SOUTH FLORIDA RESEARCH CENTER

Report T-666
An Inventory of the Plant Communities within the Deep Lake Strand Area, BICY

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INTRODUCTION

The Deep Lake Strand area is one of five sites selected for intensive study within the Big Cypress National Preserve. The study sites are used to inventory the vegetation of the preserve. The Deep Lake Strand site is located along the western border of the preserve and covers a rectangular 5 x 10 km (50 km^2) area. The principal vegetation types found in this region are large strands of cypress, cutover-pine forests, and vast expanses of prairie vegetation.

Deep Lake Strand is named for the nearby Deep Lake (located just outside the preserve). The lake is small, circular (100 m diameter) and relatively deep (30 m) (Hutchinson, 1957) at least by south Florida standards. The extensive cypress strand surrounds the lake.

Previous work

Previous workers have described the plant communities of areas that have included this study site. Harshberger (1914) and Harper (1927) both listed the major species found in cypress strands in the Big Cypress Swamp area. Davis (1943) explored the relationships between plant species composition and soils in the swamp area, and mapped the major plant associations at a small scale. Leighty et al. (1954), correlated plant species with the various soil types found in Collier County. McPherson (1973) mapped portions of the Big Cypress Swamp and portrayed a mosaic of cypress forest, mixed swamp forest, prairie and pine forest in the currently outlined study area. Craighead (1971) made detailed observations on the flora of the Big Cypress region, as well as relating the plant associations to geologic, hydrologic, and edaphic features. Craighead also examined the role of natural perturbations such as hurricanes, fires, frosts and animals in maintaining the various plant associations. Duever et al. (1978) working at Corkscrew Swamp, 50 km to the north, were the first to quantify the hydrologic patterns in the swamp forests of south Florida.

Objectives

This inventory of plant communities in the Deep Lake Strand study area was designed to meet three objectives. The first was to quantitatively describe the major associations. To meet this objective, a quantitative analysis of relocatable plots has been used to determine species composition and current relative importance rankings of species. This information will be used as baseline data for comparison with information from future remonitoring of the plots. We expect that the resolution of the data from these methods will suffice to detect significant changes resulting from lowering of water tables or other causes.

The second objective was to map the current spatial distribution of the plant communities. McPherson mapped the area as recently as 1973, but his map is at a scale too small to identify minor features. A larger scale was needed to document the current pattern, so that a future evaluation of the area could use this map in determining association boundary shifts or major changes in species composition within specific areas as small as 100 m^2.

The third objective was to establish correlations among the plant communities and their associated elevations, soils and hydrologic patterns. Because of the continual threat of increasing water manipulation in south Florida, thorough understanding of these relationships is essential for serious efforts at maintaining wetland plant associations. The soil surface topography and soil types combine with the annual rainfall pattern of wet summers and dry winters to produce characteristic hydroperiods in each plant community. Knowledge of hydrologic patterns is important in predicting successional changes that may occur as a result of internal processes, as well as the impacts of recurring natural perturbations, especially fire.

METHODS

Vegetation Inventory

The vegetation in a cypress-mixed hardwood swamp, an oak hammock and a *Muhlenbergia* prairie was quantitatively inventoried. Only one plot was sampled in the former two types, and two plots were sampled in the prairie. The locations of the plots are shown on the vegetation map (enclosed in back cover of the report).

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

Trees

The diameters (dbh) of tree-size stems which were rooted within a 15 x 40 m rectangular plot (Figure 1) were measured to the nearest 0.13 cm (0.05 in). Tree plots were oriented along cardinal bearings, either north to south or east to west, and placed in homogeneous vegetation types. 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. 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 5 x 5 m subplots (Figure 1) was recorded and frequency of occurrence determined for each species. Relative frequency was calculated based on the summation of the frequencies of all species.

Neither tree heights nor canopy cover were measured. Since *Sabal palmetto* trees with remnant leaf bases (boots) were difficult to measure using a diameter tape, the diameters were measured using a meter stick held at breast height. Relative dominance, relative density, and relative frequency are summed for each species to yield an importance value index.

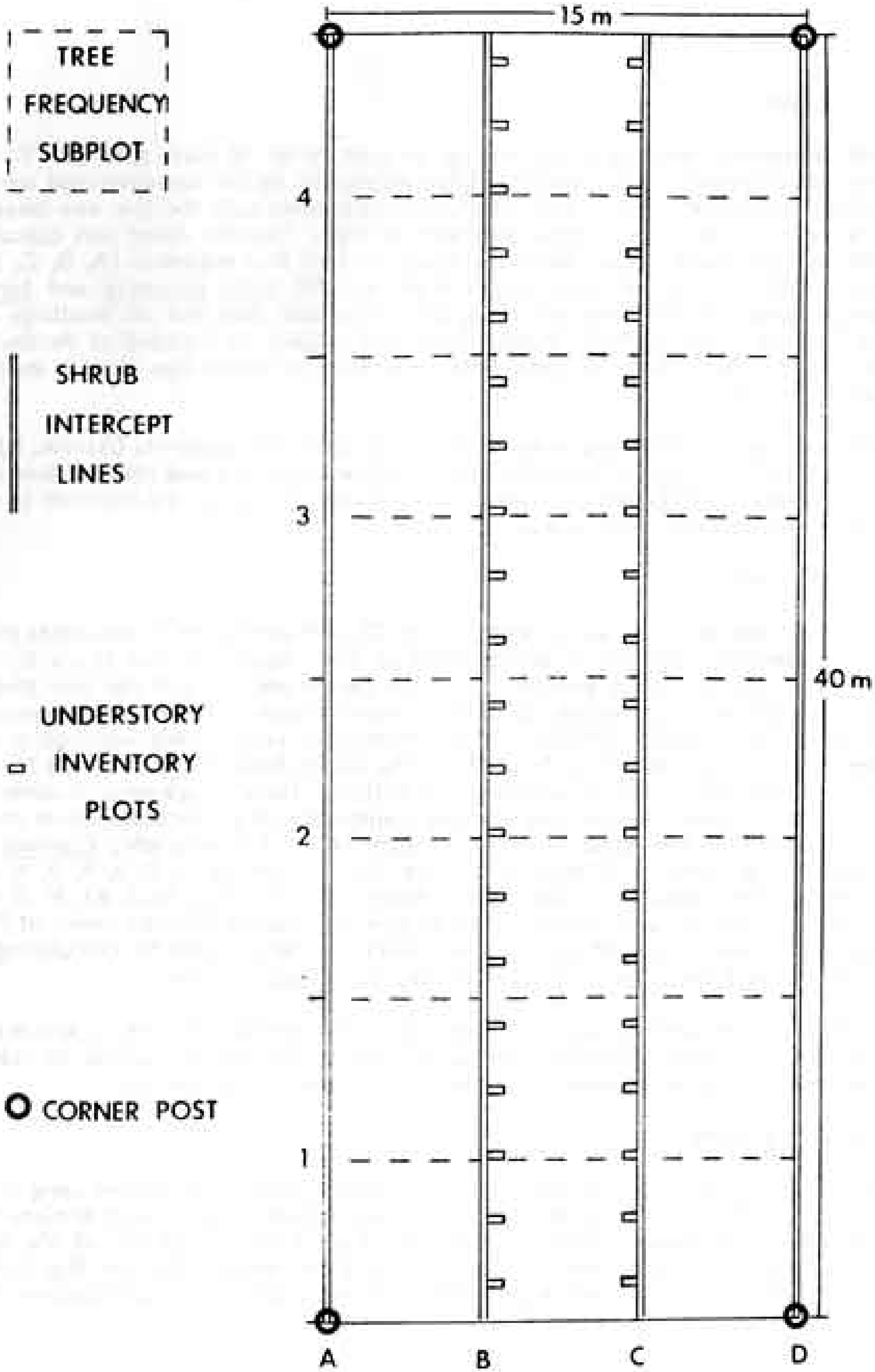

Figure 1. Schematic diagram of vegetation inventory plots.

Shrubs

Shrub dominance was expressed as the percent cover of each species. Percent cover was determined along four 40 m line segements by the line-intercept method. The intersection of the live leaf cover of each species with the line was measured to the nearest cm 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 1) divided by the total length (160 m). All Sabal palmetto and Serenoa repens individuals that were not trees (no measurable dbh) and not seedlings were measured using this method. Woody vines were usually inventoried as shrubs. 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 line segments (A1-A4, B1-B4, C1-C4, D1-D4; in Figure 1) and used to calculate frequency and relative frequency of each species. Relative dominance and relative frequency are summed to yield the shrub importance value index.

Understory

Understory species were listed within forty 20 x 50 cm (0.1 m^2) mini-plots placed at 2 m intervals along the 2 center lines of the vegetation plot (lines B, C in Figure 1). The mini-plots were placed in the center one-third of the tree plot and always placed on the same side of the 2 m 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) 6-25%, (3) 26-50%, (4) 51-75%, (5) 76-95%, and (6) 96-100% 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 6 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 plots. Relative frequency was calculated and added to relative dominance to yield an importance value for each understory species.

Plant Identification

Identification references included Long and Lakela (1971), Lakela and Long (1976), Hitchcock (1950), and Ricketts (1967). Species not previously found in plots were collected and compared with specimens on file at the herbarium of the South Florida Research Center and checked with a plant species list for Big Cypress National 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 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 transferred to a skeleton map using a Map-O-Graph opaque projector. The features on the skeleton map were used as control points to transfer the delineations from the color photographs to the skeleton map. The rough draft was field checked on the ground and by helicopter during February, 1981. The map was then drafted, colored 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, to a scale of approximately 1:17,000.

Species Composition and Environmental Variables

In order to correlate species composition with environmental variables, a line transect was established through prairie, swamp forest, and hammock areas (see vegetation map).

Fifty-four benchmarks were established as measurement points at approximately 23 m (75 ft) intervals along the 1240 m transect. The benchmarks were set by driving a 0.95 cm (3/8 in) diameter steel rod into the bedrock. The benchmarks were numbered; one was assigned to the easternmost benchmark, and the numbers increased to the west.

Soil surface elevations, soil depth, and soil type were measured at each benchmark. The elevation of the top of the benchmark was surveyed from nearby known elevations. The soil surface elevation 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 the benchmark. When a ringing sound indicated that bedrock had been reached, the depth was measured. The three measurements were averaged to yield a mean soil depth. A cut-away soil tube was used to assess each soil type. Major classes of soils were sands, marls, muck, and litter.

A list was made of all plant species within a 100 m^2 circular plot, which was centered on certain benchmarks. The plots were set up on benchmarks where a representative sample of a community could be taken. Ecotonal benchmarks were not inventoried.

Shallow wells were placed in the <u>Muhlenbergia</u> prairie, cypress-mixed hardwood swamp, and oak hammock (at benchmarks number 1, 26, 32 along the transect). The water levels in the wells were measured to the nearest 0.5 cm. Levels in each well were measured bimonthly between October, 1980 and July, 1981. This period reflects essentially the period of highest and lowest water levels throughout an annual cycle. Water levels were monitored on the same day as the test wells at the permanent U.S. Geological Survey Station designated C-495. This well is at the intersection of Wagon Wheel and Birdon Roads. All of these hydrologic stations are also shown on the vegetation map.

RESULTS

Vegetation Inventory

Cypress-Mixed Swamp Forest

The swamp forest is characterized by an emergent overstory of baldcypress, Taxodium distichum. Heights of the nine cypress trees included in the plot ranged from 4 to 22 m and fell into two groups--2 to 6 m and 18 to 22 m (Figure 2). Diameters (dbh) of the trees ranged from 5 cm to 50 cm. The largest tree measured is not large for a baldcypress as Fowells (1971) and Duever (1978) report trees up to 30-35 m tall and 4 m in diameter.

Although cypress trees had nearly half the total basal area in the plot because of their large diameters, cypress had only the third highest importance value due to low density and frequency (Table 1).

