GUIDE TO THE PALMS OF NORTHEASTERN BRAZIL

LARRY R. NOBLICK

UEFS Editora

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REDE PINDORAMA

Este manual de identificação das palmeiras é resultado a longa experiência cientifica do autor, Dr. Larry Noblick (Montgomery Botanical Center - MBC, Miami, USA), que se associou aos pesquisadores brasileiros no estudo da palmeiras na **Rede Pindorama**. O livro traz os gêneros e espécies da família Arecaceae que ocorrem no Nordeste, com chaves que facilitam ao iniciante à identificação dos táxons existentes. Trata-se de uma grande contribuição científica.

Além do Dr. L. Noblick, os estudos da Rede Pindorama contaram com a participação de pelo menos outros 50 pesquisadores e 45 estudantes que direta ou indiretamente participaram das atividades de pesquisas dos cinco principais projetos que a constituem coletivamente. A Rede é fruto de uma indução do Governo Federal pela "Chamada MCTI/CNPq/FNDCT Ação Transversal Nº 79/2013" do Conselho Nacional de Desenvolvimento Científico e Tecnológico (#407717/2013-7). Assim, esta rede é vinculada à Rede Nordeste de Biotecnologia (RENORBIO).

A maior parte dos pesquisadores e estudantes que se congregaram à Rede Pindorama é de universidades de diferentes estados do Nordeste. Assim os cinco principais projetos da Rede tiveram envolvimento das seguintes universidades: UEMA – Universidade Estadual do Maranhão, UEFS – Universidade Estadual de Feira de Santana, UESC – Universidade Estadual de Santa Cruz, UFAL - Universidade Federal de Alagoas, UFBA - Universidade Federal da Bahia, UFPI - Universidade Federal do Piauí, UFRPE – Universidade Federal Rural de Pernambuco, UFS - Universidade Federal de Sergipe e UNEB - Universidade do Estado da Bahia. A única instituição de ensino com atuação exclusiva na Escola Básica foi a EFA - Escola Família Agrícola de Jaboticaba (Secretaria Estadual de Educação, Bahia), instituição que se destaca ante os seus estudos associados ao licuri (*Syagrus coranata*).

Houve também uma convergência de pesquisadores de diferentes institutos de ensino e pesquisa para a temática do estudo das palmeiras, entre os quais estão: CEPLAC - Comissão Executiva do Plano da Lavoura Cacaueira – Estação Experimental Lemos Maia (Bahia), EMBRAPA Tabuleiros Costeiros - Empresa Brasileira de Pesquisa Agropecuária (Alagoas e Sergipe), EMPARN - Empresa de Pesquisa Agropecuária do Rio Grande do Norte, IESM - Instituto

de Ensino Superior Múltiplo (Maranhão), IF Baiano – Instituto Federal de Educação, Ciência e Tecnologia Baiano, e IFPB – Instituto Federal de Ciência e Tecnologia da Paraíba.

Associado à rede, também está o MBC, única instituição estrangeira da Rede Pindorama, que gentilmente possibilitou a participação do Dr. Larry Noblick. Como grande conhecedor das espécies de Arecaceae do Brasil, este pesquisador assessorou os demais pesquisadores em aspectos da biologia das espécies.

Essa Rede Pindorama, cujo nome foi inspirado no nome tupi-guarani do Brasil e que significa *terra das palmeiras*, é, portanto, uma iniciativa para ampliar o conhecimento dos recursos que essas plantas disponibilizam, e também as possibilidades de usos dos resíduos que podem por elas serem gerados. A Rede é apenas um "despertar" para um grupo de plantas que além do significado histórico, tem um importante papel na fisionomia de várias áreas do Nordeste e também importância sócio-econômica para várias comunidades e até cidades.

Francisco de Assis Ribeiro dos Santos

Coordenador da Rede Pindorama

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I would like to acknowledge Dr. Francisco de Assis Ribeiro do Santos for inviting me to participate in the Pindorama Project. He and the students and professors of the Universidade Estadual de Feira de Santana, Universidade Federal da Bahia, and the Universidade Federal Rural de Pernambuco were just the catalyst that I needed to inspire me to produce the present guide. Thanks to Montgomery Botanical Center for supporting me during the writing of this guide and especially to my colleague, Dr. Joanna Tucker Lima, for her careful reading and editing of the manuscript.

CHAPTER 1
INTRODUCTION

Brazil's Northeast (NE) is currently home to ca. 83 palm species and at least 8 hybrids. This guide contains keys and a brief description of 72 of these species with key characters that can be used for identification. The NE includes the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, and Bahia. The region is rich in palm species that have adapted to and flourish in a wide diversity of vegetation types including coastal Restinga, Atlantic Forest, arid Caatinga, Campo Rupestre and Cerrado. The Amazonian and Pre-Amazonian forest extend into western Maranhão, and some species are more Amazonian or pre-Amazonian than typical of Brazil's NE. I have excluded eleven of these species from this guide. The excluded Maranhão palm species considered to be more Amazonian are *Euterpe oleracea*, *Oenocarpus distichus*, *Syagrus inajai*, *Attalea maripa*, *Astrocaryum gynacanthum*, *Bactris brongniartii*, *Bactris gasipaes*, *Bactris major*, *Desmoncus phoenicocarpus*, *Geonoma baculifera*, and *Geonoma deversa.*

HISTORY OF PALM TAXONOMY IN THE NE

The first published account of Brazilian palms, which included those of the NE was recorded in *Historia Natural Palmarum* (Martius 1823, 1845, 1853). Later Drude (1881, 1882) revised the family for Brazil in Martius' *Flora Brasiliensis*. Barbosa Rodrigues (1903), continued the work on the Brazilian flora and included illustrations in his *Sertum Palmarum Brasiliensium*. Beccari (1916) transferred many of the species described under the genus *Cocos* by Drude and others to different genera (i.e. *Arecastrum*, *Butia*, *Syagrus*), but he never personally visited Brazil. Max Burret (1933, 1937, 1940) also described new species from the NE, even though he visited Brazil only once.

Gregorio Bondar was one of the first to begin serious work on the palm flora of the NE region, mostly in Bahia where he resided, describing several new species with their uses and economic potential (Bondar 1938a, 1938b, 1939a, 1939b, 1939c, 1939d, 1939e, 1939f, 1939g, 1939h, 1939i, 1940, 1941a, 1941b, 1941c 1941d, 1941e, 1942a, 1942b, 1942c, 1942d, 1952, 1953a, 1953b, 1954, 1959, 1964). Alex Hawkes (1952) transferred some of Bondar's new names from *Cocos* to *Syagrus* or to other allied genera, but Bondar had transferred most of the names himself (1942).

Sidney Glassman arrived in the NE ca. 1969 and together with Judas Tadeu de Medeiros-Costa, a Brazilian palm enthusiast, they collected specimens of the genus *Syagrus* (Glassman 1965, 1968a, 1968b, 1969, 1970a, 1970b, 1970c, 1971, 1972, 1978, 1979, 1987) and later *Attalea* (Glassman 1991). Dr. Pedrito Silva (1976, unpublished) assembled an unpublished list of palm species of Bahia from his personal notes, the literature, and his personal experiences working with Bondar, which I found to be a valuable source of information. Medeiros-Costa continued his work with palms and produced a palm flora for the state of Pernambuco (Medeiros-Costa 1982). His student Rosangela Lyra Lemos (1987) produced another palm flora for the state of Alagoas. Pinto and Bautista (1986) also produced a preliminary list of palms for the state of Bahia.

I first became interested in Brazilian palms in 1978–1980 and made a concerted effort to collect them during my time at the Universidade Estadual de Feira de Santana (1981–1990). Later I focused on them exclusively while working on my doctorate in Chicago (1986–1991) and produced a complete palm flora for the state of Bahia with vouchered specimens (Noblick 1991). Several new species have been described from the NE since that time (Henderson 2000, Noblick 2004, 2012, Noblick & Lorenzi 2010a, 2010b, Lorenzi *et al.* 2010, Soares *et al.* 2013, 2014), and new revisions and keys that include species from this region have also been published (Henderson *et al.* 1995, Henderson & Galeano 1996, Henderson 2000, 2001, Moraes 1996, Noblick 2017a, 2017b, Noblick & Lorenzi 2010a, 2010b). The purpose of this guide is to produce an updated list of palms from the region, incorporating all current names and information, including generic transfers and name changes (Noblick & Meerow 2015, Zona 2002).

THE PALM FAMILY IN THE NORTHEAST

Three subfamilies of palms are found in the NE: Calamoideae, Coryphoideae and Arecoideae. Most NE palms belong to the subfamily Arecoideae. The more evolutionarily primitive Calamoideae palms of the NE consist of only two species, *Mauritia flexuosa* L.f. and *Mauritiella armata* Mart. These grow mainly in temporarily flooded Cerrado vegetation and are easily identified by their fan-shaped leaves and the overlapping scales on their fruits. In the NE, all fan-leaved palm species of the Calamoideae belong to the tribe Lepidocaryeae and subtribe Mauritiinae.

Palms from the subfamily Coryphoideae are mostly fan-leaved palms with only one species found in the NE: *Copernicia prunifera*, the carnaúba wax palm. It grows in the drought-ridden Caatinga region, usually close to an available water source, such as a sandy river floodplain or a periodically flooded depression.

The Arecoideae, the largest subfamily of the NE, grow in many different habitats including coastal Restinga, rain forest, Caatinga, Cerrado, and Campo Rupestre. The Arecoideae consists of three tribes: Cocoseae, Euterpeae, and Geonomateae. All in the NE have their flowers grouped into triads (one female flanked by two male flowers). The Cocoseae are the largest occurring tribe in the NE. Their leaf sheath is typically split to the base, so they lack a crownshaft. This tribe includes three subtribes: Attaleinae, Bactridinae and Elaeidinae. The Attaleinae is the largest of the three, containing non-spiny species in the *Cocos*, *Attalea*, *Syagrus* and *Allagoptera* genera. The subtribe Bactridinae contains spiny species in the *Acrocomia*, *Astrocaryum*, and *Bactris* genera. The last subtribe, Elaeidinae is not native to the NE and includes only one species, *Elaeis guineensis*, the African oil palm or dendê, with its spiny petiole margins. It is included here because it has naturalized throughout most of the region.

The tribe Euterpeae is distinguished by a well-developed crownshaft. The most common species in the NE is *Euterpe edulis*, which is highly sought after for its edible palm heart. Introduced specimens of *Euterpe oleracea* are also commonly seen in the region, but they are only native to a very small part of Maranhão. This species is sought out for its fruit, açaí, which is used in a number of foods and beverages by health-conscience consumers.

Finally, the last tribe found in the NE is Geonomateae, which consists of several attractive, understory palm species in the genus *Geonoma*. They are distinguished by floral triads born in pits along the inflorescence branches. The above information can be summarized in the following keys to the subfamilies, tribes and subtribes of the NE.

KEY TO THE THREE PALM SUBFAMILIES FOUND IN THE NE

1. Leaves fan-like ..... 2.
– Leaves entire, bifid, trijugate, pinnate, but not fan-like ..... Arecoideae (see tribes)
2. Leaflet segments V-shaped (induplicate), fruit smooth or without scales ..... Coryphoideae (*Copernicia*)
– Leaflet segments ^-shaped (reduplicate), fruit with overlapping scales ..... Calamoideae: Lepidocaryeae: Mauritiinae (*Mauritia* and *Mauritiella*)

KEY TO THE THREE *ARECOIDEAE* TRIBES FOUND IN THE NE

1. Crownshaft present ..... Euterpeae (*Euterpe*)
– Crownshaft absent, leaf sheath split to base ..... 2.
2. Endocarp lacking pores, triads born in rachillae pits ..... Geonomateae (*Geonoma*)
– Endocarp with three distinct pores, triads not born in rachillae pits ..... Cocoseae (see subtribes)

KEY TO THE *COCOSEAE* SUBTRIBES OF THE NE

1.Spiny or prickly palms (rarely unarmed, i.e. *Bactris bahiensis*) ..... Bactridinae
– Unarmed palms except for perhaps the petiole margin
2. Peduncular bract woody, endocarp pores located at or below the middle ..... Attaleinae
– Peduncular bract fibrous, endocarp pores located at or above the middle ..... Elaeidinae (*Elaeis*)

CHAPTER 2
KEYS AND DESCRIPTIONS

The following keys and descriptions of palms of the NE are arranged from what are currently thought to be the more primitive to the more evolutionarily advanced palm groups following Dransfield *et al.* (2008). However, the figures are arranged alphabetically for those not yet familiar with the organization and relationships within the Arecaceae.

KEY TO PALM GENERA OF THE NE

1. Leaves fan-like ..... 2.
– Leaves entire, bifid, trijugate, and pinnate, but not fan-like ..... 4.
2. Leaflet segments V-shaped (induplicate), fruit smooth, plum-like, petiole spiny ..... ***Copernicia***
– Leaflet segments ^-shaped (reduplicate), fruit with overlapping scales, petiole unarmed ..... 3.
3. Large solitary palms, stems unarmed ..... ***Mauritia***
–Small to medium, frequently clustering palms, stems armed with root spines ..... ***Mauritiella***
4. Crownshaft present ..... ***Euterpe***
– Crownshaft absent ..... 5.
5. Palms unarmed (with the exception of petiole margins) ..... 6.
– Palms armed, spiny or prickly palms (with exception of *Bactris bahiensis*) ..... 12.
6. Peduncular bract fibrous, chartaceous or papery, endocarp pores absent or located above the middle, female flowers or triads born in or sunken into pits .. 7.
– Peduncular bract usually woody, endocarp pores located below the middle, female flowers not or only slightly sunken into the rachillae ..... 8.
7. Endocarp pores absent, triads of functional male and female flowers found in the same inflorescence born inside pits in the rachillae ..... ***Geonoma***

– Three clearly defined apical endocarp pores, functional male and female flowers born in separate inflorescences with only the female flowers born in pits ..... ***Elaeis***
8. Peduncular bract nearly smooth to striate, raphides present on margins of male flower petals, the two sides of the leaf form a strong V-shape ..... ***Butia***
– Peduncular bract with deep sulcate grooves or splits, raphides absent on margins of male flower petals, two sides of leaf nearly flat or may form a shallow V-shape with its clustered leaflets (rarely a strong ^-shape) ..... 9.
9. Fruits large (ca. 25 cm) with large interior cavity when mature, adapted for floating ..... ***Cocos***
– Fruits smaller with no or a small interior cavity, viable fruits do not float .... 10.
10. Palms usually producing two kinds of inflorescences on the same tree with functional male and female flowers separated into a functionally male and functionally female inflorescences, fruit outer epicarp thick, firm, durable, and fibrous ..... ***Attalea***
– Palms producing only one kind of inflorescence with functional male and female flowers in the same inflorescence, fruit epicarp thin, pliable and less fibrous ..... 11.
11. Inflorescence a spike, female flowers congested at the base or proximal end of the spike, palms usually acaulescent (except for *A. caudescens*)..... ..... ***Allagoptera***
– Inflorescence usually branched to one order, if a spike then female flowers more widely spaced, palms usually caulescent in the NE with a few exceptions ..... ***Syagrus***
12. Triads with female flowers scattered along most of the length of the rachillae ..... 13.
– Female flowers or triads located only at the very base of the rachillae..... 14.
13. Climbing palms, tips of the leaves modified into acanthophylls .... ***Desmoncus***
– Non-climbing palms, tips of the leaves without acanthophylls ..... ***Bactris***
14. Palm stem solitary and sometimes with a swollen trunk, leaves green on the abaxial surface, peduncular bract covered with dense brown fur and spines, fruit globose with an egg-shell-like epicarp, endocarp pores are deep equatorial holes ..... ***Acrocomia***
– Palms stems often clustered or acaulescent, in the NE never with a swollen trunk, leaves silvery on the abaxial surface, peduncular bract spiny, not furry,

fruit ovoid or ellipsoid, epicarp fibrous only, endocarp pores between the middle and the base, each forming a star-like pattern ..... ***Astrocaryum***

Subfamily CALAMOIDEAE (Mauritia, Mauritiella)

Brazilian species in this subfamily are dioecious and the unisexual flowers of the two sexes can rarely be distinguished from one another. These palms have fan-shaped leaves and fruits covered with overlapping scales (Fig. 16D), which are present on the young ovary as well. The palmate leaf segments are reduplicate (^-shaped), unlike most fan-leaved palms, which have induplicate (V-shaped) leaflet segments and are members of the Coryphoideae subfamily.

