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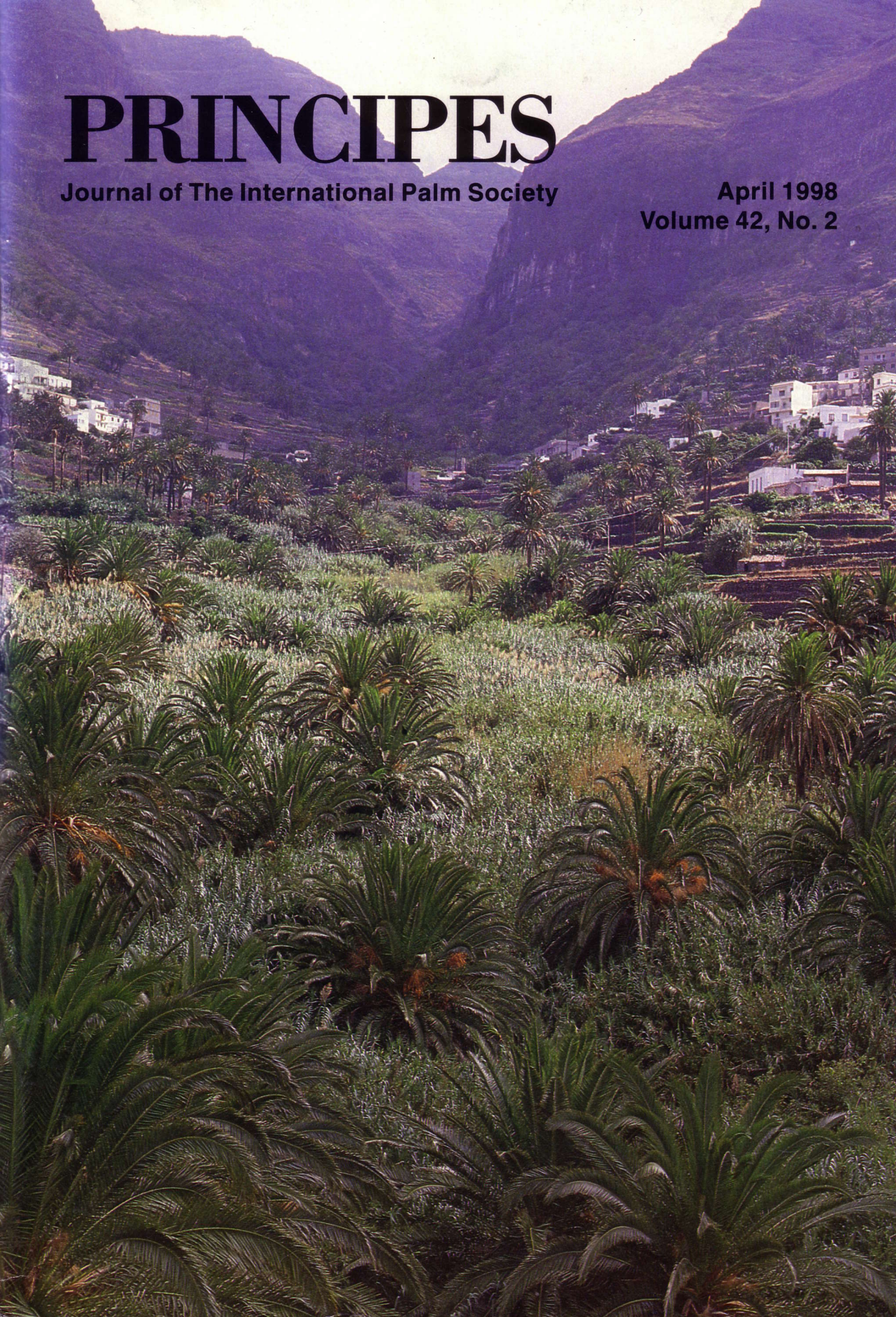

THE INTERNATIONAL PALM SOCIETY, INC.

THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for April

Front Cover

The bottom of Valley Gran Rey (La Gomera, Canary Islands); *Phoenix canariensis* emerge from a sea of reeds (*Arundo donax*). Photo by Carlos Simon.

PRINCIPES

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Principes, 42(2), 1998, p. 63

Editorial

In the October 1996 issue of *Principes* we included an article by De Hull on the facilitation of hurricane recovery by a *proprietory* plant growth supplement, *Ecosane.* Since then there has been very lively discussion on the efficacy of this product, with strong claims for both its efficacy and its lack of efficacy. In this issue we include two articles, one by David *Romney,* the other by Howard *Waddell*, that report simple experiments which they have conducted into the effects of *Ecosane.* We anticipate that there will be further reports and correspondence about this product.

Another article we include reports on the effects of *imidaclopprid* in the control of the potentially serious pest, the Royal Palm Bug. F. Howard and A. *Stopek* describe methods of application and effectiveness of this pesticide.

The remaining articles cover aspects of palms in the wild, information essential for a umber of reasons. If we are to conserve palms for the future, their geographical distribution, their ecology and their uses all need to be well documented. The grower can glean much background information from these articles, useful for deciding what sort of growing conditions the palms may require in cultivation. *Belen Jimenez* and Sandy Knapp describe and provide a key to the palms of a substantial area of Paraguay. Their article includes information on some familiar palms such as *Syagrus romanzoffiana* as well as rarities or otherwise very poorly documented species, many of which are potentially ornamental. The palms occur in the forest and in the *cerrado* where they are variously threatened or endangered.

The story of Phoenix *canariensis* in the Canary Islands is a fascinating one. This familiar palm, so widely cultivated throughout the subtropics, still occurs in abundance in its native home. Its origins are of great interest because of the possible relationships with the date palm *P. dactylifera,* and the extensive fossil record of the genus. Carlo *Morici* presents information on the current status of the Canary Date Palm on each of the seven Canary Islands, providing an accessible summary of what is known.

Greg *De Nevers* and Michael *Grayum* describe two new species in the genus *Geonoma* and provide new information on several others. There remain many unresolved taxonomic problems in *Geonoma,* one of the largest of all palm genera. With its beautiful line drawings, the present article clearly defines the two new species so there should be few of the problems of interpretation within the genus that have occurred again and again in the past.

In the last article, *Lim* Chong *Keat* applies his extensive knowledge of Malaysian and Thai palms in the wild and his considerable experience with historic type specimens in European herbaria, to disentangling some taxonomic problems in beautiful species of *Areca, Pinanga* and *Iguanura* in Southern Thailand. Those members who plan to take excursions to south Thailand after the IPS Biennial this September, may well encounter some of the species discussed in the article.

NATALIE UHL
JOHN DRANSFIELD

Principes, 42(2), 1998, pp. 63–64

Note from the President

Here in California, El Nino has certainly given us a very wet winter. This is a phenomenon well known to those living in the Western Hemisphere and is secondary to warming of the ocean waters off the Pacific Coast. The meteorologist's weather predictions did prove true and many areas have received record rainfall, especially in Central and Southern California. San Francisco south to Los Angeles has received amounts of rain expected in the northwestern states. Although not a record, we in

San Diego have received fifty percent more rain than normal. The temperatures were quite mild compared to a normal winter. It has also given very peculiar weather patterns throughout the United States. I.P.S. members in the eastern U.S. reported unseasonably warm weather, thus causing a drop in oil prices. Those in Florida complained of more water than they needed or wanted, while Hawaiian members are praying for more rain and are having to truck in extra water to keep their palms alive. Members in South America reported that some areas were pounded with torrential rains and unusually heavy storms. Compound this with tornadoes and water spouts in Florida and California and we have certainly had peculiar and sometimes dangerous weather. Despite all this, the enthusiasm for palms continues to grow. At our Southern California Chapter meeting March 28th, we feared for the first "rain out" ever. Members showed up with umbrellas and raincoats and pursued their interests despite inclement weather. Just like a palm researcher in the wet tropical jungles, the "show must go on" and we continue our fervor for palms.

As all of you have now received your announcement, information pages, and registration form for the 1998 I.P.S. Biennial and Post Biennial Tour in Thailand in the January issue of *Principes*, I ask that those interested in attending please reply promptly. This will be an absolutely unforgettable experience. Please note that the deadline for registration is July 15, 1998! After that date a late registration will apply. Also, there may be limitations on how many people can attend the Post Tour, so a prompt reply will guarantee your reservation. In your information packet there is an extensive description of the itinerary and costs for both events. If anyone did not receive their packet or has questions, please feel free to contact me directly.

You will note that there are some great articles in the January issue of *Principes*. You will also note that many of these articles were written by palm enthusiasts and I.P.S. members such as yourself. The Editors and I want to encourage you to submit articles for inclusion in *Principes*. Some of our most well-received articles don't come from research scientists but rather from palm enthusiasts like yourself. Ours is the only palm journal that reaches almost 3000 members worldwide with copies to all Chapters of the I.P.S. If you want your observations, notes on culture or travel journeys to palm habitats to reach the most readers, compose an article and send it to the Editors. Your contributions will be most appreciated and guarantee that members get the types of articles they want and that *Principes* will continue to be the leading palm journal in the world.

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Principes, 42(2), 1998, pp. 65–79

Palms of the Reserva Natural del Bosque Mbaracayú, Paraguay (Mbaracayú Natural Forest Reserve)

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ABSTRACT

The Reserva Natural del Bosque Mbaracayú in eastern Paraguay is an area of great interest for conservation. Twelve species of palms (three not yet collected in the Reserve, but to be expected) are described and their conservation status discussed. Palms occur in both the forest and the cerrado, and several of these, such as *Syagrus campicola*, are endangered or under severe threat. A key to the species in the Reserve is provided and many of the species are illustrated.

RESUMEN

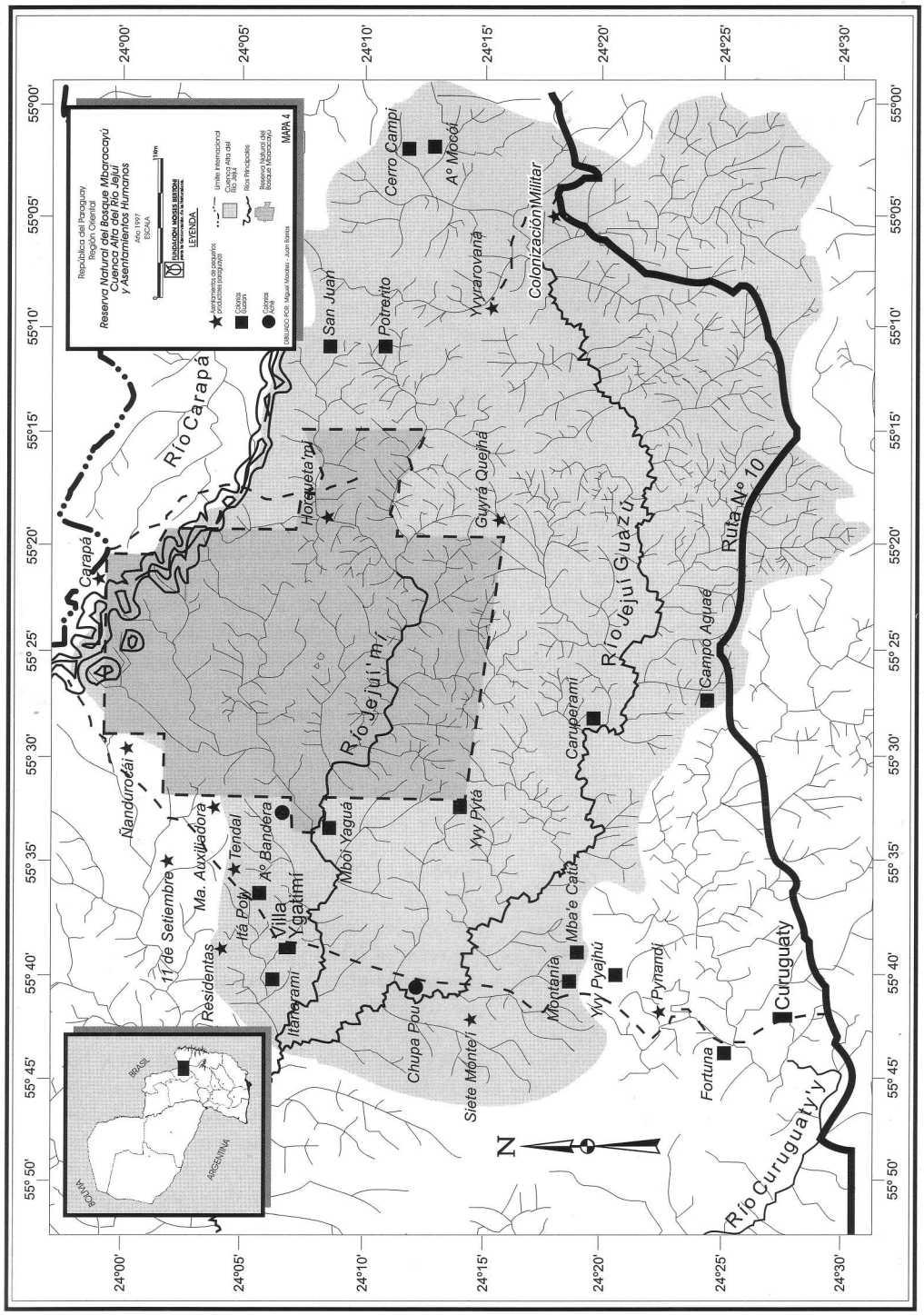
La Reserva Natural del Bosque Mbaracayú en el este de Paraguay es un área de alto interés para la conservación. Se describen aqui doce especies de palmeras, incluyendo tres áun no colectadas en la Reserva, pero esperadas dentro de los límites, y se discute el estado de conservación de las mismas. Las palmeras habitan tanto en el bosque como en el cerrado y algunos de ellas como *Syagrus campicola* se encuentran en amenazadas o en peligro de extinción. Se incluyen una clave para las especies de la Reserva, así como ilustraciones.

The Mbaracayú Natural Forest Reserve is situated in the northeastern part of the Oriental region of Paraguay in the department of Canindeyú between 23°59–24°16′S longitude and 55°20–55°33′W latitude (Fig. 1). The reserve covers an area of approximately 600 km^2, largely covered with Atlantic Forest ("Bosque Atlantico del Interior": FMB 1991; "Selva Paranaënse," Laclau 1994; "Mata Atlântica," Davis et al. 1997) and is between 140 and 150 m above sea level.

In the 1980s the original area of the reserve (then much smaller than at present) was the property of the World Bank and during its tenure some parts of the forest were selectively logged for tropical hardwoods. In 1991, thanks to the efforts of many individuals and organizations (such as The Nature Conservancy) the area was purchased and passed to the Fundación Mbaracayú for management. At this time the Fundación Moises Bertoni, a Paraguayan NGO involved in conservation throughout the country, undertook the management and protection of the reserve, and continues to assume responsibility for its protection today.

With the help of private donations and the ceding of government-controlled lands, the reserve has grown from its original size. Between 1992 and 1994 approximately 6000 hectares of grassland, the "campos cerrados" known as Aguara Ñu, were incorporated into the area of the reserve. These grasslands are of great importance from a floristic point of view, especially for the diversity of palms in the Mbaracayú area.

Approximately 80% of the area of the RNBM is covered with Atlantic Forest (see Fig. 11). This forest is a subtropical semideciduous wet forest (Hueck 1978, Keel and Herrera-MacBryde 1997). The extent of the forest cover has been reduced severely in recent times due to deforestation, and now this forest type appears only as fragmented and isolated patches (Bozzano S. and Weik 1992). These continental forests are similar to those found along the eastern coast of Brazil (see Mori et al. 1983, Mori 1989), but are distinct in that they harbour several endemic subtropical genera and some tropi-



1. Map of the Mbaracayú Forest Nature Reserve (courtesy Fundación Moisés Bertoni).

cal and cerrado species at the southern edge of their distribution. The affinities of these forests are both with the tropical forests to the north and also with the southern temperate forests, thus making them biogeographically interesting (Keel and Herrera-MacBryde 1997). Atlantic Forest has been designated one of the high priority habitats for conservation on a global scale (IUCN 1995, Davis et al. 1997) and the Mbaracayú Reserve is the only example of this habitat type with effective protection that exists in Paraguay.

The nonforested part of the reserve consists of savannah vegetation made up of campos cerrados and grasslands of various sorts (see Fig. 9). Cerrado vegetation is represented by a wide range of open woodland, open scrub, and grassland forms (Eiten 1972), but is always found on uplands such that the soils are well drained and do not remain water logged. In this way it is very different from other grass-dominated vegetation types in South America (Eiten 1972). Cerrado is a climax vegetation type and is not maintained by human interference such as annual burning (Eiten 1972). Paraguay is the southern limit for cerrado vegetation (Dinerstein et al. 1995), which is largely found in Brazil and to a lesser extent in western Bolivia. In Paraguay, cerrado vegetation is found mostly in the departments of Amambay, Concepción, and Canindeyú. In the reserve the cerrado represents the most biodiverse habitat, with palms being prominent and an important part of the vegetation. Wet or semiflooded grasslands also occur within the limits of the reserve; here sedges and grasses dominate and the shrubby component of the vegetation is absent.

The current area of the reserve was previously occupied by nomadic hunter-gatherers of the Aché people (Hill and Hurtado 1996). At the time of contact in the late 20th century there were four independent populations of Aché. The largest group, the northern Aché, roamed an area of about 18,500 km^2 from the Sierra San Jaoquin to the Río Paraná. The northern limit of this group's present territory is in the Sierra de Mbaracayú. This northern group numbered about 550 persons before contact (in the 1970s) and inhabitated the Río Jejuí drainage, using the natural resources of the then pristine forest. Later, many of the groups mixed and established themselves in association with various missions. The northern Aché people today number about 600 (Hill and Hurtado 1996). Although all the communities are outside the core protected area of the reserve, the Aché have retained the right to hunt and gather within its limits in their traditional ways.

Other indigenous groups have more recently migrated to the area and have established communities around the limits of the reserve. In the area of the cerrado the Ava Katuete or Ava Chiripa, who traditionally inhabit the transition zone between cerrado and forest, have established communities, near the southeastern boundary are Mbyá communities, and towards the Río Jejuí Guazú are communities of Pa'i Tavytera (see Fig. 1). All these groups are members of the Guaraní linguistic family.

Although all of the communities are more or less integrated into Paraguayan society, they all retain much of their traditional knowledge and many of their cultural practices, above all in the uses of the plant life around them. This knowledge needs to be taken into account in planning any study in the region.

With funding from the UK government's Darwin Initiative for the Survival of Species we have been carrying out an inventory of the plants and selected insect groups in the Mbaracayú Reserve, with the senior author having spent the last two years collecting intensively within the borders of the protected area. Palms are a conspicuous component of the vegetation in the reserve, especially in the cerrado. Only four of the 12 species described here occur in the forested parts of the reserve: *Acrocomia aculeata, Euterpe edulis, Geonoma brevispatha,* and *Syagrus romanzoffiana.* These species are of relatively wide distribution in areas of similar forest in adjacent countries. The cerrado palms on the other hand are mostly endemics or have narrow distributions: *Acrocomia hassleri, Syagrus campicola,* and *Syagrus lilliputiana* are all in this category. *Syagrus campylospatha* and *S. graminifolia* have not yet been collected in the reserve, but are also local endemics to be expected in the area. Our collections of *Syagrus campicola* are especially interesting, as this species has not been collected since 1895 (see below for further discussion).

Here we present a key to the palms found in the reserve with brief descriptions of each species, including several species not yet collected within the boundaries but highly likely to occur in the area. Since this area is the southern limit for the distribution of many cerrado species

we expect that with increased interest in the palms of Paraguay, more taxa will be encountered in the future. The number of specimens we cite are limited and are not intended to be a complete listing of all specimens of each taxon for the area. Some other collections of plants from Paraguay with some plants from the Mbaracayú area can be found in CTES (collections of Schinini), G (collections of Hassler, Bernardi), and MO (collections of Hahn, Zardini), although our recent inventory is the most intensive collecting in the area since Hassler's visits over a hundred years ago. Many current collections of Paraguayan plants can be found in PY and FCQ in Asunción.

