SOUTH FLORIDA RESEARCH CENTER

Report T-655

A Survey and Inventory of the Plant Communities in the Pinecrest Area, Big Cypress National Preserve

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INTRODUCTION

The Pinecrest study area is the second to be investigated in a network of five study areas selected to encompass the ecological variation of the Big Cypress National Preserve. Studies of the plant ecology of these areas are aimed at providing necessary baseline information for long-term management of the Preserve by the National Park Service. Emphasis is upon documenting current species composition of representative, relocatable examples of plant communities and upon determining relationships between plant species composition and environment - particularly the influence of water levels upon vegetation. The Pinecrest study area is located in the southeastern portion of the Preserve (Figure 1). It is part of the region designated by Craighead (1971) as the "Hammock and Cypress Ridge", the region that forms the western rim of the Everglades physiographic unit.

Vegetation

Cypress forests and tropical hardwood hammocks are the dominant plant communities in the Pinecrest area, (Craighead, 1971). The cypress forests are also referred to as dwarfed (Davis, 1943; Craighead, 1971) scrub or hat-rack cypress. Most of the cypress forests consist of monospecific stands of stunted pondcypress, *Taxodium ascendens*. The understory of dwarf cypress forests is similar in species composition and cover to wet prairie associations, so the name cypress prairie is used. The hammocks are diverse associations of tree species of mostly Antillean origin. Principal species in the hammocks are *Lysiloma latisiliquum*, *Bursera simaruba*, *Quercus laurifolia*, *Nectandra coriacea*, *Coccoloba diversifolia*, *Bumelia salicifolia*, and *Myrcianthes fragrans*, (Olmsted, et al. 1981). Other plant communities in the study area are willow, *Salix caroliniana* heads; popash, *Fraxinus caroliniana*, sloughs; marshes of *Typha* spp., *Pontederia lanceolata* and sawgrass, *Cladium jamaicense*; and pine, *Pinus elliottii* var. *densa*, forests.

The Pinecrest study area was included in vegetation maps made by Davis (1943) (1:400,000) and McPherson (1973) (1:120,000). Davis mapped hammock, cypress and pine flatwood forests in the study area. Categories mapped by McPherson in the area were hammock forest, cypress forest, and prairies. The hammocks in the Pinecrest area were also numbered and mapped by Humes (Pilsbry, 1946).

Environmental Factors

Many factors enter into determining the set of environmental conditions which results in a given association of plant species. The important, and interrelated, factors include the substrate characteristics, elevational differences, hydrologic patterns, and recent histories of disturbances such as fires, hurricanes or logging.

Various geologic formations are reported for the Pinecrest area. Parker and Cooke (1944) and Craighead (1971) classify all of the bedrock and outcrops in the area as belonging to the Tamiami formation. Schroeder and Klein (1954) found younger sediments, classified as the Fort Thompson formation, over the Tamiami formation. Duever et al. (1979) suggest the presence of an even more recent formation,

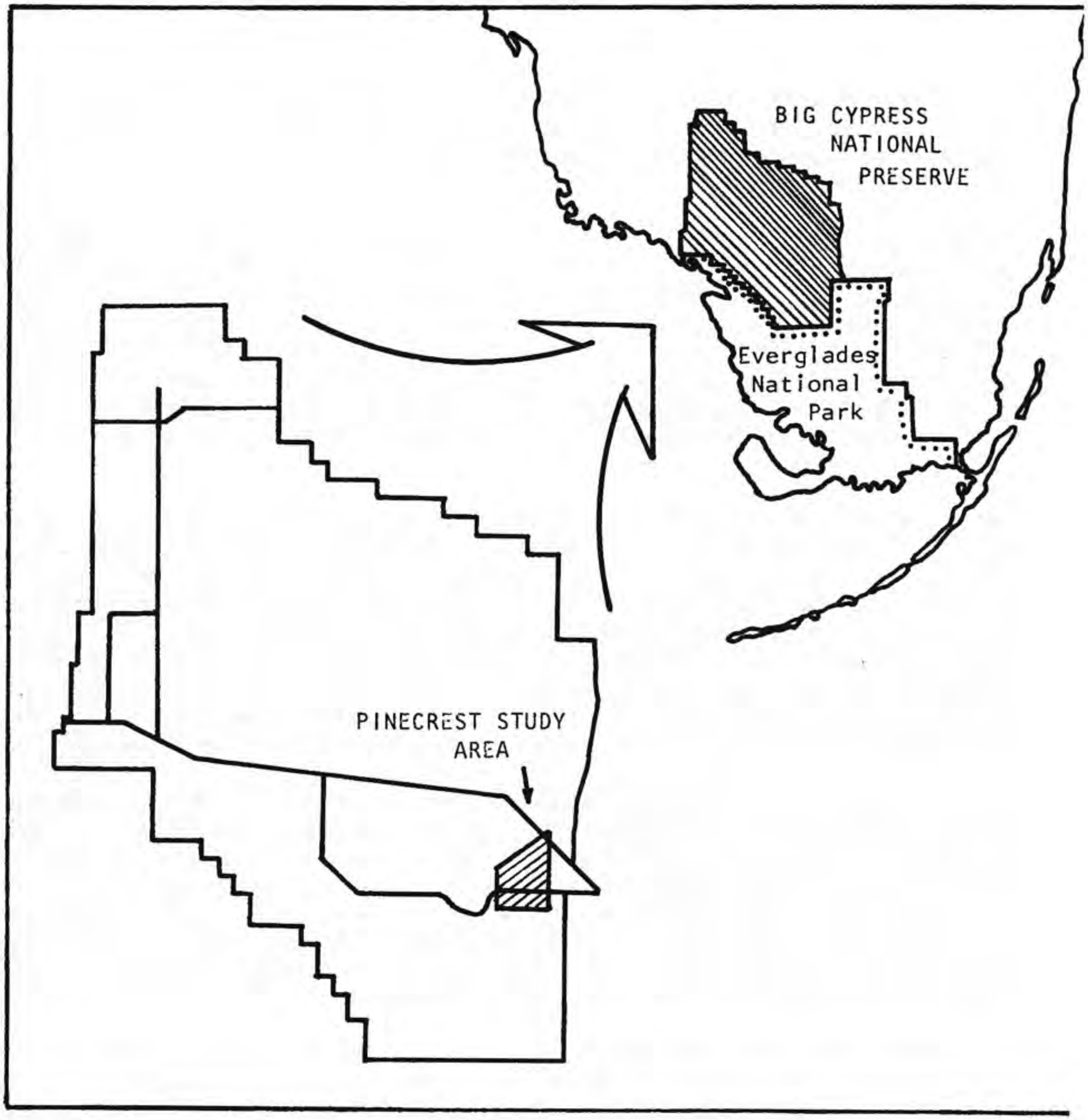

Figure 1. Location of Pinecrest Study Area within Big Cypress National Preserve in Southern Florida.

the Pinecrest beds. Residual outcrops of this Pinecrest formation support the tropical mixed hardwood hammocks (Duever et al., 1979). The discrepancies appear to be a function of increasing knowledge about the area, not major changes in classifications.

Leighty et al. (1954) mapped three major groups of soils in the Pinecrest area; shallow fine sandy marl, shallow fine sand and cypress swamp soils. The shallow fine sandy marl type is found beneath the cypress prairie association. Craighead (1971) found the depths of these soils to be from 10 to 25 cm. Leighty et al. (1954) indicate that the fine sands are found in hammock forests, but there is also an organic component in these soils. Comprised of partially decomposed litter and sand, the hammock soil ranges from 20 to 45 cm in depth (Craighead, 1971). The cypress swamp soils are mixtures of sands and peat located in sloughs beneath the taller cypress trees.

Elevational differences that correspond to bedrock undulations result in changes in species composition of vegetation which can be regarded as distinct plant communities. The cypress prairie areas are approximately 0.6 m (2 ft) below the ground surfaces in the hammocks (Klein et al., 1970) in the Big Cypress area. Craighead (1971) found the ground elevations in hammocks to be 0.3 to 0.5 m (1 to 1.5 ft) above surrounding pinelands and 0.3 to 1.3 m above sawgrass glades, in Everglades National Park, but recent measurements (Olmsted, pers. comm.) show there may not be an elevational difference between pineland and hammocks. Flohrschutz (1978) measured a 25 cm increase in elevation from cypress prairie to pineland.

The elevational and edaphic features combine with rainfall and runoff to produce the hydrologic pattern. Craighead (1971) states that cypress prairies are inundated all year except the late winter months, while Flohrschutz (1978) measured an average hydroperiod of approximately 200 days in the western region of the Big Cypress Swamp. The deeper cypress areas are inundated longer, whereas the hammock forests are seldom, if ever, inundated. However, solution holes within the hammocks may have prolonged hydroperiods and support swamp hardwood species, as well as various ferns, lichens and mosses.

Our investigation of this study area involved, an inventory of the species composition of the major plant associations, the preparation of a vegetation map, and an examination of the elevational, edaphic and hydrologic conditions in relation to vegetation.

METHODS

Vegetation Inventory

The vegetation in the cypress prairie and a tropical hardwood hammock was quantitatively inventoried. The inventory in the cypress prairie was done in cooperation with a concurrent fire ecology project, and in order to facilitate logistics, the plots were placed outside the area of the vegetation map. The locations of the cypress prairie plots are given in Table 1. The plot size was 15 m x 40 m in the cypress prairies. One inventory plot was placed in tropical hardwood

Table 1. Universal Transverse Mercator (UTM) coordinates (Zone 17) of vegetation plots in Pinecrest study area. Coordinates represent approximate centers of the 15 x 40 m plots.

Plot Designation	UTM Coordinates	
Cypress prairie #1	$^{28}61.15$ N	$^{5}02.98$ E
Cypress prairie #2	$^{28}61.25$ N	$^{5}03.10$ E
Hammock #1	$^{28}51.10$ N	$^{5}09.60$ E

hammock #40 (location in Table 1). Because it was difficult to find homogeneous areas of hammock vegetation, the plot size was decreased to 15 m x 20 m, which decreased by half the number of all of the subplots within the 15 m x 40 m plot.

The vegetation was divided into three categories for quantitative analysis: trees, shrubs, and understory. Trees were defined as any woody plant with a stem greater than 5 cm (2 inches) in diameter at breast height (1.37 m or 4.5 ft). Shrubs included any woody plant with a stem less than 5 cm dbh and more than 1 m tall. The understory category encompassed any herbaceous plant, any woody plant less than 1 m tall and any epiphyte with a basal elevation of less than 1 m above ground level.

Trees

The diameters (dbh) of tree-size stems rooted within a 15 x 40 m (15 m x 20 m in the hammock) rectangular plot (Figure 2) were measured to the nearest 0.13 cm (0.05 in). Sabal palmetto trees with remnant leaf bases (botts) were difficult to measure using a diameter tape, so the diameters were measured using a meter stick held at breast height. Tree plots were oriented along cardinal bearings, either north to south or east to west, and placed within homogeneous vegetation stands. Basal areas were calculated and used as an expression of dominance of each species. Relative dominance, based on the total basal area of the plot, was determined for each species. The number of tree stems was tallied within the tree plot to yield stem densities per 600 m^2 (300 m^2 in hammock). Relative density for each species was calculated based on the total stem density in the plot. Occurrence of each species within each of twenty-four (twelve in hammock) 5 m x 5 m subplots (Figure 2) was recorded and frequency of occurrence determined for each species. Relative frequency was calculated based on the summation of the frequencies of all species. Relative dominance, relative density and relative frequency are summed for each species to yield an importance value index.

Shrubs

Shrub dominance was expressed as the percent cover of each species. Percent cover was determined along four 40 m (29 m in hammock) line segments by the line-intercept method. The intersection of the live leaf cover of each species with the line was measured to the nearest centimeter using a retractable metric tape. Percent cover was calculated by the sum of intersection distances along all four line segments (A, B, C, D, in Figure 2) divided by the total length (160 m) (80 m in hammock). All Sabal palmetto and Serenoa repens individuals that were not trees (no measureable dbh) and not seedlings were measured using this method. Woody vines were usually inventoried in the shrub class. All intersections were recorded, regardless of where the shrub was rooted, inside or outside the tree plot.

Shrub occurrence was noted in each of sixteen 10 m (5 m segments in hammock) line segments (A1-A4, B1-B4, C1-C4, D1-D4; in Figure 2) and used to calculate frequency and relative frequency of each species. Relative dominance and relative frequency were summed to yield the shrub importance value index.

