SOUTH FLORIDA RESEARCH CENTER

Report T-604

Tropical Hardwood Hammocks of the Interior of Everglades National Park and Big Cypress National Preserve

NATIONAL PARK SERVICE

DEPARTMENT OF THE INTERIOR

Everglades National Park, South Florida Research Center, P.O. Box 279, Homestead, Florida 33030

TROPICAL HARDWOOD HAMMOCKS OF THE INTERIOR OF EVERGLADES NATIONAL PARK AND BIG CYPRESS NATIONAL PRESERVE

Report T-604

Ingrid C. Olmsted, Lloyd L. Loope and Charles E. Hilsenbeck

National Park Service
South Florida Research Center
Everglades National Park
Homestead, Florida 33030

November 1980

Olmsted, Ingrid C., Lloyd L. Loope and Charles E. Hilsenbeck. 1980. Tropical Hardwood Hammocks of the Interior of Everglades National Park and Big Cypress National Preserve. South Florida Research Center Report T-604. 58 pp.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Tropical Hardwood Hammocks of the Interior of Everglades National Park and Big Cypress National Preserve

Ingrid C. Olmsted, Lloyd L. Loope and Charles E. Hilsenbeck

INTRODUCTION

At the southern tip of peninsular Florida and in the Florida Keys, the vegetation includes tropical hardwood forests similar in species composition to coastal hardwood forests of most Caribbean islands. The land that this vegetation occurs on is above the level subjected to seasonal inundation. These tropical forests, at their northern limit in Florida, are relatively impoverished in number of species, but as a result of higher precipitation the trees are generally more luxuriant and larger in size than their Caribbean counterparts (Robertson, 1955). Phillips (1940) pointed out that 82% of the 128 vascular plant species in one somewhat typical hammock occur also in the West Indies, while few occur in the United States outside Florida. As pointed out by Robertson (1955), the tropical hardwood forest vegetation of southern Florida falls within the category "Evergreen Seasonal Forest" in the classification of Beard (1944, 1955).

The term "hammock" has come to be used for these tropical forests of southern Florida, both in the local vernacular and botanical literature (Robertson, 1955), although application of the term is not very precise or consistent. In the literature, "hammock" usually refers to a forest type with a particular species composition, but it is sometimes used in a physiognomic sense (e.g., cypress hammock). In this paper, the terms "tropical hardwood hammock" and "hammock" are used to refer to forests of southern Florida dominated by West Indian hardwood species.

Since tropical hardwood hammocks are a totally different type of vegetation from any other in the continental United States, they hold great interest for botanists and visitors to southern Florida. Indeed, these hammocks attracted much attention from biologists during the early decades of the twentieth century. Important early accounts are given by Bessey (1911), Harshberger (1914), Safford (1919), Simpson (1920), Harper (1927), and Davis (1943). A major attraction were the epiphytic orchids and bromeliads that are often abundant in these hammocks (Craighead, 1963; Luer, 1972).

Hammocks occupy relatively high ground in an area that has extensive freshwater and saline marshes. To accommodate a rapidly expanding human population, large areas of hammock vegetation have been obliterated--especially in the Florida Keys and on the present site of Miami. Nevertheless, many hammocks are included within preserves, including Everglades National Park, Big Cypress National Preserve, Biscayne National Monument, and numerous state and county parks. Efforts are being made in the Florida Keys to encourage private landowners to preserve hammock forests. Within Dade County, many hammocks are included within county parks--such as Castellow Hammock Park, where the investigations of Phillips (1940) and Alexander (1967) were carried out.

Remarkably, in view of the unique character of the tropical hammocks of southern Florida, very little ecological work has been reported in the literature. Robertson (1955) gave an excellent overview of the considerable variation within the type and of relationships with other plant communities. Some quantitative data on composition of various types of hammocks is reported by Phillips (1940) and Alexander (1955, 1958a, 1958b, 1967). Hilsenbeck (1978) has provided a quantitative description of mature hammock vegetation of Totten Key of Biscayne National Monument and Key Largo--somewhat representative of mature forest of the upper Florida Keys.

This investigation focuses on hammocks of the interior of Everglades National Park and, to a lesser extent, the adjacent Big Cypress National Preserve. These hammocks are located at least 18 km from the coast. Within the preserves, the National Park Service has the responsibility for managing ecosystems in as natural a condition as possible (Houston, 1971). Such management requires a good understanding of ecological processes, especially in southern Florida, where the demands of modern man have begun to severely stress natural systems--even within the boundaries of parks and reserves (Robertson, 1958; Carter, 1973; Kushlan, 1979).

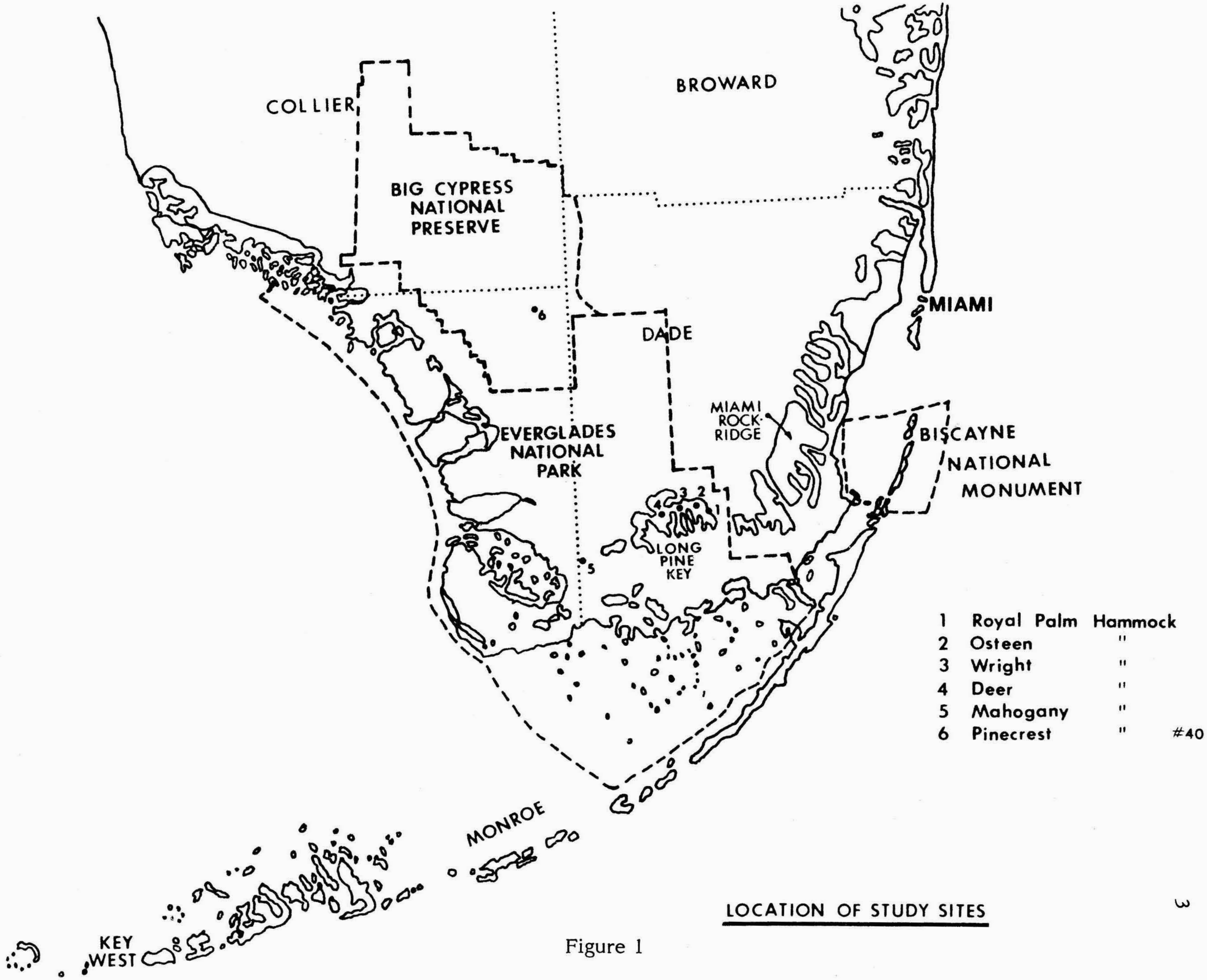
The major problem confronting the National Park Service in safeguarding hammock ecosystems is destructive fires. Some fires can burn into hammocks during periods of extreme drought, consuming organic soil and killing trees. Such fires may be increased in severity by lowered water tables as a result of nearby drainage canals. However, most ecosystems of South Florida, including hammocks, have evolved in the presence of recurring fire as a major ecological factor. A better understanding of successional dynamics in hammocks is needed to refine fire management practices.

This study was initiated to gather basic information on the species composition and apparent successional trends within mature hammocks of the interior of Everglades National Park. A major objective has been the establishment of baseline vegetation analysis in long-term quadrats so that successional patterns can be more fully understood through future reexamination.

Interior Hammocks and Their Environment

The tropical hardwood hammocks of the interior region of southern Florida are located in two major areas (Figure 1): (1) the southwestern extension of the Miami Rock Ridge (including "Long Pine Key") extending to the vicinity of Mahogany Hammock in Everglades National Park, and (2) a ridge extending northeast from Pinecrest in Big Cypress National Preserve. Pilsbry (1946) published maps of hammock locations in both the Long Pine Key and Pinecrest areas compiled by collectors of *Liguus*, a tree snail found in numerous color forms in hammocks throughout southern Florida. Craighead (1974) published a much revised version of Pilsbry's Long Pine Key map showing over 100 hammocks.

The hammocks of Long Pine Key range in size from 1 to 91 hectares and occur within a matrix of pine forest vegetation. Both pine forest and hardwood forest occur on a substrate of Miami oolite. The ground surface within both pineland and hammocks is elevated only a few cm to 2 m or more above the level of annual periodic flooding. Numerous solution holes occur in the rugged limestone substrate of both vegetation types. Little soil occurs in the pinelands, but the hammocks have a thin organic soil consisting of decomposing litter.



LOCATION OF STUDY SITES

Figure 1

The hammocks of Long Pine Key and vicinity are characterized by a closed canopy of mixed tropical hardwoods at heights of 6-10 m with occasional emergents to 15-17 m. The understory consists of tropical shrubs and small trees, some of which are the same species as those in the canopy. In contrast, the Long Pine Key pinelands have a single overstory species - Pinus elliottii var. densa - with a relatively open canopy. The pineland understory consists of about 40 tree and shrub hardwood species, including many of the same species found in tropical hardwood hammocks, and over 120 herbaceous species (Loope, et al. 1979). The hardwood trees and shrubs of the pineland are maintained in a short growth-form by recurrent periodic fire. If fire is excluded from pineland for 15-25 years, succession proceeds toward hammock formation (Robertson, 1953).

Beard (1938) believed it likely that before the introduction of fire to South Florida by man's activity "the Everglades Keys were once all hammock growth with intervening sawgrass glades," and that areas now occupied by pineland, because of man-caused fires, were originally hammock. Robertson (1953) pointed out the uniqueness of the Miami Rock Ridge pineland and recognized that numerous species confined to that type have fire adaptations. Avery and Loope (1980a) have identified 17 taxa as being found only in the Miami Rock Ridge pineland and nowhere else in the world.

Relative stability of hammock boundaries in relation to pineland also suggests that the current vegetation mosaic is similar to the one which has existed during the recent past.

The hammock-pineland relationship is a rather complex one in which pineland is maintained by fire on some sites, and hammocks prevail, in spite of occasional destruction by fire of vegetation and soil, on others. Hammocks persist on these sites perhaps because of the differential hardness of the limestone (Craighead, 1974) caused by localized solution and reprecipitation of calcium.

In contrast to the situation on Long Pine Key, Mahogany Hammock and the Pinecrest hammocks are surrounded by graminoid vegetation. Mahogany Hammock occupies a slight elevation of marl substrate surrounded by seasonally inundated sawgrass (Cladium jamaicense) and spikerush (Eleocharis cellulosa) marsh. The Pinecrest hammocks occur on remnant platforms of Miami limestone (oolite) (Duever et al., 1979) and occupy the only sites in the vicinity which are not seasonally flooded.

South Florida is very young geologically and was entirely under the sea at least as recently as 70,000 years ago when recession occurred with the onset of the early Wisconsin glacial period (Hoffmeister, 1974). Another incursion of the sea may have occurred during a major interglacial period about 35,000 B.P., between the Early and Late Wisconsin Glacial periods. During full glacial times, the sea level had dropped to a depth of about 135 m below its present stand and all present continental shelf areas lay out of the water. South Florida was approximately twice as wide then as it is now (Fairbridge, 1974). Clearly, most of South Florida was upland during the glacial periods, probably being without extensive wetland areas and with extensive limestone bedrock at or near the surface. The oldest radiocarbon dates recorded for peat deposits from the Everglades and from mangrove swamps are approximately 5000 years old (Gleason, et al., 1974). According to Fairbridge (1974), sea level rose concurrently with glacial retreat until about 6000 years ago and has since been oscillating. His scenario includes a rise in sea level to up to 4 m above the present one during the period of 6000-4700 B.P. In contrast, Scholl, Craighead, and Stuiver (1969) present evidence that sea level in South Florida has been rising continuously during the past 7000 years.

Interior hammocks of Everglades National Park range in surface elevation from about 1 m to 4 m above msl. Those of Big Cypress National Preserve range in elevation from 3 m to 6 m. Even if the hypothesized 4 m rise in sea level 5000 years ago did occur, high enough elevations with favorable substrates for hammock vegetation have presumably existed for 35,000 to 70,000 years.

Data for mean monthly precipitation and mean temperature maxima and minima from Royal Palm Ranger Station (Table 1) are representative of the climatic regime of the region occupied by tropical hardwood hammocks in southern Florida. Frosts occur somewhere in the region about every other year (Craighead, 1971). Hurricanes or tropical storms may strike southern Florida about every 8 years (Gentry, 1974). Severe hurricanes, even though relatively infrequent, have had tremendous impacts on vegetation of coastal areas and substantial impacts for interior hammocks (Craighead and Gilbert, 1962).

STUDY SITES

Vegetation of tropical hardwood hammocks of South Florida is a complex mosaic of stands of differing histories of disturbance (fire, hurricane, etc.). Since the initial aim of this study was to characterize the composition and successional trends within mature hammocks, in choosing sites for detailed study, we sought mature-appearing, seemingly diverse hammocks distributed over the geographic area of interest. Four of the hammocks chosen - Royal Palm, Osteen, Wright, and Deer - are in the Long Pine Key area of Everglades National Park and Mahogany Hammock is just west of this rock ridge - Pinecrest #40 is northeast of the settlement of Pinecrest in Big Cypress National Preserve.

Royal Palm Hammock (91 ha), located on Paradise Key at the eastern edge of Long Pine Key, is one of the largest and best known hammocks in South Florida. It was incorporated into Royal Palm State Park in 1916, long before the establishment of Everglades National Park (1947). Approximately 90% of the hammock was severely affected by a fire which occurred in April, 1945 (Alexander, 1954; Robertson, 1953, 1955). The portion of Royal Palm hammock chosen for our study site was not affected by the 1945 fire. Examination of 1940 aerial photography suggests that this portion of the hammock had not been affected by fire for at least several decades prior to the photographs.

Osteen Hammock (28 ha) is located on Long Pine Key, about 3 km northwest of Royal Palm. Aerial photography taken in 1940 suggests that the northern half of the hammock had been strongly affected by fire in the previous decade or two. Aerial photography from 1952 shows that the hammock had severely burned. Canopy trees were killed over 70% of the hammock. The portion of the canopy that survived appears to be primarily oaks in the north-central portion of the hammock. The date of this last major fire was probably 1945. Based on the 1952 aerial photography, the area chosen for sampling had few if any trees which survived the fire of the 1940's.

Table 1. Climatic Data for Flamingo, Homestead, and Royal Palm Ranger Station

	Flamingo 1970 - 1979 Mean		Homestead 1970 - 1979 Mean		Royal Palm 1970 - 1979
	Max°C	Min°C	Max°C	Min°C	cm Rainfall*
January	24.3	13.0	24.6	12.5	4.0
February	23.9	12.9	24.6	12.3	4.5
March	26.3	15.8	27.4	14.9	2.4
April	27.5	17.8	28.7	16.5	8.5
May	29.4	20.2	30.4	19.4	15.2
June	30.9	22.6	31.5	21.5	22.6
July	31.1	23.5	32.1	22.1	17.3
August	31.7	23.3	32.2	22.4	20.3
September	31.2	23.3	31.8	22.3	19.7
October	29.7	20.4	29.7	19.8	13.2
November	27.5	17.3	27.4	16.7	4.9
December	25.4	14.4	25.4	13.9	4.7
Annual Average Rainfall 1970-1979	121.5cm		137.5cm		137.3cm

*Temperatures are not available for Royal Palm for the period 1970-1979. The Homestead temperatures are very similar to those at Royal Palm.

Wright Hammock (11 ha) is 4 km west of Osteen. Based on examination of aerial photographs taken between 1940 and 1964, this hammock appears not to have been subjected to major fire damage in 60 years or more.

Deer Hammock (8 ha) is located on Long Pine Key, 4 km west of Wright Hammock. Aerial photography shows that this hammock was severely burned just prior to 1940, destroying the canopy in the western half. Although there has been no major damage to the forest canopy of this hammock for the past 40 years, fires have encroached into the margins. Study plots were located in the relatively mature-appearing half of the hammock.

