

Looking Back on the Florida Freeze of 1962*

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The freeze of December 12–13, 1962, brought the lowest temperatures experienced in central Florida in this century. Readings of below 20° F. were general throughout the area. Damage to plants was extensive. Not only were tropical plants, for which this had always been considered a fringe area, affected, but many species that had formerly been considered hardy for this region were severely frozen back or even killed. In this paper an attempt will be made to describe the extent of damage to some representative species, particularly on South Merritt Island, long considered an especially protected locality. In addition, an attempt will be made to compare the damage to that suffered in previous major freezes.

The coldest previously recorded official temperature reading on South Merritt Island was 26° F. at Georgianna

during the February, 1917 freeze. This is at a locality that has somewhat less cold protection than the extreme southern end of the island. During the freezes of December, 1957, and February, 1958, temperatures probably reached about the same minimums. Other major freezes occurred in 1926, 1934 and 1940. My personal observations cover only those that have occurred in this area since 1946. Severe freezes in February, 1947, and a year later in January, 1948, did considerable damage to tropical plants on the mainland as far south as Fort Pierce but had little or no effect on those on Merritt Island. The 1957–58 winter was probably the most severe of the century prior to 1962, as far as central Florida is concerned, and the mean temperature was lower than during 1962–63. Dent Smith recorded minimums of 32° F. or less on three mornings in December, 1957 (with a low of 25° F.), on one morning in January, 1958, and on seven mornings in February, 1958. Of the latter, four were consecutive, from February 17 through 20, and on both the 18th and 19th temperatures reached lows of 26° F. During these four days the maximum was only 54° F. This was on the peninsula at Daytona Beach, between the Halifax River and the ocean. While somewhat colder than South Merritt Island this area has similar protection from surrounding salt water and many tropical species have been cultivated there (6). Actual minimum temperatures reached on Merritt Island during the freeze of December 13, 1962, are unfortunately not available, at least not for the

* In May of 1963 I prepared a report on the effects of the freeze of December, 1962, on native and exotic plants on South Merritt Island, Florida, with notes on some other locations and effects of previous freezes. Nearly five years have elapsed since that time, but possibly the portion of the report dealing with the palms may be of some value to members of The Palm Society. In that report I quoted freely from Dent Smith's report on the effects of the 1957–58 freezes on his collection on the peninsula at Daytona Beach, as included in *Principes* 2: 116–126, 1958. His reports on the 1962 freeze had not been published at the time that I prepared the paper. I have extracted information from my 1963 report as it pertained to the cycads and palms, emending it by adding some brief notes on the current status of the specimens discussed. At the time of this writing (January, 1968) there have been no subsequent killing freezes at this location. Numbers appearing in the text are keyed to the literature cited at the end of the report.

TABLE 1. *Readings for December, 1962, from Brevard County and some examples of inland locations.*

<i>Location</i>	<i>Date</i>	<i>Minimum in degrees F.</i>	<i>Hours below 32° F.</i>
Kissimmee	Dec. 11	24	11.0
"	Dec. 13	21	15.2
"	Dec. 14	22	13.4
Orlando	Dec. 11	29	6.8
"	Dec. 13	20	?
"	Dec. 14	26	11.0
Orsino (N. Merritt Island)	Dec. 11	30	8.5
"	Dec. 13	26	10.0
"	Dec. 14	29	7.6
Cocoa	Dec. 11	28	7.0
"	Dec. 13	22	13.1
"	Dec. 14	25	11.5
Merritt Island	Dec. 11	31	4.0
"	Dec. 13	24	11.0
"	Dec. 14	29	7.0
Malabar	Dec. 11	27	8.0
"	Dec. 13	23	10.5
"	Dec. 14	25	9.5

specific locale that is the subject of the bulk of this report, but it is certain that they were at least as low as 26° F. (see supplement). This was probably two or three degrees colder than minimums reached in 1957-58, although total hours of freezing weather in the earlier freeze were much greater. Later in this report it will be shown that this repeated freezing weather caused more damage to a few species than did the one extreme low reached in 1962, which was not followed by extreme lows during the remainder of the winter. During the 1957-58 freeze, hundreds of coconut palms were killed on South Merritt Island and on the peninsula east of the Indian and Banana Rivers. Many of these had been planted prior to 1930 and had survived the freezes of 1934 and 1940. Nearly all coconut palms on the mainland north of Vero Beach were killed. However, perhaps about 25 per-

cent of those on the peninsula and Merritt Island survived.