The species with the highest importance value in the plot was Fraxinus caroliniana (popash), due to the large number (138) of tree-sized stems. All of the stems were less than 15 cm in diameter, and most were between 5 and 10 cm (Figure 3). Fraxinus did not grow as individual trees, but with multiple stems from a common base. The reported stem density then should not be construed to represent individual trees. The average height of the popash stems was slightly less than 10 m, with a normal distribution about the mean (Figure 3), and a range from 4 to 18 m.

Annona glabra (pondapple), has a similar multistemmed morphology, but had fewer stems than Fraxinus. Heights and diameters of Annona were similar to Fraxinus.

Sabal palmetto and Ficus aurea were the other subcanopy trees with substantial importance (Table 1). Only single individuals were found of Myrica cerifera (wax myrtle), and Persea borbonia (swamp bay).

Fraxinus also dominated in the shrub inventory plot (Table 2), but the measured cover was low (3.2%) and popash occurred in only 50% of the subplots. The cover and frequencies of all species were low, resulting in high relative values for popash (Table 2). Ficus, Annona, and Myrsine were encountered as scattered individuals, and only one interception of Sabal palmetto was recorded (Table 2).

Epiphytic ferns were the important understory species in the swamp forest (Table 3). Polypodium phyllitidis (strap fern), was locally very abundant, as was Nephrolepis exaltata. The portions of the downed cypress trees above the high-water line were almost completely covered by these ferns so that these species had high cover values in the understory plots that fell on these logs. However, the sample-lines intersected only portions of these downed logs, and no species were found in many of the mini-plots. Therefore, all species had low average cover value.

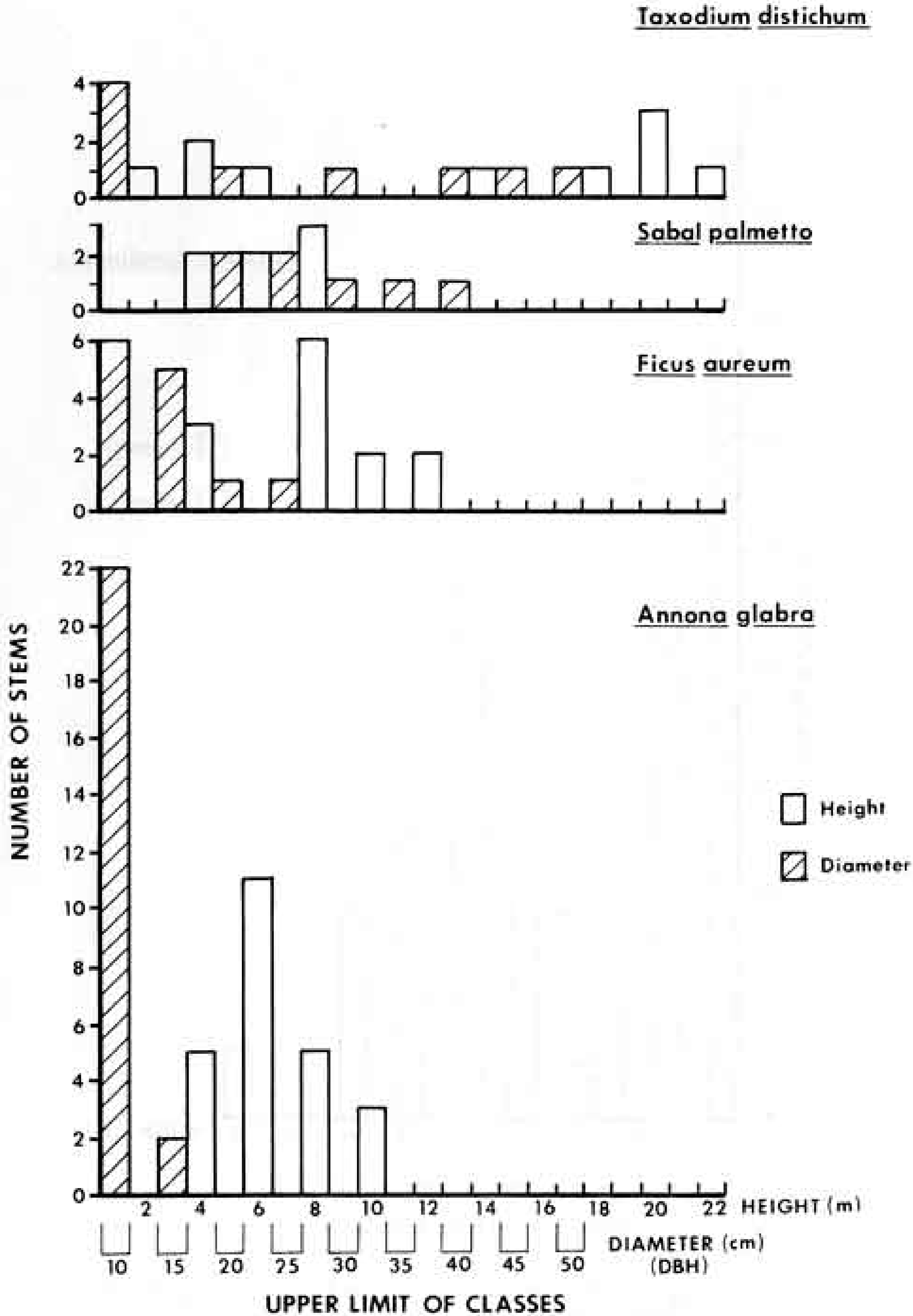

Figure 2. Stem height and diameter distributions of four tree species in cypress-mixed hardwood swamp plot.

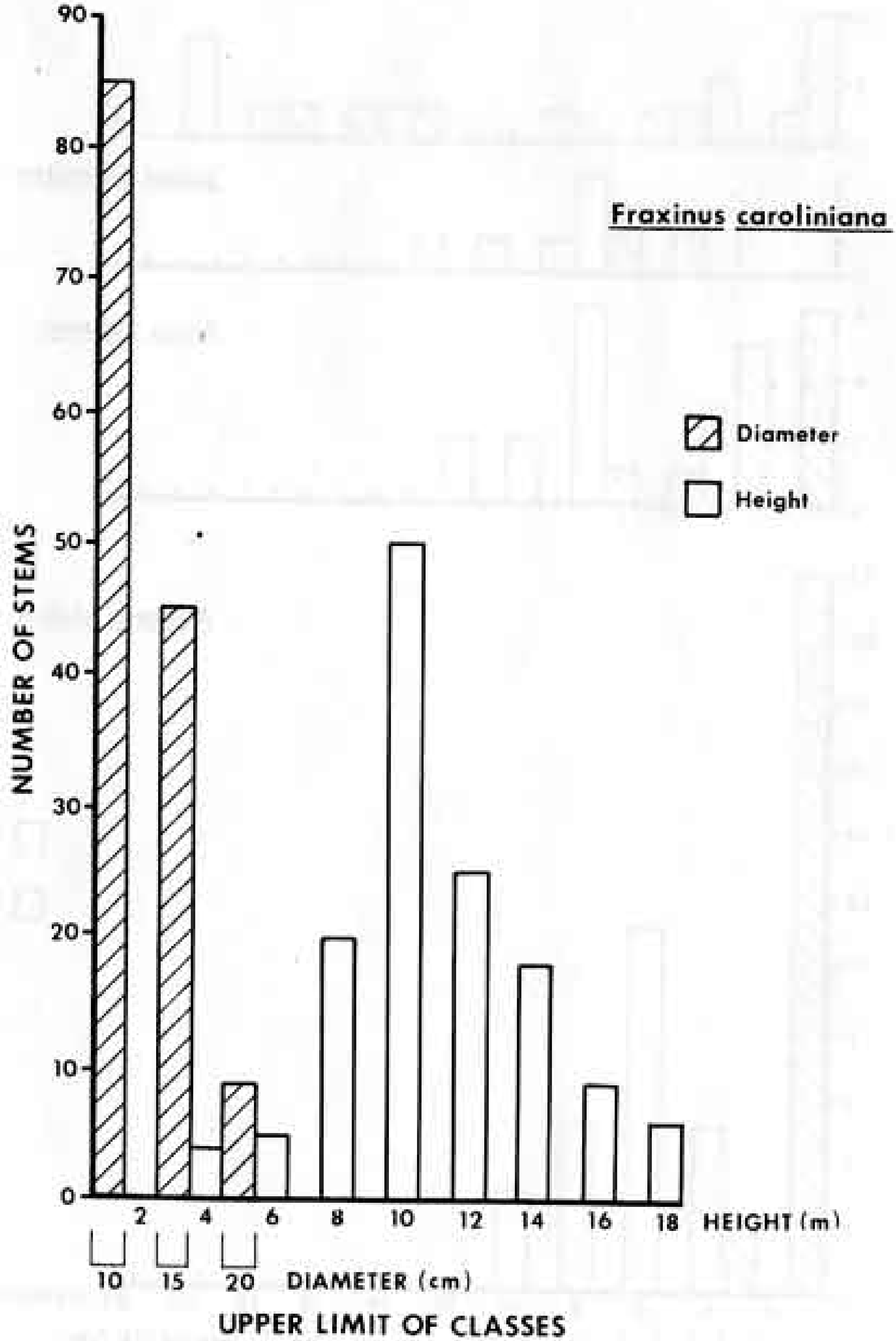

Figure 3. Stem height and diameter distribution of Fraxinus caroliniana in cypress-mixed hardwood swamp plot.

Table 1. Statistics for tree species in cypress-mixed hardwood swamp inventory plot.

Trees	Total Basal Area ($cm^2/600\ m^2$)	Density ($no/600\ m^2$)	Frequency	Relative Dominance	Relative Density	Relative Frequency	Importance Value
Fraxinus caroliniana	12194.9	138	83.3	48.2	71.5	40.8	160.5
Annona glabra	991.9	24	41.7	3.9	12.4	20.4	36.7
Taxodium distichum	5323.4	9	20.8	21.1	4.7	10.2	36.0
Sabal palmetto	5390.2	7	20.8	21.3	3.6	10.2	35.1
Ficus aurea	1295.9	13	29.2	5.1	6.7	14.3	26.1
Myrica cerifera	50.3	1	4.2	0.2	0.5	2.1	2.8
Persea borbonia	28.7	1	4.2	0.1	0.5	2.1	2.7

Table 2. Statistics for shrub species in cypress-mixed hardwood swamp inventory plot.

Shrub Species	Percent Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Fraxinus caroliniana	3.2	50.0	51.6	61.4	113.0
Sabal palmetto	1.6	6.3	25.8	7.7	33.5
Ficus aurea	0.8	6.3	12.9	7.7	20.6
Annona glabra	0.3	12.5	4.8	15.4	20.2
Myrsine floridana	0.3	6.3	4.8	7.7	12.5

Table 3. Cover and frequency values for understory species in cypress-mixed hardwood swamp inventory plot.

Shrub Species	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Polypodium phyllitidis	7.31	17.5	54.7	21.9	76.6
Nephrolepis exaltata	1.43	10.0	10.7	12.5	23.2
Pontederia cordata	1.88	5.0	14.1	6.3	20.4
Fraxinus caroliniana	0.31	12.5	2.3	15.6	17.9
Boehmeria cylindrica	0.81	7.5	6.1	9.4	15.5
Sabal palmetto	0.12	5.0	0.9	6.3	7.2
Utricularia foliosa	0.12	5.0	0.9	6.3	7.2
Polypodium aureum	0.38	2.5	2.8	3.1	5.9
Polypodium polypodioides	0.38	2.5	2.8	3.1	5.9
Psychotria nervosa	0.38	2.5	2.8	3.1	5.9
Ludwigia repens	0.06	2.5	0.4	3.1	3.5
Annona glabra	0.06	2.5	0.4	3.1	3.5
Bacopa caroliniana	0.06	2.5	0.4	3.1	3.5
Toxicodendron radicans	0.06	2.5	0.4	3.1	3.5

Other groups were sampled in the understory mini-plots. Aquatic herbs such as Pontederia, Utricularia, Ludwigia and Bacopa were found in the lower and wetter areas. Seedlings of Fraxinus, Annona, and Sabal were also found throughout the plot, indicating that regeneration of these subcanopy species may be occurring.