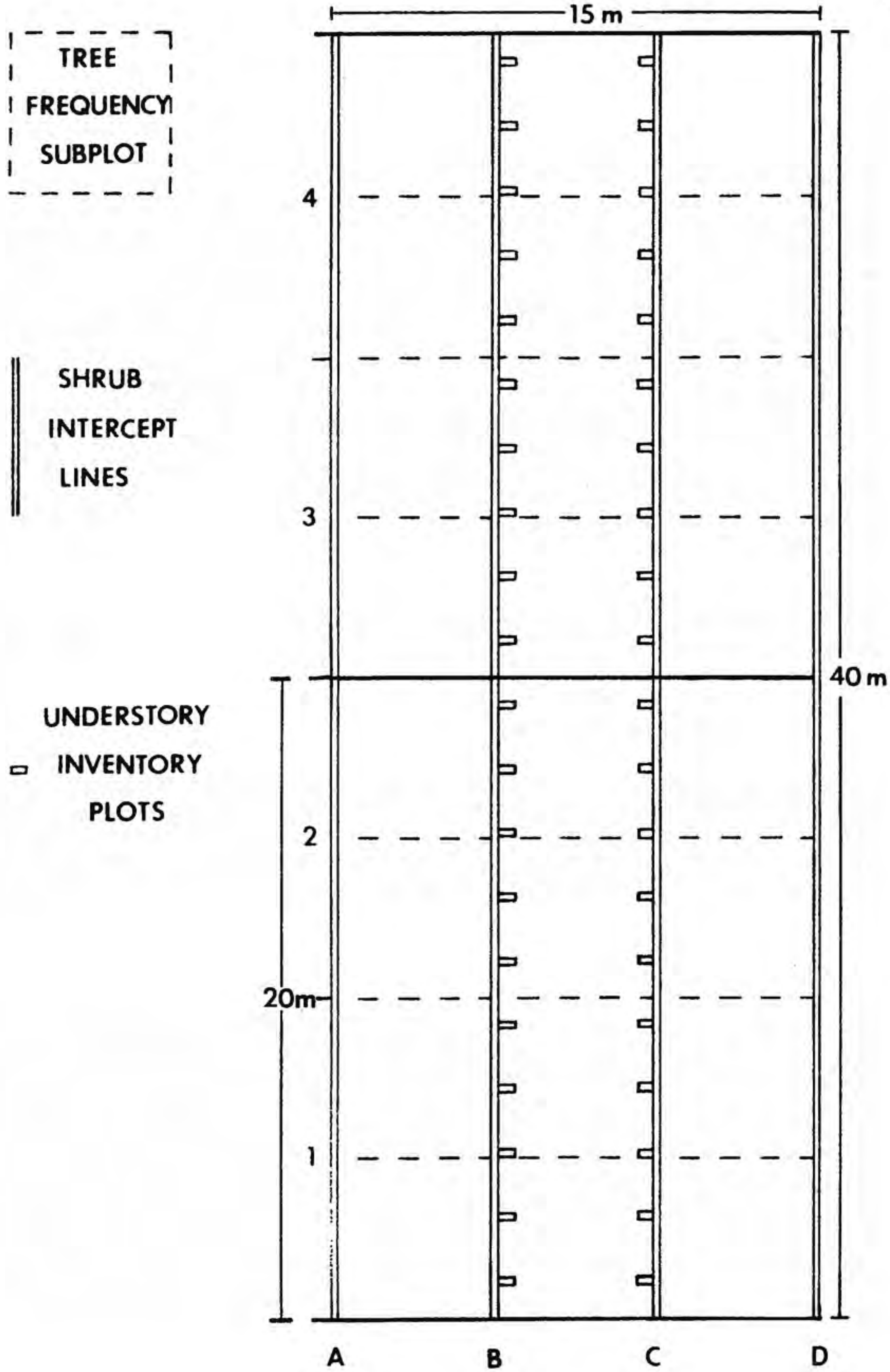

Figure 2. Schematic map of vegetation inventory plots, 15 x 40 m format was used in cypress prairie vegetation; 15 x 20 m format in hammock vegetation.

Understory

Understory species were listed within forty (twenty in hammock) 20 x 50 cm (0.1 m^2) plots placed at two meter intervals along the two center lines of the vegetation plot (lines B, C in Figure 2). The plots were placed in the center one-third of the tree plot and always placed on the same side of the two-meter-interval mark. Cover classes were used following Daubenmire's (1959) methods. Numerical values were assigned to each cover class as follows: (1) 0-5%, (2) 5-25%, (3) 25-50%, (4) 50-75%, (5) 75-95%, and (6) 95-100% for ease of recording in the field. The average percent cover of a species was obtained by summing the range midpoints of all recorded cover classes then dividing by the total number of plots (40). For example, Cladium was encountered six times in 40 plots and cover class values of 1, 2, 3, 4, 5, 6 were recorded. The midpoints of the cover classes (2.5, 15, 37.5, 62.5, 85, 97.5) were summed to yield 300 and divided by 40 to give an average percent cover of 7.5%. Relative dominance (based on relative cover) was determined by calculating the percent of the total understory cover attributed to each species.

Frequency of occurrence was calculated from the number of times a species was found in the 40 (20 in hammock) plots. Relative frequency was calculated and added to relative dominance to yield an importance value for each understory species.

Plant Species Identification

Identification references include Long and Lakela (1971), Lakela and Long (1976), Hitchcock (1950), and Ricketts (1967). Species not readily identifiable in plots were collected and compared with specimens on file at the herbarium of the South Florida Research Center as well as being cross-checked with a species list for the Preserve (Black and Black, 1980). Nomenclature generally follows Black and Black (1980).

Vegetation Map

The vegetation map was made by first delineating the plant communities on 22.9 cm x 22.9 cm (9 in x 9) in color contact prints (1:7800 taken in December 1978). Readily discernible features were also outlined on USGS 7.5 minute orthophoto maps. The features from the orthophoto maps were then used to produce a skeleton map (so-called because it forms a rudimentary map with just a "skeleton" of important features) using a Map-O-Graph opaque projector. The features on the skeleton map were used as control points to transfer the delineations of plant communities from the color photographs to the skeleton map. The rough draft was field checked on the ground and by helicopter during February, 1980. The map was then drafted, precolored and printed. The final draft was made at a scale of 1:10,000 but was reduced during printing due to limitations on the press size, so that the scale of the printed map is approximately 1:18,000.

Species Composition and Environmental Variables

In order to correlate species composition with environmental variables, a line transect was established. The 1030 m (3375 ft) line traversed tropical hardwood hammocks numbered 40 and 41 (on vegetation map) as well as the surrounding areas of cypress prairie, marsh, willow and popash slough. A total of 46 benchmarks were established at 23 m (75 ft) intervals as measurement points along the transect. The benchmarks were numbered; with the easternmost point as 46. The benchmarks were established by driving a 0.95 cm (3/8 in) diameter steel rod into the ground until secure. The elevation of the top of each benchmark was surveyed to mean sea level from nearby known elevations.

Soil surface elevations, soil depth were measured at each benchmark. The soil surface elevation (to msl) was obtained by subtracting the height of the steel rod from the elevation of the top of the rod. Soil depths were determined by inserting a soil probe at three points around each benchmark. When a ringing sound indicated that bedrock had been reached, the depth was measured.

A cut-away soil tube was used to assess each soil type. Major classes of soils were sands, marls, muck and litter.

The plant species were listed within a 100 m^2 circular plot which was centered on benchmarks that were in homogeneous vegetation. Ecotonal benchmarks were not inventoried. A list was made of all plant species within the plot. Each tree (greater than 5 cm dbh) within the 100 m^2 plot was counted. Diameters at 1.3 m (4.5 ft or dbh) were also measured for all trees within this plot.

Water levels were monitored in three vegetation types to assess hydrologic patterns. Water levels within a 30.5 cm (12 in) diameter well in a Typha-dominated marsh, a 2.5 cm (1 in) well in a solution hole in hammock 40, and at an iron rod benchmark in the cypress prairie were measured monthly by D. Sikkema (South Florida Research Center, Hydrology Group) for one annual cycle. Only surface water conditions were recorded at the cypress prairie benchmark, because hard bedrock precluded the placement of a groundwater well by our human-powered well driver.

RESULTS

Vegetation Inventory Plots

Cypress Prairie Plots

Taxodium ascendens (pondcypress) was the only tree or shrub found in the cypress prairie plots. Density of trees ranged from 18 to 28 stems per 600 m^2 (for plots 1 and 2, respectively). Total basal area (calculated from dbh) was fairly consistent between the plots with values of 948 cm^2/600 m^2 and 984 cm^2/600 m^2 recorded for plots #1 and #2 respectively. The range in tree heights from both plots was 1.7 to

6.0 m, with an average of 3.2 m in plot #1 and 3.8 m in plot #2. The frequency of occurrence of pondcypress trees was 100%. The average cover of shrub-sized Taxodium was 7%, and the frequency of shrub occurrence was 56%.

Results of the understory inventory in the cypress prairie plots are given in Tables 2 and 3. Rhynchospora microcarpa had the highest average importance value from both plots, while Paspalum monostachyum and Cladium jamaicense had slightly lower values. Totals of 26 and 27 species were encountered in plots #1 and #2 respectively. The similarity index of Sorenson (1948) was applied to the two plots and yielded a value of 72. This index is calculated by dividing twice the number of species common to the two plots by the total number of species found in the two plots combined. An index which incorporates a quantitative assessment (based on importance values) was applied and a similarity value of 93 was calculated. These two values (72, 93) in a theoretical range from O to 100, indicate that 72% of all the species encountered were common to both plots, and that 93% of the total importance value is attributable to the common species.

Hammock Plot

Sixteen tree species were encountered in the hammock quantitative inventory plot (Table 4). Lysiloma latisiliquum had the highest importance value, due to the number of stems and large size of the stems. The tallest trees in the plot were also Lysiloma. Nectandra had a high importance value because of the large number of stems. Species of Zanthoxylum, Coccoloba, Bursera, Myrcianthes, Ficus and Sabal had similar importance values to each other, but lower than Lysiloma or Nectandra. Total basal area of all tree stems in the plot was 17,780 cm^2, and the number of tree-size stems was 90, both values similar to those reported by Olmsted et al. (1980) for Pinecrest hammocks.

Shrub foliage cover was high, totalling 71%. The structure of the hammock is such that many shrub-sized stems are present. The foliage measured on these stems included more than one stratum of the canopy, and therefore resulted in the high cover values. Nectandra and Coccoloba were the shrubs with the highest cover, frequencies, and importance values (Table 5).

Due to high canopy cover, the understory in the hammocks is sparse. In addition to a scattered distribution of plants, only five species were encountered. All species in the understory plots were seedlings of tree and shrub species. Nectandra was the most important understory plant. High importance values in the seedling, shrub, and tree classes indicates that Nectandra is actively regenerating and should continue to dominate the stand in the asence of disturbances, although this species will always have a sub-canopy status in the hammock.

Vegetation Around Benchmarks

The plant species lists made around each benchmark on the transect, were ordinated using the method of Bray and Curtis (1957). This linear algorithm compared the species in common between every stand and the two most dissimilar stands. Only the presence or absence of a species was compared between the two stands, not the abundance of a species in each stand. One plot in the tropical

Table 2. Statistics for understory species in cypress prairie inventory plot #1, ranked according to Importance Value.

Species	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Paspalum monostachyum	5.38	.80	19.7	14.6	34
Rhynchospora microcarpa	4.38	.65	16.0	11.9	28
Rhynchospora divergens	3.25	.68	12.0	12.4	24
Cladium jamaicense	2.44	.48	9.0	8.8	18
Schizachyrium rhizomatum	2.75	.25	10.1	4.6	15
Rhynchospora tracyi	1.69	.43	6.2	7.9	14
Panicum tenerum	1.25	.25	4.6	4.6	9
Taxodium ascendens	1.63	.18	6.0	3.3	9
Cassytha filiformis	.94	.25	3.4	4.6	8
Cirsium horridulum	.56	.23	2.0	4.2	6
Solidago stricta	.56	.23	2.0	4.2	6
Dichromena colorata	.44	.18	1.6	3.3	5
Panicum virgatum	.31	.13	1.1	2.4	4
Aristida purpurascens	.25	.10	.9	1.8	3
Pluchea rosea	.25	.10	.9	1.8	3
Ludwigia simpsonii	.19	.08	.7	1.5	2
Aster dumosus	.06	.03	.2	.6	1
Andropogon virginicus	.06	.03	.2	.6	1
Aster tenuifolius	.06	.03	.2	.6	1
Cynoctonum mitreola	.06	.03	.2	.6	1
Dyschoriste oblongifolia	.06	.03	.2	.6	1
Eragrostis elliotti	.13	.05	.5	.9	1
Flaveria linearis	.06	.03	.2	.6	1
Gerardia linifolia	.06	.03	.2	.6	1
Hymenocallis palmeri	.06	.03	.2	.6	1
Oxypolis filiformis	.06	.03	.2	.6	1
Sabatia bartramii	.06	.03	.2	.6	1

Table 3. Statistics for understory species in cypress prairie inventory plot #2, ranked according to Importance Value.

