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# The Palm Flora of the Maquipucuna Montane Forest Reserve, Ecuador

JENS-CHRISTIAN SVENNING AND HENRIK BALSLEV
*Herbarium AAU, Department of Systematic Botany, Universitetsparken, bygn. 137, DK-8000, Aarhus C, Denmark*

ABSTRACT

Eleven species of palms occur at altitudes of 1 000–2 800 m in the Maquipucuna reserve and adjacent areas in the Ecuadorian Andes. Of these, at least five have lower upper altitudinal limits in Maquipucuna than elsewhere in Ecuador, possibly due to the Massenerhebung effect. Nine species represent Andean elements, while two species represent lowland elements. The species vary from abundant to very rare in the area. The palms provide edible fruits, palm heart, and leaves for Palm Sunday. The eleven species are described and a field key based on sterile characters is given.

RESUMEN

Once especies de palmas están presentes en altitudes entre los 1 000 m y 2 800 m en la reserva de Maquipucuna y áreas adyacentes en los Andes del Ecuador. De éstas, por lo menos cinco tienen, en Maquipucuna, límites altitudinales superiores más bajos que en el resto del Ecuador, posiblemente debido al efecto Massenerhebung. Nueve especies representan elementos andinos, mientras que dos especies representan elementos de bajas altitudes. Las especies varían entre abundante y muy rara en el área. Las palmas proveen frutos comestibles, palmito y hojas para Domingo de Ramos. Se proveen descripciones de las once especies y se incluye una clave de campo basada en caracteres vegetativos.

While the majority of neotropical palm species occur in tropical lowland rain forests, the Andean highlands above 1 000 m are home to ca. 14% of all neotropical palm species (Moraes et al. 1995). In this paper we present the palm flora of a montane forest in the Ecuadorian Andes.

The Maquipucuna montane forest reserve, Bosque Protector Maquipucuna, lies on the western slopes of the Andes, ca. 40 km northwest of the Ecuadorian capital, Quito. It is owned by Fundación Maquipucuna, a private environmental organization. Established in 1988, the reserve encompasses ca. 4 500 ha at altitudes from 1 200 to 2 800 m above sea level (Webster and Rhode, unpublished manuscript). Most of the protected area is covered by pristine forest, but in areas below 1 500 m the landscape is a mosaic of mature forest, secondary forest and scrub, and newly abandoned pastures. The natural vegetation includes lower montane rain forest below 2 500 m and upper montane rain forest above 2 500 m (Webster 1995). The vegetation above 1 500 m also qualifies as cloud forest, having a persistent cloud cover (Fig. 1) (Webster and Rhode, unpublished manuscript). The lower montane rain forest in the Maquipucuna reserve has a 25–30 m tall canopy. Characteristic features are the prominence of the canopy tree, *Otoba gordoniifolia* (DC.) Walp. (Myristicaceae) and the abundance of understory palms (Fig. 2). Above 1 800 m, the vegetation grades into upper montane forest, i.e., the forest is lower and temperate taxa are more prominent, while some tropical taxa, such as palms and *Otoba gordoniifolia*, disappear (Webster and Rhode, unpublished manuscript) (Fig. 3). The flora of the Maquipucuna reserve and adjacent areas includes 1160 species (Webster and Rhode, unpublished manuscript). No long-term climatic data exist for the Maquipucuna area, but two adjacent villages, Nanegal and Nanegalito, have annual precipitations of 3 000–3 500 mm; and the climate is seasonal, with a dry period from June/July through September/October (Sarmiento 1994). Mean annual temperature is estimated to be ca. 18°C at 1 200 m and ca. 10°C at the highest point, nearly 2 800 m above sea level (Webster and Rhode, unpublished manuscript).