Oak-Sabal Hammock

Laurel oak, Quercus laurifolia, was by far the dominant tree species in the hammock plot. With heights up to 18 m and diameters up to 65 cm (Figure 4), oak was the single overstory species and formed a fairly closed canopy. Individuals of oak were found throughout the height and diameter ranges, indicating that oak is actively regenerating.

Sabal palmetto (cabbage palm) was found only to subcanopy heights (Figure 4). The characteristic large trunks of these tall Sabals resulted in large basal area values (Table 4). However, low density and frequency values resulted in an importance value lower than Myrcianthes fragrans (naked wood). Myrcianthes was the second most important species due to its density and widespread occurrence. All of the diameters of naked wood were less than 15 cm, and heights were less than 12 m (Figure 4).

Assorted hardwoods such as Ilex cassine (dahoon holly) and Ficus aurea (strangler fig) were also in the inventory plot, but only occurred as one or two scattered individuals. Two vines, Vitis munsoniana and Berchemia scandens, had tree-size stems so were included in the tree statistics (Table 4).

Tropical hardwoods were also found in the shrub inventory. Psychotria nervosa was the most important shrub species, but its growth form is such that it never attains tree size in this area. The remainder of the shrub species--Myrsine, Ardisia, Myrcianthes, Ilex, and Cornus (Table 5)--do attain tree size.

Psychotria was also the dominant understory species (Table 6). Of the 19 species in the understory plots, six were seedlings of the species found in the tree and shrub plot. Included in this group were Ardisia, Myrsine, Myrcianthes, Sabal, Ilex, and Acer.

Muhlenbergia Prairie

The prairie community is a diverse association of grasses, sedges and herbs. Rhynchospora divergens was the most important of the 35 species in plot 1 (Table 7), and of the 43 species in plot 2 (Table 8). This small sedge attains heights of about 20 cm, and is found widely interspersed beneath the taller, clumped plants of Schoenus, Muhlenbergia, and Schizachyrium. These species are the next most important to R. divergens. The two plots were similar in species composition with a similarity index (Sorenson, 1948) of 87%.

Vegetation Map

The vegetation map is enclosed inside the back cover of the report. Principal associations or groups are differentiated by color, with patterns representing variations within each association.

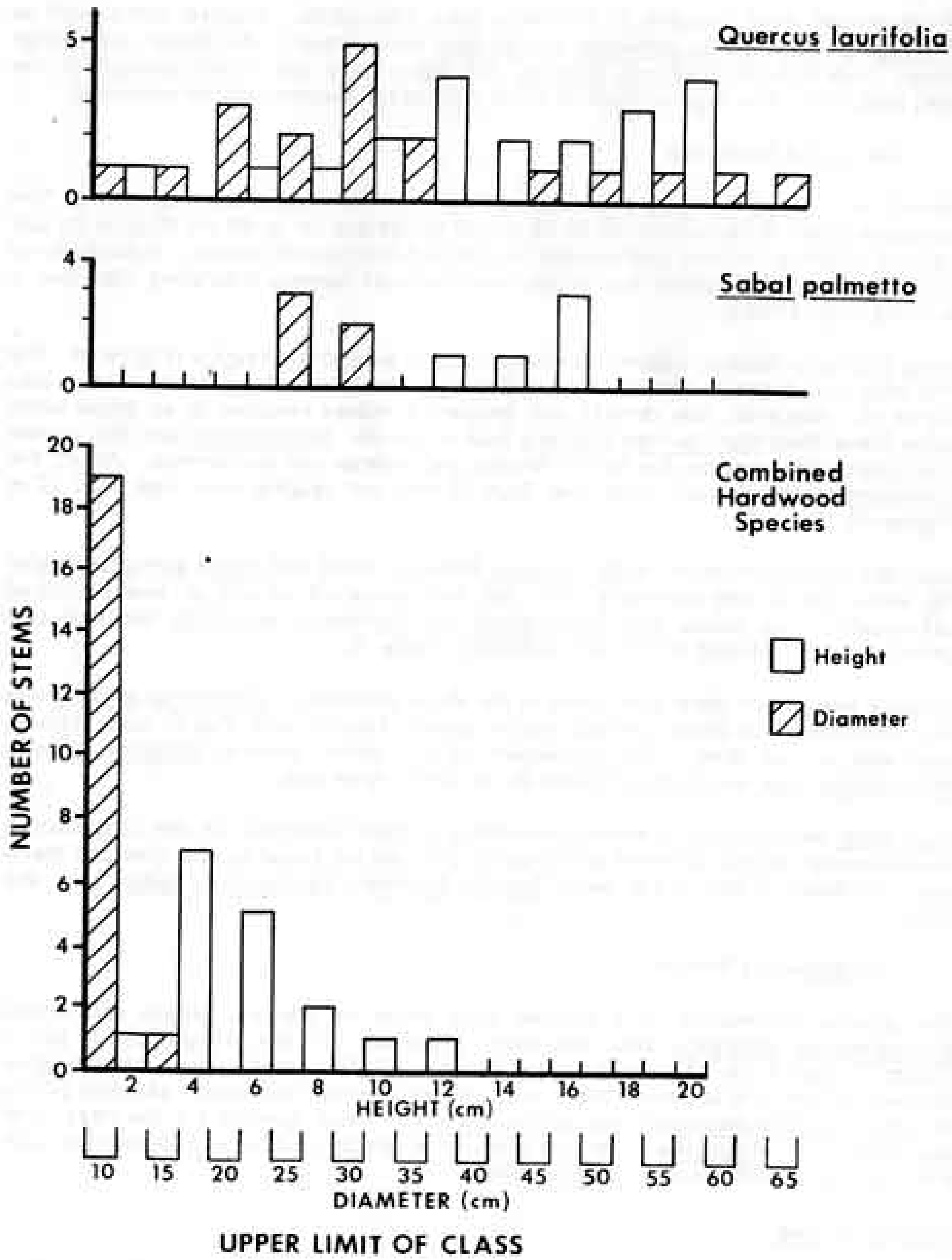

Figure 4. Stem height and diameter distributions of tree species in oak-Sabal hammock plot.

Table 4. Statistics for tree-sized stems in oak-Sabal hammock inventory plot.

Trees	Total Basal Area ($cm^2/600\ m^2$)	Density ($no./600\ m^2$)	Frequency	Relative Dominance	Relative Density	Relative Frequency	Importance Value
Quercus laurifolia	18283.0	19	46	83.9	43.2	33.8	160.9
Myrcianthes fragrans	364.0	8	25	1.7	18.2	18.4	38.3
Sabal palmetto	2369.6	5	21	10.9	11.4	15.4	37.7
Ilex cassine	59.6	2	8	0.3	4.5	5.9	10.7
Myrsine floridana	48.9	2	8	0.2	4.5	5.9	10.6
Magnolia virginiana	44.2	2	8	0.2	4.5	5.9	10.6
Persea borbonia	74.0	2	4	0.3	4.5	2.9	7.7
Acer rubrum	441.1	1	4	2.0	2.3	2.9	7.2
Ficus aurea	52.8	1	4	0.2	2.3	2.9	5.3
Vitis munsoniana	28.3	1	4	0.1	2.3	2.9	5.3
Berchemia scandens	25.5	1	4	0.1	2.3	2.9	5.3

Table 5. Statistics for shrub species in oak-Sabal hammock inventory plot.

Shrub Species	Percent Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Psychotria nervosa	27.9	100.0	35.7	23.5	59.2
Myrsine floridana	21.3	87.5	27.2	20.6	47.8
Sabal palmetto	11.1	75.0	14.2	17.6	31.8
Ardisia escallonioides	7.7	68.8	9.8	16.2	26.0
Myrcianthes fragrans	4.8	37.5	6.1	8.8	14.9
Ilex cassine	2.6	25.0	3.3	5.9	9.2
Cornus foemina	1.4	6.3	1.8	1.5	3.3
Berchemia scandens	0.1	12.5	0.1	2.9	3.0
Psychotria sulzneri	0.8	6.3	1.0	1.5	2.5
Toxicodendron radicans	0.5	6.3	0.6	1.5	2.1

Table 6. Cover and frequency values for understory species in oak-Sabal hammock inventory plot.

Species	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Psychotria nervosa	19.1	87.5	39.2	25.5	64.7
Blechnum serrulatum	14.9	52.5	30.6	15.3	45.9
Ardisia escallonioides	4.2	42.5	8.6	12.4	21.0
Sabal palmetto	2.6	30.0	5.3	8.8	14.1
Nephrolepis exaltata	2.9	10.0	6.0	2.9	8.9
Parthenocissus quinquefolia	0.6	22.5	1.2	6.6	7.8
Myrsine floridana	0.9	10.0	1.8	2.9	4.7
Berchemia scandens	0.3	12.5	0.6	3.6	4.2
Toxicodendron radicans	0.3	12.5	0.6	3.6	4.2
Panicum sp.	0.3	12.5	0.6	3.6	4.2
Chiococca alba	0.8	5.0	1.6	1.5	3.1
Myrcianthes fragrans	0.2	7.5	0.4	2.2	2.6
Thelypteris kunthii	0.2	7.5	0.4	2.2	2.6
Psychotria sulzneri	0.4	5.0	0.8	1.5	2.3
Acer rubrum	0.4	5.0	0.8	1.5	2.3
Vitis munsoniana	0.1	5.0	0.2	1.5	1.7
Ilex cassine	0.1	5.0	0.2	1.5	1.7
Boehmeria cylindrica	0.1	2.5	0.2	0.7	0.9
Cyperus sp.	0.1	2.5	0.2	0.7	0.9

Table 7. Cover and frequency values for all plant species in Muhlenbergia prairie inventory plot #1.

Species	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Rhynchospora divergens	24.69	95.0	29.4	8.3	37.7
Schoenus nigricans	15.38	72.5	18.3	6.3	24.6
Muhlenbergia filipes	8.25	85.0	9.8	7.4	17.2
Schizachyrium rhizomatum	5.06	77.5	6.0	6.8	12.8
Centella asiatica	3.31	95.0	3.9	8.3	12.2
Hymenocallis palmeri	3.69	62.5	4.4	5.5	9.9
Euphorbia polyphylla	2.25	77.5	2.7	6.8	9.5
Flaveria linearis	2.56	65.0	3.1	5.7	8.8
Elytraria caroliniensis	1.75	70.0	2.1	6.1	8.2
Dichanthelium dichotomum	2.75	47.5	3.3	4.2	7.5
Cladium jamaicense	3.00	35.0	3.6	3.1	6.7
Cirsium horridulum	1.31	40.0	1.6	3.5	5.1
Stenandrium dulce	1.31	27.5	1.6	2.4	4.0
Vernonia blodgettii	0.81	32.5	1.0	2.8	3.8
Crinum americanum	1.13	20.0	1.3	1.7	3.0
Dichromena colorata	0.63	25.0	0.8	2.2	3.0
Stillingia aquatica	0.69	15.0	0.8	1.3	2.1
Aristida purpurascens	0.38	15.0	0.5	1.3	1.8
Rynchospora microcarpa	0.38	15.0	0.5	1.3	1.8
Scleria verticillata	0.38	15.0	0.5	1.3	1.8
Hypoxis sp.	0.31	12.5	0.4	1.1	1.5
Piriqueta caroliniana	0.31	12.5	0.4	1.1	1.5
Buchnera floridana	0.25	10.0	0.3	0.9	1.2
Schoenolirion elliottii	0.25	10.0	0.3	0.9	1.2
Panicum tenerum	0.25	10.0	0.3	0.9	1.2
Spermacoce verticillata	0.19	7.5	0.2	0.7	0.9
Ludwigia microcarpa	0.19	7.5	0.2	0.7	0.9
Ipomea sagittata	0.13	5.0	0.2	0.4	0.6
Polygala grandiflora	0.13	5.0	0.2	0.4	0.6
Andropogon virginicus	0.13	5.0	0.2	0.4	0.6
Heliotropium polyphyllum	0.13	5.0	0.2	0.4	0.6
Coreopsis leavenworthii	0.13	5.0	0.2	0.4	0.6
Phyla nodiflora	0.06	2.5	0.1	0.2	0.3
Cynoctonum mitreola	0.06	2.5	0.1	0.2	0.3
Sisyrinchium atlantecum	0.06	2.5	0.1	0.2	0.3

Table 8. Cover, frequency and importance values for all plant species in Muhlenbergia prairie inventory plot #2.