Merritt Island, especially the two or three southernmost miles, has long been of interest to botanists as a sort of outpost of the tropics located in the temperate zone. While several miles wide at its northern end, it tapers southward to a long, narrow, knifelike projection until near the extreme southern tip it is only a few yards across. Lying as it does between two tidal lagoons known as the Indian and Banana Rivers, it receives the protection of surrounding salt waters. The Indian River on its west affords the greatest protection, being several miles wide and of greater depth than the Banana River. Since freezing winds almost invariably come into this area from the northwest, they must cross several miles of salt water, warmer than the air or the land areas, before striking the island. The island itself, especially

the southern tip, is underlain by coquina rock formations. The dominant vegetation of the southern two miles is almost exclusively West Indian in character, the only noticeable warm-temperate zone exception being the cabbage palm, *Sabal Palmetto*. It is a remnant of a flora that was undoubtedly at one time much more extensive over coastal Florida but now survives only in specially protected areas. It extends over most of the Florida Keys, the Cape Sable area, the Ten Thousand Islands and around the shores of Florida Bay and Biscayne Bay northward to Lake Worth. North of this, traces remain in scattered spots as far as Cape Kennedy (Cape Canaveral), which is the northermost limit for most species (9). Typical trees are the gumbo limbo, *Bursera Simaruba*; strangler fig, *Ficus aurea*; mastic, *Mastichodendron foetidissimum* (*Sideroxylon foetidissimum*); satin leaf, *Chrysophyllum oliviforme*; sea grape, *Coccoloba Uvifera* and pigeon plum, *Coccoloba diversifolia* (*C. laurifolia*). Smaller shrubs of West Indian origin include the marlberry, *Ardisia escallonioides* (*Ipacorea paniculata*); myrsine, *Rapanea guianensis* (*Myrsine Rapanea*); ironwood, *Krugiodendron ferreum*; wild coffee, *Psychotria undata*; necklace bean, *Sophora tomentosa*, and several "stoppers" of the genus *Eugenia* (4). During a one-afternoon walk on South Merritt Island in the 1920's, Charles T. Simpson identified more than fifty trees and shrubs native to the West Indies, including all of those listed above. He remarked on the fact that they were of large size with none of the appearance of plants growing near the limit of their range (5). Early settlers on Merritt Island took advantage of its protected location and planted many tropical fruit trees and ornamentals. Early in the century, extensive pineapple plantings were cultivated here. It was obviously ideally suited for citrus

cultivation and much of the fame of Indian River citrus was due to the superior fruit grown on Merritt Island. In addition, such exotic fruits as mangos, avocados, sapodillas, tamarinds, bananas, papayas and the various annonas were planted and thrived. Commercial plantings of mangos and avocados grew to produce large crops of excellent fruit. Such tropical ornamentals as the various banyans, royal palm, *Roystonea*, coconut palm, *Cocos nucifera*, royal poinciana, *Delonix regia*, candle nut, *Aleurites moluccana*, crotons, *Codiaeum*, *Hibiscus* and many others were planted around the homes and grew into fine specimens. Some of these were occasionally injured by the rare freezes but not severely and recovery was rapid. The 1957-58 winter, however, did serious damage, though not as severe as on the adjacent mainland. But in December, 1962, came the worst freeze so far in this century and it brought the worst damage seen on the island. Oddly enough, neither this freeze nor the ones of 1957-58 did serious damage to coastal areas south of St. Lucie County, although in earlier freezes it had been noted that some localities south of Miami had been injured more than the Merritt Island area. An attempt will be made to describe this damage in some detail.

It was previously mentioned that during this freeze some plants heretofore considered fully hardy in at least the warmer parts of central Florida suffered severely. Examples include the queen palm *Arecastrum Romanzoffianum*, and *Melaleuca quinquenervium* (misidentified in Florida horticulture as *M. Leucadendron*). Thousands of the former were killed in the colder localities and many more were defoliated. The latter were defoliated, in some cases frozen to the ground and in the case of smaller examples killed outright.

Native vegetation that received injury

consisted mostly of the remnants of West Indian flora. The mangroves, being disseminated by water, are continually extending their range northward along the coasts during warm periods and then being destroyed at their northern limit by freezes. Recovery was noted, however, as far north as the lagoons north of New Smyrna, of the red mangrove, *Rhizophora Mangle*, usually considered the tenderest of the mangroves occurring in Florida. Since the native West Indian flora had already been destroyed in all but the most protected locations by previous freezes, damage to it was not as extensive as to the exotic species planted by man. Most of the West Indian species on South Merritt Island were defoliated with loss of branch ends but are making a good recovery. With the passage of two or three years, barring another major freeze, damage to the native vegetation will not be apparent. (Note: This was written in May, 1963, five months after the freeze. Now, in January, 1968, this forecast is essentially borne out. Most signs of the freeze are gone, although to one who knows what happened, dead trees can still be seen here and there that were victims of the 1962 disaster.) The case of the exotic species is quite different, as is outlined below.