Mahogany Hammock (11 ha) is located just west of the westernmost pine stands of Long Pine Key. It is surrounded by marsh vegetation, much of which is too sparse to carry fires. No evidence is available to suggest that this hammock has been influenced by fire during the past 50 years. However, the hurricane of September 1960 had a tremendous impact on this hammock (Craighead and Gilbert, 1962). This storm disrupted a previously closed canopy of mahogany (W. B. Robertson, personal communication).

Pinecrest Hammock #40 (16 ha) is located 4 km northeast of Pinecrest. Aerial photographs show that it was in an early successional stage following disturbance (probably a fire) in 1940, but has not had major disturbance since then.

Damage from hurricanes to Long Pine Key hammocks would not be visible on aerial photographs. However, light gaps - opened up by debris of broken branches and tree tops, were frequent after hurricanes Donna and Betsy. Robertson (personal communication) mentioned the quick establishment of Carica papaya in these gaps that were observable from the air.

METHODS

1. Field Sampling

Three 100 m^2 plots were used in each hammock. Hilsenbeck (1976) showed that rectangular plots of 100 m^2 produce best results for analysis of hammocks and that 300 m^2 is an adequate area for sampling. We placed plots in the most mature-looking areas of the hammocks. Transects were placed along the north-south axis of the hammocks to be sampled. The plots were laid out at roughly equal distances from each other and placed to avoid the edge effects encountered at hammock margins.

Each rectangular plot was divided into four subplots of 5 x 5 m^2. All specimens taller than 2 m and with more than 6 cm^2 basal area were considered trees. We used a "basal area tape." Any plants between 60 cm and 2 m were considered saplings. All plants shorter than 60 cm were considered seedlings. All trees were counted in each subplot, and height and basal area were measured. All saplings were also identified in each subplot. Within each subplot, square quadrats, 1 m on each side (1 m^2), were placed at the corners and in the center for total count of seedlings.

Epiphytes within the plots were given abundance ratings based on estimated counts, as follows:

Rating	Bromeliads	Ferns	Orchids
1	1-15 individuals	1-2 individuals	1-3 individuals
2	16-50 individuals	3-8 individuals	4-10 individuals
3	more than 50	more than 8	more than 10

Soil depths (ten per subplot, 120 per hammock) were taken with a meter stick. Complete species lists were made for all hammocks studied. Nomenclature follows Avery and Loope (1980b) which diverges slightly from Long and Lakela (1976).

2. Data Analysis

Data were entered directly into a computer, values sorted and statistics applied. Histograms for height and basal area were established for individual species, individual hammocks and all stands together. Analysis of variance was calculated on most measures of height and basal area. Importance values for species were calculated from relative density, relative dominance (basal area), and relative frequency values for each hammock as well as based on those measures for all hammocks. Statistical tests on basal area were done after basal area was converted to a lognormal distribution. Duncan's Multiple Range Test (Steel and Torrie, 1960) was used for grouping hammocks according to density of trees and saplings.

RESULTS

1. Stand Comparisons

a. Species Richness

A species list made before analysis for each hammock is given in Appendix A. As would be expected, the number of species encountered in each hammock exceeded the number found in the plots alone for that hammock. Table 2 gives a comparison of the total number of species per hammock vs. those found in analyzed plots only, broken down according to trees, shrubs, vines, etc. Trees found in the plots represent 60-70% of all the trees known from each hammock. These percentages suggest that the number of species sampled is sufficient to represent the species composition (Müller-Dombois, 1974).

b. Similarity Index

Table 3 shows a similarity index calculated according to the method of Sorensen (1948) for the total number of species in each hammock, the total number of species in plots, for the number of trees and shrubs of the total species list, and for the trees and shrubs of plot species only.

c. Density

Table 4 is an indication of tree, sapling and seedling density/plot/hammock.

Table 2. Numbers of Species According to Growth Form

	Wright		Deer		Mahogany		Osteen		Pinecrest		Royal Palm	
Trees	18*	(30)	20	(28)	18	(26)	19	(31)	15	(25)	22	(35)
Shrubs	3	(4)	3	(4)	2	(7)	4	(4)	3	(6)	3	(8)
Vines	7	(11)	6	(11)	5	(17)	6	(11)	2	(11)	5	(14)
Palms	2	(2)	2	(3)	2	(4)	2	(3)	0	(2)	2	(3)
Graminoids	1	(3)	4	(5)	1	(5)	3	(6)	1	(5)	0	(6)
Forbs	1	(3)	2	(2)	0	(3)	1	(3)	1	(1)	1	(2)
Ferns	3	(7)	6	(6)	5	(11)	5	(13)	3	(9)	5	(10)
Orchids	2	(4)	6	(9)	1	(7)	2	(7)	1	(2)	3	(6)
Bromeliads	5	(5)	6	(6)	6	(6)	4	(7)	1	(5)	4	(7)
TOTAL	42	(69)	55	(74)	40	(86)	46	(85)	28	(67)	45	(91)

* Actual number of species in three 100 m^2 plots

( ) Total number of species in whole hammock, excluding ecotonal and solution hole species

Table 3. Comparison of Hammock Floristic Similarities using Sorensen's Index

	Deer				Mahogany				Osteen				Pinecrest				Royal			
	*	●	+	#	*	●	+	#	*	●	+	#	*	●	+	#	*	●	+	#
Deer																				
Mahogany	61	70	71	68																
Osteen	63	65	83	78	58	60	78	82												
Pinecrest	41	62	67	70	44	48	72	75	46	57	68	62								
Royal	58	58	72	73	59	70	84	80	68	79	84	88	44	47	71	74				
Wright	76	77	83	82	68	78	74	69	73	77	81	87	46	65	69	67	69	70	81	81

* all species in plots

● trees - shrubs in plots

\+ all species in hammock

\# trees - shrubs in hammock

Sorensen's Index: $\frac{2C}{A+B}$

Where: A is # of species in area A
B is # of species in area B
C is # of species common to A and B

Table 4. Tree, Sapling and Seedling Densities for Each Plot

	Trees				Saplings				Seedlings			
Plot	1	2	3	Total	1	2	3	Total	1	2	3	Total
Deer	95	100	107	302	209	146	122	477	559	425	248	1232
Mahogany	98	119	89	306	111	124	82	317	972	715	242	1929
Wright	79	61	92	232	140	164	141	445	397	357	509	1263
Osteen	83	70	74	227	110	77	58	245	347	316	305	968
Royal Palm	58	47	77	182	85	70	95	250	310	397	264	971
Pinecrest	44	51	38	133	71	39	35	143	328	195	359	882

<u>Results of Duncan's Multiple Range Test:</u> Groups, based on densities of trees and saplings.

Trees	Saplings
Pinecrest #40, Royal Palm	Pinecrest #40, Osteen, Royal Palm
Royal Palm, Osteen, Wright	Osteen, Royal Palm, Mahogany
Deer, Mahogany	Wright, Deer
	Wright, Mahogany

d. Height and Basal Area

Table 5 shows the total basal area/species/hammock and the average basal area/species/hammock for the 300 m^2 area of the plots. Average height and basal area for the most important species/hammock are shown in Table 6. The distribution of height for all species over all hammocks is shown in Figure 2, and that of basal area in Figure 3. The distribution of height and basal area measuremetns for each hammock are shown in Figures 4 and 5, respectively. Figure 6 shows the distribution of height measurement for the most common tree species in all hammocks.

e. Importance Values

Appendix B shows absolute density, absolute frequency, and absolute basal area for each species in each hammock. Relative density, relative frequency and relative basal area for all tree species for each hammock were summed to give the importance values in Tables 7-12. In this way each hammock is looked upon as an entity. Table 13 shows the ranking of the 11 most important species as compared to the densities, basal areas and frequencies of all species in all hammocks. It also indicates the overall frequency of the species as well as their constancy. The species ranking highest in Importance Value are listed in Table 14 for each hammock.

f. Epiphytes

Abundance of bromeliads, orchids and ferns are shown in Table 15.

g. Herbaceous Understory

The herbaceous understory, consisting of forbs, grasses, ferns and vines, is analyzed in Table 16.

h. Soil Depth

Table 17 shows the average soil depth for each hammock.

2. Species Comparison

Histograms showing distributions of height measurements for selected species in individual hammocks are shown in Figure 7-12. Table 18 shows the tree, sapling and seedling density by species for each hammock.

DISCUSSION

Robertson (1955) pointed out the qualitative similarities and differences between the South Florida tropical hardwood hammocks. On the basis of our data we will show qualitatively and quantitatively the present floristic, structural and successional state of the six hammocks studied.

Species Richness and Similarity in Species Composition Between Hammocks

The total number of species listed during a thorough search in each hammock before quantitative analysis includes solution hole, rare and ecotonal species

Table 5. Basal Area Statistics for all Hammocks (300 m^2/hammock)

Species	Deer n	Deer $\bar{x}$ ± SD	Deer (cm^2) Total	Mahogany n	Mahogany $\bar{x}$ ± SD	Mahogany (cm^2) Total	Osteen n	Osteen $\bar{x}$ ± SD	Osteen (cm^2) Total
Acoelorraphe wrightii				6					
Ardisia escallonioides	8	15.8 ± 17	127	11	11.6 ± 6	127	17	15.2 ± 6	259
Ateramnus lucidus	62	18.8 ± 13	1165				3	27 ± 20	81
Bumelia (Dipholis)									
salicifolia	21	32 ± 30	679	14	56 ± 57	788	9	67 ± 47	605
Bursera simaruba	2	72.5 ± 37	145	15	144 ± 182	2164	12	253 ± 408	3040
Calyptranthes pallens				18	29.3 ± 34	527			
Calyptranthes zuzygium				1					
Celtis laevigata									
Coccoloba diversifolia	43	58.2 ± 64	2513	3	9.3 ± 1	28	51	30.7 ± 24	1565
Chrysophyllum									
oliviforme				2		45			
Eugenia axillaris	19	12.3 ± 6	233	101	18.0 ± 10	1819	8	11.6 ± 7	93
Eugenia foetida				16	35 ± 24	561			
Exothea paniculata	16	26.3 ± 28	421	1		8	16	33.5 ± 30	537
Ficus aurea	2	141 ± 79	282	3	309 ± 417	928	6	85.6 ± 56	514
Guettarda scabra							1		16
Krugiodendron ferreum	14	21 ± 13	293						
Lysiloma latisiliquum	12	106 ± 81	1270				11	412 ± 294	4538
Mastichodendron									
foetidissimum									
Metopium toxiferum	17	63 ± 58	1069	63	32 ± 43	2025	9	291.4 ± 183	2623
Myrcianthes fragrans	6	13.5 ± 10	81	1		14			
Myrsine floridana	2	10 ± 4	20				2	10 ± 4	20
Nectandra coriacea	16	11.5 ± 6	185	1		7	27	36.3 ± 20	981
Prunus myrtifolia							16	48.5 ± 36	776
Persea borbonia	1		28						
Pisonia aculeata							2	13 3	26
Quercus virginiana	11	569 ± 420	6265	2	650 ± 250	1300			
Sabal palmetto				4					
Schoepfia									
chrysophylloides	4	15.5 ± 7	62						
Simarouba glauca							1	36	
Swietenia mahogoni				13	673 ± 956	8755			
Tetrazygia bicolor							2	49 ± 9	98
Zanthoxylum fagara									
Total			14338			19096			15801

Species	Pinecrest n	Pinecrest $\bar{x}$ ± SD	Pinecrest (cm^2) Total	Royal n	Royal $\bar{x}$ ± SD	Royal (cm^2) Total	Wright n	Wright $\bar{x}$ ± SD	Wright (cm^2) Total
Acoelorraphe wrightii									
Ardisia escallonioides	2	10 ± 2	20	1		8	15	11.7 ± 3.8	175
Ateramnus lucidus									
Bumelia (Dipholis)									
salicifolia	4	538 ± 530	2153	11	111.6 ± 96	1228	23	88.4 ± 66	2033
Bursera simaruba	5	1000 ± 742	5000	1		14	5	169 ± 99	845
Calyptranthes pallens									
Calyptranthes zuzygium				40	39.5 ± 43	1580			
Celtis laevigata	4	124 ± 42	496						
Coccoloba diversifolia	30	60.8 ± 81	1825	1		10	24	53.4 ± 42	1283
Chrysophyllum									
oliviforme	2	21.5 ± 1	43						
Eugenia axillaris	12	17.5 ± 8	210	1		6	16	14.2 ± 13	228
Eugenia foetida									
Exothea paniculata	1		23	28	48 ± 74	1355	10	37.4 ± 37	374
Ficus aurea				1		4450			
Guettarda scabra				9	10.8 ± 2	97	31	18.3 ± 10	568
Krugiodendron ferreum	9	98.3 ± 140	885						
Lysiloma latisiliquum	7	834 ± 271	5840				7	252 ± 154	1765
Mastichodendron									
foetidissimum	2	3450 ± 450	6900				3	25.3 ± 17	76
Metopium toxiferum				7	135.6 ± 115	949	5	176.6 ± 80	883
Myrcianthes fragrans							6	22.5 ± 15	135
Myrsine floridana	4	35.5 ± 40	142				2	15 ± 5	30
Nectandra coriacea	33	67.9 ± 82	2243	26	26.4 ± 39	687	25	26.8 ± 18	671
Prunus myrtifolia				11	48.7 ± 36	536	1		14
Persea borbonia									
Pisonia aculeata									
Quercus virginiana				7	2164 ± 134	15150	4	1037.5 ± 657	4150
Sabal palmetto									
Schoepfia									
chrysophylloides	1		22	3	35.7	107			
Simarouba glauca	1		13	7	157 ± 121	1102			
Swietenia mahogoni									
Tetrazygia bicolor				1		29			
Zanthoxylum fagara	4	158 ± 72	632						
Total			26447			27314			13239

Table 6. Comparison of Average Basal Area and Height Among Species - All Hammocks

Species		Deer x̄ ± SD	Mahogany x̄ ± SD	Osteen x̄ ± SD	Pinecrest #40 x̄ ± SD	Royal Palm x̄ ± SD	Wright x̄ ± SD	N	F.	Probability
Ardisia escallonioides	BA*	0.9 ± 0.3	1.0 ± 0.2	1.1 ± 0.2	1.0 ± 0.1		1.0 ± 0.1	54	0.56	NS
	HT**	4.3 ± 1.6	4.4 ± 0.7	5.1 ± 1.3	5.7 ± 0.1		4.1 ± 1.2	54	2.04	NS
Bumelia salicifolia	BA	1.3 ± 0.4	1.5 ± 0.5	1.7 ± 0.3	2.5 ± 0.4	1.8 ± 0.5	1.8 ± 0.3	82	8.01	0.01
	HT	6.1 ± 2.1	7.0 ± 1.5	9.1 ± 1.8	10.3 ± 2.2	9.7 ± 3.6	8.4 ± 1.4	82	6.86	0.01
Bursera simaruba	BA		1.7 ± 0.7	2.1 ± 0.5	2.8 ± 0.4		2.1 ± 0.3	37	4.98	0.01
	HT		6.9 ± 2.6	8.5 ± 1.4	11.9 ± 1.8		8.7 ± 1.3	37	7.8	0.01
Coccoloba diversifolia	BA	1.5 ± 0.4	1.0 ± 0.1	1.4 ± 0.3	1.6 ± 0.4		1.6 ± 0.3	151	3.55	0.01
	HT	5.2 ± 1.8	3.5 ± 0.9	5.3 ± 1.5	6.2 ± 2.2		5.3 ± 1.8	151	2.45	0.05
Eugenia axillaris	BA	1.0 ± 0.2	1.2 ± 0.2	1.0 ± 0.2	1.2 ± 0.2		1.0 ± 0.2	152	3.9	0.01
	HT	4.2 ± 0.7	5.2 ± 1.0	4.8 ± 1.7	5.8 ± 1.5		4.5 ± 0.9	152	5.6	0.01
Exothea paniculata	BA	1.4 ± 0.3		1.4 ± 0.4		1.3 ± 0.5	1.4 ± 0.3	70	0.12	NS
	HT	4.8 ± 1.3		6.2 ± 1.5		5.7 ± 2.1	4.9 ± 2.1	70	1.88	NS
Guettarda scabra	BA					1.0 ± 0.1	1.2 ± 0.2	40	3.8	NS
	HT					4.5 ± 0.6	4.3 ± 0.9	40	0.32	NS
Krugiodendron ferreum	BA	1.2 ± 0.2			1.6 ± 0.6			23	4.46	0.05
	HT	4.6 ± 0.6			6.9 ± 2.7			23	9.16	0.01
Lysiloma latisiliquum	BA	1.9 ± 0.4		2.5 ± 0.3	2.9 ± 0.2		2.3 ± 0.3	37	15.9	0.01
	HT	6.8 ± 2.0		11.3 ± 1.1	15.6 ± 0.9		8.5 ± 1.8	37	51.2	0.01
Metopium toxiferum	BA	1.6 ± 0.5	1.3 ± 0.3	2.3 ± 0.5		1.8 ± 0.7	2.1 ± 0.4	99	14.4	0.01
	HT	6.0 ± 1.9	6.0 ± 1.3	11.0 ± 2.5		8.7 ± 2.8	8.2 ± 2.0	99	20.9	0.01
Myrcianthes fragrans	BA	1.0 ± 0.3					1.2 ± 0.4	12	0.9	NS
	HT	4.0 ± 1.2					4.2 ± 1.3	12	0.09	NS
Myrsine floridana	BA	1.0 ± 0.2			1.3 ± 0.5			6	0.8	NS
	HT	3.4 ± 0.3			6.0 ± 1.4			6	5.6	NS
Nectandra coriacea	BA	1.0 ± 0.2		1.5 ± 0.2	1.6 ± 0.4	1.2 ± 0.4	1.3 ± 0.3	127	13.1	0.01
	HT	4.7 ± 0.7		6.7 ± 1.2	7.3 ± 1.7	6.2 ± 1.8	5.1 ± 1.4	127	13.1	0.01
Prunus myrtifolia	BA			1.5 ± 0.4		1.5 ± 0.4		28	0.14	NS
	HT			7.2 ± 1.8		7.4 ± 1.9		28	0.09	NS
Quercus virginiana	BA	2.6 ± 0.3				3.2 ± 0.3	2.9 ± 0.3	22	6.2	0.01
	HT	10.8 ± 2.1				14.2 ± 2.6	10.2 ± 1.5	22	6.08	0.01