	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Rhynchospora microcarpa	7.63	.85	21.5	16.7	38
Cladium jamaicenses	7.69	.73	21.7	14.3	36
Schizachyrium rhizomatum	7.84	.53	21.0	10.4	31
Paspalum monostachyum	4.19	.68	11.8	13.3	25
Cassytha filiformis	2.94	.58	8.3	11.4	20
Cirsium horridulum	1.0	.28	2.8	5.5	8
Taxodium ascendens	1.25	.20	3.5	3.9	7
Panicum tenerum	.38	.15	1.1	2.9	4
Rhynchospora divergens	.56	.13	1.6	2.6	4
Sabatia bartramii	.38	.15	1.1	2.9	4
Aristida purpurascens	.25	.10	.7	2.0	3
Ludwigia simpsonii	.25	.10	.7	2.0	3
Solidago stricta	.25	.10	.7	2.0	3
Unknown #1	.19	.08	.5	1.6	2
Centella asiatica	.06	.03	.2	.6	1
Dichromena colorata	.06	.03	.2	.6	1
Eleocharis caribaea	.06	.03	.2	.6	1
Gerardia linifolia	.13	.05	.4	1.0	1
Hymenocallis palmeri	.06	.03	.2	.6	1
Muhlenbergia filipes	.06	.03	.2	.6	1
Oxypolis filiformis	.06	.03	.2	.6	1
Panicum virgatum	.13	.05	.4	1.0	1
Pluchea rosea	.13	.05	.4	1.0	1
Stillingia aquatica	.06	.03	.2	.6	1
Unknown #2	.06	.03	.2	.6	1
Unknown #3	.13	.05	.4	1.0	1

Table 4. Statistics for tree species in hammock inventory plot, ranked according to Importance Value.

Species	Total Basal Area ($cm^2/300m^2$)	Number of Stems $/300m^2$	Frequency %	Relative Dominance	Relative Density	Relative Frequency	Importance Value
Lysiloma latisiliquum	9,450	15	67	53	17	17	87
Nectandra coriacea	1,011	18	67	6	20	17	43
Zanthoxylum fagara	637	11	42	4	12	11	27
Coccoloba diversifolia	490	11	42	3	12	11	26
Bursera simaruba	1,138	8	33	6	9	8	23
Myrcianthes fragrans	422	11	25	2	12	6	20
Ficus aurea	2,325	3	17	13	3	4	20
Sabal palmetto	1,665	2	17	9	2	4	15
Bumelia salicifolia	210	2	17	1	2	4	7
Mastichodendron foetidissimum	61	2	17	1	2	4	7
Krugiodendron ferreum	41	2	8	1	2	2	5
Exothea paniculata	95	1	8	1	1	2	4
Quercus laurifolia	156	1	8	1	1	2	4
Ardisia escallonioides	28	1	8	1	1	2	3
Eugenia axillaris	39	1	8	1	1	2	3
Simarouba glauca	23	1	8	1	1	2	3

Table 5. Statistics for shrubs in hammock inventory plot, ranked according to Importance Value.

Species	% Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Nectandra coriacea	23	.88	31	21	52
Coccoloba diversifolia	19	.75	26	18	44
Myrcianthes fragrans	10	.38	14	2	23
Schoepfia chrysophylloides	6	.38	8	9	17
Ardisia escallonioides	3	.50	4	12	16
Eugenia axillaris	4	.38	5	9	14
Psychotria nervosa	4	.38	5	9	14
Myrsine floridana	2	.13	3	3	6
Pisonia aculeata	1	.13	1	3	4
Bumelia salicifolia	1	.13	1	3	4
Simarouba glauca	1	.13	1	3	4

Table 6. Statistics for understory species in hammock inventory plot, ranked according to Importance Value.

	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Nectandra coriacea	8.7	60	55	63	118
Myrsine floridana	6.0	20	38	21	59
Quercus laurifolia	0.8	5	5	5	10
Chiococca alba	0.1	5	1	5	6
Psychotria nervosa	0.1	5	1	5	6

hammock and one plot in an area dominated by popash (Fraxinus carolinianus) were used as endpoints of the first ordination (Index "A"). All of the stands were ordinated again (Index "B"), using another plot in the hammock and a plot in cypress prairie as endpoints. The ordination indices were used as coordinates for plotting the stands (Figure 3). Most of the stands fell into distinct groupings. All of the hammock plots were quite similar to each other and dissimilar from the other groups. The cypress prairie group was also clearly segregated from other associations. The cypress dome stands were, however, similar to both the areas of willow and popash. The overall species composition may be quite similar among these three latter groups, but they are each overwhelmingly dominated by a single species: Taxodium ascendens, cypress; Salix caroliniana, willow; or Fraxinus carolinana, popash. Intergradations exist, but there appears to be justification for retaining these three groups as mapping units. Based on these groupings of plant communities, species lists were made for each association from the inventory plots around each benchmark, excluding ecotonal areas (Table 7).

The density and total basal area (based on dbh) are given for each benchmark inventory plot (Table 8). Densities in cypress areas ranged from 1 tree/100 m^2 to 10 trees/100 m^2. Basal areas varied from 40 cm^2/100m^2 to 2400 cm^2/100 m^2. Stem densities in the hammock associations (benchmarks 15, 16, 17, 18, 24, 27, 28, 35) were measured to be from 11 stems/100 m^2 to 24 stems/100 m^2 and basal areas ranged from 466 cm^2/100 m^2 to 3600 cm^2/100 m^2.

Vegetation Map

The plant associations on the vegetation map (enclosed in pocket at end of report) are differentiated by color and pattern. Similar or related groups of overstory species are included in the same color, and different patterns are assigned to variations in species composition within each group.

The yellow color represents areas of Taxodium ascendens, (pondcypress). The plain (no pattern) yellow indicates cypress prairie vegetation, with the shortest cypress trees and a gramineous understory. This category includes regions of very sparse cypress trees. The stippled yellow represents stands of taller and denser pondcypress, with usually a graminoid or aquatic-plant understory. Zones of the tallest pondcypress trees, with a subcanopy of hardwood trees, are delineated by yellow with horizontal lines. Although the cypress heights form a continuum and the categories are somewhat arbitrary, the combination of tree height, density and understory features define each category reasonably well. Every effort was made to be consistent in delineation, but some errors may have resulted from overlap among the categories.

The light-green color indicates stands of swamp hardwoods: Salix caroliniana (willow), Annona glabra, (pond apple), and Fraxinus caroliniana, (popash). Willow heads are usually found with only one species of tree, whereas pond apple and popash are found either separately or together. All three species invade severely burned cypress strands and are grouped together for this reason.

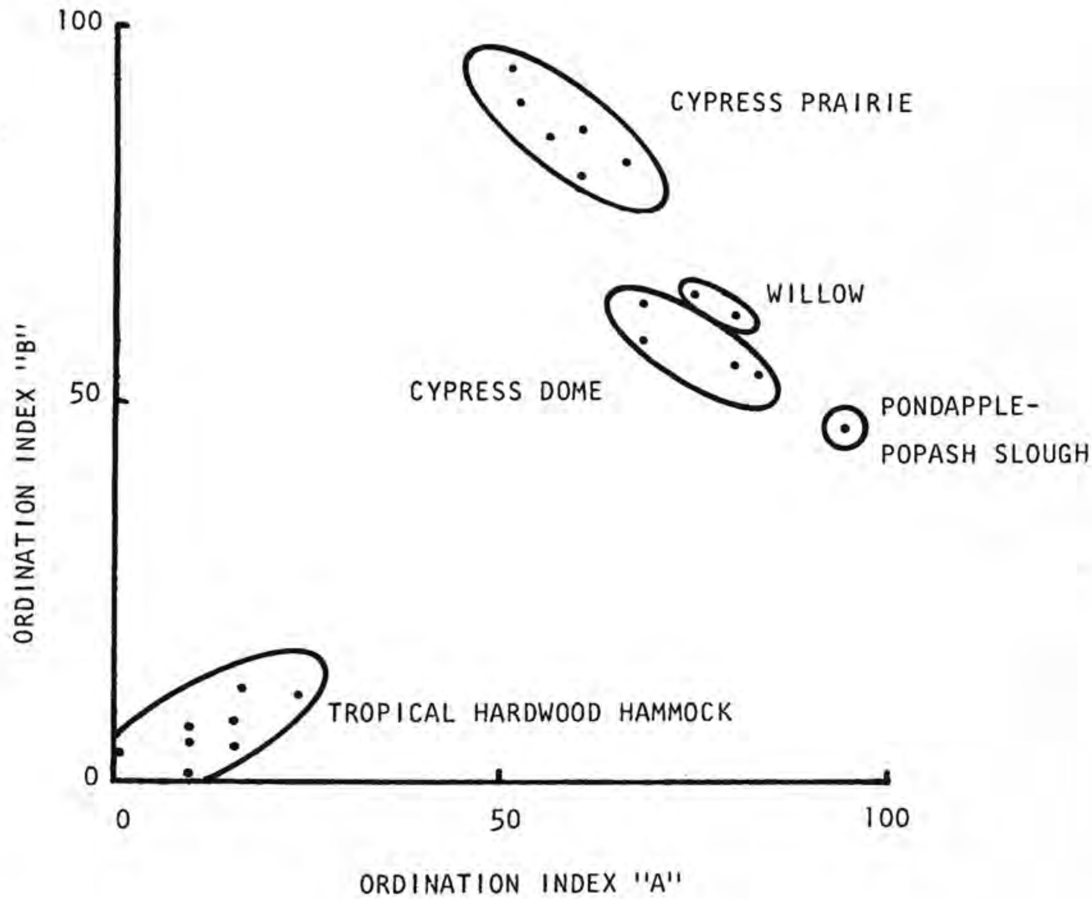

Figure 3. Ordination of vegetation stands around benchmarks along transect (polar ordination technique of Bray and Curtis, 1957).

Table 7. Species found in each plant community, compiled from lists made around benchmarks along transect.