CALAMOIDEAE SPECIES FROM THE NE

MAURITIA

Mauritia flexuosa L.f. (Fig. 16C, 16D)

This large fan-leaved palm has a stem 35 m × 30–50 cm. It is considered by some to be the tallest palm in Brazil. This is the economically important 'buriti' palm, which has an orange mesocarp rich in vitamin A. It is common in periodically flooded Cerrado areas (humid savannahs) or coastal Restinga in Maranhão, and often occurs as groves in standing water. The overlapping scales on its moderately large attractive fruits are unmistakable.

MAURITIELLA

Mauritiella armata (Mart.) Burret (Fig. 16E, 16F, 16G)

This palm goes by the common name 'buritiana, buriti-mirim or buriti-nana', all of which translate as the small buriti. This clustering, fan-leaved palm has a stem 2–10 (–20) m × 8–12 cm, and is heavily armed with stiff, root spines along its stem. The fruits are much smaller than the *Mauritia flexuosa* fruits, but resemble them with their reddish orange to reddish-brown overlapping scales. It tends to grow in swampy areas that are seasonally flooded, such as riverbanks, humid savannas and gallery forests.

The subfamily CORYPHOIDEAE (*Copernicia*)

Brazilian species in this subfamily have fan-shaped leaves with induplicate leaflet segments and bisexual flowers, often containing functional anthers and pistils in the same flower. The fruits are smooth and lack scales of any kind.

CORYPHOIDEAE SPECIES FROM THE NE

COPERNICIA

Copernicia prunifera (Mill.) H. E. Moore (Fig. 13A, 13B, 13C)

The 'carnaúba' wax palm is a moderate-sized palm with solitary stems 10–15 m × 15–20 cm. Its fruits are like small plums, both in color and size, ca. 2.0–2.5 cm in diameter. Well-armed leaf petioles are often persistent at the base of the stem. For years its fan leaves were harvested for their wax, which was used in many products sold by the Johnson's Wax Company. *Copernicia prunifera* grows in the driest parts of the NE, in temporarily and periodically flooded areas along sandy flood plains of rivers or in low lying depressions adjacent to Caatinga vegetation.

ARECOIDEAE SPECIES FROM THE NE

Subfamily ARECOIDEAE

Brazilian species in this subfamily are monoecious, always have unisexual flowers arranged in triads with one female (pistillate) and two male (staminate) flowers. All have simple to pinnate leaves and some species have crownshafts (unsplit leaf sheath that surrounds the stem), while others do not. Four tribes occur in the NE: the Cocoseae, Elaeidinae, Euterpeae and Geonomatae, but only the Euterpeae exhibit a crownshaft. Many species in the NE belong to the Cocoseae, which have hard endocarps with three pores. Of these some are well armed with spines (Bactridinae), but most are unarmed (Attaleinae).

ARECOIDEAE

The tribe *COCOSEAE*: subtribe *ATTALEINAE* (*Allagoptera*, *Attalea*, *Butia*, *Cocos*, and *Syagrus*)

The subtribe Attaleinae have pinnate leaves with leaf sheaths split to the base, no crownshaft, and are unarmed for the most part, with the exception of a few species that have spines along the leaf petiole margin. The inflorescence is born between the leaves and is encased within two bract-like structures. The lower, shorter bract is called the prophyll and is often hidden between the leaf bases or buried below ground in the case of the stemless species. The upper bract, or peduncular bract, is larger, thicker and often woodier or chartaceous in texture. The flowers are usually born in triads near the base, but arranged in diads (two males) or singly at or near the tips of the inflorescence.

ALLAGOPTERA: BRIEF DESCRIPTION

Most species of *Allagoptera* have short underground stems with the exception of *Allagoptera caudescens* (formerly *Polyandrococos caudescens*). They all have spike inflorescences of closely spaced triads with female flowers on the proximal end and only male flowers on the distal end.

KEY TO *ALLAGOPTERA*

1. Palm usually with an aerial stem, leaf rachis over 200 cm long ..... ***A. caudescens***
– Palm usually with a subterranean or very short stem, leaf rachis less than 135 cm ..... 2.
2. Coastal species of white loose, sandy soils or old coastal plains, leaves often white waxy above, with wax often flaking off on drying ..... 3.
– Inland species of Cerrado or transitional Cerrado or Campo Rupestre vegetation, leaves not waxy above ..... 4.
3. Small palms, mostly less than 1 m, rarely to 1.2 m in height, leaflets mostly with oblique or lobed tips, middle series to ca. 24 cm long, fruits smooth, glabrous with a persistent perianth or calyx that encloses very little of the fruit ..... ***A. brevicalyx***
– Larger palms, commonly 1–1.5 (–2) m in height, leaflets mostly with acute or acuminate tips, middle series to 66 cm long, fruits covered with floccose

hairs and with a persistent perianth or calyx that encloses more than half of the fruit ..... ***A. arenaria***
4. Small palms 0.3–1.2 m in height, middle leaflets 12–32 cm long with inconspicuous transverse secondary nerves, stamens 6 (common palm in Bahia) ..... ***A. campestris***
– Larger palms, 1–2.5 m in height, middle leaflets 30–52 cm long with very conspicuous transverse secondary nerves, stamens 9–14 (rare palm in Bahia) ..... ***A. leucocalyx***

ALLAGOPTERA SPECIES FROM THE NE

1. *Allagoptera arenaria* (Gomes) Kuntze (Fig. 1D, 1E)

This species grows in coastal sand dunes and has leaves to 1.5–2 m long with acute or acuminate tips. The fruits are covered with floccose hairs and a persistent calyx or perianth encloses more than half of the fruit. It has an ample distribution that extends between the state of São Paulo and much of Bahia. The distribution of this species is thought to stop at some point just south of Salvador, Bahia.

2. *Allagoptera brevicalyx* M. Moraes (Fig. 1F, 1G)

This species is normally shorter than *Allagoptera arenaria* with leaves usually less than 1 m long and possessing leaflets with oblique or lobed tips (1F). It grows from Salvador, Bahia to all points north into the state of Sergipe. *Allagoptera brevicalyx* was formerly misidentified as *A. arenaria*, because of its similar coastal sand dune habitat, but it has smaller leaves and fruits with a very short calyx or perianth that encloses only a small portion of the fruit, leaving most of the green, glabrous fruit visibly exposed.

3. *Allagoptera campestris* (Mart.) Kuntze (Fig. 2A, 2B)

This species grows mostly in Campo Rupestre or Cerrado vegetation. It is a smaller palm with leaves rarely over 1 m in length (to 1.2 m) with inconspicuous transverse secondary veins and only six stamens in its male flowers. A fine tomentum is present on the apical portions of their fruits. *Allagoptera campestris* is more common in the interior, rather than along the coast.

4. *Allagoptera caudescens* (Mart.) Kuntze (Fig. 2C, 2D, 2E)

Formerly *Polyandrococos caudescens*, this is the only *Allagoptera* which usually has a well-developed aerial stem 4–8 m × 12–20 cm, distinguishing it from all others in the genus. However, exceptional populations with no aerial stems do grow in nutrient-poor sandy soils in Sergipe and also in Espirito Santo (fide Boudet-Fernandes, personal comm.). Even though it has a very *Allagoptera*-like spike inflorescence and the molecular data show its sister relationship to *Allagoptera*, its leaflet anatomy is distinctive enough to suggest that it probably could have remained in its own genus of *Polyandrococos*. Only *A. caudescens* have been collected as far north as southern Alagoas, and as of this writing, no species of *Allagoptera* have been collected in Pernambuco or north of it. Some argue that this generic complex contains two species, but the clustered-leaflet palms from Alagoas and Sergipe to southern Bahia are definitely *A. caudescens*.

5. *Allagoptera leucocalyx* (Drude) Kuntze (Fig. 2F)

This normally acaulescent Cerrado species has leaves up to 1–2 m long and longer middle leaflets (30–52 cm long) with conspicuous secondary transverse veins. This species can occasionally form a short aerial stem, but usually appears stemless. It characteristically has a somewhat swollen peduncle just below the inflorescence and male flowers with 9–14 stamens. The name would seem to indicate a whitish or whitish-green calyx and papillose hairs on the calyx margins of both male and female flowers may be responsible for this character.

ATTALEA: BRIEF DESCRIPTION

Attalea are among some of the most massive palms in Brazil. *Attalea* are distinguished by being monecious, but only occasionally with male and female flowers in the same inflorescence. Instead the functional male and female flowers are produced in separate inflorescences but on the same plant. At times some *Attalea* specimens appear to be predominately male or female, but they have the capability of producing either one or even both sets of inflorescences at the same time on the same plant.

KEY TO *ATTALEA*

(Including the hybrids, but excluding *A. salvadorensis*)

1. Staminate flower with normal flat lanceolate petals with acute or acuminate tips, anthers linear, relatively straight, sometimes with a slight twist ..... 2.
– Staminate flower petals with curved spoon-like or strap-like petals with acute or dentate tips, anthers coiled or severely twisted into a ball or pom-pom-like shape .. 12.
2. Palm with subterranean stem, appearing acaulescent ..... 3.
– Palm with aerial stem ..... 6.

LINEAR ANTHERS

SUBTERRANEAN STEMS

3. Coastal species of Restinga and adjacent rain forest, fruits dull green to yellow-green or grayish brown tomentose when mature ..... 4.
– Inland species of Cerrado vegetation, fruits variously colored, yellow to reddish orange turning purple or dark brown to yellow with rusty brown tomentum when mature ..... 5.
4. Coastal Restinga palm, leaflets clustered with drooping tips, staminate rachillae 8–21 cm long, fruits 10–15 cm long, smooth, glabrous, dull green to yellow green ..... ***A. funifera*** (northern portion of its range, north of Salvador, Bahia)
– Rain forest palm, leaflets evenly spaced with straight tips, staminate rachillae 4–6 cm long, fruits 4–9 cm long, fibrous with grayish brown tomentum ..... ***A. humilis***
5. Leaflets clustered, pistillate flower petals with tridentate tips, stigmas 1–3, fruit 1-seeded, yellow to reddish orange turning purple when mature ..... ***A. barreirensis***
– Leaflets regular, pistillate flower petals acute, stigmas 3–6, fruit 2–4(–6)-seeded, dark chocolate brown to yellow with rusty brown tomentum when mature ..... ***A. geraensis***

AERIAL STEMS

6. Coastal palms of Restinga and Atlantic rain forest vegetation ..... 7.
– Inland species of Campo Rupestre and Cerrado vegetation ..... 11.
7. Leaves clustered in at least the lower 1/5 of the leaf, petioles with medium to long flexible "piassava-like" fibers, often tangled in a mass where the lower leaves meet the stem ..... 8.

– Leaves regularly distributed along the rachis, petioles with short, stiff, thick, woody fibers, base of leaves free of fiber masses ..... 10.
8. Leaflets clustered for at least 3/4 or more of the leaf, leaflets drooping, fruits, smooth, dull green to yellowish green when mature ..... ***A. funifera***
– Leaflets with middle to upper leaflets regular, but the lower 1/5 to 1/2 of the leaf with clustered leaflets, leaflets more or less flaccid to rigid and straight, fruits often fibrous or tomentose and various shades of brown when mature ..... 9.
9. Leaflets drooping and clustered in the lower 1/2 of the leaf, rachis of pistillate inflorescence longer than 70 cm, pistillate portion of rachillae 6–9 cm long, fruit with two mesocarps, the outer spongy and inner fibrous 2–5 mm thick . ..... ***A. × piassabossu***
– Leaflets straight, clustered only in the lower 1/5 of the leaf, rachis of pistillate inflorescence less than 50 cm long, pistillate portion 2.5–3 cm long, fruit with only one mesocarp 1–2 mm thick ..... ***A. × voeksii***
10. Abaxial outer edge of the leaf midrib usually brown to dark brown, lighter in the center (Fig. 4G), anthers 9–14 mm long, fruit fairly large to 12 cm long, usually 2 or 3 seeded with a starchy mesocarp ..... ***A. burretiana***
– Abaxial side of leaf midrib green or not as above, anthers 6–8 mm long, fruit smaller, 3.5–7.5 (–9) cm long, usually 1-seeded with an oily mesocarp (Bondar 1938b) ..... ***A. oleifera***
11. Leaflets clustered in at least the lower 1/3 to 1/2 of the leaf, staminate inflorescence with peduncular bract 115–150 cm long and a rachis 60–85 cm long, androgynous inflorescence with peduncular bract 109–125 cm long and rachis 70–80 cm long ..... ***A. seabrensis***
– Leaflets regular or if clustered only on the lower 1/10 of leaf, staminate inflorescence with peduncular bract 155–210 cm long and rachis 83–157 cm long, androgynous inflorescence with peduncular bract ca. 200 cm long and rachis 96–100 cm long ..... ***A. pindobassu***

COILED ANTHERS

12. Palm with subterranean stem, acaulescent, staminate and pistillate inflorescences with rachillae that are arranged to one side of the rachis (unilateral) ..... ***A. eichleri***
– Palm with large aerial stem, staminate and androgynous inflorescences with rachillae that are spirally arranged on the rachis ..... 13.
13. Adaxial surface of leaf lustrous, length of rachillae 10–24 cm, mature fruit color rust-brown ..... ***A. speciosa***

– Adaxial surface of leaf glaucescent, length of rachillae 2–6.5 cm, mature fruit color brown-yellow ..... 14.
14. Fruit smaller, 6–11 × 4.5–7 cm, but persistent perianth is larger 5–6 cm deep enclosing up to 2/3 to 3/4 of the fruit with up to 8 stigmas and 8 seeds per fruit ..... ***A. brejinhoensis***
– Fruit slightly larger 8–12 × 5.5–9 cm, but persistent perianth is smaller 3.5–5.5 cm deep enclosing less than 1/3 to 1/2 of the fruit with up to 6 stigmas and 6 seeds per fruit ..... ***A. vitrivir***

ATTALEA SPECIES FROM THE NE

1. *Attalea barreirensis* Glassman (Fig. 3E, 3F, 3G, 4A)

This acaulescent Cerrado species has leaves that are strongly arching with irregularly arranged leaflets. The rachillae are spirally arranged around the rachis. Pistillate flower petals frequently have tridentate tips and male flowers have relatively flat petals with straight stamens. It usually has one-seeded fruits (4–6 × 3–5.5 cm), which are variously colored from greenish, yellowish, reddish-orange to purple when ripe or ripening.

