

# Scrub Species Patterns on the Atlantic Coastal Ridge, Florida

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## ABSTRACT

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The coastal Scrub dune ridge patterns in southeastern Florida were mapped; 7 major ridges are recognizable in addition to numerous minor ridges. Each ridge has marks of the factors that have molded it. To some extent the flora reflects the history, with the highest diversity and species richness occurring on the highest Pamlico ridge. Florida Scrub community indicators decrease in frequency and richness to the east and west of the highest dune system.

**ADDITIONAL INDEX WORDS:** *Atlantic Coastal Ridge, Pamlico Terrace, dune ridges, Scrub community, scrub indicators, species richness, patterns.*

## INTRODUCTION

Since English speaking people began to call the pine/oak thickets in Florida "Scrub" in the 1800's (e.g. VIGNOLES, 1823; MACKAY, 1845), comparatively few studies have been made of the community. To list notable samples, MULVANIA (1931), COOKE (1939, 1945), KURZ (1942), MACNEIL (1949), and LAESSLE (1942, 1958, 1967) have commented on community definition, while others have discussed different aspects (AUSTIN, 1975, 1976, 1977; RICHARDSON, 1977). Isolated accounts exist for the natural history of some of the individual species, but little has been detailed on how the ridges and plants interact in a small region. These relationships have become critical since this high land is being urbanized rapidly.

Xeric Scrub pineland is dominated by a single canopy species (*Pinus clausa*), two characteristic shrub genera (*Quercus* and *Ceratiola*), and the herb layer has *Rhynchospora megalocarpa* as the most frequent indicator herb. Typical Scrub grows on St. Lucie fine sand and its associated types which are all eolian silicon deposits almost devoid of nutrients (USDA, 1978).

This study examines physically similar and proximal stands of vegetation on the Atlantic Coastal Ridge in Palm Beach County where parts of the his-

torical system remain. Most previous study has concentrated either on the Central (Lake Wales) Ridge or farther north in the state (LAESSLE, 1942, 1958; ABRAHAMSON *et al.*, 1984, *alia*).

## MATERIALS AND METHODS

Dune ridge patterns were mapped with USGS topographical quadrangles, 1940-1973 aerial photography and ground surveys. Both the twenty and ten foot contour intervals were used to delimit the baseline of the ridge systems, and then checked on the ground for accuracy. Elevation values for ridges having sample areas with different elevations were determined as the average elevation per acre for the total sampled acreage on that ridge. Average elevation =  $\text{sum (AE)} / \text{sum A}$ , where A = area and E = elevation. To study the plants on the ridges a series of quadrats were used to sample from east to west across the ridge system, with additional samples north and south. Because of the patchiness and local urbanization, these samples varied in size from one-quarter acre to almost three hundred acres (Figure 1). The sizes of the plots were determined with a graphics tablet and Apple IIe computer. Plant species were surveyed randomly and also by using transects at ten meter intervals. Studies varied in length from one to fifteen years. Some sites are still being studied while others have been urbanized. Plants were determined with both

