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Editor

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A Taxonomic and Ecological Study of the Genus *Coccoloba* (Polygonaceae) on San Salvador Island

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ABSTRACT

There are five species of the genus *Coccoloba* on San Salvador Island. Each species was studied and field investigations were made to determine if there was hybridization among the species. Plant association studies were also made with species of *Coccoloba*. This was done by the circle study plot method. General ecology notes were also recorded.

INTRODUCTION

The flora of San Salvador Island, exhibit unique characteristics. Habits ranging from vines and herbaceous plants to tree or woody scrubs are present. In all, approximately 513 species of vascular plants in 337 genera representing 106 families are present (Smith, 1982). Studies of the flora began as early as 1905 when some of the first vegetative lists were published for this remote island. In particular, the genus *Coccoloba*, which today has five specific representatives on the island, was observed by William C. Coker. In 1905, Coker and his colleagues had reported siting three of the five species that are present today on the island. *Coccoloba diversifolia* Jacq. was observed in higher elevations, while *C. krugii* Lindau was sited in lower elevations and *C. uvifera* was observed on the coastal strands (Coker, 1905). *Coccolob swartzii* Meisn. had not been seen on San Salvador, but was sited on Long Island, The Bahamas (Coker, 1905). The Bahama Pigeon Plum, *C. tenuifolia* L., had not been observed on any of the Bahama Islands as of 1905 (Coker, 1905). Later in 1920, Britton and Millspaugh had reported siting all five species that are present on the island today (Britton and Millspaugh, 1920).

The genus *Coccoloba* is among the genera of the flora that causes some confusion in the field. Therefore investigations on the genus were made, and a taxonomic key was constructed for the genus. Species descriptions were prepared using both the literature and observed characteristics. The possibility of hybridization among species was examined. This investigation was accomplished by combining observations of leaf, fruit, and inflorescence morphology and the ecological investigations. The ecological studies were undertaken to determine 1) other species associated with the *Coccoloba*, 2) insect and animal associations, 3) soil and topography preferences of the species and 4) the general location and distribution of the *Coccoloba* on San Salvador Island.

TAXONOMY OF THE *COCCOLOBA*

Description of Family

The Family Polygonaceae is located in both temperate and tropical regions. The family representatives that are found in temperate areas are herbaceous, while those found in the tropical areas are either herbaceous or woody. Several characteristics of this family are common among the temperate and the tropical representatives. The leaves of these representatives are predominantly arranged in an alternate fashion. Associated with the leaves is a modified stipule, known as an ocrea (ochrea), which encompasses the leaf. The presence of the ocrea gives the nodes of the plant a sheathed and swollen appearance. This appearance is a result of the fusion of the ocrea and the petiole of the leaf (Adams, 1972).

In terms of the floristics of the Polygonaceae, small and inconspicuous flowers are present in most members of the family. The flowers occur on a raceme inflorescence, with pedicels ranging from 5mm to nearly

sessile flowers. The calyx is composed of two to six sepals and is often corolloid with a whitish or pinkish tint (Correll, 1982). The corolla is usually lacking. The androecium consists of two to nine stamens containing 2-celled anthers which split longitudinally (Correll, 1982). The gynoecium is superior and exhibits free-central placentation. The ovary is 3-carpellate and the styles are 2 or 3 in number (Correll, 1982). The fruit is achenial, enclosed often by accrescent perianth parts (Adams, 1972). Of these characteristics mentioned above, the presence of an ocrea and alternate leaves serve as good field characteristics for identification of this family. On San Salvador Island, the Bahamas, there are two genera of this family represented, *Antigonon* and *Coccoloba* (Smith, 1982). *Antigonon* is a perennial herbaceous vine, while *Coccoloba* is a woody genus.

Description of Genus

The genus *Coccoloba* is represented in the United States by two species (Long and Lakela, 1971), in Jamaica by ten species (Adams, 1972), in Puerto Rico and the Virgin Islands by eleven species (Howard, 1957), and in the Bahamas by six species (Correll, 1982). This tropical genus has five representatives on San Salvador Island in the Bahamas. Each of these species has alternate leaves with entire margins. The morphology of these leaves varies greatly from species to species and from one environmental type to another.

The genus *Coccoloba* is characterized by shrub-like or tree habits. As previously stated, this genus is the only woody genera of the Polygonaceae family. The plants in the genus have ocreae, which are coriaceous, usually membranous, cylindric, truncate and occasionally deciduous (Correll, 1982). The majority of the leaves are coriaceous, in fact only one of the five species, on San Salvador, exhibits chartaceous leaves, *Coccoloba tenuifolia*. The flowers of *Coccoloba* are found on racemes, some nearly spikes (Correll, 1982). The perianth is usually four to five-merous, with the inner whorl (the corolla) absent (Adams, 1972). According to Correll, (1982), some degree of connation occurs at the bases of the green or whitish sepals. The stamens are usually eight in number and slender, the ovary is three-angled with erect ovules and three styles (Long and Lakela, 1971). The fruit is falsely drupaceous and is actually an achene enclosed by an accrescent perianth (Adams, 1972). This perianth usually thickens and becomes succulent (Correll, 1982). The fruit of the Pigeon Plum, *C. diversifolia* and Sea Grape, *C. uvifera* are edible but very astringent and must be well ripened. Sea grapes are used in jelly making (Correll, 1982).

Determining the Species. The following key was constructed through accumulation of knowledge about the species. The key is primarily based on inflorescence and pedicel length as well as leaf morphology.

Key to the Species of *Coccoloba* on San Salvador Island.