2. *Attalea brejinhoensis* Glassman (Fig. 4B, 4C, 4D)

This large Bahian palm has a 15–30 m × 40–50 cm stem, evenly arranged leaflets, yellow streaks on the broadly flattened sheath, pseudopetiole, short petiole, and leaf rachis, and coiled anthers similar to *A. speciosa*, but it has a persistent perianth that covers nearly ½ to 2/3 of the fruit, as opposed to *A. speciosa* that only covers about ¼ of the fruit. Fruits are large (6–11 × 4.5 cm) and may have as many as 8 stigmas and 8 seed (Noblick 1991).

3. *Attalea burretiana* Bondar (Fig. 4E, 4F, 4G)

This species has a 10–30 m × 30–40 cm stem. The leaflets are evenly arranged along the rachis. The leaf petioles or pseudopetioles and sheath have short, stiff, thick, woody fibers along their margins. The male flowers have 3 (rarely 4) petals (4 petals is a character cited for *A. salvadorensis*, a species that I do not support). Some have placed *A. burretiana* in synonymy with the more robust *A. oleifera* (Henderson *et al.* 1995), which grows

farther north in the states of Alagoas, Pernambuco, and Paraíba. There is a difference in the coloration of the underside or abaxial side of the leaf midrib. In *A. burretiana* the midrib is brown or dark brown on the outer edge of the midrib with a lighter brown streak running up through the center of the midrib. In *A. oleifera*, the abaxial side of the midrib is usually just green or a uniform light grayish brown color. *Attalea burretiana*, besides being less robust, usually has fewer female flowers and fruits per rachilla (2–3), but tends to have larger fruits with more seeds, 2–3 (–4) seeds. On the other hand, *A. oleifera* has up to 5 female flowers and fruits per rachilla, and the fruits usually have only one (rarely 2) seed. *Attalea oleifera* fruit is reported to only grow to ca. 3.5 cm long (Lorenzi *et al.* 2010), which I also observed in Paraíba. In Pernambuco, the fruit of *A. oleifera* is reported to be up to 7.5 cm long (Medeiros-Costa 1982), in Alagoas to 8–9 cm long (Lyra-Lemos 1986), while in Bahia, *A. burretiana* fruit ranges from 7–11 cm long (Noblick 1991). *Attalea burretiana* is one of the most common *Attalea* palms in the coastal Atlantic Forest growing from the state of Sergipe through Bahia to northern Espirito Santo. Taking a closer look at the two species growing in close proximity at Montgomery Botanical Center (MBC), the pseudopetiole of the two species looks almost identical with sheath fibers stopping just short of where the basal leaflets begin. So in that respect, *A. burretiana* and *A. oleifera* are similar, but even in cultivation *A. oleifera* appears more robust than *A. burretiana*. Perhaps the differences we are seeing are all part of the total clinal variation observed from a more robust *A. oleifera* with more numerous and smaller fruits per rachilla in the north to a less robust *A. burretiana* with fewer and larger fruits per rachilla in the south. More robust *A. burretiana* have been observed in southern Bahia. If we accept that the two are indeed the same species and that the differences are only clinal, then the older name, *A. oleifera*, must take precedence.

4. *Attalea eichleri (Drude)* A. J. Hend. (Fig. 5A, 5B)

This acaulescent, Cerrado palm species has irregularly arranged leaflets and is distinct from all other acaulescent Cerrado species in having inflorescences with unilaterally arranged rachillae, leaving one side completely devoid of rachillae, flowers or fruits (5B). It is the only acaulescent *Attalea* in the NE with coiled anthers.

5. *Attalea funifera* Mart. (Fig. 5C, 5D)

This palm grows on coastal stabilized sand dunes and can be nearly acaulescent or produce stems 1.5–15 m × 20–25 cm. Leaflets are clustered and are unusually pendulous for an *Attalea* species, producing a very beautiful plumose leaf. The leaf sheath is composed of long fibers called 'piassava' fiber that are commercially important with some fibers as long as 3 m. Because these fibers do not easily deteriorate, they are used locally to make brooms and brushes and to bind the wooden framework of homes. In previous times, the fiber was used to make ropes to anchor ships, because it held up well in salt water. The shorter, less stiff fibers used are incorporated into 'pentes' that are used to thatch rooves (Noblick 1991). This species becomes acaulescent in the northern portion of its range, rarely growing an aerial stem and producing fibers of inferior quality.

6. *Attalea geraensis* Barb.Rodr. (Fig. 5E, 5F, 5G)

This acaulescent Cerrado species has evenly spaced leaflets and fairly erect or straight leaves. Within the inflorescence, its rachillae are spirally arranged. The flowers have flat petals with straight or nearly straight anthers. Fruits are smooth and covered by a dark brown indument. Seeds usually number 3–6.

7. *Attalea humilis* Mart. ex Spreng. (Fig. 5H, 6A, 6B)

This understory, acaulescent palm grows in the Atlantic Forest with evenly arranged leaflets. It usually has a short underground stem, but may develop a short aerial stem with age. The rachillae are spirally arranged on the rachis, its flowers have flat petals and nearly straight anthers, and its fruits are covered with a light grayish brown tomentum.

8. *Attalea oleifera* Barb.Rodr. (Fig. 6C, 6D)

This species has a stem 8–25 m × 30–50 cm and evenly arranged leaflets. *Attalea oleifera* have more rachillae, smaller fruits, and fewer seeds per fruit (usually 1 or 2) than *A. burretiana* (usually 3–4). There is also a difference in the coloration of its midrib, which is usually just plain green on is lower or abaxial surface rather than the browns described for *A. burretiana*. Lorenzi *et al.* (2010) reports that *A. oleifera* has narrower middle leaflets than *A. burretiana*

(3.5–5.5 vs. 5–8 cm), but I am not convinced that those measurements reflect a real difference, as middle leaflets of both *A. oleifera* and *A. burretiana* grown at MBC measured 4–4.5 cm, falling within the narrow range of *A. oleifera* (Lorenzi et al 2010). *Attalea oleifera* is more common in the mountainous areas of Paraíba, Pernambuco and Alagoas. In the Atlantic Forest, it is hard to tell exactly where *A. oleifera* stops and the *A. burretiana* begins. The change appears to occur somewhere between the states of Alagoas and Sergipe.

9. *Attalea pindobassu* Bondar (Fig. 6E, 6F)

This large palm has an aerial stem 5–15 m × 35–50 cm. Old leaf sheath bases persist on the stem for a fair distance below the crown. The leaflets are usually evenly arranged along the leaf rachis with the exception of the basal 1/10 portion, where the leaflets occasionally cluster (compare *A. seabrensis*). The leaflets tend to be somewhat drooping. The staminate or male flowers have a maximum of 12 stamens. The fruits are fairly large (7–9 × 4.5–6 cm) with as many as 5 seeds in each fruit, but usually 3–4. This palm is found in the Serra do Ouro (region of Jacobina and south to Tapiramutá, Bahia).

10. *Attalea salvadorensis* Glassman

I do not support this species and believe it to be a variant of *A. burretiana*, with 4 petals in the staminate flowers, rather than the normal 3 (a character occasionally seen in *A. burretiana* as well). The type species was collected in the same locality of a known population of *A. burretiana*, between Salvador and Feira de Santana in the vicinity of Amélia Rodrigues, Bahia.

11. *Attalea seabrensis* Glassman (Fig. 6G, 6H, 7A)

This palm species has an aerial stem that is 4–20 m × 25–40 cm. In the basal or proximal portion of the leaf, the leaflets are clustering or irregularly arranged for 1/3—1/2 of its length compared to *A. pindobassu*, which is clustered to less than 1/10 of its length or not at all. *Attalea seabrensis* also has a larger number of stamens in its male flowers (up to 17 compared to a maximum of 12 in *A. pindobassu*). *Attalea seabrensis* is found in the Serra do Sincorá region, which is geographically separated from the Serra do Ouro (*A. pindobassu* habitat) by a large area of arid Caatinga vegetation (Noblick 1991).

12. *Attalea speciosa* Mart. (Fig. 7B, 7C, 7D, 7E)

The 'babassu' palm is a large palm 10–30 m × 30–60 cm. It is easily recognized by near lack of a petiole, but a pseudopetiole, which is broad and flattened, with yellow streaks running longitudinally from the sheath and pseudopetiole all the way through its leaf rachis. The leaf has evenly spaced leaflets, and the male flowers have coiled anthers. The large rusty brown fruits (10–12 × 5–10 cm) have a persistent perianth covering less than ¼ of the fruit (compare *A. brejinhoensis* and *A. vitrivir*). The 'babassu' palm is an important source of palm seed oil throughout most of Brazil's NE and the Amazon region and into Bolivia as well. It can be found growing in pre-Amazonian and Amazonian forests, reaching far into the NE in Maranhão, Piauí, and into the mountains of Ceará.

13. *Attalea vitrivir* Zona (7F, 7G)

This species looks very similar to *A. speciosa* with 10–20 m × 30–55 cm stems and evenly arranged leaflets, but the upper adaxial surface of its leaves are glaucescent instead of lustrous as in *A. speciosa*, and the lower or abaxial surface is densely lepidote, instead of being smooth to moderately lepidote in *A. speciosa.* The leaf itself is rigid throughout. The male flowers have coiled anthers. The pistillate portion of the female rachillae is short, 2–3 cm long compared to 10–15 cm in *A. speciosa* (Glassman 1999), and the persistent perianth covers 1/3 to less than ½ of the fruit. The species grows along stream floodplains and has very large (8–12 × 5.5–9 cm) brownish yellow fruits versus the rusty brown fruits of most *A. speciosa*. This palm is more common in the Southeast of Brazil, especially western Minas Gerais, and southwestern Bahia.

ATTALEA HYBRIDS IN THE NE

14. *Attalea* × *piassabossu* Bondar (*A. burretiana* × *funifera*) (Fig. 7H, 7I, 8A)

The stem of this hybrid is 6–10 m × 35–40 cm. At a distance the leaflets appear flaccid or drooping like *A. funifera*. The leaf has clustered leaflets for about 1/3 to ½ of the proximal portion of the leaf, but evenly spaced leaflets like *A. burretiana* on the distal half. The fruit has an interesting two-layered

mesocarp in which the first outer layer is soft and spongy like *A. funifera* but the second inner layer is fibrous in texture like *A. burretiana*. To date it has only been found where the populations of *A. burretiana* and *S. funifera* overlap near Salvador, Bahia.

15. *Attalea* × *voeksii* Noblick ex Glassman (*A. humilis* × *funifera*).

This large, nearly acaulescent palm grows in southern Bahia just south of Ilhéus, where *A. humilis* populations overlap with *A. funifera* populations. This hybrid forms between an acaulescent palm (*A. humilis*) and one with tall aerial stem (*A. funifera*). The shortened stem of this hybrid is totally obscured by short piassava-like fibers found in *A. funifera*. The leaf is intermediate between the two with some clustering leaflets like *A. funifera* and some evenly arranged leaflets that are neither flaccid, drooping nor pendulant like *A. funifera*. The fruit is intermediate as well, being ovoid like *A. funifera*, but with a thin endocarp like *A. humilis*.

BUTIA: BRIEF DESCRIPTION

This genus has evenly spaced leaflets, and the two sides of the leaf form a strong V-shape. The rachis of the leaf is often strongly arched. Many *Butia* species have leaves that are silvery-bluish in color, and many have armed petioles, but the smaller nearly acaulescent species are usually unarmed. All *Butia* have smooth, nearly smooth, or slightly striate peduncular bracts. The leaflet anatomy is distinctive, with an adaxial (upper) surface that closely mirrors the abaxial (lower) surface of the leaf (isolateral symmetry). All *Butia* staminate flower petals have raphides along their margins (Martel *et al.* 2013). *Butia* fruits vary widely in color (green, yellow, red, orange, and purple). The endocarp often contains more than one seed with three pores located slightly above the base of the endocarp rather than basal as in *Syagrus*. The mesocarp is succulent and fleshy and not fibrous or pulpy as in *Syagrus*.

BUTIA

BUTIA SPECIES FROM THE NE

Butia capitata Mart. (Fig. 12D, 12E)

This species has a short stem 0.5–4 m tall and has distinctively arching leaves with evenly spaced leaflets with the two sides of the leaf form a strong V-shape. The greenish-yellow to yellow fruits are succulent and not pulpy as in most *Syagrus* species. The nut or endocarp, 1.8–2.4 × 1.0–1.4 cm, is fusiform (not round), with up to 3 seeds, and the endocarp pores are located slightly above the base. The peduncular bract is nearly smooth and glabrous. Sheath remnants on the petiole margins are more like stiff-fibers rather than actual teeth that are characteristic of *Butia odorata* from southern Brazil and Uruguay, which has been erroneously identified as *B. capitata*.

COCOS: BRIEF DESCRIPTION

This genus has evenly arranged leaflets and a fibrous leaf sheath. The unique aspect of this genus is its fruits, which have a very hard epicarp, very thick fibrous mesocarp, a thick, hard, bony endocarp, and an endosperm with a very large air filled central interior cavity, enabling the fruit to float long distances. This genus contains only one species, making it monotypic.

COCOS

Cocos nucifera L. (Fig. 12F)

This well-known palm starts off with a swollen base and then grows a stem to 25–30 m × 30 cm. Leaves are about 6 m long and the leaflets are evenly arranged along the rachis. The fruit is large, ca. 30 cm long. The palm is beautiful with its handsome coconuts hanging in bunches just below the crown. It is an iconic symbol of the tropics. With only one species in the genus, the additional characters listed above describe it nicely. It is one of the world's most economically important palms after the African oil palm (*Elaeis guineensis*).

SYAGRUS: BRIEF DESCRIPTION

Syagrus can have conspicuous, aerial stems or can appear stemless (acaulescent). *Syagrus* palms usually have solitary stems, or less frequently, clustering stems. Leaflets can be evenly spaced, lying in nearly one plane or more frequently clustered in groups that are commonly inserted at different angles extending in various planes. The peduncular bract is sulcate with deep, longitudinal grooves. Inflorescences can be unbranched (a spike), although most are branched to one order. The fruit possesses a hard bony or woody endocarp within a fibrous or pulpy to fleshy layer (mesocarp) covered by a thin outer skin (epicarp). Pores are located closest to the basal end of the endocarp. Fruits have only one seed (rarely two). The endosperm of the seed is homogeneous or less commonly ruminate.

KEY TO *SYAGRUS*

(Excluding the hybrids)

1. Plants erect with an aerial stem ..... 2.
– Plants without an above ground stem or only a very short or prostrate stem ..... 16.
2. Stems clustering ..... 3.
– Stems solitary ..... 5.

CLUSTERING PALMS WITH ERECT AERIAL STEMS

3. Stems usually two (twins), occasionally 4 or clustered; mature fruit broadly flattened at tip and covered with brownish lepidote scales; seed often with a central cavity, inflorescence spirally branched ..... ***S. cearensis***
– Stems usually clustering, more than two; mature fruit rounded or tapering at the tip and glabrous or only sparsely lepidote; seed solid, without a central cavity, inflorescence unilaterally branched (rachillae all on one side) ..... 4.
4. Leaflets flexible more or less membranaceous, pendant at the tips, widespread distribution ..... ***S. flexuosa***
– Leaflets stiff, thick, and more or less leathery, straight or only slightly pendant at the tips, endemic to Bahia ..... ***S. cataphracta***

SOLITARY PALMS WITH ERECT AERIAL STEMS

5. Pseudopetiole margins with well-defined teeth along its margins ..... 6.
– Pseudopetiole margins nearly smooth, with flexible or rigid fibers, but no teeth ..... 7.