A brief description of the writer's property and of the plantings on it may be of value before going into the list of damage by species. In 1950 I obtained a piece of property on South Merritt Island, about three miles north of the southern tip, and with the acquisition of adjacent property in 1953 have about two acres. The property is midway between the Indian and Banana Rivers but does not touch either. At this point the island is approximately 1100 feet wide. The greater part of the property was covered by a stand of sand pine, *Pinus clausa*, with a heavy undergrowth of scrub hickory, saw palmetto, red bay,

Smilax and other plants typical of the dry Florida "scrub." The easternmost side is somewhat lower and was covered with dense saw palmettos and some live oak, *Quercus virginiana*. In contrast to the portion of the island just to the south, where coquina rock is at or near the surface, it is an area of deep sand, probably an inland dune from an old shoreline. It is very dry but larger trees seem to extend their taproots into the water table and grow vigorously. The plantings were begun in 1950. Specimens were secured from commercial nurseries, as gifts in the form of seeds, small plants or cuttings, or from collecting of wild plant materials. No large specimens were secured, and the only large trees now present that were originally there are one Haden mango and two oaks. All others have grown from seeds or small plants since 1950. Artesian water has been used for irrigation. Generous amounts of commercial fertilizers, as well as such organic materials as seaweed, poultry manure, leaf mulch and compost have been applied. Most of the plants have responded well. A list of species, with notes on the cold damage, follows arranged alphabetically under the two families Cycadaceae and Palmae.

CYCADACEAE

***Cycas circinalis*.** Queen Sago. Tropical Africa. This specimen was set out as a small plant in 1956 and had made rapid growth with a dense crown of leaves about 12 feet high and a spread of 14 feet in 1962. It showed no damage in the 1957-58 freezes. Notes taken after the 1962 freeze follow: "Dec. 15: no apparent damage. Dec. 30: Some outer fronds burned. April 16: same. A rapid recovery from these slight effects is being made and all traces of damage will soon disappear as the older fronds are replaced. At other locations

damage to examples of this species was much more severe, with loss of the entire crown of leaves in some interior Central Florida locations." By November, 1964, the plant had fully recovered and was in vigorous growth with no evidence of freeze damage. The plant in January, 1968 is considerably larger than at the time of the 1963 notes and shows no trace of the freeze damage. This specimen has never been "pruned" and has a number of large offshoots.

Encephalartos sp. South Africa. This specimen was grown from a seed obtained from Edwin Menninger of Stuart, Florida, in 1957. It grew slowly as a potted plant and was set out in 1962. It was about one foot tall in 1962. It showed no effect of the freeze, but was protected by covering with a cardboard box. This is still a slow grower but now, in 1968, it has about doubled the size noted above.

Zamia integrifolia. Coontie. Native. Set out in 1950, this plant had made a clump about four feet across in 1962. It was undamaged by the freeze. Five years later the clump is about six feet across.

PALMAE

Acoelorrhaphe Wrightii (*Paurotis Wrightii*). This is a native palm, being found in the southern Everglades in the transition zone between fresh and brackish water. It is also native to Cuba, Mexico, the Bahamas and Honduras. It is a clustering fan palm, extensively used in recent years in landscaping around homes, motels, restaurants, etc. This example was set out as a small plant in 1958, and is now about three feet in height and spread. It showed no damage from the freeze. It was noted that landscape specimens in other, colder areas also escaped injury; it must be included among the hardier palms despite its

native habitat at the extreme southern end of the state. It was also undamaged at Dent Smith's collection in 1957-58.

Butia capitata. Pindo palm. Brazil and Argentina. This specimen was planted in 1951 as a small plant from a collection in Jacksonville. It is a slow grower, but in 1962 had about three feet of trunk and an overall height of about ten feet. It is one of the hardiest of palms, being grown outdoors as far north as North Carolina, and as to be expected, showed no damage from this or previous freezes. Examples observed in North Florida were also seen to have suffered no apparent damage. At present (1968), this palm has about four feet of trunk. It fruits profusely and seedlings are abundant around its base and even in the "boots."

Butia hybrid. (\times *Arecastrum* ?). This is an example of a natural hybrid, apparently between *Butia capitata* and *Arecastrum Romanzoffianum*. A number of these have been found in Florida, many in the Leesburg area, and are prized by palm collectors. They show the persistent leaf bases of *Butia* but the pinnae are not as stiff, being more like those of *Arecastrum*. Both parents are members of the subfamily Coccoideae, and were at one time referred to as *Cocos australis* and *Cocos plumosa*, the two names persisting among nurserymen. This specimen was received as a small potted plant in 1960 and set out in 1962. It showed no damage from the freeze. Several large examples of *Arecastrum* growing on the place were also undamaged, but as previously noted this species was severely damaged at many inland locations. At present (1968), this palm has grown to a height of over five feet. The *Butia* characteristics are dominant and its actual status as a hybrid is somewhat in doubt.

