The Needle Palm: Rhapidophyllum hystrix

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Rhapidophyllum is a monotypic palm genus endemic to the southeastern United States. Its single species, *R. hystrix* (Fig. 1), is commonly referred to as the needle palm. Other names which have been used are blue palmetto (Elliott, 1817), creeping palmetto (Small, 1923), vegetable porcupine (Small, 1923), dwarf saw palmetto (Moore, 1963), and spine palm (Mitchell, 1963).

In the United States, the needle palm is cultivated to a limited extent both within and outside its natural range. It is very cold hardy, having been successfully grown out of doors as far north as Virginia and Tennessee (Popenoe, 1973).

Outside the United States, *R. hystrix* has been successfully grown in the Black Sea region of the Soviet Union (Saakov, 1963) and on the French Riviera (Barry, 1961).

Although *Rhapidophyllum* has great potential as an ornamental because of its attractiveness, ability to withstand freezing temperatures, and ease of maintenance, it is rare in the nursery trade. Only recently has it begun to to be used in public and private landscaping. Most plants found in the nursery trade and in cultivation have been taken from the wild. This is probably due, at least in part, to the fact that seeds are slow to germinate and the plant is very slow growing. It takes from four to six years from the time seed is planted until a marketable plant is produced, thus not making it economically feasible for nurseries to grow it from seed.

Rhapidophyllum is on the rare and endangered plant species list for the United States as a threatened species which is commercially exploited. During the late 1800's and early 1900's, this palm was commercially exploited by foliage shippers. Whole crowns were cut off and shipped north for use as decoration in homes. This has been called to our attention by Harper (1906) who lamented the exploitation of this palm in the vicinity of Evergreen, Alabama. Later, Harper (1928) related that the species has been exterminated in the Evergreen area. Today the exploitation continues, but is through the nursery trade.

This paper is for a large part the result of the senior author's personal observations of both wild and cultivated specimens over a five-year period. Field observations were made throughout much of the range of the species in Florida with the more critical and detailed observations made on a population near Oviedo, Seminole County, Florida.

Taxonomic History

Rhapidophyllum is a monotypic genus of coryphoid palms in the *Trithrinax* unit of the *Trithrinax alliance* (Moore, 1973). This unit also includes the gen-

1. *Rhapidophyllum hystrix* near Oviedo, Seminole County, Florida.

era *Trachycarpus* and *Chamaerops* in addition to *Trithrinax* and *Rhapidophyllum.*

Small (1923) presented a fairly complete and accurate taxonomic history of *Rhapidophyllum* so only a few points need to be touched on here in summation and for clarification.

In 1814, Frederick Pursh described the species from material collected near Savannah, Georgia by John Fraser several years earlier, and placed it in the genus *Chamaerops.* In 1818, Thomas Nuttall, apparently having seen only sterile material, transferred it to the genus *Sabal* because of its superficial resemblance to *S. adansonii* (= *S. minor*). Finally, in 1876, Wendland and Drude found that the species could not be satisfactorily accommodated in either *Chamaerops* or *Sabal* and accordingly created the monotypic genus *Rhapidophyllum.*

Small (1923) states that the species has been placed in two other genera in addition to those previously discussed, *Corypha* and *Rhapis*, although he does not elaborate.

Dahlgren (1936), and later Glassman (1972), give *Rhapis arundinacea* Ait. (Hort. Kew. ed. 1, 3: 474. 1789) and *Rhapis caroliniana* Hort. ex Kunth (Enun. Pl. 3: 246. 1841) as synonyms of *Rhapidophyllum hystrix.* From Aiton's protologue of *Rhapis arundinacea,* it is immediately obvious that the plant described is not *Rhapidophyllum hystrix.*

William Wood (*in* Rees, Cycl. 7, n. 3. 1807) transferred Aiton's species to *Chamaerops* with no additional clues to its identity.

