PART IV

THE PHYTOGEOGRAPHICAL SUBDIVISION OF CUBA

(WITH THE CONTRIBUTION OF O. MUÑIZ)

CONTENTS

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The phytogeographical subdivision of Cuba (With the contribution of O. Muñiz)

21 The phytogeographical status of Cuba

21.1 Good's phytogeographic regionalization of the Caribbean

Cuba belongs to the Neotropical floristic kingdom whose phytogeographic subdivision has been defined by Good (1954) and, later by Takhtadjan (1970). According to these authors, the Neotropical kingdom is divided into seven floristic regions and is characterized by 32 endemic plant families, 10 of which occur in Cuba. These are: Marcgraviaceae, Bixaceae, Cochlospermaceae, Brunelliaceae, Picrodendraceae, Calyceraceae, Bromeliaceae, Cyclanthaceae, Heliconiaceae and Cannaceae. The Caribbean floristic region has been divided into four provinces: 1. Southern California—Mexico, 2. Caribbean, 3. Guatemala—Panama, and 4. North Colombia—North Venezuela, Cuba, as a separate sub-province, belongs to the Caribbean province.

21.2 A new proposal for the phytogeographic regionalization of the Caribbean area

In the author's opinion the above-mentioned phytogeographic classification does not reflect correctly the evolutionary history and the present floristic conditions of the Caribbean. In addition, the early isolation of the Antilles and the rich endemic flora of the archipelago are not considered satisfactorily. For these reasons it seems justified to make a distinction between two equally important subregions, continental and Antillean, within the Caribbean floristic region and, further, to modify the regionalization as follows (see Fig. 139).

Neotropical kingdom (32 endemic families)
Caribbean region (2 endemic families, Goetzeaceae and Plocospermataceae, and more than 500 endemic genera).

A) Mexican–Venezuelan sub-region (a single endemic family, Plocospermataceae, and approximately 200 endemic genera)

Provinces:
1. Baja–California–Mexico
2. Guatemala–Panama
3. North Colombia–North Venezuela (including Trinidad and Tobago)

B) Antillean sub-region (a single endemic family, Goetzeaceae, and about 200 endemic genera and 7500 endemic species)

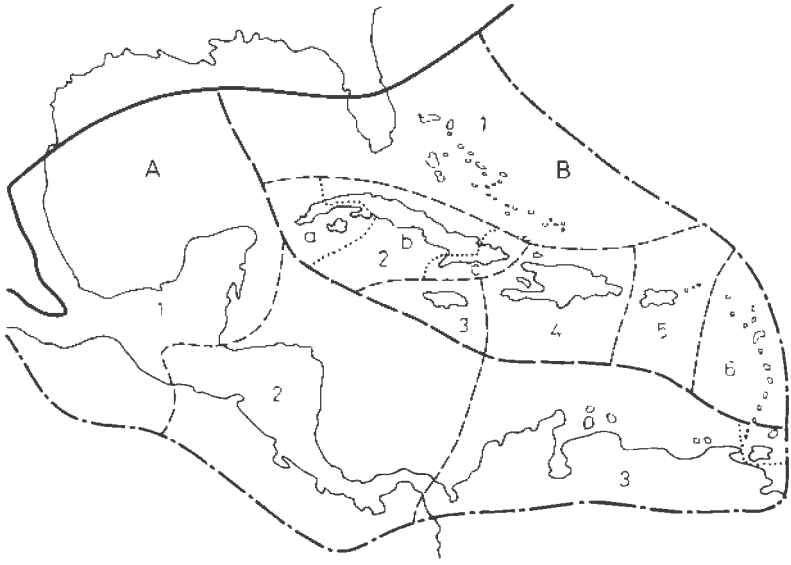


Fig. 139 Phytogeographical regions of the Caribbean territory (after Good 1954, strongly modified). —— border of the phytogeographical kingdom, –·–·–·– border of the phytogeographical territory, – – – – – border of the phytogeographical subterritory, – – – – – border of the phytogeographical province, ····· border of phytogeographical subprovince

Provinces:

1. South Florida Bahamas–Bermuda (7%, 10% and 8% endemics, respectively)
2. Cuba (51.4% endemics, 72 endemic genera and approximately 3200 endemic species)
3. Jamaica (20–22 % endemics, 8 endemic genera)
4. Hispaniola (39.2% endemics, 37 endemic genera approximately 1800 endemic species)
5. Puerto Rico (13% endemics, 2 endemic genera)
6. Lesser Antilles (10—12% endemics)

21.3 Relationships within the flora of the West Indies

In the paper on the vegetation of the Antilles by Howard (1974), the relationships between the flora of the islands and the distribution patterns of plants, rather than the vegetation, are discussed. In Howard's views the geobotanical relationship between the continent and the islands should be evaluated on the basis of genera, rather than species. The results of this analysis are presented in 30 tables where only those genera are listed which were considered by Howard to be free from taxonomic problems. Based on this analysis the following statements were made.

In the Antilles several endemic genera are restricted to one or two islands and there are only two endemic genera with more than 20 species. Picrodendraceae,

including a single genus and three species, is the only family restricted to the Antilles in distribution.

The flora of the Greater Antilles has several genera in common with central America which are otherwise absent from the Lesser Antilles. Contrarywise, the Lesser Antilles have several South American genera that are missing from the Greater Antilles.

Howard's study suggests that the flora of the West Indies is not uniform and its development is not completely independent, since inner disjunctions are more characteristic than close relationships. This idea has been manifested in Klotz's (1978) work in which a northern Caribbean subregion is distinguished within the Caribbean floristic region by excluding the Lesser Antilles. Within this sub-region a Greater Antillean province is delimited.

The regionalization concept described above was developed (Borhidi 1973) in the year of Howard's publication and the studies carried out since then appear to support the author's early view. In the meantime, the Picrodendraceae family, considered earlier as being endemic to this area, was incorporated into Euphorbiaceae, whereas the family status of Geotzeaceae was restored (Airy Shaw 1965, Hunziker 1979, Fuentes 1982). The latter family comprises four genera, all endemic to the Antilles. Several new genera were described from the Antillean area (Borhidi 1973, 1977, 1981, 1982, Aiello 1979, Alain H. Liogier 1981) and new species of West Indian genera were discovered. Following Howard's pioneer studies, some problems concerning the floristic relationships between the Lesser and Greater Antilles were clarified. Also, the presence of some South American genera in the Lasser Antilles turned out to be the result of secondary introduction (Howard 1982).

In the sequel some tables will summarize the genera whose distribution is confined to the West Indian subregion (in the sense of Borhidi). In addition, genera having the evolutionary centre in the West Indies but also represented by as few as 1—2 species in the South or Central American continent are listed, these are indicated by an asterisk (Table 31).

Table 31 Genera with West Indian distribution pattern

Borrichia (Compositae) 2 species
Calycogonium (Melastomataceae) 33 species
Cataesbaea (Rubiaceae) 20 species
Coccothrinax (Palmae) 55 species (1 in Mexico)
Consolea (Cactaceae) 14 species
Ernodea (Rubiaceae) 3 species
Gesneria (Gesneriaceae) 55 species
Gundlachia (Compositae) 10 species
Hypelate (Sapindaceae) 1 species
Metopium (Anacardiaceae) 3 species
Neolagueria (Rubiaceae) 5 species
Oplonia (Acanthaceae) 20 species (2 in Peru and 3 in Madagascar)
Oxandra (Lauraceae) 2 species
Petitia (Verbenaceae) 2 species
Reynosia (Rhamnaceae) 18 species (1 in Central America)
Rhytidophyllum (Gesneriaceae) 22 species (2 in South America)
Rochefortia (Borraginaceae) 12 species (1 in Central and South America)
Rondeletia (Rubiaceae) 130 species (2 in Central and 12 in South America)
Sarcomphalus (Rhamnaceae) 12 species
Scolosanthus (Rubiaceae) 22 species
Strumpfia (Rubiaceae) 1 species
Tetrazygia (Melastomataceae) 15 species
Tetrazygiopsis (Melastomataceae) 13 species
Thrinax (Palmae) 8 species
Wallenia (Myrsinaceae) 26 species (2 in Central America)

In summary, not less than 27 flowering plant genera are considered as being endemic to, or having the evolutionary centre in the West Indies. These genera are represented by a total of 500 species, approximately.

The number of endemic genera common in the Greater Antilles is 15, most of those occurring in the Bahamas as well (Table 32). They include more than 100 species. This indicates that the flora of Bahamas is closely related to that of the Greater Antilles, in particular, of Hispaniola. The floristic relationships among the islands of West Indies are best illustrated by examining the number of endemic genera found only in the combination of three, or two islands or in a single island.

Table 32 Genera endemic to the Greater Antillas and partly to the Bahamas

Auerodendron (Rhamnaceae) C. J. B. 8 species	*Phialanthus* (Rubiaceae) C. J. PR. B. 18 species
Bonania (Euphorbiaceae) C. H. B. 8 species	*Picrodendron* (Euphorbiaceae) C. J. H. B. 3 species
Grimmeodendron (Euphorbiaceae) C. J. H. B. 2 species	*Pseudocarpidium* (Verbenaceae) C. H. B. 8 species
Lasiocroton (Euphorbiaceae) C. J. H. B. 4 species	*Sachsia* (Compositae) C. H. J. PR. B. Fl. 2 species
Leptocereus (Cactaceae) C. H. J. PR 14 species	*Spathelia* (Rutaceae) C. J. D. 15 species
Nashia (Verbenaceae) C. H. B. 6 species	*Tetranthus* (Compositae) H. B. 2 species
Neobracea (Apocynaceae) C. B. 8 species	*Triopteris* (Malpighiaceae) C. J. H. B. 5 species
Neothymopsis (Compositae) C. B. 2 species	

The importance of insularity in evolution is emphasized by the fact that the number of endemics occurring on three islands is lower than that on two islands. This number is the highest for the single islands. When Cuba, Jamaica and Hispaniola are viewed together, then there are 7 endemic genera with 44 species (Table 33). Cuba, Hispaniola and Puerto Rico together possess 3 endemic genera with 7 species, so the total is 10 genera with 51 species (Table 34).

Table 33 Genera occurring only in Cuba, Jamaica and Hispaniola

Acidocroton (Euphorbiaceae) 10 species	*Gyrotaenia* (Urticaceae) 5 species
Broughtonia (Orchidaceae) 2 species	*Haenianthus* (Oleaceae) 4 species
Brya (Fabaceae) 12 species	*Lagetta* (Thymelaeaceae) 5 species
Cameraria (Apocynaceae) 6 species	

Table 34 Genera occurring only in Cuba, Hispaniola and Puerto Rico

Ditta (Euphorbiaceae) 2 species	*Torralbasia* (Celastraceae) 2 species
Ottoschulzia (Icacinaceae) 3 species	

If pairwise combinations are taken, the following figures are obtained: Cuba and Hispaniola have in common 30 endemic genera with 168 species (Table 35). Cuba and Jamaica have 10 genera with 32 species (Table 36). There is only a single genus with two species common to Cuba and Puerto Rico (Table 37). Hispaniola and

Table 35 Genera endemic to Cuba and Hispaniola

Ampelocera (Ulmaceae) 2 species	*Neoregnellia* (Sterculiaceae) 1 species
Barleriola (Acanthaceae) 5 species	*Ottoschmidtia* (Rubiaceae) 1 species
Bellonia (Acanthaceae) 2 species	*Pachyanthus* (Melastomataceae)
Bisgoeppertia (Gentianaceae) 2 species	24+1 species in SA!
Chascotheca (Euphorbiaceae) 1 species	*Peratanthe* (Rubiaceae) 2 species
Cubanola (Rubiaceae) 1 species	*Picardaea* (Rubiaceae) 2 species
Cubanthus (Euphorbiaceae) 3 species	*Pinillosia* (Compositae) 1 species
Ekmanianthe (Bignoniaceae) 2 species	*Plethadenia* (Rutaceae) 2 species
Fuertesiella (Orchidaceae) 2 species	*Saugetia* (Gramineae) 2 species
Isidorea (Rubiaceae) 20 species	*Scutachne* (Gramineae) 2 species
Lantanopsis (Compositae) 3 species	*Spirotecoma* (Bignoniaceae) 5 species
Leucocroton (Euphorbiaceae) 27 species	*Suberanthus* (Rubiaceae) 7 species
Macrocarpaea (Gentianaceae) 2 species	*Thogsennia* (Rubiaceae) 1 species
Margaritopsis (Rubiaceae) 3 species	*Verhuellia* (Piperaceae) 3 species
Mozartia (Myrtaceae) 9 species	*Victorinia* (Euphorbiaceae) 1 species

Table 36 Genera endemic to Cuba and Jamaica

Acrosynanthus (Rubiaceae) 7 species	*Homalopetalum* (Orchidaceae) 1 species
Calyptronoma (Palmae) 2 species	*Neo-Urbania* (Orchidaceae) 2 species
Cheilophyllum (Scrophulariaceae) 8 species	*Pheidonocarpa* (Gesneriaceae) 2 species
Cionosicyos (Cucurbitaceae) 1 species	*Strempeliopsis* (Apocynaceae) 2 species
Dinema (Orchidaceae) 2 species	*Urbananthus* (Compositae) 2 species

Table 37 Genera occurring only in Cuba and Puerto Rico

Gaussia (Palmae) 2 species

Table 38 Genera endemic to Hispaniola and Puerto Rico

Goetzea (Solanaceae) 1 species	*Pleodendron* (Canellaceae) 2 species
Piptocoma (Compositae) 1 species	*Stahlia* (Leguminosae) 2 species

Puerto Rico have in common four species, each representing a different genus (Table 38). The totals are 45 and 206, respectively, for genera and species.

Finally, the number of genera confined to one island is 121 altogether (237 species) (Tables 39, 40, 41, 42). The number of species per endemic genus in 2.27 in Cuba, 1.4 in Hispaniola, 2.12 in Jamaica and 1 in Puerto Rico. This ratio is 5.6 for Cuba and Hispaniola taken together, 3.2 for the pair of Cuba and Jamaica, 2 for Cuba and Puerto Rico, and 1 for Hispaniola and Puerto Rico.

Table 39 Endemic genera of Cuba and the ecological characteristics of their occurrence

	No. of species	Limestone	Sandstone	White sand	Serpentine	Other bedrocks
Acunaeanthus (Rubiaceae)	1	–	–	–	1	
Adenoa (Flacourtiaceae)	1	–	–	–	1	–
Amphiolanthus (Scrophulariaceae)	3	+	+	+	–	+
Ancistranthus (Acanthaceae)	1	1	–	–	–	–
Antillia (Asteraceae)	1	–	–	–	–	1
Ariadne (Rubiaceae)	2	–	–	–	2	–
Asciadium (Apiaceae)	1	–	–	1	–	–
Behaimia (Fabaceae)	2	+	+	–	+	+
Belairia (Fabaceae)	6	3	1	1	1	1
Bembicidium (Fabaceae)	1	1	–	–	–	–
Caribaea (Nyctagynaceae)	1	1	–	–	–	–
Ceratopyxis (Rubiaceae)	1	1	–	–	–	–
Ceuthocarpus (Rubiaceae)	1	–	–	–	1	–
Chaetium (Poaceae)	1	+	–	–	+	–
Ciceronia (Asteraceae)	1		–	–	1	
Cubacroton (Euphorbiaceae)	1	1	–	–	–	–
Daystropis (Acanthaceae)	1				1	
Dendrocereus (Cactaceae)	1	1	–	–	–	–
Doerpfeldia (Rhamnaceae)	1	1				
Ekmania (Asteraceae)	1	1	–	–	–	–
Ekmanochloa (Poaceae)	2				2	–
Encopella (Scrophulariaceae)	1	–	–	+	–	+
Eosanthe (Rubiaceae)	1	–	–	–	1	–
Espadaea (Geoetzeaceae)	1	+	+		+	+
Euchorium (Sapindaceae)	1	1	–	–	–	–
Euleria (Anacardiaceae)	1	1	–	–		
Feddea (Asteraceae)	1	–	–	–	1	–
Gastrococos (Arecaceae)	1	+		–	+	+
Goerziella (Amaranthaceae)	1	1			–	
Grisebachianthus (Asteraceae)	7	2			5	–
Harnackia (Asteraceae)	1	–	–	–	1	–
Hebestigma (Fabaceae)	1	+	+	–	+	+
Henleophytum (Malpighiaceae)	1	+	–	–	+	–
Henoonia (Goetzeaceae)	1	+	–	–	+	–
Heptanthus (Asteraceae)	7	1	1	1	4	–
Herpyza (Fabaceae)	1	–	+	+	–	–
Kodalyodendron (Rutaceae)	1	–	–	–	1	–
Koehneola (Asteraceae)	1	–	–	–	1	
Krokia s. l. (Myrtaceae)	11	2	–	–	8	1
Lachnorrhiza (Asteraceae)	1	–	+	+	+	–
Lepturidium (Poaceae)	1	–	–	1	–	–
Lescaillea (Asteraceae)	–	–	–		1	–
Linodendron (Thymelaeaceae)	3	–		–	2	1
Megalopanax (Araliaceae)	1	1	–	–	–	–
Microcycas (Cycadaceae)	1	+	+	–	–	–
Mniochloa (Poaceae)	2		+	–	+	+
Moacroton (Euphorbiaceae)	7	–	–	–	7	–

	No. of species	Limestone	Sandstone	White sand	Serpentine	Other bedrocks
Neomazaea (Rubiaceae)	1	—	—	—	1	—
Nodocarpaea (Rubiaceae)	1	—	—	1	—	—
Notodon (Fabaceae)	4	2	—	—	2	—
Phania (Asteraceae)	2	1	+	—	1	—
Phidiasia (Acanthaceae)	1	—	—	—	1	—
Phyllacanthus (Rubiaceae)	1	—	—	—	?	
Phyllomelia (Rubiaceae)	1	—	—	—	1	—
Pinosia (Caryophyllaceae)	2	1	—	1	—	—
Platygyne (Euphorbiaceae)	7	1	1	1 ?	4	2
Rhodogeron (Asteraceae)	1			—	—	1
Roigella (Rubiaceae)	1	—	+	+	+	—
Sapphoa (Acanteaceae)	2		—		2	
Sauvallella (Fabaceae)	1			—	1	—
Schmidtottia (Rubiaceae)	16			—	16	—
Shafera (Asteraceae)	1	—	—		1	—
Shaferocharis (Rubiaceae)	3			—	3	—
Siemensia (Rubiaceae)	1		—	—	—	—
Solonia (Myrsinaceae)	1			—		1
Spaniopappus (Asteraceae)	5	1	—	—	3	1
Synapsis (Bigroniaceae)	1	1			—	—
Tetralix (Tiliaceae)	5		—		5	
Tetraperone (Asteraceae)	1	—	1			—
Triscenia (Poaceae)	1	+		—	+	+
Woehleria (Amaranthaceae)	1	+	—	—		+
Zonanthus (Gentianaceae)	1	1(?)	—	—		—

Table 40 Genera endemic to Hispaniola

Anacaona (Cucurbitaceae) 1 species
Arcoa (Caesalpiniaceae) 2 species
Casabitoa (Euphorbiaceae) 1 species
Coeloneurum (Solanaceae) 1 species
Cryptorhiza (Myrtaceae) 1 species
Ekmaniocharis (Melastomataceae) 1 species
Eupatorina (Asteraceae) 1 species
Fuertesia (Loasaceae) 1 species
Haitia (Lythraceae) 1 species
Herodotia (Asteraceae) 2 species
Hottea (Myrtaceae) 4 species
Leptogonum (Polygonaceae) 3 species
Manekia (Piperaceae) 1 species
Mattfeldia (Asteraceae) 1 species
Mommsenia (Melastomataceae) 1 species
Narvalina (Asteraceae) 1 species
Neoabbottia (Cactaceae) 2 species
Neobuchia (Bombacaceae) 1 species
Neocogniauxia (Orchidaceae) 2 species
Pedinopetalum (Umbelliferae) 1 species
Penelopeia (Cucurbitaceae) 1 species
Poitaea (Fabaceae) 5 species
Priamosia (Flacourtiaceae) 1 species
Pterocissus (Vitaceae) 1 species
Rhodopis (Fabaceae) 1 species
Samuelssonia (Acanthaceae) 2 species
Sarcopilea (Urticaceae) 1 species
Selleola (Caryophyllaceae) 1 species
Selleophytum (Asteraceae) 3 species
Stevensia (Rubiaceae) 6 species
Theophrasta (Theophrastaceae) 1 species
Tortuella (Rubiaceae) 1 species
Ulbrichia (Malvaceae) 1 species
Vegaea (Myrsinaceae) 1 species
Wunschmannia (Bignoniaceae) 1 species
Xymeniopsis (Olacaceae) 1 species
Zombia (Arecaceae) 1 species

Table 41 Genera endemic to Jamaica

Acanthodesmos(Asteraceae) 1 species	*Odontocline* (Asteraceae) 2 species
Dendrocousinia (Asteraceae) 1 species	*Peltostigma* (Rutaceae) 1 species
Jacaima (Asclepiadaceae) 1 species	*Portlandia* (Rubiaceae) 6 species
Jacmaia (Asteraceae) 1 species	*Tetrasiphon* (Celastraceae) 1 species

Table 42 Genera endemic to Puerto Rico

Cybianthus (Myrsinaceae) 1 species	*Neorudolphia* (Leguminosae) 1 species

21.4 The phytogeographical subdivision of Cuba

Two proposals for the geobotanical subdivision (Fig. 140) of Cuba have been published. León (1946) makes a distinction among three floristic sectors and 9 districts and gives a short description of the flora and vegetation of each. Voronov (1970) also distinguishes 3 sectors within which 11 districts plus 5 sub-districts are differentiated without detailed characterization. Samek (1973c) elaborated the first comprehensive phytogeographic regionalization of Cuba distinguishing 3 sectors, 7 subsectors and 39 districts and describing some of the main characteristics of the Cuban flora. The regionalization presented here is based on the geographical, geological and soil conditions and the flora and vegetation, giving equal weight to each. As a result, the suggested geobotanical system distinguishes 3 sub-provinces, 9 sectors and 36 floristic districts (see Fig. 140, and Borhidi and Muñiz and Borhidi 1973, 1985).

SUB-PROVINCE A. WESTERN CUBA (Occidento-Cubanicum) (Fig. 141)

The western part of Cuba to Bahia Honda, to Cayajabos, River San Juan and Laguna de Piedras the southern swampy coast of the Habana province and the en tire Isla de Pinos and the Zapata peninsula plus the adjacent marshland belong to this category. The geological and soil conditions are highly varied, the landscape is characterized by mountains of medium height, sandy plains, lagoons, marshes, flat and conical karsts. 16 endemic genera and approximately 500 endemic species occur. Important features of the flora are the high proportion of elements from Florida, south-western USA and the northern areas, as well as the occurrence of Mexico–Yucatan elements. Several genera, such as *Befaria, Kalmiella, Chaetolepis, Rhexia, Pieris, Syngonanthus, Xyris* and *Eriocaulon* (with one exception) do not occur elsewhere in Cuba. Coniferous forests of flat and rolling countries and tropical karstic forests are the predominant and characteristic vegetation types. Swamps, marshes and, on the flat karsts, semi-deciduous and dry evergreen forests also cover extensive areas.

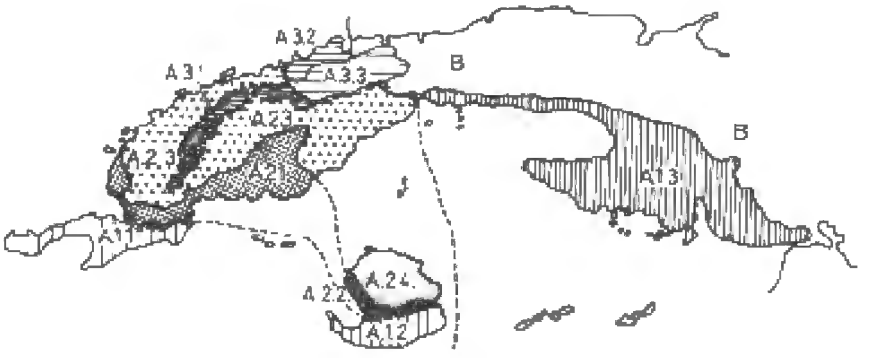


Fig. 141 The phytogeographic subdivision of the West Cuban sub-province

A.1. Sector: Peninsularicum
- A.1.1. District: Guanahacabibense
- A.1.2. District: Sudpineroënse
- A.1.3. District: Zapatense

A.2. Sector: Pinaricum
- A.2.1. District: Sabaloënse
- A.2.2. District: Indiosense
- A.2.3. District: Pinarense
- A.2.4. District: Geronense

A.3. Sector: Rosaricum
- A.3.1. District: Viñalense
- A.3.2. District: Cajalbanënse
- A.3.3. District: Rosariense

Sector A.1. Karstic peninsulas (Peninsularicum) (Fig. 141)

Guanahacabibes, southern Isla de Pinos and Zapata, the three spatially isolated peninsulas that comprise this sector, have a similar geological past, vegetation and a relatively monotonous flora poor in endemics. These lands formed a common shoreline at the end of the Pliocene. This land contact has been reflected by the similarity between the forest and shrub vegetation of marshes and flat karsts. The relationship between the flora of Guanahacabibes peninsula and Isla de Pinos is best shown by the presence of some common endemics *(Erythroxylon roigii, Allophylus roigii)* and rare floristic elements, e.g., *Bauhinia jenningsii* which is also present in Central America, and *Diospyros tetrasperma,* also occurring in Jamaica. The flora of Zapata peninsula includes some elements common with Guanahacabibes, as *Cissus formosa, Pontederia lanceolata* and *Heliotropium antillarum.*

District A.1.1. Guanahacabibes Peninsula (Guanahacabibense) (Fig. 141)

Geography: Flat karsts composed of coral limestone originated from neritic medium of the Quaternary. Shallow ferralitic soils (Fig. 142).

Climate: Seasonal tropical climate with 5—6 arid months, tending to be bixeric in the east.

Flora: A single endemic genus, *Goerziella,* occurs. Important endemic species are *Harrisia teatra* (Fig. 143), *Piper guanahacabibense, Galactia acunaena, Callicarpa roigii, Vitex acunae, V. guanahacabibensis, Serjania occidentalis,* and *Tabebuia capotei. Diospyros anisandra, Forchhammeria trifoliata* and *Bumelia retusa* originate probably from the Yucatan Peninsula reaching only this part of Cuba.

Vegetation: Mangrove on the peaty silt deposits on the northern shore. Dry evergreen shrubwoods on the rocky southern shore. In the inner part of the peninsula semi-deciduous forests predominate (Fig. 144).

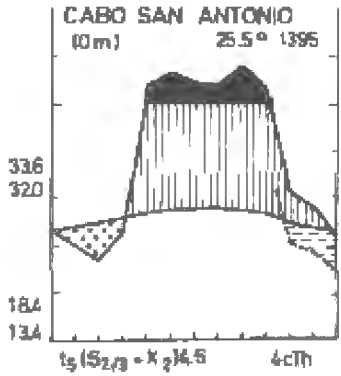


Fig. 142 Characteristic climate type in Guanahacibibes Peninsula at Cabo San Antonio

Fig. 143 Harrisia teatra Areces an endemic cactus of the dry deciduous littoral scrub of the Guanahacabibes Peninsula (Photo: A. Borhidi)

District A.1.2. Southern Isle of Youth (Isla de la Juventud, Sudpineroënse) (Fig. 141)

Geography: Marine limestone deposited in the Neogene shallow tropical brown soils in the west, humic carbonated skeletal soils in the east.

Climate: Semi-arid seasonal with 5–6 dry months, tending to be bixeric in the west. Annual precipitation is 1200—1600 mm (Fig. 145).

Flora: One exclusive endemic is *Phialanthus bissei*. The area is characterized by the endemics of western and northern Cuba, as *Allophylus roigii* (common with the Guanahacabibes Peninsula) and *Neobracea angustifolia* etc. (Fig. 117).

Vegetation: mangrove and swamp forests and reed vegetation in the Lanier Swamps in the north. In the west semi-deciduous forests, in the east dry evergreen forests predominate. Karstic lagoons are commonly found. An interesting stand of *Pinus caribaea* on limestone grows near Cayo Piedra, in a rather complete community of pine forest.

Fig. 144 Cutting of a semi-deciduous littoral limestone forest in the Guanahacabibes Peninsula (Photo: A. Borhidi)

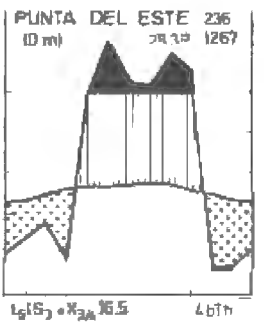


Fig. 145 Characteristic climate type in the southern part of Isle of Pine at Punta del Este

District A.1.3. Zapata Peninsula (Zapatanse) (Fig. 141)

The Zapata Peninsula (Fig. 141) the Hatiguanico river basin and the surrounding swamps, Laguna del Tesoro, the eastern marshlands of Zapata, the karstic lowland and the marshy mangrove coast of southern Habana province to Majana belong to this district.

Geography: Young, mainly peaty and boggy areas with a Neogene limestone ridge of NW—SE direction in the middle. Occasionally, flatland karsts, dissected by lagoons, with shallow, humic carbonated soils.

Climate: Seasonal, dry in the winter. 5—6 dry months, 1200—1700 mm annual precipitation (Fig. 146).

Flora: Very few exclusive endemics *(Acacia zapatensis, Phoradendron zapatanum, Bucida palustris, Calyptranthes peninsularis, Guapira peninsularis).* Furthermore, some species also occurring in the swamps of Florida and Virginia,

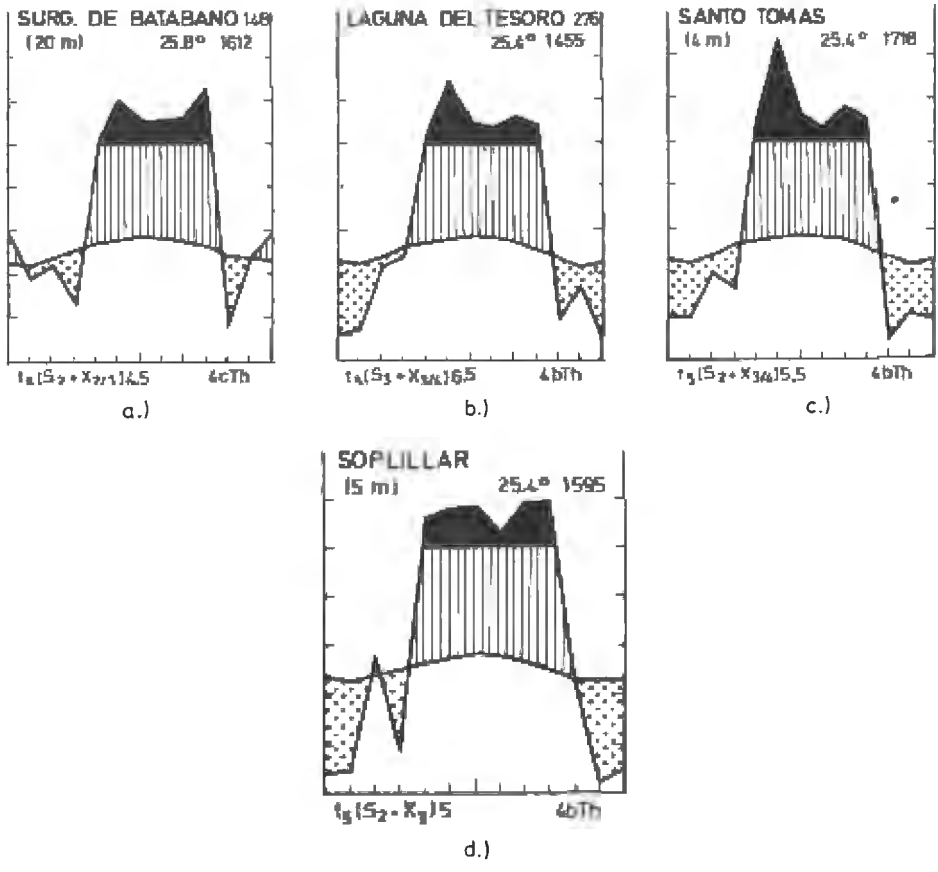


Fig. 146 Characteristic climate types in the phytogeographic district Zapatense at a) Surgidero de Batabanò, b) Laguna del Tesoro, c) Santo Tomas and d) Soplillar

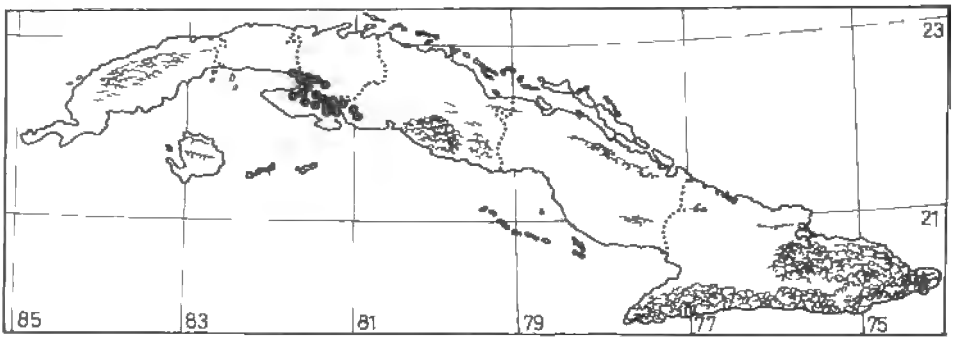


Fig. 147 Geographical distribution of *Fraxinus caroliniana* Mill. ssp. *cubensis* (Griseb.) Borhidi (Samek 1973, modified)

e.g., *Fraxinus caroliniana* ssp. *cubensis* (Fig. 147), *Vallisneria neotropicalis* (Marie-Victorin 1944) and *Polygala carteri,* are characteristic.