Chamaedorea. These are small, shade loving palms from Mexico and

Central America. One is the palm commonly sold in curio shops as a souvenir of Florida, and known by nurserymen as "Neanthe bella." Its correct botanical name is *Chamaedorea elegans*. Examples of several species are growing in this collection. None showed any damage.

Chrysalidocarpus lutescens. Madagascar. Two specimens of this clustering palm were planted in 1950. They showed diversity of growth, one producing a large number of slender stems and the other three larger stems. They had reached a height of some 20 feet. They were moderately damaged by the freezes of 1957-58, with loss of outer fronds on the higher stems, but made a rapid recovery. Damage from the 1962 freeze was much more serious. The example with the larger number of stems exhibited severe damage to the higher stems but the lower ones were undamaged and should eventually replace the others. The example with only three large stems showed no evidence of recovery in May, 1963, all fronds being dead and no growth appearing from the center.

Note dated November, 1964: "One of the three large canes sprouted almost a year after the freeze, but then died. Vigorous growth from the lower canes on the other example." Present (1968): growth of smaller stems had practically obliterated all evidence of the freeze on the multiple stemmed specimen. The other showed signs of recovery through feeble growth but died after about a year. Attempts to save it by sawing off below the damaged terminal portion of the stems produced initial growth but apparently the damage was too severe.

Coccothrinax argentata. Silver palm. Native to the rock pinelands of south Dade County, Florida. This is a notoriously slow growing palm. The example in this collection was obtained from a Homestead nursery as a small

plant in 1953, and was then several years old. It was about four feet tall in 1962 with about a foot of trunk, and had flowered for several years. It showed no damage from either freeze. This specimen is now over six feet tall with three feet of trunk.

Coccothrinax crinita. Another very slow grower, this Cuban palm is noted for the long, hairlike fibers that cause the trunk to appear to be clothed with long, light-colored fur. The example here was received as a very small potted plant in 1960 and set out in 1962. It was unaffected by the freeze. At the present time, six years after being set out, this palm is only 11 inches tall. However, it appears healthy and hopefully will accelerate its growth at a later stage.

Cocos nucifera. Coconut. Prior to the 1957 freeze, there were 28 coconut palms on the property and several had flowered for the first time and were developing fruit. That freeze killed 23 of the 28. Some appeared to be recovering in the spring, new fronds emerging, but succumbed either to damage deeper in the bud, to insect attack or to a combination of the two. To the five that survived was added a specimen of the 'Golden Malay Dwarf' variety planted in 1958. This had grown rapidly and was fruiting for the first time in 1962, as were two of the survivors of the earlier freeze. In May, 1963, it was not possible to be sure of the damage done by the 1962 freeze. It appeared likely that three would recover; two, including the Malay Dwarf, were doubtful and one, the largest, seemed almost certainly killed. The last three showed signs of recovery but the new frond that emerged fell over. The rotted part of the bud in the dwarf variety was cut away and the area treated with an insecticidal dust, and a green stub emerged. The same thing was done with the other two and green growth was found in the bud of

one but not the other. It is perhaps noteworthy that the three that showed definite evidence of survival in May, 1963, were all growing in the lower, eastern portion of the property, which would be expected to be colder than the higher portion nearer the Indian River. Two of these were grown from coconuts produced by trees growing in the island. It seems possible that these parents had a somewhat greater than average cold tolerance, having survived previous major freezes. In the southernmost mile of the island nearly all coconuts seemed to be recovering by May, 1963. At the Dent Smith collection at Daytona Beach nine *Cocos nucifera* to 13 feet tall were growing in 1957. All were killed by the 1957-58 freezes. (6)

By November, 1964 the coconut nearest the house (the largest example referred to above) recovered after seemingly having died. One of three in the lower end of the property died during the second summer following the freeze. The other two made good recovery and the larger was flowering. Four smaller ones (sprouts at time of freeze and not mentioned above) had been set out and were growing rapidly. By the present, in January, 1968, three of the specimens described eventually recovered, including one that appeared hopeless. This, the largest one, was given a severe treatment by sawing off the entire terminal end of the trunk to several inches below the emerging growth. It has made a complete recovery and has added about two feet of trunk. The 1957-58 and 1962 freeze damage is easily seen in the two constricted areas in the trunk which is now about 16 feet tall. Of the three referred to as showing the clearest indication of recovery, one, as indicated in the 1964 note, died about a year and a half after the freeze. The other two are now vigorous and are bearing. The 'Golden

Malay Dwarf,' although it produced some new growth, eventually died. It should be noted that a freeze-injured coconut palm, if it had developed a trunk at the time of the freeze, will always bear the evidence of the injury in the smaller size of that portion produced from growth made immediately after that period. This is in contrast to *Roystonea*, which at least at this location, shows little evidence of freeze damage.

