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AN ANALYSIS OF THE VEGETATION AT TURTLE MOUND

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ABSTRACT: *Turtle Mound, a shell midden built by the Timucua Indians is now covered by dense vegetation. Many of the dominant species are of tropical origin. Climatic and edaphic conditions have allowed these species to flourish. The remainder of the species on the mound are elements from coastal dune, salt marsh, temperate hammock, mangrove and ruderal communities.*

SHELL MOUNDS, remains of Indian activity in Florida and elsewhere, have drawn the attention of archeologists for a long time. Occasionally botanists also have been intrigued by them because of the interesting plant associations found growing there. It was primarily to find out more about these plant associations that this study of Turtle Mound was undertaken—i.e., (1) what are the dominant species on the Mound and what is their distributional pattern? (2) what are the ranges of the tropical species, and is Turtle Mound their northern limit? (3) what factors allowed so many tropical elements to be established that far north in Florida? and (4) how does the flora of Turtle Mound compare with that of other shell mounds?

Turtle Mound is located 9 miles southeast of New Smyrna Beach, Florida, on the narrow peninsula which separates the Atlantic Ocean from Indian River North. It borders on the river, rises to a maximum elevation of 35 ft, extends 330 ft in a north-south direction and 180 ft to the east, and is thickly covered by tropical vegetation.

HISTORY—Goggin's map (1952) records 132 mounds for the area south of St. Augustine to Mosquito Lagoon on the coast and similar latitudes along the St. Johns River. Many of these mounds have been destroyed, primarily for road building purposes. According to Goggin northeastern coast of Florida was first occupied during the St. John I Period (100-1100 A.D.). He states that the Timucuas, the inhabitants of north central Florida, were agriculturists, producing large crops of maize. During the winter months, the Indians near the coast occupied sites along the brackish rivers that parallel the Ocean. Bullen and Sleight (1959) in their archeological work on Castle Windy Midden, 4 miles south of Turtle Mound, reinforce this idea of seasonal occupation. They point out that bones of several migratory birds and the lack of antlers with the deer remains indicate that these animals were taken in the winter months. Castle Windy Midden was occupied from approximately 1000-1350 A.D. according to radiocarbon dating. Green Mound, 20 miles north of Turtle Mound, also studied by Bullen and Sleight (1960) was occupied several centuries earlier than Castle

No there are orange Lites (500BC–500AD)

But not here

what sp?

Seminole Rest shows some summer occupations

Windy. Turtle Mound has never been excavated and its age has only been ascertained from pottery fragments collected at the site. Goggin designates it as being from the St. John II Period (1000-1600 A.D.). Brinton (1859) mentions the observations of a "gentleman of the vicinity" who stated that after a strong gale had caused considerable erosion of the mound on the river end he found low at the bottom and as high as he could observe numberless pieces of Indian pottery, and quantities of bones, mostly fish, but no human ones, also charcoal and beds of ashes.

Mexia, a Spanish soldier who traveled in 1605 from St. Augustine to south of Cape Canaveral wrote a report of his trip and drew a map of the east coast of Florida. He referred to Turtle Mound as Baradero de Surruque. Mexia wrote (Higgs in Rouse 1951) "the river passes close by the old Indian habitation which is named Surruque which is a mound of oyster shells and low shrubs." At the foot of this mound the Indians launch their canoes to go out to sea." *The Travels of William Bartram* published in 1791 contains a map on which Mt. Turtle appeared at the appropriate location. This as far as we know is the earliest reference to the Mound under its modern name. According to Harper (1958) Bartram was in the vicinity of New Smyrna Beach in December 1766 and referred to two mounds in the area (XXVIII. 144). The one mentioned in the introduction may be Turtle Mound. In his book Bartram reminisced:

"crossing over a narrow isthmus of sand hills which separated the river from the ocean, I passed over a pretty high hill, its summit crested with a few palm trees, surrounded with an orange grove; this hill whose base was washed on one side by the floods of the Musquitoe river, and on the other side by the billows of the ocean, was about one hundred yards diameter and seemed to be an entire heap of sea shells. I continued along the beach, a quarter of a mile, and came up to a forest of *Agave vicipara*."

Today orange trees are not uncommon on the Mound, there are large cabbage palms at its base and agaves can be found nearby but more convincing that this is Bartram's location is that the peninsula is quite narrow in this area. In fact, from the descriptions of Mexia and Bartram, it would seem to have been even narrower in earlier days.

