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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

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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

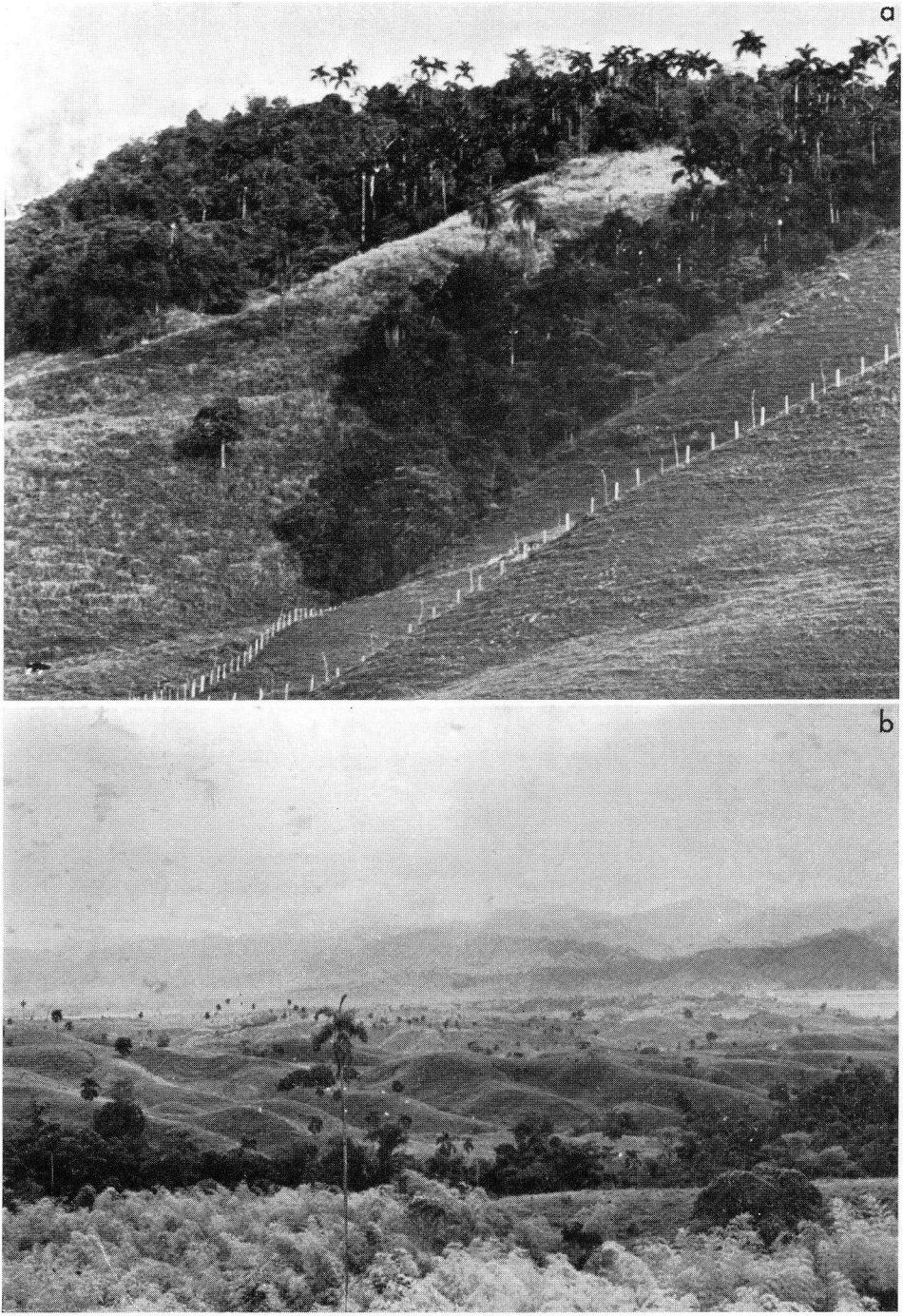
where these palms grew has been much modified since 1960, and although a few individuals of *Socratea salazarii* were seen in 1974 in a ravine much disturbed by debris from a road cut, the natural vegetation of the region where *Chrysallidosperma* had been found appears to have been cut down. It is likely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