Key to the Species of Palms in the Mbaracayú Forest Nature Reserve

1. Trunk well developed 2
   Trunk poorly developed or palms acaulescent 6
2. Plants taller than 5 m 3
   Plants less than 5 m tall 5
3. Trunk diameter greater than 15 cm; petioles not sheathing the stem 4
   Trunk slender, less than 15 cm diameter; petioles with a distinct sheath ..... ***Euterpe edulis***
4. Plant not spiny, common in the forest interior ..... ***Syagrus romanzoffiana***
   Plant spiny, common in open areas or at the edge of the forest ..... ***Acrocomia aculeata***
5. Trunk without persistent leaves or leaf bases, less than 5 cm diameter; petioles not spiny; forest understory in wet or inundated areas ..... ***Geonoma brevispatha***
   Trunk covered with persistent leaf bases, greater than 5 cm diameter; petioles with spiny margins; campos cerrados or grasslands with good drainage .. ***Butia paraguayensis***
6. Plants with spines 7
   Plants not spiny or spinescent 8
7. Acaulescent, the stems entirely subterranean; spines ca. 4 cm long, fine and black, distributed over the petiole and rachis; inflorescence to ca. 5 cm long, emerging at soil level ..... ***Acrocomia hassleri***
   Trunk poorly developed, but always at least partially visible; spines coarse, ca. 0.5 cm, distributed only along the petiole margins; inflorescence not emerging at soil level ..... ***Butia paraguayensis***
8. Inflorescence branched 9
   Inflorescence a simple spike, unbranched 12
9. Inflorescence with 18–35 branches; tips of the pinnae acute ..... ***Syagrus campylospatha***
   Inflorescence with less than 10 branches; tips of the pinnae not acute 10
10. Peduncular bract less than 10 cm long; branches 3–4, to ca. 4.5 cm long; ovary densely brown tomentose ..... ***Syagrus lilliputiana***
    Bract of the inflorescence longer than 10 cm; branches (0)2–7, to 18 cm long; ovary glabrous, occasionally shiny 11
11. Branches of the inflorescence (rachillae) few and long ..... ***Syagrus graminifolia***
    Branches of the inflorescence (rachillae) shorter and more numerous than in the preceding species or more commonly the inflorescence spicate ..... ***Syagrus petraea***
12. Pinnae to 50 cm long, bunched and oriented in different planes; rachis erect and straight; flowers crowded along the rachis; peduncle of the inflorescence longer than the rachis ..... ***Allagoptera leucocalyx***
    Pinnae less than 50 cm long, usually evenly spaced and oriented in the same plane; rachis zig-zag; flowers evenly spaced, not crowded; peduncle of the inflorescence shorter than the rachis 13
13. Inflorescence shorter than the peduncular bract, to 60 cm long; bract 2–3 cm wide .... ***Syagrus petraea***
    Inflorescence equal to or longer than the peduncular bract, 28–40 cm long; bract much less than 2 cm wide ..... ***Syagrus campicola***

1. **Acrocomia aculeata** (Jacq.) Lodd. ex Mart. (*Acrocomia totai* Mart.)
Fig. 5

Common names: Aché: *to'i pura*
Guaraní: *mbokaya*
Spanish: *coco*

Distribution: Widely distributed throughout tropical America from Mexico to Argentina, Bolivia, and Paraguay, also in the West Indies (not found in Peru and Ecuador).

Habitat: In open areas such as grasslands, savannahs, edges of forest or degraded forests, commonly in well-drained and sandy soils. Often found in dense populations called *mbokajaty* in Paraguay.

Description: Arborescent palm 4–20 m tall and 10–20 cm in diameter; trunk usually swollen, normally smooth and with visible rings left by fallen leaves, occasionally covered with the spiny remains of leaf bases. Leaves 10–25, greyish-green, 1–3 m long with numerous linear pinnae, whitish beneath, irregularly arranged and oriented in different planes which gives the leaf a plumose aspect. Petiole short or practically absent, abaxially angular or rounded, adaxially channelled, usually spiny or densely hirsute; rachis covered with robust spines, especially along the margins. Inflorescence shorter than the leaves, 50–100 cm long, spiny, branched, arching and hanging down. Peduncular bract woody and persistent. Fruits globose, 2.5–5 cm in diameter, yellowish green, with a single seed within a smooth and easily shattered epicarp;

2. *Acrocomia hassleri*, leaves and old inflorescences, Aguara Ñu, Mbocaya'i. 3. *Acrocomia hassleri*, plant growing along road in Aguara Ñu (*Jiménez et al. 1323*). 4. *Acrocomia hassleri*, close-up of inflorescence just prior to anthesis (*Jiménez et al. 1323*). 5. *Acrocomia aculeata*, Cordillera de Mbaracayú near El Mirador along road from Ñandurokai to Carapá.

mesocarp fleshy and fibrous adhering to the wall of the endocarp; endocarp thick and hardened with three pores situated approximately in the middle of the fruit.

Uses: This palm has a huge variety of uses. The fruits are edible to both humans and animals: the husk and seed are used for fertilizer and fuel, due to their high calorific content. An edible oil is extracted from the pulp and the seed. This oil is also used in the manufacture of soaps and cosmetics (Gonzalez Torres 1980). Leaves of *A. aculeata* are used as animal forage

and rope is made from the fibers. The incredibly resistant trunks are used as posts and pillars in construction. The leaves and roots of young plants have many diverse medicinal applications and are widely used in the preparation of *tereré*, the national drink of Paraguay (a cold infusion of the leaves of yerba mate, *Ilex paraguayensis*). The Aché people use the trunks of certain very mature individuals of this species for the manufacture of arrows.

Conservation Status: Not threatened. This species is widely distributed in Paraguay (CDC 1996).

Notes: Acrocomia aculeata is a highly variable species and some doubt exists as to the status of some divergent populations. The genus according to Henderson et al. (1995) is composed of two quite different species, one distributed widely throughout tropical America and the other (*A. hassleri*) restricted to the cerrado vegetation of Brazil and Paraguay. Both taxa are relatively common in Mbaracayú.

Representative Material Examined: Cordillera: "Cordillera de Altos", Nov 1885/95, *Hassler 1503* (BM, K). Amambay: 'N de Paraguay, zwischen Rio Apa und Rio Aquidabán", 25 Nov 1908/1909, *Fiebrig 4359* (K).

2. **Acrocomia hassleri** (Barb. Rodr.) Hahn
(*Acanthococos hassleri* Barb. Rodr.)
Figs. 2, 3, 4

Common Name: Guaraní: *mbokaja'i*

Distribution: Restricted to the south of Brazil (Goías, Mato Grosso do Sul, Minas Gerais, Paraná, São Paulo) and Paraguay (Sierra de Amambay and Canendiyú).

Habitat: Typical species of the campos cerrados, usually in well-drained soils, abundant in clearings and along roads (see Fig. 3).

Description: Small palm with a subterranean trunk. Leaves 2–6, ca. 50 cm long, with linear pinnae, these irregularly placed and oriented in different planes. Petiole and rachis spiny, the spines ca. 2 cm long, thin, black. Inflorescence emerging at soil level, 4.5–5 cm long, branched, with 6–8 branches each ca. 3 cm long. Peduncular bract densely reddish brown pubescent. Flowers yellowish. Fruit globose, 1.5–3 cm in diameter, brown and covered with short, fine tomentum.

Uses: None known.

Conservation Status: Not known.

Notes: It has been suggested (IUCN 1996) that more studies and monitoring should be carried out with this species, which although of relatively wide distribution, is not common.

Representative Material Examined: Canindeyú: "Reserva Natural del Bosque Mbaracayú, Aguara Ñu," 5 Aug 1996, *Jiménez, Knapp and Marín 1323* (BM, CTES, PY).

3. **Allagoptera leucocalyx** (Mart.) Kuntze
(*Allagoptera hassleriana* (Barb. Rodr.) H.E. Moore)
Fig. 8

Common Names: None known.

Distribution: Brazil (Bahia, Goías, Mato Grosso do Sul, Minas Gerais, southern Pará, Paraná, São Paulo), Paraguay (Alto Paraguay, Amambay, Concepción, Cordillera, Paraguarí), Bolivia (Beni, Santa Cruz), and Argentina (Misiones).

Habitat: Cerrados, on sandy soils. In Mbaracayú it occurs in the grassy areas along with *Butia paraguayensis*, forming dense populations.

Description: Small palm with a short or subterranean trunk. Leaves 5–30, ca. 1.5 m long, with pinnae ca. 50 cm long and greater than 1 cm wide, greenish grey, the tips usually bifid, distributed in irregular groups of 2–5 pinnae along the rachis and oriented in different planes. Petiole rounded abaxially, channelled adaxially, the rachis triangular in cross section. Inflorescence erect, unbranched, 40–110 cm long including the peduncle, the rachis much shorter than the peduncle.

Uses: The mesocarp and seeds are said to be edible (Henderson et al. 1995; Moraes R. 1996), but no uses are known from the Mbaracayú area.

Conservation Status: Data concerning the conservation status of this palm in Paraguay are not available, but it is widely distributed in appropriate habitats (Henderson et al. 1995; see Moraes R. 1996 for specimen citations).

Notes: Allagoptera leucocalyx is very similar to *Allagoptera campestris* and their distributions overlap in Paraguay (*A. campestris* has been recorded elsewhere in the department of Canendiyú). The significant differences between the two taxa are in the smaller overall size of leaves, pinnae, fruits, and inflorescences of *A. campestris*. It is possible that *A. campestris* will be found in the future in the reserve as it has

been collected in Canendiyú (Moraes R. 1996). For a complete treatment of the synonymy of *A. leucocalyx* and its differences with *A. campestris* see Moraes R. (1996).

Representative Material Examined: Alto Paraguay: "Chovoreca", 12 Aug 1983, *Hahn 1605* (K). Canindayú: "Reserva Natural del Bosque Mbaracayú, Aguara Ñu", 5 Aug 1996, *Jiménez, Knapp and Marin 1326* (PY), "Reserva Natural del Bosque Mbaracayú, Lagunita", 11 Aug 1996, *Jiménez 1365* (BM, PY).

4. **Butia paraguayensis** (Barb. Rodr.) L.H. Bailey
(*Butia yatay* var. *paraguayensis* (Barb. Rodr.) Becc.)
Figs. 9, 10

Common Name: Guaraní: *yata'i*

Distribution: Southern Brazil (Mato Grosso do Sul, Paraná, Rio Grande do Sul, São Paulo), Paraguay (Amambay, Caaguazú, Canindeyú, Concepción, Cordillera, Misiones, Ñeembucú, San Pedro), and northern Uruguay.

Habitat: A very common species in open areas in the cerrado on well-drained, usually sandy, soils.

Description: A very variably sized plant, from acaulescent to having a trunk 4 m tall. Trunk usually covered with the persistent leaf bases and petioles (see Fig. 10), these provide habitat for the colonization of various species of epiphytic orchids (*Catasetum* sp., "casco romano") and ferns (*Vittaria, Polypodium,* etc.). Leaves 5–7, very arched, margins of the petiole dentate; pinnae 32–53 on each side, glaucous, evenly spaced along the rachis in the form of a "V"; pinnae bases bearing large brown scales. Inflorescence ca. 80 cm long, shorter than the leaves, branched with 18–43 branches. Peduncular bract woody, long pedunculate, slightly grooved. Fruits 2–3.9 × 1–2.5 cm, orange, the epicarp smooth, the mesocarp fleshy and of variable width and the endocarp thick with pores near the bottom half.

Uses: The fruits are sweet and are consumed by a wide variety of animals. These fruits are a preferred food of the maned wolf (*Chrysocyon brachyurus*), known in Paraguay as *aguara guazú* or *lobo de crin,* a characteristic but highly endangered species of cerrado areas. When the palm fruits are ripe, feces of the wolf are full of the digested seeds. An on-going project on the biology of the maned wolf in the reserve will determine the extent to which the animals are dependent upon palm fruits for nutrition (Esquivel, personal communication). Parrots and macaws also search out the ripe fruit. The fruits are eaten by local people, as are the hearts of palm. The leaves are used in the manufacture of hats and other handicrafts, and green fruit are thought to have vermifugal properties.

Conservation Status: This species is secure and not under threat in Paraguay (CDC 1996).

Notes: This palm is often misidentified as *Butia yatay* (Mart.) Becc. (see Keel and Herera-MacBryde 1997). The two taxa are easily distinguishable, above all in their habit and size, with *B. yatay* being always arborescent and with much larger leaves and inflorescences (Henderson et al. 1995). *Butia yatay* is a more southern species, occurring in extreme southeastern Brazil and adjacent Argentina and Uruguay. It has not been recorded from Paraguay. However, it has been suggested that the two are conspecific (Henderson et al. 1995). After a fire new leaves of *B. paraguayensis* soon sprout, making this one of the most fire-resistant species in the cerrado.

Representative Material Examined: Amambay: "N de Paraguay, zwischen Río Apa und Río Aquidibán", 18 Oct 1908/09, *Fiebrig 4097* (BM, K); "Cerro Corá", 6 Jan 1988, *Zardini, Soria and Ortiz 4088* (K). Canindeyú: "Reserva Natural del Bosque Mbaracayú, Aguara Ñu", 21 Oct 1996, *Jiménez and Albert 1435* (PY), "Reserva Natural del Bosque Mbaracayú, Lagunita", 20 Aug 1996, *Jiménez 1681* (BM, PY). Cordillera: "Cordillera de Altos", Aug 1897, *Hassler 2163* (BM). Ñeembucú: "Paso de Patria ad Gnal Díaz", 1980, *Bernardi 20494* (BM). Paraguarí: "Ybcui", 1 Oct 1985, *Gentry, Peréz and Brunner 51947* (K).

5. **Euterpe edulis** Mart.
Figs. 12, 13

Common Names: Aché: *to'i jakambe*
Spanish: *palmito*

Distribution: Atlantic coastal forests of Brazil (Alagoas, Bahía, Espirito santo, Minas Gerais, Paraíba, Paraná, Pernambuco, Rio de Janeiro, Rio Grande del Norte, Rio Grande do Sul, Santa Catarina, São Paulo, Sergipe), extending to the interior to Brasilia, and south to Argentina (Misiones) and Paraguay (Alto Paraná).

Habitat: This palm has a very narrow ecologi-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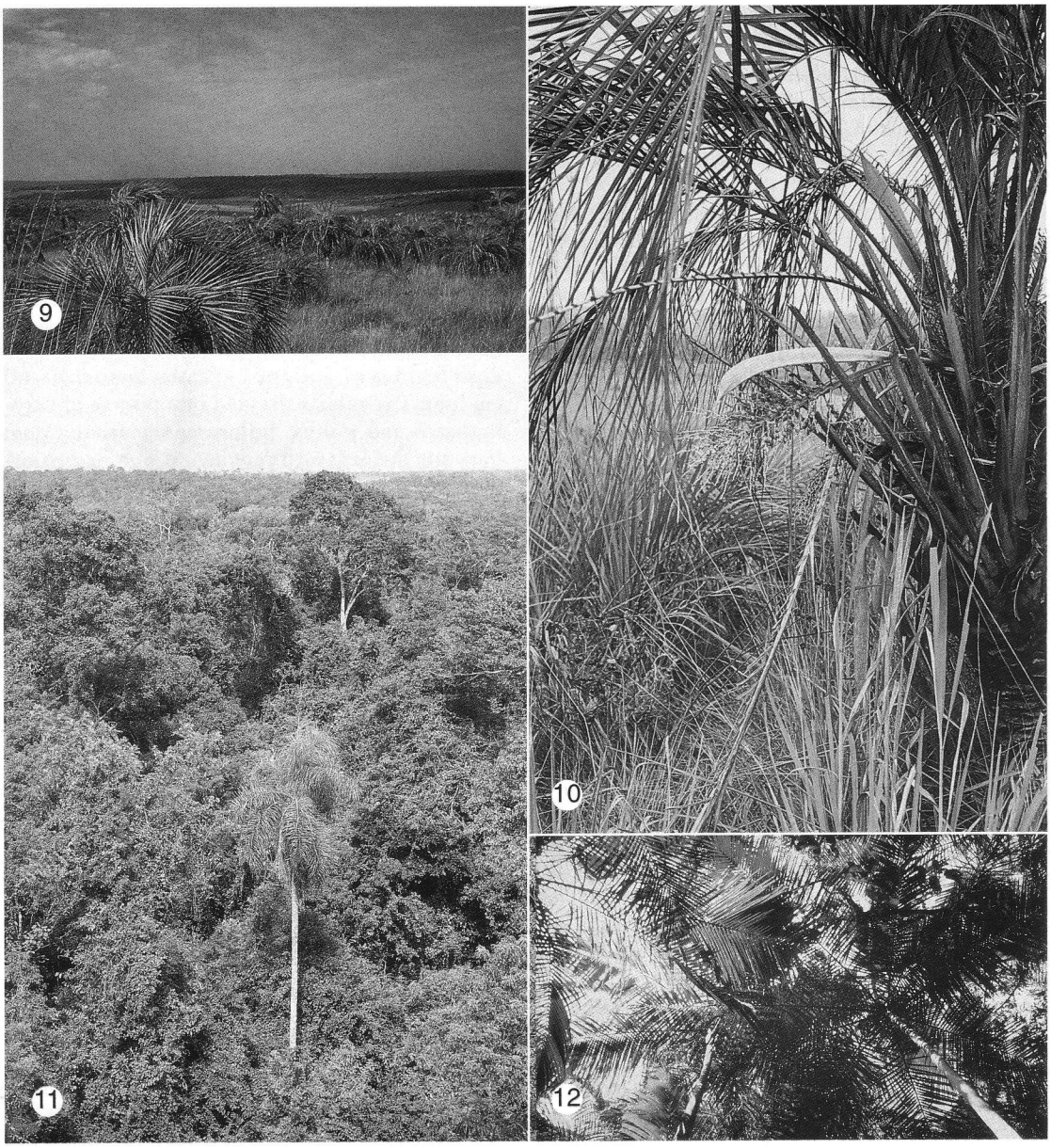

9. Cerrado vegetation with typical stands of *Butia paraguayensis*, Aguara Ñu. 10. *Butia paraguayensis*, trunk and inflorescence. 11. Atlantic Forest with *Syagrus romanzoffiana*. 12. *Euterpe edulis*, crown (photograph courtesy Miguel Morales: Itabó, Alto Paraná).

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6. *Syagrus campicola*, whole palm among grasses in Aguara Ñu (*Jiménez & Albert 1424*). 7. *Syagrus campicola*, close-up of inflorescence (*Jiménez & Albert 1424*). 8. *Allagoptera leucocalyx*, leaves and inflorescence (*Jiménez 1365*).

cal range and is only found on wet clay soils. It grows along the banks of rivers and streams and in inundated areas, normally in the deep shade of the forest as part of the middle to lower stratum of the forest. *Euterpe edulis* is more common in the Atlantic coastal forest, where it grows on steep banks.

Description: Erect palm to 5–20 m tall, the trunk 10–20 cm in diameter, grey, with clearly visible adventitious roots at the base. Leaves 8–20, 1–3 m long, the leaf sheath elongate and tubular, forming a distinct crownshaft; pinnae narrow, normally extending horizontally or occasionally pendulous, green occasionally tinged with red or orange. Inflorescence branched, the branches ca. 2 cm in diameter, densely short tomentose. Fruits globose, 1–2 cm in diameter, blackish-purple, with a single seed.

Uses: The young shoots, or hearts of palm (see Fig. 12), are considered a delicacy worldwide. Originally the hearts were part of the basic diet of indigenous communities of the region, but are now mainly exploited for commercial purposes. The intensive extraction of hearts of palm is a major problem affecting the remaining fragments of wet forest in Paraguay. Various measures to alleviate this pressure due to overutilization have been initiated, such as the commercialization of the hearts of *karanda'y* (*Copernicia alba*), a common species of the Chaco region (western Paraguay).

Conservation Status: Due largely to its overexploitation for hearts of palm, this species is under critical threat in Paraguay. Deforestation is also playing a part in its demise and the IUCN (1996) has recommended that specific plans be developed for the protection of this vulnerable species.

Notes: Euterpe edulis is very rare in the Mbaracayú area and only has been seen in a small area in the buffer zone, outside the core protected area of the reserve. This area is being colonized and thus the species is in danger of being overexploited and exterminated if adequate measures to ensure its protection are not taken.

Representative Material Examined: We have seen no collections of this species from the reserve area, but have seen the live palms in the field. The preparation of a specimen is of high priority for the immediate future.

6. **Geonoma brevispatha** var. **brevispatha** Barb. Rodr.
(*Geonoma schottiana* var. *palustris* Warm. ex Drude)

Common Names: Guaraní: *guarika*
Spanish: *palmerita*

Distribution: Central and southeastern Brazil, mainly in the planalto region, also Perú, Bolivia, and Paraguay.

Habitat: In the understory of forest and in gallery forest and in small wet depressions, where it forms dense populations together with tree ferns.

Description: Palm 1–4 m tall, trunk 2.5–4 cm in diameter, smooth and without the remnants of dead leaf bases. Leaves 7–12, the lamina 40–60 cm long, irregularly divided into pinnae of varying sizes and widths. Inflorescence arising from beneath the leaves, branches to one or two orders, reddish, the peduncle 10–18 cm long, the branches 3–9, ca. 23 cm long, 1–2 mm in diameter. Fruits globose to somewhat ovoid, 0.8–1.1 × 0.6–0.8 cm, black when mature.

