Ecological Studies of the Cabbage Palm, Sabal palmetto.

IV. Ecology and Geographical Distribution.

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Habitats

Sabal palmetto is found in a diversity of coastal and inland habitats within its geographical range. These habitats incorporate broad ranges of substrate pH and salinity, extremes of moisture conditions from high dry areas to periodically flooded areas, and topography ranging from level coastal plains to gently rolling hills.

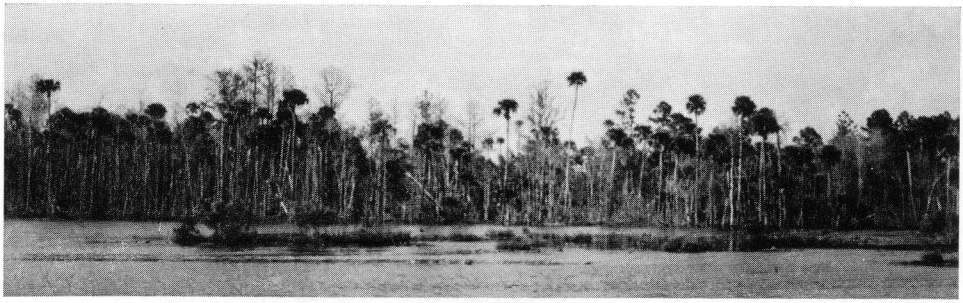
In the coastal zone, *S. palmetto* is found in three major habitats. It is often the dominant vegetation on low marsh islands and mainland marsh shorelines. In the maritime forest *S. palmetto* is a scattered but permanent reproducing member of the oak-dominated mature forest. Within the dune system *S. palmetto* often stands alone or in association with another palm, *Serenoa repens* (Bartram) Small, on the fore dune area. On the lee side of dunes the species is an emergent member of the shrub thicket community (Fig. 1).

Populations in the coastal zone throughout the range are undergoing an imposed migration due to rising sea level. In estuarine areas, where salt marsh is encroaching on land, it is not uncommon to find mature trees surviving in the marsh, often several meters from shore. How long these mature individuals can persist in the marsh is unknown but reproduction does not take place there. Along the ocean side, the rising sea is causing the dune system to migrate landward with resulting encroachment of dunes into the maritime forest and salt marshes. Mature *S. palmetto* is more resistant to salt water intrusion and salt spray than any other native arborescent species and therefore persists in place as the dunes migrate inland. This explains the presence of *S. palmetto* in the beach zone where periodic attrition of the trees occurs during storm tides. Reproduction on the fore dune and beach face is conspicuously absent, probably due to the erosional nature of the rising sea and frequent storm tides, but reproduction does occur on the lee side of the dunes, where the mature trees are emergent from the shrub thicket. In this protective environment seeds are subject to burial by accumulating organic matter or sand and thus apparently escape predation.

All inland populations are found in peninsular Florida with the few exceptions cited in the section on distribution to follow. Only on the peninsula is the full dimension of ecological amplitude expressed. In the lowland savannas adjacent to the coastal zone *S. palmetto* occurs as a subdominant with slash

1. *Sabal palmetto* as an emergent species in the shrub thicket on Smith Island, N. C.

2. A pine-palm (*Sabal palmetto*) savanna in the coastal plain of Charlotte County, southwest peninsular Florida.



3. Flood plain forest with *Sabal palmetto* at the mouth of Cabbage Creek (now Rodman Reservoir), Putnam County, Florida.

pine (Fig. 2). On relic inland dune ridges the species is locally common in the long leaf pine-turkey oak community. Along many large creeks and rivers it is a locally dominant tree in the flood plain forest (Fig. 3). In the mixed deciduous forest in the rolling highlands of central Florida it is widely scattered on ridges, to locally common along streams. In the southern interior peninsula on hammocks in the Kissimmee Prairie it is a co-dominant or dominant tree in a monotonous forest with live and laurel oaks (Fig. 4). Further south, in the Big Cypress, Everglades, and Keys, *S. palmetto* shares dominance with various species in subtropical hammocks (Fig. 5).