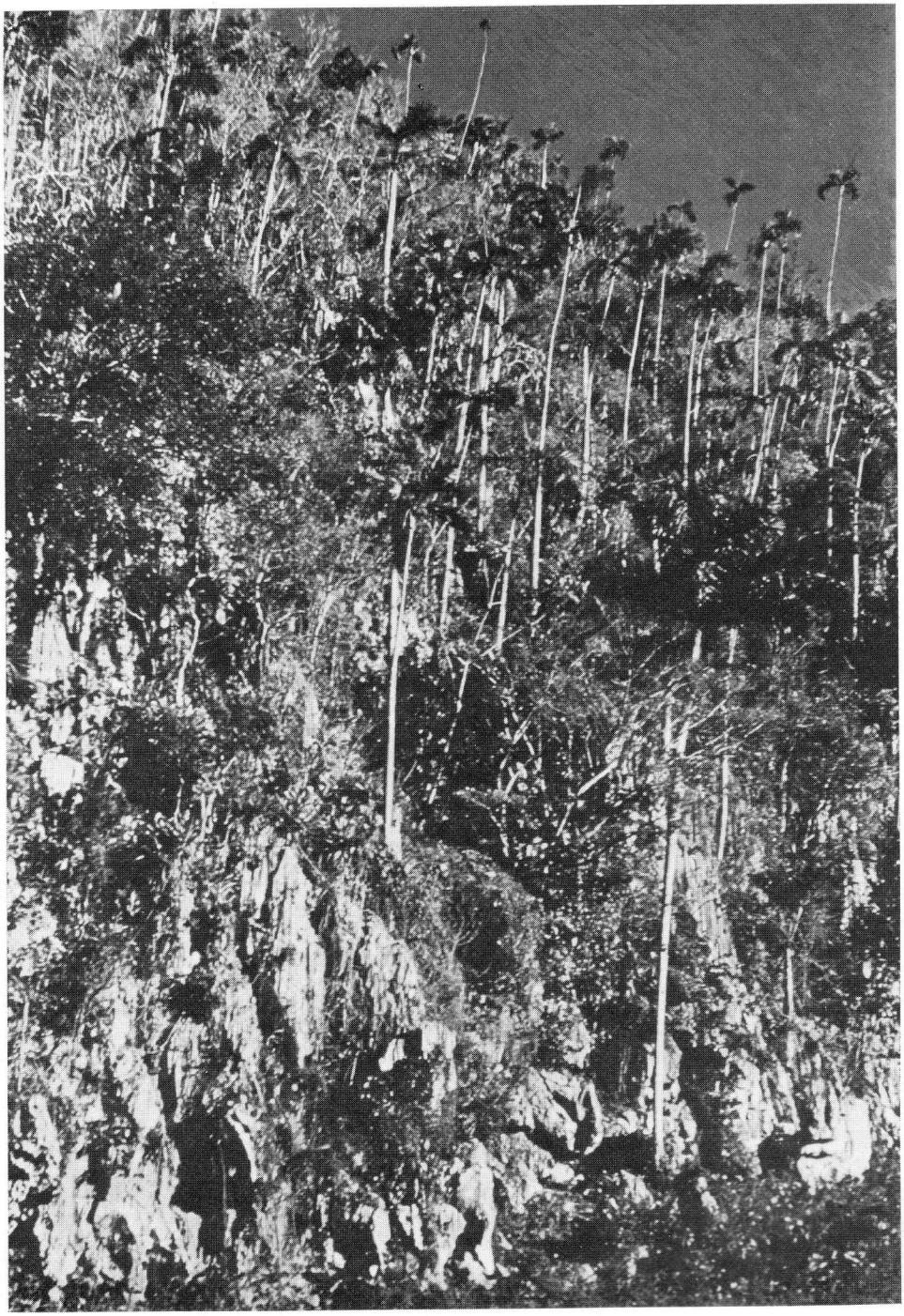
Ceroxylon quindiuense, growing as it does at higher elevations, may still be seen in small patches of forest, as at Tenerife in the Departamento del Valle, but it is vulnerable. A similar situation prevails in Peru where only very limited populations of the complex centered on *Ceroxylon crispum* Burret 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



1. *Syagrus sancona* once was widespread in the Cauca Valley of Colombia in forest like the remnants (a) now being felled near Alcalá, Valle. Although still remaining in fields and pastures as at La Virginia, Risaralda (b), it does not reproduce effectively without the intervention of man.



