



Revista Peruana de Biología

ISSN: 1561-0837

Iromeroc@unmsm.edu.pe

Universidad Nacional Mayor de San Marcos  
Perú

Kahn, Francis

The genus *Astrocaryum* (Arecaceae)

Revista Peruana de Biología, vol. 15, núm. 1, noviembre, 2008, pp. 29-46

Universidad Nacional Mayor de San Marcos

Lima, Perú

Available in: <http://www.redalyc.org/articulo.oa?id=195020250004>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative

## The genus *Astrocaryum* (Arecaceae)

### El género *Astrocaryum* (Arecaceae)

Francis Kahn

IRD, UMR-DIAPC, Casilla 18-  
1209, Lima – Peru. Email: francis.  
kahn@ird.fr

#### Abstract

The palm genus *Astrocaryum* with 40 species is common in tropical South America extending northwards reaching Central America and Trinidad. Twenty-six species grow in Brazil, 14 in Peru, 11 in Colombia, 9 in Guyana, 9 in Suriname, 8 in Bolivia, 8 in French Guiana, 6 in Venezuela, 4 in Ecuador, 2 in Costa Rica, 2 in Panama, and 1 in Trinidad. The genus includes solitary or caespitose species in the following classes: (i) large palms with tall stem, (ii) palms with large leaves and medium-sized, or short, or subterranean stem, (iii) slender to medium-sized palms, (iv) acaulescent palms with very short leaves. Although most *Astrocaryum* species are used by humans, only a few may have promising economic potential and are significantly important in the local and regional trade. In this article, I propose a new taxonomic classification based on characters of the fruit, flowers and vegetative parts. The genus is divided in three subgenera: (i) *Munbaca* with two sections, *Munbaca* and *Mumbacusu*, each with 2 species; (ii) *Astrocaryum* with two sections, *Euchambira* (new section with 1 species) and *Astrocaryum* with three subsections — *Astrocaryum* (9 species), *Acaulia* (5 species) and *Perstaminata* (new subsection with 1 species); (iii) *Monogynanthus* with four sections: *Monogynanthus* (with 3 species), *Ayri* (1 species), *Guatinajo* (new section with 1 species) and *Huicungo* (new section) that includes three subsections — *Huicungo* (7 species); *Sachacungo* (new subsection with 5 species), and *Murumuru* (3 species). A synoptic review of the genus is presented herein, including descriptions and illustrations as well as data on distribution, habit, ecology and common names for each species. An identification key to all species is also supplied.

**Keywords:** *Astrocaryum*, Arecaceae, taxonomy, distribution, ecology, uses, economic potential.

Trabajo presentado al Simposio Internacional "LAS PALMERAS EN EL MARCO DE LA INVESTIGACIÓN PARA EL DESARROLLO EN AMÉRICA DEL SUR", del 07 al 09 de Noviembre 2007, Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Perú.

#### Resumen

El género *Astrocaryum* con 40 especies es común en las regiones intertropicales de América del Sur y se extiende al norte hasta América central y Trinidad. Son 26 las especies que crecen en Brasil, 14 se encuentran en Perú, 11 en Colombia, 9 en Guyana, 9 en Suriname, 8 en Bolivia, 8 en Guayana francesa, 6 en Venezuela, 4 en Ecuador, 2 en Costa Rica y Panamá, 1 en Trinidad. El género produce palmeras solitarias o cespitosas en las siguientes categorías: (i) palmeras grandes de tallo alto, (ii) palmeras de hojas largas y de tallo mediano o corto o subterráneo, (iii) palmeras delgadas a medianas, (iv) palmeras acaulescentes de hojas cortas. La mayoría de las especies son utilizadas por los pobladores de las zonas rurales; sin embargo pocas son las que tienen importancia en los mercados locales y regionales. Se propone aquí una nueva clasificación del género *Astrocaryum* en tres subgéneros, basada en los caracteres del fruto, de las flores y de las partes vegetativas: (i) *Munbaca* con dos secciones, *Munbaca* y *Mumbacusu*, cada una con 2 especies; (ii) *Astrocaryum* con 2 secciones, *Euchambira* (sección nueva con 1 especie) y *Astrocaryum* con tres subsecciones — *Astrocaryum* (9 especies), *Acaulia* (5 especies) y *Perstaminata* (subsección nueva con 1 especie); (iii) *Monogynanthus* con cuatro secciones: *Monogynanthus* (con 3 especies), *Ayri* (1 especie), *Guatinajo* (sección nueva con 1 especie), y *Huicungo* (sección nueva) que incluye tres subsecciones — *Huicungo* (7 especies), *Sachacungo* (subsección nueva con 5 especies) y *Murumuru* (3 especies). Se presenta una tabla sinóptica del género con las referencias de las descripciones e ilustraciones de cada una de las especies, datos sobre su distribución geográfica, forma de vida y ecología, y los nombres vernáculos más comunes. Una clave de identificación de las especies es presentada.

**Palabras clave:** *Astrocaryum*, Arecaceae, taxonomía, distribución, ecología, usos, potencial económico.

Publicado online: 29/11/2008

#### Introduction

The palm genus *Astrocaryum* (*Arecoideae: Cocoseae: Bactridinae*, Uhl and Dransfield, 1987; Dransfield et al., 2005) is commonly found in most tropical ecosystems of South America and in Pacific and Atlantic forests of Central America. It encompasses many life forms, from large palms in the forest canopy to small acaulescent palms hidden in semi-arid shrubby vegetation. Fruits of several species are edible and fiber is extracted from leaves of other species. Moreover all *Astrocaryum* species are heavily armed with long spines. For all these reasons, these palms cannot escape the eye of the naturalist who traverses South and Central America.

In 1980 it was almost impossible to identify most *Astrocaryum* species. Existing collections did not provide useful information. Several type specimens were destroyed in the Berlin herbarium during World War II, and Barbosa Rodrigues' collection had disappeared, probably in a domestic fire (Glassman, 1972). The absence of types was offset, in part, by the excellent descriptions and illustrations published by Martius (1874, 1844)

revised the genus and described several new species but did not provide any illustrations. Wessels Boer (1965) treated the indigenous species of Suriname. Granville (1989) described and discussed the distribution of French Guianan species. Several taxa, considered varieties in Henderson (1995) and Henderson et al. (1995), are maintained as valid species in Govaerts and Dransfield (2005).

We have revisited the type localities and collected new material. Once differential characters were identified, we checked their relevance throughout the area of distribution of the species. This fieldwork was the basis for the identification keys. We added to the knowledge of the species and supplemented the description of many of them, re-validating several or justifying synonymy (Kahn, 2001a,b, 2003; Kahn and Granville, 1998; Kahn and Gluchy, 2002). Eight new species have been described. These include two from Colombia, two from Brazil and four from Peru (Galeano-Garcés et al., 1988; Kahn and Millán, 1992; Kahn and Ferreira, 1995). The species of the dry zones of Brazil are still not completely understood and must be

A new infrageneric classification of *Astrocaryum* is presented. The genus is divided in three subgenera. Several new sections and subsections are described. A key to species is given.

### General data

**Number of species and distribution area** — The genus *Astrocaryum* is composed of 40 species distributed in 12 countries (Table 1). It is well represented in Brazil, Peru, Colombia and in the Guianas with 26, 14, 11 and 10 species, respectively. Eight species are endemic to Brazil, 4 to Colombia, and 4 to Peru. Detailed distribution for each species is given under sections and subsections, and recapitulated in Table 2.

**Habit and Ecology** — Species of *Astrocaryum* produce solitary or caespitose palms in the following classes (quantitative categories are given in Table 2): (i) large palms with tall stem, (ii) palms with large leaves and medium-sized stem, or short stem, or subterranean stem (considered “acaulescent”), (iii) slender to medium-sized palms, (iv) small, acaulescent palms with short leaves.

Palms of the genus *Astrocaryum* are found in all parts of the Amazon basin. They commonly form dense stands in riparian or swampy forests, as well as in terra firme forests on well-drained

clayey soils, fluvial terraces or on sandy soils; some species are also found in savannas located inside the basin or at its periphery in drier condition. Most of those forest species usually tolerate open areas very well (Kahn and Granville, 1992; Jardim and Stewart, 1994). Several species are limited to the eastern valleys of the Andes under Amazonian influence; they do not grow above 1000 m elevation, except *A. faranae* collected from 130 m in Amazonian lowlands (Rio Moa, Acre, Brazil) to 1650 m in the eastern cordillera of central Peru. Outside the Amazon basin, *Astrocaryum* species are found in tropical Pacific or Atlantic rain forests and savannas. The species of subsection *Acaulia* grow in semi-arid cerrado-vegetation in Brazil. Studies on population dynamics and dispersal have been made in *Astrocaryum jauari* (Piedade, 1984), *A. standleyanum* (Smythe, 1989; Hoch and Adler, 1997), *A. sciophilum* (Sist, 1989a,b; Charles-Dominique et al., 2003), *A. paramaca* (Forget, 1991), *A. aculeatum* (Nascimento et al., 1997), *A. aculeatissimum* (Galetti et al., 2006), and *Astrocaryum* spp. (as *A. murumuru*, Cintra, 1997; Cintra and Horna, 1997; Beck and Terborgh, 2002). Leaf production was measured in *Astrocaryum paramaca* and *A. sciophilum* in the Kabo and Mapane regions of Suriname (Steege, 1983); Granville (1977) described the trapping system of dead leaves by the funnel-shaped crown of these two palms, and Gasc (1986)

**Table 1.** Distribution of *Astrocaryum* species by country, <sup>(e)</sup>: endemic species.

Country	Species
Bolivia (8 species)	<i>Astrocaryum aculeatum</i> , <i>A. campestre</i> , <i>A. chonta</i> , <i>A. gratum</i> , <i>A. gynacanthum</i> , <i>A. huaimi</i> , <i>A. jauari</i> , <i>A. ulei</i> .
Brazil (26 species)	<i>Astrocaryum acaule</i> , <i>A. aculeatum</i> , <i>A. aculeatissimum</i> <sup>(e)</sup> , <i>A. arenarium</i> <sup>(e)</sup> , <i>A. campestre</i> , <i>A. chambira</i> , <i>A. echinatum</i> <sup>(e)</sup> , <i>A. faranae</i> , <i>A. farinosum</i> , <i>A. ferrugineum</i> , <i>A. giganteum</i> <sup>(e)</sup> , <i>A. gynacanthum</i> , <i>A. huaimi</i> , <i>A. jauari</i> , <i>A. jaoarensis</i> , <i>A. kewense</i> <sup>(e)</sup> , <i>A. minus</i> , <i>A. murumuru</i> , <i>A. paramaca</i> , <i>A. pygmaeum</i> <sup>(e)</sup> , <i>A. rodriguesii</i> , <i>A. sociale</i> <sup>(e)</sup> , <i>A. sciophilum</i> , <i>A. ulei</i> , <i>A. vulgare</i> , <i>A. weddellii</i> <sup>(e)</sup> .
Colombia (11 species)	<i>Astrocaryum acaule</i> , <i>A. ciliatum</i> <sup>(e)</sup> , <i>A. chambira</i> , <i>A. cuatrecasatum</i> <sup>(e)</sup> , <i>A. ferrugineum</i> , <i>A. gynacanthum</i> , <i>A. malybo</i> <sup>(e)</sup> , <i>A. macrocalyx</i> , <i>A. standleyanum</i> , <i>A. triandrum</i> <sup>(e)</sup> , <i>A. urostachys</i> .
Costa Rica (2 species)	<i>Astrocaryum confertum</i> , <i>A. standleyanum</i> .
Ecuador (4 species)	<i>Astrocaryum chambira</i> , <i>A. jauari</i> , <i>A. standleyanum</i> , <i>A. urostachys</i> .
French Guiana (8 species)	<i>Astrocaryum gynacanthum</i> , <i>A. jauari</i> , <i>A. minus</i> , <i>A. murumuru</i> , <i>A. paramaca</i> , <i>A. rodriguesii</i> , <i>A. sciophilum</i> , <i>A. vulgare</i> .
Guyana (9 species)	<i>Astrocaryum aculeatum</i> , <i>A. farinosum</i> , <i>A. gynacanthum</i> , <i>A. jauari</i> , <i>A. murumuru</i> , <i>A. paramaca</i> , <i>A. rodriguesii</i> , <i>A. sciophilum</i> , <i>A. vulgare</i> .
Suriname (9 species)	<i>Astrocaryum aculeatum</i> , <i>A. farinosum</i> , <i>A. gynacanthum</i> , <i>A. jauari</i> , <i>A. murumuru</i> , <i>A. paramaca</i> , <i>A. rodriguesii</i> , <i>A. sciophilum</i> , <i>A. vulgare</i> .
Panama (2 species)	<i>Astrocaryum confertum</i> , <i>A. standleyanum</i> .
Peru (14 species)	<i>Astrocaryum carnosum</i> <sup>(e)</sup> , <i>A. chambira</i> , <i>A. chonta</i> , <i>A. faranae</i> , <i>A. gratum</i> , <i>A. gynacanthum</i> , <i>A. huaimi</i> , <i>A. huicungo</i> <sup>(e)</sup> , <i>A. jauari</i> , <i>A. jaoarensis</i> , <i>A. macrocalyx</i> , <i>A. perangustatum</i> <sup>(e)</sup> , <i>A. scopatum</i> <sup>(e)</sup> , <i>A. urostachys</i> .
Trinidad (1 species)	<i>Astrocaryum aculeatum</i> .
Venezuela (6 species)	

**Table 2.** Synopsis of the genus *Astrocaryum*. LITERATURE CITED: the list includes most descriptions with illustrations of the species. DISTRIBUTION: North and south regions of the Amazon basin are defined by referring to the Amazon and Marañón rivers; from the Andes to Atlantic coast, the basin is approximately divided into three longitudinal parts that correspond to west, central and east regions, respectively. HABIT: **solitary or caespitose** — (i) **large palms** (stem up to 35 m long, up to 40 cm in diameter); (ii) **large-leafed** (4 to 8 m long), **stemmed** (up to 15 m long, rarely more, up to 30 cm in diameter, usually 15–25 cm), or **short-stemmed** (up to 3–4 m long) or **subcaulescent** (stem up to 1 m long, entirely covered with the sheaths of dead leaves), or **“acaulescent”** (the palm does not produce any stem above ground; leaf sheaths and parts of petioles and peduncles are in the soil); (iii) **slender to medium-sized palms** (stem up to 12 m long, up to 15 cm in diameter, leaves about 2.5–3 m long); and (iv) small, **short-leafed** (up to 2 m long), **acaulescent** palms. A caespitose species can produce either multistemmed individual palms or single stemmed individual palms with new branching basally, or single stemmed individual palms without branching basally; the character caespitose will be verified by observing several individual palms in the population. COMMON NAMES (Martius, 1844; Barbosa Rodrigues, 1903; Bailey, 1933; Burret, 1934; Dugand, 1940a; Wessels Boer, 1965; Glassman, 1972; Boom, 1988; De Nevers et al. 1988; Galeano-Garcés et al. 1988; Kahn and Granville, 1991; Kahn and Millán, 1992; Henderson et al. 1995; Borchsenius et al. 1998; Moraes, 2004).