Uses: Cultivated as an ornamental.

Conservation Status: This species is considered endangered in Paraguay due to the destruction of its habitat (CDC 1996).

Notes: According to Henderson et al. (1995), var. *brevispatha* differs from the similar var. *occidentale* by its very numerous, linear vs. few, wide pinnae and its inflorescences arising from below rather than from in the axils of the leaves. Var. *occidentale* does not occur in Paraguay. Plants from the reserve have previously been referred to *G. schottiana* (Keel and Herrera-MacBryde 1997). *Geonoma schottiana,* however, has very regularly divided, narrow, sickle-shaped leaflets with three conspicuous raised veins and is distributed in the coastal Atlantic forests (Henderson et al. 1995). Further taxonomic work is clearly necessary in this species complex.

Representative Material Examined: Amambay: "Cerro Corá", 7 May 1984, *Hahn 2500* (K). Canindeyú: "Ygatimí", Stp 1898/1900, *Hassler 4715* (K), "Reserva Natural del Bosque Mbaracayú", 18 Apr 1996, *Jiménez and Martín 171* (PY).

7. **Syagrus campicola** (Barb. Rodr.) Becc.
(*Cocos campicola* Barb. Rodr.)
Figs. 6, 7

Common Names: None known.

Distribution: Known only from Paraguay, in the cerrados of the departments of Canindeyú and Cordillera.

Habitat: Savannah formations, cerrados and grasslands, in sandy soils and open areas.

Description: Acaulescent palm of less than 1 m in height. Leaves 3–9, 40–50 cm long, arching, without spines on the margins, fibrous, with 10–16 pinnae on each side placed in a "V" shape, the pinnae 0.3–0.5 cm wide and evenly spaced ca. 2 cm apart. Inflorescence a spike, 28–40 cm long, arising from below the level of the leaves, the peduncle long and covered with the leaf bases. Peduncular bract woody, the peduncle 26–27 long, the bract ca. 16 × 0.8–1 cm, sparsely tomentose, slightly grooved. Male flowers densely imbricate, the upper smaller than the lower, sepals lanceolate with a membranous margin; petals irregular; base of the anthers sagittate. Female flowers larger than the male flowers but otherwise similar. Fruit ovoid, ca. 0.6 × 0.5 cm.

Uses: None known.

Conservation Status: This endemic species has been included in Appendix II of the Red List (IUCN 1996), indicating that it is under severe threat.

Notes: Noblick (1996), although including this species in the genus *Syagrus,* questioned its placement there rather than in *Butia* to which he felt it was more closely related. Both Henderson et al. (1995) and IUCN (1996) use the name in the genus *Butia* although the nomenclatural combination has never been formally made. We have thus used the validly published combination *Syagrus campicola.* Barbosa Rodrigues (1900) mentioned the resemblance between *Syagrus campicola* and *Syagrus petraea,* especially in habit, although the two are easily distinguishable using floral and fruit characters.

Syagrus campicola was first collected by the Swiss botanist Emile Hassler in the Sierra de Mbaracayú and in Piribebuy at the end of the last century (1895) and ours is apparently the first collection since that time. The rediscovery and study of this little known species were a recommendation of the IUCN palm report (1996). Our discovery of this taxon in the protected area of the reserve means that its biology and distribution can be studied in detail in the future. *Syagrus campicola* is a very inconspicuous palm, and has perhaps been overlooked by collectors in the past.

Representative Material Examined: Canindeyú: 'Ypé Jhu", Oct 1898/99, *Hassler 5057* (BM, isotype), "Reserva Natural del Bosque Mbaracayú, Aguara Ñu", 20 Aug 1996, *Jiménez and Albert 1424* (BM, CTES, PY), "Reserva Natural del Bosque Mbaracayú, Ñandurokai", 14 Oct 1996, *Jiménez and Marín 1633* (BM, CTES, MO, PY).

8. **Syagrus campylospatha** (Barb. Rodr.) Becc.
(*Cocos campylospatha* Barb. Rodr., *Syagrus hassleriana* (Barb. Rodr.) Becc.)

Common Name: Guaraní: *yata'i mi*

Distribution: Endemic to Paraguay (Glassman 1987). Occurs in the northern and central parts of the country (Cordillera, Concepción, Paraguarí).

Habitat: Campos cerrados, usually on sandy soils.

Description: Small palm with a subterranean or very short trunk, to 1.5 m tall. Leaves to 1.5 m long; pinnae 30–50 per side, rigid, irregularly grouped and distributed, oriented in the same plane, adaxially pubescent, abaxially glaucous, the tips of the pinnae spinescent. Inflorescence erect, branched with 18–35 branches. Peduncular bract woody. Fruit ellipsoid, ca. 2 × 1 cm.

Uses: None known.

Conservation Status: Little is known about the conservation status of this endemic species and it has been recommended that it be more fully protected in its natural habitat (IUCN 1996).

Notes: This species has not yet been collected in the reserve, but may occur in some parts of the cerrado in the Mbaracayú area. Our intensive collecting in the Reserve has shown several other plants previously thought to be found only in north-central Paraguay are in fact found much farther east. *Syagrus campylospatha,* like other cerrado palms, seems to survive periodic fires with ease.

Representative Material Examined: Cordillera: "Cordillera de Altos", Dec 1885/1895, *Hassler 1733* (K).

9. **Syagrus graminifolia** (Drude) Becc.
(*Cocos graminifolia* Drude)

Common names: None known.

Distribution: Brazil (southern Goías, Mato Grosso do Sul) and eastern Paraguay.

Habitat: Cerrado vegetation, in open areas.

Description: Palm with short, subterranean stems. Leaves ca. 1 m long, with 23–25 pairs of pinnae, the pinnae regularly spaced and oriented in the same plane. Inflorescence to 18 cm

long, branched, with 2–7 branches. Peduncular bract woody, 30–39 cm long, 4–7 mm wide in the widest part. Male flowers in the distal portion of the inflorescence smaller than those in the proximal part. Female flowers with sepals larger than the petals. Fruits ellipsoid, ca. 2 × 1.3 cm.

Uses: None known.

Conservation Status: Not known.

Notes: Although this species has not been collected in the reserve, it is likely to occur there. According to Noblick (1996), *Syagrus graminifolia* is easily confused with the very similar *S. petraea* (see below). In the specimens we have examined there exists a clear difference in the degree of inflorescence branching: the inflorescence of *S. graminifolia* is less branched and the branches are longer than in *S. petraea.* Henderson et al. (1995) state that branched inflorescences are unusual in *S. graminifolia.*

Representative Material Examined: Only Brazilian material has been examined for this species, but it is to be expected in the reserve.

10. **Syagrus lilliputiana** (Barb. Rodr.)Becc.

(*Cocos lilliputiana* Barb. Rodr.)
Fig. 14

Common Names: None known.

Distribution: Brazil (southern Goías, Mato Grosso do Sul) and eastern Paraguay.

Habitat: Campos cerrados, forming part of the vegetation of open areas and the edges of roads.

Description: Acaulescent palm of less than 1 m tall. Leaves ca. 50 cm long, with 10 pairs of pinnae, the basal smaller than the distal; rachis triangular in cross-section. Inflorescence ca. 10 cm long, branched, with 3–5 branches 4 cm long; peduncle short, densely lanose. Peduncular bract ca. 7 cm long (the peduncle not visible), woody and finely sulcate, red tomentose within. Flowers arranged spirally along the branches; male flowers with three small sepals, three yellow petals in the form of a beak, and six stamens with short filaments; female flowers slightly bigger than the male flowers, the ovary densely lanate.

Uses: None known.

Conservation Status: Included in the Red List of New World palms (Dransfield et al. 1988) in the endangered species category. It has been suggested (IUCN 1996) that this species deserves special attention and study.

Notes: This is a very poorly known species and has been synonymized by some with *Syagrus graminifolia* (Henderson et al. 1995) and by others with *S. petraea* (Hahn 1989). This is due to the gross morphological similarity between these taxa and also to intraspecific variability in *S. petraea.* However, Noblick (1996) highlights certain characteristics such as the tomentose ovary that clearly distinguish *S. lilliputiana* from *S. petraea.* The degree of inflorescence branching and even more importantly the overall size of the inflorescence can be used to distinguish *S. lilliputiana* from *S. graminifolia.* Our material is clearly different from specimens of *S. graminifolia* and *S. petraea.*

Representative Material Examined: Canindeyú; "Reserva Natural del Bosque Mbaracayú, Aguara Ñu", 9 Aug 1996, *Jiménez 1354* (BM, CTES, PY).

11. **Syagrus petraea** (Mart.) Becc.

Common Names: None known.

Distribution: Widely distributed across the planalto region of Brazil (Bahia, Mato Grosso do Sul, Minas Gerais, Pará, Piauí, Rôndonia, São Paulo), eastern Bolivia (Santa Cruz), and eastern Paraguay (Amambay, Caaguazú).

Habitat: Typical species of the campos cerrados, growing in a wide variety of soils and in a variety of vegetation types, from open areas to woody patches.

Description: Plants solitary or occurring in groups, the trunks short and subterranean. Leaves 4–8, with 9–50 pinnae distributed usually regularly along the rachis and oriented in the same plane. Inflorescence erect, ca. 60 cm long, usually a simple spike, but when branched with up to 9 branches. Peduncular bract with a well-developed peduncle, woody and sulcate, 2–3 cm wide, shorter than the inflorescence. Male flowers with 6–8 stamens with short anthers and fleshy filaments, the distal flowers smaller than the proximal ones. Female flowers conical, smaller than the male flowers, the sepals imbricate and wide, the petals fleshy and imbricate, the gynoecium columnar. Fruits ellipsoid, 2–3 × 1–2 cm, green and covered with brown pubescence.

Uses: The leaves are used to manufacture brooms and baskets.

Conservation Status: Although not especially common, this species is of wide distribution and appears to be well represented. Further studies

13. *Euterpe edulis,* heart of palm after harvest (photograph courtesy Alberto Madroño: Itabó, Alto Paraná). 14. *Syagrus lilliputiana,* plant at anthesis, Aguara Ñu (*Jiménez 1354*). 15. *Syagrus romanzoffiana,* crown and inflorescence (photograph courtesy Alberto Madroño: Parque Nacional Iguazú, border of Argentina and Brazil).

of its status and monitoring have been recommended (IUCN 1996).

Notes: This is an enormously variable species in form and in size, and according to Noblick (1996) the lack of fixed characters throughout its range makes it extremely difficult to key out. Although *Syagrus petraea* has not yet been collected in the reserve, we have included it in this list as we feel it is likely to be found in the future. It is also possible that it has been confused with other very similar species, although not in material we have examined.

Representative Material Examined: Amambay: "Cerro Corá", 1 Nov 1983, *Hahn 1765* (K), 26 Feb 1990, *Zardini, Soria and Ortiz 4090* (K).

12. **Syagrus romanzoffiana** (Cham.) Glassman (*Arecastrum romanzoffianum* (Cham.) Becc., *Cocos romanzoffiana* Cham.)
Figs. 11, 15

Common Names: Aché: *to'i*
Guaraní: *pindó*
Spanish: *pindó*

Distribution: Widely distributed in southern tropical America. Central and southeastern Brazil (Bahia, Espirito Santo, Goías, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina, São Paulo), eastern Paraguay (Amambay, Alto Paraná, Canndeyú, Central, Guairá, Paraguarí, Cordillera), northern Argentina (Corrientes, Entre Ríos, Misiones), eastern Uruguay (Rochas), and probably Bolivia.

Habitat: Occurs in a variety of habitats and in the Mbaracayú area it is one of the most common forest species. *Syagrus romanzoffiana* forms part of the canopy (see Fig. 11) of the bosque medio and the bosque alto on shallow, poor soils and also in very wet or inundated areas, intermixed with tree species such as *Cedrela* spp., *Peltophorum dubium, Tabebuia heptaphylla* and *Balfourodendron riedelianum.* Where the edaphic conditions are extremely limiting and forest is poorly developed, *pindó* becomes dominant (López 1987).

Description: Canopy palm reaching some 20 m in height; trunk 35–40 cm in diameter. Leaves 7–15, 2.5–4.4 m long, the rachis arching, with 150–250 pairs of pinnae arranged irregularly in groups of 2–7, the groups oriented in different planes, the pinnae often bent towards the soil. Inflorescence ca. 1.5 m long, branched, with 80–280 branches. Fruits ovoid, 2–3 × 1–2 cm, yellowish orange; endocarp cavity irregular, with three bristles penetrating the seed.

Uses: This species has a wide variety of uses to humans and others animals. The fruits are eaten by a huge number of different species of mammals and birds including *ka'i* (*Cebus apella,* spider monkeys), *karaya* (*Alouatta caraya,* howler monkeys), *mborevi* (*Tapirus terrestris,* tapir), *agutíes* (*Agouti paca,* agouti), and several canids such as the very common *aguara'i* (*Cerdocion thous,* the crab-eating fox), and various birds of the family Cracidae (personal observation). Important dispersers of the fruits are the characteristic guans of these forests called *jaku* (*Penelope superciliaris,* the rusty-margined guan, and *Pipile jacutinga,* the black-fronted piping-guan). For the Aché, the original inhabitants of the Mbaracayú area (see Hill and Hurtado 1995), the *to'i* palm constituted one of their principal resources. Fruits were consumed fresh or crushed in water with honey and the hearts were eaten from every palm felled. The rest of the plant was used for diverse purposes. Leaves were woven into mats, screens, and baskets, and were used in roofing; the large peduncular bract was used as a container for the transport of various foods and household articles. Fiber from the interior of the trunk of a few individuals (only one in 20 approximately) is rich in starch called *kraku* by the Aché. This starch was extracted by pressing with water (Hill, personal communication). Beetle larvae (weevils known as *mbuchu*) developing in the shoot of fallen palms are still an important dietary resource for the community. The Paraguayan pharmacopeia attributes various medicinal properties to the root (as a purgative, an antirheumatic, and combined with others plants, an abortifacient) and heart (for diabetes) of *S. romanzoffiana* (Gonzalez Torres 1980).

Conservation Status: In Paraguay this species is apparently secure and not under threat (CDC 1996). However, due to the high rates of deforestation in the eastern half of the country its status in the long term may change.

Notes: This is a highly variable species and hybridization with other related taxa in other parts of its range has been recorded (Henderson et al. 1995). The existence of subspecific or varietal differentiation in *S. romanzoffiana* has also been suggested. Material from the Mbaracayú area, however, is very uniform.

Representative Material Examined: Alto Paraná: "Itabó", 1984, *Billiet and Jadin 3464* (BM). Cordillera: "Cordillera de Altos", Aug 1885/1895, *Hassler 704* (BM). Paraguarí: "Ybucuí", 1 Oct 1985, *Gentry, Peréz and Brunner 51852* (K).

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Control of Royal Palm Bug with Imidacloprid

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ABSTRACT

Imidacloprid at 42.5 g per palm used as a root drench was effective in preventing damage to royal palms (*Roystonea regia* (Kunth) O. F. Cook) by the royal palm bug, *Xylastodoris luteolus* Barber (Hemiptera: Thaumastocoridae) in a test in Florida, USA. Infestation levels on untreated palms were at levels up to 300 bugs per leaflet. The treatment was effective for at least three months. The potential of this treatment for managing this and related pests of palms is discussed.

The royal palm bug, *Xylastodoris luteolus* Barber (Hemiptera: Thaumastocoridae), feeds exclusively on royal palms (*Roystonea regia* (Kunth) O. F. Cook. It has been reported from Cuba and Florida. Extremely small piercing-sucking insects, the adults of *X. luteolus* are elongate, 2–2.5 mm long and of a pale yellow-green (luteous) color (Fig. 1). Baranowski (1958) conducted a very thorough study of this insect's bionomics.

The bugs attack freshly opened leaves. This results in small, yellow spots scattered on the lower frond surfaces. As the bug populations increase and more bugs feed, fronds become necrotic, turning brown and desiccated (Fig. 2). Damaged fronds eventually become tattered due to wind action, and sunlight bleaches them to a lighter grey color. As each new leaf is produced about monthly the bugs attack them so by the end of the summer a large portion of the crown may be damaged (Baranowski 1958).

Royal palm bug damage was reported as unusually intensive in Florida in 1921, 1957 and 1975 (Reinert 1975). In 1997 and several preceding years, severe damage was observed on royal palms throughout southern Florida. These reports, indicating peak activity being 36, 18, and 22 years apart, may be biased and inaccurate, being based on opportunistic observations by different people rather than systematic observations. Nevertheless, most observers would agree that the bugs do more damage to royal palms during some years than others.

Reinert (1975) identified three species of spiders that preyed on royal palm bugs, and suggested that they, along with heavy rains, were major factors in the natural control of the species. However, we have observed dense populations of the bugs on palm fronds during very rainy periods, and whether populations of these prolific bugs are regulated by spiders and rain alone is still open to question. Other natural enemies or abiotic factors that may regulate royal palm bug populations in Florida have not been identified.

When populations of royal palm bugs reach damaging proportions, chemical control is the only known method of controlling them. But chemical control of *X. luteolus* is difficult because of the tallness of the palms: Baranowski (1958) reported that *X. luteolus* seldom attacks palms less than 4 m in height. Reinert (1975) found that foliar applications of oxamyl, monocrotophos, and carbofuran reduced royal palm bug populations from more than 68 to less than three bugs per three leaflets. Unfortunately, because of chemical drift, none of these highly toxic chemicals would be suitable for foliar applications to tall palms, especially in cities.

Root drenches of oxamyl and monocrotophos reduced numbers of bugs per three leaflets after two weeks, but after four weeks the bug popula-

tions were well into recovery (Reinert 1975). Again, these chemicals were applied in a research study; they may not be suitable for widespread use as root drenches, especially under the edaphic and hydrological conditions of southern Florida (chemicals travel fast in the sandy soil and the water table is relatively high, especially in summer). Dimethoate shares some of the undesirable characteristics of other synthetic pesticides, but used as a drench was probably the safest of the methods tested. This treatment reduced the bug populations from 113.2 to 32.8 bugs per three leaflets after four weeks (Reinert 1975). Because about one-third of the population remained, it would have rebounded quickly. In summary, a practical method for controlling royal palm bug has not been available for years.

A relatively new insecticide, imidacloprid, seemed promising for this use. This chemical was discovered and developed as an insecticide by Bayer AG, Agriculture Division. It is the active ingredient in several of Bayer's products, including Admire, Gaucho, and Provado in different countries for use on various food crops—Premise for termite control, Marathon for use on ornamentals in greenhouses, and Merit for use on ornamentals and turf grass out of doors. Imidacloprid is also the active ingredient in Advantage, which is administered to dogs and cats for flea control. According to the product label, Merit has been proven to be effective against insect pests of 14 taxa. It was particularly encouraging that Tingidae (lacebugs) was one of these taxa, because they are closely related to the Thaumastocoridae.

The present report communicates results of a test of imidacloprid for effectiveness in controlling royal palm bug.

Methods

The experiment was conducted in the town of Palm Beach, Florida, which is on a coastal barrier island with sandy soil. Field evaluations were conducted at two sites where royal palm bug damage had been severe in previous years. Site 1 was adjacent to Lake Worth. Site 2 was about 1.5 km inland on the island from Lake Worth.

Four palms were treated on each site with 56.7 g (2 oz.) of Merit 75 WP mixed in 9.5 L (2.5 gal) of water, the equivalent of 42.5 g of imidacloprid per palm. Half of this rate was applied to one palm at one of the sites. This mixture was poured from a bucket very slowly into the soil immediately surrounding each palm. Mulch layers, if present, were scraped back, then returned after the drench treatment. At both sites, every other palm was treated, leaving alternate palms as controls. The treatments were applied on 21 January 1997.

Damage assessment was conducted 51, 108, and 170 days later (13 March, 8 May, and 10 July), on which dates the first, second, and youngest leaves of treated and control palms were observed from the ground for evidence of royal palm bug damage.

Initially we attempted to count numbers of royal palm bugs per leaflet as a measure of their populations on each palm. However, the mean height of the palms at both sites was about 20 m. With a lift truck we could reach the fronds of only about half of the palms at about 15 m. Because we could not reach the fronds of all the palms, we did not obtain statistically analyzable data to compare insect populations on treated palms and controls. However, we examined many fronds closely to confirm the association between bugs and their damage, and counted the numbers of bugs per leaflet on several fronds as an indication of the severity of the infestations at the study sites. We examined some leaflet samples in the laboratory under a stereoscopic microscope to determine the presence of eggs.

Results

Damage Assessment. Prior to application of treatments on 21 January, at site 1 there was only minor damage due to royal palm bugs, but some fronds had necrotic areas that we attributed to wind damage from a storm in November. At site 2, there were brown necrotic streaks typical of royal palm bug damage on some younger fronds of some palms. Royal palm bug damage had been especially severe at this site in past years (Richard Horne, Parks Foreman, Palm Beach Public Works Department, personal communication).