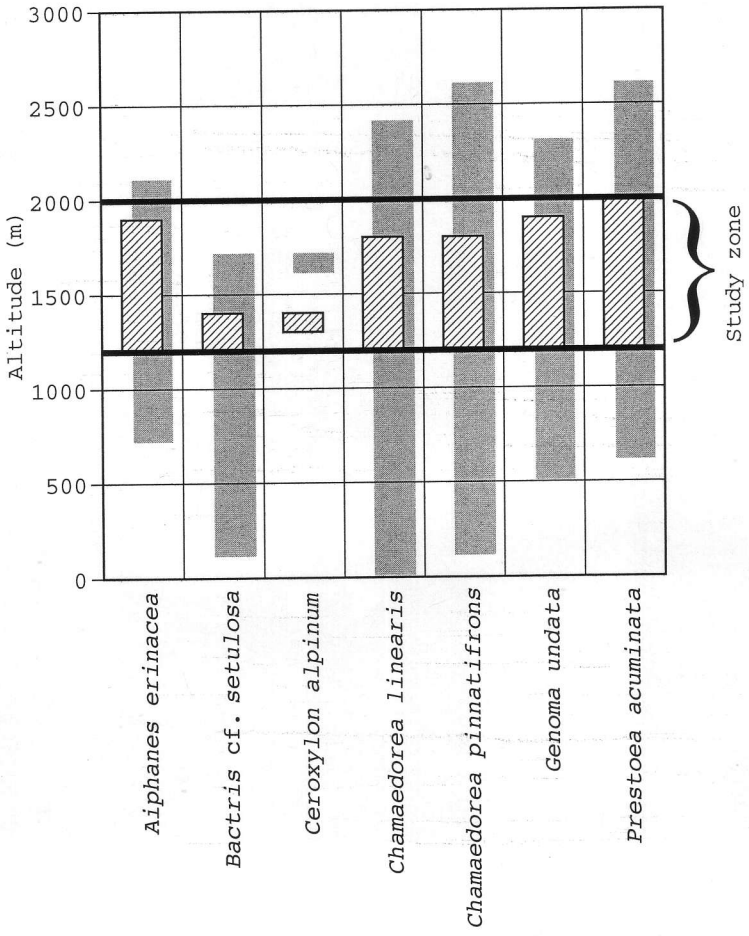
As part of our research on the ecology of Ecuadorian palms, one of us (J.-C. Svenning) studied the factors determining local scale distribution of palm species in the northwestern part of the reserve, near the Thomas Davis Scientific Station.

Within the reserve, we found eight species of palms (Table 1). Three additional species grow along the Río Alambi, just west of the Maquipucuna reserve (and above 1 000 m) (Table 1). Figure 3 shows the altitudinal distribution of palm species near the scientific station. It is interest-


1. Cloud forest with *Prestoea acuminata* near summit of Cerro Sosa. 2. *Aiphanes erinacea* in forest below the cloud forest zone.

ing to note that all the species found within the area, except *Prestoea acuminata* (not considering the very rare *Ceroxylon alpinum*) have upper altitudinal limits 200–1 000 m below those given for Ecuador by Borchsenius et al. (in press). This could be due to differences in the species' environmental requirements throughout their range or to environmental differences along the Ecuadorian Andes. Our study area is restricted to the two mountains, Cerro Sosa and Cerro Santa Lucia, and includes their summits at 1 900–1 950 m, which is much lower than the main mountain ranges of the Ecuadorian Andes (Fig. 3). The lower altitudinal boundaries might be due to a reverse *Massenerhebung* effect (the phenomenon whereby vegetation zones are found at lower elevations on lower mountains relative to taller mountains at otherwise similar sites) (Kappelle 1995).

When we compare the Maquipucuna palm species list to that of Andean palms (Moraes et al. 1995), it is obvious that the Maquipucuna palm flora is a typical Andean palm flora composed mainly of taxa centered in the Andes, but also including lowland taxa that rarely ascend to more than 1 500 m. *Ceroxylon* is endemic to the Andes, while *Aiphanes* is strongly Andean-centered. *Chamaedorea pinnatifrons* is widespread both in the lowlands and highlands of the western neotropics; *Chamaedorea linearis, Geonoma undata,* and *Prestoea acuminata* are widespread in the Andes; *Bactris* cf. *setulosa* and *Socratea rostrata* represent a premontane element, while *Oenocarpus bataua* and *Phytelephas aequatorialis* are distributed mainly in the tropical lowland (Henderson et al. 1995, Moraes et al. 1995).




