male plant of *Phoenix acaulis* with old inflorescences. 2. Excavated female plant of *Phoenix acaulis* with almost mature fruit.

3. Natural habitat of *Phoenix acaulis* near Dehra Dun. 4. Group of *Phoenix acaulis* including a female in almost ripe fruit.

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Hybridization—Butia × Syagrus

BY DR. MERRILL WILCOX AS TOLD TO DON TOLLEFSON

I first noticed this unusual hybrid about four years ago when I went to visit Pauleen Sullivan in Ventura, California. It looked a little like a Queen palm, but it was quite different. It was more plumose and the fronds were more recurving. Pauleen informed me that the palm in question was a cross between *Butia capitata* and *Syagrus romanzoffiana* (Queen palm). The next winter I was truly amazed at how this palm grew steadily and rapidly through the winter. By the end of the winter it had begun forming a trunk and its fronds were even more plumose than before. I commented on the palm to Pauleen who responded that it was decidedly a "fast grower."

That same year at the 1992 I.P.S. Biennial in Florida, I spotted a similar hybrid on the grounds of the Fairchild Tropical Garden. It was gorgeous, and sure enough, the name placard revealed that it was a *Butia* × *Syagrus.* Back in Ventura, another year went by and of all Pauleen's many palms, the hybrid was by far her fastest grower, and it was also very striking and very lovely. Each year, Pauleen's hybrid added about two feet of trunk and it currently has about six feet of trunk with an imposing array of fronds.

Then in June of this year (1996) I visited Bob and Marita Bobick in Orlando, Florida and once again I was exposed to a *Butia* × *Syagrus* hybrid. It appeared similar to Pauleen's hybrid and I asked its origin. Bob Bobick informed me that he had obtained it from Dr. Merrill Wilcox, a professor at the University of Florida in Gainesville, and that to his knowledge, Dr. Wilcox was the only person who could intentionally hybridize these two palms successfully.

Back in California, Pauleen informed me that she also had obtained her hybrid from Dr. Wilcox. Recalling that I had sat beside Dr. Wilcox during a rather adventurous jeep ride to the top of Mt. Avila at the 1994 I.P.S. Biennial in Venezuela, I thought I would give him a call and see if he might share some of his hybridizing experience with the International Palm Society. Dr. Wilcox was obliging, so what follows is our conversation.

D.T.: How did you become interested in palms?

M.W.: It occurred after I began teaching at the University of Florida. I was 33 years old at the time. I was from the northern part of the United States, so Gainesville was my first exposure to palms. After a while I began to notice a distinction between palms. Some were pinnate, and some were palmate. I then began to concentrate on this distinction, and shortly thereafter I commented to my roommate about this difference. He not only was aware of it, but he told me also of a hybrid between two of the pinnate palms which occurred infrequently, and resulted in a very rare and beautiful palm.

D.T.: Did this excite your interest?

M.W.: It certainly did, particularly when I discovered that the two parents required for this hybrid were both growing at my apartment complex.

D.T.: How did you become involved in the hybridization process?

M.W.: It was sort of an indirect occurrence. I had a minor in botany, but I had never had a taxonomy course. I was curious enough, though, that I examined the inflorescence of a *Butia.* Upon observing the *Butia* flower, I discovered that the inflorescence looked like a corn tassel with a female flower added. As a young man, I had pollinated corn at Beltsville, Maryland, so I went to the library to obtain literature on palm pollination. The material that I found was about coconut and African oil palms, but figuring they were similar to *Butia* and *Syagrus,* I studied the process.

Editors' Note: The hybrid described in this article was formally named by P. Vorster in *Taxon* 39: 662–663 (1990). Interestingly the name he chose, ×*Butyagrus nabonnandii* (Prochowsky) Vorster, nicely commemorates Nabonnand who first made the cross. Larry Noblick has drawn our attention to the fact that in 1940 [*Rodriguezia* 4(13): 277] Max Burret mentioned the hybrid as occurring in the Rio de Janeiro Botanical Garden. Larry also informs us that the hybrid may occur spontaneously in Uruguay.

D.T.: Can you share your pollination experience with us?

M.W.: Certainly, although it's all in the research material about coconuts and African oil palms. I merely extended the effort to hybridization between *Butia* and queen palms. I start by collecting a queen palm inflorescence. I then put the inflorescence in a paper bag and placed it in an oven at 40° centigrade (approximately 104° F.) for about 20 hours.

D.T.: What does the oven process do?

M.W.: The heat causes the pollen to drop off freely into the bag.

D.T.: Won't the bag catch fire?

M.W.: Not at 40°. I should mention that I use a laboratory oven, but I have on occasion used a standard kitchen oven.

D.T.: Why a paper bag?

M.W.: Because plastic bags create humidity, which kills pollen. After 20 hours, you remove and pound on the bag to loosen the pollen. I like to drop the pollen onto tin foil. Next I use a rolling pin to crush the inflorescence and the male flower to obtain the maximum amount of pollen. I remove the male flowers, and then I sift the pollen through a standard strainer of approximately 40 mesh. This provides pure pollen. Then I store the pollen in a refrigerator, and save it until the female *Butia* flowers are receptive. When the female flowers are ready, I remove the male *Butia* flowers by hand or with a brush, and cover the remaining female flowers on the inflorescence with a plastic bag for 24 hours before the female flowers become receptive. The humidity build up from placing a plastic bag over the *Butia* inflorescence kills any *Butia* pollen that may have remained or perhaps prevents insects from pollinating the *Butia* or both. Then I remove the plastic bag and spread the *Syagrus* pollen on the *Butia* inflorescence with a 10 milliliter hypodermic syringe.

D.T.: A hypodermic syringe?

M.W.: Don't be intimidated by the hypodermic syringe. I use it as a small duster. You could probably just as easily use a salt or pepper shaker. Any seeds that develop should be the offspring of a male *Syagrus* and a female *Butia*. I wait until the seeds are ripe, pick them, and then germinate them. The result should be a *Butia* × *Syagrus* seedling.

D.T.: What happens if you reverse the parents—say a female *Syagrus* and a male *Butia*?

M.W.: I have rarely performed the hybridization process that way because the queen palms are so tall that much of the procedure would have to be performed on a tall ladder, and since it is already quite labor intensive the way I do it, I simply haven't been able to find the time to complete the cross in reverse. Although I have produced reversed seedlings, they have not survived. However, I have seen unintentional hybrids with a female *Syagrus* and a male *Butia* cross and they do tend to look different. They seem to be taller and lacier. In terms of cold hardiness and growth rate, I have not had the opportunity to make any distinctions.

D.T.: What have been your observations as to cold hardiness with the hybrids that you have developed?

M.W.: It's been my observation that the hybrids are usually more cold hardy than the parent queens, but less cold hardy than the parent *Butia*. As between the two parents, the hybrid appears closer to the queen than the *Butia* in cold sensitivity.

D.T.: What about crosses between the *Jubaea chilensis* and *Butia capitata*?

M.W.: I've performed several of those as well. For one thing, the *Jubaea* will not grow for us here in Florida, but the cross will. I have several of the *Jubaea* × *Butia* hybrids growing on my property.

D.T.: Is it because of the cold that the *Jubaea* will not grow in Florida?

M.W.: No, the *Jubaea* is definitely more cold hardy than the *Butia*. Maybe it's because of our humidity or high temperatures. *Jubaea* demands an atmosphere more arid than that of Gainesville.

D.T.: What's the physical distinction between the *Jubaea* × *Butia* and the *Jubaea*?

M.W.: The two are similar. The cross appears as though it may some day be as large as a regular *Jubaea*, so in that respect it's more like the *Jubaea* parent than the *Butia* parent. There's a *Jubaea* × *Butia* at Fairchild Tropical Garden. You can't miss it. It's much more glaucous than the regular *Jubaea*.

(*Continued on p. 54*)

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The growth form of *Phytelephas seemannii*—a potentially immortal solitary palm

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ABSTRACT

I studied the growth form of the vegetable ivory palm *Phytelephas seemannii* on the Pacific coast of Chocó, Colombia. The palm grows in the understory of riverine forests and has a large crown up to 16 m in diameter. The prostrate stem is erect for some distance at the apex and has abundant adventitious roots throughout its length. The palm differs from other plants having Corner's architectural model in that its stem often rots at the older end. Growing at the apex and dying at the base, the palm has no mechanical constraints to indefinite growth, and individuals can be potentially immortal. The creeping aspect of the stem is not due to plagiotropic growth but is the result of oblique orthotropic growth combined with gradual subsidence due to the crown's own weight, accumulated litter, or the impact of falling branches. This growth form is considered as the adaptation of a palm with a large crown to the understory of a frequently flooded forest. The same growth form is noted for the palm *Elaeis oleifera* and the cycad *Zamia roezlii.*

RESUMEN

Se estudió la forma de crecimiento de la palma de tagua *Phytelephas seemannii* en la costa Pacífica de Colombia. La palma crece en el sotobosque de selvas ribereñas y tiene una corona de hasta 16 m de diámetro. El tallo es postrado, erecto en el ápice, y está provisto de abundantes raíces adventicias en toda su longitud. La palma difiere de otras plantas que tienen el modelo arquitectónico de Corner, en que el tallo a menudo se pudre en el extremo basal. Creciendo en el ápice y muriendo en la base, la palma no tiene limitaciones mecánicas para un crecimiento indefinido, y los individuos pueden ser potencialmente inmortales. El aspecto rastrero del tallo no se debe a crecimiento plagiotrópico, sino que es el resultado de crecimiento ortotrópico oblicuo, combinado con una gradual reclinación debida al propio peso de la corona, a la hojarasca acumulada o al impacto de ramas que caen. Se considera esta forma de crecimiento como la adaptación de una palma con gran corona al sotobosque de selvas frecuentemente inundadas. Se señala el mismo hábito de crecimiento para la palma *Elaeis oleifera* y la cícada *Zamia roezlii.*

In spite of their overall architectural simplicity, palms exhibit a wide variety of growth forms (Holttum 1955, Dransfield 1978, Uhl and Dransfield 1987, Tomlinson 1990, Kahn and de Granville 1992). Four of the 23 architectural models described by Hallé et al. (1978) for trees are represented among palms: Corner's model (a solitary, unbranched, pleonanthic axis, as in the coconut); Tomlinson's model (axis branched at base, as in all clustering palms, individual axes being either hapaxanthic or pleonanthic); Holttum's model (a solitary, unbranched hapaxanthic axis, as in *Corypha*); and Schoute's model (dichotomously branched axes, as in *Hyphaene*). Although appropriate for describing the variation in architecture, the models do not describe aspects relevant to the ecological performance of palms, such as size, phyllotaxis, or overall growth form. Dransfield (1978) recognized four basic growth forms for palms, accounting for plant size: tree, shrub, acaulescent, and climbing palms. These categories, however, can hardly accommodate palms with prostrate or creeping stems. Uhl and Dransfield (1987) have briefly discussed the case of palms with prostrate stems, and Kahn and de Granville (1992) have treated them as a separate life form. In this paper, I describe the growth form of the vegetable ivory palm *Phytelephas seemannii* O. F. Cook, discuss its ecological significance, and compare it to that of other species with prostrate stems.

Phytelephas seemannii is a large, dioecious, solitary, understory palm with a thick stem up to 2–6 (occasionally up to 12) m long and 25 cm in diameter. Most of the stem lies on the ground, but its apical part is erect and up to 2–4 m tall. Leaf scars are densely arranged, and those of the lower side are hidden by numerous adventitious roots. The crown usually has 15–35 pinnate leaves to 8 m long and ca. 4.5 kg in weight. Female palms bear up to 20 infructescences in different developmental stages. The mature infructescence is spherical and compact, to 40 cm in diameter and weighs ca. 7 kg.

Phytelephas seemannii ranges from northwestern Colombia to Central Panama. It forms large homogeneous stands (Fig. 1) in the understory of riverine forests that are subject to brief flooding (Bernal and Ervik 1996) with an average density of 352 adult palms per hectare (Bernal, unpublished observations). This species was one of the former sources of vegetable ivory (Barfod 1989, Bernal 1992), and it is the basis of handicraft production in Panama (Dalling et al. 1996) and Colombia.

Materials and Methods

Stem length was measured in all adult palms in two 0.1-ha plots and in a plotless site ca. 0.3 ha (total n [number] = 201) at the Valle and Boroboro Rivers, in the Department of Chocó, on the Pacific coast of Colombia (5°34′–6°04′N, 77°20′–30′W). Sex and state of the stem base (whether complete or rotten above ground) were recorded for 320 palms along the Boroboro River. For palms having the base apparently undamaged above ground, underground rotting was not checked, as this would have required potentially destructive excavation. Height of the crown center from the ground was recorded for 120 palms along the same river. For 16 male and 18 female palms, the number of abrupt bends on the stem (reflecting past falls) was counted and the distance between bends measured; for these and 30 other palms in the area, stem shape and growth direction of the adventitious roots were studied in detail, in order to reconstruct the palm's past creeping history. Additionally, many casual observations were made during several years. Data from demographic plots (Bernal, unpublished observations) were used to describe the initial growth phase of the palm.

Results

Phytelephas seemannii has remote ligular germination (Fig. 2). The cotyledonary axis extends geotropically for 10–15 cm before the plumule emerges. The seedling produces three scale leaves (occasionally the upper one with a few reduced pinnae) before the plumule becomes evident (Bernal, unpublished observations). The eophyll has 14–18 pinnae on each side of the rachis, and successive leaves increase the number of pinnae. As the seedling grows, it produces an obconical, oblique stem (Fig. 3). The palm begins to produce an aboveground stem when it has already reached sexual maturity, at an approximate age of 24 years; at this point, the palm is still increasing the number of leaves in the crown (Bernal, unpublished observations). The stem initially grows orthotropically, either vertically or slightly leaning (Fig. 4), and in no case does it creep from its initial stages.

Totally vertical stems taller than 1 m are scarce. Only three individuals were observed in the study area with vertical stems 3–4 m tall; they all were males. As the palm grows, it often rotates the whole crown toward an area of higher light intensity, which is more evident near gaps or forest edges. Stems ca. 1.5–2 m long often exhibit a curved shape, the basal portion lying on the tangential side of the curve (Fig. 5). Stems ca. 2–3 m long are also curved, but they usually lie on the plane described by the curve (Fig. 6). Longer stems usually exhibit a range of patterns, from almost straight and creeping for most of their length, to variously meandering or describing a complete circle and with the apical portion erect (Fig. 7). These long stems are often marked at intervals by abrupt bends (Fig. 8) that contrast with their rather smooth curvature. Up to three such bends were found on the longest stems. These bends were closer to each other in females than in males (mean = 1.6 vs. 2.0 m, respectively; n = 22 females, 25 males; $F = 4.3$; $P = 6.8 \times 10^{-4}$). On average, males have longer stems than females (mean = 2.8 vs. 2.0 m; n = 105 males, 96 females; $F = 2.5$; $P = 3.8 \times 10^{-6}$), and the center of their crown is located higher than that of females (mean = 1.8 vs. 1.4 m; n = 60 males, 60 females; $F = 2.8$; $P = 5.1 \times 10^{-5}$). In 38% of all palms studied (n = 320), the stem was rotten at the base above ground. There was no significant difference between males and females in aboveground rotting at the base (P = 0.39). The longest stem recorded was that of a male 12.1 m long, the base of which was rotten. The stem of a 3-m-tall palm that was broken 1 m above ground by a falling tree at the river Arusí, fell to the ground and resumed growth after a few months, initially producing reduced leaves. Many palms that were cut down in a pasture at the Valle River were still growing several months later, although some others died.

Discussion

Phytelephas seemannii fits Corner's architectural model in having a single, unbranched stem with axillary inflorescences. Although palms conforming to this model have indefinite apical

1. A stand of *Phytelephas seemannii* at the Arusí River, Chocó, Colombia. 2–3. Early growth of *P. seemannii.* 2. A seedling showing remote ligular germination and first eophyll. 3. The subterranean stem of a juvenile ca. 15 years old, at the Valle River.

8. A *Phytelephas seemannii* with two straight stem segments and an abrupt bend (near the center of the photo), revealing at least two sudden falls. The stem was dusted with corn flour for contrast.

growth, there are mechanical constraints associated with stem size (Holttum 1955, Tomlinson 1990), and each particular palm species cannot exceed a certain size. Individuals must eventually die due to mechanical limitations. In *P. seemannii,* however, longevity is not conditioned by stem size. By losing the older portions at the base of the stem, the palm can keep within the mechanically functional limits of stem size. In this way, an individual may be potentially immortal because none of its tissues are ever too old. A similar pattern of growth is observed in the palm *Elaeis oleifera* (Jacq.) Cortés (Fig. 9), which occupies similar habitats to *P. seemannii,* and in the cycad *Zamia roezlii* Linden (Zamiaceae), which grows in mangroves on the Pacific coast of Colombia (Fig. 10). By growing at the apex and dying behind, these plants virtually move through the forest, probably being able, at least partially, to "discover" better light conditions. This departure from Corner's architectural model is so unique structurally and ecologically, that it should perhaps be recognized as an architectural model on its own.

The form and curvature of the stem allow one, in most cases, to trace the growth history of a particular individual. The process apparently begins from the seedling stage. Seedlings require forest gaps to grow into juveniles; thus, when an individual reaches adulthood, it is probably growing in or around an old gap. As the palm's stem grows obliquely, the crown rotates toward the area of higher illumination. As the lever arm on the rooting base increases, the palm gradually subsides. Because the palm apex always has orthotropic (although oblique) growth, the progressive sinking of the stem often results in an open curvature (Fig. 11a). When this process has advanced for a long time the base is often slightly risen from the ground. Rather than creeping (as a plagiotropic stem would do), the palm is almost rolling. If the torque caused by the crown is too strong, due either to its own weight (numerous developing infructescences), to litter accumulation, or to an impact by a falling branch, the crown will probably fall to the ground, and the stem will either uproot and rise (Fig. 11b) or break. Because uprooting (which seems to be more common) results in an unstable balance, the stem ends up lying on its side (Fig.

9. *Elaeis oleifera* near Juradó, Colombia. Note the rotten base of the stem.