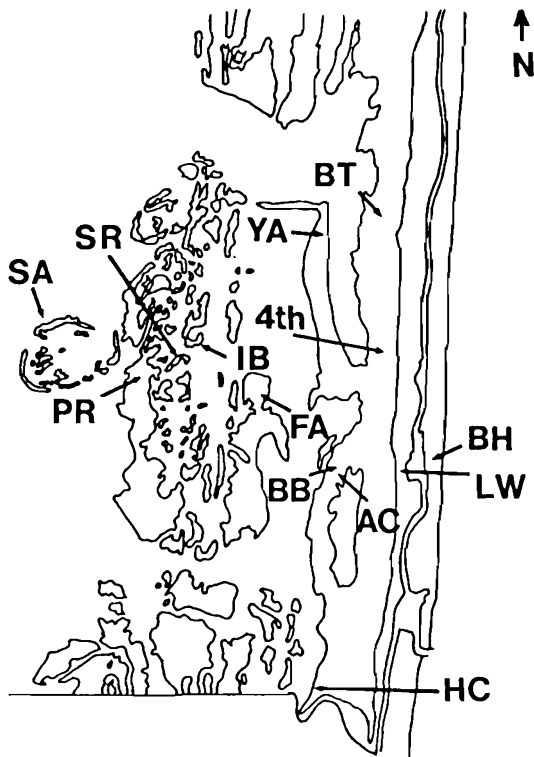


Figure 1 Sample plots located within the Scrub vegetation systems of 1900 on the Atlantic Coastal Ridge. Based on Austin in BLANFORD and WINSTON (1975), AUSTIN (1977) and RICHARDSON (1977). Key to locations: SA = St. Andrews; PR = Potomac Road; SR = Spanish River Road; IB = IBM properties; FA = Florida Atlantic University; AC = NW 4th Avenue, Boca Raton; BB = Boca Bibletown; YA = Yamato; HC = Hillsboro Canal; BT = Boca Teeca; 4A = NE 4th Avenue, Boca; LW = Lake Worth; BH = Boca Hammock; JD = Jonathan Dickinson State Park; EX = Executive Airport.

LONG and LAKELA (1971) and WUNDERLIN (1980). Notes were taken at each site on the ages of plants by counting nodes of *Ceratiola* (JOHNSON, 1982) or by cores of the pines. Any evidence of disturbances such as fires, roads or dumping, were recorded.

### DUNE RIDGES

In spite of several excellent geological studies of landforms and sea level changes in Florida in recent years (LAESSLE, 1958, 1967; TANNER, 1960; WHITE, 1970; WINKER and HOWARD, 1977; FAIRBRIDGE, 1984; ROBBINS, 1984) there is no study we know of that attempts to explain or understand the ridge patterns and associated Scrub vegetation in south-

eastern Florida. Indeed, the last real attempt to delimit patterns of ridges seems to have been the one published by MACNEIL (1949).

Since 1970, we have been examining the vegetation in southeastern Florida. The paper we published on the Yamato Scrub within the current town of Boca Raton (AUSTIN, 1977) was a specific case to document the more general studies we were doing at the time (cf. RICHARDSON, 1977; STEINBERG, 1980).

A general pattern has emerged which is, we believe, understandable, and which is consistent with the patterns found farther north by MACNEIL (1949). It is thought that the last drop in sea level was irregular and proceeded in stages, as did the rise to its modern stand (cf. FAIRBRIDGE, 1984; ROBBINS, 1984). Each of the drops in level was marked by the buildup of a coastal ridge system. Because of the scale involved and also the subsequent erosion of many of these ridges, we have only a partial image of what really happened. Yet, much remains for interpretation.

The Atlantic Coastal Ridge in Palm Beach County is a southern extension of the Pamlico system noted farther north by COOKE (1939, 1945) and MACNEIL (1949), but the patterns are more complex than DAVIS (1943) and most other people have expected. Instead of a ridge system of 2 or 3 peaks, there are several major crests. In Palm Beach County there are 7 major ridges (Figure 2) within the system. All of these except the innermost were still high enough to retain large areas of Scrub before urbanization. Only islands of Scrub remained on the inner ridge as, for example, St. Andrews (Figure 2). Each of these ridges is associated with numerous shallow ridges that may be seen from ground surveys, but which are not visible on the level of topographic surveys. Presumably at least the outer part of the outer ridge is Recent (6,000-16,000 BP). The 6 inner remnants decrease in elevation and integrity toward the west. This decrease suggests that they were deposited at different times in the Pamlico (100,000 BP) and have been subjected to differential erosion.

Some of the modern physical patterns show part of the geological and biological history of the region. In the northern part of the county the ridges are reasonably discrete and comparatively high (20-50 ft msl). Farther south the ridges curve to the west and become highly dissected. One of the forces shaping the remaining uplands was the changing channel of the Hillsboro River, a major outlet from the Everglades transversing the ridges at Boca