1. Leaves orbicular, 7-20 cm board, coriaceous, apices rounded, bases cordate; inflorescences longer than the leaves, pedicels 3-4 mm in length..... .....*Coccoloba uvifera*

1. Leaves not orbicular but other (ovate, obovate, or lanceolate).....2
   2. Inflorescences longer than the leaves (usually drooping).....3
   2. Inflorescences not longer than the leaves but, equal to or shorter than the leaves in length (usually erect).....4
      3. Leaves broadly ovate to nearly orbicular, chartaceous,apices bluntly acute, bases oblique and cuneate; pedicels thin, 1 mm or greater in length on long thin racemes.....*Coccoloba tenuifolia*
      3. Leaves ovate to elliptic or obovate, coriaceous, apices rounded, blunt, bases rounded, obtuse; pedicels less than 1 mm in length, inflorescence nearly a spike.....*Coccoloba swartzii*
         4. Leaves ovate to elliptic (elliptic to obovate when young), coriaceous, apices blunt, rounded, bases rounded, margins usually recurved; pedicels 2-4 mm in length on short erect, rigid inflorescences..... .....*Coccoloba diversifolia*
         4. Leaves broadly ovate, subcoriaceous, apices broadly acute, bases cordate;

pedicels less than 1 mm in length, inflorescence nearly a spike..... .....*Coccoloba krugii*

Description of the Species. The following descriptions result from personal observations in combination with literature. Adams (1972), Britton and Millspaugh (1920), Howard (1957) and Correll (1982) have been very useful in obtaining descriptive and historical information concerning the species of the genus: *Coccoloba*. Each species is diagrammed in Figures 1 thru 5.

Coccoloba uvifera (L.) L - Sea Grape

Low spreading shrub to tree, common in coastal or waste areas; branches spreading and terete, twigs stout; the bark smooth and brown.

Leaves alternate; petioles stout (up to 2 cm in length), petioles of leaves enclosed in coriaceous ocreae, the modified stipule (ocrea) rigid at the base; blades orbicular to reniform, coriaceous, 7-20 cm board, primary venation large and prominent, bifurcate and weakly anastomosing near the margin, secondary venation reticulate to obscure. Bases rounded to boardly cordate, apices rounded, truncate or emarginate.

Flowers numerous, usually white occasionally yellow or greenish, occuring in dense clusters (rows) on racemes that are 8-20 cm in length; pedicels 3-4 mm. Calyx white, corolla absent. Fruits forming drooping clusters (occasionally erect) somewhat resembling bunches of grapes, globose, purplish, the pulp thin. (Figure 1)

Coccoloba tenuifolia L. - Bahama Pigeon Plum

Shrub, rarely a small tree to about 5 meters tall; branches terete, light brown in color.

Leaves alternate; petioles 3-5 mm in length, arising from a conspicuous base above the base of the ocrea; blades chartaceous, elliptic, occasionally obovate, ovate, oblong or suborbicular; primary veins 6 to 8 on a side, midrib and veins flat or impressed above, prominent beneath, arcuate, ultimate venation finely reticulate. Leaves with upper surface bright green, lower surface pale; entire margins are undulate; bases narrowly and unevenly rounded, oblique; apices acute, short acuminate or rarely obtuse.

Racemes very slender, numerous, usually long (longer than the leaves), weak and drooping, strongly curved. Pedicels, thin, 1 mm long in fruit, much longer than ochreolae. Flowers bright white, sepals oval, obtuse, about as long as stamens; fruit an achene, ovoid, 6 mm in length, the perianth appressed. (Figure 2)

Coccoloba swartzii Meisn. - Tie-tongue

Shrub or tree, 3 to 12 meters tall; branches numerous and stout, terete; the bark grayish colored. Found in interior Blacklands.

Leaves alternate; petioles rather stout (8-15 mm long), attached at the base of the coriaceous ocrea; blades ovate to elliptic or obovate, entire and coriaceous; primary veins inconspicuous or flat above, prominent below, primary veins 6 or 7, arcuate, anastomosing; secondary venation strongly reticulate. Bases rounded, obtuse to subcordate or shortly cuneate, apices rounded or slightly cordate.

Inflorescence a raceme, nearing a spike, longer than leaves; pedicels shorter than 1 mm, flowers greenish, very nearly sessile; fruit an achene, ovoid, 8-10 mm in length, 6 mm in diameter, the perianth 1-1.5 mm in length, coronate in fruit; the pericarp slightly fleshy. (Figure 3)

Coccoloba diversifolia Jacq. - Pigeon Plum

Shrub or small tree to 7 meters tall, the branches terete, the thin gray bark mottled, common in rocky Blacklands.

Leaves alternate; petioles 5-20 mm long, arising from base of ocrea, non-conspicuously swollen, blades ovate to elliptic (or lanceolate when young) to somewhat obovate, coriaceous; midrib and primary veins prominent above, veins 3-7 in pair, arcuate, anastomosing before reaching the margin; secondary venation reticulate on both surfaces; entire margins commonly recurved; bases cuneate to rounded or subcordate, apices rounded or obtuse to acute or acuminate.