4. Hammock with oaks and *Sabal palmetto* in Kissimmee Prairie, Glades County, peninsular Florida.

5. A subtropical hammock with *Eugenia* species, *Sabal palmetto*, and *Roystonea elata*, Royal Palm Hammock, Collier County, southwest peninsular Florida.

Current Distribution

While a broad range of habitats has long been realized (Small, 1923; Bailey, 1944), the detailed geographical distribution of *S. palmetto* has not been precisely documented. Small (1923) quotes several early accounts which incorrectly indicated *S. palmetto* far north of its present range. Sargent (1922)

had reported the species in the neighborhood of Cape Hatteras. These early authors may have mistaken robust plants of *S. minor* for *S. palmetto* in areas north of Cape Fear. The two are sympatric on Cape Fear and in early stages are often quite difficult to distinguish. I have not been able to substantiate these records and therefore agree with M. A. Curtis (1867) that *S. palmetto* is to be found from Cape Fear southward (Fig. 6).

Sabal palmetto is also on the mainland along the coast west of Smith Island, N. C. Coker and Totten (1945) mention a small population of 12 trees near Gause Landing, N. C., seven miles north of the state line. Although I have not relocated this population, I did find six mature trees in the maritime forest near Shalotte Inlet (Fig. 6A). Although this population at Shalotte Inlet is the northernmost substantiated location for *S. palmetto* in the wild, the plants on Smith Island represent the maximum extension of the range along the coast.

The range map of *S. palmetto* by Little (1971) is the most recent for the species. It shows a major disjunction between the continuous range in South Carolina and the Cape Fear area of North Carolina with intermediate isolated populations around Shalotte and Gause Landing. One small population exists at Oak Island, across the Cape Fear River from Smith Island (Fig. 6A). Another single small tree has also been reported from Battery Island in the Cape Fear River, but I have not been able to substantiate this report.

The hiatus in the natural range in South Carolina occurs on the immediate coast between the Georgetown area and the North Carolina populations (Fig. 6B). Large numbers of trees are common from the south side of North Inlet southward; however, to the north their numbers dwindle rapidly. Six mature trees were found in the maritime forest adjacent to the upper marshes of De Bordieu Creek about two miles north of North Inlet. These are now thought to be the northernmost trees occurring naturally on the South Carolina coast.[1]

According to Gurdon Tarbox,[2] two populations north of North Inlet have been either completely removed for landscaping purposes or otherwise destroyed since 1930. A small group of trees near North Litchfield Beach at Midway Inlet were removed in the early 1960's. At Murrells Inlet a much larger population on Drunken Jack Island was removed beginning in the early 1930's. This extinct population represents the northernmost modern extension of the species on the South Carolina coast and the true beginning of the disjunction prior to man's disruption.

Climatic differences cannot explain this disjunction, for the average and extremes of climate are not materially different in the area not inhabited. Further, horticultural plantings of *S. palmetto* do quite well in this area. There is a major difference in land form, however. The portion of the coast not inhabited by *S. palmetto*, which extends for approximately 35 miles, is comprised of a mainland strand beach. In adjacent areas where *S. palmetto* does occur, the physiographic situation is one of barrier islands or peninsulas, with bays or sounds separating the beach from the mainland (Fig. 6B). It was noted above that *S. palmetto* never becomes established on beaches but rather on the bay side of islands and adjacent mainland.

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[1] Green, Fred; Developer, De Bordieu Colony, Georgetown, S. C.; personal communication.

[2] Tarbox, Gurdon; Curator, Brookgreen Gardens, Murrels Inlet, S. C.; personal communication.

The obvious conclusion is that *S. palmetto* is absent in nature from the northern South Carolina coast because of the lack of habitats suitable for germination and seedling establishment.

The distribution pattern along the rest of the southern Atlantic coast through South Carolina, Georgia, and into Florida is an essentially unbroken series of populations in dunes, maritime forests, and on the edge of marshes. The first truly interior population appears to be that at Magnolia Bluff along the Big Satilla River in extreme southeastern Georgia (Fig. 6C). This population is documented in the Georgia Natural Areas Council Activities Report of 1970, Appendix X. One other isolated, but considerably larger, interior population is in Georgia about 40 miles southwest of Magnolia Bluff on the St. Marys River (Fig. 6C).