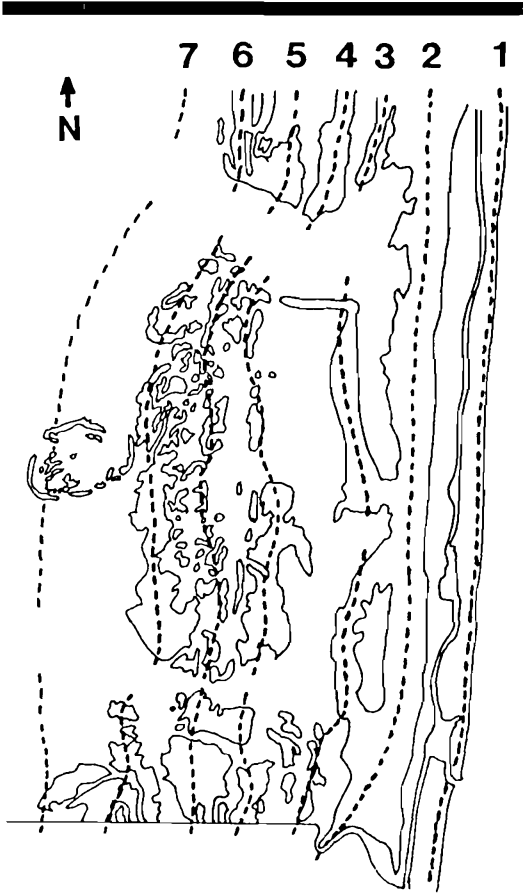


Figure 2. Pamlico ridge systems overlain on the Scrub vegetation of 1900 on the Atlantic Coastal Ridge in southern Palm Beach County, Florida. The heavy dashed lines show what were probably the crests of the major ridges. Based on field study, USGS topographic quadrangles and 1940-1973 aerial photography.

Raton. This waterway, formerly a river, has been degraded to the Hillsboro Canal since the 1920's (for recent history *cf.* AUSTIN, 1984). It would appear that past changes in the point where this waterway breached the ridges (*cf.* break in ridges in Figure 2) has resulted in the complex ridge patterns.

Those patterns associated with the coastal ridges of probable Pamlico origin show more complicated dual pattern. This was interpreted by MACNEIL (1949) as the coastal shore and the offshore bar formed by the same sea level stand. Presumably there was, in Pamlico times, a coastal lagoon system similar to the Intracoastal system with barrier islands that exists today. Actually this may be more complicated than it appears, since there is a multiple ridge system on the outside of the barrier island.

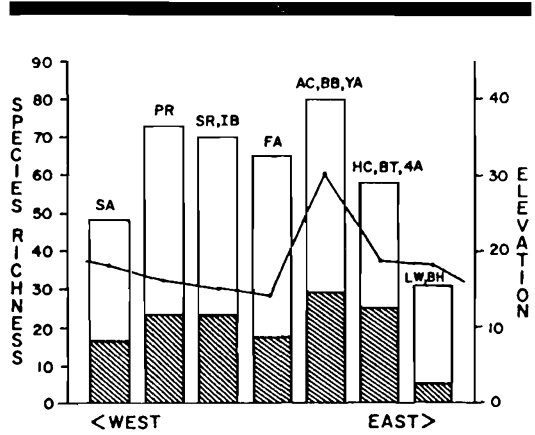


Figure 3. Graphic representation of species richness patterns compared to elevation and relative position of dune ridge communities. Left scale indicates numbers of species present (species richness). Each bar indicates the total number of different species found on each ridge; the shaded area in each bar indicates the number of obligate species found on each ridge. The right scale indicates elevation above MSL; each point associated with a bar and connected with a solid line indicates elevation between ridge communities.

Perhaps this was an outside ridge formed during Pamlico times, with the inner bar ridge being the inside of the island. The complex pattern continues north of the Lake Worth area where there is an island system that is geographically linked to the ridges farther south.

### SCRUB INDICATORS

To obtain our data we have sampled thirteen sites (Figure 1) in coastal Palm Beach County; these are compared species by species with one in Martin County (JD) and one in Broward County (EX) (Table 1). A composite list of plants considered Scrub indicators was compiled, resulting in 90 taxa for the study region.

A similar comparison is made with what we have termed obligate Scrub species, those known to occur only in Scrub or Scrubby Flatwoods (LAESSLE, 1942) in the area. Elsewhere in the state the species may occur in the successional habitat of High Pine (= Sandhill). Most of these 33 obligate Scrub species are also endemic to Florida.

The Atlantic Coastal Ridge Pamlico system also has the greatest number of endangered and endemic taxa in southeastern Florida. In the areas we have sampled there are no fewer than eight taxa on the State Endangered Plant list. In nearby areas

Table 1 Checklist comparison of scrub on the Atlantic coastal ridge in SE Florida. Species capitalized are scrub obligates; species in lower case are scrub indicators. 1 = present; 0 = absent.