In the early decades of this century John K. Small made numerous trips to Florida and soon began to note the tropical vegetation covering the still numerous middens. He attributed the tropical vegetation in these habitats to the "blanket of warm air which is radiated from the stored up interior heat in the spaces between the shells of the mound" (1927). In the spring of 1921, Small made the first botanical exploration of Turtle Mound (1923). He wrote:

"There are over thirty kinds of woody plants and perhaps twice as many herbs on the Mound. The vegetation, although the locality is pretty far north along the coast, is largely of a tropical character; the snowberry (*Chiococca*, buttonbough (*Exothea*), torchwood (*Amyris*), marlberry (*Ardisia*), wild coffee (*Psychotria*), black mangrove (*Avicennia*), white mangrove (*Laguncularia*), red mangrove (*Rhizophora*) and spice tree (*Canella*) were among the more abundant shrubs and trees. Among the herbs of a tropical flavor were the poor-man's patches (*Ventzelia*) and the wild plumbago (*Plumbago scandens*). A broom grass (*Andropogon*) was not rare. This may have been the grass that covered the mound in Baldwin's time."

Mexia wrote *yerba menuda* which is best translated as low herbs

Dave Brewer radio-carbon dated samples

yes no pre-pottery occupation (orange)

visited in ~~1770s~~ 1766

This doesn't sound like Tm

Yes there aren't many mounds I know of in narrower areas unless one gives credence to

hmm... so is Agave native?

yes cause today the ocean doesn't wash up to the east side

hmm

NW side

1605

Ethel Michaux

Wil Sartain & Michaux

(Small confused the Baldwin reference with Mexia's report, with which he was familiar, since he cited an account of it in the New Smyrna News in 1921. There is no mention of Turtle Mound in Baldwin's work (1843).) Small also mentioned seeing papaya, wild orange, *Urtica chamaedryoides*, *Eugenia axillaris*, *Xanthoxylum fagara*.

The Mound was saved from destruction by the efforts of Mrs. Jeannette T. Connor, John B. Stetson, Jr. and others. It was acquired by the state of Florida in 1951 and is now designated as a State Historic Memorial. A 6 ft high wall was erected on the northwest side in 1964 to stop erosion. Two lookout towers were built in 1972 to offer the public a panoramic view of the river and the ocean.

ENVIRONMENTAL FACTORS—Thirteen soil samples were collected from the Mound and neighboring areas and were analyzed at the Soil Laboratory of the University of Florida. These data are given in Table 1.

TABLE 1. Soil Analysis from Turtle Mound.

Sample	Organic Matter	pH	Ions in ppm				
			Ca	Mg	P	K	NO_3
1. Dunes, surface	1-2%	7.3	2000	182	29.7	86	< 4
2. Dunes, profile 8"-19"	1-2%	7.4	2000	174	22.9	86	< 4
3. Dunes, profile 19"-4'	1-2%	8.0	2000	128	11.4	70	< 4
4. Palmettos, w. of paved road	1-2%	8.0	2000	120	17.0	84	< 4
5. Palmettos, profile 4"-18"	0.2-1%	7.9	2000	50	24.0	46	< 4
6. Palmettos, profile 18"-3'	0.2-1%	8.2	2000	30	22.1	18	< 4
7. Oaks, e. of Mound, surface	2-4%	6.9	2000	540	32.8	62	< 4
8. Oaks, e. of Mound, profile 8"-4'	2-1%	6.6	510	56	15.3	30	< 4
9. E. base of Mound, surface	17%	7.3	8000	2160	139.6	184	4
10. E. base of Mound, 5"-2.5'	4-8%	7.7	2000	4000	134.9	126	4
11. E. side of Mound-halfway	17%	7.8	8000	4000	139.6	314	4
12. Top of Mound	17%	7.8	8000	3700	139.6	172	4
13. W. side of Mound-halfway	17%	8.0	8000	3700	139.6	324	4

The large increases in organic matter, calcium, magnesium, phosphorus and potassium on the Mound are due to the weathering of shells and decaying vegetation. These findings are in general similar to those obtained from soils of south Florida at Boynton Beach Hammock and surrounding dunes and scrubs (D. F. Austin, personal communication). Although calcium and magnesium concentrations are considerably higher on the Mound than at Boynton Beach, low levels of nitrates are found in both localities; this differs from soil analysis at Pompano Beach Hammock in which Alexander (1958) reports 60 ppm for this ion.