Finally, Moore (1975), after having examined the type specimen of *Rhapis arundinacea* in the British Museum (Natural History), revealed Aiton's species to be based on an aberrant, juvenile specimen of *Sabal minor.*

Also, *Rhapis caroliniana*, the second *Rhapis* species placed in synonymy under *Rhapidophyllum hystrix* by Dahlgren and Glassman, can also be excluded. The name *Rhapis caroliniana* is not found under the discussion of *Rhapis* which appears on pages 251–252 of Kunth (1841). However, on page 246 under the treatment *Sabal adansonii* (= *S. minor*), the name *Sabal carolinianum* Hort. is proposed in synonymy. If this is the source of *Rhapis caroliniana* Hort. ex Kunth, which appears to be the case, this name must be removed from the synonymy of *Rhapidophyllum hystrix* and added to that of *Sabal minor.*

No validly published name in *Corypha* can be accredited to *R. hystrix*. *Corypha hystrix* Desf. (Tabl. 1. 19. 1804) is a *nomen nudum* and in addition undoubtedly not synonymous with *Rhapidophyllum hystrix* since it is reported as a native of South America. Also, *Chamaerops hystrix* (spelled "*histrix*" by Steudel) Desf. ex Steud. (Nom. Bot. ed. 1. 183. 1840. based on *Corypha hystrix* Desf.) is also a *nomen nudum* and is accordingly removed from consideration here.

Martius (1838) provides an excellent description and illustration of the needle palm under *Chamaerops hystrix.* In addition to *Sabal hystrix*, *Rhapis arundinacea*, and *Chamaerops arundinacea*, Martius also lists *Corypha repens* Bartr. in synonymy. The last is now well known as *Serenoa repens* (Bartr.) Small.

Of final note, the crediting of *Chamaerops hystrix* to Fraser instead of to Pursh by some authors is an error in citation.

In summation, the following nomenclature is to be applied to the needle palm:

Rhapidophyllum hystrix (Pursh) H. Wendl. & Drude, Bot. Zeit. 34: 803. 1876.

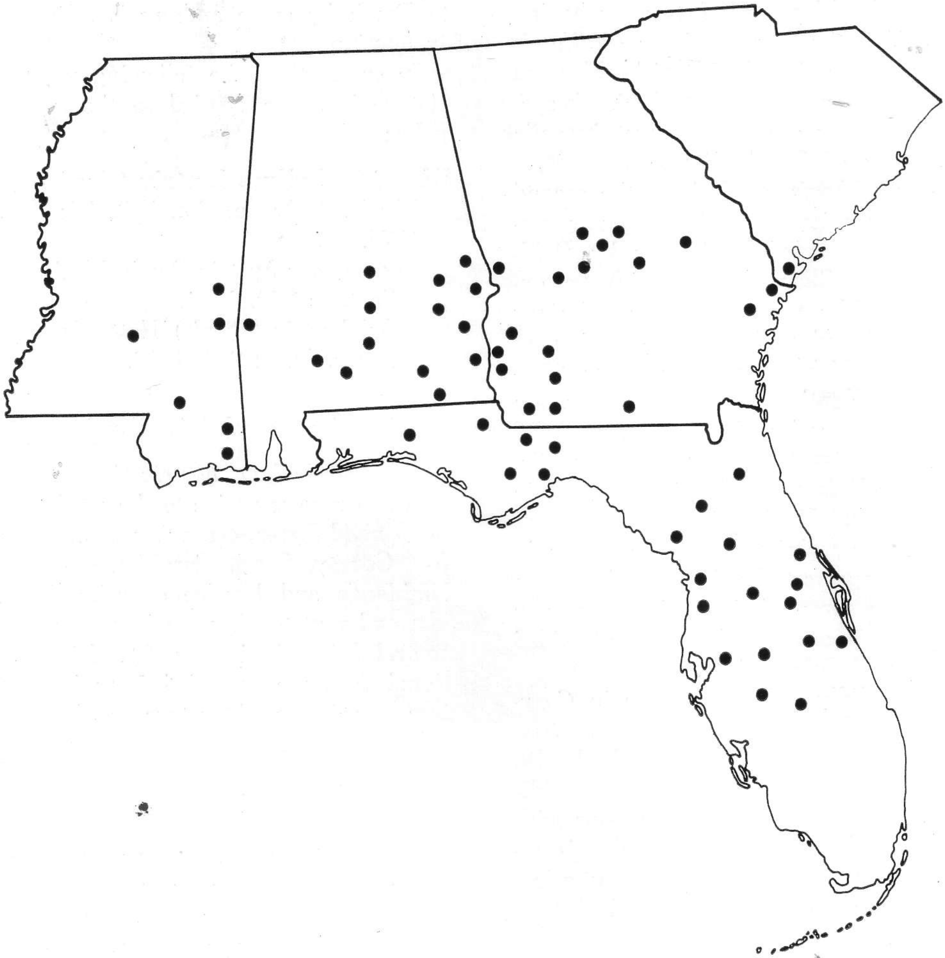
Chamaerops hystrix Pursh, Fl. Amer. Sept. 1: 240. 1814.