## 1. SUBGENUS *ASTROCARYUM*

### 1.1. SECTION *ASTROCARYUM*

#### 1.1.1. SUBSECTION *ASTROCARYUM*

*Astrocaryum acaule* Mart. (1824:78, t. 24, 63 fig. 5); Wallace (1853, t. 44); Dahlgren (1959, t. 10–11); Kahn and Millán (1992, figs. 1–2); Henderson (1995, fig. 6.54a–b); Lorenzi et al. (1996:42); Kahn (1997:178); Stauffer (2000:169–170); Miranda et al. (2001, figs. 3–5); Miranda and Rabelo (2006, figs. 13 a–i).

Distribution: north central region of the Amazon basin — Brazil (Amazonas, Roraima), Colombia, Venezuela.

Habit: solitary, large-leafed, acaulescent palms.

Ecology: swampy forest, on sandy soils.

Common names: tucumã-í (Brazil).

*Astrocaryum aculeatum* G. Mey. (cons. name) — Martius (1824:77, t. 65 fig. 2); Wallace (1853, t. 2 fig. 5, t. 41); Wessels Boer (1965, t. 11); Kahn and Millán (1992, figs. 3–7); Moussa et al. (1994:67); Henderson (1995, fig. 6.54c–d); Lorenzi (1996:44); Kahn (1997:177); Kahn and Moussa (1999, figs. 1–3); Stauffer (2000:170); Miranda et al. (2001, figs. 6–9); Moraes (2004: fig. 4); Miranda and Rabelo (2006, figs. 14 a–l).

Distribution: central region of the Amazon basin, from south to north — Bolivia (Beni, Pando, Santa Cruz), Brazil (Acre, Amazonas, Pará, Rondônia, Roraima), Guyana, Suriname, Trinidad, Venezuela.

Habit: solitary, large palms.

Ecology: terra firme forest, secondary vegetation.

Common names: chonta, tucumo, panima (Bolivia); tucumã, tucumã-arara, tucumã-piranga, tucumã-piririca, tucumã-uassu-rana, tucum-assu, tucum-bravo, tucum-da-serra, tucum-do-matto, tucum-purupuru (Brazil); akuyuro palm, cuyuru-palm, tucumou (Guyana); amana, toekoemau, warau (Suriname); cumare, yavaide (Venezuela).

*Astrocaryum confertum* H. Wendl. ex Burret (1934:136); De Nevers et al. (1988, figs. 1–4).

Distribution: Atlantic slope — Costa Rica, Panama.

Habit: solitary, large palms.

Ecology: terra firme forest.

Common names: coyolillo, coyolito, pejibaye-de-montana, zurubre (Costa Rica); pina-pina (Panama).

*Astrocaryum echinatum* Barb. Rodr. (1898:51, t. 17; 1903, t. 70).

Distribution: central Brazil (Goiás, Matto Grosso).

Habit: solitary, slender palms.

Ecology: dry forest, savanna.

Common names: tucum-do-campo, tucum-vermelho (Brazil).

*Astrocaryum giganteum* Barb. Rodr. (1902:82, t. 10C; 1903, t. 65, 67B).

Distribution: east region of the Amazon basin — Brazil (Pará).

Habit: solitary, large-leafed, subcaulescent to short-stemmed palms.

Ecology: riparian forest.

Common names: tucumã-í-da-vargem (Brazil).

*Astrocaryum huaini* Mart. (1844:86, t. 13 fig. 3, t. 30A); Henderson (1995: fig. 6.54j–k); Lorenzi et al. (1996:49); Moraes (2004: fig. 7).

Distribution: west and central parts of the southern periphery of the Amazon basin — Bolivia (La Paz, Santa Cruz), Brazil (Matto Grosso), Peru (Madre de Dios).

Habit: caespitose, slender to medium-sized palms.

Ecology: dry forest.

Common names: chontilla, chonta, huaimi-tococa (Bolivia).

*Astrocaryum jauari* Mart. (1824:76, t. 52, 65 fig. 1); Wallace (1853, t. 42); Barbosa Rodrigues (1903, t. 1, 67C); Kahn and Millán (1992, figs. 13–14); Moussa et al. (1994:70); Henderson (1995, fig. 6.56a–b); Henderson et al. (1995: t. 53); Lorenzi et al. (1996:50); Kahn (1997:178); Borchsenius et al. (1998, t. 3D); Stauffer (2000:172); Miranda et al. (2001, figs. 16–19); Moraes (2004:255, fig. 8); Pintaud et al. (2008, figs. 1, 3F).

Distribution: throughout the Amazon basin, found in a few places in the Guianas, collected once in Bolivia (Beni) — Bolivia, Brazil, Colombia, Ecuador, Peru, French Guiana, Guyana, Suriname, Venezuela.

Habit: caespitose, large palms.

Ecology: riparian forest.

Common names: jauari (Brazil); alvarico, guara, yuari, yavari (Colombia); chambillira, huiririma (Ecuador); sawarai (Guyana); huiririma (Peru); liba-awarra, soela-awarra (Suriname), alvarico (Venezuela).

*Astrocaryum standleyanum* L.H. Bailey (1933:88, figs. 67–70); Henderson et al. (1995: t. 54); Borchsenius et al. (1998, t. 3 A–B).

Distribution: Pacific slope — Costa Rica, Colombia, Ecuador, Panama.

Habit: solitary, large palms.

Ecology: terra firme forest.

Common names: guinol, mocora (Ecuador); black palm, chonta, chungá (Panama).

**Table 2.** Synopsis of the genus *Astrocaryum*. (...Continuation)

*Astrocaryum vulgare* Mart. (1924:74, t. 62–63); Dugand (1940b, fig. 12); Dahlgren (1959, t. 24–25); Lima et al. (1986, figs. 3–9); Kahn and Granville (1992, fig. 46); Kahn and Millán (1992, figs. 15–16); Henderson (1995, fig. 6.56i–j); Lorenzi et al. (1996:55); Kahn (1997:178); Miranda et al. (2001, figs. 28–31).  
 Distribution: east region of the Amazon basin and south periphery – Brazil (Amapá, Goiás, Maranhão, Pará, Piauí, Tocantins), French Guiana, Guyana, Suriname.  
 Habit: caespitose, medium-sized to large palms.  
 Ecology: secondary vegetation, savanna, forest on sandy coastal ridges, forest on top of some granite outcrops.  
 Common names: tucumã, tucum-bravo (Brazil); aouara (French Guiana); cumare (Colombia); awarra (Suriname); cumare (Venezuela).

**1.1.2. SUBSECTION ACAULIA DRUDE**

*Astrocaryum arenarium* Barb. Rodr. (1898:53, t. 18; 1903, t. 69A).

Distribution: central Brazil (Matto Grosso).

Habit: solitary, short-leafed, acaulescent palms.

Ecology: semi-arid vegetation.

Common names: tucum-rasteiro, tucum-liso-do-campo (Brazil).

*Astrocaryum campestre* Mart. (1824:79, t. 63 fig. 4, t. 64); Dahlgren (1959, t. 14); Lorenzi et al. (1996:45); Moraes (2004: fig. 5).

Distribution: Bolivia (Santa Cruz), central Brazil (Goiás, Minas Gerais).

Habit: caespitose (?), short-leafed, acaulescent palms.

Ecology: semi-arid vegetation.

Common names: javirá (Brazil).

*Astrocaryum kewense* Barb. Rodr. (1903:70, t. 74).

Distribution: central Brazil (Goiás).

Habit: solitary, short-leafed, acaulescent palms.

Ecology: semi-arid vegetation.

Common names: tucum-da-chapada, tucum-rasteiro (Brazil).

*Astrocaryum pygmaeum* Drude (1881:384, t. 83 fig. 2).

Distribution: central Brazil (Goiás).

Habit: solitary, short-leafed, acaulescent palms.

Ecology: semi-arid vegetation.

Common names: not reported.

*Astrocaryum weddellii* Drude (1881:383, t. 83 fig. 1).

Distribution: central Brazil (Goiás).

Habit: solitary, short-leafed, acaulescent palms.

Ecology: semi-arid vegetation.

Common names: tucum-rasteiro (Brazil).

**1.1.3. SUBSECTION PERSTAMINATA F. KAHN**

*Astrocaryum malybo* H. Karst. (1857:245; 1861, t. 83).

Distribution: Magdalena, Cauca and Sinu river valleys – Colombia.

Habit: solitary, large-leafed, acaulescent palms.

Ecology: terra firme forest.

Common names: bobil, chingalé, malibo, palma estera (Colombia).

**1. 2. SECTION EUCHAMBIRA F. KAHN**

*Astrocaryum chambira* Burret (1934:122); Dugand (1955, figs. A–B); Kahn and Granville (1992, fig. 4); Kahn and Millán (1992, figs. 8–12);

Henderson (1995, fig. 6.54e–f); Henderson et al. (1995: t. 52); Lorenzi et al. (1996:46); Kahn (1997:82, 177); Borchsenius et al. (1998, t. 3E).

Distribution: west region of the Amazon basin – Brazil (Acre, Amazonas), Colombia, Ecuador, Peru, Venezuela.

Habit: solitary, large palms.

Ecology: forest on alluvial terraces.

Common names: corombolo, palma-coco (Colombia); chambira, coco (Ecuador); chambira (Peru).

**2. SUBGENUS MUNBACA DRUDE****2.1. SECTION MUNBACA**

*Astrocaryum gynacanthum* Mart. (1824:73, t. 60–61); Drude (1881, t. 82 fig. 2); Dahlgren (1959, t. 17); Kahn and Granville (1992, fig. 36);

Kahn and Millán (1992, figs. 17–19); Moussa et al. (1994:69); Henderson (1995, fig. 6.54g–i); Henderson et al. (1995: t. 52–53); Granville

(1997, figs. 85F–J); Lorenzi et al. (1996:48); Kahn (1997:179); Stauffer (2000:171); Miranda et al. (2001, figs. 12–15); Moraes (2004: fig. 6);

Miranda and Rabelo (2006, figs. 15 a–m).

Distribution: throughout the Amazon basin and the Guianas, found in lower frequency in the northwest region – Bolivia (Pando), Brazil (Acre, Amapá, Amazonas, Pará, Rondônia, Roraima), Colombia, French Guiana, Guyana, Peru, Suriname, Venezuela.

Habit: caespitose, slender palms.

Ecology: terra firme forest.

Common names: munbaca, marajá-assu, marajá-da-terra-firme (Brazil); coco-de-puerco (Colombia); ti-ouara (French Guiana); pakiramaka (Surinam); cubarro (Venezuela).

*Astrocaryum minus* Trail (1877:78); Drude (1881, t. 81 fig. 3); Kahn and Millán (1992, fig. 20); Kahn and Granville (1998, figs. 1–4).

Distribution: Amazon basin, known from Brazil (Jutahy river) and French Guiana (near Cayenne).

Habit: solitary, slender to medium-sized palms.

Ecology: terra firme forest.

Common names: not reported.

**Table 2.** Synopsis of the genus *Astrocaryum*. (...Continuation)**2.2. SECTION MUMBACUSU** (BARB. RODR.) F. KAHN

*Astrocaryum paramaca* Mart. (1844:88); Bailey (1949, fig. 57–58); Dahlgren (1959, t. 22); Wessels Boer (1965, fig. 7); Kahn and Granville (1992, figs. 19, 33); Kahn and Millán (1992, figs. 20–21); Henderson (1995, fig. 6.56e–f); Lorenzi et al. (1996:52); Granville (1997, figs. 85A–E).

Distribution: northeast region of the Amazon basin, Guianas – Brazil (Amapá, Pará), French Guiana, Guyana, Suriname.

Habit: solitary, large-leafed, acaulescent palms.

Ecology: terra firme forest.

Common names: murumuru-í-da-terra-firme (Brazil); counana (French Guiana); koenana, paramaka (Suriname).

*Astrocaryum rodriguesii* Trail (1877:79); Barbosa Rodrigues (1903, t. 75–76A); Kahn and Millán (1992, figs. 23–25).

Distribution: central and northeast regions of the Amazon basin, Guianas – Brazil (Amazonas, Pará), French Guiana, Suriname.

Habit: solitary, medium-sized to large palms.

Ecology: terra firme forest.

Common names: mourou-mourou (French Guiana); murumuru-da-terra-firme (Brazil).

**3. SUBGENUS MONOGYNANTHUS** BURRET**3.1. SECTION MONOGYNANTHUS**

*Astrocaryum farinosum* Barb. Rodr. (1875:21; 1903, t. 77–78); Drude (1881, t. 81 fig. 2); Kahn and Millán (1992, figs. 26–27a); Kahn (1997:181; 2001a, figs. 2, 6, 9–10); Miranda et al. (2001, figs. 10–11).

Distribution: north and northeast regions of the Amazon basin, Guianas – Brazil (Amazonas, Pará, Roraima), Guyana, Suriname.

Habit: solitary, large-leafed, subcaulescent to short-stemmed palms.

Ecology: terra firme forest.

Common names: murumuru-iry (Brazil).