Because boundaries of plant distribution are often determined climatically, data were obtained on minimum temperatures which might control the spread of tropical species. Records for 1910-1926 from New Smyrna Beach (Mitchell and Ensign, 1928) and for 1935-1973 from Daytona Beach (Daytona Beach Weather Station) showed a mean minimum of 25° F (-2°C) for the 55 year period. During this time the temperature fell below 20° F (-7°C) only twice, 18° (-8°C) in January and 19° F (-7°C) in February 1917. The temperature on the Mound probably never falls as low as that at the weather stations because of its elevation and its sheltered position next to the river.

These data indicate that only every few decades is the temperature low enough to injure some of the tropical species. Probable evidence of these extremes can be seen in the dead central trunks of several specimens of *Exothea*, *Xanthoxylum fagara* and *Mastichodendron*. New branches have sprouted from the bases however.

Dr. Small's hypothesis that the soil on the mound was warmer than in nearby areas was tested by burying three maximum-minimum thermometers about 6 in below the surface. One was placed near the top of the Mound under a hackberry, in almost pure shells. The second was buried near dwarf live oaks about 25 ft from the Mound. The third was added later near the base of the Mound in a mixture of soil and broken shells near a red bay. The data are given in Table 2.

Comparisons show that soil temperatures on the Mound are not only warmer but also colder. This would be expected as the shells are rather loosely arranged thus allowing air to penetrate more readily than in soil of finer particles. We probably added to this factor by not compacting the shells after each reading as much as they were originally. But in any case, judging from the data obtained, it would seem very unlikely that soil temperatures in this area would be a limiting factor in the spread of tropical species.

Looseness of the soil of shell mounds provides good aeration of roots. This is probably an important requirement for species which are normally associated with limestone soils.

TABLE 2. Minimum-Maximum Soil Temperatures for 3 locations on or near Turtle Mound.

Dates	Top of Mound		Base of Mound		Off Mound	
	°F	(°C)	°F	(°C)	°F	(°C)
3-16-72	58-80	(14-27)			64-82	(18-28)
4-20-72	60-90	(16-32)			70-88	(21-30)
5- 5-72	58-84	(14-29)			66-78	(19-26)
6- 2-72					72-88	(22-31)
6-27-72	70-87	(21-31)			77-79	(25-26)
7-14-72	74-87	(23-31)			77-81	(25-27)
8- 8-72	72-87	(22-31)			77-83	(25-28)
8-28-72	75-84	(24-29)			78-82	(26-28)
9-24-72	68-88	(20-30)			78-83	(26-28)
10- 5-72	74-92	(23-33)			78-84	(26-29)
12- 1-72	55-88	(13-31)			65-82	(18-28)
12-28-72	50-76	(10-24)			60-76	(16-24)
1-19-73	56-72	(13-22)	56-72	(13-22)	56-74	(13-23)
2-23-73	49-70	(9-21)	55-68	(13-20)	53-72	(12-22)
2-28-73	52-63	(11-17)	53-63	(12-17)	57-64	(14-18)
3-13-73	50-78	(10-26)	59-71	(15-22)	64-72	(18-22)
3-19-73	51-78	(11-26)	54-74	(12-23)	64-77	(18-25)
4- 3-73	54-85	(12-29)	58-72	(14-22)	60-72	(16-22)
4-13-73	53-79	(12-26)	58-72	(14-22)	63-74	(17-23)
4-20-73	62-80	(17-27)	64-71	(18-22)	63-74	(17-23)
5- 4-73	59-85	(15-29)	61-76	(16-24)	66-77	(19-25)
5-14-73	62-86	(17-30)	66-85	(19-29)	66-79	(19-26)
7-14-73	60-84	(16-29)	64-83	(18-28)	64-82	(18-28)

VEGETATION—The vegetation consists of a mixture of floristic elements which are characteristic for several plant communities as follows: 30% from tropical hammocks, 20% from salt marshes, 18% ruderals, 15% temperate hammocks, 12% dunes and 5% mangrove. In all, 108 species in 56 families were identified as shown in the Annotated List of Species.

To determine the geographical ranges of the tropical hammock elements, specimens at New York Botanical Garden, Missouri Botanical Garden, University of Florida and University of South Florida Herbaria were examined. Most of these taxa have widespread distributions in the Caribbean, South America, Central America, Mexico and even southern Texas. These data are tabulated in Table 3.