*BA log transformed

** HT in m

TOTAL TREE HEIGHT DISTRIBUTION IN ALL HAMMOCKS

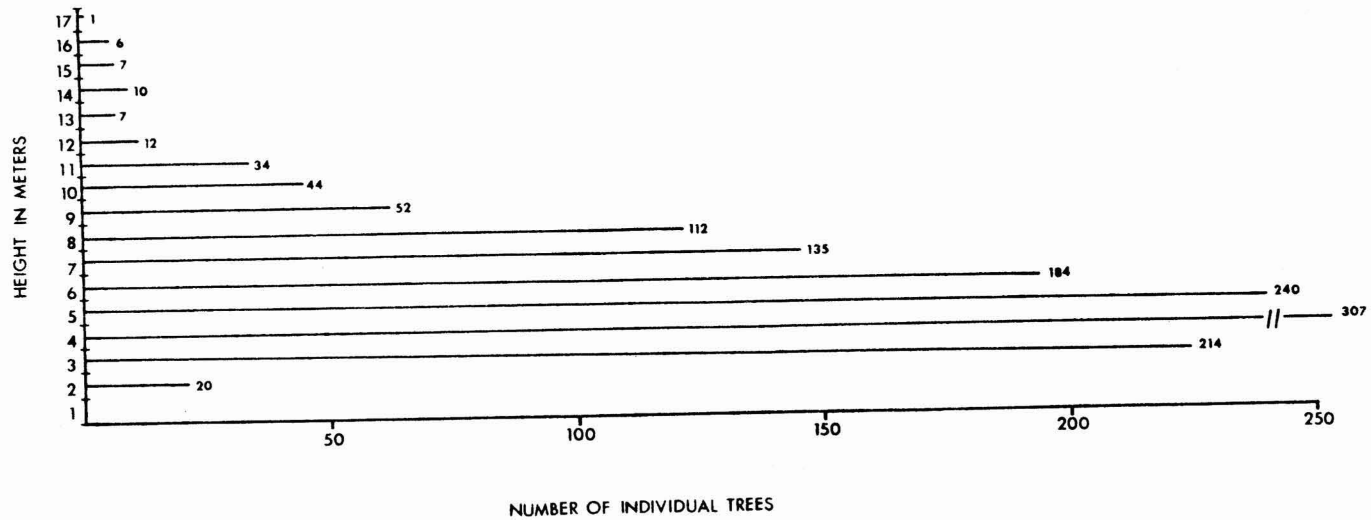


Figure 2

BASAL AREA DISTRIBUTION IN ALL HAMMOCKS

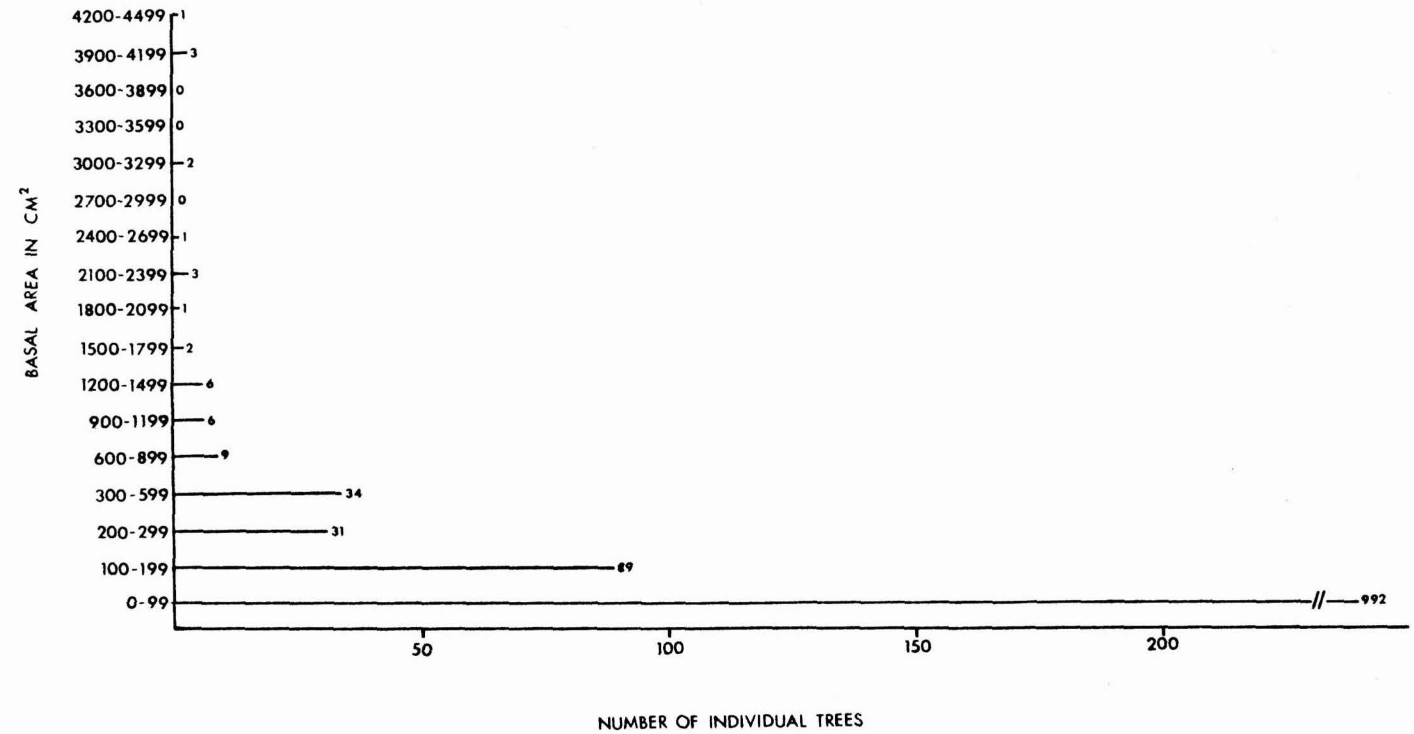


Figure 3

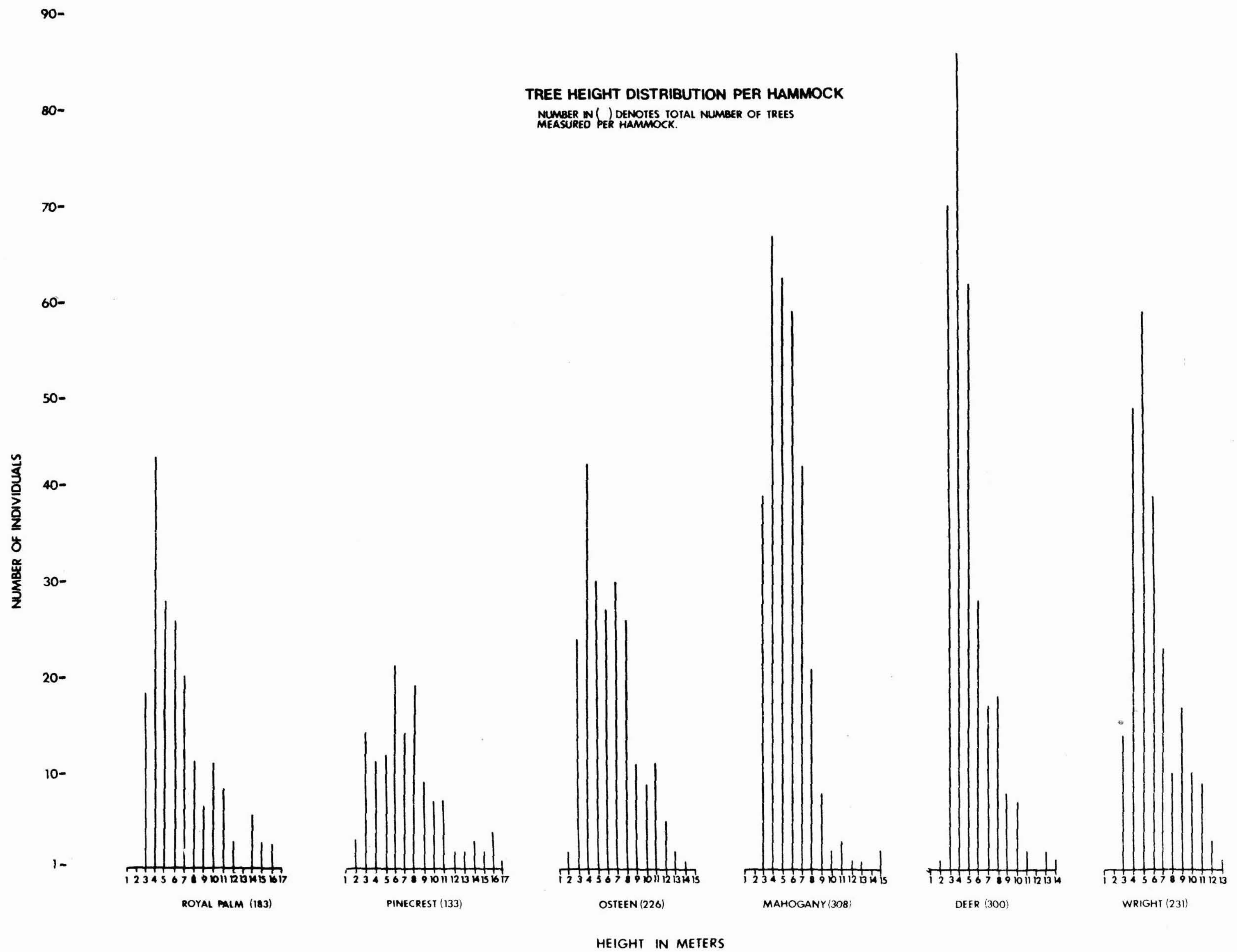
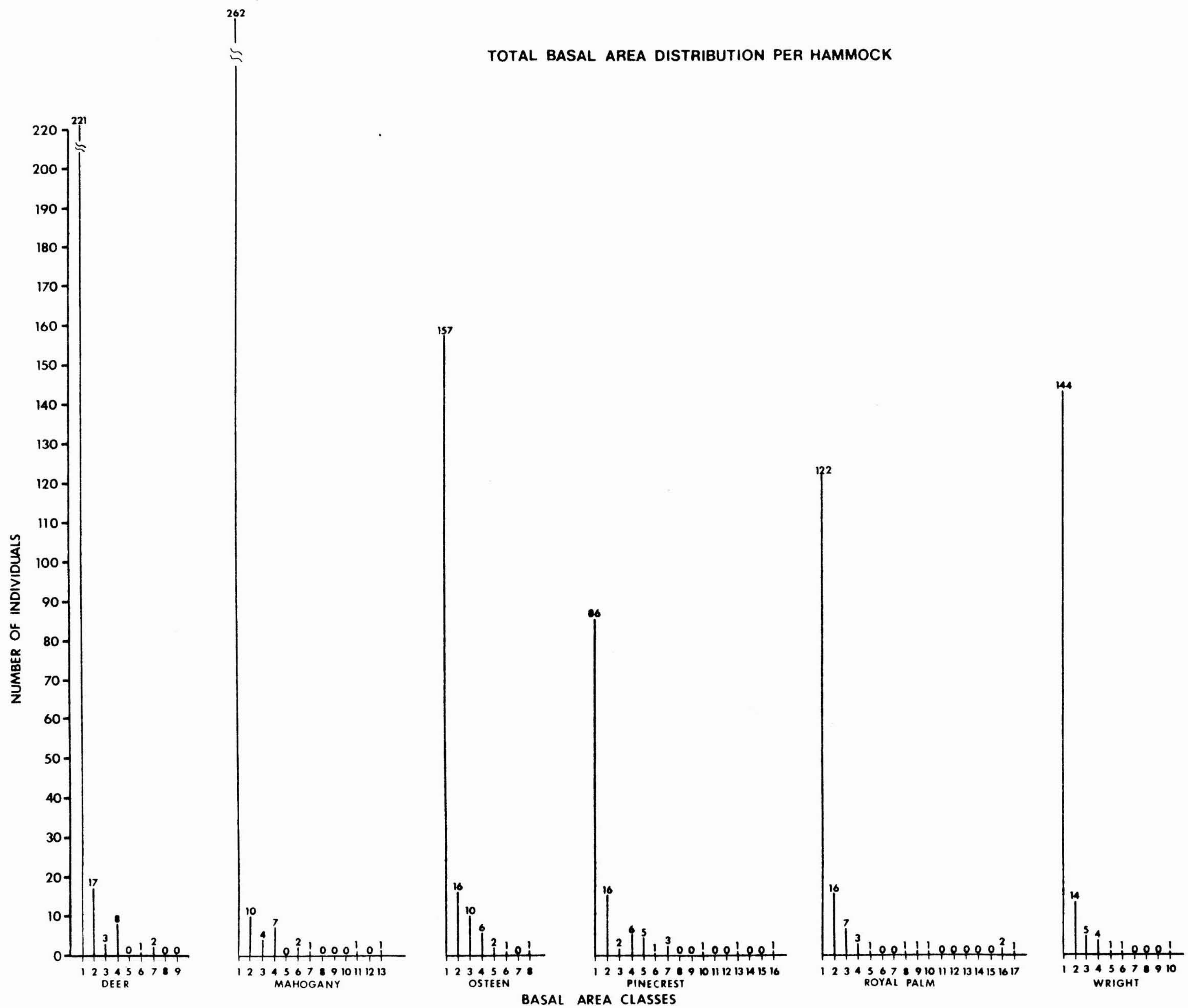

TREE HEIGHT DISTRIBUTION PER HAMMOCK
NUMBER IN ( ) DENOTES TOTAL NUMBER OF TREES MEASURED PER HAMMOCK.
NUMBER OF INDIVIDUALS
90-
80-
70-
60-
50-
40-
30-
20-
10-
1-
ROYAL PALM (183)
PINECREST (133)
OSTEEN (226)
MAHOGANY (308)
DEER (300)
WRIGHT (231)
HEIGHT IN METERS

Figure 4



BASAL AREA CM^2	CLASS
6 - 99	1
100 - 199	2
200 - 299	3
300 - 599	4
600 - 899	5
900 - 1199	6
1200 - 1499	7
1500 - 1799	8
1800 - 2099	9
2100 - 2399	10
2400 - 2599	11
2700 - 2999	12
3000 - 3299	13
3300 - 3599	14
3600 - 3899	15
3800 - 4199	16
4200 - 4499	17

Figure 5

HEIGHT DISTRIBUTIONS FOR 10 SPECIES IN ALL HAMMOCKS

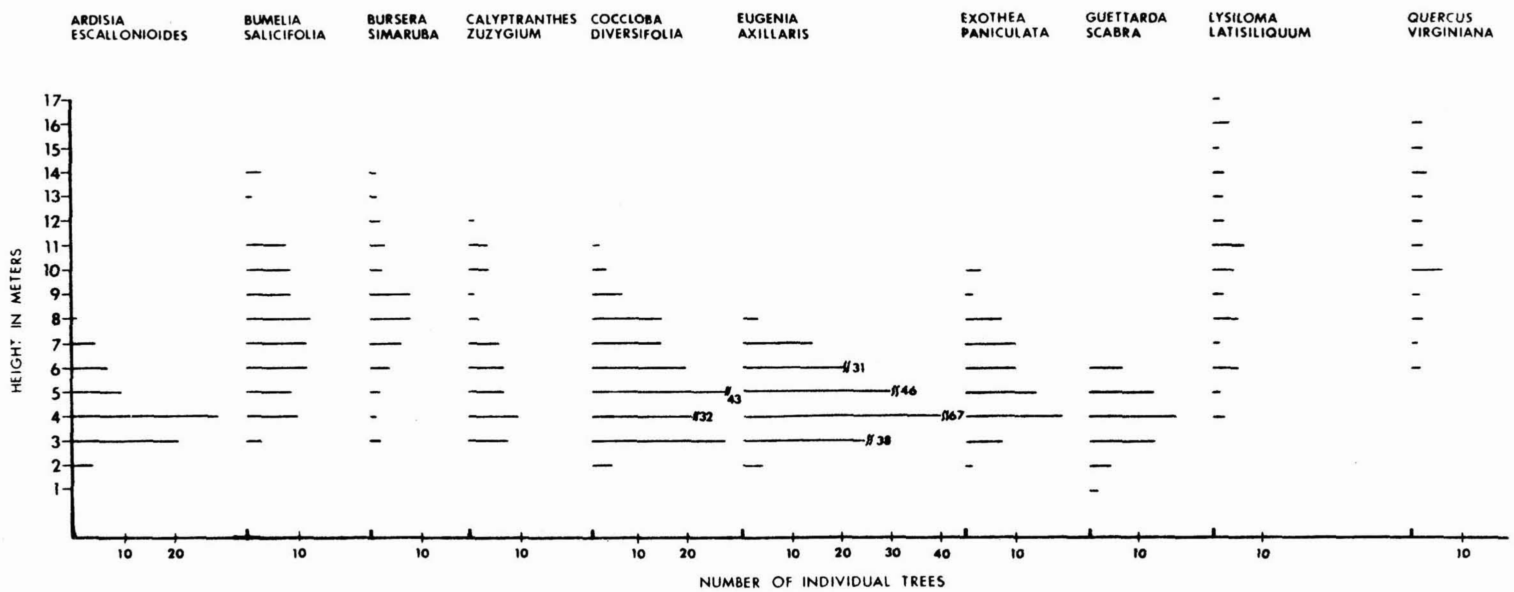


Figure 6

Table 7. Tree Species Importance Values for Deer Hammock

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Ardisia escallonioides	7.9	.86	6.6	15.4
Ateramnus lucidus	23.2	7.8	11.3	42.3
Bumelia salicifolia	6.9	4.6	8.5	20.0
Bursera simaruba	.7	1.0	1.9	3.6
Coccoloba diversifolia	14.2	16.9	11.3	42.4
Eugenia axillaris	8.6	1.6	8.4	18.6
Exothea paniculata	5.3	2.8	9.4	17.5
Ficus aurea	.7	1.9	1.9	4.5
Krugiodendron ferreum	5.0	2.0	4.7	11.7
Lysiloma latisiliquum	4.0	8.5	5.6	18.1
Metopium toxiferum	6.0	7.2	9.4	22.6
Myrcianthes fragrans	2.0	.5	1.9	4.4
Myrsine floridana	2.0	.1	4.7	6.8
Nectandra coriacea	8.0	1.2	6.6	15.8
Persea borbonia	.3	.2	.9	1.4
Quercus virginiana	3.6	42.2	5.7	51.5
Schoepfia chrysophylloides	1.3	.4	.9	2.6