Species	Average % Cover	Frequency	Relative Cover	Relative Frequency	Importance Value
Rhynchospora divergens	31.31	97.5	34.1	8.6	42.7
Schizachyrium rhizomatum	13.75	90.0	15.0	7.9	22.9
Muhlenbergia filipes	10.69	20.0	11.6	1.8	13.4
Centella asiatica	4.06	90.0	4.4	7.9	12.3
Hymenocallis palmeri	3.00	70.0	3.3	6.2	9.5
Cladium jamaicense	3.00	57.5	3.3	5.1	8.4
Euphorbia polyphylla	1.63	65.0	1.8	5.7	7.5
Dichanthelium dichotomum	2.06	57.5	2.2	5.1	7.3
Rhynchospora microcarpa	2.00	55.0	2.2	4.8	7.0
Paspalum monostachyum	1.69	55.0	1.8	4.8	6.6
Dichromena colorata	1.31	52.5	1.4	4.6	6.0
Cirsium horridulum	1.44	45.0	1.6	4.0	5.6
Piriqueta caroliniana	2.75	27.5	3.0	2.4	5.4
Flaveria linearis	1.06	42.5	1.2	3.7	4.9
Elytraria caroliniensis	2.25	22.5	2.4	2.0	4.4
Unknown	.81	32.5	0.9	2.9	3.8
Schoenus nigricans	2.38	12.5	2.6	1.1	3.7
Spermacoce verticillata	0.69	15.0	0.8	1.3	2.1
Stenandrium dulce	0.4	17.5	0.5	1.5	2.0
Ipomea sagittata	0.38	15.0	0.4	1.3	1.7
Panicum tenerum	0.38	15.0	0.4	1.3	1.7
Buchnera floridana	0.38	15.0	0.4	1.3	1.7
Schoenolirion eliottii	0.38	15.0	0.4	1.3	1.7
Vernonia blodgettii	0.38	15.0	0.4	1.3	1.7
Aster tenuifolius	0.31	12.5	0.3	1.1	1.4
Rhynchospora inundata	0.31	12.5	0.3	1.1	1.4
Crinum americanum	0.25	10.0	0.3	0.9	1.2
Ludwigia microcarpa	0.50	7.5	0.5	0.7	1.2
Pluchea rosea	0.25	10.0	0.3	0.9	1.2
Stillingia aquatica	0.25	10.0	0.3	0.9	1.2
Hypoxis sp.	0.25	10.0	0.3	0.9	1.2
Scleria verticillata	0.25	10.0	0.3	0.9	1.2
Sisyrinchium atlanticum	0.25	10.0	0.3	0.9	1.2
Erigeron quercifolius	0.19	7.5	0.2	0.7	0.9
Cynoctonum mitreola	0.19	7.5	0.2	0.7	0.9
Polygala grandiflora	0.13	5.0	0.1	0.4	0.5
Solidago stricta	0.13	5.0	0.1	0.4	0.5
Myrica cerifera	0.06	2.5	0.1	0.2	0.3
Diodia virginiana	0.06	2.5	0.1	0.2	0.3
Coreopsis leavenworthii	0.06	2.5	0.1	0.2	0.3
Andropogon virginicus	0.06	2.5	0.1	0.2	0.3
Aristida purpurascens	0.06	2.5	0.1	0.2	0.3
Heliotropium polyphyllum	0.06	2.5	0.1	0.2	0.3

The stippled yellow areas represent forests of pondcypress, Taxodium ascendens. The understory may be variable, but is typically graminoid, with occasional scattered hardwood shrubs. In all the pondcypress forests, T. ascendens is the single dominant overstory tree. A wide range in cypress heights and densities are within this category, from small (less that 5 m) scattered individuals (cypress prairie) to tall (up to 20 m), dense stands (domes and strands).

The pondcypress forests are differentiated from the baldcypress (or potential baldcypress) forests. The baldcypress forests are colored orange-red on the map. The baldcypress trees are found as emergent individuals from a dense canopy of swamp hardwoods. Therefore, this category is called cypress-mixed hardwood swamp. Abundance of hardwoods was used as the criterion for placement in this category. Some overlap may exist between the two cypress categories, and the lines between them should be viewed as a subjective interpretation. Stippled areas represent swamp hardwoods with no overstory cypress.

Pine forests are depicted by green on the map and three understory types are found. All have an overstory of Pinus elliottii var densa (south Florida slash pine), but the trees may be sparse in certain areas due to logging followed by little or no regeneration. The most common pine forest type, pine-Sabal-Serenoa, is colored plain green. Sabal palmetto (cabbage palm) and Serenoa repens (saw palmetto) dominate the understory in this type; the remainder of the species being herbs and grasses. Pine prairie (stippled green) areas have few or no palms present and a predominately graminoid understory, dominated by Schizachyrium rhizomatum, Cladium jamaicense and Paspalum monostachyum. Areas of substantial hardwood abundance are designated as pine-hardwood and colored green with horizontal lines. These areas have presumably escaped from fire for a number of years, allowing hardwood invasion to proceed.

The hardwood stands are colored brown. Hammocks with an overstory of Quercus laurifolia (laurel oak) and subcanopies comprised of Sabal palmetto, Ardisia escallonioides and Myrcianthes fragrans are designated with no pattern. Hardwood stands with a low-profile, dense shrub cover are categorized as hardwood shrub and are cross-hatched over the brown.

Marsh areas are colored light blue, with areas dominated by Cladium jamaicense (sawgrass) designated as plain light blue. Marshes of mixed species such as Pontederia lanceolata, Sagittaria, spp. and Typha spp. are light blue and stippled.

Graminoid areas that are slightly drier than the marshes are called prairie, and colored orange. Muhlenbergia filipes is one of the dominant species--hence the name Muhlenbergia prairie is used. This species may not always dominate in terms of cover (see Tables 7 and 8 for inventory of the prairie), but it is perhaps the most widespread and conspicuous species. Other species such as Spartina bakeri and Cladium jamaicense may be locally dominant, but such areas are still included in this category.

Open water areas are found in canals and borrow pits (large pits excavated for road or house construction). These areas of dark blue on the map have little or no emergent vegetation, but submergent aquatic plants may be present.

The only exotic plant species found in the study area were roadside stands of Schinus terebinthifolius (Brazilian pepper, light brown on the map). Schinus was found in other areas, growing in association with other species, but only pure stands of Schinus were designated as exotic stands on the map.

Any areas of early successional vegetation and/or bare ground are categorized as disturbed sites (white with cross-hatch).

Ordination of Stands from Transect Data

The species lists from each benchmark plot were compared with the lists from the rest of the plots in order to get an idea of the variation in species composition both within and between plant associations. An index was calculated which was based on the dissimilarity between two stands. First the similarity index of Sorenson (1948) was calculated. If two plots were exactly the same in species composition, a similarity index of 100 would be calculated. This similarity index was subtracted from 100 to yield a dissimilarity index, so that two identical stands would have a dissimilarity value of 0, and two stands with no common species would have a dissimilarity value of 100.

The dissimilarity indices for each benchmark plot are shown in the matrix of Table 9. The indices comparing plots within an association were generally low (e.g., Muhlenbergia prairie all values were less than 17). Even the most variable plots, those in the cypress-mixed swamp forests, had intra-community dissimilarities less than 35, showing a fairly consistent set of common species. Differences between communities were generally much greater. For example, dissimilarity values were in the 90's between the Muhlenbergia prairie and the forested plots in the oak hammock and cypress swamp areas.

The dissimilarity indices were ordinated following the techniques of Bray and Curtis (1957). In this method, the two most dissimilar stands are used as end points and the rest of the stands compared to these end point stands. Using the dissimilarity values to each end point or pole, ordination values are assigned using a geometric algorithm. This is done twice to assign a set of ordination coordinates to each stand.

The technique of polar ordination is useful in graphically grouping plots into similar plant associations. Five groups were identified from the ordination (Figure 5). The prairie plots were widely isolated from the other groups. The prairie plots had some common species with the hardwood scrub areas, and increasingly fewer with the oak-Sabal and cypress swamp forests. Oak-Sabal hammocks were intermediate between the scrub and the swamp because of the presence of hardwoods common to the scrub, such as Myrica cerifera, Persea borbonia, Ilex cassine and Myrsine floridana, and common understory species of herbs, ferns and vines in the swamp forest. The cypress dome had fewer species than the more diverse cypress-mixed swamp and therefore formed a distinct group. The species listed around the benchmarks were combined based on the visual groupings in the ordination plot. The combined species list is given in Table 10.

Table 9. Dissimilarity indices (DI*) within and among stands in different plant communities along vegetation transect.

	Muhlenbergia Prairie			Hardwood Scrub			Oak-Sabal Hammock			Cypress Dome	Cypress-Mixed Hardwood Swamp			
Muhlenbergia prairie (4 benchmark plots for comparison)	15	13	17	80	84	78	91	95	92	82	93	97	93	96
		16	16	78	81	76	92	96	93	80	90	94	93	93
			10	83	87	81	95	95	96	86	96	95	95	96
				79	83	77	95	95	96	90	96	95	95	96
Hardwood Scrub (3 plots)					42	34	84	85	86	72	92	89	87	96
						34	64	55	64	67	84	82	79	88
							72	68	71	70	89	87	84	92
Oak-Sabal Hammock (3 plots)								18	23	70	72	74	65	79
									25	71	72	75	61	76
										75	64	70	53	74
Cypress Dome (1 plot)											62	66	59	65
Cypress-Mixed Hardwood Swamp (4 plots)												24	30	26
													20	23
														35

$$* \ DI = 100 - \frac{2c}{a+b}$$

a = # species in plot 1
b = # species in plot 2
c = # species common to plots 1 and 2