Approximately one third of the species reach their northern extension at Turtle Mound. Another third are known from collections made by Curtis in 1878 from shell islands at the mouth of the St. Johns River. His botanical explorations in that region are described vividly (1879). The last third have their northern limits on shell mounds or in one case, on limestone outcrops, between Turtle Mound and Jacksonville. These tropical species probably range further north on the east coast than on the west coast of Florida because of the Gulf Stream and the prevailing easterly winds. Harper had noted decades ago (1921) that the northernmost tropical hammocks are all on shell mounds and that most of the woody species of such a community have fleshy fruits which are spread by birds.

TABLE 3. Distribution of Tropical Hammock Elements.

Species	Bahamas	Greater Antilles	Lesser Antilles	South America	Mexico & C. America	Northern Limit
1. *Forestiera segregata*	x	x	x			Bermuda; Sapelo Isl. Ga.
2. *Passiflora suberosa*	x	x	x	x	x	Bermuda; s. Tex.
3. *Mentzelia floridana*	x					Isl. mouth of St. John R.
4. *Eugenia axillaris*	x	x	x		x	Isl. mouth of St. John R.
5. *Myrcianthes fragrans*	x	x	x	x	x	Isl. mouth of St. John R.
6. *Capsicum frutescens*		x	x	x	x	Isl. mouth of St. John R.
7. *Chiococca alba*	x	x	x	x	x	Bermuda; Ariz.; Tex. Isl. mouth of St. John R.
8. *Psychotria nervosa*	x	x	x	x	x	Bermuda; Tex. Isl. mouth of St. John R.
9. *Ipomea alba*	x	x	x	x	x	Welaka, Putnam Co.
10. *Exiandra cordifolia*		x		x	x	Citra, Marion Co.
11. *Zanthoxylum fagara*	x	x	x	x	x	Tomoka S.P.; s. Tex.
12. *Ardisia escallonioides*	x	x			x	Tomoka S.P.
13. *Plumbago scandens*	x	x	x	x	x	Cedar Key; s. Tex. s. Ariz.
14. *Myrsine floridana*	x	x	x	x	x	Green Mound
15. *Amyris elemifera*	x	x	x		x	Turtle Mound
16. *Cissus trifoliata*	x	x	x	x		Turtle Mound
17. *Cereus eriophorus*		? Cuba				Turtle Mound
18. *Exothea paniculata*	x	x	x		x	Turtle Mound
19. *Heliotropium angiospermum*	x	x	x	x	x	Turtle Mound. s. Tex.
20. *Mastichodendron foetidissimum*	x	x	x			Turtle Mound
21. *Nectandra coriacea*		x	x		x	Turtle Mound
22. *Schoepfia chrysophylloides*	x	x				Turtle Mound

In order to obtain more precise data on the composition of the vegetation of Turtle Mound, 24 transect lines were established. The transects all began at the base of a large sour orange tree in the small hump between the north-south summits and were made at 15° intervals from that point to the base of the Mound. The transects on the steep western exposure were approximately 90 ft long while the others were often up to 200 ft long. The plants within 1.5 ft of either side of the line were recorded; seedlings of woody plants were not counted if less than 3 ft high. Only an estimate of herbaceous plant density was made.

The most common species are listed below. The first number is actual number of plants encountered. The second figure refers to the number of transects in which it was found.

TREES AND SHRUBS

Eugenia axillaris 175-24
Myrcianthes fragrans 152-19
Amyris elimifera 105-19
Celtis laevigata 95-23
Xanthoxylum fagara 90-23
Ardisia escallonoides 64-12
Yucca aloifolia 57-20
Forestiera segregata 49-21
Chiococca alba 46-13
Persea borbonia 34-10
Opuntia stricta var *dillenii* 34-17

VINES

Parthenocissus quinquefolia 69-18
Sageretia minutiflora 46-14
Passiflora suberosa 45-20
Plumbago scandens 44-20
Cissus trifoliata 35-18
Cynanchum scoparium 27-14

HERBS

Parietaria praetermissa 290-23
Leiandra cordifolia 50-4
Oplismenus setarius 50-4
Malvastrum coromandelianum 28-13
Galium hispidulum 20-6
Bidens pilosa 15-7

Some of the dominant woody species have been mapped to show their distributional pattern on the Mound. (Fig. 1). Notes on individual species follow.

Eugenia axillaris grows in both shade and exposed areas. In the latter instance the plants are shorter with smaller leaves. On other shell mounds along Mosquito Lagoon south of Turtle Mound this species often grows in almost pure stands.

Myrcianthes fragrans attains a height of 25 ft on the Mound. It grows on dunes as well, but there it is a stunted shrub about 3 ft high.

Amyris elimifera grows best on the exposed northern and southern slopes.