In northern Florida this widely scattered, isolated pattern continues with a population about 20 miles further upstream on the St. Marys River at the mouth of and extending up Cedar Creek several miles. There are three mature and two juvenile trees at O'Leno State Park on the Santa Fe River and a few young nonreproductive trees were sighted along the Suwanee River near Branford. All of these interior populations in Georgia and Florida are along rivers and all are below 100 feet elevation. Their existence may be due to initial dispersal by birds such as fish crows which are known to feed on the fruit and occasionally fly up coastal plain rivers for feeding and nesting activities.[3]

On the Atlantic side of north Florida the continuous range of *S. palmetto* remains in the coastal zone and extends up rivers no further than there is obvious tidal activity. On the St. Johns River plants can be found as far inland as Jacksonville. Very little inland movement by the species has occurred but a few young trees are beginning to appear in pine flat woods adjacent to tidal rivers and marshes.

Plants are often found in very heavy concentrations in low swale areas parallel to the beach and up to several miles inland. These are populations which have become established in old lagoons shut off from the ocean by shoreline dynamics. As a lagoon fills in from erosion and accumulation of debris, plants along the banks provide seed to populate the entire depression with palms.

On the Gulf coast side of northern and western Florida, the continuous range also remains in the coastal zone; however, some movement into upland mixed hardwood forests adjacent to coastal habitats has occurred. Forest management practices of clearing all "undesirable" plant growth and replanting with pines has eliminated any original *S. palmetto* from many areas and continued management discourages reestablishment. It is only in hardwood forests that have obviously been left undisturbed for many years that *S. palmetto* is making advances into the uplands away from the coast. Such areas are more frequent in western Florida. Even in areas of advance into uplands, *S. palmetto* is seldom seen in nature more than five or ten miles from the sea.

The natural range becomes somewhat less than a true continuous distribution west of Apalachee Bay for probably the same reason it does in northern South Carolina. The western terminus, according to Little (1971), is the eastern

[3] Additional field observations since 1973 have revealed another significant isolated population in interior northeast Florida. This reproducing population extends for at least one mile along either side of the Ortega River in western Duval County in the vicinity of U. S. Highway 90 and Interstate 10.

shore of St. Andrews Bay; however, careful investigation in that area revealed several reproducing trees on the west side of the bay along marsh borders on the peninsula at St. Andrews State Park.

Determination of where the continuous range crosses the peninsula of Florida was somewhat difficult. From field observations it appears that a line can be drawn from Cedar Key on the west coast to Gainesville, on to St. Augustine on the east coast. With some certainty one can say that south of this line *S. palmetto* can be found frequently at all elevations and in most habitats (Fig. 6C).

Immediately south of this line *S. palmetto* is most frequent on the slopes of the central ridge at all elevations. In the neighborhood of the line the plant is conspicuously absent from areas north of and above the 100-ft contour except for a few scattered individuals on slopes near Hawthorne and Melrose which are adjacent to the 100-ft contour. The 100-ft contour approximates, with a few exceptions due to surface and subterranean erosion, the shoreline of the Wicomico Sea, an interglacial sea of middle Pleistocene (Cooke, 1939). This old shoreline approximates the interior northern limits of continuous distribution for *S. palmetto* in peninsular Florida as the species is not found in natural stands to the north (inland) side of this elevation.

Thus it seems that the current continuous distribution of *S. palmetto* across northern peninsular Florida correlates better with a fossil shoreline than it does with current climatic conditions.