Table 8. Tree Species Importance Values for Mahogany Hammock

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Acoelorraphe wrightii	1.9	-	2.2	4.1
Ardisia escallonioides	6.5	.7	9.0	16.2
Bumelia salicifolia	5.2	4.1	7.9	17.2
Bursera simaruba	4.8	11.3	10.2	26.3
Calyptranthes pallens	5.8	2.7	7.9	16.4
Calyptranthes zuzygium	.3	-	1.1	1.4
Coccoloba diversifolia	.9	.1	2.2	3.2
Chrysophyllum oliviforme	.6	.2	2.2	3.0
Eugenia axillaris	39.0	9.5	13.6	62.1
Eugenia foetida	5.5	2.9	6.8	16.0
Exothea paniculata	.3	.03	1.1	1.4
Ficus aurea	.9	4.8	3.4	9.1
Metopium toxiferum	20.1	10.6	13.6	44.3
Myrcianthes fragrans	.6	.06	2.2	2.8
Nectandra coriacea	.3	.03	1.1	1.4
Quercus virginiana	.6	6.8	1.1	8.5
Sabal palmetto	1.3	-	3.4	4.7
Swietenia mahagoni	4.2	45.8	10.2	60.2

Table 9. Tree Species Importance Values for Osteen Hammock

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Ardisia escallonioides	15.5	1.6	9.5	26.6
Ateramnus lucidus	1.3	.5	3.2	5.0
Bumelia salicifolia	4.8	3.8	7.4	16.0
Bursera simaruba	5.3	19.2	7.4	31.9
Coccoloba diversifolia	23.2	9.9	10.6	43.7
Eugenia axillaris	5.7	.6	4.2	10.5
Exothea paniculata	7.0	3.4	6.4	16.8
Ficus aurea	2.6	3.2	4.2	10.0
Guettarda scabra	.4	.1	1.1	1.6
Lysiloma latisiliquum	4.8	28.7	9.6	43.1
Metopium toxiferum	3.9	16.6	8.5	29.0
Myrsine floridana	2.6	.1	4.2	6.9
Nectandra coriacea	12.7	6.2	10.6	29.5
Prunus myrtifolia	7.9	4.9	6.4	19.2
Pisonia aculeata	.9	.2	2.1	3.2
Simarouba glauca	.4	.2	1.1	1.7
Tetrazygia bicolor	.9	.6	2.1	3.6

Table 10. Tree Species Importance Values for Pinecrest #40

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Ardisia escallonoides	5.3	.1	7.8	13.2
Bumelia salicifolia	3.0	8.1	3.1	14.2
Bursera simaruba	3.8	18.9	7.8	30.5
Coccoloba diversifolia	23.3	6.9	15.6	45.8
Celtis laevigata	3.0	1.9	3.1	8.0
Chrysophyllum oliviforme	1.5	.2	1.6	3.3
Eugenia axillaris	12.8	.8	9.4	23.0
Exothea paniculata	.7	.1	1.6	2.4
Krugiodendron ferreum	6.8	3.3	9.4	19.5
Lysiloma latisiliquum	5.3	22.1	7.8	5.2
Mastichodendron foetidissimum	1.5	26.1	3.1	30.7
Myrsine floridana	3.0	.5	3.1	6.6
Schoepfia chrysophylloides	.7	.1	1.6	2.4
Simarouba glauca	.7	-	1.6	2.3
Nectandra coriacea	25.6	8.5	18.7	52.8
Zanthoxylum fagara	3.0	2.4	4.7	10.1

Table 11. Tree Species Importance Values for Royal Palm Hammock

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Ardisia escallonioides	2.0	.03	4.0	6.0
Bumelia salicifolia	7.0	4.0	10.0	21.0
Bursera simaruba	1.0	.05	1.0	2.0
Calyptranthes pallens	1.0	.04	1.0	2.0
Calyptranthes zuzygium	27.0	6.0	14.0	47.0
Coccoloba diversifolia	1.0	.04	1.0	2.0
Eugenia axillaris	3.0	.02	4.0	7.0
Exothea paniculata	16.0	5.0	10.0	31.0
Ficus aurea	1.0	16.0	1.0	18.0
Guettarda scabra	5.0	.3	5.0	10.3
Metopium toxiferum	4.0	3.0	4.0	11.0
Myrsine floridana	1.0	-	1.0	2.0
Nectandra coriacea	18.0	3.0	14.0	35.0
Prunus myrtifolia	6.0	2.0	9.0	17.0
Quercus virginiana	4.0	55.0	6.0	65.0
Schoepfia chrysophylloides	2.0	.4	3.0	5.4
Simarouba glauca	4.0	4.0	8.0	16.0

Table 12. Tree Species Importance Values for Wright Hammock

Species	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value
Ardisia escallonioides	12.1	1.3	9.3	22.7
Bumelia salicifolia	10.3	15.4	11.3	37.0
Bursera simaruba	2.1	6.4	4.1	12.6
Coccoloba diversifolia	13.4	9.8	10.3	33.5
Eugenia axillaris	9.9	1.7	9.3	20.9
Exothea paniculata	4.3	2.8	6.2	13.3
Ficus aurea	.4	-	1.0	1.4
Guettarda scabra	17.7	4.3	11.3	33.3
Lysiloma latisiliquum	3.0	13.3	6.2	22.5
Mastichodendron foetidissimum	1.3	.6	2.1	4.0
Myrcianthes fragrans	2.6	1.0	4.1	7.7
Metopium toxiferum	2.1	6.7	5.1	13.9
Myrsine floridana	2.1	.2	3.1	5.4
Nectandra coriacea	15.9	5.1	11.3	32.3
Prunus myrtifolia	.4	.1	1.0	1.5
Quercus virginiana	1.7	31.3	3.1	36.1
Tetrazygia bicolor	.4	-	1.0	1.4

Table 13. Tree Species in each of Six Hammocks for which Importance Values Exceeded 20.

Deer	
Quercus virginiana	(51)
Coccoloba diversifolia	(42)
Ateramnus lucidus	(42)
Metopium toxiferum	(23)
Bumelia salicifolia	(20)

Mahogany	
Eugenia axillaris	(62)
Swietenia mahagoni	(60)
Metopium toxiferum	(44)
Bursera simaruba	(26)

Osteen	
Coccoloba diversifolia	(44)
Lysiloma latisiliquum	(43)
Bursera simaruba	(32)
Nectandra coriacea	(30)
Metopium toxiferum	(29)
Ardisia escallonioides	(27)

Pinecrest	
Nectandra coriacea	(53)
Coccoloba diversifolia	(46)
Lysiloma latisiliquum	(35)
Bursera simaruba	(31)
Mastichodendron foetidissimum	(31)

Royal Palm	
Quercus virginiana	(65)
Calyptranthes zuzygium	(47)
Nectandra coriacea	(35)
Exothea paniculata	(31)
Bumelia salicifolia	(21)

Wright	
Bumelia salicifolia	(37)
Quercus virginiana	(36)
Guettarda scabra	(33)
Coccoloba diversifolia	(33)
Nectandra coriacea	(32)

Table 14. Selected Statistics for the Eleven Species with the Highest Importance Values in the Six Hammocks of this Study.

	Relative Density %	Relative Dominance %	Relative Frequency %	Importance Value	Total Frequency %*	Constancy %**
Eugenia axillaris	14.6	2.2	8.2	30.0	60	100
Quercus virginiana	1.7	23.0	2.8	27.0	21	66.6
Coccoloba diversifolia	11.7	6.0	8.6	26.3	62	100
Nectandra coriacea	11.3	4.0	9.9	25.2	72	100
Bumelia salicifolia	6.5	6.3	8.4	21.2	61	100
Metopium toxiferum	7.3	6.3	7.2	20.8	53	83.3
Lysiloma latisiliquum	2.7	11.3	4.9	18.9	36	66.6
Bursera simaruba	2.9	9.4	5.3	17.6	39	100
Ardisia escallonioides	8.5	0.6	8.0	17.1	58	100
Exothea paniculata	5.3	2.3	6.0	13.6	44	100
Swietenia mahagoni	0.9	7.3	1.7	9.9	12	16.6

* $\frac{\text{actual times of occurrence}}{\text{possible times of occurrence in all hammocks}}$

** $\frac{\text{\# of presences in hammocks}}{\text{6 hammocks}} = \text{constancy}$

Table 15. Abundances of Epiphytic Ferns, Bromeliads and Orchids in Subplots of 25 m^2

	Deer			Royal Palm			Osteen			Mahogany			Wright			Pinecrest		
	Class			Class			Class			Class			Class			Class		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Ferns		*																
Polypodium aureum	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Polypodium heterophyllum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	4	1
Polypodium phyllitidis	4	3	-	1	-	-	1	1	-	2	-	-	2	-	-	3	1	-
Polypodium polypodioides	11	1	-	2	1	4	3	1	-	7	2	-	7	2	-	-	-	-
Epiphytic Bromeliads																		
Catopsis berteroniana	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tillandsia balbisiana	11	-	-	-	-	-	1	-	-	7	-	-	9	-	-	-	-	-
Tillandsia circinnata	3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-
Tillandsia fasciculata	2	3	1	4	-	-	2	-	-	6	1	-	5	1	1	1	-	-
Tillandsia setacea	7	3	-	2	4	2	6	-	-	4	4	1	4	4	-	-	-	-
Tillandsia utriculata	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Tillandsia valenzuelana	5	-	-	5	5	1	10	2	-	7	2	-	2	4	2	-	-	-
Epiphytic Orchids																		
Cyrtopodium punctatum	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Encyclia cochleata	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Encyclia tampensis	10	1	-	2	-	-	3	-	-	6	3	-	6	1	-	1	-	-
Epidendrum nocturnum	4	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Epidendrum rigidum	3	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polystachia concreta	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Peperomia obtusifolia	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Class Rating:	Rating	Bromeliads	Ferns	Orchids
	1	1-15 individuals	1-2 individuals	1-3 individuals
	2	16-50 individuals	3-8 individuals	4-10 individuals
	3	more than 50	more than 50	more than 10

Table 16. Herbaceous Understory Analysis

Species	Deer Freq. %	Deer Density #	Mahogany Freq. %	Mahogany Density #	Osteen Freq. %	Osteen Density #	Pinecrest #40 Freq. %	Pinecrest #40 Density	Royal Palm Freq. %	Royal Palm Density	Wright Freq. %	Wright Density
VINES												
Cardiospermum sp.											8	1
Chiococca parvifolia											17	3
Cynanchum scoparium							17	2				
Galactia sp.	33	5			17	2					33	7
Hippocratea volubilis			58	72								
Morinda royoc	33	17			42	30			100	32	92	144
Parthenocissus quinquefolia			75	20	8	2	8	1	8	1		
Passiflora suberosa	17	4	8	1	8	1						
Smilax auriculata	25	5	8	1	42	13			8	1	50	16
Toxicodendron radicans	25	7	42	10					17	6	25	3
Vitis munsoniana	25	3			33	6			25	4	42	12
GRASSES												
Lasiascis divaricata	42	11			8	1						
Oplismenus hirtellus	17	6	58	31	8	1	8	1			25	3
Dichanthelium commutatum	25	3										
Paspalum caespitosum					8	1						
Schizachyrium rhizomatum	17	2										
FORBS												
Leiphaimos parasitica	17	4			17	2						
Rivina humilis							75	96				
Zamia pumila	42	6							42	7	42	6
FERNS												
Acrostichum danaefolium			25	3								
Adiantum tenerum					25	9						
Anemia adiantifolia	25	3			17	4			25	4	17	2
Blechnum serrulatum			8	1								
Nephrolepis exaltata							8	4	25	8		
Pteridium aquilinum	8	1										
Pteris longifolia	8	1										
Thelypteris kunthii	8	1							42	11		

Table 17. Mean Soil Depth and Standard deviation for each hammock (based on 120 depth measurements per hammock).

	Mean depth (cm)	Standard deviation (cm)
Royal Palm	11.1	5.0
Osteen	11.0	6.5
Deer	10.2	6.5
Wright	15.1	7.2
Mahogany	21.7	15.2
Pinecrest	8.2	8.8

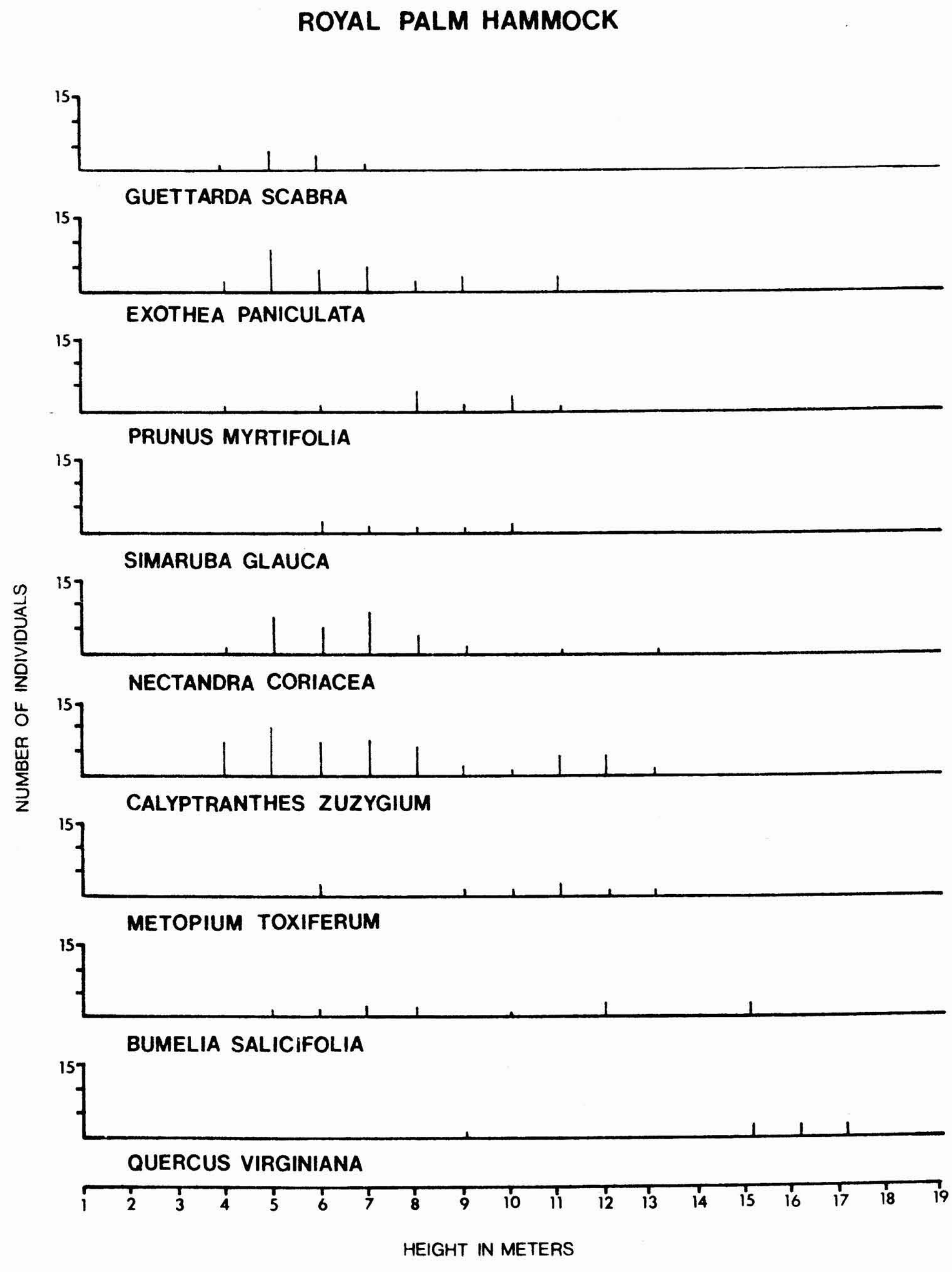

ROYAL PALM HAMMOCK
NUMBER OF INDIVIDUALS
15
GUETTARDA SCABRA
EXOTHEA PANICULATA
PRUNUS MYRTIFOLIA
SIMARUBA GLAUCA
NECTANDRA CORIACEA
CALYPTRANTHES ZUZYGIUM
METOPIUM TOXIFERUM
BUMELIA SALICIFOLIA
QUERCUS VIRGINIANA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
HEIGHT IN METERS