Celtis laevigata, a deciduous species, is most common on the arid western slope of Turtle Mound. Many of the trees are approximately 20 ft high and 14 in in diameter. Borings were made with an increment borer to determine the age of these plants. A maximum of 40 annual rings was counted. Dr. Small did not mention this species for Turtle Mound. If it was there 50 yr ago it must have been much less conspicuous than it is now.

Xanthoxylum fagara, a prickly shrub, thrives in the exposed areas near the top of the Mound.

Ardisia escallonoides is a shade loving shrub which does best in areas of high organic contents. It resembles *Myrsine floridana* which is considerably less common here—22 plants in 7 transects. The latter grows in more exposed areas at the base of the Mound.

Parietaria praetermissa, the most common herb during our study is an ephemeral species, appearing from February to May. It is almost completely absent the rest of the year and is replaced partially by *Galium hispidulum* later in the season. The presence of *Leiandra cordifolia* is also variable; it becomes much less conspicuous during periods of low rainfall.

COMPARISON WITH OTHER MOUNDS—It can be seen that Turtle Mound is dominated by a tropical woody flora. This is replaced on the river side by herbaceous and woody brackish species and on the eastern exposure by more temperate woody taxa such as Red Bay, Live Oak and Cabbage Palm. Why are tropical hammock species more successful than temperate hammock elements? It has

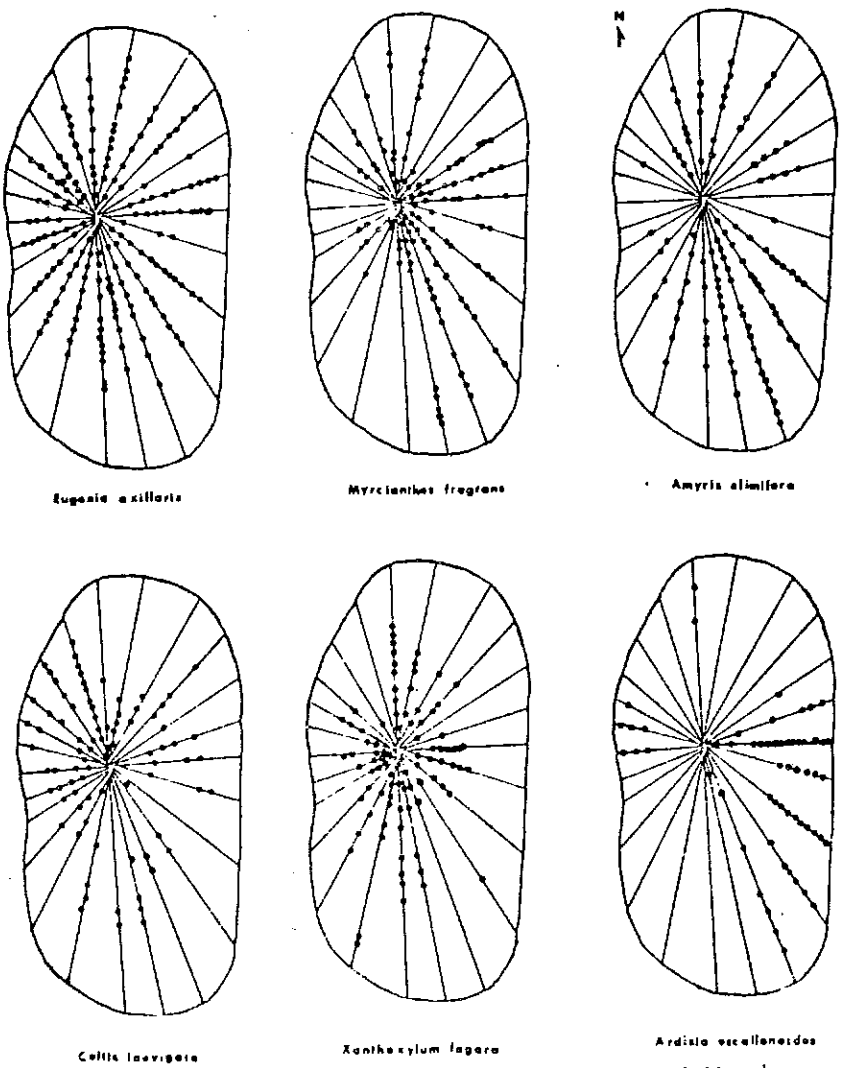

Fig. 1. Distributional pattern of 6 dominant woody species on Turtle Mound.