***Copernicia macroglossa* (C. Torreana).** This palm from Cuba is interesting for its extremely short petioles and persistent leaves, arranged spirally so that it is clothed to the ground while young and superficially resembles a *Pandanus*. It is another extremely slow grower. The specimen in this collection was set out in 1959 and has grown only two or three new leaves since that time. It was unaffected by the freeze. In 1968, still small although nine years old, this specimen is showing signs of accelerated growth as new leaves are developing more frequently and each new one is noticeably larger.

***Dictyosperma album*.** Hurricane palm. Mauritius. This specimen was set out in 1954 and at the time of the freeze had grown about a six-foot clear trunk. Notes on different dates after the 1962 freeze follow: "Dec. 15: light damage noted, some outer fronds discolored. Dec. 30: very severe, all fronds brown. Feb. 3: center fronds emerging green, April 16: recovery seems likely, center fronds green." In May, 1963, it appeared certain to recover and show little effect of the freeze within a few months. Notes on the 1957-58 freezes show that it suffered minor foliage damage at that time. At Dent Smith's collection at Daytona, all four specimens that he had were killed by the 1957-58 freezes. He noted that one persisted until May when killed by insect larvae. (6) In 1968, this palm

had recovered completely and now has ten feet of trunk below the crown shaft. It flowers but has produced no fruit.

Howeia Forsteriana. Forster's sentry palm. Lord Howe Island. This palm was a favorite in conservatories during the nineteenth century because of its soft, dark green, graceful leaves. The specimen in this collection was received as a small potted plant in 1954 and set out in 1957. Notes on damage are as follows: "Dec. 15, no damage noted. Dec. 30, slight browning of oldest fronds. Feb. 3, same. Very slight foliage burn." It showed little effect of the freeze in May, 1963. This specimen recovered completely from the freeze and never showed serious injury. At present, in 1968, the new fronds show signs of bud damage, either caused by physical injury to the emerging leaf portion from a large frond or spathe falling from an overhanging *Arecastrum*, or from insect damage.

Latania lontaroides (*L. borbonica*). Red latan palm. Mascarene Islands. This is a very showy palmate palm with red petioles and midribs. Two specimens were growing here in 1957, having been grown from seed received in 1950 and set out in 1953. After the 1957-58 freezes the two specimens, which were growing within ten feet of each other, at first showed no injury. In a few weeks, however, the fronds of one became discolored and died, and it was found to be rotted in the bud with heavy infestation of insect larvae. The other specimen showed no damage. By 1962, while having formed only a short trunk, it had huge "fan" leaves over six feet in diameter. Again it showed no damage and in May 1963 was growing vigorously. At Dent Smith's collection there were five, to five feet tall. All were killed, the last one by insect larvae in July. (6) My specimen recovered completely and is very impressive in 1968 with leaves over

eight feet across. It is probably inhibited somewhat by being excessively shaded by taller *Sabal* palms and a *Kigelia* tree.

Livistona. Several species. Southeast Asia and Australia. These are the popular "fountain" or "fan" palms, the best known being *Livistona chinensis*, the Chinese fan palm. Two of this species, grown from seed and set out in 1958 and 1959, some three and four feet tall, were undamaged by the 1962 freeze. A specimen of *L. australis*, the Australian cabbage palm, was set out in 1960 and had reached about the same size. It is considered the hardiest of this genus and as to be expected suffered no damage. A specimen of *L. Saribus* (*L. Hoogendorpii*), was set out in 1960 and had made much more rapid growth, with a height and spread of five feet. It was also undamaged. A specimen of *Livistona rotundifolia*, however, set out in 1960 had made slow growth and after showing severe foliage burn it died with the bud area rotted. This appears to be the tenderest of the commonly cultivated livistonas. Dent Smith's experiences with this genus in 1957-58 were parallel, with no damage to the first three species and loss of one of two specimens of *L. rotundifolia*; the larger of the two lost its foliage but recovered. (6)

The specimen of *Livistona Saribus* is probably the most rapidly growing palm in this collection in 1968. The specimen of *L. australis* died, not from the effects of the freeze but apparently from building materials that were left piled around it when a garage was built near it.

