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Cover Picture

A palm, probably a date palm, is figured on a gold cup from Greece. See page 85. Photograph by W. H. Hodge.

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Endangerment at the Specific and Generic Levels in Palms*

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Palms are characteristic components of many tropical ecosystems (Moore, 1973a). They occur in a diversity of habitats, ranging from seacoasts, mangroves, desert oases, and open savannas to swamp forest, lowland and montane rain forests, and even to deciduous forests of warm-temperate parts of the world. Sometimes they form nearly pure stands of one species, as *Mauritia flexuosa* L.f. in the basins of the Amazon and Orinoco Rivers. At other times they may be abundant both in kinds and in numbers, as they are in the lowland rain forests of America and Indomalaysia, but they often are represented by very limited populations. Palms frequently serve as indicators of soil types, drainage patterns, or vegetation types (e.g., Eiten, 1974; Pérez Jiménez, 1974; Read, 1974; Romney, 1959), and they may also be very precise markers, such as the species of *Geonoma* in certain montane forest types of Venezuela (Otto Huber, pers. comm.). They occasionally are known to influence the formation of soil, as suggested by Furley (1975) for *Orbignya cohune* (Mart.) Dahlgr. ex Standl.

Though interrelationships between palms and animals are poorly documented, they certainly are important. Palm/insect relationships are perhaps best known, having been considered in general by Lepesme and Paulian (1947). The sometimes elegant methods of pollination, however, were not treated by the two authors and this subject has only recently begun to receive the detailed study it deserves (Brown, 1976a; Essig, 1971, 1973; Read, 1967, 1975; Schmid, 1970), as have the adaptive morphology and anatomy of the plants (Uhl and Moore, 1977). Palm flowers, inflorescences, and fruits are utilized by insects other than those that actually pollinate, as sources of food and sites for oviposition (Essig, 1973; Schmid, 1970). Bruchid beetles, for example, may feed on nectar of *Sabal palmetto* (Walt.) Lodd. ex Schult. & Schult. f. as adults and pass their larval instars in the endosperm of the fruit (Brown, 1976b).

The fruits of many palms are fleshy and colored, sometimes against bright red or orange inflorescence axes, and obviously adapted for dispersal by animals (Corner, 1966; Van der Pijl, 1969). Birds are probably the palm's chief feeders and disseminators (see Brown, 1976b; Keppler, 1970; Leck, 1969; Read, 1960), though mammals, from rodents to primates, including man, also feed on their fruits and disperse their seeds (Burtt, 1929; Enders, 1935; Janzen, 1971), even those such as *Caryota*, which are filled with irritant crystals (Dransfield, 1974).

Man benefits enormously from palms throughout the tropics, as accounts of many explorers amply demonstrate (for

* Reprinted with permission from G. T. Prance and T. S. Elias (eds.). 1977. Extinction is Forever: the Status of Threatened and Endangered Plants of the Americas. New York Botanical Garden, Bronx, N.Y. pp. 267–282. Footnotes added in reprinting.

example Wallace, 1853). They serve him in almost every aspect of life, ranging from shelter to clothing, food, drink, stimulants, medicine, arms, and religion (Braun, 1968; Burkill, 1935; Dransfield, 1976a; Gowda, 1951; Hodge, 1963; Miller, 1964; Schultes, 1974). Palm products also play an important role in our industrial society (Hodge, 1975; Kitzke and Johnson, 1975).

Many other examples can be cited to show the importance of palms in the ecosystem. The family also fulfills another important scientific, though less immediately obvious, role, as a subject for the study of evolution. Distinctive pollen of the Asiatic mangrove palm, *Nypa*, is one of the earliest fossils identified as to family and genus (Muller, 1970), dating from the Senonian (Upper Cretaceous), about 70 or more million years ago. Although contemporary *Nypa fruticans* Wurmb. seems to differ little from its fossil antecedents and retains some characteristics considered primitive (Moore and Uhl, 1973), it is advanced in other characteristics and must represent a significant span of evolutionary time beyond the origin of the even more primitive palm stock from which it evolved. This long history probably accounts for the great diversity we find at the subfamilial, tribal, and generic levels within the family today (Moore, 1973b, 1975).