11c). Evidence of this can often be seen by a change of direction of the adventitious roots. The stem recovers upright growth, and the process starts again (Fig. 11d). If the stem has risen to a height of 1 m or so when the crown falls next time, the older portion of curved stem that was lying on the ground may have risen to some height (Fig. 11e), if the stem does not break in the process. In some cases, the falls are probably instantaneous, as evidenced by the more or less abrupt bends on the stem (Fig. 8), which mark the point where the stem resumed apogeotropic growth. The fact that the bends are significantly closer in females indicates that they have abrupt falls more often than males. This is probably due to the weight of the numerous developing infructescences usually present on the crown, and it might explain why female crowns reach a lower height on average than males. It probably accounts also for the shorter stems in females: If female stems fall more often, they have a higher risk of breaking during an abrupt fall, and have more portions exposed to being covered by flooding.

The falls are probably not always instantaneous, as evidenced by the occurrence of many stems lacking abrupt bends. In such cases, the smooth curvature of the stem is probably the result of gradual subsiding, combined with orthotropic growth of the stem and probably also with the rotation of the crown toward changing light conditions in the forest canopy.

For the American oil palm *Elaeis oleifera,* which has the same growth form, Tomlinson (1990) considered that the gradual subsidence of the stem may be only apparent, and that the reverse is what happens: the initially horizontal apex becomes erect. My observations on this species (Fig. 9) indicate that the process is identical to that of *P. seemannii,* and that gradual subsidence occurs. Casual observations of the cycad *Zamia roezlii* (Fig. 10) suggest that it also grows in the same way. Other palms described as having creeping stems, e.g., *Johannesteijsmannia altifrons, Licuala* spp. (Uhl and Dransfield 1987), *Chelyocarpus repens* (personal observations, Kahn and Mejía 1988, Kahn and de Granville 1992), *Nypa fruticans* (Tomlinson 1990) or *Serenoa repens* (personal observations, Fisher and Tomlinson 1973, Tomlinson 1990) differ in having plagiotropic development, and are therefore true creeping palms. Rotting of the older portions of the stem in these species has been documented only for *Licuala* spp. (Saw Leng Guan, personal communication) and for very old plants of *Serenoa repens* (J. B. Fisher, personal communication), and it apparently occurs also in *Johannesteijsmannia altifrons* (Uhl and Dransfield 1987).

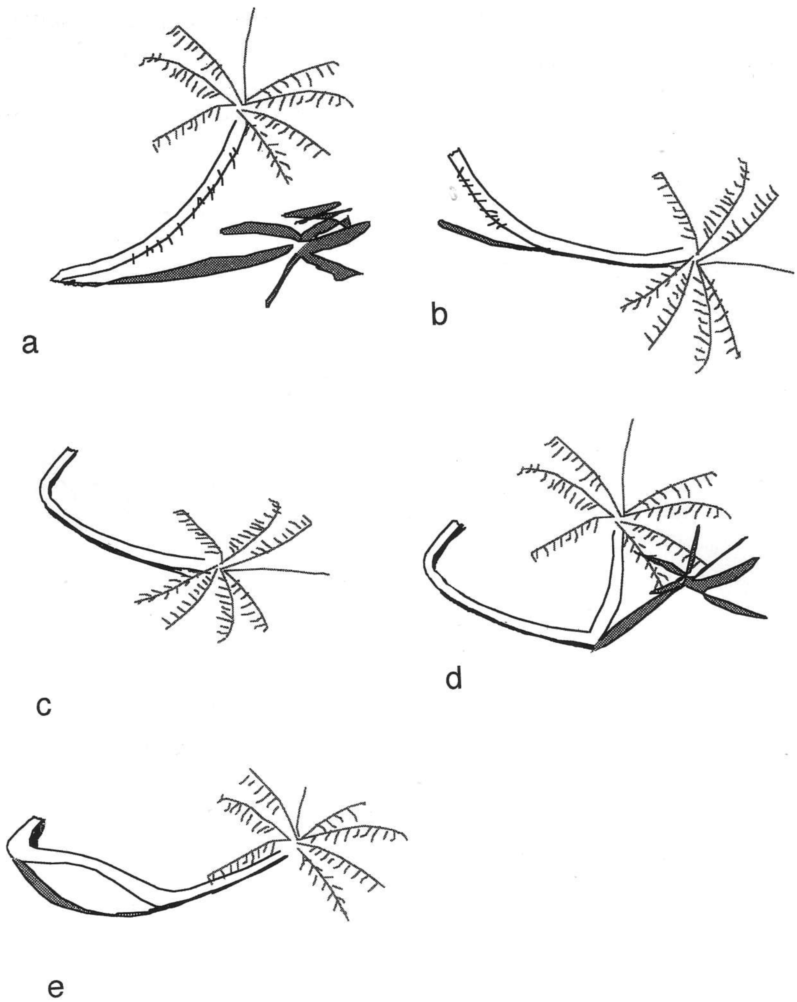
The ability of *P. seemannii* to resume growth after its stem has been broken is rare in the palm family, and it can be explained by the abundant adventitious roots present all along the stem. In most other palms, adventitious roots are confined to the basal portions of the stem (Tomlinson 1990). The occasional failure of individuals of *P. seemannii* to recover from a stem rupture is probably associated with the season of the event, and the length of the stem portion that remains attached to the crown (Bernal, unpublished observations). If a stem is broken during the dry season or is cut very close to the crown, the available roots probably will not be enough to cover the water stress.

The growth form of *P. seemannii* is not only unusual in the palm family, but also within the genus *Phytelephas.* It probably represents the

10. A young individual of *Zamia roezlii* at the Pacific coast of Colombia. Note the rotten stem base.

optimal growth form for a large palm (crown up to 16 m in diameter) of the forest understory, in an area where the high rainfall (5000–7000 mm per year) does not favor the development of a subterranean stem on river banks, due to the high water table. This is supported by the fact that in drier areas in Panama this species is often acaulescent or has a stem up to 1 m tall (Dalling et al. 1996); also, its closest relative, *P. macrocarpa* ssp. *schottii,* of the Magdalena River basin in Colombia, usually has a subterranean stem when it grows on drier slopes (Barfod 1991), but populations growing on the alluvial plains have the same growth form as *P. seemannii* (Claés 1925). The fact that the two other plants reported here as having the same growth form as *P. seemannii,* viz. *Elaeis oleifera* and *Zamia roezlii,* both also have large crowns, grow in areas with high water table, and have relatives with subterranean stems growing in drier areas also supports this view. *E. oleifera* has a crown as large as that of *P. seemannii* (both palms are strikingly similar, Fig. 9), and grows in swampy or frequently flooded areas (Vallejo Rosero 1976, Kahn and Mejía 1986); its closest American relative, *Barcella odora,* is a palm of the sandy soils in the campinaranas north of the Rio Negro in Brazil, and has a subterranean stem (Henderson 1986). *Z. roezlii* (Fig. 10) has perhaps the largest crown of any South American cycad, up to 6 m in diameter and with up to 30 leaves, abounds in mangrove swamps (personal observations, Norstog 1986), and has many close relatives with subterranean stems. The fact that the three species are dominant elements of the understory in their respective areas bespeaks the ecological success of this growth form.

Phylogenetic analysis of the subfamily Phytelephantoideae (Barfod 1991) has shown *P. seemannii* and *P. macrocarpa* as the most derived species in the genus. *P. macrocarpa* ssp. *schottii* is endemic to the Magdalena River valley in Colombia and, as mentioned above, it exhibits both subterranean and aerial, oblique, partially prostrate stems depending on the habitat. Thus, I hypothesize that migration of *P. macrocarpa* (or of its acaulescent ancestor) from northwestern Amazonia into the wetter areas of the Magdalena River valley before the upheaval of the Colombian Eastern Cordillera, and further west into



11. Schematic representation of the growth form of *P. seemannii.* (a) Orthotropic growth combined with progressive sinking of the stem often results in an open curvature. (b) A sudden fall uproots and raises the stem base. (c) Because balance of b is unstable, the stem ends up lying on its side. (d) The stem resumes upright growth. (e) The crown falls again, and the older portion of curved stem that was lying on the ground is raised slightly.

the Chocó, giving rise to *P. seemannii,* entailed the ability to develop an aerial stem provided with abundant adventitious roots. Frequent flooding and strikes of falling branches and trees on the easy target offered by the large crown must have acted as strong selective pressures for this growth form.

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(Continued from p. 8)

Everywhere there were palms, many growing submerged in water along the river margins, others growing in swampy upland conditions, but most were located on terra firme sandy loam soil. Climatically it was hot but not oppressive. Fortunately there were few mosquitoes on the tannin-stained waters of the Rio Negro, as its strong acidity apparently inhibits heavy mosquito breeding. Although the area was sparse in population, we visited several villages and isolated thatched homes of the local Portuguese-speaking caboclos, several of whom guided us to palm-growing sites and sold us fish, including piranhas, etc., which we later cooked on board.

Traveling northwestward on the Rio Negro we cruised as far as the confluence of the smaller Rio Padauari and the Rio Negro, almost the head of navigation for a craft of our draft, as further upstream rapids prohibit onward navigation. Altogether, we traveled up the Rio Negro eight days before reversing course downstream where after two days and two nights we were back in Manaus for a last day of sightseeing. Throughout our trip on the river we were accompanied by the famed pink Amazonian dolphins, which continually swam and leaped around us in friendly curiosity.

Our final count of palms was 18 genera and 55 species, the most outstanding of which were: *Astrocaryum jauari* (clumping, fruits eaten by fish), *Astrocaryum paramacca* (uncommon on the Rio Negro), *Attalea racemosa* (trunkless), *Bactris bidentula* (a probable rheophyte), *Bactris campestris* (flat leaf spines), *Bactris riparia, Barcella odora* (highlight, a rare sight), *Desmoncus polyacanthos, Euterpe catinga* (orange crownshaft), *Geonoma stricta* (blue fruits), *Leopoldinia major* (clumping in deep water), *Leopoldinia piassaba* (rare, drooping fibers), *Lepidocaryum tenue* (understory, scaled fruit), *Manicaria saccifera* (huge leaves, warty fruits), *Mauritia carana,* and *Mauritiella aculeata.* There were of course many more, far too numerous to mention.

Bill Poston

4–7. Stem bending in *Phytelephas seemannii.* 4. A female palm with leaning stem. 5. A stem resuming upright growth after falling to the ground. 6–7. Two palms with different stem lengths. The stems were dusted with corn flour for contrast.

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Trachycarpus latisectus: The Windamere Palm

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It was Henry Noltie of the Royal Botanic Garden, Edinburgh, who first alerted us to the existence of a strange *Trachycarpus* in Darjeeling, India. He had been in the area during the Royal Botanic Garden Edinburgh Sikkim Expedition in 1992 and had noticed a pair of these trees in the garden of the famous Windamere Hotel. He took photographs and collected herbarium specimens, but our later examination of these at Kew provided no clue as to the identity of this palm, other than that it appeared indeed to be a species of *Trachycarpus*.

Different solutions occurred: Could they be some kind of hybrid? Or were these the "real" *Trachycarpus martianus* of Nepal (Noltie 1994; Spanner et al. 1997), and were those that we had encountered the previous year in Meghalaya, India (Gibbons and Spanner 1994), actually *Trachycarpus khasyana* as they were originally described by Griffith in *Palms of British East India* (1850) who believed them to be a separate species?

There was only one way to find the answers to these questions and that was to visit the palms to see for ourselves. Thus it was that in November 1994 as part of our "Trachycarpus Asia" expedition, we simply decided to take a side trip to see whether we could throw any light on the identity of these mysterious palms.

First, we spent a week in Nepal where we saw many *Trachycarpus martianus*, both in the wild and in cultivation. It was clear from a close examination of these palms that *Trachycarpus martianus* and *T. khasianus* are indeed one and the same species, so that particular theory could no longer hold water. So it was with some excitement that we headed off for Darjeeling to see these unidentified palms for ourselves.

Darjeeling is a most lovely town, an old hill station from the days of the British Empire, still with many colonial buildings and much architecture intact, though in many cases, fading. We were travelling by taxi in which we had driven from Biratnagar on the Nepalese border, and after passing through the town of Siliguri, we began to climb. This hilly road is accompanied from bottom to top by the narrow gauge railway line of the "Toy Train," a true miniature locomotive with carriages, which brings both passengers and goods up to Darjeeling, and down again. The journey, while fun is rather slow and takes eight hours. Our Formula One taxi driver took just two.

We reached the Windamere Hotel at 11 pm, and had high hopes of it, having read the many accolades and complimentary remarks about it in our guide book ("best porridge in India," for example). Though we had no booking and the hotel was full, a comfortable room was somehow found for us, and we were supplied with hot-water bottles as at this altitude, 2200 m above sea level, it was distinctly chilly, with a slight mist worthy of the lake from which the hotel takes its name. Notwithstanding this, we couldn't wait for the "boy" who carried up our bags to go so we could explore the grounds and the *Trachycarpus* waiting for us there.

If we had any expectation of being able to identify these two big palms at a single glance, we were much mistaken, and we stood there for some time in the dark, examining them by torchlight. Although a little wind damaged, they were very robust and quite stately looking trees with smooth grey trunks and large leaves, resembling those of some *Livistona* more than any *Trachycarpus* we knew (Fig.1). Eventually we had to admit that we were stumped—we simply knew everything that they weren't. Further inspection by daylight the following morning after breakfast (the promised porridge, eggs, and bacon) only served to confuse us more and we continued to be at a loss as to what they could be.

During our brief stay in this attractive town we saw many other *Trachycarpus*, both in the town itself and in the rather disappointing and much neglected Lloyd Botanic Gardens. These were, without exception, *T. fortunei*, and despite *T. martianus* having been reported as growing here (Dhar 1994), a thorough search revealed not a single tree.

We left Darjeeling still scratching our heads, and drove to Gangtok in Sikkim, and thence down to Kalimpong. On the way we saw many *Phoenix rupicola* and *Wallichia disticha,* both "special" palms to us and which we were delighted to find.

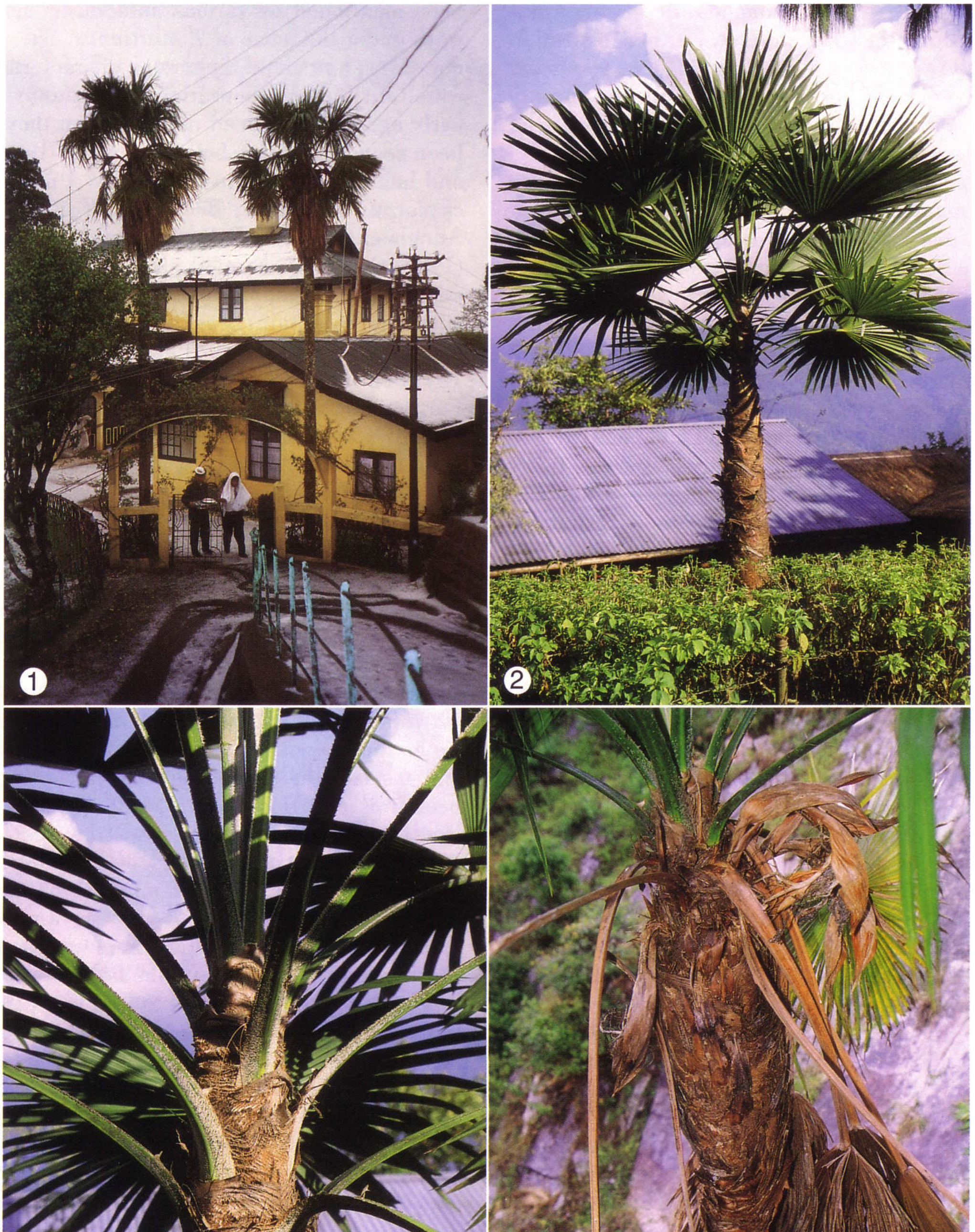
On arrival in Kalimpong, another pleasant town, we checked in at the Himalayan Hotel and our surprise can only be imagined when, in the garden, we saw another of the Windamere palms! The answer to the conundrum came in a flash: this was a new and undescribed species of *Trachycarpus*, quite distinct and different from all others. In the following few days we were to see many more, all, it must be said, in cultivation, generally in gardens in and around the town. They were indeed splendid trees (Fig. 2) with slender trunks to about 8 m tall, occasionally even taller. Their numerous, comparatively large, leathery and, for a *Trachycarpus*, shallowly divided, nearly circular fan-leaves are carried on long, robust, unarmed petioles (Fig. 3) and form an upright, open crown. After dying, the leaves hang down in a small skirt below the crown and eventually drop, together with the coarse, fibrous leafsheath, revealing a smooth, light grey trunk (Fig. 4). The leaf is also most notable for its rather wide segments producing a slightly convoluted leaf profile (Fig. 5). Some of the segments in the leafblade, particularly the lower ones, are fused for nearly their entire length, in groups of 2–4 (Fig. 6). Many of the female trees carried bunches of oval, flattened, yellowish-brown and eventually blueish-black fruit. The seeds resembled those of *T. martianus*, albeit slightly larger, proving the two to be closely related.