Racemes, rigid, erect, 5-15 cm, usually shorter than leaves; pedicels 2-4 mm in length; staminate flowers clustered (2 to 5), pistillate flowers solitary. Calyx greenish yellow; fruit an achene, globose to obpyriform, thickened perianth lobes appressed at apex of fruit. (Figure 4)

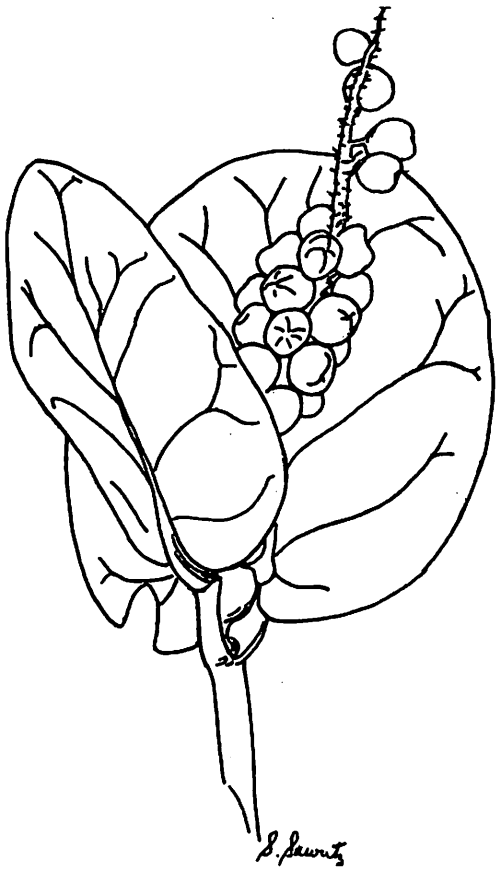


Fig. 1. *Coccoloba uvifera* (L.) L.: Sea Grape, note the large orbicular leaves with prominent venation. Fruit on raceme resembling clusters of grapes.

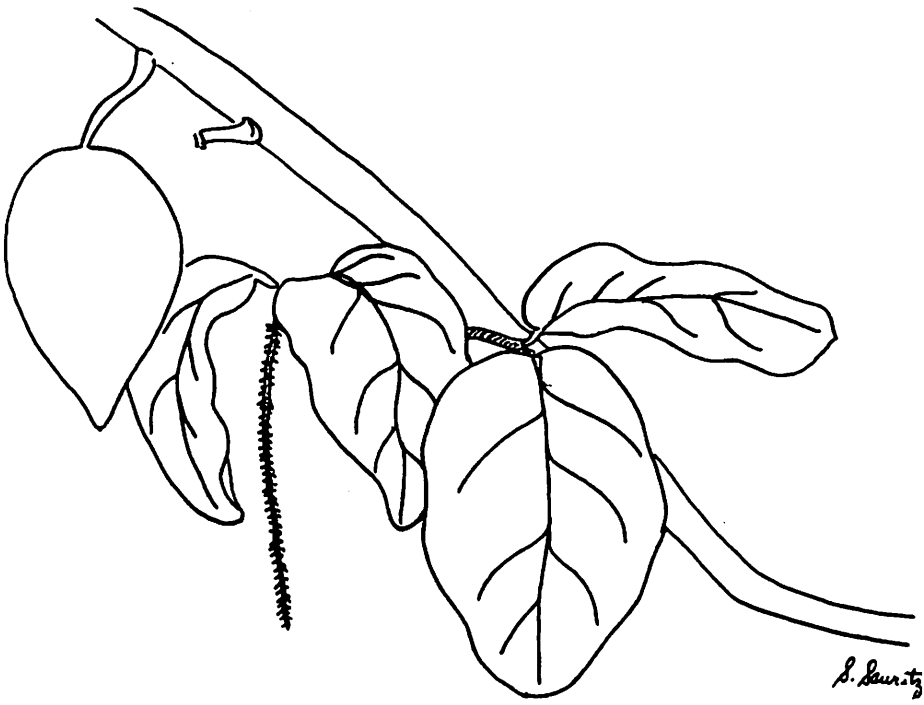


Fig. 2. *Coccoloba tenuifolia* L.: Bahama Pigeon Plum, note the thin pedicels on the long thin raceme. Leaves with oblique bases.

Fig. 3. *Coccoloba swartzii* Meisn.: Tie-tongue, note racemes are longer than the leaves. Pedicels short nearly cuplike, less than 1 mm in length.

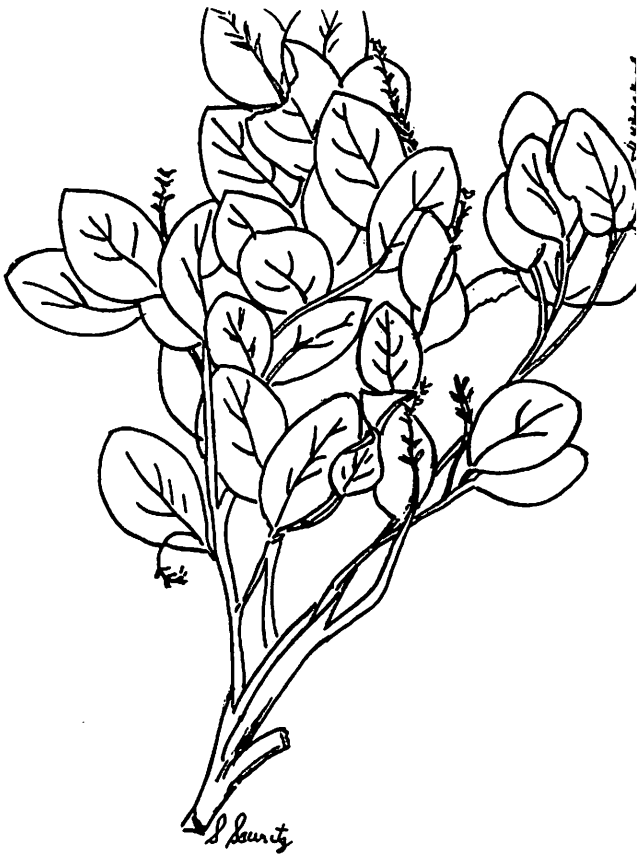


Fig. 4. *Coccoloba diversifolia* Jacq.: Pigeon Plum, note the short erect inflorescences, shorter than leaves. Pedicels are rigid and usually 2 to 4 mm in length.