3. Altitudinal distribution of the palm species near the Thomas Davis Scientific Station (striped) and in Ecuador (grey). The heavy lines indicate the altitudinal limits of our study area near the field station.

Our descriptions of the palm species from Maquipucuna focus on characteristics that are useful for identification in the field. We provide a key based on sterile characters (Table 2). Local names given in Table 1 are those used by the mestizo inhabitants of the area.

## Aiphanes chiribogensis *Borchs. & Balslev*

*Aiphances chiribogensis* Borchs. are solitary trees with male and female flowers on the same individual. The stem ≤3 m tall and 3–6 cm in diameter. Leaves are pinnately divided, with grouped leaflets that are narrowly wedge-shaped and jagged at the tip; the sheath is often violet inside. Inflorescence is often branched from the base, with pendulous flowering branches with a long sterile part near the base.

Although we did not observe *Aiphanes chiribogensis*, it has been collected within the reserve above the Río Pichan at 2 000 m (Webster and Rhode, unpublished manuscript). This species is endemic to the western slopes of the Ecuadorian Andes.

## Aiphanes erinacea *(H. Karst.) H. Wendl.*

These are clustering trees (Fig. 4) with male and female flowers on the same individual, often with >10 clustered stems, 2–6 m tall and 2.5–5 cm in diameter. Leaves are pinnately divided with grouped triangular leaflets with broad jagged tips and longitudinal folds; the underside of the blade is whitish. The inflorescence has a long stalk and numerous spreading flowering branches. Both stems, leaves, and inflorescence

*Table 1. Palm species occurring in the Maquipucuna zone. Systematic classification follows Uhl and Dransfield (1987), while scientific species names follow Borchsenius et al.* (in press).

| Subfamily | Tribe | Species | Common Name(s) |
|---|---|---|---|
| Ceroxyloideae | Ceroxyleae | *Ceroxylon alpinum* | Palma de ramo |
| | Hyophorbeae | *Chamaedorea linearis* | Chonta verde |
| | | *Chamaedorea pinnatifrons* | Molinillo |
| Arecoideae | Iriarteeae | *Socratea rostrata* | — |
| | Areceae | *Prestoea acuminata* | Palmito |
| | | *Oenocarpus bataua* | — |
| | Cocoeae | *Aiphanes chiribogensis* | — |
| | | *Aiphanes erinacea* | Chontilla |
| | | | Chonta |
| | | *Bactris* cf. *setulosa* | Chonta fina |
| | | | Chonta |
| | Geonomeae | *Geonoma undata* | Corozo |
| Phytelephantoideae | — | *Phytelephas aequatorialis* | Tagua |

stalks are strongly armed with numerous yellow spines. Seedlings are easily distinguished from other palm seedlings in the area by the combination of the whitish underside of the bifid leaf blade and the presence of small bristles at the blade margin.

This species is common near the scientific station. It often occurs in dense populations, probably because stems bent to the ground may establish a new cluster several meters away from the parent clump. Clonal reproduction appears to be more common than sexual reproduction; only a few seedlings were observed in spite of abundant fruiting.