*Astrocaryum sciophilum* (Miq.) Pulle (1906:73); Wessels Boer (1965, t. 12–13); Kahn and Granville (1992, fig. 9); Kahn and Millán (1992, figs. 27b–30); Henderson (1995, fig. 6.56g,h); Lorenzi et al. (1996:53); Granville (1997, figs. 86A–D); Kahn (2001a, figs. 3, 8–10); Pintaud et al. (2008: fig. 3C).

Distribution: northeast region of the Amazon basin, Guianas – Brazil (Amapá, Pará), French Guiana, Guyana, Suriname.

Habit: solitary, large-leafed, stemmed palms.

Ecology: terra firme forest.

Common names: boegroemaka, pingomaka (Suriname); mourou-mourou (French Guiana).

*Astrocaryum sociale* Barb. Rodr. (1888:48; 1903, t. 79A); Kahn and Millán (1992, figs. 31–32); Moussa et al. (1994:71); Kahn (2001a, figs. 4–5, 7, 9–10); Miranda et al. (2001, figs. 24–27).

Distribution: north central region of the Amazon basin – Brazil (Amazonas, Pará).

Habit: solitary, large-leafed, acaulescent palms.

Ecology: terra firme forest.

Common names: murumuru-da-terra-firme, palha (Brazil).

**3.2. SECTION AYRI** DRUDE

*Astrocaryum aculeatissimum* (Schott) Burret (1934:152); Dahlgren (1959, t. 12–13); Boudet Fernandes (1987, fig. 1); Henderson et al. (1995: t. 51); Lorenzi et al. (1996:43).

Distribution: Atlantic forest – Brazil (Rio de Janeiro, Espírito Santo, Minas Gerais, Bahia).

Habit: caespitose, large-leafed, stemmed palms.

Ecology: terra firme forest (mata atlántica).

Common names: airi, brejaúva (Brazil).

**3.3. SECTION GUATINAJO** F. KAHN

*Astrocaryum triandrum* G. Galeano, R. Bernal and F. Kahn (1988:279, figs. 1–3).

Distribution: Magdalena River valley – Colombia.

Habit: solitary, large-leafed, stemmed palms.

Ecology: terra firme forest, open areas.

Common names: cabecenegro, guatinajo-hembra (Colombia).

**3.4. SECTION HUICUNGO** F. KAHN**3.4.1. SUBSECTION HUICUNGO**

*Astrocaryum carnosum* F. Kahn and B. Millán (1992:504, fig. 41).

Distribution: west region of the Amazon basin (known from upper Huallaga river, Tocache to Tingo María) – Peru.

Habit: caespitose, large-leafed, subcaulescent to short-stemmed palms.

Ecology: seasonal swamp forest.

Common names: huicungo (Peru).

*Astrocaryum ciliatum* F. Kahn and B. Millán (1992:500, figs. 37–39).

Distribution: northwest region of the Amazon basin – Colombia.

Habit: solitary, large-leafed, acaulescent palms.

Ecology: terra firme forest.

Common names: coco-peludo, coco, cumare-de-guara (Colombia).

*Astrocaryum faranae* F. Kahn and E. Ferreira (1995:321, figs. 1–3); Lorenzi et al. (1996:47); Kahn (1997:181); Pintaud et al. (2008, fig. 2B,C).

Distribution: west region of the Amazon basin – Brazil (Acre), Peru (Huánuco, San Martín, Ucayali).

Habit: caespitose, large-leafed, subcaulescent to short-stemmed palms.

Ecology: forest on alluvial terraces (Amazonian lowlands), forest on slope (sub-Andean valleys).

**Table 2.** Synopsis of the genus *Astrocaryum*. (...Continuation)

- Astrocaryum ferrugineum* F. Kahn and B. Millán (1992:497, figs. 33–36); Moussa et al. (1994:68); Kahn (1997:180).  
Distribution: central region of the Amazon basin – Brazil (Amazonas), Colombia.  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: terra firme forest.  
Common names: murumuru-da-terra-firme (Brazil).
- Astrocaryum javarense* Trail ex Drude (1881:372); Kahn and Millán (1992, figs. 42–43; 1997:64).  
Distribution: west region of the Amazon basin, Jauari river valley and lower Ucayali river valley – Brazil (Acre, Amazonas), Peru.  
Habit: solitary, large-leafed, subcaulescent to short-stemmed palms.  
Ecology: terra firme forest.  
Common names: murumuru (Brazil); huicungo (Peru).
- Astrocaryum huicungo* Dammer ex Burret (1934:146); Kahn and Millán (1992, fig. 44); Henderson (1995, fig. 6.56d).  
Distribution: lower Huallaga river valley (Moyobamba, Tarapoto, Yurimaguas) – Peru.  
Habit: caespitose, large-leafed, subcaulescent to short-stemmed palms.  
Ecology: seasonal samp forest.  
Common names: huicungo (Peru).
- Astrocaryum scopatum* F. Kahn and B. Millán (1992:503, fig. 40; 1997:36); Kahn (1997:36); Pintaud et al. (2008, fig. 3G).  
Distribution: west region of the Amazon basin (upper Marañon river and tributaries, Cenepa, Morona, Nieva, Santiago) – Peru.  
Habit: caespitose, large-leafed, subcaulescent to short-stemmed palms.  
Ecology: forest on alluvial terraces.  
Common names: huicungo (Peru).

**3.4.2. SUBSECTION SACHACUNGO F. KAHN**

- Astrocaryum cuatrecasatum* Dugand (1940a:18; 1940b, fig. 12).  
Distribution: known from Caquetá Department – Colombia.  
Habit: solitary (?), large-leafed, stemmed palms.  
Ecology: savanna.  
Common names: chuchana (Colombia).
- Astrocaryum gratum* F. Kahn and B. Millán (1992:520, fig. 51).  
Distribution: southwest and central periphery of the Amazon basin – Bolivia (Beni, La Paz, Santa Cruz), Peru (Madre de Dios).  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: dry forest.  
Common names: chonta, chonta-negra, chonta-de-macallo (Bolivia); huicungo (Peru).
- Astrocaryum macrocalyx* Burret (1934:150); Kahn and Millán (1992, figs. 45–46).  
Distribution: northwest region of the Amazon basin – Colombia, Peru.  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: terra firme forest.  
Common names: chuchana (Colombia); huicungo (Peru).
- Astrocaryum perangustatum* F. Kahn and B. Millán (1992:517, figs. 49–50); Pintaud et al. (2008, fig. 1).  
Distribution: Pozuzo, Palcazu, Pichis and Perene river valleys – Peru.  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: forest on slope.  
Common names: coquito del monte, huicungo (Peru).
- Astrocaryum urostachys* Burret (1934:151); Kahn and Millán (1992, figs. 47–48); Borchsenius et al. (1998, t. 3C); photo F. Kahn, front cover Palms 45 (2001).  
Distribution: northwest region of the Amazon basin – Colombia, Ecuador, Peru.  
Habit: large-leafed, subcaulescent to stemmed palms.  
Ecology: forest on alluvial terraces, seasonal swamp forest.  
Common names: chuchana (Colombia); chuchana, etsoje, huicungo, sirá (Ecuador); huicungo (Peru).

**3.4.3. SUBSECTION MURUMURU BARB. RODR.**

- Astrocaryum chonta* Mart. (1844:84, t. 4 figs. 1–2, t. 29C); Kahn and Millán (1992, figs. 52–53).  
Distribution: southwest region of the Amazon basin and south periphery – Bolivia (Santa Cruz), Peru (Loreto).  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: forest on alluvial terraces periodically flooded.  
Common names: chonta, chipichiquia, chique-chique (Bolivia); huicungo (Peru).
- Astrocaryum murumuru* Mart. (1824:70, t. 58–59); Dahlgren (1959, t. 20–21); Barbosa Rodrigues (1903, t. 32C, 81B); Granville (1997, figs. 86E–H); Kahn and Millán (1992, figs. 54–55); Henderson (1995, fig. 6.56c); Lorenzi et al. (1996:51); Kahn (1997:181; 2001b, figs. 2–3).  
Distribution: Guianas, northeast and central regions of the Amazon basin, to Acre southwestwards – Brazil (Acre, Amapá, Amazonas, Pará, Rondônia, Roraima), French Guiana, Guyana, Suriname.  
Habit: caespitose, large-leafed, stemmed palms.  
Ecology: seasonal swamp forest; forest on alluvial terraces periodically flooded; coastal swamps under tidal influence.  
Common names: mourou-mourou (French Guiana); murumuru (Brazil).
- Astrocaryum ulei* Burret (1934:147); Kahn and Millán (1992, fig. 56); Lorenzi et al. (1996:54).  
Distribution: southern central regions of the Amazon basin – Bolivia (Pando), Brazil (Acre, Amazonas, Rondônia).  
Habit: solitary, large-leafed, stemmed palms.  
Ecology: terra firme forest.  
Common names: chonta-loro (Bolivia), murumuru (Brazil).

studied the herpetofauna that lives in *Astrocaryum paramaca*. Listabarth (1992) studied the reproductive biology of a species of section *Huicungo* and several other works dealt with the entomofauna associated with various species (Couturier and Kahn, 1989, 1992; Llosa et al., 1990; Delobel et al., 1995; Couturier et al., 1998).

**Uses and Economical potential** — All parts of *Astrocaryum* palms are used:

(i) *Fruit and kernel* — The fruits of *Astrocaryum acaule* (Barbosa Rodrigues, 1903) and *A. jauari* (Wallace, 1853) are used as bait for fishing, and the epicarp of *A. aculeatum* to smoke-cure rubber (Pinheiro and Balick, 1987). Several species have a fleshy mesocarp that is more or less sweet and edible as in *Astrocaryum acaule*, *A. gratum*, *A. gynacanthum*, *A. jauari*, *A. carnosum*, *A. murumuru*, *A. ulei* and *A. urostachys* (Fouqué, 1975; Anderson, 1978; Balick, 1988; Boom, 1988; Kahn and Millán, 1992; Millán, 1998; Balslev et al., 2008). Fruits and seeds of various species are reported to be used for oil production in the Amazon region. Existing analyses of fruit fat content show a relatively homogeneous composition among species, with ca. 20% of fat content in the mesocarp, mostly composed of oleic and palmitic acids, and 20-35% of fat content in the endosperm, with a predominance of lauric acid (Coradin and Lleras, 1983; Pesce, 1985; Pinheiro and Balick, 1987; Lleras and Coradin, 1988; Oboh and Oderinde, 1988). Fruits of *A. farinosum* are used to prepare meal and starch (Barbosa Rodrigues, 1903). Liquid endosperm of unripe fruit is drunk in most species of subgenus *Monogynanthus*; that of *Astrocaryum aculeatum* is used as eye drops. Liquid and solid endosperm of *Astrocaryum chambira* is drunk or eaten in the same way as coconuts (Mejía, 1988, 1992; Kahn and Millán, 1992; Kahn, 1993). Palikur Amerindians use oil extracted from the seed to cure boils and toothache (Grenand et al., 2004). The Apinayé Amerindians of northeastern Brazil use endocarp of *Astrocaryum campestre* to make beads and ornaments for necklaces (Balick, 1988). This is a common use of Amazonian species (Lévi-Strauss, 1950). The endocarp of *Astrocaryum aculeatum* and *A. jauari* is the raw material for the manufacture of rings, earrings and necklaces (Balslev and Barfod, 1987; Kahn and Moussa, 1999). Shamans use halved endocarps of *Astrocaryum aculeatum* as bowls to offer the potions to the sick; in Manaus, the halved and well-polished endocarps become game pieces for miniature soccer (jogo do pião) in which each piece is propelled with the help of a comb (Kahn and Moussa, 1999). Larvae collected from fruit (and stem) are eaten in Bolivia (Balslev and Moraes, 1989).

Only a few species are significant in the local or regional trade and may have greater economic potential. Such is the case of *Astrocaryum aculeatum* and *A. vulgare* and their edible fruits. Prospections were carried out in Brazil with the purpose of gathering and assessing *Astrocaryum vulgare* (Lima et al., 1986), and a germoplasm collection is still available in Belém (Lima and Costa, 1991). Fruit centesimal composition is analyzed for this species (Cruz et al., 1984). The mesocarp is rich in provitamin A (Cavalcante, 1974); it provides a fatty, mashed pulp that is used to prepare the very popular French Guianan “bouillon d’awara”, traditionally eaten at Easter time (Fouqué, 1975; Kahn, 1997). Fruits of *Astrocaryum aculeatum* are very much appreciated by the inhabitants of Manaus; they are sold downtown in

are prepared from the pulp. The fruit is one of the traditional components of the regional breakfast, which has become more and more popular since the 1980’s (Kahn and Moussa, 1999). Schroth et al. (2004) studied extractive use, management and in-situ domestication of this species from a small holding located near Rio Preto da Eva in central Amazonia.

(ii) *Leaf* — Leaflets of several species are commonly used for basketry (*Astrocaryum jauari*, *A. aculeatum*, *A. vulgare*). Young leaves of *Astrocaryum farinosum* are used by the indigenous people for making hats and for basketry, and large leaves are used for thatching (Barbosa Rodrigues, 1903); leaves of *Astrocaryum huaimi* are used to make hats (Martius, 1844). *Astrocaryum standleyanum* is used for basketry in Panamá (Velásquez Runh, 2001). Petioles and rachis of *Astrocaryum murumuru* have been suggested as an alternative source for producing paper but physical-resistance studies are needed to evaluate the potential of this idea (Rocha and Potiguera, 2007). Fiber is extracted from leaflets of *Astrocaryum aculeatum*, *A. chambira*, *A. jauari*, and *A. vulgare* in the Amazon basin (Archer and Hooker, 1855; Wheeler, 1970; Schultes, 1977; Pinheiro and Balick, 1987). It is used to make bags, hammocks, and fishing nets (Balslev and Barfod, 1987; Kahn, 1997; Vormisto, 2002); fiber from leaves of *Astrocaryum arenarium* is used to make rope in central Brazil (Barbosa Rodrigues, 1903). *Astrocaryum standleyanum* (Borgtoft Pedersen, 1994) and *A. chambira* (Kahn, 1988; Holm Jensen and Balslev, 1995; Gomez et al., 1996) are locally significant resources for fiber extracted from the leaves; by-products (bags, hammocks) are marketed through craft industry network at regional and national level in Colombia, Ecuador, and Peru.