Sabal hystrix (Pursh) Nutt., Gen. N. Amer. Pl. 1: 230. 1818.

Habitat and Distribution

Rhapidophyllum hystrix is an uncommon species native to the southeastern United States, occurring from Beaufort County, South Carolina, south to Highlands and Hardee counties, Florida, and west to Simpson County, south central Mississippi (Fig. 2). Distributional data are compiled from herbarium specimens, literature, and sight records (pers. comm.). Questionable records in the literature which could not be verified with specimens are excluded.

Throughout its range, *Rhapidophyllum* is found primarily in low, moist to wet sites with rich, humus, calcareous clay, or sandy soils in woods, swamps, and hammocks (Fig. 3). Less commonly, it occurs in limestone sinks, grottos, and shaded pinelands. Although rarely found in full sun and well-drained sites in the wild, the species will thrive in such locations in cultivation if sufficient soil moisture is present. Specimens occasionally found in the wild on well-drained sites are generally smaller and in poorer condition as compared to those found in wetter soils. There does not appear to be a specific correlation of soil type with the presence of *Rhapidophyllum.* However, in the north central part of its range it is generally associated with



2. Distribution of *Rhapidophyllum hystrix.*

limestone soils. In central Florida, where the limestone bedrock is overlain with sandy soils, *Rhapidophyllum* often occurs in seepage areas along the edges of the various uplands constituting the central Florida ridge area.

Rhapidophyllum apparently has a fairly high degree of salt tolerance, at least for periods of short duration. To cite a specific example: a cultivated specimen in the medial strip of US 90 near Biloxi, Mississippi, which undoubtedly was submerged in salt water by Hurricane Camille in 1969 was a large and beautiful clump in 1973. It apparently was not severely affected.

Rhapidophyllum can be considered locally common or even abundant in some areas within its range, but its distribution is irregular. It was observed to be the dominant understory species in several Florida hardwood swamps, although it is rarely found where it would be highly competitive with other species.

The species does not appear to be

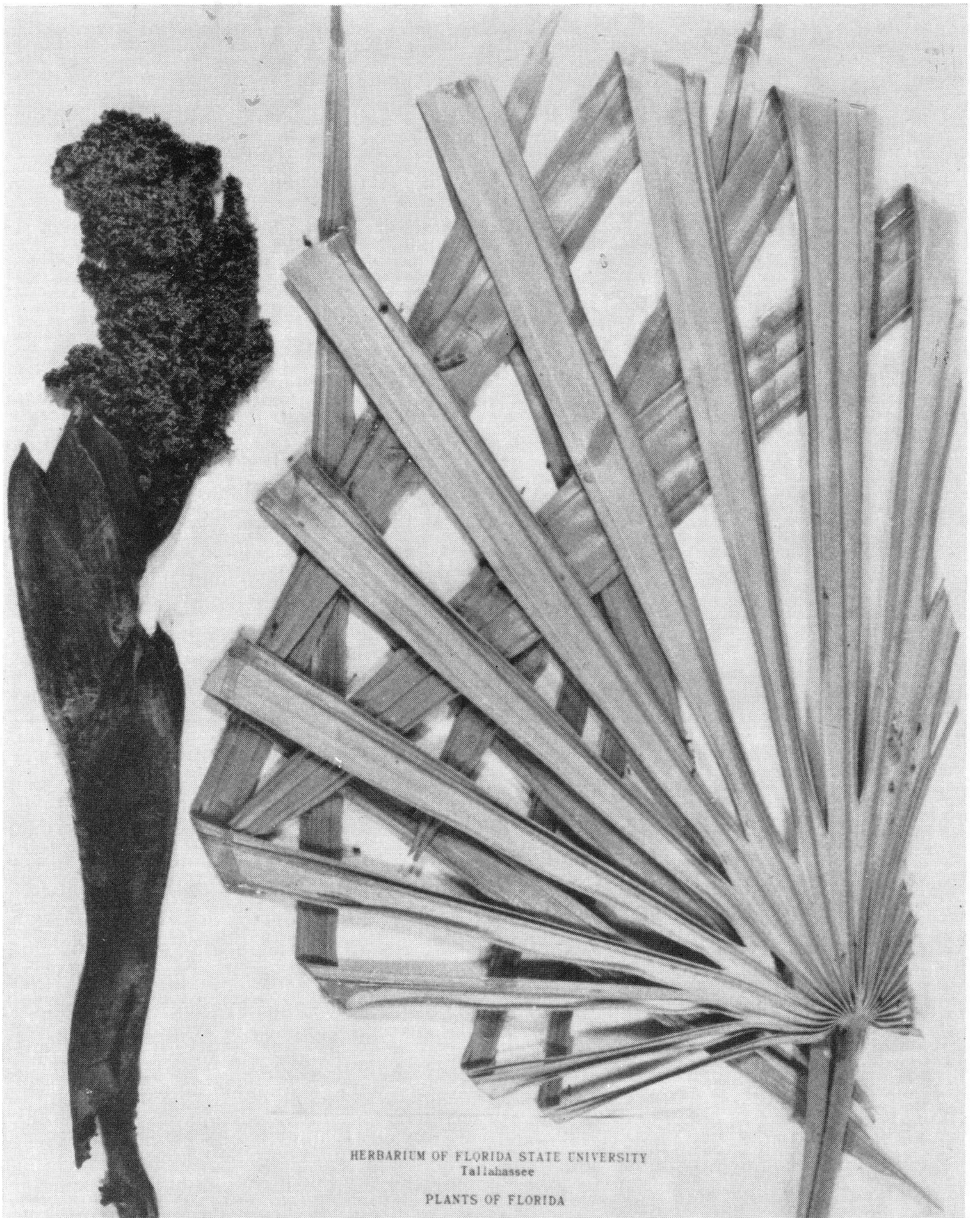
3. *Rhapidophyllum* colony near Oviedo, Seminole County, Florida.