**Bactris** *cf.* **setulosa** *H. Karst.* (Chonta fina, Chonta)

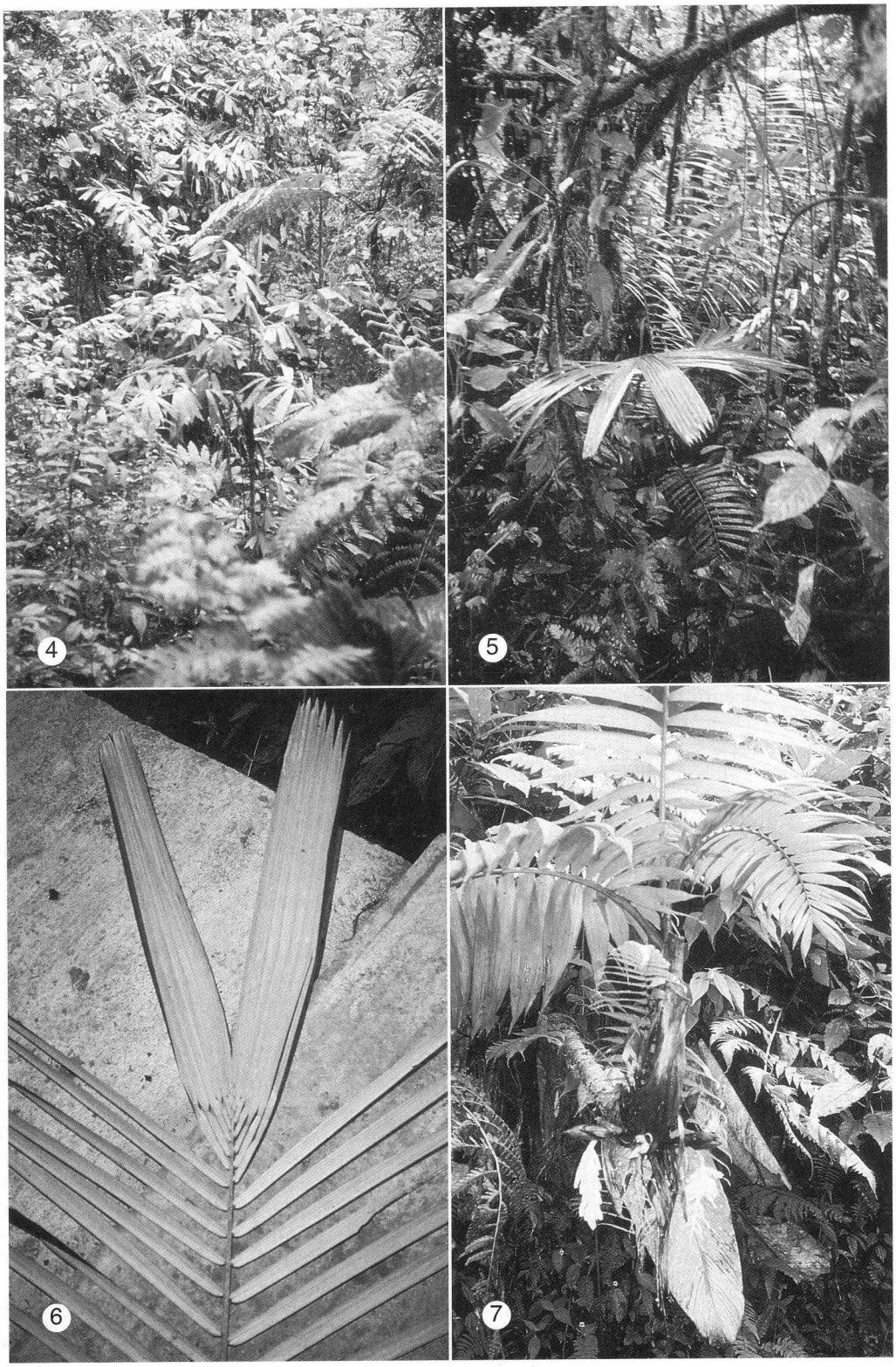
These are clustering trees with male and female flowers on the same individual. There are often 10 or more stems in a cluster, each one up to 10 m tall and 10–15 cm in diameter. Leaves are pinnately divided with many irregularly spaced linear leaflets that spread in different planes. Inflorescence is pendulous with numerous branches and a large, cowl-like bract. Stems, leaves, and inflorescences are strongly armed with numerous spines. Seedlings can be recognized by the combination of the green underside of the bifid leaf blade and by the presence of bristles at the blade margin.

We found only a few individuals of this species in the reserve, but it is common in forest remnants and pastures at slightly lower altitudes just outside the reserve. *Bactris* cf. *setulosa* is highly valued by the local population for its edible fruits. The local name, which loosely translated means "fine palm," refers to its utility. For this reason, it is often left when the forest is cleared for pasture, and there appears to be some interest in cultivating this species.