Vegetation: Extensive mangrove and swamp vegetation, (Figs 148, 149, 150) alluval forests and derived *Sabal* savannas on the northern edge. Semi-deciduous forests, dry evergreen forests and patches of shrubwoods occur on the karsts.

National park, beard and crocodile protection areas (Fig. 151).

Sector A.2. The flatland and hill-country of Pinar del Rio Province and north of Isle of Pines (actually Isle of Youth, Pinaricum)

This sector comprises the northern Isle of Pines (Fig. 141) (Isla de la Juventud) and the province of Pinar del Rio, excluding Sierra del Rosario, the mogotes of Sierra del los Organos and the serpentine area of Cajalbana. Mainly hills, with sandstone and slate as chief rocks, and flatlands covered by oligotrophic soil with quartz sand underneath. The dominant vegetation types are closed and open coniferous forests and their derived savannas, sandy lagoons and swampy patches with palms. Eight endemic genera occur in this area, one of them (*Microcycas*) also present in Sierra de los Organos. *Colpothrinax, Herpyza, Nodocarpaea* and *Roigella* (Fig. 152), are found throughout the area, *Tetraperone* is confined to Pinar del Rio, whereas *Lepturidium* is found only in Isle of Pines. In addition, 95 endemic species have been detected, for example, *Pinus tropicalis, Colpothrinax wrightii* (Fig. 154), *Phyllanthus junceus, Heptanthus ranunculoides, Syngonanthus wilsonii, Kalmiella ericoides* (Fig. 153). *Lyonia myrtilloides, Vaccinium cubense* ssp. *ramonii, Pieris cubensis, Paepalanthus alsinoides, Chaetolepis cubensis, Miconia adrosaemifolia, Pachyanthus cubensis, P. angustifolius, P. wrightii.* Several vicarious species pairs occur, such as *Lachnocaulon anceps* (Isle of Youth) — *L. ekmanii* (Pinar del Rio); *Lyonia vaccinoides* (Isle of Youth) — *L. ekmanii* (Pinar del Rio); *Galactia jenningsii* (Isle of Youth) — *G. isopoda* (Pinar del Rio); and others in the genera of *Phyllanthus, Tabebuia, Eugenia* and *Eriocaulon.*

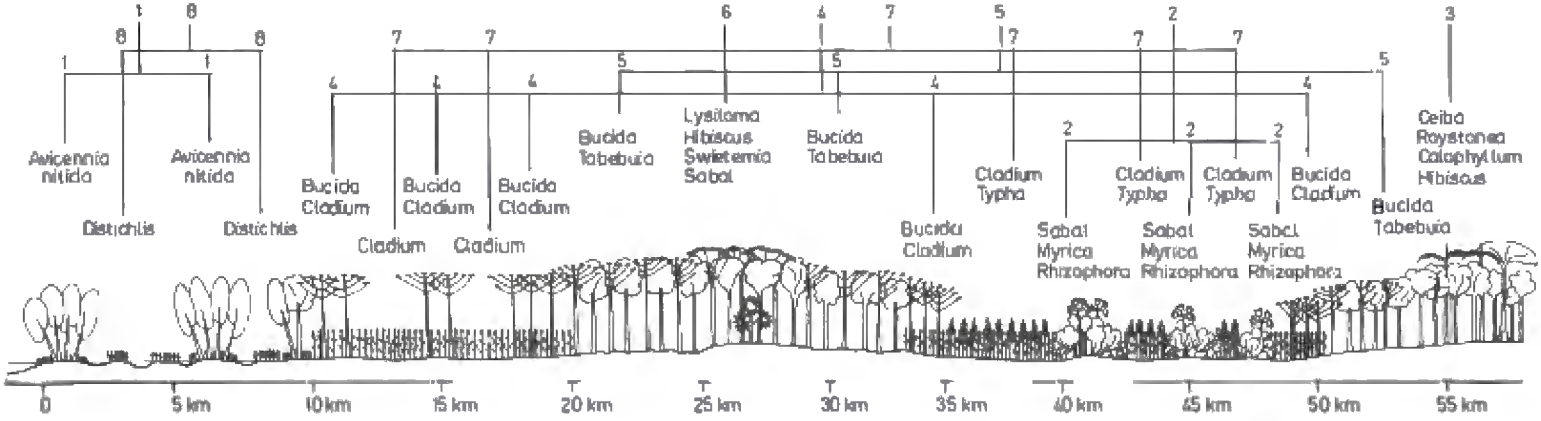


Fig. 148 Vegetation transect through the western basin of the Zapata Swamp in north-south direction (Borhidi and Del-Risco 1975). 1. Mangrove of salt water, 2. Mangrove of low salinity water, 3. Tropical evergreen seasonal forest, 4. Swamp forest on peat. 5. Swamp forest on limestone, 6. Tropical semi-deciduous forest, 7. Herbaceous swamp, 8. Salt herbaceous swamp

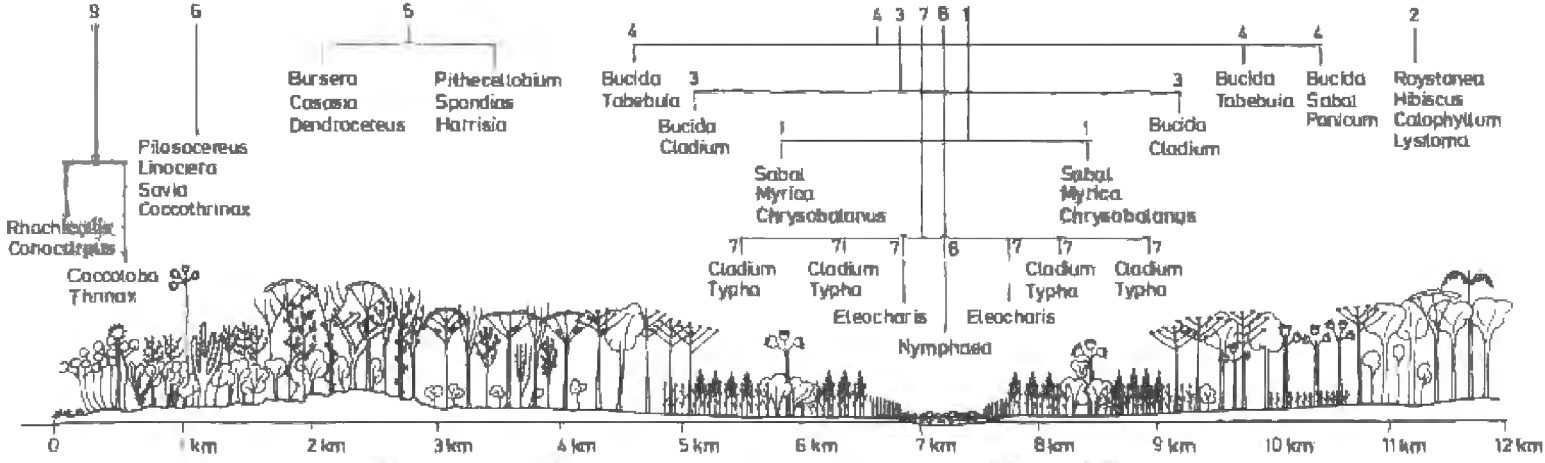


Fig. 149 Vegetation transect through the eastern basin of the Zapata Swamp in north-south direction (Borhidi Del Risco 1975). 1. Mangrove of low salinity water, 2. Tropical evergreen seasonal forest, 3. Swamp forest on peat, 4. Swamp forest on limestone 5. Tropical deciduous forest, 6. Thorn dry forest, 7. Herbaceous swamp, 8. Freshwater vegetation of the ponds and canals, 9. Littoral rock pavement and littoral thicket

Fig. 150 Zonation of the swamp vegetation in the Zapata Swamp. Dominant species are: *Nymphaea blanda, Thalia geniculata, Typha domingensis, Bucida palustris* with *Sabal parviflora* (Photo: A. Borhidi)

Fig. 151 Crocodile reserve area in the Zapata Peninsula at Laguna del Tesoro, with a large population of endemic Cuban crocodiles: *Crocodilus rhombifer* (Photo: A. Borhidi)

Fig. 152 An endemic genus and species of the pinewoodlands and savannas of West Cuba: *Roigella (Rondeletia) correifolia* (Griseb.) Borhidi et Fernandez (Photo: A. Borhidi)

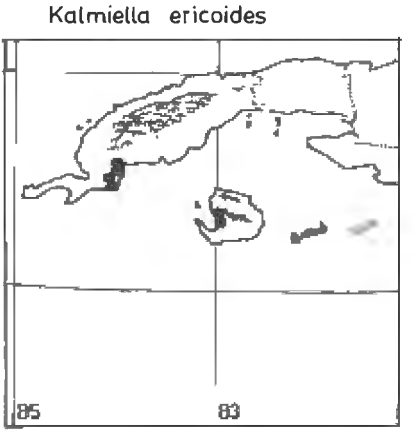


Fig. 153 Geographical distribution of *Kalmiella ericoides* (Wr. ex Griseb.) Small, a common endemic of the phytogeographical subregion of the white sand areas (Klotz 1978)

Sub-sector A.2.a. White sandlands (Sabalo-Indiosense) (Fig. 141)

Light-coloured sandy areas with low nutrient content on the western and southern border of Isle of Youth and South Pinar del Rio from the pre-isthmus of the Guanahacabibes Peninsula till Paso Real de San Diego (Fig. 141). The open pine woodlands and the swampy sand lagoons have several endemic species in

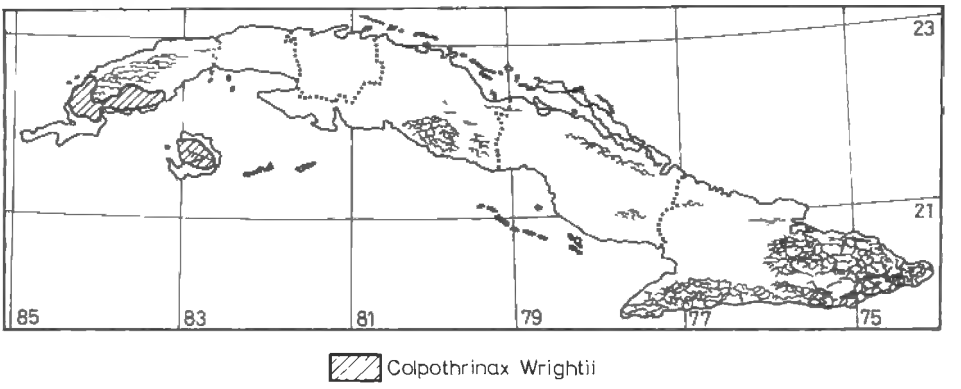


Fig. 154 Geographical distribution of *Colpothrinax wrightii* Griseb. et Wendl. (Marie-Victorin and León 1942, Samek 1973 and personal observations)

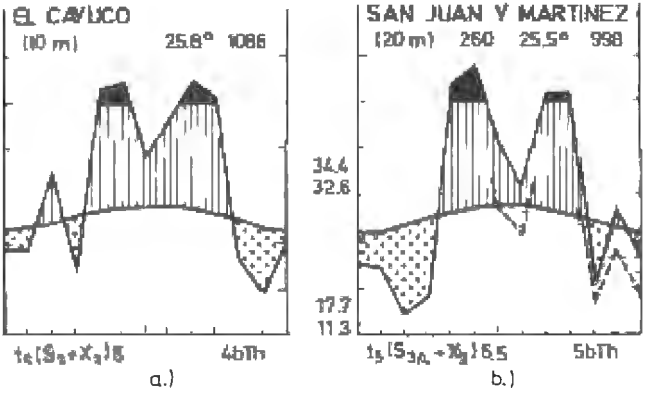


Fig. 155 Characteristic climate types in the white sand areas in Pinar del Rió Province (phytogeographical district: Sabaloënse) at a) El Cayuco and b) San Juan y Martinez

common, for example, *Xyris bicarinata, X. grandiceps, Paepalanthus seslerioides, Aristida brittonorum, Eriocaulon sphaerocephalum, E. dioecum, Amphiolanthus arenarioides, Micranthemum rotundatum, Lindernia alternifolia, Bacopa longipes,* and *Colpothrinax wrightii* (Fig. 154).

District A.2.1. White sandlands of South West Pinar del Rio (Sabaloënse) (Fig. 141)

Geography: Flatland covered by soils of mild glei character with quartz sand underneath. The area is relatively abundant in oligotrophic lakes.

Climate: Seasonal with dry winter, 5—6 dry months. Annual precipitation is 1000–1400 mm on the average (Fig. 155).

Flora: Several endemics common to this district and the pinewoods of slate areas. These are *Befaria cubensis, Gochnatia ekmanii, Pinguicula albida* (Fig. 156),

Byrsonima pinetorum, Quercus oleoides ssp. *sagraeana* (Fig. 157). Approximately 30 exclusive endemics, for example: *Aristida fragilis, Syngonanthus leoni,* eight *Eriocaulon* species, *Hibiscus urbanii, Mollugo enneandra, M. brevipes, Pachyan thus mantuensis* and *Plinia ramosissima.*

Vegetation: Mixed palm-pine woodlands with loose canopy layer *(Eragrosti cubensi-Pinetum Samek)* was the original vegetation in which *Colpothrinax wrightii,* (Fig. 154). *Acoeloraphe wrightii* and *Pinus tropicalis* were dominant. Also, derived savannas, wet *Acoelorraphe* palm groves (Fig. 158) swampy and freshwater vegetation rich in Eriocaulaceae.

District A.2.2. White sandlands of Isle of Youth (Indiosense)

Geography: The area of El Soldado—Los Indios, San Pedro and Santa Isabel, is located north of the Lanier Swamp and on the westerns shore of the island (Fig. 141). Similarly to the preceding area, it is a humid, acidic, quartz sand plain.

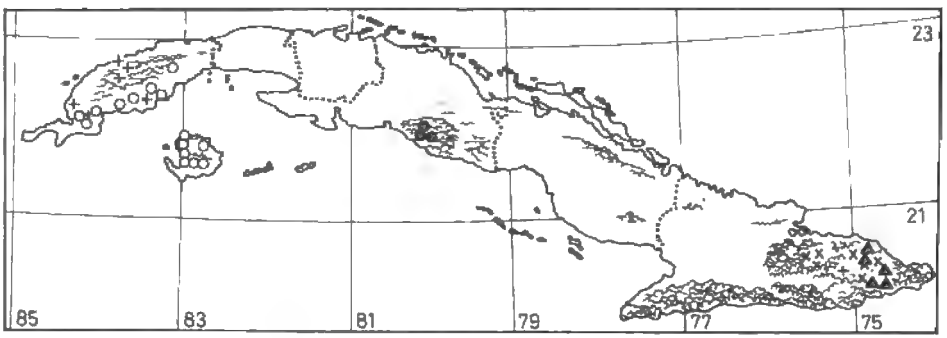


Fig. 156 Geographical distribution of the Cuban taxa of the genus *Pinguicula (Lentibulariaceae)* (Bisse et al. 1975)

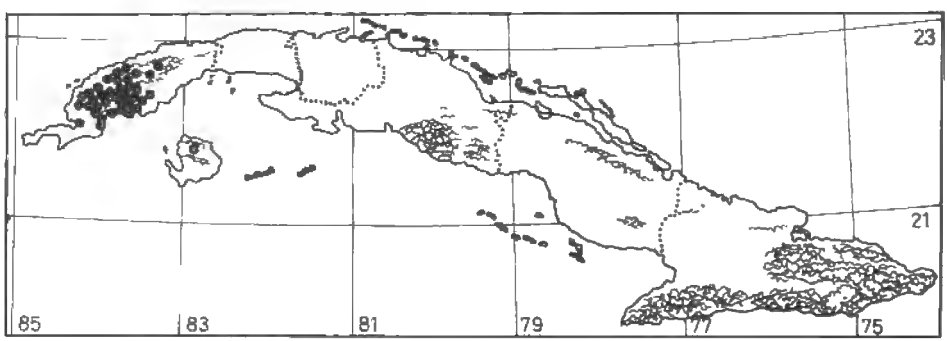


Fig. 157 Geographical distribution of *Quercus oleoides* Schlecht. et Cham. ssp. *sagraeana* (Nutt.) Borhidi (Borhidi and Capote)

Fig. 158 Regenerating pine-woodland-savanna ecotone in the white sand area of the Pinar del Rió Province, with young *Colpothrinax* palm, *Copernicia glabrescens* Becc. *Acoelorraphe wrightii* Wendl. and *Pinus tropicalis* Morelet (Photo: A. Borhidi)

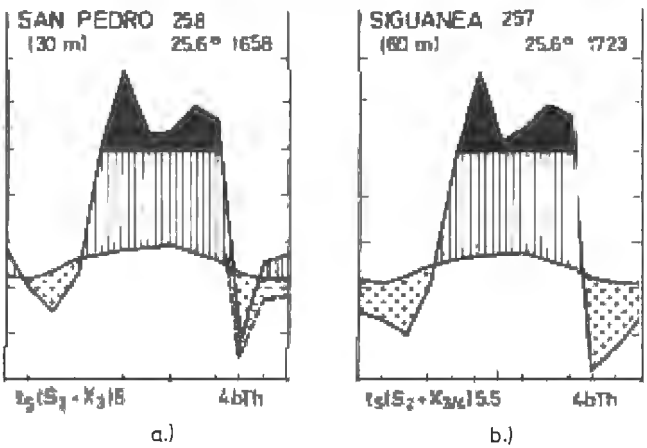


Fig. 159 Characteristic climate types in th white sand area of Isle of Pine, at a) San Pedro and b) Siguanea

Climate: Seasonal with 3—4 dry months in the winter. Annual precipitation is 1400—1600 mm (Fig. 159).

Flora: A single endemic genus, *Lepturidium,* and approximately 20 endemic species, such as *Eugenia victorini, Mollugo pinosia, Pectis pinosia, Pachyanthus*

longifolius, Kalmiella aggregata, K. simulata, Phyllanthus selbyi, Evolvulus siliceus and six species of *Eriocaulon* characterize this floristic district. *Bulbostylis paradoxa* is found only here in Cuba, the savanna plant *Byrsonima verbascifolia* occurs here and in Oriente.

Vegetation: Open pinewoods on sandy soils (*Paepalantho-Pinetum tropicalis* Samek), derived savannas, wet *Acoelorraphe* groves. Swampy and freshwater vegetation rich in *Eriocaulons* (Fig. 160).

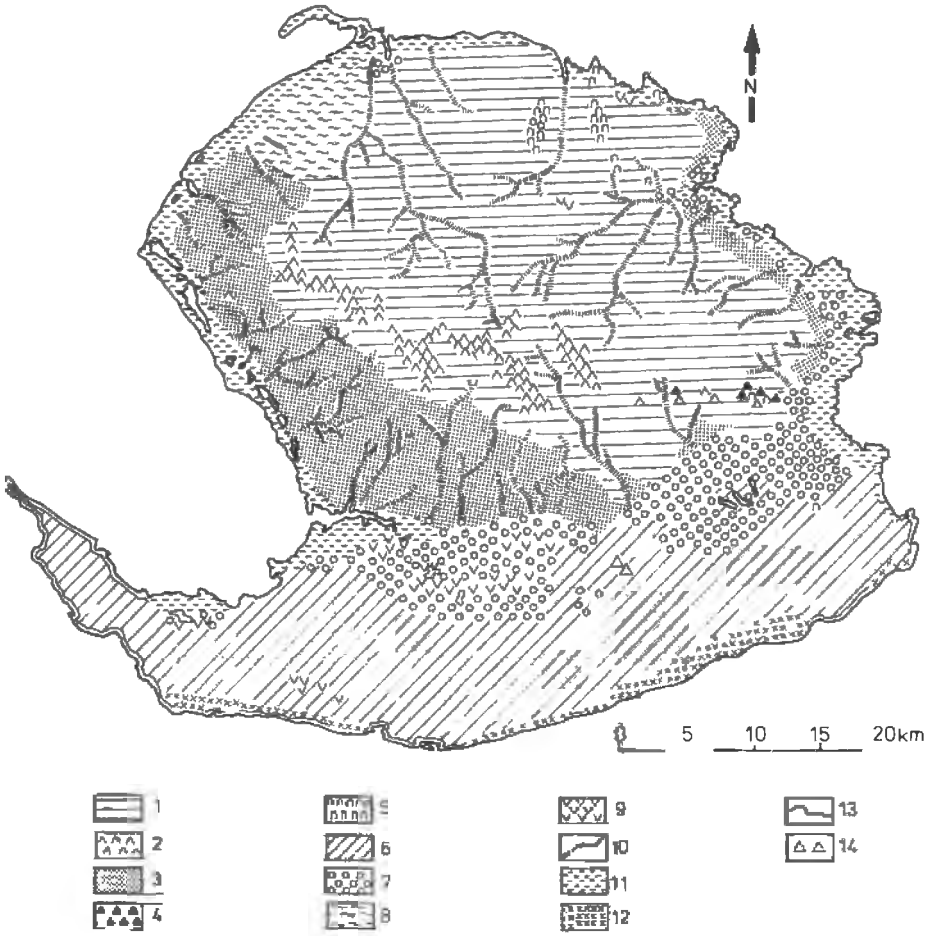


Fig 160 Map of the natural vegetation of Isle of Pine (Samek 1969, modified by Borhidi). 1. Pine woodland of the hilly region; 2. Pine woodland of the slatey ridges; 3. Pine woodland of the white sand, "sabana arenosa"; 4. Semi-deciduous forest in the Pine woodland belt; 5. Vegetation complex of the limestone "haystack hills"; 6. Dry broad-leaved forests on the "dog-tooth" limestone; 7. Wet evergreen lowland forest; 8. Vegetation complex of the "Great Savanna"; 9. Swamps; 10. Riverain forests; 11. Mangroves; 12. Sandy beach vegetation, 13. Vegetation of the coastal embankments; 14. Pine woodland on "dog-tooth" limestone

Sub-sector A.2.b. Silicate heights and their alluvial plains
(Eu-Pinaricum, Fig. 141)

This area includes the silicate heights in the north and south side of Sierra de los Organos, with the adjacent alluvial sites and the northern and north-eastern part of Isle of Youth. Two endemic genera, *Roigella* and *Nodocarpaea,* and about 70 endemic species occur, some of them listed in A.2.

District A.2.3. The slatey heights and plains of Pinar del Rio
(Pinarense, Fig. 141)

Geography: Gently rolling hill-country, the plains are divided by rivers. The parent material of hills is composed of sandstone and lower Jurassic slate layers (the so-called San Cayetano formation) (Fig. 161). The quartz-siallitic soils of hills are acidic, yellow in colour, and poor in nutrients. On the plains tropical meadow soils of a medium glei character predominate, these are covered by acidic sand.

Climate: Seasonal tropical with dry winter. 1—2 dry months and 1600—2300 mm annual precipitation in the hills, 3—4 dry months and 1200—1600 mm annual precipitation in the plain (Fig. 162).

Flora: Characteristic are the endemics of the sectors, these are in common with the other floristic districts. The dominant coniferous vegetation (*Pinus tropicalis*

Fig. 161 Profile of the Cayetano-sandstone in the Sierra de los Organos, covered by pine forest of *Pinus caribaea* Morelet (Photo: A. Borhidi)

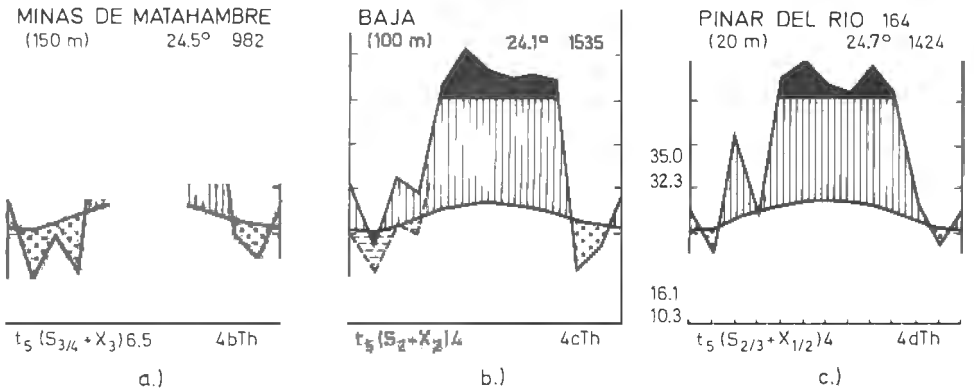


Fig. 162 Characteristic climate types of the slatey and sandstone pine-woodland areas of Pinar del Rió Province (phytogeographical district: Pinarense) at a) Minas de Matahambre, b) Baja and c) Pinar del Rió

Fig. 163 Befaria cubensis Griseb., an endemic element of the pine woodlands of West-Cuba growing on sandstone and slatey soils (Photo: A. Borhidi)

and *P. caribaea*) causes certain floristic uniformity. Additional characteristic elements are *Quercus oleoides* ssp. *sagraeana* (Fig. 157) in the tree layer, and *Befaria cubensis* (Fig. 163), *Vaccinium cubense* ssp. *ramonii, Lyonia myrtilloides, Miconia ibaguensis, M. splendens, Pachyanthus poiretii, P. angustifolius, Tabebuia lepidophylla* (Fig. 164), *Roigella correifolia* (Fig. 152), *Rhus copallina* ssp. *leucantha*

Fig. 164 Tabebuia lepidophylla (A. Rich.) Greenm. an endemic shrub of the savannas of West Cuba. (Photo: A. Borhidi)

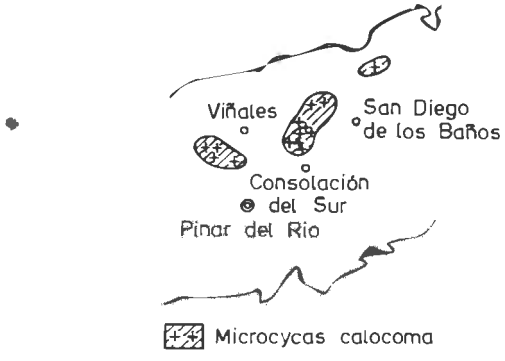


Fig. 165 Geographical distribution of *Microcycas calocoma* (Miq.) A. DC. (Marie-Victorin and León 1942, Samek 1973, Klotz 1978 and personal observations)

in the shrub layer. Species in common with *Cajalbana,* but rare, are *Acunaeanthus tinifolius, Hyperbaena columbica* and *Pisonia petiolaris. Microcycas calocoma* (Figs 165—166) is common to this district and the limestone karsts. Local endemics are lacking with the exception of *Cassia roigii* in Cerro de Cabras. In the southern plains, however, several local endemics appear, such as *Gochnatia mantuensis, G.*

Fig. 166 The famous living fossil of the flora of West Cuba: *Microcycas calocoma* Miq., a Cretaceous Angiosperm growing in the deciduous shrub forest of the mogotes at Santo Tomas (Photo: A. Borhidi)

ekmanii, Peperomia nummularia, Hyptis cubensis, Galactia herradurensis, Lyonia ekmanii and *Melochia manducata,* usually at the edge of the plain.

Vegetation: On the hard cristalline slates an open pine woodland formed by *Pinus tropicalis* (Fig. 167) and *P. caribaea* was the original dominant vegetation, but it is mostly replaced by secondary grasslands of *Hyparrhenia rufa* and *Andropogon bicornis.* In the areas of the softer sandstone bedrock (San Cayetano formation) a deeper brownish-yellow soil has developed covered mostly by evergreen sclerophyllous oak forests of *Quercus oleoides* ssp. *sagraeana* (Figs 157, 168), *Buchenavia capitata, Pithecellobium cubense, Xylopia aromatica.* On the southern slopes and foothills a narrow strip of tropical semi-deciduous forest has developed frequently transformed into orchards or plantations of vegetables. In the lowland areas *Colpothrinax* palm-pine woodland was extended, but its sites actually are used as rice fields, pastures and secondary grasslands. The district may be subdivided into two sub-districts: the slatey heights (Eu-Pinarense) and the alluvial plains (Herradurense).

District A.2.4. North of Isle of Youth (Geronense, Fig. 141)

Geography: Alluvial plain is the most extensive with some karstic limestone mountains (Sierra de las Casas, Sierra de Caballos) and low silicate hills (Sierra de la Cañada, Sierra de La Siguanea, Loma de Mal Pais etc.). The dominant soil types are yellow quartz-allitic or yellow pseudoglei soils.

Climate: Seasonal tropical. The dry season is winter. 5—6 dry months, 1400—1700 mm annual precipitation.

Flora: Very similar to that of the preceding flora district, although several elements (*Microcycas* Figs 165—166) have not reached this area despite the land connection at the end of the Tertiary and during the glacials of the Quaternary. Some characteristic endemic species are *Hyeronima crassistipula, Stenandrium pinetorum, Machaonia acunae, M. pauciflora, Miconia perelegans, Jacquinia curtissii, Hypericum incurvum* and, on the limestone mountains, *Tabebuia geronensis* and *Eugenia ignota.*

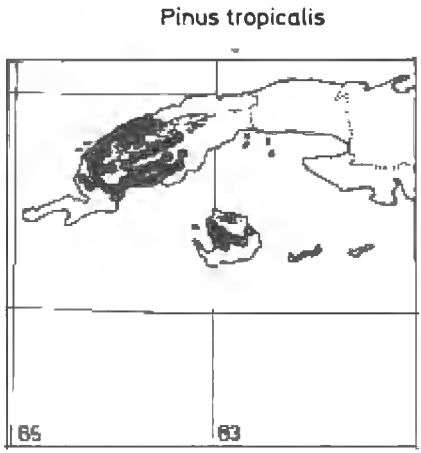


Fig. 167 Geographical distribution of *Pinus tropicalis* Morelet (Klotz, 1979 and personal observations)

Fig. 168 Evergreen oak-forest on white sand at El Cayuco, Pinar del Rió Province, formed by old individuals of *Quercus oleoides* C. H. Muell. ssp. *sagraeana* (Nutt.) Borhidi (Photo: A. Borhidi)

Vegetation: Forests of *Pinus tropicalis,* in some places mixed with *P. caribaea,* mostly replaced by pastures. On the limestone hills semi-deciduous forests at the foothill areas and karstic forests on the steep formations.

Sector A.3. The mountainous Pinar del Rio (Rosaricum) (Fig. 141)

Three mountainous areas of very different geological structure, geomorphology and vegetation have been included: the haystack mountains of Sierra de los Organos (Fig. 169). the serpentine area of Cajalbana and vicinity, and the geologically highly varied mountain range of Sierra del Rosario. The main justification for considering these three fundamentally different areas as parts of the same flora sector is that the mountains form an unbroken system, and many species from the limestone flora of Sierra de los Organos and the serpentinophilous flora of Cajalbana are found together in Sierra del Rosario.