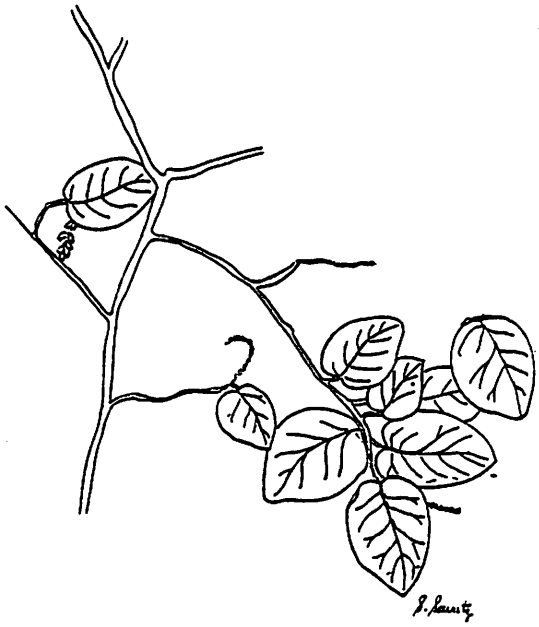


Fig. 5. *Coccoloba krugii* lindau: Crabwood, note the cordate bases of the leaves. Fruit in clusters on racemes shorter than the leaves. Leaves usually tightly arranged on the tree.

Coccoloba krugii Lindau. - Crabwood

Shrub or small tree to 6 meters tall; branches slender numerous and terete, slightly nodose, the gray bark smooth; common in scrub-lands; trees very small in diameter.

Leaves alternate; petioles rather stout 4-8 mm long; borne at the base of the appressed ocrea; blades boardly ovate to nearly orbicular (suborbicular), light green in color, subcoriaceous; primary venation prominent below, flattened above, veins 4-6 pairs, straight, bifurcating and anastomosing near the margin, secondary venation reticulate below; entire margins flat or recurved, usually leaves appear with a slight twist; bases cordate to subcordate, apices obtuse or rounded.

Inflorescence raceme-like, nearly a spike as long as leaves or shorter; pedicels less than 0.5 mm in length; perianth green in color; stamens white; fruit ovoid or angularly fusiform; strongly triangular in outline, black in color, 4-5 mm long, 3-4 mm in diameter, the perianth appressed, above half the length of the fruit. (Figure 5)

HISTORICAL APPROACH TO THE TAXONOMY

The family Polygonaceae was named by Antoine Laurent Jussieu, the first individual to introduce natural families of plants (Bailey, 1949). Ten genera of this family, including Sea Grape, serve as cultivated plants. *Coccoloba uvifera* is used as a cultivated plant in Florida and the tropics (Bailey, 1949). The genus *Coccoloba*, coming from the Greek, referring probably to the lobed perianth persisting on the fruit, was first known to many by the name *Coccolobis* (Correll, 1982). Patrick Browne was the first to use the name *Coccolobis* in 1756. Later, in 1759, Browne referred to the genus as *Coccoloba* (Howard, 1957). The earliest known name given to the genus was *Guaiabara.* This name was assigned to the genus by Philip Miller in 1754 (Howard, 1957). In 1957, Richard A. Howard returned the genus back to the name *Coccoloba* under the "nomina conservanda" principle of the International Code of Botanical Nomenclature (Correll, 1982).

The five species of the genus *Coccoloba* on San Salvador Island were named by various botanists. Carolus Linnaeus is credited with naming *Coccoloba uvifera* in 1760 (Howard, 1957). This particular species held the names: *Polygonum uvifera* Linnaeus in 1753, *Guaiabara uvifera* (L.) House in 1922, and *Coccolobis uvifera* Britton and Millspaugh in 1924 (Howard, 1957). Under the "nomina conservanda", the genus name was returned to *Coccoloba* and the species name, *uvifera*, was retained from Linnaeus, under the priority ruling. The species, *C. tenuifolia* was also named by Linnaeus in 1759 (Howard, 1957). Other names that are also associated with this species are: *Coccoloba leptostachyoides* by Lindau, in 1890, *Coccoloba excoriate* Linneaus in 1759, *Coccolobis bahamensis* Britton and Millspaugh in 1920 and *Coccolobis obtusifolia* Northrop (not Jacquin in 1902) (Correll, 1982). Under the "nomina conservanda" and priority principles of the International Code of Botanical Nomenclature, the name is presently *Coccoloba tenuifolia* Linneaus (Howard, 1957).

Coccoloba swartzii was named by Karl Friedroth Meisner of Switzerland in 1856 (Howard, 1957). Meisner named this plant in honor of Olof Peter Swartz, a Swedish botanist (Correll, 1982). This species was

known as *Coccolobis diversifolia* in 1902 by Britton and Millspaugh (Howard, 1957). Today, the name remains *Coccoloba swartzii* under the "nomina conservanda" and priority rulings. G. Lindau of Germany is credited with the naming of *Coccoloba krugii*. Lindau named this plant in honor of Carl Wilhelm Leopold Krug, a German botanist. This species was later known to Britton and Millspaugh as *Coccolobis krugii* in 1920 (Howard, 1957). Again, the genus name was returned to *Coccoloba* in 1957. Finally *Coccoloba diversifolia* was named by Nicolaus Joseph Jacquin of Austria in 1760. This species was also known as *Coccoloba laurifolia* by Lindau in 1890, *Coccolobis laurifolia* by Britton and Wilson in 1928 (not Jacquin), *Coccoloba longifolia* by Schmidt in 1927 (not Fischer) and *Guiabara laurifolia* by House in 1922 (Howard, 1957). The principles of "nomina conservanda" and priority pertain to this species also.