Mascarena lagenicaulis. Mascarene Islands. This specimen of the "spindle palm" group was set out in 1958, and had reached a height of three feet. Notes taken after the 1962 freeze: "Dec. 15, light foliage burn. Dec. 30, outer fronds burned. Two opened and one unopened frond still green. Feb. 3, same." Dam-

age to this palm was slight, it made a complete recovery and has grown well since but rather slowly.

Mascarena Verschaffeltii. Mascarene Islands. Another spindle palm. There are two specimens, grown from seed and set out in 1953. They had reached a height of about eight feet by 1962. Notes taken after the 1962 freeze: "Dec. 15: no damage noted. Dec. 30: all but center fronds dead. Feb. 3: center fronds emerging green." The same effect occurred in 1957-1958, with loss of all outer fronds but quick recovery with emergence of healthy center fronds. Seven specimens of this palm in Dent Smith's collection to eight feet tall were all killed in the 1957-58 freezes. One made a partial recovery but died in June from insect larvae attack. (6)

Phoenix. Various species. Old World tropics and subtropics. Since there are at least five species of *Phoenix* in this collection, they will be grouped together, although varying in hardiness and size. This genus includes the date palm, *P. dactylifera*. The largest specimen on my place is an example of *P. reclinata*. It was first planted in Eau Gallie in 1949 after being found uprooted and thrown on a trash pile. It was transplanted to its present location in 1950, and in 1962 was about 12 feet tall with a spread of 20 feet or more, consisting of numerous stalks. It had flowered for several years. It was totally unaffected by the freeze. Specimens growing in Orlando and Tampa showed severe injury with loss of most of the outer fronds. This palm is grown as far north as Jacksonville but is only semi-hardy there. A small example of the Canary Island date, *P. canariensis*, was set out in 1962. It was undamaged. This palm is considerably harder than *P. reclinata* and is used extensively for landscaping in European countries bordering the Mediterranean. *Phoenix Roe-*

belenii, the pigmy date, is another very popular small palm for patios but is one of the tenderest of the genus. My example, set out in 1959 and about five feet tall and flowering in 1962 had only a hint of browning of the outer fronds but specimens on the mainland in Eau Gallie were severely injured and others in Orlando and Clearwater appeared to have been killed. A small example of *P. "tomentosa,"* set out in 1960, showed no damage. Most severely injured was a specimen of an unknown species, of small size, set out in 1960. Notes on this example: "Dec. 15: no damage noted. Dec. 30: all but the two center fronds burned. Feb. 3: center bud pulled out, apparently dead." By May, however, healthy new leaves were emerging from the center. This has been noted in other palms, when at times the center bud has been pulled out but new leaves have still emerged from deeper in the bud. Removal of the damaged tissues in the bud appears to facilitate recovery. Dent Smith noted no injury to *P. canariensis*, *P. Roebelenii* or *P. reclinata* in 1957-58. Some of his hybrids of unknown parentage lost their outer fronds but recovered. (6) Palms of the genus *Phoenix* hybridize readily and it is impossible to make definite identification in the case of some specimens. All the phoenix palms made complete recoveries including the one referred to above as having the center leaf pulled out.

Ptychosperma Macarthurii. New Guinea. This is a clustering palm with slender stems. My specimen was set out in 1954, but made poor growth, being in excessive shade. It was transplanted to its present location in 1956 and there made rapid growth. At the time of the 1962 freeze the older stems were some ten feet tall and were flowering. Notes taken after this freeze: "Dec. 15, no damage noted. Dec. 30, all fronds on higher stalks burned. Leaves on lower

stalks green. Feb. 3: same." It appeared in May, 1963, that all the taller stems had been killed but that those of two or three feet would survive. In 1957-58 this palm suffered only light damage. Dent Smith had two specimens in 1957, three and four feet high. Both were killed. It may be noted here that the only palm, other than one *Latania* and the coconuts, killed at my collection in 1957-58, was an 8-foot specimen of *P. elegans*, a single-stemmed member of this genus. Its death was possibly caused, at least in part, by insect larvae in the bud.

By November, 1964, the taller stems had died but lower clusters had recovered. The plant had not regained its original height. In January, 1968, growth from undamaged smaller stems has now recovered the former size of this specimen but it has not flowered again to date.

Roystonea. Royal palm. Caribbean region. There are several species of *Roystonea* cultivated in Florida and positive identification is difficult. I suspect that all of my specimens are *R. regia*, the Cuban royal palm, the one most commonly grown here. The native Florida royal palm, *R. elata*, is similar and by some botanists considered identical. It is native to the hammocks of the southern Everglades. *Roystonea oleracea*, the Caribbean royal, is also occasionally seen in Florida. The oldest specimen on my place was obtained as a very small seedling in 1947, and is now some 40 feet tall. Six more were obtained as small plants from the L. M. Crowder place on South Merritt Island in 1950. These were voluntary seedlings that had grown at that place. Another was grown from seed from another South Merritt Island specimen. These examples in 1963 ranged from 20 to 40 feet tall but none had fruited. During the 1957-58 freezes they suffered only minor damage

with loss of some of the outer fronds but made quick recovery. Notes taken after the 1962 freeze: "Dec. 15: very severe, all fronds burned brown. Dec. 30: same. Some unopened center fronds appear green. Feb. 3: center fronds emerging green on all." In May, 1963, all were making a good recovery with several green fronds having emerged on each.