Species	Cypress Prairie	Cypress Dome	Hammock	Willow	Pondapple Popash
Andropogon virginicus		X			
Annona glabra	X		X	X	X
Ardisia escallonioides			X		
Aster carolinianus		X		X	
Aster elliottii		X			
Aster subulatus	X				
Aster tenuifolius	X				
Baccharis glomeruliflora		X		X	
Bacopa caroliniana	X				X
Blechnum serrulatum		X		X	X
Boehmeria cylindrica	X	X		X	X
Bumelia salicifolia			X		
Bursera simaruba			X		
Cardiospermum corindum			X		
Cassytha filiformis	X				
Centella asiatica	X	X			
Cephalanthus occidentalis				X	
Chiococca alba			X		
Chrysobalanus icaco		X			
Chrysophyllum oliviforme			X		
Cladium jamaicense	X	X			X
Coccoloba diversifolia			X		
Crinum americanum		X		X	X
Croton humilis			X		
Cynoctonum mitreola	X				
Cyperus haspan		X			
Cyperus odoratus	X				
Dichromena colorata		X			
Encyclia tampensis				X	X
Epidendrum anceps					X
Eragrostis elliottii	X				
Erianthus giganteus		X		X	
Eryngium yuccifolium		X			
Erythrina herbacea			X		
Eugenia axillaris			X		
Eupatorium coelestinum	X				
Eupatorium mikanioides		X			
Eustachys glauca		X			
Ficus aurea	X	X		X	
Fuirena breviseta		X			

Species	Cypress Prairie	Cypress Dome	Hammock	Willow	Pondap Popas
Galactia elliottii		X			
Helenium vernale	X				
Hydrocoyle umbellata		X			
Hyptis alata		X		X	
Ilex cassine		X			X
Ipomoea sagittata		X		X	
Kosteletzkya virginica		X			
Ludwigia microcarpa		X		X	X
Ludwigia peruviana		X		X	
Ludwigia repens		X			X
Lysiloma latisiliquum			X		
Melothria pendula		X			
Mikania scandens		X		X	
Muhlenbergia filipes	X	X			
Myrcianthes fragrans			X		
Myrica cerifera	X	X			
Myrsine floridana		X	X		
Nectandra coriacea			X		
Nephrolepis exaltata		X	X		
Oxypolis filiformis	X				
Panicum hemitomon		X			X
Panicum virgatum	X	X			
Parthenocissus quinquefolia				X	
Paspalidium geminatum	X				
Peltandra virginica		X		X	X
Persea borbonia		X			X
Phyla nodiflora		X			
Phyllanthus caroliniensis		X			
Pisonia aculeata			X		
Pluchea rosea	X	X			
Polygala grandiflora		X		X	
Polygala incarnata		X			
Polygonum densiflorum		X			
Polypodium aureum		X		X	
Polypodium heterophyllum			X		X
Polypodium phyllitidis			X		X
Polypodium polypodioides				X	X
Pontederia cordata		X		X	X
Proserpinaca palustris		X		X	X
Psilotum nudum		X		X	X
Psychotria nervosa			X		
Psychotria sulzneri			X		
Pteris vittata	X				

Species	Cypress Prairie	Cypress Dome	Hammock	Willow	Pondapple Popash
Randia aculeata			X		
Rhynchospora microcarpa	X	X			
Rhynchospora tracyi	X				
Rivina humilis			X		
Sabal palmetto	X	X			
Sagittaria graminea		X		X	X
Salix caroliniana		X		X	X
Sarcostemma clausum		X		X	X
Saururus cernuus				X	
Schizachyrium rhizomatum	X	X			
Setaria geniculata	X				
Simarouba glauca			X		
Smilax bona-nox			X		
Solidago stricta		X			
Spilanthes americana		X			
Taxodium ascendens	X	X			
Thalia geniculata					X
Thelypteris interrupta				X	
Thelypteris kunthii		X	X		
Tillandsia balbisiana	X	X	X		X
Tillandsia fasciculata	X			X	X
Tillandsia setacea					X
Tillandsia valenzuelana			X		X
Toxicodendron radicans		X			
Typha domingensis				X	
Utricularia foliosa	X			X	X
Ximenia americana			X		
Zanthoxylum fagara			X		

Table 8. Tree Density (A*) and Total Basal Area (B*-based on DBH) within 100 m² plots centered on benchmarks along transect.

Species		Benchmark Number 1	2	3	4	5	15	16	17	18	24	27	28	31	35	39	42	43	44	45	46
Taxodium ascendens	A	8	3	5	10									2			9	4	2	3	1
	B	1,815	669	1,780	2,438									366			1,703	222	41	137	74
Sabal palmetto	A	1										1									
	B	2,055										1,075									
Myrica cerifera	A				2																
	B				170																
Salix caroliniana	A					19										7					
	B					590										158					
Lysiloma latisiliquum	A						3	5	2	3	1	3	2								
	B						1,498	2,454	603	801	199	1,329	116								
Simarouba glauca	A						1														
	B						299						125		132						
Nectandra coriacea	A						10	6	7	4	3		6		14						
	B						424	407	281	369	178		306		1010						
Coccoloba diversifolia	A						2	4		8	2	11			5						
	B						115	203		334	49	95			300						
Myrcianthes fragrans	A						1		1	3			2								
	B						71		167	210			180								
Bumelia salicifolia	A						1	1			1		2		2						
	B						54	163			58		93		284						
Eugenia axillaris	A						1				1					1					
	B						20				30					95					
Bursera simaruba	A							2	1	4	1		1			4					
	B							266	260	556	90		111			1,940					
Pisonia aculeata	A							1													
	B							31													
Zanthoxylum fagara	A							2		2	1										
	B							91			176	20									
Myrsine floridana	A										4										
	B										25										
Chrysophyllum oliviforme	A												1								
	B												53								
Annona glabra	A															6					
	B															308					
Totals	A	9	3	5	12	19	19	21	11	14	11	20	16	2	27	13	9	4	2	3	1
	B	3,870	669	1,780	2,608	590	2,481	3,615	1,311	2,270	780	2,544	984	366	3,761	466	1,703	222	41	137	74

*A = Stem density/100 m²

*B = Total basal area/100 m²

Pine forests, with an overstory of Pinus elliottii var. densa, (south Florida slash pine), are shown by green on the map. Sabal palmetto, (cabbage palm), and Serenoa repens (saw palmetto), are dominant understory plants.

The hardwood associations are shown in brown. The tropical associations are stippled and areas of scrubby (generally less than 5 m tall) hardwoods have parallel lines. Lysiloma latisiliquum, Bursera simaruba, Quercus virginiana, Q. laurifolia, Bumelia salicifolia, and Mastichodendron foetidissimum comprise the larger overstory trees in the tropical hammocks. The canopy heights are much lower in the hardwood scrub than the tropical hammocks. The scrub areas are usually on the periphery of hammocks and are characterized by such species as Quercus virginiana, Myrica cerifera, and Sabal palmetto. Tropical hardwood species may also be present in the scrub communities, but the canopy profile is lower than in the designated hammocks.

The light blue color represents marsh communities. Tracts of dense, tall (1-3 m) sawgrass, Cladium jamaicense, are colored plain light blue. The light blue is stippled to represent associations of emergent aquatic plants. Dominant species in this latter type of marsh include: Typha domingensis (cattail), Pontederia lanceolata (pickerel weed), and Sagittaria latifolia.

Open water regions are colored dark blue, and submergent vegetation may or may not be present. Open water is usually found in canals along roads, pits, or, as in the region in the south-central part of the map, an airboat landing.

The white areas with horizontal lines outline disturbed land. These areas have been cleared in the past and recently abandoned. Disturbed areas are found around homesites, campsites, and oil pads. If vegetation is present, it is early successional grasses and forbs.

The stippled white areas are sites with exotic trees. The dominant exotic in these areas is Melaleuca quinquenervia, which occurs in monospecific stands or intermingled with cypress prairie vegetation. The populations probably originated from roadside ornamental plantings, and are still largely restricted to roadside areas. However, Melaleuca is clearly increasing its extent, as indicated by the height structure of the population.

Environmental Parameters

The three parameters analyzed were elevation, soil type and hydroperiod. The elevation and soil types were correlated with species composition of all communities on the transect, but hydroperiod was applied only to the wetland types.

The elevational profile from the vegetation transect is depicted in Figure 4 and shows the soil surface and mean bedrock elevation. The transect traversed cypress prairie, emergent aquatic marsh, tropical hardwood hammock, popash slough, willow head and sawgrass marsh. Benchmarks, which fell in borders between two vegetation types were considered to have sampled ecotonal areas and not included

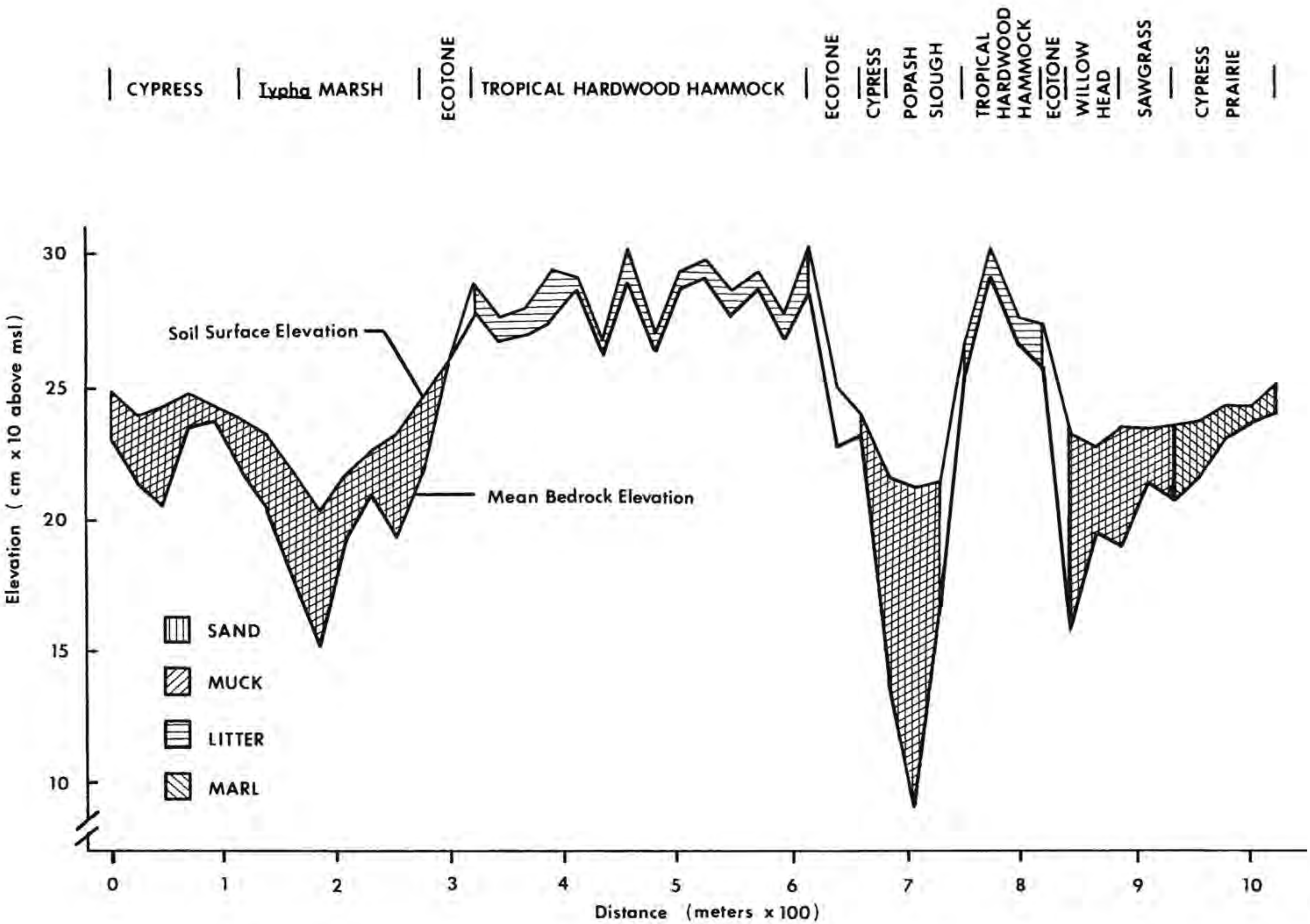

Figure 4. Elevational profile of soil surface and bedrock along line transect.

in any environmental analysis. The tropical hammocks were found on the highest elevations, both surface and bedrock. The lowest measured bedrock elevation was beneath a popash slough, but the lowest ground surface elevation was beneath the Typha dominated marsh.

The soil surface elevation data was transformed to relative values from the absolute elevations (msl). The transformation was done by setting the lowest value to zero, then calculating the difference between the lowest value and each of the remaining points. The mean, highest and lowest relative soil surface elevations of each plant community are shown in Figure 5. Six plant associations were sampled within the range of elevations - a range of slightly less than one meter. A non-parametric analysis of variances (Kruskal-Wallis, from Sokal and Rohlf, 1969) indicated that the mean soil surface elevations were significantly different among the communities ($p = 0.005$). Determining which of the groups were different from the rest was not done due to small sample sizes in most of the groups. Without rigorous analysis, it appears obvious that the hammocks are significantly higher than the other communities. Further testing is needed to determine any statistical elevational differences among the lower, wetland plant associations.

Mean, shallowest and deepest soil depths are plotted for the communities along the transect (Figure 6). The shallowest soils (usually less than 20 cm) were in the hammocks. The soil in the hammocks is what Craighead (1971) called hammock peat; a mixture of partially decomposed litter and a small amount of sand. Shallow soils were also found in the cypress prairie areas. The sandy marls in these areas were found to be up to 40 cm deep. The soils in the other areas were classified as black muck, characterized by dark black, finely decomposed organic matter with a sand component. The deepest mucks were beneath the popash sloughs, with shallower mucks under the willow, marsh and cypress associations.