In northeastern Brazil, leaves of *Astrocaryum campestre* are used by Apinayé Amerindians to prepare a cure for venereal disease (Balick, 1988).

(iii) *Palm heart* of most species is edible. Some attempts have been made in Brazil to exploit *Astrocaryum jauari* for palm heart canning in Barcelos region (Kahn, 1997). Borgtoft Pedersen and Balslev (1990) proposed this species as a potential component of agroforestry systems. Extracts from palmito of several species are said to cure hepatitis and fibers, and used as cataplasm for calming back pains (Balslev et al., 2008).

(iv) *Stem* of *Astrocaryum jauari* (Mejía, 1988), *A. aculeatum* (Balslev and Moraes, 1989) and *A. triandrum* (Galeano-Garcés et al., 1988) is known to be rot-resistant and serves as building material. Bows and arrow points are made from wood of *Astrocaryum aculeatum* (Balslev and Moraes, 1989); canes are made from wood of *Astrocaryum standleyanum* (Bailey, 1933).

(v) *Root* — Palikur Amerindians prepare a decoction of the roots of *Astrocaryum vulgare*, which is said to have an effect against furunculosis (Grenand et al., 2004). Extracts from roots of *Astrocaryum chambira* have an effect on hepatitis, malaria and yellow fever (Balslev et al., 2008)

(vi) *Sap* of *A. ciliatum* is said to cure snakebite (La Rotta et al., 1989).

**Common names** — One or several common names are reported for 38 species (Table 2). Two very rare species do not have common names — *Astrocaryum pygmaeum*, known only from the type specimen, and *A. minus*, known from the type



## Taxonomy

***Astrocaryum*** G.Mey. (conserved name) — Meyer (1818:265).

Type species: *Astrocaryum aculeatum* G.Mey.

*Avoira* Giseke (1792:53). Name rejected in favor of *Astrocaryum*. Lectotype: *A. vulgaris* Giseke (= *Astrocaryum* sp.), see Cook (1940:299).

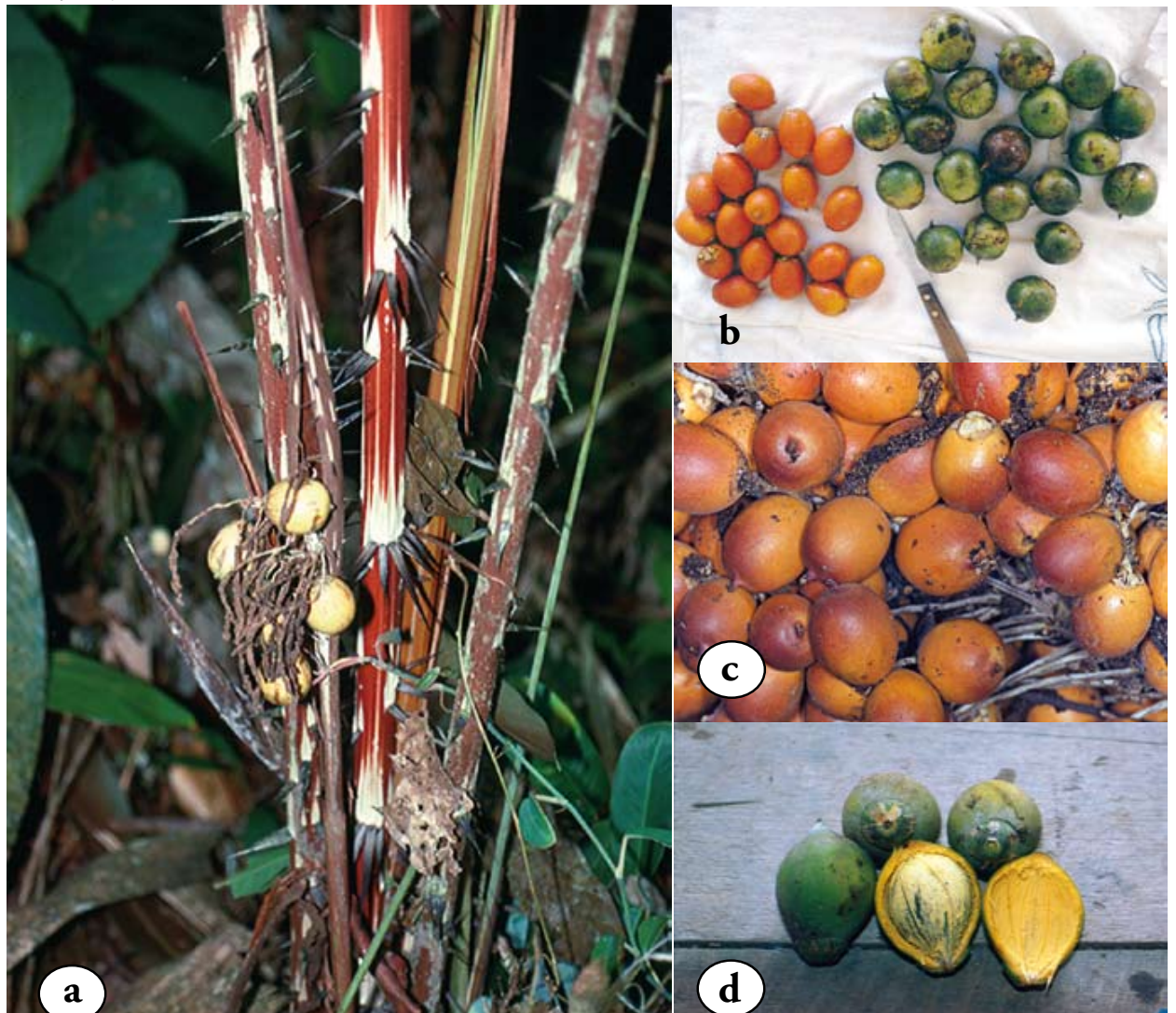
*Toxophoenix* H.W. Schott (in Schreibers, 1822:12). Type: *T. aculeatissima* H.W. Schott (= *Astrocaryum aculeatissimum* (Schott) Burret).

*Astrocaryum mexicanum* and *A. alatum* are excluded. These two species are treated in the genus *Hexopetion* (Pintaud et al., 2008). They differ from all the other species of *Astrocaryum* in having (i) multifold lateral segments in adult palms, (ii) staminate flowers covering the whole rachilla, without a sterile part, (iii) rachilla woolly-white between the flowers, (iv) stigmas much shorter than ovary, and (v) perivascular sclerified sheath continuous (discontinuous in *Astrocaryum*).

**Taxonomic history of *Astrocaryum*** — Martius (1844, 1845) divided the genus *Astrocaryum* in § I *Caudescentia* and § II *Acaulia*. Under *Caudescentia* he separated the species according to the number of pistillate flowers, either one inserted at the base of the rachilla, or several superposed in the proximal part of the rachilla.

From the characters of the fruit, Drude (1881) divided the genus in four sections: *Munbaca*, *Ayri*, *Tucuma* (with two subsections, *Caudescentia* and *Acaulia*), and *Malybo*. This latter section is inconsistent joining together *Bactris humilis* and two *Astrocaryum* species (*A. acaule* and *A. caudescens*=*A. aculeatum*) that clearly belong to section *Tucuma*. Drude (1889, 1897; see Burret, 1934, footnote p.115) considered two subgenera, *Munbaca* and *Tucuma* (this including the sections *Ayri*, *Tucuma* and *Malybo*). Barbosa Rodrigues (1888, 1891, 1902, 1903) reduced the number of sections to three: (i) *Leiocarpeae* with two subsections, *Yauary* and *Chambira*; (ii) *Astrocarpeae* with two subsections, *Munbaca* and *Mumbacuçu*; and (iii) *Acanthocarpeae* with two subsections, *Ayri* and *Murumuru*.

**Figure 1.** Subgenus *Astrocaryum* — a) Fruit and habit of *Astrocaryum acaule*; b) fruit of *A. vulgare* (left) and *A. aculeatum* (right); c) fruit of *A. malybo*; d) fruit of *A. chambira*.







**Figure 2.** Subgenus *Munbaca* — a) habit of *Astrocarium gynacanthum*; b) fruit of *A. rodriguesii*, with epicarp splitting at maturity.

*Hexodon* is abandoned; this latter being treated under synonymy of the genus *Hexopetion* (Pintaud et al., 2008).

*Astrocarium aculeatum* G.Mey., the type species of the genus *Astrocarium*, was misinterpreted. Drude (1881) and Burret (1934) treated the species as *incertae sedis*. Wessels Boer (1965) applied the name *A. aculeatum* G.Mey. to *A. tucuma* Mart. putting this latter into synonymy. Kahn and Millán (1992) and Henderson (1995) followed this position. Bernal rediscovered the type specimen (*E. Rodschied s.n.*) at GOET. It corresponds to the species *A. gynacanthum* Mart. described later. Barbosa Rodrigues (1903) was right in classifying the species described by Meyer in section *Astrocarpeae* subsection *Munbaca*. The correct name for *A. gynacanthum* Mart. should be *A. aculeatum* G.Mey. to comply with the rule of priority. However, Bernal (2008) proposes to conserve the name *A. aculeatum* for *A. tucuma* — a position I follow here (see nomenclatural notes under subgenus *Astrocarium* and subgenus *Munbaca* if Bernal's proposal is rejected). *Astrocarium aculeatum* (syn. *A. tucuma*) is the type of subgenus *Astrocarium*, section *Astrocarium* and subsection *Astrocarium*.

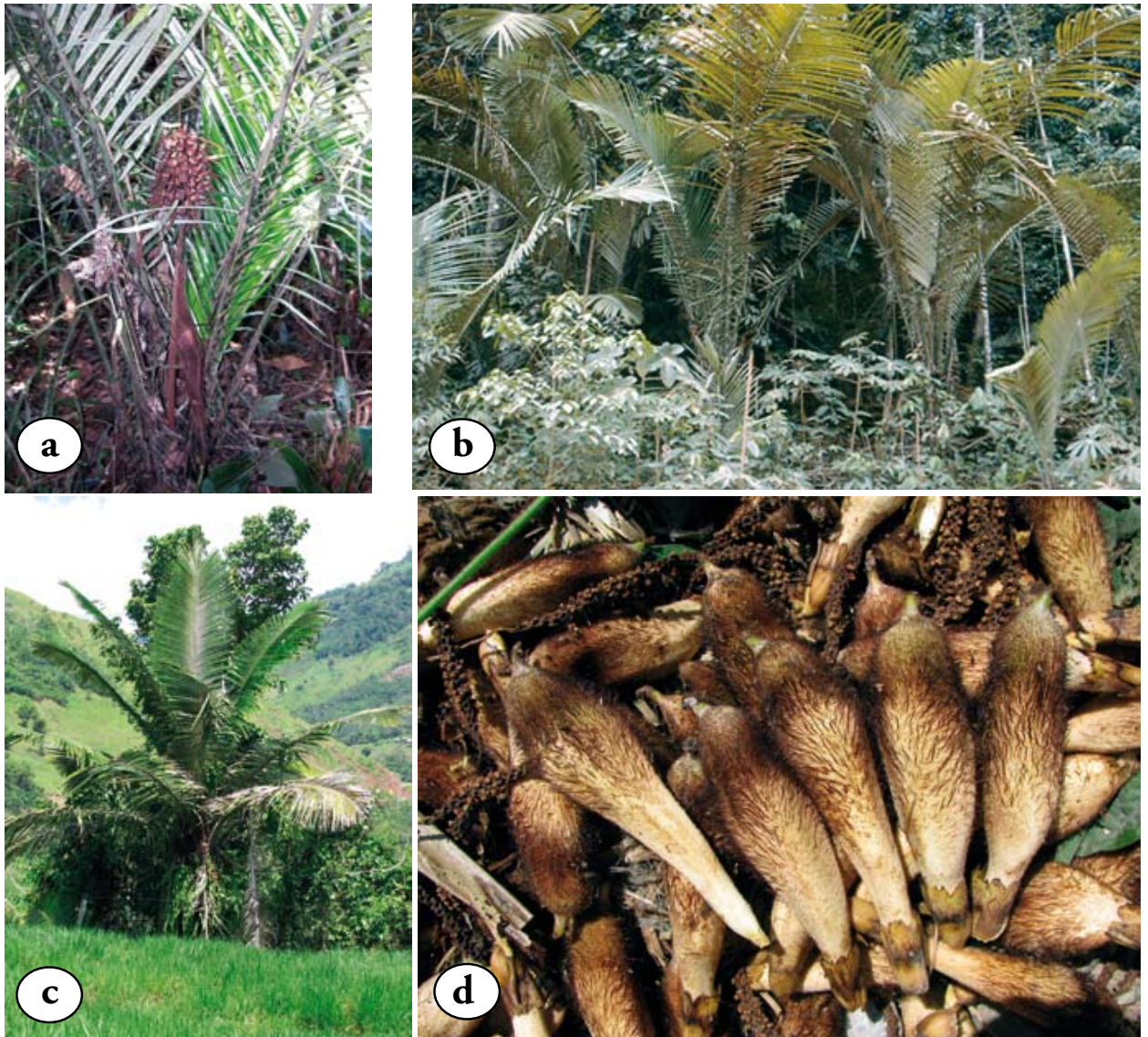
**Description of the genus** — Solitary or caespitose, acaulescent or stemmed, spiny, pleonanthic, monoecious palms. *Stem* short to very large, slender to robust, 3–40 cm in diameter, erect, covered with leaf bases, or becoming bare and conspicuously tinged with leaf scars, unarmed or armed with usually black flat spines in rows or groups, pointing in several directions. *Leaf* from less than 1 m to 8 m long, pinnate, reduplicate; sheath, petiole and rachis covered with a dense indument, armed with large and small spines; petiole very short to long, adaxially channeled near the base, distally flattened or angled, abaxially rounded; rachis usually much longer than the petiole, adaxially angled, abaxially rounded; leaflets numerous, regularly arranged in one plane or grouped and oriented in several directions, single-fold or secondarily plicate, linear acute, adaxial face dark green and shiny, abaxial face usually with abundant white indument, rarely pilose, margins usually armed with short spines or bristles. *Inflorescence* branching to one order, interfoliar, erect, arching or pendulous, protogynous; peduncle usually elongated, circular to oval in cross section, densely covered in indument, often heavily armed with spines; prophyll short, bicarinate, fibrous, unarmed or armed with small spines or bristles, hidden in the leaf

Burret (1934) recognized two subgenera from the number of pistillate flowers at the base of the rachilla: subgenus *Pleio gynanthus* with two or more pistillate flowers per rachilla, and subgenus *Monogynanthus* with only one pistillate flower per rachilla. *Monogynanthus* is divided in two sections, each of them defined from the fruit (epicarp splitting or not): (i) *Munbaca* with two subsections, *Eumunbaca* and *Munbacucu*, these defined by characters of the pistillate flower and fruit, and (ii) *Ayri* with two subsections, *Symphiodon* and *Hexodon*, defined by the staminodes either connected and forming a staminodial ring or reduced to six free teeth. Subsection *Symphiodon* includes two series, *Plicata* and *Eplicata*, according to whether the pinna possesses or lacks prominent secondary nerves.