**Ceroxylon alpinum** *Bonpland* (Palma de ramo)

*Ceroxylon alpinum* are solitary trees (Fig. 5) with male and female flowers on different individuals. Stems are ≥20 m tall, ca. 20 cm in diameter, and are covered with a thin, waxy layer. Leaves are pinnately divided with many regularly spaced linear leaflets along the midrib which spread horizontally; their undersides have a thick, whitish tomentum, and the tips of the leaflets are asymmetrical. The apical leaflets are joined at the tip (Fig. 6). Seedlings are characterized by the whitish underside of the bifid leaf blade, the two halves of which are relatively short and broad, and by the absence of bristles along the blade margin.

The leaves of this species are highly valued and are used in religious processions on Palm Sunday (*Domingo de Ramos*), hence the local name "Palma de ramo." Several inhabitants have planted it for this use as well as its beauty. Within the area around the scientific station we found only a few seedlings and one juvenile of this species, but no adults. *Ceroxylon alpinum* appears to be rare or absent also in the neighboring areas. This near-absence is mysterious, because it is common elsewhere in the reserve at similar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5
6
7

altitudes. The survival of this species may be severely threatened by the disappearance of its natural habitat throughout its entire range (Ecuador, Colombia, Venezuela) due to deforestation (Henderson et al. 1995).

**Chamaedorea linearis** *(R. & P.) Mart.* (Chonta verde)

These are solitary trees (Fig. 7) with male and female flowers on different individuals. The stem is smooth and green, 2–10 m tall and 2–8 cm in diameter. The local name, which means "green palm," refers to the color of the stem. Leaves are pinnately divided and totally glabrous; leaflets are linear to somewhat sigmoid, spaced regularly along the midrib and spreading horizontally. There are usually >10 leaflets per side. There are several inflorescences per node. *Chamaedorea* seedlings have glabrous bifid leaves and are easily distinguished by their serrate leaf margins. We were not able to identify reliable characteristics that separate seedings of *Chamaedorea linearis* from those of *C. pinnatifrons*. *Chamaedorea linearis* is very common near the scientific station.

**Chamaedorea pinnatifrons** *(Jacq.) Oerst.* (Molinillo)

This is a solitary tree with male and female flowers on different individuals. The stem is smooth, green, 1.5–3 m tall, and 1–2 cm in diameter, often with abundant adventitious roots on the basal part. Leaves are pinnately divided and totally glabrous; leaflets are sigmoid, broad, spaced regularly along the midrib and spreading horizontally. There are not more than eight leaflets per side, and only a single inflorescence at each node. The seedlings are similar to those of *Chamaedorea linearis*.

*Chamaedorea pinnatifrons* is present but not common near the scientific station. The basal part of the stem with its numerous adventitious roots has been used by the local population for whipping food; thus the local name, which means "little mill."

**Geonoma undata** *Klotzsch* (Corozo)

*Geonoma undata* are solitary trees (Fig. 8) with male and female flowers on the same individual. Stems are light brown, 2–10 m tall, and 5–10 cm in diameter. Leaves are irregularly pinnately divided into broad leaflets of unequal sizes and the leaflets are spread in a horizontal plane. A brown covering is present on the petiole and midrib. The inflorescence is three or four times branched with somewhat swollen branches, with the flowers sunken into pits. Seedlings have bifid leaves in which all secondary veins, and both the inner and outer margin of each of the two leaf blade halves, bend outward away from the line of symmetry. This species is present, but not abundant, near the scientific station.

**Oenocarpus bataua** *Mart.*

This is a solitary tree with male and female flowers on the same individual. The stem is >20 m tall and 20–40 cm in diameter. Leaves are erect, giving the crown an obconical shape; they are very large (to 10 m long), regularly pinnately divided into many more or less pendulous leaflets. Leaflets are linear, with a long, slender, terminal point. Their undersurface is white; and leaf sheaths have abundant large, stiff, black fibers and smaller, softer, brown fibers. Inflorescence is distinctly like a horsetail, with a short peduncle and numerous close-together pendulous branches. Seedlings have a bifid leaf blade, the two halves of which are slender and long with a whitish underside, and lack bristles along the blade margin.

We have observed only a single, very tall individual of this species left in a deforested area at ca. 1200 m, close to a small village at the Río Alambi, between the larger villages of Nanegal and Nanegalito.