Ten endemic genera characterize this sector, these are *Euchorium* (Sapindaceae), *Ancistranthus* (Acanthaceae), *Neomazaea* (Rubiaceae), *Phyllomelia* (Rubiaceae), *Phyllacanthus* (Rubiaceae), *Sauvallea* (Commelinaceae), *Sauvallella* (Fabaceae), *Lescaillea* (Compositae), *Siemensia* (Rubiaceae) (Fig. 170) and *Ceratopyxis* (Rubiaceae). Genera common to Sierra de los Organos and Sierra del Rosario are *Siemensia, Ceratopyxis* and *Gaussia,* whereas *Phyllomelia* is common to Cajalbana and Sierra del Rosario. Here is the distributional centre of the genera *Acunaeanthus* and *Phania* which occur sporadically in the east, in the provinces of Matanzas and Las Villas. In addition to the endemic genera, about 150 endemic

Fig. 169 Isolated haystack hills in the Sierra de los Organos formed by Jurassic hard limestone deposited on the acid Cayetano formation at San Vicente (Photo: A. Borhidi)

Fig. 170 An endemic genus and species of Organos range: *Siemensia pendula* (Wr. ex Griseb.) Urban a Rubiaceae climber hanging from the perpendicular walls (Photo: A. Borhidi)

species prove the ancient character of the western Cuban mountains and the long, isolated development of their flora.

The vegetation of this area is also characterized by high diversity and intensive mingling. The vegetation of limestone rocks of Sierra de los Organos is also found in several localities in Sierra del Rosario (Pan de Guajaibón, Peña Blanca, Monte Toro). Communites similar to the pinewoods and scrubs of Cajalbana occur at several points in Sierra del Rosario (Loma Zambumbia near Rancho Mundito, Rangel, Cuzco, Loma Pelada de Cayajabos). Despite these similarities, the three mountainous areas are sharply different from one another in geomorphology, flora and vegetation.

District A.3.1. Sierra de los Organos (Viñalense) (Fig. 141)

Geography: Deeply inclined, tower-like karstic hills with narrow and deep gorges, hidden cave systems and a long valley separating the mountains in a SW-NE direction (Fig. 171). The surface of mountains is usually bare rock or more or less eroded skeletal soils. In the gorges deep humic-carbonated rendzina soils are deposited, whereas in the so-called intercolline valleys tropical brown and red soils predominate.

Climate: Seasonal tropical with dry winter. The dry season is shortened in the SW-NE direction. In the west and north 3—4, in the south and east 1—2 dry months. In some centrally situated areas humid rainforest climate may occur mesoclimatically. The annual precipitation is 1500—2200 mm (Fig. 172).

Flora: The mountains composed of old, very hard upper Jurassic rocks, the so-called blue limestone, emerged in the Cretaceous. They have been dry lands since then. Due to the gradual erosion of soft rocks, free-standing limestone cliffs were formed. On the top of rocks a very ancient and highly specialized flora

Fig. 171 Extremely sharp morphological and ecological limit of the basic limestone and the acid sandstone areas near San Cayetano (Photo: A. Borhidi)

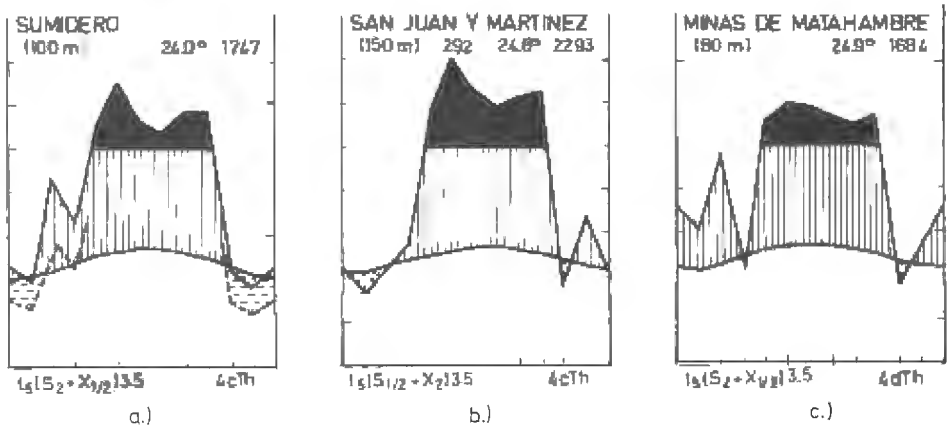


Fig. 172 Characteristic climate types of the limestone mogote district of the Sierra de los Organos (Viñalense) at a) Sumidero, b) north to San Juan y Martinez and c) south to Minas de Matahambre

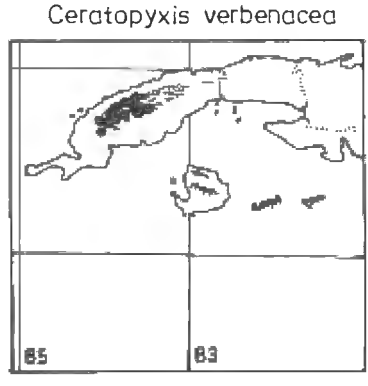


Fig. 173 Geographical distribution of *Ceratopyxis verbenacea* (Griseb.) Hook.f.

developed preserving several taxonomically isolated relicts, conditioned by the decreased competition in the extremely unfavourable habitats.

Two monospecific genera, *Euchorium* and *Ancistranthus*, and two other genera common to this district and Sierra del Rosario (*Ceratopyxis* and *Siemensia*), as well as *Microcycas* (Figs 165—166) (which is also present in the slatey heights) illustrate the richness of the flora, likewise the 90 endemic species (e.g., *Gaussia princeps* (Fig. 89), *Ancistranthus harpochiloides, Ceratopyxis verbenacea* (Fig. 173), *Siemensia pendula* (Fig. 170), *Ekmanianthe actinophylla, Spathelia brittonii* (Fig. 78), *Bourreria polyneura, Eugenia galeata, Gesneria celsioides, Omphalea hypoleuca, Annona cascarilloides, Malphighia roigiana, Anthurium venosum, Philodendron urbanianum, Bursera shaferi*, etc.).

Important species of karstic woods are the endemic *Bombacopsis cubensis* (Fig. 174—175), *Thrinax morrisii* and *Agave tubulata*. Many local endemics have been

Fig. 174 The water accumulating bottle-shaped trunk of *Bombacopsis cubensis* indicates an extremely dry habitat on the steep limestone slopes of the "mogotes" (Photo: A. Borhidi)

Fig. 175 Flowering branches of *Bombacopsis cubensis* A. Robyns (Photo: A. Borhidi)

discovered here. The most intensively explored area is Viñales where 17 local endemics were found, for example: *Pilea affinis, P. simplex, Salmea glaberrima, S. umbratilis, S. caleoides, Rhytidophyllum rupincola, Clusia brittonii* and *Acalypha mogotensis,* (for others, see the list above). Sumidero has 10 local endemics, e.g., *Piper sumideranum, Calycogonium saxicola, Plinia rubrinervis, Cissus dichroa,* and *Chaetocarpus humilis,* Cerro de Guane has 5, e.g., *Eugenia guanensis, Peperomia guanensis* and *Caesalpinia guanensis. Dorstenia roigii* is an endemic of Mogote la Jagua, whereas *Gouania ekmanii* is endemic to Mogote de la Baliza. Five endemics have been found in the Sierra de la Güira (*Pilea güirana, Bourreria mucronata, Tetrazygia minor, Guettarda amblyophylla* and *Rondeletia susannae*). In the mountains isolated by coombs from one another a number of local vicarious endemics occur, e.g., *Leptocereus assurgens* (Viñales) — *L. prostratus* (Sumidero) — *L. ekmanii* (Cerro de Guane); *Psidium vicentinum* (Viñales) — *P. nummularium* (Pand de Guajaibón). *Pilea hemisphaerica* (Viñales) — *P. sumideroensis* (Sumidero). The mountains of Viñales and Sumidero may be regarded as being the most important centres of speciation.

Vegetation: The karstic hills (mogotes or haystack hills) are covered by a unique mogote vegetation (Fig. 176) including the open *Agave* scrub of sunny cliffs with *Mammillaria* in the slits (Fig. 177) the veil-communities of shady rock walls and

crevices, bromelia-rich open shrubwoods of the eroded tops, and the closed forest on gravel slides and ravines (intrazonal semi-deciduous shrubwoods). On the gravel slides at the foothills semi-deciduous forests, in the coombs seasonal evergreen forests and extrazonal rainforest patches develop. The intercolline valley, formerly covered by seasonal evergreen forests, is a cultivated land with fragments of a *Roystonea – Ceiba* secondary savanna.

Fig. 176 Elephant-shaped mount of the tropical conical karsts in the Ancón range of the Sierra de los Organos with perpendicular walls densely covered by vegetation (Photo: A. Borhidi)

Fig. 177 Mamillaria prolifera (Mill.) Haw. a nice little characteristic cactus of the limestone rocks (Photo: A. Borhidi)

District A.3.2. Cajalbana Mountains (Cajalbanense) (Fig. 141)

Geography: Due to the red ferritic soils and the very rich flora, this small (about 70 km^2) area of old serpentine mountains extending to the coastal lowland of La Mulata satisfies the criteria of being a separate floristic district. The relief is characterized by wide, flat hilltops and deep valleys with steep slopes. Regarding physiognomy, soil and vegetation, this area is a smaller, vicarious complement of Sierra de Nipe of eastern Cuba.

Loma Preluda to the west, and the range of serpentine hills from Las Pozas to south of Bahia-Honda and the coastal area of Toscano-Morrillo are also included in the district. The adjacent northern coast, composed mainly of serpentine or young sedimentary rocks as the top layer, is also considered here.

Climate: Seasonal with dry winter, 3—4 rainy months, 1400—1600 mm annual precipitaton (Fig. 178).

Flora: Four monospecific endemic genera: *Neomazaea, Sauvallella, Phyllacanthus* and *Lescaillea,* and 40 endemic species, including several palaeoendemics characterize the district. Of the endemics of pinewoods *Tetrazygia coriacea, Psidium cymosum, Phania cajalbanica, Tabebuia leptopoda, Plinia dermatodes, Rondeletia venosa, Coccothrinax yuraguana* (Fig. 179), *Phyllanthus sagraeanus, Chaptalia ekmanii,* and *Eupatorium grisebachianum* are noteworthy. Noted species of the evergreen shrubwoods are *Agave cajalbanensis, Moacroton trigonocarpus*

(Fig. 130), *Euphorbia cubensis, Zanthoxylum dumosum* s.str. *Gesneria ferruginea, Gochnatia intertexta, Guapira cajalbanensis, Machaonia dumosa, Phialanthus rigidus,* and *Scolosanthus acunae.* Several floristic elements are vicariads of Nipe and Moa endemics, for example, *Lescaillea—Harnackia* (Fig. 113), *Euphorbia cubensis—E. helenae, Moacroton trigonocarpus—M. lanceolatus* (Fig. 130), *Anemia cajalbanica—A. coriacea* (Fig. 128), and *Helicteres trapezifolia—H. nipensis.* Isolated populations of several species may also be encountered in the serpentine areas of central Cuba, e.g., *Ottoschmidtia dorsiventralis, Anemia cajalbanica, Harpalyce cubensis* (Matanzas), *Acunaeanthus tinifolius, Leucocroton revolutus, Linodendron venosum, Coccothrinax crinita* (Macizo de Guamuhaya).

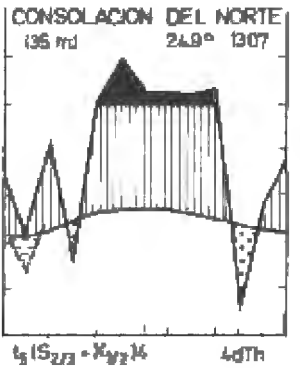


Fig. 178 Characteristic climate type of the Cajalbana region (Phytographical district: Cajalbanense) at Consolacion del Norte

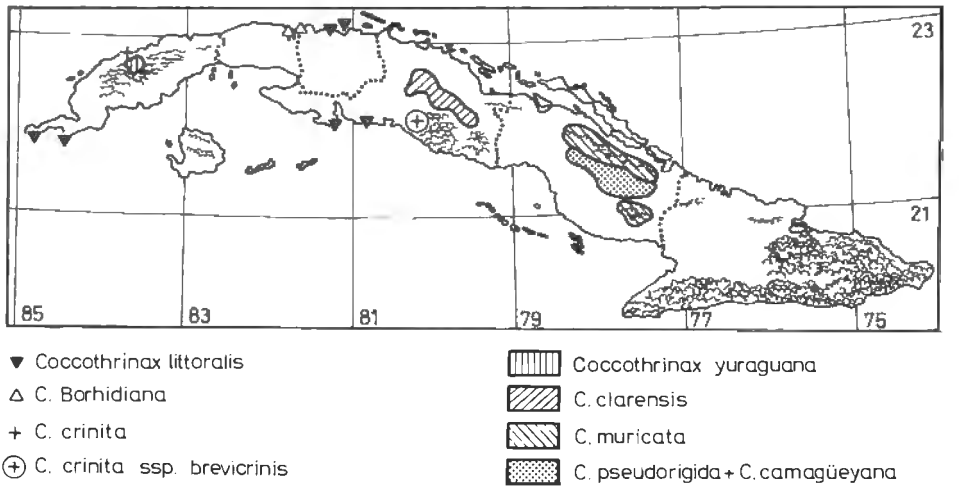


Fig. 179 Geographical distribution of the West and Central Cuban taxa of the genus *Coccothrinax* (Borhidi 1973, modified)

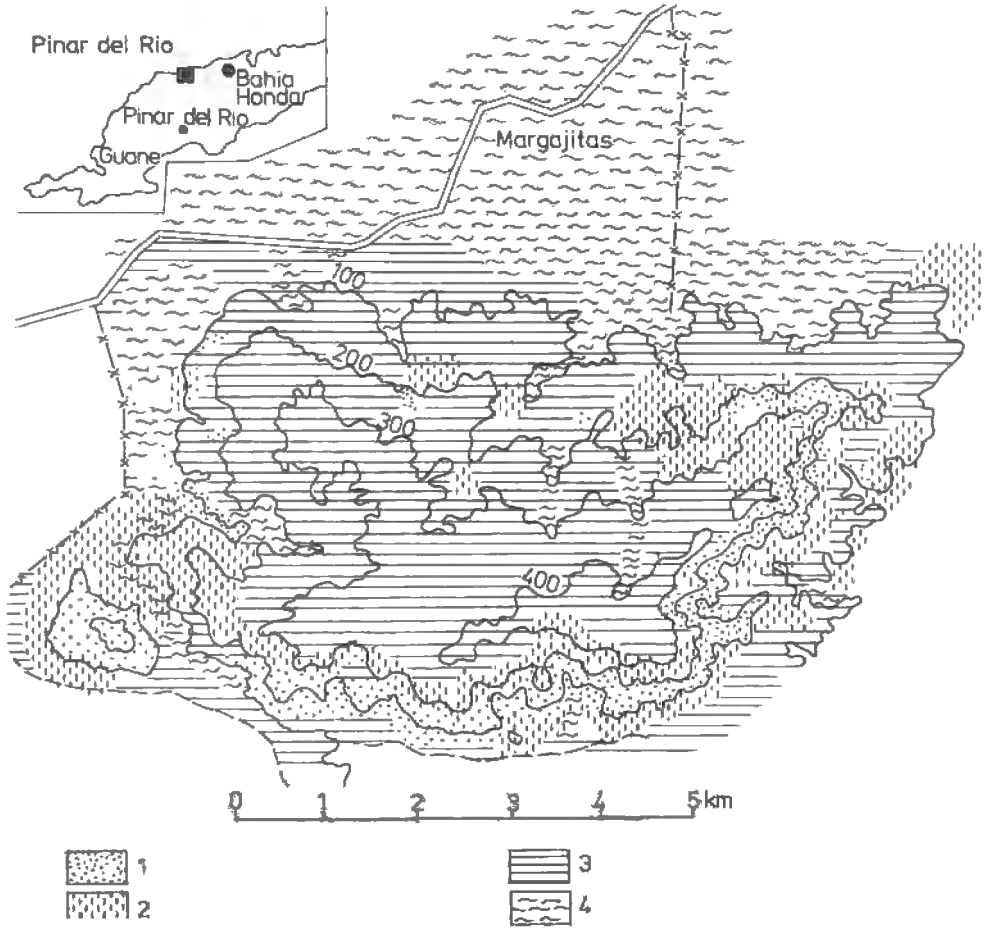


Fig. 180 Map of the natural vegetation in the Cajalbana range (Samek 1973, modified) 1. Serpentine thicket, *(Neomazaeo-Reynosion retusae)* 2. Open rocky pine woodland *(Agavo cajalbanensi-Pinetum)*, 3. Serpentine pine forest *(Neomazaeo-Pinetum)*, 4. Humid valley pine forest *(Guettardo valenzuelanae-Pinetum)*.

The coastal belt at Toscano — Playa Morrillo originally had a highly specialized flora. The present vegetation, however, is strongly degraded and an endemic genus *(Phyllacanthus)* and 19 endemic species, e.g., *Maytenus lineata, Heptanthus brevipes, Ilex ternatifolia, Mimosa apleura, M. catalinae, Calycogonium microphyllum,* and *Calyptranthes gracilipes, Randia cubana* etc., have not been collected here for a long time.

Vegetation: (Figs 180—181) On the rocky soil of the steep slopes and cliffs evergreen shrubwoods, whereas on the hilltops *Pinus caribaea* forests grow. In the valleys wet coniferous gallery forests with ferns, palms and *Odontosoria wrightiana* are found (Fig. 182). In the lowland areas semi-deciduous forests, serpentine shrub woods, and mangrove vegetation grow.

District A.3.3. Sierra del Rosario (Rosariense) (Fig. 141)

Geography: Mountainous formations composed primarily of upper Jurassic limestone and, to a lesser extent, of sandstone, gneis and others. Serpentine intrusions often reach the surface forming more or less extensive patches. Two parallel ranges reach the altitude of 500—600 m, some peaks (Monte Toro, Peña Blanca, Piedra Calzada, Pan de Guajaibón) are elevated over 600 m. The relief is highly varied. Tropical brown soils predominate but there are also yellow quartz-allitic soils on sandstone, red ferrallitic soils on serpentine and tropical rendzina on limestone.

Climate: Tropical climate with 1—2 months long dry winter. In the central basin, particularly in the east, rainforest climate occurs humid throughout the year.

Flora: Rich and diverse, thanks to the high geological variability of the mountains. On the serpentine outcrops the plants of the Cajalbana Mts and its vicinity occur, for example, *Phyllomelia coronata, Malpighia wrightiana, Rondeletia chamaebuxifolia, Eugenia rigidifolia.* Some species of slatey heights, e.g., *Pinus caribaea, Quercus oleoides* ssp. *sagraeana* (Fig. 157) and *Byrsonima pinetorum,* occur in the sandstone areas, whereas several plants from the karst of Sierra de los Organos *(Siemensia pendula, Gaussia princeps, Auerodendron acuminatum)* are found on limestone rocks. The exclusive endemics are relatively few in number, totalling about 25. Examples are *Pilea bullata, Zanthoxylum ekmanii, Z. organosium, Banara acunae, Daphnopsis guacacoa, Lagetta wrightiana, Plinia recurvata, Myrtus sagraei, Myrcia valenzuelana, Pachyanthus tertamerus, Mouriri valenzuelana, Henriettea granularis, Cordia valenzuelana,* and *Gochnatia ekmanii.*

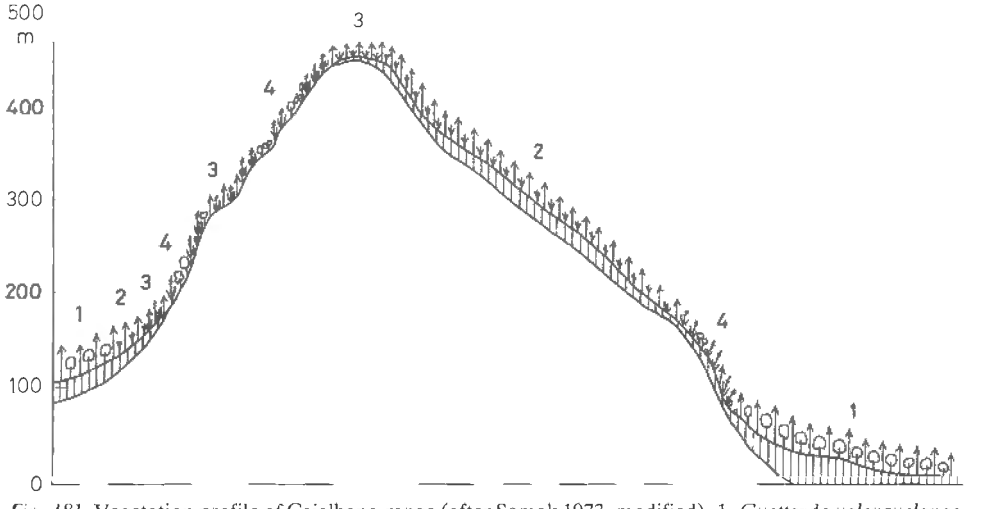


Fig. 181 Vegetation profile of Cajalbana-range (after Samek 1973, modified). 1. *Guettardo valenzuelanae-Pinetum* 2. *Neomazaeo-Pinetum,* 3. *Agavo cajalbanensi-Pinetum* 4. Sclerophyllous evergreen serpentine scrub *(Neomazaeo-Reynosion retusae)*

Fig. 182 Wet pine forest of *Pinus caribaea* on the serpentine latosols of the Cajalbana range, with characteristic *Copernicia glabrescens* palms (Photo: A. Borhidi)

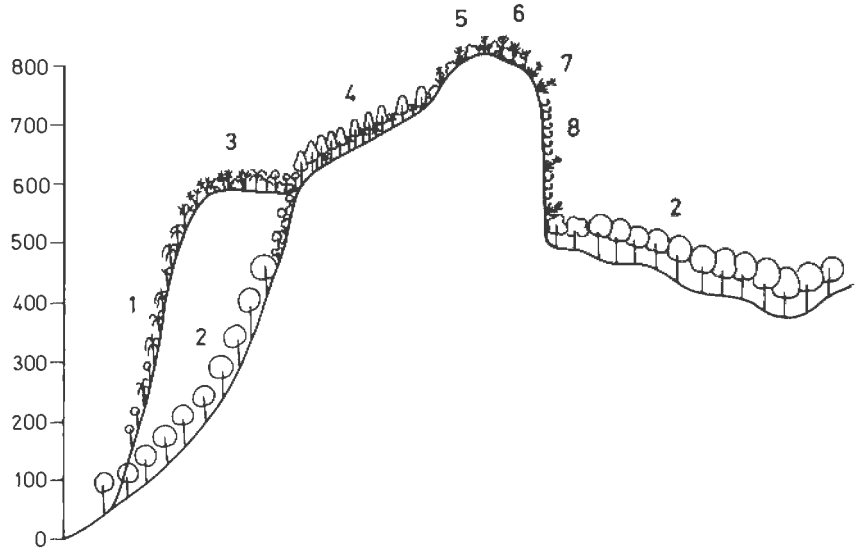


Fig. 183 Vegetation transect of the mogote Pan de Guajaibón (Borhidi and Capote) 1. Semi-deciduous forest; 2. Seasonal evergreen forest; 3. Tropical karstic forest; 4. Montane rainforest; 5. Deciduous shrubwood; 6. Agave thicket; 7. Vegetation of insolated limestone crevices

Four local endemics are known from Pan de Guajaibón (Fig. 183), namely *Gesneria brevifolia, Piper perditum, Psidium nummularia* and *Tetrazygia lanceolata.*

Vegetation: Originally seasonal evergreen tropical forests (Figs 184—185) predominated. Most of the native vegetation was replaced by coffee plantations in the second half of the last century, but these fields were abandoned resulting in degraded, secondary forests. Below the peak of Pan de Guajaibón (Fig. 183) developed a small stand of montane rainforest. On the southern slopes and the foothills semi-deciduous forests grow. The mogotes are covered by deciduous shrubwoods, whereas on the sandstone outcrops pinewoods and mixed pine-oak-woods are found. The serpentine areas are covered by microphyllous thorn scrubs.

SUB-PROVINCE B. CENTRAL CUBA (Centro-Cubanicum Fig. 187)

The plains, isolated mountains and hills of central Cuba are included in this sub-province which extends from Bahia Honda and the Rosario Mountains in the west to the Cauto Basin and the central valley of Oriente in the east, reaching the feet of Sagua-Baracoa and Sierra Maestra. This area has been a contiguous land mass since the end of the Pliocene only. Before that period, the terrestrial plants were scattered over the extensive archipelago of limestone mountains and cliffs. The plants of the plain of central Cuba originated primarily from the mountains of Oriente, and also from Pinar del Rio. This view is supported by the fact that the plains are poor in exclusive endemics most of which being local or vicariant

Fig. 184 Seasonal evergreen submontane forest belt in the Sierra del Rosario at 450 m a.s.l. (Photo: A. Borhidi)

Fig. 185 Zanthoxylum martinicense (Lam.) DC. one of the emergent and upper canopy trees of the seasonal evergreen submontane forest, Loma El Salon, Sierra del Rosario (Photo: A. Borhidi)

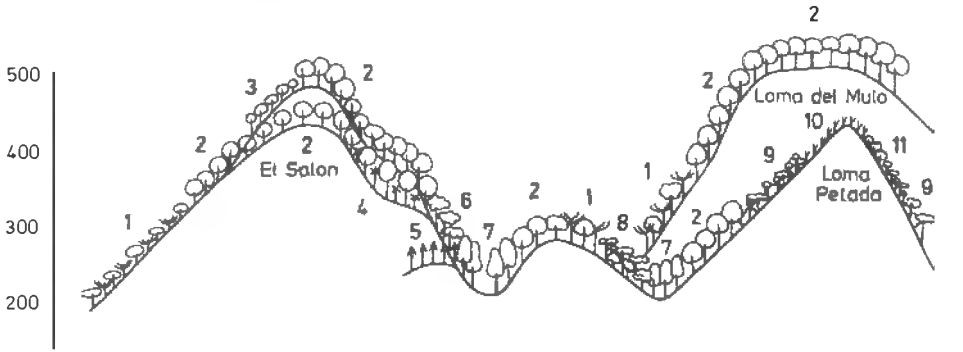


Fig. 186 Vegetation transect of the eastern Sierra del Rosario through the Loma El Salon (Borhidi and Capote) 1. Semi-deciduous forest; 2. Seasonal evergreen forest; 3. Montane evergreen forest; 4. Submontane rainforest; 5. Pine forest; 6. *Syzygium jambos* secondary forest; 7. Riveraine forest; 8. Dry evergreen forest on sandstone; 9. Sclerophyllous serpentine forest; 10. Secondary grassland, 11. Serpentine shrubwood.

endemics. Those distributed all over the area, partly serpentine plants partly coastal elements, are in common with western or eastern Cuba or both nearly without exception. The landscape and the vegetation are characterized by dominant Antillean, Caribbean and Neotropical species that are also found elsewhere. Being most abundant, however, these plants may be considered as the most typical species of the area.

Of the serpentine endemics *Neobracea valenzuelana* (Fig. 117), *Phyllanthus orbicularis* (Fig. 127), *Annona bullata,* of the mesophilous forest species *Ficus subscabrida, F. combsii, Coccoloba retusa, Tabernaemontana amblyocarpa, Espadaea amoena, Casasia calophylla* and *Guettarda calyptrata* are mentioned here.

Pan-Cuban endemics of the dry shrublands and coastal communities are *Belairia mucronata, Oplonia tetrasticha* (Fig. 116), *Randia spinifex, Platygyne hexandra* and *Gastrococos crispa* (Fig. 188).

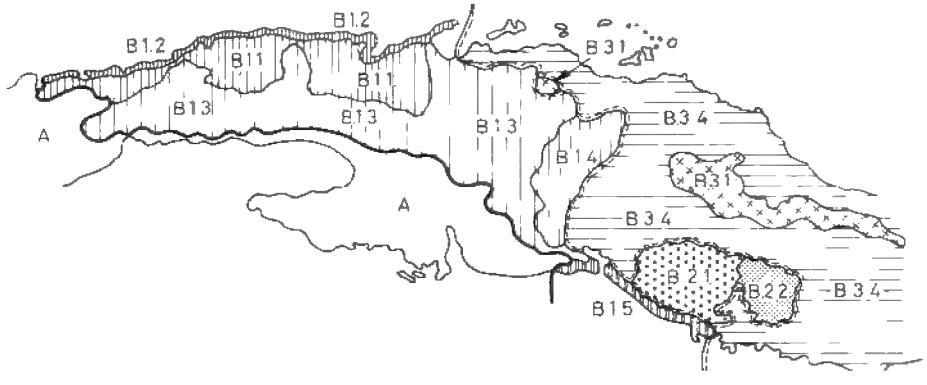


Fig. 187 The phytogeographical subdivision of the western part of the Central Cuban sub-province

B.1. Sector: Western Central Cuba (Havanicum)
B.1.1. District: Jarucoënse B.1.3. District: Güinense
B.1.2. District: Havanense B.1.4. District: Cascajalense
B.1.5. District: Casildense

B.2. Sector: The Guamuhaya Massif of Escambray (Trinidadicum)
B.2.1. District: Trinidadense B.2.2. District: Spirituënse

B.3. Sector: Eastern Central Cuba (Camagüeyicum)
B.3.1. District: Claraënse B.3.2. District: Sagüense

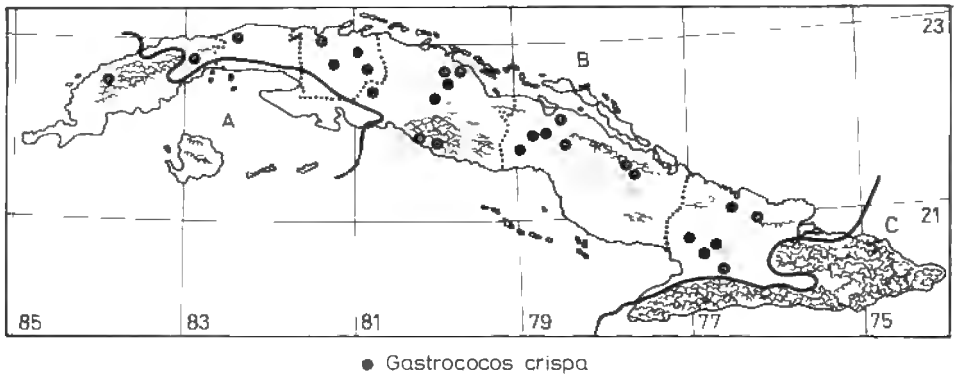


Fig. 188 Geographical distribution of *Gastrococos crispa* (Saakov 1970, modified)

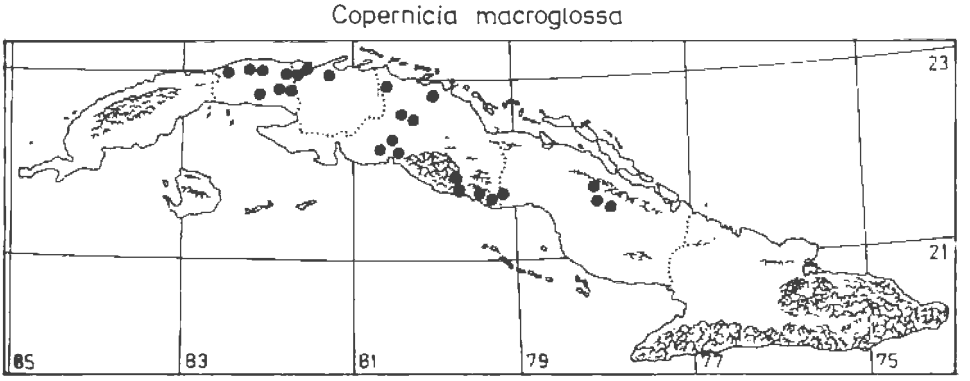


Fig. 189 Geographical distribution of *Copernicia macroglossa* Wendl. ex Becc. (Dahlgren and Glassman 1963, modified by Borhidi and Muñiz)

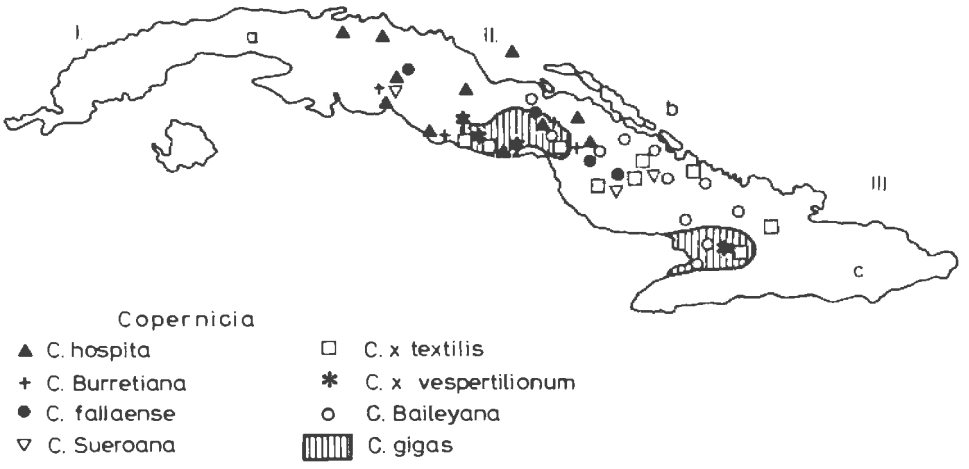


Fig. 190 Geographical distribution of some Central and East Cuban taxa of the genus *Copernicia* (Dahlgren and Glassman 1963, modified)

Further characteristic elements of the landscape are non-endemics, such as *Roystonea regia, Ceiba pentandra, Bucida buceras, Cecropia peltata, Samanea saman, Croton lucidus, Eugenia maleolens,* these are the most common in this area. In addition, species whose dispersal is facilitated by human activity are *Comocladia dentata, Glyricidia sepium, Dichrostachys cinerea* and *Rhynchelytrum roseum.* In the floristic sub-province of Central Cuba 21 endemic Cuban genera occur, seven being confined to this area. Of these *Megalopanax, Euleria* and *Rhodogeron* have a local distribution pattern, and only 4 genera, *Gastrococos, Behaimia, Henleophytum* and *Chaetium,* have been widely distributed all over the area, although the role of the latter in the vegetation is negligible. There are only about 25—30 non-local endemics characterizing this sub-province although their distribution extends a little to the neighbouring areas (e.g., on the southern coast of Oriente).