occupying all the available suitable habitat. Many areas that appear environmentally identical from visual observations to those occupied by *Rhapidophyllum* do not support the species, even though the occupied and unoccupied areas are often found quite near one another. Also, what appears to be a uniform habitat is frequently poorly utilized by the species. Some possible reasons for this irregular distribution will be discussed later in this paper.

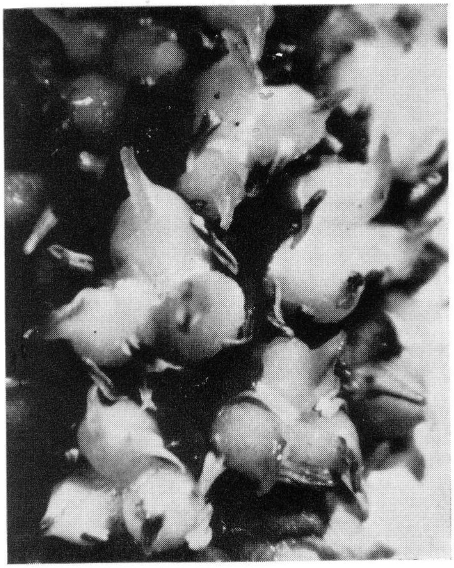
Reproductive Biology

Flowering generally occurs from March to August with flowering having been observed in both cultivated and wild plants as early as February and as late as November. Flowering in the wild is irregular and infrequent. Individual plants generally do not bloom annually. The reason for this irregularity is not known, but may be due in part to less than optimum environmental conditions. For example, flowering in central Florida populations in 1970, a wet year, was good, but since 1970 the seasons have been considerably drier and as a result flowering less frequent and more irregular. However, cultivated specimens which appear to receive sufficient moisture will also flower irregularly. Although the availability of moisture may play a role in initiating the process, flowering appears to be physiologically more complex.

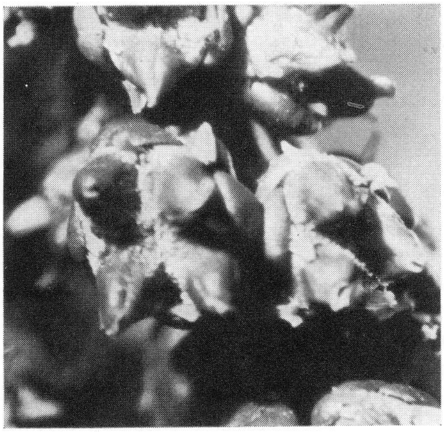
Rhapidophyllum is usually dioecious, less commonly polygamodioecious or rarely monoecious. In most populations staminate or predominately staminate inflorescences are more fre-



4. Specimen showing staminate inflorescence.



5. Close-up of pistillate flowers.



6. An unusual 4-carpellate flower (left) and a typical 3-carpellate flower (right).

quently observed than pistillate. The staminate inflorescences (Fig. 4) are the more conspicuous of the two with most or all of the inflorescence being forced clear of the bracts. The pistillate inflorescences are less noticeable, being much more constricted and not well projected from the bracts with half or more usually remaining permanently enclosed. A close-up view of the pistillate flowers is seen in Figure 5.