6. Leaflets 18–50, rachillae 8–32, fruits not splitting at tips, endosperm ruminate at least at the margins with an intruded seed coat ..... ***S. schizophylla***
– Leaflets 70–90, rachillae 43–62, fruits split at tips, endosperm homogeneous ..... ***S. santosii***
7. Leaflets evenly spaced, the two sides of the leaf form a V-shape, and leaf rachis is recurved ..... ***S. botryophora***
– Leaflets clustered at least near the base, sides of leaf do not form a distinctive V-shape, leaf rachis more or less straight ..... 8.
8. Leaf bases in five vertical or slightly spiraled rows on the stem .....
..... ***S. coronata***
– Leaf bases not in rows; leaves spirally arranged ..... 9.
9. Rachillae devoid of flowers at the tips; naked tips folded back and forth like dried ramen noodles ..... ***S. vermicularis***
– Rachillae flowering to the tip; straight or only slightly twisted ..... 10.
10. Pistillate flowers large, 16–35 mm long..... 11.
– Pistillate flowers small, 5–15 mm long .....14.
11. Peduncular bract 9–12 mm thick, pistillate flowers rounded, fruit and endocarp nearly globose, endocarp apex with "Chinese cap" .. ***S. pseudococos***
– Peduncular bract 1–3 mm thick, pistillate flowers pyramidal, fruit and endocarp ellipsoid or conical, endocarp apex smooth or beaked, but lacking "Chinese cap" ..... 12.
12. Middle leaflets usually less than 40 cm long, fruit and endocarp conical or ovoid with a very distinctively pointed apex ..... ***S. guaratingensis***
– Middle leaflets usually more than 50 cm long, fruit and endocarp ovoid or ellipsoid, apex rather indistinct ..... 13.
13. Pistillate flower petals terminating in a long tapering valvate tip, fruit mostly glabrous, scale or short hairy indument present only at the tip ..... ***S. oleracea***
– Pistillate flower petals abruptly terminating in a short valvate tip, fruits mostly covered by a fine lepidote scale or indument ..... ***S. cearensis***
14. Pistillate flowers 7 mm long or less, endocarpal wall irregular and penetrating the seed or endosperm, irregular in cross-section ..... ***S. romanzoffiana***
– Pistillate flowers usually 5–15 mm long, endocarpal wall not irregular, smooth and circular in cross-section ..... 15.
15. Stem smooth, more or less self-cleaning, peduncular bract thin 1–3 mm thick, fruit ovoid to pear-shaped, 3.5–6 cm long ..... ***S. cocoides***
– Stem rough or with persistent leaf bases, peduncular bract thicker 2.5–7 mm thick, fruit ellipsoid, 2–3 cm long ..... ***S. comosa***

SHORT, SUBTERRANEAN or PROSTRATE STEMMED PALMS

16. Leaflet blades covered with silvery pubescence abaxially, fruits red to reddish-orange, small 1.0–1.3 × 0.6 –0.7 cm ..... ***S. itapebiensis***
– Leaflets blades glabrous to waxy abaxially, fruits green, brown, yellow, orange, and greater than 1.3 cm long and 1.0 cm in diameter ..... 17.
17. Leaflets all deflexed (bent downwards) or strongly drooping .....
..... ***S. harleyi*** (lower elevation form)
– Leaflets in one plane or in various planes but not all deflexed or drooping ..... 18.
18. Leaves gray-blue, silvery-blue or silvery-green ..... ***S. microphylla***
– Leaves various shades of light to dark green or dark blue-green ..... 19.
19. Leaves erect to strongly ascending in habit, leaves usually coriaceous, often with visible prostrate trunk ..... 20.
– Leaves more prostrate or spreading in habit and usually membranaceous (prostrate leaves tend to be more coriaceous), trunk usually short, subterranean, not prostrate nor visible ..... 21.
20. Inflorescence covered with a fine dense white tomentum .....
..... ***S. werdermannii***
– Inflorescence glabrous ..... ***S. vagans***
21. Leaflets evenly arranged along the rachis with only slight clustering at the very base ..... 22.
– Leaflets clustering along most of the length of the rachis ..... 23.
22. Rachis of inflorescence 0–5 cm with up to 3 (rarely 6) rachillae .....
..... ***S. glazioviana***
– Rachis of inflorescence 10–39 cm with up 5–31 rachillae.....
..... ***S. harleyi*** (higher elevations)
23. Middle leaflets 10–20 cm long, newer leaflets often whitish or glaucous abaxially, tightly clustered and highly divergent ..... ***S. allagopteroides***
– Middle leaflets 20–66 cm long, green to pale green abaxially, loosely clustered, nearly lying in the same plane ..... ***S. glazioviana***

SYAGRUS SPECIES FROM THE NE

1. *Syagrus allagopteroides* Noblick & Lorenzi (Fig. 16H)

This solitary palm has a short subterranean stem. The plant itself is about 50 cm tall with leaf midribs 23–52 cm long. Leaflets are arranged much like those on an *Allagoptera* leaf with tightly clustered leaflets inserted at various angles and thus the name. The inflorescence is a small spike about 6–17 cm long, and mature fruit grow to 3.3 cm and are usually green when mature. On closer study, this palm species unfortunately included two taxa (see illustration in Lorenzi *et al.* 2010). The true *S. allagopteroides* from western Bahia and Goiás have dark green foliage with a waxy bloom on the underside of their clustered leaflets. The other *Syagrus allagopteroides*, also illustrated in Lorenzi *et al.* (2010), has more leathery leaves that are green on both sides, and occurs mostly in Minas Gerais. Its leaves also tend to be more procumbent. Both grow in open Cerrado (savanna) vegetation, sandy soil in full sun.

2. *Syagrus botryophora* (Mart.) Mart. (Fig. 17A, 17B, 17C)

This solitary palm has a stem 6–18 m × 15–25 cm. The leaf midrib is 180–300 cm long with evenly spaced leaflets. The inflorescence is branched and 30–69 cm long. Mature fruit grows to 5 cm and is yellow to orange in color. Key characters are the recurved leaves with regularly arranged leaflets, the two sides of the leaf forming a strong V-shape, and a thick (0.8–1.2 cm) peduncular bract. The younger trees hold onto their lower leaves for quite a while until the tree begins to flower and fruit, and then the lower leaves drop off and the crown becomes more compact. This is one of the fastest growing palms, growing ca. 1.5 meters a year. It grows in the Atlantic Forest below 400 m in lateritic clay soils along the eastern Atlantic coast from Sergipe to Espírito Santo. The species is protected in a few of the national parks along this coast.

3. *Syagrus cataphracta* (Mart.) Noblick (Fig. 17D, 17E)

This small clustering, occasionally solitary palm has a stem 1–2.5 (–4) m × 2–10 cm (ca. 15 cm in diameter with persistent leaf sheaths) and is easily distinguished from other *Syagrus*. It has been confused with *Syagrus flexuosa* by its clustering habit, unilaterally branching inflorescence, clustering leaflets, large pistillate flowers, and large ellipsoid fruits; however, it differs

in having thinner stems, stiffer plumose leaves, a white waxy bloom on the abaxial side of somewhat coriaceous, non-pendulant, narrower leaflets, and a distinct leaflet anatomy with many large fiber bundles (Noblick, 2017b). This palm occurs in high elevation disjunct Cerrado and Campo Rupestre areas in the central part of Bahia, on sandstone outcrops or in fine sand (Abaira, Jussiape, Mucugê, Palmeiras, and Caetité). Part of its population is protected within the Parque Nacional da Chapada Diamantina.

4. *Syagrus cearensis* Noblick (Fig. 17F, 17G)

This solitary to clustering palm has a stems 4–10 m × 10–18 cm. It frequently has two stems, but may form multistemmed clumps. Its leaf midribs are 230–320 cm long with clustering leaflets. The inflorescence is branched and 45–85 cm long. This palm has an unusual propensity to form twins from a single seed. The pale yellowish, 4 cm long fruits are flattened at their apex, and are covered with fine brownish lepidote indument. This palm grows in Ceará, Pernambuco, Paraíba and Alagoas, in the seasonally dryer portions of the fragmented Atlantic Forest, on hilly and mountainous terrain, as well as in the arboreal Caatinga in the interior at elevations of 100–750 m. I am not aware of this palm occurring within any of the national parks, so it is relatively unprotected, although locally common.

5. *Syagrus cocoides* Mart. (Fig. 17H, 17I, 18A)

This small-crowned, solitary palm has a stem 2–9 m × 6–12 cm. The leaf midribs are 80–180 cm long, and it has clustering, very narrow leaflets that form plumose leaves. The inflorescence is branched and 21–58 cm long. The obpyriform (pear-shaped), large (3.5–6.0 cm), yellow-green fruit is distinctive. While maturing, the fibrous fruit mesocarp splits irregularly at the apex exposing the inner nut. The plant grows in eastern Amazonas, Pará, Maranhão, Piauí, Tocantins, Goiás and Mato Grosso, in the Amazonian or pre-Amazonian forest, gallery forest and Cerrado, usually in rocky terrain to 500 m elevation. The palm is widespread and under no immediate threat.

6. *Syagrus comosa* (Mart.) Mart. (Fig. 18B, 18C)

This solitary, slow-growing palm usually has a short 1–3 m × 6–12 cm stem, rarely growing up to 8 m. Its leaf midribs are 60–140 cm long with clustering

leathery leaflets. The inflorescence is branched (rarely a spike) and 13–32 cm long. Mature fruit grows to 3 cm and is yellowish-green in color. The palm has small rounded female flowers, ca. 5–10 mm long, coriaceous leaves that show raised veins on the upper surface when dried, and woody peduncular bracts. This palm has a wide distribution covering much of Brazil and parts of eastern Bolivia. In the NE, this Cerrado-loving species grows in Bahia, Maranhão, and Piauí, in open areas, principally over rocky terrain and slopes to 1200 m elevation. The palm is widespread and is protected in several national parks.

7. *Syagrus coronata* (Mart.) Becc. (Fig. 18D, 18E, 18F))

This solitary, slow-growing, drought-resistant palm has a stem 3–10 m × 15–25 cm. *Syagrus coronata* leaf midribs are 120–280 cm long with clustering leaflets. The inflorescence is branched and 30–88 cm long. Mature fruit grows to 3 cm and is greenish-yellow in color. Distinguishing features include an angular trunk, leaf bases arranged in 5 rows, no apparent internodes, and thick flat woody sheath fibers. This plant grows mostly east of the Rio São Francisco in Bahia, northern Minas Gerais, Sergipe, Alagoas and southern Pernambuco, in dry Caatinga vegetation and semideciduous forests, as well as in the transitional zones between Restinga and Cerrado. This species is widespread and is currently under no threat of extinction, although its numbers are gradually decreasing.

8. *Syagrus flexuosa* (Mart.) Becc. (Fig. 18G)

This common clustering, Cerrado species has stems 1–5 m × 6–15 cm. Its leaf midribs are 95–110 cm long with clustering leaflets. The palm has plumose leaves and pendulant membranaceous leaflets with drooping tips, a unilaterally branched inflorescence 7–36 cm long with large 2 cm long female flowers, and large ellipsoid fruit. Mature yellowish-green fruit grows to 5.5 cm. This palm is found in Bahia, Tocantins, Goiás, Mato Grosso, Mato Grosso do Sul, São Paulo and Minas Gerais, in Cerrado with sandy soils. This is the most common clustering palm in Brazilian Cerrados and is protected within many national parks.

9. *Syagrus glazioviana* (Dammer) Becc. (Fig. 18H, 18I)

This solitary to clustering palm has a subterranean stem, and grows to ca. 1 m tall or less. Leaf midribs 37–129 cm long support regular to loosely

clustering coriaceous leaflets that are long, fairly narrow, and often dark bluish green. The inflorescence is usually a spike (occasionally branched) 6–17 cm long. Mature yellowish-green fruit grows to 3 cm. This palm has been repeatedly misidentified as *S. petraea*, but differs in its leaflet anatomy and overall habit. Significant diversity seen in its leaflet anatomy indicates that this species merits further study (Noblick 2017b). The plant occurs in open or semi-open Cerrado areas of the planalto region in Minas Gerais, Goiás, Bahia, and Tocantins. It is a widespread species that is contained within the boundaries of several national parks.

10. *Syagrus guaratingensis* Noblick (Fig. 19A, 19B, 19C)

This rock-loving palm has a solitary, slender columnar stem, which is 2–4 m × 9–15 cm. It has leaves with leaf midribs 175–240 cm long and clustering leaflets. The inflorescence is branched with a rachis 21–42 cm long. Mature fruit to 4 cm long is orange-brown in color. Until recently, researchers (including myself) have confused this species with S. *picrophylla* or *S. lorenzoniorum* (Noblick 2018), but *S. guaratingensis* fruit and nut are conical and not globose or ellipsoidal, it has no or very little leaf petiole and leaves display ramenta on the underside of the leaflet veins, much like *S. lorenzoniorum*. This palm is named for the municipality in which it was first discovered and in which it appears so far to be an endemic. This species has only been seen and collected in Guaratinga, Bahia growing on the top or sides of rock monoliths in very thin soils. Its leaflet anatomy is distinctive and easily separates it from *S. lorenzoniorum* and *S. picrophylla*. Because of its rocky, inaccessible, montane habitat, which is unsuitable for agriculture or other uses, this species is not threatened by anything but perhaps fire.

11. *Syagrus harleyi* Glassman (Fig. 19E, 19F, 19G, 19H)

This solitary to clustering palm has a very short, subterranean stem. It has leaf midribs 60–180 cm long with regularly distributed leaflets, which are stiff and erect at high elevations (Fig. 19A), but pendant and flaccid at lower ones (Fig. 19C). The tall inflorescence is branched and 18–40 cm long, while its branches are only 7–17 cm long. Small mature fruit up to 2.5 cm long is rusty or orangish-brown in color. This plant is endemic to Bahia in the region of the Chapada Diamantina, in high elevation Campo Rupestre, over sandy and rocky soils. It is preserved within the boundaries of the Chapada Diamantina national park.

12. *Syagrus itapebiensis* (Noblick & Lorenzi) Noblick & Meerow (Fig. 20A, 20B, 20C)

Syagrus itapebiensis has a short, underground stem and was transferred from *Lytocaryum* (Noblick & Meerow 2015). The inflorescence is unique in that all the inflorescence branches appear to be oriented in nearly the same plane. The peduncular bract often tightly embraces the peduncle with no or little expanded portion, which is very atypical of most Attaleinae palms, but has been rarely observed in some grassy *Butia* species, i.e. *Butia exospadix* (Noblick 2006). As the inflorescence emerges from the peduncular bract and staminate flowers begin to open, the peduncle is shorter than the leaves; as the female flowers become receptive and the fruits mature to a reddish color, the peduncle expands far beyond the peduncular bract and often above the leaves themselves. Fruit have a very thin endocarp and are very small (1.2–1.5 cm long) in comparison to most other *Syagrus*. This species is rare and occurs on the drier upper shaded, rainforest slopes on clay soils. This palm is known from only one forest valley in the Municipio of Itapebi, Bahia. Loss of habitat has brought this palm to near extinction status. Much of the regions natural forest has been converted into pasture, and it does not occur within any protected areas, making this species critically endangered, if not nearly extinct in the wild. Nevertheless, it is being successfully cultivated, providing a glimmer of hope for its survival.