Examples are *Andropogon multinervosus, Scleria havanensis, Agave legrelliana, Copernicia macroglossa* (Fig. 189), *C. baileyana* (Fig. 190), *Coccothrinax miraguama* p. maj. p. (Fig. 179), *Behaimia cubensis, Piscidia cubensis, Malpighia nummulariifolia, Byrsonima motembensis, Leucocroton moncadae, L. havanensis, Chamaesyce paucipila, Tabebuia lepidota, Cissus torreana, Eugenia camarioca* (Fig. 191), *Rondeletia camarioca, Machaonia subinermis* s. l. (Figs 89, 192), *Plumeria cubensis, P. keyensis, Mesechites minima, Scolosanthus crucifer, Hyptis armillata*, and *Pectis cubensis*, etc. Recently, more than 75% of this area is a managed or cultivated land. Its original vegetation may be reconstructed only from relicts of some fragmental stands. The native vegetation survived in the mountains, on the coast, keys and the less fertile serpentine areas.

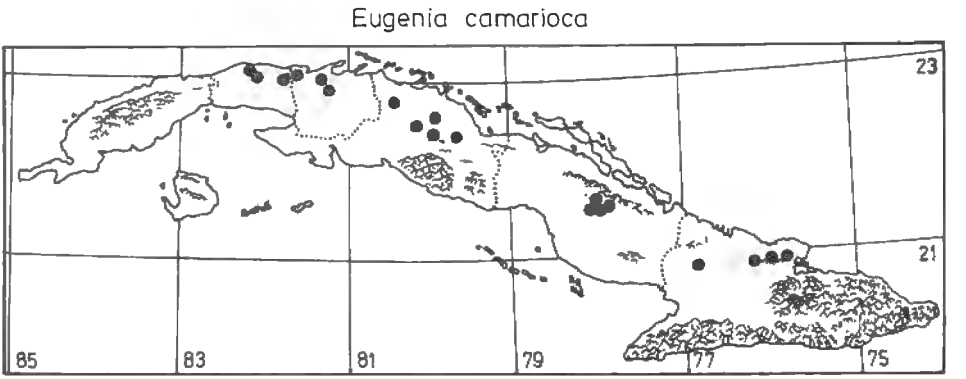


Fig. 191 Geographical distribution of *Eugenia camarioca* Wr. in Sauv. (Klotz 1978, modified)

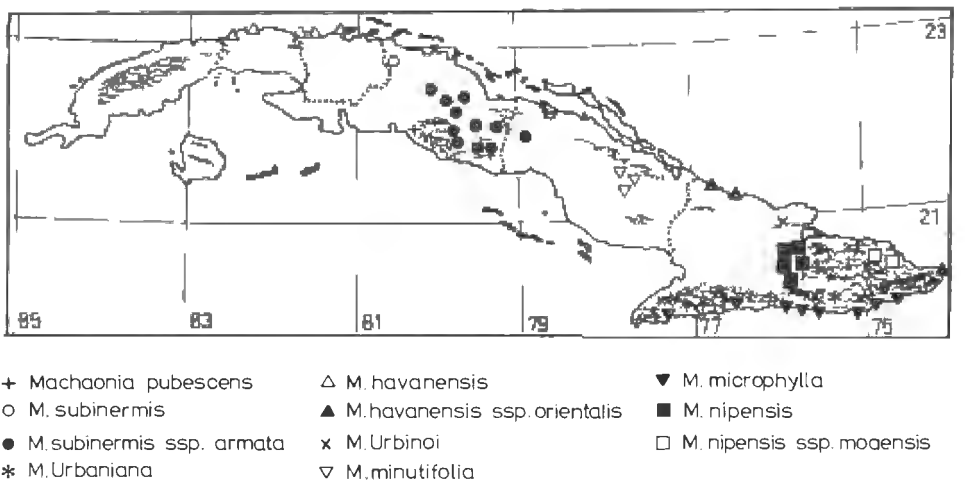


Fig. 192 Geographical distribution of some Central and East Cuban species of the genus *Machaonia* (Fernandez and Borhidi 1984)

Sector B.1. Western Central Cuba (Havanicum) (Fig. 187)

This area ranges from Bahia Honda and Artemisa to Cardenas, Cienfuegos and, on the southern coast, as far as Casilda. Coastal zones with rich flora, mountainous and hilly regions of varied bedrocks and diverse plant communities and flatland with monotonous vegetation are included. The plains have been cultivated for centuries. In addition to the few local endemic species, endemic genera (e.g., *Amphiolanthus, Acunaeanthus, Phania* — and species (*Eriochloa setosa, Coccothrinax litoralis* (Fig. 179), *Zephyranthes rosea, Crinum oliganthum, Bombacopsis cubensis, Coccoloba pallida, Harpalyce cubensis, Phyllanthus discolor, Hyeronima havanensis, Callitriche occidentalis, Comocladia mollifolia, Terminalia intermedia, Eugenia farameoides, Rauvolfia cubana, Cordia angiocarpa, Brunfelsia nitida, Rhytidophyllum wrightianum, Oplonia nannophylla* (Fig. 116), *Machaonia havanensis* (Fig. 192), etc. in common with western Cuba are characteristic.

District B.1.1. Limestone and serpentine areas between Bahia-Honda and Limonar (Jarucoënse) (Fig. 187)

The Las Pozas-Cabanas hilly range at the northern edge of Sierra del Rosario, and Sierra de Anafe, the Habana—Matanzas hills and, south of and parallel to it, the Bejucal-Madruga-Limonar range are included.

Geography: This area, being divided into several smaller hilly ranges by valleys, has a varied geological structure. The mosaic-like intermingling of limestone and serpentine rocks is typical. As a consequence, the soil conditions are also diversified. On the Cretaceous limestone (Habana-Matanzas heights) tropical brown soils predominate, often in the form of their very shallow, rocky variant. On the Jurassic limestone of Anafe Mountains and the Jaruco karst calcareous soils have developed. Red latosolic, nutrient poor soils cover the serpentine outcrops.

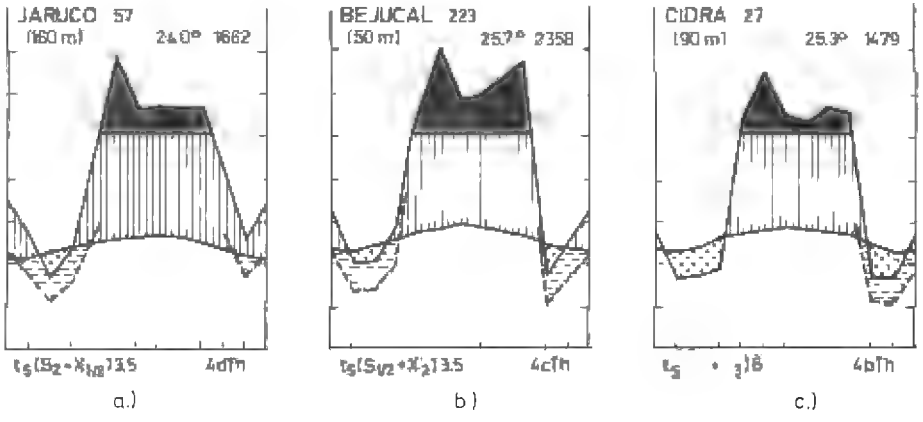


Fig. 193 Characteristic climate types of the Habana-Matanzas ranges (phytogeographical district Jarucoënse) at a) Jaruco, b) Bejucal and c) Cidra

Fig. 194 A rare and threatened cactus species of the serpentine areas of Matanzas Province: the local endemic *Melocactus matanzanus* León (Photo: A. Borhidi)

On the Tertiary, mainly Oligocene, limestone of the Bejucal-Madruga-Coliseo range calcareous, ferrallitic soils of good quality predominate.

Climate: Seasonal, dry in the winter. 3—4 dry months and 1400—1600 mm annual precipitation in the western part of the district, 1—2 dry months and an average precipitation up to 1100—2300 mm to the south–south-east of Havana, and 5—6 dry months and 1400—1800 mm annual precipitation east of Jaruco (Fig. 193).

Flora: Due to the mosaic-like geological and soil structure the number of common endemics is lower than that of the local endemics. For instance, four local endemics occur in the Sierra de Anafe (e.g., *Eugenia anafensis* and *Guapira leonis*). Two vicarious subspecies of *Tabebuia anafensis* occur in the whole limestone range, like *Rhytidophyllum exsertum.* Endemic species of the serpentine of Campo Florido are *Pectis havanensis* and *Psidium havanense.* The richest in endemics is the Canasi serpentine area; *Melocactus matanzanus* (Fig. 194), *Coccothrinax miraguana* ssp. *roseocarpa, Myrtus matanzasia, Moacroton revolutus* (Fig. 130), *Buxus gonoclada, Reynosia microphylla, Bucida ophiticola, Spermacoce matanzasia* occur here. Some of them are also found on the serpentine of Camarioca. There are a number of species in common either with Cajalbana (*Anemia cajalbanica* (Fig. 128), *Ottoschmidtia dorsiventralis, Copernicia curtissii* (Fig. 195), *Harpalyce cubensis*) or with the serpentine areas of Las Villas *(Acacia daemon, Buxus flaviramea).*

Vegetation: Dominant types are semi-deciduous forests in the northern and middle part of the district and dry evergreen forests in the Sierra de Anafe. The species-poor variant of the karstic forests of the Sierra de los Organos predominates on the Jaruco mogotes and other karstic hills, with *Thrinax morrisii* as dominant

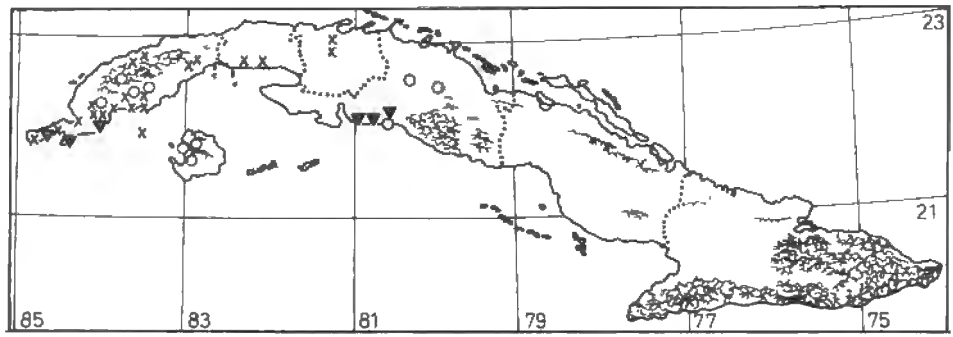


Fig. 195 Geographical distribution of the West Cuban taxa of the genus *Copernicia* (Dahlgren and Glassman 1963, modified)

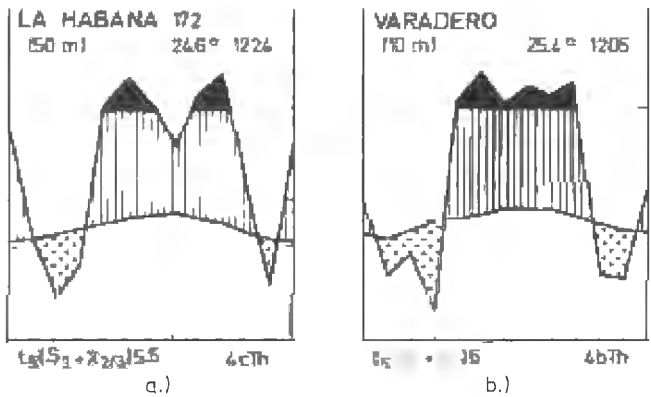


Fig. 196 Characteristic climate types of the phytogeographical district Havanense between Bahia Honda and Varadero at a) Habana and b) Varadero

species. The foothills and the valleys are covered by fragments of semi-deciduous forests and derived savannas of seasonal evergreen forests. Dry evergreen forests grow on the sperpentine areas, whereas at Canasi evergreen shrubwoods with dwarf palms are found.

District B.1.2. Seashore of the Bahia Honda-Hicacos zone (Havanense) (Fig. 187)

Geography: The coast ranging from Bahia-Honda to Varadero consists mainly of Pliocene limestone which is seldom broken by muddy or sandy beaches. Flat karsts and cliffs (Seboruco) are most usual but rocky hills may also be seen. Mainly shallow, rocky, humic-carbonated soils cover the area.

Climate: Seasonal with dry winter, the annual precipitation is 1000—1400 with a

distribution similar to that in the preceding district. The dry season gets longer eastward, reaching a duration up to 5—6 months (Fig. 196).

Flora: The area abounds in drought-tolerant endemic species. *Coccothrinax borhidiana* (Figs 88, 179, 197), *Piper cojimaranum, Gochnatia sagraeana, Croton litoralis,* ssp. *rugelianus, Pilosocereus robinii, Leptocereus wrightii, Eugenia mollifolia, Rhytidophyllum crenulatum, Borrichia cubana, Rondeletia rugelii* and *Guettarda undulata* (Fig. 89) worth mentioning.

Vegetation: Coastal thickets (Fig. 197), dry evergreen forests and shrubwoods, fragments of semi-deciduous forests on the slopes, small stands of mangrove.

District B.1.3. The plain Artemisa-Colón (Güinense) (Fig. 187)

Geography: Gently rolling denuded plain. Fertile, calcareous red ferrallitic soils predominate.

Climate: Seasonal with dry winter. Usually 5—6 dry months, 1200—1800 mm annual precipitation (Fig. 198).

Flora: Monotonous, no local endemics occur. The influence of the human impact of centuries is obvious.

Fig. 197 Dry littoral scrub on the northern limestone coastal belt between Habana and Matanzas, with *Opuntia dillenii* Ker. Gawl. and *Coccothrinax borhidiana* Muñiz (Photo: A. Borhidi)

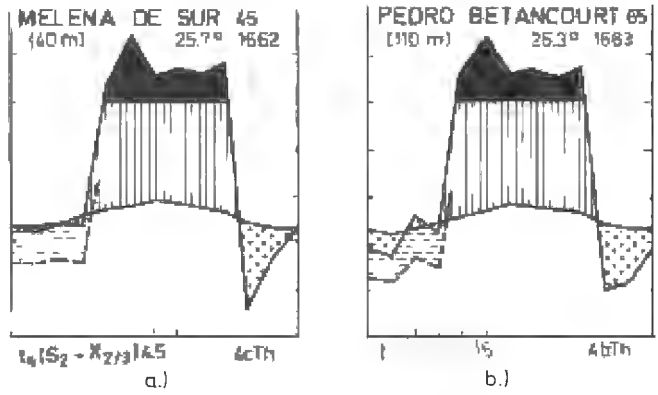


Fig. 198 Characteristic climate types of the fertile lowland area between San Cristóbal and Colón at a) Melena de Sur and b) Pedro Betancourt

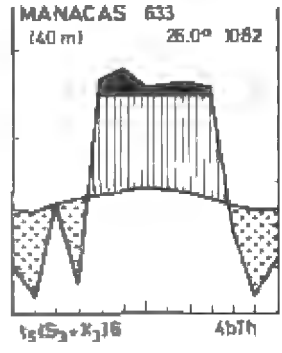


Fig. 199 Characteristic climate type of the mocarrero-area Cascajal-Manacas (phytogeographical district: Cascajalense) at Manacas

Vegetation: Originally, this is the zone of seasonal evergreen and semi-deciduous forests which have been replaced by secondary savannas and agricultural fields. Native vegetation occurs only in the mangrove and gallery forest belt on the seashore.

District B.1.4. Yaguaramas-Cascajal plain (Cascajalense) (Fig. 187)

Geography: On the border of Matanzas and the old Las Villas province this completely flat area lies at an altitude of about 100 m. The soil is mocarrero having an impermeable layer close to the surface.

Climate: Seasonal with 5—6 dry months in the winter. The annual precipitation is 1200—1400 mm (Fig. 199).

Flora: A single endemic monospecific genus *(Rhodogeron coronopifolius)* and nearly 10 endemic species (e.g., *Bucida subinermis, Brunfelsia clarensis, Eriocaulon echinospermum, Lachnocaulon cubense* and three *Cheilophyllum* species) characterize the flora. The eastern limit of the distribution of western "savanna" plants may

be drawn here. Eastward the flora becomes completely different: on the mocarrero soil shrublands and secondary savannas with *Copernicia* palms exist.

Vegetation: Thorny shrublands and savannas with *Sabal* palms on poorly drained hardpan soils. This is one of the largest edaphic savanna areas in Cuba. It may have turned to marshes several times during the Quaternary, and then dried up.

District B.1.5. Coastal area between Cienfuegos–Casilda (Casildense) (Fig. 187)

Geography: This zone begins at Juragua, east of Playa Giron and extends to the Casilda peninsula. Flat karsts consisting mainly of coastal coral limestone alternate occasionally with sand beaches. It is the ecological equivalent of floristic district B.1.2. on the southern coast, with shallow, humic-carbonated soils.

Climate: In the western part seasonal with dry winter of 5—6 months duration. In the east two arid seasons occur and the annual precipitation is 1000—1200 mm (Fig. 200).

Flora: Strongly xerotherm flora containing large succulents, for example, *Dendrocereus nudiflorus, Leptocereus silvestris, Rhodocactus cubensis* and *Pilosocereus brooksianus*. Widespread endemics are *Pavonia calcicola, Acalypha hutchinsoni, Rondeletia pedicellaris, Pectis ritlandi* and *Cassia clarensis*. A local endemic at Cienfuegos *(Acacia polypyrogenes)* and nearly ten further ones at Casilda (e.g., *Cordia intricata, Ipomoea flavopurpurea, Hyptis rivularis, Myrtus crenulata, Chrysophyllum clarense, Casearia formosa, Crossopetalum ekmanii,* etc.).

Vegetation: Rocky and sandy coastal communities, evergreen scrubs on the flat karsts, dry evergreen forests and semi-deciduous forests on deeper soils (Figs 201—202).

Sector B.2. The Guamuhaya Massif of Escambray (Trinidadicum) (Fig. 187)

Isolated mountains above the southern coastal zone of central Cuba, divided into two smaller mountains: the more elevated Trinidad Mountains and the lower Sancti

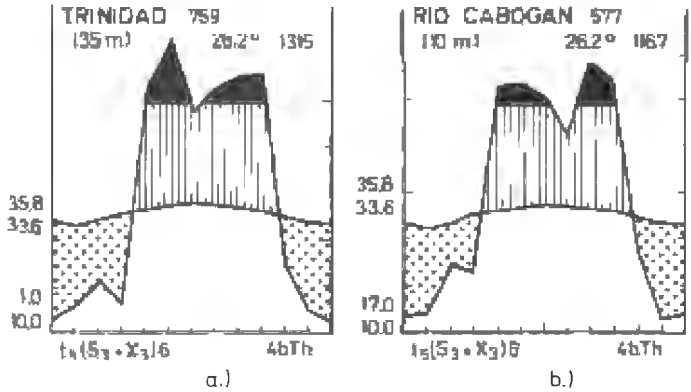


Fig. 200 Characteristic climate type of the phytogeographical district: Casildense at a) Trinidad and b) Rio Cabogan

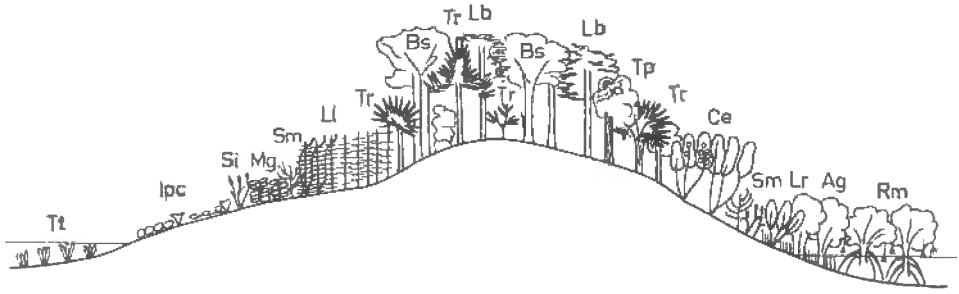


Fig. 201 Vegetation transect of the Casilda Peninsula (Photo: A. Borhidi) Tt=*Thalassia testudinum*, Ipc=*Ipomoea pes-caprae*, Si=*Sporobolus indicus*, Mg=*Mallotonia gnaphaloides*, Sm=*Suriana maritima*, Ll=*Leucaena leucocephala*, Tr=*Thrinax radiata*, Bs=*Bursera simaruba*, Lb=*Lysiloma bahamense*, Tp=*Thespesia populnea*, Ce=*Conocarpus erecta*, Lr=*Laguncularia racemosa*, Ag=*Avicennia germinans*, Rm=*Rhizophora mangle*

Fig. 202 Zonation of the littoral sand vegetation in the Casilda Peninsula at Trinidad. From right to left: *Ipomoea pes-caprae*, *Sesuvium portulacastrum*, *Mallotonia (Tournefortia) gnaphaloides*, *Suriana maritima*, *Coccoloba uvifera* (Photo: A. Borhidi)

Spiritus and Banao Heights. A peculiarity of the flora is its double origin. The montane elements came from the mountains of Oriente, the plants of karsts partly originated from Pinar del Rio. An endemic monospecific genus *(Euleria)* and approximately 20 regional endemics (e.g., *Miconia ancistrophora, M. wilsonii, Pachyanthus lunanus, Rondeletia leonis, R. pedicellaris, Tabebuia Rimaoensis, T. glaucescens, Neobracea howardii* (Fig. 117), *Lunania elongata, three Calyptranthes*

species, *Pithecellobium trinitense, Guettarda urbaniana* and *Gesneria clarensis* ssp. *clarensis)* characterize the area. Noted endemics in common with the mountains of Oriente are *Magnolia cubensis* s.l. (Fig. 203), *Hedyosmum grisebachii* (Fig. 138), *Coccoloba wrightii, Ossaea ottoschmidtii, Clidemia wrightii, C. capituliflora, Meliosma oppositifolia, Ocotea ekmanii,* etc. Also, many Caribbean—Neotropical elements of montane rainforests occur, e.g., *Ocotea cuneata, O. wrightii, Guatteria blainii, Oxandra laurifolia, Garrya fadyeni,* etc. Some elements of the limestone forest communitites of western Cuba reaching this sector eastward are *Tabebuia sauvallei, Sapium leucogynum, Rhytidophyllum wrightianum, Karwinskia rocana, Rondeletia odorata* and *Miconia cubensis.*

District B.2.1. Trinidad Heights (Trinidadense) (Fig. 187)

Geography: Steeply inclined mountains with the highest point at 1156 m and a central plateau at 700 m. The parental rocks are mainly limestone or crystalline slate. Extensive limestone and dolomite karsts in the central and south-eastern part, and a granodiorite zone with scattered serpentine outcrops (San Blas) in the west. Humic carbonated soils on the southern slopes, tropical brown soils on the northern sides, acidic yellowish-red soils in the montane zone.

Climate: Seasonal with dry winter 3—4 months duration up to an altitude about 400 m. One or two dry months up to 700 m and moist rainforest climate further up. The annual precipitation is 1200—2300 mm (Fig. 204).

Flora: In addition to the regional endemics mentioned above, a number of local endemics occur, particularly in the montane rainforests, e.g., *Calyptronoma microcarpa, Pilea clarana, P. cacuminum, Rhytidophyllum lomense, Calyptranthes lomensis,* and *Spaniopappus iodostylus.* The montane karsts of Pico Potrerillo — the contact area of montane rainforests, semi-deciduous forests and karstic forests — are especially rich in local endemics (*Vernonia potrerilloana, Rondeletia*

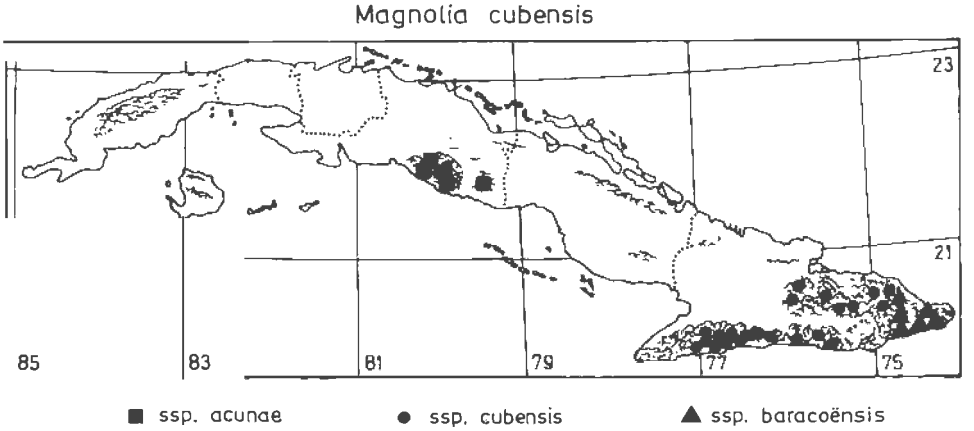


Fig. 203 Geographical distribution of *Magnolia cubensis* Urb. dots: ssp. *cubensis,* squares: ssp. *acunae,* tringles: ssp. *baracoënsis.* (Imchanitskaya 1975, Klotz 1978 and personal observations)

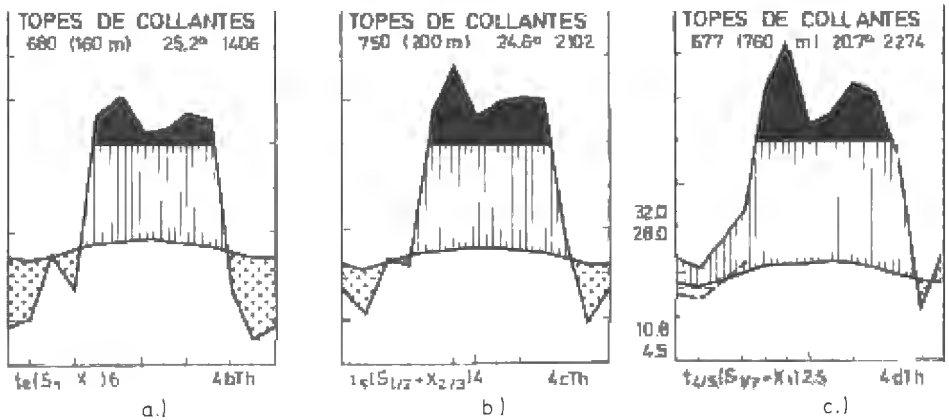


Fig. 204 Characteristic climate types of the Escambray Mountains in the surroundings of Topes de Collantes. (phytogeographical region: Trinidadicum)

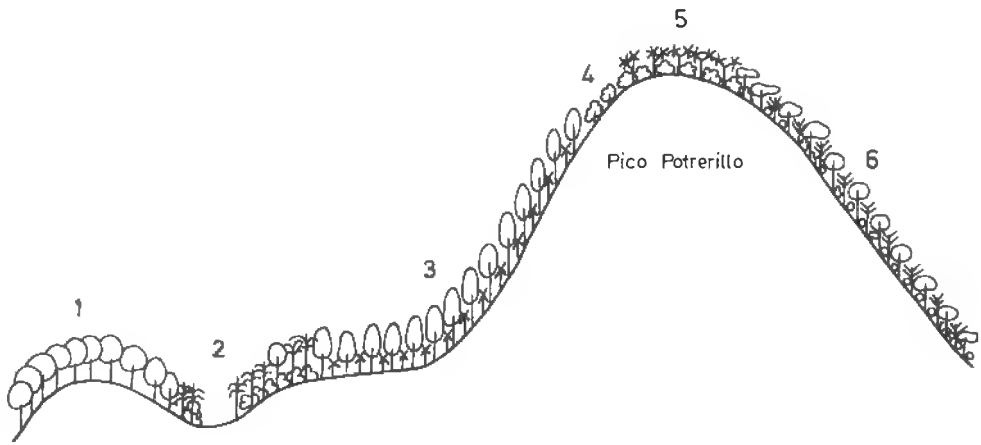


Fig. 205 Vegetation transect of the high mogote: Pico Potrerillo in the Escambray range 1. Submontane evergreen forest; 2. Riverside palm forest "Manacal"; 3. Montane rainforest; 4. Montane evergreen thicket; 5. Montane karstic forest; 6. Semi-deciduous forest

potrerilloana, Karwinskia potrerilloana, Daphnopsis alainii, Banara glaberrima, Psychotria martii, etc.). The Hanabanilla area (*Psidium celastroides, Erigeron capillipes, Cardamine porphyrophylla)* and the karsts (Fig. 156) of Buenos Aires *(Pinguicula jackii)* may also be mentioned. On the dry southern slopes several endemics with point-like geographical distribution occur, for instance, *Machaonia pubescens* (Fig. 192) and *Guettarda nervosa.*

Vegetation: Dry evergreen shrubwoods on the southern slopes up to 200 m, dry evergreen forests up to 550 m. In Pico Potrerillo the semi-deciduous forest (Fig. 205) occurs at the highest altitude in Cuba (900 m). In the interior of the mountains and on the northern slopes the seasonal evergreen forest belt occurs at an elevation

as low as 400 m. At about 800 m the vegetation turns into montane rainforests. In the high parts of the valleys montane rainforests may occur downwards to 5—600 m. Some montane elements may descend along the watercourses even to the plains (e.g., *Calyptronoma dulcis, Didymopanax morototoni* (Fig. 206). In many valleys secondary forests of the introduced *Syzygium jambos* predominate.

District B.2.2. Sancti Spiritus Heights (Spirituënse) (Fig. 187)

Geography: Mountainous area east of the Agabama river, similar to the preceding district in geology, although much fewer karstic formations occur. The highest point is 843 m at the Banao Peak. Humic-carbonated soils predominate.

Climate: Seasonal with dry winter: 3—4, or at the higher altitude 1—2 dry months. The annual precipitation is 1600—1800 mm.