If the number of pistillate flowers per rachilla easily identifies the subgenera, it is also true that several species of section *Ayri*, which are supposed to have no more than one pistillate flower per rachilla, may be found with several pistillate flowers. These exceptions to the rule are rather frequent when the species grow in open areas, pastures or riverside.

The classification proposed by Barbosa Rodrigues (1903) in defining three groups from the characteristics of the fruit appears to be the most efficient system (Fig. 1–3). This leads us to consider those three groups at the subgeneric rank: subgenus *Astrocarium* with two sections, one of them with three subsections; subgenus *Munbaca* with two sections; subgenus *Monogynanthus* with four sections, one of them with three subsections. Burret's





<http://sisbib.ummsm.edu.pe/BVRevistas/biologia/biologiaNEW.htm>

**Figure 3.** Subgenus *Monogynanthus* — a) Habit and unripe fruit of *A. ciliatum*; b) habit of *A. farinosum*; c) habit of *A. perangustatum*; d) fruit of *A. perangustatum*.

shaped, often rostrate, splitting longitudinally along the abaxial face, persistent or eroding, usually densely tomentose, heavily armed with spines or unarmed; rachis shorter than the peduncle bearing spirally arranged rachillae, each sustained by a narrow triangular bract; rachillae ca. 10 to numerous, proximal part glabrous, setose or spiny, bearing 1–5 triads, distal part catkin-like, bearing densely packed staminate flowers partially sunken into pits. *Staminate flower* symmetrical, trimerous, from barely to widely open at anthesis; *sepals* 3 short,  $\pm$ triangular, sometimes basally connate; *petals* 3, much exceeding the sepals, valvate, boat-shaped, straight or reflexed, basally connate; *stamens* 3–12, anthers small,  $\pm$ oval-linear, versatile, latrorse; pistillode present, minute, trifold, or absent. *Pistillate flower* much larger than the staminate ones; *calyx* subglobose, urn-, vase-, cask- or cup-shaped, or tubular, truncate, tridenticulate or shallowly to deeply tridentate, with limb straight or curved inwards, or pleated horizontally, unarmed or armed with small spines, glabrous, glabrate or tomentose, limb margin sometimes bristly or spiny; *corolla* shorter or longer than the calyx, or subequal,

or contracted, truncate, tridenticulate or shallowly to deeply tridentate, with limb straight or curved inwards or outwards, or pleated horizontally, sometimes carinate vertically, tomentose, bearing bristles or spines, these flattened, flexuose, yellowish to brownish, black, limb margin sometimes bristly or spiny; *staminodes* connate into a ring, this adnate in the corolla or free and membranous, entire, sometimes deeply lacinate, or reduced to 6 small teeth, or absent; *pistil* tomentose, setose, sometimes armed with whitish to brownish spinules, tricarpellate, triovulate, *styles* connate, straight or recurved, tomentose, rarely spiny, usually short, sometimes long and trifid, *stigmas* large, fleshy, papillate, sometimes neatly tongue-shaped. *Fruit* 1(–2) seeded with apical stigmatic remains, subglobose, obovoid, ellipsoid, top-shaped, pear-shaped, short to long beaked; *epicarp* brown, yellowish or orange-red, not splitting when ripe, or splitting and spreading to expose the endocarp, tomentose, setulose or glabrous, unarmed or armed with flattened, brown or black, up to 1,5 cm long spines; *mesocarp* 2–10 mm thick, fleshy or dry and starchy,  $\pm$ fibrous; *endocarp* thick, stony, with flattened

pores, these located in the distal part; *endosperm* homogeneous. *Eophyll* bifid, usually bristly.

## Subgenera, Sections and Subsections

### 1. Subgenus *Astrocaryum*

Subgenus *Pleiogynanthus* Burret (1934:119). Section I *Leiocarpae* Barb. Rodr. — Barbosa Rodrigues (1888:47, 1891:102, 1902:80, 1903:62).

Type: *Astrocaryum aculeatum* G.Mey.

Nomenclatural note: If Bernal's proposal to conserve *Astrocaryum aculeatum* with conserved type is rejected, the name *Pleiogynanthus* Burret must be applied to this subgenus. *Astrocaryum tucuma* Mart. is then a valid name and the type of subgenus *Pleiogynanthus* Burret, section *Pleiogynanthus* and subsection *Pleiogynanthus*.

Epicarp smooth (rarely with indument, scale-like spines, or bristles when unripe), not splitting when ripe; pistillate flowers 2–5 per rachilla.

#### 1.1. Section *Astrocaryum*

Section *Tucuma* Drude (1881:367). Section *Malybo* Drude (1881:368, excluded *A. humile*).

The fruit characterizes this section. The epicarp is yellowish, orange or red and the perianth is cup-shaped, more or less widened, to wheel-shaped. The staminodial ring is adnate, high or low in the corolla. The petiole in young plant is armed with black to reddish spines. The pinnae are more or less neatly arranged in groups and oriented in several directions, except for *Astrocaryum malybo* (subsection *Perstaminata*), whose pinnae are arranged in one plane.

##### 1.1.1. Subsection *Astrocaryum*

Subsection *Caudescentia* Drude (1881:368). Subsection *Chambira* Barb. Rodr. — Barbosa Rodrigues (1902:80, 1903:62). Subsection *Yauary* Barb.Rodr., *pro parte* — Barbosa Rodrigues (1902:80, 1903:62).

This subsection brings together solitary or caespitose, medium-sized to large, or subcaulescent, or acaulescent palms, all of them with large leaves (4–8 m long), and two slender species with leaves 2–3.5 m long and a stem up to 3–4 m in height and up to 15 cm in diameter. The pinnae are usually grouped and oriented in several directions. The stem is heavily armed with long spines at the internodes. The subsection includes nine species. Five are found in the Amazon basin (*Astrocaryum acaule*, *A. giganteum*, *A. jauari*, *A. vulgare* and *A. aculeatum*, the type of the genus); the latter three reach the Guianas; *Astrocaryum aculeatum* is also reported from Trinidad (Wessels Boer, 1965). Two species are found in the northwestern part of South America and in Central America (*Astrocaryum standleyanum* on the Pacific slope and *A. confertum* on the Atlantic slope). And the two slender species grow in the southern drier periphery of the Amazon basin (*Astrocaryum echinatum* in Brazil and *A. huaimi* in Bolivia, Brazil and Peru).

##### 1.1.2. Subsection *Acaulia* Drude (1881:368).

Type: *Astrocaryum campestre* Mart.

Subsection *Yauary* Barb.Rodr., *pro parte* — Barbosa Rodrigues (1902:80, 1903:62).

This subsection includes five species (*Astrocaryum arenarium*, *A. campestre*, *A. kewense*, *A. pygmaeum*, and *A. weddellii*) that grow in the dry regions of Brazil at the southern periphery of the Amazon basin. *A. campestre* is also found in Bolivia. These five species are small acaulescent palms with very short leaves (usually less than 1.5 m long). Drude (1881) provided a key for identifying *Astrocaryum campestre*, *A. pygmaeum* and *A. weddellii*. Barbosa Rodrigues (1903) listed the differential characters of *Astrocaryum weddellii* and *A. arenarium*, respectively. Burret (1934), however, considered *Astrocaryum arenarium* as a possible synonym of *A. weddellii*. This group of small acaulescent palms is still poorly known and needs additional study.

##### 1.1.3. Subsection *Perstaminata* F. Kahn, *subsect. nov.* — *Pinnis in eadem directione abeuntibus, regulariter dispositis, parte distali rami floriferi staminatis floribus omnino obtecti.*

Type: *Astrocaryum malybo* H.Karst.

This subsection is monotypic. *Astrocaryum malybo* differs from all the other species of section *Astrocaryum* in having the pinnae regularly disposed in one plane and in having the distal pistillate flower contiguous with the staminate portion of the rachilla. *Astrocaryum malybo* is a Colombian species, found in Magdalena, Cauca and Sinu valleys; it reaches the Isthmus of Panama.

The name *Perstaminata* refers to the distal part of the rachilla, which is entirely covered with staminate flowers.

##### 1.2. Section *Euchambira* F. Kahn, *sect. nov.*

— *Epicarpio in fructu juveni albido-furfuraceo, nigrosetuloso; demum glabrato, inermi. Perianthio fructifero obconico. Annulo staminodiali altissimo, corollam altitudinae fere aequans.*

Type: *Astrocaryum chambira* Burret.

This section is monotypic. *Astrocaryum chambira* differs from the other species of subgenus *Astrocaryum* in having the biggest fruit, with epicarp glabrate when unripe, usually smooth, sometimes sparsely spinulose, greenish to yellowish when ripe, and a distinctive massive obconical perianth, and in having yellowish spines on the petioles of juvenile plants. DNA analysis (AFLP) clearly separates *Astrocaryum chambira* from the other Amazonian species in subgenus *Astrocaryum* (Kahn and Second, 1999).

### 2. Subgenus *Munbaca* Drude (1889:83, 1897:57)

Type: *Astrocaryum gynacanthum* Mart.

Section *Munbaca* Drude (1881:366); Section *Astrocaryum* Barb. Rodr. — Barbosa Rodrigues (1888:47, 1891:102,

Nomenclatural note: If Bernal (2008)'s proposal to conserve *Astrocaryum aculeatum* with conserved type is rejected, the name of subgenus *Munbaca* Drude and section *Munbaca* is *Astrocaryum*. *Astrocaryum aculeatum* G. Mey. (type specimen *E. Rodschied s.n.*, syn. *Astrocaryum gynacanthum*) is then the type of genus *Astrocaryum*, subgenus *Astrocaryum* and section *Astrocaryum*. And the name *Munbaca* Drude will be applied to section *Mumbacusu* (Barb. Rodr.) F. Kahn.

Epicarp splits and opens at maturity like a flower, showing the yellowish, orange or red mesocarp with the endocarp at the center. This phenomenon never occurs in the other two subgenera. The fruit is prolonged into an elongated rostrum, up to 2 cm long. The pistillate flowers are armed with dense black spines and they are crowded on the rachis that seems to be itself black as a result.

## 2.1. Section *Munbaca*

§ *Munbaca* Barb. Rodr. (1902:80; 1903:62). § 1. *Leiocarpeae* Drude (1897:57, not *Leiocarpeae* Barb. Rodr. 1888). Subsection *Eumunbaca* Burret (1934:139).

This section is distinguished through the following characters: pistillate flower sessile, calyx cup-shaped. It includes two species: *Astrocaryum gynacanthum*, the type of subgenus *Munbaca* and section *Munbaca*, and *Astrocaryum minus*. The first species, a slender caespitose palm, occurs in all parts of the Amazon basin but less frequently in the northwestern region. The second species, a slender single stemmed palm, was collected only twice: the first time in Brazil, Jutahy river valley, in the western part of the basin (Trail, 1877); the second time, more recently, in French Guiana, on Grand Matoury hill near Cayenne (Kahn and Granville, 1998). The fruit of *Astrocaryum minus* is still unknown. Morphological characters (Kahn and Granville, 1998) as well as DNA analyses (Kahn and Second, 1999; Pintaud, in prep.) clearly show that this species is closely related to *A. gynacanthum*.

## 2.2. Section *Mumbacusu* (Barb. Rodr.) F. Kahn, *stat. nov.*

Type: *Astrocaryum paramaca* Mart.

Subsection *Mumbacuçu* Barb. Rodr. — Barbosa Rodrigues (1902:80, 1903:62), Burret (1934:141). § 2. *Acanthocarpeae* Drude (1897:57, not *Acanthocarpeae* Barb. Rodr. 1888).

The section is distinguished through the following characters: pistillate flower pedicelled, calyx vase-shaped, deeply tridentate. It includes two species: *Astrocaryum paramaca*, an acaulescent palm with large leaves, and *A. rodriguesii*, a tall, single stemmed palm. Both species grow in terra firme forests in the Guianas. *Astrocaryum rodriguesii* is also found in the central region of the Amazon basin where it is a medium-sized palm.

## 3. Subgenus *Monogynanthus* Burret (1934:139, excluding Sect. *Munbaca* Drude)

Type: *Astrocaryum sciophilum* (Miq.) Pulle

*thocarpeae* Barb. Rodr. — Barbosa Rodrigues (1888:47, 1891:102, 1902:81, 1903:62). Subsection *Symphyodon* Burret (1934:143).

Epicarp covered in indument, setose to spiny; usually with only one pistillate flower inserted at the base of the rachilla (2–3 flowers per rachilla can be occasionally found in palms growing in open areas).

## 3.1. Section *Monogynanthus*

Series *α*. *Plicata* Burret (1934:143).