Hydroperiods were calculated from water level data collected in three communities; a solution hole in hammock number 40, in the cypress prairie along the transect east of hammock 41 and in a Typha marsh to the west of hammock 40. Provisional water levels were obtained at Bridge 105 on US 41 from the USGS for the same days that water levels in the wells were measured. A correlation analysis (Sokal and Rohlf, 1969) was used to generate a linear equation that described the principal axis of the bivariate scattergram of water levels at Bridge 105 and each well. The equation was used to determine the critical water level at Bridge 105 that corresponded to a condition at each of the test wells when water level equalled ground surface elevation. The number of days for each year of record at Bridge 105 (1953-1978) that the critical level was equalled or exceeded was tallied. Mean hydroperiod, plus and minus one standard deviation and the range of values is depicted in Figure 7. The average hydroperiod in the cypress prairie was 240 days, with a range from 120 to 365 days. Mean hydroperiod in the Typha marsh was slightly longer, at 260 days/year. A paired t-test analysis showed that the annual hydroperiods at these two stations were statistically different ($p = 0.01$). Instead of calculating the hydroperiod within the solution hole of hammock 40, the critical value was extrapolated to the surrounding higher areas, which are more characteristic of hammock elevations. Based on a critical value that corresponded to an

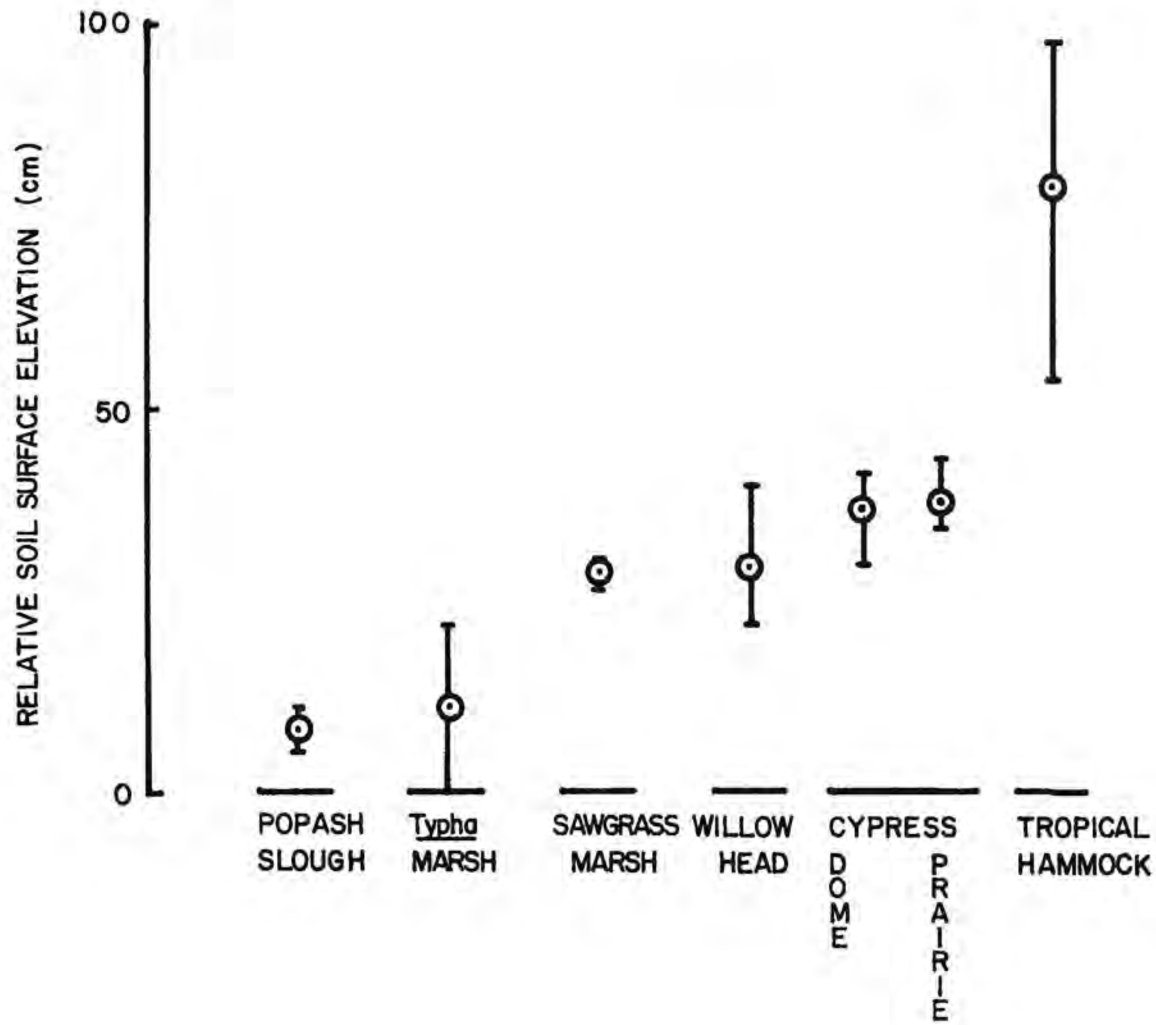

Figure 5. Mean, high and low relative soil surface elevations of plant communities along transect. Values based on lowest point on transect (in Typha marsh) equal to zero.

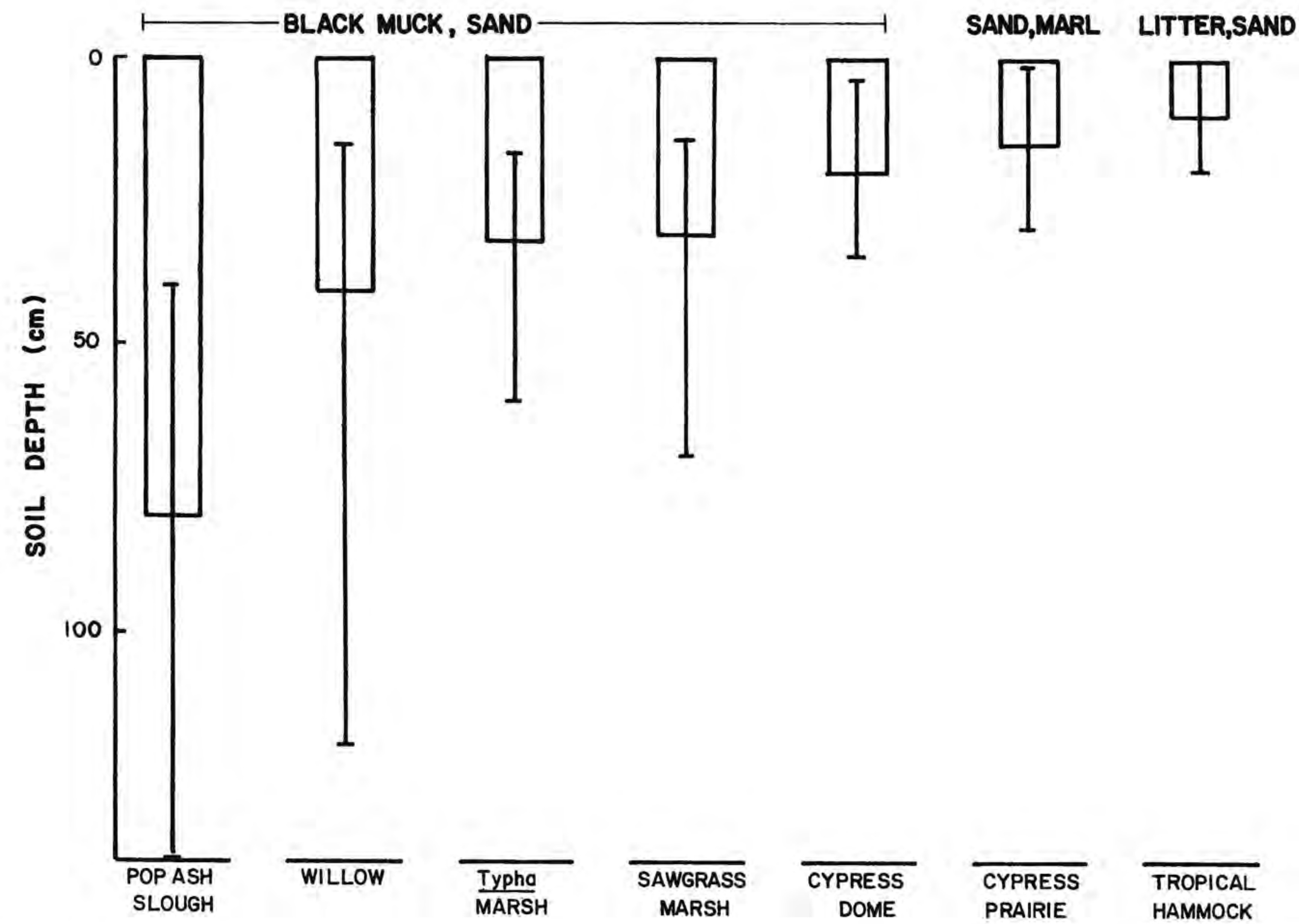

Figure 6. Soil depths and types found beneath plant associations along transect. Bars represent means, lines are ranges in depth.

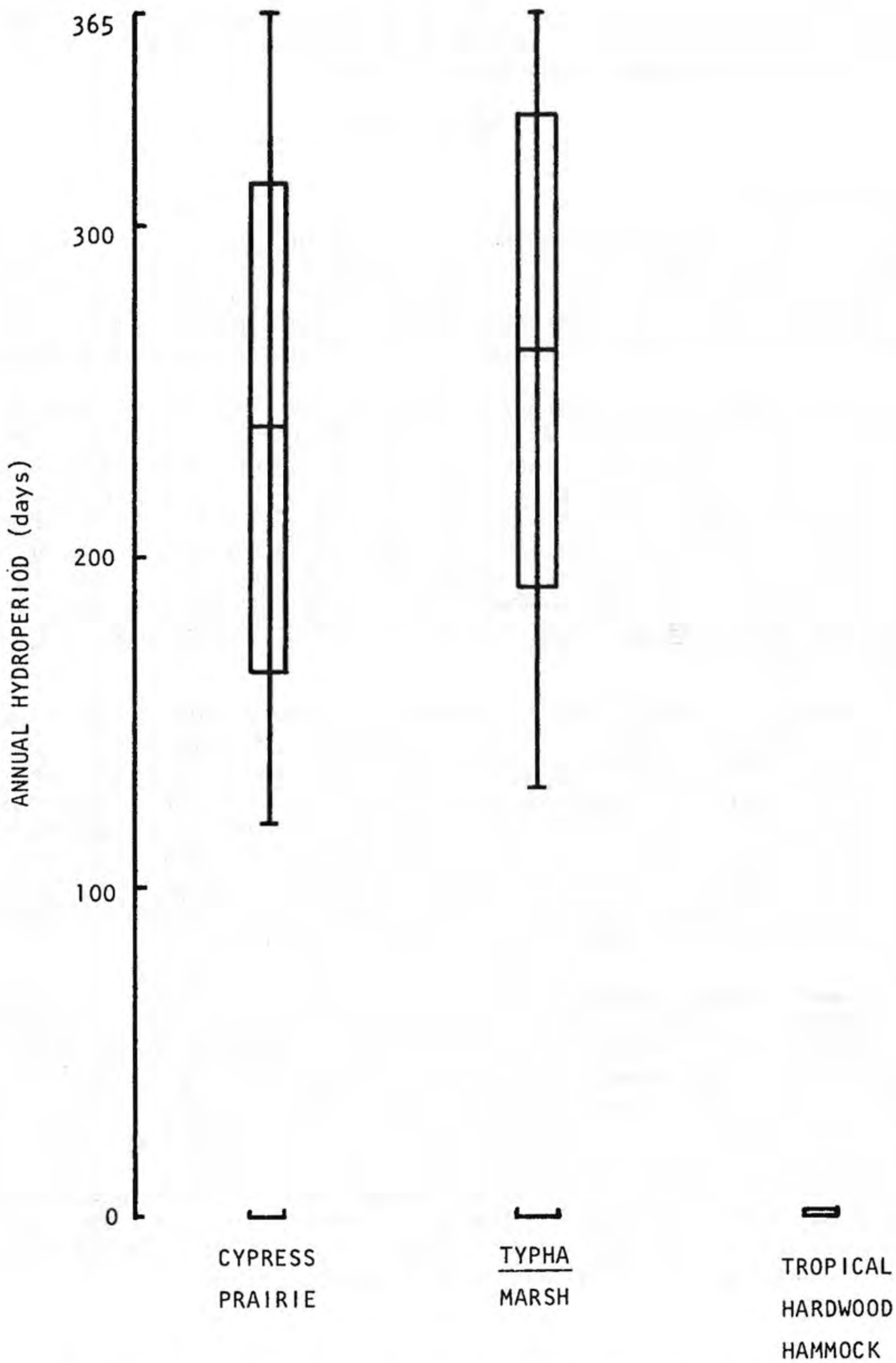

Figure 7. Calculated hydroperiods in a cypress prairie, a Typha marsh, and a tropical hardwood hammock. Values are means, plus and minus one standard deviation and range of values.

average hammock elevation, the stage at Bridge 105 exceeded the critical value only two days in 25 years. From this analysis, it seems that inundation is rare and, perhaps, even nonexistent in these hammock areas.