Diversity at the specific level is less well understood, owing to the fact that in the past, species were frequently described from fragmentary specimens that are difficult to compare with the often more complete specimens of modern collectors. Moreover, the great size of many palms deters most botanists from including them in their collections at all. As a consequence, it is frequently difficult to assess endangerment at the specific level, especially in the Americas. Because palms also provide us with exceptional material for the study of evolution at the generic level, and because more than one-third are monotypic and nearly one-half have only one or two species, I have chosen, with permission of the organizers of this Symposium, to broaden my approach in order to call attention to endangerment in both hemispheres since some of the more clearly documented examples come from the Old World.

Despite their versatility in the ecosystem, palms as a group have a great disadvantage. A few are notable colonizers of disturbed habitats, examples being *Pigafetta filaris* (Giseke) Becc. after clearing in the Celebes (Dransfield, 1976b), *Prestoea montana* (Grah.) Nichols. ("*Euterpe globosa*") after hurricanes in the Lesser Antilles (Beard, 1945, 1976), an unidentified palm on volcanic flows in Costa Rica (Gary Hartshorn, pers. comm.), and *Acrocomia* in Costa Rican pastures (Janzen, 1971). Most palms, however, appear to require precise conditions for germination and establishment, although few adequate studies have been made in this regard, those of Bannister (1970) and of Vandermeer *et al.* (1974) being exceptions. Palms are often commanding presences left standing when the forest is cleared, but they do not regenerate until their requirements for shade and moisture are met by regrowth of forest following shifting agriculture. When cleared land is retained in pasture, as in the Sarapiquí Valley of Costa Rica or on the slopes of the Andes in Colombia and to an increasing degree elsewhere, regeneration is severely limited or fails to occur at all.

Palms have another disadvantage. They are often overutilized by man. Each stem has a single growing point, and when this is cut for the tender "heart" or terminal bud, the stem or the plant, when the stem is solitary, is de-

stroyed. Such destruction appears to have been a major factor in the virtual elimination of palms as wild plants on Mauritius and a similar elimination of *Euterpe macrospadix* Oerst. is at present taking place in Costa Rica (Balick, 1976). A less immediate threat, but one which in time is expected to become more serious, is the constant collection of fruit or seed in the wild for sale, or the continued cutting of young leaves to be used for hats, baskets, and other items. Another constant threat to palms is the excess cutting of mature leaves for thatch or for sale as greenery (Vosters, 1975).

Palms in cultivation (and potentially in the wild state) also are jeopardized by the increasing incidence of lethal yellowing, a disease attributed to the presence of mycoplasmalike organisms in the phloem of palms, transmitted by an as yet unknown vector (Fisher *et al.*, 1973; Parthasarathy and Fisher, 1973; Romney *et al.*, 1976).

The Threatened Plants Committee of the International Union for Conservation of Nature and Natural Resources has recently set up a Threatened Palms Subcommittee. Six species of particular interest are already listed as vulnerable —*Caryota no* Becc., *Johannesteijsmannia altifrons* (Rchb. f. & Zoll.) H. E. Moore, *Juania australis* (Mart.) Drude ex Hook. f., *Lodoicea maldivica* (J. F. Gmel.) Pers., *Maxburretia rupicola* (Ridl.) Furtado, and *Phoenix theophrasti* Greuter—and two—*Medemia argun* (Mart.) Wuerttemb. and *Neoveitchia storckii* (H. Wendl.) Becc.—as endangered. Five more, which are probably endangered or even extinct, have been documented for consideration by the Threatened Plants Committee, but our work has only begun, as the following comments on palms of America, Africa, Asia, and oceanic islands will suggest.

Endangered Palms in the Americas

There are so few proper monographic treatments of palms in the American tropics that it is difficult to assess endangerment in larger genera, many species of which can only be listed as insufficiently known; that is, they are suspected of being rare, vulnerable, or endangered, but current information is insufficient to categorize them. Too many species are still known only from a single collection and too much of the area still needs to be explored for palms.