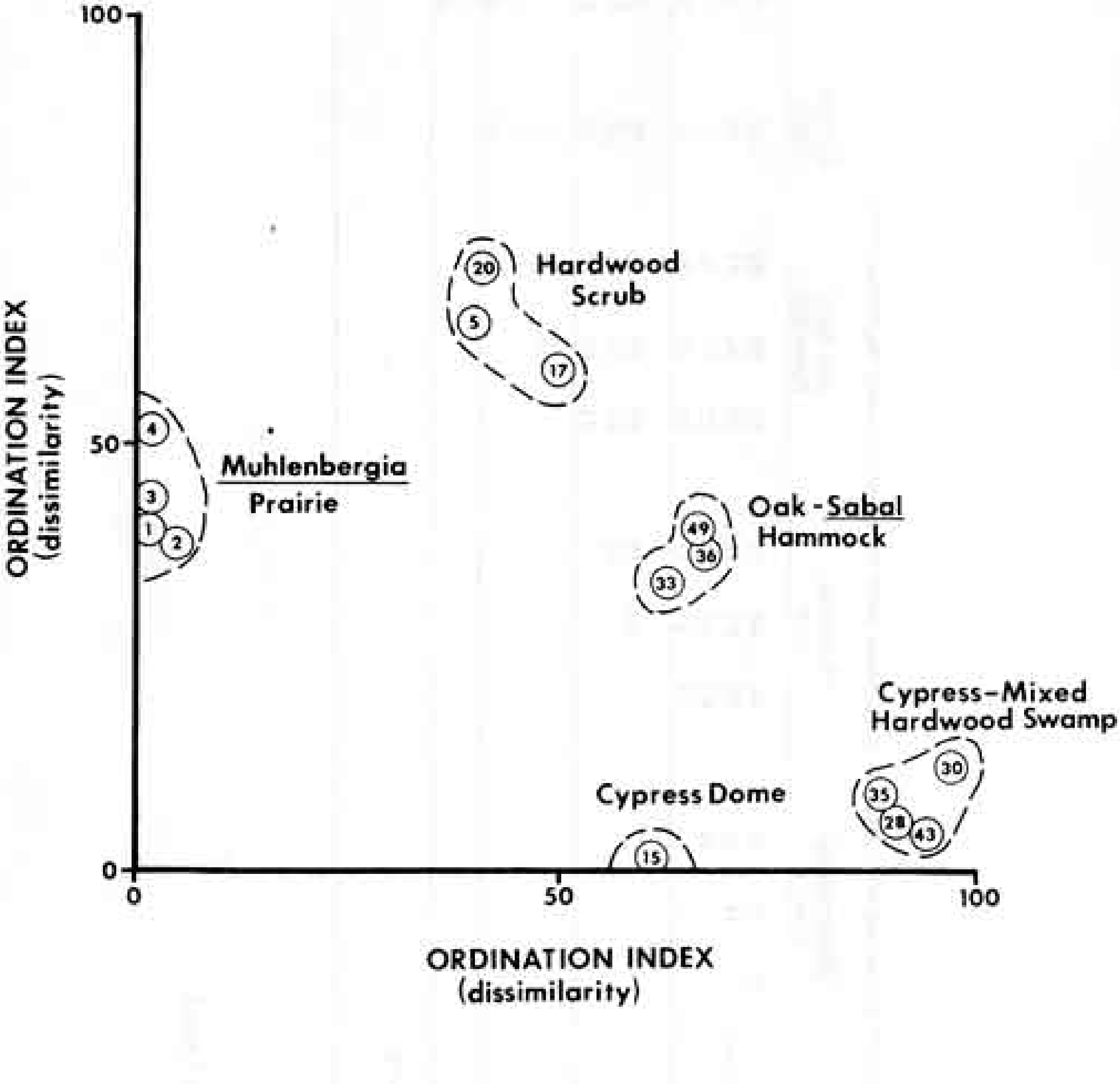

Figure 5. Ordination of stands along transect. Numbers show associated benchmarks along transect. Community groupings based on visual spatial proximities.

Table 10. Alphabetical species list from inventory plots centered on benchmarks* along transect. Plant associations are from ordination analysis.

	Muhlenbergia Prairie	Hardwood Scrub	Oak-Sabal Hammock	Cypress-Mixed Swamp Forest	Cypress Dome
Acer rubrum				X	
Aletris lutea	X				
Andropogon virginicus		X			
Annona glabra				X	
Ardisia escallonioides		X			
Aristida purpurascens	X				
Aster adnatus		X			
Aster carolinianus				X	
Aster tenuifolius	X				
Baccaris glomeruliflora		X	X		
Baccharis halimifolia				X	
Bacopa caroliniana			X		
Berchemia scandens			X	X	
Boehmeria cylindrica			X	X	X
Blechnum serrulatum		X	X	X	X
Bumelia reclinata		X			
Callicarpa americana		X			
Carex gigantea				X	
Cassytha filiformis	X				
Chiococca alba			X		
Cirsium horridulum	X	X			
Cladium jamaicense	X				X
Cornus foemina				X	
Crinum americanum	X		X	X	X
Dichromena colorata	X				
Diodia virginiana				X	
Elytraria caroliniensis	X				
Encyclia tampensis				X	
Eragrostis elliottii	X	X			
Eryngium yuccifolium	X	X			

	Muhlenbergia Prairie	Hardwood Scrub	Oak-*Sabal* Hammock	Cypress-Mixed Swamp Forest	Cypress Dome
Eupatorium coelestinum		X			
Eupatorium leptophyllum		X			
Eupatorium mikanioides		X			
Ficus aurea				X	X
Fraxinus caroliniana				X	
Fuirena breviseta	X				
Habenaria odontopetala		X	X		
Hydrocotyle umbellata			X		
Hyptis alata	X	X			
Ilex cassine		X	X		
Juncus megacephalus				X	
Ludwigia microcarpa	X				
Ludwigia peruviana	X	X		X	
Mikania scandens				X	X
Muhlenbergia filipes	X				
Myrcianthes fragrans			X		
Myrica cerifera		X	X	X	X
Myrsine floridana		X	X		
Nephrolepis exaltata			X	X	
Parthenocissus quinquefolia			X		
Panicum sp.	X				
Panicum sp.	X	X			
Panicum tenerum	X				
Panicum virgatum			X	X	
Paspalum monostachyum	X	X			
Phyla nodiflora				X	
Pinguicula lutea	X				
Pinguicula pumila	X				
Pluchea rosea	X				X
Polygala grandiflora	X				
Polygonum sp.				X	
Polypodium aureum		X			X

	Muhlenbergia Prairie	Hardwood Scrub	Oak-Sabal Hammock	Cypress-Mixed Swamp Forest	Cypress Dome
Polypodium phyllitidis				X	
Pontederia cordata				X	
Proserpinaca palustris	X			X	X
Psychotria nervosa			X	X	
Psychotria sulzneri		X	X		
Pteridium aquilinum		X			
Persea borbonia		X	X	X	X
Quercus laurifolia			X		
Quercus virginiana var. virginiana		X			
Rhus copallina		X			
Rhynchospora divergens	X	X			
Rhynchospora inundata				X	
Rhynchospora microcarpa	X				
Rudbeckia hirta		X			
Sabal palmetto		X	X	X	X
Sagittaria graminea	X				
Sagittaria lancifolia				X	
Salix caroliniana				X	X
Sarcostemma clausum				X	
Schinus terebinthifolius			X	X	
Schizachyrium rhizomatum	X				
Schoenus nigricans	X				
Scleria verticillata	X				
Serenoa repens	X	X			
Setaria gracilis	X				
Smilax auriculata			X		
Smilax laurifolia				X	
Solidago stricta		X		X	
Spermacoce verticillata	X				
Stenandrium dulce	X				
Taxodium ascendens					X
Taxodium distichum				X	
Thelypteris kunthii			X		
Tillandsia balbisiana				X	
Tillandsia fasciculata			X	X	

	Muhlenbergia Prairie	Hardwood Scrub	Oak-Sabal Hammock	Cypress-Mixed Swamp Forest	Cypress Dome
Tillandsia pruinosa				X	
Tillandsia setacea			X	X	
Tillandsia usneoildes			X	X	
Tillandsia utriculata				X	
Tillandsia valenzuelana				X	
Toxicodendron radicans		X	X	X	
Vitis munsoniana		X			
Vittaria lineata			X	X	
Zeuxine strateumatica	X				
*Numbered benchmarks used to compile lists for each association	1 2 3 4	5 7 20	33 36 44	28 30 35 43	15

Elevations, Soils and Hydroperiod

The soil surface elevations along the transect seem to follow the profile of the underlying bedrock (Figure 6). Low bedrock elevations correlate with low soil surface elevations, and a bedrock high was found beneath the highest soil surface elevations. Soil surface elevations ranged from a low of 198 cm (msl) in the cypress swamp to a high of 270 cm (msl) in an oak hammock. A scattergram of soil surface elevation and bedrock elevation shows good correlation between the two variables (Figure 7). This correlation holds because little difference was noticed in soil depth among the communities. Differences in soil depths among communities can occur however, especially in inundated areas where peat accumulation can proceed. This transect profile correlation may be somewhat unique, in that a large portion of the organic soil in the cypress areas appears to have been removed by a fire.

The plant association groupings, generated from the ordination analysis, were used to classify each of the benchmarks into plant groups for elevational and soil analyses. Benchmarks that fell in ecotonal areas were not included in any elevational group. The soil surface elevations were converted to relative elevations by setting the lowest elevation equal to 0 (0 relative elevation = 198 cm above msl).

The mean relative soil surface elevations, standard deviations, and range of values within each type were calculated (Figure 8). The soil elevations in the cypress-mixed swamp averaged 20 cm above the zero point. The next highest community was the Muhlenbergia prairie, averaging 40 cm above the zero point, and having a range of values of only 12 cm. The highest communities were the hardwood associations. The mean elevation in the oak hammocks was 55 cm above the zero point, whereas the hardwood scrub areas averaged 58 cm. Without statistical analysis, there appear to be significant differences in the average elevations of the cypress swamp, the prairie and the hardwood areas. No significant difference seems to exist between the relative elevations of the oak hammock and the hardwood scrub areas.

Despite the elevational differences that exist among the associations, no significant differences in soil depths were apparent. Mean and ranges of measured soil depths in each of the associations are shown in Figure 9. Averages in the communities were 28 cm in the hardwood scrub, 40 cm in both the prairie and the oak hammock, and 55 cm in the swamp forest. High variability masked any differences between the mean values.

A crude classification of the soils was made by observation. Sand was the principal component in the scrub and prairie, with some marl present in the prairie. The soils in the hammock were a mixture of dark brown to black organic matter and sand. The swamp soils are composed of brown peat and sand.

The water levels in the wells at the prairie, swamp, and hammock sites were correlated with the water levels at a USGS permanent water level recorder, designated C-495, located at the intersection of roads C-837 and C-838 (Wagon Wheel and Birdon Roads). The regression equations and correlation coefficients for

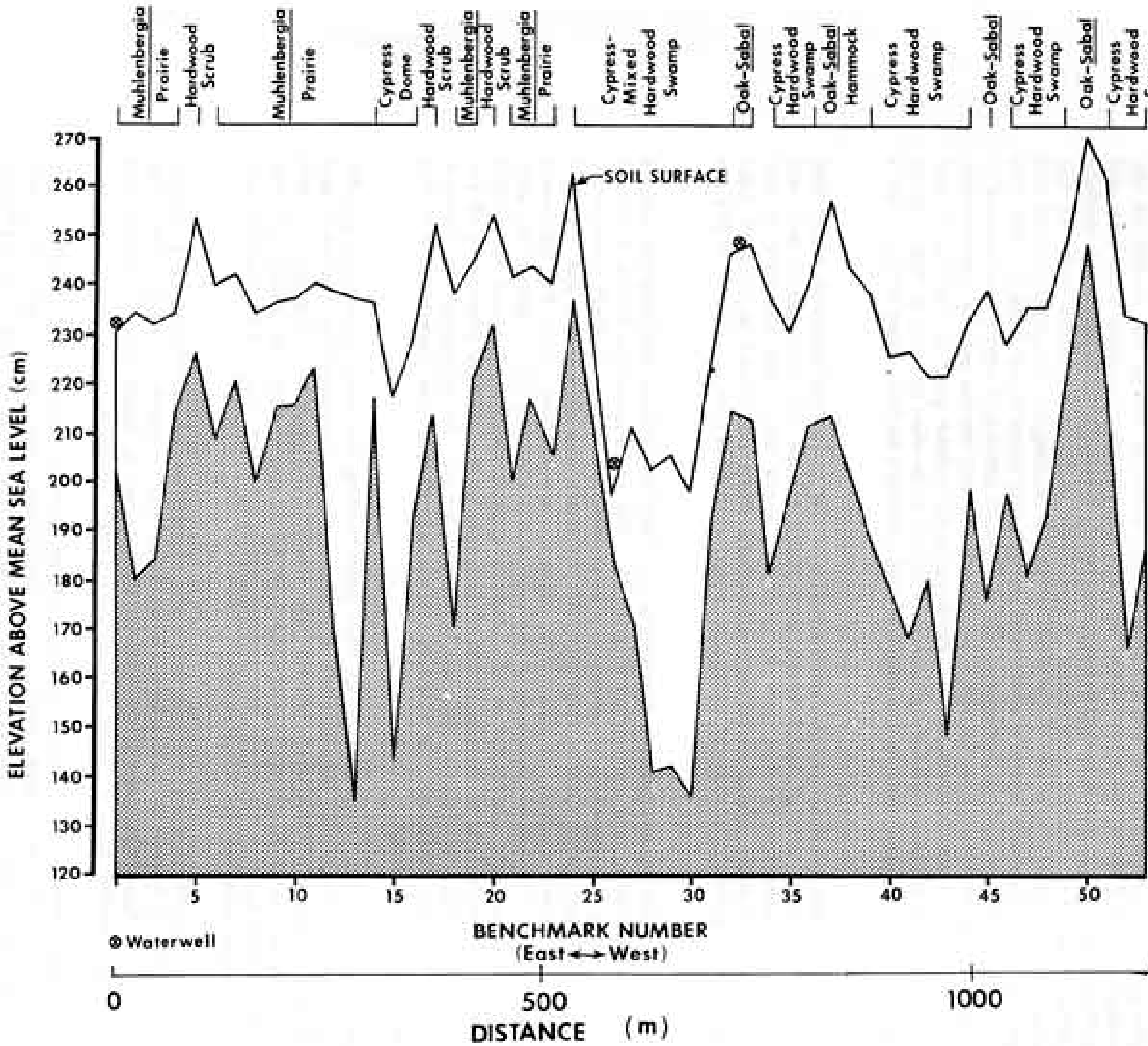

Figure 6. Soil surface and bedrock elevation profile along transect, showing associated plant community at each benchmark.