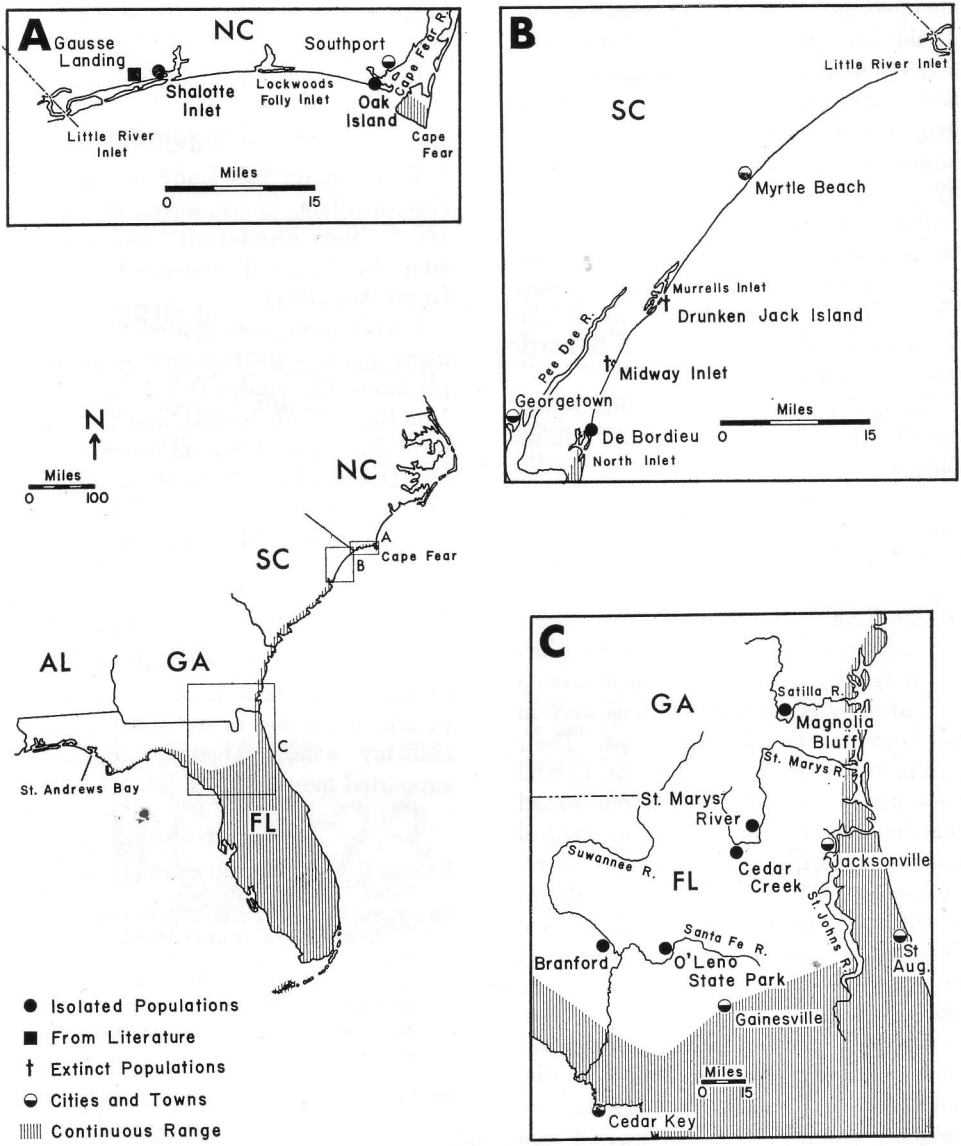
Unfortunately time did not allow detailed study of the inland populations, although examples of all inland habitat types were visited at least briefly. As in the coastal zone, inland populations associated with constant or periodic water flow display the greatest reproductive potential. This is assumed to be due to the same factors, such as efficient dispersal by water, debris and soil accumulation and subsequent escape from seed predators.

In addition to the mainland and barrier islands of the southeastern United States, the geographical range of *S. palmetto* includes the Bahama Islands and certain of the Florida Keys. According to Small (1913) the range includes the lower (Miami limestone) keys from No Name and Little Pine Keys to Key West, with a disjunction from the mainland on the middle (coral) keys and upper (sand) keys. In the Bahama Islands, Britton and Millspaugh (1920) reported the species on the "borders of marshes and in rocky soil throughout the Archipelago."