Flora: Due to the drier climate and lower altitude the montane rainforest belt is lacking although some montane elements occur, as *Meriania leucantha* ssp. *nana, Torralbasia cuneifolia.* Yet, this area possesses about ten local endemics, such as *Tetrazygia aurea, Pachyanthus clementis, Rondeletia bicolor, R. convoluta, Hyperbaena acutifolia, Pilea clementis, Dorstenia rocana,* and *Psychotria banaoana.*

Vegetation: Less diverse than the vegetation of the preceding district. Semi-deciduous forests and, at a higher altitude, seasonal evergreen forests represent the dominant types.

Fig. 206 A semi-anthropic giant tree of submontane and montane rainforests: *Didymopanax morototoni (Araliaceae)* (Photo: A. Borhidi)

Sector B.3. Eastern Central Cuba (Camagüeyicum) (Fig. 207)

Mainly young plains formed at the end of the Tertiary and in the Quaternary. Emergent, strongly eroded Cretaceous block mountains (Cubitas, Chorrillo, Jatibonico) and denuded serpentine ridges make the geology of this area more diverse. The limestone flora is originated mainly from the southern slopes of the Baracoa Mountains via the karsts of Sierra Maestra and Sierra de Nipe. The serpentine elements came directly from Nipe and reached the serpentine hills around Holguin. An evidence of this is the recent distribution of three endemic genera in common with Oriente (*Hemithrinax, Doerpfeldia* and *Henoonia*). The colonization of the plains by plants was influenced by the relatively early rise of the northern coast in central Cuba: in the north the Oriente flora migrated to the farthest whereas on the southern coasts the most intensive migration was exhibited by the western elements. This discrepancy is expressed by the well-marked recent boundary of the two sectors.

The descent of plants to the lowlands resulted in a significant change of both the serpentine flora and the xerotherm forest flora. In this regard, the secondary

Fig. 207 The phytogeographical subdivision of the eastern part of the Central Cuban sub-province (Borhidi and Muñiz 1986)

B.2. Sector: Guamuhaya Massif (Trinidadicum)

B.2.1. District: Trinidad Heights (Trinidadense)

B.2.2. District: Sancti Spiritus Heights (Spirituënse)

B.3. Sector: Eastern Central Cuba (Camagüeyicum)

B.3.1. District: Claraënse

B.3.2. District: Camagüeyense

B.3.3. District: Holguinense

B.3.4. District: Sagüense

B.3.5. District: Guaimarense

B.3.6. District: Cautoënse

B.3.7. District: Gibarense

speciation within two young palm genera of high genetic plasticity, *Copernicia* (Figs 89, 93, 195) and *Coccothrinax*, (Fig. 179) was particularly intensive producing several taxa of hybrid origin (*Copernicia* × *textilis*, *C.* × *sueroana*, *C.* × *verpertilionum*, *C.* × *burretiana*, *C.* × *shaferi* (Fig. 190). In addition, *Copernicia gigas*, *C. hospita*, *C. rigida*, *C. yarey*, *C. molineti*, *C. curbeloi*, *Coccothrinax salvatoris* and *C. clarensis* may be mentioned. Typical are the endemic species in common with southern Oriente, e.g., *Doerpfeldia cubensis*, *Henoonia brittonii*, *Eriochloa ekmanii*, *Mimosa fagaracantha*, *Jatropha tupifolia*, *Sarcomphalus acutifolius*, *Croton myricifolius*, *Ravenia clementiana*, *Pictetia marginata*, *Tabebuia trachycarpa*, *Brya chrysogonii*, *Polygala guantanamana* and *Antirhea aristata*.

Sub-sector B.3/a Isolated serpentine areas of Motembo—Holguin (Eu-Camagüeyicum) (Fig. 207)

Four serpentine outcrops of different area 100—200 kilometres apart from one another. The smallest one is Motembo having an area of about 50 km², the others are of 500—800 km² area each. Despite the isolation, the flora is unexpectedly uniform. The presence of Pan-Cuban endemics and the absence of *Anemia coriacea* and the *Moacroton* aggregate (Figs 128 and 130) characterize all areas. Some exclusively local endemics also occur, e.g., *Jacaranda cowellii*, *Zanthoxylum nannophyllum*, *Myrtus anomala*, and *Coccoloba geniculata* (Fig. 131).

Numerous serpentinophilous species occur only in two neighbouring areas. For instance, common endemics of the Las Villas and Camagüey serpentines are: *Croton nephrophyllus*, *C. camagüeyensis*, *C. heteropleurus*, *Daphnopsis oblongifolia*, *Machaonia subinermis* (Figs 89, 192), *Gochnatia cowellii*, *Thymopsis thymoides*. The number of Camagüey—Holguin endemics is much larger, e.g., *Platygyne parvifolia* (Fig. 115), *Jacquinia shaferi*, *Stenandrium crenatum*, *Cordia grisebachii*, *Myrtus cabanasensis*, *Karwinskia orbiculata*, *Ginoria microphylla*, *Polygala ambigua*, *Notodon savannarum*, and *Coccoloba cowellii*.

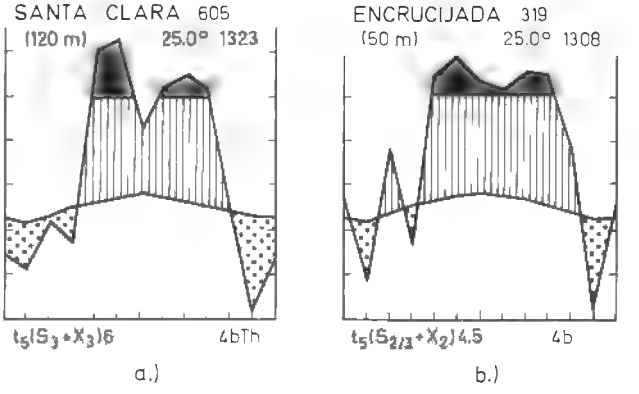


Fig. 208 Characteristic climate types of the serpentine district of the Las Villas province at a) Santa Clara and b) Encrucijada

District B.3.1. The serpentine of Santa Clara (Claraënse) (Fig. 207)

Geography: Hilly serpentine area with emergent ridges, in Sierra de Agabama up to 450 m, with gabbro and limestone outcrops. Red ferrallitic soils, occasionally with pseudoglei character, and brown soils cover the first, humic carbonated soils the second. The isolated serpentine area around Motembo also belongs to this district.

Climate: Seasonal with 5—6 (or 3—4 in the north) dry months in the winter. The annual precipitation is 1100—1600 mm (Fig. 208).

Fig. 209 Thorn scrub woodland on the serpentine of Santa Clara, with *Brya ebenus* auct. cub. *Erythroxylon minutifolium* Griseb. and *Agave brittoniana* Trel. (Photo: A. Borhidi)

Flora: In addition to those mentioned above, about 15 local endemics occur. For example, *Eugenia clarensis, E. subdisticha, Guettarda clarensis, G. roigiana, Xylosma acunae, Karwinskia oblongifolia, Hypericum ophiticola, Xylosma claraënse, Melocactus actinacanthus, Dorstenia lanei, Harpalyce macrocarpa.* To the Motembo area *Paspalum edmondi, P. motemboënse, Cheilophyllum sphaerocarpum* and *Scleria motemboënsis* are endemic.

Vegetation: Dry evergreen thorny shrublands (Figs 209—210). Evergreen shrubwoods and forests on the brown soils. In many places forests and shrubwoods are replaced by secondary dwarf grass savannas and secondary *Brya* and *Dichrostachys* scrubs.

District B.3.2. The serpentine of northern Camagüey (Camagüeyense) (Fig. 207)

Geography: Low, gently rolling flatland. Different allite-ferritic soils derived from serpentine, magnesium humic-carbonate soils, in the northwest ferritic latosols. Here and there granite, porphyrite and diorite intrusions occur.

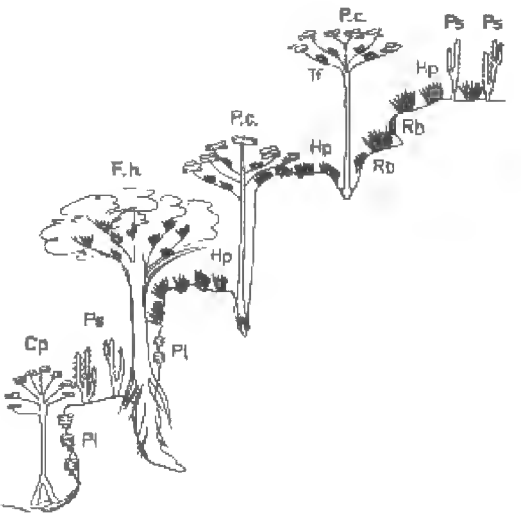


Fig. 210 Transect of the chasmophytic vegetation of Cerro Pelo Malo on isolated limestone rock. (Borhidi and Muñiz) Cp=*Cecropia peltata*, Pl=*Philodendron lacerum*, Ps=*Pilosocereus* sp. Fh=*Ficus havanensis*, Hp=*Hohenbergia penduliflora*, Pc=*Plumeria cubensis*, Rb=*Rhipsalis baccifer*

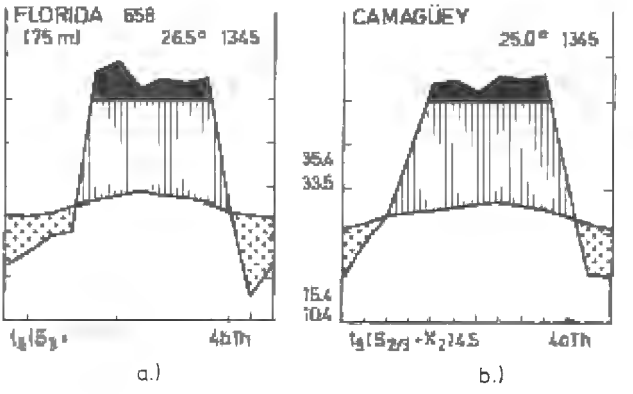


Fig. 211 Characteristic climate types of the serpentine area of the Camagüey Province at a) east of Florida and at b) Camagüey

Fig. 212 Coccothrinax camagüeyana Borhidi and Muñiz, a recently discovered endemic palm of the serpentine areas of Camagüey province (Photo: A. Borhidi)

Fig. 213 Coccothrinax pseudorigida León, a dwarf serpentine palm, endemic to Camagüey (Photo: A. Borhidi)

Climate: Seasonal with dry winter of 5—6 months duration and 1200—1400 mm annual precipitation (Fig. 211).

Flora: In addition to the common serpentinophilous endemics listed above, this district has 15 local endemic species. In particular, the palms (*Copernicia cowellii, Coccothrinax camagüeyana* (Fig. 212), *C. pseudorigida* (Fig. 213) are famous. Further endemics are *Reynosia camagüeyensis, Randia acunae, Waltheria ovalifolia, Eugenia shaferi, E. malanadenia* ssp. *santayana, Cameraria microphylla, Nashia varifolia, Cheilophyllum macranthum, Justicia stenophylla, Guettarda camagüeyensis,* and *Wedelia urbanii.*

Vegetation: The primary vegetation of this district is evergreen thorny shrub-woods with dwarf palms and shrublands with small grassy clearings. The latter type became gradually predominant due to burning and grazing. The formerly widespread views that the "serpentine savannas" are original is not supported by the comparative taxonomic-phytogeographic-phytosociologic studies of the author (see Borhidi and Herrera 1977, Borhidi 1973, 1974, 1976).

District B.3.3. The serpentine of Holguin (Holguinense) (Fig. 207)

Geography: A diversified hilly landscape with wide ridges and inclined conical serpentine hills (Fig. 214) with isolated limestone terraces and cliffs. On the SW and NE border of the area there are red allitic-ferritic soils. Elsewhere tropical brown soils derived from serpentine predominate.

Fig. 214 Cerro de Fraile, a conical serpentine hill above Holguin covered by secondary grasslands and original sclerophyllous evergreen scrub (Photo: A. Borhidi)

Climate: Seasonal with two dry seasons. 5—6 dry months, 800—1200 mm annual precipitation (Fig. 215)

Flora: Rich in endemics. The flora, especially in Cerro Galano, is closely related to that of Sierra de Nipe and Sierra del Cristal with several endemics in common, for example, *Spirotecoma holguinensis, Piper holguinianum, Ateramnus revolutus, Moacroton lanceolatus* (Fig. 130), *Jacquinia robusta, Brya hirsuta, Leucocroton*

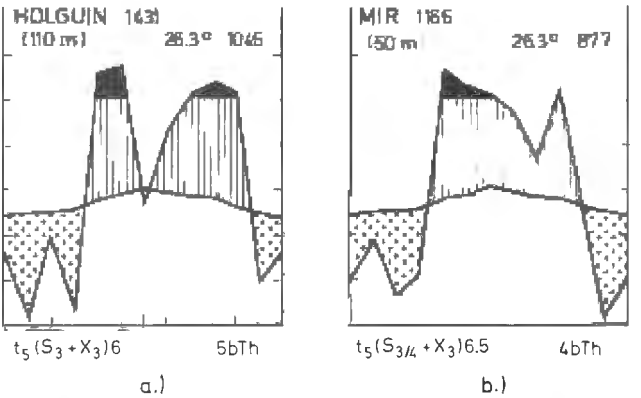


Fig. 215 Characteristic climate types of the phytogeographical district Holguinense at a) Holguin and b) Mir

Fig. 216 Euphorbia podocarpifolia Urb. a common endemic shrub of the serpentine scrubs of the Nipe and Cristal ranges and the serpentine area of Holguin (Photo: A. Borhidi)

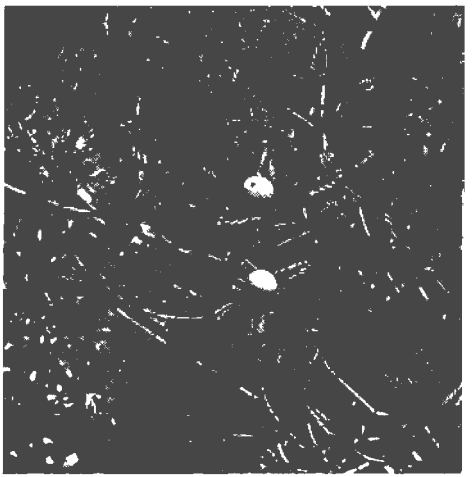


Fig. 217 Guettarda shaferi Standl. a common shrub of the dry evergreen serpentine scrubs of North-Oriente (Photo: A. Borhidi)

saxicola, Salacia nipensis, Antirhea ophiticola, Euphorbia podocarpifolia (Fig. 216), *Antirhea minutifolia, Coccoloba nipensis, Guettarda shaferi* (Fig. 217). Approximately 20 local endemics have been indicated, e.g., *Agave anomala, Coccothrinax garciana, Acacia belairioides, Pithecellobium savannarum, Caesalpinia hermeliae, Acidocroton trichophyllus, Chamaesyce filicaulis, Buxus heterophylla, Neobesseya cubensis, Justicia tomentulosa, Rondeletia savannarum, R. shaferi, Gochnatia parvifolia, Cassia holguinensis, Croton acunae, C. holguinensis, Melocactus holguinensis, Machaonia urbinoi* (Fig. 192). *Oplonia multigemma* (Fig. 116).

Vegetation: The conical serpentine mountains, the rocky ridges and the plains were formerly covered by thorny sclerophyllous evergreen shrubwoods containing dwarf palms. These have been replaced by secondary savannas with short grasses and palms. The microphyllous semi-deciduous forests in the valleys were cleared and then turned to agricultural lands.

Sub-sector B.3/b The lowlands, limestone hills, south-coastal zones and keys of eastern Central Cuba (Guaimaricum) (Fig. 207)

Mainly farmland with unvaried vegetation. The points made in B.1. and B.3. are relevant here, too. The flora is characterized by relatively few endemics, in particular, *Copernicia hospita, C. gigas, C. vespertilionum, C.* × *textilis, C.* × *sueroana, C. baileyana* (Fig. 190) and *Hildegardia cubensis* (reaching to the northern coasts and keys too and the xerotherm endemics in common with the southern arid zone of Oriente. Its phytogeographic division is based primarily on the characteristics of lands because the phytogeographical boundaries have been obscured as a result of human impact. Many important elements of the Neotropical xerotherm flora, such as *Phyllostylon brasiliense* and *Prosopis juliflora* have reached this sub-sector from the east.

District B.3.4. The hilly and flat areas and the northern coastal zone in Las Villas (Sagüense) (Fig. 207)

Geography: Diversified landscape. The coastal zone is covered by peaty and meadow soils developed on Quaternary sediments. On the Jurassic limestone of the north-western heights and the Cretaceous limestone of the north-eastern heights (including Sierra de Jatibonico) there are humic-carbonated soils. In the valleys ferrallitic soils are predominant. In the lowlands and hills of the west and south-west the tropical brown soils derived from young Tertiary sediments cover extensive areas.

Climate: Seasonal bixeric with two dry season (3—4 dry months) on the northern coast. Elsewhere monoxeric seasonal with dry winter (5—6 dry months). At the north-eastern heights only 3—4 dry months. Annual precipitation is 1200—1600 mm on the average (Figs 218, 219).

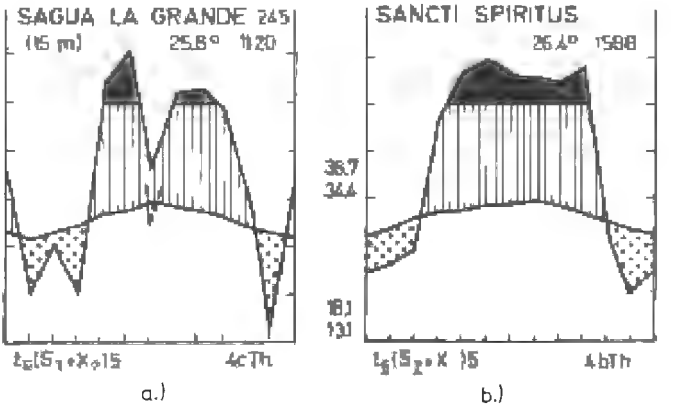


Fig. 218 Characteristic climate type of the Central Cuban lowland areas (phytogeographical district Sagüense) at a) Sagua la Grande and b) Sancti Spiritus

Flora: It is characterized by the forest elements of limestone rocks, these are in fact typical of the whole country. The Caguaguas mogotes at Sagua la Grande possess a special flora, including the representatives of two rare endemic genera, (*Thrinax ekmaniana* (Fig. 114), *Megalopanax rex*). Endemic palms of the savannas are *Copernicia burretiana, C.* × *textilis, C. molineti* (Fig. 190), *Caesalpinia savannarum* and *C. glaucophylla* are also endemic species of the savannas.

Vegetation: The coastal zone is lined with a broad mangrove belt. On the meadow soils moist and treeless secondary savannas predominate taking the place of the former woodlands. In the hills some fragments of semi-deciduous forests represent the natural climax vegetation. Most part of this area is agricultural land, all the tropical brown and red ferrallitic soils are utilized for agricultural purposes. On the mocarrero soils in the south-east semi-anthropogenic savannas with *Copernicia* palms occur, probably in the place of microphyllous semi-deciduous forests.

District B.3.5. The Ciego de Avila-Alto Cedro-La Maya Plains (Guaimarense) (Fig. 207)

The central and southern parts of Camagüey and the western lowlands in Oriente, except the northern coastal zone and the low Cauto Basin are included.

Geography: Mainly denuded plains with a gentle inclination towards the southern coast. Along the shore a wide swamp belt occurs. In western Camagüey, on the plain of Ciego de Avila-Morón, mainly calcareous and fertile red ferrallitic soils are found. On the Camagüey-Tunas-Holguin denuded plains in the interior of the island except the area of districts B.3.3—B.3.4. tropical brown soils predominate. The karstic limestone mountains (Sierra de Najasa) are covered with humic-carbonated soils. In the lowlands parallel to the coast alluvial soils are the most common. Tropical brown soils with mocarrero mosaics are also found here. The only sandy area of Central Cuba is located south of Victoria de las Tunas with a peculiar flora and fauna.

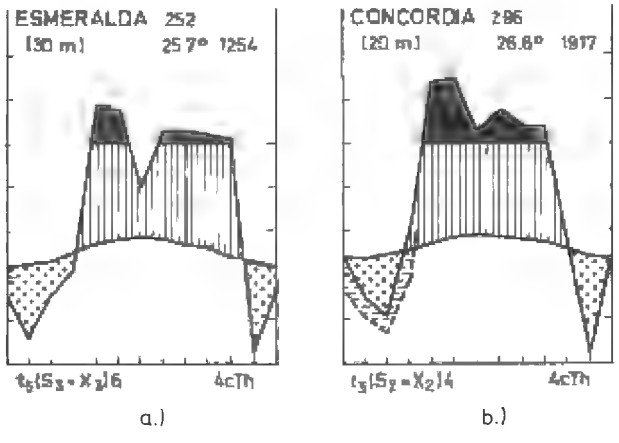


Fig. 219 Characteristic climate types of the East Cuban lowland areas (phytogeographical district Guaimarense at a) Esmeralda and b) Concordia

Climate: Seasonal tropical which is dry in the winter; 5—6 dry months occur per year. In southern Camagüey a more humid climate persists with 3—4 dry months in the winter. East of Holguin and in the northern foothills of Sierra Maestra there are two dry seasons of 5—6 months duration. The annual precipitation is 1800 mm in the west and gradually decreases eastward to a level of 800 mm/year (Fig. 219).

Flora: Similar to that of the preceding district. Strongly affected by human impact and quite uniform. Some local endemics occurring in certain places, e.g., *Cleome tenuifolia* (Galbis), *Caesalpinia hornei* (Ciego de Avila), *Rondeletia gamboana, Catesbaea gamboana, Cleome gamboensis* (Gamboa). *Copernicia longiglossa* is found on the sands at Victoria de las Tunas and also at Dumañuecos (!). At the edge of the Cauto valley *Ateleia parvifoliola* (Mir), *Crotalaria urbaniana* and *Bergia*

sessiliflora (Bayamo), *Coccothrinax savannarum* and *C. pauciflora* (Miranda) occur.

Vegetation: The natural vegetation of the ferrallitic soils on the central Cuban denuded plains are seasonal evergreen forests, semi-deciduous forests and gallery forests along the rivers on alluvial soils and black tropical soils. In the brown soil zone of the Camagüey—Tunas—Holguin plains extensive semi-deciduous forests with *Swietenia mahagoni* were found even at the turn of this century. This species is still present as a standard tree in the recent deciduous tree-savannas. On sand and mocarrero microphyllous semi-deciduous forests with *Copernicia* palms, remnants of open forests with loose canopy layer (forêt claire) and their derived savannas are found. The shoreline is covered by broad mangrove vegetation. On the rocks of Sierra de Najasa the eastern versions of karstic forests occur in which *Coccothrinax* palms and columnar cacti are typical.

District B.3.6. The Cauto Basin (Cautoënse) (Fig. 207)

Geography: The alluvial area and the delta of Rió Cauto are among the youngest areas on the surface of Cuba. The delta is covered by peaty soils containing brackish water. On the alluvium tropical black soils and alluvial soils are found. These tend to become alkaline soils in some places.

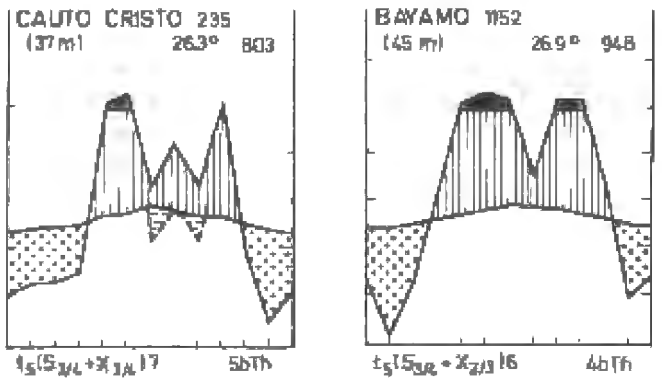


Fig. 220 Characteristic climate types of the Cauto valley (phytogeographical district Cautoënse) at a) Cauto Cristo and b) Bayamo

Climate: Seasonal with dry winter in the west. Two dry seasons in the eastern part of the area with a total of 5—6 dry months. The annual precipitation is about 700—1200 mm (Fig. 220).

Flora: Impoverished through human influence, monotonous, species poor. *Chamaesyce biramensis* is an endemic of the marshes in the delta area.

Vegetation: Only a few degraded stands of the extensive rainforest-like gallery forests remained. The natural vegetation is replaced by treeless marshy meadows and moist savannas. As a result of deforestation, erosion is intensive.

District B.3.7. Littoral terraces and islands of the northern coastal area; the Cayo Frances-Turiguano-Cebolla zone (Gibarense) (Fig. 207)

Geography: The flat coastal area and the archipelago are composed of young Tertiary and Quaternary limestone sediments and subfossil peat layers. There are also some small limestone outcrops (Turiguano, Cayo Romano). For phytogeographic reasons, the higher limestone hills and karstic mountains, Loma Cunagua, the upper Cretaceous-Eocene blocks of the Sierra de Cubitas and the limestone mountains of the Mariabón group at Gibara and Banes are also assigned to this district. Salt marshes and flat karsts covered by shallow humic-carbonated soils alternate in this area. Occasionally, smaller serpentine, gabbro and diabase outcrops increase the geological variability (Puerto Padre, Bahia de Naranjo). The hills and mountains are covered by tropical brown soils and brown carbonated soils. In the valleys of Sierra de Cubitas red ferrallitic soils occur.

Climate: Seasonal bixeric climate with two dry seasons. In general, 5—6 dry months occur, 7—8 in the islands and only 3—4 in the east at Banes. The annual precipitation is 700—1100 mm on the average. The precipitation is very low in the Puerto Padre-Gibara area where climate is similar to that of South Oriente and sometimes years of extreme drought may also occur (Fig. 221).

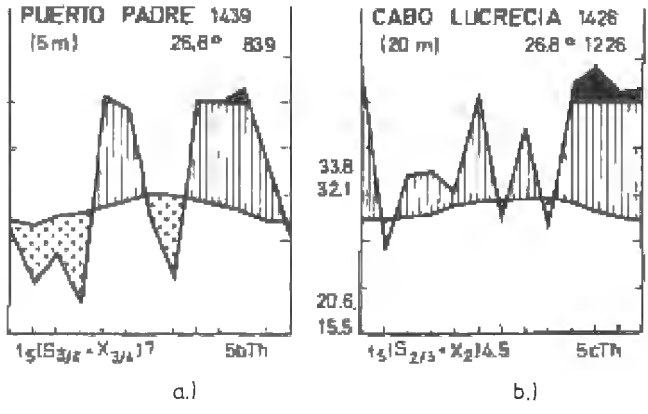


Fig. 221 Characteristic climate type of the north-east coastal zone of CENTRAL Cuba (phytogeographical district Gibarense) at a) Puerto Padre and b) Cabo Lucrecia

Flora: Local xerotherm endemics. The close relationship to the flora of Bahamas is indicated by many species shared by the two regions, e.g., *Guapira bracei, Pithecellobium millspaughii, Eugenia lucayana, Cordia bahamensis, Auerodendron northropianum* and *Phialanthus myrtilloides.* Relatively few indigenous species are typical of the whole district, for example, *Coccothrinax salvatoris, Trichilia pungens* (Fig. 222), *Sarcomphalus obovatus.* In contrast many local endemics are found in the islands and peninsulas e. g., *Chamaesyce paredonensis, Heliotropium myriophyllum* (Cayo Paredon Grande), *Selenicereus brevispinus, Nashia cayensis, Isocarpha glabrata, Notodon cayensis (Cayo Guayaba), Crescentia*

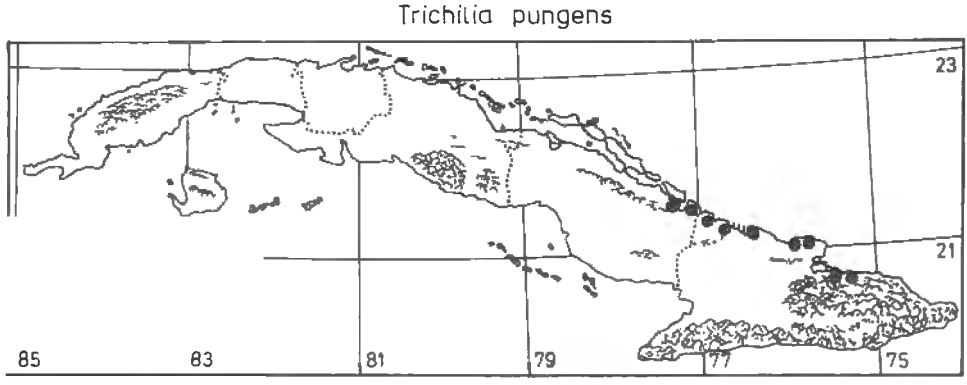


Fig. 222 Geographical distribution of *Trichilia pungens* Urb.

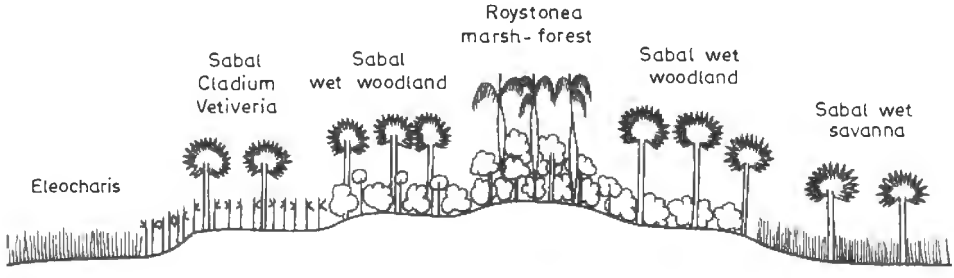


Fig. 223 Vegetation transect of the swamp of Laguna de Leche, north of Morón (Borhidi and Muñiz)

mirabilis (Cayo Sabinal). *Guettarda lanuginosa* and *Argythamnia microphylla* are in common with Sierra de Cubitas and the coast. *Coccothrinax muricata* in an endemic palm species of the Cubitas and Najasa mountains. A local endemic of Sierra de Cubitas is *Guettarda munizii*. *Copernicia oxycalyx* occurs in the savannas of Manati. The Puerto Padre-Playa Herradura area is the richest in endemics, e.g., *Ximenia roigii, Acacia cupeyensis, A. curbeloi, A. roigii, Zanthoxylum curbeloi, Banara wilsoni, Tabebuia truncata, Xylosma roigii, Randia costata, Baccharis orientalis* ssp. *orientalis, Galactia rotundata* and *Casasia clusiifolia* var. *hirsuta* are endemic to Gibara and surroundings, whereas *Pictetia arborescens* is endemic to Playa Pesquero Nuevo. *Eugenia pteroclada* is an endemic species of Banes. In the very dry coastal area between Puerto Padre and Banes some elements of the southern Oriente semi-desert zone also occur, for instance, *Ritterocereus hystrix, Bonania microphylla, Amyris diatrypa, Samyda ramosissima, Cordia curbeloi, Eupatorium littorale, Thouinia pseudopunctata, Pseudocarpidium avicennioides, Oplonia polyece*, and *Doerpfeldia cubensis*.

Vegetation: Besides the extensive mangroves and swamps north of Morón (Fig. 223), the most attractive types are the dry evergreen forests and the xerotherm evergreen scrubs of flat karsts. The former gallery forests grown on alluvial soils have been replaced by secondary savannas. The natural vegetation on brown soils is

the semi-deciduous forest as seen in Loma Cunagua and the valleys of Sierra de Cubitas. The eastern Cuban karstic mogotes with *Coccothrinax* palms have been even less intensively studied.