2. *Gaussia princeps* is restricted to limestone haystack hills (mogotes) in Pinar del Río, Cuba, where it would be vulnerable if the hills were mined for lime, as they are in Malaya.

often inaccessible upper slopes of one part of the island (Moore, 1969b) where it regenerates well. The islands were declared a national park in 1935, and the palm therefore is now protected by law. So long as the sale of tourist items made from the hard black fibers of the trunk is controlled, *Juania* is probably only vulnerable, though possibly endangered.

In the West Indies, *Gaussia princeps* H. Wendl. is restricted to the *mogotes* (haystack hills) of dogtooth limestone (Fig. 2) in Pinar del Río province of Cuba (Leon, 1946) and must be considered vulnerable. If these hills were to be mined for limestone, as similar hills are in Malaya, the species would clearly be endangered. The related *Gaussia attenuata* (O. F. Cook) Becc. of Puerto Rico, occupies a more extensive limestone area in the north as well as limestone hills in the southwest (Little and Wadsworth, 1964) but it is considered endangered (Roy O. Woodbury, pers. comm.). *Calyptronoma rivalis* (O. F. Cook) L. H. Bailey, also from Puerto Rico, is known from only one locality three miles east of San Sebastián in the northwestern portion of the island (Little *et al.*, 1974) plus two recently discovered small Puerto Rican populations (Roy O. Woodbury, pers. comm.) or, if Wessels Boer (1968) is followed, from two additional localities in Hispaniola. It must surely be listed as endangered. Efforts should be made to introduce this species into cultivation in Puerto Rico as well as elsewhere.

Some other palms in the West Indies also occur in very limited populations and should be considered for conservation. On Hispaniola, *Zombia antillarum* (Descourt.) L. H. Bailey is known from a few localities (Bailey, 1939; Jiménez, 1960), *Coccothrinax ekmanii* Burret, sometimes separated as *Haitiella ekmanii* (Burret) L. H. Bailey, is reported from two or perhaps three localities, and *Pseudophoenix ekmanii* Burret and *P. lediniana* Read are known from very limited populations (Read, 1968). The genus *Coccothrinax*, now being studied by Read, may provide additional examples of species that require action on the part of our subcommittee.

The genus *Chamaedorea*, abundantly represented in Mexico and Central America, contains several species that are apparently very rare and presumably endangered—*C. stolonifera* H. Wendl. ex Hook. f., from Chiapas, *C. tuerckheimii* (Damm.) Burret from Guatemala being two examples. *Colpothrinax cookii* Read, is reported from two widely separated localities in Guatemala and Panama (Read, 1969) and is probably endangered in both localities. Two species of *Brahea*, *B. decumbens* Rzedowski and *B. moorei* L. H. Bailey ex H. E. Moore, occur in limited populations, the latter with *Chamaedorea radicalis* Mart. on limestone outcrops of eastern Mexico, where they may be considered vulnerable. As in South America, tropical North America still requires exploration and study of its palms before all the possibly endangered species can be listed.

At least two species in the United States are endangered. *Roystonea elata* (Bartr.) F. Harper, which was at one time quite abundant in Florida's Fakahatchie Swamp, is now much depleted and is protected only in a small area at Royal Palm Hammock in Collier County in that state. Further taxonomic study is desirable to determine whether this species is truly distinct from the more abundant Cuban (and probably Mexican) populations of *Roystonea regia* (HBK) O. F. Cook. The second species, *Pseudophoenix sargentii* H. Wendl. ex Sarg. subsp. *sargentii* is represented only by a few individuals remaining on Elliott Key, Long Key, and Sands Key, Florida, and probably at its two localities in Mexico and one in Belize as well. Other

populations in the Bahamas, Cuba, and Hispaniola represent a different subspecies (Read, 1968).

Africa and the Mediterranean

Africa is a continent with a limited complement of palms today, though the continent is considered to have been part of the original center of palms (Moore, 1973a). In the south, *Jubaeopsis caffra* Becc., a monotypic genus, is limited to the northern banks of two rivers in South Africa—the Msikaba and the Mtentu—where its status in terms of endangerment is presently being investigated. The genus is of particular interest both because of its apparently unspecialized nature among the cocosoid palms and also its disjunct distribution. All other genera except *Cocos* itself and one species of *Elaeis* are now restricted to the Western Hemisphere.