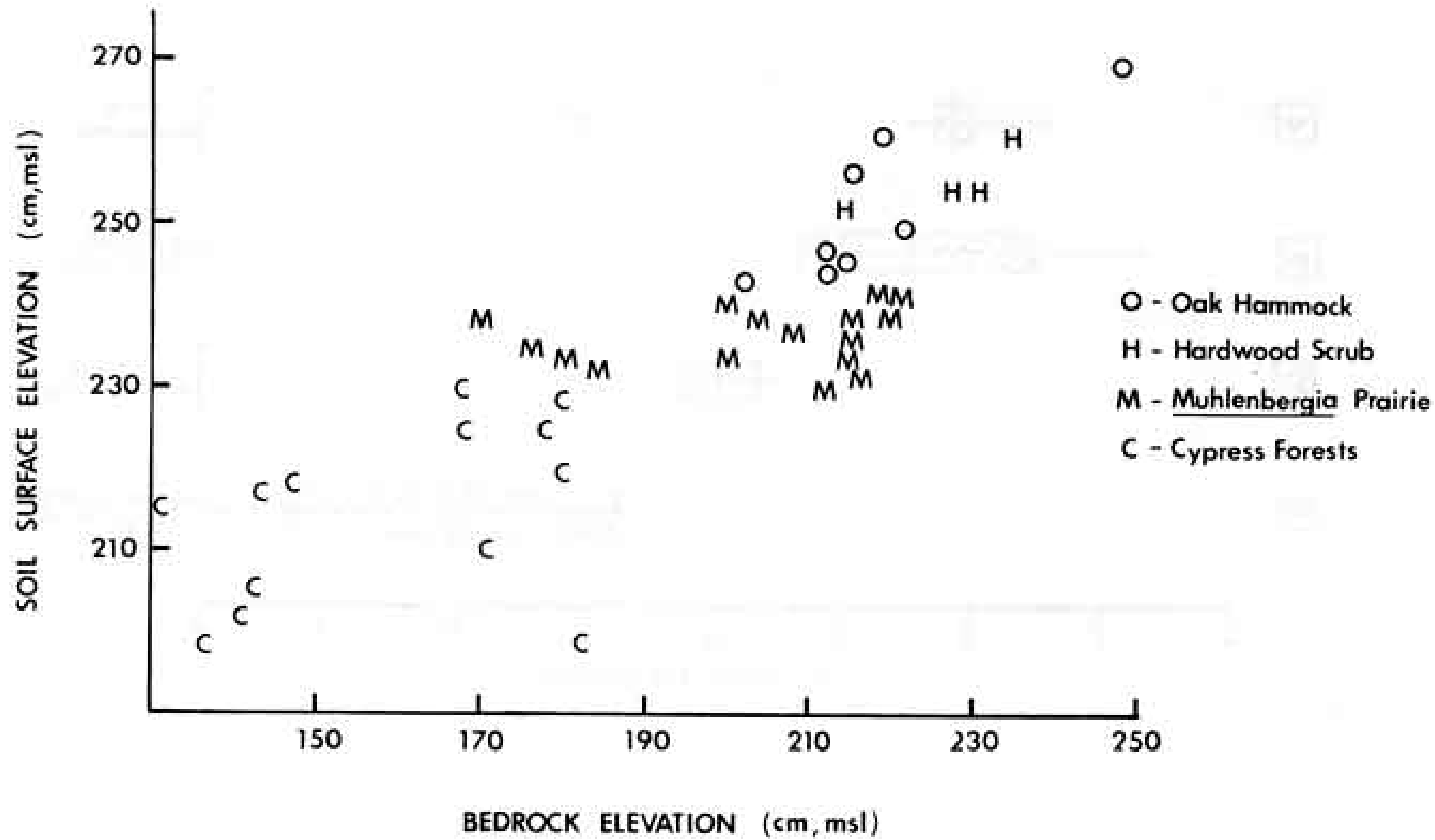

Figure 7. Soil surface and bedrock elevation scattergram, showing correlation between bedrock and surface topography.

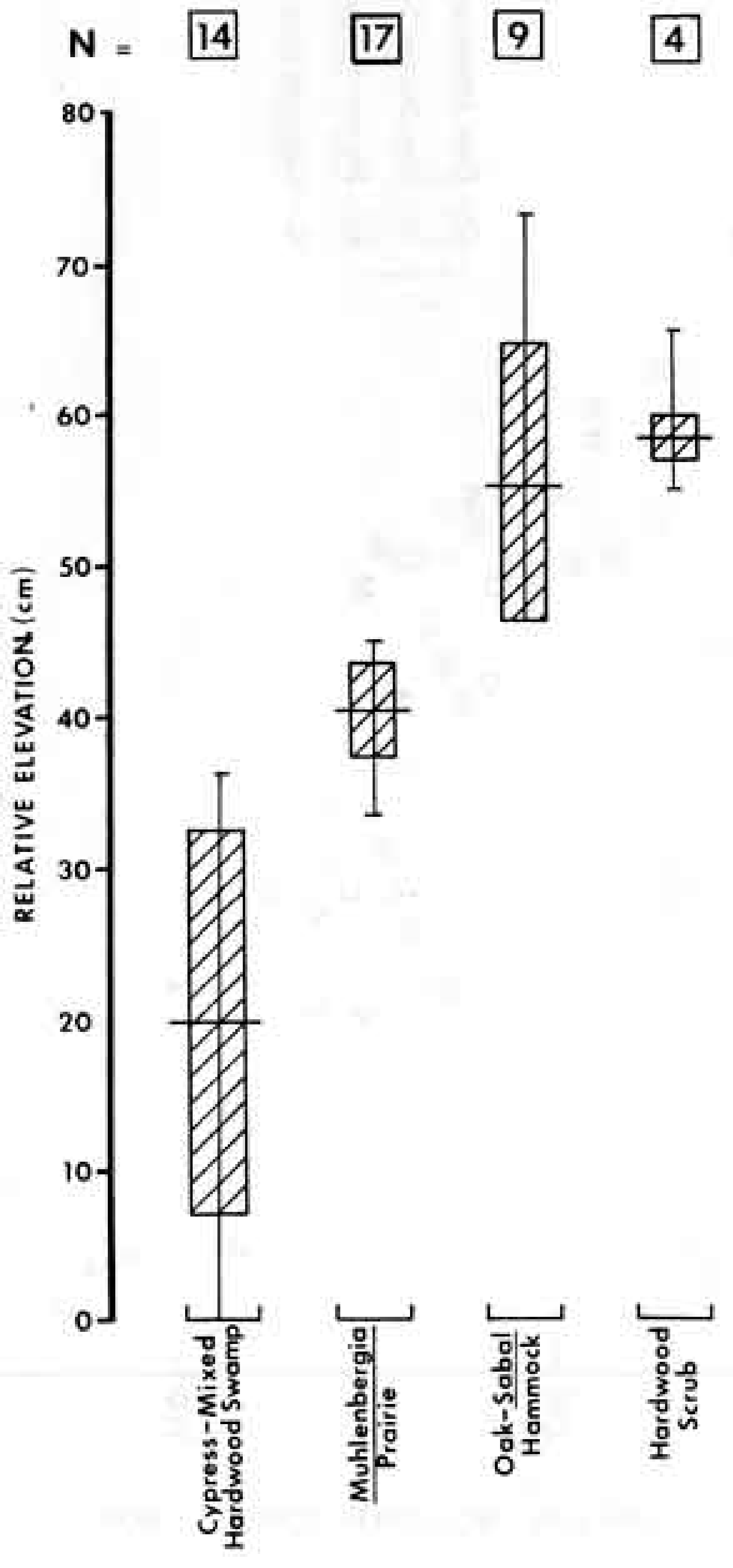

Figure 8. Relative soil surface elevations of four plant communities along transect. Zero relative elevation equals lowest elevation on transect.

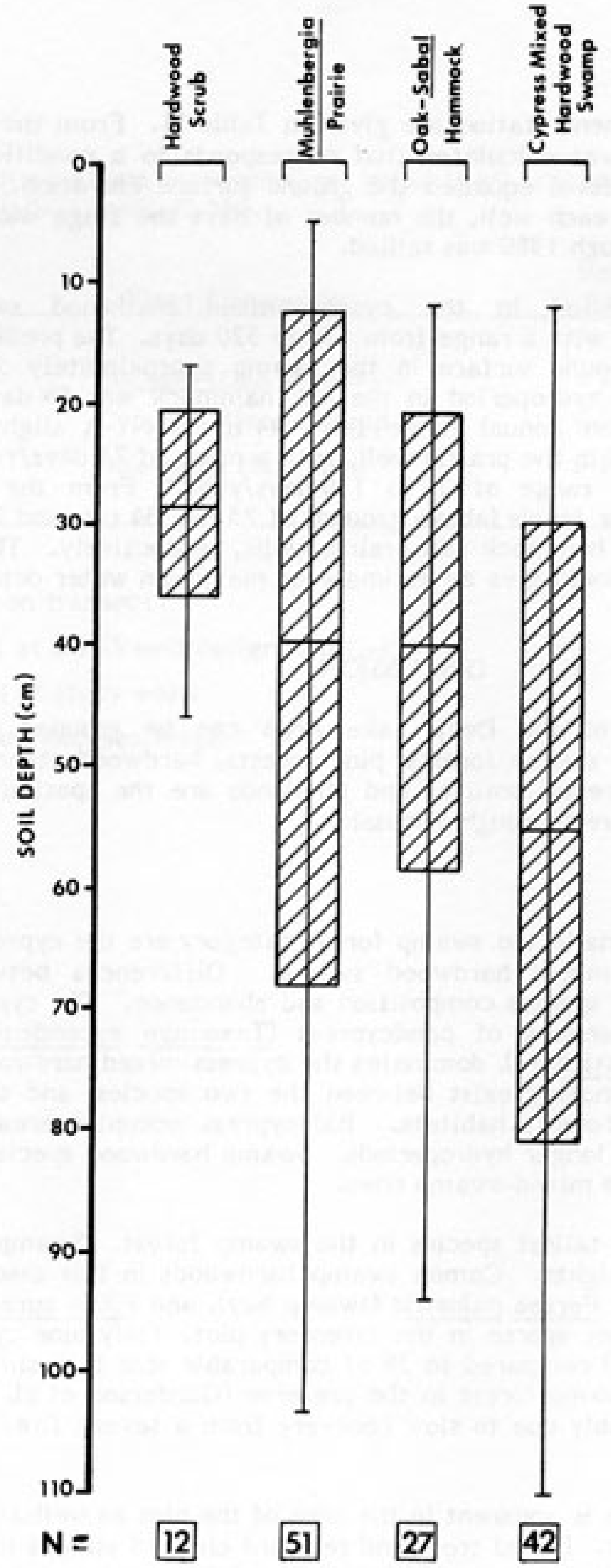

Figure 9. Soil depths beneath each plant community along transect. Values are means, plus and minus one Std. Dev. and range of values.

the test wells and permanent station are given in Table 11. From the regression equations, a stage value was calculated that corresponds to a condition at each sample well when water level equalled the ground surface elevation. Using the predicted stage value for each well, the number of days the stage was exceeded every year from 1973 through 1980 was tallied.