13. *Syagrus microphylla* Burret (Fig. 20D, 20E, 20F)

This small, solitary or occasionally clustering palm has a short subterranean stem. It is a very attractive palm with beautiful silvery, glaucous blue foliage. The plant is less than 50 cm tall with leaf midribs 30–62 cm long and clustering leaflets. The inflorescence is 7–18 cm long with 2–13 branches. The small, mature fruit grows to 2.5 cm and is greenish-yellow in color. This plant is endemic to the state of Bahia, in the Chapada Diamantina region (Serra do Tombador). It grows in the transition between Caatinga and Campo Rupestre, at elevations above 800 m, generally in sandy gravelly soils to very rocky habitats. This species is protected within the Chapada Diamantina National Park.

14. *Syagrus oleracea* (Mart.) Becc. (Fig. 21A, 21B, 21C)

This medium-sized, solitary palm has a stem 5–20 m × 15–30 cm. Its leaf midribs are 180–380 cm long with clustering leaflets. The inflorescence is

branched and 40–93 cm long. Mature fruit grows to 5.5 cm and is greenish-yellow in color. The species is similar to *S. romanzoffiana*, but leaflets are stiffer and not pendulant, female flowers are larger (13–27 vs. 6 mm), fruits are larger (4–5.5 vs. 2–3 cm), and the nut is smooth on the inside surface of the endocarp and round in cross-section. This plant grows in Bahia south to Paraná, Mato Grosso do Sul, Goiás, Mato Grosso, Tocantins and Minas Gerais, in semideciduous forests and Cerrados. The species has a wide distribution and some plants are protected within national parks. The palm is prized by locals for its tasty meristem (palm heart) and is often chopped down, but by the same token, the palm is cultivated by many for its palm heart and is also utilized as a popular street tree.

15. *Syagrus pseudococos* (Raddi) Glassman (Fig. 21D, 21E, 21F, 21G, 21H)

This is a medium to large palm with a stem 3–10 m × (10–)15–25 cm and self-cleaning. Distinguishing characters are its large, 9–12 mm thick peduncular bract with the expanded portion measuring 40–56 × 21–27 cm width (measured in a straight line across the bract). It has large rounded pistillate flowers 20–22 × 15–20 mm, resembling the rounded pistillate flowers of the coconut palm, except a bit smaller. The endocarp is globose with a distinctive apex shaped like a broadly triangular "Chinese cap". The palms grow at the base of the granitic mastiffs, as well as on the slope and top. In the NE, I have only seen it in Guaratinga. Although they grow in a similar habitat as *S. guaratingensis*, I have not seen the two growing together, so they may have slightly different ecological or soil requirements. I believe that *S. guaratingensis* may be slightly more drought tolerant. *Syagrus pseudococos* is more common and currently not threatened, except by fire and the expansion of pastures.

16. *Syagrus romanzoffiana* (Cham.) Glassman (Fig. 22A, 22B, 22C, 22D)

This medium to large, solitary palm has a stem 7–15 m × 20–50 cm. The palm has plumose leaves with pendulant, clustering leaflets and leaf midribs 170–440 cm long. Its long inflorescence is branched and 81–167 cm long, and is distinguished by small female flowers (less than 6 mm). A thick white tomentum covering its pistils persists as a white tuft of hairs at the tip of its ca. 4 cm long fruits. The irregular endocarp (nut wall) that penetrates

into an irregular, non-spherical seed makes this species unique among *Syagrus*. Mature fruit is variable in color (red-orange, orange or yellow). This species has a wide distribution and grows from Bahia south to Rio Grande do Sul, Uruguay, Paraguay and Argentina, and west to Mato Grosso do Sul and Goiás, in the Atlantic and semideciduous forests of the Paraná basin. The species is highly cultivated as an ornamental and is not threatened.

17. *Syagrus santosii* K. Soares & C.A.Guim. (Fig. 22E, 22F, 22G)

This short to moderately-sized, solitary palm has a stem ca. 1.6–4.4 m × 15–21 cm; generally inclined for 0.6–3.5 m with persistent spiny leaf bases. According to Soares *et al.* (2014), its spiny petioles are similar to *S. schizophylla*, but *Syagrus santosii* differs from *S. schizophylla* by its larger fruits, larger endocarps, and homogeneous endosperm. The *S. santosii* inflorescence also has many more rachillae (43–62 vs. 14–38). Its leaf rachis is only slightly curved with 71–90 leaflets, while *S. schizophylla* is notably curved with only 18–50 leaflets. *Syagrus schizophylla* grows a short distance from the coast in the Restinga region, while *S. santosii* grows more than 70 km from the coast along the Rio Jequitinhonha in the rainforest region. Only one population of this species has been located on the margins of the Rio Jequitinonha, in the Municipio of Itapebi, Bahia, Brazil, where it grows for a distance of 4 km along the southern margin of the river at an elevation of 111–119 m on rocky 80° slopes in areas of heavy brush in sandy clay soils. This is not a protected area, making it vulnerable, but since the land is unsuitable for agriculture, the species is not under any immediate threat, although sections of the population have been recently damaged by fire. Fire that was set to restore pastures located above the river, but penetrated the palm population and burned to the river.

19. *Syagrus schizophylla* (Mart.) Glassman (Fig. 22H, 22I)

This short palm has a dense, somewhat flattened crown, and a stem 1–4 m × 10–15 cm with very short internodes. Large spiny teeth arm its petiole or sheath margins, and its leaf bases persist on the stem. It has leaf midribs 70–190 cm long with regularly spaced leaflets. The long inflorescence (ca. 2 m) has a long peduncle and is branched with a rachis 18–60 cm long. Mature fruit grows to 3.5 cm and is reddish-yellow to orange in color. The endosperm is ruminate and is the known cause for its bitter-tasting nut. Its common Tupí

Indian name "arikuryroba" means long infructescence (arib) with nuts (kury) that are bitter (rob). This species grows in Pernambuco, Alagoas, and Sergipe, and along most of the coast of Bahia, in open coastal areas along the beaches, as well as in the nearby Restinga forests, generally in sandy soils. This palm is somewhat threatened because its natural habitat is highly prized for coastal building and development sites.

18. *Syagrus vagans* (Bondar) A. D. Hawkes (Fig. 23A, 23B, 23C)

This solitary palm, which sometimes appears clustering and stemless, has a prostrate stem. The prostrate stem of this palm causes the crown of the palm to constantly shift location as the stem grows and thus the name "vagans" or wandering. This drought-resist plant is about 1–2 m tall with stiff erect leaves and narrow tooth-like fibers along the sheath and pseudopetiole. It has leaf midribs 44–185 cm long with stiff, leathery clustering leaflets. The inflorescence is branched to 18–65 cm. The narrowly ellipsoid fruit grows to ca. 3.7 cm and remains green in color when mature. This species is mostly endemic to the state of Bahia and a small part of Minas Gerais in arid Caatinga vegetation, above 250 m elevation. This palm is not threatened due to the low agricultural value of its habitat.

19. *Syagrus vermicularis* Noblick (Fig. 23D, 23E)

This solitary palm has an 8–15 m × 12–20 cm stem. This is the only *Syagrus* species with rachillae tips completely devoid of flowers and coiled and twisted like ramen noodles. The young fast growing palms have stems covered by a white waxy coating that disappears with age. Some specimens dehisce their peduncular bract early. The large endocarps (4.5–5.0 × 3.5–4.0 cm) cm possess a prominent trilobed beak. It just barely enters the NE via the state of Maranhão and should probably be considered a palm of pre-Amazonian forests, but because of its unique inflorescence it is included here.

20. *Syagrus werdermannii* Burret (Fig. 23F, 23G)

This solitary palm sometimes appears to be clustering, and has a subterranean prostrate stem. The total height of this palm is about 1 m tall, with short stiff leaves, and leaf midribs 26–80 cm long with stiff clustering leaflets. The inflorescence 16–43 cm long is branched with 6–18 rachillae. Mature fruit grows to 2.5 cm and is brownish-green in color. Its subterranean prostrate stem resembles a diminutive version of *S. vagans* to which it is probably related. Unlike glabrous *S. vagans*, this species has a branched inflorescence covered with fine dense grayish-white to light brown, wooly tomentum or hairs. It is endemic to the state of Bahia, occurring in a high elevation Cerrado in sandy soils restricted to a small area of the municipio of Caetité (central-west Bahia), where it is seriously threatened with extinction due to the increasing cultivation of soybeans.

NATURAL *SYAGRUS* HYBRIDS OCCURRING IN THE NE

21. ***Syagrus* × *camposportoana*** (Bondar) Glassman (*S. coronata* × *S. romanzoffiana*) (Fig. 24A)
This hybrid resembles a very robust *S. coronata*, but the interior of the endocarp wall is slightly irregular like that of *S. romanzoffiana*.

22. ***Syagrus* × *costae*** Glassman (*S. coronata* × *S. cearensis*) (Fig. 24B, 24C, 24D, 24E)
This hybrid has the stiff woody fibers along its pseudopetiole like *S. coronata*, except they are narrower; and the leaves are spirally arranged like *S. cearensis*, instead of in rows as in *S. coronata*.

23. ***Syagrus* × *matafome*** (Bondar) A.D.Hawkes (*S. coronata* × *S. vagans*) (Fig. 24F, 24G, 24H, 24I, 24J)
This solitary, caulescent palm has narrow woody fibers along its pseudopetiole like *S. coronata*, but with spirally arranged leaves like *S. vagans*.

24. ***Syagrus* × *lacerdamourae*** K. Soares & C. A. Guim. (*S. coronata* × *S. botryophora*) This hybrid has a tall, slender, smooth stem like that

S. botryophora, but the leaves have clustered leaflets in divergent planes and a peduncular bract similar to *S. coronata* (Soares *et al.* 2014).

25. ***Syagrus* × *mirandana*** Noblick (*S. coronata* × *S. microphylla*) (Fig. 25A, 25B, 25C)
These hybrids have subterranean stems and inflorescences that extend beyond their leaves like *S. microphylla*, but the leaves themselves resemble *S. coronata* and the inflorescence is similar to a small *S. coronata* as well.

26. ***Syagrus* × *tostana*** (Bondar) Glassman (*S. coronata* × *S. schizophylla*) (Fig. 25D)
Leaves are greener and not grayish green and are arranged spirally on the stem as in *S. schizophylla*, but the plant is more robust with stiffer leaves that are not arching and have wider petiole bases as in *S. coronata*.

ARECOIDEAE

The tribe COCOSEAE: subtribe BACTRIDINAE (*Acrocomia*, *Astrocaryum*, *Bactris*, *Desmoncus*)

The members of this subtribe are all spiny.

ACROCOMIA: BRIEF DESCRIPTION

These palms are well armed on their stem, leaves and inflorescences. Many species have aerial stems, but some are acaulescent. It is my opinion, however, that the acaulescent ones should be returned in their own genus, *Acanthococos* as evidenced by their significantly different leaflet anatomy (Vianna *et al.* 2016).

ACROCOMIA

ACROCOMIA SPECIES FROM THE NE

1. *Acrocomia aculeata* (Jacq.) Lodd. (Fig. 1A)

This solitary palm has a 6–15 m × 15–30 cm stem. It can be clean and spiny, but it is often clothed with persistent spiny leaf sheath remains. The peduncular bract is covered by a thick tomentum and fine spines as is

A. intumescens. Fruits are 3.5–5.0 cm in diameter and are globose or subglobose with an egg-shell-like epicarp, an oily, spongy, fibrous mesocarp and a woody or bony endocarp. This species is the *Acrocomia* most likely to be collected throughout Brazil and Paraguay for its biodiesel potential.

2. *Acrocomia intumescens* Drude in C. F. P. von Martius & auct. suc. (Fig. 1B, 1C)

This species has a stem ca. 8 m tall. It differs from *A. aculeata* in that it nearly always displays a self-cleaning ventricose (belly) stem. The middle third of the trunk is usually swollen. The peduncular bract is covered by a thick tomentum and fine spines as is *A. aculeata*. Vianna *et al.* (2016) have proven it to be a unique species via its distinctive leaflet anatomy. Its fruits are similar to *A. aculeata*, but a bit larger in size, 3.7–5.5 cm in diameter. This species is endemic to the NE (Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará).

ASTROCARYUM: BRIEF DESCRIPTION

Astrocaryum are well-armed palms, with vicious flat spines. They have pinnate, fibrous leaves with a whitish or silvery lower or abaxial surface. Each rachilla has but one or two triads with well-developed female or pistillate flowers at the base, followed by an apical portion with no flowers and finally a cluster of male flowers. The endocarp or nut has three star-resembling pores near the base and thus the name *Astrocaryum* or "star nut".

KEY TO *ASTROCARYUM*

1. Acaulescent palm, leaf segments less than 45 in number; rachis of inflorescence short to 20 cm ..... ***A. campestre***
– Arborescent palms up to 6–10 m in height, leaf segments greater than 60 in number; rachis of inflorescence relatively large 30–60 cm ..... 2.
2. Southern Atlantic Forest palm, usually 1(–2 or 3) pistillate flowers per rachilla, fruit epicarp covered with fine rigid reddish brown hairs (often sloughing off), fruit almost globose ..... ***A. aculeatissimum***
– Northern Atlantic and Amazonian forest palm, usually (2–)3–4 flowers per rachilla, fruit epicarp smooth, glabrous, yellow to orange, fruit ellipsoid ..... ***A. vulgare***

ASTROCARYUM SPECIES FROM THE NE

1. *Astrocaryum aculeatissimum* (Schott) Burret (Fig. 2G, 3A, 3B)

This very spiny, clustering palm has 4–8 m × 11–15 cm aerial stems that are heavily armed at the internodes. The epicarp of the fruit is covered with hairs and bristles, which may fall off at maturity. Each rachilla usually has only one flower (2–3 in more vigorously growing individuals). This species is only found in the extreme south of Bahia in the Atlantic Forest.

2. *Astrocaryum campestre* Mart. (Fig. 3C, 3D)

This common Cerrado species has a short, subterranean stem, leaves up 2 m long and an inflorescence with a short rachis to 10 cm long. Apical pinnae or leaflets are threadlike and 2–4 fruits per rachilla are located on the proximal portion of the inflorescence.

3. *Astrocaryum vulgare* Mart.

This large spiny, caespitose palm have stems to 20 m × 20 cm. This is the only species encountered in the extreme western parts of the NE. One that I collected in the northwest corner of Bahia along a river margin was originally identified as *A. jauari*, but this was probably a mistake, as the expert in this genus (F. Kahn) shows it to be strictly Amazonian (Lorenzi *et al.* 2010). The only other *Astrocaryum* recorded from this region of the NE is *A. vulgare*.

BACTRIS: BRIEF DESCRIPTION

Bactris are solitary or clustering palms. Usually spiny, but rarely unarmed. The leaflet tips are acute or rarely praemorse. *Bactris* have connate petals for 1/3–1/2 their length. The endocarp has three pores located near the equatorial region of the nut or near its apex. Flowers are nearly all born in triads, even to the tips of its branches or rachilla, unlike *Astrocaryum* and *Acrocomia* which are born only on the proximal or basal portion of the rachilla.