Species	Locations*														
	SA	PR	SR	IB	FA	AC	BB	YA	HC	BT	4A	LW	BH	JD	EX
Obligates															
<i>ALDENELLA TENUIFOLIA</i>	0	0	1	0	1	0	1	1	1	0	0	0	0	1	0
<i>ARISTIDA SPICATA</i>	1	1	1	1	0	0	1	1	1	1	0	1	0	0	0
<i>ARISTIDA TENUISPICA</i>	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0
<i>ASCLEPIAS CURTISSII</i>	0	1	0	0	0	1	1	1	0	0	0	0	0	1	1
<i>BALDWINIA ANGUSTIFOLIA</i>	0	1	0	1	1	1	0	0	1	1	0	0	0	1	1
<i>CERATIOLE ERICOIDES</i>	1	1	0	1	0	0	0	1	1	1	0	0	0	1	1
<i>CHAMAESYCE CUMULICOLA</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0
<i>CONRADINA GRANDIFLORA</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1
<i>CUTHBERTIA ORNATA</i>	1	1	0	1	1	0	0	1	0	0	0	0	0	1	0
<i>EUPHORBIA POLYPHYLLA</i>	1	1	1	1	1	0	0	1	0	1	0	0	0	1	1
<i>FROELICHTIA FLORIDANA</i>	0	1	0	0	1	1	0	1	1	1	0	0	0	1	1
<i>HEDYOTIS PROCUMBENS</i>	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0
<i>HELLANTHEMUM NASHII</i>	0	1	0	1	1	0	0	0	1	1	0	0	0	1	1
<i>HETEROOTHECA SCABRELLA</i>	1	1	1	1	0	0	0	1	1	0	0	0	0	1	0
<i>LECHEA CERNUA</i>	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1
<i>LECHEA DECKERTHI</i>	0	0	0	0	1	0	0	0	1	1	0	0	0	1	1
<i>LECHEA DIVARICATA</i>	0	1	0	1	1	0	0	1	1	1	0	1	0	1	1
<i>LIATRIS TENUIFOLIA</i>	1	1	1	1	0	0	0	1	0	0	0	1	0	1	1
<i>LUPINUS DIFFUSUS</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
<i>MONOTROPA BRITTONII</i>	0	1	0	0	0	0	0	1	0	1	0	0	0	1	1
<i>PARONYCHIA AMERICANA</i>	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
<i>PERSEA HUMILIS</i>	1	0	0	1	0	0	0	1	0	0	0	1	1	1	0
<i>PETALOSTEMON FEAYI</i>	1	0	0	1	0	0	0	1	0	1	0	0	0	1	0
<i>PINUS CLAUUSA</i>	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
<i>POLYGONELLA POLYGAMA</i>	1	1	1	1	1	0	0	1	1	1	0	0	0	1	1
<i>RHYNCHOSPORA MEGALOCARPA</i>	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1
<i>SABAL ETONIA</i>	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
<i>SELAGINELLA ARENICOLA</i>	1	1	1	1	1	0	1	1	1	1	0	0	0	1	1
<i>SEYMERIA PECTINATA</i>	0	1	1	1	0	0	0	1	1	1	0	0	0	1	1
<i>SISYRINCHUM SOLSTITIALE</i>	1	1	1	1	1	0	0	1	1	1	0	0	0	1	1
<i>STIPULICIDA SETACEA</i>	0	1	0	1	1	0	1	1	0	1	1	0	0	1	1
<i>XIMENIA AMERICANA</i>	0	1	1	1	1	1	0	1	1	1	1	0	0	1	1
<i>ZAMIA PUMILA</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Indicators															
<i>Asminda reticulata</i>	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1
<i>Asclepias pedicellata</i>	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Befaria racemosa</i>	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1
<i>Bulbostylis ciliatifolia</i>	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1
<i>Bumelia tenax</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
<i>Callicarpa americana</i>	0	1	0	1	1	0	0	1	0	0	0	1	1	1	0
<i>Carphephorus corymbosus</i>	1	1	1	1	1	0	0	1	0	0	0	1	0	1	1
<i>Carya floridana</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
<i>Cassia chamaecrista</i>	1	1	1	0	1	1	0	1	1	1	1	1	0	1	0
<i>Cassytha filiformis</i>	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1
<i>Cnidioscolus stimulosus</i>	0	1	0	1	1	0	0	1	0	0	0	1	1	1	0
<i>Commelina erecta</i>	0	1	0	0	1	1	1	0	1	1	0	1	1	1	0
<i>Crotalaria rotundifolia</i>	0	1	1	1	1	1	0	1	1	1	0	1	0	1	0
<i>Croton glandulosus</i>	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1
<i>Cyperus nashii</i>	0	1	1	1	1	1	1	1	1	1	1	0	0	0	1
<i>Cyperus compressus</i>	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0
<i>Eryngium aromaticum</i>	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0
<i>Galactia volubilis</i>	0	1	0	0	1	1	1	1	1	1	1	0	0	0	1
<i>Helianthemum corymbosum</i>	1	1	0	1	1	0	1	1	0	0	0	0	0	1	0
<i>Heterotheca graminifolia</i>	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
<i>Heterotheca subaxillaris</i>	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
<i>Ilex glabra</i>	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1
<i>Licania michauxii</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Lyonia ferruginea</i>	1	1	1	1	1	0	0	1	1	1	0	0	0	1	1
<i>Lyonia lucida</i>	1	1	1	1	1	0	0	1	0	1	0	0	0	1	1
<i>Myrica cerifera</i>	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1
<i>Opuntia compressa</i>	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1
<i>Palafoxia feayi</i>	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1
<i>Palafoxia integrifolia</i>	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0
<i>Panicum patentifolium</i>	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0
<i>Phyllanthus abnormis</i>	0	1	0	0	1	1	1	1	1	1	1	0	1	1	1
<i>Physalis viscosa</i>	0	0	0	1	1	1	0	1	1	1	0	0	0	1	1