The *Trachycarpus* from this area were certainly not missed by the early plant hunters and have been mentioned by various authors, though always under the name of *T. martianus*. We asked ourselves, how could the unique characteristics, which distinguish them from *T. martianus* from early age on, have been missed, when they had been seen by eminent botanists both in the field and later, as herbarium specimens? Under *Trachycarpus martianus*, Beccari tells us in 'The Annals of the Royal Botanic Gardens, Calcutta' (1931) that " . . . stunted plants have been encountered by Gamble on the Rissom (actually Rissisom; mountain) near Dumsong beyond Darjeeling, at about 1970m, and (by Brandis, in 1879) on the Dumsong Hills at about 2400m." Further, he notes that "C. B. Clarke collected . . . a young plant of *Tr. martiana* in Sikkim at Rungbong at about 1,200m elevation." Of these two latter collections Beccari states that "the leaves of the young plants are of a rather herbaceous texture (and) have few segments." Of his own collection, Gamble, in *A Manual of Indian Timbers* (1902) writes, "The writer has once found small plants of what is probably this palm (*T. martianus*) on Rissoom, near Dumsong. . . . " It seems clear that these collections were not of *T. martianus* at all but were of the same species as we had now seen in Darjeeling and Kalimpong, and the fact that it was new and different had been missed. However, reading between the lines, it does seem that perhaps they were not 100% convinced of the true identity of the plants they had collected. Later examination of some of their herbarium specimens now at Kew confirmed our suspicions; they were identical to those we had come across in the field.

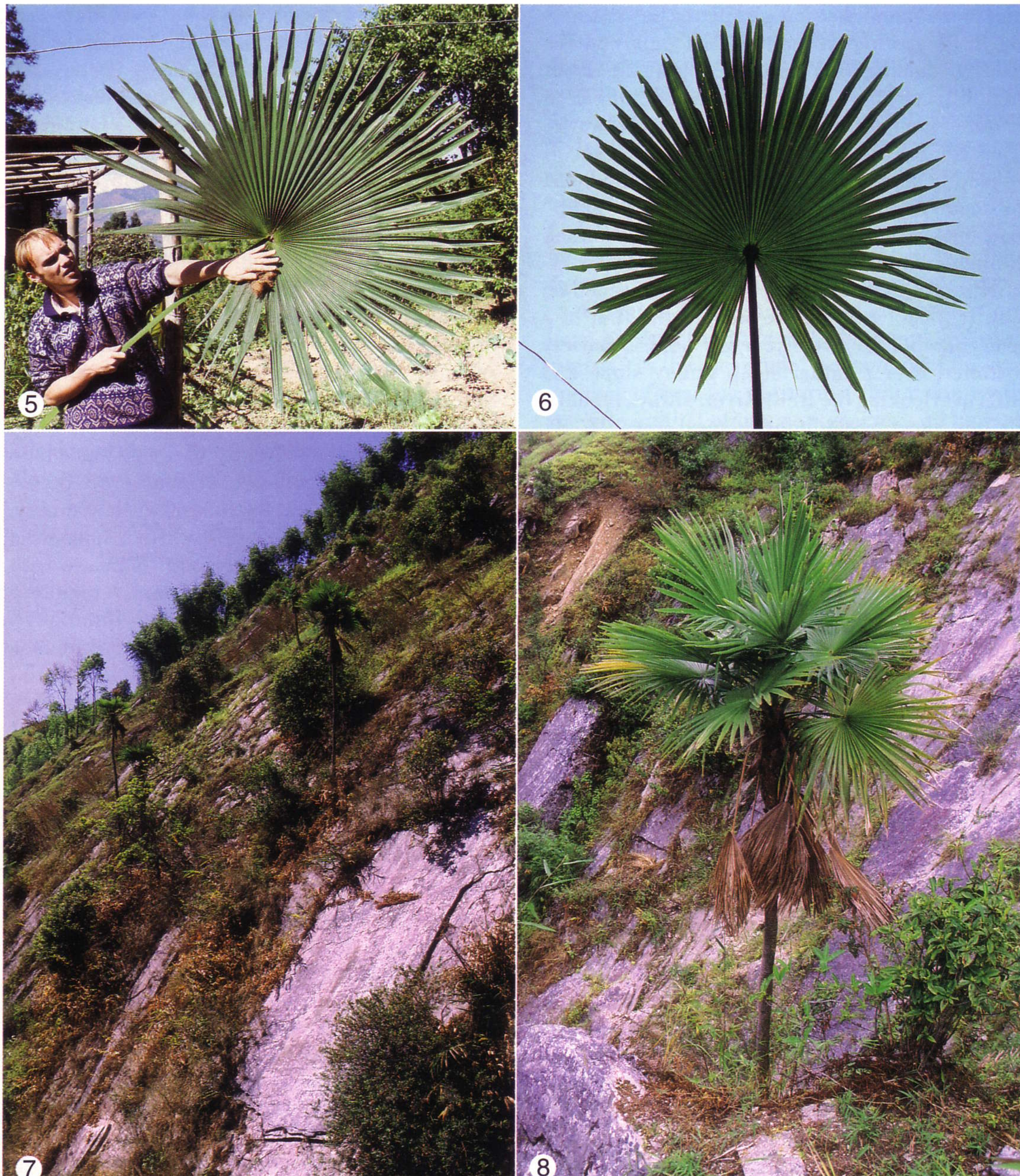
While we were delighted to find this palm in so many gardens in Kalimpong and were certain about its identity, we felt we really had to try to locate a population in the wild before formally describing it as a new species. This was to take another 12 months, during which it was searched for high and low in Sikkim and in the Kalimpong district.

Just a week before our return trip to India in October 1995, a small population had been found some 20 miles east of Kalimpong, growing on the slope of a steep valley in the Dumsong range of hills near where it had originally been recorded (as *T. martianus*). We travelled back, looking forward with great excitement to what was to be a highlight of the trip.

We had allowed ourselves considerably more time than in the previous year and before our



1. *Trachycarpus latisectus* at the Windermere Hotel, Darjeeling. Photo: David Albon. 2. *Trachycarpus latisectus*. Cultivated tree, Kalimpong, West Bengal, India. 3. The large leaves of *Trachycarpus latisectus* are supported by strong petioles. 4. *Trachycarpus latisectus*. The leaf fibers adhere just below the crown, below which the trunk is bare.



5. *Trachycarpus latisectus.* The large, leathery leaves are unique in the genus. 6. The unique leaf silhouette of *Trachycarpus latisectus* easily distinguishes it from all other species in the genus. 7. *Trachycarpus latisectus.* In its natural habitat the palms grow on steep rocky slopes. 8. *Trachycarpus latisectus* in its natural habitat, Mirik Busty, West Bengal, India.

visit to the palm's habitat we spent a day examining in greater detail many of the palms in the town, becoming increasingly optimistic about their attractiveness and suitability for cultivation in other temperate climate areas of the world. Then, finally, the great day arrived and we set off by jeep to see them in nature. We travelled east for some 15 miles, then turned off the "main" road onto a narrow and extremely bumpy track through villages and rice and millet paddies. Finally we could drive no further and proceeded on foot. It wasn't long before we saw the first of a good number of *Trachycarpus* palms, loosely scattered over a rather steep grassy slope and cliffs overlooking the Relli River, always inhabiting the most precipitous places (Figs. 7, 8). Whereas the day before the weather had been cool and misty, today there was hardly a cloud in the sky, and the leaves of our palms were brightly glistening in the mid-morning sun. The palms themselves seemed rather stunted compared with those we had seen in cultivation and their habitat much degraded. We soon learned that the entire slope had once been densely covered with monsoonal forest of which now only a few crippled trees remain. It needs no great imagination to realize that the palms' habitat used to be much more humid and calm, protected, at least in part, under a canopy of larger trees. Without this canopy the site seems too dry for them to successfully set seed and for seedlings to establish. Even with this grim reality, it was a most exciting place to visit and we were soon scrambling up and down the slope, taking photographs and measuring the palms. After a happy day we returned to Kalimpong, leaving soon after, and with regrets, for the return trip to Europe. The whole area, and that of Sikkim proper is a rich one for palm enthusiasts and we will certainly return.

The following description of this new species was first published in *The Edinburgh Journal of Botany* (Spanner, Noltie, and Gibbons 1997) and is reproduced here in a slightly adapted version to bring it to the attention of a wider audience. Growers and enthusiasts might like to note that seeds and seedlings of this species have been distributed as *T.* "sikkimensis" in the recent past (see below):

Trachycarpus latisectus Spanner, Noltie and Gibbons

Solitary, unarmed, dioecious fan palm to about 12 m tall; trunk slender, erect, bare, light grey, obscurely ringed, (10–)14–17 cm diameter, clothed in persistent, fibrous leaf-sheaths for 0.6–2 m below the crown. Leaves (8–)15–25, forming an erect, open crown, some leaves reflexed, marcescent leaves numerous, forming a small skirt below the crown; leaf-sheath fibrous, 30 cm long or more, coarse, abaxial surface covered in pale tomentum, broadly triangular towards the apex, not breaking down into threads; petiole (50–)120–140 cm, slender (about 2.5 cm wide and 1.2 cm high near the middle), flat above, slightly keeled towards the leaf-blade, broadly triangular to rounded beneath, margins smooth, sharp-edged, base very thick and robust, about 3.8 cm wide and 2 cm high, covered in pale tomentum; hastula less than 1 cm long, broadly triangular, slightly crested; leaf-blade palmate, 3/4 to completely orbicular, 65–85 cm long from hastula, 110–135 cm wide, leathery, dark green above, with thin whitish tomentum along the folds, slightly glaucous beneath, with clearly visible cross veinlets, nearly regularly divided for less than half its length into 65–75 stiff, linear segments with two inconspicuous longitudinal folds on either side of the midrib, tapering towards the apex from their broadest point, arranged at slightly differing angles, producing a slightly convoluted leaf profile; central segments 65–80 cm long, 3.5–5 cm wide at middle, with a prominent midrib beneath, lateral segments gradually more narrow and shorter, to about 21–45 cm long and 1 cm wide, the more lateral segments joined for nearly the entire length in groups of 2–4, apex of central segments acute, notched, of lateral segments acuminate, bifid for 1–3 cm. Inflorescences 3–6, solitary, interfoliar, branched to three orders. Male inflorescence 60–100 cm long, spreading; peduncle short; prophyll two-keeled, apex acute; peduncular bract single, keeled, base tubular, inflated distally, about 7 cm wide in the distal portion, apex acuminate; rachis bracts 3, similar to peduncular bracts; rachillae short, about 2 mm diameter, yellowish; flowers globose, 2.5–3 mm diameter, yellowish, arranged in groups of 2–4 on short pedicels; sepals ovate-triangular, joined into a fleshy base for lower 1/4; petals nearly orbicular, minutely triangular-tipped, 3 times as long as sepals; stamens 6, slightly exceeding petals; filaments ventricose; anthers broadly ovate-sagittate, blunt; pistillodes less than half the length of the stamens. Female inflorescence 100–150 cm long, stiff, spreading; peduncle about 50 cm long, oval in cross section, 4.2 cm wide, 1.8 cm high; prophyll two-keeled, about 30 cm long, apex acute; peduncular bracts 2, keeled, long, tubular, about 4.5 cm wide, apex acuminate; rachis bracts 3, similar to peduncular bracts; rachillae 5–18 cm long, 1–2 mm diameter, yellowish-green (in fruit); flowers globose, about 1.5 mm diameter, yellowish, usually in pairs, subsessile, sepals briefly connate into a distinctly swollen base; petals oblong-orbicular, twice as long as sepals; staminodes 6, slightly exceeding petals; carpels with a very short, conical style, stigma punctiform. Fruit shortly stalked, oblong-ellipsoid, flattened on one side, 16–18 mm long, 11–13 mm wide; epicarp thin, yellowish-brown when ripe, turning bluish-black; mesocarp thin, fibrous; seed oval-oblong, flattened or shallowly depressed and grooved on one side, 13–16 mm long, 8.5–11 mm wide; endocarp very thin, with a crustaceous sand-like layer of light brown, small, irregular scales; endosperm homogeneous with a deep, lateral intrusion. Germination remote-tubular, eophyll simple, plicate, to 2 cm wide, glabrous.

The specific epithet *latisectus* (with wide segments) was chosen for this species' unusually wide leaf segments, a characteristic through which it usually can be easily identified from other members of the genus.

Distribution and conservation status. INDIA: in the foothills of the Sikkim Himalayas in extreme northeastern West Bengal (Kalimpong) and southern Sikkim between about 1200m and 2440m elevation (Gamble 1902, Cowan and Cowan 1929, Beccari 1931).

In Sikkim and two locations in West Bengal, it has apparently not been recorded for at least 60 years and could not be relocated to date. It is under immediate threat of extinction in the wild with only about 50 plants surviving in what may be its last remaining site on a steep, deforested slope on rocky soil at Mirik Busty on the Relli River between 1300 and 1400 m, where it is unable to reproduce. Unless immediate action is taken, the chances for its survival in the wild seem bleak.

Vernacular names and uses. The following local names have been recorded: talaerkop, punkah, tarika, purbung, and bhotay kucho. The stems have reportedly been used in construction.

Cultivation. Trachycarpus latisectus is a frequently cultivated ornamental in Kalimpong and environs and its future in cultivation there seems fairly secure. Young plants are commonly encountered. Being cold-hardy as well as fast and easy to grow, it has good prospects of becoming a popular ornamental for temperate and subtropical regions. Seeds from cultivated trees around Kalimpong have been distributed to many growers around the world during recent years as *Trachycarpus* "sikkimensis", a provisional name of no botanical standing, relating to the area of its historical distribution being floristically and geographically known as the "Sikkim Himalayas."

Although many growers and enthusiasts may have become familiar with the name *T.* "sikkimensis" in the meantime, we have decided for a number of reasons not to use this name as the specific epithet of this new species and hope we will not have added too much to the confusion already surrounding this genus.

Note: There is no recent taxonomic treatment of the genus *Trachycarpus* (but see Beccari 1931, Kimnach 1977, and Gibbons 1996). Relationships of *T. latisectus* will be dealt with in a conspectus of the whole genus, which will appear in a later publication.

Acknowledgments

We would like to express our appreciation to Henry Noltie of the Royal Botanic Gardens, Edinburgh, co-author in our formal description of this species in the Edinburgh Journal of Botany. Very special thanks are due to Dr. John Dransfield of the Royal Botanic Gardens Herbarium, Kew for his unfailing enthusiasm and encouragement and for his critical review of this manuscript.

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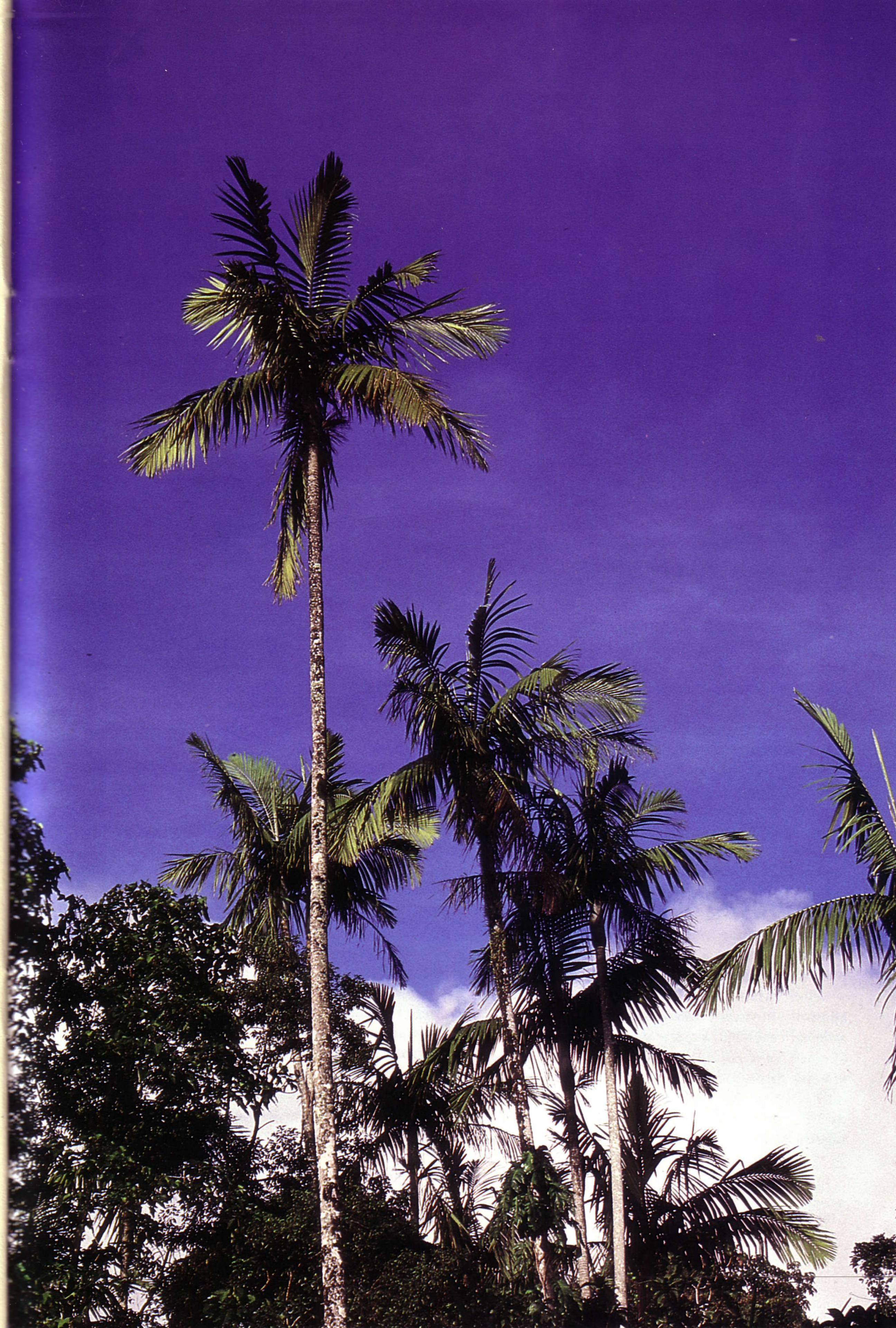

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A Revision of Kentiopsis, a Genus Endemic to New Caledonia

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The definitive and unparalleled work of Harold E. Moore, Jr. and Natalie W. Uhl (1984) on the palms of New Caledonia has proven to be unusually successful. It unraveled the intriguing but perplexing mysteries of the extraordinary assemblage of palms on the island and has ably served as a stable foundation for future palm studies there. Essentially, Moore and Uhl completed nearly all the most difficult work when they made order out of the chaos of the numerous and interesting genera on the island. Their contribution to palm taxonomy in New Caledonia cannot be overstated. The little they did leave for future palm taxonomists mainly involved naming and describing the additional new species that were sure to be discovered when the large, geographically, and ecologically diverse island of New Caledonia was more thoroughly explored. Indeed, Moore and Uhl's work inspired local palm enthusiasts to search the mountains and forests of New Caledonia for additional treasures in the palm family. This work was rewarded with the discovery of the two new species of *Kentiopsis* that we name and describe here in anticipation of publishing a fully illustrated book, now in preparation, on the palms of New Caledonia.