ECOLOGICAL STUDIES

Materials and Methods

The field research was conducted from the CCFL Bahamian Field Station on San Salvador Island, The Bahamas, in January of 1985. The research period consisted of four weeks. In general, taxonomic studies were performed during the first week. During the second, third and fourth weeks, investigations were focused on the ecological characteristics of the genus *Coccoloba*. The purpose of the taxonomic study was threefold: (1) to enhance field identificationof the species of *Coccoloba*, (2) to construct a taxonomic key and prepare species descriptions and (3) to determine the possibility of hybridization among the species. Collections were made from the Catch Basin and Sinkhole Areas near the CCFL campus. Using these collected specimens and the information previously obtained from Correll, (1982), a chart comparing and contrasting the five species of *Coccoloba* was constructed. Characteristics from the chart were reinforced through herbarium studies on the island and at Hartwick College's Hoysradt Herbarium. The combined information was used in identifying species of *Coccoloba* in the field.

The ecological studies of the genus were performed during the second, third and fourth weeks of the field research. Circular study plots, with a radius of five meters and a center of a randomly selected species of *Coccoloba* were used. For each plot, the area was divided into four sub-plots, using compass bearings. This division facilitated the data and allowed for easier interpretation. Each tree, with a circumference breast height (cbh) greater than 10 cm, within a 5 meter radius of the central *Coccoloba* was recorded. The sub-plots, the diameter breast height (dbh), the distance the tree was located from the central *Coccoloba* and the species name of the tree were recorded in the field notebook. The compass was used in orientation, as well as determination of the sub-plots. A tape measure was used to obtain measurements of DBH and two strings with half-meter markings were used to obtain the distances.

Species which were not identified in the field were collected and labeled. These specimens, as well as specimens of *Coccoloba*, were taken to the field station for identification or verification. General ecology notes (insect infestation, slopes, soil type, etc.) and photographs were also taken for each study plot. A study of twenty-five plots were made: six each for *C. diversifolia*, *C. tenuifolia*, *C. krugii* and *C. swartzii*, and one for *C. uvifera*. (Figure 8)

Results

On San Salvador Island, the species of *Coccoloba* are found in clumping patterns, as are the other trees. In most cases a solitary individual is rare. This dispersion pattern disputes the beliefs of early ecologists such as Wallace, who suggest a uniform dispersion (Hubbell, 1979). Modern theories suggest that the trees in the tropics will be dispersed either randomly or clumped but very seldomly uniform (Hubbell, 1979). In addition, it was found that more than one species of the genus may be present in a study plot. Single individuals of *Coccoloba* occurred in only 3 of 25 plots surveyed.

Observations concerning distribution were made around the island. From these observations, general localities of the plants can be determined. *Coccoloba uvifera* was observed throughout the island on coastal strands, in waste areas and even as a cultivated plant. In Columbus Landings Subdivision #3, near Pigeon Creek Tidal Basin, only *C. uvifera*

was observed. The absence of the others is primarily due to the disturbed characteristics of the area. That is, *C. uvifera* is an invader of waste lands or altered plant communities. Since many roads are found in the area, disturbance is high.

Working up the eastern shore, just south of Dim Bay, *C. krugii* was found in abundance. *Coccoloba krugii*, crabwood, appears in areas with dense understory growth. In these areas, the plants exhibits reddish petioles. This species has been observed on the northern and western sides of the island in abundance. Probably the region most abundant in Crabwood is in the Columbus Landings Subdivision one area, near the Blue Hole. It is here that portions of the land had been cleared for development. Succession is now restoring the land to its natural state. *Coccoloba krugii* appears to be dominant in these types of areas. On occasion, the trees will develop root suckers if the area is rocky (Adams, 1972). This was observed near Dim Bay.

Coccoloba diversifolia was also found throughout the interior of the island. This species appears to be dominant in rocky areas, which are open. Usually, *C. diversifolia* can be found in association with sinkholes. The trees observed under these conditions are full and have a larger basal area than those in other regions. The largest *C. diversifolia*, with a basal area of 198.5 cm^2, was observed at the Fortune Hills Plantation ruins. This particular individual was solitary and dominated the area.

Coccoloba tenuifolia, Bahama Pigeon Plum, is also found in rocky areas. This species can be found among low lying shrubs. The plant is usually slightly smaller than the vegetation that it is found in. Oddly enough, the majority of the observed individuals of this species are found in the northern sections of the island. The sinkhole region, Jake Jones' Road area and the shrubby area around the Lighthouse are the three main locations of this species.

Coccoloba swartzii has been observed in dense forest-like conditions. This species is found in the dense interior away from disturbance. These characteristics are unique to this species. The other four species are usually found closer to civilization. *Coccoloba swartzii*, Tie-Tongue, has also been observed in sinkhole areas where they are predominantly in the open. The Granny Lake study plot was a common site of Tie-Tongue. Likewise, Jake Jones' Road was an area high in abundance with *C. swartzii.*

Plant Associations

Importance values of the 50 species observed were calculated using the technique described by Clark and Evans, (1954). Relative density was calculated using the formula: relative density = individuals of a species/individuals of all species x 100; relative dominance was calculated using the formula: relative dominance = dominance for a species/total dominance for all species x 100; and relative frequency was calculated using the formula: relative frequency = frequency value for a species/total of frequency values for all species x 100.
Dominance was calculated using the diameter breast height to compute basal areas. The basal areas were then used to compute dominance and relative dominance. The importance value is equal to the sum of the relative frequency, relative density and relative dominance. The importance values for the species appear in Figure 6. Likewise, graphical analysis occurs in Figure 7. These importance values were used to determine associations with the species of *Cocoloba.* Higher importance values were considered to show more association.