When the palms at both sites were examined 51 days after application of treatments, bug damage had progressed since January on some of the untreated palms, but there was no conclusive difference between treatment and controls.

When the palms were examined 108 days after application of treatments, the fronds of the seven palms treated with 42.5 g of imidacloprid were virtually free of royal palm bug damage, ex-

cept for damage on older fronds, which may have been caused by either bugs, wind, or cold spells prior to the treatment (Fig. 3). The single palm treated with 21.3 g of imidacloprid was similarly free of damage. In contrast, the first and second fronds of the eight untreated palms previously selected as controls had extensive damage typical of royal palm bugs. The tissue of these leaves was mostly brown with some small green areas remaining. The damage was very conspicuous from the ground.

As a further observation, a total of 15 royal palms in a row at site 1, including the four treated palms and 11 untreated palms, were examined 108 days after treatment. The four undamaged (treated) palms contrasted dramatically with the 11 untreated palms, which were all severely damaged by royal palm bug.

When the palms were examined 170 days after the treatments were applied, the newly opened leaf of both treated and control palms was free of damage. The next three youngest leaves of most of the untreated palms had extensive damage typical of royal palm bug. All fronds of the treated palms remained free of bug damage.

Observations on Royal Palm Bugs. On 21 January, we counted a mean of 3.0 (range: 2–5) royal palm bugs per leaflet on ten leaflets randomly selected from palms at site 1. At site 2, where there was typical royal palm bug damage on younger fronds of some palms, a mean of 59.1 (range: 8–17) royal palm bugs per leaflet were counted on seven leaflets from one of these palms.

When examined 108 days after treatments, there were abundant royal palm bugs on young damaged fronds of three of the untreated palms that we could reach. On a leaflet that we selected as harboring a typical infestation, we determined that there were about 300 of the bugs, including adults and nymphs. There were only about 15 bugs per leaflet on the fourth untreated palm that we examined. Bug damage was as severe on this palm as on the other untreated palms, suggesting that the population had been higher and was now declining. On the treated palms, 0–5 royal palm bugs per leaflet were observed.

Several fronds of treated and untreated palms were closely examined 170 days after the application of treatments (10 July). The bug populations appeared to have declined since the previous observation. Many fronds were free of the bugs, although aggregations of up to about 20 bugs per leaflet were seen on untreated palms. When these leaflets were examined under a stereoscopic microscope, groups of up to four eggs were observed inserted in fibrous scales all along the midvein, as described by Baranowski (1958). This indicated that a new generation of the bugs would soon be emerging to attack the leaves.

We observed no evidence of important natural enemies of royal palm bugs on any of the palms.

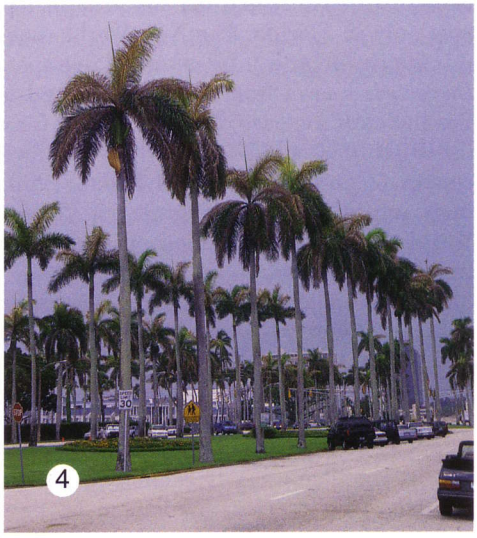
Discussion

These preliminary data on bug populations show that royal palm bugs occurred at levels of up to 300 bugs per leaflet in association with severe damage. More frequent observations on a larger number of palms would be required for conclusive data on population dynamics of this bug. However, the results of damage assessment clearly showed that the treatments prevented damage by royal palm bugs.

Imidacloprid is considered to be a pesticide of unusually low mammalian toxicity. Animal toxicity data from the Material Safety Data Sheet for this product list oral LD50 rates as 1858–2591 mg/kg and the dermal LD50 rate as >2000 mg/kg. When applied as a root drench, it remains for long periods in the soil and is taken up slowly by the plant. For this reason, there is typically a delay of a few weeks to a few months, depending partly on the size of the plant, before the chemical becomes active against the target pest. Once active, it may remain so for an extended period as long as the plant continues to take up the chemical. These characteristics make it potentially very useful for controlling the royal palm bug.

The delayed period before imidacloprid treatments become effective and the period during which they remain effective in controlling royal palm bug remain unclear. Since it protected the youngest three leaves, and in royal palm a new leaf is produced about monthly (Baranowski 1958), it was apparently effective in the palms that we treated for at least three months, possibly longer.

A disadvantage of this product for this use is its cost. At current prices the cost of treatment at the lowest rate used in this evaluation (21.3 g) is $14–$19 per palm. It is doubtful that even wealthy communities such as Palm Beach will use this treatment to protect large numbers of



1. Royal palm bugs, *Xylastodoris luteolus*. Photo by J. V. DeFilippis. 2. Typical damage to *Roystonea regia* leaf caused by *Xylastodoris luteolus*. Photo by F. W. Howard. 3. Left to right, untreated and imidacloprid-treated royal palms 108 days after application. Note damage to new leaves of untreated palm. Photo by Alan Stopek. 4. Royal palms along avenue in Palm Beachshowing major royal palm bug damage.

royal palms. However, it may be applicable to limited areas, e.g., on private properties or around tourist hotels. Imidacloprid has been applied to royal palms on Fisher Island, an affluent development in Miami, for control of royal palm bugs (Lee Anderson, Property Management, Montgomery Foundation, Miami, Florida, personal communications).

A cost advantage of the imidacloprid soil drench over other potential treatments, e.g., insecticides applied to leaves, is that there is no need for a hydraulic lift truck or other special equipment. Also, the relatively long period during which the treatment is effective may make it more economical than other potential treatments. Further testing may possibly reveal that imidacloprid is effective against royal palm bug at a dosage lower than those that we tested, thus reducing the cost. Finally, because the royal palm bug reaches damaging populations only during certain years, treatments would not be necessary every year.

Because the damage to royal palms by the royal palm bug was widespread in Florida this year, local newspapers reported partial results of our experiments. Unfortunately, many residents

formed the impression that any product containing imidacloprid could be used to control this insect. Many inquired how to apply Advantage, the flea control product, to palms. We wish to emphasize that insecticides should be used only for uses registered on the label, and products formulated for one use probably would not be effective for another use.

Xylastodoris luteolus is the only palmivorous species of Thaumastocoridae reported as a pest. Its host, *R. regia,* is native to Florida, Cuba, Caiman Islands, and the Yucatan Peninsula, and has long been planted widely in the New and Old World tropics as an ornamental. The insect has been reported only in Cuba and Florida, and as a pest only in Florida. The New World species of this family include *X. luteolus* and five species of *Discocoris* known from widely separated localities in South America. *Discocoris* spp., for which information is published, feed on the infructescences of palms (Slater and Schuh 1990), but their impact on the plants is not known. Old World thaumastocorids feed on dicotyledonous trees.

Natural enemies of *X. luteolus* of potential use in biocontrol may possibly be present in Cuba, or in other parts of tropical America in association with species of *Discocoris.*

Imidacloprid is potentially useful for controlling *Stephanitis typica* (Distant), which is in the family Tingidae, closely related to Thaumastocoridae. This species is common on palms in Asia and has been implicated as a vector of Kerala root wilt of coconut in India (Mathen et al. 1990). The bug also sometimes causes direct damage in coconut nurseries (Dr. Rey Abad, Philippine Coconut Authority, personal communication).

Acknowledgments

Richard Horne arranged for us to use a hydraulic lift truck of the Palm Beach Public Works Department and helped us locate suitable study sites. We appreciate the field assistance of Mark Gregorson, Ed Armstrong, and others of the Palm Beach Public Works Department and Greg Mihalko of the West Palm Beach Public Works Department. Dr. Brent Philbrook, Bayer Corporation USA, Agriculture Division, provided imidacloprid for this study and supplied useful information on this product. This report communicates research results only and mention of a commercial product does not imply a recommendation or endorsement of it. This is Florida Agricultural Experiment Station Journal Series Number R-05816.

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Phoenix canariensis in the Wild

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ABSTRACT

Phoenix canariensis is one of the most grown and appreciated ornamental trees of the world. Its native habitat, the Canary Islands, is renowned for its richness in climatic diversity and its endemic flora. This *Phoenix* apparently did not radiate, as did many other plants, but succeeded in colonizing many different ecological niches. In each of these environments, it grows associated with different ecological communities and often shows an astonishing diversity of epiphytes on its fibrous trunks. The wild populations suffered a dramatic decrease during the early centuries of the Spanish colonization of the islands, which started at the end of the 15th century. Today *P. canariensis* is sparsely and unevenly distributed on all the seven islands and the conservation status is different on each of them. The main threat seems to be hybridization with *P. dactylifera*.

RESUMEN

Phoenix canariensis es uno de los árboles ornamentales más plantados y apreciados del mundo. Su hábitat de procedencia, las Islas Canarias, es conocido por su riqueza en diversidad climática y su flora endémica. Esta especie de *Phoenix* aparentemente no sufrió radiación, como pasó a muchas otras plantas, pero tuvo éxito en colonizar muchos nichos ecológicos diferentes. En cada uno de estos medios, crece en asociación con diferentes comunidades ecológicas y a menudo posee una asombrosa diversidad de plantas epífitas en sus troncos fibrosos. Las poblaciones naturales sufrieron una reducción impresionante durante los primeros siglos de la colonización de las islas, a finales del siglo XV. Hoy día, *P. canariensis* se encuentra distribuida de manera esparcida y no uniformemente en todas las siete islas y el estado de conservación es diferente en cada una de estas. El peligro principal parece ser la hibridación con *P. dactylifera*.

A Softer Palm for a Softer Climate

The origin of *Phoenix canariensis* is not well documented. During the Tertiary, when many tropical species that were occupying the Mediterranean area undertook a huge and slow migration to the south because of the cooler weather, the Canary Islands remained floristically isolated (Bramwell in Kunkel 1976) as Northern Africa became a desert. A *Phoenix* has probably taken part in this migration, but we do not know if the *Phoenix* that migrated in the Tertiary was a *P. canariensis* or a parent species that afterwards evolved into the modern Canary palm.

These islands have by far a more even climate than Northern Africa, with abundant humidity from mist and richer soils. This suggests speciation from an ancestor similar to *Phoenix dactylifera* (or perhaps *P. sylvestris*), to the less xeromorphic *P. canariensis*.

The Different Ecological Communities and Associations

In present times *Phoenix canariensis* is sparsely and unevenly distributed on all the islands of the Canaries. It is very scarce on the two drier eastern islands of Lanzarote and Fuerteventura and on the other islands it grows at lower altitudes in the northern section of the islands, where it forms part of the *bosque termófilo*, a mediterranean subxeric (slightly dry) area, which has now been mostly substituted by banana cultivation, hotels, and beautiful gardens with ravenalas, scheffleras, and other exotics.

If the *bosque termófilo* is almost gone (a good area survives in Los Silos, Tenerife), there are some other ecological communities, known as "*palmerales*," that have *P. canariensis* as a dominant species, often associated with *Juniperus phoenicea* and/or *Dracaena draco* (dragon tree). Modern *palmerales* are usually very disturbed areas cultivated with exotic crops, where the reproduction of the palm is directly or indirectly helped by man's presence.

P. canariensis may also contribute to another ecological community called *laurisilva*. *Laurisilva* is a sort of subtropical cloud forest endemic to the Canary Islands, Madeira, and the Azores, mostly composed of trees of the Lauraceae family and other "laurifolious" trees. It is unusual to see wild palms growing in this environment but when it happens they take on a more "plumose" appearance as in the population observed in the lower range of the forest near Teno, Tenerife.

1. Hermigua (La Gomera); Huge specimens of *Phoenix canariensis* growing along a stone wall in a terraced field (Photo: C. Simón). 2. *P. canariensis* overlooking the Atlantic Ocean in Taguluche (La Gomera), in the foreground, the roof of a typical rural house (Photo: G. Orlando). 3. Presa de la Encantadora (La Gomera); a water storage basin surrounded by palms that are periodically flooded (Photo: G. Orlando). 6. Possibly an individual of so-called *Phoenix atlantica*, a branching plant with leaves only 1.5 m long, in Puerto de La Cruz (Tenerife), along the Carretera General. The palm behind is *P. dactylifera* (Photo: C. Morici).

4. Palms growing below the Laurus cloud forest, between Madre del Agua and Los Silos, Tenerife. Photo: G. Orlando. 5. A trunk loaded with epiphytes in the historical palm avenue named Camino Largo, in La Laguna (Tenerife); the large plant in flower is *Sonchus acaulis* (Photo: C. Morici).

The palms are found growing on a wide variety of soils, all of volcanic origin and usually fertile. *P. canariensis* has an extensive root system, which allows these palms to explore the surrounding earth to find subterranean water even at long distances. In the Canary Islands, *Phoenix* trees that grow in subxeric areas show themselves to be resistant to temporary swamping of the soil caused by sudden rains. Rivas-Martinez et al. (1993) explain that other trees and shrubs, with typical root systems, which could act as competitor species do not get established in those sites as they cannot resist asphyxia caused by the waterlogged soil.

The wide distribution of the palm on the island is reported and discussed by many authors and some give specific locations of most palmerales (Bravo 1964, Montesinos-Barrera 1979, Barquín-Diez and Voggenreiter 1988, Bramwell and Bramwell, 1990, Anonymous 1992).

This is why the *palmera canaria* is one of the most grown palm trees throughout the world. It tolerates cold and warmth, drought and floods, shade and sun, and salt spray as well as mountain climate.

Epiphytic Life on *P. canariensis*

Those *P. canariensis* growing in humid environments, often host on their trunks many endemic epiphytic plants, that add ornamental value to their already beautiful stems. I wish to mention that the Canary Islands palm has the

most fibrous and stout trunk in its genus, and I suppose it is the only *Phoenix* species that can host in its habitat such a spectacular mass of epiphytes on a single specimen. The astonishing diversity of epiphytes that can be found growing within the fibers of these spongy trunks is most unusual for nontropical zones: *Sonchus congestus* (a yellow-flowered member of Asteraceae), the majestic *Sonchus acaulis*, with rosettes up to 1 m in diameter, the succulent *Aeonium urbicum* and *A. ciliatum* (Crassulaceae); and the small creeping ferns *Polypodium cambricum* subsp. *macaronesicum* and *Davallia canariensis*. All these plants show mechanisms to withstand summer drought: the aeoniums are true succulents, the ferns shed their leaves in summer, and the Asteraceae lose a large part of their rosettes and wrap themselves inside their old dry leaves. Also other less unusual nonendemic species may be found on the trunks, such as the annual *Fumaria officinalis*, the tuberous *Umbilicus horizontalis* (Crassulaceae), and the South African weedy bulb *Oxalis pes-caprae* and some others.

In 1982 observations were carried out (Haroun and Die 1982) on epiphytes that were growing on *Phoenix* trunks of the historic palm avenue of Camino Largo, in La Laguna (Tenerife), at 600 m a.s.l. The authors recorded 31 species, but most of them were introduced exotics and some were nonepiphytic species exceptionally found growing on palms, such as *Erica* sp. and *Opuntia* sp. One interesting datum from this work is that 32.25% of these species were zoochorous ones (animal-borne seed dispersal) and 67.75% anemochorous (wind dispersed).

The Different Islands

. . . toda la isla era un jardín, toda poblada de palmas, porque de un lugar que llaman Tamarasaite, quitamos más de sesenta mil palmitos i de otras partes infinitas. . .

Pedro Gomez Escudero

A description of the island of Tenerife of the 16th century said: " . . . the northern side of the island is completely covered by enchanting forests of palms and dragon trees." In 1417, another writer, Pedro Gomez Escudero, said about Gran Canaria: " . . . the whole island was a garden, all populated by palms, because we took away from a place they call Tamarasaite more than sixty thousand palm trees . . . " (cited in Padrón 1978).

In 1997 Tamarasaite is called Tamaraceite and is a peripheral part of the city of Las Palmas with its population of half a million people. Today the palm situation in the Canaries is not so enchanting, but still deserves attention.

La Gomera

The most interesting island of all for palms is La Gomera: thousands of *P. canariensis* live in the most diverse landscapes, from desert to waterfalls, showing every possible aspect that this mighty palm can assume. *La palmera* is extremely respected by the islanders, *los gomeros*, because it is still a source of *guarapo*, palm honey. This tasty product is regularly hand-extracted from incisions made in the apical bud without killing the palm and then sold in the island's markets. One of the most beautiful *palmerales* of all the seven islands is found in the majestic scenery of Valle Gran Rey: a canyon with 700-m high vertical dry cliffs of volcanic lava, which hang above the very humid terraced floor, intensively cultivated with bananas (*Musa* 'Dwarf Cavendish'), *Arundo donax*, and *P. canariensis*.

The valley is entirely free of *P. dactylifera*. The only exotic palms are a few washingtonias and *Roystonea* sp. The entire island is a biosphere reserve and Valle Gran Rey is its pearl. It is not possible to build even a small wall without using local techniques and styles.

Gran Canaria

In Gran Canaria the environmental deterioration caused by man during the last centuries reduced the wild palm population to small isolated stands.

The *palmeral* of Maspalomas is quite small and disturbed, but still needs mention for the beautiful landscape that surrounds it—a huge plain covered with Sahara-desert-like dunes of fair sand, the Oasis de Maspalomas. The true *palmeral* now belongs to a hotel, and has been "enriched" by planting a lawn and adding many *P. dactylifera*. Fortunately the sand dunes are now a nature reserve and include some scattered palm groves, growing in wild conditions within a curious sand-loving, xerophytic vegetation of Mediterranean origin—a mostly thornless scrub with *Tamarix* as the dominant shrub.

During the last few years a high number of young *P. canariensis* (I estimate about 40,000) have been planted all over the island, along roads and in abandoned fields that cover so

much of the land since tourism developed and offered a better life to most of the population. These plants are just starting to develop trunks, but represent a marvelous promise for the landscape of the island and the local fauna, which could start again to feed on wild dates.

The Eastern Islands

Lanzarote and Fuerteventura, due to their lower altitude and closeness to Africa, show a much more arid landscape. They were once partially covered by the endemic Lauraceae forest, but since the end of the Tertiary they have been thoroughly affected by the climatic change suffered by Africa and the subsequent desertification process. The forest has disappeared totally and the only arborescent vegetation now present in these islands are the small stands of *Phoenix*. (A. Machado in Kunkel 1976).

Nature alone has probably not been the only cause of forest loss in the eastern islands. In 1590 the Italian traveller Leonardo Torriani reported in Fuerteventura the existence of 100 large herbivores per square kilometer; a total of 139,000 beasts, of which there were 4,000 camels and 60,000 goats and sheep (Torriani 1978). If any tree would have survived the climatic deterioration, it would surely have disappeared in that zoo!

The palm stands of these islands are much less charming than those of La Gomera but are anyway peculiar, due to their adaptation to aridity and association with the shrubs *Tamarix africana* and *T. canariensis*.

Exotic *Phoenix* Species in Tenerife

On the largest island, Tenerife, there are hundreds of *P. dactylifera*. Most of them are grown in the lowlands of the southwestern part of the island, an area that has probably never been home to *P. canariensis* because of its dryness. Indeed, the true date palm apparently grows there better than the native *Phoenix*. Most of the "aliens" actually existing have been imported as adult specimens some 15–20 years ago mostly from Elche, the "date city" of southeastern Spain, to line roads of the then new tourist areas. Nevertheless, small populations of date palms have been present on the islands since time immemorial, maybe prehistory (Schmid in Kunkel 1976), and became locally naturalized in some small areas of Tenerife, Gran Canaria, Fuerteventura, and Lanzarote. Date palms were so integrated in the Canaries that the well-known *Enciclopedía Espasa* reported the existence of only 30 "not-well-identified" date palm varieties in the Elche area and, in the Canaries, 15 varieties of the "Berbería" type (Anonymous 1970).