**Phytelephas aequatorialis** *Spruce* (Tagua)

The tagua is a solitary tree with male and female flowers on different individuals. The stem is usually a few meters tall but may reach 15 m in height; it is ca. 20 cm in diameter and rough from the persistent leaf sheaths. Leaves are 6–8 m long, regularly pinnately divided into numerous linear leaflets; the leaflets are usually placed in clusters, spreading in different planes. Male inflorescences are 1–2.5 m long, pendulous, slender, cylindrical, and yellow. The infructescence is a round head, ca. 30 cm in diameter, of large fruits covered with woody, warty projections. Seedling leaves are pinnately divided, which is

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4. *Aiphanes erinacea* dominating the understory. 5. The single juvenile *Ceroxylon alpinum* found during our survey. 6. Apex of a juvenile *Ceroxylon alpinum* leaf. 7. An adult *Chamaedorea linearis* with a very bent stem.

8. *Geonoma undata* and *Aiphanes erinacea* left in a pasture. 9. Tall individuals of *Prestoea acuminata*.

unique among the palm species of the Maquipucuna zone.

This palm is quite common in the Río Alambi valley at 1100–1300 m, but it does not occur near the scientific station. Its seeds have an extremely hard, white endosperm, the so-called "vegetable ivory." In Ecuador, vegetable ivory is called *tagua,* hence the local name. As this material can be used for handicraft, there is some local interest in cultivating the palm. Fundación Maquipucuna has a program to integrate native plant species in the local agriculture, and this is one of the species included in this project.

**Prestoea acuminata** *(Willd.) H. E. Moore* (Palmito)

These are clustering trees (Fig. 9) with male and female flowers on the same individual and >10 stems in a cluster. Stems are 3–10 m or more tall and usually ca. 10 cm in diameter. Leaves are pinnately divided into numerous slender linear leaflets, each terminating in a long slender point; the leaf sheaths are partially closed and form a prominent tubular crownshaft below the crown. The crownshaft is sometimes purple; there is a reddish-brown tomentum on the petiole. The peduncle is much shorter than the main axis of the inflorescence. Seedlings have bifid leaves in which the outer secondary veins and the outer margins bend outwards, while the inner (towards the plane of symmetry) secondary veins and the inner margins bend inwards. The tomentum on the petiole is obvious even in the seedlings.

*Prestoea acuminata* is abundant near the scientific station and is highly valued by the local population as a source of palm heart, which is the edible young apical meristem. For this reason, there is some local interest in cultivating this species. Cultivation would probably not be too difficult, as the palm appears to grow well in open places. Seedlings were abundant close to

*Table 2. Key to stemmed individuals of the palm species of the Maquipucuna zone.*

| | | |
|---|---|---|
| 1. | Spines on stem or leaf or at least small dark bristles at the blade margin. | → 2 |
| 1. | No such spines or bristles. | → 4 |
| 2. | Leaflets wedge-shaped with a jagged tip; stem <6 cm in diameter. | → 3 |
| 2. | Leaflets linear, with a regular, slender tip; stem usually 10–15 cm in diameter | *Bactris* cf. *setulosa* |
| 3. | Sheath and petiole with yellow spines; stems usually clustered. | *Aiphanes erinacea* |
| 3. | Sheath and petiole with black spines, and stems always solitary. | *Aiphanes chiribogensis* |
| 4. | Stem ≥15 cm in diameter. | → 5 |
| 4. | Stem <10 cm in diameter. | → 8 |
| 5. | Stem with a basal cone of thick stilt roots; leaf sheaths forming a conspicuous crownshaft. | *Socratea rostrata* |
| 5. | Stem without thick stilt roots, but may have numerous slender adventitious roots; crownshaft absent. | → 6 |
| 6. | Stem rough from persistent leaf sheaths and the underside of leaflets green. | *Phytelephas aequatorialis* |
| 6. | Stem smooth; underside of the leaflets whitish. | → 7 |
| 7. | Stem with a waxy covering; leaflets with an asymmetrical tip not terminating in a slender point; leaf sheath glabrous. | *Ceroxylon alpinum* |
| 7. | Stem without a waxy covering; leaflets with a symmetrical tip terminating in slender point; leaf sheaths with abundant long stiff black fibers and short soft brown fibers. | *Oenocarpus bataua* |
| 8. | Leaves irregularly divided into broad segments of unequal sizes and the trunk brown, not green. | *Geonoma undata* |
| 8. | Leaves regularly divided into rather slender leaflets, and the trunk green or brown. | → 9 |
| 9. | Leaflets terminating in a long thread-like point; trunk usually brown but sometimes green, usually ~10 cm in diameter. | *Prestoea acuminata* |
| 9. | Leaflets not terminating in a slender point; trunk always green, <8 cm in diameter. | → 10 |
| 10. | Stem 1–2 cm in diemater, leaflets broad and sigmoid; ≤ eight per side. | *Chamaedorea pinnatifrons* |
| 10. | Stem 2–8 cm in diameter, leaflets linear to somewhat sigmoid; >10 per side. | *Chamaedorea linearis* |