DISCUSSION

Cypress Forests

Cypress forests are the spatially dominant plant community in the Pinecrest area. A single species, Taxodium ascendens (pondcypress) dominates the forests. Taxodium is found in varying sizes and densities within the forests and also has different groups of associated species. Based on these criteria, two major types of cypress forests are recognized: cypress prairie and cypress domes or strands.

Cypress prairies are characterized by an open canopy of stunted (generally less than 5 m tall) pond cypress with a graminoid understory. Measured tree heights averaged 3 to 4 meters and ranged from 2 to 6 meters. Tree diameters in both inventory plots averaged 6.8 cm and ranged from 2 to 11 cm. Tree densities ranged from 1 to 5 trees/100 m^2, less than half the value of 1360 trees/ha reported by Wade et al. (1980), yet, as shown on the map, a wide range of tree density can be found in the prairie area without an appreciable change in understory composition. Important understory species in the cypress prairie are Paspalum monostachyum, Rhynchospora microcarpa, Schizachyrium rhizomatum, Rhynchospora divergens and Cladium jamaicense.

Cypress domes or strands have an overstory of larger, denser pondcypress. Tree heights in the domes range from 6 to 12 m, and densities vary from 4 to 12 trees/100 m^2 (400 to 1200 trees/ha). Understory species associations in the domes are variable. Some of the same species in the understory of the cypress prairie can be found in domes, but are usually not dominants. The major difference is the greater abundance of hardwood shrub species such as Myrica cerifera, Persea borbonia, and Salix caroliniana in domes and strands. Sabal palmetto and Ficus aurea are also common associates. Aquatic herbs, such as Bacopa caroliniana, and Ludwigia repens may also be important understory components.

Correlations among certain environmental parameters and mean tree size were made to determine which factor or factors might be responsible for the observed variations of tree size within the cypress forests. A mean tree size was obtained by dividing the total basal area by the number of stems within the benchmark inventory plots. The largest tree used in the correlations had a diameter (dbh) of 25 cm. Correlations were made with the soil depth, soil surface elevation and bedrock elevation (Figure 8). Surprisingly, poor correlation coefficients were obtained in the surface elevation comparison and in the bedrock elevation comparison. The correlation between the average tree size and soil depth, however, proved to be significant, indicating that within the pond cypress forests, soil depth may determine the potential for maximum tree size.

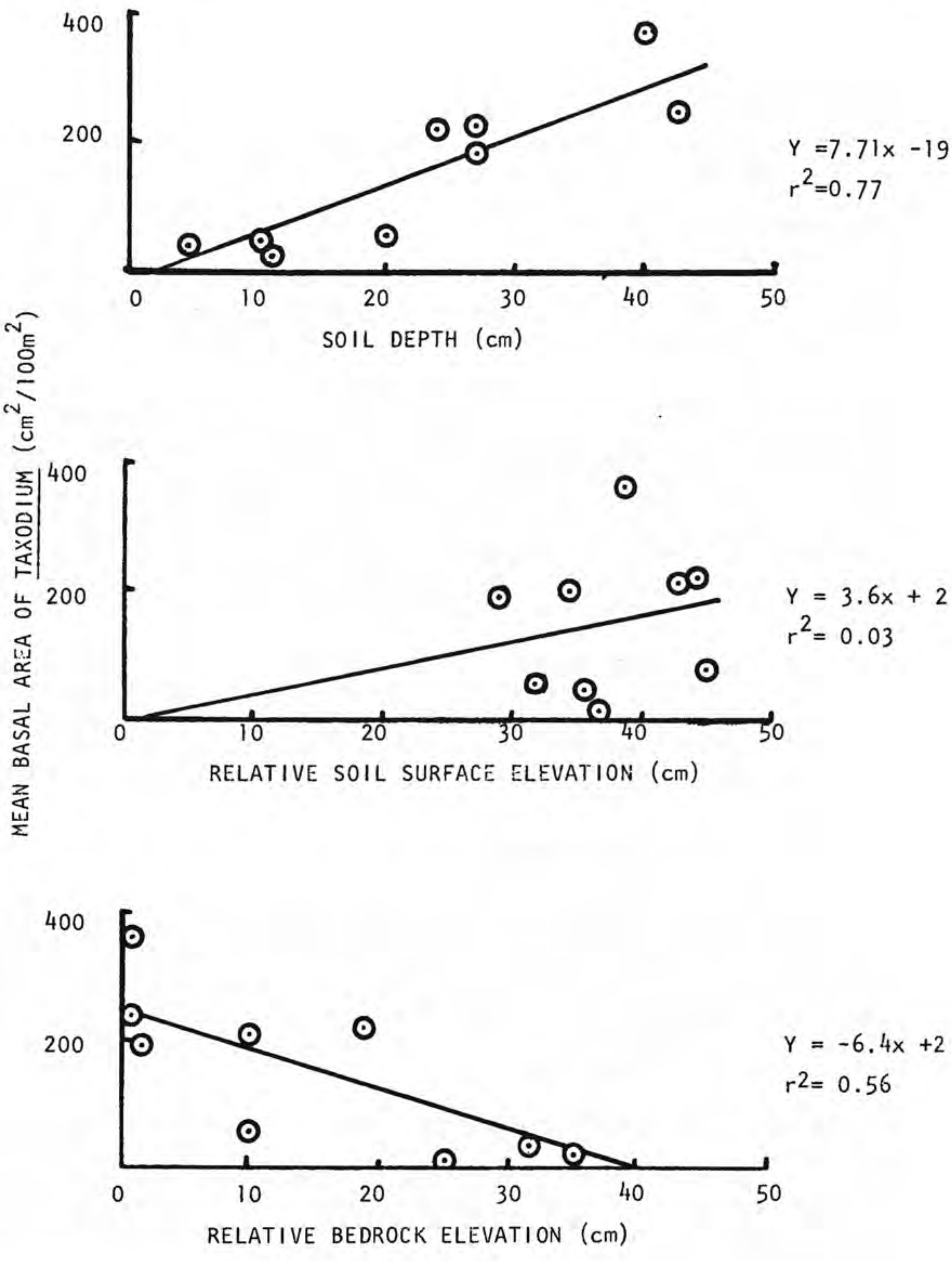

Figure 8. Correlations between average size of Taxodium and parameters of soil depth, relative surface elevation, and related bedrock elevation.

Tropical Hardwood Hammocks

Tropical hardwood hammocks, which are found on elevated limestone bedrock, have the most diverse tree species composition of any vegetation type in the Big Cypress National Preserve. This forest type seems to reach its optimal development in the preserve in the Pinecrest area, where hammocks similar to those of Long Pine Key of Everglades National Park are found. Most of the species originate from the West Indies, and approach the absolute northern limits of their ranges. The most notable exception is Quercus virginiana which is near its southern limit although this species is found in Cuba and Mexico (Little, 1971).

Lysiloma latisiliquum had by far the highest importance value in the inventory plot, due to the large basal area of several individuals. Robertson (1953) and Olmsted et al. (1980) found that Lysiloma typically becomes established following disturbance and persists in older hammocks only as mature individuals. Our data and observations are consistent with this conclusion. Bursera simaruba, Ficus aurea, and Sabal palmetto appear to have similar successional status to Lysiloma in these hammocks. In contrast, Nectandra coriacea was present in all size classes indicating active regeneration. Nectandra has a high importance value due to widespread occurrence (high frequency) and high stem density.

Areas adjacent to the hammocks are sometimes colonized by scrubby hardwoods and associated species. These associations are found on elevated bedrock, sites which once probably supported hammock vegetation. Severe fires appear to have burned these previous hammock areas, and they now support successional species. Quercus virginiana, Sabal palmetto, Myrica cerifera and Lysiloma are commonly found species.

Willow Heads and Popash Pondapple Sloughs

Willow heads are dominated by willow, Salix caroliniana, whereas the popash-pondapple sloughs are dominated by Fraxinus caroliniana and Annona glabra. The two groups are similar in that they appear to colonize deep-water cypress areas after a severe fire. The post-fire colonization by Salix has been well documented by Robertson (1953), Loveless (1959), Alexander and Crook (1973) and Gunderson (1977). The successional status of the pondapple-popash sloughs is not as well-understood, or documented.

Both the willow and popash groups were similar in overall species composition to cypress dome association, even though each was dominated by a different tree species. Aquatic herbs such as Crinum americanum, Bacopa caroliniana, Sagittaria graminea, were common to all three vegetation types, as were same species of ferns and epiphytes. Weedy shrubs such as Baccharis glomeruliflora and Ludwigia peruviana were more prevalent in the willow areas.

The environmental differences between the willow areas and pondapple-popash areas may account for the differences in species dominance. The lowest bedrock elevations, and deepest soils were found beneath the pondapple-popash slough.

Willow heads were at slightly higher soil surface elevations, and the soils were not as deep as in the sloughs. Determination of whether or not these differences are significant will require further investigation.

Sawgrass and Mixed Marshes

The marshes of the Pinecrest area fall into two categories: (1) monospecific stands of sawgrass, Cladium, or (2) mixed aquatic marshes, composed of species such as Typha spp., Pontederia lanceolata, and Sagittaria graminea.

The sawgrass marsh was found at a higher soil surface elevation than the mixed marsh, indicating that this small difference in elevation may be responsible for the dominance of a sawgrass, whereas the other aquatic species are better adapted to the lower, wetter site. The role of fire in sawgrass marshes is well documented (Wade et al., 1980) and recurring fires help to preclude tree establishment at these sites.

Observations of remnant, charred stumps and the black color of soil in the Typha marsh along the transect indicate this marsh is a post-fire cypress community. Severe fires in swamps can consume organic substrate and decrease the soil surface elevation. Indeed, the lowest soil surface elevations along the transect were beneath the Typha marsh. The ground elevations in the marsh were similar to those in the popash-pond apple area indicating that these trees or cypress might readily colonize the site. As with the sawgrass marsh, recurring fires probably curtail tree establishment in the mixed marshes and retain the herbaceous character of the marsh.

Environmental Parameters of Plant Communities

Three parameters of the plant communities were measured; hydroperiods, soil depths and soil surface elevations. Hydroperiods were calculated for only three plant associations, so comparisons among other plant types may only be made with more measurements. Also, hydroperiods appear to be nonexistent for tropical hardwood hammocks. Therefore within the spectrum of plant communities in the Pinecrest area, hydroperiod definitions may be only applicable to wetland areas. Soil depths and soil surface elevations were compared among all the plant associations, and appear to be important determinants in plant species composition.

Soil depths were correlated to differences in species compositions (Figure 9). The two most dissimilar stands were used as endpoints in the Bray-Curtis (1957) ordination. These two stands also had the greatest difference in soil depths. A correlation analysis (Sokal and Rohlf, 1969) yielded a poor correlation, when all sites were compared. The poor correlation was obtained because soil depths in the hammocks and cypress prairie were similar, even though different soil types were observed. A second correlation was done, this time omitting the hammock sites. A positive correlation coefficient was obtained when the soil depths were compared to species ordination values in only the wetland areas, indicating that soil depths may be an important factor in species composition of wetland sites.