Associations with *Coccoloba uvifera*

The ecological study of Sea Grape was not very intense. General information about this species is widely known, since it is cultivated and very abundant. This plant was observed in a waste area associated with *Leucaena* (Jimbay), *Eugenia axillaries* (White Stopper), *E. foetida* (Bahama Stopper) and *E. confusa* (Ironwood). In its more common habitat, the coastal strands, this species is found in association with: *Uniola paniculata* (Sea Oats), *Suriana maritma* (Bay Cedar), *Erithalis diffusa* (Black Torch), and numerous herbaceous plants and vines (Smith, 1982).

For the remaining four species, comparison of the importance values for the 50 species observed with the *Coccoloba* yields the varying associations for each of the four species of *Coccoloba.* In general, the higher the importance values, the more significant that species is to the species of *Coccoloba.* This evaluation is, of course, a relative

Figure 6

Listing of Species Found With Coccoloba

Importance Values of the Species 1 to 50

Species Number	Species Name	C. diversifolia	C. swartzii	C. tenuifolia	C. krugii
1	Coccoloba diversifolia	20.28	10.46	6.85	5.81
2	C. swartzii	2.92	39.13	17.26	4.98
3	C. krugii	12.96	7.77	12.89	54.43
4	C. tenuifolia	0.00	0.00	19.26	0.00
5	Ficus citrifolia	7.99	0.00	0.00	0.00
6	Ateramnus lucidus	18.29	4.87	7.17	15.12
7	Bursera simaruba	14.58	9.16	14.78	3.26
8	Metopium toxiferum	28.24	55.64	4.68	26.02
9	Diospyros crassinervis	7.98	10.81	18.61	4.21
10	Eugenia foetida	11.16	0.00	5.00	2.26
11	Reynosia septentrionalis	9.87	8.67	14.70	4.73
12	Zanthoxylum flavum	7.36	0.00	9.69	0.00
13	Triopteris jamaicensis	1.90	0.00	0.00	0.00
14	Bourreria ovata	6.47	4.12	34.51	16.73
15	Guapira discolor	16.63	12.27	25.35	25.96
16	Eugenia axillaris	19.80	8.33	5.39	0.00
17	Eugenia confusa	23.46	11.26	6.20	2.26
18	Acacia chloriophylla	5.57	5.19	0.00	2.76
19	Dodonaea ehrenbergii	4.82	0.00	0.00	12.18
20	Calyptranthes pallens	12.50	7.08	1.97	0.00
21	Thouinia discolor	5.37	0.00	0.00	4.62
22	Tabebuia bahamensis	8.35	5.15	13.98	8.73
23	Erithalis fruticosa	13.04	6.92	17.35	12.67
24	Amyris elemifera	3.56	4.08	2.99	7.98
25	Antirhea sp.	2.68	0.00	0.00	0.00
26	Zanthoxylum bifoliolatum	4.46	0.00	0.00	0.00
27	Guapira obtusata	1.96	0.00	0.00	0.00
28	Guettarda krugii	2.32	0.00	4.33	6.63
29	Jacquinia keyensis	1.88	2.03	6.35	16.59
30	Erithroxylon rotundifolium	3.33	6.05	4.50	6.02
31	Psidium longipes	21.56	40.97	23.25	6.38
32	Manilkara bahamensis	0.00	5.25	1.95	0.00
33	Savia bahamensis	0.00	13.25	0.00	8.80
34	Bunchosia gladulosa	0.00	4.54	0.00	0.00
35	Piscidia piscipula	0.00	2.85	0.00	0.00
36	Croton eluteria	0.00	1.98	0.00	0.00
37	Leucaena leucocephala	0.00	5.92	0.00	0.00
38	Mimosa bahamensis	0.00	0.00	0.00	2.24
39	Drypetes diversifolia	0.00	2.03	4.42	0.00
40	Guaiacum sanctum	0.00	0.00	25.04	8.52
41	Melicoccus bijugatus	0.00	0.00	1.96	0.00
42	Citharexylum fruticosum	0.00	0.00	1.97	0.00
43	Conocarpus erectus	0.00	0.00	9.88	6.69
44	Sabal palmetto	0.00	0.00	3.19	0.00
45	Myrcianthes fragrans	0.00	0.00	0.00	11.47
46	Phyllanthus epiphyllanthus	0.00	2.00	0.00	0.00
47	Catesbaea parviflora	0.00	0.00	0.00	3.25
48	Cassine xylocarpa	0.00	0.00	0.00	7.42
49	Caesalpinia vesicaria	0.00	0.00	0.00	2.38
50	Plumeria obtusa	0.00	0.00	0.00	4.18

Figure 7

Importance Values of Species(1-50)