After extensive field work in New Caledonia spanning several years, we had, at one time, considered erecting two new genera for the two new species of *Kentiopsis.* However, the two new species prove to be intermediate between the existing genera *Kentiopsis* and *Mackeea* and serve as a bridge or continuum to tie the two extremes together. Thus, we decided to include the two new species and *Mackeea* in the older *Kentiopsis.* We feel this arrangement best reflects the natural variation and diversity of palms at the generic level in New Caledonia.

Kentiopsis Brongn, Compt. Rend. Hebd. Séances Acad. Sci. 77: 398. 1873; Moore & Uhl, Allertonia 3(5): 324–325. 1984; Uhl & Dransfield, Genera Palmarum, 374–375. 1987. Type species: *K. oliviformis* (Brongn. & Gris) Brongn., (lectotype) vide Beccari, Palmae Nuova Caled. 18. 1920. ('*olivaeformis*').

Mackeea H. E. Moore, Gentes Herb. 11: 304. 1978. Type species: *M. magnifica* H. E. Moore. **Syn. nov.**

Solitary, tall, erect, unarmed, pleonanthic, monoecious palms. Trunk aging gray, often expanded proximally with exposed adventitious roots, ringed with not too prominent leaf scars, internodes nearly smooth but with superficial longitudinal fissures. Leaves regularly pinnate, spreading to arching, neatly abscising; sheaths tubular, forming a prominent cylindrical crownshaft, fibrous and ± woody, waxy and puncticulate to tomentose; petiole channelled adaxially, rounded abaxially, glabrescent to variously tomentose; rachis adaxially ridged proximally and angled distally, flattened to slightly rounded abaxially, glabrescent to variously tomentose; pinnae ± flat and arranged in one plane to stiffly erect, lanceolate, acute to acuminate, single-fold, midrib elevated adaxially and prominent abaxially, numerous secondary ribs very conspicuous abaxially, marginal ribs prominent and second in size to midrib, waxy glabrescent adaxially sometimes with remnant tomentum on midrib, abaxially puncticulate with tiny scales, midrib and secondary ribs with numerous, con-

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spicuous, membranous, medifixed ramenta. Inflorescences infrafoliar, protandrous, stiffly and paniculately branched to (2-)3–4 orders; peduncle short, stout, variously tomentose; prophyll and first peduncular bract caducous, chartaceous, sparsely scaly to tomentose, prophyll markedly two-keeled, flattened, encircling peduncle at insertion and enclosing first peduncular bract, this one similar to prophyll but not keeled, rostrate, 2–4 subsequent small, triangular, peduncular bracts present; rachis longer than peduncle, waxy-glabrescent to minutely scaly, main branches rounded or angled, with same indument as rachis; bracts subtending branches and rachillae acute to acuminate proximally and reduced to low ridges distally; rachillae slender to rather stout, straight or curved, mostly glabrous. Flowers in spirally arranged triads of two earlier-opening distal-lateral or rarely median-lateral staminate flowers flanking a central later-opening pistillate flower, sunken in a prominent cleft subtended proximally by a conspicuous liplike or sharp-edged, rounded bract; triads at least in proximal 2/3 of rachillae, distally with only paired or solitary staminate flowers; outermost bracteole low, small to inconspicuous, bracteoles surrounding pistillate flower markedly unequal or rarely subequal, inner one often sepal-like. Staminate flowers symmetrical to asymmetrical; sepals 3, distinct, variable in shape, imbricate basally, ± keeled or costate abaxially; petals 3, ± connate basally, valvate apically, acute or rounded; stamens 11–38, shorter or equal to or exceeding petals, filaments shorter or equal to or longer than anthers, mostly straight apically, free or connate basally and there variously adnate to a variable receptacle, anthers elongate, latrorse or introrse, emarginate to bifid distally, bifid to bilobed proximally, dorsifixed about 1/3 from base, connective narrow to wide, tanniniferous or not; pollen elliptic to triangular, monosulcate or trichotomosulcate with finely pitted to reticulate tectate exine; pistillode much shorter than to equalling filaments, conical to columnar. Pistillate flowers symmetrical; sepals 3, broadly imbricate basally; petals 3, broadly imbricate basally, valvate only briefly apically, acute; staminodes mostly 3, toothlike and borne within 1 petal or 6 and connate in a ring with triangular lobes; gynoecium unilocular, uniovulate, with 3 prominent, recurved stigmatic lobes, ovule pendulous or rarely lateral. Fruits ellipsoid, red or purplish, stigmatic remains apical or rarely subapical, perianth remains prominent; epicarp smooth, thin, drying minutely pebbled; mesocarp containing short sclereids, longitudinal fibers anastomosing or not and variously adherent to the endocarp and a thick layer of tannin cells over the endocarp; endocarp thin, fragile, not operculate, not adherent to seed. Seeds ellipsoid to rarely pyriform, hilum elongate, raphe branches various, numerous, anastomosing, slightly embedded, endosperm homogeneous; embryo basal. Germination adjacent-ligular; eophyll bifid, 4–6 subsequent deeply bifid leaves with narrowly lanceolate lobes, before first pinnate leaf. Leaves of juvenile individuals spirally or distichously arranged, "saxophone" type establishment growth present or lacking.

Distribution. NEW CALEDONIA. Four species endemic to the main island "Grande Terre," two in the northeast of the island, one in the center, and one in the extreme southeast (Fig. 1). All have a very limited distribution at low to medium elevations.

Ecology. The four species are clearly gregarious and often develop pure stands. They are found mostly in lowland rain forest where they grow up to 30 m tall as emergent or canopy trees; however, *K. oliviformis* is restricted to transitional semihumid forest and *K. piersoniorum* is frequently exposed in wet, shrubby montane vegetation. *Kentiopsis pyriformis* grows on ultramafic rocks, often on unstable steep slopes; the other three species occur on schists, or rarely basalt, sometimes mixed with serpentine colluvium.

Taxonomic history. In 1873, A. Brongniart established *Kentiopsis* and included three species, *K. macrocarpa, K. divaricata,* and *K. oliviformis.* Earlier, Vieillard had invalidly named the former two while Brongniart and Gris (1864) had named the last, all in *Kentia* Blume, a name accepted at the time but now included in *Gronophyllum* Scheffer. According to Brongniart (1873), *Kentiopsis* differed in the staminate flowers bearing numerous stamens (20–50) adnate to a prominent receptacle, instead of the 6–12 stamens in *Kentia.* Dammer (1906) transferred *K. divaricata* to *Actinokentia,* and, although Vieillard (1873) had transferred *K. macrocarpa* to *Chambeyronia,* he had done so invalidly, leaving Beccari (1920) to validate the transfer; thus *Kentiopsis* has been a monotypic genus until the present.

(Continued on p. 41)

Principes, 42(1), 1998, pp. 34–40

Pigafetta

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Large, highly distinctive and easily recognized palms often repay careful reassessment. It is all too easy dismissively to identify a palm such as *Pigafetta filaris* and not look more closely. *Pigafetta filaris,* after all, is unlike any other tree palm in the Far East and is instantly recognizable. With a plethora of other palms in the region requiring taxonomic disentanglement, why bother to waste any more time on a species as distinctive and apparently as well known as *Pigafetta?*

I have certainly been guilty of not taking the trouble to look more closely, until 1988 when I was confronted in Queensland in a private collection by two growers and their two palms. The palms were both obviously pigafettas, and yet significantly different from each other in size, rate of growth, and coloration. This was the first inkling I had that there might be two quite different taxa in the genus *Pigafetta,* and it was at this point that my wife, Soejatmi, said "I told you so, but you wouldn't listen." She had seen *Pigafetta* growing in Sulawesi and the Moluccas in the mid-1970s and had told me that the Moluccan palm appeared to be different from the Sulawesi palm.

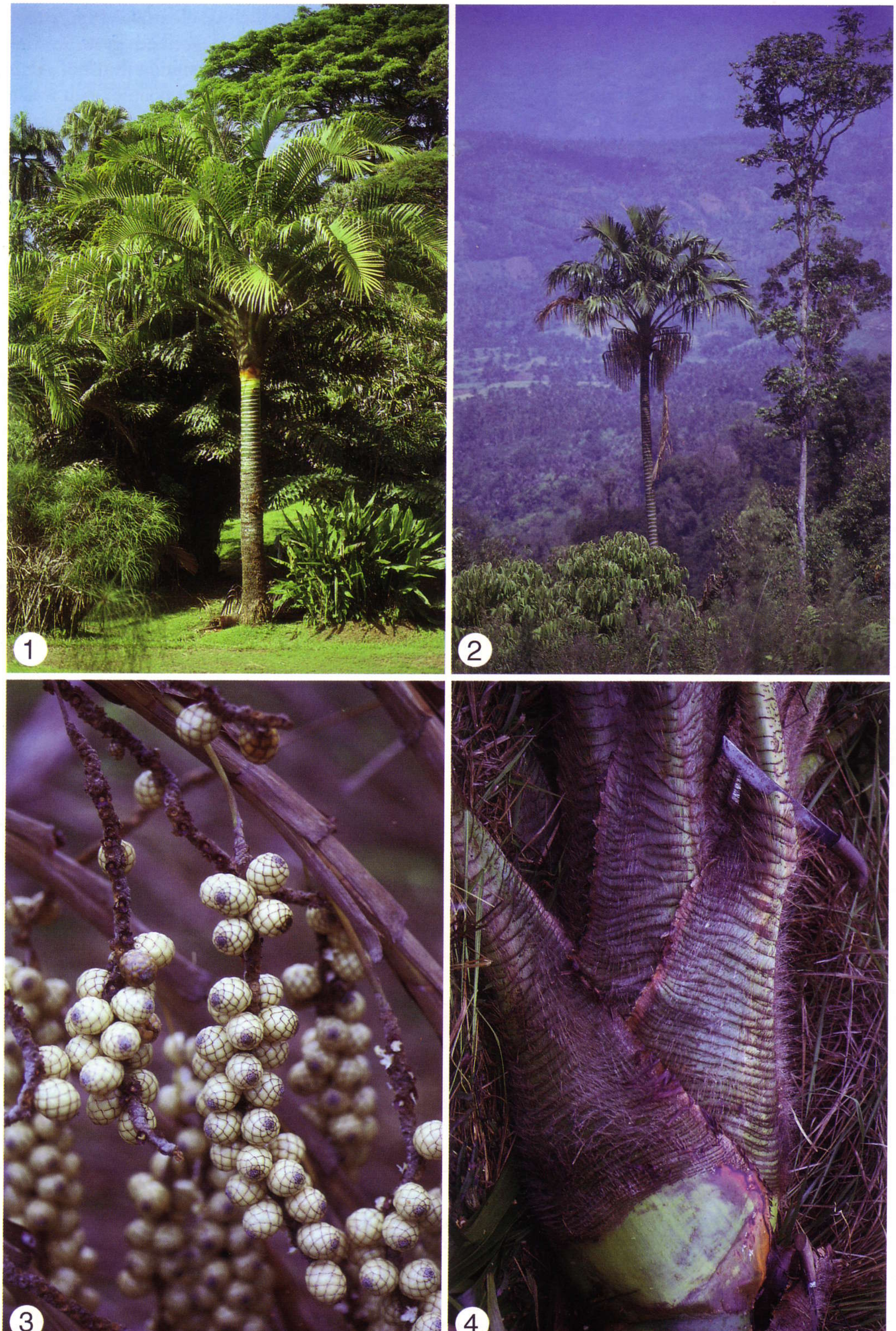
At this point we need to mention that most of the very few herbarium specimens of *Pigafetta* look the same. They are usually so poorly collected and with such scanty notes that if you followed current dictum that there is only one species of *Pigafetta* you would not look twice. Such large palms tend to defeat the herbarium method that underpins classification; plants that are manifestly distinct when growing can look identical when reduced to scraps stuck to a herbarium sheet, a point I made in my paper on *Caryota* (Dransfield 1974).

I first saw *Pigafetta* in 1971 in Sibolangit Botanic Garden in North Sumatra (Dransfield 1973). At the time the genus had been almost lost from general cultivation. As David Fairchild's favorite palm, there was a great deal of interest among growers to obtain more information about the palm and to reintroduce it into cultivation. I introduced the first batch of seeds and seedlings from Sibolangit to Bogor where the palm had once grown but had then been lost. No one knows the origin of the Sibolangit *Pigafetta*; the Sibolangit Garden had long since stopped functioning as a botanical garden, and as far as I know there are no records of the introductions to the Garden, although there is a strong possibility that the seed came to Sibolangit from Bogor. Seedlings from this first reintroduction I made were planted out in the Kebun Raya, Bogor in 1974 (Fig. 1), some to form an avenue. Since then the trees have reached maturity and beyond, and several have been felled and replaced with more seedlings of the same type of *Pigafetta.*

In 1973 I saw *Pigafetta* for myself in the wild for the first time in North Sulawesi (Fig. 2)—a most impressive palm (Dransfield 1976). I made full, detailed herbarium collections of the palm and was also able to make a large collection of ripe seed (Fig. 3); it was from this collection that the IPS Seed Bank distributed seed around the world. Many of the now large individuals in collections originate from this 1973 introduction. During my stay in Indonesia I did not have the opportunity to travel farther east than North Sulawesi so was unable to see *Pigafetta* in the field in the Moluccas and New Guinea.

In 1993 we were once more in Queensland and saw the same cultivated specimens of *Pigafetta,* now considerably larger, and I began to be convinced that *Pigafetta* required a careful reassessment. The most striking difference between the two forms is in the petioles and rachises. In the Sulawesi *Pigafetta* the petioles and rachises of the mature exposed leaf present a rather forbidding dark color, densely covered with dark spines (Fig. 4), while in the other palm, said to be from New Guinea, the petioles and rachis are pale, covered in white powder, and with sparser spines (Fig. 5).

In 1995 I finally saw the eastern *Pigafetta* in the field (see Back Cover and Fig. 6). Together with Soejatmi, Scott Zona from Fairchild Tropical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Garden, Rudi Maturbongs from Manokwari, and Ary Prihardhyanto Kiem from Bogor, we visited forest in the north-east Kepala Burung area of Irian Jaya. *Pigafetta* is abundant here, growing at elevations from sea level up to about 300 m (incidentally, this is the type locality of Beccari's *Pigafetta papuana*). What instantly differentiates it from the Sulawesi taxon is the color of the petioles and rachises, as described above.

At last convinced that there might be two species of *Pigafetta* I set out to determine how they actually differ from each other in detail and what they should be called. Underlying the whole story is the recurring theme of the frequent inadequacy of herbarium specimens to record manifest differences between palms. I have to state immediately that, although we have a few vegetative differences between the two taxa, the full differences have yet to be properly studied. However, it is clear that there is a rising awareness that there are two different pigafettas for which we need scientific names. The following imperfect account does at least provide names for the two palms.

History of the Genus

It is not at all surprising that *Pigafetta* was well known to early Dutch naturalists working in the Netherlands East Indies; so abundant is the palm in Sulawesi and the Moluccas and so much used by local people that an enquiring naturalist could not fail to become aware of it. The first published account of the palm is that of the great Dutch naturalist Rumpf (Rumphius). In the first volume of his monumental *Herbarium Amboinense* (1741) the palm is referred to as *Sagus Filaris*; published before the time of Linnaeus this name has no nomenclatural priority. Nevertheless the account does have some nomenclatural significance as I shall show below. Rumphius provided in Latin and Dutch a good description of the palm, its uses, and its geographical distribution. He also provided an illustration of a leaf, leaflet, and infructescence and a fruit. Although the illustration is rather crude, it is nevertheless clearly a *Pigafetta*. The palm that Rumphius described grew in Ceram, Buru, and neighbouring islands (but not Ambon), and was well known to local people, as it was used for the production of fiber for cloth weaving. After discussing the form of the palm, its distribution, names and uses, Rumphius added a note about the tree called Wanga that grows on the east coast of Celebes (Sulawesi) in the region of Tambocco; Wanga is taller and thicker than the Calappa (coconut) and is very much like *Sagus Filaris* but is not used for clothing by local people, except as fiber for sewing, and is also used as a source of spongy material for the occlusions of blow-pipe darts. The palm called Wanga at the present day in North Sulawesi is indeed a *Pigafetta,* so I have no doubt that Rumphius was referring to this same Sulawesi *Pigafetta.*

What is most important is that Rumphius clearly stated that the palm he named *Sagus Filaris* is the one that grows in Ceram and Buru. Although not saying how the Sulawesi palm is distinguished from the Moluccan, he clearly gave it a separate entry.

The first post-1753 reference I have found to the palm we now call *Pigafetta* is that of Houttuyn (1774), where the author provided a description of the Draad or Gaaren-Boom of Ceram, giving an abbreviated transcription of Rumphius' account and directly referring to *Sagus Filaris* of Rumphius. Whether this can be interpreted as effective publication is debatable. At any rate, Giseke (1792) explicitly published a binomial, *Sagus filaris* Giseke. Understanding of the palm and its structure had then to wait until the time of Martius and Blume.