Average annual hydroperiod in the cypress-mixed hardwood swamp was 213 days/year (Figure 10), with a range from 125 to 320 days. The predicted water levels were above the ground surface in the swamp approximately 59% of the period of record. Mean hydroperiod in the oak hammock was 84 days (23% of period of record), with an annual range from 44 to 140. A slightly shorter hydroperiod was predicted in the prairie well, with a mean of 73 days/year (20% of period of record), and a range of 32 to 110 days/year. From the regression equations, maximum water levels (above ground) of 75 cm, 34 cm, and 25 cm were predicted for the swamp, hammock and prairie wells, respectively. These values are approximations but should give an estimate of maximum water depths in each of the communities.

DISCUSSION

The plant communities of the Deep Lake Area can be grouped into major categories for discussion: swamp forests, pine forests, hardwood stands, marshes and prairies. Swamp forests, prairies and pinelands are the spatially dominant associations and merit more thorough discussion.

Swamp Forests

The two major associations in the swamp forest category are the cypress dome or strand and the cypress-mixed hardwood swamp. Differences between these associations are based on species composition and abundance. The cypress domes and strands have an overstory of pondcypress (Taxodium ascendens), whereas baldcypress (Taxodium distichum), dominates the cypress-mixed hardwood swamps. Differences in tree morphology exist between the two species, and they occupy similar, but slightly different, habitats. Baldcypress occupies areas of lower bedrock, deeper soils and longer hydroperiods. Swamp hardwood species are more abundant and larger at the mixed-swamp sites.

Baldcypress is by far the tallest species in the swamp forest. Swamp hardwoods attain only subcanopy heights. Comon swamp hardwoods in this association are Acer rubrum (red maple), Persea palustris (swamp bay), and Ficus aurea (strangler fig). Baldcypress is rather sparse in the inventory plot. Only nine cypress trees were in the plot (Table 1) compared to 39 of comparable size in a similar plot in another cypress-mixed swamp forest in the preserve (Gunderson et al. 1982). The low density here is probably due to slow recovery from a severe fire that burned into the area.

Evidence of a severe fire is apparent in the area of the plot as well as throughout most of the swamp forest. Felled trees and remnant charred stumps indicate that the fire burned through the area and killed many of the cypress trees. Exposed roots indicate that peat loss may have also occurred after the severe fire. Marks

Table 11. Regression equations between water levels (msl) at study wells and permanent water level recorder (USGS well), C-495.

Well location[1]	Plant Community	Regression Equation[2]	Correlation Cofficient (r^2)
0	Muhlenbergia prairie	$y = 1.06x - 6.35$	0.86
26	Cypress-Mixed Swamp	$y = 0.98x - 4.2$	0.88
32	Oak-Sabal Hammock	$y = 1.20x - 7.0$	0.87

[1] Benchmark number on transect

[2] x = msl water level at USGS well designated C-495

y = msl water level at study wells

msl = elevation above mean sea level.

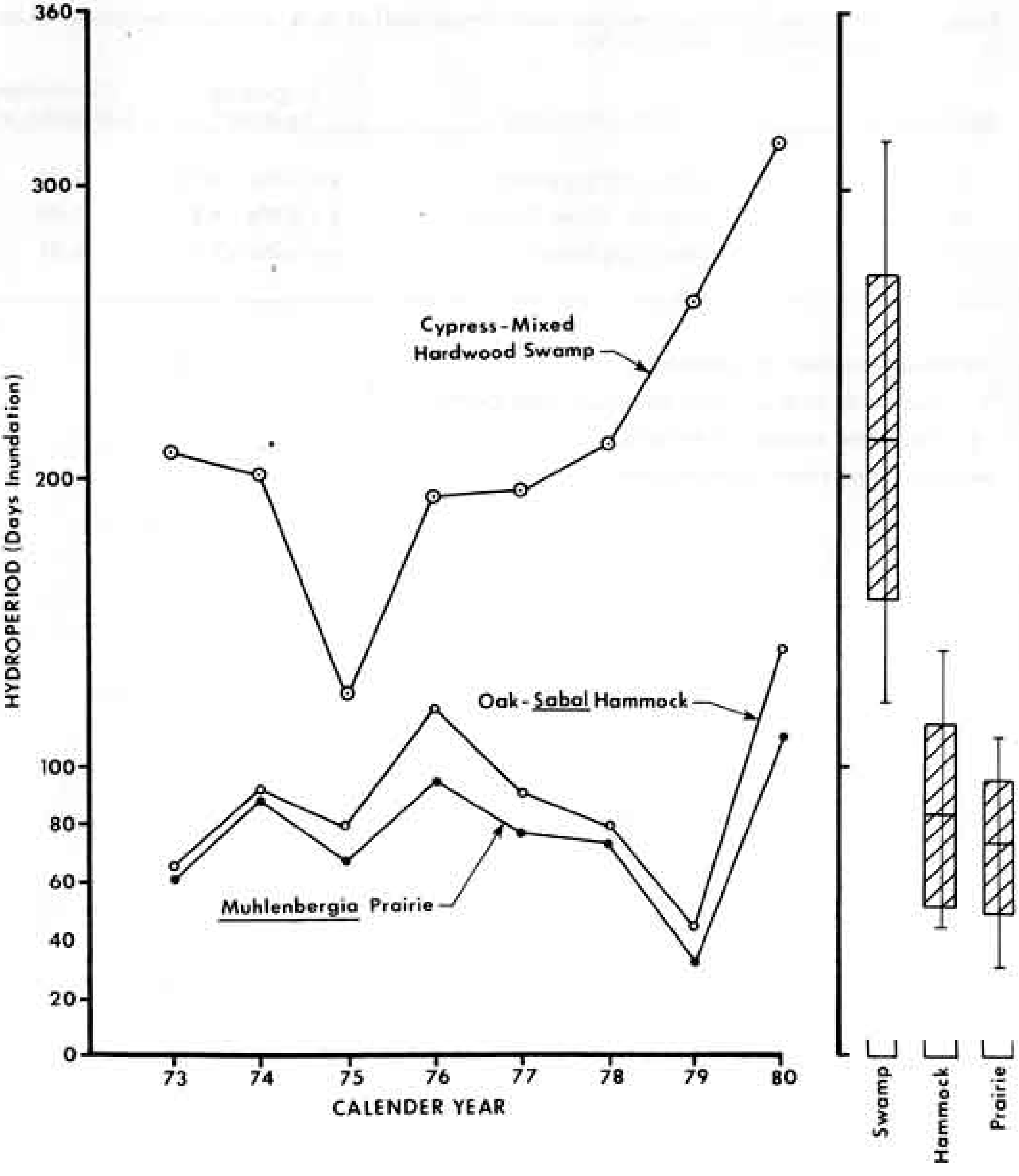

Figure 10. Hydroperiod patterns in three plant communities, 1973-1980. Values on right represent means, plus and minus one Std. Dev., and range of values in cypress swamp, oak hammock, and Muhlenbergia prairie.

on trees and roots interpreted as indicators of a past soil surface level were found as much as 1/2 m above the current soil surface.

Fire has probably had a major role in shaping current species composition. Fire in this area appears to have reduced the density of cypress by killing many overstory trees. Some lumbering may have also occurred which also decreased the cypress density. Fraxinus (and to a lesser extent, Annona), although not believed to have any particular adaptations to survive fire in situ, appear to have aggressively colonized (presumably through seed dispersal and seedling establishment) the areas where cypress was removed. Since cypress trees are present--both large and small trees--regeneration should continue, resulting in increased abundance of cypress.

Hydrologic patterns in the swamp do not appear to be altered. The average inundation value of 213 days/year is at the low end of reported values (Duever et al. 1978) for undrained cypress habitats. This value is twice the hydroperiod of a similar nearby cypress swamp that was considered to have been hydrologically altered (Gunderson, et al. 1982).

The pondcypress trees in domes and strands do not attain the stature of the baldcypress in the mixed-swamp forests. The pondcypress grow on sites with less organic soil and shorter hydroperiods. Stunted mature cypress (up to 6 m tall) with a graminoid understory are found on shallow sand and marl substrates. On sites with deeper soils and long hydroperiods, such as the center of domes and strands, pondcypress attain heights of 25 m and diameters (dbh) reach 30 cm.

Hardwoods such as Myrica cerifera, Persea borbonia, and Sabal palmetto are sparse in domes and strands, probably as a result of frequent fires burning through these areas, killing the hardwoods, but allowing the more fire resistant cypress to remain. These hardwoods reestablish much more slowly than Fraxinus, probably because they can establish only under a narrow range of relatively dry conditions which are rarely met in these wet habitats.

Pine Forests

All pine forests in the area have an overstory of Pinus elliottii var. densa (south Florida slash pine). Understory features appear to be mainly related to microtopographic variation. Serenoa repens (saw palmetto) dominates the higher and drier sites, and mixed grasses are abundant on the lower, wetter pine sites. Sabal palmetto occurs throughout the hydrologic gradient on pine sites. These understory plants are adapted to a regime of frequent, fast-moving ground fires. The fires typically consume the foliage near the ground leaving perennating buds undamaged either above or below ground and allowing rapid vegetative regeneration. Overstory pines have thick bark and are rarely killed by the fires, although needles are often dropped when scorched by hot fires.

Prior logging of the pine stands seems to have affected species composition in certain areas. Many of the small "islands" designated as hardwood scrub and surrounded by Muhlenbergia prairie on the map were former pine sites. Examination of 1940 aerial photographs of the area indicates that these areas were logged. Such evidence, visible on the photographs as logging roads leading to each of these "islands," and remnant stumps, indicates that pine trees had been present, then removed.

Hardwoods such as Ilex cassine, Quercus virginiana, Myrica cerifera and Persea borbonia colonized these sites probably during an absence of fire for 5-10 years. Once the hardwoods were established, recurrent fires have not eliminated these species. The fires only top kill these species, which quickly resprout and recapture the site. These "islands" still lack pine, more than 40 years post-logging. Local elimination of a pine seed source is undoubtedly causing a failure of regeneration. Most "islands" with pine trees present (and to all appearances similar in soil conditions, hydrologic conditions, fire frequency, and density of hardwoods to those lacking pine trees) show signs of pine reestablishment.

Hardwood Stands

Areas of hardwood scrub with the above-mentioned history compose the common association of hardwoods. The scrub areas are intermediate in species composition between pine forests and mature oak hammocks. Adaptable species from the earlier pine community remain, as well as species that have colonized the site after lumbering.

Oak hammocks are mature hardwood stands found in the vicinity of mixed-swamp forests. Quercus laurifolia is the principal overstory species. Sabal palmetto attains subcanopy heights, as do the tropical hardwoods Myrcianthes fragrans and Ardisia escallonioides.

Elevations of the oak hammocks are similar to those of hardwood scrub area pine forests. The elevations correspond to bedrock highs, and are not a result of greater soil accumulation over the bedrock. Although the hammocks are elevated above the prairies, hydroperiods are slightly longer. This may be because the water levels are maintained at higher levels in the surrounding swamp forest for long periods of time, decreasing the rate of water level decline in the hammock and thereby prolonging the inundation.

In addition to prolonging the hydroperiod, the surrounding swamp protects the oak hammocks from periodic fires. The hammocks are "insulated" from fire by the swamp, which is under water 2/3 of the year and moist for much of the remainder of the time. Ground fires must be very rare in hardwood islands surrounded by swamp. Even hardwood sites adjacent to the swamp on only one side receive much fire protection. When the swamp gets dry enough to burn, then the hammocks are also susceptible. The hammocks also occupy relatively small areas, and the canopy does not extend above the surrounding swamp areas. The small area decreases the probability of a lightning strike in the hammocks, which could potentially start a fire.

Quercus, Sabal, Ardisia, Myrcianthes, and Myrsine all showed signs of regeneration in the inventory plot. In the absence of disturbance, we would expect continued regeneration of these species, resulting in some filling-in of the subcanopy layer. The great size of Quercus and apparent occurrence of adequate reproduction seems to guarantee its continued dominance of the overstory.