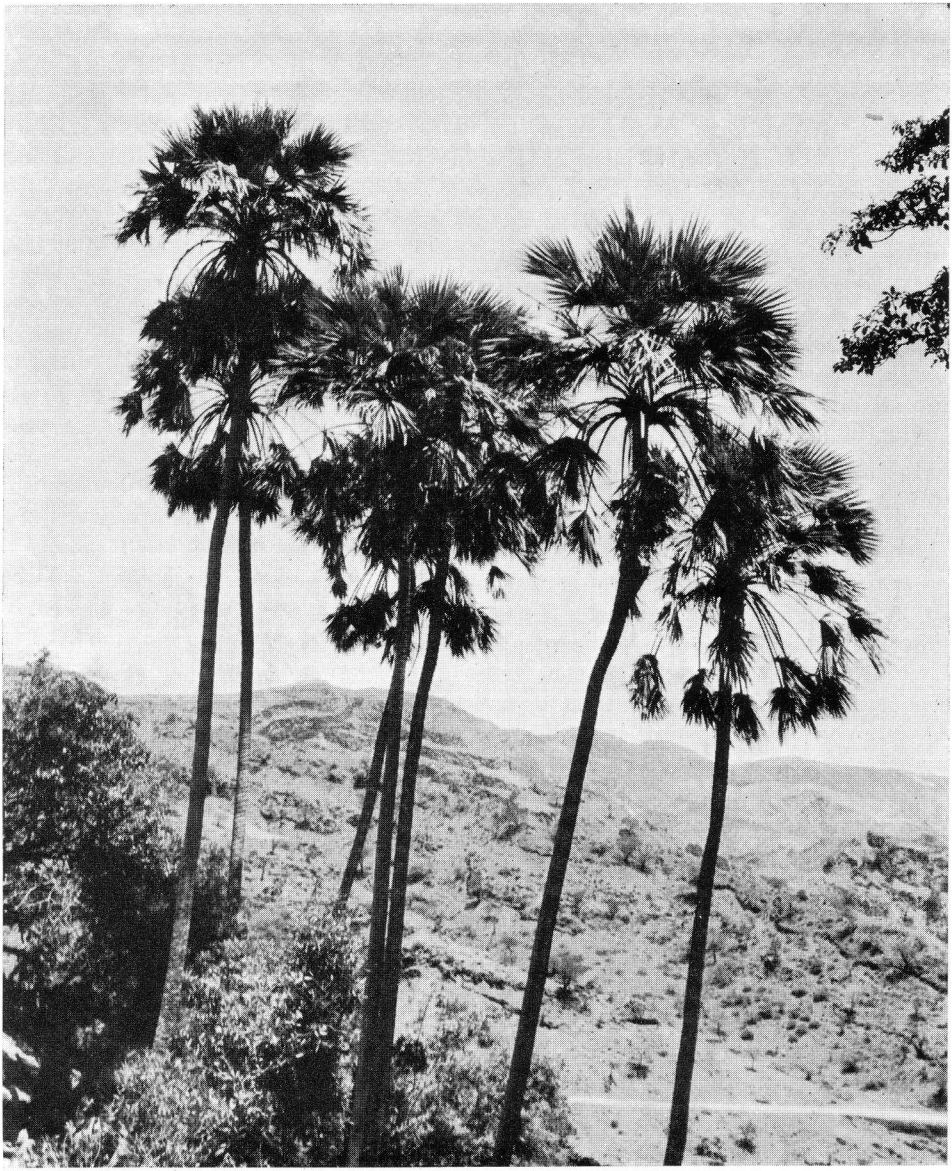
In the north, the monotypic genus *Medemia argun* is listed as endangered. It occurs as single or few individuals in three localities in Egypt and one in the Sudan (Ahti *et al.*, 1973; Boulos, 1968) and although fruits have been found in Egyptian tombs, the nature of staminate and pistillate flowers is insufficiently known. Thus the relationship between this species and *Bismarckia nobilis* Hildebrandt & H. Wendl. from Madagascar, which is sometimes considered a species of *Medemia*, cannot yet be fully understood and may never be understood if conservation is not effected.