In the first edition of part 7 of the third volume of Historia Naturalis Palmarum (1838), Martius (p. 216) provided brief diagnoses of *Metroxylon filare* and *M.* (?) *elatum* but confused their ranges. The former was described as occurring in Ceram, Xulla, and Buru and also in Celebes. He refers to Rumphius' account of *Sagus Filaris.* The only

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1–4. *Pigafetta elata*. 1. Cultivated individual in Kebun Raya, Bogor. 2. *Pigafetta elata* growing in Minahassa, North Sulawesi. 3. Mature fruits. 4. Close-up of crown, showing dense, dark spines and thin indumentum. All photos J. Dransfield.

→ (p. 38)

5–8. *Pigafetta filaris*. 5. Close-up of leaf sheath, showing dense white indumentum and pale spines. 6. View of the crown of *Pigafetta filaris* near Nuni, Manokwari, Irian Jaya. 7. The two auricles at the distal end of the petiole. 8. Immature fruits. All photos J. Dransfield.

Table 1. Differences between Sagus filaris *and* S. elata *recorded by Blume.*

filaris	fruit scales in 13–15 orthostichies	fruit ellipsoid	seed angular or foveolate	sheath spines distant
elata	fruit scales in 11–12 orthostichies	fruit globose	seed depressed-globose	sheath spines very dense

character clearly differentiating it from the next species is the shape of the fruit, which was described as oval. *M. elatum* was described as having a globose fruit and was said also to occur in Celebes. Martius referred to *Sagus elata,* a name suggested by Reinwardt in a letter; he also went on to say that the palm is very frequent in Ceram. By the time Martius published the second edition of this part (see Dransfield and Moore 1982), Blume had already provided a much more complete description and had used the epithet *Pigafetta* as a sectional name under *Metroxylon.*

Blume (1843) in Rumphia, Volume 2, provided a full description of *Sagus* (*Pigafetta*) *filaris,* illustrating his description with a fine plate of part of an infructescence. In a much shorter passage he named and described *Sagus* (*Pigafetta*) *elata,* saying that it differs from the former by having globose rather than ovoid fruit. The former was described as originating in Ceram and other islands of the Moluccas while the latter was described as originating in Celebes, thus effectively correcting the confusion in geographical distribution published by Martius. The differences between the two species mentioned by Blume are shown in Table 1.

In the Second (replacement) Edition of part 7 of Volume 3 of *Historia Naturalis Palmarum,* Martius (1845) was able to correct mistakes in the first edition and added information on the number of vertical rows of scales on the fruit: 13–15 in *M. filare,* 11–12 in *M. elatum.* Miquel (1855) repeated much of what Martius and Blume had said before, recognizing two species (*M. filare* and *M. elatum*). Fruit of *M. elatum* was described as "drupae globulo sclopeti minores, globosae"—that is, fruit globose, the size of a musket ball.

Beccari was the first botanist post Rumphius actually to have had field experience of *Pigafetta,* having seen and collected the palm at Andai in the Manokwari area of what is now Irian Jaya, New Guinea. This was the basis of his name, *Pigafetta papuana,* published in Malesia, Volume 1, in 1877. In this article he also transferred *Metroxylon filare* to *Pigafetta* but not *M. elatum* (this was transferred by Wendland in Kerchove's Les Palmiers in 1878). In his commentary to the description of *P. papuana,* he stated that because his material was incomplete he could not be certain that it was distinct. He believed it could be distinguished from *P. filaris* by the absence of ramenta on the undersurface of the leaflets and the calyx being entire or more rarely minutely three-lobed rather than being trifid or three-toothed. Eventually Beccari wrote in his last account of *Pigafetta,* published in the Annals of the Royal Botanic Garden Calcutta in 1918:

> *I think there is only one species of Pigafetta, as the specifical differences between* Metroxylon filare *and* M. elatum *indicated by Blume, Martius and Miquel seem to me to be very obscure, and I have not noticed any diagnostic character among the numerous specimens of Pigafetta examined by me.*

Thus, by 1918 the three species of *Pigafetta* recognized by Beccari and previous authors had been subsumed into one, a situation not contradicted by the herbarium specimens and followed by most authors ever since. Although the three names have been used from time to time, their use has not been accompanied by any real understanding of differences between taxa.

Just before Beccari's account was published, Merrill published his interpretation of Rumphius' Herbarium Amboinense (Merrill 1917). Under *Pigafettia* (sic), he referred to two names, *P. filifera* (Giseke) Merrill and *P. elata* (Reinw.) H. Wendl., based on Rumphius *Sagus Filaris* and *Wanga,* respectively.

Records for *Pigafetta filaris* for Indochina are based on loose fruits, collected by Otto Kuntze, and said to be from Indochina. First described as *Calamus kunzeanus* Becc., Beccari later decided that the fruits were those of *Pigafetta.* The material is so meagre that we can scarcely be certain of their identity.

Two other names have been associated with *Pigafetta—Metroxylon microcarpum* and *M. microspermum.* Both names were published by


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Table 2. Apparent differences between the two species of Pigafetta.

Characteristic	*Pigafetta filaris*	*Pigafetta elata*
Locality	Maluku, New Guinea	Sulawesi
Indumentum	dense chalky white indumentum abundant on leaf sheath and rachis	indumentum sparse, dull, not chalky white
Spines	sparse, usually golden	dense, golden in juveniles, dark brown in the leaves of mature individuals
Auricles	Two very conspicuous auricles present at the tip of the apparent petiole, usually projecting beyond the base of the lowermost leaflets (Fig. 7)	Auricles low, rounded, not projecting beyond the base of the lowermost leaflets
Posture of leaves in juveniles	Tending to be held more or less erect	Tending to be held more horizontally
Fruit	Ovoid (Fig. 8)	Globose to ovoid
Scales	13–15 vertical rows	11–12 vertical rows
Seed	Somewhat angled-foveolate	More or less smooth
Habitat	Common in lowlands from sea level up to about 300 m	Usually restricted to areas above 500 m above sea level to about 1000 m.

Martius (1838) based on two names published by Zippelius in Macklot (1830), *Sagus microcarpa* and *S. microsperma.* These four names, published without description, are *nomina nuda* and without botanical standing. Beccari (1877) assumed they both referred to *Pigafetta filaris* and so they are sometimes cited in synonymy.

How Many Species?

In fact, the evidence available to me now suggests that there are two species, one in Sulawesi and the other in Maluku (Moluccas) and the western part of New Guinea. The correct name for the former is *Pigafetta elata,* while the correct name for the latter is *Pigafetta filaris.* As most material in cultivation apparently originates from Sulawesi, and is referred to as *Pigafetta filaris,* there will thus need to be a change in the name on these palms to *P. elata,* a situation I regret. Nevertheless, I am sure all who grow *Pigafetta* will be excited by the thought that there are clearly two species with apparently slight ecological differences that may extend the range of climates in which the genus is grown.

Precise differences between the two species have yet to be described in full—herbarium material is limited and, as far as I know, although several collectors and gardens have both species, nowhere have both species growing together reached flowering, thereby allowing a direct comparison.

Synonymy may be cited thus:

PIGAFETTA (Blume) Beccari, Malesia 1: 89 (1877).

Sagus section *Pigafetta* Blume, Rumphia 2: 154 (1843).

Metroxylon section *Pigafetta* (Blume) Martius, Historia Naturalis Palmarum 3 (ed. 2): 213 (1845).

"*Pigafettia*"

1. Pigafetta filaris (Giseke) Becc., Malesia 1: 90 (1877).

Sagus filaris Giseke, Prael. Ord. Nat. Pl. 94 (1792); Blume, Rumphia 2: 154 (1843). Lectotype: Tab. 19, Herb. Ambon. Vol. 1.

Metroxylon filare (Giseke) Martius, Hist Nat Palm. 3 (ed.1): 216 (1838); (ed. 2.): 215 (1845); Miquel, Fl. Ind. Bat. 3: 149 (1855). Type: as above.

Pigafettia filifera (Giseke) Merrill, Interpr. Rumph. Herb. Amboinense 114 (1917). Type: as above.

Pigafetta papuana Beccari, Malesia 1: 89 (1877). Type: Irian Jaya, Andai, *Beccari* s.n. (FI).

?*Calamus kunzeanus* Beccari, Ann. Roy Bot. Gard. Calcutta 11: 490 (1908). Type: *Kuntze* s.n. (FI).

Sagus Filaris Rumphius, Herb. Amb. 1: 84, t.19 (1741).

2. Pigafetta elata (Martius) H. Wendl., in Kerchove, Les Palmiers 253 (1878).

Metroxylon elatum Reinw. ex Martius, Hist. Nat. Palm 3(ed.1): 216 (1838), (ed.2): 216 (1845). Miquel, Fl. Ind. Bat 3: 150 (1855). Type: **Wanga** Rumphius, Herb. Amb. 1: 85 (1741).

Sagus elata Reinw. ex Blume, Rumphia 2: 156 (1843). Type: **Wanga** Rumphius, Herb. Amb. 1: 85 (1741).

Wanga Rumphius, Herb. Amb. 1: 85 (1741).

Acknowledgments

I thank Geoff and Julie Fowler for first drawing my attention to the two different pigafettas, Scott Zona, Ary Prihardhyanto Kiem, Rudy Maturbongs and Soejatmi for help in the field in Irian Jaya, and Scott Zona for comments on this manuscript.

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RUMPHIUS, G. E. 1741. Herbarium Amboinense. Volume 2. J. Burmann, Meinard Uytwerf, Amsterdam.

(*Continued from p. 56*)

cited as "holotype" and "lectotype" for *Oenocarpus tarambapo*). And the printer, apparently not used to taxonomic texts, has been sloppy with such details as italicizing and indenting correctly the synonymy blocks (e.g., *Mauritiella armata*). The illustrations in the book are disappointing. The line drawings only give a very general idea of what the plant looks like. Taxonomic details on which the separation of the species depend are hardly illustrated. Four color plates with 16 photographs are beautiful and highly illustrative, but their number is far from adequate to make up for the lack in quality of the line drawings. The distribution maps are clear and give excellent impressions of overall distribution and collection density, but it would be easier to use them if the name of the taxon in question had been written directly on the map and not only in the figure legend. For a pricey book from a prestigious publisher one expects more careful editing and handling of illustrations.

Regardless of these points of critique, the book stands as a milestone in the study of Amazonian palms. It will be the reference that everyone who studies the palms of the region, taxonomists, ecologists, and ethnobotanists alike, will consult and will learn a great deal from. For the taxonomists the book will be a solid point of departure for further studies of the variation and distribution of Amazonian palms. Many taxonomic problems remain unresolved, but the book provides a solid framework. Many taxonomic problems will be much easier to define and circumscribe than they were before. That may be this book's greatest contribution and service to botanists who study the flora of the Amazon basin.

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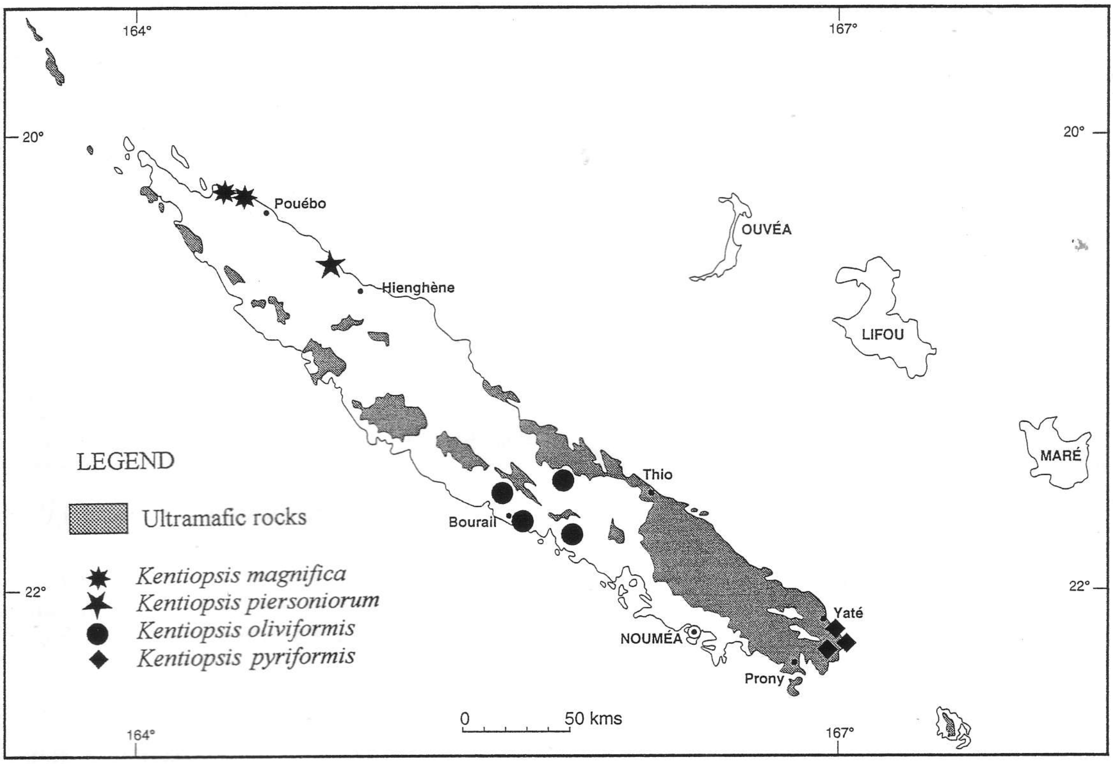
(Continued from p. 33)



1. Distribution of *Kentiopsis* species.

Kentiopsis includes the stateliest palms of New Caledonia; they often attain or exceed 20 m in height and grow in impressive colonies. There is great floral variation among the species, especially regarding the size and symmetry of the flowers, insertion of the stamens, shape of the receptacle and pistillode and also in the bracteoles. The manner in which the leaves are held is also very diverse; *K. piersoniorum*, with leaves sharply recurved and stiff pinnae held in a narrow V, and *K. magnifica*, with pinnae flat in one plane and initially held vertically by the twist of the rachis, are the extremes. On the other hand, pinna morphology is strikingly similar in all species. Pinnae have an elevated midrib adaxially, this one also prominent abaxially and bearing numerous ramenta, many prominent secondary nerves, prominent marginal ribs and abaxial pinna surface minutely and regularly dotted with scale-like trichomes. Fruits with a thick and very conspicuous layer of tannin cells in the inner part of the mesocarp are also distinctive. Each species has at least one important diagnostic character: *K. pyriformis* has fruits with subapical stigmatic remains and mostly pyriform seeds; *K. magnifica* has staminate flowers with stamens connate basally in a ring; *K. oliviformis* has strongly asymmetrical staminate flowers with deltoid sepals and lacks sepal-like bracteoles; and *K. piersoniorum* has pistillate flowers with six staminodes connate in a crownlike ring. Groups of two or three species have several shared characters. For example, distichously arranged leaves in the juvenile stage and a short conical pistillode occur in *K. pyriformis* and *K. magnifica*; "saxophone" type establishment growth and persistent indument of inflorescence are exhibited in *K. pyriformis* and *K. oliviformis*; recurved leaves and waxy puncticulate sheaths are found in *K. pyriformis* and *K. piersoniorum*, glaucous-waxy inflorescences and truncate-depressed seeds in *K. magnifica* and *K. piersoniorum*. The northeastern species *K. magnifica* and *K. piersoniorum* seem to be less specialized than the central and southern species, *K. oliviformis* and *K. pyriformis*. The last share the "saxophone" type establishment growth, and they produce simultaneously several complex, much branched inflorescences with small flowers followed by numerous, rapidly maturing (three months), small fruits in great quantity with readily germinating seeds. These features promote and enhance their gregarious nature.

Keys to the Species of *Kentiopsis*
Key Based on Vegetative Characters

Leaf sheath densely dotted with scales to tomentose, rachis not recurved, pinnae flat to drooping.
  Sheath initially densely covered with appressed white tomentum, rachis initially white-tomentose also, new expanding leaf light green . . . . .2. *K. oliviformis*
  Sheath initially covered with prominent, blackish-centered, white-margined scales, aging densely dotted with blackish scales, rachis persistently brown-tomentose, new expanding leaf chocolate-brown to bright red . . . . .1. *K. magnifica*
Leaf sheath waxy, almost glabrous but minutely puncticulate with sunken, lacerate, dark brown, barely visible scales, rachis ± recurved
  Leaf sheath conspicuously wine-colored to purple or copper-colored, glaucous wax layer thin to thick, leaves slightly to moderately recurved, pinnae held in an open V or flat to slightly pendulous, dark green . .4. *K. pyriformis*
  Leaf sheath purplish obscured by a thick layer of bright glaucous wax, leaves strongly recurved, pinnae stiffly erect in a narrow V, glaucous . . . . .3. *K. piersoniorum*

Key Based on Floral Characters

Branches of inflorescence ± swollen basally, rounded to angled, branching to (2)-3 orders, staminate flowers with 30 or more stamens and distal-lateral to the pistillate flower in the triad
  Inflorescence erect, branches pale green and bearing white scales, inner bracteole not sepal-like, staminate flowers strongly asymmetrical, pointed in bud, with deltoid sepals . . . . .2. *K. oliviformis*
  Inflorescence spreading, branches glaucous and spotted with brown scales, inner bracteole large, rounded, ± sepal-like, staminate flowers ± symmetrical, not pointed in bud, with rounded or emarginate sepals
    Staminate flowers broadly ovoid to barrel-shaped in bud, stamens connate in a conspicuous basal ring, pistillode short, conical, staminodes 2–3 . . . . .1. *K. magnifica*
    Staminate flowers elongate, bullet-shaped in bud, stamens free or nearly so, pistillode columnar, nearly equalling stamens, staminodes 6 in a crownlike ring . . . . .3. *K. piersoniorum*
Branches of inflorescence not swollen basally, sharply angled and dorsiventrally flattened, branching to 3–4 orders, staminate flowers with 20 or fewer stamens and median-lateral to the pistillate flower in the triad . . . . . .4. *K. pyriformis*

Key Based on Fruits and Seeds

Fruits with apical stigmatic remains
  Mesocarp fibers adherent to endocarp throughout, seeds ovoid-elongate to ellipsoid, fruits bright red . . . . .2. *K. oliviformis*
  Mesocarp fibers not adherent to endocarp throughout, seeds bullet-shaped and truncate to depressed basally
    Mesocarp fibers adherent to endocarp only basally, leaving a striate ring on it, fruit red . . . .1. *K. magnifica*
    Mesocarp fibers few, not leaving a striate basal ring on endocarp, fruit purplish . . . . .3. *K. piersoniorum*
Fruit purplish with subapical stigmatic remains, mesocarp fibers not adherent to endocarp, seed pyriform . . . . .4. *K. pyriformis*

Key to the Juveniles

Leaves 50–100 cm long spirally arranged
  "Saxophone" type growth, petiole with prominent appressed scales . . . . .2. *K. oliviformis*
  No "saxophone" growth, petiole glabrous . . . . .3. *K. piersoniorum*
Leaves 50–100 cm long distichously arranged
  "Saxophone" growth, petiole reddish to purple, glabrous . . . . .4. *K. pyriformis*
  No "saxophone" growth, petiole densely and shortly brown tomentose . . . . .1. *K. magnifica*

1. **Kentiopsis magnifica** (H. E. Moore) Pintaud & Hodel **comb. nov.** (Fig. 3)

Mackeea magnifica H. E. Moore, Gentes Herb. 11:304 (1978); Moore & Uhl, Allertonia 3(5): 324–325 (1984). Type: *MacKee 26471* (holotype BH).