Table 1, *continued*

	Species Locations														
	SA	PR	SR	IB	FA	AC	BB	YA	HC	BT	4A	LW	BH	JD	EX
<i>Indicators, continued</i>															
<i>Polygonella gracilis</i>	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1
<i>Pterocaulon virgatum</i>	1	1	0	1	1	0	0	1	0	0	0	1	0	1	1
<i>Quercus chapmanii</i>	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
<i>Quercus geminata</i>	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
<i>Quercus minima</i>	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1
<i>Quercus myrtifolia</i>	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1
<i>Quercus virginiana</i>	0	1	0	1	1	1	0	1	0	0	0	1	1	1	0
<i>Rhynchospora intermedia</i>	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sabal palmetto</i>	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1
<i>Satureja rigida</i>	1	1	1	1	1	0	0	1	0	0	0	1	0	1	1
<i>Scleria ciliata</i>	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0
<i>Serenoa repens</i>	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
<i>Smilax auriculata</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Stillingia sylvatica</i>	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
<i>Tillandsia fasciculata</i>	0	1	0	1	0	0	0	1	1	0	0	0	0	1	1
<i>Tillandsia flexuosa</i>	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1
<i>Tillandsia paucifolia</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Tillandsia recurvata</i>	1	1	1	1	1	0	1	1	1	1	0	0	0	1	1
<i>Tillandsia usneoides</i>	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1
<i>Tillandsia utriculata</i>	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1
<i>Trichostema dichotomum</i>	0	0	1	0	1	0	0	1	1	1	0	1	1	1	1
<i>Vaccinium myrsinites</i>	1	1	1	1	1	0	1	1	1	1	0	0	0	1	1
<i>Vaccinium stamineum</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
<i>Vitis rotundifolia</i>	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
<i>Vitis shuttleworthii</i>	0	1	0	1	1	1	0	1	0	0	0	1	1	1	0
Total Species	48	73	46	62	65	29	32	77	50	53	22	30	12	70	60
Number of Obligates	16	23	12	22	17	6	8	28	20	23	3	5	1	27	22
% Possible Obligates	48	70	36	67	52	18	24	85	63	70	9	15	3	81	67
% Possible Species	53	81	51	69	72	32	36	86	56	59	24	33	13	78	67

Percent possible scrub obligates = no. present/no. in area (e.g., 16/33 = 48%)

Percent possible scrub species = no. present/no. in area (e.g., 48/90 = 53%)

Key: Species obligate to scrub = 33/90 = 36.6%

\*Locations: SA = St. Andrews; PR = Potomac Road; SR = Spanish River Road; IB = IBM properties; FA = Florida Atlantic University; AC = 7th and 4th in Boca Raton; BB = Boca Biletown; YA = Yamato; HC = Hillsboro Canal; BT = Boca Teeca; 4A = 4th Avenue, Boca; LW = Lake Worth; BH = Boca Hammock; JD = Jonathan Dickinson State Park, Martin County; EX = Executive Airport, Broward County.

there are others, e.g., *Asimina tetrapetala* in northern Palm Beach County.