been suggested by several authors (Rorison, 1969; Salisbury, 1921) that when a species is close to its climatic limits it can survive competition only in edaphic extremes of which it is tolerant and of which its competitors are less tolerant. At Turtle Mound edaphic conditions promote the spread of tropical hammock species. Does the same situation hold for mounds at the same latitude on the Gulf Coast and along the St. Johns River? Judging from Small's description of the mounds around Crystal River, the flora there is temperate. The mound at Hontoon Island State Park along the St. Johns River made up of snail shells (*Viviparа*) was investigated by S. Smith, S. Acree, L. M. Carlton, and R. Thompson, students at Stetson University. The soil analysis (unpublished data) for pH and mineral contents revealed very similar values to those found on Turtle Mound yet the only tropical hammock species here is *Psychotria nervosa*. There are probably several factors for the almost total absence of southern elements on these mounds. First of all the climate is somewhat harsher inland and on the Gulf Coast than it is for comparable latitudes along the Atlantic coast. Secondly, the source of tropical species is further away in the former areas. Thirdly, it may be that the distribution and movement of birds, which are thought to be responsible for the northern transport of the tropical taxa, are more common along the East Coast.

DISCUSSION—Small had suggested (1928) that some of the species now growing on kitchen middens might be there because they had been used by the Indians. There is no evidence to support his hypothesis. The only plants now found on the mound that are known to have been used by the Timucua Indians are cacti, and yaupon. These species are found off the Mound as well.

Judging from the vegetation on eroded area on the western side of Turtle Mound and the excavated areas of Green Mound, probably the first invaders of shell middens in this area of Florida are weedy species such as *Bidens pilosa*, *Malvastrum coromandelianum*, *Andropogon virginicus*. This was probably the stage of succession that Mexia observed in 1605. Somewhat later shrubby species that grow on calcareous dunes such as *Yucca aloifolia*, *Myrsine floridana*, *Ilex vomitaria*, *Myrcianthes fragrans* and *Forestiera segregata* moved in. The tropical hammock species are probably introduced over a long period of time and grow when conditions become favorable.

Shell mounds can be considered comparable to islands. Even though many have been partially or completely obliterated they have acted, and still act, as stepping stones in the northern distribution of widespread tropical species. The factors discussed by MacArthur (1972) for species distribution on islands are clearly applicable here. In general these are: chance, size and elevation of island, age, distance from source of species, extinction of species, amount of competition and climate. With all these variables we would expect the flora to be somewhat different on each of the mounds and this is what we find as we continue to explore the area. Probably one of the reasons why Turtle Mound is floristically rich is because its height has been a landmark for birds as well as for man.

ANNOTATED LIST OF SPECIES

Plant collections were made during 1971-73 (with permission of the Florida Department of Natural Resources) to obtain a complete inventory of the vascular flora. The 108 species in 56 different families listed below represent a rich variety of species for an area only slightly larger than an acre.

POLYPODIACEAE

Phlebodium aureum (L.) J. Smith. Golden Polypody. Rare epiphyte on *Persea.*
Vittaria lineata (L.) J. Smith. Shoe String Fern. Rare epiphyte on *Persea.*

CUPRESSACEAE

Juniperus silicicola (Sm.) Bailey. Southern Red-cedar. Occasional on river side.

GRAMINEAE

Andropogon virginicus L. Broomsedge. Occasional on river side.
Cenchrus echinatus L. Sandspur. Rare.
Chloris petraea Swartz. Fingergrass. Occasional on river side.
Distichlis spicata (L.) Greene. Saltgrass. Occasional on river side.
Oplismenus setarius (Lam.) Roem & Schult. Frequent in shade.
Panicum fasciculatum Swartz. Browntop Panicum. Rare.
Setaria geniculata (Lam.) Beauv. Knotroot Bristlegrass. Occasional on river side.
Setaria macrosperma (Scribn. & Merr.) Schum. Foxtail. Occasional on river side.
Sporobolus poiretii (Roem. & Schultes) Hitchc. Smutgrass. Occasional.

CYPERACEAE

Cyperus ligularis L. Frequent on river side.
Cyperus strigosus L. Occasional on river side.

PALMAE

Sabal palmetto (Walt.) Todd. ex Schult. & Schult. Cabbage Palm. Occasional at base of mound.
Serenoa repens (Bartr.) Sm. Saw Palmetto. Occasional at base of mound.

BROMELIACEAE

Tillandsia fasciculata Sw. Giant Air Plant. Rare.
Tillandsia simulata Sm. Rare.
Tillandsia usneoides (L.) L. Spanish Moss. Occasional on river side.