This section is characterized by having remarkable tongue-shaped stigmas. The basal (sterile) part of the rachillae is pilose. Leaf segments are plicate longitudinally (i.e. secondary nerves are prominent); the spines on the petiole are regularly arranged in horizontal or oblique parallel rows. The inflorescence and infructescence are erect. The section includes three gregarious species that form dense stands in the understory of terra firme forests. *Astrocaryum sociale*, an acaulescent species with large leaves, is common in the central region of the Amazon basin (Brazil, Amazonas and west of Pará). *Astrocaryum farinosum*, a subacaulescent palm, is found in northern Brazil (Roraima, north of Amazonas and northwest of Pará), in Guyana and in the central region of Suriname. *Astrocaryum sciophilum*, the type of subgenus *Monogynanthus*, produces an unarmed stem with sheaths of dead leaves persistent in the upper part under the crown; this palm occurs in Suriname, Guyana, French Guiana and in the neighbouring regions of Brazil, in Pará and Amapá.

## 3.2. Section *Ayri* Drude (1881:366, *pro parte*; reduced to *A. ayri* Mart.= *A. aculeatissimum* (Schott) Burret).

This section is monotypic. Burret (1934) treated *Astrocaryum aculeatissimum* in the series *Epicata* (subsection *Symphyodon*). The middle pinnae are plicate, however. *Astrocaryum aculeatissimum* differs from the other species of subgenus *Monogynanthus* in the following characters: sheaths of dead leaves not persistent under the crown, stem heavily armed with dense spines falling with the age, infructescence pendulous, petals of the staminate flower reflexed, pistil with a long style. These differences are important enough to justify its treatment in a section apart. *Astrocaryum aculeatissimum* grows in the Brazilian Atlantic forest.

## 3.3. Section *Guatinajo* F. Kahn, *sect. nov.*

— *Pinnis in nervis secundariis haud plicatis; parte proximali sterili rami floriferi setosa; floribus masculis tristaminibus; staminodiis nullis.*

Type: *Astrocaryum triandrum* G. Galeano, R. Bernal and F. Kahn

This monotypic section is characterized by the number of stamens being reduced to three, and the absence of staminodes. The basal part of the rachillae is covered with yellowish bristles. Leaf segments are not plicate longitudinally. *Astrocaryum triandrum* is known from the middle Magdalena river valley in

“Guatinajo” is a vernacular name for this palm species (Ranghel, 1941).

### 3.4. Section *Huicungo* F. Kahn, *sect. nov.*

— *Pinnis in nervis secundariis haud plicatis; parte proximali sterili rami floriferi glabra.*

Type: *Astrocaryum huicungo* Dammer ex Burret

Series  $\beta$  *Epilicata* Burret (1934:146, excluding *A. aculeatisimum*).

This section differs from the three others in the basal (sterile) part of the rachilla that is not pilose. Leaf segments are not plicate longitudinally. The subsections are distinguished on the basis of characters of the pistillate flower.

“Huicungo” is the vernacular name given to these species in Peru.

#### 3.4.1. Subsection *Huicungo*

The calyx of the pistillate flower is armed with flat, flexuose, yellowish, brownish or black spinules or spines. It is shorter or longer than the corolla, or subequal, cask-, cup-, or vase-shaped, or tubular, with limb straight or pleated horizontally, truncate, tridenticulate or tridentate. Subsection *Huicungo* includes seven Amazonian palms. Three species are endemic to Peru (*Astrocaryum carnosum* in the upper Huallaga river valley, *Astrocaryum huicungo*, the type of section *Huicungo*, in the lower Huallaga river valley and *Astrocaryum scopatum* in the upper Marañón and lower Cenepa, Morona, Nieva and Santiago river valleys). One species is endemic to Colombia (*Astrocaryum ciliatum* known from the middle Caquetá river valley and from the Amazonas river valley, near Leticia). Two species grow in Brazil and Peru (*Astrocaryum faranae* is found from the upper Moa river in Acre, the westernmost region of Brazil, to the upper Huallaga river valley in Peru, and *Astrocaryum javarense*, found in the lower Jauari river valley in Brazil, extends to the lower Ucayali river valley in the neighbouring Peruvian region). And one species (*Astrocaryum ferrugineum*), frequent in the central part of the Amazon basin in Brazil (Manaus, Balbina, Borba), extends westwards to Colombia (Leticia).

### 3.4.2. Subsection *Sachacungo* F. Kahn, *subsect. nov.*

— *Calyce floris pistillati glabro vel glabrato, urceolato, elongato-urceolato, corolla longiore.*

Type: *Astrocaryum macrocalyx* Burret.

The calyx of the pistillate flower is glabrous or glabrate (with bristles in *Astrocaryum gratum* and *A. urostachys*, and spinules in *A. perangustatum*), longer than the corolla, urn- or vase-shaped, very contracted at the orifice, the limb straight or turned inwards, pleated horizontally (in *Astrocaryum macrocalyx*, *A. perangustatum* and *A. urostachys*), shallowly tridentate or tridenticulate. Subsection *Sachacungo* includes five species. *Astrocaryum gratum* is found from Santa Cruz de la Sierra in Bolivia to Madre de Dios in Peru. *Astrocaryum macrocalyx* is found from Iquitos, Peru, northwards to Colombia. *Astrocaryum urostachys* is found throughout Amazonian Ecuador; it reaches the neighbouring regions of Colom-

*perangustatum*, endemic to Peru, grows in the Pozuzo, Palcazu, Pichis and Perene river valleys. *Astrocaryum cuatrecasanaum* is only known from Colombia (Caquetá Department).

“Sachacungo” is a contraction of *sacha* (that means “-like” in quechua) and *huicungo*.

### 3.4.3. Subsection *Murumuru* Barb. Rodr. — *Barbosa* Rodrigues (1902:80, 1903:63).

Type: *Astrocaryum murumuru* Mart.

The calyx of the pistillate flower is glabrous, cup-shaped, shallowly tridentate, shorter than corolla, rarely hardly subequal, never covering it. Subsection *Murumuru* includes three species: *Astrocaryum chonta*, found from Santa Cruz de la Sierra in Bolivia to the lower Ucayali river valley in Peru; *Astrocaryum ulei*, found from north of Bolivia to the southern bank of Rio Solimões in Brazil (Acre, Amazonas, Rondônia), and *Astrocaryum murumuru*, found in the Guianas and in the northeastern and central regions of the Amazon basin in Brazil (Amapa, Amazonas, Pará, Roraima, Rondônia, it reaches Acre westwards in the southern region).

#### Key to species

(References with illustrations, as well as data on distribution, habit and ecology are given for each species in Table 2).

- 1a. Epicarp splitting and spreading to expose the endocarp when ripe; pistillate flower one at the base of the rachilla — 2
- 1b. Epicarp not splitting when ripe; pistillate flowers one or several at the base of the rachilla — 5
- 2a. Pistillate flower inserted on the rachilla at some distance (2–5 mm) from the rachis; calyx vase-shaped (resembling a long inverted truncate cone), deeply tridentate, up to 18 mm long — 3
- 2b. Pistillate flower sessile, inserted on the rachis or very close to it; calyx cup-shaped, minutely 3-denticulate, up to 9 mm long — 4
- 3a. Acaulescent palms with large leaves; inflorescence erect; fruit with a crown of black bristles in the distal third — *Astrocaryum paramaca*
- 3b. Medium-sized to large palms with stem up to 20 m long, more than 12 cm in diameter, internodes spiny, spines falling in old palms; inflorescence pendulous; fruit not bristly — *Astrocaryum rodriguesii*
- 4a. Caespitose, with stems less than 10 cm in diameter, internodes up to 5 cm long, spiny; leaves with less than 50 pinnae per side; inflorescence pendulous; pistillate flower 8–11 mm long, calyx and corolla armed with flat, flexuose spines long enough to hide the floral parts; petals of the staminate flower strongly reflexed — *Astrocaryum gynacanthum*
- 4b. Solitary, with stem 10–15 cm in diameter, internodes up to 10 cm long, spiny; leaves with more than 50 pinnae per side; inflorescence arching horizontally; pistillate flower 13–20 mm long, the spines not hiding the floral parts completely; petals of the staminate flower slightly reflexed — *Astrocaryum minus*
- 5a. Epicarp smooth (rarely with indument, scale-like spines or glabrate when fruit unripe); pistillate flowers 2–5 per rachilla — 6
- 5b. Epicarp covered in indument, setose or spiny; pistillate flower usually one per rachilla (some rachillae, usually those located at the base of the rachis, are sometimes found with 2–3 flowers in the most vigorous plants) — 21
- 6a. Epicarp greenish to yellowish; corolla obconical in fruit; staminodial ring almost as high as the corolla; stamens 6; limb of the pistillate corolla turned inwards girdling the style; fruit 5–7 cm long, 4.5–5 cm broad; petiole armed with yellowish spines in young plant



- 6b. Epicarp yellowish, orange or red; corolla cup-shaped to flat in fruit; staminodial ring high or low in the corolla; stamens 6—12; limb of the pistillate corolla not turned inwards, not girdling the style; fruit usually up to 5 cm long (6,5 cm in *A. aculeatum*), up to 4,5 cm broad; petiole armed with black to reddish spines in young plant — 7
- 7a. Length of the leaves more than 2,5 m; tall or short-stemmed, subacaulescent or acaulescent palms — 8
- 7b. Length of the leaves up to 2 m; small, acaulescent palms — 17
- 8a. Pinnae arranged in one plane; distal pistillate flower contiguous with the staminate part of the rachilla — *Astrocaryum malybo*
- 8b. Pinnae pointing in several directions; distal pistillate flower not contiguous with the staminate part of the rachilla — 9
- 9a. Inflorescence pendulous, the peduncle recurved — *Astrocaryum standleyanum*
- 9b. Inflorescence erect — 10
- 10a. Epicarp with small scale-like spines — *Astrocaryum confertum*
- 10b. Epicarp smooth, without scale-like spines — 11
- 11a. Length of the leaves up to 3 m; slender to medium-sized palms, stem up to 15 cm in diameter — 12
- 11b. Length of the leaves more than 4 m; palms with stem more than 15 cm in diameter, or subacaulescent, or acaulescent palms — 13
- 12a. Pinnae markedly curved downwards; peduncular bract curved downwards, dark rusty tomentose; pistillate flowers up to 3 at the base of the rachilla; fruit oval, 4,2 cm long, 3,5 cm broad; solitary palms — *Astrocaryum echinatum*
- 12b. Pinnae straight, or slightly curved; peduncular bract spindle-like, not dark rusty-tomentose; pistillate flowers up to 5 at the base of the rachilla; fruit obovato-subglobose, 3,5—3,9 cm long; caespitose palms — *Astrocaryum buaimi*
- 13a. Acaulescent or subacaulescent (to short-stemmed) palms; petiole rusty-red tomentose; rachis up to 30 cm long, bearing up to 70 rachillae up to 20 cm long — 14
- 13b. Palms with large stems; petiole not rusty-red tomentose; rachis usually longer than 40 cm, bearing more than 90 rachillae usually longer than 25 cm — 15
- 14a. Acaulescent palms; leaves up to 5 m long; inflorescences erect; fruit obovoid slightly asymmetrical — *Astrocaryum acaule*
- 14b. Subacaulescent or with a short stem up to 4 m in height, 22 cm in diameter; leaves up to 7 m long; inflorescence erect to arching horizontally; fruit obovoid, symmetrical — *Astrocaryum giganteum*
- 15a. Stamens 9—12; staminodial ring  $2/3$ — $4/5$  as long as the corolla; caespitose, riparian palms — *Astrocaryum jauari*
- 15b. Stamens 6; staminodial ring up to  $1/2$  as long as the corolla; solitary or caespitose, not riparian palms — 16
- 16a. Solitary palms; pistillate flower with calyx vase-shaped, corolla clearly shorter than the calyx; ripe fruit greenish to brownish, 4,5—6,5 cm long, 3,5—4,5 cm broad — *Astrocaryum aculeatum*
- 16b. Caespitose palms; pistillate flower with calyx urn-shaped, corolla as long as the calyx; ripe fruit orange to reddish, up to 4 cm long and 3 cm broad — *Astrocaryum vulgare*
- 17a. Peduncular bract woolly, rusty-red or dark flesh-coloured; rachis length more than 10 cm — 18
- 17b. Peduncular bract not woolly; rachis length up to 10 cm — 19
- 18a. Peduncular bract obtuse, dark flesh-coloured; leaves crisp-like; pinnae long acuminate; leaf rachis rusty-red tomentose, setose and spiny; peduncle of the inflorescence with rusty-red prickly bristles; pistillate flowers 3—4 per rachilla; fruit obovoid, 3,5—4 cm long, 2,5—3 cm broad — *Astrocaryum weddellii*
- 18b. Peduncular bract acute, mucronate, curved downwards, rusty-red; leaves not crisp-like; pinnae obliquely acuminate; leaf rachis whitish tomentose, 3,5 cm long, 3,3 cm broad — *Astrocaryum arenarium*
- 19a. Apical pinnae thread-like; middle pinnae long acuminate; peduncular bract with sparse or dense spines — 20
- 19b. Apical pinnae not thread-like; middle pinnae obliquely long acuminate; peduncular bract brown-tomentose with dense spines — *Astrocaryum kewense*
- 20a. Length of the leaves up to 1 m; peduncular bract covered with velvet, not spiny; rachillae ca. 10, each with 1—2 pistillate flowers — *Astrocaryum pygmaeum*
- 20b. Length of the leaves up to 2 m; peduncular bract tomentose with sparse to dense spines; rachillae more than 20, each with 2—4 pistillate flowers — *Astrocaryum campestre*
- 21a. Basal part of the rachilla pilose — 22
- 21b. Basal part of the rachilla glabrous — 26
- 22a. Stamens 3; staminodes absent; middle pinnae not plicate; fruit armed with up to 15 mm long spines; solitary palms — *Astrocaryum triandrum*
- 22b. Stamens 6; staminodes forming a ring; middle pinnae plicate; fruit armed with short or long spines; solitary or caespitose palms — 23
- 23a. Caespitose, stemmed palms; stem heavily armed at the internodes, spines falling with the age; sheaths of the dead leaves not persistent on the stem; spines on the petiole not arranged in parallel rows; inflorescence pendulous; petals of the staminate flower reflexed — *Astrocaryum aculeatissimum*
- 23b. Solitary, acaulescent, subacaulescent or stemmed palms; stem not spiny; sheaths of the dead leaves persistent on the stem or only in the upper part under the crown; spines on the petiole regularly arranged in horizontal or oblique parallel rows; inflorescence erect; petals of the staminate flower not reflexed — 24
- 24a. Acaulescent palms; spines on lateral and abaxial sides of the petiole arranged in more or less horizontal parallel rows, those on the abaxial side are longer; inflorescence less than 0,6 m long; pistillate flower 8—13 mm long, calyx shallowly tridentate; epicarp with short spines, less than 5 mm long — *Astrocaryum sociale*
- 24b. Subacaulescent or stemmed palms; spines on both lateral sides of the petiole clearly arranged in oblique parallel rows; inflorescence more than 0,6 m long; pistillate flower 12—20 mm long; calyx deeply tridentate; epicarp with short or long spines — 25
- 25a. Stem up to 12 m high, sheaths of the dead leaves persistent only in the upper part; inflorescence about 1 m long; epicarp with 5—12 mm long spines; staminate flower without an apparent bract — *Astrocaryum sciophilum*
- 25b. Subacaulescent palms, or with a short stem entirely covered with sheaths of the dead leaves; inflorescence up to 2 m long; epicarp with short spines, up to 5 mm long; staminate flower with an acute 2—3 mm long bract — *Astrocaryum farinosum*
- 26a. Calyx of the pistillate flower armed with flat, flexuose, yellowish, brownish or black spinules or spines — 27
- 26b. Calyx of the pistillate flower glabrous or glabrate — 34
- 27a. Calyx of the pistillate flower with the limb pleated horizontally — 28
- 27b. Calyx of the pistillate flower with the limb not pleated horizontally — 29
- 28a. Caespitose palms; calyx of the pistillate flower with spines persistent; fruit top-shaped to obovate, not remarkably long tapering basally; mesocarp very fleshy when ripe, up to 8 mm thick — *Astrocaryum carnosum*
- 28b. Solitary palms; calyx of the pistillate flower not spiny or with spines falling in fruit; fruit top-shaped with a remarkably long tapering, often slightly curved base; mesocarp not very fleshy when ripe, up to 3 mm thick — *Astrocaryum perangustatum*
- 29a. Abaxial side of the leaf pilose, with brown to rusty-red hairs