**PATTERNS**

Although succession has been studied for the ecosystem (AUSTIN, 1976, 1977; RICHARDSON, 1977, etc.), successional patterns of plant communities between these different ridges have essentially remained unstudied (KURZ, 1942; AUSTIN, 1976). Known patterns are mostly applicable to the Central Florida Scrub systems (MULVANIA, 1931; ABRAHAMSON *et al.*, 1984) or to the combined Pamlico ridges (RICHARDSON, 1977).

Floristically, the Pamlico system that currently has the highest elevation also has the greatest species richness. In our composite list of Scrub indicator species, fully 86% of them occur on the Yamato Scrub ridge (Figure 3). The next highest ridge, the IBM properties, has 69%, and the inland Pamlico

Scrub of the St. Andrews system has 53%. An anomalous number occurs at the Potomac Road Scrub where there are 81% Scrub species. These figures are perhaps not as unexpected as those east of the major Pamlico dunes. On what was the western edge of the Intracoastal depression there are still 33% Scrub species. Outside the Intracoastal canal on the barrier island we found that 13% of the species were associated with Scrub.

Our data indicate that there is a decline in herbaceous taxa as a stand of Scrub ages. The decline is not only found in the weedy, disturbed site taxa, but in the Scrub indicator species as well (Figure 3). Yamato Scrub, being especially diverse and on the highest Pamlico ridge, has been used as an example of this trend (Figure 4).

From the limited recovery data now available, it may be that the herbaceous species remain as either seeds or roots for decades until again released by fire or a comparable disturbance. Recovery of Scrub

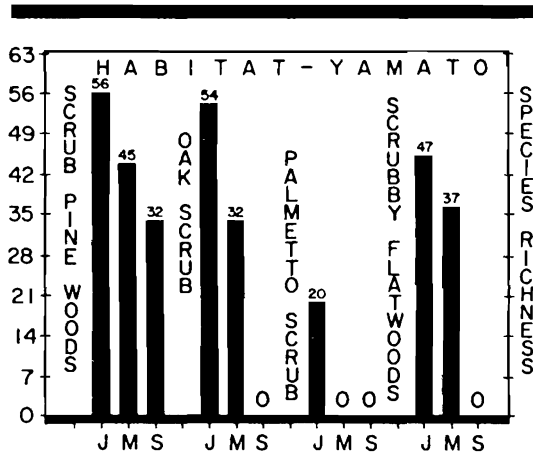


Figure 4. Decline in herbaceous species with age at Yamato. J = juvenile; M = mature; S = senescent; 0 = absent from site.

species on the Florida Atlantic University campus since the termination of a decade of mowing in 1973 has partially supported this conclusion. When quadrat samples were taken on the FAU campus in 1971 during the mowing period, there were 29 species found; now there are 65 species. Annual or more frequent mowing appears to cause the species richness to drop about 50%. The first species to be lost are the annuals, but continued mowing begins to cause the perennials to disappear. Although we currently have no data to support the conclusion, we assume that frequent fires would have the same effect. Richness on the FAU plot is now in the range of those sites without similar disturbance (*cf.* Figure 3).

Our study further indicates that the species composition differs as a function of succession in response to differential extirpation and immigration rates. In Boca Raton, the Scrub palmetto (*Sabal etonia*) grows only on two of the highest Pamlico systems. The palm is present in areas that have not burned in twenty to forty years and absent from sites burned more often. This limited range reflects the differential extirpation by fires, since the species is thought to be sensitive to burning. Our Pamlico Shore system was predominantly a Scrubby Flatwoods, because of the loss of some Scrub species and the substitution of slash pine for Scrub pine. Frequent fires and the absence of a seed source were responsible for the loss of *Pinus clausa*. A seed source nearby resulted in Scrub pine's replacement with *Pinus elliottii*. Erosion and the resultant decrease in elevation brought the ground surface of the Scrubby Flatwoods nearer to the water table and this prox-

imity excluded some of the Scrub plants. Decrease in species richness is somewhat correlated with reduction of habitat area, but not to the extent that might be expected by island biogeographic theory (MACARTHUR and WILSON, 1967). A linear regression of the area/richness has an  $r = 0.645$ ; or 58% of the variation of richness is caused by something other than area. The Scrub has been so recently fragmented that the species richness has not reached the equilibrium required by island biogeographic theory. Thus, modern size is not a reliable estimate of the probable species richness, and will not allow prediction of the future changes in richness. While random dispersal and establishment of plants in the similarly dry habitats of the coastal vegetation may be responsible for the Scrub species, it is our hypothesis that several factors were involved, including fires, erosion, reduction in habitat area (fragmentation) and decreased elevation.