KEY TO *BACTRIS*

1. Rachillae few, 1–6 ..... 2.
– Rachillae numerous, more than 6 (rarely 6 or less in *B. glassmanii*) ..... 7.
2. Leaf with wedge-shaped (praemorse) leaf segments ..... ***B. caryotifolia***
– Leaf with normal, lanceolate leaf segments or leaf entire ..... 3.
3. Leaf segments evenly distributed, spines yellow; fruits ellipsoid. ..... ***B. horridispatha***
– Leaf segments irregularly distributed, clustered or leaf entire, or if evenly distributed then spines black; fruits globose or depressed-globose ..... 4.
4. Rachillae 1 ..... ***B. bahiensis***
– Rachillae 2 or more ..... 5.
5. Leaf sheath, petiole and rachis white-wooly tomentose intermixed with fine black spines; rachillae 4–6; Restinga palm of sand dune habitats ... ***B. soeiroana***
– Leaf sheath, petiole and rachis glabrous, bristly or brown tomentose intermixed with fine black spines; rachillae 2 or 3 (rarely 4); forest palms ..... 6.
6. Underside of leaf with velvety hairs; fruits 1.0–1.5 cm diameter, purple-black, depressed-globose ..... ***B. pickelii***
– Underside of leaf glabrous or bristly; fruits less than 0.8 cm in diameter, red, globose ..... ***B. hirta***
7. Palms usually acaulescent, rarely with 1 m trunk; fruit red armed with tiny black spines ..... ***B. acanthocarpa***
– Palms with well-defined stems; fruit yellow or purple-black, glabrous ..... 8.
8. Leaves with black to reddish brown spines ..... 9.
– Leaves with yellow spines ..... 10.
9. Leaf petiole with narrow, round, black spines to 7 cm; abaxial surface of leaf whitish with short white tomentum; fruit yellow at first then purple ..... ***B. vulgaris***
– Leaf petiole with wide, flat, black to brown spines to 4 cm; abaxial surface of leaf pale green; fruit purple-black ..... ***B. ferruginea***
10. Stem less than 2 cm in diameter; leaf segments 25 or less; fruit yellow, to 0.8 cm in diameter (larger in southern Bahia) ..... ***B. glassmanii***
– Stem 4–10 cm in diameter; leaf segments 30 or more; fruit purplish black, 1.0–1.5 cm in diameter ..... 11.
11. Inflorescence large with 30 or more rachillae; wet to dry secondary forest and roadsides ..... ***B. ferruginea***
(yellow spiny form tentatively called var. ***xanthacantha*** (Noblick 1991))
– Inflorescence moderate with 10–25 rachillae; swampy habitats often with standing water, in water-logged soils or very wet forest ..... ***B. setosa***

BACTRIS SPECIES FROM THE NE

1. *Bactris acanthocarpa* Mart. (Fig. 8B, 8C, 8D)

This palm has a subterranean or a very short aerial stem. The leaflets are clustered, and the infructescence is nestled between spiny petioles. The infructescence has a spiny, fibrous peduncular bract that quickly disintegrates into a mass of loose fibers, leaving the bright red or reddish-orange, black, spiny covered fruits exposed and thus the name *acanthocarpa*, 'spiny fruit" (formerly *B. humilis*).

2. *Bactris bahiensis* Noblick ex A. J. Hend. (Fig. 8E, 8F, 8G)

This small, nearly spineless understory palm has solitary or clustering stems 1–2 m × 0.5–1.0 cm. It has glossy green leaves that are smooth and glabrous on the lower surface. Its inflorescence is a very simple, erect spike that produces yellow green to pale green fruit. It looks very similar to the Amazonian *B. simplicifrons* except for the erect spike inflorescence, rather than a strongly recurved peduncle characteristic of *B. simplicifrons*.

3. *Bactris caryotifolia* Mart. (Fig. 8H)

This small clustering, understory species has 1–1.5 m × 1–2 cm stems and is occasionally seen in the southern portion of Bahia. It is unmistakable with its wedge-shaped leaflets like a *Caryota* or 'fish-tail' palm and yellow spines.

4. *Bactris ferruginea* Burret (Fig. 9A, 9B, 9C)

This is the largest *Bactris* species in the NE, typically with clustering, spiny stems 4–9 m × 6–10 cm. It has irregularly arranged, clustered pinnate leaves. The spines on this palm are usually a rusty brown color and thus the name, which means rusty. This species has a very large peduncular bract 60–75 cm long. Fruit are 1.5–2.3 cm and a dark, lustrous purple. A variety of this palm with yellow spines grows south of the Rio Jequitinonha in southern Bahia.

5. *Bactris glassmanii* Med.-Costa & Noblick ex A. J. Hend. (Fig. 9D, 9E, 9F)

This clustering, understory palm has thin, spiny stems 1–3 m × 1–1.5 (–3) cm with short flat yellowish spines. It has clustering pinnate leaflets. The thin peduncular bract typically curls downward, bending its apex toward the base of the bract and completely envelopes the inflorescence like a huge mouth. Occasionally the bract rolls in from the sides. The inflorescence has exceptionally thin, delicate rachillae with persistent pedicels from the staminate flowers. In the northern portion of its range, the specimens are often smaller with narrower leaflets. The palm is found from Pernambuco to southern Bahia.

6. *Bactris hirta* Mart. (Fig. 9G, 9H, 10A)

This clustering, spiny palm has a 1–3 m × 1–2 cm stem that has simple bifid to pinnate, bristly leaves. When pinnate, it has 2–16 leaflets along each side. The inflorescence is small, compact, 4–9 cm long, usually 2–3 branched with a chartaceous or papery peduncular bract armed with black setose spines. The fruits are ca. 0.8 cm in diameter and are red at maturity. It has a large distribution with several varieties found from the Amazon to the Atlantic Forest.

7. *Bactris horridispatha* Noblick ex A.J.Hend. (Fig. 10B, 10C)

This clustering, very spiny species has 1–6 m × 1.5–3 cm stems. It is one of the few *Bactris* in the NE with regularly pinnate leaves; all others usually have clustered leaflets. As the name implies the peduncular bract is heavily armed with yellow and brown spines and bristles, and it has an inflorescence with few (2–5) thick rachillae. It is found in Southern Bahia.

8. *Bactris pickelii* Burret (Fig. 10D, 10E)

This short, clustering, spiny understory species has a 1–2.5 m × 1–1.5 cm stem and glossy green leaves. The most unique diagnostic character is a covering of velvety soft hairs on the lower or abaxial side of the leaf. The small, characteristic peduncular bract densely covered with very fine black setae, is swollen out to one side more than the other and terminates abruptly in an acuminate beak. Fruits are smooth, globose, 1.2–1.5 cm

in diameter and reddish purple or crimson red. This palm is found in the Atlantic Forest from Paraíba to Espirito Santo.

9. *Bactris setosa* Mart. (Fig. 10F, 10G, 11A)

This clustering palm has a 2–6 m × 3–4 cm stem with yellow spines and dark purple, globose of grape-like fruits 1–2 cm in diameter. The tasty fruits are very edible giving it the common name 'uva de terra' or earth grape. This *Bactris* tends to grow in seasonally flooded low areas with high water tables. It is the only spiny palm in Bahia that grows in swamps.

10. *Bactris soeiroana* Noblick ex A. J. Hend. (Fig. 11B, 11C, 11D)

This clustering species has stems 1–1.5 m × 1–2 cm. It has beautiful glossy green leaflets that are sigmoid and somewhat convex in shape. The species is characteristically covered with soft whitish hairs, and thin black spines cover the stem, leaf sheath, leaf rachis, peduncular bract and peduncle. This coastal sand dune species is found in Northeastern Bahia just north of Salvador, Bahia.

11. *Bactris tucum* Burret (Fig. 11E, 11F, 11G)

Bactris tucum of the Rio Sao Francisco is a 2 m tall spiny mystery palm that is currently a synonym of *Bactris glaucescens* fide Henderson (2000). However, if this is so, then this species is very distant from its normal Pantanal and humid Chaco populations, which are located in Mato Grosso do Sul, Bolivia, Paraguay and Argentina. It was originally collected by P. von Luetzelburg from Pilão Arcado, Bahia and more recently in sandy dunes near Xique-xique by A. M. Giulietti *et al.* (Fig. 7A). I believe this species merits further study.

12. *Bactris vulgaris* Barb. Rodr. (Fig. 12A, 12B, 12C)

This clustering understory palm has a 1.5–3 m × 2–3.5 cm stem. It produces leaves with clustered, dark-green leaflets and short, white wooly tomentum beneath. It has long black, round, needle-sharp spines. It is distinguished from *Astrocaryum* by having triads with female flowers born nearly to the tip of the rachillae instead of only at the base and roundish rather than flattish spines. It grows in the Atlantic Forest of southern Bahia.

DESMONCUS: BRIEF DESCRIPTION

These are well-armed lianas or vines. They have pinnate leaves, but the apical leaflets are modified into acanthophylls (recurved hardened spines) that function like grappling hooks and enable the palm to climb through the canopy or understory vegetation.

KEY TO *DESMONCUS*

1. Leaf rachis with long, slender, straight, shiny black spines to 2.5 cm long; peduncular bract unarmed (or with few small slender, black spines) .... ***D. orthacanthos***
– Leaf rachis sparely or profusely covered with short, thick, recurved, green to light brown spines to 0.1–0.8 cm long; peduncular bract profusely armed with recurved spines ..... ***D. polyacanthos***

DESMONCUS SPECIES FROM THE NE

1. *Desmoncus orthacanthos* Mart. (Fig.13D)

This species has long, thin, straight spines present on the stem and on the peduncular bract.

2. *Desmoncus polyacanthos* Mart. (Fig. 13E)

This species has short, thick recurved spines along its stem and on the peduncular bract.

ARECOIDEAE (COCOSEAE, ELAEIDINAE)

ELAEIS: BRIEF DESCRIPTION

This genus has few species. One in the Americas and one in Africa. *Elaeis* is characterized by having sheath fibers modified into spine-like projections along the margins of its pseudopetiole. It has separate male and female inflorescences born among the leaf bases on the same palm. The hard endocarp or nut has three apical pores, rather than basal or equatorial pores observed in most other Cocoseae.

ELAEIS SPECIES FROM THE NE

Elaeis guineensis Jacq. (Fig. 13F, 13G, 13H)

This species, the African oil palm or dendê, has a 12–15 m × 35 cm stem. Its leaflets are clustered and inserted at different angles along the petiole, which differs from its American counterpart *Elaeis oleifera* that has regularly spaced leaflets and a horizontal stem. The male and female inflorescences also differ from *E. oleifera* in having spine-tipped rachillae. *Elaeis guineensis* is widely cultivated for its oil and, sadly, is the palm most responsible for the world-wide destruction of native palm habitat.

ARECOIDEAE (EUTERPEAE)

EUTERPE: BRIEF DESCRIPTION

This genus is composed of medium to large palms that are easily recognized by their slender gray stems, long well-developed crownshafts and narrow evenly spaced pinnate leaves, with leaflets that are usually pendulous. The inflorescences are borne below the crownshaft and are branched to one order. The fruits are small, usually round and purplish-black with homogenous endosperm.

EUTERPE

Euterpe edulis Mart. (Fig. 14A, 14B)

This is the only palm with a crownshaft native to the NE. It is usually solitary with a single aerial stem, and the crownshaft is usually green, although it has been seen with an orange crownshaft. Inflorescences are infrafoliar. The palm is often harvested for its edible palm heart. Only in the extreme south of Bahia do clustering specimens occur, but this is not the normal growth form. The most commonly cultivated *Euterpe* seen in the NE with a clustering stem is *Euterpe oleracea*, açaí, however its natural range just barely extends into the state of Maranhão.

ARECOIDEAE (GEONOMATEAE) (GEONOMA)

GEONOMATEAE

Palms in this tribe have no crownshaft and have one prophyll and one peduncular bract (sometimes 2 or more) at the base of the inflorescence. Flowers are in triads sunken into pits along the rachillae.

GEONOMA: BRIEF DESCRIPTION

These are mostly small understory palms with simple, trijugate, evenly pinnate to irregularly pinnate leaves. The inflorescence rachillae or branches have pits, within which one female and two male flowers are arranged in a triad. Much confusion persists as to the number of *Geonoma* species. I am continuing to use an older system followed by Lorenzi *et al.* (2010), which recognizes 8 species instead of the system proposed by Henderson (2011), which only recognizes two species with 3 varieties. Henderson's varieties are given in parentheses below. Flowers are usually spirally arranged on the rachilla, but are sometimes distichously arranged in two ranks. That is, each opposite triad pair on the rachilla are arranged at right angles to the pair that is directly above and below it.

KEY TO *GEONOMA*

1. Stem 1–1.5(–1.7) cm in diameter, leaves usually entire bifid, sometimes trijugate, or sometimes irregularly divided (to 6) ..... 2.
– Stem thicker than 1.5 cm diameter, leaves trijugate, irregularly to regularly divided into many segments (to 42) ..... 4.
2. Leaf rachis 52–74 cm, Inflorescence rachillae usually 7 or more ..... ***G. bondariana***
– Leaf rachis 10–58 cm, inflorescence rachillae 1–6 ..... 3.
3. Leaves light green, veins inconspicuous, glabrous on abaxial surface of veins, rachillae ca. 3 mm in diameter ..... ***G. pauciflora***
– Leaves dark green (purplish), veins conspicuously prominent, rusty lepidote on abaxial surface of veins, rachillae thicker 4–5 mm ..... ***G. conduruensis***

4. Leaves and stem reddish tinged, rachillae few (2–7), and held stiffly erect in a candelabra fashion ..... ***G. rubescens***
– Leaves green to yellow-green and stem green, gray or brown, rachillae usually more than 7, and more lax, drooping or never held stiffly erect in a candelabra fashion ..... 5.
5. Flowers decussate (alternating pairs) on rachillae for most of its length (*G. pohliana* may come out here, but bracts are different), prophyll and peduncular bract membranaceous to papery (in Bahia) to parchment-like in texture ..... 6.
– Flowers verticillate, alternate trimerous, or almost spiral on rachillae for most of its length (sometimes decussate at tip), peduncular bract chartaceous, and thick fibrous or subcoriaceous ..... 7.
6. Leaves usually pinnate (in Bahia), prophyll and peduncular bract short and papery (at least in Campo Rupestre areas), 7–15 cm long, staminate flowers 1.5–2.5 mm long, mature fruit 8–11 × 6–8 mm ..... ***G. brevispatha***
– Leaves trijugate to pinnate, prophyll and peduncular bract longer, 33–48 cm long, staminate flowers larger than 4 mm long, mature fruit larger, 10–18 × 9–10 mm ..... ***G. blanchetiana***
7. Leaves bijugate, trijugate, irregular to regularly pinnate, prophyll and peduncular bract subcoriaceous, profusely and deeply folded or rugose and often persistent on the plant tending to split or decay into fibers along the folds of the bracts, rachillae 2–3 mm thick, flowers dense 1.5 mm apart ..... ***G. pohliana***
– Leaves usually pinnate, prophyll and peduncular bract chartaceous and relatively smooth, caducous, falling off as a unit, rachillae thicker 5–6 mm, flowers 2–3 mm apart ..... ***G. littoralis***

GEONOMA SPECIES FROM THE NE

1. *Geonoma blanchetiana* H.Wendl. ex Drude (*G. pohliana* var. *pohliana*) (Fig. 14C)

This solitary palm has a stem ca. 3 m × 2–4 cm. Leaves are pinnate with regularly arranged leaflets, or the leaves are irregularly pinnate with wider pinnae mixed with narrower pinnae and some even trijugate. Inflorescence is branched. Peduncular bract is membranaceous or papery. Flowers are arranged in a distichous pattern on the rachillae for much of its length.