Dispersal Dynamics and Current Distribution

Experimental results reported in a previous article (Brown, 1976a) indicate a dispersal mechanism in *Sabal palmetto* related to coastal zone water movements. Thus the chief vector for direct long-range dispersal from existing populations to outlying areas for this species appears to be salt water. Perhaps of more importance, salt water offers a dispersal vector for rapid colonization of nearby unexploited coastal zone habitats. There is also the possibility that tropical storms and hurricanes might disperse the fruit or seed great distances in relatively short periods of time. This may explain the existence of some insular distributions mentioned above.

The extension of the range to the population at Smith Island, North Carolina, can be looked upon as the logical product of such a dispersal mechanism. However, Cape Fear apparently presents



6. Geographical distribution of *Sabal palmetto*. A, distribution in North Carolina. B, distribution in northern South Carolina. C, distribution in southeast Georgia and northeast Florida.

an insurmountable natural barrier to further salt water dispersal, probably due to the prevailing southward-moving alongshore current north of the cape. No climatic or land form features exist which would exclude the survival of the species immediately north of Cape Fear. Thus, there exists the possibility for outward migration over land in this area.

Although seed dispersal appears to be the immediate factor controlling the northward extent of *S. palmetto*, it seems

obvious that low winter temperatures would become the limiting factor not much farther north than the present horticultural range. The control by low temperatures may be expressed at germination and seedling stages as indicated by the experimental evidence (Brown, 1976b). In addition, ice storms and freezing winds could also be a limiting factor in the survival of mature trees. This effect is seen periodically in the more northern populations and in horticultural plantings.

The few plants established and beginning to reproduce west of St. Andrews Bay, Fla., are the vanguard of a slowly expanding range on the Gulf Coast. Further dispersal westward along the Gulf Coast can be expected to continue at a slow rate since littoral currents are weakly developed and inconsistent there.

Inland populations in peninsular Florida may be descendents from survivors of past periods when those areas were in the coastal zone of higher seas. Their ability to remain and thrive on upland sites attests to the species inherent broad ecological amplitude. It is the central and southern Florida populations, as revealed by the Melbourne and Miami experimental material and field observations, which harbor the greatest amount of variability in external morphology and seed-germination response. These populations possess the genetically diverse material typical of centers of distribution and necessary to support outward migrations to distant and ecologically diverse habitats.

Sabal palmetto may well have had a long evolutionary history, possibly dating back to early Tertiary or before (Berry, 1916, 1917, 1924; Cooke, 1945; LaMotte, 1952; Read and Hickey, 1972). It has taken a conservative course in the strategy of reproduction and possesses the broad ecological amplitude of a heterogenous species, both of which are features of a species well fitted to long existence in various habitats.

Acknowledgements

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PALM BRIEFS

South Carolina's Bicentennial License Plate

Tropical and subtropical lands for many years have landscaped their streets and highways with handsome, stately palms. This year, streets and highways in South Carolina are literally teeming with palms. The explanation—South Carolina's Bicentennial license plate carries a reproduction of the state tree, *Sabal palmetto* (Fig. 1). Artistic license was taken, however (no pun intended); the palmetto is colored a bright red, numerals and letters blue on an off-white background. While far from being authentic, it comes across as both attractive and unique.

1. South Carolina's license plate carries a reproduction of the state tree, *Sabal palmetto*. Photo courtesy South Carolina Highway Department.

There have been occasional references in PRINCIPES to palm enthusiasts who make a hobby of collecting postage stamps bearing reproductions of palms. As part of the United States Bicentennial observance, South Carolina's state flag, which also pictures the palmetto, is depicted on one of the stamps in the nation's Bicentennial series.

JACK COOK

CLASSIFIED

International Symposium on Coconut Research and Development

The second circular of information on the above symposium has been received. The symposium is to be held at the Central Plantation Crops Research Institute, Kasaragod 270 124, Kerala State, India, on December 28–31, 1976, in celebration of the Diamond Jubilee of Coconut Research in India. Papers are to be presented in nine sessions, and exhibits, a commemorative stamp, and sight-seeing tours are associated with the symposium. Details may be obtained from I. K. Satyabalan at the above address.