NON-WOOD FOREST PRODUCTS

10/Rev.1

Tropical palms

2010 revision

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FOREWORD

Tropical palms, originally published in 1998, has been updated in 2010 by the author to include the most recent information and developments regarding the conservation status and use of various tropical palm species. The deteriorating conservation status of several tropical palm species, particularly in the rattan group, as well as recent developments regarding the use of palm products in the food, bioenergy and fibre processing industries, for example, required a thorough review of the first edition.

For the reader's comfort, as well as to make it easy to identify where updates took place, the revised edition follows the same format and chapter sequence as in the original publication, including by following as much as possible the same order of tables, graphs and illustrations and by adding new ones where applicable.

Palms are among the most common plants in tropical countries, where they often dominate the rural landscape. An example is the massive expansion of industrial oil-palm plantations for food or bioenergy in the past 10 years in Southeast Asian countries.

Palms belong to the Arecaceae family, which comprises some 2 450 species, distributed mainly throughout the tropics and subtropics. The palm family is highly variable and exhibits a tremendous morphological diversity. Palms are found in a wide range of tropical and subtropical ecological zones, but they are most common in the understorey of tropical humid forests.

Since ancient times, humankind has derived an impressive assortment of products from palms for food, construction, fibre and fuel. Given their frequent occurrence in tropical forests and the vast array of products derived from them, increased attention to the conservation or re-introduction of palms is warranted in the design and implementation of forest management or reforestation plans.

ACKNOWLEDGEMENTS

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This report derives its basic information on the conservation status of palms from the plants database of the United Nations Environment Programme/World Conservation Monitoring Centre, Cambridge, U.K. The assistance of Harriet Gillett of UNEP/WCMC is gratefully acknowledged. The preparation of this report also draws upon data collected by the World Conservation Union/Species Survival Commission (IUCN/SSC) Palm Specialist Group in the course of preparing an action plan on palm conservation and sustained utilization.

Thanks go to Ms Susy Tafuro for the formatting and layout.

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1 INTRODUCTION

Palms are monocots, included in the section of Angiosperms characterized by bearing a single seed leaf. Scientifically, palms are classified as belonging to the family Palmae (the alternative name is Arecaceae), are perennial and distinguished by having woody stems.

According to Dransfield[1] *et al* (2008), the palm family consists of five subfamilies, each representing a major line of evolution. The Calamoideae is the subfamily with the most unspecialized characters. It is followed by the, Nypoideae, Coryphoideae, Ceroxyloideae and Arecoideae; subfamilies; the last exhibiting the greatest number of specialized characters. The foregoing names are based on the genus originally thought to be most characteristic of each subfamily, all of which have species of economic importance. These are: the rattan palm (*Calamus*), nipa palm (*Nypa*), talipot palm (*Corypha*), Andean wax palm (*Ceroxylon*) and betel nut palm (*Areca*).

About 183 palm genera are currently recognized. The number of palm species is much less precise because of conflicting concepts by palm taxonomists as to what constitutes a distinct species, and the need to revise a number of genera. According to Govaerts and Dransfield (2005), incorporating on-line updates (www.kew.org/monocotchecklist/) there are about 2,450 palm species.

Natural history information on the palm family can be found in Corner (1966). Palm anatomy and structural biology have been the subjects of studies by Tomlinson (1961; 1990). Palm horticulture is treated in detail by Broschat and Meerow (2000). Illustrated books which provide general information on the more common palms of the world include McCurrach (1960), Langlois (1976), Blombery and Rodd (1982), Lötschert (1985), Del Cañizo (1991), Stewart (1994), Jones (1995), Riffle and Craft (2003) and Squire (2007).

Growth Habit

The stem or trunk is a principal means of describing and identifying palms. There are five basic stem types: solitary, clustering, aerial branching, subterranean branching and climbing. The first two types are not mutually exclusive; in some instances the same species may exhibit either a solitary or clustering habit.