found with Coccoloba

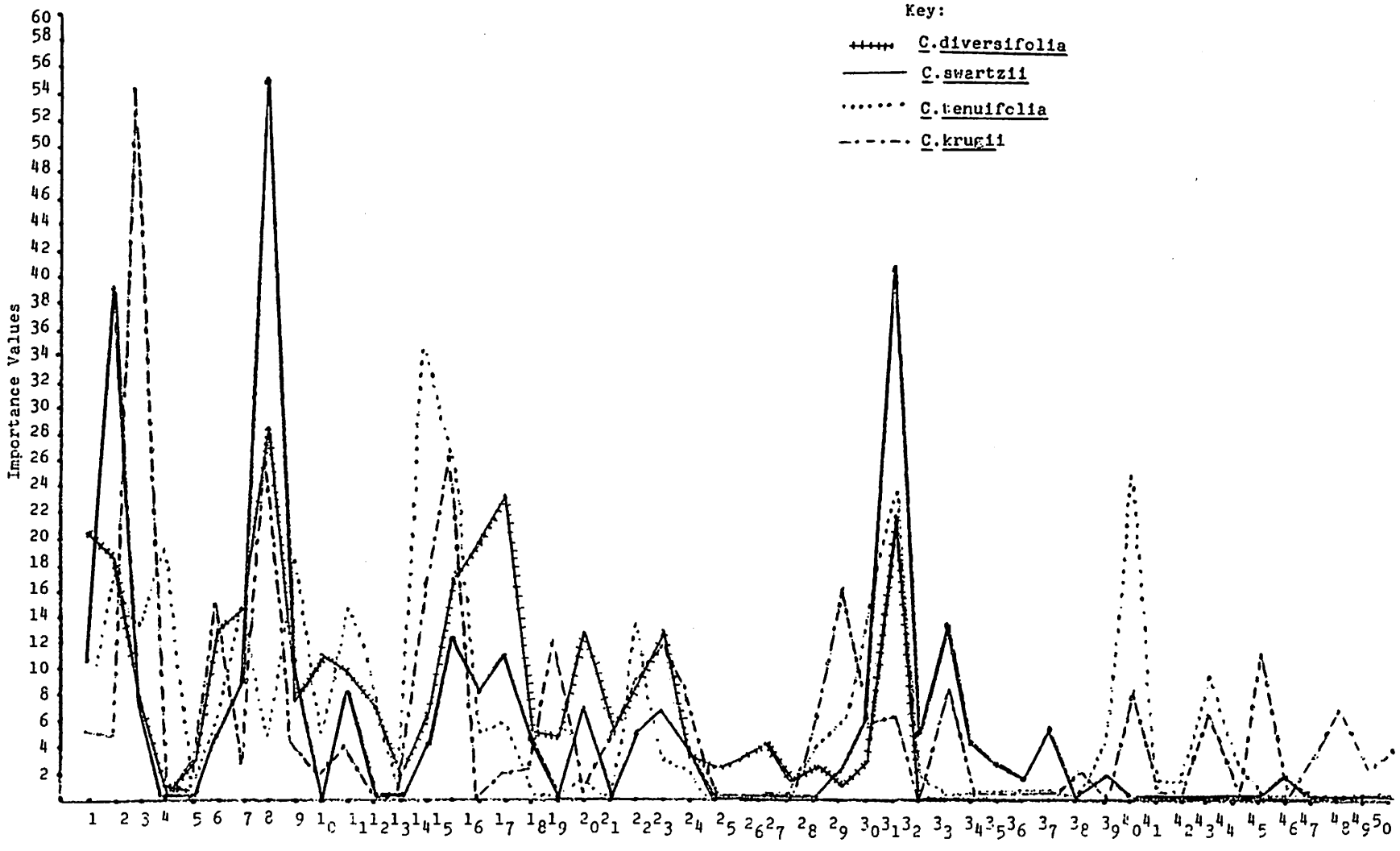
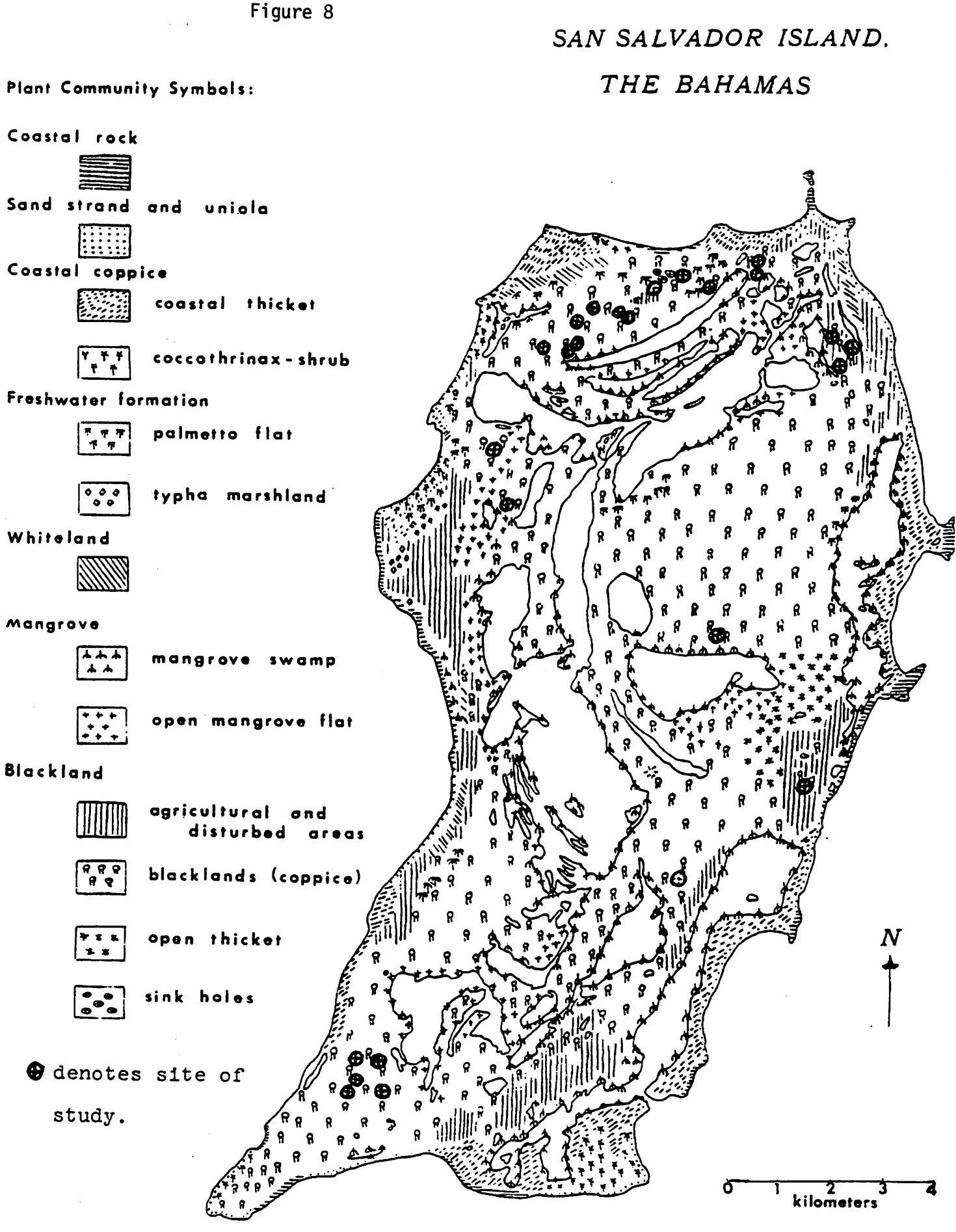