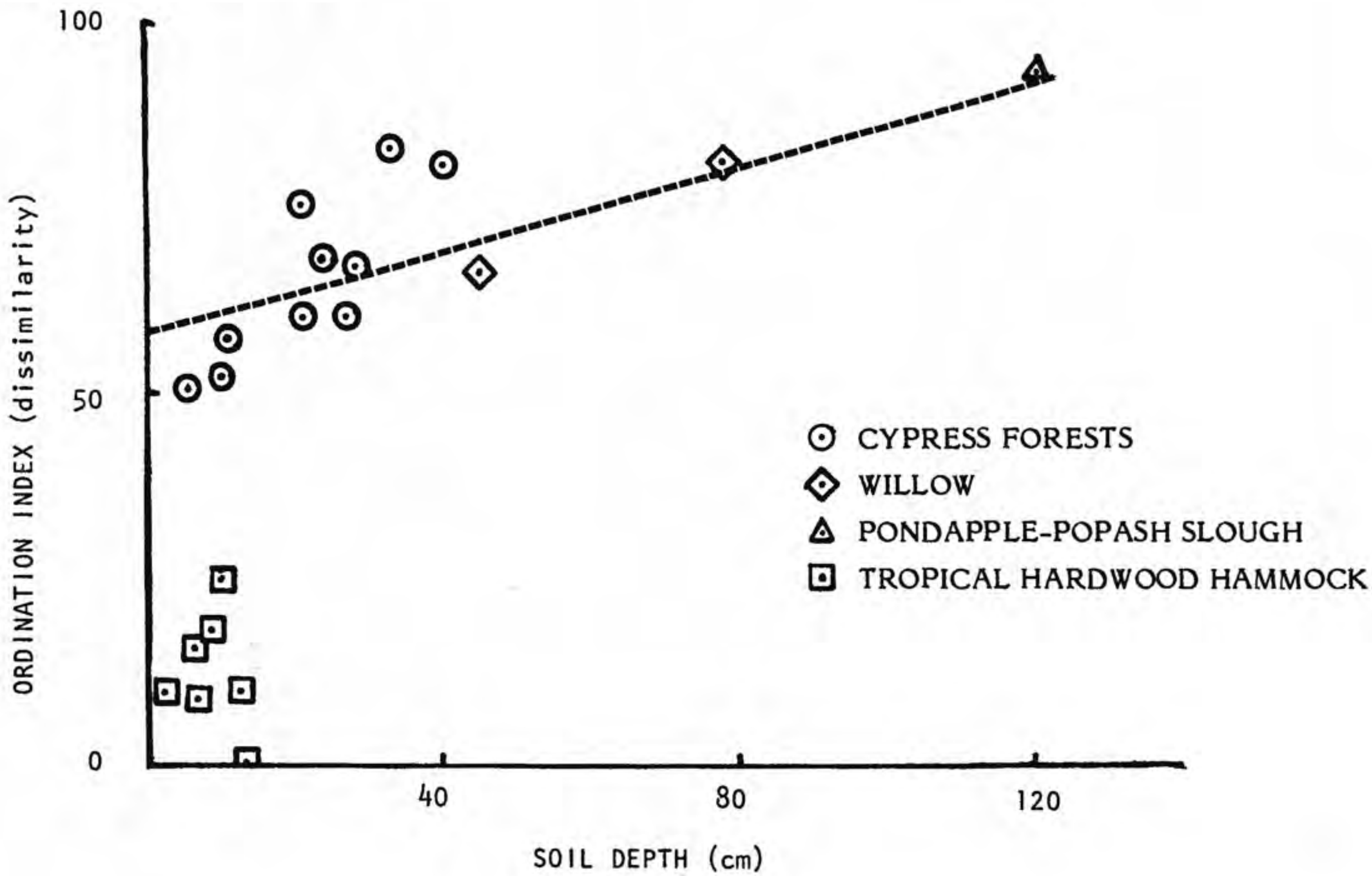

Figure 9. Correlation of species ordination index and soil depth (excluding hammock sites). Product-moment correlation coefficient = 0.54 (significant at p = 0.05).

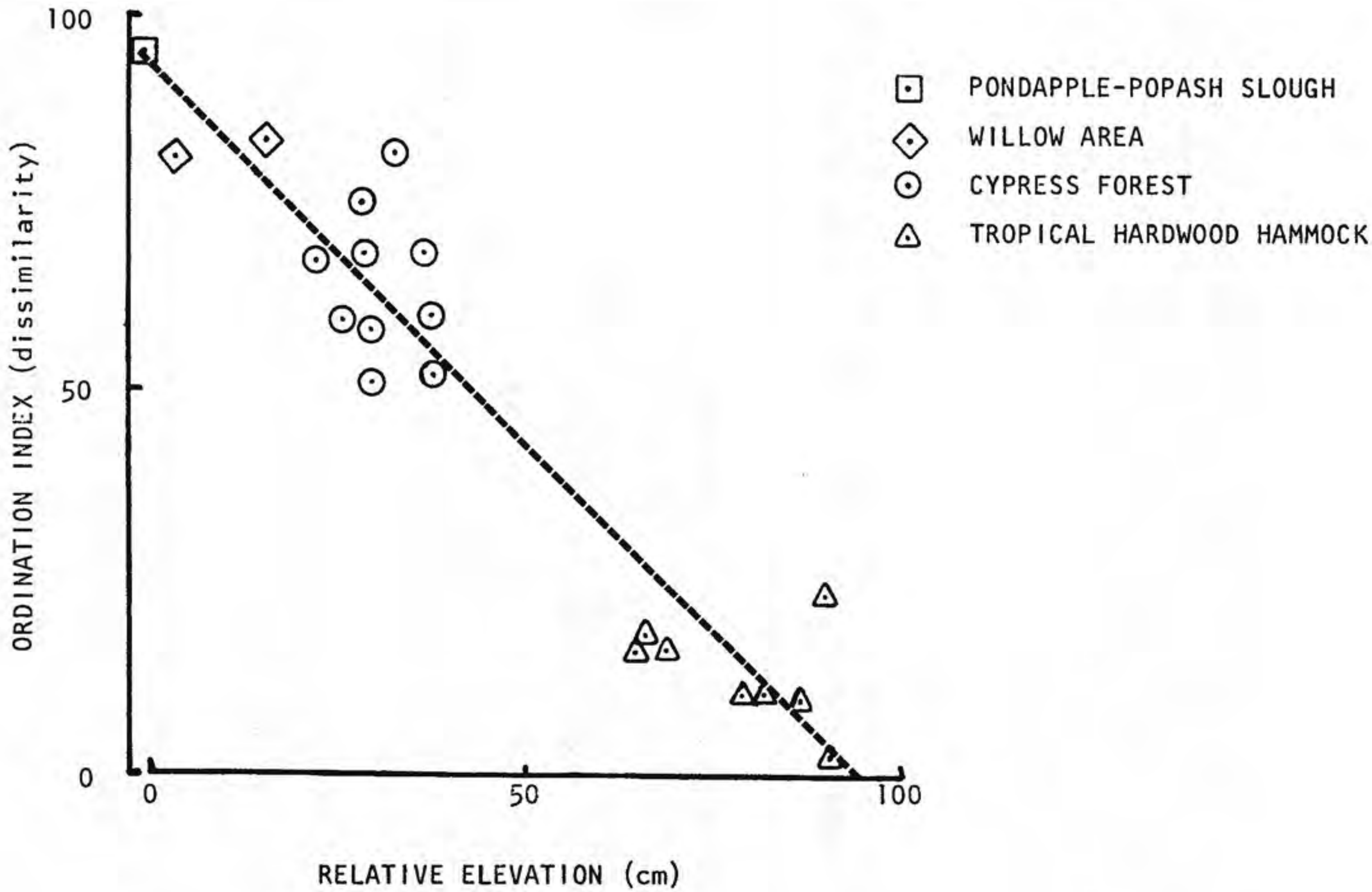

Figure 10. Correlation of species ordination index and soil surface elevation. Product-moment correlation coefficient = 0.93 (significant at p = 0.01).

Relative soil surface elevations were also compared to the species composition. The two most dissimilar stands also had the greatest difference in elevation. The ordination index of each stand (compared to the two most dissimilar stands) was plotted as a function of surface elevation (Figure 10). The correlation analysis (Sokal and Rohlf, 1969) resulted in a strong linear association between the variables. Therefore, it appears that the soil surface elevation may be a more important determinant in the plant species composition. However, the interrelated nature of soil surface elevations, soil depths and hydrologic patterns makes the identification of one single "most important" parameter very difficult.

SUMMARY AND CONCLUSIONS

1. Permanent vegetation plots in cypress prairie areas and a tropical hardwood hammock were inventoried for the first time and baseline data are presented.

2. A vegetation map was made to document current spatial vegetation patterns.

3. Ordination analysis indicates segregation exists (in terms of species composition) among plant associations designated as tropical hardwood hammocks, cypress prairie and cypress dome. Further distinctions are made among cypress dome, willow and popash sloughs based upon individual dominance of Taxodium, Salix and Fraxinus, respectively.

4. The range in soil surface elevations was 100 cm. The lowest average elevation was found in the popash slough. Increasingly, higher elevations supported a Typha marsh, willow area, cypress dome and cypress prairie. Tropical hardwood hammocks were on the highest bedrock and soil surfaces, at elevations significantly different from the other associations.

5. Soil depths were greatest (120 cm) beneath the popash slough, where a black muck and sand substrate was encountered. Shallow soils ($<$ 20 cm) were found in both the cypress prairie (a sandy marl) and the tropical hardwood hammock (a mixture of litter and sand).

6. Hydroperiods averaged 240 days/year in the cypress prairie and 260 days/year in the Typha marsh. From our analysis, hydroperiods appear to be nonexistent in tropical hardwood hammocks.

7. Positive correlations between species ordination indices and relative elevations indicates the importance of the topography in determining plant species compositions.

8. Plant species lists are presented for various tropical hardwood hammocks in the Pinecrest area.

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David and Sally Black are contributing authors in that as part of their inventory of the plant species in the Big Cypress, they generated species lists of various hammocks in the Pinecrest area.

Mr. Antonio Jurado of the U.S. Geological Survey in Miami, Florida was particularly helpful in the preparation of the vegetation map. Fred Dayhoff was consulted when numbers were assigned to the hammocks in the vegetation map. Mr. Archie Jones and Mr. Erwin Winte also made useful comments on discrepancies between the numbering of the hammocks on our map and prior maps.

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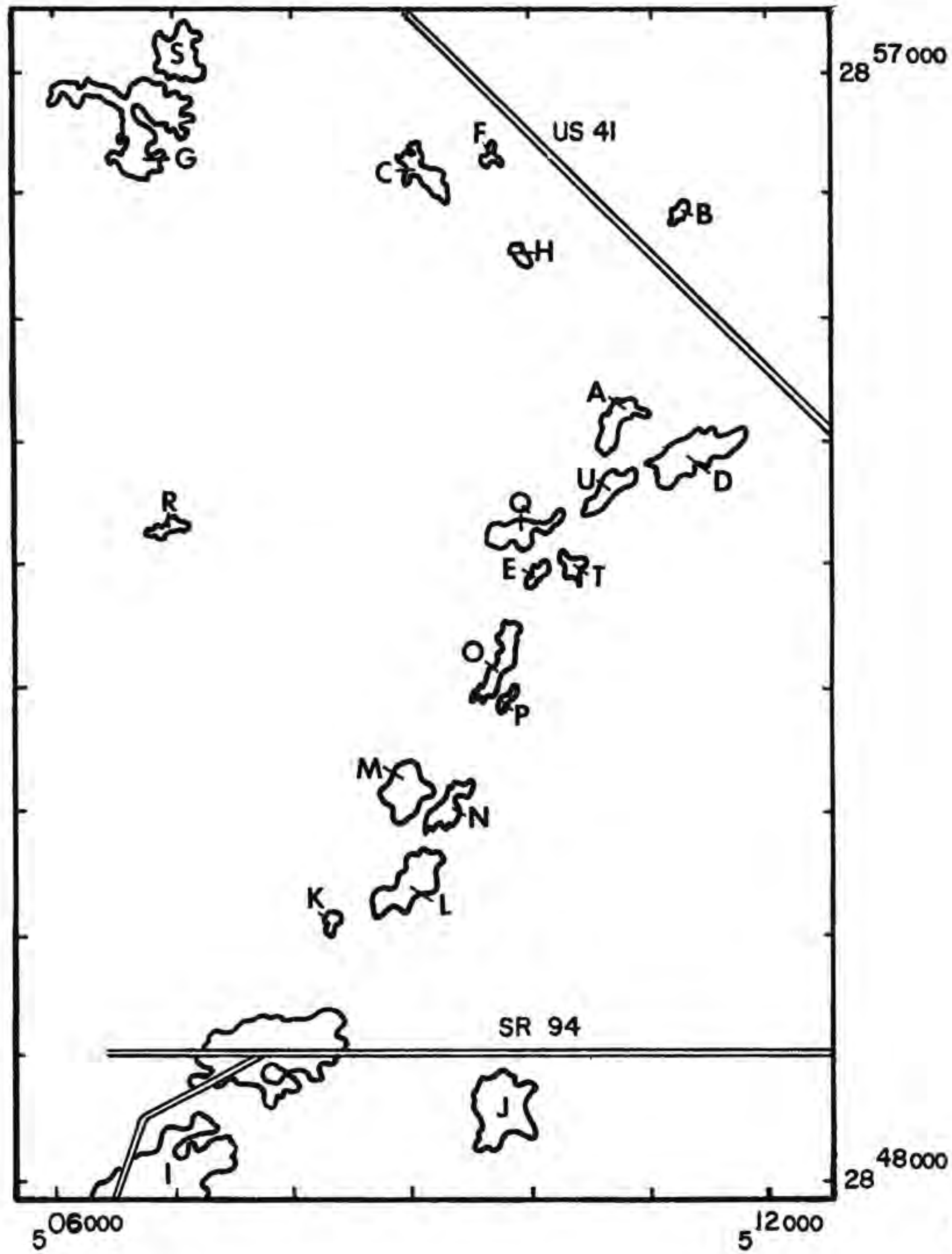
ERRATA SHEET - VEGETATION MAP