Flower color has been reported as being yellow, orange, or purple. We have observed all three colors in the field with purple predominant. Staminate flowers appear yellowish from a distance because of the predominantly cream-colored anthers. The calyx, corolla, and rachis vary from a dirty cream-color to pale pink to deep purple or brownish-purple. The corolla of the pistillate flowers ranges from brownish-purple to deep purple before pollination. The gynoecium in *Rhapidophyllum* is apocarpus and usually tricarpellate. However, the carpel number is sometimes reduced to one or two by abortion or rarely increased to four (Fig. 6). This latter condition is highly unusual in palms and merits further investigation. The young carpels are yellow to yellowish-green, turning yellow or yellowish-cream at anthesis. The rachis of the pistillate inflorescence is purple. After pollination, or in age, the corolla turns a whitish or yellowish color, eventually becoming brown. The four to six bracts are cream or dirty white in color, occasionally purple-tinged. Two major color variations of pistillate flowers were observed in the Seminole County, Florida populations. Two plants were seen which had a clear citrus-orange corolla and a whitish calyx. The rachis of the inflorescence was purple. A third plant was observed with an orangish-purple corolla and a purplish-white calyx. The rachis of this inflorescence was also purple. These flowers were fresh, having emerged from the bracts only a short time before observation. Although these color variations are striking, it is improbable that they have any taxonomic significance.

During the day, the staminate flowers emit a distinct musky odor. The pistillate flowers give off little or no odor during the day. However, they emit a weak version of that produced by the staminate flowers during the evening hours. It has not been determined if a fragrance is produced by either the pistillate or staminate flowers at night. The exact time relationship of the pollinator visitation needs further investigation.

Rhapidophyllum is self-compatible since isolated, cultivated plants will occasionally set abundant fruit. As the fruit matures, the white-hirsute condition, which is very evident when young, becomes more diffuse, but is persistent. The surface of the mature fruit varies from brown to reddish- or purplish-brown to red. The flesh is orangish and somewhat mealy in consistency. The fruits mature from December to February. The pistillate inflorescences remain crowded in the bracts and sheath fibers during fruit maturation. As a result, the fruits on the lower and inner parts of the stalks usually become greatly distorted (squarish or pyriform) while those on the upper part possess the more characteristic ovoid or globose shape. The fruits average 1.5–2.0 cm in diameter. Fruit clusters weighing up to 845 grams have been found. Most fruits possess a small spine near the apex of the endocarp. This spine varies from practically nonexistent to 2 mm in length. The endocarp frequently has a marking resembling that of pressed cork board. However, some endocarps, are smooth.

Inflorescences well projecting from the subtending bracts and resembling the staminate, but with scattered fruits, are sometimes encountered. This is indicative of the polygamodioecious condition. Plants have also been observed that produce abundant fruit which is smaller than normal and hollow or with shriveled, inviable seeds. These fruits are usually produced on well-projected inflorescences which resemble staminate inflorescences. The reason for this condition is unknown.

Rhapidophyllum seeds are extremely well protected by spines surrounding the trunk. They appear to be largely unattractive to animals since they are rarely disturbed. The pistillate inflorescence is so short that most fruits are caught in the cluster of petioles and needles surrounding and below it. Most of the fruits remain in the crown until they either decay or sprout. Manley (1967) found the ripe fruits of needle palm chewed on by what he thought to be mice. *Rhapidophyllum* seeds in the Seminole County, Florida populations have been found scattered around the bases of the parent plant. Most of the flesh had been removed and the seed bore marks produced by the teeth of a small mammal. The fresh mature fruit apparently has few properties to attract animals. It is bland in taste, being only slightly sweetish. Little or no odor was detected. However, overripe fruit emits a strong, overly sweet, pungent odor. Manley (1967) describes it as being like rotten cheese. It may be the odor of the overripe fruits that attracts animals. This odor is apparently produced after the fruits have been subjected to freezing temperatures.