2. *Geonoma bondariana* Lorenzi (*G. pohliana* var. *pohliana*)

Solitary understory palm has a 1.5–4 m × 2.4–3.2 cm stem. Leaf blades are trijugate and sometimes nearly entire. Flowers are spirally arranged or in 4 vertical rows on the rachillae. This species grows in wet, marshy soils.

3. *Geonoma brevispatha* Barb. Rodr. (*G. pohliana* var. *weddelliana* (H. Wendl. ex Drude) A. J. Hend.) (Fig. 14D, 14E)

This species usually has pinnate leaves and grows at higher elevations in Bahia, however in the central and southern parts of its range, which extends into Paraguay, the leaves are usually trijugate. Flowers are arranged distichously on the rachillae. It is the only *Geonoma* that grows in the mountains far from the coast.

4. *Geonoma conduruensis* Lorenzi (*G. pauciflora*) (Fig. 14F, 14G, 14H)

This clustering palm has stems 1–3 m × 1.3–1.7 cm. The species has very large, simple narrowly bifid leaves with a central vein 33–58 cm long. Leaves are purplish or vinaceous when young, becoming dark green as they age. Veins on the lower side of the leaf are covered with a dense lepidote indument. Inflorescences consist of ca. 5 rachillae that are 4–5 mm thick with spirally arranged flowers.

5. *Geonoma littoralis* Noblick & Lorenzi (*G. pohliana* var. *pohliana*) (Fig. 15A, 15B, 15C)

This palm is one of the tallest *Geonoma* species in the NE with a stem 7–8 m × 3–5 cm. This species usually has pinnate leaflets and a long prophyll and peduncular bract that is chartaceous or stiff papery and smooth in texture, which falls off as a single unit (caducous). The inflorescence has fairly thick rachillae (5 mm). It grows near the coast and to date has only been collected in the vicinity of Ilhéus and Cairu, Bahia. Images of the *G. littoralis* inflorescence in Lorenzi (2010) are actually of a *G. pohliana.* The characteristic, persistent, thickish, sulcate or fissured bracts in the photo well-illustrate *G. pohliana.* These features are not representative of *G. littoralis* as originally discovered and conceived as Species A in Noblick (1991).

6. *Geonoma pauciflora* Mart. (Fig. 15D, 15E, 15F)

This clustering palm species has 1–3 m × 1–1.5 cm stems, which are a bit thinner than *G. conduruensis*. Leaves are entire or simple bifid to small trijugate, and the leaf rachis is 20–38 cm long (consistently shorter than *G. conduruensis*). The inflorescence can be spicate or branched 2–5, but usually with only 2 or 3 branches, and rachillae are less than 3 mm thick. Flowers are usually spirally arranged on the rachilla.

7. *Geonoma pohliana* Mart. (*G. pohliana* var. *pohliana*) (Fig. 15G, 16A)

This clustering species has stems 3 m × 2–3 cm. The leaves have a rachis 40–70 cm long with 3–6 broad leaflets. This species has a distinctively persistent, thickish, sulcate or fissured peduncular bract. Flowers are spirally arranged or in whorls of 3 on 8–14 rachillae. It is the most widely distributed species in the Atlantic Forest.

8. *Geonoma rubescens* H.Wendl. ex Drude (*G. pohliana* var. *rubescens* (H. Wendl. ex Drude) A. J. Hend.) (Fig. 16B)

This species has a stem 1–2.5 m ×1.5–4 cm with distinctive reddish to purplish tinged leaves and stem. The leaves usually have 2–4 pairs of broad leaflets. The inflorescence has distinctly thick (3–5 mm) reddish rachillae that are few (2–7) in number. Flowers are spirally arranged on the rachilla.

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FIGURE 1. A. *Acrocomia aculeata*. B. *Acrocomia intumescens*. C. *A. intumescens* hairy peduncular bract (common in all *Acrocomia*). D. *Allagoptera arenaria* with Luiz A. Mattos Silva. E. *A. arenaria* inflorescence with pistillate flowers. F. *Allagoptera brevicalyx* infructescence, arrow shows lobe-tipped leaflets. G. *A. brevicalyx* habit.

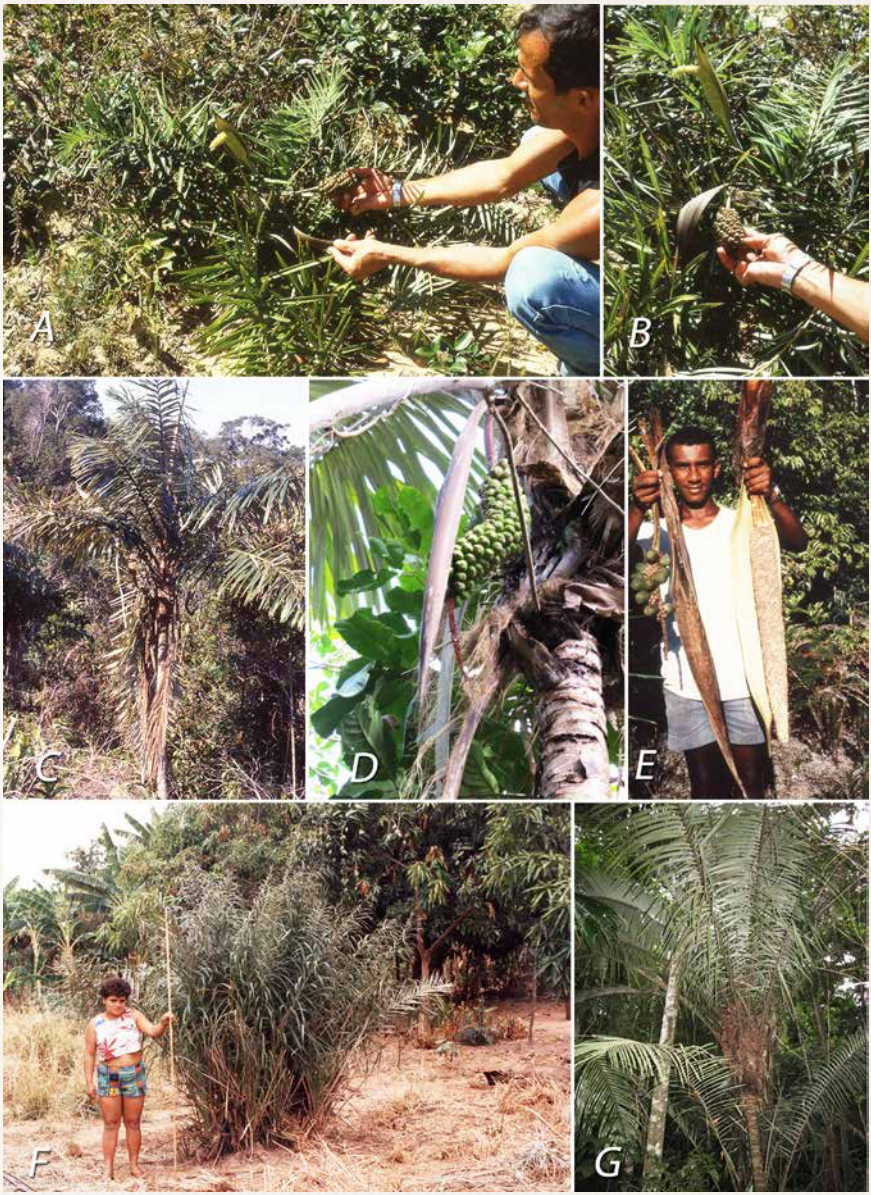

FIGURE 2. A. *Allagoptera campestris* with Clodoaldo J. de Morais. B. *A. campestris infructescence*. C. *Allagoptera caudescens* habit. D. *A. caudescens* close-up of infructescence. E. *A. caudescens* infructescence and inflorescence. F. *Allagoptera leucocalyx* with scale = 2 m. G. G. *Astrocaryum aculeatissimum*.

FIGURE 3. A. *Astrocaryum aculeatissimum* stem. B. *A. aculeatissimum* infructescence. C. *Astrocaryum campestre* with inflorescence, arrow shows female flowers at the base of rachillae. D. *A. campestre* with infructescence. E. *Attalea barreirensis* with male inflorescence. F. *A. barreirensis* with Jose Lopes. G. *A. barreirensis* leaf, fruits, female and male inflorescences. Yellow scale = 1 m.

FIGURE 4. A. *Attalea barreirensis* fruits, infructescences and peduncular bract. Scale = 35 cm. B. *Attalea brejinhoensis*. C. *A. brejinhoensis* infructescence showing perianth covering ½ to ¾ of the fruit. D. *A. brejinhoensis* male and female inflorescences and leaf with scale = 1 m. E. *Attalea burretiana*. F. *A. burretiana* infructescence with Ivomar C. Britto, scale = 1 m. G. Close-up of *A. burretiana* midrib unique brown coloration.

FIGURE 5. A. *Attalea eichleri* with infructescence. B. *A. eichleri* leaf, infructescences with fruits arranged unilaterally, old male inflorescences with peduncular bract and female inflorescence. Arrows show unilateral orientation of flowers and fruits. C. *Attalea funifera* with Larry Noblick. D. *A. funifera* infructescence. E. *Attalea geraensis* with Jose Lopes. F. *A. geraensis* infructescence. G. *A. geraensis* leaf, female and male inflorescence and infructescences. Scale = 1 m. H. *Attalea humilis* infructescence.

FIGURE 6. A. *Attalea humilis* with Jose Lopes. B. *A. humilis* leaf, infructescence, female and male inflorescence and peduncular bract. Scale = 1 m. C. *Attalea oleifera*. D. *Attalea oleifera* fruits. E. *Attalea pindobassu*. F. *A. pindobassu* infructescence. G. *Attalea seabrensis*. H. *A. seabrensis* leaf base with clustered leaflets and with Jose Lopes.

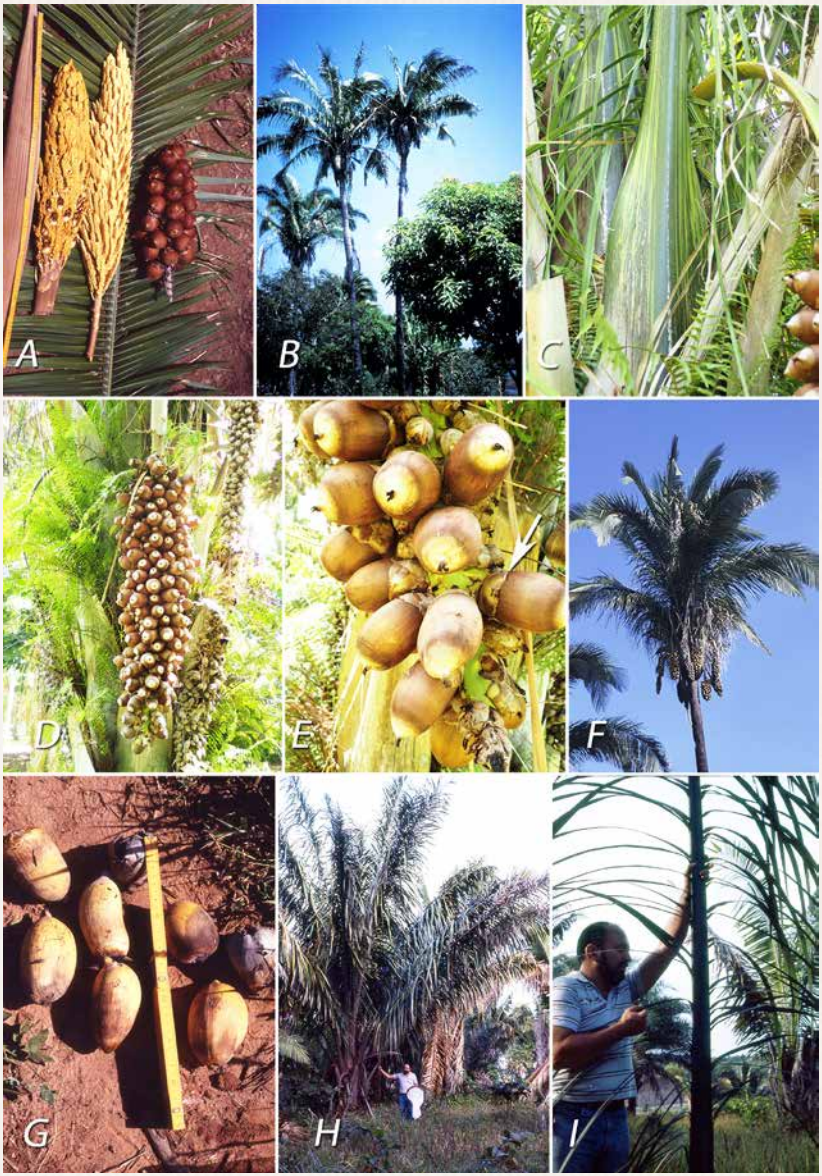

FIGURE 7. A. *Attalea seabrensis* peduncular bract, female and male inflorescences and infructescence. B. *Attalea speciosa*. C. *A. speciosa* sheath and petiole showing yellow streaking. D. *A. speciosa* infructescence. E. *A. speciosa* fruits with arrow showing perianth covering ca. ¼ of fruit or less. F. *Attalea vitrivir*. G. *A. vitrivir* fruits. H. *Attalea* × *piassabossu*. I. *A.* × *piassabossu* lower clustered leaflets with Donald Smith.

FIGURE 8. A. *Attalea* × *piassabossu* infructescence. B. *Bactris acanthocarpa* with Cassia Sacramento. C. *Bactris acanthocarpa* infructescences with mature reddish orange fruits. D. *B. acanthocarpa* infructescence, note small black spines on fruit. E. *Bactris bahiensis*. F. *B. bahiensis* inflorescence. G. *Bactris bahiensis* infructescence. H. *Bactris caryotifolia* note wedge-shaped, fishtail-like leaflets.