Figure 7

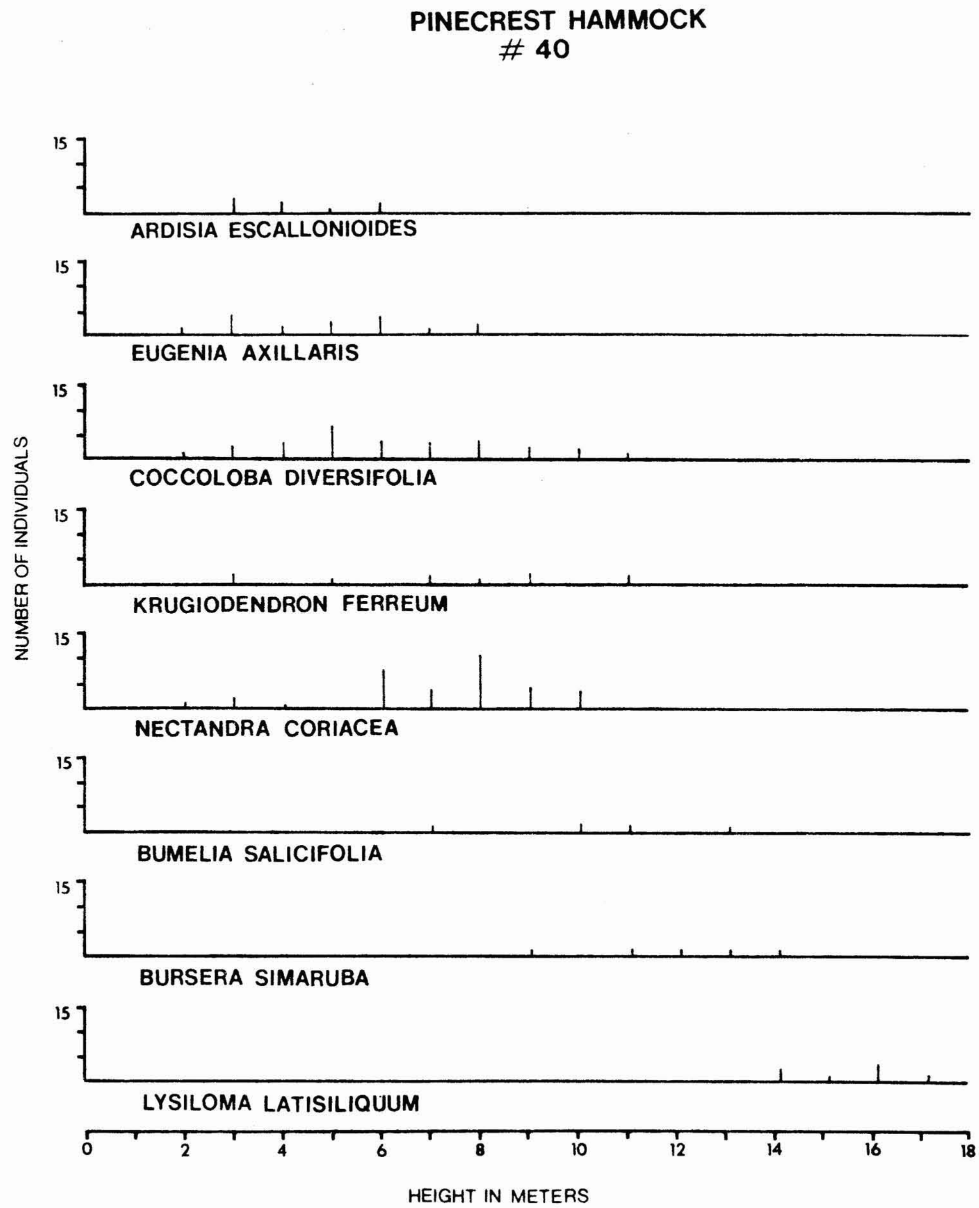

PINECREST HAMMOCK
40
NUMBER OF INDIVIDUALS
15
ARDISIA ESCALLONIOIDES
EUGENIA AXILLARIS
COCCOLOBA DIVERSIFOLIA
KRUGIODENDRON FERREUM
NECTANDRA CORIACEA
BUMELIA SALICIFOLIA
BURSERA SIMARUBA
LYSILOMA LATISILIQUUM
0
2
4
6
8
10
12
14
16
18
HEIGHT IN METERS

Figure 8

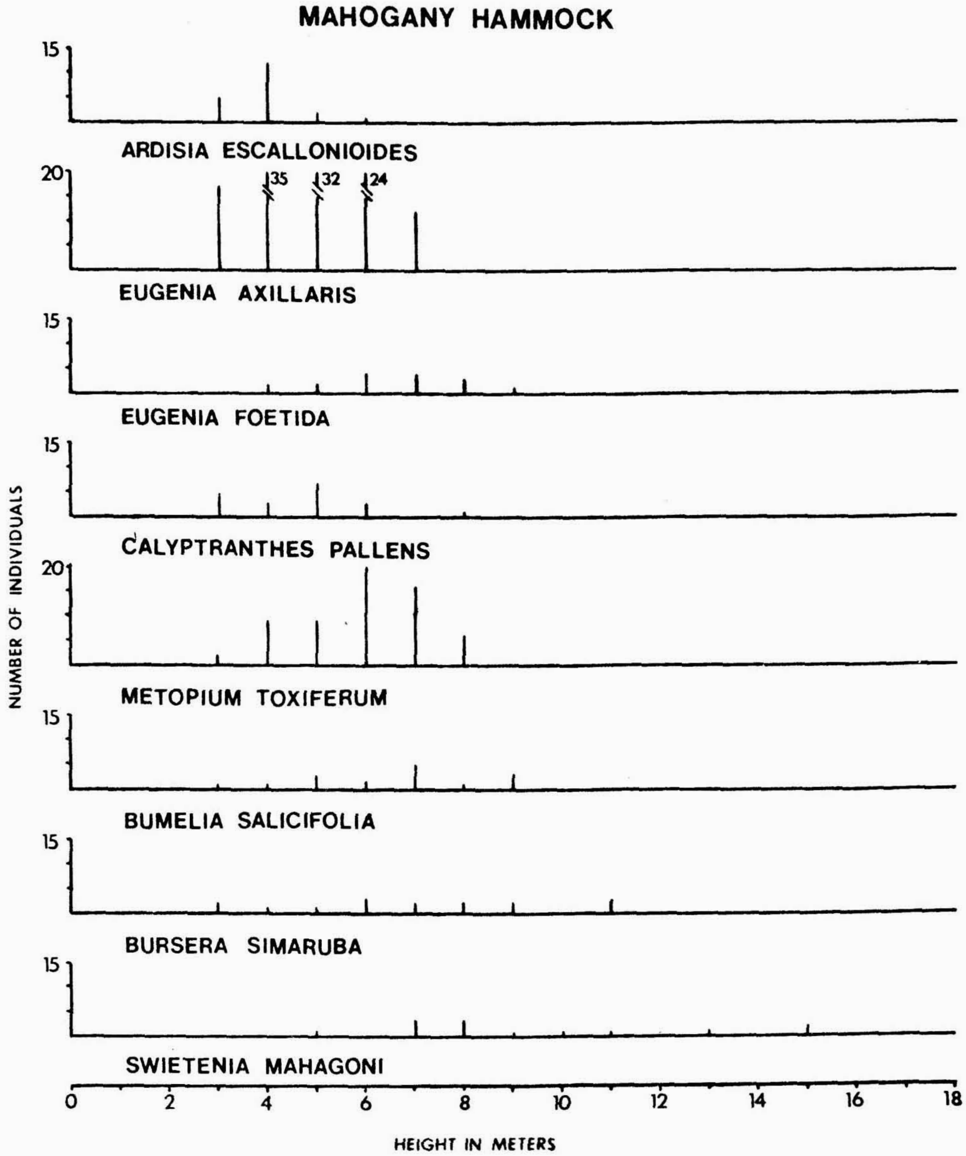

MAHOGANY HAMMOCK
15
ARDISIA ESCALLONIOIDES
20
35
32
24
EUGENIA AXILLARIS
15
EUGENIA FOETIDA
15
CALYPTRANTHES PALLENS
20
METOPIUM TOXIFERUM
15
BUMELIA SALICIFOLIA
15
BURSERA SIMARUBA
15
SWIETENIA MAHAGONI
0
2
4
6
8
10
12
14
16
18
HEIGHT IN METERS
NUMBER OF INDIVIDUALS

Figure 9

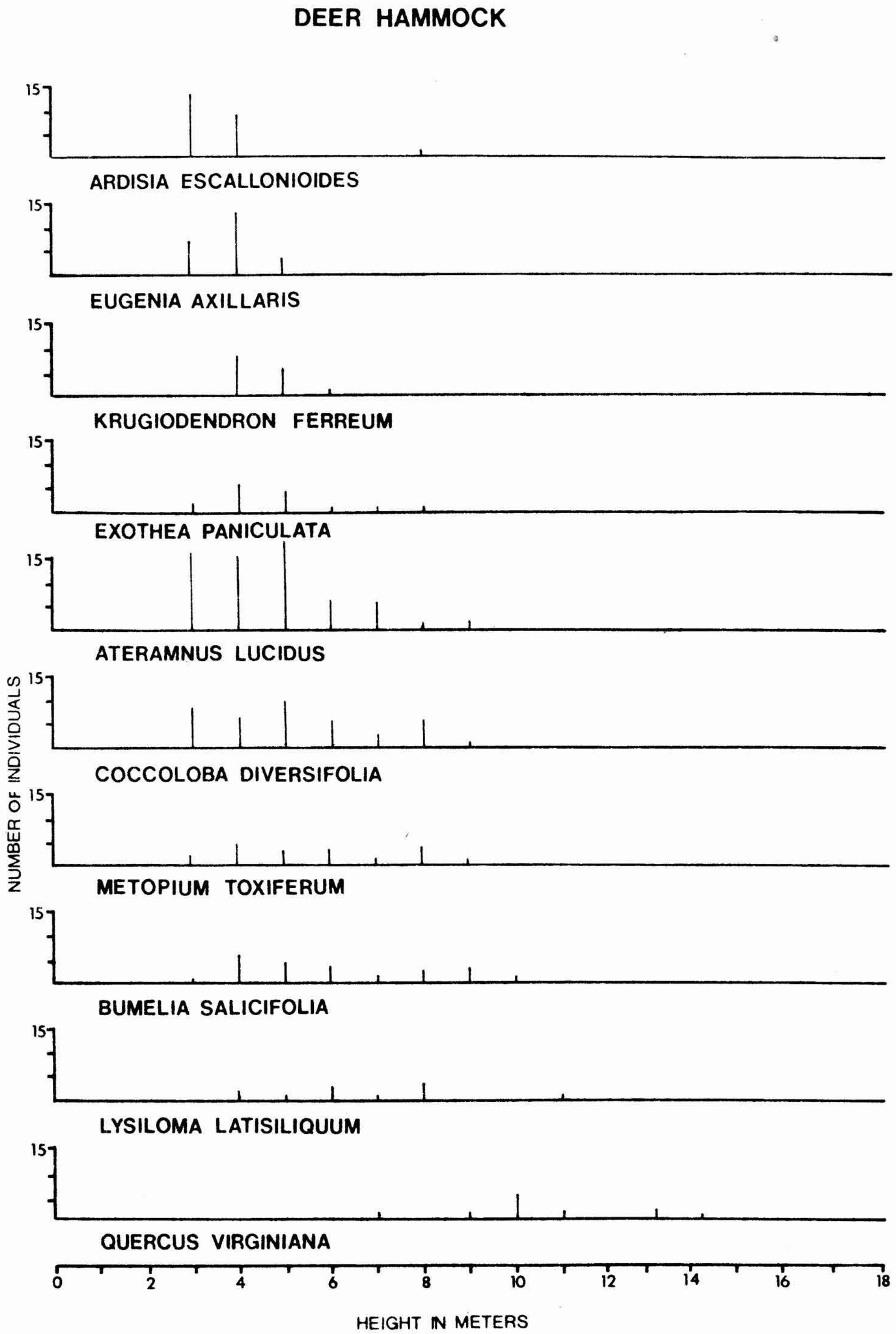
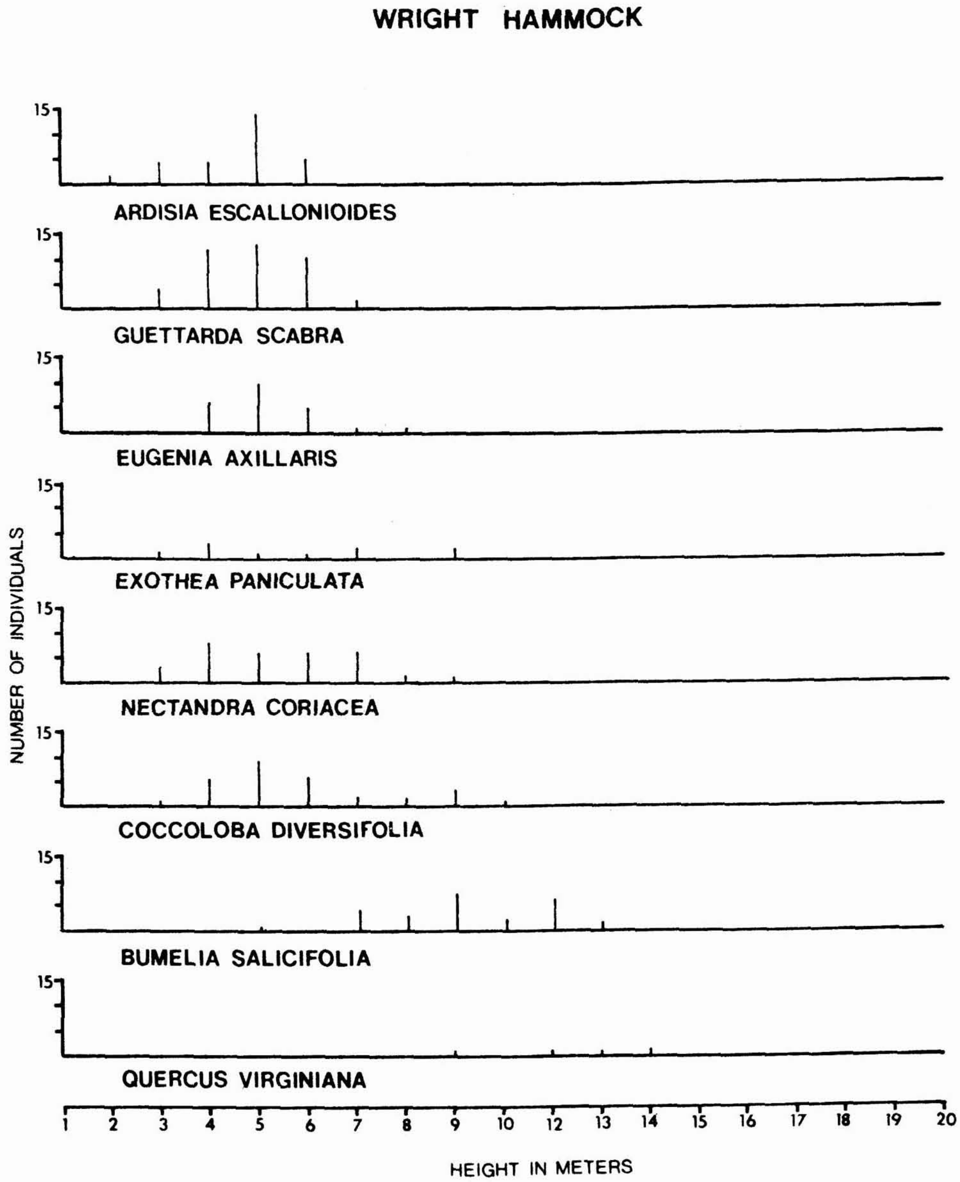

DEER HAMMOCK
15
ARDISIA ESCALLONIOIDES
15
EUGENIA AXILLARIS
15
KRUGIODENDRON FERREUM
15
EXOTHEA PANICULATA
15
ATERAMNUS LUCIDUS
15
COCCOLOBA DIVERSIFOLIA
15
METOPIUM TOXIFERUM
15
BUMELIA SALICIFOLIA
15
LYSILOMA LATISILIQUUM
15
QUERCUS VIRGINIANA
NUMBER OF INDIVIDUALS
0
2
4
6
8
10
12
14
16
18
HEIGHT IN METERS

Figure 10



WRIGHT HAMMOCK
15
ARDISIA ESCALLONIOIDES
15
GUETTARDA SCABRA
15
EUGENIA AXILLARIS
15
EXOTHEA PANICULATA
15
NECTANDRA CORIACEA
15
COCCOLOBA DIVERSIFOLIA
15
BUMELIA SALICIFOLIA
15
QUERCUS VIRGINIANA
NUMBER OF INDIVIDUALS
1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18 19 20
HEIGHT IN METERS