COMMELINACEAE

Commelina diffusa Burm. f. Common Dayflower. Rare.
Leiandra cordifolia (Sw.) Raf. Frequent on shells in shade.

LILIACEAE

Smilax laurifolia L. Bamboo Briar. Occasional at base of mound.

AGAVACEAE

Yucca aloifolia L. Spanish Dagger. Abundant.

AMARYLLIDACEAE

Hymenocallis sp. Spider Lily. Rare, has not flowered.

MYRICACEAE

Myrica cerifera L. Wax Myrtle. Occasional, base of mound.

FAGACEAE

Quercus laurifolia Michx. Laurel Oak. Occasional, base of mound.
Quercus virginiana Mill. Live Oak. Occasional, base of mound.

ULMACEAE

Celtis laevigata Willd. Hackberry. Dominant.

URTICACEAE

Parietaria praetermissa Hinton. Pellitory. Dominant in shade.
Urtica chamaedryoides Pursh. Stinging Nettle. Rare near southern overlook.

OLACACEAE

Schoepfia chrysophylloides (A. Rich.) Planch. Whitewood. Rare.

CHENOPODIACEAE

Chenopodium album L. Lamb's Quarters. Occasional on river side.

AMARANTHACEAE

Iresine diffusa H. & B. ex Willd. Juba's Bush. Occasional near base.

NYCTAGINACEAE

Boerhavia diffusa L. Red Spiderling. Rare.

PHYTOLACCACEAE

Phytolacca americana L. Pokeweed. Rare.
Ricina humilis L. Rouge Plant. Occasional.

AIZOACEAE

Sesuvium portulacastrum (L.) L. Seaside Purslane. Occasional near base.

PORTULACACEAE

Portulaca pilosa L. Pink Purslane. Occasional along trail.
Portulaca phaeosperma Urban. Yellow Purslane. Rare on trail.

CARYOPHYLLACEAE

Arenaria lanuginosa (Michx.) Rohrb. Sandwort. Rare on trail.

LAURACEAE

Nectandra coriacea (Sw.) Griseb. Lancewood. Rare.
Persea borbonia (L.) Spreng. Red Bay. Abundant.

CRUCIFERAE

Lepidium virginicum L. Peppergrass. Abundant along trail.

CRASSULACEAE

Kalanchoe pinnata (Lam.) Pers. Life Plant. Rare on northern side of mound.

LEGUMINOSAE

Canavalia maritima (Aubl.) Urb. Seaside Bean. Occasional on river side.
Erythrina herbacea L. Coral Bean. Occasional.
Galactia regularis (L.) BSP. Milk Pea. Occasional on river side.
Vigna luteola (Jacq.) Benth. Cow Pea. Occasional on river side.

OXALIDACEAE

Oxalis dillenii Jacq. Sour Grass. Rare along trail.

RUTACEAE

Amyris elemifera L. Torchwood. Dominant.
Citrus aurantium L. Sour Orange. Occasional.
Xanthoxylum fagara (L.) Sarg. Wild Lime. Dominant.
Xanthoxylum clava-herculis L. Hercules Club. Occasional.

EUPHORBIACEAE

Chamaesyce hirta (L.) Millsp. Rare.
Euphorbia cyathophora Murr. Wild Poinsettia. Occasional along trail.

ANACARDIACEAE

Rhus copallinum L. Winged Sumac. Occasional, base of mound.

AQUIFOLIACEAE

Ilex comitaria Ait. Yaupon. Occasional, base of mound.

SAPINDACEAE

Exothea paniculata (Juss.) Radlk. Inkwood. Frequent.

RHAMNACEAE

Sageretia minutiflora (Michx.) Mohr. Buckthorn. Abundant.

VITACEAE

Cissus trifoliata (L.) L. Possum Grape. Abundant, west side.
Parthenocissus quinquefolia (L.) Planchon. Virginia Creeper. Dominant.
Vitis rotundifolia Michx. Muscadine Grape. Rare, at base of mound.
Vitis shuttleworthii House. Calusa Grape. Rare, at base of mound.

MALVACEAE

Malvastrum coromandelianum (L.) Garcke. False Mallow. Abundant along trail.
Pavonia spinifex (L.) Cav. Spur Bur. Frequent along trail.

PASSIFLORACEAE

Passiflora suberosa L. Passionflower. Abundant.

CARICACEAE

Carica papaya L. Papaya. Rare.

LOASACEAE

Mentzelia floridana Nutt. ex Torr & Gray. Poor Man's Patches. Occasional in open areas.