Damage to this genus on the mainland was much more severe, but many specimens were recovering. Its usual northern limit of cultivation on the mainland is in the Cocoa area, although there have been examples in Orlando and New Smyrna. These latter were almost certainly killed by this freeze. Dent Smith had a total of 27 of three species in his collection in 1957: eight were *R. elata*, four feet tall, and all were killed; two were *R. oleracea*, three and five feet, and both were killed; 17 were *R. regia*, from 5 to 24 feet tall. Of these, all were killed except one 12-foot specimen, one of 14 feet and one 24 feet tall. These lost all foliage but by late fall were flourishing. The smallest of the three was growing under oak foliage and possibly received some protection from this. Dent Smith feels that hardiness of this genus, and of many others, is definitely related to size (6).

It may be of interest to note that the royal palm once had a much wider native range in Florida. William Bart-ram unmistakably described specimens growing in the forests along the St. John's River in the vicinity of the present city of Deland in the late eighteenth century (2). Very severe freezes occurred in the 1840's and again in the 1890's, and it seems likely that at these times the genus was exterminated in localities north of its present range. Native royal palms, some over 100 feet tall, can be seen now in the Everglades National Park at Royal Palm Hammock

and a few other places, at Collier Memorial State Park near Marco and at a few other localities in southern Collier County (4).

Of my eight specimens described above, all but one had made full recovery by November 1964. One died after Hurricane Cleo almost two years after the freeze. Weakened center growth may have been further damaged by the hurricane winds. Four of the larger specimens are now fruiting in 1968, have been fruiting for several years, and seedlings have been grown from them.

Sabal causiarum. Puerto Rico. This is a much more massive relative of our native *S. Palmetto*. My example was set out as a small plant in 1960. It had made very rapid growth and was over nine feet in May, 1963. It was unaffected by the freeze. The palm has continued its rapid growth. It now has about four feet of very heavy trunk and an overall height of about 15 feet. It fruits heavily and a number of seedlings have been grown.

Sabal Palmetto. Peninsular Florida, coastal Georgia and South Carolina. No effect was noted, here or in more northern areas, on the native cabbage palm. Since it has been used in landscaping as far north as North Carolina and grown to maturity out of doors in Japan, it must be considered one of the hardiest of palms.

Thrinax. Several species of the thatch palms, natives of the Bahamas, Florida Keys and West Indies, are in this collection. None were seriously affected by the cold. One unidentified species had some discoloration of the outer fronds while an example of *T. Morrisii* and one of *T. parviflora* were completely uninjured. However, the specimen of *T. Morrisii* was very small and was protected by covering with a cardboard box. This is in contrast to Dent Smith's experience at Daytona Beach, some ninety

miles to the north, since he lost all of his *Thrinax* species in 1957-58. He noted, however, that the genus is much hardier when mature (6). My specimens have all made good growth since 1963, with *T. Morrisii* the slowest grower. The unidentified specimen mentioned in the report is probably *T. microcarpa*.

Trachycarpus Fortunei. Fortune's windmill palm. East Asia. This is considered the hardiest of all palms, having been grown out-of-doors on Vancouver Island, in Edinburgh, Scotland and in Virginia. As to be expected, my small specimen, set out in 1962, was unaffected by the freeze. Unaffected by the cold, this palm has nevertheless been a very slow grower and in January, 1968, is only 32 inches tall.

Veitchia Merrillii. Philippine Islands. This palm, formerly known as *Adonidia*, is one of the most popular landscape subjects in south Florida. It resembles a small *Roystonea*, and bears large clusters of brilliant red fruit. It is, however, quite tender. My collection included two examples set out in 1950 and about 15 feet tall, two about four feet and one about two feet, the latter a seedling from one of the older ones. The three smaller ones were killed in 1962. All fronds on the two larger specimens were killed but green center fronds had emerged in May, 1963, and recovery seemed likely but not certain. This palm tends to show permanent scars from freeze injury in its stem, with that part developed during and soon after injury much reduced in size and scarred or furrowed. This is also typical of *Cocos nucifera*. It also tends to be susceptible to attack by boring beetles after being injured: one of my specimens suffered severely after the 1957-58 freezes and was saved only after elaborate treatment. A small seedling that had voluntarily sprouted from a seed dropped from one of the two larger examples was unaf-

fectured by the last freeze. Apparently temperatures at ground level were considerably higher, as several coconut sprouts were similarly unaffected and some germinated after the freeze. Dent Smith had 19 specimens of *V. Merrillii* from three to nine feet tall. All were killed by the 1957-58 freezes (6).