Wissmannia carinensis (Chiov.) Burret (Fig. 3) is a third monotypic genus known from two limited regions in Africa—the Oasis of Uncad or Uncud in the Somali Republic, and a series of springs in the Monts Goda, in the Territoire Français des Afars et des Issas—and one in Arabia (Monod, 1955; Moore, 1971), although the species has recently been introduced into cultivation. The population at Uncad is reported to be much reduced while that in the Hadhramaut (Burret, 1943) is little known. If the principal population at Bankoualé is at all typical of the other six at Monts Goda, then the species is clearly endangered. At Bankoualé, about 90 individuals cluster by a trickle of water. All are mature and of substantial height. Reproduction is apparently absent because the ubiquitous goats eat every shred of green, including the fallen leaves. If a proposal to fence this population has been acted upon, then there may be some hope of limited regeneration. Since the palm has many of the ornamental attributes of *Washingtonia robusta* H. Wendl., it may ultimately be reproduced in cultivation.

The island of Crete is the home of *Phoenix theophrasti*, known from five localities along the coast, where use of the largest grove by tourists and campers prevents regeneration. Since other groves consist of only a few individuals (Barclay, 1974; Greuter, 1967), its status is vulnerable. The present extent of the sole European species, *Chamaerops humilis* L., has not been studied but its distribution is certainly more limited than formerly and a survey of localities and numbers is in order.

Asia and Indonesia

Several species of continental Asia and larger islands of Indonesia are vulnerable, endangered, or perhaps even extinct. The two species of the genus *Calospatha* from Perak, West Malaysia —*C. confusa* Furtado and *C. scortechinii* Becc.—are known only from the fragmentary type collections, each from a different mountain where some forest remains but where a recent effort to locate *C. confusa*, at least, met with



3. A small group of *Wissmannia carinensis* is framed against the forbidding desert hills among which it grows near Ronda, in the vicinity of the main population at Bankoualé, Territoire Français des Afars et des Issas.

failure. If these species are extinct, we will never have a complete understanding of the morphology or biology of the genus, which is a problematic one in terms of position among the scaly-fruited lepidocaryoid palms of the rattan group. If they are not extinct,[1] these species must surely be considered endangered.

[1] *Calospatha* was rediscovered by John Dransfield in 1977.

Ceratolobus glaucescens Bl., another rattan of more than usual interest is, so far as is known, now restricted to a single population at Sukawayana, West Java. It is estimated at 30 plants or fewer, and is about equally divided between staminate and pistillate individuals. The genus is a small one, characterized by a greatly reduced inflorescence enclosed within a prophyll that opens only at the tip. Both reproductive cycle and morphology are therefore of exceptional interest to the student of palm evolution.

One of the most primitive of palms, the monotypic coryphoid genus *Maxburretia rupicola*, is confined to three limestone hilltops within 40 km of Kuala Lumpur in West Malaysia (Whitmore, 1971), where probably fewer than 1,000 individuals now remain. These hills are relicts of an ancient calcareous mantle and have a rich endemic flora that is threatened by quarrying at Batu Caves and by fire at one or both of the other localities despite their protected status. Again, a genus now listed as vulnerable is threatened, and two of its closest relatives, also monotypic (and one as yet undescribed), are very rare indeed.[2]

All four species of another coryphoid genus, *Johannesteijsmannia* (Dransfield, 1972), appear to be threatened despite their occurrence in forest preserves and *J. altifrons* is listed as vulnerable. It does not survive clear-felling of trees, though it can survive with some damage when logging is selective. It does not appear in secondary regrowth.

The status of other species of continental Asia and Indonesia is presently being studied and a longer, perhaps much longer, list of vulnerable and endangered species is to be expected.

[2] All were combined by Dransfield into one genus, *Maxburretia*, with three species in Gentes Herbarum 11: 191. 1978.