CACTACEAE

Cereus eriophorus Pfeiffer var. *fragrans* (Sm.) Benson. Rare.
Opuntia compressa (Salisb.) Macbride var. *amnophila* (Sm.) Benson. Occasional.
Opuntia stricta Haw. var. *stricta*. Occasional.
Opuntia stricta Haw. var. *dillenii* (Ker.) Benson. Frequent.

RHIZOPHORACEAE

Rhizophora mangle L. Red Mangrove. Occasional on river side.

COMBRETACEAE

Laguncularia racemosa (L.) Gaertn. f. White Mangrove. Rare on river side.

MYRTACEAE

Eugenia axillaris (Sw.) Willd. White Stopper. Dominant.
Myrcianthes fragrans (Sw.) McVaugh. Nakedwood. Dominant.

MYRSINACEAE

Ardisia escallonioides Schlecht. & Cham. Marlberry. Dominant.
Myrsine floridana D.C. Myrsine. Frequent.

PLUMBAGINACEAE

Plumbago scandens L. Leadwort. Frequent.

SAPOTACEAE

Bumelia tenax (L.) Willd. Tough Buckthorn. Occasional.
Mastichodendron foetidissimum (Jacq.) Cronquist. Rare.

OLEACEAE

Forestiera segregata (Jacq.) Krug. & Urban. Florida Privet. Abundant.

ASCLEPIADACEAE

Cynanchum scoparium Nutt. Leafless Cynanchum. Frequent.

CONVOLVULACEAE

Ipomea alba L. Moonflower. Occasional.
Ipomoea acuminata (Vahl) Roem. & Schult. Occasional.

BORAGINACEAE

Heliotropum angiospermum Murray. Dog's Tail. Occasional on river side.

AVICENNIACEAE

Avicennia germinans (L.) L. Black Mangrove. Occasional on river side.

VERBENACEAE

Callicarpa americana L. French Mulberry. Occasional.
Lantana ovalifolia Britt. Shrub Verbena. Rare on north side at base.
Verbena maritima Sm. Seaside Verbena. Rare on river side.

LABIATAE

Salvia coccinea Buc'hoz ex Etlinger. Scarlet Salvia. Occasional in exposed areas.

SOLANACEAE

Capsicum frutescens L. Bird Pepper. Frequent.
Lycium carolinianum Walt. Christmas Berry. Rare on river side.
Physalis viscosa L. var. *maritima* (M.A. Curtis) Waterfall. Ground Cherry. Occasional along wall near river.

RUBIACEAE

Chiococca alba (L.) Hitch. Snowberry. Abundant.
Psychotria nervosa Sw. Wild Coffee. Frequent.
Galium hispidulum Michx. Bedstraw. Frequent.

CUCURBITACEAE

Melothria pendula var. *crassifolia* (Sm.) Cogn. Creeping Cucumber. Rare.

COMPOSITAE

Ambrosia artemisiifolia L. Common Ragweed. Occasional along river side.
Baccharis halimifolia L. Groundsel Tree. Occasional on river side.
Bidens pilosa L. Spanish Needle. Abundant along trail.
Borrichia frutescens (L.) D.C. Sea Oxeye. Occasional on river side.
Iva frutescens L. Marsh Elder. Occasional on river side.
Melanthera aspera Jacq. var. *aspera*. Occasional on river side.
Solidago sempervirens L. Goldenrod. Occasional on riverside.
Sonchus oleraceus L. Sow-Thistle. Occasional along trail.
Verbesina laciniata (Poir.) Nutt. Crownbeard. Abundant along trail.
Vernonia gigantea (Walt.) Trel. Ironweed. Abundant along trail.

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Biological Sciences

SIZE TRENDS IN LIVING BENTHONIC FORAMINIFERIDA

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ABSTRACT: *Except for the very largest species of calcareous benthonic Foraminiferida (10 mm or larger), there appears to be only a slight trend toward a higher percentage of large-sized species in warm water. The agglutinated Foraminiferida have a slight trend toward larger size in cold water, and all of the largest species (20 to 40 mm) live in water that is less than 5°C.*

WE RECORDED the size of each species of living benthonic Foraminiferida in ten regional monographs. Previously, little analysis of this type had been done on invertebrates, although Be (1965, p. 881) noted that tropical and subtropical species of planktonic Foraminiferida were generally larger than those living in cold water, and Nicol (1966, p. 109-113) observed that a higher percentage of large-sized species of marine pelecypods live in warm water.