- 29b. Abaxial side of the leaf not pilose — 30
- 30a. Middle pinnae with 1—2 parallel ribs on each side of the midrib near the margins; corolla of the pistillate flower armed with black spinules forming a dense fringe at the margin, persisting in fruit; acaulescent, solitary palms — *Astrocaryum ciliatum*
- 30b. Middle pinnae without parallel prominent ribs; corolla of the pistillate flower without a fringe of black spinules at the margin; subacaulescent, solitary or caespitose palms — 31
- 31a. Solitary palms — *Astrocaryum javarense*
- 31b. Caespitose palms — 32
- 32a. Pistillate flowers not very crowded on the rachis, subglobose, calyx cask-shaped — *Astrocaryum scopatum*
- 32b. Pistillate flowers crowded on the rachis, much longer than broad, calyx cup-shaped or tubular — 33
- 33a. Epicarp setose; calyx of the pistillate flower hardly shorter than the corolla or equal — *Astrocaryum huicungo*
- 33b. Epicarp armed with spines, up to 15 mm long; calyx of the pistillate flower neatly shorter than the corolla, rarely subequal — *Astrocaryum faranæ*
- 34a. Calyx of the pistillate flower covering the corolla entirely, very contracted at the orifice, urn- to vase-shaped, glabrous or glabrate — 35
- 34b. Calyx of the pistillate flower not covering the corolla entirely (calyx shorter than the corolla or hardly subequal), cup-shaped to tubular, glabrous — 39
- 35a. Calyx of the pistillate flower with the limb pleated horizontally — 36
- 35b. Calyx of the pistillate flower with the limb straight — *Astrocaryum gratum*
- 36a. Fruit top-shaped with a long tapering, slightly curved base; leaf segment satiny beneath — *Astrocaryum perangustatum*
- 36b. Fruit top-shaped to sub-globose, not remarkably long tapering basally; leaf segment whitish beneath — 37
- 37a. Epicarp armed with spines up to 15 mm long — *Astrocaryum cuatrecasani*
- 37b. Epicarp setose or armed with spines up to 7 mm long — 38
- 38a. Solitary palms; calyx of the pistillate flower glabrous, usually shorter than 14 mm; fruit with 3—4 mm long bristles — *Astrocaryum macrocalyx*
- 38b. Caespitose palms; calyx of the pistillate flower glabrate (some bristles are always present), usually longer than 15 mm; fruit with 5—6 mm long bristles or armed with spines — *Astrocaryum urostachys*
- 39a. Caespitose palms; infructescence often pendulous; fruit up to 9 cm long, 4.5 cm broad; mesocarp very fleshy when ripe, 6—10 mm thick; corolla of the pistillate flower vase-shaped, or tubular often shallowly contracted at the middle or at the distal third (like a 8), large enough to encompass the proximal part of the stigmas — *Astrocaryum murumuru*
- 39b. Solitary palms; infructescence usually erect or arching; fruit up to 6.5 cm long, 3.5 cm broad; mesocarp more or less fleshy when ripe, less than 4 mm thick; corolla of the pistillate flower cask- or pitcher-shaped, or regularly tubular, not or hardly covering the base of the stigmas — 40
- 40a. Leaf rachis up to 4 m long; palms subacaulescent or with a stem up to 4 m long; calyx of the pistillate flower bone-colored, usually 1/4—1/3 as long as the corolla; corolla cask-shaped; fruit obovate to top-shaped, often asymmetrical, 4—5 cm long, with a pedicel up to 3 cm long — *Astrocaryum ulei*
- 40b. Leaf rachis up to 7 m long; palms with a stem up to 15 m long; calyx of the pistillate flower tawny to brown, usually 1/3—4/5 as long as the corolla; corolla pitcher-shaped to tubular; fruit obovate, 4—6.5 cm long, sessile or with a 0.5—2 cm long pedicel — *Astrocaryum cbonta*

## Acknowledgements

I am especially indebted to Scott Zona who helped me to solve problems of nomenclature and revised the English version, and to Henrik Balslev, Rodrigo Bernal, Jean-Jacques de Granville and Jean-Christophe Pintaud for their useful comments and suggestions on the manuscript. I thank Betty Millán, Irés Paula de Andrade Miranda, Afonso Rabelo and Harri Lorenzi for providing material of several species.

## Literature cited

- Anderson A.B. 1978. The names and uses of palms among a tribe of Yanomama Indians. *Principes*, 22: 30—41.
- Archer T.C. & W.J. Hooker. 1855. On two fibres from Brazil; with a note by Sir W.J. Hooker. *Hooker's J. Bot. and Kew Gard. Miscellany*, 7: 84—87.
- Bailey L.H. 1933. Certain palms of Panama. *Gentes Herb.*, 3: 33—116.
- Bailey L.H. 1949. *Palmae incertae et novae*. *Gentes Herb.*, 8: 93—205.
- Balick M.J. 1988. The use of palms by the Apinayé and Guajajara Indians of Northeastern Brazil. *Adv. Econ. Bot.*, 6: 65—90.
- Balslev H. & A. Barfod. 1987. Ecuadorean palms – an overview. *Opera Bot.*, 92: 17—35.
- Balslev H. & M. Moraes. 1989. Sinopsis de las palmeras de Bolivia. *AAU Reports* 20, Aarhus.
- Balslev H., C. Grandez, N.Y. Paniagua Zambrano, A.L. Moller & S.L. Hansen. 2008. Palmas (Arecaceae) útiles en los alrededores de Iquitos, Amazonia Peruana. *Rev. peru. biol.* 15(supl. 1): 121- 132.
- Barbosa Rodrigues J. 1875. *Enumeratio palmarum novarum quas valle fluminis amazonum*. Rio de Janeiro, pp. 1-43.
- Barbosa Rodrigues J. 1888. *Palmae Amazonenses Novae*. *Vellozia*, 1: 33—56.
- Barbosa Rodrigues J. 1898. *Palmae mattogrossenses novae vel minus cognitae*, pp. 1-88, Rio de Janeiro.
- Barbosa Rodrigues J. 1891. *Palmae Amazonenses Novae*. *Vellozia*, 2: 91—112.
- Barbosa Rodrigues J. 1902. *Palmae-Amylocarpus*. *Contrib. Jard. Bot. Rio de Janeiro*, 3: 69—88.
- Barbosa Rodrigues J. 1903. *Sertum Palmarum Brasiliensium, ou relation des palmiers nouveaux du Brésil, découverts, décrits et dessinés d'après nature*. *Imprimerie Monnom, Bruxelles*, 2 vol., 1: 1—140, 91 pl.; 2: 1—114, 83 pl.
- Beck H. & J. Terborgh. 2002. Groves versus isolates; how spatial aggregation of *Astrocaryum murumuru* palms affects seed removal. *J. Trop. Ecol.*, 18: 275—288.
- Bernal R. 2008. Proposal to conserve the name *Astrocaryum aculeatum* (Palmae) with a conserved type. *Taxon* 57 (3): in press.
- Boom B. M. 1988. The Chácobo indians and their palms. *Adv. Econ. Bot.*, 6: 91-97.
- Borchsenius F., H. Borgtoft Pedersen & H. Balslev. 1998. *Manual of the palms of Ecuador*. *AAU Report* 37, Aarhus University Press, Aarhus.
- Borgtoft Pedersen H. 1994. Moco palm-fibers: use and management of *Astrocaryum standleyanum* (Arecaceae) in Ecuador. *Econ. Bot.*, 48: 310—325.
- Borgtoft Pedersen F. & H. Balslev. 1990. Ecuadorean palms for agroforestry. *AAU Reports* 23, Aarhus.
- Boudet Fernandes H. Q. 1987. *Espécies de Palmae da reserva florestal da FEEMA. Alberto 1 (7)*: 47—54.
- Burret M. 1934. Die Palmengattung *Astrocaryum* G. F. W. Meyer. *Repert. Spec. Nov. Regni Veg.*, 35: 114—158.
- Cavalcante P.B. 1974. *Frutas comestíveis da Amazônia*. *Publicações avulsas n° 27*, Tome 11, Museo Paraense Emilio Goeldi,