Solitary palms. (Figure 1-1, C). The single-stemmed growth habit is very common and is characteristic of many of the palms cultivated for ornamental and economic purposes. Great variability exists in both the height and diameter of solitary palms. At one extreme is the ornamental potato-chip palm (*Chamaedorea tuerckheimii*) which has a stem no larger than the shaft of a pencil and may reach a height of only 30 cm. At the other extreme are the Chilean wine palm (*Jubaea chilensis*) with a stem diameter up to 2 m and the Andean wax palm (*Ceroxylon alpinum*) which may reach a height of 60 m. The economic disadvantage of solitary palms is that they must be propagated by seed and are vulnerable to fatal damage to the single growing tip.

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1 *Genera Palmarum,* revised edition 2008, is the best source of scientific information about the palm family to the generic level. It also defines technical terms associated with describing palms and provides illustrative line drawings and photographs. However, it contains little in the way of detailed information about individual palm species.

Clustering palms. (Fig. 1-1, B). Multiple-stemmed palms are also quite common. From a common root system, the palm produces suckers (basal offshoots) at or below ground level; the suckers growing to maturity and replacing the oldest stems as they die. Clustering palms may be sparse or dense; in the latter they may form thickets. Numerous examples of clustering palms are found among the popular ornamental species of the genus *Chamaedorea*; another is the date palm (*Phoenix dactylifera*). However, the date palm, in formal cultivation, typically has its suckers removed giving it the appearance of a solitary palm. Many clustering palms can be propagated by separating and transplanting young suckers, making them easier to cultivate.

Aerial branching palms. (Fig. 1-1, A). Aerial branching in palms is unusual and only found naturally in species of the genera *Hyphaene* and *Dypsis*, as well as in the rattan genera *Korthalsia* and *Laccosperma*. Branching occurs by equal forking (dichotomous branching) at the growth point and, in *Hyphaene compressa*, may occur as many as five times. Because of sublethal damage to the growing point by insects or a physical force such as lightning, aerial branching can occur abnormally in solitary palms. Examples of this are found in the coconut (*Cocos nucifera*) and palmyra (*Borassus flabellifer*). No technique has yet been devised to induce abnormal aerial branching for economic purposes.

Subterranean branching palms. (Fig. 1-1, D). Subterranean branching occurs by at least two processes. Nipa palm (*Nypa fruticans*) is an example of dichotomous branching; the salak palm (*Salacca zalacca*) is representative of lateral branching and is similar to the type of branching which takes place in dicots with branches developing from the growth of lateral meristems. Palms producing subterranean branches by either process can be vegetatively propagated by separating and transplanting individual branches.

Climbing palms. (Fig. 1-2). Over 500 species of palms in some 14 genera have a climbing growth habit. Most noteworthy is the genus *Calamus*--the largest genus in the palm family with approximately 374 described species--source of nearly all commercial rattan. The majority of climbing palms are also clumping palms, sending out new shoots from the root system.

Initially erect, the slender stems seek out trees for support and climb up into the forest canopy by means of recurved hooks and spines growing on the stem, leaves and inflorescences. In all climbing palms the leaves are pinnate and grow along the stem instead of forming a dense crown. The stems of climbing palms, more often referred to as canes, are solid in contrast to bamboo poles which are almost always hollow.

Leaves

Palm leaves are as variable as palm growth habits. In a forest setting, the leaves of palms are generally large and in many instances spectacular, making them a key aspect of identification. Palms typically bear their leaves, frequently referred to as fronds, in a crown at the top of the stem. Some exceptions to this leaf arrangement occur, such as in the ornamentally-popular lady palms (*Rhapis* spp.) which have leaves distributed along the upper stem. Among the acaulescent (stemless) palms, leaves may appear to be emerging from the root system but are in fact growing from the subterranean stem.

Four basic forms are characteristic of palm leaves: pinnate, palmate, bipinnate and entire