The monotypic *Itaya amicorum* H. E. Moore from Peru may serve as an example. Discovered originally in 1960 while crossing from the Itaya River to the Amazon, and described twelve years later (Moore, 1972) after several attempts to obtain more complete material, the species is still known from fewer than 100 individuals in what constitutes, essentially, a single population adjacent to a clearing that is being extended into the forest and in the vicinity of some dwellings. If one judges from current evidence, *Itaya* must be considered endangered, yet there has been no effort to determine the extent of its range and any attempt to do so will be severely handicapped by the difficulty of travel in the region. The single introduction of this palm, truly one with potential as an ornamental, failed in 1974 when the entire shipment of fruit was "cooked" because some seeds were found to be infested with larvae.

Similarly, on the basis of current knowledge, at least three other species of Peru—*Chrysallidosperma smithii* H. E. Moore, *Iriartella ferreyrae* H. E. Moore, and *Socratea salazarii* H. E. Moore —may be endangered. Each is known from only two small areas in Peru, one near Aguaytía, the other near Yurimaguas. The region near Aguaytía

where these palms grew has been much modified since 1960, and although a few individuals of *Socratea salazarii* were seen in 1974 in a ravine much disturbed by debris from a road cut, the natural vegetation of the region where *Chrysallidosperma* had been found appears to have been cut down. It is likely that other populations exist, but the determination of the range and the size of populations is very difficult to ascertain.

Since I have just returned from field work in Colombia, let me introduce some situations that are clearer. Populations of wax palms (*Ceroxylon* spp.) in the Andes from Venezuela to Peru and Bolivia occur mostly at high altitudes, where forest has been or is being cleared and kept in grass, or more rarely at elevations as low as 1,500–1,900 m in the region where coffee is grown. Only recently has the identity of the original species, *C. alpinum* Bonpl. ex DC. from the Quindio Pass in Colombia, become clear (Moore and Anderson, 1976). Because of the forest, the 80 km journey from Ibagué to Cartago over the pass, required 10–25 days in the early 1800's (Bomhard, 1937), whereas a paved road now carries one there in hours. On the eastern side of the pass, the road winds through pastures where *Ceroxylon quindiuense* (Karst.) H. Wendl. (Colombia's national tree, once cut by the thousands for wax, [André, 1878]) is still extant though with little evident regeneration. On the western side, at lower elevations among coffee plantations, *Ceroxylon alpinum* is occasionally to be seen, though also with little evidence of regeneration. On the other side of the Cauca Valley, populations of *C. alpinum* share the same fate. One can still find specimens, but low population levels and lack of regeneration suggest that the species should be considered endangered.

Ceroxylon quindiuense, growing as it does at higher elevations, may still be seen in small patches of forest, as at Tenerife in the Departamento del Valle, but it is vulnerable. A similar situation prevails in Peru where only very limited populations of the complex centered on *Ceroxylon crispum* Burret are known (personal observation, 1960, 1974). Because of their habitat and the difficulty of finding appropriate regions in which to cultivate them, all species of *Ceroxylon* appear increasingly endangered unless steps are taken to protect wild populations and to plant and protect young trees.

Slightly lower, on slopes bounding the Cauca Valley at elevations from 900 to 1,200 m, *Syagrus sancona* (HBK) Karst. once was abundant. Today the last remnants of forest where it occurs are being cut (Fig. 1a). The species is frequently left in pastures (Fig. 1b), where it does not reproduce. Though it is cultivated as an ornamental throughout the valley and even on the western slopes of the Cordillera Occidental, it is clearly endangered as a wild species. A comparable species is *Aiphanes caryotifolia* (HBK) H. Wendl., which is cultivated for the edible fruits, though it also is infrequent as a wild plant.

Elsewhere in South America, clearing of land, especially in montane areas, is reducing or eliminating palm populations. *Jubaea chilensis* (Mol.) Baill., the Chilean wine palm, once had a more extensive range along the west coast of Chile, but because it has been cut to extract the sap for honey and wine, the populations today are reduced to five from Cuesta Las Palmas in the north to El Almacigo in the south, and it is considered endangered by Chilean botanists. *Juania australis*, also monotypic, occurs only on the island of Masatierra in the Juan Fernandez Islands off the coast of Chile. Here, probably 500–1,000 or perhaps even more individuals still inhabit forests on the relatively undisturbed and