Figure 11

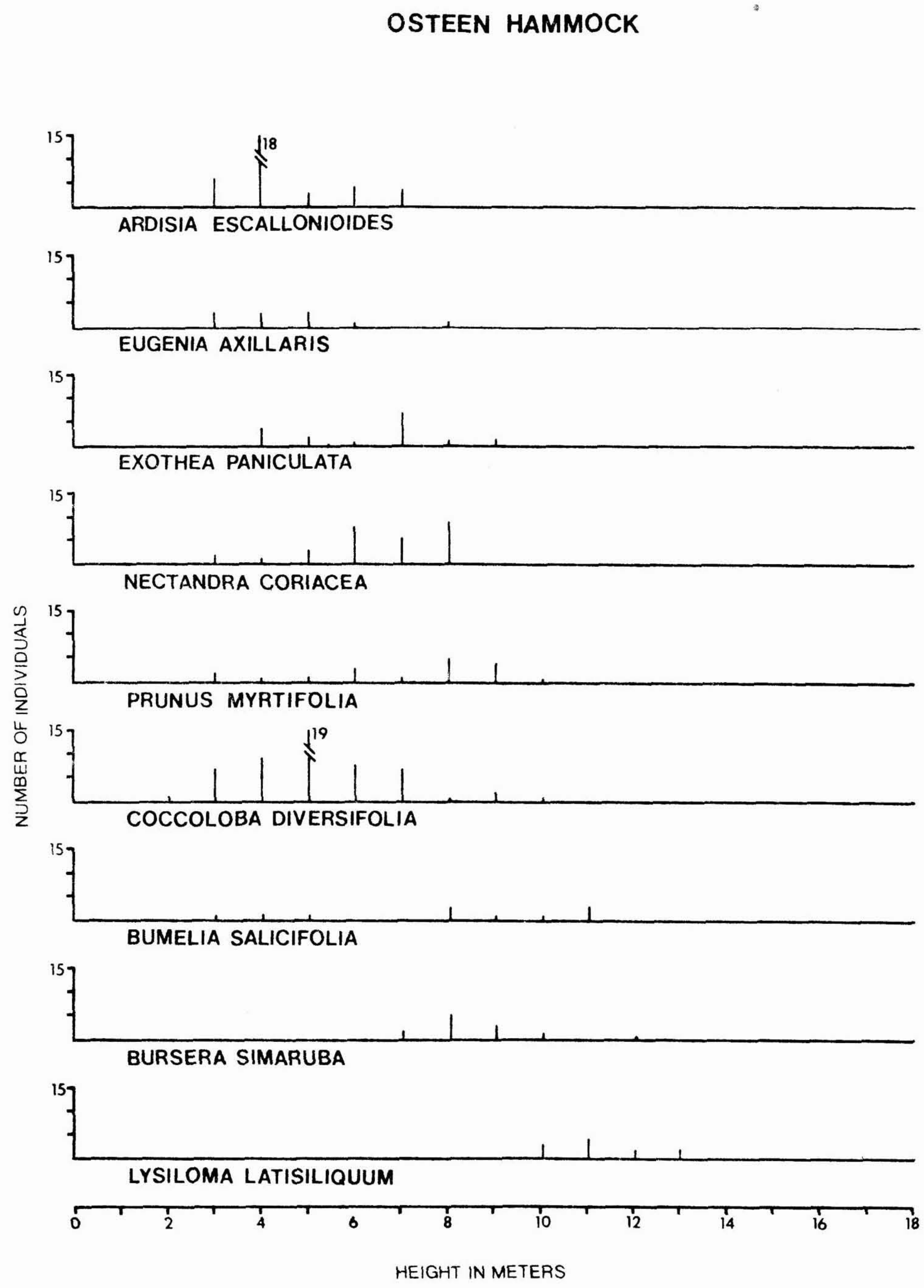

OSTEEN HAMMOCK
NUMBER OF INDIVIDUALS
15
18
ARDISIA ESCALLONIOIDES
EUGENIA AXILLARIS
EXOTHEA PANICULATA
NECTANDRA CORIACEA
PRUNUS MYRTIFOLIA
19
COCCOLOBA DIVERSIFOLIA
BUMELIA SALICIFOLIA
BURSERA SIMARUBA
LYSILOMA LATISILIQUUM
0
2
4
6
8
10
12
14
16
18
HEIGHT IN METERS

Figure 12

Table 18. Number of Trees, Saplings and Seedlings/Species/300 m^2 Sampled Area of Each Hammock.

Species	Deer			Mahogany			Osteen			Pinecrest #40			Royal			Wright		
	Tree	Sap-ling	Seed-ling	Tree	Sap-ling	Seed-ling	Tree	Sap-ling	Seed-ling	Tree	Sap-ling	Seed-ling	Tree	Sap-ling	Seed-ling	Tree	Sap-ling	Seed-ling
Acoelorraphe wrightii	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ardisia escallonioides	24	111	198	20	51	65	35	55	188	7	7	31	4	46	72	28	138	203
Ateramnus (Gymnanthes) lucidus	70	30	43	-	-	-	3	2	16	-	-	-	-	-	-	-	-	-
Bumelia (Dipholis) salicifolia	21	9	21	16	10	42	11	7	12	4	-	13	13	8	30	24	5	3
Bursera simaruba	2	-	-	15	7	3	12	1	2	5	-	-	1	-	-	5	-	-
Calyptranthes pallens	-	-	-	18	47	38	-	3	3	-	-	-	-	-	-	-	-	-
Calyptranthes zuzygium	-	-	-	1	1	8	-	-	-	-	-	-	47	31	166	-	-	-
Celtis laevigata	-	-	-	-	-	-	-	-	-	4	1	88	-	-	-	-	-	-
Chiococca alba	-	5	8	-	-	-	-	1	1	-	1	2	-	-	-	-	5	6
Chrysobalanus icaco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Chrysophyllum oliviforme	-	-	-	2	7	1	-	5	-	2	-	-	-	-	-	-	4	-
Citharexylum fruticosum	-	-	-	-	-	-	-	-	9	-	-	-	-	-	12	-	-	-
Coccoloba diversifolia	43	51	85	3	4	1	53	47	55	31	37	78	1	10	4	31	48	44
Eugenia axillaris	26	42	113	120	76	1308	12	21	46	17	27	65	5	57	114	23	37	244
Eugenia foetida	-	-	-	17	28	35	-	-	-	-	-	-	-	-	-	-	-	-
Erythrina herbacea	-	-	-	-	-	-	-	1	1	-	-	3	-	1	-	-	-	-
Exothea paniculata	16	7	88	1	-	-	16	8	73	1	-	-	29	9	212	10	3	130
Ficus aurea	2	-	-	3	-	-	6	3	-	-	-	-	1	1	-	1	-	-
Guapira discolor	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guettarda scabra	-	-	-	-	-	-	1	1	6	-	-	-	9	7	11	41	63	53
Hypelate trifoliata	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ilex krugiana	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Krugiodendron ferreum	15	8	149	-	-	-	-	-	-	9	7	36	-	-	-	-	-	-
Lysiloma latisiliquum	12	3	20	-	-	-	11	-	3	7	-	-	-	-	-	7	-	4
Mastichodendron foetidissimum	-	-	-	-	-	-	-	-	-	2	2	-	-	1	-	3	-	-
Metopium toxiferum	18	27	47	62	35	34	9	1	2	-	-	-	7	5	6	5	10	19
Myrcianthes fragrans	6	30	19	2	7	16	-	-	-	-	-	-	-	-	-	6	11	3
Myrsine floridana	7	35	19	-	2	-	6	25	27	4	11	7	2	11	9	5	14	3
Nectandra coriacea	24	23	62	1	3	5	29	34	248	34	19	367	35	40	109	37	78	145
Persea borbonea	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pisonia aculeata	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Prunus myrtifolia	-	-	-	-	-	-	18	11	50	-	-	-	11	5	12	1	1	1
Psychotria nervosa	-	51	232	-	20	75	-	15	147	-	31	79	-	15	138	-	14	65
Quercus virginiana	11	2	46	2	-	9	-	-	1	-	-	-	7	-	11	4	-	104
Randia aculeata	-	27	15	-	7	1	-	-	-	-	-	2	-	-	3	-	3	-
Roystonea elata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Sabal palmetto	-	4	20	4	11	8	-	3	6	-	-	1	-	-	-	-	-	9
Schoepfia chrysophylloides	4	1	2	-	-	-	-	-	-	1	-	-	3	1	1	-	-	-
Serenoa repens	-	1	-	-	-	-	-	-	6	-	-	-	-	1	-	-	1	-
Simarouba glauca	-	-	-	-	-	-	1	-	-	1	1	1	7	-	8	-	-	-
Swietena mahagoni	-	-	-	13	1	176	-	-	-	-	-	-	-	-	-	-	-	-
Tetrazygia bicolor	-	6	7	-	-	-	2	1	6	-	-	-	1	-	-	1	10	5
Zanthoxylum fagara	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-

(Appendix A). The total number of characteristic hammock species of all growth forms in all six hammocks ranges from 67 in Pinecrest #40 to 91 species in Royal Palm hammock. Those numbers are 93 and 135, respectively, if ecotonal and solution hole species are included. Factors which may influence this number include: disturbance history, time since the latest disturbance, hammock size, relative isolation from other hammocks, and physical environment. Considering only the woody vegetation occurring in the analyzed plots, the number of species is very similar in all hammocks (18-22, Table 2). The number of species of all growth forms (including vines, forbs, ferns, and epiphytes as well as trees and shrubs) encountered in the plot analysis varies from a low of 28 in Pinecrest to 55 in Deer Hammock. Whereas, the number of trees and shrubs per 300 m^2 is rather consistent, the number of non-woody growth-forms is highly variable. We interpret the number of non-woody species to be primarily influenced by light availability, which is in turn influenced by the state of recovery from disturbance (maturity).

Floristic composition varies substantially between hammocks for both woody and herbaceous species. Sorensen's similarity index (Table 3), based on species presence only, compared the similarity of composition between the hammocks. We calculated the similarity index comparing four different lists: (1) the species encountered in the whole area of each hammock excluding solution hole, rare and ecotonal species; (2) the species in all analyzed plots (300 m^2) in each hammock; (3) trees and shrubs encountered in all plots in each hammock; and (4) trees and shrubs for each entire hammock area.

In general, higher values for similarity indices result from the comparisons of lists for entire hammocks rather than for plots only. In the following discussion we use mean values of the four computations of similarity index given in Table 3. The Long Pine Key Hammocks (taken here and in the following discussion to include Deer, Wright, Osteen, and Royal Palm) are much more similar to each other than to Pinecrest #40. The similarity of Mahogany Hammock to Long Pine Key hammocks is greater than to Pinecrest #40. The highest similarity indices occur between Osteen-Royal Palm and Osteen-Wright, with slightly lower values for Royal Palm-Wright and Wright-Deer. Among the Long Pine Key hammocks, Deer is somewhat distinctive in species composition from the others. Lowest similarity values result from comparison of Pinecrest #40 with Mahogany, Royal Palm, and Osteen. Based on species composition, Mahogany is more similar to Royal Palm and Wright than to the other hammocks studied, whereas Pinecrest is more similar to Wright and Deer than to the others.

From the above discussion, it is clear that the hammocks fall into three groups based on species composition - the Long Pine Key hammocks, Mahogany, and Pinecrest #40. However, we hesitate to state that this strongly suggests that we are dealing here with three distinct tropical hardwood hammock communities.

<u>Canopy Structure: Height and Basal Area</u>

<u>Quercus</u>, <u>Swietenia</u>, <u>Mastichodendron</u> and <u>Ficus aurea</u> have by far the largest average basal areas of all trees measured. <u>Lysiloma</u>, <u>Bursera</u>, <u>Metopium</u> and <u>Bumelia</u> rank next. Except for <u>Mastichodendron</u> and <u>Ficus</u> all of the above-mentioned are believed to be shade intolerant species that persist in mature hammocks and develop very large basal areas. They are also the ones that reach the tallest heights (Figures 5 and 6). The relatively shade tolerant hammock

species Nectandra, Coccoloba, Krugiodendron, Eugenia axillaris, Calyptranthes zuzygium, Prunus myrtifolia, and Exothea paniculata have intermediate average basal areas and are also intermediate in total basal area/hammock. Ardisia, Eugenia axillaris, Guettarda scabra, Myrsine and Psychotria nervosa are the trees with lowest basal areas and lowest heights.

In a comparison of average height and basal area of the 15 most important species, significant differences in height were found to exist between hammocks for nine species (Table 6). Pinecrest #40 had the tallest and biggest specimens of all species of all hammocks. Royal Palm and Osteen ranked second. The fact that low tree density, high mean basal area, high total basal area and tall height all occurred in Pinecrest #40 suggests that it is the most mature stand of all six hammocks.

The heights of trees range to 17 m. The height distribution in Figure 2 illustrates that the largest numbers of trees fall into the height classes from 3-8 m in all hammocks together. On the histogram of basal area for all hammocks in Figure 3, 90% of the 1200 entries fall into the group of 10-300 cm^2, while the rest range from 300 to 4200 cm^2. The latter condition was also described by Hartshorn (1978) for species in a Costa Rican rain forest.

When the height distribution for each hammock is considered (Figure 4), a distinct picture emerges with regard to grouping the hammocks into two major categories: Pinecrest, Royal Palm and Osteen with a smaller number of individuals at taller heights, and Deer, Mahogany and Wright with a greater number of trees at low to medium height.

The question of whether distinct strata are present in tropical forest canopies is a controversial one and has been much discussed in the literature, including the contributions of Robertson (1955), Beard (1944, 1955), Dittus (1977) and Hilsenbeck (1976) with regard to "evergreen seasonal forest" and "semi-evergreen forest." All our measurements indicate that a certain group of species grow to be very tall, up to 17 m (outside the park on less disturbed sites to 25 m), whereas another group does not reach above 8-10 m. Our height histograms (Figure 4) suggest that the densest canopy exists between 4-7 m in all hammocks. Between 7 and 10 m the reduced density is similar in all hammocks, while the canopy between 10 and 16 m is very discontinuous, and most pronounced in Royal Palm and Pinecrest #40 hammocks. Since there are always intermediate heights between the two major height groups, we do not consider the hammocks to be stratified. Instead we agree with the discussion of the architecture of forests by Hallé, Oldeman and Tomlinson (1978), in which they consider "aggregations at certain levels of particularly built trees that form horizontal sets." It would be better to consider one canopy that has some species for which individuals reach heights that are considerably taller than most of the trees in the stand. Our basic hammock structure seems to be similar to that described by Dittus (1977) for semi-evergreen forest in Sri Lanka and to a lesser degree to that described by Hilsenbeck (1976) for Key Largo and Totten Key.

Reproductive Structure

The tree and sapling densities (Table 18) indicate adult-juvenile relationships in each hammock. The comparison of sapling to seedling ratio lumping all species in each hammock (Table 4) may suggest the survivorship of recruitment. The average tree and sapling densities differed significantly between stands (Table 4). Application of Duncan's Multiple Range Test (Steel and Torrie, 1960) suggested the occurrence of three distinct groups with regard to the tree density and four groups with regard to sapling density. Pinecrest #40 and Royal Palm hammocks have the lowest tree densities, Deer and Mahogany have the highest tree densities, and Osteen and Wright hammocks are intermediate. The evidence is similar with regard to sapling density. We interpret the tree and sapling density differences as suggesting a gradient of increasing successional maturity from Deer-Mahogany to Wright-Osteen to Royal Palm-Pinecrest #40.

Interpretation of Relative Maturity

Succession in tropical hardwood hammocks will not be truly well understood until the results of long-term monitoring of carefully marked plots is carried out. The plots established in this study are permanently marked and can be monitored for successional change at intervals in the future. Meanwhile, the concept of hammock "maturity" must remain somewhat vague, particularly since we do not know ages of individual trees or stands because of the lack or inconsistency of annual rings in the wood of the trees (Craighead and Tomlinson, 1972). Nevertheless, we are able to interpret the six hammocks studied as lying along a gradient from least mature to most mature as follows: Deer (portion sampled interpreted from aerial photography to have been burned just prior to 1940 and not since) < Mahogany (no fire evidence, but major canopy disturbance by hurricane of 1960) < Osteen (severely affected by fire in 1945) < Wright (no evidence of disturbance, based on aerial photography) < Royal Palm (no evidence of disturbance evident in aerial photography to portion of hammock where sampling was done) < Pinecrest #40 (interpreted from aerial photography as burned not long before 1940 but not subjected to major disturbance since). The interpretation of relative maturity is based primarily upon the following criteria, discussed in more detail in previous sections:

1. Lower absolute numbers of trees, saplings, and seedlings are interpreted as an indication of greater maturity.

2. Hammocks with greater total basal area and mean height of trees are interpreted as more mature.

The poor correlation between relative maturity inferred from stand structure and disturbance history inferred from aerial photographs could be due to inability of the latter technique to detect the effects of ground fires which do not destroy the entire canopy. Differences in previous fire history and severity as well as the effect of hurricanes and subtle environmental, especially substrate, differences between hammocks complicate the issue. If we could age the oldest individuals of live oak or *Lysiloma* anywhere in each of the hammocks studied, we would probably arrive at a different ranking according to such an age structure.

Role of Individual Species in Hammock Succession

The role of various tropical hardwood species in succession in hammocks of the South Florida mainland has been discussed by Simpson (1920), Phillips (1940), Robertson (1955), and Alexander (1967). Robertson (1955) identified *Lysiloma* and

Quercus virginiana as the chief "pioneer" tree species and Metopium, Coccoloba diversifolia, Bumelia salicifolia and Bursera as other species present early in stand development. He observed that the following species are seldom found becoming established except under hammock canopy: Mastichodendron, Simarouba, Ficus aurea, Nectandra, Exothea, Ilex krugiana, and Prunus myrtifolia. Our data from six relatively mature hammocks provide a good opportunity to evaluate these earlier observations by examining population structure (Table 18, Figures 8-13) for individual species.