A few old specimens of *Phoenix rupicola* grow on the island. Two plants are found in the small square of Icod de Los Vinos (Northern Coast), where they usually pass unnoticed because of

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Left
Bactris pliniana Granv. & Henderson

This medium sized, cespitose palm is not very common but can be locally frequent. It is found in the Guianas, the Amazon region of Brazil (Amapá, Pará, Amazonas, Acre), and parts of Peru (Loreto). It always grows in swampy places and along small streams in forest understory. The species was described in 1994 and named in honor of Dr. Plinio Sist, a botanist who worked on palm dynamics and regeneration in French Guiana from 1985 to 1987. The leaves are usually pinnate, with broad, sigmoid, long acuminate leaflets, arranged in clusters along the leaf rachis. A very rare form with entire leaves, here photographed in the lower Oyapock basin, has been observed in two places in French Guiana, one in the Southwest, the other in the Northeast. The inflorescences are infrafoliar with a persistent peduncular bract densely covered with dark brown, soft hairs, intermixed with yellowish hairs. Like the other *Bactris* species of the PIRANGA group, the fruits are bright orange when ripe and densely spinulose.—Jean-Jacques de Granville

Right
Kentiopsis magnifica (H.E. Moore) Pintaud & Hodel

In a few palms leaves when just unfolding are red, the actual shade of red varying according to the species. The newly emerging leaf of *Kentiopsis magnifica*, shown here photographed by Jean-Christophe Pintaud at 500 m on Col d'Amos in New Caledonia, is one of the most brilliant. Formerly this palm was known as *Mackeea magnifica*, having been named by Dr. H. E. Moore in honor of Dr. Hugh S. MacKee and his wife, Margaret E. MacKee, who for many years collected palms and other plants in New Caledonia. Recent field work by J.C. Pintaud and Don Hodel has revealed intermediates between the former *Mackeea* and *Kentiopsis* and this palm, one of the largest and most elegant in New Caledonia, is now a species of *Kentiopsis*. For more on these stately New Caledonian endemics, see the last issue of *Principes*, Vol. 42 (1), p. 32.—Natalie Uhl

the notable presence of the very famous crested *Livistona chinensis* ssp. *chinensis* with eight heads, and the ancient dragon tree, a *Dracena draco*, thought to be around 2000 years old. More *P. rupicola* can be seen in old gardens of Santa Cruz and other historical settlements.

Many *P. roebelenii* have appeared as ornamentals in the last few decades but, luckily, *P. reclinata* is almost unknown, except in the Botanical Garden of La Orotava, where other less common species, such as *P. theophrasti*, are grown.

Last year, a few other exotic *Phoenix* spp. have been unwillingly imported for the new Palmetum of Santa Cruz.

The Doubtful *Phoenix atlantica*

In the southern portions of the islands another *Phoenix* species may have existed rather than *P. canariensis*: *P. atlantica* A.Chev., a taxon of very doubtful status, whose common name is *Palma Berberisca*. The peculiarities of the "atlantic" species, closely related to *P. dactylifera*, are the shorter, stiffer leaves and a curious habit of producing new shoots directly from the crown of leaves instead of from the base of the trunk, therefore resulting in irregularly branched palm trees (Kunkel and Kunkel 1974). *Phoenix atlantica* was reported from all the Macaronesian archipelagos, Canarias, Cabo Verde, and Madeira, but nowadays specimens in Canary Islands, if they exist, are too much mixed with common dactyliferas to be easily identified and studied. Moreover, most branched palm trees have been collected and planted in streets, parks, and road intersections.

The Problem of Hybridization

Phoenix spp. are well known for their tendency to cross very easily. Large species, such as *P. dactylifera*, are very well "built" for wind pollination; their pollen is said to be able to travel for many kilometers and with all this profusion of exotic *Phoenix* spp. on the islands, the genetic contamination of native *Phoenix* with pollen of imported species is a problem. Some studies on the structure of hybrid populations have been undertaken at the University of Las Palmas de Gran Canaria (Santana-Santana et al., in press) and a ban has been enforced to prevent importations of exotic *Phoenix* spp.

Crosses between the *palmera canaria* and the *palmera datilera* are very hard to detect at their young stage, because canariensis-green leaves are usually dominant over the dactylifera-blue ones. Hybrid plants reveal their origin just at the adult stage when they start to produce a trunk thinner than normal, leaves appear more rigid, and fruits turn out to be red and fleshy. A fully variable collection of hybrids is grown at the Casino Taoro Gardens in Puerto de La Cruz, Tenerife. It is difficult to tell the parents by looking at a single plant as many of them are probably second-generation hybrids, but all the plants grown may come from a mix of *P. canariensis*, *P. dactylifera*, and *P. rupicola*.

Smaller *Phoenix* species, such as *P. roebelenii*, represent a lesser danger as pollen producers. Their pollen is not able to cruise long distances because of their low height and inflorescence structure, which seems to be zoophilous rather than anemophilous.

Nowadays the number of wild palms in the Canaries is evidently growing. In the last 20 years, since many of the fields had been abandoned, palms started to recolonize naturally some of the valley bottoms from which they had been eradicated centuries before. In most cases, all the new palms, all of similar age, originated from a few tall mother plants, which are still in place.

In some places, as observed in the valley of San Andrés, where some of the mother plants were *P. dactylifera*, many of the new palms are hybrids, so we are in the dangerous situation of encountering the first wild hybrid populations.

Fortunately, the native palms abundantly exceed the aliens by number. Minor efforts are being made to conserve the species: many streets are being lined with pure "canariensis." *Los Canarios*, the inhabitants, are very cooperative people from an ecological point of view and are starting to realize how big the problem is. Sadly some nurserymen are illegally importing exotic *Phoenix* spp. among other palms from places as far away as Cuba, and some others are planting thousands of locally produced seeds of *P. rupicola*. "¡Es para la peninsula!" (Mainland Spain), they say, but I am sure that a few plants will not leave the island as the temptation to keep one (Just one, come on!) is too big. Luckily in the island of La Gomera, *la palmera canaria* is almost safe.

Acknowledgments

I wish to thank my dear friends Carlos Simón Rodriguez, I.P.S. member, and Giuseppe Orlando, who permitted me to use some of their beauti-

ful pictures for this article; the Department of Botany for having allowed me to use many of their facilities, especially my University teacher Marcelino del-Arco Aguilar, who advised and helped me greatly with the bibliography.

I also wish to dedicate this paper to my late grandfather Tullio, who planted, 25 years ago, a small *P. canariensis* in what later became my garden in Sicily. Thanks to him I grew up playing with spines, leaflets, and dates, and this may have played a role in the development of my passion for palms.

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Notes on Geonoma in Mesoamerica

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ABSTRACT

Geonoma hugonis Grayum & de Nevers and *G. monospatha* de Nevers are described as new species. *Geonoma hugonis*, known only from western Panama, is a member of subg. *Geonoma*, but cannot be assigned to either of its two sections as currently circumscribed. *Geonoma monospatha*, known from western Panama and eastern Costa Rica, belongs to sect. *Geonoma* of subg. *Geonoma*, and is compared with *G. stricta* (Poit.) Kunth. New observations are presented relevant to *Geonoma calyptrogynoidea* Burret, *G. congesta* H. Wendl. ex Spruce, *G. divisa* H. E. Moore, *G. edulis* H. Wendl. ex Spruce, *G. epetiolata* H. E. Moore, *G. ferruginea* H. Wendl. ex Spruce, and *G. jussieuana* Mart.

Continuing study of herbarium material for floristic and monographic projects involving Central American palms (cf. de Nevers and Grayum 1995) has uncovered two new Mesoamerican species of *Geonoma*. New information has also become available on seven other *Geonoma* species occurring, or alleged to occur, in Panama.

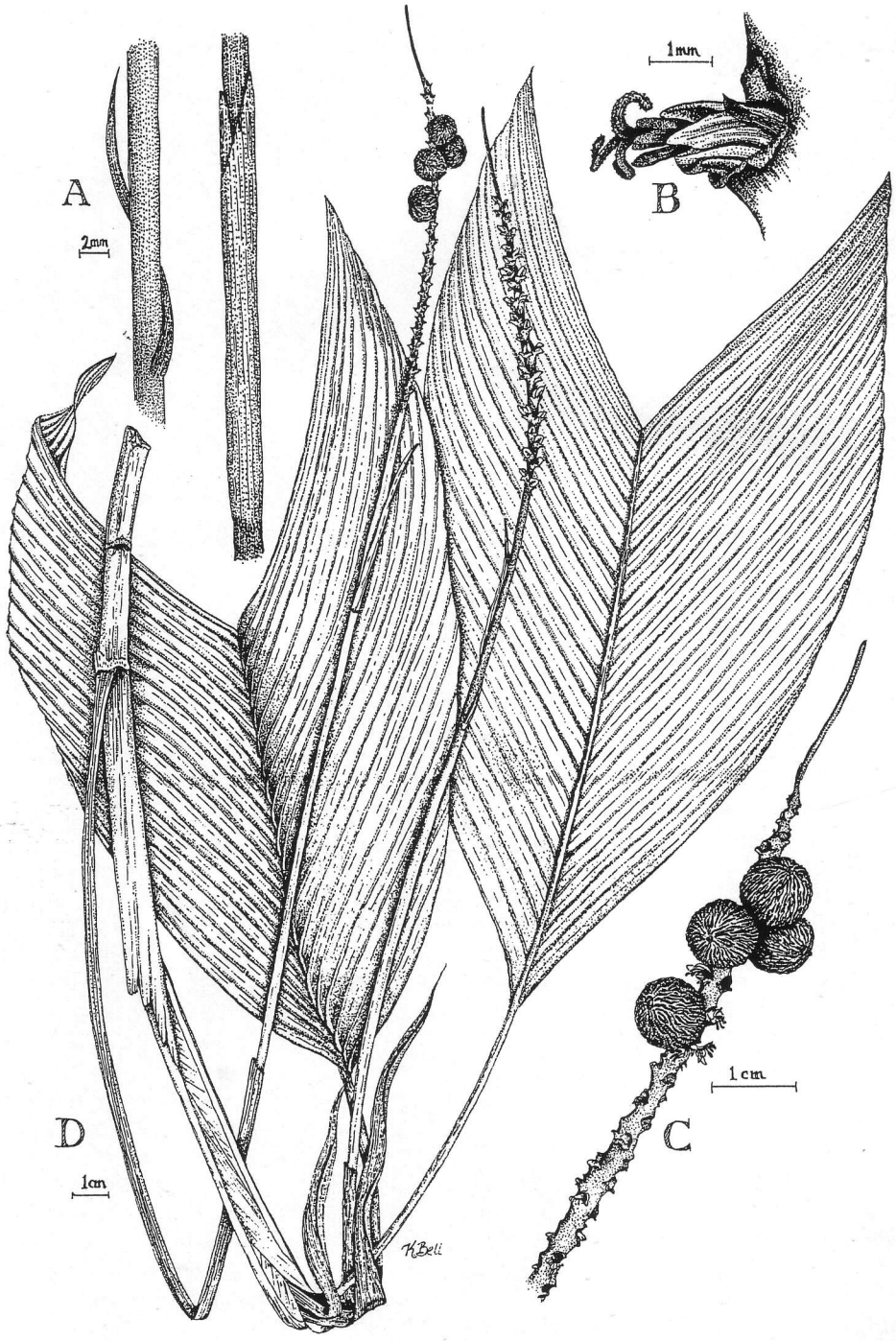
Descriptions of New Species

Geonoma hugonis Grayum & de Nevers **sp. nov.** (Figs. 1–2).

Species combinatione inflorescentiae spicatae cum bractea pedunculi supra orem prophylli inserta et tubo staminodiali florum pistillatarum digitate lobato a congeneribus diversa. Typus: Panama, Chiriquí, Fortuna Dam area, between Quebrada Los Chorros and Quebrada Hondo [sic], to N of reservoir, in forest N of road, 8°45′N, 82°14′W, 1,100 m, 20 Sep. 1984, *Churchill & Churchill 6185* (holotypus MO-4324593! MO-4326527!; isotypus CAS!).

Stems 0.5–1 (−1.5) m × 4–7 (−10) mm, solitary or subcespitose, erect or decumbent at the base and then rooting at the nodes ("prop roots" of label data), producing small offshoots at the lower nodes; leaves 5–8; sheath ca. 4–8 cm, at first tubular and enclosing stem, later splitting opposite the petiole; petiole beyond sheath 3.5–13 (−18) cm, shallowly channelled adaxially, rounded abaxially; rachis 5.5–20 cm; blade 9.5–30 (−36) × 6–13 (−19) cm, simple, bifid 1/3 to 1/2 its length, narrowly obovate to obdeltate, drying a deep chocolate-brown, with 17–26 primary lateral veins per side, these prominently raised adaxially, less so abaxially, subglabrous to densely appressed-scurfy abaxially and often setulose, diverging from midrib at ca. 24–42°; inflorescences 1–3 per stem, interfoliar, spicate; peduncle 15.5–53 cm × 2–4 mm, flattened, glabrous to densely brownish scurfy; prophyll and peduncular bract tubular, papyraceous; prophyll 7–15.5+ cm × 2–4 mm; peduncular bract 4–7 (−17.5) cm × 2–3 mm, or (often) reduced to a scale or obsolete, attached 12.8–29 cm above the insertion of the prophyll (usually well beyond its mouth); rachis 4.5–13 cm × 1.5–3.5 mm, subglabrous to sparsely or densely puberulent, red in fruit, the distal 5–15 mm usually sterile and narrower than the fertile portion; floral pits spirally arranged, bilabiate, ca. 1–2 mm apart, the lower lip usually bifid, the upper lip entire, the orifice ca. 1–2 × 1–2 mm, glabrous but coarsely tessellate within; sepals of staminate flowers 1.5–2 mm, obovate, bluntly keeled abaxially, ciliolate, weakly striate-nerved; petals 2.5–3.5 × 1.5 mm, narrowed to the base, connate below, free distally, imbricate at the tips, the lobes abaxially convex with ca. 10 prominent nerves; staminal tube funnelform, ca. 1.2–2 mm, stamens 6, filaments ca. 1.0 × 0.2 mm, flattened, anthers ca. 0.7–0.9 mm, inflexed at anthesis, spirally coiled after dehiscence; sepals of pistillate flowers 2.0–2.5 mm, narrowly obovate, imbricate, keeled abaxially, ciliolate; petals 2.8–3.2 × 0.9–1.2 mm, connate below, free and valvate in distal 1/3, the lobes subacute,

2. *Geonoma hugonis*. Habit. *Hodel et al. 1242*. Photo by Don Hodel.



1. *Geonoma hugonis*. (A) Variation in peduncular bract. (B) Flower, showing digitate staminodial tube. (C) Fruits. (D) Habit. Drawn from *Croat 48653 & 67809*.

striate with ca. 7–9 nerves; staminodial tube ca. 2.0 mm, cylindrical, digitately lobed, the lobes 0.5–0.7 mm, subequal, barely exserted from corolla; styles 3, ca. 1 mm, reflexed; fruits 4.5–6 mm diameter, subglobose to slightly oblate, apiculate, black when ripe, finely striate when dry; germination unknown.

Distribution and phenology. Geonoma hugonis is known only from the Continental Divide area of western Panama in Bocas del Toro and Chiriquí Provinces. It occurs in the Premontane Rain Forest and Lower Montane Rain Forest life zones between 1000 and 1,450 m elevation. Flowering specimens have been collected during most months of the year.

Paratypes. PANAMA. Bocas del Toro: headwaters of Río Culebra, ca. 5 km ENE of Cerro Pate Macho, 4,400 ft., *Hammel 6134* (MO); Chiriquí border along Continental Divide on Carretera del Oleoducto ca. 1 km N of Quebrada Arena, IRHE Fortuna Hydroelectric Project, 8°46′N, 82°12′W, 1,150 m, *Knapp 5078* (MO). Chiriquí: between Gualaca and the Fortuna Dam site, at 5.9 mi NW of Los Planes de Hornito, 1,370 m, *Antonio 4092* (MO); Fortuna Dam area, Quebrada Bonito to N of reservoir, 8°45′N, 82°13′W, 1,100 m, *Churchill 5752* (MO), *5800* (MO); rd. to the Fortuna Dam Site, N of Gualaca, 11.8 mi N of Los Planes de Hornito, 1,400 m, *Croat 48653* (MO, PMA); between Gualaca and Fortuna Dam site, 8.3 mi NW of Los Planes de Hornito, 82°16′W, 8°44′N, 1,260 m, *Croat 49946* (MO); Gualaca-Chiriquí Grande Rd. over Fortuna Lake, along gravel rd. which departs main hwy. near Continental Divide, 8°44′N, 81°17′W, 1,170 m, *Croat 66671* (MO); between Gualaca and Chiriquí Grande, 1 km S of Continental Divide, 8°45′N, 82°18′W, 1,075 m, *Croat 66850* (CAS, MO); Gualaca-Chiriquí Grande, 7.2 mi beyond Los Planes de Hornito, 8°44′N, 82°14′W, 1,165–1,200 m, *Croat 67809* (MO, US); Fortuna Dam Area, Fortuna-Chiriquí Grande, 5.3 mi N of center of Fortuna Dam, then 1.4 mi along gravel rd., 8°44′N, 82°17′W, *Croat & Zhu 76331* (MO); Fortuna dam area, rd. from Gualaca to Chiriquí Grande, continental divide trail W of rd., 8°45′N, 82°15′W, 1,150 m, *de Nevers & McPherson 6856* (MO); La Fortuna hydroelectric project, along trail uphill behind camp, 1,200–1,400 m, *Hammel 2116* (MO); 15 km N of Hornito on road to La Fortuna, 4,500 ft., *Hammel 6225* (MO); west from Fortuna Dam Camp to La Fortuna, 8°43′N, 82°14′W, 1,300 m, *Hampshire & Whitefoord 892* (BM); 1 km N of Fortuna Lake, 8°43′N, 82°14′W, 1,200 m, *Hampshire & Whitefoord 922* (BM); trail behind Fortuna Dam Camp up ridge, 1,300–1,600 m, *Hodel et al. 1242* (MO); 10 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Project, 1,150 m, *Knapp & Vodicka 5618* (MO); between Fortuna Dam and the continental divide, ca. 8°45′N, 82°15′W, 1,150 m, *McPherson 7300* (MO); Fortuna Dam region, above N edge of lake, ca. 8°45′N, 82°15′W, 1,100 m, *McPherson 9071* (MO); Cerro Colorado, 35.6 km from Río San Félix bridge, 1,390 m, *Sullivan 365* (MO); Cerro Colorado, wet forest on windswept ridge, 8°40′N, 81°45′W, 1450 m, *de Nevers et al. 8924* (CAS).

The specific epithet of *Geonoma hugonis* commemorates the late Hugh W. ("Hugo") Churchill (1946–1993), former curator of the Summit Herbarium (SCZ) and friend and colleague of both authors. Though primarily a pteridologist specializing on tree ferns, Hugo prepared many ample and well-annotated palm specimens from the Fortuna region (where he collected extensively) and other sites throughout Panama.

Specimens of *Geonoma hugonis* have routinely been determined as *G. cuneata* H. Wendl. ex Spruce (including *G. gracilis* H. Wendl. ex Spruce), a sympatric species which also has simple leaf blades and spicate inflorescences. Nonetheless, *G. hugonis* is sharply distinguished from *G. cuneata* (and all other *Geonoma* species with the aforementioned characteristics) by the very wide separation of its prophyll and peduncular bract (with the latter inserted beyond the mouth of the former), in conjunction with the digitately lobed staminodial tubes of its pistillate flowers.

On the basis of having six (rather than three) stamens, *G. hugonis* is unequivocally referable to subg. *Geonoma* in the classification of Wessels Boer (1968); however, it cannot be so easily accommodated in either of the two sections of that subgenus, and seems to blur the distinction between them. All species in sect. *Taenianthera* (Burret) Wess. Boer have spicate inflorescences and digitately lobed staminodial tubes, but also have the prophyll and peduncular bract inserted "closely together at the base of the peduncle" (Wessels Boer 1968: 96; the phrase "closely together" is nowhere quantified). The larger sect. *Geonoma* is variable with regard to inflorescence branching and bract insertion, but digitately

lobed staminodial tubes occur only "in species with branched inflorescences" (Wessels Boer 1968: 104). Our perusal of *Geonoma* descriptions published since Wessels Boer's revision has turned up no additional species that flagrantly defy his sectional circumscriptions after the manner of *G. hugonis*.

The French Guianan *Geonoma oldemanii* Granv., assigned to sect. *Taenianthera* by its author (de Granville 1975), is perhaps the best overall phenetic match for *G. hugonis*. The two species share simple leaf blades, spicate inflorescences, and digitately lobed staminodial tubes, and both exhibit a separation between the prophyll and peduncular bract. However, this separation is not nearly so great in *G. oldemanii* (2–6 cm) as in *G. hugonis* (12.8–29 cm), and the peduncular bract of the former species is not even exserted from the prophyll, let alone inserted above its mouth. *Geonoma oldemanii* also has proportionately narrower and much longer (115–130 cm) leaf blades than *G. hugonis*.

Geonoma schottiana Mart. (sect. *Geonoma*), of southeastern Brazil, may be the only *Geonoma* species with tubular inflorescence bracts, other than *G. hugonis*, to have the peduncular bract inserted beyond the mouth of the prophyll. It does not otherwise resemble *G. hugonis*, however; the inflorescence is branched to two orders, the flower pits are decussate, and the staminodial tube is shortly dentate.