SUB-PROVINCE C. EASTERN CUBA (Oriento-Cubanicum) (Fig. 224)

This phytogeographic unit includes two big massifs in Oriente, the Sierra Maestra and the Nipe-Baracoa range, the basin in between and the adjacent coastal lowlands. This area is considered to be the cradle of the Cuban flora and, together with western Hispaniola, the most prominent centre of speciation in the Antilles. In addition to the 13 Pan-Cuban and 5 central-eastern Cuban endemic genera, there are 24 genera and more than 1500 species exclusively endemic to this sub-province. Approximately 1950 endemic taxa, including western and Pan-Cuban elements, occur in this area of about 18 000 km². The close relationship to Hispaniola is indicated by ten other endemic genera (*Plethadenia, Spirotecoma, Bellonia, Barleriola, Picardaea, Isidorea, Margaritopsis, Peratanthe, Fuertesiella,* and *Victorinia*) and 103 species present on both islands. Furthermore, this sub-province is

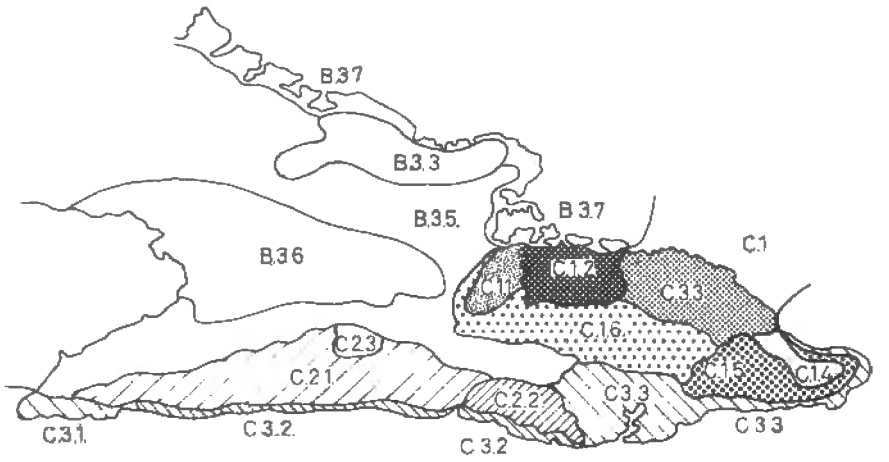


Fig. 224 The geographical subdivision of the east Cuban sub-province (Borhidi and Muñiz 1986)

C.1. Sector: Nipe-Baracoa Massif (Moanicum)

C.1.1. District: Sierra de Nipe (Nipense)
C.1.2. District: Sierras del Cristal and Micara (Cristalense)
C.1.3. District: Sierras de Moa and Toa (Moaënse)
C.1.4. District: Serpentines of Baracoa and Jauco (Baracoënse)
C.1.5. District: Purialense
C.1.6. District: Yaterense

C.2. Sector: Sierra Maestra (Maestricum)

C.2.1. District: Western and central Maestra (Turquinense)
C.2.2. District: Eastern Sierra Maestra (Piedraënse)
C.2.3. District: Mogotes of the Maestra (Bairense)

C.3. Sector: South-eastern coasts (Santiagicum)

C.3.1. District: Pilonense
C.3.2. District: Uveroënse
C.3.3. District: Guantanamense

the evolutionary centre of 22 Caribbean genera, such as *Roystonea, Spathelia, Leucocroton, Bonania, Reynosia, Auerodendron, Neobracea, Pseudocarpidium, Gesneria, Rhytidophyllum* and *Acrosynanthus,* and the largest or one of the largest evolutionary centres for additional 32 Neotropical and Pantropical flowering plant genera, e.g., *Coccothrinax, Lepanthes, Metopium, Buxus, Purdiaea, Calyptranthes, Pimenta, Eugenia, Pachyanthus, Ossaea, Lyonia, Tabebuia, Dorstenia, Coccoloba, Schoepfia, Pilea* (shared with Hispaniola), *Harpalyce, Amyris, Rondeletia* and *Gochnatia.* It may be concluded from this list that this area is in fact one of the richest gene reserves of the world. Its exploration, however, is by no means complete.

Two humid mountainous areas (Sierra Maestra and Nipe-Baracoa) and an arid coastal plain is included in this phytogeographical category. The mountains have three endemic genera (*Synapsis, Zonanthus, Triscenia)* and more than 325 endemic species, mainly orchids (e.g., *Pleurothallis, Lepanthes, Epidendrum, Maxillaria species*). Furthermore, many species of *Lyonia, Coccoloba, Clusia, Pilea, Peperomia, Ossaea, Miconia, Calycogonium, Eupatorium* and *Vernonia;* and several montane species, such as *Clathra cubensis, Magnolia cubensis* (Fig. 203), *Purdiaea nipensis, Euphorbia, helenae, Calyptronoma clementis, Talauma minor* (Fig. 225), *Myrica punctata, M. shaferi, Cleyera nimanimae, Guatteria moralesi, Illicium cubense, Laplacea ekmanii, L. wrightii, Dalbergia cubensis* and *Bumelia jubilla* may be mentioned. Contrarywise, the arid coastal plain has many species in common primarily with the limestone karsts of mountains, e.g., *Hyperbaena cubensis, Calliandra orientalis, C. colletioides, Alvaradoa arborescens, Bursera glauca, Stigmaphyllon lineare, S. sericeum, Plumeria lanata* (Fig. 226), *P. stenophylla, Rocherfortia stellata, Tabebuia arenicola, T. hypoleuca, T. libanensis,*

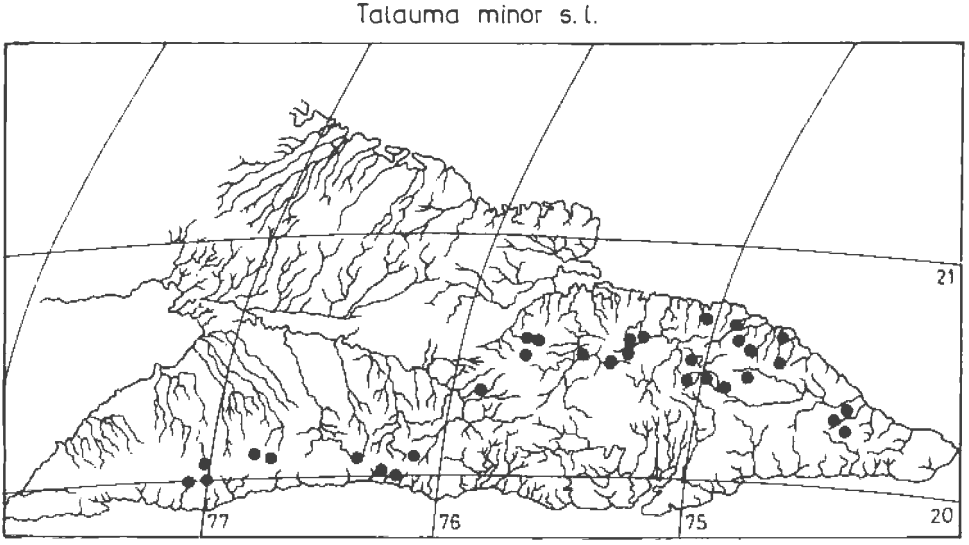


Fig. 225 Geographical distribution of *Talauma minor* Urb. (after Imchanitskaya 1975 and personal observations)

Fig. 226 Plumeria lanata Britt., a little deciduous pachycaul tree of the dry thorn scrub vegetation of south-east Oriente (Photo: A. Borhidi)

Fig. 227 A living fossil monocot of the flora of Cuba: *Dracaena cubensis* M. Vict. endemic to Moa and Baracoa (Photo: A. Borhidi)

T. simplicifolia, Gesneria gibberosa, Rhytidophyllum intermedium, Agave underwoodiana, Rondeletia lomensis, R. baracoënsis, Eupatorium (Grisebachianthus) carsticola, Aristida laevigata, A. pradana, Rajania baracoënsis, Pitcairnia cubensis, Aristolochia lindeniana, Coccothrinax gundlachii and *Gochnatia maisiana.* Particular attention should be paid to two isolated ancient relicts of this area, namely *Dracaena cubensis* (Fig. 227) which has its closest relatives in the Canaries and Honduras, and *Cneorum trimerum* (Fig. 125), the only Neotropical species of the Cneoraceae which includes merely 3 species, the other two being native to the Canaries and the European Mediterranean.

Sector C.1. The Nipe-Baracoa Massif (Moanicum) (Fig. 224)

Extensive serpentine ranges and large, bordering limestone karsts. The flora development of this area has been continuous since the upper Eocene. This region is characterized by high relief energy and diversified edaphic, macro- and microclimatic conditions. The richest flora of the Caribbean, and one of the richest floras of the World is found here and this area is also the most significant evolutionary centre of the Cuban flora and a starting point for the dispersal of species groups with different ecological requirements (serpentinophilous, montane and karstic elements). Eighteen endemic genera occur, five confined to this sector, namely *Tetralix, Phidiasia* (Fig. 228), *Schmidtottia* (16 species!), *Ariadne* and *Ekmanochloa.* The majority of species belonging to highly polymorphic genera, such as *Podocarpus, Gochnatia, Vernonia, Guettarda, Rondeletia, Purdiaea, Phyllanthus, Moacroton* (Fig. 130), *Coccoloba, Casearia, Spathelia* (Fig. 109), *Siphocampylus* and *Thrinax* (Fig. 114), etc., have a limited geographical range restricted to this sector. The number of regional endemic species is about 200.

However, if the local endemics are also considered this number reaches 725. Some typical species are *Podocarpus ekmanii, Pinus cubensis (Fig. 229), Dracaena cubensis* (Fig. 227), *Guettarda ferruginea, Phyllanthus myrtilloides, Cyrilla cubensis, Rauvolfia salicifolia* and *Clerodendron nipense, Bactris cubensis* (Fig. 230)

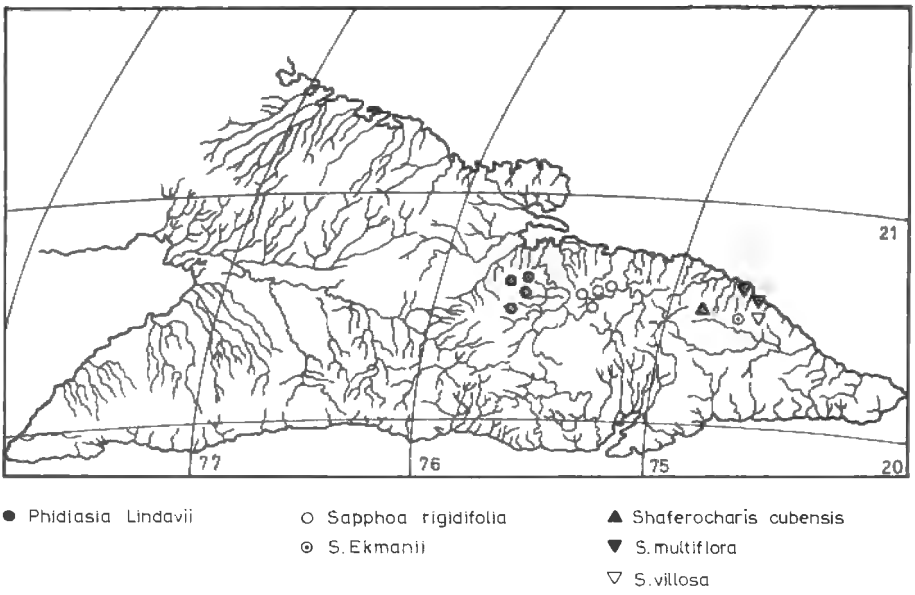


Fig. 228 Geographical distribution of the endemic genera *Phidiasia, Sapphoa* and *Shaferocharis* (Borhidi 1981, modified 1986)

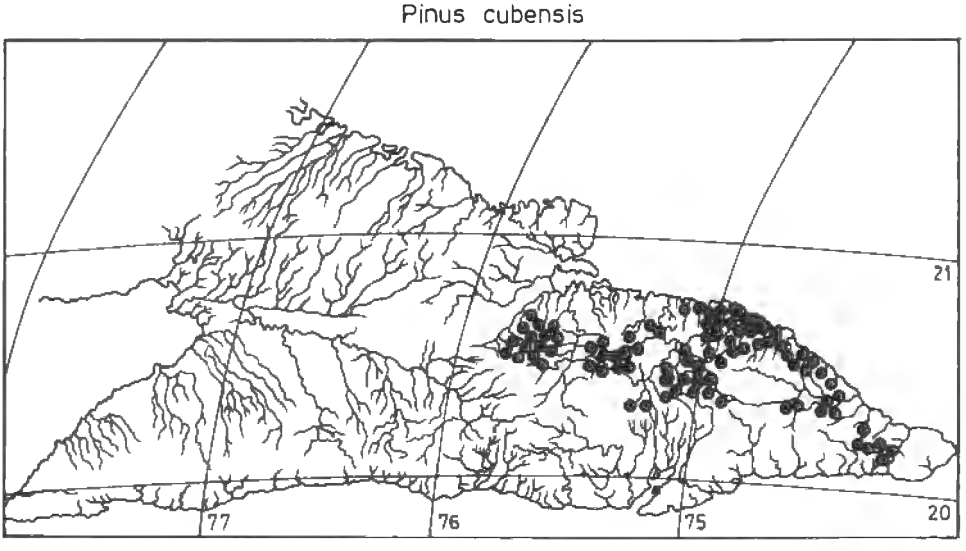


Fig. 229 Geographical distribution of *Pinus cubensis* Griseb. (Bisse 1957, modified)

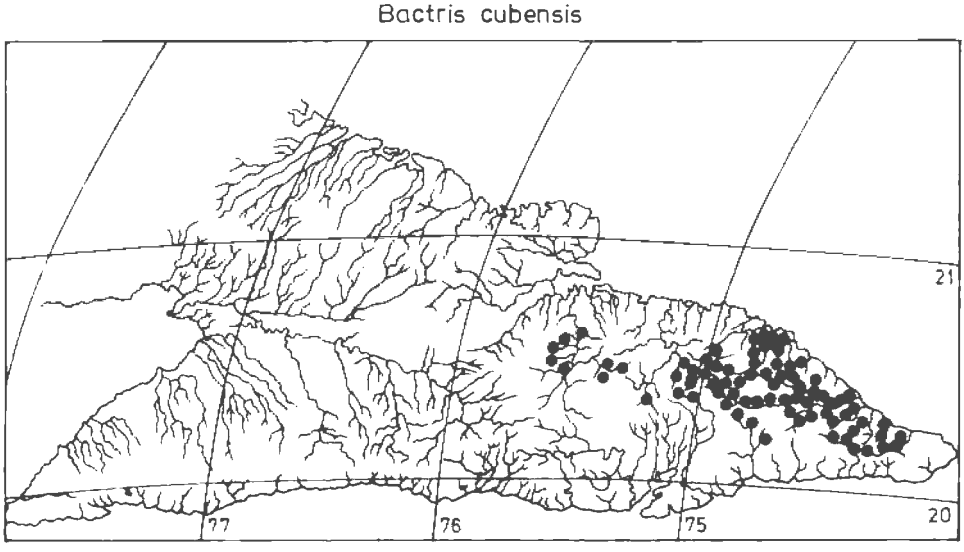


Fig. 230 Geographical distribution of *Bactris cubensis* Burret (Marie-Victorin and León 1956 and personal observations)

Sub-sector C.1/a. The serpentine mountains of the Nipe-Baracoa Massif (Eu-Moanicum) (Fig. 224)

Four mountains or mountain groups have been distinguished from a phytogeographic point of view. These are the Nipe, Cristal, Moa and the Baracoa-Jauco zone. The first two, just as the second two, represent more closely related units. Nipe and Cristal are separated only by a narrow limestone strip, the valley of Rió Mayari. The boundary between Moa and Baracoa is a narrow gabbro zone. However, Cristal and Moa are widely separated by the Sagua de Tanamo depression covered by Tertiary limestone. This area, with its mesophilous tropical forest, must have acted as an important barrier of migration for the serpentine floras. Within the east Cuban sub-province, this area has the richest flora. Of its eighteen endemic genera sixteen are confined to this sub-sector, including all regional endemic genera and the majority of the 725 endemic species. The number of vicarious species in the mountains is large. Also, many vicarious subspecies occur providing evidence for speciation in more recent times. The *Calycogonium rosmarinifolium,* (Fig. 121), *Casasia nigrescens,* (Fig. 120), *Moacroton lanceolatus* (Fig. 130), *Anemia coriacea* (Fig. 128), and *Phyllanthus myrtilloides* aggregates are examples. All developmental stages of serpentine soils are found in this area and, as a result of the different ecological conditions of serpentine habitats, the floristic and vegetational variability ranges from the arid evergreen shrublands to the submontane rainforests.

District C.1.1. Sierra de Nipe (Nipense) (Fig. 224)

Geography: A serpentine plateau at 600 m elevation, relieved by narrow and deep canyons and covered by old fossil ferrallitic and ferritic soils. The eroded

forms of these soils are mixed with more recent serpentine rendzina on the ridges and covered by the humic drift of slopes in the valleys.

Climate: Seasonal with dry winter, 3—4 dry months in the south and 1—2 dry months in the interior. Two dry seasons of 3—4 months duration on the northern slopes. Montane rainforest climate at Loma Mensura. The annual precipitation is between 1200 and 2300 mm (Fig. 231).

Flora: The relatively wide climatic conditions of this small area account partly for the uniqueness of the flora. Four monospecific endemic genera, *Dasytropis, Koehneola, Harnackia* and *Ciceronia,* and about 140 local endemic species, like

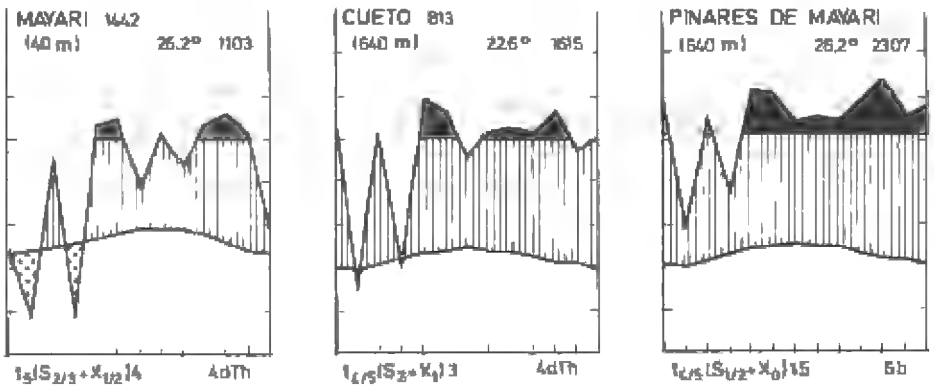


Fig. 231 Characteristic climate types of the Sierra de Nipe (phytogeographical district Nipense) at a) Mayari, b) Cueto and c) Pinares de Mayari

Clusia nipensis (Fig. 232) and *Gesneria nipensis* and especially from (Fig. 233), the genera of *Tabebuia, Leucocroton, Chaptalia, Brunfelsia, Callicarpa, Eugenia, Calyptranthes, Phyllanthus* and *Rhynchospora* also occur. Further 21 species are common to this district and the Cristal Mountains, examples are *Euphorbia podocarpifolia, Eugenia piedraensis, Schmidtottia cubensis, Rondeletia canellaefolia, Senecio subsquarrosus, Vernonia desiliens,* and *Gochnatia cubensis,* etc. Some species are exclusively found here and in Moa, being absent from the Cristal Mountains in between. These are *Pithecellobium nipense, Ravenia simplicifolia, Phyllanthus phlebocarpus, Ph. estrellensis, Buxus aneura, Phidiasia lindavii* (Fig. 228), *Matelea nipensis, Exostema stenophyllum* and *Psychotria lopezii.* The richness of certain valleys (e.g., Rio Piloto) or peaks and ridges (Loma Mensura, Loma Bandera, Loma Winch) in local endemics is also of particular interest.

Vegetation: Semi-arid evergreen shrubwoods on the sharp ridges. Various natural and secondary *Pinus cubensis* forest communities on the slopes and the plateau. Semi-arid montane rainforests predominate along the watercourses. Semi-arid montane shrubwoods occur on the western and eastern slopes of Loma Mensura. The "montane serpentine savannas" of Carabia (1945b) have resulted from the deforestation of relict pinewoods.

Fig. 232 Clusia nipensis Borhidi a characteristic tree of the open rocky pine woodland on the serpentine of the Nipe Mountain (Photo: A. Borhidi)

Fig. 233 Gesneria nipensis Britt. et Wils. an endemic shrub of the evergreen montane serpentine scrub of the Nipe Mountain (Photo: A. Borhidi)

District C.1.2. Sierras del Cristal and Micara (Cristalense) (Fig. 224)

Geography: Massif consisting of deeply inclined conical hills and sharp ridges. The lower sections are covered by ferralitic soils. Over 700 m these are replaced by yellowish-red montane clays.

Climate: More uniform than the climate of the preceding district. The dry season is in the winter with 1—2 dry months at the margin of the mountains. Humid rainforest climate in the interior. Annual precipitation between 1600—2300 mm (Fig. 234).

Flora: Strikingly poor and monotonous when compared to the flora of the neighbouring Nipe and Moa Mountains. This is indicated by breaks in the distribution of numerous species mentioned in the discussion of the preceding district. This situation may be partially accounted for by the deficiency of these mountains in extreme, dry rocky habitats. Another reason is that this area is not thoroughly explored. Thus, only one (!) endemic monospecific genera *(Eosanthe cubensis* (Fig. 88)) and about 50 endemic species are known. Most of these species

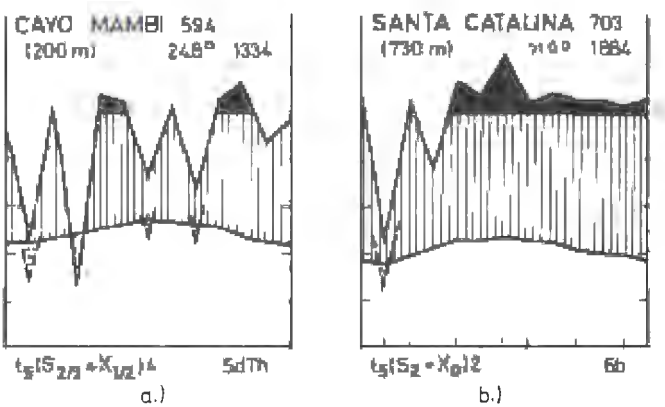


Fig. 234 Characteristic climate types of the Sierra del Cristal (phytogeographical district: Cristalense) at a) Cayo Mambi and b) Santa Catalina

are markedly different from their relatives, for example, *Lagenocarpus cubensis, Freziera conocarpa, Moacroton cristalensis* (Fig. 130), *Buxus imbricata, B. olivacea, Erythrina leptopoda, Croton pachyrachis, Ilex cristalensis, I. eoa, I. paucinervis, I. subavenia, Chaetocarpus cordifolius, Leucocroton obovatus, Pachyanthus monocephalus, Jacquinia sessiliflora, Senecio ekmanii, Sapphoa rigidifolia* (Fig. 228), *Acrosynanthus ovatus, Gesneria pachyclada, Dendropanax nervosus, Ossaea cristalensis,* etc. Whereas the Cristal Mountains are poor only in comparison with the neighbouring districts, the coniferous forests of Sierra de Micara are monotonous by any standard with an only exception of the dry rocky ridge of Saca La Lengua: as few as 6—8 endemics, such as *Annona cirstalensis, Erythroxylon flavicans, Ossaea micarensis, O. pinetorum, Myrtus micarensis* and *M. del-riscoi* have been known.

Vegetation: The coniferous zone is much narrower than in Nipe. Seasonal

evergreen forests extend up to an altitude of 600 m with moist rainforest mosaics. Between 600 and 1100 m pine forests of *Pinus cubensis* are dominant. From 1100 to 1230 m semi-dry montane shrubwood, variant of cloud forest on serpentine, is found. On the southern serpentine cliffs of Pico del Cristal the existence of a peculiar vegetation, namely dry montane evergreen shrubwoods, may be assumed.

District C.1.3. Sierras de Moa and Toa (Moaënse, Fig. 224)

The most extensive floristic district on serpentine. Its flora probably has the longest history in Cuba, as this area is considered to be the evolutionary centre of the flora and vegetation in these mountains.

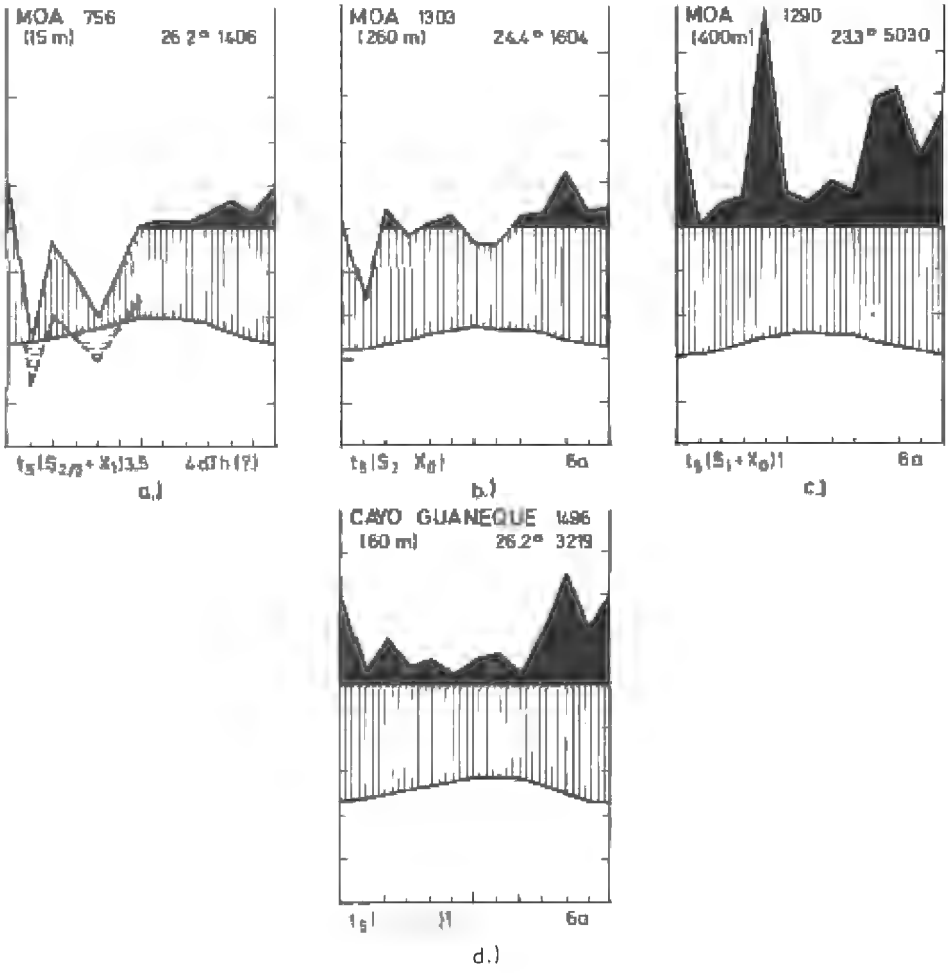


Fig. 235 Characteristic climate types of the Sierra de Moa, (phytogeographical district Moaënse) at a—c) Moa and d) Cayo Guaneque

Geography: In general, wide and flat ridges and plateaux are typical (Cupeyal, El Toldo, Altos de Iberia) although the Cuchillas de Toa range between the Jaguani and Toa rivers consists of conical and pyramidal mounts. Very old, red ferritic soils predominate. In zones close to the coast (Cerro Miraflores, Yamanigüey) younger ferrallitic serpentine soils are found. The middle and upper section of the Toa Valley is mainly covered by yellowish-red montane soils derived from serpentine.

Climate: The most humid area in Cuba. At the northern, western and southern boundary there are two dry seasons of 1—2 dry months duration. In the interior the climate is warm and moist throughout the year. At about 7—800 m altitude it is replaced by moist montane rainforest climate. Annual precipitation ranges between 1400—3000 mm, occasionally near to 5000 mm in certain localities (Fig. 235).

Flora: Very rich and diverse. Five endemic genera, *Ceuthocarpus* (Fig. 236), *Kodalyodendron, Shaferocharis, Shafera* and *Feddea,* and nearly 200 local endemic species, e.g., *Thrinax rivularis* and var. *savannarum* (Fig. 114), *Moacroton leonis; M. tetramerus, Phyllanthus chryseus, Callicarpa oblanceolata, Bonnetia cubensis, Laplacea moaënsis, Talauma minor* ssp. *oblongifolia, Shafera platyphylla, Shaferocharis cubensis* (Fig. 228), *S. multiflora, S. villosa, Cassia bucherae, Byrsonima bucherae, Acacia bucheri, Brya subinermis, Casearia ophiticola, Euphorbia munizii* (Fig. 237), *Jacquinia acunana,* and 7 *Buxus,* 4 *Coccoloba,* 5 *Leucocroton,* 4 *Ilex,* 5 *Calyptranthes,* 4 *Myrcia,* 6 *Eugenia,* 6 *Miconia,* 5 *Calycogo-*

Fig. 236 Ceuthocarpus involucratus (Vernh.) Aiello, an endemic genus and species of the coastal area of Moa (Photo: A. Borhidi)

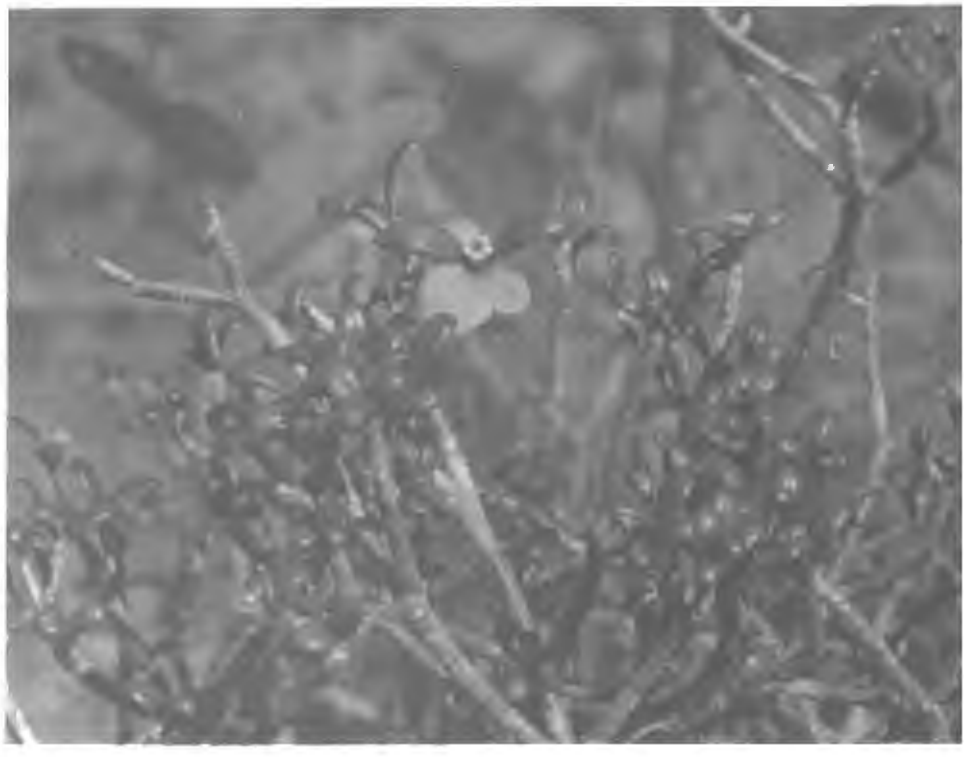


Fig. 237 Euphorbia munizii Borhidi an endemic leptophyllous evergreen shrub of the montane serpentine scrub of El Toldo, Moa range (Photo: A. Borhidi)

nium, 6 *Ossaea,* 4 *Clusia,* 8 *Cordia,* 3 *Callicarpa,* 6 *Tabebuia,* 6 *Schmidtottia* and 6 *Senecio* species, etc. occur. Numerous endemics are in common with the Nipe Mountains (see above), with Sierra del Cristal (e.g., the endemic genus *Sapphoa, Neobracea ekmanii* (Fig. 117), the Baracoa-Jauco district discussed below (e.g., *Moacroton ekmanii* (Fig. 130)), *Cordia duartei, Platygyne obovata, Rondeletia stellata, Casearia bissei, Feddea cubensis, Dracaena cubensis* (Fig. 227), etc.) and even with the Monte Libano group (e.g., *Gesneria cubensis,* and *Columnea tincta*). Several minor developmental centres may be recognized within the mountains (Cerro Miraflores-Playa la Vaca, Yamanigüey (Fig. 238), Alto de Iberia El Toldo (Fig. 239), Pico Galán, and the sorroundings of old nickel mines: Mina Iberia, Mina Potosi, Mina Franklyn, Mina Cayo Guam, Mina Delta), although it has been shown (Borhidi and Muñiz 1973b) that many species had been thought to be local endemics turned out to be, in fact regional endemics of wider distribution.