Our data overwhelmingly support the hypothesis that Lysiloma requires disturbance for establishment and persists in a mature stand only as large individuals. In the plots in Royal Palm hammock, Lysiloma is absent although it is abundantly present nearby in younger portions of the hammock. In Pinecrest #40, seven Lysiloma individuals are present, but all are at least 14 m tall (no seedlings or saplings). In Osteen hammock, there are 11 Lysiloma trees, all between 10 m and 13 m tall. The fact that those Lysiloma seedlings are present in Osteen is probably not significant. In this case and in many other cases to follow in this section, the presence of seedlings of a species in a forest stand does not necessarily mean that they will grow to be saplings (e.g., White, 1979). In Deer hammock, heights for Lysiloma are fairly well distributed including some seedlings and saplings, apparently as a result of the persistence of light windows in this hammock.

Quercus, similarly, has only the larger height and basal area classes among the trees present in Royal Palm, Wright, and Deer. Although large numbers of root-sprouts may be present (as in Wright and Deer), recruitment to saplings does not seem to be occurring. Quercus appears to be the most fire resistant of hammock species because its thick bark provides protection from heat damage to the cambium. Large individuals may have survived several fires which have periodically destroyed the remainder of the canopy.

Our data strongly support the "pioneer" status of Bursera. Although height of Bursera is evenly distributed in Mahogany, it is strongly skewed toward larger classes in Pinecrest #40 and in Osteen. In the Pinecrest plots, there were five individuals, all 9 m or taller.

For Bumelia salicifolia, the height class distributions are fairly even for Mahogany and Deer, the most immature hammocks, but have a preponderance of individuals in taller classes in Osteen, Wright, Royal Palm and Pinecrest #40.

Our data do not appear to support Robertson's contention that Coccoloba diversifolia is one of the pioneer species, at least not in the sense of species which becomes less prominent as succession advances. In Deer, Wright, Osteen, and Pinecrest #40, Coccoloba has a well distributed height classification 2-11 m, with numerous saplings and seedlings. Although rare in Royal Palm and Mahogany, Coccoloba is one of the most widely distributed hammock species and appears to be very efficiently dispersed.

Metopium is in many places a colonizer, probably because of efficient dispersal. Our data show this, and our observations in a number of hammocks confirm it. Mahogany Hammock, the most recently disturbed study area (hurricanes of 1960, 1965), and Deer Hammock which has numerous light gaps (possibly produced during the same hurricanes) have rather even height class distributions of

Metopium. In Osteen Hammock, it is in taller height classes and reproduction is lower. The time since last disturbance (a fire in 1945) is longer. In Royal Palm, the species occurs only in one plot (Table 18), closest to the disturbed area. In Pinecrest, Metopium is missing, but Metopium is very rare throughout the Big Cypress area. Metopium is very abundant in the Long Pine Key pineland and could colonize light gaps in hammocks easily.

Among the species categorized by Robertson as more characteristic of mature hammocks, Nectandra and Exothea stand out as typically having all height classes present and abundant seedlings and saplings. Data for Prunus myrtifolia from Osteen and Royal Palm support its status as a tree that increases in number in the absence of disturbance. The same is true for Simarouba based on a small sample size from Royal Palm. There are insufficient data available to support any hypothesis for the successional position of Mastichodendron or Ficus aurea. Ilex krugiana was not present in any of our plots.

The data for Swietenia mahagoni from Mahogany hammock suggest that it needs disturbance for regeneration. Although seedlings are abundant, there is only one sapling and only one individual (5 m tall) in the 2-6 m height range. There are 12 individuals between 7 and 15 m in our three 100 m^2 plots.

Importance Value

Absolute measures of density, basal area and frequency are shown in Appendix B for all hammocks by plot. Relative density, relative dominance and relative frequency were calculated and the three quantities added to give the Importance Value (I.V.) (Curtis and McIntosh, 1951) of each species (Tables 7-12). The first three measures were calculated with respect to each hammock, i.e., as a proportion of the total density, total basal area and frequency in the individual hammock. Not surprisingly, the species take on different ranks in different hammocks.

Only one species, Quercus, attains the highest I.V. in more than one hammock. If we consider the species in each hammock with the highest I.V.'s, we find that they include both relatively shade tolerant and intolerant species. Intolerant species do not always rank first in the "least mature" hammocks nor do the tolerant species in the "most mature" ones. Eugenia axillaris ranks first in Mahogany, and live oak (intolerant, but persistent) ranks far ahead of Nectandra (tolerant) in Royal Palm, a more mature hammock where one might expect the order to be reversed. In Pinecrest #40, interpreted as the most mature hammock, Nectandra and Coccoloba have highest I.V.'s followed by Bursera, Lysiloma and Mastichodendron. Wright Hammock has 5 species with roughly equivalent importance values. Among the hammocks studied, a species exceeds all others in I.V. only through having a very large number of individuals (as does Eugenia axillaris in Mahogany) or by having several individuals falling in plots with very large basal areas (as does Quercus virginiana in Royal Palm).

Table 13 shows that of the 4-6 highest ranking species in each hammock, Coccoloba and Nectandra appear in the top five in four hammocks. Metopium, Bursera and Quercus are in the top six values three times each, and Lysiloma twice.

Table 14 lists I.V.'s for the 11 most important species as if all six hammocks were considered one large stand. No single species ranks very high above the rest. Quercus, Lysiloma and Bursera have high I.V.'s because they are persistent intolerant species with very large basal areas. Coccoloba and Nectandra, relatively tolerant species, rank high because of consistently high density and frequency in individual hammocks. Eugenia axillaris ranks high because it has a very high I.V. in a single hammock (in Mahogany) and a high frequency overall although it does not rank in the top six in I.V. for any of the five other hammocks studied. Bumelia salicifolia and Metopium toxiferum (both intolerant) are fairly evenly distributed in all three categories. The constancy column shows the intolerant species to be less constant. The absolute total frequency follows the same ranking as relative frequency.

In contrast to our findings of codominance (based on I.V.'s) of many tree species in these tropical hardwood forests of southern Florida, Dittus (1977), working in semi-evergreen tropical forest in Sri Lanka found one species (Drypetes sepiara, with an I.V. of 55 vs. 20 for the next ranking species) dominant above all others.

Discontinuity of Species Distributions

Previous investigators, including Robertson (1955), Craighead (1974), and Little (1976) have noted discontinuities in distribution patterns of tropical hardwood hammock species of southern Florida. Whereas most common tropical tree species of southern Florida (including Lysiloma, Bursera, Bumelia salicifolia, Eugenia axillaris, Coccoloba diversifolia, Nectandra, etc.) are widely distributed and present in most interior hammocks, there is a sizeable group of relatively rare species whose distribution patterns - present in a few hammocks, absent in others - are difficult to explain. In some cases these "rare" species may be locally important, as shown by the data gathered in this study (Tables 7-12, 13). Others are minor components in the stands in which they are present.

Ateramnus lucidus attains the second highest Importance Value in Deer hammock (together with Coccoloba), is sparsely present in Osteen and in at least one other Long Pine Key hammock, but is elsewhere absent from the mainland of southern Florida. However, Hilsenbeck (1976) found it to be a dominant in the mature tropical hardwood hammock forests of the upper Florida Keys, and Browder (unpublished 1975) listed it as dominant on Lignum Vitae Key.

Krugiodendron ferreum is moderately important in Deer and Pinecrest #40, but otherwise absent from our plots. It is rather common in Pinecrest hammocks, rare in the Long Pine Key area, and common in hammocks of the Florida Keys.

Calyptranthes zuzygium, one of the rarest trees in southern Florida, attains the second highest Importance Value in Royal Palm, is sparsely present in Mahogany and neighboring hammocks, and is not known by us from elsewhere in the park.

Calyptranthes pallens is moderately important in Mahogany, sparsely present in Osteen, and absent from our other plots. It is perhaps most common in scattered hammocks north of Long Pine Key and in the East Everglades, as well as in the Big Cypress area.

Prunus myrtifolia has a moderate Importance Value in Royal Palm and Osteen, is scarce in Wright and is present elsewhere in southern Florida only in relatively few hammocks of Long Pine Key.

Hypelate trifoliata, probably the rarest tree in Everglades National Park, is barely present in our Deer hammock plots and the adjacent hammock-pineland area and nowhere else on the mainland of North America.

Ilex krugiana was entirely missed by our sampling effort, but is present sparingly in some of the Long Pine Key hammocks and surrounding pineland.

Other species which show up rather infrequently in interior hammocks and were infrequently encountered in this study are common in nearby habitats. Eugenia foetida, which attains a moderate Importance Value in Mahogany and was not encountered in other plots of this study, is abundant in coastal hammocks of Everglades National Park and the upper Florida Keys. Guettarda scabra, attaining the third highest Importance Value in Wright, present in Royal Palm and Osteen, and absent in the other hammocks studied as well as from the entire Big Cypress National Preserve, is abundant in Miami Rock Ridge pinelands, which includes Long Pine Key.

Epiphytes

Epiphytic bromeliads and orchids vary in abundance and kind between hammocks (Table 15). We found a total of seven ferns, eight bromeliads, nine orchids and one Peperomia. The bromeliads were most abundant, ferns ranked second and orchids third. Polypodium polypodioides (resurrection fern) and Encyclia tampense (butterfly orchid) were most widely distributed together with four bromeliads: Tillandsia balbisiana, T. fasciculata, T. setacea and T. valenzuelana.

Deer and Mahogany hammocks have the largest numbers of ferns, bromeliads, and orchids. Orchids are found in the sample plots in Mahogany in lower numbers than in Deer hammock. History of illegal collecting may or may not be a major factor influencing relative orchid abundance. The greater recent disturbance resulting in light gaps in Deer and Mahogany hammock may account for the greater epiphyte abundance there. Pinecrest and Royal Palm plots are almost completely lacking in bromeliads and orchids. Osteen and Wright take an intermediate position.

In Deer Hammock there are portions of the ground covered with large plants of Tillandsia fasciculata, that probably fell to the ground from old trees after a destructive fire. This phenomenon was only observed here and in no other hammock.

Herbaceous Understory

The frequencies and densities indicated for species in Table 16 are the accumulated totals of 60 m^2 (3 x 20 m^2) per hammock. It is obvious from the results that the understory is quite sparse.

Vines are frequently encountered and contribute the greatest number of species to the herbaceous understory. Morinda royoc is apparently the most abundant on Long Pine Key, while Smilax auriculata is the most widely distributed vine. Hippocratea is common in Mahogany Hammock. Forbs are uncommon, except for Rivina humilis which is abundant in Pinecrest #40 and does not occur anywhere else. Grasses found are typical hammock species, except for Schizachyrium which is a pineland-glade species. Anemia adiantifolia is the most widely distributed terrestrial fern on Long Pine Key. Cover of the herbaceous understory, including seedlings of trees, was estimated to be between 1 and 5% in most plots except Deer and Wright. Wright averaged 13% and Deer varied from 1% in the most mature plots to 31% in one with numerous light gaps.

Soil Depth

Average soil depths vary from 8 cm (Pinecrest #40) to 21 cm (Mahogany) in the six hammocks studied. The Long Pine Key hammock soil depth averages vary between 10 and 15 cm. This organic "soil" apparently consists of accumulated leaf and woody material in varying stages of decomposition. No horizon development is apparent.

The average soil depth of Wright hammock (15.1 cm) is 4 cm greater than the soil depth of any of the other Long Pine Key hammocks. It is possible that the lack of fire during the last 40 years in Wright hammock has protected the soil there.

The deeper soil of Mahogany Hammock may result from its accumulation over marl (vs. limestone rock for the other hammocks) and/or from the rarity of fire at that site (Robertson, 1955). Although Mahogany is one of the least mature hammocks, based on population structure, its disturbance history results from hurricanes, not fire.

We are unable to provide a likely explanation for the fact that Pinecrest #40 regarded as the most mature hammock by criteria of population structure, has the shallowest average soil depth.

SUMMARY AND CONCLUSIONS

1. Six interior tropical hardwood hammocks were analyzed, five in Everglades National Park and one in Big Cypress National Preserve.

2. The number of tree and shrub species was relatively similar (18-22) for all six hammocks within the 300 m^2 area of sample plots. The total species numbers varied considerably, from a low of 28 species in Pinecrest #40 to a high of 51 species in Royal Palm.

3. The six hammocks fall into three groups based upon similarity of species composition - the four Long Pine Key hammocks, Mahogany, and Pinecrest #40.

4. Based on differences in population structure, we interpret the six hammocks studied as lying along a gradient from least mature to most mature as follows: Deer $<$ Mahogany $<$ Osteen $<$ Wright $<$ Royal Palm $<$ Pinecrest #40. This maturity gradient is based on the following criteria:

   a. Lower absolute numbers of trees, saplings, and seedlings are interpreted as an indication of greater maturity.

b. Hammocks with greater basal area and mean height of trees are interpreted as more mature.

5. The data overwhelmingly support the hypothesis that Lysiloma latisiliquum, Quercus virginiana, Bursera simaruba, Bumelia salicifolia, and Swietenia mahagoni require disturbance for establishment and persist in mature stands only as large individuals.

6. Nectandra coriacea and Exothea paniculata stand out as typically having all height classes present and abundant seedlings and saplings in mature stands. Prunus myrtifolia has similar ecological status.

7. The six highest Importance Values in the six hammocks are held by 14 different species. The species with the highest Importance Value totals for the six hammocks are Quercus virginiana (because of large basal area); Eugenia axillaris (because of great density); Coccoloba diversifolia and Nectandra coriacea (because of high constancy, density, and frequency); and Bumelia salicifolia, Lysiloma latisiliquum, and Metopium toxiferum.

8. The following species of the six hammocks studied have sporadic distributions for which the reasons are not apparent to us: Ateramnus lucidus, Calyptranthes pallens, Calyptranthes zuzygium, Hypelate trifoliata, Krugiodendron ferreum, and Prunus myrtifolia.

9. Epiphyte numbers and species richness are highest in the "immature" hammocks where light gaps in the canopy are apparent.

10. The herbaceous understory vegetation of these hammocks is sparse and the flora is poor in species.

11. Average soil depths vary from 8 cm (Pinecrest #40) to 21 cm (Mahogany). The soil depth means of Long Pine Key hammocks vary between 10 and 15 cm.

12. Classification of Mahogany hammock as a community distinct from the other interior hammocks studied may be warranted, based on the following reasoning. The nature of major disturbance differs, with hurricanes having the dominating influence on Mahogany and fire the controlling force in the Long Pine Key and Pinecrest hammocks. Swietenia mahagoni, a species absent in the other hammocks (a few introduced specimens in Royal Palm), thoroughly dominates the upper canopy of Mahogany hammock in later stages of periods between hurricanes. Lysiloma, an ecological equivalent of Swietenia in most inland hammocks, is absent. Substantial floristic differences occur between Mahogany and Long Pine Key hammocks with such "coastal" species as Eugenia foetida and Acoelorrhaphe wrightii. Mahogany hammock has a marl "subsoil," whereas the others have limestone bedrock under the thin organic "soil." A more definitive discussion of hammock communities of southern Florida must await quantitative analysis of a wider range of the existing spectrum of variation.

LITERATURE CITED

Alexander, T. R. 1954. Paradise Key on fire. Everglades Natural History 2(1):31-34.

Alexander, T. R. 1955. Observations on the ecology of the low hammocks of southern Florida. Quart. Jour. Fla. Acad. Sci. 18:21-27.

Alexander, T. R. 1958a. High hammock vegetation of the southern Florida mainland. Quart. Jour. Fla. Acad. Sci. 21:293-298.

Alexander, T. R. 1958b. Ecology of the Pompano Beach Hammock. Quart. Jour. Fla. Acad. Sci. 21(4):299-304.

Alexander, T. R. 1967. A tropical hammock on the Miami (Fla.) limestone: a twenty-five year study. Ecology 48:863-867.

Avery, G. N. and L. L. Loope. 1980a. Endemic taxa in the flora of South Florida. South Florida Research Center Report T-558.

Avery, G. N. and L. L. Loope. 1980b. Plants of Everglades National Park: a preliminary checklist of vascular plants. South Florida Research Center Report T-574.

Beard, D. B. 1938. Everglades National Park project. National Park Service. Report on file at Everglades National Park. 106 p.

Beard, J. S. 1944. Climax vegetation in tropical America. Ecology 25(2):127-158.

Beard, J. S. 1955. The classification of tropical American vegetation types. Ecology 36(1):89-100.

Bessey, E. A. 1911. The hammocks and everglades of South Florida. Plant World 14:268-276.

Carter, L. J. 1974. The Florida Experience. The Johns Hopkins University Press, Baltimore and London. 355 p.

Craighead, F. C. 1963. Orchids and other air plants of the Everglades National Park, Univ. of Miami Press, Coral Gables, Fla. 127 p.

Craighead, F. C. 1971. The Trees of South Florida. Univ. of Miami Press, Coral Gables, Fla. 212 p.

Craighead, F. C. 1974. Hammocks of South Florida, p. 53-60. In Environments of South Florida: Present and Past, P. J. Gleason (ed.), Miami Geol. Soc. Memoir 2.

Craighead, F. C. and V. C. Gilbert. 1962. The effects of Hurricane Donna on the vegetation of southern Florida. Quart. Jour. Fla. Acad. Sci. 25:1-28.

Craighead, F. C. and P. B. Tomlinson. 1972. Growth ring studies on the native trees of subtropical Florida. In Research Trends in Plant Anatomy. p. 39-51.

Curtis, J. T. and R. P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology 32:476-496.

Davis, J. H. 1943. The natural features of southern Florida. Fla. Geol. Surv. Bull. 25. 311 p.

Dittus, W. P. J. 1977. The ecology of a semi-evergreen forest community in Sri Lanka. Biotropica 9(4):268-286.

Duever, M. J., J. E. Carlson, J. F. Meeder, L. C. Duever, L. H. Gunderson, L. A. Riopelle, T. R. Alexander, R. F. Myers, and D. P. Spangler. 1979. Resource inventory and analysis of the Big Cypress National Preserve. Final Report to National Park Service. 1225 p.