Emergent palm. Trunk to 25 m tall, 25 cm dbh. Leaves 8–9, spreading; sheath 0.8–0.9(–1.5) m long, initially covered with blackish-centered, white-margined scales; petiole 20 cm long, minutely covered with brown-centered pale-margined scales of trichomes concrescent toward center; rachis ca. 2.25 m long, densely covered by similar scales; pinnae to 55 on each side, dark green on both surfaces and coriaceous, with numerous veins especially prominent abaxially, median pinnae 74–80 × 2.4–5 cm, the lowermost continuing into lorae to 2 m long, all arranged in one plane, although leaves in upper part of crown often twisted so pinnae oriented vertically (but still in one plane). Inflorescences 45–55 cm long, spreading, branched to three orders; peduncle 6.5–9 cm long, densely covered especially proximally with small brown-centered scales with long diverging white trichomes along margins; prophyll and first peduncular bract 51–55 cm long, densely tomentose-floccose abaxially; rachis 16–17.5 cm long, scarcely scaly, with 15–20 angled branches; rachillae 27–44 cm long, waxy glaucous and glabrous. Flowers in triads nearly to apex of rachillae; bract subtending triad prominent, rounded, liplike; staminate flowers brown in bud, white inside, symmetrical, 12 mm diameter and 10 mm high at anthesis; stamens 32–38, exceeding petals, connate basally in a conspicuous ring, filaments 5 mm long, equalling petals, subulate, awl-shaped, straight at apex, anthers 3.5 mm long, linear-oblong, introrse, connective large, dark; pistillode less than half as high as filaments, conic, 3-lobed; outer bracteole surrounding pistillate flower ring-like, equalling triad bract, inner one twice as high, partly surrounding flower, both brown.; pistillate flowers 8 × 6 mm at anthesis, gynoecium 5 mm high, ovoid, stigmatic lobes prominent, white; staminodes 2–3. Fruits 2.2 × 1.2 cm, red, perianth brown, stigmatic remains apical; mesocarp with longitudinal fibers adherent to endocarp only basally; endocarp glossy, with longitudinal groove and round basal invagination. Seeds 15–16 × 9 mm, bullet-shaped, truncate basally. Leaves of juvenile individuals distichously arranged; "saxophone" type establishment growth lacking.

Specimens examined, additional to those cited in Moore & Uhl (1984). NEW CALEDONIA. Upper Mayavetch valley, 550 m elev., 20°18′S, 164°23′E, 29 Apr. 1995 (stam. fl.), *J.-C. Pintaud & J.-L. Aubé 175 & 176* (K), *177* (NY), *178 & 179* (NOU), *180* (K) (all juv.); Col d'Amos, 550 m elev., 20°18′S, 164°26′E, 13 Jun. 1995 (ster.), *J.-C. Pintaud & M. Olivier 215* (K); Upper Mayavetch valley 550 m elev., 18 Sept. 1995 (juv.), *J.-C. Pintaud 281* (NOU), 282 (NY); id., 17 Mar. 1996 (stam. fl.), *J.-C. Pintaud & D.R. Hodel 339* (K, NY); Col d'Amos 550 m elev., 29 Apr. 1996 (stam. fl.), *J.-C. Pintaud & J.-P. Tivollier 346* (NY); Mayavetch, 550 m elev., 6 Jun. 1996 (pist. fl.), *J.-C. Pintaud & D. R. Hodel 373* (NOU).

Distribution. *Kentiopsis magnifica* occurs in an area of about 10 × 1–4 km along Col d'Amos and the Pam Penninsula ridge at the north end of New Caledonia where it grows in dense populations at 300–600 m elevation.

Ecology. *Kentiopsis magnifica* is an emergent tree in remnant rain forest on schists in many small, close but mostly separate valleys. Associated palms include *Basselinia gracilis, Cyphophoenix elegans*, and *Moratia cerifera*.

Phenology. Anthesis occurs from March through June; fruits mature from December through March (Fig. 2). Flowers are visited by bees that have nests in the forest while the ant *Polyrhachis guerini* feeds on the stigmas of pistillate flowers; also, a very abundant *Tetranichydae* mite feeds on the fleshy inflorescence branches and flowers.

Conservation status. Vulnerable (Jaffré et al. in press). Although *K. magnifica* occurs gregariously in numerous populations, its range is quite limited and the remnant forest habitat is fire-prone.

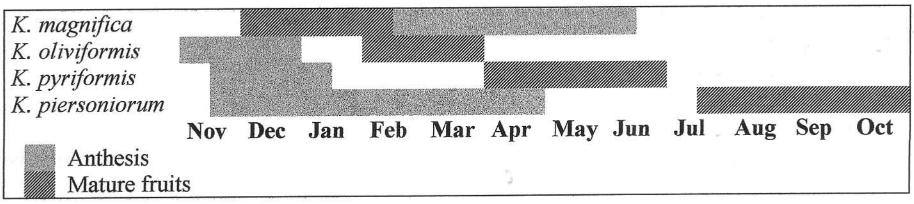
Taxonomic history. H. E. Moore, Jr. (1978) named and described *Mackeea magnifica* as a monotypic genus, stating that it differed from *Kentiopsis*, also monotypic at the time, by its symmetrical staminate flowers, mesocarp fibers adnate only basally to the endocarp, and short, trifid pistillode. These characters proved to be quite variable from species to species within the New Caledonian Archontophoenicinae with the wider series of specimens now available for study and thus are not sufficiently significant to maintain *Mackeea* as a distinct genus. Moore also stated that *Mackeea* was distinctive by the conspicuous layer of tannin cells overlaying the endocarp but *Kentiopsis oliviformis* was ambiguously described as having or lacking a layer of tannin cells in Moore and Uhl (1984). *K. oliviformis* has, in fact, a layer of tannin cells like the three other members of the genus. On the other hand, Moore did not say anything about the connation of stamens in a ring, a unique character.

Derivation of name. Moore (1978) chose the epithet because *K. magnifica* is one of the tallest and stateliest palms of New Caledonia.

Distinguishing features of *Kentiopsis magnifica* include the thick indument of brown scaly-concrescent trichomes on the petiole, rachis, and peduncle; bright red to chocolate-brown expanding leaf with pinnae held in one plane (initially vertically) and stamens connate in a ring in the proximal 1/3. "Saxophone" type establishment growth is not present but eccentric root development does occur. Leaves are distichously arranged in juvenile plants and petioles are covered by a dense brown tomentum. *Kentiopsis magnifica* is very similar to *K. piersoniorum* in inflorescence architecture and morphology but quite different in floral structure.

2. Kentiopsis oliviformis (Brongn. & Gris) Brongn., Compt. Rend. Hebd. Séances Acad. Sci. 77: 398. 1873; Beccari, Le Palmae della Nuova Caledonia: 18. 1920; Moore & Uhl, Allertonia 3(5): 324–325. 1984. (Fig. 4)

Kentia oliviformis Brongn. & Gris, Bull. Soc. Bot. France 11: 313. 1864; Ann. Sci. Nat. Bot. V.



2. Phenology of *Kentiopsis* species.

2: 161. 1864 (*'olivaeformis'*); Vieillard, Bull. Soc. Linn. Normandie II. 6:229. 1873. Type: Vieillard 1281 (holotype P).

Emergent palm. Trunk to 30 m tall, 25 cm dbh, gray, base thickened. Leaves 8–10, ascending to spreading; sheath to 1.1 m long, initially densely covered with ± concrescent white-translucent appressed trichomes, becoming grayish with age, glabrescent; petiole to 10 cm long; rachis to 3 m long, initially with same indument as sheath; pinnae 40–55 on each side, median ones 80–105 × 4–6 cm, basal ones continuing into lorae, all ± drooping, shining dark green adaxially, paler abaxially. Inflorescences erect to ascending, branched to three orders; peduncle 7–10 cm long; prophyll and first peduncular bract 60–70 × 20 cm, with deciduous brown-centered white-floccose scales becoming puncticulate; rachis to 35 cm long, bearing stellate scales; branches ca. 18, bearing same scales; rachillae to 30 cm long, ± glabrescent; bracts subtending branches and rachillae low, rounded, ± ruffled. Flowers in triads nearly to apex of rachillae, bract subtending triad prominent, rounded, liplike; bracteoles surrounding pistillate flowers low, unequal, rounded to pointed, not sepal-like; staminate buds 5.5–6.5 mm high, very asymmetrical, pointed; stamens 34–37, slightly shorter than petals, filaments 2 mm long, straight and not attenuate apically, anthers 2.8–3 mm long, linear, latrorse, emarginate apically, bifid basally, connective elongate, large, black; pistillode nearly as high as stamens, columnar, attenuate to a sometimes briefly trifid apex; pistillate flowers 5.5–7 mm high, staminodes 3, gynoecium 4.8 × 3.5 mm, ± diamond-shaped. Fruits 14–17 × 8–9 mm, red; stigmatic remains apical; mesocarp with flat fibers adherent to endocarp throughout. Seeds 11–13 × 6 mm, ellipsoid. Leaves of juvenile individuals spirally arranged; "saxophone" growth present.

Additional specimens examined. NEW CALEDONIA. Boghen Valley, Mecounia, 100 m elev., 21° 37′ S, 165° 39′ E, 9 Nov. 1995 (stam. fl.), *J.-C. Pintaud, S. Blancher, M. Grouzis & T. Jaffré 292* (NOU); id. 7 Mar. 1996 (fr.), *J.-C. Pintaud 324* (leg. *J.-M. Veillon, S. Blancher & M. Boulet*), (BH, BRI, K, NY, P); Houé-Moindou Valley, Tindéa, 150 m elev. 21° 39′ S, 165° 43′ E, 27 May 1996 (ster.), *J.-C. Pintaud, R. Gatefait & N. Natiello 358* (K, NOU, NY); id. 359 (juv.) (P).

Distribution. Kentiopsis oliviformis is restricted to central New Caledonia at low elevations (10–300 m), from Farino to Col des Roussettes on the west side and from Canala (not recently seen) to Kouaoua on the east side.

Ecology. A gregarious species, *Kentiopsis oliviformis* is an emergent tree in transitional, semihumid *Aleurites* forest only, where it occurs on schists and basalts often mixed with serpentine colluvium. In valley bottoms in the Tindéa-Boghen area, there are numerous populations, each nearly forming a pure stand of 0.1–1 ha (usually on flat land along a temporary stream), within which there is no regeneration due to continuous leaf fall from tall (25–30 m), mature trees. Regeneration occurs only on the periphery of each stand where mature trees are more widely spaced. Mature trees become even more widely spaced farther out from the center of each population then disappear altogether on adjacent hillsides and valley slopes. In the Koh region of Kouaoua, under a more humid climate, but also around Farino, *K. oliviformis* escapes from valley bottoms and is scattered on well-drained hill slopes.

Phenology. Anthesis occurs from November through December; fruits mature from February through March (Fig. 2). Seeds germinate immediately after dispersion.

Conservation status. Kentiopsis oliviformis is endangered (Jaffré et al. in press). All populations are in areas under agricultural pressure; none have normal regeneration. In the Tendéa-

Boghen area with several populations exceeding 1000 individuals, regeneration is very low due to cattle grazing; dramatic population reduction is expected here. The government of the South Province of New Caledonia has established an experimental, fenced area near Boghen to exclude cattle from one stand of *K. oliviformis.* However, these measures need to be greatly expanded to protect these and other populations adequately. Clearing of forests and harvesting trees for the edible cabbage or palm heart have much reduced populations near Kouaoua, La Foa, and Bourail.

Taxonomic history. A. Brongniart and A. Gris (1864) named and described *Kentia olivaeformis* from an incomplete collection of Vieillard from Canala lacking leaves and male flowers. Brongniart (1873) transferred the species to *Kentiopsis* and listed a more complete collection, *Balansa 766* near Nera River at Bourail. This population still exists but is much reduced as this area is now converted to agricultural land. Vieillard reported the vernacular name of Kipe for this species in Canala and said it exceeded 30 m tall and outgrew the coconuts from which *K. oliviformis* differed only by the small red fruits.

Derivation of name. The epithet means olive-shaped, and refers to the shape of the fruits.

Kentiopsis oliviformis is distinctive within the genus by the very asymmetrical staminate flowers, not glossy in bud, the bracteoles not sepal-like and mesocarp fibers adherent to endocarp throughout. Other distinguishing features include the dense white indument on the leaf sheath, petiole, rachis, bracts and peduncle, bright, pale green expanding leaf and erect inflorescences with scarcely divergent rachillae. "Saxophone" type establishment growth is present. Leaves are spirally arranged in young juvenile plants and petioles have prominent dark brown scales becoming marginally more and more white-fimbriate and finally white-floccose with age of the plant.

3. Kentiopsis piersoniorum Pintaud & Hodel **sp. nov.** (Figs. 5, 9)

K. magnificae (H. E. Moore) Pintaud & Hodel affinis sed folliis valde recurvatis, pinnis erectis, vaginis purpurascentibus vel purpureis-viridibus glabrescentibus ceraceis albis, staminodiis 6, filamentis basaliter distinctis, pistillodiis circa fila aequantibus differt. Typus: New Caledonia, Mont Panié, 570 m elev, 20°34′S, 164°48′E, 29 Dec. 1995, *Pintaud 309* (holotypus P; isotypus BH).

Emergent palm. Trunk 10–15 m tall or more, 18–25 cm dbh, gray, sometimes with an expanded base. Leaves 10–12, sharply recurved; sheath 80–120 cm long, purplish-green to purple obscured by a layer of bright glaucous wax and dotted with tiny brown scales abaxially, only slightly splitting opposite petiole and there bearing small auricles 1 cm long; petiole 12–18 cm long, rachis 2.2–2.3 m long, petiole and rachis purplish, soon glabrescent but covered initially by a dense, short white tomentum; pinnae 35–40 on each side, median ones 110 × 3–4.5 cm, proximal 2 pairs continuing into lorae, all straight, narrowly acute, coriaceous, 1-ribbed, ascending in a narrow V, adaxially waxy, glaucous-green, midrib bearing abaxially twisted brown ramenta on proximal 1/2 to 3/4 of the pinnae. Inflorescences 80–100 cm wide, spreading, branched to three orders, all parts except flowers and bracts strikingly glaucous and discretely spotted with minute, brown scales; peduncle short, encircling half the trunk; prophyll 60–70 × 20 cm, acute, with marginal wings 2–5 cm wide; first peduncular bract 60–70 × 15–18 cm, rostrate, both bracts densely covered abaxially with brown indument; rachis 30 cm long, main branches 6–10 cm long, 1–2 cm wide, ± rounded, swollen at base; bracts subtending branches small, triangular proximally, reduced to a low ridge distally; rachillae 100–200 or more, 35 cm long, 0.5 cm diameter, straight to reflexed, rounded, glabrous. Flowers in triads in proximal 2/3–3/4 of rachilla, bract subtending triads a thin, sharp-edged, rounded shelf 1.5–1.75 mm high; flowers glossy, dark brown in bud, flowering basipetally; staminate flowers in bud 9.5 × 4.5 mm, bullet-shaped, slightly asymmetrical; calyx 4 × 6 mm, cupular, triangular, sepals cup-shaped, rounded or truncate apically, strongly angled abaxially; petals 8 × 4.5 mm, long-ovate, connate in basal 1/4–1/3, pink adaxially; stamens 35–38, exceeding petals, filaments 5 mm long, slender, white, attenuate apically, straight or inflexed, free or nearly so, anthers 4–4.5 mm long, slender, dorsifixed 1.5 mm from base, connective narrow, tanniniferous; pistillode 3.5–4 mm high, 2/3 as high to equalling filaments, conic basally, attenuate apically; outer bracteole surrounding pistillate flower conspicuous, 2.5 mm high, inner bracteole very large, sepal-like, 4.5 mm high, only partly surrounding flower on one side, rounded; pistillate flowers at anthesis 10 × 5 mm, ovoid-elongate; calyx 5 × 5.5 mm, cup-shaped, sepals broadly rounded apically; petals cup-shaped, acute apically; staminodes 6, ± thick, connate basally and forming a crownlike ring 0.6 mm high; gynoecium 6 × 4 mm at anthesis, ovoid, stigmatic lobes thick, blunt, straight at anthesis, recurved later, angled, ovule pendulous. Fruits 17–23 × 9–10 mm, cylindrical and smooth when fresh, purplish, drying bullet-shaped and pebbled, fruiting perianth 6.5 mm high, stigmatic remains apical; mesocarp with a layer of flat, mostly separate, longitudinal fibers included in a thick layer of tannin cells; endocarp thin. Seeds 10–15 × 6.5–7 mm, bullet-shaped but truncate at both ends, endosperm homogeneous. Seedling with deeply bifid eophyll, lobes narrowly lanceolate to 15 cm long, with prominent nerves adaxially; trunkless juvenile individuals with spirally arranged leaves; saxophone growth absent.

Additional specimens examined. NEW CALEDONIA. East slope of Mont Panié, 600–700 m elev., 20° 34′ S, 164° 48′ E, 23 June 1971 (fr.), *H. E. Moore, Jr., H. Brinon, M. Schmid & J.-M. Veillon 9968* (BH, NOU); Mont Panié, on trail to summit, in open shrubby vegetation dominated by *Araucaria montana*, 570 m elev., 12 Jun. 1995 (juv.), *J.-C. Pintaud & M. Olivier 208* (NOU, NY, P); 211 (ster.) (P); id. 26 Jul. 1995 (juv.), *J.-C. Pintaud & P.-O. Albano 238* (P); id. 17 Jan. 1996 (pist. fl.), *J.-C. Pintaud 318* (BH, BRI, K, NY, P); id. 18 Mar. 1996 (pist. fl.), *J.-C. Pintaud 341* (leg. *D. R. Hodel*), (NOU); id. 5 Jun. 1996 (juv.), *J.-C. Pintaud & D. R. Hodel 367* (NOU).