Use of these hammocks by native Indians through the early 20th Century may have affected plant species composition. Since the mixed-swamp forests were used as travel routes during periods of high water (Dayhoff, pers. comm.), the higher hammocks were used as campsites or homesites (Ehrenhard, et al. 1978). Clearing of hammocks may have favored establishment of oaks following abandonment, but this is sheer speculation on our part.

Marshes and Prairies

The treeless associations are divided into two groups: marshes and prairies. Marshes occupy lower, wetter sites and usually have a high organic component to the the substrate. Prairies are diverse associations of grasses, sedges and herbs on slightly drier sites. Both are subjected to and maintained by periodic fires. Aquatic plant species such as Typha, Pontederia, and Sagittaria are found in mixed aquatic marshes. Sawgrass marshes are overwhelmingly dominated by Cladium.

Muhlenbergia prairie is one of the spatially dominant associations in the Deep Lake area. Many small areas of hardwood scrub, pine islands, willow heads and marshes lie within the extensive prairie areas. These communities reflect bedrock highs (hardwood and pine areas) or bedrock depressions (cypress, willow, and marshes) with the prairie occupying the sites of intermediate elevations.

Some 44 species were found in the quantitative inventory prairie plots. Although Rhynchospora divergens had the highest importance values, Muhlenbergia is still a characteristic plant of the association. During flowering in October-November, Muhlenbergia floral spikes are ubiquitous and are used in naming the association because of its dominance of most similar sites in the preserve. The prairie appears to be dominated by this one species (a good example of the phenomenon of "aspect dominance" described by Oosting, 1956).

The hydrologic pattern in prairies may prevent establishment of cypress and pine. Hydroperiods in the prairies averaged 70 days, presumably too long for pine seedlings to become established, and too short for cypress seed germination and subsequent survival. Pine seeds will not germinate with standing water (Fowells, 1965), and the prairies are usually inundated through September, the month when pine seeds are dispersed. Cypress seed do not fall until late October-November, when the prairies are dry. Unless cypress seed soak for a period of 1 to 3 months, they are unlikely to germinate (Mattoon, 1916; Murphy and Stanley, 1975).

Frequent fires occur in the prairies. D. Taylor and R. Rochefort (pers. comm.) have observed two fires at the same location in the Deep Lake Strand area prairies within 3 years, and this is probably as frequently as they can occur. Recurring burns kill establishing tree species, including cypress and pine. Fire regime and hydrologic regime undoubtedly both contribute to maintenance of the prairies in a non-forested condition. The grasses, sedges, and herbs of the prairie are adapted to frequent fire and resprout from subterranean perennating buds.

Portions of the prairies were farmed, but native species have returned to these sites.

Exotic Vegetation

Schinus terebinthifolius is the only exotic woody plant species found in the study area. Stands are located along the roadside on spoil banks and berms. No active invasion is occurring into the surrounding prairies, even though the prairie soils were disturbed several decades ago by farming. Thickets of Schinus also occur on the periphery of oak hammocks, where the forest canopy may be frequently opened by fire. With continued periodic fires, Schinus may be expected to increase, but not to dominate any but the most disturbed areas.

SUMMARY AND CONCLUSIONS

1. Quantitative inventory was made in each of the following plant associations: Muhlenbergia prairie, oak-Sabal hammock, and cypress-mixed hardwood swamp. Locations and methods of inventory of these relocatable plots are given.

2. A vegetation map was made of the study area in order to document current spatial distribution of the plant associations.

3. Similarities in plant species composition were compared among associations sampled along a line transect. Discrete groupings were identified as: Muhlenbergia prairie, oak-Sabal hammock, cypress-mixed hardwood swamp, hardwood scrub and cypress dome. Species lists were compiled for each of these groups.

4. Relative elevations were calculated for the plant associations measured along the transect. Cypress-mixed hardwood swamps and cypress domes had the lowest soil surface elevations. Muhlenbergia prairies occupied sites that averaged 20 cm above the mean elevations in the cypress sites. Oak hammocks averaged 35 cm above the cypress areas, and the hardwood scrub was found 38 cm above the cypress.

5. Soil depths did not differ dramatically among the associations, but soil type did. Peats and sands were found beneath the cypress swamps. A dark black organic muck and sand was found in the hammocks. A mixture of sand and marl was identified beneath the prairie sites, and sand was found over bedrock at the hardwood scrub areas.

6. Mean hydroperiods were calculated for the cypress-mixed hardwood swamp (216 days/year), oak-Sabal hammock (84 days/year) and Muhlenbergia prairie (73 days/year).

7. The plant communities in the Deep Lake Strand area appear to be determined primarily by the hydrologic regime and substrate features. The hydrologic pattern characteristic of each community is a result of the substrate topography and rainfall pattern of wet and dry seasons. Hydrologic patterns do not seem to have been changed drastically in the Deep Lake Strand area. Logging, severe fires, and (perhaps), Indian use have modified the species compositions of some of the forested areas, especially the cypress-mixed swamp forests, the pine forests, and hardwood hammocks.

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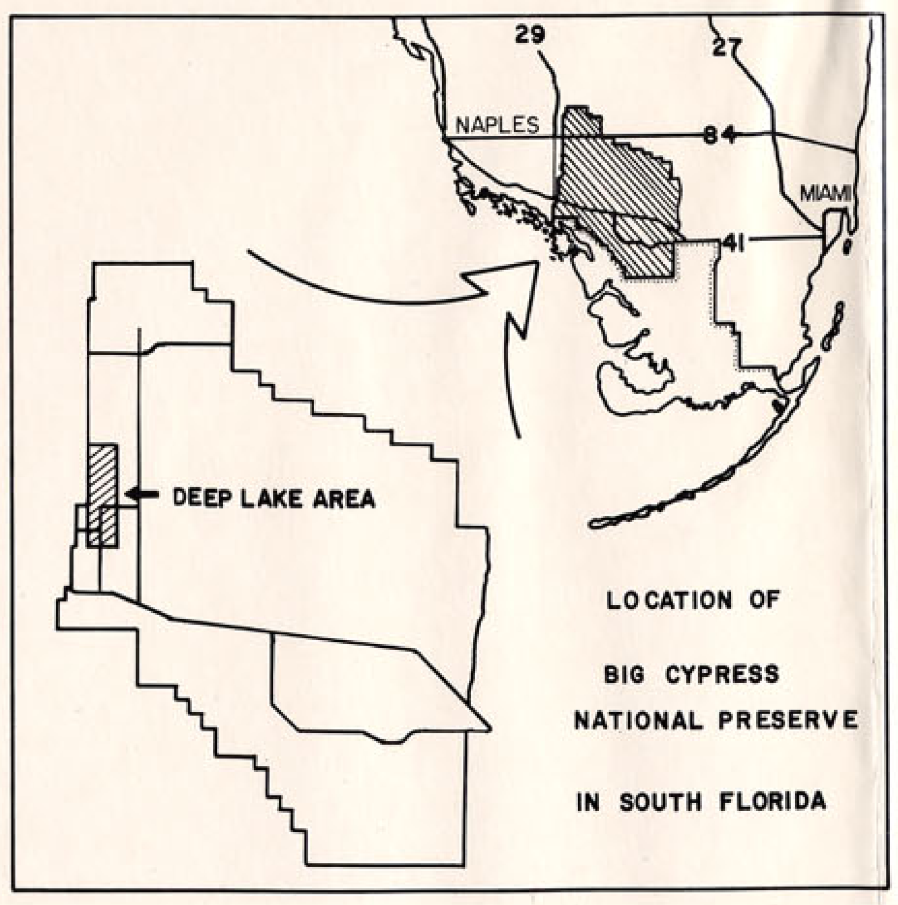
VEGETATION MAP
DEEP LAKE AREA

BIG CYPRESS NATIONAL PRESERVE
FLORIDA
1981

L.H.GUNDERSON AND J. VAN HORN
U.S. NATIONAL PARK SERVICE
SOUTH FLORIDA RESEARCH CENTER

0 0.5 1
kilometers

0 0.5 1
miles



PLANT COMMUNITIES

CYPRESS DOMES, STRANDS. Forests of Taxodium ascendens (pondcypress) with an understory of mainly graminoid species such as Rhynchospora microcarpa, Paspalum monostachyum, Cladium jamaicense, Muhlenbergia filipes and Schizachyrium rhizomatum, but scattered hardwood shrubs may be present.

WILLOW HEADS. Monospecific stands of willow, Salix caroliniana, with a few species of aquatic herbs in the understory.

CYPRESS-MIXED SWAMP FOREST. Dominated by Taxodium distichum (baldcypress), with subcanopy of Acer rubrum (red maple), Persea borbonia and Ficus aurea (strangler fig). Ferns, especially Blechnum serrulatum (swamp fern), and aquatic herbs dominate the understory. Stippled areas indicate swamp hardwoods without overstory baldcypress.

PINE-SABAL-SERENOA FORESTS. Forests of Pinus elliottii var. densa (South Florida slash pine), with an understory of Sabal palmetto (cabbage palm) and Serenoa repens (saw palmetto), in varying abundance. Overstory pines may be scarce in some areas due to logging and little or no subsequent regeneration.

PINE-PRAIRIE. Forests of Pinus elliottii var. densa (south Florida slash pine) with a mixed graminoid understory dominated by Muhlenbergia filipes, Schizachyrium rhizomatum, Cladium jamaicense and Paspalum monostachyum. Sabal palmetto and Serenoa repens may be present, but occupy a small percentage of the area.

PINE-HARDWOOD STANDS. Forests of Pinus elliotti var. densa (south Florida slash pine), with a well developed hardwood understory. Common hardwood species include, (Myrica cerifera, Ilex cassine and Quercus virginiana.

OAK-SABAL HAMMOCKS. Hardwood stands dominated by Quercus laurifolia (laurel oak). Subcanopy species include Sabal palmetto (cabbage palm), Myrsine floridana (myrsine), Ardisia escallonioides (marlberry) and Psychotria spp. (wild coffee).

HARDWOOD SCRUB. Stands of hardwood shrubs (< 5 m) tall including: Myrica cerifera (wax myrtle), Ilex cassine (dahoon holly), Quercus virginiana (live oak) and Serenoa repens (saw palmetto).

SAWGRASS MARSH. Graminoid community dominated by dense, tall (2 m) Cladium jamaicense (sawgrass).

EMERGENT AQUATIC MARSH. Community of emergent aquatic plants such as Pontederia lanceolata (pickerel weed), Sagittaria spp., Typha spp. (cattails) and Nymphaea odorata.

MUHLENBERGIA PRAIRIE. Graminoid community dominated by Muhlenbergia filipes. Associated species which may be locally dominant includes: Cladium jamaicense (sawgrass); Paspalum monostachyum; and Spartina bakeri (cordgrass).

OPEN WATER. Canals and borrow pits with no emergent vegetation, but may support submergent species such as Utricularia spp., Ceratophyllum demersum, Hydrilla verticillata, and Najas flexilis.

EXOTIC AREAS. Areas dominated by Schinus terebinthifolius (Brazilian pepper).

DISTURBED LAND. Bare or recently disturbed ground that may be colonized by weedy successional vegetation, including areas around campsites, homesites, and spoil banks.

VEGETATION TRANSECT

VEGETATION PLOT (15 m x 40 m)

HYDROLOGIC MONITORING STATION

METHODS

Plant communities were delineated on 9 in. x 9 in. color aerial photgraphs. The details were transferred to a skeleton map (1:10,000), which was generated from USGS 7.5 minute orthophoto quadrangle sheets, using a Map-O-Graph opaque projecter. Plant communities largely correspond to those used by Davis (1943), Craighead (1971), McPherson (1973) and Duever et al. (1979). Ground truthing was done during February 1981. We thank Mr. Antonio Jurado of the Water Resources Division, U.S. Geological Survey in Miami, Florida for aid and consultation. Dr. Lloyd Loope is also acknowledged for his contributions in the early planning stages of this project.