Vegetation: In the northern foothills, the Cupeyal Plateau and the upper Toa Valley various forest communities of *Pinus cubensis* predominate. Along the coast these forests alternate with microphyllous evergreen shrubwoods very rich in species, including strongly isolated endemics such as *Kodalyodendron cubense,*

Shaferocharis multiflora (Fig. 238), *Tabebuia linearis, Acrosynanthus minor, Miconia javorkaeana, Forchhammeria emarginata, Coccoloba acuna, Phyllanthus comosus, Eupatorium minutifolium.* Over 400 m and up to 6—700 m semi-arid montane rainforests occur (Fig. 239). At higher altitude semi-arid montane shrubwoods correspond to the climax vegetation type. On the dry tops of some serpentine plateaux (e.g. El Toldo, Fig. 240) a dwarf pine woodland of *Pinus*

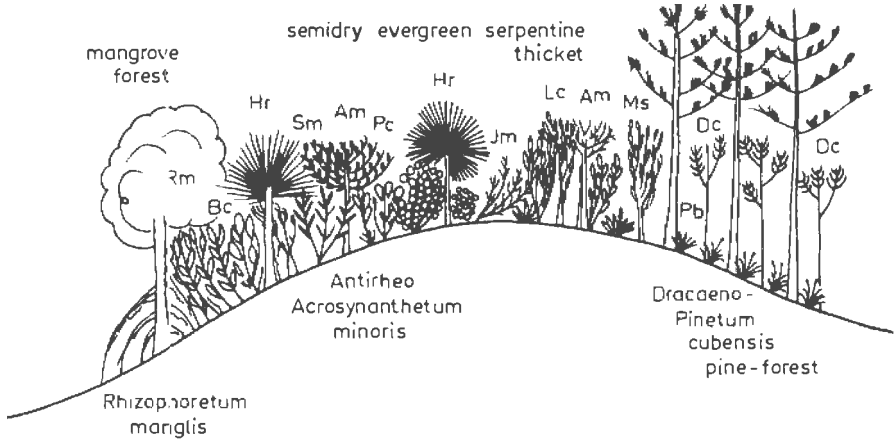


Fig. 238 Vegetation transect of the Cerro Yamanigüey in the coastal range of the Sierra de Moa

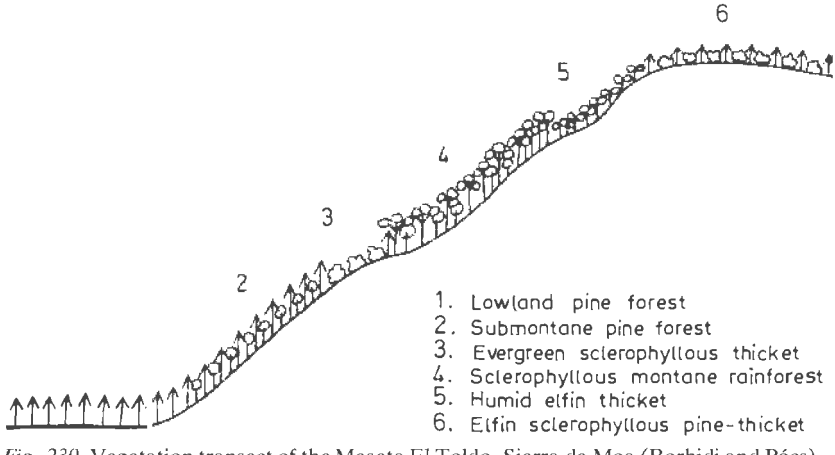


Fig. 239 Vegetation transect of the Meseta El Toldo, Sierra de Moa (Borhidi and Pócs)

Fig. 240 Inner view of the Sierra de Moa at La Melba with Loma Redonda (left) and El Toldo with Camp of Glory (right) type locality of many species discovered by Shafer (Photo: A. Borhidi)

cubensis has developed (Pócs, pers. comm). In the valleys of the Jaguani and Toa rivers the *Carapa guianensis* forests, are found representing the only submontane tropical rainforest zone in Cuba.

District C.1.4. The serpentine areas of Baracoa and Jauco (Baracoënse) (Fig. 224)

Geography: This area, situated east of the Quibiján and Toa rivers, is younger, lower and also poorer in species than the preceding districts. Yellowish red montane soils and ferritic soils occur in the west, ferrallitic red serpentine soils in the east.

Climate: Humid rainforest climate with no seasons. Annual precipitation between 1600 and 2900 mm.

Flora: Most species are in common with Moa. Approximately fifty local endemic species are found here, for example: *Melocactus radoczii, Buxus baracoënsis, Cordia baracoënsis, Siphocampylus baracoënsis, Schmidtottia multiflora, Ossaea elliptica, Henriettea cuabae, Exostema shaferi, Xylopia ekmanii, Spathelia leonis* (Fig. 109), *Leucocroton ekmanii, Rhamnidium pruinosum, Ternstroemia baracoënsis* etc.

Vegetation: Submontane rainforests in the west, pinewoods on ferritic soils, and mainly microphyllous evergreen shrubwoods in the Peladeros de Jauco zone in the east.

Sub-sector C.1/b. The limestone karsts and other not serpentine ranges of the Nipe-Baracoa Massif (Yatericum) (Fig. 224)

This sub-sector includes the mogotes of the south-western Sierra de Nipe, the partially eroded limestone blocks folded at the margin of serpentine mountains, in the Monte Libano–Monte Cristo–Monte Verde group, the sandstone hills mingled with the limestone blocks, and the Sierra del Purial range with the Sierra de Imias which continues as a limestone plateau towards the end of the island. The endemics are not evenly distributed over the area. The deciduous forests occurring on sandstone have very few floristic specialities, whereas the limestone cliffs are very rich in endemics due to geographical isolation. In spite of this heterogeneity, the sub-sector played a significant role in the flora evolution of Cuba for two fundamental reasons:

1. Via this area the montane flora migrated from the north (Moa, Cristal) southward (Sierra Maestra).
2. The limestone cliffs are considered to be the cradle of the southern Oriente xerotherm flora which, in the Quaternary, moved both to the west and towards the terraced coastal area. The existence of these floristic relationships is best shown by the distribution of the vicarious species of *Gesneria, Eupatorium* and *Siphocampylus*.

District C.1.5. Sierra del Purial, Yunque de Baracoa and the Gran Tierra Plateau (Purialense) (Fig. 224)

Geography: Diversified mountainous area. Sierra del Purial is a deeply inclined range up to 1100 m altitude, Gran Tierra is a "meseta" area. Quite different are the mogotes west of the Yumuri Valley and the anvil-shaped Yunque de Baracoa monadnock (Fig. 241) consisting of limestone and dolomite. Tropical brown soils predominate in the Sierra del Purial and Yunque. In some elevated places yellowish red montane soils occur. In the limestone area of Gran Tierra and Yumuri humic-carbonated soils are the most common.

Climate: Characterized by sudden changes along the gradient. There is hardly any transition between the bixeric climate of two dry seasons (3—4 dry months), the wet tropical and the montane rainforest climate. In the northeast a particular tropical seasonal climate occurs which is dry in the summer. Annual precipitation 1000—2200 mm (Fig. 242).

Flora: The flora of Sierra del Purial and Sierra de Imias is little investigated so that only few endemics have been known (*Senecio saugetii, Croton tropidophyllus, Scolosanthus wrightianus, Phialanthus parvifolius, Ph. macrostemon, Ardisia baracoënsis* and *Platygyne leonis*) but the discovery of others is expected. A single endemic genus, *Bembicidium,* and several endemic species, e.g., *Callicarpa areolata, Gesneria gibberosa, G. yumuriensis* (Fig. 243), *G. purpurascens, Victorinia regina, Siphocampylus yumuriensis* (Fig. 244), *Spathelia yumuriensis* (Fig.

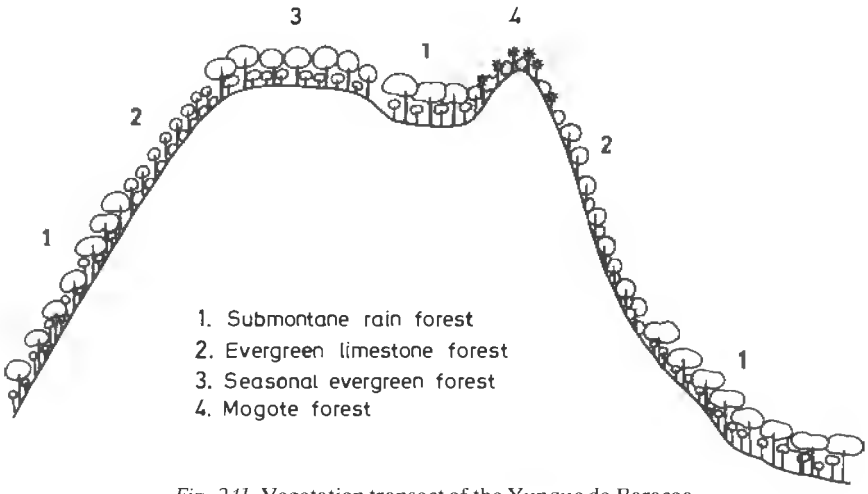


Fig. 241 Vegetation transect of the Yunque de Baracoa

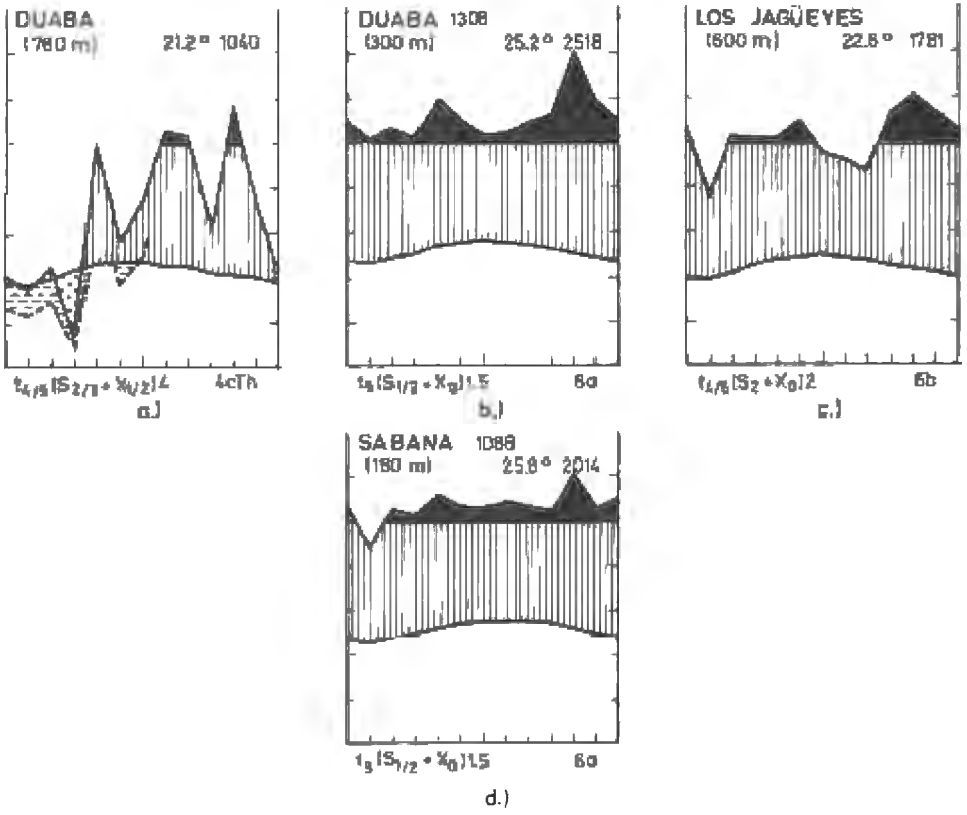


Fig. 242 Characteristic climate types of the Sierra de Imías and the Cuchillas at a—b) Duaba, c) Los Jagüeyes and d) Sabana

Fig. 243 Gesneria purpurascens var. *yumuriensis* (Britt. et Wils.) Borhidi, endemic of the gorge of the Yumuri river (Photo: A. Borhidi)

Fig. 244 Siphocampylus yumuriensis M. Vict., an endemic *Lobeliaceae* of the Baracoa range (Photo: A. Borhidi)

109), *Heptanthus yumuriensis* (Fig. 111), and *Ossaea yumuriensis*, etc. occur in the Gran Tierra and Yumuri area. The richest evolutionary centre is the Yunque de Baracoa monadnock from the Pliocene, which has one endemic genus *(Ekmania)* and about 25 endemic species, for instance, *Spaniopappus ekmanii, Vernonia yunquensis, Jacquinia yunquensis, Ossaea heterotricha, Calycogonium plicatum, Ilex wrightii, Croton yunquensis, Erythroxylon baracoënse, Coccothrinax yunquensis* (Fig. 245), three *Gesneria* and 5 *Pilea* species, *Siphocampylus manettiifolius* (Fig. 246), *Arthrostylidium angustifolium,* etc.

Vegetation: This is the zone of seasonal evergreen forests, although over 7—800 m montane rainforests and, in the Sierra de Imias, even mossy forests may occur (Fig. 247). The mogote zone is covered by karstic forests whose floristic composition is still unknown.

District C.1.6. The mogotes of the Nipe-Yateras area (Yaterense) (Fig. 224)

Geography: Inclined conical karsts and also wide and terraced limestone plateaus with serpentine intrusions often reaching the surface. The limestone formations alternate with monotonous sandstone ridges. The predominant soils are humic-carbonated soils on limestone, tropical brown soils on sandstone and ferritic soils on serpentine.

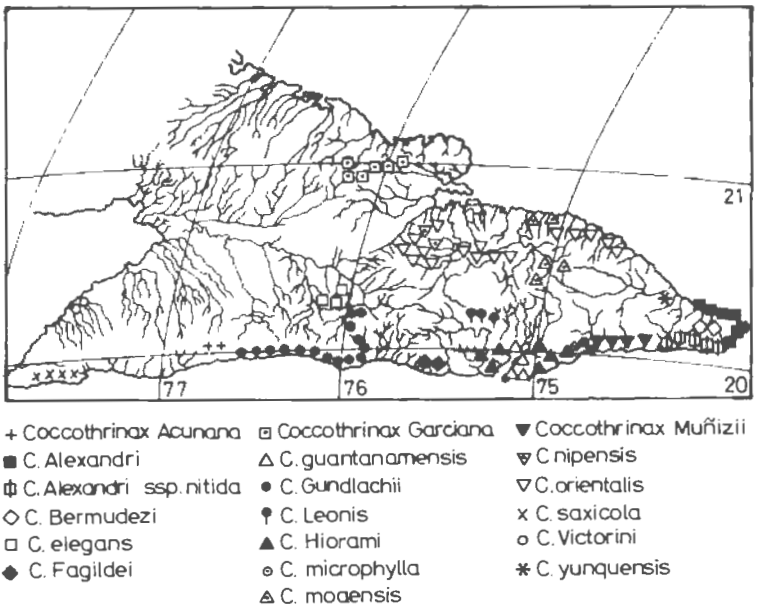


Fig. 245 Geographical distribution of the East Cuban taxa of the genus *Coccothrinax* (Borhidi 1973, 1986)

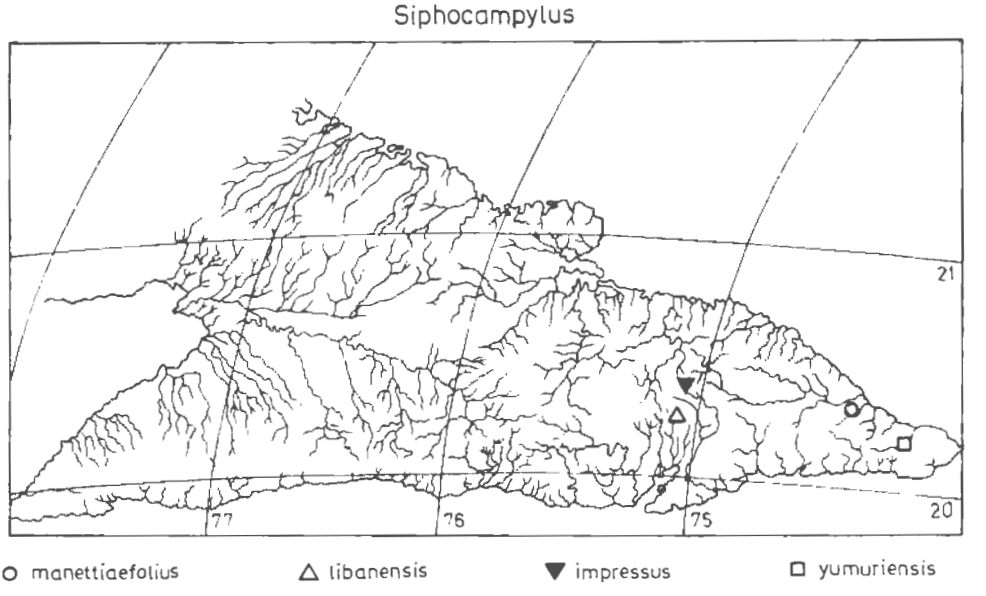


Fig. 246 Geographical distribution of *Siphocampylus manettiifolius* Hook.f. (open circles), *S. impressus* Urb. (full triangle) and *S. libanensis* Urb. (triangles) and *S. yumuriensis* (squares) (Marie-Victorin 1942, modified)

Fig. 247 The Sierra de Imias covered by clouds above 800 m a.s.l. (Photo: A. Borhidi)

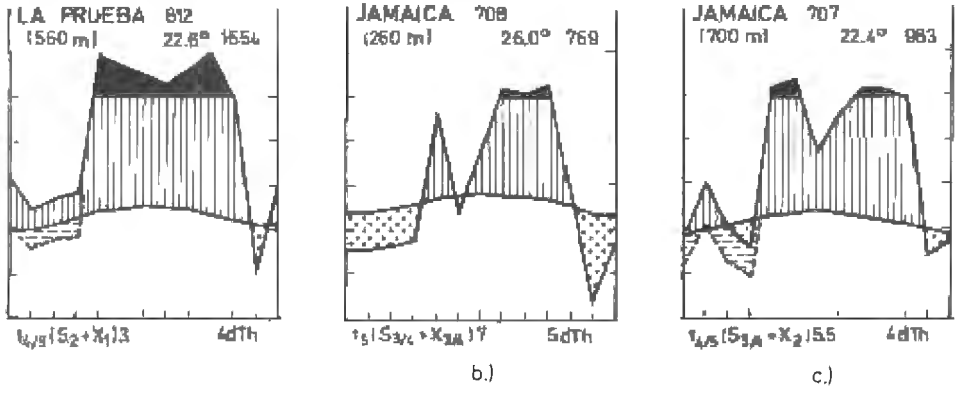


Fig. 248 Characteristic climate types of the mogote region of Sierra de Nipe — Monte Libano range at a) La Prueba and b—c) Jamaica

Climate: Seasonal with dry winter of 1—2 or 3—4 months duration. Annual precipitation 1000—1800 mm (Fig. 248).

Flora: Two centres of flora development may be distinguished, both being rich in endemics. The first is the mogotes of Sierra de Nipe with about 15 endemic species, such as *Thrinax compacta* (Fig. 114), *Spathelia lobulata* (Fig. 109), *Plinia ramosissima, Calyptranthes paradoxa, Eugenia bayatensis, E. excisa, Hydrocotyle*

oligantha, Matelea bayatensis, Tabebuia picotensis, T. mogotensis, Gesneria lopezii (Fig. 249) and *Isidorea polyneura.* The other centre is the group of Monte Libano, Monte Verde and Monte Cristo which must have been the principal junction of migratory routes during the development of the Oriente flora. This area is still a rich meeting point of the limestone and serpentine floras (Fig. 250), as well as of the semi-desert xerotherm elements. On the soils derived from serpentine the range of

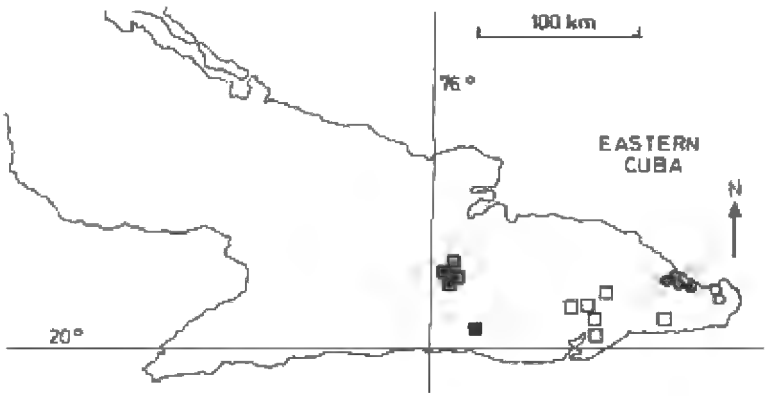
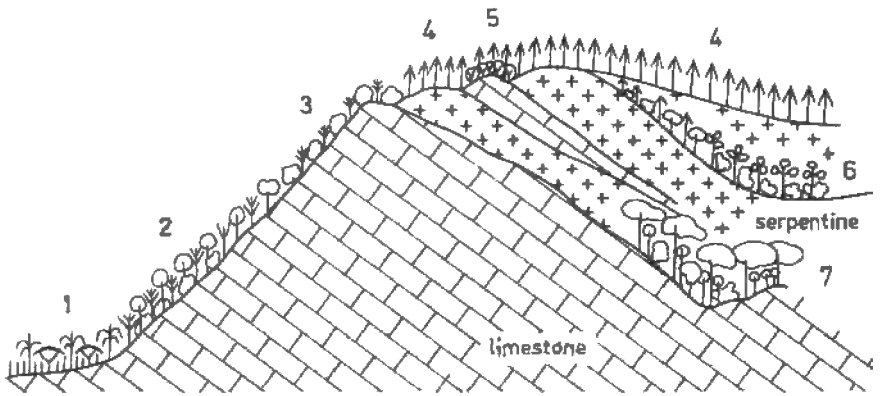


Fig. 249 Geographical distribution of *Gesneria purpurascens* Urb. full circles: var. *purpurascens,* open circles: var. *yumuriensis* and *Gesneria libanensis* Linden, — open squares: ssp. *libanensis,* full squares: ssp. *lopezii* (Morton) Borhidi (Skog 1976, modified)



1. Roystonea - Samanea grassland
2. Semideciduous forest
3. Mogote - forest
4. Pine - forest on serpentine
5. Pine - forest with Agave on limestone
6. Sclerophyllous montane rainforest
7. Submontane rainforest

Fig. 250 Vegetation transect of the Montane Libano

Fig. 251 The montane pine woodland of the Monte Libano above Guantanamo (Photo: A. Borhidi)

many species of Nipe and Cristal overlaps the distribution of Moa elements. Moreover, only at this point reach certain serpentinophilous species *(Pinus cubensis, Agave shaferi)* the limestone zone.

Some coastal species were able to spread up to 6—700 m on the southern slopes where the xerotherm elements and the montane rainforest species meet. The three mountains possess 40 endemics altogether, some of them exhibiting vicariance (e.g., *Siphocampylus, Gesneria*). Examples of characteristic plant species are *Hernandia cubensis, Auerodendron glaucescens, Salacia wrightii, Begonia libanensis, Scolosanthus granulatus, Spermacoce exasperata, Verbesina wrightii,* 3 *Dorstenia,* 6 *Pleurothallis,* 2 *Calyptranthes* and 2 *Ossaea* species.

Vegetation: Karstic woods on the mogotes, seasonal evergreen forests in the valleys as well as on the sandstone areas. Arid scrubs on limestone slopes and pinewoods on serpentine which may occasionally extend to the limestones (Fig. 251). Rainforest patches may occur in some places in the deep valleys and montane rainforest fragments are found at higher altitudes.

Sector C.2. Sierra Maestra (Maestricum) (Fig. 224)

The 250 km long and 15—20 km vide Sierra maestra is almost 750 m higher than the ancient Sagua-Baracoa Massif from which its flora originated. As a result of this altitude difference and of the presence of rocks more effectively enhancing the

moist climate (limestone, sandstone, granite, grano-diorite and diorite), a wide montane rainforest and cloud forest belt developed, in which the ancient Sagua-Baracoa flora enriched in Jamaican and Hispaniolan elements, may have become a new evolutionary centre. This spontaneously formed secondary centre is characterized by two endemic genera (*Solonia* and *Cubacroton*) and 155 endemic species, for example, *Cneorum trimerum* (Fig. 125), (ancient relict!), *Pinus maestrensis* (Fig. 89), *Laplacea urbani, Cleyera ekmanii, Persea anomala, Pithecellobium maestrense, Platygyne dentata* (Fig. 115), *Pera microcarpa, Sapium maestrense, Cubacroton maestrensis, Maytenus saxicola, Crossopetalum spathulifolium, Karwinskia bicolor, Cinnamodendron cubense, Talauma orbiculata, T. truncata, Scolosanthus maestrensis, Cordia longipedunculata, Solanum maestrense, Tabebuia oligolepis, T. hypoleuca, Justicia maestrensis, Peratanthe cubensis, Schradera cubensis,* 9 *Eugenia,* 6 *Miconia,* 6 *Ossaea,* 5 *Gesneria,* 5 *Eupatorium* and 6 *Rondeletia* species. The boundary of this sector runs at 300—400 m on the slopes in the south, and at the margin of the Cauto Basin in the north.

District C.2.1. The western and central Maestra (Turquinense) (Fig. 224)

Geography: This area extends from Pilón to the Santiago Valley and includes two higher mountainous groups (Turquino and La Bayamesa), whose highest points are over 1500 m. These mountains comprise, deeply inclined sharp ridges and conical formations so that the superficial drainage ratio is high (35—50 l/sec. km^{-2}) and the erosion is intensive. Tropical brown soils occur at medium elevation, up to 600 m and then yellowish red montane soils are found up to 1300 m. Next, up to 1750 m yellowish brown montane soils become predominan t, these are replaced by brown montane soils on the peaks. The northern slopes are covered by yellow montane soils over 1300 m.

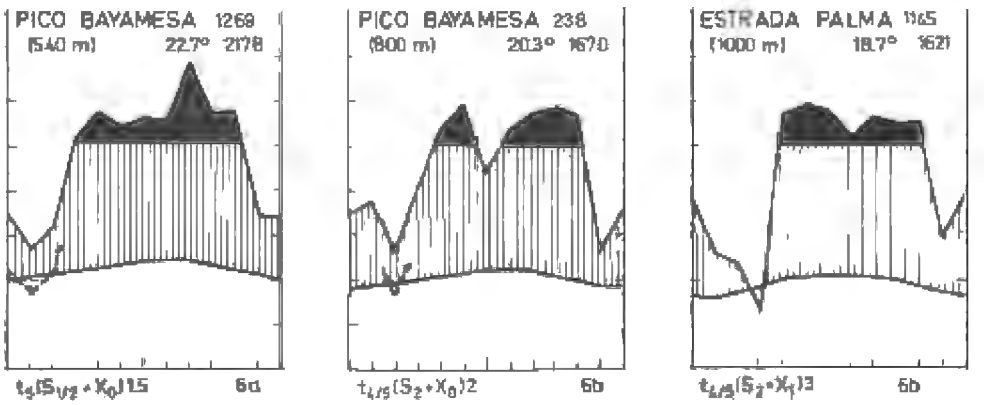


Fig. 252 Characteristic climate types of the western range of the Sierra Maestra at a—b) Pico Bayamesa and c) Estrada Palma

Climate: Seasonal with dry winter. 3—4 dry months at the foothills, 1—2 dry months up to 800 m. Further up there is a moist montane rainforest climate which is replaced by a humid, high-altitude temperate rainforest climate at 1700 m. The annual precipitation ranges from 800 to 3000 mm (Fig. 252).

Flora: Besides the characteristic endemics listed in section C.2., there are numerous regional endemic species of mossy forests in this district. For example, *Myrsine microphylla*, *Nectandra reticularis*, *Eupatorium paucibracteatum*, *E. praestans*, *Henriettea ekmanii*, *Hedyosmum cubense* (Fig. 138), *Ossaea turquinensis*, *Rondeletia naguensis*, *Myrica cacuminis*, *Rubus turquinensis* (Fig. 253), *Symplocos leonis*, *Sapium erythrococcum*, *Eugenia maestrensis*, and *E. laeteviridis*, etc. In addition, local endemics have been found in several mountain groups and valleys: Nagua has 4 endemics *Citharexylum ternatum*, *Tabebuia elongata*, *Eugenia naguana* and *Polygala rhynchosperma*, Pico Caracas is famous for the remarkable palaeoendemism *Cneorum trimerum* and the *Podocarpus* woods; (Rio Guamá, Hacienda Sevilla, Nima-nima, El Cuero, Rio Yara, Yao Arriba, Pico Joaquin, and Loma Regino possess one-two endemics each, whereas in Pico Bayamesa 4 local endemics

Fig. 253 A local endemic of the highest summits of the Maestra range: *Rubus turquinensis* Rydb. (Photo: A. Borhidi)

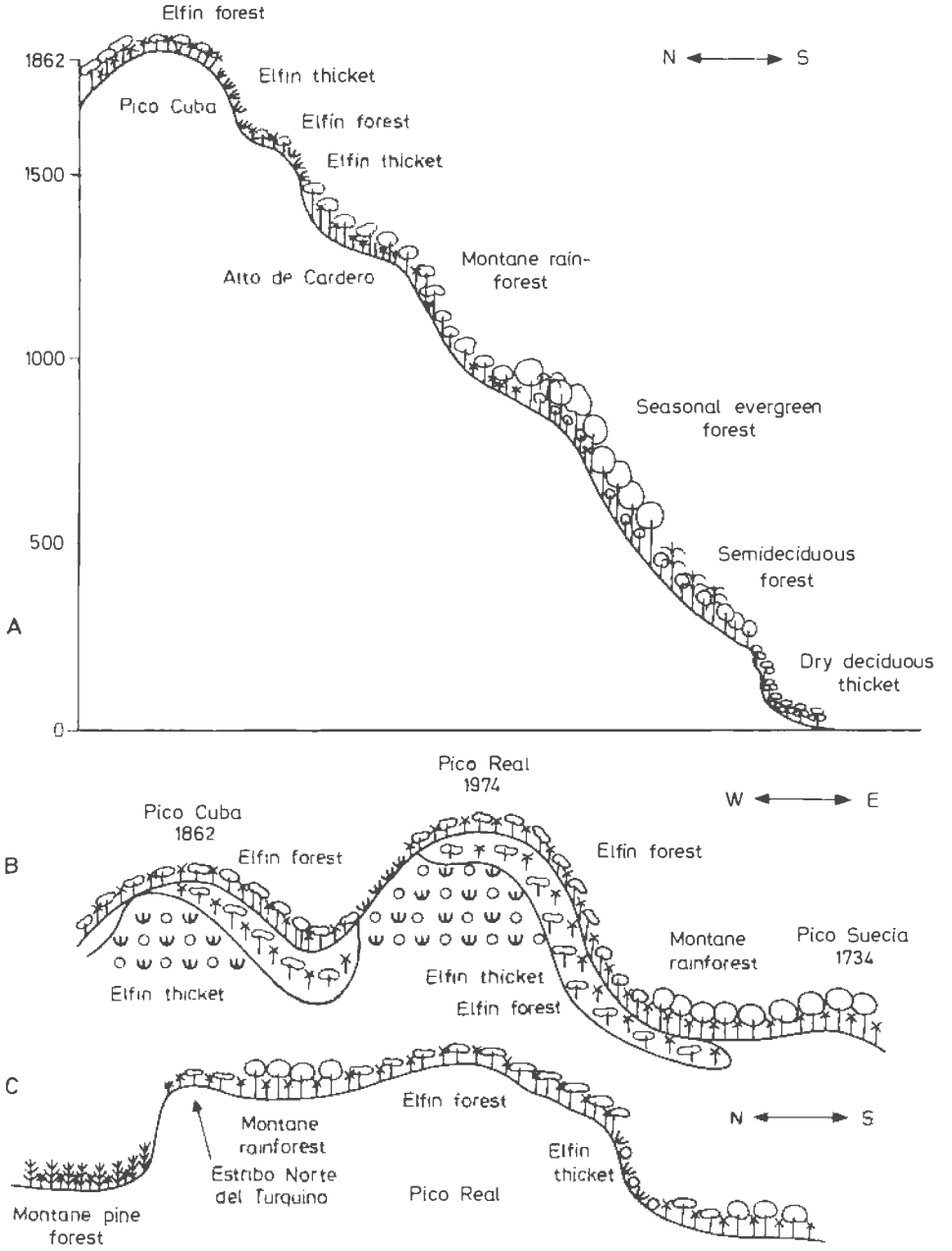


Fig. 254 Vegetation transects of the high belts of Pico Turquino (A. Borhidi)

occur (e.g., *Vernonia maestralis, Purdiaea maestrensis, Lepanthes acunae* and *Psychotria ekmanii*). The most prominent evolutionary centre is the Turquino group having approximately 25 local endemics (e.g., *Coccothrinax acunana* — (Fig. 245) *Agave pendentata, Satureja bucheri, Juniperus saxicola, Miconia turquinensis, Ilex turquinensis, I. nunezii, Lobelia cacuminis, Chaptalia turquinensis, Mitracarpus acunae, Lepanthes ekmanii, L. turquinoënsis* and *pergracilis,* etc.