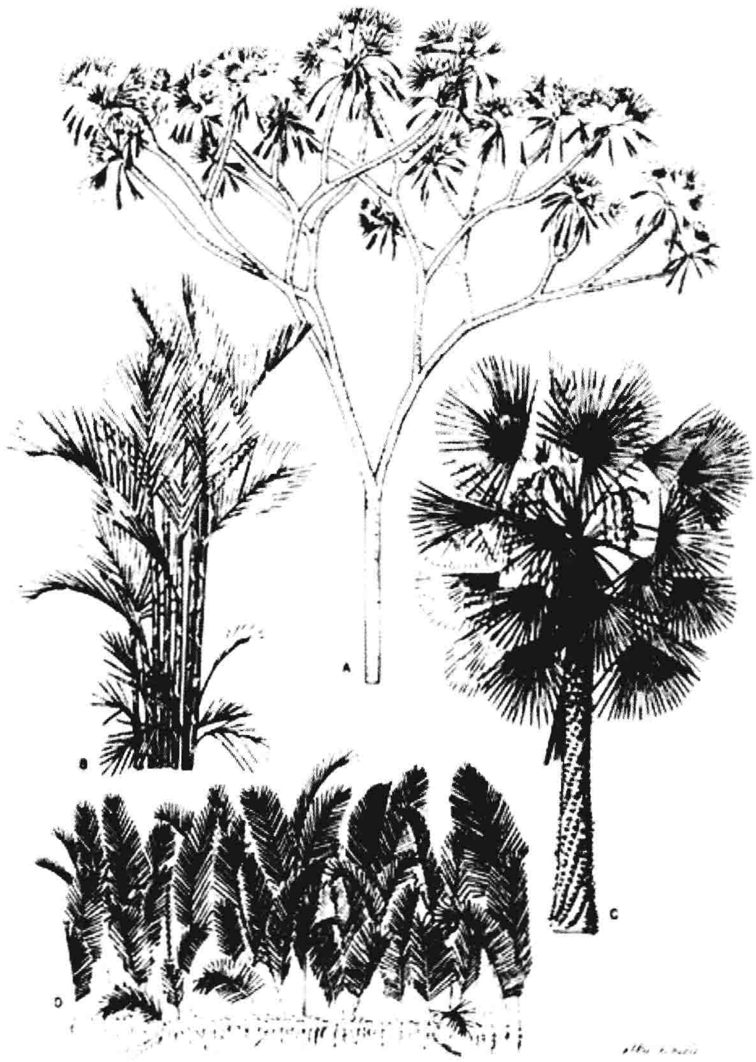

Figure 1-1 ***Palm Growth Habits I.*** *A.* ***An aerial branching palm, the doum palm (*****Hyphaene thebaica*****).*** *B.* ***A clustering palm, the sealing wax palm (*****Cyrtostachys renda*****).*** *C.* ***A solitary palm, the carnaúba wax palm (*****Copernicia prunifera*****).*** *D.* ***A subterranean branching palm, the nipa palm (*****Nypa fruticans*****).***

Figure 1-2 ***Palm Growth Habits II. A climbing palm, the rattan palm (*Calamus *sp.). A. Bare section of old stem. B. Young shoot. C. Spiny leaf sheath. D. Flagellum. Redrawn from Jones, 1995.***

Pinnate leaves. (Fig. 1-3, D) Pinnate leaves are the most common type found in the palm family. They are divided into leaflets attached to a central leaf axis (the rachis) and often resemble a feather; hence palms bearing such foliage are often referred to as being feather-leaved or simply feather palms. Pinnate leaves exhibit an extreme size-range in the Palmae, varying from (including the petiole) well under 1 m in length in species of *Chamaedorea* to 25 m long in *Raphia regalis*. The latter is reputed to be a world record for the plant kingdom. All five major economic palms have pinnate leaves: coconut (*Cocos nucifera*), African oil palm (*Elaeis guineensis*), date (*Phoenix dactylifera*), betel nut palm (*Areca catechu*) and pejibaye (*Bactris gasipaes* var. *gasipaes*).

Palmate leaves. (Fig. 1-3, A) These are also known as fan-leaved or fan palms. Palmate leaves have extended leaf parts (lamina) which are circular or semi-circular, divided into segments and radiate out from the point where they are attached to the petiole. Laminae may be slightly divided to being divided nearly to the leaf base. In size, leaves may be not much larger than a human hand in the lady palms (*Rhapis* spp.), to a maximum of 5 m across such as in the talipot palm (*Corypha umbraculifera*). The most important economic palm with palmate leaves is the palmyra palm (*Borassus flabellifer*). A variation of the palmate leaf form occurs in some genera, such as *Sabal*. The midrib or costa is short and gives the leaf a somewhat V shape, described as "costapalmate."