In November, 1964, one of the two large specimens had made fair recovery but the top was much reduced. The other large one made poor recovery and the center leaf fell out. Apparently the new growth was too weak to be self-supporting. This was cut off but recovery seemed doubtful. Three smaller specimens had been set out and are growing well. Two of these survived the freeze.

The larger specimens, although growing a few new center fronds, eventually died although one survived for more than three years. However, one of the smaller specimens, apparently dead at the time of the 1963 report, recovered and now in January, 1968, is about 12 feet tall. As noted, the damage inflicted in 1962 is apparent in its trunk.

Before leaving the palms note is made of the numerous cases where insect larvae damage to injured bud tissues was a contributing if not decisive factor in the ultimate death of the specimen. It appears that prompt removal of all dead or damaged fronds and injured bud tissue, and application of an insecticide, might save some specimens that would otherwise be lost.

Conclusions

While most species showed greater damage from the freeze of 1962 than from those of 1957-58, there were a few that seemed to suffer more from the latter. This would seem to indicate that these species are capable of withstanding

one extremely low period better than a continuous, repeated series of freezes during which the minimum is not as low but the mean and maximum are lower. Examples of these as observed at this location include the following: *Cocos nucifera* (while damage to coconut palms was again very severe, the percentage of total kill in May, 1963, appeared to be less, and at the extreme south end of Merritt Island all seemed to be recovering), *Latania lontaroides*, *Mascarena Verschaffeltii*.

All of the other species noted were more severely damaged by the later freeze, when they were exposed to a temperature of 25° F. or possibly even less, than by the series of freezes of 1957-58 when they were exposed to a minimum of 27° F. but to many more hours of sub-freezing temperatures intermittently over a period of three months. For the majority of these species, however, temperatures of below 32° F. repeated each winter would prevent their ever producing normal growth or fruiting. It must also be noted that for the species listed above, the minimum reached in December, 1962, was probably very near to the absolute minimum to which they could be exposed even for a short time and survive.

One species was omitted from the original report of 1963, largely because identification was then and still is in doubt. There are two specimens, both grown from seed, one planted in 1953 and the other in 1960. They are either *Attalea*, *Orbignya* or *Scheelea*; I feel that it is most likely that they are *Orbignya Cohune*. At any rate, only minor damage in the form of leaf burn of the older fronds occurred in either freeze. Both have grown fairly rapidly. The larger has fronds over 20 feet long and still no indication of formation of a trunk.

SUPPLEMENT

Data on freezes of 1957-58 and December, 1962, from Federal-State Frost Warning Service Publications, received after preparation of the report in May, 1963.

The average temperature for December, 1957 and January and February, 1958, was the coldest ever recorded in Florida for any three consecutive months. Lower minimum temperatures had, however, been recorded in previous seasons. Lowest of the season, at stations in the central districts, occurred on the morning of December 13, with readings of 15° F. to 22° F. January 9 through 11 had readings of 20° F. to 27° F. in colder locations in the central districts, and from the 8th to the 23rd of February temperatures were below freezing each night in these locations. The Indian River District had a minimum of 22° F. on December 13, with 33 nights below 36° F. and 19 nights below 32° F. These readings were from colder, low ground locations.

For the northern portion of Florida, and for the high ground and other so-called "warm locations" of central Florida, the freeze of 1962 was the most severe freeze of the twentieth century (see Table 1). Some representative readings at colder locations, all occurring on the morning of December 13, 1962: at Glen St. Mary, 9° F. Here the temperature was below 32° F. for 20.4 hours. This is in the Gainesville District of north central Florida. Waldo and La-Crosse had readings of 11° F. and McClenny, Starke, Orange Lake and Williston had 13° F. These are all in the Gainesville District. Umatilla in the Orlando District had 16° F. and Lake Alfred, in the Ridge District, 18° F.

Lowest in the Indian River District was 20° F. at Cocoa 2, where readings were below 22° F. for 4 hours, below 26° F. for 8 hours and below 32° F. for 14 hours. It is certainly worthy of note that the lowest temperatures reached in 1957 and in 1962 were on the same date, December 13 (11, 12).

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In verifying the botanical names of the palms included in the original report, I referred "An annotated checklist of cultivated palms" by Harold E. Moore, Jr., in *Principes* 7(4) for October, 1963.