adult stems in an abandoned home garden. The clonal nature of the palm facilitates its cultivation, because clumps will not be killed by harvesting one or a few of the stems. It is also promising that there is a national and even international market for *Prestoea acuminata* palm hearts (Balslev and Henderson 1987). The vernacular name *palmito* is the Spanish word for palm heart.

## Socratea rostrata *Spruce*

*S. rostrata* are solitary trees with male and female flowers on the same individual. The stem is <25 m tall and 15–30 cm in diameter. The tree is supported by a cone of thick stilt roots, which is unique among the palm species at Maquipucuna.

The leaves are 1.5–3.5 m long and rather short compared to the height of the plant, and regularly pinnately divided. Each leaflet is longitudinally split into 2–10 unequal segments spreading in different planes, which gives the leaf a bushy appearance. The leaflet segments are often golden-brown below; leaf sheaths are closed and form a conspicuous crownshaft. Inflorescence has a rather short stalk and pendulous branches; as the branches are more loosely placed than in *Oenocarpus bataua,* the inflorescence is not horsetail-like. Seedlings are unique in the area by having bifid leaves with a jagged outer margin.

The palm is quite common in the Río Alambi valley at 1 100–1 300 m, sometimes nearly dominating the remnant forest patches.

## Acknowledgments

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## PALM LITERATURE *(Continued from p. 217)*

Riffle believes that the tropical look has an "irresistible appeal," is achievable far away from the tropical climates, and is underutilized by gardeners outside zones 10 and 11. As he aptly describes this type of gardening, "it is the stuff dreams are made of." Riffle defines the tropical look as "all plants with relatively large or boldly shaped foliage and flowers, and all plants with colored or variegated leaves and large and spectacular flowers or flower clusters." A true tropical plant will not tolerate any frost. Thankfully, many of the 2,000 plants and 400 color photos in this book are not tropical in the true sense of the word.

The author includes plants based on a criterion of "tropical looking landscape subjects whose appeal is of at least a reasonably permanent status." Palm trees, of course, are the quintessence of the tropical look, and 57 varieties of palms are included in the book. The palms which are susceptible to lethal yellowing are identified, and cycads, which many people mistakenly believe to be palms, are also included.

Aside from finding information on almost every plant my husband grows in his garden, my reasons for liking this book are many. A pronouncer guide is provided to help overcome those verbal stumbling blocks when referring to plants by their botanical name. A foreword emphasizes the importance of botanical names, and I appreciate the helping hand in integrating these important references into my daily vocabulary. A list of common names is provided only in the index, so a person looking for "Canary Island date palm" will be at a disadvantage until such time that the botanical name of *Phoenix canariensis* is the first one that comes to mind.

Each plant listed has a quick reference guide and a detailed description. The quick reference includes a brief description of the plant's appearance, its zone rating, sun and water preferences, soil requirements, and methods of propagation. The author describes plants in ways that make them sound like his personal friends. Phrases such as "spectacularly beautiful," "gracefulness of form," and even "checkered

*(Continued on p. 228)*