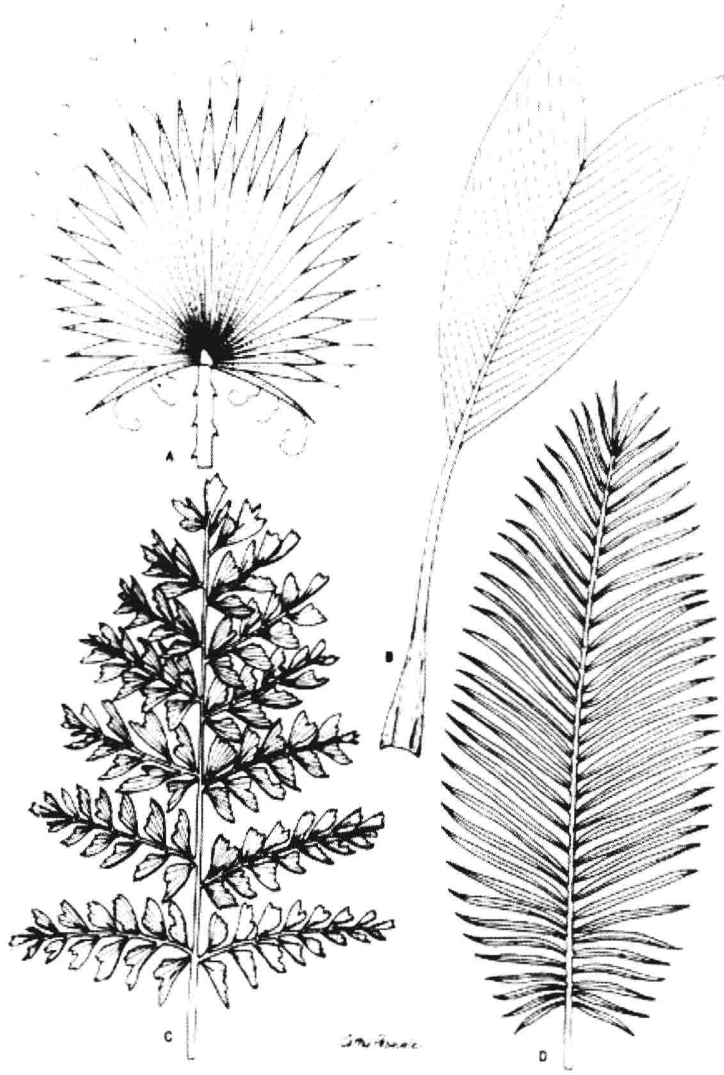

Figure 1-3 ***Palm Leaf Types. A. A palmate leaf, as in the Mexican fan palm (Washingtonia robusta). B. An entire leaf, as in the necklace palm (Chamaedorea geonomiformis). C. A bipinnate leaf, as in the fishtail palms (Caryota spp.). D. A pinnate leaf, as in the nipa palm (Nypa fruticans).***

Bipinnate leaves. (Fig. 1-3, C) Bipinnate means twice-divided and gives leaflets (pinnules) a resemblance to a fishtail. This leaf type is rare in the Palmae, apparently restricted to *Caryota* spp., the fishtail palms. Individual fronds are as much as 4 m long and 3 m wide, depending upon the species.

Entire leaves. (Fig. 1-3, B) Entire leaves have a basic structure that is similar to pinnate leaves except that they are simple and undivided. Only about five palm genera have species with entire leaves; the largest and most spectacular is the diamond-shaped leaf of *Johannesteijsmannia magnifica*.

Fruits

In the palm family as a whole, from as little as two years to 40 years or more are required before individual palm species reach maturity and begin to flower and produce fruit.

Examples of rapid sexual maturity are found among *Chamaedorea* spp., whereas the buri palm (*Corypha utan*) is one of the slowest to mature.
Figure 1-4 demonstrates the variability of fruits in the palm family. Illustrations A through F depict a representative fruit from each genus which gives its name to a palm subfamily. (Note that Fig. 1-4 represents the earlier division of the palm family into six subfamilies, before *Phytelephas* was reclassified as belonging to the Ceroxyloideae.) In terms of weight and size, palm seeds exhibit extreme differences. An individual seed of the popular ornamental parlor palm (*Chamaedorea elegans*) weighs only 0.23 g, as compared to the massive seed of the double coconut (*Lodoicea maldivica*) which weighs as much as 20 kg. The double coconut has the distinction of bearing the largest seed in the plant kingdom.