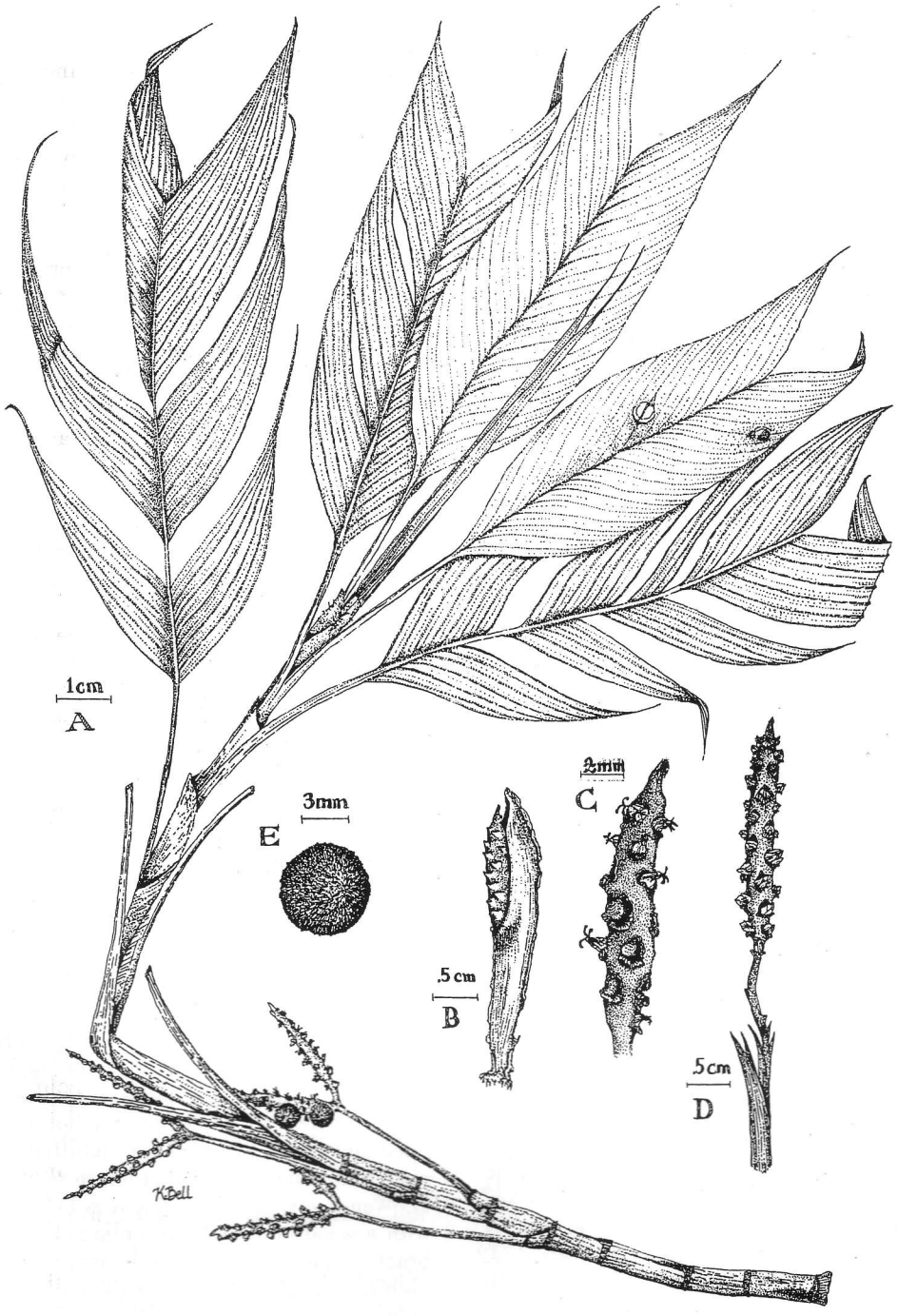
The relative lengths and position of insertion of the major inflorescence bracts (prophyll and peduncular bract) are important diagnostic characters in *Geonoma* (Wessels Boer 1968:26–28). There seem to be two basic patterns, correlated with developmental changes in ontogeny. In one, the bracts are short and fat (relative to the overall size of the plant), and are inserted close together at the base of the peduncle. The peduncular bract is enclosed in the prophyll, the bracts split at the sutures to reveal the developing inflorescence and are early deciduous (during or shortly after anthesis), and the rachillae are coiled in bud. In the other pattern the bracts are tubular, persistent even in fruit, and split distally for only a short distance to allow the inflorescence to emerge by elongation. In the latter group there is variation as to the position of insertion of the peduncular bract, from proximal on the peduncle (within 1–3 cm of the prophyll) in the majority of species, to distal on the peduncle but within the prophyll (as in *G. jussieuana*, *G. hoffmanniana* H. Wendl. ex Spruce, and *G. lehmannii* Dammer ex Burret), to beyond the mouth of the prophyll (*G. hugonis* and *G. schottiana*). *Geonoma stricta* (Poit.) Kunth and *G. monospatha* (described below), which have only one inflorescence bract, may exemplify a third developmental pattern. In these species the bract splits lengthwise to reveal the inflorescence and is deciduous shortly after anthesis (as in the first pattern).

The only somewhat aberrant specimen among the paratypes of *Geonoma hugonis* is *Hammel 6134* (MO), which accounts for the parenthetical maxima for leaf-blade length and width in the species description. This is also the only collection from Cerro Pate Macho and, apparently, one of just two collections from the Atlantic slope (Prov. Bocas del Toro). It is in no other way unusual.

Geonoma monospatha de Nevers **sp. nov.** (Fig. 3).

Geonoma strica aemulans, differt pedunculo rachillis longiore inflorescentiaque glabra vel stellato-pubescenti. Typus: PANAMA. Veraguas: Cerro Tute, just west of Santa Fe, 8°40′N, 81°05′W, 800–1,000 m, 27 Feb. 1995, *de Nevers, Henderson, Galeano & Bernal 10556* (holotypus PMA!; isotypi CAS, COL, K, MO, NY).

Stems 1–2.5 m × 6–9 mm, cespitose, erect, smooth and cane-like; leaves 5–9, cleanly deciduous; sheath 2–4 cm, at first tubular and encircling stem, at maturity encircling the stem only basally, split opposite the petiole distally; petiole beyond sheath 6–12 cm, flattened adaxially, rounded abaxially, densely appressed-scurfy, glabrescent; rachis 15–18 cm; blade 19–24 × 5–5.5 cm, simple and bifid (1/6 to 1/4 its length), or trijugate, or irregularly divided (the leaves of taller stems tending to be simple basally grading into divided apically), parallel-sided, cuneate at base, subglabrous to densely appressed-scurfy abaxially and often setulose, drying a light chocolate-brown, with 17–32 primary lateral veins per side, these not conspicuously raised, or conspicuous abaxially, diverging from the midrib at ca. 25°–35°; inflorescences 1–4, interfoliar or infrafoliar at anthesis, infrafoliar in fruit, with two rachillae or (less commonly) spicate or with three rachillae; peduncle 4.3–7 cm × 2–4 mm, flattened, glabrous to densely brownish scurfy; prophyll 4.5–6 cm ×



3. *Geonoma monospatha.* (A) Habit. (B) Inflorescence bud. (C) Rachilla at pistillate anthesis. (D) Inflorescence just prior to staminate anthesis. (E) Fruit. Drawn from *Knapp & Kress 4342, Croat 48961, Hammel 4616, de Nevers 10556.*

4–6 mm, thin, tubular, early deciduous; enlarged peduncular bract absent, the peduncle with 2–5 scalelike bracts; rachis obsolete; rachillae 2–4 cm × 2–4 mm, subglabrous to sparsely or densely puberulent, red in fruit, the distal 1–4 mm, sterile and narrower than the fertile portion; floral pits spirally arranged, bilabiate, ca. 2–3 mm apart, the lower lip usually bifid, the upper lip entire, inconspicuous, the orifice ca. 1–2 × 1–2 mm, glabrous and smooth within; sepals of staminate flowers 1.5–2 mm, obovate, bluntly keeled abaxially, margins entire, nerves obscure; petals 2.5–3.5 × 1–1.5 mm, narrowed to the base, connate below, free distally, imbricate at the tips, the lobes abaxially convex with ca. 10 prominent nerves; staminal tube funnelform, ca. 1.2–2 mm, stamens 6, filaments ca. 1.0 × 0.2 mm, flattened, anthers ca. 0.7–0.9 mm, inflexed at anthesis, spirally coiled after dehiscence; sepals of pistillate flowers 2.0–2.5 mm, narrowly obovate, imbricate, keeled abaxially, ciliolate; petals 2.8–3.2 × 0.9–1.2 mm, connate below, free and valvate in distal 1/3, the lobes subacute, striate with ca. 7–9 nerves; staminodial tube ca. 2.0 mm, cylindrical, crenulate (often irregularly so), barely exserted from corolla; styles 3, ca. 1 mm, reflexed; fruits 4.8–5.26 mm diameter, globose, blunt apically, black, finely verrucose when dry; germination unknown.

Distribution and phenology. Geonoma monospatha is known from Premontane Wet Forest (Holdridge 1971) on the Atlantic slope and Continental Divide area of western Panama and eastern Costa Rica between 350 and 1,500 m elevation. Flowering specimens are known from March and September through November; fruiting specimens are known only from November. This species probably blooms irregularly throughout the year.

Paratypes. PANAMA. Bocas del Toro: hills just S of Chiriquí Grande, at end of pipeline access road 10 mi. N of Continental Divide, 350–500 m, *Hammel et al. 14732* (CAS). Veraguas: Cerro Tute, just west of Santa Fe, 8°32′N, 81°07′W, 800–1,400 m, *Knapp & Kress 4342* (MO); 1,250–1,350 m, *Croat 48961* (MO); 800–1,000 m, *Dressler 5182* (MO, PMA, US); *Folsom et al. 3339* (MO); 3,200–5,600 ft., *Hammel 4616* (MO). COSTA RICA. San Jose: Cantón de Turrubares, Z.P. Cerros de Turrubares, Cerros de Puriscal, faldas del Cerro Pelón, 1 km Oeste de San Rafael, 09°40′50″N, 84°28′W, 1500 m, *Zúñiga & Varela 942* (CAS, MO, CR).

The species epithet of *Geonoma monospatha* refers to its lack of an enlarged peduncular bract, a rare condition in *Geonoma* shared only with *G. stricta* (sensu Henderson et al. 1995). *Geonoma monospatha* phenetically resembles *G. stricta,* an Amazonian species, with which it also shares narrowly cuneate leaves and a crenate staminodial tube. *Dressler 5182* was determined as *G. stricta* without query by H. E. Moore. The inflorescence of *G. stricta* is usually spicate, with a very short peduncle and much longer spike. This is the reverse of the situation in *G. monospatha,* which has a long peduncle and short inflorescence, usually with two or three rachillae. The rachis of *G. stricta* is usually densely pubescent, with the flower pits barely emerging through the tomentum, while the rachillae of *G. monospatha* are subglabrous. Furthermore, *G. stricta* has densely crowded, vertically superposed flower pits and oblong, apically pointed fruits, whereas *G. monospatha* has spirally arranged pits and globose, apically rounded fruits.

Another Amazonian species similar phenetically to *G. monospatha* is *G. aspidiifolia* Spruce, which has similarly proportioned and branched inflorescences. *Geonoma aspidiifolia* differs in having enlarged peduncular bracts and digitately lobed staminodial tubes.

A species likely to be encountered in Panama with or near *G. monospatha* is *G. epetiolata* H. E. Moore. These two species have somewhat similar inflorescences; however, those of *G. epetiolata* are almost always spicate, with the rachis much longer than the peduncle, and are larger in all their dimensions (peduncle 6.5–9 cm, rachis 19–22 cm). The leaves of *G. epetiolata* are very different from those of *G. monospatha,* being epetiolate, narrowly triangular, and purplish red.

In Wessels Boer's (1968) monograph of the geonomoid palms, specimens of *G. monospatha* with spicate inflorescences cannot be keyed. Specimens with two or three rachillae key, with moderate leaps of imagination, to *G. ferruginea* H. Wendl. ex Spruce. This is a larger species with a woody prophyll, an enlarged peduncular bract, much longer and more numerous rachillae, and inflorescences usually branched to two orders.

Notes on Additional Species

Geonoma calyptrogynoidea Burret

Henderson et al. (1995) placed *Geonoma calyptrogynoidea* Burret in synonymy under *G.*

congesta H. Wendl. ex Spruce without comment. Judging from the specimens cited below, *G. calyptrogynoidea* is quite distinct from *G. congesta* and is, in fact, not even in the same group within the genus (Wessels Boer 1968). The inflorescence of *Geonoma congesta* is usually branched to two orders and has a short (6.5–8 cm) peduncle with a distinct rachis, and numerous (ca. 11) short rachillae (15–17 cm). Its inflorescence bracts are short, oval, and coriaceous, its peduncular bract is shorter than the prophyll, and both bracts are deciduous at the time of anthesis. The inflorescence of *Geonoma calyptrogynoidea*, on the other hand, is nearly digitate, being branched to only one order, and has a long peduncle (40–55 cm), a short or obsolete rachis (to 5 cm), and fewer (4–7) longer (23–25 cm) rachillae than *G. congesta*. The inflorescence bracts of *G. calyptrogynoidea* are thin, tubular, and persistent on fruiting specimens, and the peduncular bract exceeds the prophyll.

Geonoma congesta and *G. calyptrogynoidea* are allopatric, with the latter species ranging from Prov. Darién, Panama, into Depto. Chocó, Colombia, at elevations below 500 m. *Geonoma congesta* is common on the Atlantic slope of Nicaragua, Costa Rica and Panama from sea level to about 800 m, and has one Pacific slope occurence on the Osa Penninsula of Costa Rica. It seems odd that *G. congesta* ranges east in Panama to Colón Province (Santa Rita Ridge), yet apparently does not reach San Blas, although there is no obvious biogeographic break there. *Astrocaryum alatum* Loomis has a similar ecogeographical range with the same eastern terminus. D'Arcy (1987a: 26) listed *G. calyptrogynoidea* as occurring in western Panama (Prov. Bocas del Toro, Veraguas), but the sole voucher cited (D'Arcy 1987b: 269) is a misidentified specimen of *G. congesta*. In Panama, *G. calyptrogynoidea* occupies drier forest types than *G. congesta*.

Geonoma calyptrogynoidea Burret, Bot. Jahrb. 63:223. 1930.

Type. Colombia, La Mesa, *Kalbreyer 1398* (Holotype B, destroyed). COLOMBIA. Chocó: Zona de Uraba, Cerro del Cuchillo, sector Cuchillo Blanco, Bmh-t, 10–20 m, 15 octubre 1987, *D. Cárdenas 668* (Neotype MO, here designated; isoneotypes: CAS, JAUM [n.v.]).

Additional specimens examined. PANAMA. Darién: Quebrada Bidoto (Peccary Creek), off Río Areti, "doqidua" (Chocó), "cortadero" (Sp.), used for thatch, *Duke 13598* (MO); Serranía del Sapo, Río Chado, 7°30′N, 78°10′, *Hahn 293* (MO); 1 mi. E of Manene, *Hartman 12113* (MO); Parque Nacional del Darién, ridge between Río Topalisa and R. Pucuro, ca. 9 km E of Pucuro, Quebrada Pobre, 8°02′N, 77°24′W, 450 m, *de Nevers 8305* (CAS, MO); 13 km E of Pucuro, 450–600 m, *de Nevers et al. 8319* (CAS); Cuasi-Cana trail, between Tres Bocas and Cerro Campamiento, *Kirkbride & Duke 1349* (MO); Río Jaque valley, ridges, 7°26′N, 78°05′W, 300–500 m, *Knapp & Mallet 3103* (MO); Mamey, *Whitefoord & Eddy 417* (MO). COLOMBIA. Chocó: Mpio. Turbo, Carretera Tapón del Darién, Sector Río León-Lomas Aisladas km 16, "suelo pantanoso," 20 m, *Brand & González 520* (MO); Mpio. Riosucio, Zona de Urabá, Cerro Cuchillo, 520 m, *Cárdenas 469* (MO); *Cárdenas 771* (MO); Alto de Río Jurbidó, cerca de las bocas de la quebrada Mundaquera, 06°05′N, 77°10′W, 0–100 m, *Barbosa 6480* (MO); Bahía Solano, near Ciudad Mutis, Quebrada Jella, 0–75 m, *Killip & García 33623* (US); La Concepción, 15 km E of Quibdó, 75 m, *Archer 1980* (US). Santander: Puerto Berrío, between Río Carare & Río Magdalena, 100–700 m *Haught 1850* (US). Valle: Bajo Calima, Concesión Pulpapel/Buenaventura, 03°55′N, 77°00′W, 100 m, *Monsalve 350* (MO).

Geonoma divisa H. E. Moore

Henderson et al. (1995: 256) attributed *Geonoma divisa* H. E. Moore to Panama, presumably on the basis of *de Nevers 6392* (NY), annotated as *G. divisa* by G. Galeano in 1992. This specimen actually represents a depauperate, high-elevation form of *G. longevaginata* H. Wendl. ex Spruce. In addition, Henderson et al. (1995: 226) changed the concept of *G. divisa* from that intended by Moore (with flower pits in whorls of three) to one with spirally arranged flower pits (as in *de Nevers 6392*). Examination of the MO isotype of *G. divisa* suggests that it may represent no more than a variety or form of *G. deversa* (Poit.) Kunth with unusually shaped leaves. Moore (1980) distinguished *G. divisa* from *G. deversa* on the basis of its leaf shape and "very prominently elevated, narrow ribs on the dull upper surface of the leaf blade." Whatever the status of *G. divisa*, the evidence for its inclusion in the Panamanian flora is inconclusive at best.

Geonoma edulis H. Wendl. ex Spruce

Wessels Boer (1968) placed *Geonoma edulis* H. Wendl. ex Spruce in synonymy under *G. interrupta* (Ruiz & Pav.) Mart., and Henderson et al. followed Wessels Boer. Our examination of the holotype of *G. edulis* (*Wendland s.n.*, Costa Rica, Turrialba, 1857) has caused us to reappraise this synonymy. The holotype, though consisting only of an inflorescence, clearly does not represent *G. interrupta*. The flower pits have a distinct upper lip and the pits are glabrous within. Furthermore, the fruits are globose, rather than apiculate as in *G. interrupta*, and the inflorescence is less ramified. Rather, the type of *G. edulis* belongs to the species currently known as *Geonoma seleri* Burret (sensu Wessels Boer), a much more recent name. Thus we propose the following new synonymy:

Geonoma edulis H. Wendl. ex Spruce

TYPE: COSTA RICA. Cartago: Turrialba, *Wendland s.n. 1857* (Holotype K!).

Geonoma seleri Burret

TYPE: GUATEMALA. Huehuetenango: Yalambohoch, *Seler 2757* (holotype, destroyed at B).

NEOTYPE: GUATEMALA. Alta Vera Paz: between Sepacuite and Panzas, 24 June 1904 *Cook & Doyle 327* (US, five sheets here designated).

Interestingly, plants of this montane species are commonly exploited in Costa Rica for their bitter, yet edible (when roasted) palm hearts. This is the only *Geonoma* species that the second author has heard mentioned in this connection, during nearly 20 years of field experience in Costa Rica.

Henderson et al. (1995) placed *G. seleri* in synonymy under *G. undata* Klotzsch (an older name even than *G. edulis*), restricted by Wessels Boer (1968) to South American and Caribbean material. However, we consider the evidence for this relationship to be inconclusive. Central American material (*G. seleri* sensu Wessels Boer, here treated as *G. edulis*) is uniformly characterized by short, stiff rachilla hairs, lacking in *G. undata* sensu Wessels Boer. We have studied a topotype of *G. undata* (*Davidse & Miller 28010*, MO) identified by Henderson in 1987.

Geonoma epetiolata H. E. Moore

In 1980, H. E. Moore annotated a specimen from eastern Panama [*Hammel 3107* (MO), Prov. Colón, Cerro Bruja as having the leaves of *Geonoma epetiolata*, but the "female flowers wrong." Moore suggested with a query that the specimen might represent a new species. In the original publication of *G. epetiolata*, Moore (1980) described and illustrated clearly an exserted, crenate staminodial tube. The staminodial tube of *Hammel 3107* is digitate. Examination of all available flowering material of *G. epetiolata* at CAS, F, MO, and US revealed that the Costa Rican and western Panamanian material (east to Santa Fe, the type locality) has crenate staminodial tubes, whereas material from east of Coclecito Road has digitate staminodial tubes. The two forms meet in the vicinity of El Copé and Coclecito Road, where both occur. The characters of staminodial tube lobing and exsertion vary independently. *Geonoma epetiolata* is an unusually distinctive species, and no other characters appear to vary in correlation with staminodial tube lobing. We thus consider the variation in staminodial tube lobing described above as normal for this species. This would appear to be the first report of such extreme intraspecific variation in this taxomomically important character.