Figure 8


SAN SALVADOR ISLAND.
THE BAHAMAS
Plant Community Symbols:
Coastal rock
Sand strand and uniola
Coastal coppice
coastal thicket
coccothrinax-shrub
Freshwater formation
palmetto flat
typha marshland
Whiteland
Mangrove
mangrove swamp
open mangrove flat
Blackland
agricultural and disturbed areas
blacklands (coppice)
open thicket
sink holes
denotes site of study.
N
0 1 2 3 4
kilometers

comparison. In the case of species #31, Figure 6 and Figure 7, *Psidium longipes* (Bahamas Stopper), one species of *Coccoloba* shows a relatively high importance value, while one shows a relatively low value and two approximately medium, equal values. Therefore, the species is predominantly associated with *C. swartzii* but is also associated with *C. diversifolia* and *C. tenuifolia* to some extent. The importance value for *C. krugii* is low relative to the other values, therefore it is not associated with Bahama Stopper to the same degree as the other species. One major flow of this analysis is that the values must be considered in a relative sense. That is, a single value means nothing, it must be evaluated by comparing it to the other values.

Although the ecology of each species may be slightly different, the species are very similar. Evaluation of the Figures 6 and Figure 7 gives a good view of the amount of overlap that occurs between the species of *Coccoloba.*

CONCLUSIONS

The possibility of hybridization does exist, but the occurrence of hybridization was not observed. Judging from infloresence and leaf morphology, no hybridization appears to be present. However, more in depth studies of the floristics of the genus should be conducted. The morphology differences in leaves is attributed to environmental factors. This is reinforced by the differing morphology of the leaf with respect to changes in substrate, light penetration and the amount of understory growth.

Importance values give a less biased analysis of the data, but do show some weaknesses. Assocations are determined by the sum of the relative frequency, relative density, and the relative dominance values. The higher these importance values, the more association a species shows to the species of *Coccoloba*, relative to the other species of *Coccoloba.*

The species of *Coccoloba* show some degree of similarity. Certain species are prevalent with more than one species of *Coccoloba*. Although the ecology of each differs slightly, general overall importance to the plant communities is approximately the same in all species of *Coccoloba.* In short, the species of the genus *Coccoloba* on San Salvador Island, are a diverse, yet highly interrelated group, which play a significant role in the plant communities and the overall flora of the island.

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REFERENCES CITED

Adams, C.D., 1972, Flowering Plants of Jamaica. University of the West Indies, Mona, Jamaica.

Bailey, Liberty H., 1949, Manual of Cultivated Plants. Macmillion and Co., New York.

Britton, N.L. and C.F. Millspaugh, 1920, The Bahama Flora. New York; reprinted 1962 by Hafner Publ. Co., New York.

Cherry, R.H., 1980, Host Plant Preference of the White Fly *Aleurodicus dispersus.* Florida Entomology 63(2): 222-225.

Clark, P. and F.C. Evans, 1954, Distance to nearest neighbor as a measure of spatial relationships in populations: Ecology 35: 445-453.

Coker, W.C., 1905, Vegetation of the Bahama Islands. in: Shattuck G.B., The Bahama Islands. Geogr. Soc. Bult., John Hopkins Univ. Press: 185-270.

Correll, D.S. and H.B., 1982, Flora of the Bahama Archipelago: Cramer, Germany.

Craton, M., 1965, A History of the Bahamas. Collins, London.

Gillis, William T., 1970, Isled of Columbus. Fairchild Tropical Garden Bulletin 25: 5-7.

_____, 1974, Name changed for the

seed plants in the Bahama Flora: Rhodora 76: 67-138.

Howard, Richard A., 1957, Studies in the genus *Coccoloba* IV. The species from Puerto Rico and the Virgin Islands and from the Bahama Islands. J. Arnold Arbor. 38: 211-42.

Hubbell, Stephen P., 1979, Tree Dispersion, Abundance, and Diversity in a Tropical Dry Forest. in: Jordan, 1981, Tropical Ecology, Hutchinson Ross, Corp.

Long, R.W. and Olga Lakela, 1971, A Flora of Tropical Florida. Banyan Books, Miami.

Mooney, C.N., 1905, Soils of the Bahama Islands. in: Shattack, G.B., The Bahama Islands. Geogr. Soc. Bult., John Hopkins Univ. Press: 147-185.

Smith, Robert R., 1982, Field Guide to the vegetation of San Salvador Island, The Bahamas. CCFL, San Salvador, Bahamas.

Twelve International Botanical Congress, 1978, International Code of Botanical Nomenclature. Leningrad.