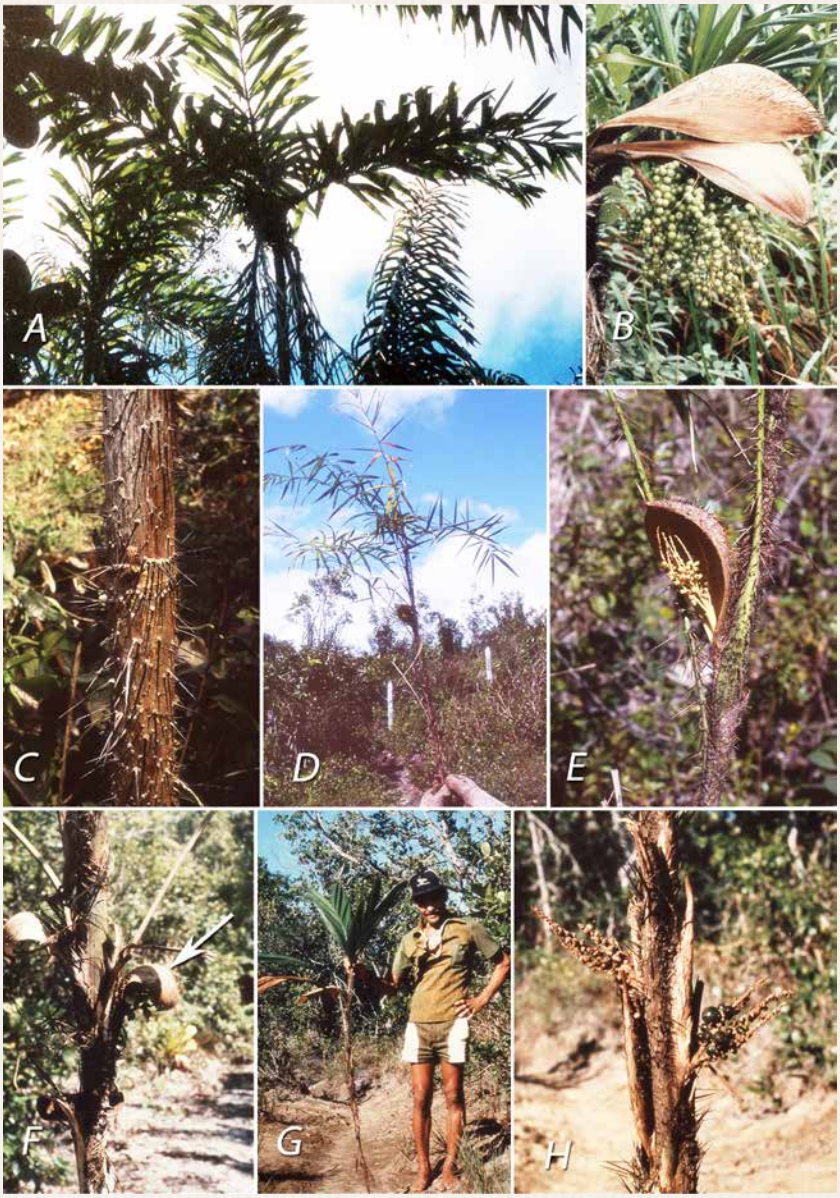

FIGURE 9. A. *Bactris ferruginea* leaves. B. *B. ferruginea* with rare double peduncular bract, normally there is only one. C. *B. ferruginea* stem. D. *Bactris glassmanii*. E. *B. glassmanii* inflorescence. F. *B. glassmanii* infructescences. Arrow shows strongly recurved bract. G. *Bactris hirta*. H. *Bactris hirta* stem with infructescences.

FIGURE 10. A. *Bactris hirta* variable leaf shapes from simple to pinnate. B. *Bactris horridispatha* with Raimundo Soeiro. C. Close-up of *B. horridispatha* inflorescence. D. *Bactris pickelii*. E. *B. pickelii* stem inflorescence and infructescence. F. *Bactris setosa* in waterlogged soils.

FIGURE 11. A. *Bactris setosa* stem. B. *Bactris setosa* young infructescence. C. *Bactris soeiroana*. D. *B. soeiroana* inflorescence. E. *B. soeiroana* infructescence. F. *Bactris tucum* (?) infructescence. Lens cap ca. 6.5 cm. G. *B. tucum* herbarium sheets with infructescence and leaf. H. Close-up of *B. tucum* leaf.

FIGURE 12. A. *Bactris vulgaris*. B. *Bactris vulgaris* showing silver underside of leaf. C. *B. vulgaris* infructescence. D. *Butia capitata*. E. *B. capitata* petiole with arrow showing fiber-like spines. F. *Cocos nucifera*.

FIGURE 13. A. *Copernicia prunifera*. B. *C. prunifera* at MBC. C. *C. prunifera* plum-like fruits. D. *Desmoncus orthacanthos* with arrow and insert showing straight spine. E. *Desmoncus polyacanthos* with arrow and insert showing short recurved spines. F. *Elaeis guineensis*. G. *E. guineensis* stem with swollen base. H. *E. guineensis* infructescences.

FIGURE 14. A. *Euterpe edulis*. B. *E. edulis* with arrow showing orange crownshaft, which is usually green. C. *Geonoma blanchetiana*. D. *Geonoma brevispatha* with Clodoaldo J. de Morais. E. *G. brevispatha* leaf and inflorescence. F. *Geonoma conduruensis* with L. R. Noblick. G. *G. conduruensis* with new red leaf. H. *G. conduruensis* infructescence.

FIGURE 15. A. *Geonoma littoralis*. B. Close-up of G. *littoralis* inflorescence. C. G. *littoralis* inflorescence, note long narrow peduncular bracts. D. *Geonoma pauciflora*. E. *G. pauciflora* with infructescence and trijugate leaves. F. *G. pauciflora* with immature infructescence. D. *Geonoma pohliana* inflorescences.

FIGURE 16. A. *Geonoma pohliana*. B. *Geonoma rubescens* with arrow showing sagging inflorescence with thick rachillae, which usually stands erect like a candelabra. C. *Mauritia flexuosa* male tree. D. *M. flexuosa* fruit. E. *Mauritiella armata* with infructescence. F. *M. armata* stem with root spines. G. *M. armata* infructescence and leaf. H. *Syagrus allagopteroides*, scale ca. 50 cm long.

FIGURE 17. A. *Syagrus botryophora*. B. *S. botryophora* infructescence. C. *S. botryophora* fruit and endocarp. D. *Syagrus cataphracta*. E. *S. cataphracta* inflorescence. F. *Syagrus cearensis*. G. *S. cearensis* fruit with flattish apex. H. *Syagrus cocoides*. I. *S. cocoides* infructescence.

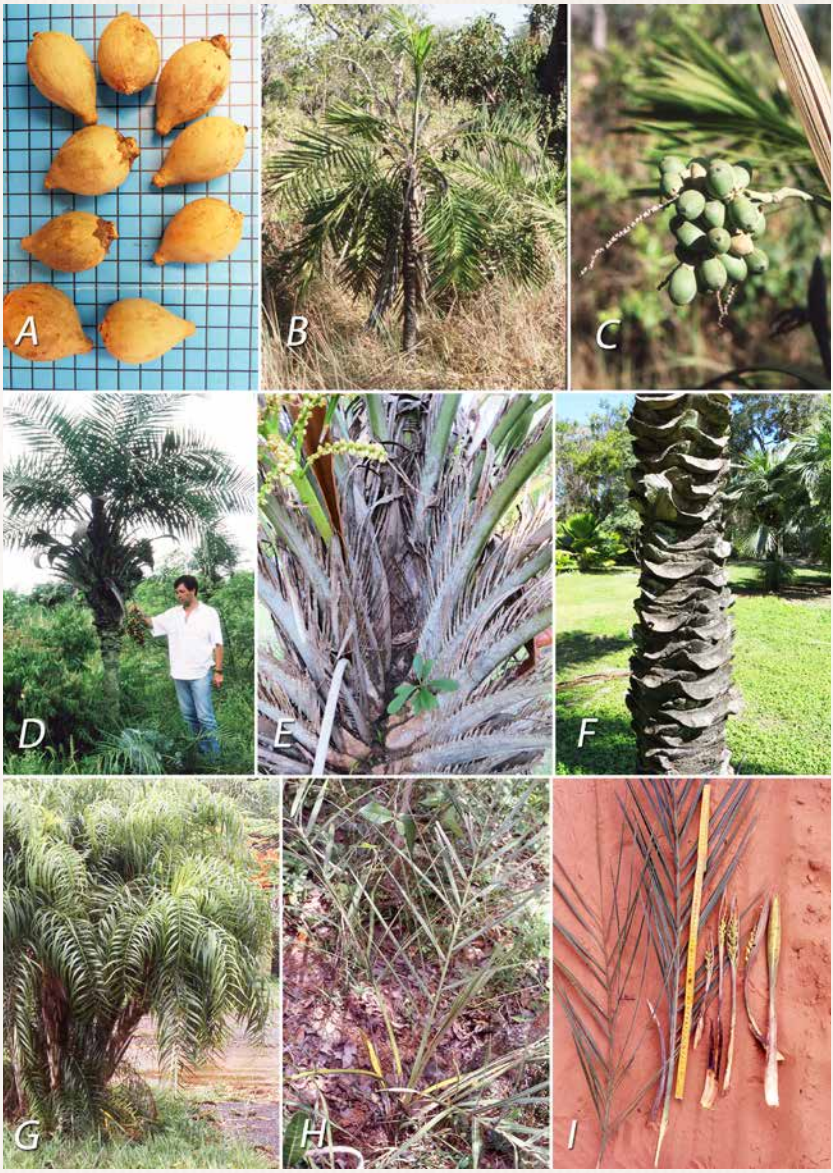

FIGURE 18. A. *Syagrus cocoides* obpyriform (pear-shaped) fruits. B. *Syagrus comosa*. C. *S. comosa* infructescence. D. *Syagrus coronata* with Luciano Paganucci de Queiroz. E. *S. coronata* leaf sheaths arranged in rows with flat woody fibers. F. *S. coronata* stem. G. *Syagrus flexuosa*. H. *Syagrus glazioviana*. I. *S. glazioviana* leaves and spike inflorescences. Scale = 1 m.

FIGURE 19. A. *Syagrus guaratingensis* habitat with João E. Santos and L. de J. Santana. B. *S. guaratingensis* habit. C. *S. guaratingensis* endocarp. D. *S. guaratingensis* inflorescence. E. *Syagrus harleyi* high elevation form near Mucugê - BA. F. *S. harleyi* high elevation infructescence. G. *S. harleyi* low elevation form with flaccid pendulant leaves near Andaraí - BA. H. *S. harleyi* low elevation infructescence.

FIGURE 20. A. *Syagrus itapebiensis*. B. *S. itapebiensis* inflorescence. C. *Syagrus itapebiensis* infructescence with small red fruit. D. *Syagrus microphylla* with L. R. Noblick, Morro do Chapéu, Bahia. E. *S. microphylla*. F. *S. microphylla* leaf and inflorescence.

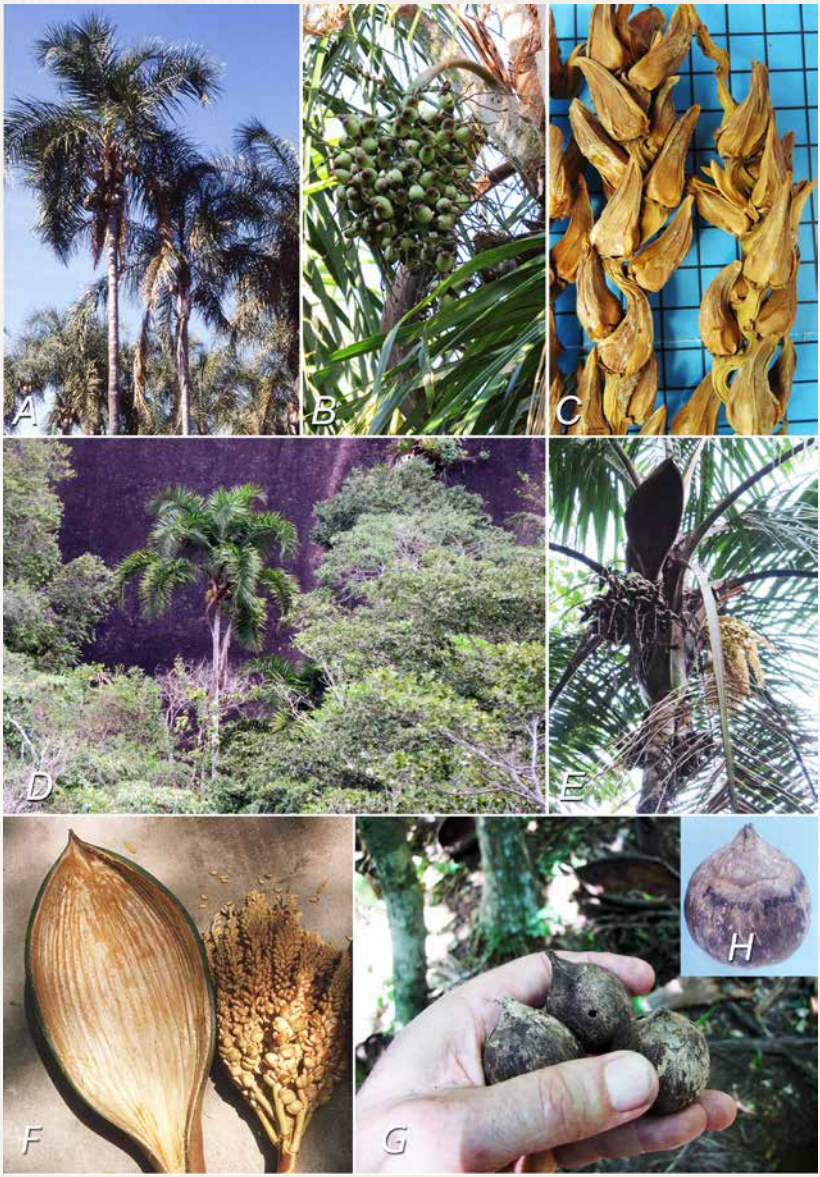

FIGURE 21. A. *Syagrus oleracea*. B. *S. oleracea* infructescence. C. *S. oleracea* large pistillate flowers. D. *Syagrus pseudococos* near Guaratinga, Bahia. *E. S. pseudococos* crown with inflorescence and infructescence. F. *S. pseudococos* thick peduncular bract and inflorescence with large rounded pistillate flowers. G. *S. pseudococos* globose endocarps. H. *S. pseudococos* endocarp with broad "Chinese hat" apex.

FIGURE 22. A. *Syagrus romanzoffiana*. B. *S. romanzoffiana* inflorescence. C. *S. romanzoffiana* irregular endocarp wall. D. *S. romanzoffiana* immature fruits with white tomentose apices. E. *Syagrus santosii*. F. *S. santosii* armed petioles. G. *S. santosii* mature fruits, some splitting at apex. H. *Syagrus schizophylla*. I. *S. schizophylla* armed petioles. Images E, F, and G taken by C. A. Guimarães.

FIGURE 23. A. *Syagrus vagans* with L. R. Noblick. B. *S. vagans* with horizontal underground stem. C. *S. vagans* inflorescence. D. *Syagrus vermicularis*, note infructescences maturing below the crown. E. *S. vermicularis* inflorescence with noodle-like rachillae. F. *Syagrus werdermannii* with infructescences and Clodoaldo J. de Morais. G. *S. werdermannii* inflorescence and infructescence, note white tomentum on rachis and rachillae of inflorescence.

FIGURE 24. *Syagrus* hybrids: A. *Syagrus* × *camposportoana* (Bondar 1939f). B. *Syagrus* × *costae* (Glassman 1970c). C. *S.* × *costae* leaves spirally arranged and not in rows. D. *S.* × *costae* thinner and narrower leaf sheath fibers. E. S. × *costae stem* note internodes and leaf scars not in vertical rows. F. *Syagrus* × *matafome.* G. *S.* × *matafome* with Luciano Lima de Santos, second from left, and Dr. Sidney F. Glassman, second from right. H. *S.* × *matafome* stem. I. *S.* × *matafome*, note leaves are arranged spirally and not in vertical rows. Black lens cap ca. 6.5 cm. J. *S. matafome* inflorescence, leaf, and infructescence. Scale = 1 m.

FIGURE 25. *Syagrus* hybrids: A. *Syagrus* × *mirandana*, note acaulescent habit. B. *S.* × *mirandana* inflorescence far exceeding the height of its leaves. C. Close-up of *S.* × *mirandana* inflorescence. D. *Syagrus* × *tostana* (Bondar 1939f).

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