Fairbridge, R. W. 1974. The Holocene sea-level record in South Florida, p. 223-232. In Environments of South Florida: Present and Past, P. J. Gleason (ed.), Memoir 2, Miami Geol. Soc., 452 p.

Gentry, R. C. 1974. Hurricanes in South Florida, p. 73-81. In Environments of South Florida: Present and Past, P. J. Gleason (ed.), Memoir 2, Miami Geol. Soc., 452 p.

Gleason, P. J., A. D. Cohen, W. G. Smith, H. K. Brooks, P. A. Stone, R. L. Goodrick, and W. Spackman, Jr. 1974. The environmental significance of Holocene sediments from the Everglades and saline tidal plain, p. 287-341. In Environments of South Florida: Present and Past, P. J. Gleason (ed.), Memoir 2, Miami Geol. Soc., 452 p.

Halle, F., R. A. A. Oldeman, and P. B. Tomlinson. 1978. Tropical Trees and Forests: An Architectural Analysis. Springer Verlag.

Harper, R. M. 1927. Natural resources of southern Florida. Florida Geol. Survey, 18th Ann. Rept., p. 25-206.

Harshberger, J. W. 1914. The vegetation of South Florida south of 27°30' north, exclusive of the Florida Keys. Trans. Wagner Free Inst. Sci. 7:49-189.

Hilsenbeck, C. E. 1976. A comparision of forest sampling methods in hammock vegetation. M.S. Thesis, Univ. of Miami, Coral Gables, Fla. 92 p.

Hoffmeister, J. E. 1974. Land from the Sea: the Geologic Story of South Florida. Univ. of Miami Press, Coral Gables, Fla. 143 p.

Houston, D. B. 1971. Ecosystems of National Parks. Science 172:648-651.

Kushlan, J. A. 1979. Design and management of continental wildlife reserves: lessons from the Everglades. Biological Conservation 15(4):281-290.

Little, E. L. 1976. Rare tropical trees of South Florida. U.S. Forest Service. Conservation Research Report No. 20. 20 p.

Little, E. L. and F. H. Wadsworth. 1964. Common trees of Puerto Rico and the Virgin Islands. U.S. Forest Service, Agric. Handbook No. 249. 548 p.

Little, E. L., R. O. Woodbury, and F. H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands, second volume. U.S. Forest Service, Agric. Handbook No. 449. 1924 p.

Long, R. W. and O. Lakela. 1976. A Flora of Tropical Florida. Banyan Books, Miami, Fla. 962 p.

Loope, L. L., D. W. Black, S. Black, and G. N. Avery. 1979. Distribution and abundance of flora in limestone rockland pine forests of southeastern Florida. South Florida Research Center Report T-547. 37 p.

Luer, C. A. 1972. The Native Orchids of Florida. New York Botanical Garden, New York. 293 p.

Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of vegetation Ecology. John Wiley & Sons. 547 p.

Philipps, W. S. 1940. A tropical hammock on the Miami (Florida) limestone. Ecology 21:166-175.

Pilsbry, H. A. 1946. Land Mollusca of North America. Liguus. Philadephia Acad. Nat. Sci. Monographs, No. 3, Vol. II, Part 1, p. 37-102.

Robertson, W. B. 1953. A survey of the effects of fire in Everglades National Park. Mimeo. Rpt. 169 p.

Robertson, W. B. 1955. An analysis of the breeding bird populations of tropical Florida in relation to the vegetation. Ph.D. dissertation, Univ. of Illinois. 599 p.

Robertson, W. B. 1959. Everglades: the Park Story. Univ. of Miami Press, Coral Gables, Fla. 95 p.

Safford, W. E. 1919. Natural history of Paradise Key and the nearby Everglades of Florida. Smithsonian Institution, Annual Report for 1917, p. 377-434.

Scholl, D. W., F. C. Craighead, and M. Stuiver. 1969. Florida submergence curve revised: its relation to coastal sedimentation rates. Science 163:562-564.

Simpson, C. T. 1920. In Lower Florida Wilds. Putnam, New York. 404 p.

Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Det. Kong. Danske Vidensk. Biol. Skr. (Copenhagen) 5(4):1-34.

Steel, G. O. and J. H. Torrie. 1960. Principles and Procedures of Statistics. McGraw Hill Book Co., Inc.

Weiner, A. H. 1979. The Hardwood Hammocks of the Florida Keys: An Ecological Study. National Audubon Society and Florida Keys Land Trust.

White, P. S. 1979. Pattern, process, and natural disturbance in vegetation. Botanical Review 45(3):229-299.

Appendix A. Vascular plant species composition of the six hammocks studied

Species		Hammock					
		Deer	Mahogany	Osteen	Pinecrest	Royal Palm	Wright
Trees/Shrubs (s)							
Acacia pinetorum	s					*	
Alvaradoa amorphoides		x					
Annona glabra			*	*	*	*	*
Ardisia escallonioides		x	x	x	x	x	x
Ateramnus lucidus		x		x			
Baccharis glomeruliflora	s	*	*	*	*	*	*
B. halimifolia	s					*	
Bumelia reclinata	s		*	*		*	*
Bumelia salicifolia		x	x	x	x	x	x
Bursera simaruba		x	x	x	x	x	x
Byrsonima lucida	s	*		*			
Callicarpa americana	s		*	*	*	*	*
Calyptranthes pallens			x	x	x	x	
C. zuzygium			x	x		x	
Carica papaya			x	x		x	
Celtis laevigata					x		
Cephalanthus occidentalis	s		x			x	
Chiococca alba	s	x	x	x	x	x	x
Chrysobalanus icaco		x	x	x	x	x	x
Chrysophyllum oliviforme		x	x	x	x	x	x
Citharexylum fruticosum		x	x	x		x	x
Coccoloba diversifolia		x	x	x	x	x	x
Colubrina arborescens							x
C. cubensis		x					x
Conocarpus erecta		*	*	*		*	*
Conchorus siliquosus				*		*	*
Crossopetalum rhacoma	s	*					
Dalbergia ecastophyllum			*				
Diospyros virginiana						*	
Dodonaea viscosa	s	*	*	*		*	*
Drypetes lateriflora				x		x	
Erythrina herbacea	s		x	x	x	x	x
Eugenia axillaris		x	x	x	x	x	x
Eugenia foetida			x				
Eupatorium villosum	s	*	*	*		*	*
Exothea paniculata		x	x	x	x	x	x
Ficus aurea		x	x	x	x	x	x
F. citrifolia		x	x	x		x	x

		Hammock					
Species		Deer	Mahogany	Osteen	Pinecrest	Royal Palm	Wright
Forestiera segregata var. pinetorum		x		x		x	x
F. segregata var. segregata			*				
Guapira discolor		*		*		*	*
Guettarda elliptica	s	*	*	*		*	*
G. scabra		x		x		x	x
Hamelia patens					x		
Hypelate trifoliata		x					
Ilex cassine		*	*	*	*	*	*
I. krugiana				x		x	x
Jacquinia keyensis		*					
Krugiodendron ferreum		x			x		
Lantana involucrata	s	*	*	*	*	*	*
Lysiloma latisiliquum		x		x	x	x	x
Mastichodendron foetidissimum		x	x	x	x	x	x
Metopium toxiferum		x	x	x	x	x	x
Morus rubra					x	x	
Myrcianthes fragrans var. simpsonii		x	x	x	x	x	x
Myrica cerifera		*	*	*	*	*	*
Myrsine floridana		x		x	x	x	x
Nectandra coriacea		x	x	x	x	x	x
Persea borbonia		*	*	*	*	*	*
Pinus elliottii var. densa		*		*		*	*
Pisonia aculeata			x	x	x	x	x
Prunus myrtifolia				x		x	x
Psychotria nervosa	s	x	x	x	x	x	x
P. sulzneri	s		x		x	x	
Quercus laurifolia					x		
Quercus virginiana		x	x	x		x	x
Randia aculeata	s	x	x	x	x	x	x
Rhus copallina		*		*		*	*
Salix caroliniana		*	*	*	*	*	*
Sambucus simpsonii	s		*			*	
Sapindus saponaria						x	
Schinus terebinthifolius			*	*	*	*	*
Schoepfia chrysophylloides		x	x	x	x	x	x
Simarouba glauca		x	x	x	x	x	x
Solanum erianthum	s	x	x		x	x	
Swietenia mahagoni			x			x	
Tetrazygia bicolor		x		x		x	x
Trema micranthum		*	*	*	*	*	*
Ximenia americana		*	*	*	*	*	*
Zanthoxylum fagara			x		x	x	

Species	Hammock: Deer	Mahogany	Osteen	Pinecrest	Royal Palm	Wright
Palms						
Acoelorraphe wrightii		x				
Coccothrinax argentata	x		x			
Roystonea elata		x			x	
Sabal palmetto	x	x	x	x	x	x
Serenoa repens	x	x	x	x	x	x
Vines						
Ampelopsis arborea	x	x	x	x	x	x
Angadenia sagraei	*		*		*	*
Aster caroliniensis		*		*	*	
Berchemia scandens				*		
Cardiospermum halicacabum		*		*	*	
Cassytha filiformis		*	*		*	*
Centrosema virginianum			*			
Chiococca parvifolia	*		*		*	*
Cissus sicyoides		*	*	*	*	*
Cynanchum blodgettii	x		x			
C. scoparium	x	x	x	x	x	x
Echites umbellata	*	*	*	*	*	*
Galactia spiciformis	x	x	x		x	x
G. volubilis				*		
Galactia sp.	*	*				
Gouania lupuloides		*				
Hippocratea volubilis		x			x	
Ipomoea alba		*		*	*	*
Ipomoea indica		x			x	x
Ipomoea tenuissima	x					
Jacquemontia curtissii			*			*
Melothria pendula		*	*	*	*	*
Mikania scandens	*	*	*	*	*	*
Mikania cordifolia		x		x		
Morinda royoc	x	x	x		x	x
Parthenocissus quinquefolia	x	x	x	x	x	x
Passiflora pallens	x	x	x	x	x	x
P. suberosa		x			x	x
Rhynchosia minima	*		*		*	*
Smilax auriculata	x	x	x	x	x	x
S. bona-nox		x				
S. laurifolia		x		x		
Toxicodendron radicans	x	x	x	x	x	x
Vicia acutifolia		*			*	*

	Hammock					
Species	Deer	Mahogany	Osteen	Pinecrest	Royal Palm	Wright
Vitis aestivalis		x	x	x	x	
V. rotundifolia	x	x	x	x	x	x
V. shuttleworthii					x	
Tournefortia hirssutissima				x		
Tournefortia volubilis		x				
Forbs						
Galium hispidulum	x	x			x	
Leiphaimos parasitica	x	x	x	x	x	x
Rivina humilis				x	x	
Zamia pumila	x	x	x		x	x
Ferns						
Acrostichum danaeaefolium		x		x	x	
Adianthum melanoleucum			x			
A. tenerum			x			
Anemia adiantifolia	x		x		x	x
Nephrolepis biserrata				x		
N. exaltata		x	x	x	x	
Polypodium aureum		x	x	x	x	x
Polypodium heterophyllum				x		
P. phyllitidis	x	x	x	x	x	x
Polypodium polypodioides	x	x	x	x	x	x
P. ptilodon		x				
Pteridium aquilinum var. *caudatum*	x	x	x	x	x	x
Pteris longifolia var. *bahamensis*	x	x	x		x	x
Pteris vittata	*		*	*	*	*
Thelypteris kunthii	x	x	x	x	x	x
T. augescens		x	x		x	
T. reptans			*			
Stenochlaena tenuifolia			x			
Tectaria lobata			x			
Vittaria lineata		x				
Graminoids						
Dichanthelium commutatum	x	x	x	x	x	x
Lasiascis divericata	x	x	x	x	x	x
Oplismenus hirtellus	x	x	x	x	x	x
Paspalum caespitosum	x		x		x	
P. setaceum	x	x	x	x	x	x
Scleria triglomerata		x	x	x	x	

Species	Hammock: Deer	Mahogany	Osteen	Pinecrest	Royal Palm	Wright
Orchids and Allies						
Catopsis berteroniana	x					
Encyclia cochleata	x	x	x		x	x
E. tampensis	x	x	x	x	x	x
Epidendrum difforme	x					
E. nocturnum	x	x	x		x	
E. rigidum	x	x	x			
Habenaria quinqueseta	x		x	x		
H. odontopetala	x	x	x	x	x	x
Oncidium ensatum	x		x			
Peperomia obtusifolia					x	
Polystachya concreta	x	x	x		x	x
Tillandsia balbisiana	x	x	x	x	x	x
T. circinnata	x	x	x		x	x
T. fasciculata	x	x	x	x	x	x
T. flexuosa	*	*	*			*
T. polystachia		*				
T. recurvata	*	*			*	*
T. setacea	x	x	x	x	x	x
T. usneoides	x	x	x		x	
T. utriculata	x	x	x	x	x	x
T. valenzuelana	x	x	x	x	x	x

S - Shrubs
X - Representative hammock species
* - Ecotonal, rare and solution hole species

Appendix B. Pinecrest #40 Hammock

	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Ardisia escalloniodes	7	20	125
Bumelia salicifolia	4	2153	50
Bursera simaruba	5	5000	125
Celtis laevigata	4	496	50
Chrysophyllum oliviforme	2	43	25
Coccoloba diversifolia	31	1825	250
Eugenia axillaris	17	210	150
Exothea paniculata	1	23	25
Krugiodendron ferreum	9	885	150
Lysiloma latisiliquum	7	5840	125
Mastichodendron foetidissimum	2	6900	50
Myrsine floridana	4	142	50
Nectandra coriacea	34	2243	300
Schoepfia chrysophylloides	1	22	25
Simarouba glauca	1	13	25
Zanthoxylum fagara	4	632	75

Appendix B. Mahogany Hammock

	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Acoelorrhaphe wrightii	6		50
Ardisia escallonioides	20	127	200
Bumelia salicifolia	16	788	175
Bursera simaruba	15	2164	225
Calyptranthes pallens	18	527	175
Calyptranthes zuzygium	1		25
Chrysophyllum oliviforme	2	45	50
Coccoloba diversifolia	3	28	50
Eugenia axillaris	120	1819	300
Eugenia foetida	17	561	150
Exothea paniculata	1	8	25
Ficus aurea	3	928	75
Metopium toxiferum	62	2025	300
Myrcianthes fragrans	2	14	50
Nectandra coriacea	1	7	25
Quercus virginiana	2	1300	25
Sabal palmetto	4		75
Swietenia mahagoni	13	8755	225

Appendix B. Royal Palm Hammock

	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Ardisia escallonioides	4	8	75
Bumelia salicifolia	12	1228	200
Bursera simaruba	1	14	25
Calyptranthes pallens	1	10	25
Calyptranthes zuzygium	49	1580	275
Coccoloba diversifolia	1	10	25
Eugenia axillaris	5	6	75
Exothea paniculata	29	1355	200
Ficus aurea	1	4450	25
Guettarda scabra	9	97	100
Metopium toxiferum	7	949	75
Myrsine floridana	2	-	25
Nectandra coriacea	32	685	275
Prunus myrtifolia	11	536	175
Quercus virginiana	7	15150	125
Schoepfia chrysophylloides	3	107	50
Simarouba glauca	7	1102	150
Tetrazygia bicolor	1	29	25

Appendix B. Wright Hammock

	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Ardisia escallonioides	28	175	225
Bumelia salicifolia	24	2033	275
Bursera simaruba	5	845	100
Coccoloba diversifolia	31	1293	250
Eugenia axillaris	23	228	225
Exothea paniculata	10	374	150
Ficus aurea	1		25
Guettarda scabra	41	567	275
Lysiloma latisiliquum	7	1765	150
Mastichodendron foetidissimum	3	76	50
Metopium toxiferum	5	883	125
Myrcianthes fragrans	6	135	100
Myrsine floridana	5	30	75
Nectandra coriacea	37	671	275
Prunus myrtifolia	1	14	25
Quercus virginiana	4	4150	75
Tetrazygia bicolor	1		25

Appendix B. Deer Hammock.

Species	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Ardisia escallonioides	24	127	175
Ateramnus lucidus	70	1164	300
Bumelia salicifolia	21	679	225
Bursera simaruba	2	145	50
Coccoloba diversifolia	43	2513	300
Eugenia axillaris	26	233	225
Exothea paniculata	16	421	250
Ficus aurea	2	282	50
Krugiodendron ferreum	15	293	125
Lysiloma latisiliquum	12	1270	150
Metopium toxiferum	18	1069	250
Myrcianthes fragrans	6	81	50
Myrsine floridana	7	20	125
Nectandra coriacea	24	185	175
Persea borbonia	1	28	25
Quercus virginiana	11	6265	150
Schoepfia chrysophylloides	4	62	25

Appendix B. Osteen Hammock

Species	Absolute Density	Absolute Basal Area (cm^2)	Absolute Frequency (%)
Ardisia escallonioides	35	252	225
Ateramnus lucidus	3	81	75
Bumelia salicifolia	11	605	175
Bursera simaruba	12	3040	175
Coccoloba diversifolia	53	1565	250
Eugenia axillaris	12	93	100
Exothea paniculata	16	537	150
Ficus aurea	6	514	100
Guettarda scabra	1	16	25
Lysiloma latisiliquum	11	4538	225
Metopium toxiferum	9	2623	200
Myrsine floridana	6	20	100
Nectandra coriacea	29	982	250
Prunus myrtifolia	18	776	150
Pisonia aculeata	2	26	50
Simaruba glauca	1	36	25
Tetrazygia bicolor	2	98	50