A cross-section of a palm fruit is provided in Figure 1-4, G. It serves to introduce the terminology associated with the different parts of the palm fruit to be employed in subsequent discussions.

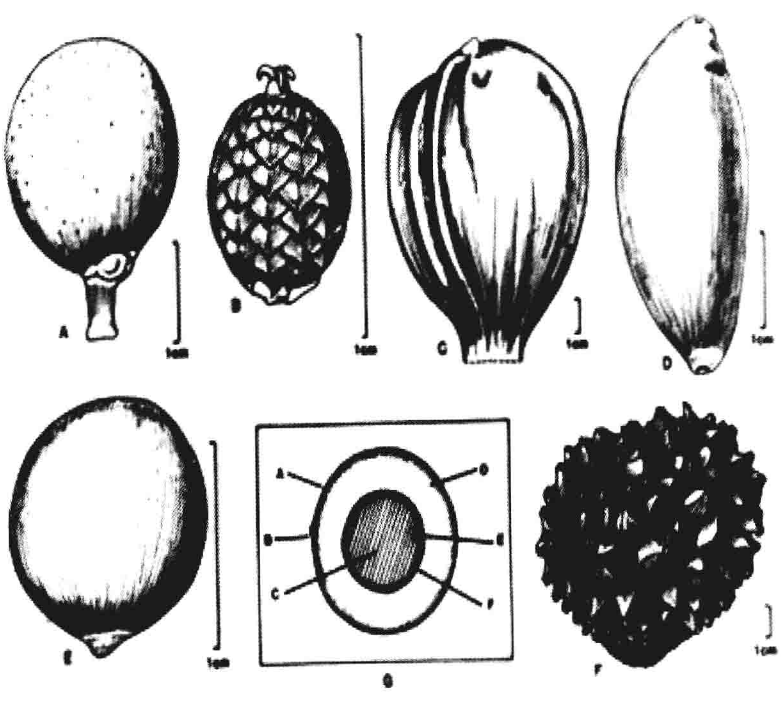

Figure 1-4 ***Palm Fruit Types. A.* Corypha, *Coryphoideae subfamily. B.* Calamus, *Calamoideae subfamily. C.* Nypa, *Nypoideae subfamily. D.* Ceroxylon, *Ceroxyloideae subfamily. E.* Areca, *Arecoideae subfamily. F.* Phytelephas, *Phytelephantoideae subfamily. G. A Palm Fruit in Cross-section. A. Epicarp. B. Hilum. C. Endosperm. D. Mesocarp. E. Embryo. F. Endocarp.***

Habitats

Geographically, palms can be found in habitats ranging from southern France where the European fan palm (*Chamaerops humilis*) naturally occurs at 44o north latitude, to Chatham Island, New Zealand, at 44o south latitude, where the shaving brush palm (*Rhopalostylis sapida*) is native. However, despite this impressive spread of latitude, the overwhelming majority of palm species are native to the tropical regions of the earth. Dowe (1992) estimated that only about 130 palm species occur naturally beyond the tropical latitudes (23.5o N. & S.).

Detailed data do not yet exist on a global basis as to the precise habitat of each palm species, and therefore it is somewhat difficult to discuss palms in terms of common habitat types. Nevertheless, on the basis of what we do know, palm habitats can be generalized into five types: forest habitats; montane habitats; grassland and scrubland habitats; desert habitats; and unusual soil-type habitats.

Forest habitats. Included here are both closed forest and open forest. Palms are predominantly forest species, as evidenced by two studies in South America. According to a habitat characterization of native Peruvian palms, 90 percent of the species occur in forests (Kahn and Moussa, 1994); across the continent in the Brazilian state of Espírito Santo, part of the Atlantic Forest, Fernandes (1993) did a similar study and found that 27 of the 30 native palms (90 percent) also were forest species.

Within tropical forests, individual palm species may be tall enough to be emergent and to form a part of the canopy or they may be understory species of short stature adapted to shady conditions. From the standpoint of forest degradation or destruction, it is the understory species which seldom survive, whereas some emergent species may appear actually to thrive as a result of disturbance.