Oceanic Islands

Some of the most unusual palms are endemic on both large and small islands, especially those of the Indian and Pacific Oceans. Two relatively large islands, Madagascar and New Caledonia, offer an interesting comparison. Madagascar, in the Indian Ocean, is about 1,000 miles long. It is of interest to the student of palms because of the large number of species there (about 115) that are described in relatively few genera. Of the 18 genera listed by Jumelle and Perrier de la Bathie (1945), five are also African (*Hyphaene*, *Borassus*, *Raphia*, *Elaeis*, *Phoenix*) and it is doubtful that even the species are distinct. One genus, the monotypic *Bismarckia*, is closely related to or sometimes even considered generically identical to the endangered *Medemia* of Africa. Twelve genera are endemic to the island or to its outliers as far north as Pemba. An added genus, *Marojejya*, was described by Humbert in 1955. Generic limits are not yet completely worked out and it is likely that there will be further consolidation among *Chrysalidocarpus*, *Neophloga*, *Neodypsis*, and *Antongilia*. Doubtless, many species of the larger genera are threatened by the unceasing destruction of forests, especially along the east coast, which in many areas has become a jungle of *Ravenala*. One of the classic localities for palms, the Forêt d'Analamazoatra near the railway station at Perinet, halfway between Tananarive and Tamatave, is now much degraded and reduced in size, with only remnants of its former palm flora remaining (Moore, 1965). *Vonitra utilis* Jumelle, known only from this forest, persists as fewer than half a dozen trees, according to my count in 1963: *V. fibrosa* (C. H. Wright) Becc. [*V. thouarsiana* (Baill) Becc.] is not to be found there, though it occurs elsewhere. *Louvelia lakatra*

Jumelle and *L. madagascariensis* Jumelle & Perr. have been searched for in vain on several occasions. *Ravenea robustior* Jumelle & Perr. is reduced to a few individuals, while *R. latisecta* Jumelle has not been seen, and the monotypic *Beccariophoenix madagascariensis* Jumelle & Perr. has apparently become extinct there, though it is reported on the Masoala peninsula.

It is the decimation of the generic representation that is particularly distressing. *Beccariophoenix* is apparently being exploited to near extinction in its remaining habitat on the Masoala peninsula, according to reports, even though it is not yet fully understood botanically. The monotypic *Masoala madagascariensis* Jumelle is known to me only from three individuals in the Forêt de Mahavinitra near Ambohitralanana, along with a limited population of the similarly monotypic *Sindroa longisquama* Jumelle, an exceptional palm that occurs elsewhere in limited numbers on the peninsula (Bernardi, 1974) and is related to *Orania* of Indomalaysia. The monotypic *Marojejya insignis* Humbert is known only from three localities—eastern slopes of Marojejy, rivière Anove on the east coast (Humbert, 1955), and in the Forêt d'Ankiririryra, where I visited the very small population in March, 1971, following directions given me by the late René Capuron. All of these monotypic genera, and probably *Louvelia* and *Vonitra* in their entirety as well, are apparently endangered.

New Caledonia in the Pacific is, in contrast, about one-fourth as long as Madagascar and much narrower. It has an extraordinary assemblage of 18 endemic genera, five of them as yet undescribed (Moore, in manuscript),[3] and about 30 species. Low population density, selective felling in the forested areas, poor agricultural quality of many soils, and the preservation of the Panié Massif in a botanical reserve, have thus far all served to relieve pressures on most New Caledonian palms. Even so, the only known population of *Kentiopsis oliviformis* Brongn. near Bourail, the small population of a new species of *Cyphophoenix* on Lifou, the populations of *Cyphophoenix elegans* (Brongn. & Gris.) H. Wendl., and an undescribed genus[4] from the Haute Mayavetch, as well as the two very limited populations of *Burretiokentia hapala* H. E. Moore, may be considered candidates for a list of protected species, all being somewhat vulnerable.

The exception to the above is the monotypic genus *Pritchardiopsis* that once grew near Prony. It was apparently cut by convicts for the cabbage and has been searched for on the ground and by helicopter without success. It must be considered extinct unless some very limited population elsewhere has escaped the intensive search.