Distribution. Kentiopsis piersoniorum occurs in a very limited area on the east slope of Mt Panié where it mainly occupies one valley and adjacent hills and ridges at (400)500–800(1000) m elevation.

Ecology. Kentiopsis piersoniorum grows as an emergent, gregarious, dominant, exposed tree in shrubby to forested vegetation on steep slopes and ridges on schists. Associated palm species include *Basselinia velutina, Chambeyronia lepidota, Moratia cerifera,* and *Brongniartikentia lanuginosa.* Mass germination occurs in the dense stands.

Phenology. Anthesis occurs from November through April; fruits mature from August through October (Fig. 2). The two accessible individuals from which all collections have been made (including Moore's) at 570 m elevation on the trail to the summit of Mt Panié have flowered once in two years (1995–1996), and the large proportion of sterile individuals in the main population on the opposite ridge southward suggests that flowering may be normally biennial or even more infrequent, with the production of only a single inflorescence each time.

Conservation status. Status is low risk but conservation dependant (LRcd, proposed according to IUCN [1994]). Although very abundant at the place where it occurs, *K. piersoniorum* is restricted to several hundred hectares of forest only. The population of *K. piersoniorum* is afforded some protection, especially against fire, since it occurs entirely in the Mt Panié Botanical Reserve where its habitat is undisturbed and difficult to access.

Taxonomic history. H. E. Moore, Jr. first collected this species in 1971. Despite vegetative differences, Moore assigned it to *Mackeea magnifica,* basing his decision on his incomplete collection consisting only of immature fruits. We were able to collect this palm in flower in 1995–1996, the more complete material showing it to be a distinct species.

Derivation of name. The epithet honors the Pierson families, Robert and Geneviève of Tontouta and their sons and daughters-in-law, Jean and Chantal, and Gilles and Marie-Christine of Nouméa, who have gone to exceptional measures to increase our knowledge of New Caledonia palms and encourage and support our work leading to a book on this island's extraordinary palms.

Kentiopsis piersoniorum is an impressive and spectacular palm. The sharply recurved, grayish leaves and glaucous crownshaft are remarkable, even among the many palm species with recurved leaves on Mt Panié and the strikingly glaucous color of the inflorescence contrasts aesthetically with the glossy brown buds, pink petals, white filaments and yellow anthers of the staminate flowers. Unfortunately for visitors, the breathtaking populations of *K. piersoniorum* are hardly accessible.

Kentiopsis piersoniorum is distinctive by the complete staminodial ring but also by its low rate of reproduction and long delay (one month) between anthesis of staminate and pistillate flowers in the same triad. *Kentiopsis piersoniorum* resembles *K. magnifica* in inflorescence mor-

3. *Kentiopsis magnifica*: emergent in remnant forest at Col d'Amos, 500 m (see Centerfold, left, for color). 4. *Kentiopsis oliviformis*: tall trees standing at the edge of a gallery forest in Boghen valley, 50 m (see Centerfold, right, for color). 5. *Kentiopsis piersoniorum*: a group in low montane forest, Mont Panié. 700 m. 6. *Kentiopsis pyriformis*: habit.

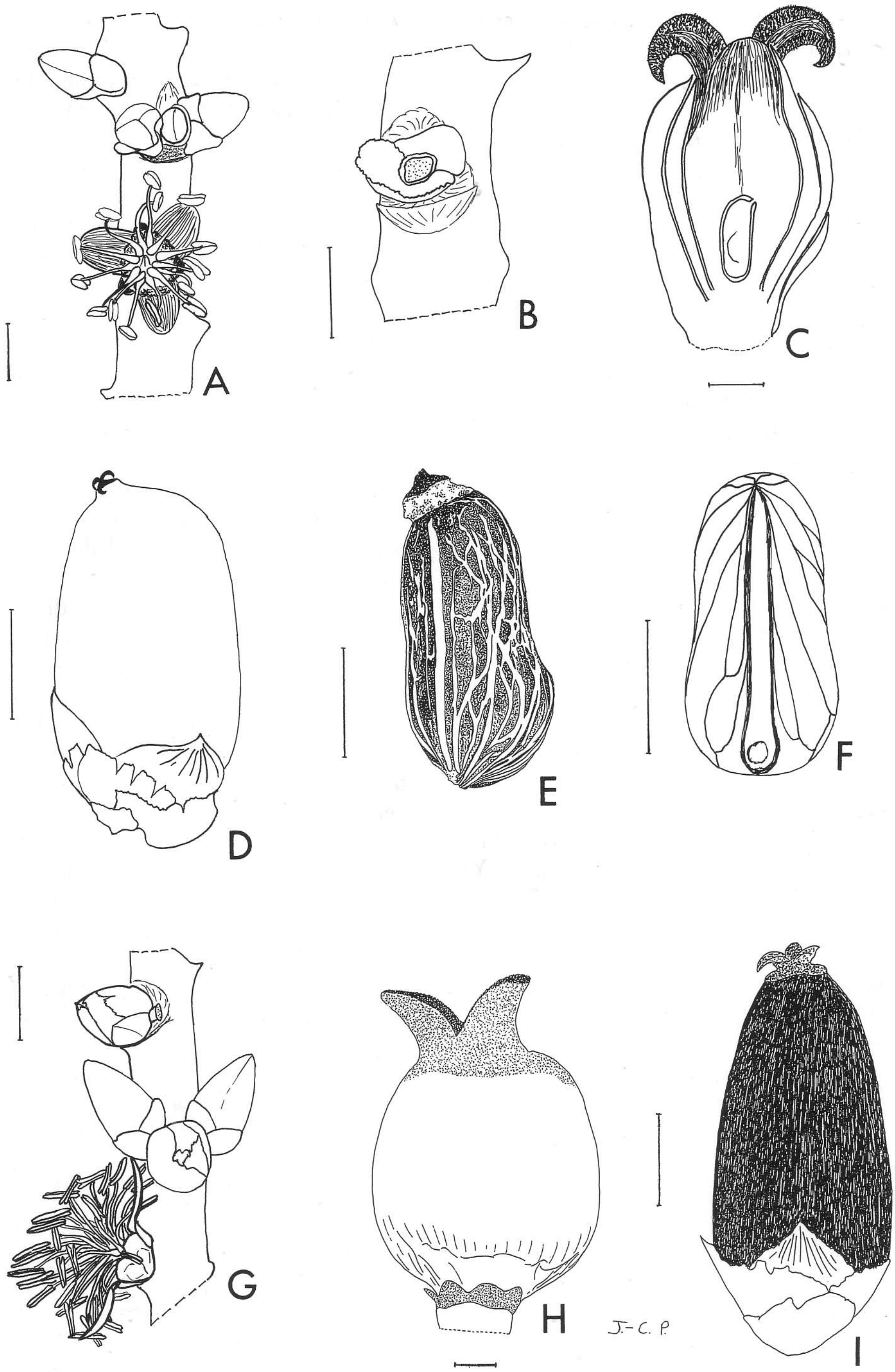
7. *Kentiopsis pyriformis*: view of the crown at Goro, 50 m. 8. *Kentiopsis pyriformis*: newly opened, pink inflorecence.

phology, both species having stout glaucous and sparsely scaly branches, glossy-brown buds and unequal bracteoles, the inner one sepal-like, but they differ markedly in flower shape and structure, leaf shape, and indument. The two species occur about 50 air kilometers apart.

4. Kentiopsis pyriformis Pintaud & Hodel **sp. nov.** (Figs. 6–9)

Kentiopsis oliviformi (Brongn. & Gris) Brongn. affinis sed foliorum vaginis glabrescentibus ceraceis cupreis vel vinosis, inflorescentiis effusis ramis principalibus angulatis, floribus masculis symmetricalibus, staminibus 11–20 differt. Typus: New Caledonia, Goro, mouth of Kuebini River, 50 m elev., 22° 16′ S, 167° E, 6 Dec. 1995, *J-C Pintaud & D. R. Hodel 303* (holotypus P; isotypi BH, BRI, K, NOU, NY).

Subcanopy to emergent palm. Trunk 10–18 m tall, 10–22 cm dbh, brown becoming gray, sometimes enlarged or bulging at the base, adventitious roots visible. Leaves 7–12, ascending to spreading, moderately recurved or nearly straight; leaf sheath 70–130 cm long, copper-colored or purplish red, with a thin cover of glaucous-white wax and minutely puncticulate with tiny brown lacerate scales abaxially, splitting in the distal 1/4–1/3 opposite petiole and there bearing small auricles 1 cm long or terminating on petiole with two wings 10 cm long; petiole 20–45 cm long (sometimes to 2.6 m long in trunkless juveniles), glabrescent, green or reddish to purplish; rachis 2.5–3 m long, petiole and rachis variously covered initially by thin feltlike indument of brown-centered, white-margined scales; pinnae 40–58 on each side, median ones 110–130 × 5–8 cm, proximal two pairs continuing into lorae, all acute, coriaceous, one-ribbed, ascending and held in open V or borne in one plane and flat to slightly pendulous, green and glossy adaxially, midrib and sometimes secondary ribs bearing abaxially membranous, medifixed ramenta in groups of 2–20. Inflorescences 1–2, 60–100 cm wide, spreading, branched to four orders; peduncle 6–10 cm long; prophyll 40–50 × 20 cm, splitting into two halves; first peduncular bract 50–60 × 15–18 cm, beaked, slightly exceeding the prophyll, both bracts pale green or dark purple, glabrescent to variously tomentose abaxially; rachis 30–40 cm long with 10 main branches 2–10 cm long, 1–4 cm wide, sharply angled, dorsiventrally flattened, brownish green to bright purple; peduncle and rachis with thin indument of brown-centered, white-margined minute scales; bracts subtending branches small, triangular-obtuse to acuminate and finally reduced to a ridge; rachillae 100–400, slender, 20–30 cm long, 0.5 cm diameter, folded and mucilaginous in inflorescence bud, rounded, glabrescent, very pale green to cream-colored in bud, becoming brown or dark purple. Flowers in horizontal triads of a central pistillate flower flanked by two median-lateral earlier-opening staminate flowers; triads in proximal 2/3 and sometimes nearly to apex of rachillae, paired staminate flowers only distally, or sometimes paired staminate flowers on unisexual rachillae; bracts subtending triads a thin, rounded, sharp-edged lip to 1 mm high; staminate flowers in bud 6 × 3.5–4 mm, glossy brown, almost symmetrical; calyx 2.5 mm high and 3.5 mm in diameter, cupular, sepals keel-like, truncate or broadly rounded apically; petals ovate, boat-shaped, spreading at anthesis, adnate to the receptacle basally and with a swollen pulvinus just above, pinkish adaxially; stamens 11–20, just exceeding petals, filaments free or nearly so, 2.5 mm long, slender, slightly fluted, white, straight, and not attenuate apically, anthers 2–2.5 mm long, slender, dorsifixed 1/3 up from base, connective white, not tanniniferous; pistillode 1–1.5 mm high, much shorter than filaments and petals, conical to columnar and fluted or rarely spindle-shaped; outer bracteole surrounding pistillate flower 1–2.5 mm high, sepal-like or not, inner bracteole 2.75 mm high, always sepal-like, sometimes forming a tube with the outer bracteole; pistillate flowers 5–6 × 3–4.5 mm, rhomboid and laterally compressed or globose-ovoid; calyx 4–4.5 × 4–4.5 mm, cupular, sepals strongly bowl-like to cup-shaped; petals bowl-like to cup-shaped, scarcely exceeding or much exceeding sepals; staminodes 3, 0.5–0.9 mm high, toothlike, thin, membranous; gynoecium 4–5.5 × 2.5–3 mm, stigmatic lobes recurved, angled, laying between corolla lobes or short, erect; ovule laterally attached or pendulous. Fruits to 17 × 7 mm, oblong, purplish pink, fruiting perianth 6 × 8 mm, stigmatic residue subapical; mesocarp with abundant, mostly elongate, but at times wandering or reticulate fibers not adherent to endocarp, tannin cells in a thick layer between fibers and endocarp; endocarp whitish, fragile. Seeds 10–12 × 5–6 mm, pyriform, rarely ± ellipsoid,



9. (A–F). *Kentiopsis pyriformis.* (A). Portion of rachilla at staminate anthesis. (B). Portion of rachillae, fruit removed, showing bracteoles. (C). Longitudinal section of pistillate flower at anthesis. (D). Ripe fruit. (E). Fruit with outer mesocarp removed to show pattern of fibers. (F). Seed (hilum view). (G–I. *Kentiopsis piersoniorum.* (G). Portion of rachilla at staminate anthesis. (H). Gynoecium just after anthesis, showing the staminodal ring. (I). Dried fruit. Scale bars: vertical = 5 mm, horizontal = 1 mm. A: from *Pintaud 303*; B, D, E, F: from *Pintaud 348*; C: from *Pintaud 310*; G: from *Pintaud 309*; H: from *Pintaud 341*; I: from *Moore 9968.*

hilum elongate, lateral, raphe branches mostly longitudinal, anastomosing little, slightly embedded. Bifid leaves 5–6 before first pinnate leaf; trunkless juvenile individuals with distichously arranged leaves, becoming spirally arranged with age, petioles glabrous, glossy reddish to dark purple; "saxophone" growth present.

Additional specimens examined. NEW CALEDONIA. Coastal locations: Touaourou, edge of the rain forest, 10 m elev., 22° 12′ S, 166° 58′ E, 26 Apr. 1995 (ster.), *J.-C. Pintaud 174* (leg. *T. Tonnelier, M. Dumas & R. Lavoix*), (NOU); Goro, mouth of Kuebini River, 50 m elev., 22° 16′ S, 167° E, 5 May 1995 (fr.), *J.-C. Pintaud & M. Dumas 190* (NOU, NY); id. 26 May 1995 (juv.), *J.-C. Pintaud & C. Pierson 203* (NOU), 204 (P); id. 10 Sept. 1995 (buds), *J.-C. Pintaud & M. Dumas 265* (BH NOU, P); id. 6 Dec. 1995 (stam. fl.), *J.-C. Pintaud & D. R. Hodel 304* (BH, BRI, K, NOU, NY, P); id. 4 Jan. 1996 (pist. fl.), *J.-C. Pintaud, T. Jaffré & J.-M. Veillon 310* (BH, K, NY); id. 4 May 1996 (fr.), *J.-C. Pintaud & M. Dumas 348* (BH, BRI, K, NOU, NY, P); Kaa Drumia south of Goro, 50 m elev., 22° 19′ S, 167° E, 26 Jun. 1996 (old infru.), *J.-C. Pintaud 374* (leg. J-M Veillon), (NOU); Inland location: South of Mts Nengone, near Port Boisé, 200 m elev., 22° 20′ S, 166° 55′ E, 26 May 1995 (juv.), *J.-C. Pintaud & C. Pierson 200 & 201* (P), *202* (K, NY); id. 10 Dec. 1995 (buds & pist. fl.), *J.-C. Pintaud & D. R. Hodel 306* (BH, BRI, K, NOU, NY, P); id. 13 Jan. 1996 (juv.), *J.-C. Pintaud & M. Dumas 316* (P); id. 12 Feb. 1996 (seeds), *J.-C. Pintaud 325* (*leg. R. Lavoix*) (NOU).

Distribution. Kentiopsis pyriformis ranges from along the east coast of New Caledonia south of Yaté, where it occurs in a fringe of forest 20 km long and 100–500 m wide from Touaourou to Goro villages at 5–100 m elevation, inland to the southwest about 11.5 air kilometers distant in remnant patches of forest at about 200 m elevation, at the southern end of Monts Nengone, near Port Boisé. The main population is at Goro on a steep, unstable, rocky slope above the mouth of Kuebini River.

Ecology. A more or less gregarious, subcanopy to canopy species, *Kentiopsis pyriformis* is found in lowland rain forest on ultramafic rocks, both on oxydic colluvium on flat land and steep, rocky, eroded slopes of peridotitic mountains and hills. The largest and more gregarious population at the Kuebini River near Goro grows with other palms including *Actinokentia divaricata, Basselinia pancheri, Clinosperma bracteale,* and *Cyphokentia macrostachya.* The population near Port Boisé is much smaller and the individuals more scattered. Associated palms there include *A. divaricata, B. gracilis, B. pancheri, Chambeyronia macrocarpa.*

Phenology. Flowers usually occur from November through February with a 15-day delay between anthesis of staminate and pistillate flowers in the same triad; fruits mature from April through June (Fig. 2).

Conservation status. Status is critically endangered (proposed). Occupying less than 2 ha, the main population of *K. pyriformis* at the Kuebini River is unprotected and consists of less than a hundred trunked individuals. Fire severely affected the entire population about 1980, destroying nearly all saplings and damaging trunks of many mature individuals. Despite an abundant and regular production of readily germinating seeds, regeneration remains extremely low due to the difficulty of seedling establishment in an unusually steep, rocky, unstable habitat. In March 1996, Cyclone Beti caused the fall of at least 25% of the adults, nearly all of them more windprone since the earlier fire destroyed protective vegetation and damaged trunks. In one group of eight adults, the cyclone felled seven of them.

Farther north along the coast at Touaourou, the forest is restricted to a narrow fringe inland from the road and next to the mountains. Here, burning, clearing for gardens and homes, and recent road improvements and rural electrification have all taken a toll on the forest. Also, native inhabitants probably harvested the palms, perhaps for the edible palm heart or cabbage and/or construction, since not one adult tree has been observed there. Some other small groups composed of a few adults and juveniles occur south of Goro where they are affected by landslides and stream erosion.

The Port Boisé population is known from ca. 20 adult trees, less than a hundred juveniles with trunks, and numerous saplings, which locally dominate the understory, and is partly, although marginally, included in a botanical reserve. Felling of trees for construction and edible palm heart has decimated this population. Jean-Marie Veillon (personal communication) reports that as a forestry officer in the 1970s, he cited people for illegal cutting of palms in the Botanical Reserve.