The immature, half-formed fruits seem to be preferred by some animals over the mature fruits. Several times the remains of immature seeds were observed scattered around and near a fruiting palm. It appears that whatever feeds on the fruit, possibly squirrels, mice, or wood rats, prefers the endosperm before it becomes hard. It is also noted that the flesh of the green fruit is very astringent in taste, similar to that of a green persimmon.

In addition, many fruits are parasitized by small cereal beetles which make small burrows into the hard endosperm making an opening through the endocarp of the fruits which have the exocarp and mesocarp removed. These openings permit the easy entry of fungi and other decomposing organisms which further damage the seed so that it eventually becomes inviable. As a conservative estimate, about 20% are parasitized by these beetles.

Seed germination takes from about six months to about two years. The first divided leaves appear about three years after germination. Small, weak spines are evident at this time. Seedlings were found to be uncommon in the wild on the ground; however, many were found in the crowns of the parent plants where they germinated among the spines and thick dark brown fiber surrounding the trunk. The chances of these seedlings surviving is low because of the lack of available nutrients and water. The fiber and spines produce a favorable environment for few plants other than some fern species.

Only one *Rhapidophyllum* population was found in Florida (Stallion Hammock, Hillsborough County) where a pronounced increase in population by seedlings could be detected. The seedlings were well established on the ground and outnumbered the adult plants. The other populations examined usually did not have enough seedlings to replace even a small percentage of the existing population of palms.

One offset to poor production of viable seed in *Rhapidophyllum* is that it is relatively long-lived, allowing it to produce seed over a long period of time.

Another factor in the maintenance of populations is that the species reproduces by suckering. Although this does not increase its range at a rapid rate, it does increase its numbers within the population.

Offshoots produced by suckering plants tend to grow away from each other. In time the connection between the parent plant and the offshoot is severed by the rotting away of the stem tissue, resulting in the establishment of two individual plants.

Many *Rhapidophyllum* specimens have a slanted or decumbent trunk with three-fourths or more of it covered with a thick coat of spines and fiber. The remainder of the trunk is naked with rings of previous leaf bases quite evident. Palms with upright trunks or those in dense clumps generally have spines and fiber almost to the ground. In large plants a sizable cloak of leaf bases and fiber is retained on the trunk. The trunk may appear to be 0.5 m or more in diameter although it actually may be only 8–10 cm. The spines are the result of the partial breakdown of the leaf sheath tissue so that only the rigid sclerotic tissue persists (Tomlinson, 1962). The spines range in length from 2–4 dm. The retention of the leaf base fiber prevents the loss of the spines. It may be speculated that the spines probably evolved to protect the rather succulent flowers from herbivores rather than the growing tip of the palm. Seedlings four or five years old produce only weak spines and if spines were needed for the protection of the growing tip, they would develop early in the life history of the plant. There may have been strong predation pressure causing the palm to develop the spines and constricted inflorescences. A second reason for the leaf base and fiber retention is for the protection of the roots. It seems that the reclining trunk of most *Rhapidophyllum* in the wild is not the result of a natural tendency to lean or crawl, as it is in some species of palms, such as *Sabal etonia*, but because of unstable anchoring. Seedling *Rhapidophyllum* show no tendency to lean as do seedlings of *Serenoa* and

Sabal. As the needle palm grows, the end of the trunk rots off, taking with it any roots which would give support. In time, the weight of the palm or other forces causes the palm to tip or fall over. *Rhapidophyllum* has the ability to produce roots anywhere along the trunk, no matter what age the plant or the diameter of the trunk. A large palm examined from the Seminole County populations showed numerous roots about three-fourths the way up on all sides of the trunk 8 cm in diameter. The roots were growing among the old leaf bases and fiber, damp and well protected. The cloak of fibers therefore acts not only as an initial protection for the young roots, but as a damp medium for the roots to pass through from the trunk to the soil should the palm fall over. It also is conceivable that the young roots function as absorption organs, imbibing water from the spongy trunk mantle. On one occasion a specimen was observed with about a foot of trunk covered to ground with fiber and spines. Upon examination, it was found that only one root reached into the soil. The rest of the functional roots were found intermeshed in leaf bases and fiber.