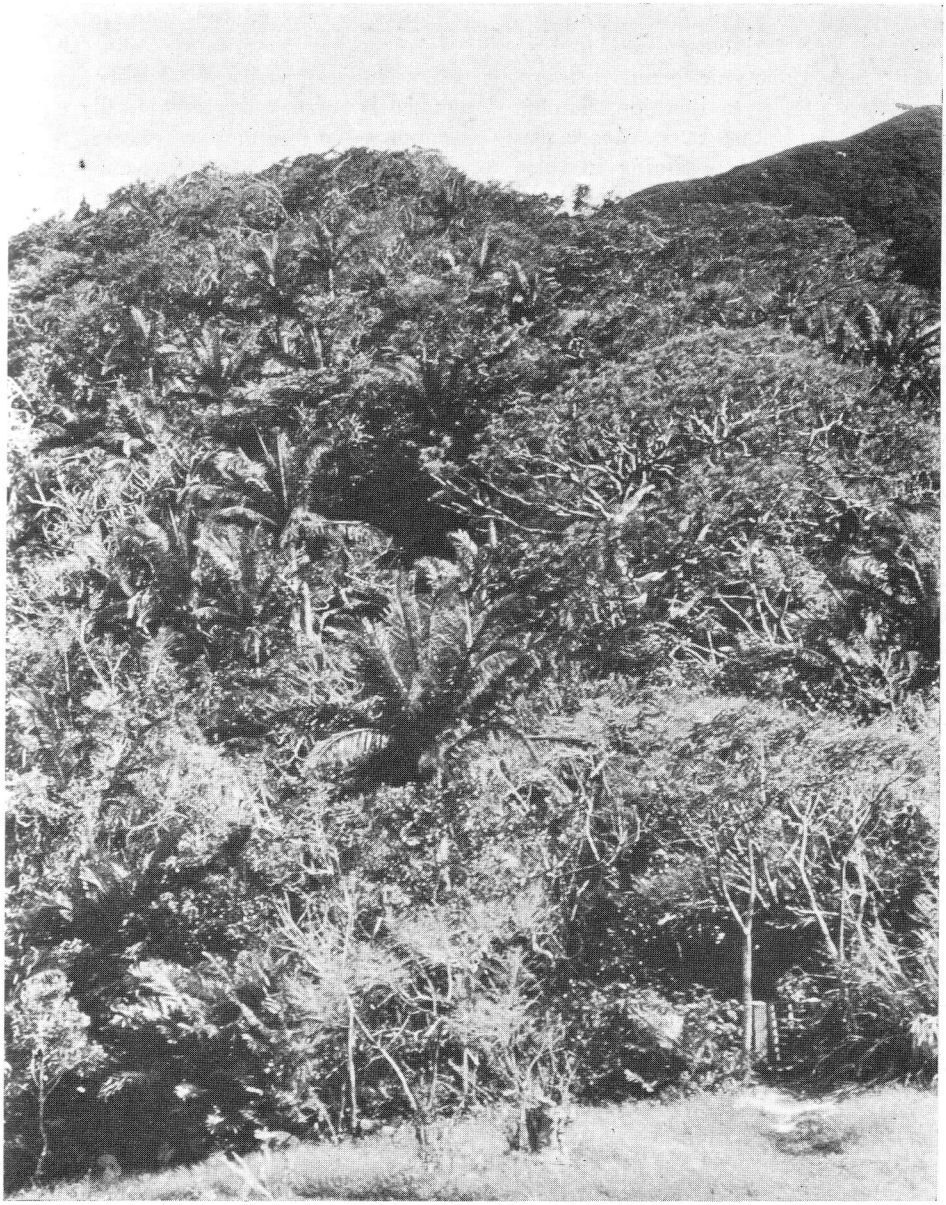
Among smaller islands, the four endemic palms of Lord Howe Island off the coast of Australia are examples of palms that are carefully husbanded by the local inhabitants as a source of commercial seed, although it is necessary to protect, with wire, the inflorescences of the small population of *Lepidorrhachis mooreana* (F. Muell.) O. F. Cook, in order to prevent loss of the seeds to rats. And in the Ryukyu Islands, the very small population of *Satakentia liukiuensis* (Hatus.) H. E. Moore (Fig. 4) on Iriomote is remote from habitations (Moore, 1969a), the population on Ishigaki (Fig. 5) has been set apart as a reserve, and plants appear to be doing well in cultivation. Although all are probably vulnerable, the indigenous palms of the

[3] Four genera have since been described in Gentes Herbarum 11: 291–309. 1978.

[4] Now described as *Mackeea magnifica*.

4. *Satakentia liukiuensis* in the wild on Iriomote, Ryukyu Islands.

Seychelles, including the extraordinary coco-de-mer, *Lodoicea maldivica*, are now protected in reserves at the Vallée de Mai and Fond Ferdinand on Praslin Island or occur (*Deckenia*, *Roscheria*) in proposed nature reserves on Mahé (Swabey, 1970). And it is to be hoped that *Neoveitchia storckii* will be protected in Fiji (Gorman and Siwatibau, 1975).



5. The population of *Satakentia liukiuensis* at Yonehara Village on Ishigaki Island consists of perhaps a thousand trees and is protected as a national monument.