We suggest that the barrier islands, thought to have historically been part of the coastal dune systems during the Pamlico times, have retained part of the Scrub flora that gained domination after the last regression of the ocean. We view Scrub species in coastal sites as remnants of those former habitats. The variety of species on the coastal habitats is surprisingly diverse in Scrub species in comparison to the well-publicized Central Ridge (ABRAHAMSON *et al.*, 1984) since there are ca. 90 in SE Florida, ca. 70 in Lake Wales, Highlands County. Moreover, the mean number of species in our study area is 51.5 ( $n = 13$ ) and the mean for some other sites is 36.6 ( $n = 8$ ) (Appendix 1). Presumably all of the species have equal or at least similar potential for becoming part of the vegetation in nearby sites. The reason for the marked richness difference between the Atlantic Coastal Ridge and other areas is not yet clear, although we have the topic under study.

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#### APPENDIX I. DESCRIPTION OF SITES

- (1) St. Andrews (SA)—T47S, R42E, S10—Palm Beach County, W of Boca Raton. RICHARDSON and AUSTIN (1977). Acres 59. Fires average about every 5 years; severely burned in past, with only one pine about 15 yrs old remaining at the time of study. Now urbanized. Elevation 18 feet.
- (2) Potomac Road (PR)—T47S, R42E, S11—Palm Beach County, W of Boca Raton. F. POSIN and D. AUSTIN list (1983-1985). Acres 30; before urbanization and study 160 acres. Not burned in more than twenty years; margins show burn scars, interior none. Pines 15-20 yrs old. Elevation 16 feet.
- (3) Spanish River Road (SR)—T47S, R42E, S11—Palm Beach County, Boca Raton. AUSTIN list (1985). Acres 2. No burn evidence. Erosion marked. Pines 15-20 yrs old. Elevation 15 feet.
- (4) IBM (IB)—T47S, R42E, S12—Palm Beach County, Boca Raton. AUSTIN list (1979-1985). Acres 27. Some burn and farming evidence. Erosion marked. Pines 20-40 yrs old. Partly urbanized. Elevation 15 feet.
- (5) Florida Atlantic University (FA)—T47S, R42E, S13—Palm Beach County, Boca Raton. AUSTIN list (1970-1985). Acres 30. Cleared in 1939-1940. Mowed from ca. 1964 to 1973, when stopped. Recovering since 1973. One pine remains, less than 20 yrs old. Elevation 14 feet.
- (6) Boca Bibletown (BB)—T47S, R43E, S19 - Palm Beach County, Boca Raton. P. HONYCHURCH list (1983); rechecked by AUSTIN (1985). Acres 1. Mowed at least once yearly; some dumping from yards. Pines 15-25 yrs old. Elevation 20 feet.
- (7) *Asclepias curtissii* site (AC)—E of BB on 4th Street—T47S, R43E, S19—Palm Beach County, Boca Raton. AUSTIN list (1970-1985). Mowed at least once a year; dumping from yards. Acres 1. Pines 15-25 yrs old. Elevation 31 feet.
- (8) Yamato Scrub (YA)—T47S, R43E, S6—Palm Beach County, Boca Raton. AUSTIN (1977), rechecked to 1985. Acres ca. 300. No fire in central part for over 40 years. Pines 15 to over 40 years old. *Ceratiola* 16 years old.

Elevation 30 feet.

(9) Lake Wyman (LW)—T47S, R43E, S17 - Palm Beach County, Boca Raton. AUSTIN list (1974-1985). Acres 5. Farming in 1940's. Mowed by city until developed into a city park. *Pinus elliottii* only, 20-30 yrs old. Elevation 10 feet.

(10) Boca Hammock (BH)—T47S, R43E, S16 & 21—Palm Beach County, Boca Raton. AUSTIN and COLEMAN-MAROS (1977). Acres 18. Burning on strand about every five years. No pines. Elevation 18 feet.

(11) Hillsboro Canal (HC)—T47S, R43E, S31—Palm Beach County, Boca Raton. AUSTIN list (1985). Acres 23. Some erosion on old marsh edge; biking trails. No burn evidence. Pines 15-25 yrs old. *Ceratiola* 11-17 yrs old. Elevation 17 feet.

(12) Boca Teeca (BT)—T47S, R43E, S32—Palm Beach County, Boca Raton. AUSTIN list (1970-1985). Acres 26. No burns for over 20 years. Pines 15-20 yrs old. *Ceratiola* 6, 9, 11, 12, and 14 yrs old. Elevation 18 feet.