When *G. epetiolata* was described it was known only from the area of the type near Santa Fe in Veraguas province. It is now known from every Atlantic slope collecting locality in Panama east to Cerro Brewster (Comarca de San Blas), and west along the Atlantic slope to Volcán Barva, in Costa Rica.

Geonoma ferruginea H. Wendl. ex Spruce

Wessels Boer (1968) and D'Arcy (1987a,b) listed *Geonoma ferruginea* H. Wendl. ex Spruce as occurring in Panama. Examination of all material at CAS, F, MO, NY, and US revealed no specimens from Panama. *Cooper 493* (F), cited by Wessels Boer as *G. ferruginea*, is better as *G. longevaginata*. A few other specimens of *G. longevaginata* from Panama were misdetermined as *G. ferruginea* and perhaps this is the source of the report by D'Arcy. Most of the Panamanian material of *G. longevaginata* is rather uniform, with a long peduncle, long rachillae, and large leaves. A mid-elevation, cloud-forest form with small leaves, short peduncles (3–10 cm), and few (3–6), short (10–20 cm) rachillae occurs at El Valle, El Copé, and Coclecito Road. This form is reported by Henderson et al. (1995) as *G. divisa* (see above).

Geonoma jussieuana Mart.

In western Panama there are two distinct forms of *Geonoma jussieuana* Mart. In 10–20 m tall, closed-canopy forest between 1800 and 2300 m the plants have narrow, entire, deeply bifid leaves with the veins converging cyclanth-like at the tips of the lobes. At slightly higher elevations on exposed, wind-swept ridgetops in elfin forest 0.5–2 m tall the plants have consistently trijugate or more finely divided leaves with similar veins. In addition, the tall-forest form has cleanly deciduous leaves and a cane-like trunk, whereas the elfin forest form has persistent leaf bases, which disintegrate into a web of heavy fibers clothing the trunk. Neither flower nor fruit differences could be found.

Acknowledgments

We are indebted to Kathy Bell for the excellent line drawings of *Geonoma hugonis* and *G. monospatha,* and to Donald R. Hodel for permission to use his fine photograph. Dr. Dale W. McNeal (UOP) kindly provided facilities for the illustrator. We thank Mireya Correa A. for providing information on duplicates represented at PMA, and Rodrigo Bernal for information on duplicates at JAUM. We thank especially the curators of the following herbaria for loans of material pertinent to this study: CAS, F, MO, NY, US.

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

Fees: 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, Department of Systematic Botany, University of Aarhus, Nordlandsvej 68, 8240-Riiskov, Denmark.

Principes, 42(1), 1998, p. 104

Effect of Ecosane on Palm Growth

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Ecosane 5000 is described on its label as "a stabilized package used to stimulate micro-flora for specific symbiotic reaction with tropical plants." It has been reported by Hull (1996) that foliar applications of Ecosane stimulated palm growth considerably in nurseries and thus facilitated recovery in Miami from Hurricane Andrew.

Object of Experiment

This experiment was aimed at assessing the effect of Ecosane on palm growth. The species used for the experiment were *Ptychosperma elegans* and *Washingtonia filifera*. Single palms 18–24 months postgermination were used. They were grown in potting soil in 2-gallon pots. Fertilizer (12-4-12 with trace elements) and irrigation were applied, but no pesticides. The *Ptychosperma* were grown in part shade; the *Washingtonia* were in open sun.

Methods

Plants were allocated to treatments according to size to achieve uniformity, hence no pretreatment growth or size record was taken. Replicates and treatments were separated by walkways. Treated palms received Ecosane at 5 fl. oz. per gallon of water, sprayed to run-off on both upper and lower surfaces of the fronds, on 3/18, 4/18, 5/30, and 7/6/97. Untreated palms were sprayed similarly with clean water using a clean sprayer. The numbers of palms in treated and untreated groups are listed in Table 1. The growth of the youngest frond on each palm at any time was measured in terms of its height in centimeters above the soil surface as described by Smith and Romney (1963). Fronds were measured on 3/29, 4/18, 5/7, 5/25, 7/9, and 8/5/97. Growth of each plant over the period of the trial is expressed as aggregate frond extension over the 20 weeks of the trial. Measuring of *Washingtonia* was stopped during the trial because it was found difficult to do accurately.

Table 1. Results of Ecosane experiment with Ptychosperma elegans.

	P. elegans			
	Ecosane		Control	
	No. palms	Mean growth	No. palms	Mean growth
Replicate 1	4	78.5	5	51.5
Replicate 2	4	62.5	6	62.0
Replicate 3	6	78.0	6	67.0
Replicate 4	6	74.0	6	76.3
Totals	20	1475.8	23	1488.8
Means		73.8		64.7
Standard deviation		+20.5		+15.5

Results

There was no visual difference in size or frond color between the treatments for either species, but there was considerable variation in the size of the *Ptychospermas* by the end of the trial (Table 1). Although the mean growth of treated palms was 14% more than untreated palms, the large standard deviations show that 66% of the growth data fell, as follows: Ecosane treated—53.3 to 94.3 cm, untreated—49.2 to 80.2 cm. Owing to the large variation, the variance was not analyzed, but the means are clearly not significantly different. Under the conditions and time frame of the experiment, Ecosane had no noticeable effect on palm growth.

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Principes, 42(1), 1998, pp. 105–109

Ecosane and the Growth of Containerized Palms

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In his article "Facilitation of Hurricane Recovery in Miami" in the October 1996 issue of *Principes*, DeArmand Hull introduced to many of us a new product called Ecosane, an "enzyme activated stabilized biologic catalyst." Applied as a foliar spray, Ecosane's many benefits were cited. These included "increased [plant] growth rates; increased root mass; increased leaf size" and an enhancement of "the plants" tolerance to normal stresses such as varied watering, temperature fluctuations, and soil pH." Hull further asserted that "as a general rule, 3–5 years of growth are achieved in one year" when using Ecosane.

Such claims are rather impressive. However, the evidence presented was more anecdotal than scientific. The article intimated that Hull participated in a controlled test of the benefits of Ecosane. "Seedlings grown by this author from the same accessions and grown in identical media and conditions as those of [an Ecosane treated] garden but without application of Ecosane have consistently shown a growth rate of half of those grown with Ecosane." No further documentation was offered.

It would seem that the growing of test plants and control plants in two separate locations, each under the supervision of a different person, would not make for a very good evaluation of Ecosane or any other product. Also, careful examination of the photographs of the root masses of four pairs of treated and untreated plants (incidently, only one of which was a palm), suggested results could be seen after only three applications of Ecosane, presumably two weeks apart, in midwinter. But again, there was no documentation.

An additional photograph of treated and untreated palms can be found on the Ecosane Web page (http://www.ecosane.com/case_pin.htm) and in the Ecosane brochure. Four containerized "pinanga caesis" [sic] are shown. Two had been treated with Ecosane over a period of eight months. The other two had not been treated. The height of the treated plants is three times the height of the untreated plants. The page describes the differences as "unbelievable."

To better evaluate the benefits of Ecosane, a more tightly controlled experiment was conducted by this author during the first eight months of 1997. Seedlings of four species of palm were each divided into two groups. One group received a foliar spray of Ecosane, at the recommended concentration, every 2–3 weeks. (At the suggestion of Dr. Michael Bitz, who has used Ecosane very successfully (see Hull article *Principes* 40(4): 208), care was taken to ensure that some of the spray reached the potting medium.) The other group received no Ecosane. At the time the experiment began, there was no discernable difference in size or color between the groups of palms that would be treated and those that would not. Seedlings that were in any way unusual were not included in the experiment.

The palm species and number of palms in each group used are shown in Table 1. All palms in the experiment were grown in a mostly shaded location within a few feet of each other. However, with each spraying, the positions of the treated and untreated palms were switched to ensure that no minor light differences would have any effect. During this plant rotation, the untreated

Table 1. Species and number of palms used in each group.

Species	No. treated	No. untreated
Oenocarpus distichus	5	4
Cyrtostachys renda	6	6
Calyptrocalyx albertisiana	4	3
Nephrosperma vanhoutteanum	3	4
Total	18	17

palms were physically removed from the area of spraying to ensure they received no windborne Ecosane.

On those nights during the winter when the temperature was forecast to drop below 45°F, all seedlings were moved into a protected area

1–2. *Cyrtostachys renda.*

where the temperature never dropped below 46°, even on the coldest of nights. All palms were lightly fertilized in early April and early June.

During the eight-month test, there has been some variability in the growth rates of the palms within each of the eight cells. However, it is not

3–4. *Oenocarpus distichus.*

possible visually to tell which groups of palms were treated with Ecosane and which ones were not (Figs. 1–8). An examination of the root masses of the treated and untreated palms also showed no differences (Figs. 1–8).

While this experiment offers no evidence one

5–6. *Calyptrocalyx albertisiana.*

way or another about Ecosane's ability to increase the cold hardiness of palms or the growth rate of *field-grown* palms, it does suggest that the "phenomenal" and "dramatic" benefits of this product may be a bit of an exaggeration.

7–8. *Nephrosperma vanhoutteanum*

Principes, 42(2), 1998, pp. 110–119

Notes on Recent Palm Species and Records from Peninsular Thailand

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Although the main focus of the Palm Search Malaysia (PSM) project has been on new and endangered taxa within Peninsular Malaysia, the study needs to encompass the Thai parts of the biodomain, with further extensions to Sumatra and Borneo for a more thorough review of certain dominant genera. My own interest and priority have been on *Areca*, *Iguanura*, *Nenga*, and *Pinanga*. As these are common (as are *Licuala* and other palms) to Southern or Peninsular Thailand and Malaya, the search continues there, transcending geographical boundaries. Indeed the herbarium collections at SING, K, and KEP contain items from the adjacent areas, some collected when Northern Malaya was still part of Thailand, such as on Ridley's expeditions to Kedah, Langkawi, and the Adang islands in 1910 and 1911, which yielded *Pinanga adangensis* among other species. It becomes a moot point whether or not to include this within Malayan flora, on a strict geographical basis, as Pulau Adang and Pulau Rawi remain within Thailand; as it happens, the taxon is also quite common on Pulau Langkawi.

In 1972, Whitmore made several collections of palms from Southern Thailand, including *Iguanura* and *Pinanga*, and in 1978, Ruth Kiew extended her studies on the genus *Iguanura* with notes on new species and records based on specimens at Kew (K) (Kiew 1978). My revision of the same genus within Peninsular Malaysia (Lim 1996), and also ongoing work on *Pinanga* had also led me to visit Narathiwat, Betong, Satun, Phuket, and Khao Sok since 1994, providing useful field experience that would help in determining the many specimens that remain unidentified among the exsiccatae (including some collected by the indefatigable Kerr during the early decades of this century) at K, Bangkok Herbarium at Kasetsart University (BK), and the herbarium of the Royal Forest Department, Bangkok (BKF), as recent visits have revealed. Clearly, more cross-referencing between the herbaria in Thailand, Malaysia, and Singapore would be beneficial in identifying new or suspected new taxa, in addition to more field collections, especially for genera not adequately represented.

In May and September 1997, Don Hodel published 18 new species from Thailand in *The Palm Journal*, the magazine of the Southern California Chapter of the International Palm Society (Hodel 1997*a*, *b*), including two *Areca*, four *Iguanura*, seven *Licuala*, three *Pinanga*, one *Rhapis*, and one *Salacca*, all at species rank; there may well be others in the pipeline, including a new *Wallichia*. His collections came from Narathiwat, Betong, Satun, Phangnga, Takua Pa (Khao Sok), Pattalung, and Rayong, all but one from Peninsular Thailand, thus of particular interest to Malaysian taxonomy. The *Licuala* species could usefully be compared with their southern relatives, as there has been a recent revision of the genus in Peninsular Malaysia by Dr. Saw Leng Guan of Forest Research Institute Malaysia (FRIM) (Saw 1997) and one would look forward to observations on the new finds by him and others such as Anders Barfod, who have been working on this genus. I will direct my comments at the *Areca*, *Iguanura*, and *Pinanga* species found in Peninsular Thailand, offering supplementary notes and proposing some positive revisions and new taxa.

Hodel was apparently commissioned to produce a book on the palms and cycads of Thailand by the fervent enthusiast and generous benefactor Kampon Tansacha, with the laudable intention of publication in time for the Biennial Conference of the International Palm Society to be held in Thailand in September 1998. The publication of some of his findings in advance, perhaps in haste, does, however, serve a purpose in arousing constructive responses, as will hopeful-

ly be seen in this paper. It is also desirable that essential cross-checks be made, especially with regional researchers, which will help to avoid superfluous naming of taxa already known. Indeed, a book on the palm flora of Thailand is long overdue; it would nevertheless benefit by more contributions and cooperation towards the enhancement of botanical information.

ARECA

ARECA RECURVATA

The author noted the strong affinity to *A. latiloba* (and to "*A. pumila,*" which is, however, a synonym of *Nenga pumila*), which has apparently been poorly represented in the herbaria in Thailand. Other collections at K, SING, and KEP, however, have many specimens displaying the range of *A. latiloba* forms, and field experience of this species confirms that it is quite often seen with broad or narrow leaflets, a common variation in character. I am also dubious about the characteristic of recurved rachillae—the specimen at BK does not seem to verify this—as being distinct from observable variants of *A. latiloba* inflorescence. In view of recent concern over confusing taxonomic comings and goings, it seems necessary to make early redeterminations to minimize nomenclatural pollution! *A. recurvata* is indeed the same taxon that Ridley described quite a long time ago, and I propose to reduce it to synonymy accordingly:

Areca latiloba Ridl., Flora Mal. Pen. 5: 2 (1925). *Areca recurvata* D. Hodel, The Palm Journal 134: 28–29 (1997), **synon. nov.**

ARECA BIFARIA

This striking *Areca* would appear to be a new record for Thailand, collected from southwest of Narathiwat. Its location can thus be related with the areas in Kelantan and N. Perak where *A. tunku* is found; the species was also discovered earlier by John Dransfield in Sumatra. Its inflorescence is unique and unmistakable from those of other Malayan *Areca*. I have no doubt that these are the same taxon, and reduce it to synonymy:

Areca tunku J. Dransf. C.K. Lim, Principes Vol. 36: 79–83 (1992).

Areca bifaria D. Hodel, The Palm Journal 136: 7 (1997), **synon. nov.**

IGUANURA

IGUANURA MULTIFIDA

This form was collected from the Betong range, growing sympatrically with *I. wallichiana* and the other new Hodel taxon, *I. divergens*. The author describes the fruit as green to pinkish (unripe), not dissimilar to those of *I. wallichiana*; the taxon is thus not *I. wallichiana* var. *rosea*. There is surely an error in sizing the fruit at "18–8 mm"; the herbarium specimen is 10–12 mm long. This is trivial, but the acceptance of narrower pinnae as a distinguishing character is questionable. As with *A. latiloba, I. wallichiana* is also frequently found with variable leaflet widths. There are, of course, other taxa with variable leaflets, and *I. diffusa* Becc. has characteristically very narrow, often unicostate pinnae. I would consider Hodel's species a form of *Iguanura wallichiana* and reduce it to synonymy:

Iguanura wallichiana (Wall. ex Mart.) J.D. Hooker var. **wallichiana,** Fl. Brit. Ind. 6: 416 (1892).

Iguanura multifida D. Hodel, The Palm Journal 136: 8 (1997). **synon. nov.**

IGUANURA SPECIOSA

This clustering palmlet is indeed an interesting and beautiful addition to the firmament of the *I. polymorpha* group, likely to attract considerable horticultural fancy. It had been collected previously by Llewelyn Williams and Smitinand, 17236 K, BK(5840), in 1950, Charoenpai & Larsen, 4032 K, in 1970, and Smith & Sumawong, GC103 K, in 1986. My own field observations and collections in 1994 serve to establish its distinction from *I. parvula* Becc., but also to confirm an inescapable similarity with *I. polymorpha* in inflorescence and habit; indeed these grew together in several colonies at Narathiwat. It appears to be localized and endemic, and has not been found south of the border. In cultivation, as at Nong Nooch, many of the plants are luxuriant and gorgeous; with the aid of garden nutrients, many wild species become literally larger than life or than in their natural habitat. It is indeed almost irresistibly tempting to justify species status, and Hodel himself presaged and alluded to other alternative inclinations to include it within *I. polymorpha*, while providing copious descriptions to establish the differ-

ences, which nevertheless further confirm the same characters as for *I. polymorpha* (other than the undivided leaf) with its range of variations. In Malaysia, this entire-leaved form has also been seen sympatrically with the usual pinnate ones, as collected by Dransfield & Saw (JD7620, K, KEP) at Ulu Besut, Terengganu. I would reduce the new taxon in rank as a variety, and given the options in taxonomy, name it under *Iguanura polymorpha* Becc. with an epithet that identifies the undivided leaves. Hodel's diagnosis serves the determination at this rank, and his specimen 1628 at BK as the holotype for the var. nov.; other reference collections have been mentioned above. This is undoubtedly a palm (together with other related *Iguanura* taxa) that may need urgent and enhanced protection in the wild, for obvious reasons.

Iguanura polymorpha Becc. var. **integra** C.K. Lim **var. nov.** *I. speciosa* D. Hodel, The Palm Journal 134: 29–30 (1997), **synon. nov.** Type: *D.R. Hodel et al.* 1628 (Holotype BK).

IGUANURA DIVERGENS

Iguanura divergens D. Hodel, The Palm Journal 136: 7–8 (1997).

This is a handsome new taxon with clustering stems, which may provide clues about transformations between the *wallichiana* and *polymorpha* types in the genus, if speculations may be countenanced; the branched rachillae are indeed reminiscent of *I. wallichiana*, whereas the trapezoidal leaflets of the pinnae are clearly similar to larger forms of *I. polymorpha*. Hodel describes the leaves as marcescent, and the inflorescences as interfoliar, and states that the stems are apparently quite robust, up to 3.5 cm in diameter, reaching to 3 m in height. Regrettably no fruit had been collected; this is unfortunate, as floral features tend to be indistinguishable in *Iguanura*. I viewed the holotype at BK, and would have liked to see more specimens. Initially I thought that there might well be a connection with the new species that I have described, *I. perdana*, from Perak, which is, however, usually solitary, but sometimes occurs with basal growths. After viewing two fine live specimens cultivated at Nong Nooch, I must note certain discrepancies from Hodel's descriptions: the leaf sheaths abscise, revealing prominently infrafoliar inflorescences, some growing a mere 10–25 cm above the base of the stems (see Fig. 1); there were of course others interfoliar, awaiting leaf abscission. Their stems were ca. 2 cm in diameter, and were not as robust as mentioned by Hodel for his holotype. Inescapably, I was reminded of the giant forms of *I. polymorpha* from Upper Belum in Perak, which also had long nine-branched inflorescences. I believe that a further collection and examination of the infructescence and drupes are needed to confirm this new taxon.

