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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 aquí doce especies de palmeras, incluyendo tres aún 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 km², largely covered with Atlantic Forest ("Bosque Atlántico del Interior": FMB 1991; "Selva Paranaense," Laclau 1994; "Mata Atlántica," 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-

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 semi-flooded 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 km² from the Sierra San Joaquín 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 inhabited 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, occasional-
ly 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 spicately
..... *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.)

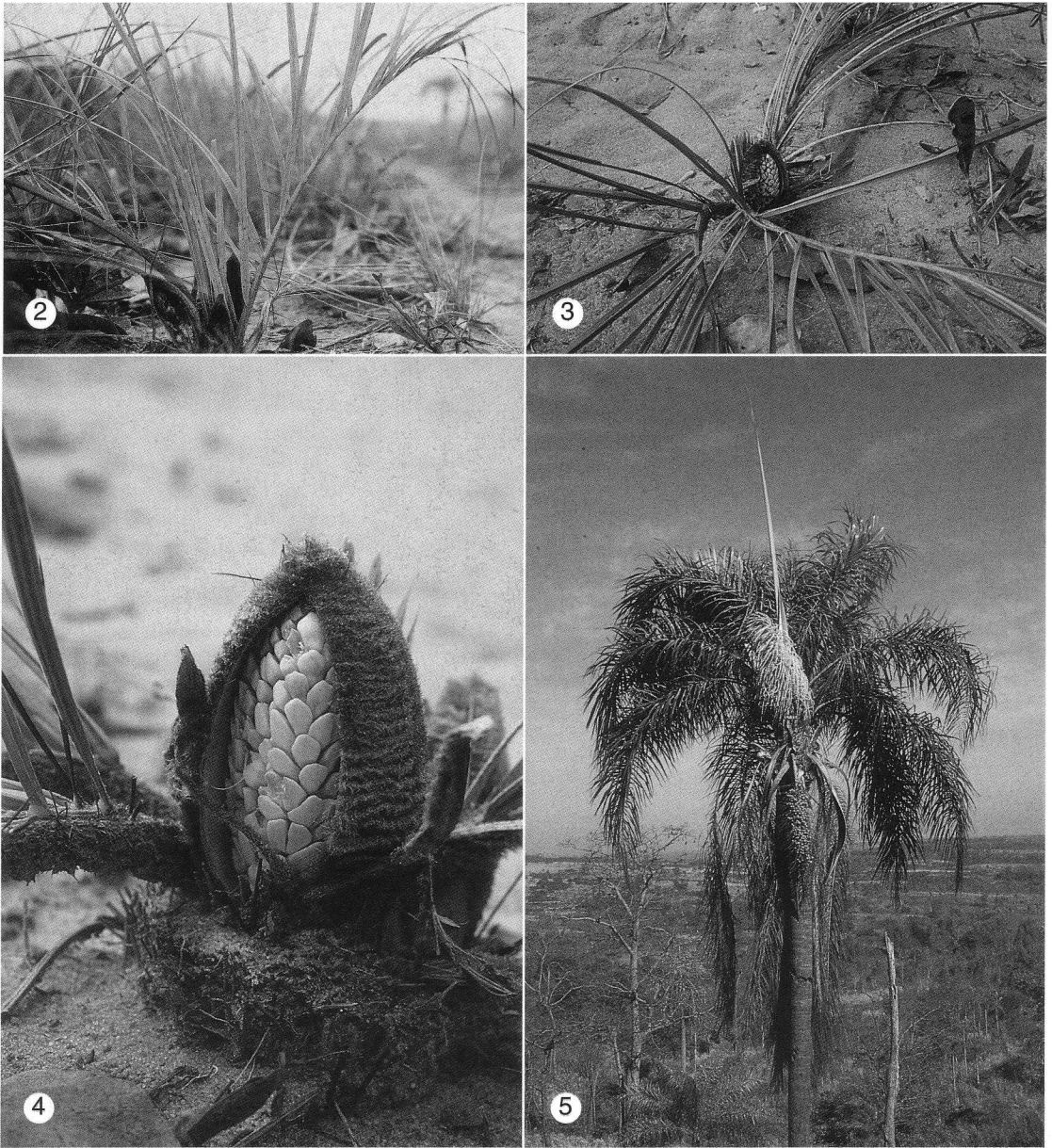
Fig. 5

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 ani-

mals: 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 Martín 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, Paraguari), 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). Paraguairí: "Ybcui", 1 Oct 1985, *Gentry, Pérez 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, Espírito 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 Brasília, and south to Argentina (Misiones) and Paraguay (Alto Paraná).

Habitat: This palm has a very narrow ecologi-





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, Paraguari).

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 Goiás, 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 Goiás, 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, Rondonia, 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 gynoeceum 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 liliputiana*, 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, Espírito Santo, Goiás, 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, Paraguari, 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 other 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), *aguties* (*Agouti paca*, agouti), and several canids such as the very common *aguara'i* (*Cerdocyon 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). Paraguari: "Ybucuf", 1 Oct 1985, *Gentry, Pérez and Brunner 51852* (K).

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