Vegetation: Arid evergreen shrubwoods on the southern slopes up to 300 m semi-deciduous forests (*yayales* p.p.) between 300—500 m seasonal rainforests (*yayales* p.maj.p.) between 500—800 m. moist montane rainforests *(rangales)* between 800—1600 m and mossy forests *(monte fresco)* between 1600—1900 m. Over 1900 m high altitude moist shrublands predominate (Figs 254, 255). On the northern slopes the seasonal rainforest zone begins as low as 150—200 m. This is replaced by montane rainforests at 800—1000 m. At the boundary of these two rainforest types a 100—200 m wide belt of "extrazonal" pinewood stands *(Pinus maestrensis)* are found on sandstone which may extend even up to 1800 m on the northern slopes of Turquino. At 1500 m begins the mossy forest zone.

District C.2.2. The eastern Sierra Maestra (Piedraënse) (Fig. 224)

Geography: This area includes Gran Piedra, a limestone range covered by granodiorite. Its highest point is 1219 m. North of it are found the limestone mountains of Sierra de Santa Maria de Loreto. All mountains are deeply inclined,

Fig. 255 Agave pendentata, Lyonia leonis, Ilex turquinensis Miconia turquinensis Chusquea abietifolia and *Mitracarpus acunae* are the characteristic elements of the elfin thicket of the Turquino Peak at 1990 m a.s.l. (Photo: A. Borhidi)

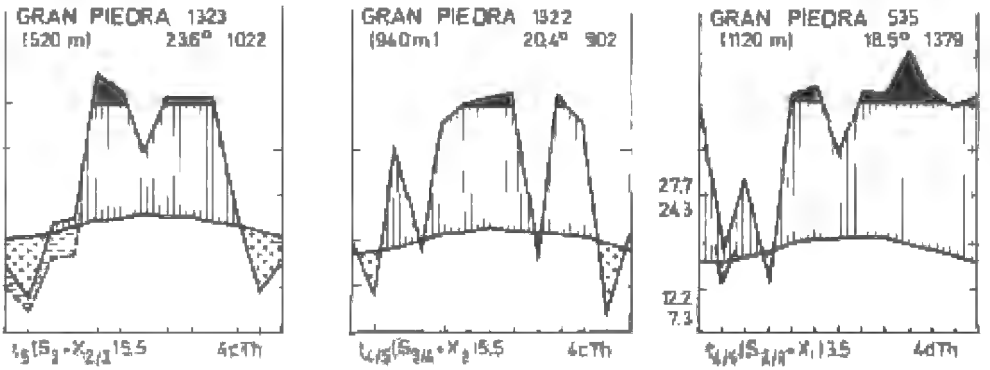


Fig. 256 Characteristic climate types of the eastern range of the Sierra Maestra at Gran Piedra in different altitudinal belts

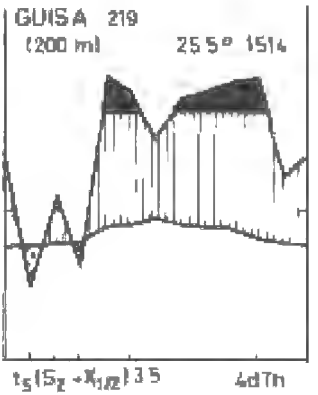


Fig. 257 Characteristic climate type of the mogote belt of the Sierra Maestra at Guisa

large bluffs occur in the north. Tropical brown soils predominate up to 800 m. Further up yellowish red montane soils are found.

Climate: Similar to that of the preceding district (Fig. 256).

Flora: As few as two local endemics (*Callicarpa floccosa* and *Rondeletia intermedia*) have been known. Here is the only population of *Pinus maestrensis* in the Sierra Maestra, which is supposed to be a hybridogenous one between *P. cubensis* and *P. maestrensis*.

Vegetation: Similar zonation as in the preceding floristic district. The only difference is that the stands enclosed by the seasonal evergreen forests and montane rainforests are composed of *Pinus maestrensis* (or rather *P. cubensis*×*P. maestrensis*.)

District C.2.3. The mogotes of Baire, northern Sierra Maestra (Bairense) (Fig. 224)

Geography: These karsts are found within the Charco Redondo–Los Monos–Matias–Los Negros quadrangle. Conical hills of 400—600 m height with perpen-

dicular rocky walls. Rendzina soils predominate, whereas in the valleys humic-carbonated soils occur.

Climate: Seasonal with dry winter of 3—4 months duration. Annual precipitation between 1200—1600 mm (Fig. 257).

Flora: The flora of this area had been unexplored for a long time. Due to geographic isolation, the flora is very rich. A remote relationship to the mogotes of Nipe is indicated by the presence of the endemic genus *Synapsis* and of *Siphocampylus undulatus, Clerodendron denticulatum* and *Byttneria microphylla.* Also, there is a connection with the flora of arid limestone terraces in the Cabo Cruz area (*Catalpa brevipes*). More than ten local endemics are found here, e.g., *Coccothrinax elegans (Fig. 245), Neobracea susannina* (Fig. 117), *Malpighia acunana, Rhytidophyllum mogoticola, Tabebuia candicans* and *Pilea uninervis.*

Vegetation: Semi-deciduous forests with Coccothrinax palms, cacti and agaves predominating in the mogotes. Seasonal evergreen forests occur in the valleys. (Figs 258—260)

Sector: C.3. The southern and northeastern coasts of Oriente (Santiagicum) (Fig. 224)

This sector includes the most extensive and most extremely arid zone of Cuba: the area extending from Cabo Cruz over Maisi to Navas in the rain shadow of the

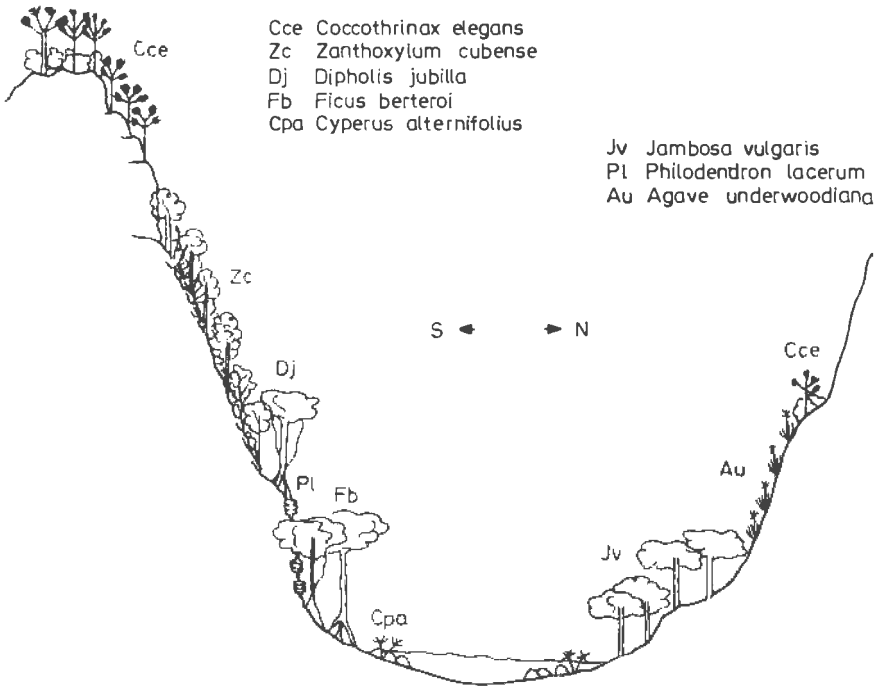


Fig. 258 Vegetation transect of the mogote formation in the valley of Rio Mogote at Matias (Borhidi and Muñiz)

Fig. 259 An almost unknown sector of the Maestra range: the mogote-region between Baire and La Tabla; the valley of the Mogote river (Photo: A. Borhidi)

Sierra Maestra and the southern Baracoa Mountains which are mainly responsible for the dry climate. This region is continued as a narrow strip along the northern coast to Navas. The Sierra Canasta, the Guantanamo Basin, the southern slopes of Sierra Maestra up to about 200 m, and the terraces of southern Baracoa up to 300—400 m are also included. In the Monte Libano group some coastal elements managed to reach 700 m altitude. This area is an old coastal land with an eventful geological past. During millions of years sections of this land rose and sunk, became separated and joined again at different points of time, resulting in several evolutionary centres of the flora. Therefore, the common species of this sector are mostly widely distributed xerophilous species, such as *Dendrocereus nudiflorus* (Fig. 261), *Lemairocereus hystrix, Cordia taylori, Pseudocarpidium avicennioides, Croton rosmarinoides, C. myricifolius* and *C. litoralis.* There is one monospecific endemic genus: *Caribaea,* and about 110 endemic species, most of them being confined to a given locality or a floristic district. The number of endemics found throughout the sector is relatively small (e.g., *Guettarda cueroensis, G. coxiana, Galactia cuneata, Consolea macracantha, Myrtus conophylla, Cordia leucosebestena, C. leptoclada, Lantana parvifolia, Callicarpa grisebachii, C. bucheri, Pseudocarpidium multidens, Spirotecoma spiralis, Eupatorium helianthemoides, Vernonia complicata, Gochnatia calcicola, Bonania elliptica, Croton micradenus, C. munizii* etc. The vicarious *Melocactus* species and *Coccothrinax* palms (Fig 245) are also typical.

Fig. 260 Semi-deciduous and deciduous forest complex on the limestone karstic area of the Sierra Maestra, with *Swietenia, Zanthoxylum cubense, Tabebuia bibracteolata,* many climber, xerophytic epiphytes, *Agaves* and *Cactaceae* (Photo: A. Borhidi)

Fig. 261 Dendrocereus nudiflorus (Engelm.) Britt. et Rose a giant endemic tree-shaped cactus of Cuba up to 12 m high, occurring in the semi-desert thorn scrub vegetation of South East Oriente, near Jauco (Photo: A. Borhidi)

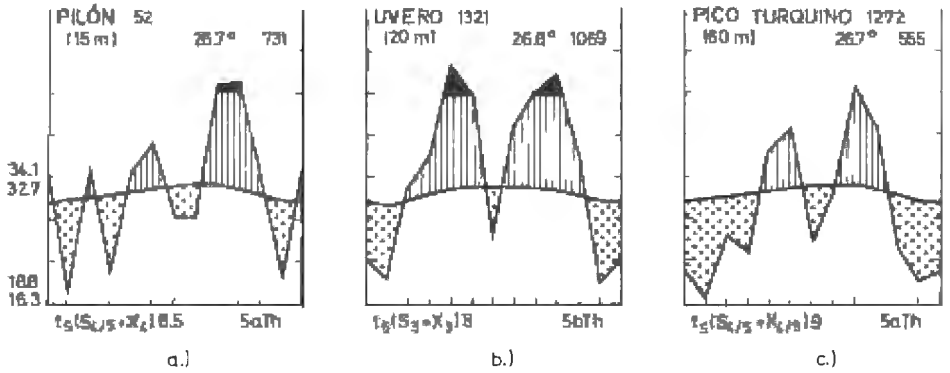


Fig. 262 Characteristic climate types of the coastal phytogeographical district Pilonense at a) Pilón and the western range of the Sierra Maestra, at b) Uvero and c) Pico Turquino

District C.3.1. The coastal and terraced land between Belic and Pilón (Pilonense) (Fig 224)

Geography: The Pliocene limestone cliffs, sometimes reaching 50 m height, the western end of Sierra Maestra having several terraced levels, and the plain at Pilón Bay with sedimentary origin from the Quaternary are included. Limestone rendzina and humic-carbonated soils predominate in the first two. The plain is covered by tropical alluvial soils.

Climate: Seasonal bixeric with two dry seasons of 7—8 or 5—6 months duration. Annual precipitation is 700—1200 mm. At higher altitudes 3—4 dry months, all in the winter, and 1000—1400 mm annual precipitation (Fig. 262).

Flora: Fairly isolated from that of the other districts in the sector. It is characterized by the low number of regional endemics and by many local endemic species with several centres of flora development. For example, Media Luna (*Coccothrinax victorini* (Fig. 245)), Niquero *(Copernicia humicola, Cassia niqueroensis, Chamaesyce niqueroana),* Cabo Cruz (*Cordia corallicola, C. dumosa, Eugenia peninsularis, E. aceitillo, Amyris polymorpha, Croton corallicola, Rondeletia peninsularis, Coccothrinax saxicola* (Fig. 245) and *Portulaca tuberculata*) and Pilón *(Chaptalia comptonioides, Justicia agria, Belairia parvifolia, Pilea cowellii, P. carnosa, Begonia cowelli, Leptocereus sylvestris).* There is a certain relationship to the flora of the mogotes of Baire as shown by the occurrence of *Catalpa brevipes.*

Vegetation: Arid evergreen shrublands in the coastal zone, dry evergreen forests in the lower terraces, and semi-deciduous forests higher up. The original vegetation of the plain was a tropical humid woodland.

District C.3.2. The coastal area between Marea del Portillo and Nima-nima (Uveroënse Fig. 224)

Geography: Narrow and mostly rocky coasts along the western part of Sierra Maestra. Gravely and sandy beaches at the estuaries, and the lower parts of the

slopes exposed to the south. Rendzina and humic carbonated soils are usual, whereas tropical brown soils occur in the valleys.

Climate: Evenly warm bixeric climate with two dry seasons of a total of 5—6 months duration. Annual rainfall 800—1200 mm (Fig. 262b—c).

Flora: Very little studied. Probably several evolutionary centres could be detected here. *Rhytidophyllum minus* is an endemic in common with the preceding district, and some local endemic species, e.g. *Tabebuia acunana, Rondeletia sevillensis, Erigeron taylori, Pilea sevillensis, Melocactus nagyii* (Fig. 265) characterize the area. There is also an endemic palm, common with the Sierra Maestra, is *Coccothrinax gundlachii* (Fig. 245).

Vegetation: Microphyllous evergreen shrublands, dry evergreen forests with deciduous elements, and locally, mangroves in the estuaries and the gravelly coastal depressions.

District C.3.3. Coastal belt and terraces between

Santiago de Cuba-Guantánamo-Maisi and Baracoa (Guantanamense) (Fig. 224)

Geography: High cliffs and low limestone terraces with small inlets and coastal plains. Rendzina and cinnamon-coloured humic carbonated soils predominate. Also the plain in the Guantánamo Basin covered partly by brown humic carbonated soils. The district includes the southern coasts at the foots of the Gran Piedra range, the Gauntánamo Basin with Sierra de Canasta, the coasts and terraces from

Fig. 263 The famous series of the limestone terraces consisting of seven in the southern slopes of Monte Cristo, near Jauco, south-east Oriente (Photo: A. Borhidi)

Guantánamo to Maisi up to an elevation of 400 m, and the northern Baracoa shores between Maisi and Navas (Fig. 263).

Climate: Evenly warm seasonal bixeric climate with two dry seasons (5—8 dry months) and annual precipitation totalling 600—1100 mm. Semi-desert climate with 9—10 dry months and 300—600 mm annual rainfall appears in the rain shadow of the Sierra de Puriales and Sierra de Imias, south and east of Guantánamo ranging eastward to Jauco. Between Maisi and Baracoa seasonal climate with short summer dry period is characteristic (Figs 264).

Flora: Very rich and diverse xerothermophilous flora, with several small areas characterized by local endemics. A single monospecific endemic genus is *Caribaea* (Nyctaginaceae), a particular littoral cushion plant with very restricted area. A great number of regional endemic species occur also, as *Coccothrinax alexandri* s.l. *C. hiorami, C. munizii* (Fig. 245), *Rhytidophyllum acunae, Melocactus acunai* (Fig. 265—266), *Caesalpinia pinnata, Passiflora santiagana, Castela victorini, Consolea macracantha, Rondeletia apiculata, Tabebuia libanensis* (Fig. 267), *Reynosia mucronata* ssp. *azulensis* (Fig. 119), *Maytenus buxifolia* ssp. *cochlearifolia* (Fig. 118). The area abounds in very important local evolutionary centres wuth 80 endemic taxa altogether. Local endemic species are at Santiago de Cuba: *Rondeletia*

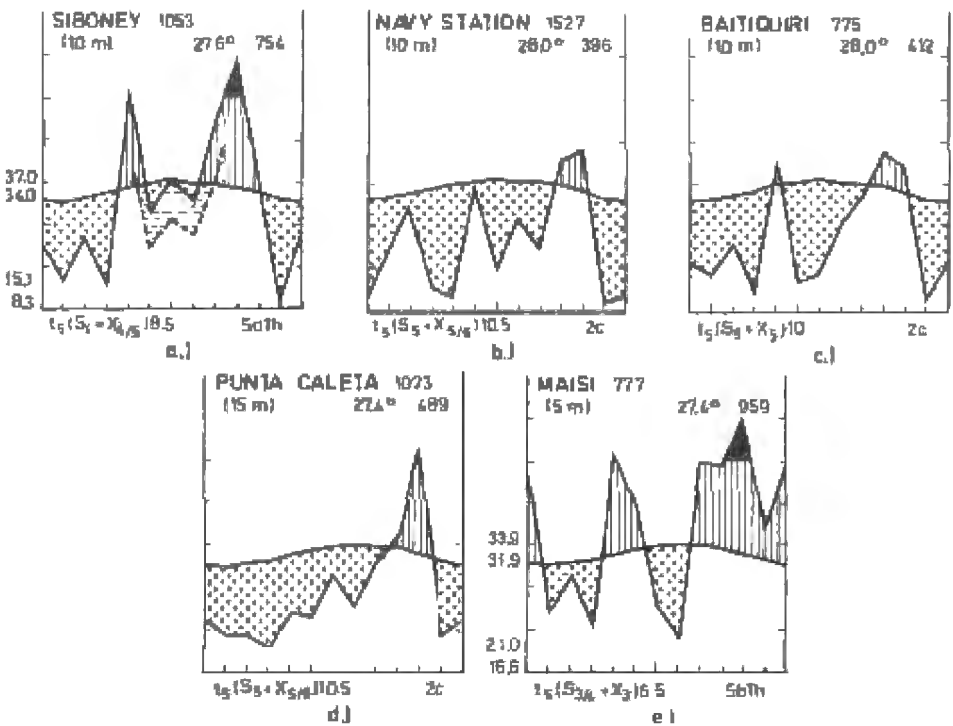


Fig. 264 Characteristic climate types of the coastal phytogeographic district Guantanamense between Santiago and Maisi at a) Siboney, b) Navy Station, c) Baitiquiri, d) Punta Caleta and e) Maisi

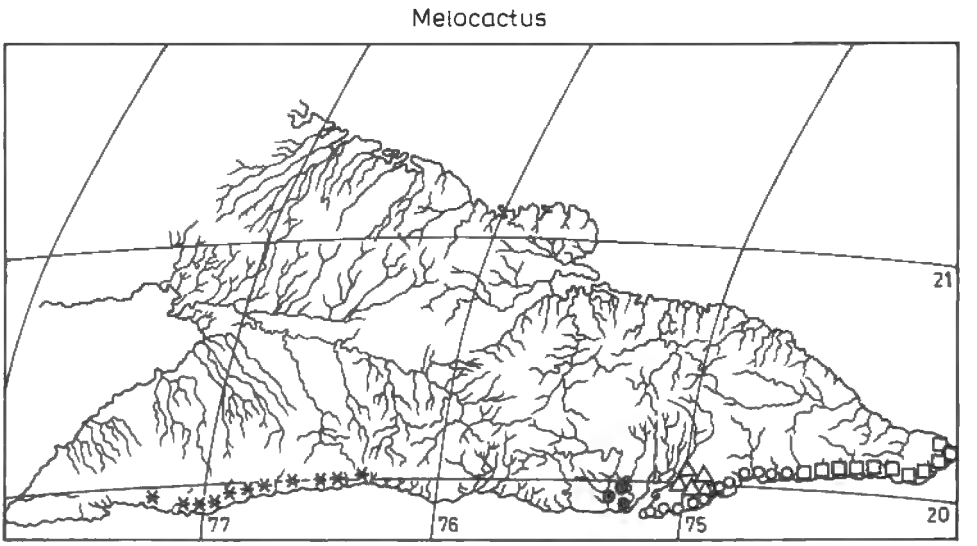


Fig. 265 Geographical distribution of *Melocactus evae* Mészáros (full circles), *M. harlowii* Britton and Rose (open circles), *M. borhidii* Mészáros (triangles) *M. acunai* León (squares) and *M. nagyii* (asterisks) (Mészáros, 1977)

Fig. 266 A well-developed example of *Melocactus acunai* León, a species endemic to the coastal limestone karsts between San Antonio del Sur and Maisi (Photo: A. Borhidi)

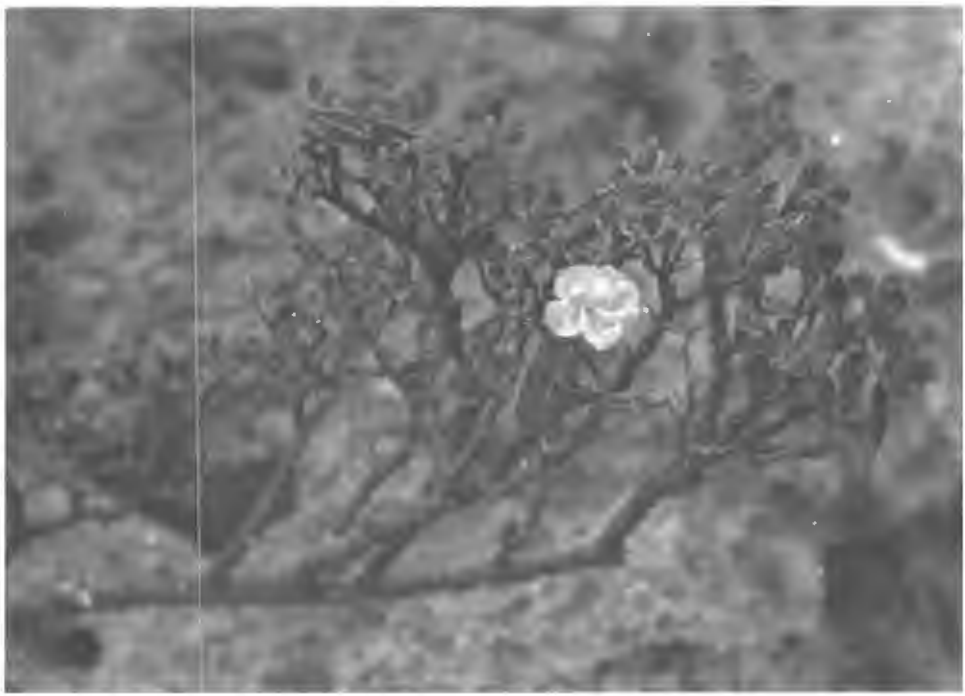


Fig. 267 Tabebuia libanensis Urb. a leptophyllous dwarf shrub of the dry limestone areas from the mogotes of the Nipe Mountains to the southern subcoastal karstic terraces of Maisi (Photo: A. Borhidi)

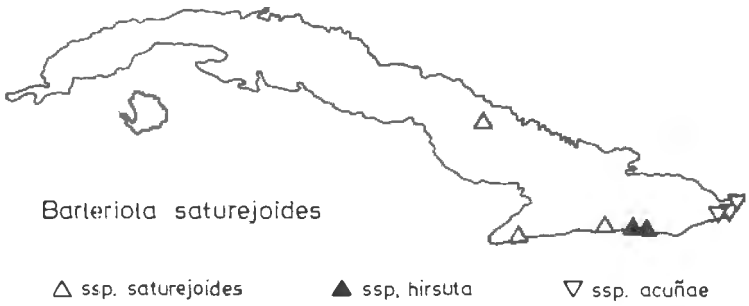


Fig. 268 Geographical distribution of *Barleriola saturejoides* (Acanthaceae) (Borhidi 1973)

norlindii, Acacia cowellii, Caesalpinia subglauca, Eugenia amblyophylla, E. itephylla, Lasiocroton gracilis and *Tephrosia clementis;* at Aguadores: *Nashia armata, Rochefortia oblongata,* at Siboney: *Neobracea martiana* (Fig. 117) and *Barleriola saturejoides* ssp. *hirsuta* (Fig. 268): at Daiquiri: *Cassia scleroxyla, Chamaesyce microclada* and *Coccothrinax fagildei* (Fig. 245); at Baconao: *Justicia maestrensis, Jacquinia verticillaris* and *Machaonia urbaniana* (Fig. 192) occur.

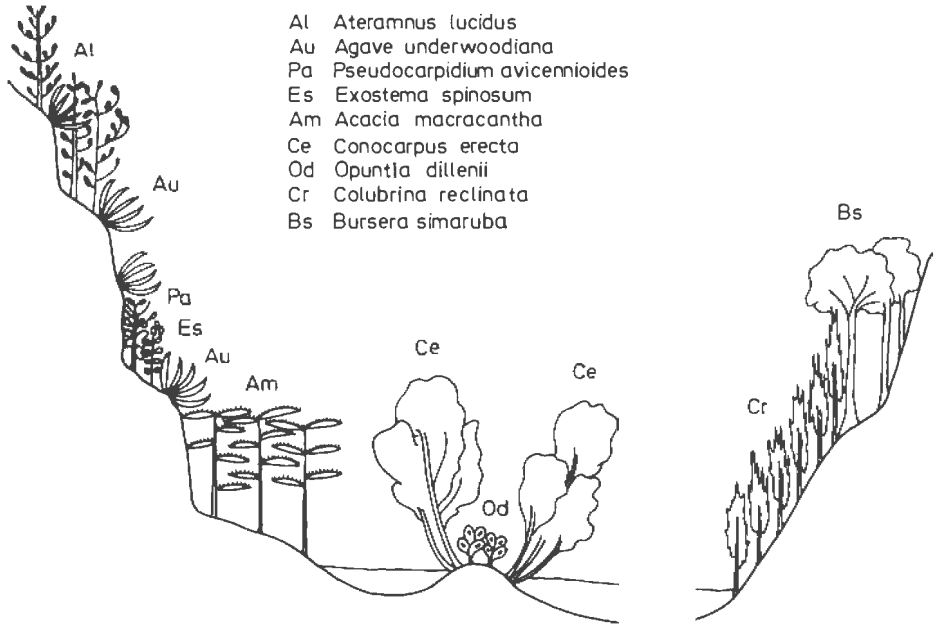


Fig. 269 Vegetation transect of the limestone terraces in the mouth of Rio Juan at Aguadores (Borhidi and Muñiz)

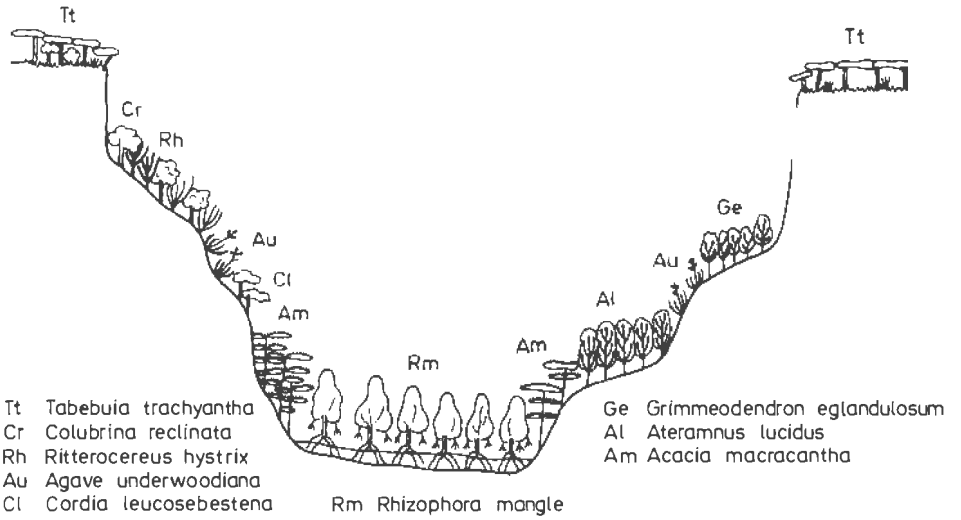


Fig. 270 Vegetation transect of the limestone terraces at Siboney (Borhidi and Muñiz)

Fig. 271 Sclerophyllous scrub forest on the limestone terraces of the mouth of San Juan river at Aguadores, Santiago de Cuba (Photo: A. Borhidi)

Fig. 272 The canyon of the Abra Mariana, N. of San Antonio del Sur with dry chasmophytic vegetation dominated by *Agave albescens* Trel. (Photo: A. Borhidi)

Fifteen local endemics live around Guantánamo, e.g. *Coccothrinax guantanamensis* (Fig. 245), *Andrachne brittonii, Croton excisus, Colubrina obtusata, Opuntia militaris, Melocactus evae* (Fig. 265), *Myrtus nummularioides* and *Geophila multiflora.* Between Guantánamo and Macambo *Agave albescens, Casearia comocladifolia, Thouinia leonis, Stigmaphyllum coccolobaefolium, Coccothrinax microphylla* (Fig. 245), *Scolosanthus strictus* occur; at Macambo *Caribaea littoralis, Drymaria glandulosa,* and *Apassalus parvulus* are local endemics, whereas between Cajobabo and Jauco, *Pheidonocarpa cubensis, Gyminda orbicularis, Isidorea rheedioides, Tabebuia jaucoensis, Micromeria suborbicularis, Barleriola saturejoides* ssp. *acunae* (Fig. 268), *Scolosanthus hirsutus* are found. Additional 15—20 endemics are known from the Maisi Plain and the surrounding terraces, for example, *Isidorea leonis, Pseudocarpidium shaferi, Cnidoscolus matosii, Acacia seifriziana, Tabebuia leonis, Duranta arida, Harpalyce maisiana, Galactia maisiana, Jacquinia maisiana, Scolosanthus hispidus* and *S. maisianus.* On the young serpentine outcrops around the langune of the Jojó Valley some local neoendemics such as *Rondeletia ingrata* and *Melocactus acunai* ssp. *lagunaënsis* (Fig. 265) are to be found.

The role of xerotherm elements that are also found in Hispaniola is increased (e.g. *Coccothrinax fragrans* (Fig. 245), *Pithecellobium oppositifolium, Bellonia spinosa, Jacquinia berterii, Caesalpinia glandulosa, Exostema spinosum* etc.) Floristic relations with Hispaniola is especially manifested at the easternmost part of the south-east coast of Oriente around Maisi, where some common species of Cuba and Hispaniola with very districted areas occur, as *Omphalea commutata, Petitia urbanii,* (Fig. 135) *Victorinia regina* etc.

Vegetation: Microphyllous evergreen and deciduous shrubwoods and shrublands (Figs 269, 270). Open shrublands with cacti in the understorey and semi-desert scrubs with columnar cacti occur in many areas. Eastward of Guantánamo the dominant vegetation type is the semi-desert scrub with tree-shaped or columnar cacti. On the terraces arid evergreen shrubwoods, open scrubs with agaves (Figs 271, 272), dwarf and tall thin palms predominate. In the flat valleys of rivers secondary savannas composed of short grasses, with *Sabal parviflora* palms are found.