- Charles-Dominique P., J. Chave, M.-A. Dubois, J.-J. de Granville, B. Riera & C. Vezzoli. 2003. Colonization front of the understorey palm *Astrocaryum sciophilum* in a pristine rain forest of French Guiana. *Global Ecol. and Biogeogr.*, 12 (3): 237–248.
- Cintra R. 1997. Leaf litter effects on seed and seedling predation of the palm *Astrocaryum murumuru* and the legume tree *Dipteryx micrantha* in Amazonian forest. *J. Trop. Ecol.*, 13: 709–725.
- Cintra R. & V. Horna. 1997. Seed and seedling survival of the palm *Astrocaryum murumuru* and the legume tree *Dipteryx micrantha* in gaps in Amazonian forest. *J. Trop. Ecol.*, 13: 257–277.
- Cook O.F. 1940. Aublet the botanist, a pioneer against slavery, with a memorial genus of palms. *Journ. Washington Acad. Sc.*, 30: 294–299.
- Coradin L. & E. Lleras. 1983. Situación actual de la investigación y desarrollo en palmeras poco conocidas. Informes por país. 1. Brasil. In: *Palmeras poco utilizadas de América tropical*, FAO-CATIE, Turrialba, pp. 28–33.
- Couturier G. & F. Kahn. 1989. *Lincus* spp., bugs vectors of marchitez and hart-rot (oil palm and cononut diseases) on *Astrocaryum* spp., Amazonian native palms. *Principes*, 33: 19–20.
- Couturier G. & F. Kahn. 1992. Notes on the insect fauna on two species of *Astrocaryum* (Palmae, Coccoaeae, Bactridinae) in Peruvian Amazonia with emphasis on potential pests of cultivated palms. *Bull. Inst. fr. Ét. and.*, 21 (2): 715–726.
- Couturier G., C.W. O'Brien & F. Kahn. 1998. *Astrocaryum carnosum* and *A. chonta* (Palmae), new host for the weevil *Dynamis borassi* (Curculionidae, Rhynchophorinae). *Principes*, 42: 227–228.
- Cruz P.E.N., E.P. Marquez, D.R. Amaya & J.A. Fáfán. 1984. Macaúba, bacuri, inajá e tucumá — caracterização química e nutricional destes frutos do estado do Maranhão e os oleos respectivos. *Rev. quim. Ind.*, Outubro: 278–281.
- Dahlgren, B.E. 1959. Index of American palms. *Plates. Field Mus. Nat. Hist. Bot.*, 14: pl. 1–412.
- Delobel A., G. Couturier, F. Kahn & J.A. Nilsson. 1995. Trophic relationships between palms and bruchids (Coleoptera: Bruchidae: Pachymerini) in Peruvian Amazonia. *Amazoniana*, XIII (3–4): 209–219.
- De Nevers G.C., M.H. Grayum & B.E. Hammel. 1988. *Astrocaryum confertum*, an enigmatic Costa Rican palm rediscovered. *Principes*, 32: 91–95.
- Dransfield J., N.W. Uhl, C.B. Asmussen, W.J. Baker, M.M. Harley & C.E. Lewis. 2005. A new phylogenetic classification of the palm family, Arecaeae. *Kew Bull.*, 60: 559–569.
- Drude O. 1881. Palmae. In *Martius Flora Brasiliensis*, 3: 253–460.
- Drude O. 1889. Palmae. In *Engler and Prantl, Naturlichen Pflanzenfamilien*, II 3: 83.
- Drude O. 1897. Palmae. In *Engler and Prantl, Naturlichen Pflanzenfamilien*, Nachtr. 1, 2 (3): 57.
- Dugand A. 1940a. Un género y cinco especies nuevas de palmas. *Caldasia*, 1: 10–19.
- Dugand A. 1940b. Palmas de Colombia. Clave diagnostica de los géneros y nomina de las especies conocidas. *Caldasia*, 1: 20–84.
- Dugand A. 1955. Palmas nuevas y notables de Colombia II. *Caldasia*, 7: 129–157.
- Forget P. M. 1991. Scatterhoarding of *Astrocaryum paramaca* by *Proechimys* in French Guiana: comparison with *Myoprocta exilis*. *Trop. Ecol.*, 32: 155–167.
- Fouqué A. 1975. *Espèces fruitières d'Amérique tropicale*. IFAC, Paris.
- Galeano-Garcés G., R. Bernal & F. Kahn. 1988. Una nueva especie de *Astrocaryum* (Palmae) de Colombia. *Candollea*, 43 (1): 279–283.
- Galetti M., C.I. Donatti, A.S. Pires, P.R. Guimaraes Jr. & P. Jordano. 2006. Seed survival and dispersal of an endemic Atlantic forest palm: the combined effects of defaunation and forest fragmentation. *Bot. J. Linnean Soc.*, 151: 141–149.
- Gasc J.P. 1986. Le peuplement herpétologique d' *Astrocaryum paramaca* (Arecaceae), un palmier important dans la structure de la forêt en Guyane française. *Mém. Mus. nat. Hist. nat.*, 132: 97–107.
- Giseke P.D. 1792. *Linnaeus, Praelectiones in Ordines Naturales Plantarum*, 38: 21–122, Hamburg.
- Glassman S.F. 1972. A revision of B. E. Dahlgren's index of American palms. *J. Cramer, Lehre*.
- Gomez D., L. Lebrun, N. Paymal & A. Soldi. 1996. Palmas útiles en la Provincia de Pastaza, Amazonia Ecuatoriana. *Manual práctico. Serie Manuales de plantas útiles amazónicas*, n° 1, Quito.
- Govaerts R. & J. Dransfield. 2005. *World checklist of palms*. Royal Botanic Gardens, Kew, UK.
- Granville J.-J. de. 1977. Notes biologiques sur quelques palmiers guyanais. *Cah. ORSTOM, sér. Biol.*, XII (4): 347–353.
- Granville J.-J. de. 1989. La distribución de las palmas en Guyana Francesa. *Acta Amazonica*, 19: 115–138.
- Granville J.-J. de. 1997. Arecaceae (Palm Family). In: Mori, S.A., G. Cremers, C. Gracie, J.-J. de Granville, M. Hoff & J.D. Mitchell, *Guide to the Vascular Plants of Central French Guiana. Part 1. Pteridophytes, Gymnosperms and Monocotyledons*. *Mem. N. Y. Bot. Gard.*, 76 (1): 190–216.
- Grenand P., C. Moretti, H. Jacquemin & M.-F. Prévost. 2004. *Pharmacopées traditionnelles en Guyane*. IRD Éditions, Paris.
- Henderson A. 1995. *The palms of the Amazon*. Oxford University Press, New York.
- Henderson A., G. Galeano & R. Bernal. 1995. *Field guide to the palms of the Americas*. Princeton University Press, New Jersey.
- Hoch G. A. & G.H. Adler. 1997. Removal of black palm (*Astrocaryum standleyanum*) seeds by spiny rats (*Proechimys semispinosus*). *J. Trop. Ecol.*, 13: 51–58.
- Holm Jensen O. & H. Balslev. 1995. Ethnobotany of the fiber palm *Astrocaryum chambira* (Arecaceae) in Amazonian Ecuador. *Econ. Bot.*, 49: 309–319.
- Jardim M.A.G. & P.J. Stewart. 1994. Aspectos etnobotânicos e ecológicos de palmeiras no Município de Novo Airão, Estado do Amazonas, Brasil. *Bol. Mus. Parense, Emílio Goeldi, sér. Bot.*, 10 (1): 69–76.
- Kahn F. 1988. Ecology and economically important palms in Peruvian Amazonia. *Adv. Econ. Bot.*, 6: 42–49.
- Kahn F. 1993. Amazonian palms: food resources for the management of forest ecosystems. In: Hladik, C.M., H. Pagesy, O.F. Linares, A. Hladik & M. Hadley (Eds), *Food and Nutrition in the tropical forest: Biocultural interactions. Man and the Biosphere series, Vol. 15* Parthenon Publ Group, pp. 153–162.
- Kahn F. 1997. *The Palms of El dorado*. Orstom Editions, Ed. Champflour, The International Palm Society, Marly-le-Roi.
- Kahn F. 2001a. Two Amazonian palm species of João Barbosa Rodrigues revalidated: *Astrocaryum farinosum* and *A. sociale*. *Palms*, 45: 29–36.
- Kahn F. 2001b. *Astrocaryum yauaperyense*: a synonym of *Astrocaryum murumuru*. *Palms*, 45: 42–45.
- Kahn F. 2003. Tracking down d'Orbigny's chonta palm in Bolivia. *Palms*, 47: 158–161.
- Kahn F. & E.J.L. Ferreira. 1995. A new species of *Astrocaryum* (Palmae) from French Guiana. *Principes*, 39: 221–229.

- Kahn F. & D. Gluchy. 2002. Variation in morphology of the pistillate flowers of *Astrocaryum urostachys* (Palmae) in Amazonian Ecuador. *Nord. J. Bot.*, 22: 353–360.
- Kahn F. & J.-J. de Granville. 1991. Los nombres vernáculos más comunes de las palmeras en la Amazonia. *Biota* 97: 17–32.
- Kahn F. & J.-J. de Granville. 1992. Palms in forest ecosystems of Amazonia. Springer Verlag, Berlin.
- Kahn F. & J.-J. de Granville. 1998. *Astrocaryum minus* Trail (Palmae), rediscovered in French Guiana. *Principes*, 42: 171–178.
- Kahn F. & B. Millán. 1992. *Astrocaryum* (Palmae) in Amazonia. A preliminary treatment. *Bull. Inst. fr. Ét. and.*, 21 (2): 459–531.
- Kahn F. & F. Moussa. 1999. Economic importance of *Astrocaryum aculeatum* (Palmae) in Central Brazilian Amazonia. *Act. Bot. Venez.*, 22 (1): 237–245.
- Kahn F. & G. Second. 1999. The genus *Astrocaryum* in Amazonia: classical classification and DNA analysis. *Mem. N.Y. Bot. Gard.*, 83: 179–184.
- Karsten H. 1857. *Plantae Columbiana*. *Linnaea*, 28: 241–281.
- Karsten H. 1861. *Florae Columbiae*, 1: 167.
- La Rotta C., P. Miraña, M. Miraña, B. Miraña, M. Miraña & N. Yucuna. 1989. Estudios botánicos sobre las especies utilizadas por la comunidad indígena Miraña, Amazonas, Colombia. WWF-FEN.
- Lévi-Strauss C. 1950. The use of wild plants in tropical South America. In: *Handbook of South American Indians* 6. Cooper Square publishers, New York, pp. 465–486.
- Lima R.R. & J.P.C. da Costa. 1991. Registro de introduções de plantas de cultura pre-colombiana coletadas na Amazônia. CPATU/EMBRAPA, Belém.
- Lima R.R., L.C. Trassato & V. Coelho. 1986. O tucumã (*Astrocaryum vulgare* Mart.). Principais características e potencialidade agroindustrial. CPATU, Bol. de Pesquisa, 75: 1–25.
- Listabarth C. 1992. A survey of pollination strategy in the Bactridinae (Palmae). *Bull. Inst. fr. Ét. and.*, 21 (2): 699–714.
- Lleras E. & L. Coradin. 1988. Native neotropical oil palms: state of the art and perspective for Latin America. *Adv. Econ. Bot.*, 6: 201–213.
- Llosa J., G. Couturier & F. Kahn. 1990. Notes on the ecology of *Lincus spurcus* and *Lincus malevolus* (Heteroptera Pentatomidae Discocephalinae) in forests of Peruvian Amazonia. *Ann. Soc. Ent. Fr. (NS)*, 26 (2): 249–254.
- Lorenzi H., H.M. de Souza, J.T. de Medeiros-Costa, L.S.C. de Cerqueira & N. von Behr. 1996. *Palmeiras no Brasil: nativas e exóticas*. Editora Plantarum, Nova Odessa, São Paulo.
- Martius C.F.P. von. 1824. *Historia Naturalis Palmarum*, 2: 29–90.
- Martius C.F.P. von. 1844 (1847). *Palmetum Orbignianum*. In: A. d'Orbigny, *Voyage dans l'Amérique méridionale*, 7 (3): 1–140, Paris.
- Martius C.F.P. von. 1845. *Historia Naturalis Palmarum*, 3: 261–304.
- Mejía K. 1988. Utilization of palms in eleven Mestizo villages of the Peruvian Amazon (Ucayali River, Department of Loreto). *Adv. Econ. Bot.*, 6: 130–136.
- Mejía K. 1992. Las palmas en los mercados de Iquitos. *Bull. Inst. fr. Ét. and.*, 21 (2): 755–769.
- Meyer G.F.W. 1818. *Primitiae Florae Essequiboensis*. Göttingen.
- Millán B. 1998. Estudio etnobotánico y taxonómico de especies amazónicas del género *Astrocaryum* (Arecaceae). Loreto, Madre de Dios. Tesis Magister en Botánica tropical, UNMSM, Lima, 114 p.
- Miranda I.P.A. & A. Rabelo. 2006. Guia de identificação de um fragmento florestal urbano. Editora da Universidade Federal do Amazonas e INPA, Manaus.
- Miranda I.P.A., A. Rabelo, C.R. Bueno, E.M. Barbosa & M.N.S. Ribeiro. 2001. Frutos de palmeiras da Amazônia. MCT INPA, Manaus.
- Moraes M. 2004. Flora de palmeras de Bolivia. Universidad Mayor de San Andrés. La Paz.
- Moussa F., I.P.A. Miranda & F. Kahn. 1994. Palmeiras no herbário do INPA. INPA, Manaus.
- Nascimento A.R.T., J.M. Corteletti & S.S. Almeida. 1997. Distribuição espacial de sementes e juvenis de *Astrocaryum aculeatum* G.F.W. Meyer (Arecaceae) en floresta de terra firme. In: Lisboa P.B. (Ed.). *Caxiuanã*. Museu Paraense Emílio Goeldi, Belém, Pará, pp. 287–296.
- Oboh F.O.J. & R.A. Oderinde. 1988. Analysis of the pulp and pulp oil of the tucum (*Astrocaryum vulgare* Mart.) fruit. *Food Chem.*, 30: 277–287.
- Pesce C. 1985. Oil palms and others oil seeds of the Amazon. Translated and cited by D. Johnson from the original, *Oleaginosas da Amazônia 1941*. Oficina Graficas da Revista da Veterinaria, Belém. Reference Publications, Algonac, Michigan.
- Piedade M.T.F. 1984. Ecologia e biologia reproductiva de *Astrocaryum jauari* Mart. (Palmae) como exemplo de população adaptada às áreas inundáveis do Rio Negro (igapós). Dissertação de Mestría, INPA/FUA, Manaus.
- Pinheiro C.U.B. & M.J. Balick. 1987. Brazilian palms. Notes on their uses and vernacular names, compiled and translated from Pio Corrêa's "Dicionário das plantas úteis do Brasil e das exóticas cultivadas", with updated nomenclature and added illustrations. Contributions from The New York Botanical Garden, volume 17.
- Pintaud J.-C., F. Millán & F. Kahn. 2008. The genus *Hexopetion*. *Rev. peru. biol.* 15(supl. 1): 049–054
- Pulle A. 1906. An enumeration of the vascular plants known from Surinam. Leiden, pp. 71–74.
- Ranghel A. 1941. Informe del inspector de bosques nacionales. *Tierras y Aguas* 4 (2): 5–26.
- Rocha C.B.R. & R.C.V. Potiguara. 2007. Morfometria das fibras das folhas de *Astrocaryum murumuru* var. *murumuru* Mart. (Arecaceae). *Acta Amazonica*, 37 (4): 511–516.
- Schreibers K. von. 1822. *Nachrichten von den Kaiserlichen Oesterreichischen Naturforschern in Brasilien*, 2: 12.
- Schroth G., M.S.S. Da Mota, R. Lopes & A.F. De Freitas. 2004. Extractive use, management and in situ domestication of a weedy palm, *Astrocaryum aculeatum*, in the central Amazon. *For. Ecol. Manage.*, 202 (1–3): 161–179.
- Schultes R.E. 1977. Promising structural fiber palms of the Colombian Amazon. *Principes*, 21: 72–82.
- Sist P. 1989a. Peuplement et phénologie des palmiers en forêt guyanaise (Piste de Saint-Elie). *Rev. Ecol. (Terre Vie)*, 44: 113–151.
- Sist P. 1989b. Demography of *Astrocaryum sciophilum*, an understory palm of French Guiana. *Principes*, 33: 142–151.
- Smythe N. 1989. Seed survival in the palm: evidence for dependence upon its seed dispersers. *Biotropica*, 21: 50–56.
- Stauffer F. 2000. Contribución al estudio de las palmas (Arecaceae) del Estado Amazonas, Venezuela. *Scientia Guayanae*, 21: 1–197.
- Steege J.G. van der. 1983. Bladproductie en Bladfytomassa van het Tropisch Regenbos van Suriname. CELOS rapporten 138, Universiteit van Suriname, Paramaribo, 33 p.
- Trail J.W.H. 1877. Description of new species and varieties of palms collected in the valley of the Amazon in north Brazil in 1874. *J. Bot.*, 15: 75–81.
- Uhl N.W. & J. Dransfield. 1987. *Genera palmarum; a classification of palms based on the work of H.E. Moore Jr*. Bailey Hortorium and International Palm Society, Allen Press,

- Velásquez Runh J. 2001. Wounaan and Emberá use of the fiber palm *Astrocaryum standleyanum* (Arecaceae) for basketry in eastern Panamá. *Econ. Bot.*, 55: 72–82.
- Vormisto J. 2002. Making and marketing chambira hammocks and bags in the village of Brillo Nuevo, northeastern Peru. *Econ. Bot.*, 56: 27–40.
- Wallace A.R. 1853. Palm trees of the Amazon and their uses. John van Voorst, London.
- Wessels Boer J.G. 1965. The indigenous palms of Suriname. E.J. Brill, Leiden.
- Wheeler M.A. 1970. Siona use of chambira palm fiber. *Econ. Bot.*, 24: 180–181.