IGUANURA TENUIS

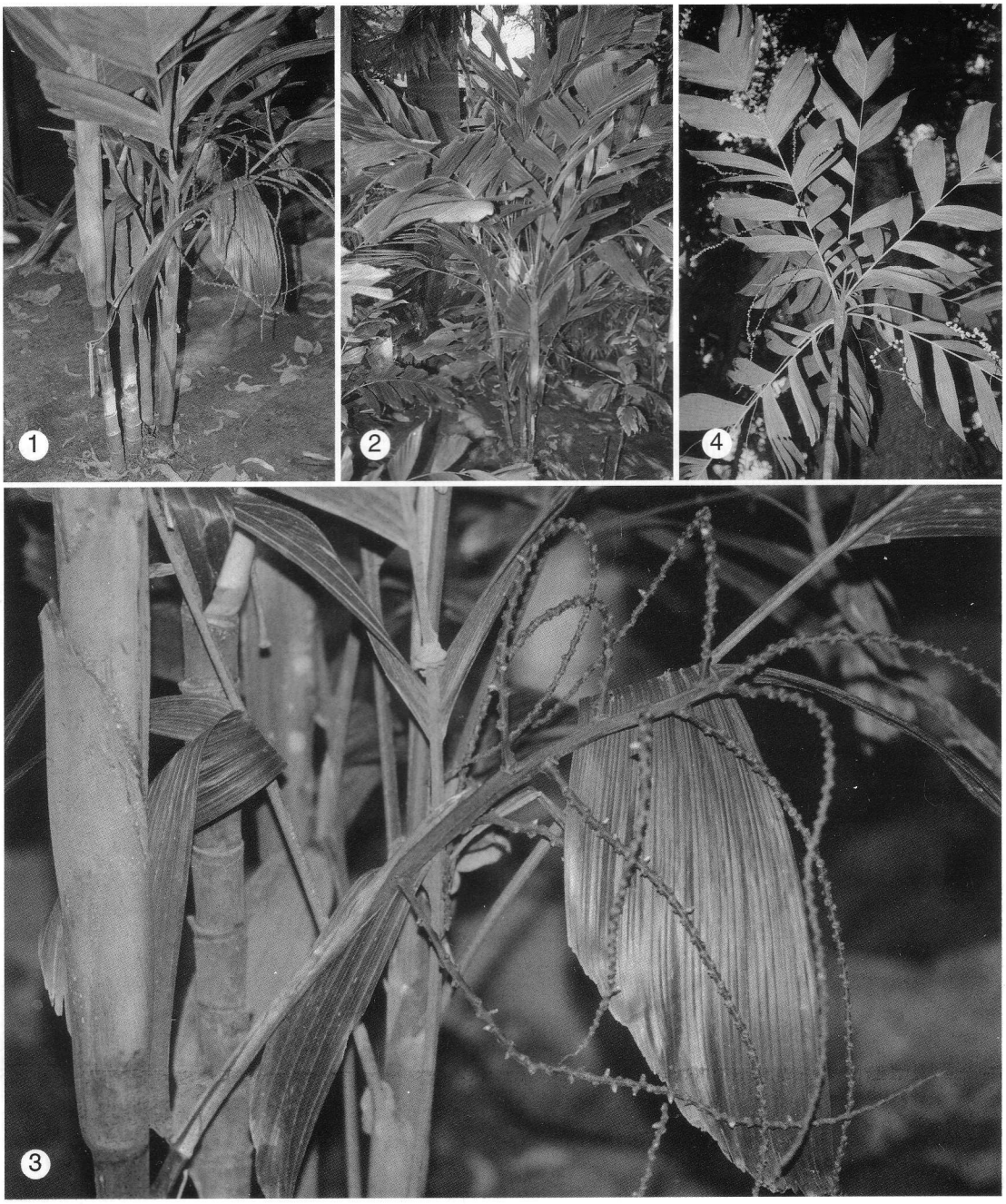
Iguanura tenuis Hodel, The Palm Journal 136: 11 (1997).

This is another new species that has been recognized from its finely branched inflorescence, collected from Takua Pa, near Khao Sok. It has been described as clustering, but is otherwise similar to the solitary palmlet commonly seen at the nature reserve. This difference in habit is important within this genus, as separate forms could be distinguished and justified by this character. On the basis of Hodel's evidence that *I. tenuis* is caespitose, I propose to recognize another solitary taxon at varietal rank, to be named *Iguanura tenuis* var. *khaosokensis* (see below). As mentioned, the species has pinnae similar to *I. polymorpha*, but with the branched inflorescences, reminiscent of elegant forms of *I. wallichiana*, interfoliar—as the sheaths do not peal off as neatly as with the regular *polymorpha* types, and may persist and shred, nevertheless leaving clean stems. In passing, it might be mentioned that between 1994 and late 1997, the understory palm population at Khao Sok appears to have declined significantly. Along the main trails, *Iguanura* numbers seem to have reduced to a quarter, and likewise for the *Pinanga* and *Licuala* spp. The only two *Wallichia* specimens that I had noted previously are also no longer to be seen.

Iguanura tenuis Hodel var. **khaosokensis** C.K. Lim **var. nov.**

A varietate typica habitu solitario bene distincta. Typus: Thailand, Surat Thani, Khao Sok, 1997, C.K. Lim H1993 (holotypus BKF, isotypus KEP).

Hodel's descriptions of the species are fully applicable to the variety, which I would recognize on the important difference of its solitary



1. *Iguanura divergens,* cultivated at Nong Nooch. 2. *Iguanura divergens,* cultivated at Nong Nooch. 3. *Iguanura divergens,* detail of inflorescence. 4. *Iguanura tenuis* var. *khaosokensis,* one of many at Khao Sok, all with solitary stems and interfoliar inflorescences.

habit (see Fig. 2), after observing the sizeable population at Khao Sok. This character in *Iguanura* is indeed distinct, as observed in other species, and is quite different from forms of stems with basal suckers or forms that are caespitose; of course adjacent seedlings growing entwined could give a false impression. The new variety has been observed growing to 2 m and sometimes fruiting at less than 1 m. The leaf sheaths may shred rather than fall off neatly; this aspect is unlike those in the regular *polymorpha* group in Malaysia and accounts for the interfoliar inflorescences. The trapezoidal pinnae are indistinguishable from the latter. It should be noted that specimens in cultivation can be quite robust, and branched inflorescences become less delicate or filiform and quite similar to those of *I. wallichiana* (as in specimens of "*I. wallichiana* var. *minor*"). Floral buds were noted to be yellow in color, and the drupes are similar to *I. polymorpha,* often ovoid and slightly curved, ripening from white to pink and black. The epithet helps to honor one of the geographic centers of this variety.

Distribution: Thailand, Surat Thani, Khao Sok, Takua Pa. Habitat: Limestone hill forest, 100m and above. Locally not rare.

Type: Thailand, Surat Thani, Khao Sok, 1997, C.K. Lim H1993 (holotype BKF, isotype KEP).

Other collections seen: Surat Thani, (Pangnga) Takua Pa, 1968, *Beusekon & Phengklai* 706 BKF(47018); Takua Pa, 1972, *Larsen* 30884 (K); Bang Ta Khun, Ban Klong, 1986, *Smith & Sumawong* GC60 (K); Bang Klong Yee Chang, Klong Saeng, 1986, *Smith & Sumawong* GC62 (K); Khao Sok, 1994, *C.K. Lim* H1615 (KEP), H1724 (PSM Collection).

IGUANURA THALANGENSIS

Iguanura thalangensis C.K. Lim **sp. nov.**

I. tenuis affinis sed habitu solitario, inflorescentiisque spiciformibus vel bifurcatis differt. Typus: Thailand, Phuket, Khao Pra Taew, 1997, *C.K. Lim* H1995 (holotypus BKF, isotypus KEP).

Solitary, stilt-rooted, stem grey or brown, 1.5 cm diameter, erect to 2 m (fruiting from 50 cm height), leaves nine or more in crown, pinnate, 60 × 24 cm, with usually four pairs of leaflets, trapezoidal as in *I. polymorpha,* leaf sheaths brown shredding or abscising, internode 1–1.4 cm, inflorescences two or more usually interfoliar, spicate or bifurcating, sometimes to four, 20–30 cm long, fruit ovoid, white to pink unripe, similar in size to *I. belumensis.*

Distribution: Thailand, Phuket, Ranong, Chumpon. Habitat: Hill forests, 200 m and above. Locally not rare.

Type: Thailand, Phuket, Khao Pra Taew, 1997 C.K. Lim H1995 (holotype BKF, isotypus KEP)

Other specimens seen: Chumpon, Kao Num Sao, 1927, Kerr 12024 (BK) (24793); Ranong, Muang Len, 1966, *Hansen & Smitinand* 11960 (BKF) (37263); Khao Pra Mi, 1966, *Hansen & Smitinand* 11829 (BKF) (40006), 1972, *Larsen et al.* 30843 (K, BKF) (77436); Kaper, Khao Pawta Luangkaew, 1929, *Kerr* 16918 (K), 1973 Geesink and Santisuk 5147 (BKF) (56635), 1979 *Shimizu et al.* 26758 (BKF) (76638); Mueang Chon, 1987 *Niyondham et al.* 1436 (K); Phuket, Khao Pra Taew, 1994, *C.K. Lim* H1615 (KEP, PSM Collection), H1731 (PSM Collection).

The epithet refers to the location where I first observed the palm; Thalang was the earlier name for Phuket. The species is apparently quite widespread with several collections having been made from the Ranong area. It is probably not uncommon, but appears to be relatively rare in its type location at 200 m within a hill forest reserve, where *Pinanga patula* var. *merguensis* and another new species of *Pinanga* are also found.

The taxon is similar in habit and appearance to *I. tenuis* var. *khaosokensis,* with which it makes an interesting comparative pairing in inflorescence differences, in parallel with *I. geonomiformis* and *I. wallichiana,* with their spicate (or forking) and branching rachillae, respectively (see Figs. 3 and 4). The spicate stalks are often vertical; the inflorescences in both taxa are interfoliar and the leaf sheaths tend to shred rather than to abscise, but do not seem to be lingeringly marcescent as for *I. wallichiana.* The more profuse and infrafoliar infructescences of *I. belumensis* are quite different and recognizable from the *I. tenuis* variants. So far, this Malaysian relative has not been found in Thailand, and vice versa; the two Thai taxa are thus endemic within the national boundary.

An Interim Checklist of Iguanura Taxa in Peninsular Thailand

From viewing collections at BK, BKF, K, KEP, SING and with the benefit of recent field observations, I would list the following nine taxa (with those not found in Malaysia underlined):

I. wallichiana (Wall. ex Mart.) J.D. Hooker var. **wallichiana** *I. multifida* D. Hodel, **synon. nov.**
I. geonomiformis (Griff.) Mart.
I. polymorpha Becc. var. **polymorpha**
I. polymorpha Becc. var. **integra** C.K. Lim **var. nov.** *I. speciosa* D. Hodel, **synon. nov.**
I. bicornis Becc.
I. divergens D. Hodel
I. tenuis D. Hodel var. **tenuis**
I. tenuis D. Hodel var. **khaosokensis** C.K. Lim **var. nov.**
I. thalangensis C.K. Lim **sp. nov.**

The last listing by Ruth Kiew (1978) was based on the then new specimens at K. It included *I. wallichiana* var. *wallichiana*, *I. wallichiana* var. *malaccensis*, which I have since revised to *I. geonomiformis*, *I. polymorpha*, and *I. bicornis*. Several specimens determined as the first three may now be identifiable as *I. tenuis* var. *khaosokensis*, *I. thalangensis*, and *I. polymorpha* var. *integra*. As mentioned, *I. divergens* may require further comparisons with large forms of *I. polymorpha*. I also believe that it is surprising that *I. geonomiformis* has been found in that geographical area, as it is mainly a species from the southern part of Peninsular Malaysia.

PINANGA

PINANGA BOWIANA

This taxon has been described by its author as related to *P. auriculata* Becc. of Borneo, without quoting comparative evidence or specimens for consideration. It does require some bravery to cross the Sunda Shelf to correlate species in this genus; so far the general perception is that there are only three *Pinanga* taxa with known similarities in common to Borneo and Peninsular Malaysia. Even the ubiquitous *P. malaiana*, found also in Sumatra, has not been seen in Borneo. The case for transnational research is nevertheless urgent, but calls for considerable cooperation, especially by taxonomists working on the Flora of the Malesian region. The specimen Hodel deposited at BK has no fruit, but is clearly similar to the numerous collections of *Pinanga patula* Bl. at SING and KEP (and of course at FI, L, K and CAL) as identified by Beccari and Ridley. The taxon rediscovered by Hodel is commonly found throughout Peninsular Malaysia mainly along the eastern coast from Johore to Kelantan, distinctive (though not unique) with its sigmoidal, bicolor leaflets. In leaf form and habit, and when sterile, it resembles *P. patula* var. *merguensis* Becc. (which is a different proposition, as will be addressed in an ongoing study within the PSM program, which will further reexamine the Bornean relatives), and indeed many herbarium collections have sometimes mixed the two taxa. The latter is widespread along the western side of Peninsular Thailand, also at Phuket and Khao Sok (where it appears to be diminishing in population), and has recently been found also in Perlis, a new record for Malaysia. The fruit of var. *merguensis* are usually more profuse, and striking when ripening, in color a shiny claret before turning black. I have some familiarity with Hodel's taxon and its collection location in Narathiwat; it is indubitably the same as the Malaysian species, and will thus be reduced:

P. patula Bl., Rumphia 2: 86, t. 115; Ridley, Materials 2: 143 (1907).

Pinanga bowiana D. Hodel, The Palm Journal 134: 35 (1997), **synon. nov.**

PINANGA FRACTIFLEXA

Pinanga fractiflexa D. Hodel, The Palm Journal 136: 17 (1997).

I most gladly welcome this new determination, surprisingly overdue; apparently there have been few collections studied. This is the prominent clustering species seen at Khao Sok, with its distinctively long petioles and coriaceous leaves. The zig-zag rachillae are also diagnostic, and reminiscent of another new *Pinanga* species from Johore, due for publication. Hodel omits mention of the unripe fruit, which are bullet-shaped, turning ovoid and mammilate, beaked and shiny dark green before turning black. This new species and record for Thailand is also an endemic. As mentioned elsewhere, the population at the Reserve is diminishing, and an in situ propagation program (also for other threatened palms) would seem recommendable, as has been successfully undertaken for *Kerriodoxa* at Phuket.

PINANGA BADIA

Pinanga badia D. Hodel, The Palm Journal 136: 16–17 (1997).

This is another of the new *Pinanga* to be added to the growing list, again hardly known in previous collections. As Hodel mentions, the re-

5. *Iguanura tenuis* var. *khaosokensis*, detail of inflorescence.
6. *Iguanura tenuis* var. *khaosokensis*, leaves and inflorescence.

cent surge of efforts has been promoted by his sponsor Kampon Tansacha, with important field coverage by his collector Poonsak Vatcharakorn, providing fresh material for research and for horticultural development. It would indeed be useful for collection notes and data to be kept and made available, especially in areas threatened by deforestation. The new species was collected in Satun, where the Thale Ban Reserve offers scope for more botanical and conservation research; an estimate of its population would be useful. Coincidentally, over the last two years, as a new record for Malaysia, it has also been discovered near the border in the Mata Ayer Forest Reserve in Perlis, where so far very few clusters have been found. The palm has been observed to fruit when at less than 1.5 m height, and it is indeed most distinctive in the color of its drupes, ripening brownish pink, turning to black, with yellow rachillae.

PINANGA WATANAIANA

Pinanga watanaiana C. K. Lim **sp. nov.**

P. badia affinis sed foliis maculatis variegatis et inflorenscentiis viridis vel corallinis differt. Typus: Thailand, Phuket, Khao Pra Taew, 1979 *J. Dransfield & C. Boonab,* JD5424/BKF70343 (holotypus BKF, isotypus K)

Caespitose and clumping palmlet, stems greenish brown to 2.5 m, 1.5 cm diameter, with prominent internodal scars at 8–10 cm, leaves 6–8 in crown, pinnate (undivided in juveniles) to 70 cm, with 8–9 (to 13) pairs of leaflets, broader for the apicals, usually strikingly mottled (more so than in certain forms of *P. disticha*), sheaths 27 cm, yellow to brown forming crownshaft, inflorescences infrafoliar, 2–3 on nodes below, deflexed, sometimes erect rachillae green to coral red (distinct in color and usually longer than in *P. badia*) 2–4 branched 12–20 cm, peduncle to 3.5 cm, flowers not examined, fruit distichous, to 20 pairs, ovoid, beaked, 1 × 1.5 cm, green ripening scarlet to black.

Distribution: Endemic to Phuket. Habitat: hill forest, at 150 m and above, population localized, probably rare and endangered.

Type: Thailand, Phuket, Khao Pra Taew, 1979 *J. Dransfield & C. Boonab,* JD5424/BKF70343 (holotype BKF, isotype K).

Other specimens seen: Phuket, Khao Pra Taew, 1986, *Sumawong (& Smith?)* 9 (K), 1994 *C.K. Lim* H1614 (KEP), H1720, H1730 (PSM Collection), 1997, *C.K. Lim* H1994 (PSM Collection).

The clustering species is immediately recognizable from *P. badia* not only by the light-green mottle on the dark-green leaves, lighter on the underside, but also by the less numerous leaflets, and the yellow crownshaft, (see Figs. 5 and 6). The rachillae are normally green to coral, vs. yellow for *P. badia,* and the drupes green to scarlet and black, those of *P. badia* being brownish pink turning black.

This taxon has only been collected on a few occasions, but had been tentatively identified as probably related to *P. fruticans,* an elusive Ridley species, which he confused with specimens of *P. kuhlii,* his own original collection being most likely *P. scortechinii.* The new *Pinanga* has been named after Watana Sumawong, the eminent palm enthusiast and pioneer collector of Bangkok, who had himself collected it in 1986 at the same location. It has so far not been found elsewhere, and could be endangered because of its horticultural appeal.

7. *Iguanura thalangensis*, habit, showing bifurcating inflorescence. 8. *Iguanura thalangensis*, leaves, and spicate and bifurcating inflorescences.

An Interim Checklist of Pinanga Taxa in Peninsular Thailand

The following 14 taxa have been represented in the herbarium collections at BK, BKF, K, KEP, or SING:

P. malaiana (Mart.) Scheffer
P. adangensis Ridl.
P. scortechini Becc.
P. glaucescens Ridl.
P. disticha (Roxb.) Bl. ex H. Wendl.
P. simplicifrons (Miq.) Becc.
P. subintegra Ridl.
P. limosa Ridl.
P. patula Bl. var. **patula**
P. bowiana D. Hodel, **synon. nov.**
P. patula Bl. var. **merguensis** Becc.
P. riparia Ridl.
P. fractiflexa D. Hodel,
P. badia D. Hodel,
P. watanaiana C.K. Lim **sp. nov.**

Items underlined have not been found in Malaysia, and are thus endemic to Thailand. I have not been able to verify the *P. limosa* collection, nor the status of "*P. dicksonii*" (not listed here), which might have been confused with *P. adangensis*. *P. fruticans* Ridl. will be reduced to synonymy with *P. scortechinii* in an imminent revision of the genus in Peninsular Malaysia (Lim, in prep.). Specimens of "*P. paradoxa*" are mostly of *P. subintegra*. There will undoubtedly be fresh taxa yet to be found and named, and it should be obvious that a joint taxonomic program for both sides of the Malaysian-Thai border would be beneficial.

Acknowledgments

Firstly to Dr. Tim Whitmore for his invaluable taxonomic advice, and to Dr. Ivan Polunin for his encouragement to persevere in botanical pursuits, and to the herbaria consulted and their directors and staff at BK, BKF, K, KEP, and SING, Chamlong Phengklai, Kongkanda Chayamarit, Jaray Sadakorn, Pramote Triboun, Aroon Chomcharn, Dr. John Dransfield, Dr. Saw Leng Guan, Dr. Chin See Chung, Dr. Ruth Kiew, Ali Ibrahim, to my friends and field collectors Annop Ongsakul, Thean Wan, Peter Mayotte, Poonsak Vatcharakorn, Hamid Busu, Adnan bin Yusuf, Busu Ngah, and to the palm pioneer and enthusiast Watana Sumawong, my Thai hosts Patcharin and Ambassador Vara-Poj Snidvongs, Dr. Sumet Jumsai, and the hospitable Kampon & Bow Tansacha of Nong Nooch, his staff Andrea Lindstrom, Michael Ferrero and others, and to the Minister for Primary Industries, Malaysia, Datuk Seri Dr. Lim Keng Yaik, for his personal encouragement for my amateur efforts at botanical conservation and research, and for the continuing Palm Search Malaysia project.

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9. *Pinanga watanaiana*, habit. 10. *Pinanga watanaiana*, mottled leaves. 11. *Pinanga watanaiana*, stems and inflorescence. 12. *Pinanga watanaiana*, variation in leaves.


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MONTGOMERY BOTANICAL CENTER

The Montgomery Foundation, Inc. in Coral Gables, Florida has officially changed its name to the Montgomery Botanical Center. Nell Montgomery Jennings honored the name of Robert H. Montgomery, her then late husband, by founding the organization in 1959. Robert Montgomery had developed extensive palm and cycad collections at his Coral Gables estate. Nell wanted to promote scientific and educational use of these collections, and in so doing, promote recognition of the "Montgomery" name in the field of plant science.

The Montgomery Archive files, however, reflect more than thirty years of dissatisfation with the old name. Nell wrote in 1969, "We have talked at times of re-naming it the Montgomery Research Center for Plant Science or some such name." In 1988, Executive Director Nixon Smiley asked if we could adopt the name "Montgomery Research Center." In 1993, a strong consensus of the directors favored the name "Montgomery Tropical Plant Science Center." Over the years no action was taken because of inertia and nostalgia for the old name.

One of the reasons for the dissatisfaction with the old name was that it did not link "Montgomery" directly with the field of plant science. The word "Foundation" did not convey that the organization is an operating entity actively conducting its own operations. Finally, there are at least five other charitable organizations whose names are exactly the same as the old name and even more organizations with similar names.

Terrence Walters
Executive Director

Back Cover

Blue tanagers (*Thraupis aepiscopus*) are among the most frequent visitors to the ripe infructescences of *Aiphanes aculeata*, as in this picture, taken in Medellín, Colombia.