Roots from the canopy and understory trees often invade the fibrous mantle of *Rhapidophyllum.* These roots may eventually provide support for the poorly anchored palms.

Rhapidophyllum also has the potential to produce suckers anywhere along the trunk regardless of the size or age of the plant. Suckers may be found on different plants from the base of the trunk to within several inches of the growing apex. Still, many palms fail to form suckers. Fisher and Tomlinson (1973), in their studies of the branching suckering of *Serenoa repens*, found that this species produced an axillary bud which could either produce inflorescences or suckers. Of the buds produced, about 50% abort and of the remainder, 80% produce inflorescences and only about 20% produce suckers. Also suckering may be inhibited by a strong, healthy apex. Until there is damage to the apex or sufficient distance created by addition of the trunk between the apex and the vegetative bud, suckering will be inhibited. This inhibition may also be effective in *Rhapidophyllum* and would account for the absence or sparse suckering in old, large, single-stemmed plants with a large crown. However, there may also be other explanations such as environmental restrictions. A single-stemmed plant taken from the wild will often sucker profusely, probably due to transplant shock. It is also of interest that seedlings, to the best of the authors' knowledge, always produce suckers.

The ability of the plants in cultivation to grow taller is probably due to better growing conditions and more light. Drier conditions and probably better air circulation keep the trunk and roots from rotting. The creeping habit which *Rhapidophyllum* in the wild exhibits has rarely been seen in cultivated plantings.

Rhapidophyllum is not vigorous or aggressive and it is doubtful whether it could successfully compete with heliophilic plants. However, its slow growth probably allows it to occupy habitats with low light intensity. As suggested in a study of *Iguanura geonomiformis* (Kiew, 1972), the success of undergrowth palms in occupying a dark habitat is due to their slow growth because not much light is required to maintain them. *Rhapidophyllum,* like several other species of palms, apparently is occupying a habitat where it does not have to compete with faster-growing plants for light, moisture, and nutrients. Bannister (1970) noted, in the case of

Prestoea montana (reported as *Euterpe globosa*) in Puerto Rico, that it is most likely that seedlings of this, and perhaps other forest species as well, may be able to exist in a state of semidormancy until some environmental factor becomes more favorable, at which time rapid growth can resume. A similar response may also occur in *Rhapidophyllum.* In the case of *Rhapidophyllum*, as perhaps in other forest palm species as well, light is suspected to be the limiting factor. *Rhapidophyllum*, when transplanted from a dark to a well-lit site, will usually grow much more rapidly.

Popenoe (1973) reported that the species has withstood temperatures down to 12 degrees below zero without being damaged. The minimum temperature that *Rhapidophyllum* can withstand without being killed has not been determined. It certainly is one of the more hardy palms.

In April, 1975, a survey of the insects on the flowers of *Rhapidophyllum* was made. Flowering at that time was poor and a high proportion of staminate inflorescences was produced as compared to pistillate.

Inflorescences were collected with the staminate and pistillate placed in separate containers of alcohol for preservation. These were later examined and the insect visitors noted. A weevil, identified by Rose Ella Warner as probably a new species of *Notolomus* (Curculionidae) near *N. basalis*, comprised more than 90% of the insects found on both types of inflorescences. Presently only two described species of *Notolomus* are known from North America: *N. bicolor* and *N. basalis.* Based on data from the entomological collections at the United States National Museum, *N. bicolor* has been collected on the inflorescences of *Chamaerops* sp. and *Sabal palmetto. Notolomus basalis*, on the other hand, has been collected on the inflorescences of such diverse species as *Albizzia* sp. (Fabaceae), *Asimina parviflora* (Annonaceae), *Cassia tora* (Fabaceae), *Castanea mollissima* (Fagaceae), *Carica papaya* (Caricaceae), *Gossypium hirsutum* (Malvaceae), *Hibiscus* sp. (Malvaceae), *Nerium oleander* (Apocynaceae), *Passiflora* sp. (Passifloraceae), and *Pluchea foetida* (Asteraceae). The larva has also been known to bore into the stem of sugar cane (*Saccharum officinarum*—Poaceae). *Notolomus* has also been observed on the inflorescences of *Serenoa repens* and *Forestiera segregata* (Oleaceae). Based on the known preference of the two described species of this genus, it is probable that *N. bicolor* is the species found on *Serenoa* while *N. basalis* is found on *Forestiera.*