Subsequent to the printing of the vegetation map, some errors have been discovered. The mistakes are of two sorts: (1) features with the wrong color or pattern designation, and (2) discrepancies between the numbers of the hammocks on the vegetation map and the numbers assigned by experienced Liguus collectors. The authors wish to thank Mr. Archie Jones and Mr. Erwin Winte for pointing out these numbering problems. There is a region of dense cypress that should be stippled on the northeast corner of the hammock designated 90a. The enclosed, yellow-stippled area immediately to the west of hammock 40, should be colored blue and stippled, as this is a Typha marsh. The hammock designated 43, may be broken up into a number of smaller hammocks, but appeared to be linked stands of hardwoods on the aerial photographs. A small area of hammock hardwoods is located in the pine forest immediately to the west of hammock designated 34. The canal along US 41 in the northeast corner of the map is on the wrong side of the road; it should be north of the road. Below is a table with the numbers as they appear on the map and the numbers of Messers. Jones and Winte.

Number on Map	Number of Jones & Winte
34	33
67	88
72	73
66	72
90	66
90a	67

APPENDIX A. As part of an inventory of the plant species of the Big Cypress National Preserve, David and Sally Black listed species for specific hammocks in the Pinecrest Area. Nomenclature on their list follows Black and Black (1980).

The map on this page (Figure A-1) indicates the designations of the hammocks used in the following species lists. Letters were assigned to hammocks, rather than using the numbering convention on the vegetation maps, because some of the hammocks are external to the mapped area. Numbers on the figure axes are Universal Transverse Mercator (UTM) coordinates (Zone 17).



Appendix A (continued)

	HAMMOCK DESIGNATION (See Figure A-1)																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
FORBS, GRAMINOIDS & VINES																					
Acrostichum danaeifolium										X	X										X
Ampelopsis arborea	X	X	X	X	X	X	X	X			X			X	X		X	X		X	X
Berchemia scandens	X						X		X				X								
Blechnum serrulatum			X		X	X				X		X	X	X	X		X	X			X
Cardiospermum corindum				X			X						X		X					X	
Cissus sicyoides	X		X		X				X			X			X		X	X		X	
Croton humilis	X	X					X			X											
Cynanchum scoparium	X			X	X		X	X	X		X	X			X		X				X
Dicliptera assurgens				X			X				X										
Eclipta alba				X																	
Epidendrum difforme																					
Encyclia tampensis	X		X			X	X			X	X	X		X	X	X			X		X
Gouania lupuloide	X			X	X										X					X	
Habenaria quinqueseta										X											
Hydrocotyle sp.	X										X										
Lasiacis divaricata				X	X		X		X	X	X	X	X		X		X	X	X		X
Melothria pendula	X				X					X						X	X			X	
Microgramma heterophylla	X		X	X	X		X		X	X		X	X	X	X		X		X	X	X
Mikania cordifolia			X	X										X	X						X
Nephrolepis exaltata	X				X		X	X	X	X	X		X	X	X	X	X	X	X	X	
Ocimum micranthum							X														
Oplismenus hirtellus											X										
Panicum ciliatum	X			X			X			X	X			X	X		X	X		X	
Parthenocissus quinquefolia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	·X	X	X
Paspalum caespitosum							X														
P. urvillei																					
Passiflora pallens											X										
P. suberosa	X	X	X	X			X		X		X	X	X			X	X				X
Pisonia aculeata	X	X		X	X					X			X	X	X	X				X	X
Polypodium aureum				X		X							X	X	X						X
P. phyllitidis	X		X	X	X		X			X		X	X	X	X	X	X		X	X	X
P. polypodioides	X		X	X	X		X				X	X	X	X	X	X	X		X		X
Psilotum nudum														X				X			
Pteridum aquilinum	X		X	X		X	X		X	X	X		X	X	X		X	X			X
Pteris vittata			X							X	X										
P. longifolia									X		X										
Rhynchosia minima	X																				
Scleria verticillata		X		X																	
Smilax auriculata		X	X																	X	
S. bona-nox	X		X		X		X			X				X	X	X	X	X		X	
S. laurifolia										X											
Thelypteris kunthii	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix A (continued)

	HAMMOCK DESIGNATION (See Figure A-1)																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
T. ovata									X												
Tillandsia balbisiana	X	X		X		X	X						X								X
T. circinnata			X		X												X				
T. fasciculata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T. flexuosa			X																		
T. recurvata	X							X													
T. setacea	X	X	X	X	X		X				X		X	X	X		X	X	X	X	X
T. usneoides	X	X	X	X		X												X			X
T. utriculata	X		X		X		X			X	X		X				X				
T. valenzuelana	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X
Tournefortia hirsutissima		X		X	X						X				X					X	
T. volubilis				X																	
Toxicodendron radicans	X		X	X	X	X	X		X	X	X	X	X		X	X	X	X	X		X
Trichostigma octandrum			X																		
Vitis aestivalis	X	X	X	X	X	X	X		X	X	X	X	X		X		X	X			X
V. munsoniana	X		X		X	X			X						X		X	X		X	
Vittaria lineata	X			X			X		X	X	X			X	X						X

TREES AND SHRUBS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Acer rubrum							X														
Amyris elemifera		X		X																	
Annona glabra	X						X	X		X		X		X						X	
Ardisia escallonioides	X	X		X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X
Bumelia reclinata	X						X				X							X			
B. salicifolia	X	X	X	X	X	X	X	X	X		X		X	X	X	X			X	X	X
Bursera simaruba	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Callicarpa americana			X	X	X		X								X	X	X	X			X
Cassia ligustrina	X	X							X	X	X										
Celtis laevigata	X	X		X	X							X		X	X	X	X			X	X
Chiococca alba	X	X	X		X		X			X	X	X	X		X	X				X	
Chrysobalanus icaco								X		X		X		X	X					X	
Chrysophyllum oliviforme	X	X	X	X	X		X	X		X		X	X	X	X	X	X			X	X
Citrus sp.		X																			
Citharexylum fruticosum		X	X				X		X												
Coccoloba diversifolia	X	X	X	X	X		X	X		X	X	X	X	X	X		X		X	X	X
Colubrina arborescens	X	X	X					X													
Cordia globosa							X														
Cornus foemina							X												X		
Diospyros virginiana	X		X	X		X			X	X	X		X		X		X	X		X	
Drypetes lateriflora					X			X												X	
Erythrina herbacea	X	X			X	X					X					X	X	X			
Eugenia axillaris	X	X		X	X		X		X	X	X	X	X		X	X	X	X	X	X	X
Exothea paniculata	X				X			X	X	X		X			X	X	X				

Appendix A (continued)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
	HAMMOCK DESIGNATION (See Figure A-1)																				
Ficus aurea	X			X	X		X			X			X	X		X	X		X	X	X
F. citrifolia			X				X				X							X			
Hamelia patens				X	X		X		X					X	X	X	X			X	X
Ilex cassine	X						X		X	X	X	X	X	X				X	X		
Krugiodendron ferreum	X		X	X	X		X			X		X	X		X	X				X	X
Lysiloma latisiliquum	X			X	X		X		X	X	X	X	X	X	X	X	X		X	X	X
Magnolia virginiana										X										X	
Mastichodendron foetidissimum	X				X		X	X		X		X	X	X	X	X				X	
Melaleuca quinquenervia			X			X															
Metopium toxiferum	X					X				X	X	X									
Myrcianthes fragrans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Myrsine floridana	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Nectandra coriacea	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Persea borbonia	X	X	X		X				X	X	X		X		X	X	X	X			
Psychotria nervosa	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
P. sulzneri	X			X	X				X	X			X	X	X	X	X	X	X	X	X
Quercus laurifolia	X		X				X		X			X		X	X	X	X				
Quercus virginiana	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Randia aculeata	X	X				X			X	X	X		X		X		X	X			
Rivina humilis	X			X	X		X			X		X	X	X	X	X	X			X	
Sabal palmetto	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X
Schoepfia chrysophylloides	X		X	X	X	X	X							X	X		X	X			X
Serenoa repens	X		X				X			X								X	X		
Schinus terebinthifolius																					
Simarouba glauca	X			X	X		X	X	X	X			X	X	X	X	X			X	X
Solanum erianthum							X			X											
Trema micranthum							X			X								X			
Viburnum obovatum	X		X		X		X								X		X		X		
Ximenia americana	X		X		X				X		X	X					X				
Zanthoxylum fagara	X	X		X	X		X		X	X	X	X	X	X	X	X	X			X	X
WEEDY HAMMOCK EDGES																					
Abutilon permolle																				X	
Ambrosia artemisiifolia			X				X														
Andropogon sp.	X										X						X			X	
Asclepias incarnata	X																				X
Aster caroliniensis									X			X									
Baccharis glomeruliflora		X	X	X		X	X				X		X		X	X		X	X	X	
Boehmeria cylindrica																					
Canna flaccida	X		X	X	X		X				X	X	X		X	X	X			X	X
Capraria biflora		X																			
Carica papaya																					X
Cephalanthus occidentalis			X							X		X		X				X			
Chamaesyce hyssopifolia									X												

Appendix A (continued)

	HAMMOCK DESIGNATION (See Figure A-1)																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Corchorus hirtus									X												
Crinum americanum																			X		
Dichondra caroliniensis															X						
Echinochloa crusgalli																					X
Eupatorium capillifolium							X											X			
E. coelestinum	X																				
E. leptophyllum																		X			
E. serotinum			X		X					X	X			X	X		X	X		X	
Flaveria linearis															X						
Galactia sp.							X		X												
Gomphrena decumbens				X																	X
Hibiscus pilosus	X	X									X										
Hydrolea corymbosum											X										
Hypericum brachyphyllum						X											X	X	X		
Hyptis alata											X										
Ipomoea indica										X											
Jacquemontia pentantha				X																	
Kosteletzkya virginica							X				X				X	X					
Lythrum sp.		X									X						X				
Lantana camara									X												
Leptochloa fascicularis															X						X
Ludwigia octovalvis																					X
L. peruviana	X				X						X				X	X					X
Myrica cerifera			X		X			X	X	X	X	X	X		X	X	X	X	X		
Nicotiana sp.				X																	
Peltandra virginica														X			X	X		X	
Phlox drummondii						X	X														
Pluchea odorata							X														
P. symphytifolia							X														
Polygala baldwinii											X										
Psidum guajava	X																				
Rhus copallina			X										X								
Rhynchospora caduca											X				X	X	X	X		X	X
R. miliacea																		X			
Salix caroliniana	X									X					X	X				X	
Sambucus simpsonii																		X			
Sarcostemma clausum											X										
Saururus cernuus							X							X	X	X		X		X	
Setaria geniculata												X									
Sida rhombifolia									X												
Solanum erianthum										X											
Spartina sp.	X														X	X					X

Appendix A (continued)

HAMMOCK DESIGNATION (See Figure A-1)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Spilanthes americanus	X														X						X
Tephrosia sp.							X			X					X	X		X			
Teucrium canadense											X										X
Thelypteris palustris					X					X					X		X	X			
Tripsacum dactyloides											X					X					
Verbena scabra							X														
Verbesina laciniata							X														
Vigna luteola															X						X