(13) 4th Ave, Boca Raton (4A)—T47S, R43E, S8—Palm Beach County, Boca Raton. AUSTIN list (1985). Acres 0.25. Mowed at least once a year, monthly during summer. Pines 15-20 yrs old. Elevation 17 feet.

(14) Jonathan Dickinson (JD)—Martin County—checklist by POPENOE (1981?). Acres over 200. Partly burned by 1970 fire, otherwise maturing. Pines from 10 to over 60 yrs old. Elevation 16-50 feet.

(15) Executive Airport (EX)—Broward County—ANN BUCKLEY and TED HENDRICKSON list (1984). Acres 18. Some development damage. Pines 15-25 yrs old. Elevation 15 feet.

### COMPARATIVE SITES

(1) Boynton Motorola (BM)—T44S, R43E, S17—Palm Beach County, Boynton. D. RICHARDSON list (1983), rechecked by AUSTIN (1985). Grazed by cattle until 1983; fenced and kept for recovery since then. Species = 46. Acres 57.8. Pines 20-30 yrs old.

(2) 17th—T44S, R43E, S16—Palm Beach County, Boynton. AUSTIN list (1985). Considerable path and dumping damage; no fire evidence. Species = 44. Acres 26. Pines 10-20 yrs old. *Ceratiola* 10-15 yrs old.

(3) Seacrest (SE)—T45S, R43E, S33—Palm Beach County, Boynton. AUSTIN list (1985). Dumping and bulldozing damage; no fire evidence. Species = 37. Acres 13. Mostly oak scrub, pines 15 yrs old.

(4) Hobe Sound Refuge (HS)—HSNWR, Martin County, Hobe Sound. ANNE COX list (1985)—Species = 54 spp. No data on age.

(5) Marco Island (MI)—T52S, R26E, S16—Collier County. LOIS LINKER and D.F. AUSTIN list (1976)—Species = 22. No data on age.

(6) Windemere (WD)—T23, R28, S7—Windemere, Orange County. MULVANIA list (1931). Species = 31. No data on age.

(7) Cedar Key (CK)—T15S, R12 & 13E, S30, 35, 36. Levy Co. AUSTIN list (1985)—Species = 42. Pines 15-25 yrs old.

(8) Cedar Key Preserve (CP)—T15S, R13E, S22. AUSTIN list (1985)—Levy County, Species = 17. List mostly from oak scrub, pines present 15-25 yrs old.

### □ RESUMEN □

Se han obtenido datos de las acumulaciones dunares costeras (Scrub dune ridge) del sureste de Florida; se han reconocido 7 grandes elevaciones y otro gran número de pequeñas elevaciones. Cada loma o elevación tiene indicadores de los factores que la han moldeado. Hasta cierto punto, la flora refleja la historia, con la máxima diversidad y riqueza de especies que ha tenido lugar en la más alta elevación de Pamlico. Los indicadores de la comunidad de Scrub de Florida decrecen en frecuencia y riqueza hacia el este y oeste del sistema de dunas principal.—Miguel A. Losada, Universidad de Cantabria, Santander, Spain

### □ ZUSAMMENFASSUNG □

Die Gestrüppdünen-kammuster entlang der südöstlichen Küste Floridas wurden aufgezeichnet; 7 Hauptkämme und auch viele kleinere Kämme waren dabei erkennbar. Jeder Kamm darstellt individuelle Formationsmerkmale. Das Pflanzwelt zeigt seine Geschichte; die grösste Speziesverschiedenheit und -Reichtum sind auf dem höchsten Pamlicokamm zu finden. Westlich und östlich von den höchsten Kämme neigen die Verschiedenheit und Reichtum die Gestrüppdünen.—Stephen A. Murdock, CERF, Charlottesville, Virginia, USA

### □ RÉSUMÉ □

Cartographie les espèces des fourrés des crêtes dunaires littorales de SE de la Florida. Sept crêtes principales sont reconnaissables parmi de nombreuses autres, mineures. Chaque crête porte les marques des facteurs qui l'ont façonnée. La plus haute crête de Pamlico présente la plus grande diversité et richesse en espèces. Les indicateurs des communautés de fourrés de Floride décroissent d'Est en Ouest en fréquence et en richesse sur le plus haut système dunaire.—Catherine Bressolier, EPHE, Montrouge, France