This undescribed *Notolomus* species, found in great abundance on the inflorescences of *Rhapidophyllum*, is the prime candidate for pollinator. Adult beetles taken from the staminate inflorescences were found to be heavily covered with pollen. *Notolomus* sp. nov. is ideally suited as a pollinator since it is small, active, and a strong flyer. When the inflorescence is disturbed, the beetles will respond by quickly dropping from the inflorescence into the fiber or spines surrounding it, by crawling deeper into the inflorescence, or by flying away. Since the compacted pistillate inflorescence does not emerge far from the bracts a small and active pollinator would be necessary for *Rhapidophyllum.*

As previously stated, staminate flowers, and to a lesser extent, the pistillate flowers, emit a musky odor that serves as the attractant for the beetles which then feed on the pollen and various flower parts. The large numbers of beetles present (estimated to be about a hundred per inflorescence), their small size, pollen load, and mobility make this insect an effective pollinator. It is postulated that the beetle is first attracted to the area by the strong odor produced by the staminate flowers, which usually outnumber the pistillate in a given area. The beetle will then go from inflorescence to inflorescence seeking food.

Pollination by curculionid beetles is not rare in palms. Essig (1971) provides evidence that in Costa Rica, two species of *Bactris* are pollinated by *Phyllotrox megalops* and possibly *Grasidium longimanus* along with two species of the nitidulid beetle genus, *Mystrops*. Essig (1973) also suggested that the curculionid beetle *Nodocnemus* sp. pollinates *Hydriastele microspadix* in Papua New Guinea. This latter genus of beetles and related genera are believed to occur almost exclusively in palm flowers and are pantropical in distribution (Essig, 1973).

Schmid (1970) observed curculionids (*Celestes* sp. and *Phytotribus* sp.) on *Asterogyne martiana* in Costa Rica, but concluded that they were not effective pollinators for a number of valid reasons. Similarly Brown (1976) noted *Notolomus basalis* on *Sabal palmetto*, but concluded that this palm was pollinated by bees, primarily *Apis mellifera*, rather than by this curculionid.

Various other organisms were found in the inflorescences of *Rhapidophyllum*, but are discounted because they either were not found in sufficient numbers or were not physically able to satisfy the requirements for pollination of this species. Among these were neuropteran larvae, immature hemipterans, isopods, arachnids, lepidopteran larvae, chilopods, various coleopteran larvae, an amphipod, and a snail. The amphipod, which was very abundant on both the inflorescences and in the leaf litter on the forest floor in one population of *Rhapidophyllum*, has been identified by Edward Bousfield as *Talitroides topitotum* (Talitridae), an increasingly common pantropical and pansubtropical species. These organisms probably account for some of the damage to the flowers, resulting in lower fruit set.

The needle palm appears to be a senescent species. Flowering is irregular, fruit set poor, seed parasitism high. Its distribution is irregular and suggests a disintegrating range. Available habitat is also diminishing, due primarily to human activity. There appears to be no effective long-range dispersal mechanism for the establishment of new populations in now existing suitable habitats. Reproduction is apparently primarily by vegetative means, which results only in the maintenance rather than expansion of existing populations. Expansion of populations apparently only takes place locally. *Rhapidophyllum hystrix* is best interpreted as a slowly vanishing relict species.

Acknowledgments

Herbarium specimens were examined from the following herbaria: ALU, AUA, CU, FLAS, FSU, GA, GEO, MISS, MISSA, NCU, NY, USF, and VSC. The curators of these herbaria are gratefully acknowledged. Dr. Rose Ella Warner, Smithsonian Institution, provided the determination for the curculionid beetle and is gratefully acknowledged. Special thanks are extended to Dr. Frederick Essig, University of South Florida, Tampa, for his critical reading of the manuscript and helpful comments. Others who provided valuable information and are acknowledged are: William D. Manley, Stockbridge, GA; Dr. Wayne R. Faircloth, Valdosta State College, Valdosta, GA; Dr. Edward L. Bousfield, National Museums of Canada, Ottawa; Dr. James W. Hardin, North Carolina State University, Raleigh, NC; Dr. John Popenoe, Fairchild Tropical Garden, Miami, FL; Dr. J. R. Watson, Mississippi State University, Mississippi State, MS; James E. Poppleton, University of South Florida, Tampa, FL; Steven W. Leonard, Tallahassee, FL. The authors gratefully acknowledge Ms. Betty Loraamm for photographic assistance.

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