Not so comforting is the situation in the Mascarenes, three islands set in the Indian Ocean, which once contained an apparently prominent complement of palms that were decimated by man many years ago for construction purposes and for food. Five genera are native to the islands—*Latania* with three dioecious species (which unfortunately hybridize in cultivation), *Hyophorbe* with five spe-

cies, *Dictyosperma* and *Acanthophoenix*, each with one variable species, and an undescribed monotypic genus (Moore, in manuscript).[5] On Réunion, *Latania lontaroides* (Gaertn.) H. E. Moore persists as individuals remaining in tilled land, *Dictyosperma album* (Bory) H. Wendl. & Drude ex Scheff. is planted and an exceptional specimen or two has been seen on nearly inaccessible cliffs. Both are endangered. Since *Hyophorbe indica* Gaertn. has a bitter cabbage and also grows in almost inaccessible places or on land unfit for agriculture, there is a series of small populations totalling more than 100 but probably fewer than 500 individuals. *Acanthophoenix* has natural populations in the Forêt de Bebour and in forested patches near the sea. Both are vulnerable, though *Acanthophoenix* is cultivated as an ornamental and is being investigated as a potential commercial source of palm heart.

Mauritius, the largest and oldest of the islands in the Mascarenes, had its own species of *Latania*, *L. loddigesii* Mart., which apparently was once abundant in coastal savannas. Today, only a few individuals persist on tiny islands off the coast—Coin de Mire and Round Island (where most regeneration is precluded by the activity of goats and rabbits)[6]—or in cultivation: its status is presently endangered. A few individuals of *Dictyosperma album* also persist on Round Island and in cultivation. Occasional young plants, in addition to an individual or two of *Acanthophoenix*, are rarely encountered in the low scrub forest at the center of Mauritius. Though these individuals were probably disseminated by birds, they are usually cut as soon as the bud is large enough to eat, and their status is therefore endangered. Three species of *Hyophorbe* are also endangered: *H. amaricaulis* Mart. is represented by a single individual (Fig. 6), which was recognized only recently; *H. lagenicaulis* (L. H. Bailey) H. E. Moore barely survives on Round Island, but is cultivated both on the main island and elsewhere; and four individuals of *H. vaughanii* L. H. Bailey are known, all in cultivation.[7] In the center of the island, 22 or 23 individuals of an undescribed genus[8] related to *Acanthophoenix* are endangered, although four of these have already been protected and many of the remainder occur in a reserve. The palm produces little fruit and has not yet been successfully brought into cultivation.

Worst of all is the island of Rodrigues, now a botanical "poorhouse." Perhaps only four or five individuals of *Hyophorbe verschaffeltii* H. Wendl. persist outside cultivation, where it is far from abundant; a few individuals of *Dictyosperma* remain in tilled land or are deliberately planted; and the few *Latania verschaffeltii* Lem. that remained in a tiny patch of forest appeared to be in distinct danger in 1972.

The Mascarenes provide a splendid example of man's destruction of genetic potential in both palms and other plants, and regrettably this example is being followed elsewhere in the world. In late 1974, I had as a field companion a recent graduate of a small college who, travelling on a fellowship, teamed up with me for two months. At one point in

[5] Now *Tectiphiala ferox* H. E. Moore in Gentes Herbarum 11: 285. 1978.

[6] An unpublished report of a study made in 1975 by five students from the University of Edinburgh indicates that there were then about 2,500 mature trees with adequate regeneration on the western slopes according to a recent communication from T. A. M. Gardner, Assistant Conservator of Forests on Mauritius.

[7] In 1977, Messrs. Andrew and T. A. M. Gardner discovered a population of about 44 wild individuals, cf. Gentes Herbarum 11: 243. 1978.

[8] Now *Tectiphiala ferox*.

6. The last individual of true *Hyophorbe amaricaulis* on Mauritius.

our travels, he asked me why I collected palms and I replied to the effect that I was trying to make a record for future generations of what had existed. There was no immediate reply, but nearly a year later, following the destruction for road materials of a *campina* area in Amazonian Brazil upon which the young man had worked, he wrote to tell me that he had thought my reply pompous at the time, but that now he understood exactly what I meant. I can only hope that enough additional humans also will understand this important message while there still is time to save some palms other than coconuts and African oil palms.

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