Taxonomic history. Lucien Lavoix, an ardent palm enthusiast, first noticed this palm and brought it into cultivation in the early 1970s, using seedlings removed from the Port Boisé population. Donald R. Hodel saw the species in the forest at Touaourou in 1977, and suspected it might be a new species. However, *Kentiopsis pyriformis* remained undocumented until we made the only collections of mature, flowering trees in 1995–1996, relying on information from Raymond Lavoix, son of Lucien, and several members of Association Chambeyronia, the New Caledonia Palm Society.

Derivation of name. The epithet means pear-shaped, and refers to the unusual and distinctive shape of the seeds.

Since each of the two collected populations of *Kentiopsis pyriformis* (Kuebini River and inland near Port Boisé) has conspicuous differences, some explanation is needed to justify their inclusion in a single, variable species.

The two populations have the same major structural characteristics, both in vegetative and reproductive morphology. Distichous and glabrous juvenile stages associated with saxophone growth, highly branched inflorescences with flattened and sharply angled branches, slender rachillae, symmetrical flowers arranged horizontally in the triad, staminate flowers with sharply costate sepals, rather few stamens with short filaments not attenuate apically, white connectives and short pistillodes, pistillate flowers with three staminodes born within one petal, and pyriform seeds are constant and diagnostic characters. Purplish-pink fruits with subapical stigmatic remains and distinctive, elongate, wandering, reticulate mesocarp fibers may also prove to be good diagnostic characters, although mature fruits are yet unknown from populations near Port Boisé where only pyriform seeds removed from seedlings have been found so far.

The most striking differences in vegetative morphology concern the habit of the palm and characters of the leaf sheath. Individuals from the coastal population have only 7–8 recurved leaves with a copper-colored sheath bearing small auricles at apex, and pinnae held straight in an open V, while individuals of the inland population have 10–12 spreading leaves with attractive, purplish to burgundy sheaths lacking auricles, terminating in wings, and flat to slightly drooping pinnae. However, exploration in July 1996, south of Goro and on the eastern side of Port Boisé mountains not previously visited has uncovered additional populations of *Kentiopsis pyriformis* with a mix of vegetative characters and sometimes intermediate forms, which show that these features are quite variable and, in fact, lead nearly to a continuum between the two collected populations.

In reproductive morphology, the coastal and inland populations differ mainly in the shape of the pistillate flowers (rhomboid or ovoid) and surrounding bracts (forming a tube or not) and other pistillate structures such as stigmas (recurved or straight) and ovule attachment (lateral or pendulous), but we have made only one collection with pistillate flowers at each location, and thus we do not know the possible variability of these structures.

Biogeography

The discovery of two new species enhances our understanding of patterns of evolution and biogeography of *Kentiopsis.* Two species are restricted to the northeastern schistose range derived from the ancient rocks of East Gondwanan origin (Paris 1981). The rich flora of this region has been interpreted as a modified sample of the late Cretaceous East Gondwanan flora (Morat et al. 1986). With two genera and three species, Mt Panié, which is clearly a refuge for rain forest taxa, is not surprisingly rich in Archontophoenicinae, an autochthonous East Gondwanan subtribe supposedly of late Cretaceous origin. In contrast, *Kentiopsis pyriformis* has probably differentiated on more recent ultramafic substrates dating from the late Eocene, 38 million years ago (Jaffré et al. 1987). *Kentiopsis oliviformis* is unique among New Caledonia palms in growing in semihumid transitional forest, a vegetation type of late Tertiary to early Quaternary origin, rather poor in species and dominated by the possibly introduced *Aleurites moluccana* (L.) Willd. (Euphorbiaceae) and containing numerous elements of the dry sclerophyllous flora (Jaffré et al. 1993). *K. oliviformis* is, as presently known, the only endemic plant species of transitional forest. The genus has spread from the northern to the southern ends of the island in very different habitats but, despite efficient reproductive systems and gregarious behavior, the species of *Kentiopsis* remain highly localized, a pattern common to many New Caledonia endemic taxa and one still not clearly explained.

Horticultural value of Kentiopsis

The species of *Kentiopsis* have great horticultural appeal. They are tall, solitary, pinnate-leaved palms with prominent crownshafts. In many ways, they are the quintessential palm, and are highly sought after by palm collectors around the world. *K. magnifica* has the new leaf expanding bright red, especially when in the juvenile state; *K. pyriformis* often has attractive burgundy-colored leaf sheaths, *K. piersoniorum* has tightly recurved and arching leaves with upright pinnae and bright glaucous leaf sheaths. *Kentiopsis oliviformis* is the most widely cultivated, while *K. magnifica* can be admired in some botanic gardens in Australia and Hawai'i The new species are rarely cultivated, even in New Caledonia. An attractive group of *Kentiopsis pyriformis*, about 25 years old with 1–2 m trunks, exists at the Lavoix home garden on Mt Koghi, where another plant of similar height is most probably *K. piersoniorum*. Seeds of *K. pyriformis* have recently been widely distributed and healthy seedlings are now growing in New Caledonia and elsewhere, and will be a valuable ornamental addition to gardens and the landscape.

Acknowledgments

The authors are grateful to Marc Dumas, Robert Gatefait, Chantal, Gilles and Jean Pierson, Jean-Paul Tivollier, and Théo Tonnelier, all members of Association Chambeyronia for their help in locating the species and with field work, and to Raymond Lavoix for his valuable information on the wild populations and cultivated specimens at his father's home and in his nurseries. We also thank Mr Briault of the Tourism Service of South Province for providing a helicopter for exploration in the Port-Boisé-Goro areas; Serge Blancher of Service Forestier, Bourail for help in locating populations of *K. oliviformis*; Hervé Jourdan for arthropod identifications, Tanguy Jaffré and Jean-Marie Veillon for continuous support and help in this research at ORSTOM, and two donors who wish to remain anonymous for providing support for Hodel's travel and work in New Caledonia.

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(*Continued from p. 14*)

D.T.: Can the *Jubaea* × *Butia* produce viable seed?

M.W.: My oldest *Jubaea* × *Butia* is only about 20 years old, but I believe it will produce viable seed. All natural *Jubaea* × *Butia* that I've checked produce viable seed.

D.T.: What about the *Butia* × *Syagrus*?

M.W.: I don't think so. That's why the expression "mule" has been derived for this cross.

D.T.: Could you cross, say, a coconut with a *Jubaeopsis caffra*?

M.W.: I don't think so. Coconuts have only 16 chromosomes, while *Jubaeopsis caffra* have over 100. Therefore, it wouldn't seem that those two could be capable of hybridization, except with difficulty.

D.T.: I'm sure that's what most of us sort of figured. Thank you for providing us with this fascinating information. The *Butia* × queen hybrids are beginning to show tremendous potential in new frontiers because of their cold hardiness and we are all hoping that you'll continue to keep up the work in the area of hybridization.

M.W.: I probably will continue since I sprayed water during a bad freeze on my queen palm and it managed to survive this past winter, which was so cold it resulted in the demise of almost all of the other queens in Gainesville. Otherwise it would have been difficult, if not impossible to find queen pollen locally.

D.T.: How can palm enthusiasts obtain the relevant literature in the event that they want to attempt to duplicate your hybridization process?

M.W.: I would be happy to send articles to anyone interested in the process, so anyone who is interested can simply obtain my address from the IPS Roster and contact me.

D.T.: Any final advice?

M.W.: Just one thing. I have heard of these hybrids referred to as mules. I recall as a youngster my many unpleasant encounters with that cantankerous animal and I hate to see such a beautiful palm associated with it in any way. Although I realize it's none of my business what people call it, I would like to encourage the association of the *Butia* × *Syagrus* cross with the name Nabonnand after Paul Nabonnand, the botanist who first successfully hybridized these plants over 100 years before I did. Knowing first hand the degree of difficulty required, I have a great deal of respect and admiration for him.

PALMS AND PEOPLE

During the annual meeting of the Society for Economic Botany (SEB), which will be held at the University of Aarhus, Denmark, 13–17 July 1998, a special session will feature the theme "Palms and People."

The meeting is open to others than members of the SEB. Further information can be found on the SEB website:

http://www.nybg.org/bsci/seb/SEB.html

Registration for the meeting can be sent to:

John Rashford, SEB Treasurer
Dept. of Sociology and Anthropology
College of Charleston, Charleston, SC 29424 USA
email Rashfordj@cofc.edu

Fees are: nonmembers of SEB 105 USD, banquet 45 USD, accommodation 35 USD/night.

Abstract: before May 5, 1998, by email to Henrik.Balslev@Biology.aau.dk or by regular mail to Henrik Balslev, SEB-conference, Dept. of Systematic Botany, University of Aarhus, Nordlandsvej 68, 8240-Riiskov, Denmark.

Principes, 42(1), 1998, pp. 56, 40

PALM LITERATURE

The Palms of the Amazon. By Andrew Henderson, The New York Botanical Garden, with illustrations by Anthony Salazar. Oxford University Press, New York, Oxford, 1995. ISBN 0-19-508311-3, $115.00 cloth edition.

The palms of the Amazon basin were featured in such great contributions to tropical botany as Martius' *Historia Naturalis Palmarum* and *Palmetum Orbignianum* published between 1823 and 1847, Alfred Russel Wallace's *Palm Trees of the Amazon* published in 1853, and Spruce's *Palmae Amazonicae* published in 1871. Despite the greatness of these works, it was by no means an easy task to identify the species of Amazonian palms. Many new taxa had been described, and only little had been done to compare the descriptions and type specimens coherently on a regional scale. And this has not been for lack of interest in the palm family. A swarm of studies have documented the abundance and ecological importance of palms in the forests of the Amazon basin. Other numerous studies have shown how singularly important palms are to the livelihood of the people of the Amazon. Comparisons between different parts of the region were, however, hampered by the lack of a sound taxonomic basis and lack of knowledge of the distribution and variation of the individual species of Amazonian palms.

This book fills the gap. Andrew Henderson worked on it for 10 years. He visited many parts of the Amazon and collected a good number of the species. The work is also based on the study of specimens of palms deposited in a number of herbaria throughout the Amazon region and also in the great North American herbaria and some European herbaria.

The introductory section of the book defines and describes the Amazon region and gives a general introduction to the palm family and its ecology particularly in the region. There is a chapter on the history of palm exploration and research. Finally Henderson discusses the changing species concepts and explains the concept he has chosen for this treatment.

It may be surprising to some that the book ends up concluding that there are 151 species and 189 taxa of palms in the Amazon region. Compared to previous estimates that there are somewhere between 1,100 and 1,400 palm species in the New World, it looks as if something is wrong when the Amazon, renown for its abundance of palms, has only a small fraction of them. Andrew Henderson has, however, taken a conservative approach to the species circumscription. Some newer studies, cited in the text, suggest that many palms are quite widespread and morphologically variable. This situation has given rise to an overestimation of the species numbers, and to the description of too many new taxa. Many of these are treated as geographic forms or varieties in this text. *Attalea butyracea*, for example, is treated as a widespread species occurring from Mexico to Bolivia and 11 names (plus their homotypic synonyms) are reduced to synonymy. And *Astrocaryum murumuru* is distributed throughout the Amazon with eight varieties in different parts of region. This broad species circumscription will not be to the liking of all; Kahn's recent revision of *Astrocaryum*, for instance, accepts much more narrowly defined species, usually with quite restricted geographic distributions.

At the generic level the treatment is also quite conservative. For example, *Jessenia* is included in *Oenocarpus* and *Attalea* is broadly defined to include *Scheelea*, *Maximiliana*, and *Orbignya*. On this background, and considering their overlapping characteristics, it may be surprising that *Itaya* is maintained as separate from *Chelyocarpus*.

The taxonomic section makes up the bulk of the book. It is a full and detailed treatment with keys to the genera, species, and subspecific taxa, descriptions of all taxa, and names and synonymy and citation of the original literature and type specimens. All species are illustrated with line drawings and for each taxon there is a dot map of its distribution within the Amazon region. I have had the pleasure of using the book in my work on the palms of Amazonian Ecuador over the past several months. The treatment seems to be basically sound, but after repeated use many small errors and inconsistencies appear. The keys do not always agree with the descriptions, which sometimes frustrates the identification effort. The synonymy appears to be quickly done (Balick is given as author for *Jessenia bataua* (Mart.) Burret subsp. *bataua*!) and without detailed studies of the type material and quick interpretation of the code (the same specimen is

(Continued on p. 40)

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Notes on the Conservation Status of Asterogyne yaracuyense in Venezuela

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Cerro La Chapa, a fine example of the cloud forest of the Venezuelan Coastal Mountain Range, is found in the state of Yaracuy, Venezuela. This is the habitat for the palm *Asterogyne yaracuyense*. In 1979, due to the great ecological and floristic value of this cloud forest, Steyermark proposed its inclusion within the so-called "Nirgua Refuge." This area kept its vegetational cover during the drastic climate changes of the Pleistocene period, in particular during extremely arid phases, even though neighboring areas became grassy plains.

The first botanical explorations were carried out during the decade of the 1960s, by botanists such as J. Steyermark, G. Bunting, and Jean G. Wessels Boer, who visited the forest making numerous collections of plants. On repeated occasions subsequently, it was visited by Steyermark and botanists such as R. Liesner and A. Henderson who found two new palm species there in 1985. Recently Winfried Meier, a student from the Freiburg University, Germany, carried out several visits to the area as part of his intensive studies on cloud forests in the Venezuelan Coastal Range. From his first visits to the area, W. Meier recorded evidence of rapid deterioration in the area; his worries and comments motivated later visits with botanists from the Herbario Nacional de Venezuela who made a series of collections of plants with the purpose of improving floristic knowledge of this forest.

Although taxonomic studies are limited, they nevertheless reveal astonishing results about the floristic composition. Species unknown to science have been discovered. The existence of six endemic species for Cerro La Chapa is registered to date: *Asterogyne yaracuyense* (Palmae), *Froesia venezuelensis* (Quinaceae), *Dichorisandra diederichsanae* (Commelinaceae), and three species of Rubiaceae—*Ladenbergia buntingii*, *Psychotria yaracuyensis*, and *Rudgea buntingii*.

Materials and Methods

Study site. Cerro La Chapa is situated just 5–6 km to the north of Nirgua City, in the state of Yaracuy. Starting from Nirgua, there is a road that allows one to reach the summit of Cerro La Chapa. The forest occupies a small portion of Sierra Santa Maria between 1000 and 1300 m asl and extends between 10°11′47″–10°12′31″north latitude and 68°34′41″–68°35′56″ west longitude.

Methods. For this work different virgin zones of the cloud forest, as well as areas affected by human activities, were visited during the months of December 1996 and April 1997. Based on walks through the area, an estimate of the population of *Asterogyne yaracuyense* and an inventory of the rest of the observed palms were made. Herbarium samples were placed in VEN.

Results

Comments on the taxonomy of Asterogyne *in Venezuela*. After the publication of Wessels Boer (1968, 1988) there have been few additional efforts to try to understand the taxonomy of this small genus. Venezuela has three of the five species of the genus accepted by Henderson et al. (1995): *A. ramosa* from the montane cloud forest, 760–1000 m asl, state of Sucre; *A. spicata* from the low montane wet forest, 200–700 m asl, state of Miranda, and *A. yaracuyense* from the montane cloud forest, 1200–1400 m asl, state of Yaracuy. All three of them are endemic to small areas in the northern part of the country. Even if *A. yaracuyense* is fairly close to *A. ramosa*, differences in the rachis, number and length of rachilles, and number of stamens and staminodes have been observed by Henderson and Steyermark (1968). Nevertheless, Wessels Boer (1988) does not admit the differences in the staminate flowers and number of rachillae, and suggested that populations from Sucre and Yaracuy, both from cloud forest, match *A. ramosa* taxonomically.

Alteration of its natural habitat. On recent visits to Cerro La Chapa a great alteration of the forest due to agricultural and cattle-farming activities has been observed. A system of small plots that systematically has taken possession of the cloud forest has been developed in order to promote the following activities: cultivation of bananas, coffee, and tubers under rudimentary agriculture practices; cattle raising of low intensity and precarious system, where the animals graze in the forested areas and have to be forced into the surrounding cloud forest to access other pasture grounds; constructions associated with human activities such as houses, water tanks for irrigation, fences to separate plots and roads; uncontrollable alteration of the physiognomy and floristic diversity of the cloud forest.

Present population of the species. The present population of *A. yaracuyense* is roughly between 200 and 300 individuals and the possibility for survival is low for the individuals that have managed to succeed in those very disturbed environments. This disturbed area shows a drastic decline in the environmental and edaphic humidity, together with solar radiation not concordant with the demand of the palms of the cloud forest. The restricted distribution of *A. yaracuyense* is very peculiar as this palm cannot be found in the neighboring cloud forest of Salom in the same Sierra Santa Maria.

Palm richness. Cerro La Chapa has an exuberant cloud forest almost comparable to the Rancho Grande forest in Henri Pittier National Park, Venezuela. Palms are very well represented in La Chapa with 11 species: *Asterogyne yaracuyense*, *Bactris setulosa*, *Chamaedorea pinnatifrons*, *Dictyocaryum fuscum*, *Euterpe precatoria* var. *longevaginata*, *Geonoma interrupta* var. *interrupta*, *Hyospathe elegans*, *Prestoea carderi*, *Socratea exorrhiza*, *Wettinia praemorsa*, and a probable new subspecies of *Geonoma spinescens*. This high diversity is almost unique for any cloud forest of the Venezuelan Coastal Range.

Discussion and Conclusions

Though *A. yaracuyense* was originally proposed by Johnson (1996) as a species of vulnerable status, recent observation suggests it should be regarded as an endangered species due to the drastic and systematic alteration of its habitat. The presumption of De Granville (1988) is reaffirmed with this study because of the destruction of the natural habitat. The development of agriculture and farming is permanent and reducing the area occupied by the cloud forest, and additionally, is altering neighboring areas that have not yet been considered for agriculture. This advanced degree of intervention is already affecting the floristic diversity and the survival of the endemic species of this cloud forest. *Asterogyne yaracuyense*, especially, will disappear very soon if urgent measures to protect this forest are not immediately taken. In addition, it must be mentioned that the Cerro La Chapa cloud forest gives rise on its southern slopes to three different rivers of the municipality of Nirgua; consequently the present transformation will suppress the flow of water for human consumption and agricultural irrigation in the Nirgua Valley.

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Pigafetta filaris, near Manokwari, Irian Jaya, see pp. 34–40.