The tropical forest habitat is not homogenous. Apart from the lands of adequate drainage, there are some areas subject to poor drainage or periodic flooding. Such areas are characterized by distinct vegetation associations with palms often playing a principal role. In South America, for example, the moriche palm (*Mauritia flexuosa*) forms extensive almost pure stands where conditions are swampy. To cite an example from Africa, the wine palm of West Africa, *Raphia hookeri*, is abundant in coastal freshwater swamps. And in Southeast Asia, the nipa palm (*Nypa fruticans*) forms dense stands in estuaries of brackish water.

Well-drained coastal areas forming a part of the tropical forest habitat likewise have some distinctive palm communities. The best example of this is the coconut palm (*Cocos nucifera*).

Montane habitats. Tropical montane habitats are generally defined as being above 1,000 m. Any combination of lower temperatures caused by altitude, extremely wet conditions due to clouds and complex topography creates unique ecological niches to which certain palm species have become adapted. The Andean wax palms (*Ceroxylon* spp.), for example, are found only in montane forests. In Africa, the Senegal date palm (*Phoenix reclinata*) occurs both in lowland and montane forests. The montane forests in Asia do not appear to have any palm genera unique to the habitat but do have numerous species of genera common in the lowlands, such as the rattans (*Calamus* spp.)

Grassland and scrubland habitats. There is less palm species diversity in grasslands and scrublands, but the palms that do occur may be present in fairly large populations. Examples are the carnaúba wax palm (*Copernicia prunifera*) of northeastern Brazil, the vegetable ivory palm of Africa (*Hyphaene petersiana*) and the palmyra palm (*Borassus flabellifer*) of Asia. In apparently all instances, palms in these habitats are found in association with some water source, e.g. stream valleys, perched water tables or the like.

Desert habitats. These dry habitats are generally defined as areas receiving less than 254 mm of annual rainfall and represent true desert. Palms in a desert habitat are often referred to as oasis palms. The occurrence of palms in such dry habitats may, in some cases, represent relict distributions from previous geologic periods of more favourable rainfall conditions. Examples of oasis palms are the date palm (*Phoenix dactylifera*), California fan palm (*Washingtonia filifera*) and the Central Australian cabbage palm (*Livistona mariae*).

Unusual soil-type habitats. Soils derived primarily from limestone can produce extremely basic soils which support a distinctive flora. The same is true of very acidic soils rich in heavy metals (chromium, iron, copper or manganese), which are often referred to as being ultrabasic or serpentinic soils. Certain palm species tolerate such extreme soil conditions. A number of palms in the Caribbean region are adapted to limey soils, such as the thatch palms (*Thrinax* spp.). In the Pacific island of New Caledonia, to cite another example, ten of the native palm species are found only on serpentinic soils.

False Palms

The term "palm," correctly-applied, refers to plants which are members of the Palmae, but by popular usage has also been applied to plants which resemble palms in some ways. At least seven plants have a common name which includes the word "palm," but which are not palms in the scientific sense. It is useful to clear up this confusion and dispense with the false palms as being beyond the scope of this study.

Traveler's palm. (Fig. 1-5, A) *Ravenala madagascariensis*, Strelitziaceae family, is a woody tree with a palm-like stem. It is native to Madagascar and widely cultivated as an ornamental throughout the tropics. Individual leaves bear greater resemblance to a banana plant (to which it is related) than a palm; they are arranged in two distinct ranks in the same plane forming a fan-shaped head. Flowers of the traveler's palm are similar to those of the bird-of-paradise plant. The vernacular name of the traveler's palm is said to derive from the fact that the cup-like leaf bases hold water which travelers could drink.

Sago palm. (Fig. 1-5, B) Major confusion is associated with this common name because it refers to the true palm *Metroxylon sagu* as well as to the palm-like Asian cycad *Cycas revoluta*, in the family Cycadaceae. Both the stem (which is sometimes branching) and the terminal crown of pinnate leaves of *Cycas revoluta* are similar to those of a true palm. However, *Cycas revoluta* leaves are stiff and borne as a rosette not singly as in palms; the male inflorescence resembles a cone, a key identifying character. *Cycas revoluta* is the most widely cultivated cycad. Edible starch, "sago," can be extracted from the stem of both *Metroxylon sago* and *Cycas revoluta*, which explains the shared common name.